



Rotary Encoders

R35i
R35iL

RENCO R35i and R35iL rotary encoders

The RENCO R35i is an incremental optical rotary encoder without an integral bearing. Its key features include a compact design, with a 35 mm outer diameter and a height of 14 mm, and a built-in mounting aid for convenient self-centering installation. In conjunction with its OPTO-ASIC technology, the RENCO R35i offers optimal functionality in a highly compact design.



For an even lower profile, RENCO also offers the R35iL rotary encoder, featuring a height of only 8.6 mm.

Both encoders are available with U, V, and W output signals for driving motors with block commutation.



This brochure supersedes all previous editions, which thereby become invalid. The basis for ordering from HEIDENHAIN is always the brochure edition valid when the order is made.

Standards (ISO, EN) apply only where explicitly stated in this brochure.

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Areas of application

The RENCO R35i is an incremental optical rotary encoder without an integral bearing. Its key features include a compact design, with a 35 mm outer diameter and a height of 14 mm, and a built-in mounting aid for convenient self-centering installation. In conjunction with its OPTO-ASIC technology, the RENCO R35i offers optimal functionality in a highly compact design, making it ideal for the following areas of application:

Electric motor technology

Thanks to its high position measurement resolution of up to 10 000 signals per revolution (40 000 measuring steps after quadrature evaluation) and its wide operating temperature range, from $-30\text{ }^{\circ}\text{C}$ to $+115\text{ }^{\circ}\text{C}$, the RENCO R35i is an ideal feedback system for stepper motors in Closed Loop mode. The RENCO R35i also provides three commutation signals (U, V, and W) for positionally correct powering of the rotor windings in BLDC motors (brushless DC motors) with up to 32 pole pairs.

Robotics

The robotics industry is a strongly growing sector. Recent technologies in the field are opening up new areas of application well beyond the typical industrial robots used in automated manufacturing. In the future, service robots capable of direct human interaction will increasingly assist in manual production processes.

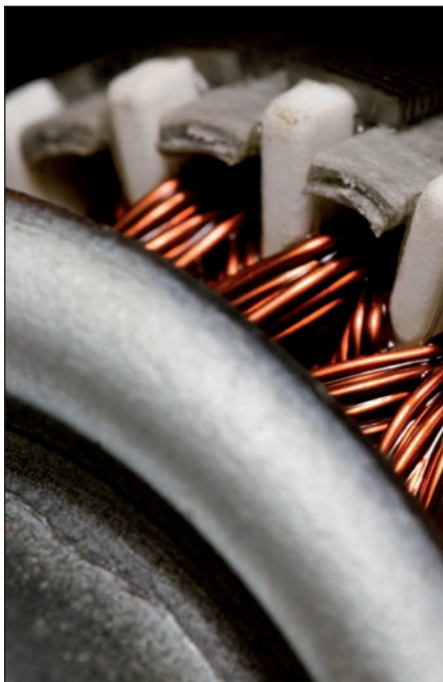
Professional service robots will also find increased use in applications such as

- building-facade and solar-panel cleaning,
- pipeline inspection,
- fully automated agricultural harvesting,
- and logistics applications, such as automated conveyor and loading vehicles.

Thanks to its compact design and outstanding performance data, the RENCO R35i is the ideal solution for all of these applications.

Medical technology

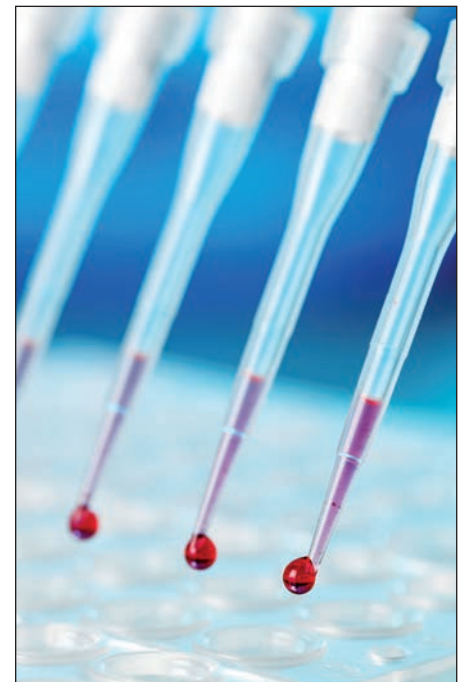
A variety of characteristics make the RENCO R35i highly suitable for demanding medical technology applications. Its materials are RoHS-conformant and therefore free of hazardous materials in accordance with EC Directive 2011/65/EU. It also features high reliability and interference-free data transmission thanks to line drivers in compliance with EIA standard RS-422. These characteristics play a key role in attaining high patient safety in physiotherapeutic devices, as well as high analysis quality and reproducibility in laboratory applications. The encoder's high resolution of up to 10 000 signal periods per revolution enables gentle, smooth, and precise control, an important characteristic for liquid-handling lab applications and for patient comfort in physiotherapeutic devices. Typical areas of application include lab automation equipment with centrifuges and pipetting systems for liquid handling, as well as physiotherapeutic devices such as movement exercisers.



Electric motor technology



Robotics



Pipetting

Automation

The RENCO R35i is an attractive solution for automation applications in industries such as semiconductors, food, and textiles. With its strong dynamic performance and very high signal resolution, this encoder excels in precise position control of machines and complex systems. Die bonders for chip-on-board manufacturing, automated textile winding machines, palleting systems, and automated coin counters are just a few of the possible applications. Short signal processing times give the RENCO R35i its high dynamic performance, while its integrated interpolation provides high resolution for precise positioning. Of course, the compact design of the R35i, made possible by its ASIC technology, also plays a significant role in factory automation.

Facility engineering

Modern residential, administrative, and industrial buildings contain numerous motor-controlled systems, including elevators, ventilation systems, and automatic doors and gates. The compact design of the RENCO R35i makes it ideal for applications such as elevator door control and speed control in ventilation systems.

Facility engineering providers place great value on reliability and failure safety. These qualities are ensured thanks to extensive certification of the encoders in accordance with ISO quality standards. Reliable data exchange is provided by the encoder's serial interface in accordance with EIA standard RS-422. This interface ensures high immunity to interference through its symmetrical differential signal transmission.

As a particularly low-profile and low-weight alternative to the R35i, RENCO also offers the R35iL rotary encoder. It can be used in the same types of applications but, thanks to its low height of just 8.6 mm, lends itself particularly to applications with critical installation parameters and limited space. Even with its low footprint, the RENCO R35iL still offers state-of-the-art performance capabilities. These include a resolution of up to 5000 signals per revolution, commutation signals (U, V, and W), and an operating temperature range of $-30\text{ }^{\circ}\text{C}$ to $+115\text{ }^{\circ}\text{C}$. With its integrated mounting aid, the R35iL is also equipped for convenient, self-centering installation. The R35iL runs on a supply voltage of either 3.3 V or 5 V.



Automation



Facility engineering

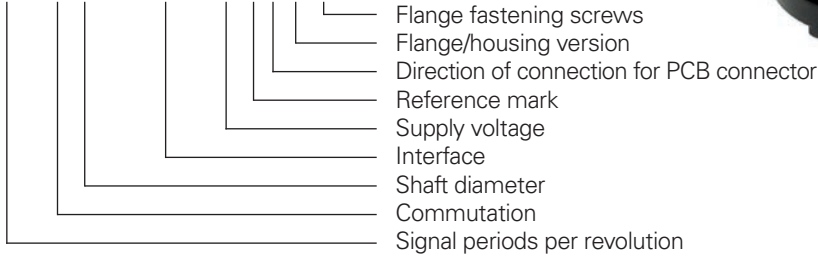


Applications with limited space

R35i and R35iL selection guide

R35i ordering key

R35i-10000/4-6mm-LD/LD-5V-1-R-C-M



Selection table

Signal periods per revolution	100, 200, 250, 256, 400, 500, 512, 625, 800, 1000, 1024, 1250, 2000, 2048, 2500, 4000, 4096, 5000, 8000, 8192, 10000		
Commutation	0	Without commutation	
	2 to 32	Number of commutation signal periods per revolution ($\hat{=}$ number of motor pole pairs)	
Shaft diameter	Metric	4 mm, 5 mm, 6 mm, 8 mm	
	Inch	1/8, 1/8+, 3/16, 3/16+, 1/4, 1/4+, 5/16, 5/16+, 3/8, 3/8+	
Interface	LD	Square-wave signals with differential line driver as per RS-422	
	PP	Square-wave signals with push-pull driver output	
Supply voltage	5V	+5V \pm 10%	
Reference mark	1	Width: 90° \pm 45° elec.	Gate: U _{a1} High and U _{a2} High
	6	Width: 90° \pm 45° elec.	Gate: U _{a1} Low and U _{a2} Low
	7	Width: 270° \pm 45° elec.	Gate: U _{a1} High and U _{a2} High
	8	Width: 270° \pm 45° elec.	Gate: U _{a1} Low and U _{a2} Low
PCB connector	R	Radial	
	A	Axial	
Flange and housing version	C, SC*	Flange with \varnothing 32.5 mm mounting screw circle, closed housing	
	H, SH*	Flange with \varnothing 32.5 mm mounting screw circle, housing with central hole	
	C4, SC4*	Flange with \varnothing 46.0 mm mounting screw circle, closed housing	
	H4, SH4*	Flange with \varnothing 46.0 mm mounting screw circle, housing with central hole	
	CR, SCR*	Synchro flange, resolver size 15, closed housing	
	HR, SHR*	Synchro flange, resolver size15, housing with central hole	
Flange fastening screws	M	Metric	
	U	UNC	

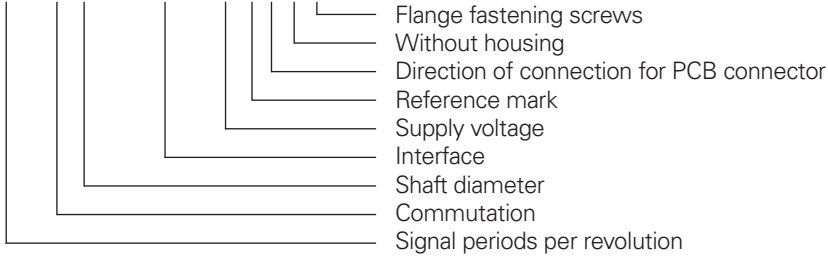
* Housing with strain relief connection for the output cable

Packaging unit

The **R35i** rotary encoder is available solely in a packaging size of **10 units**. Rotary encoder housings and mounting materials are included (flange fastening screws and offset screwdriver for shaft fastening).

R35iL ordering key

R35iL-5000/4-6mm-PP/PP-5V-1-R-.-M



Selection table

Signal periods per revolution	100, 200, 250, 256, 400, 500, 512, 625, 800, 1000, 1024, 1250, 2000, 2048, 2500, 4000, 4096, 5000		
Commutation	0 2 to 32	Without commutation Number of commutation signal periods per revolution (\triangleq number of motor pole pairs)	
Shaft diameter	Metric Inch	4 mm, 5 mm, 6 mm, 8 mm 1/8+, 3/16, 3/16+, 1/4, 1/4+, 5/16, 3/8, 3/8+	
Interface	PP	Square-wave signals with push-pull driver output	
Supply voltage	3.3 5 V	3.3 V \pm 5 % +5 V \pm 10 %	
Reference mark	1 6 7 8	<i>Width:</i> 90° \pm 45° elec. <i>Width:</i> 90° \pm 45° elec. <i>Width:</i> 270° \pm 45° elec. <i>Width:</i> 270° \pm 45° elec.	<i>Gate:</i> U _{a1} High and U _{a2} High <i>Gate:</i> U _{a1} Low and U _{a2} Low <i>Gate:</i> U _{a1} High and U _{a2} High <i>Gate:</i> U _{a1} Low and U _{a2} Low
PCB connector	R	Radial	
Housing version	.. C, SC* H, SH*	Without housing Closed housing (upon request) With central hole (upon request)	
Flange fastening screws	M U	Metric UNC	

* Housing with strain relief connection for the output cable

Packaging unit

The **R35iL** rotary encoder is available solely in a packaging size of **10 units**. Mounting materials are included (flange fastening screws and offset screwdriver for shaft fastening).

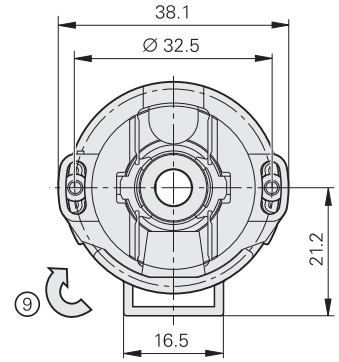
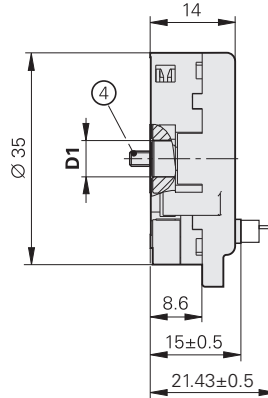
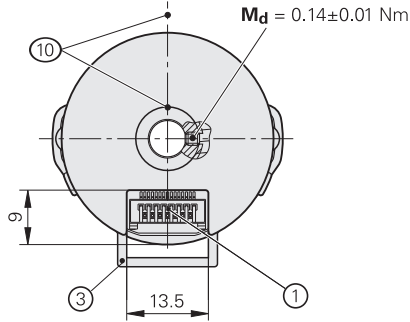
R35i rotary encoders

Incremental rotary encoders

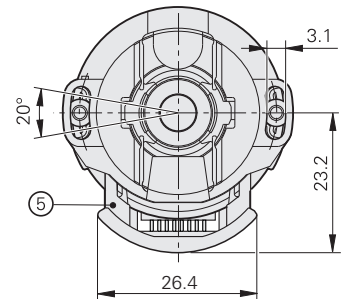
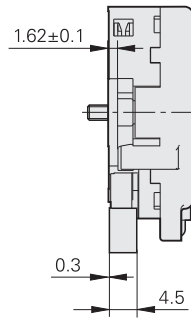
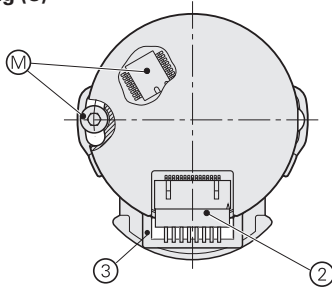
- Ø 32.5 mm flange for axial mounting
- Hollow through shaft
- Self-centering, without integral bearing



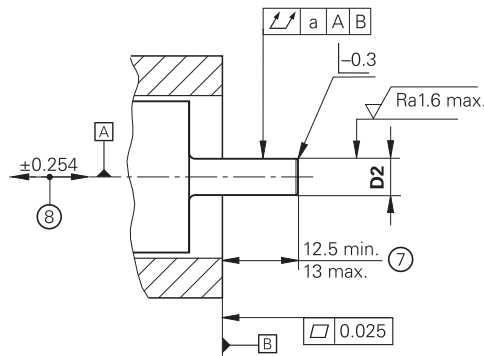
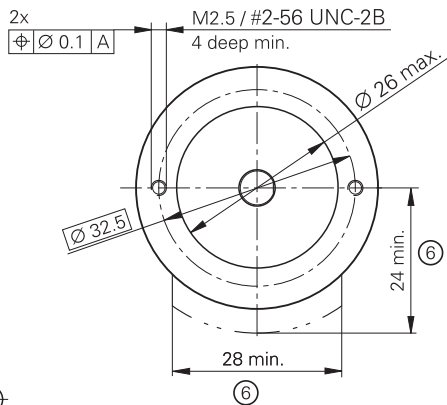
Housing with central hole (H)



Closed housing (C)



Required mating dimensions



Signal periods	$\frac{\Delta}{a}$
≤ 5000	0.05
> 5000 ≤ 10000	0.03

mm

 Tolerancing ISO 8015
 ISO 2768 - m H
 < 6 mm: ±0.2 mm

- ▢ = Bearing of mating shaft
- M = Measuring point for operating temperature
- 1 = 15-pin axial header
- 2 = 15-pin radial header
- 3 = Housing with strain relief (SH/SC)
- 4 = Torx T8 fastening screws for flange:
 2 x M2.5x5.25 ID 548595-02 or 2 x #2-56 UNCx5.25 ID 548595-03;
 tightening torque: 0.21 Nm ± 0.02 Nm
- 5 = Slide lock in mounting position
- 6 = Required installation space for slide lock in mounting position
- 7 = Max. dimension for closed housing (C/SC)
- 8 = Maximum permissible motion between shaft and stator (including thermal expansion);
 dynamic axial motion is permitted over the entire value
- 9 = Direction of shaft rotation for ascending position values
- 10 = Reference mark position ±10°

*) Shaft diameter in inches or mm

Setscrew socket	*)	D1 +0.01 0	D2 0 -0.013
SW 0.89 Hex	3/8+	Ø 9.528	Ø 9.525
	3/8	Ø 9.520	Ø 9.517
0.048" Bristol 4-Spine	8 mm	Ø 8	Ø 7.997
	5/16+	Ø 7.940	Ø 7.937
	5/16	Ø 7.932	Ø 7.929
	1/4+	Ø 6.353	Ø 6.350
	1/4	Ø 6.345	Ø 6.342
	6 mm	Ø 6	Ø 5.997
	5 mm	Ø 5	Ø 4.997
	3/16+	Ø 4.765	Ø 4.762
	3/16	Ø 4.757	Ø 4.754
	4 mm	Ø 4	Ø 3.997
	1/8+	Ø 3.178	Ø 3.175
1/8	Ø 3.170	Ø 3.167	

R35i					
Interface*	LD/0	PP/0	LD/LD	LD/PP	PP/PP
Signal periods per revolution*	100, 200, 250, 256, 400, 500, 512, 625, 800, 1000, 1024, 1250, 2000, 2048, 2500, 4000, 4096, 5000, 8000, 8192, 10000 <i>Metal graduation: up to 5000; glass graduation: over 5000</i>				
Reference mark Width and gate*	One 1 <i>Width: 90° ±45° elec. Gate: U_{a1} High and U_{a2} High</i> 6 <i>Width: 90° ±45° elec. Gate: U_{a1} Low and U_{a2} Low</i> 7 <i>Width: 270° ±45° elec. Gate: U_{a1} High and U_{a2} High</i> 8 <i>Width: 270° ±45° elec. Gate: U_{a1} Low and U_{a2} Low</i>				
Output frequency	≤ 1.83 MHz				
Commutation Signal periods per revolution*	Without 0		Signal tracks U, V, W 2 to 32		
System accuracy ¹⁾	<i>Metal graduation: ±300"</i> <i>Glass graduation: ±150"</i>				
Electrical connection Connection orientation*	15-pin PCB connector R = radial, A = axial				
Supply voltage	DC 5 V ±0.5 V				
Current consumption Typically 5 V, without load Max. 5.5 V, without load Max. 5.5 V, with load	≤ 45 mA ≤ 105 mA ≤ 205 mA	≤ 45 mA ≤ 95 mA ≤ 105 mA	≤ 45 mA ≤ 110 mA ≤ 310 mA	≤ 45 mA ≤ 105 mA ≤ 210 mA	≤ 45 mA ≤ 95 mA ≤ 115 mA
Shaft*	Hollow through shaft with radial fastening <i>Shaft diameter: see Mating dimensions</i>				
Mech. permiss. speed	<i>Metal graduation: ≤ 30000 rpm</i> <i>Glass graduation: ≤ 12000 rpm</i>				
Moment of inertia of rotor	<i>Metal graduation: 0.2 · 10⁻⁶ kgm²</i> <i>Glass graduation: 0.3 · 10⁻⁶ kgm²</i>				
Permissible motion of measured shaft	<i>Axial: ±0.254 mm</i> <i>Radial runout: 0.05 mm TIR (≤ 5000 signal periods per revolution)</i> <i>0.03 mm TIR (> 5000 signal periods per revolution)</i>				
Vibration 55 Hz to 2000 Hz Shock 6 ms	≤ 200 m/s ² (EN 60068-2-6) ≤ 2000 m/s ² (EN 60068-2-27)				
Operating temperature	-30 °C to 115 °C				
Relative humidity	≤ 93 % (40 °C/21 d as per EN 60068-2-78); without condensation				
Protection EN 60529	IP30 ²⁾				
Mass	≈ 0.03 kg				
ID number	1064590-xx	1282231-xx	11188619-xx	1282244-xx	1282236-xx

* Please select when ordering

¹⁾ Unmounted; additional errors due to mounting of the measured shaft are not considered.

For a measured shaft eccentricity of 1 µm, the measuring error increases by ±16.4"

²⁾ Electromagnetic compatibility must be ensured in the complete system.

R35i rotary encoders

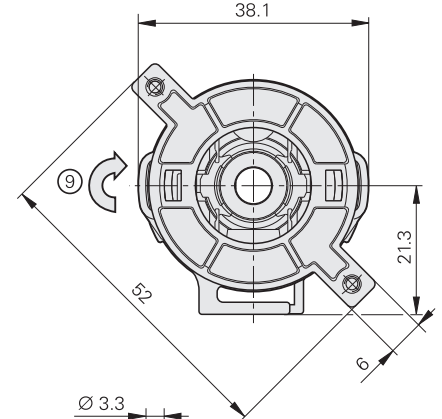
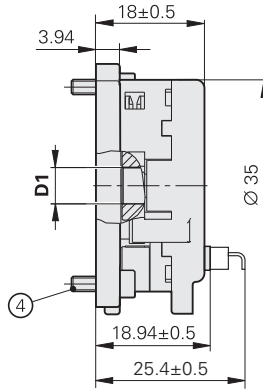
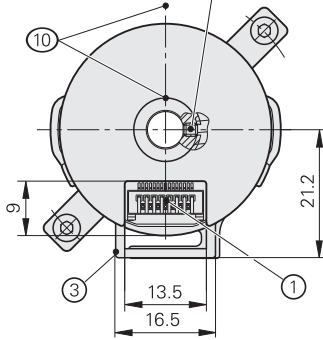
Incremental rotary encoders

- Ø 46.03 mm flange for axial mounting
- Hollow through shaft
- Self centering, without integral bearing

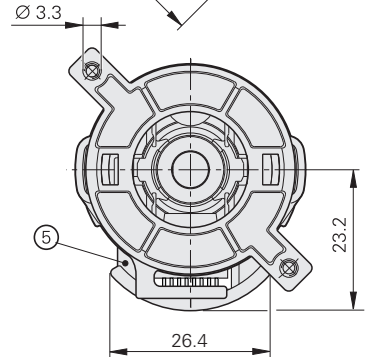
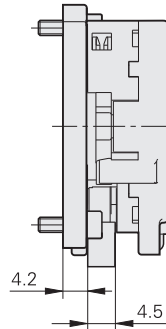
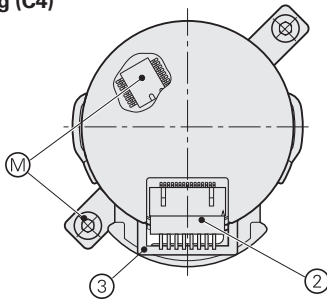


Housing with central hole (H4)

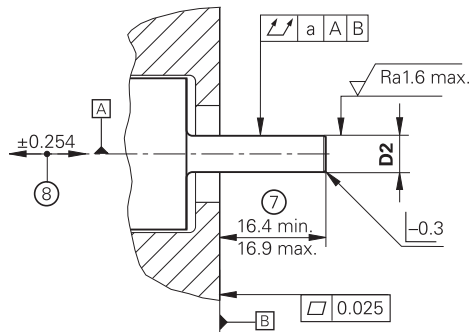
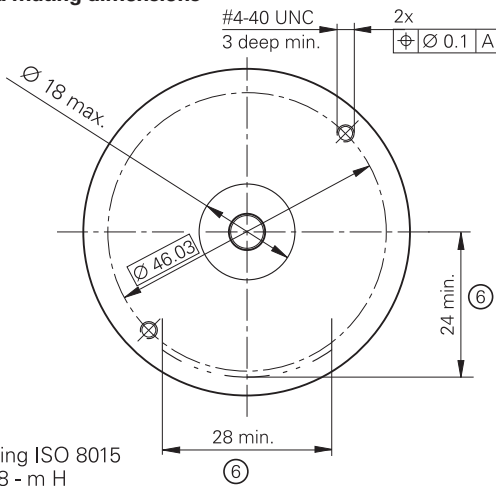
$M_d = 0.14 \pm 0.01 \text{ Nm}$



Closed housing (C4)



Required mating dimensions



Signal periods	\sqrt{a}
≤5000	0.05
>5000 ≤10000	0.03

*) Shaft diameter in inches or mm

mm

 Tolerancing ISO 8015
 ISO 2768 - m H
 < 6 mm: ±0.2 mm

- ▣ = Bearing of mating shaft
- M = Measuring point for operating temperature
- 1 = 15-pin axial header
- 2 = 15-pin radial header
- 3 = Housing with strain relief (SH4/SC4)
- 4 = Mounting screws, width A/F 3/32" hex, for flange:
2 x #4-40 UNCx6.35 ID 200507-A0; tightening torque: 0.21 Nm ±0.02 Nm
- 5 = Slide lock in mounting position
- 6 = Required installation space for slide lock in mounting position
- 7 = Max. dimension for closed housing (C4/SC4)
- 8 = Maximum permissible motion between shaft and stator (including thermal expansion);
dynamic axial motion is permitted over the entire value
- 9 = Direction of shaft rotation for ascending position values
- 10 = Reference mark position ±10°

Setscrew socket	*)	D1 +0.01 0	D2 0 -0.013
SW 0.89 Hex	3/8+	Ø 9.528	Ø 9.525
	3/8	Ø 9.520	Ø 9.517
0.048" Bristol 4-Spine	8 mm	Ø 8	Ø 7.997
	5/16+	Ø 7.940	Ø 7.937
	5/16	Ø 7.932	Ø 7.929
	1/4+	Ø 6.353	Ø 6.350
	1/4	Ø 6.345	Ø 6.342
	6 mm	Ø 6	Ø 5.997
	5 mm	Ø 5	Ø 4.997
	3/16+	Ø 4.765	Ø 4.762
	3/16	Ø 4.757	Ø 4.754
	4 mm	Ø 4	Ø 3.997
	1/8+	Ø 3.178	Ø 3.175
1/8	Ø 3.170	Ø 3.167	

R35i					
Interface*	LD/0	PP/0	LD/LD	LD/PP	PP/PP
Signal periods per revolution*	100, 200, 250, 256, 400, 500, 512, 625, 800, 1000, 1024, 1250, 2000, 2048, 2500, 4000, 4096, 5000, 8000, 8192, 10000 <i>Metal graduation: up to 5000; glass graduation: over 5000</i>				
Reference mark Width and gate*	One 1 <i>Width: 90° ±45° elec. Gate: U_{a1} High and U_{a2} High</i> 6 <i>Width: 90° ±45° elec. Gate: U_{a1} Low and U_{a2} Low</i> 7 <i>Width: 270° ±45° elec. Gate: U_{a1} High and U_{a2} High</i> 8 <i>Width: 270° ±45° elec. Gate: U_{a1} Low and U_{a2} Low</i>				
Output frequency	≤ 1.83 MHz				
Commutation Signal periods per revolution*	Without 0		Signal tracks U, V, W 2 to 32		
System accuracy ¹⁾	<i>Metal graduation: ±300"</i> <i>Glass graduation: ±150"</i>				
Electrical connection Connection orientation*	15-pin PCB connector R = radial, A = axial				
Supply voltage	DC 5 V ±0.5 V				
Current consumption Typically 5 V, without load Max. 5.5 V, without load Max. 5.5 V, with load	≤ 45 mA ≤ 105 mA ≤ 205 mA	≤ 45 mA ≤ 95 mA ≤ 105 mA	≤ 45 mA ≤ 110 mA ≤ 310 mA	≤ 45 mA ≤ 105 mA ≤ 210 mA	≤ 45 mA ≤ 95 mA ≤ 115 mA
Shaft*	Hollow through shaft with radial fastening <i>Shaft diameter: see Mating dimensions</i>				
Mech. permiss. speed	<i>Metal graduation: ≤ 30000 rpm</i> <i>Glass graduation: ≤ 12000 rpm</i>				
Moment of inertia of rotor	<i>Metal graduation: 0.2 · 10⁻⁶ kgm²</i> <i>Glass graduation: 0.3 · 10⁻⁶ kgm²</i>				
Permissible motion of measured shaft	<i>Axial: ±0.254 mm</i> <i>Radial runout: 0.05 mm TIR (≤ 5000 signal periods per revolution)</i> <i>0.03 mm TIR (> 5000 signal periods per revolution)</i>				
Vibration 55 Hz to 2000 Hz Shock 6 ms	≤ 200 m/s ² (EN 60068-2-6) ≤ 2000 m/s ² (EN 60068-2-27)				
Operating temperature	-30 °C to 115 °C				
Relative humidity	≤ 93 % (40 °C/21 d as per EN 60068-2-78); without condensation				
Protection EN 60529	IP30 ²⁾				
Mass	≈ 0.03 kg				
ID number	1064590-xx	1282231-xx	11188619-xx	1282244-xx	1282236-xx

* Please select when ordering

¹⁾ Unmounted; additional errors due to mounting of the measured shaft are not considered.

For a measured shaft eccentricity of 1 µm, the measuring error increases by ±16.4"

²⁾ Electromagnetic compatibility must be ensured in the complete system.

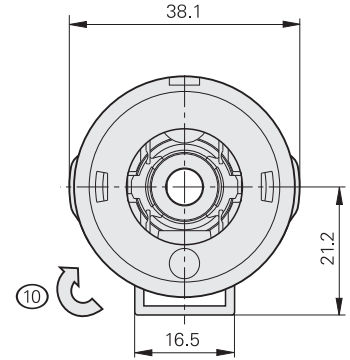
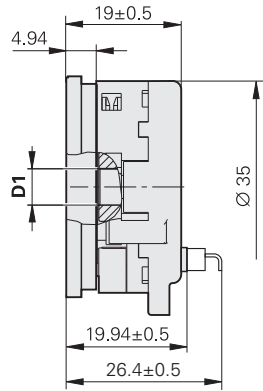
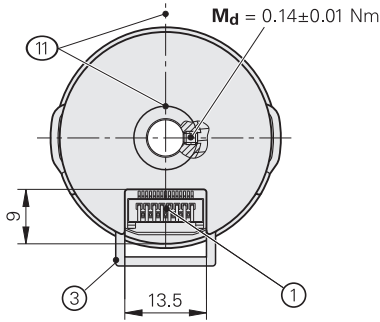
R35i rotary encoders

Incremental rotary encoders

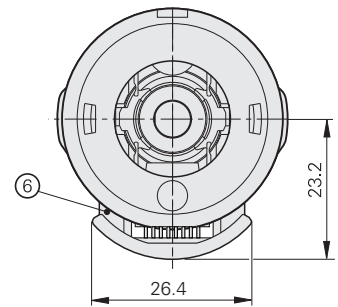
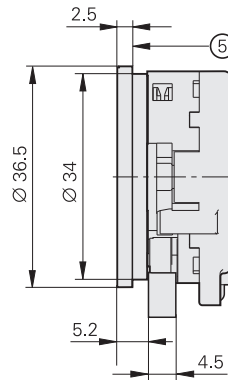
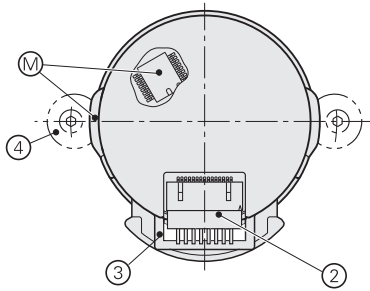
- Synchro flange (resolver size 15)
- Hollow through shaft
- Self-centering, without integral bearing



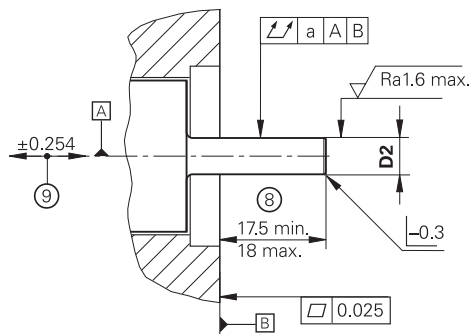
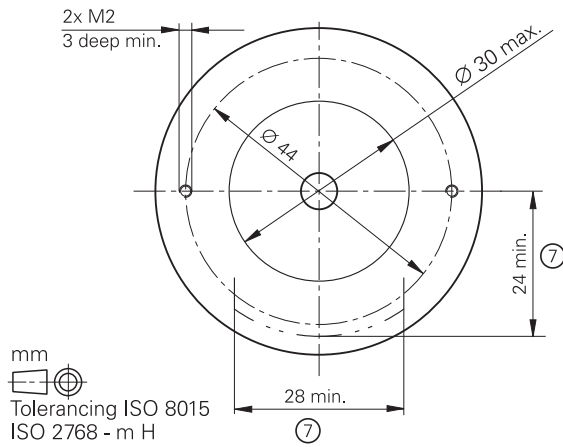
Housing with central hole (H)



Closed housing (C)



Required mating dimensions



Signal periods	\sqrt{a}
≤ 5000	0.05
> 5000	0.03
≤ 10000	0.03

*) Shaft diameter in inches or mm

- ▣ = Bearing of mating shaft
- M = Measuring point for operating temperature
- 1 = 15-pin axial header
- 2 = 15-pin radial header
- 3 = Housing with strain relief (SH/SC)
- 4 = Suggested fastening with fixing clamp, ID 200032-02, and screw, ISO 4762 – M2, 2 x 180° or 3 x 120°; tightening torque: 0.21 Nm ± 0.03 Nm
- 5 = Clamping surface
- 6 = Slide lock in mounting position
- 7 = Required installation space for slide lock in mounting position
- 8 = Max. dimension for closed housing (C/SC)
- 9 = Maximum permissible motion between shaft and stator (including thermal expansion); dynamic axial motion is permitted over the entire value
- 10 = Direction of shaft rotation for ascending position values
- 11 = Reference mark position ± 10°

Setscrew socket	*)	D1 +0.01 0	D2 0 -0.013
SW 0.89 Hex	3/8+	Ø 9.528	Ø 9.525
	3/8	Ø 9.520	Ø 9.517
0.048" Bristol 4-Spine	8 mm	Ø 8	Ø 7.997
	5/16+	Ø 7.940	Ø 7.937
	5/16	Ø 7.932	Ø 7.929
	1/4+	Ø 6.353	Ø 6.350
	1/4	Ø 6.345	Ø 6.342
	6 mm	Ø 6	Ø 5.997
	5 mm	Ø 5	Ø 4.997
	3/16+	Ø 4.765	Ø 4.762
	3/16	Ø 4.757	Ø 4.754
	4 mm	Ø 4	Ø 3.997
	1/8+	Ø 3.178	Ø 3.175
	1/8	Ø 3.170	Ø 3.167

R35i					
Interface*	LD/0	PP/0	LD/LD	LD/PP	PP/PP
Signal periods per revolution*	100, 200, 250, 256, 400, 500, 512, 625, 800, 1000, 1024, 1250, 2000, 2048, 2500, 4000, 4096, 5000, 8000, 8192, 10000 <i>Metal graduation: up to 5000; glass graduation: over 5000</i>				
Reference mark Width and gate*	One 1 <i>Width: 90° ±45° elec. Gate: U_{a1} High and U_{a2} High</i> 6 <i>Width: 90° ±45° elec. Gate: U_{a1} Low and U_{a2} Low</i> 7 <i>Width: 270° ±45° elec. Gate: U_{a1} High and U_{a2} High</i> 8 <i>Width: 270° ±45° elec. Gate: U_{a1} Low and U_{a2} Low</i>				
Output frequency	≤ 1.83 MHz				
Commutation Signal periods per revolution*	Without 0		Signal tracks U, V, W 2 to 32		
System accuracy ¹⁾	<i>Metal graduation: ±300"</i> <i>Glass graduation: ±150"</i>				
Electrical connection Connection orientation*	15-pin PCB connector R = radial, A = axial				
Supply voltage	DC 5 V ±0.5 V				
Current consumption Typically 5 V, without load Max. 5.5 V, without load Max. 5.5 V, with load	≤ 45 mA ≤ 105 mA ≤ 205 mA	≤ 45 mA ≤ 95 mA ≤ 105 mA	≤ 45 mA ≤ 110 mA ≤ 310 mA	≤ 45 mA ≤ 105 mA ≤ 210 mA	≤ 45 mA ≤ 95 mA ≤ 115 mA
Shaft*	Hollow through shaft with radial fastening <i>Shaft diameter: see Mating dimensions</i>				
Mech. permiss. speed	<i>Metal graduation: ≤ 30000 rpm</i> <i>Glass graduation: ≤ 12000 rpm</i>				
Moment of inertia of rotor	<i>Metal graduation: 0.2 · 10⁻⁶ kgm²</i> <i>Glass graduation: 0.3 · 10⁻⁶ kgm²</i>				
Permissible motion of measured shaft	<i>Axial: ±0.254 mm</i> <i>Radial runout: 0.05 mm TIR (≤ 5000 signal periods per revolution)</i> <i>0.03 mm TIR (> 5000 signal periods per revolution)</i>				
Vibration 55 Hz to 2000 Hz Shock 6 ms	≤ 200 m/s ² (EN 60068-2-6) ≤ 2000 m/s ² (EN 60068-2-27)				
Operating temperature	-30 °C to 115 °C				
Relative humidity	≤ 93 % (40 °C/21 d as per EN 60068-2-78); without condensation				
Protection EN 60529	IP30 ²⁾				
Mass	≈ 0.03 kg				
ID number	1064590-xx	1282231-xx	11188619-xx	1282244-xx	1282236-xx

* Please select when ordering

¹⁾ Unmounted; additional errors due to mounting of the measured shaft are not considered.

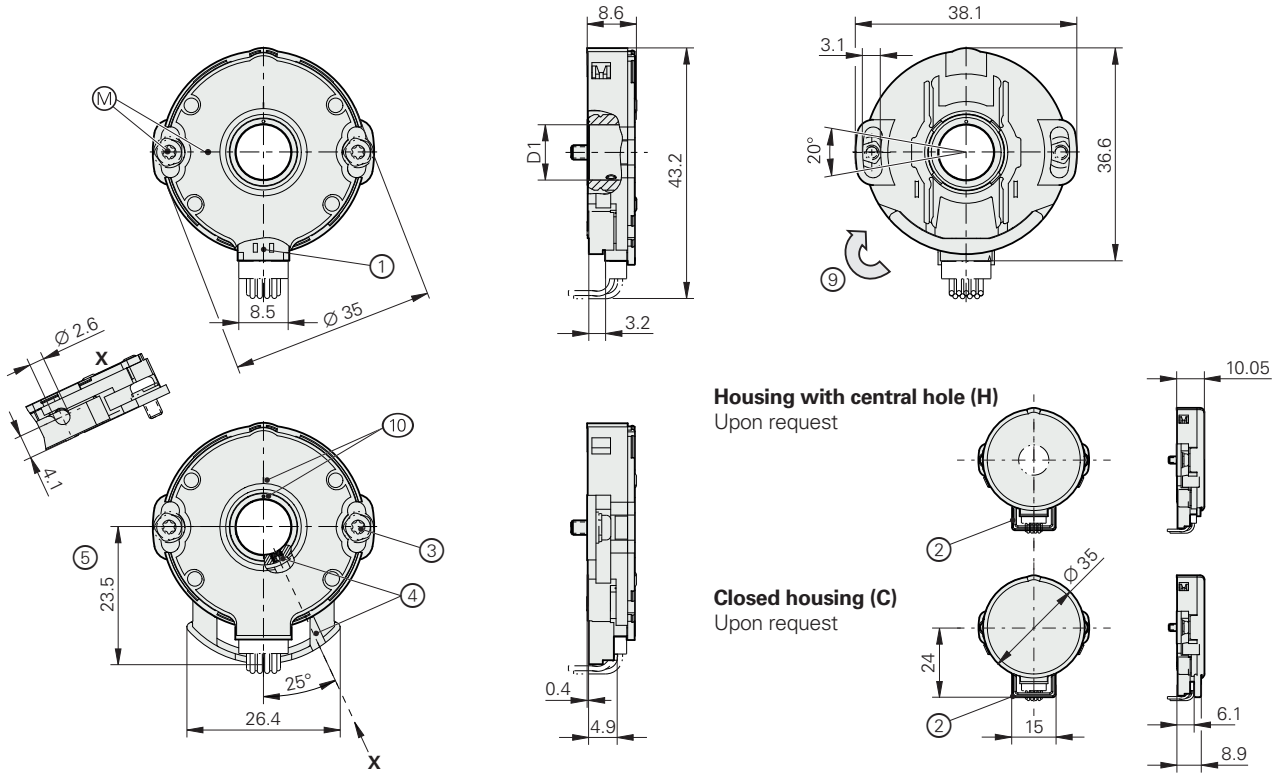
For a measured shaft eccentricity of 1 µm, the measuring error increases by ±16.4"

²⁾ Electromagnetic compatibility must be ensured in the complete system.

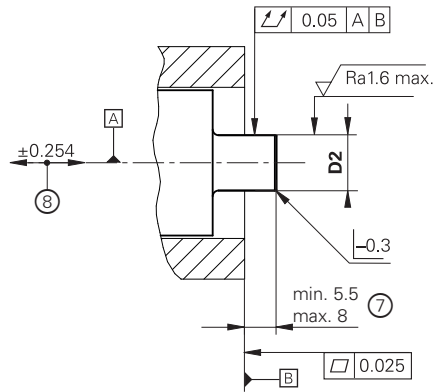
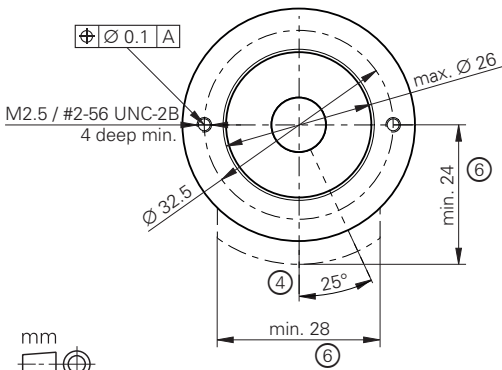
R35iL rotary encoders

Incremental rotary encoders

- Ø 32.5 mm flange for axial mounting
- Hollow through shaft
- Self-centering, without integral bearing



Required mating dimensions



*) Shaft diameter in inches or mm

mm
 Tolerancing ISO 8015
 ISO 2768 - m H
 < 6 mm: ±0.2 mm

- ☐ = Bearing of mating shaft
- M = Measuring point for operating temperature
- 1 = 9-pin radial header
- 2 = Housing with strain relief (SH/SC)
- 3 = Torx T8 fastening screws for flange:
 2x M2.5x5.25 ID 548595-02 or 2x #2-56 UNCx5.25 ID 548595-03;
 tightening torque: 0.21 Nm ±0.02 Nm
- 4 = Setscrew; tightening torque: 0.14 Nm ±0.01 Nm; note installation space for tool
- 5 = Slide lock in mounting position
- 6 = Required installation space for slide lock in mounting position
- 7 = Max. dimension for closed housing (C/SC)
- 8 = Maximum permissible motion between shaft and stator (including thermal expansion);
 dynamic axial motion is permitted over the entire value
- 9 = Direction of shaft rotation for ascending position values
- 10 = Reference mark position ±10°

Setscrew socket	*)	D1 +0.01 0	D2 0 -0.013
0.048" Bristol 4-Spine	3/8+	Ø 9.528	Ø 9.525
	3/8	Ø 9.520	Ø 9.517
	8 mm	Ø 8	Ø 7.997
	5/16	Ø 7.932	Ø 7.929
	1/4+	Ø 6.353	Ø 6.350
	1/4	Ø 6.345	Ø 6.342
	6 mm	Ø 6	Ø 5.997
	5 mm	Ø 5	Ø 4.997
	3/16+	Ø 4.765	Ø 4.762
	3/16	Ø 4.757	Ø 4.754
	4 mm	Ø 4	Ø 3.997
1/8+	Ø 3.178	Ø 3.175	

R35iL		
Interface*	PP/0	PP/PP
Signal periods per revolution*	100, 200, 250, 256, 400, 500, 512, 625, 800, 1000, 1024, 1250, 2000, 2048, 2500, 4000, 4096, 5000	
Reference mark Width and gate*	One 1 <i>Width: 90° ±45° elec. Gate: U_{a1} High and U_{a2} High</i> 6 <i>Width: 90° ±45° elec. Gate: U_{a1} Low and U_{a2} Low</i> 7 <i>Width: 270° ±45° elec. Gate: U_{a1} High and U_{a2} High</i> 8 <i>Width: 270° ±45° elec. Gate: U_{a1} Low and U_{a2} Low</i>	
Output frequency	≤ 1.83 MHz	
Commutation Signal periods per revolution*	Without 0	Signal tracks U, V, W 2 to 32
System accuracy ¹⁾	±300"	
Electrical connection Connection direction	9-pin PCB connector Radial	
Supply voltage*	DC 3.3 V ±0.165 V DC 5 V ±0.5 V	
Current consumption Typical, without load Maximum, without load Maximum, with load	DC 3.3 V or 5 V: ≤ 55 mA DC 3.47 V or 5.5 V: ≤ 90 mA DC 3.47 V or 5.5 V: ≤ 105 mA	DC 3.3 V or 5 V: ≤ 55 mA DC 3.47 V or 5.5 V: ≤ 90 mA DC 3.47 V or 5.5 V: ≤ 110 mA
Shaft*	Hollow through shaft with radial fastening <i>Shaft diameter: see Mating dimensions</i>	
Mech. permiss. speed	≤ 30000 rpm	
Moment of inertia of rotor	0.2 · 10 ⁻⁶ kgm ²	
Permissible motion of measured shaft	<i>Axial: ±0.254 mm</i> <i>Radial runout: 0.05 mm TIR</i>	
Vibration 55 Hz to 2000 Hz Shock 6 ms	≤ 200 m/s ² (EN 60068-2-6) ≤ 2000 m/s ² (EN 60068-2-27)	
Operating temperature	-30 °C to 115 °C	
Relative humidity	≤ 93 % (40 °C/21 d as per EN 60068-2-78); without condensation	
Protection ²⁾ EN 60529	<i>Without housing: IP00</i> <i>With housing: IP30</i>	
Mass	≈ 0.03 kg	
ID number	1064357-xx (DC 3.3 V) 1086065-xx (DC 5 V)	1046201-xx (DC 3.3 V) 1041174-xx (DC 5 V)

* Please select when ordering

¹⁾ Unmounted; additional errors due to mounting of the measured shaft are not considered.

For a measured shaft eccentricity of 1 µm, the measuring error increases by ±16.4"

²⁾ Electromagnetic compatibility must be ensured in the complete system.

General electrical information

Scope

This general electrical information applies to RENCO rotary encoders and output cables. For deviating information, see the specifications. No fault identification measures have been implemented in RENCO products. The operational safety of the application in conjunction with the encoders must be ensured in the complete system.

Power supply

Connect the rotary encoders only to subsequent electronics whose supply voltage comes from PELV systems (as defined in EN 50178). The R35i and R35iL rotary encoders meet the requirements of the IEC 61010-1 standard only if power is supplied from a secondary circuit with limited energy as per IEC 61010-1^{3rd Ed.}, Section 9.4, or with limited power as per IEC 60950-1^{2nd Ed.}, Section 2.5, or from a Class 2 secondary circuit as per UL1310.¹⁾

A stabilized DC voltage U_P is required for powering the encoders. Information regarding current consumption and voltage is provided in the respective specifications.

Regarding the ripple voltage of the DC power, the following parameters apply:

- High-frequency interference
 $U_{PP} < 250 \text{ mV}$ with $dU/dt > 5 \text{ V}/\mu\text{s}$
- Low-frequency fundamental ripple
 $U_{PP} < 100 \text{ mV}$

However, the limits of the supply voltage must not be violated by the ripple content.

The voltage values must be complied with at the rotary encoder. The voltage drop ΔU in the supply lines is calculated as follows:

$$\Delta U = 2 \cdot \frac{1.05 \cdot L_C}{56 \cdot A_P} \cdot I_M \cdot 10^{-3}$$

Where:

ΔU	Line voltage drop in V
L_C	Cable length in m
A_P	Cross section of the supply lines in mm^2
I_M	Current consumption in mA
2	Outgoing and incoming lines
1.05	Length factor due to twisted wires
56	Electrical conductivity of copper

Switch-on/off behavior of the rotary encoder

Valid output signals are available after the switch-on time t_{SOT} . During the time t_{SOT} , the output signals have the maximum voltage values U_{Pmax} (see specifications). If the power supply is switched off, or if the supply voltage falls below U_{Pmin} , then the output signals are invalid as well. If the rotary encoder is operated via interposed interface electronics, then their switch-on/off conditions must also be taken into account.

Selection of the power supply of the subsequent electronics

Select a power supply that is as close as possible to the upper tolerance limit. During selection, consider the voltage drop ΔU based on the cable length. The power supply of the subsequent electronics should be within the upper tolerance, particularly for the R35iL with a supply voltage of DC 3.6 V $\pm 0.165 \text{ V}$.

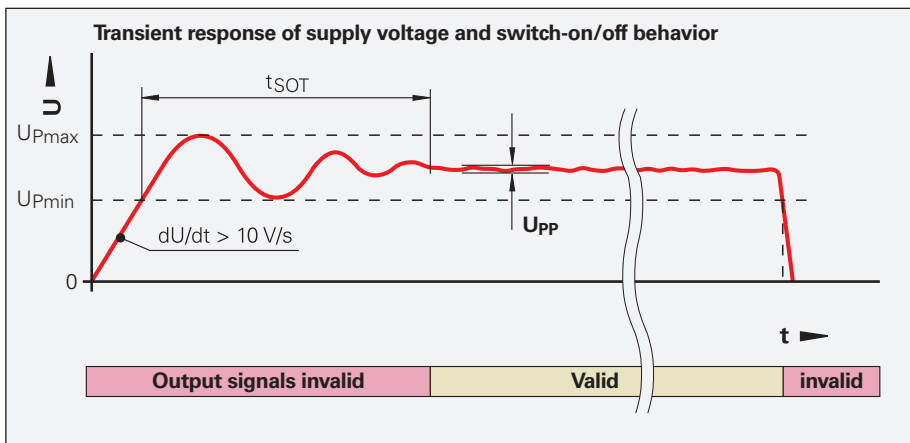
Electrically permissible speed

The maximum permissible speed of a rotary encoder is based on the following factors:

- The mechanically permissible speed (see specifications)
- The electrically permissible speed. The electrically permissible speed is limited by the following factors:
 - The maximum permissible output frequency (see specifications)
 - The minimum permissible edge separation for the subsequent electronics

Block commutation

The number of signal periods is equivalent to the number of motor pole pairs.
1 pole pair $\hat{=}$ 2 motor poles



t_{SOT} = Typical: 1.3 ms
Max.: 2.6 ms

¹⁾ Instead of IEC 61010-1^{3rd Ed.}, Section 9.4, the equivalent sections of the standards DIN EN 61010-1, EN 61010-1, UL 61010-1, and CAN/CSA-C22.2 No. 61010-1 can be used, and, instead of IEC 60950-1^{2nd Ed.}, Section 2.5, the equivalent sections of the standards DIN EN 60950-1, EN 60950-1, UL 60950-1, and CAN/CSA-C22.2 No. 60950-1 can be used.

Electrical safety

RENCO rotary encoders must be powered from PELV systems (see EN 50178). The housings of the RENCO rotary encoders are isolated from internal circuits. The rated impulse voltage of the insulation is 500 V in accordance with EN 60664-1. In addition, Pollution Degree 2 in the micro-environment must be complied with (see EN 60664-1), and operation at an elevation ≤ 6000 m above sea level (R35i) or ≤ 2000 m above sea level (R35iL) must be adhered to.

Electromagnetic compatibility

Sources of electrical interference

Electrical interference is primarily caused by capacitive or inductive couplings. Inductive couplings can arise on lines, as well as at device inputs and outputs. Typical sources of electrical interference include the following:

- Strong magnetic fields from transformers, brakes, and electric motors
- Relays, contactors, and solenoid valves
- High-frequency equipment, pulse devices, and stray magnetic fields from switching power supplies
- Power cables and supply lines to the abovementioned devices

Conformity

When the measures described below are implemented, RENCO rotary encoders comply with EMC Directive 2014/30/EU with regard to the generic standards for the following phenomena:

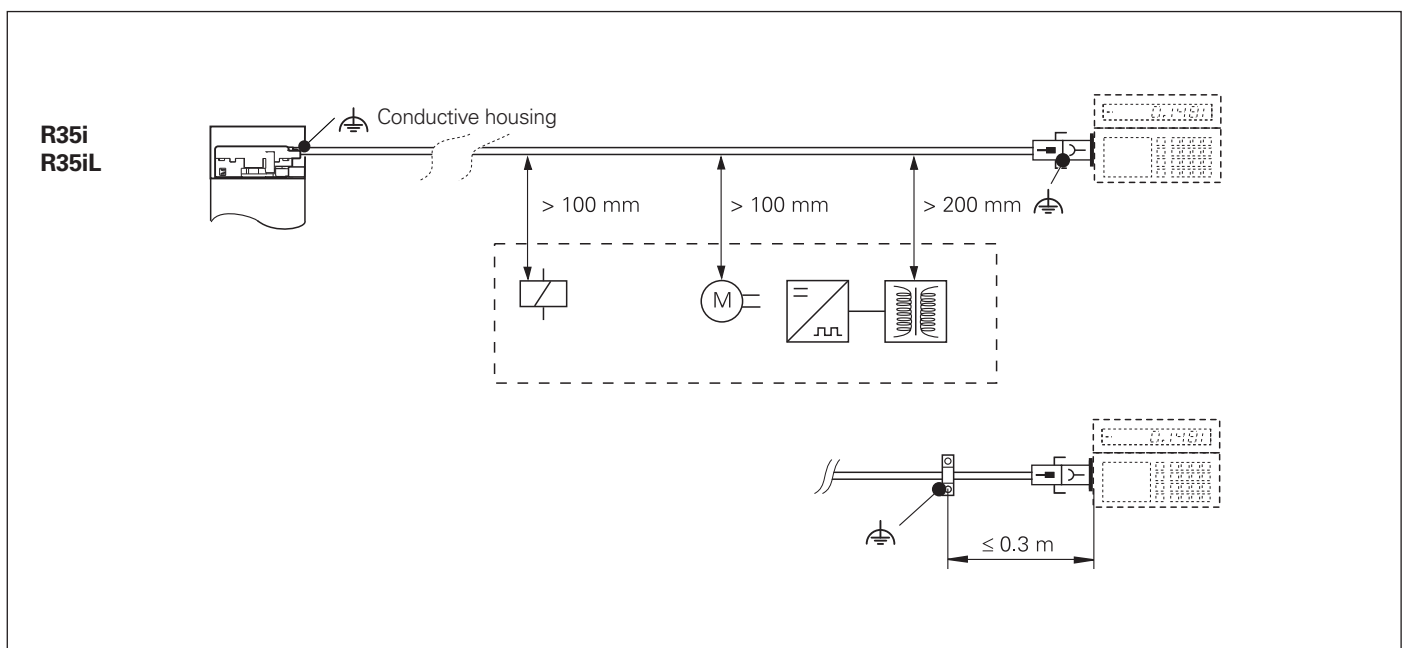
- Noise immunity EN 61000-6-2
- Specifically, the following standards:
- ESD EN 61000-4-2
 - Electromagnetic fields EN 61000-4-3

- Burst EN 61000-4-4
- Surge EN 61000-4-5
- Conducted disturbances EN 61000-4-6
- Power frequency magnetic field EN 61000-4-8
- Voltage dips, short interruptions EN 61000-4-11
- Emission EN 61000-6-4

Measures

The EMC Directive requires the attainment of interference-free operation without the need for EMC expertise. The following measures serve to ensure this level of interference-free operation (please consult with HEIDENHAIN as needed):

- Properly install or mount RENCO rotary encoders (see *Mounting*).
- Install rotary encoders in a closed metal housing (electrically conductive housing) and connect them with the shield connection from the output cable.
- For usage that deviates from standard usage (assignment of signals and connectors), the manufacturer of the complete system must ensure conformity.
- Do not install cables in the direct vicinity of sources of interference (inductive consumers such as contactors, motors, frequency inverters, solenoids).
 - Sufficient decoupling from interference-signal-conducting cables can usually be achieved by an air clearance of 100 mm or, when cables are routed in metal ducts, by a grounded partition.
 - A minimum clearance of 200 mm from storage reactors in switching power supplies is required.
- Prevent accidental contact between the shield (e.g., connector) and other metal parts.
- Use connecting elements (e.g., connectors or terminal boxes) with metal housings. Only the signals and power supply of the connected encoder may be routed through these elements.
- Connect the following elements with each other via the cable shield: the conductive protective housing for the rotary encoder, output cable, connecting elements, and subsequent electronics.
- Connect the shield over a large area along the complete circumference (360°). If other signals and sources of interference will pass through the housing, then, for interference-free operation, EMC expertise is required, and the manufacturer of the complete system must ensure conformity.
- Connect the external shield to functional earth over a large surface before the connector (for shield clamp, see figure). There must be no source of interference in the immediate vicinity.
- If compensating currents are to be expected within the complete system, then a separate equipotential bonding conductor must be provided. The shield is not meant to serve as an equipotential bonding conductor.
- For RENCO rotary encoders, provide high-frequency, low-impedance grounding (see EN 60204-01).



LD square-wave signals

For incremental and commutation signals with a differential line driver as per EIA standard RS-422.

Incremental signals	Two square-wave signals U_{a1} , U_{a2} with 90° elec. phase shift and their inverted signals $\overline{U_{a1}}$, $\overline{U_{a2}}$
Reference mark signal Pulse width	One square-wave pulse U_{a0} and its inverted pulse $\overline{U_{a0}}$ 90° elec. or 270° elec. For the ordering key, see the <i>Selection guide</i> or specifications
Commutation signals	Three square-wave signals U , V , W and their inverse signals \overline{U} , \overline{V} , \overline{W}
Signal amplitude	Differential line driver as per EIA standard RS-422
Permissible load	$Z_0 \geq 100 \Omega$ Between associated outputs $ I_L \leq 20 \text{ mA}$ Maximum load per output $C_{load} \leq 1000 \text{ pF}$ To 0V Outputs are protected against a short to 0V
Switching times (10% to 90%)	$t_r / t_f \leq 30 \text{ ns}$ (typically 10 ns) With 1 m cable and recommended input circuitry

U_{a1} , $\overline{U_{a1}}$,
 U_{a2} , $\overline{U_{a2}}$ **On-off ratio**
 $X1+X2 = 0.5T \pm 0.2T$
 $X2+X3 = 0.5T \pm 0.2T$
Phase angle
 $0.375T \geq Xn \geq 0.125T$
($n = 1, 2, 3, 4$)

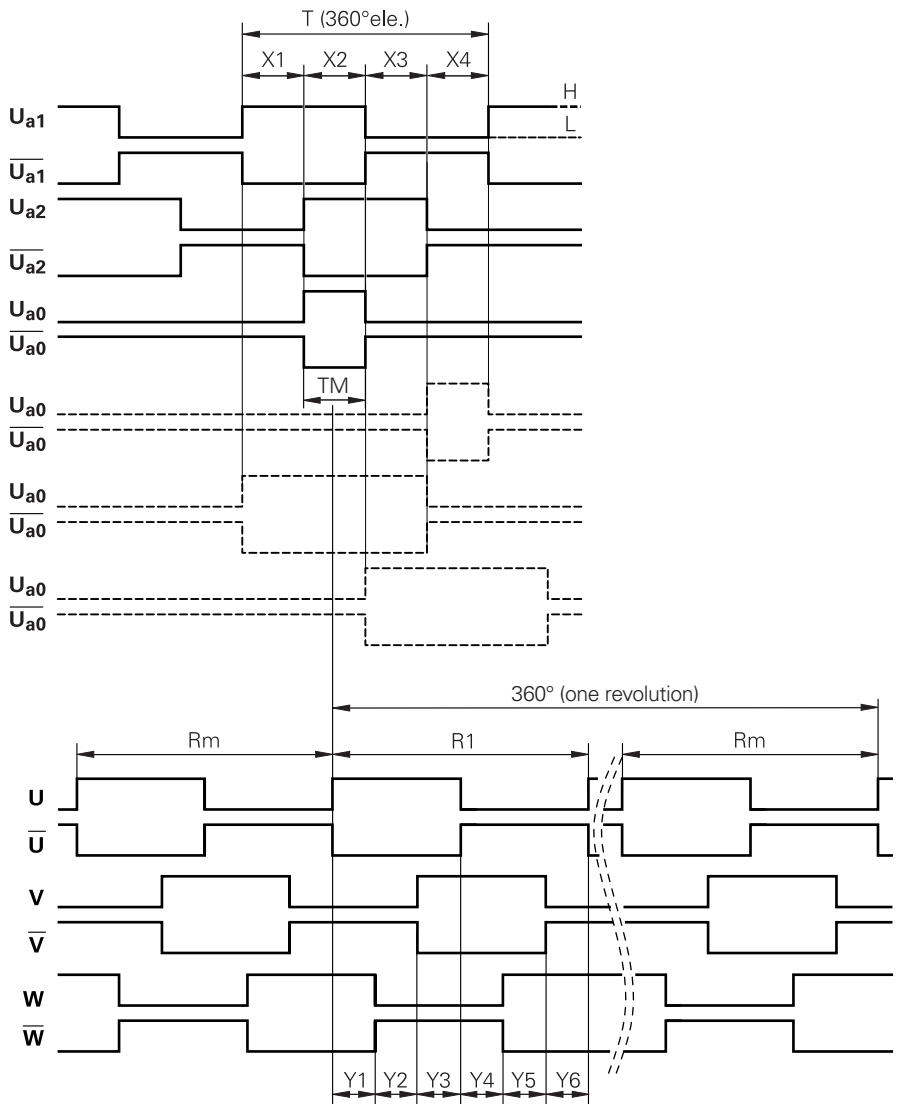
U_{a0} , $\overline{U_{a0}}$ **Pulse width and position**
1: $TM = 0.25T \pm 0.125T$

6: $TM = 0.25T \pm 0.125T$

7: $TM = 0.75T \pm 0.125T$

8: $TM = 0.75T \pm 0.125T$

U , \overline{U} , V , \overline{V} ,
 W , \overline{W} **On-off ratio**
 $Rm = (360^\circ \text{ mech.} / \text{number of signal periods}) \pm 2^\circ \text{ mech.}$
Phase angle
 $Yn = Rm / 6 \pm 0.3^\circ \text{ mech.}$
Position
Rising edge of the U signal relative to the middle of the reference mark signal U_{a0} (only in the factory default setting). This does not apply after the programming of a new position.



Input circuitry of subsequent electronics

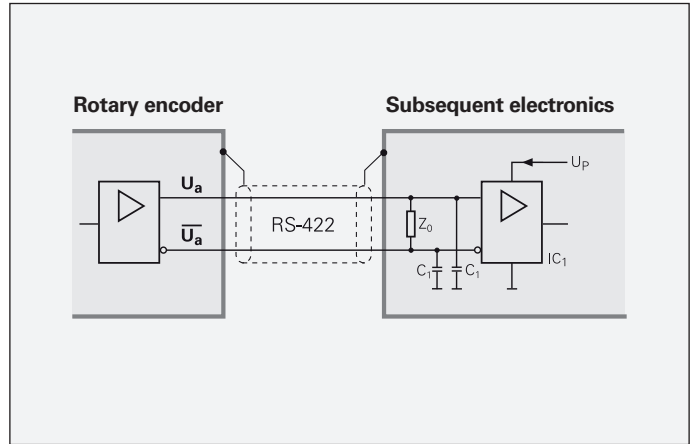
For incremental, reference-mark, and commutation signals

Dimensioning

IC_1 = Recommended differential line receiver DS 26 C 32 AT

Z_0 = 120 Ω

C_1 = 220 pF (serves to improve noise immunity)



R35i pin layout

15-pin PCB connector															
	Power supply		Incremental signals				Reference mark signal		Commutation signals						
15	13	14	1	2	3	4	5	6	7	8	9	10	11	12	
LD/0	U_P	0V	U_{a1}	\overline{U}_{a1}	U_{a2}	\overline{U}_{a2}	U_{a0}	\overline{U}_{a0}	-	-	-	-	-	-	
LD/LD	U_P	0V	U_{a1}	\overline{U}_{a1}	U_{a2}	\overline{U}_{a2}	U_{a0}	\overline{U}_{a0}	U	\overline{U}	V	\overline{V}	W	\overline{W}	
LD/PP	U_P	0V	U_{a1}	\overline{U}_{a1}	U_{a2}	\overline{U}_{a2}	U_{a0}	\overline{U}_{a0}	U	-	V	-	W	-	

Vacant pins or wires must not be used!

PP square-wave signals

For incremental and commutation signals with a push-pull driver output.

Incremental signals	Two square-wave signals U_{a1} , U_{a2} with 90° elec. phase shift
Reference mark signal Pulse width	One square-wave pulse U_{a0} 90° elec. or 270° elec. For the ordering key, see the <i>Selection guide</i> or specifications
Commutation signals	Three square-wave signals U, V, W
Signal amplitude	Voltage supply +5 V: $U_H > 2.5\text{ V}$ at $-I_H = 4\text{ mA}$ $U_L < 0.5\text{ V}$ at $I_L = 4\text{ mA}$
Permissible load	$ I_L \leq 4\text{ mA}$ maximal load per output Outputs are not short-circuit proof
Switching times (10 % to 90 %)	$t_r / t_f \leq 30\text{ ns}$ With stated input circuit (without cable)

U_{a1} , U_{a2}

On-off ratio

$X1 + X2 = 0.5T \pm 0.2T$

$X2 + X3 = 0.5T \pm 0.2T$

Phase angle

$0.375T \geq X_n \geq 0.125T$

($n = 1, 2, 3, 4$)

U_{a0}

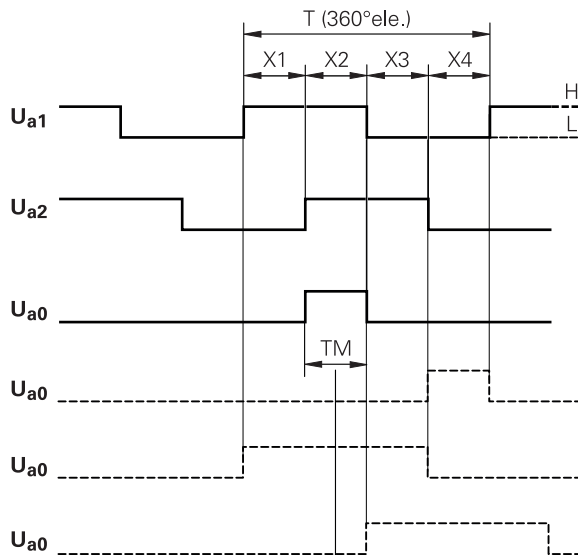
Pulse width and position

1: $TM = 0.25T \pm 0.125T$

6: $TM = 0.25T \pm 0.125T$

7: $TM = 0.75T \pm 0.125T$

8: $TM = 0.75T \pm 0.125T$



U, V, W

On-off ratio

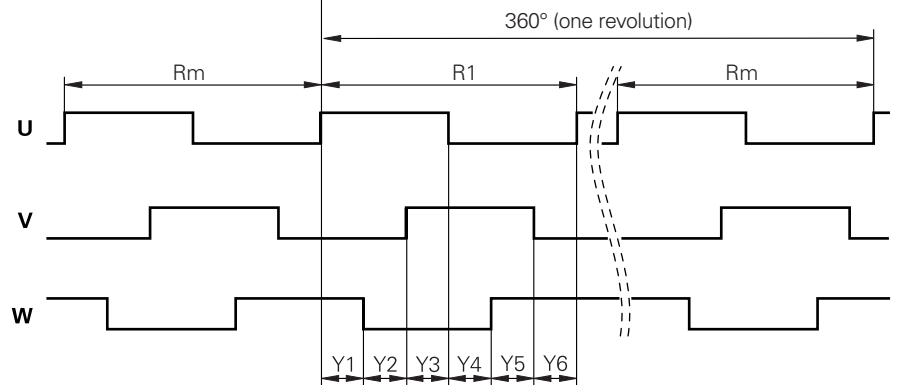
$R_m = (360^\circ \text{ mech.} / \text{number of signal periods}) \pm 2^\circ \text{ mech.}$

Phase angle

$Y_n = R_m / 6 \pm 0.3^\circ \text{ mech.}$

Position

Rising edge of the U signal relative to the middle of the reference mark signal U_{a0} (only in the factory default setting). This does not apply after the programming of a new position.



Input circuitry of subsequent electronics

For incremental, reference-mark, and commutation signals

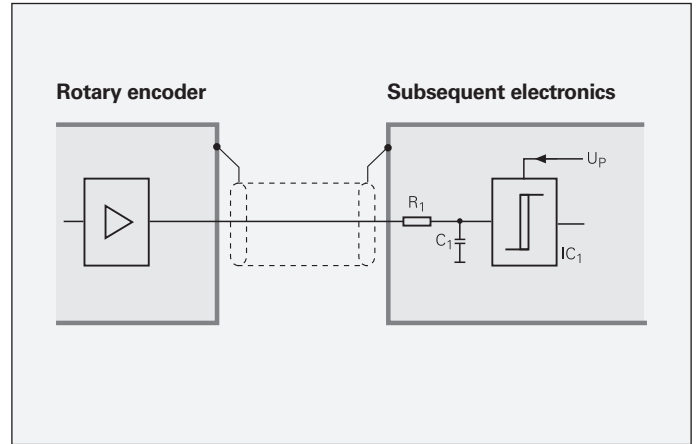
Dimensioning

IC₁ = 74HC14 CMOS


R₁ = 1 kΩ

C₁ = 47 pF (signals U_{a1}, U_{a2}, U_{a0})

C₁ = 470 pF (signals U, V, W)




R35i pin layout

15-pin PCB connector														
	Supply voltage		Incremental signals				Reference mark signal		Commutation signals					
	13	14	1	2	3	4	5	6	7	8	9	10	11	12
PP/0	U _P	0V	U _{a1}	–	U _{a2}	–	U _{a0}	–	–	–	–	–	–	–
PP/PP	U _P	0V	U _{a1}	–	U _{a2}	–	U _{a0}	–	U	–	V	–	W	–

Vacant pins or wires must not be used!

R35iL pin layout

9-pin PCB connector								
	Power supply		Incremental signals		Reference mark signal	Commutation signals		
	7	8	1	2	3	4	5	6
PP/0	U _P	0V	U _{a1}	U _{a2}	U _{a0}	–	–	–
PP/PP	U _P	0V	U _{a1}	U _{a2}	U _{a0}	U	V	W

Vacant pins or wires must not be used!

Output cables

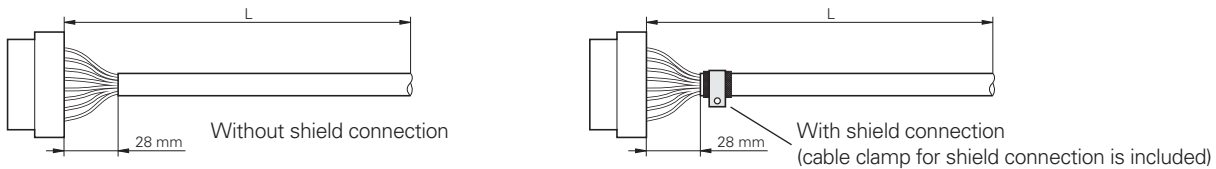
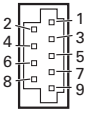
R35i rotary encoders

Output cables with 15-pin PCB connector, braided shield with drain wire, and unstripped cable end						
<p>Without shield connection</p>		<p>With shield connection (cable clamp for shield connection is included)</p>				
Commutation signal	Without commutation signals		With commutation signals			
Interface	PP/0	LD/0	PP/PP	LD/PP	LD/LD	
Output cables without shield connection						
Cable length L 0.5 m	1231728-N5	1231685-N5	1231767-N5	1231760-N5	1231752-N5	
1.0 m	1231728-01	1231685-01	1231767-01	1231760-01	1231752-01	
Output cables with shield connection						
Cable length L 1.0 m	1233223-01	1273065-01	1273064-01	1235360-01	1273058-01	
		PUR cables Ø 4.5 mm ±0.2 mm 4x2 AWG28 7/36 (twisted wire pair) <i>Single-wire insulation:</i> TPE Ø 0.6 mm Bend radius at 20 °C: <i>Rigid configuration:</i> ≥ 14 mm <i>Frequent flexing:</i> ≥ 36 mm Temperature range <i>PUR cable jacket:</i> ¹⁾ -40 °C to 100 °C <i>TPE wires:</i> -40 °C to 120 °C		PUR cables Ø 6.0 mm ±0.2 mm 8x2 AWG28 7/36 (twisted wire pair) <i>Single-wire insulation:</i> TPE Ø 0.6 mm Bend radius at 20 °C: <i>Rigid configuration:</i> ≥ 18 mm <i>Frequent flexing:</i> ≥ 48 mm Temperature range <i>PUR cable jacket:</i> ¹⁾ -40 °C to 100 °C <i>TPE wires:</i> -40 °C to 120 °C		
Pin	Signal	Wire colors				
1	$\overline{U_{a1}}$	Yellow	Yellow	Yellow	Yellow	Yellow
2	$\overline{U_{a1}}$	–	White/Yellow	–	White/Yellow	White/Yellow
3	$\overline{U_{a2}}$	Blue	Blue	Blue	Blue	Blue
4	$\overline{U_{a2}}$	–	White/Blue	–	White/Blue	White/Blue
5	$\overline{U_{a0}}$	Orange	Orange	Orange	Orange	Orange
6	$\overline{U_{a0}}$	–	White/Orange	–	White/Orange	White/Orange
7	\overline{U}	–	–	Green	Green	Green
8	\overline{U}	–	–	–	–	White/Green
9	\overline{V}	–	–	Brown	Brown	Brown
10	\overline{V}	–	–	–	–	White/Brown
11	\overline{W}	–	–	White	White	White
12	\overline{W}	–	–	–	–	White/Gray
13	$\overline{U_P}$	Red	Red	Red	Red	Red
14	$\overline{0V}$	Black	Black	Black	Black	Black
15	Vacant	–	–	–	–	–

To prevent damage to the encoders, insulate any unused wires.

¹⁾ Limited temperature range: -20 °C (when flexing) or +80 °C (when exposed to media and hydrolysis)

R35iL rotary encoders

Output cables with 9-pin PCB connector, braided shield with drain wire, and unstripped cable end		
		
Commutation signal	Without commutation signals	With commutation signals
Interface	PP/0	PP/PP
Output cables without shield connection Cable length L 0.5 m 1.0 m	1299950-N5 1299950-01	1264602-N5 1264602-01
Output cables with shield connection Cable length L 1.0 m	1299951-01	1273070-01
	<p>PUR cables \varnothing 4.5 mm \pm0.2 mm 4x2 AWG28 7/36 (twisted wire pair) <i>Single-wire insulation:</i> TPE \varnothing 0.6 mm Bend radius at 20 °C: <i>Rigid configuration:</i> \geq 14 mm <i>Frequent flexing:</i> \geq 36 mm Temperature range <i>PUR cable jacket:</i>¹⁾ -40 °C to 100 °C <i>TPE wires:</i> -40 °C to 120 °C</p>	
Pin	Signal	Wire colors
1	U _{a1}	Yellow
2	U _{a2}	Blue
3	U _{a0}	Orange
4	U	–
5	V	–
6	W	–
7	U _P	Red
8	0 V	Black
9	Vacant	–
		Yellow Blue Orange Green Brown White Red Black –

To prevent damage to the encoders, insulate any unused wires.

¹⁾ Limited temperature range: -20 °C (when flexing) or +80 °C (when exposed to media and hydrolysis)

General mechanical information

Certification by NRTL (Nationally Recognized Testing Laboratory)

The R35i and R35iL rotary encoders comply with the safety regulations as per UL for the USA and as per CSA for Canada. The NRTL certification of the PUR cable is indicated by the following label: AWM STYLE 20963 80 °C 30 V.

RoHS

HEIDENHAIN has tested the products for the safety of their materials as per European Directives 2002/95/EC (RoHS) and 2002/96/EC (WEEE).

Acceleration

During operation and mounting, the rotary encoders are subjected to various types of acceleration.

• Vibration

The encoders are qualified on a test stand under the acceleration values stated in the specifications at frequencies of 55 Hz to 2000 Hz in accordance with EN 60068-2-6. However, if the application or mounting situation causes long-duration resonant vibration, then proper functioning of the encoder may be impaired, or the encoder may incur damage. **Thorough testing of the complete system is therefore required.**

• Shock

The encoders are qualified on a test stand under the acceleration values stated in the specifications and under the exposure times in accordance with EN 60068-2-27 for non-repetitive, semi-sinusoidal shock. **Continuous shock loads are therefore not covered and must be tested in the application.**

The **maximum angular acceleration** is 10^5 rad/s^2 (DIN 32878). This is the highest permissible rotational acceleration at which the rotor can be accelerated without damage to the encoder. A sufficient safety factor is to be determined through system tests. For angular accelerations $\geq 10^4 \text{ rad/s}^2$, the use of an adhesive bond on the shaft is recommended (see *Mounting*).

Protection against contact (EN 60529)

After completed installation, any rotating parts must be sufficiently protected from unintentional contact during operation.

Protection (EN 60529)

The R35i and R35iL rotary encoders meet their specified protection rating when the cable is connected and the housing is mounted (see the specifications).

Conditions for longer storage times

For storage times of at least 12 months, HEIDENHAIN recommends the following:

- Leave the encoders in the original packaging.
- The storage location should be dry, free of dust, and temperature-regulated, as well as free of vibration, mechanical shock, and chemical influences.

Temperature ranges

For the encoder in its packaging, the applicable storage temperature range is -30 °C to $+65 \text{ °C}$. The operating temperature range specifies the temperature of the rotary encoder that is permissible during operation under actual installation conditions. Proper functioning of the rotary encoder is guaranteed within this range (DIN 32878). The operating temperature is measured at the measuring point (see dimension drawing) and must not be confused with the ambient temperature. The temperature of the rotary encoder is influenced by its installation conditions, the ambient temperature, and the encoder's own heat generation.

System tests

The R35i and R35iL rotary encoders are generally integrated as components into the complete system. In such cases, regardless of the encoder's specifications, thorough tests of the complete system are required. The specifications provided in this brochure apply only to the encoder and not to the complete system. Any operation of the encoder outside of the specified range or intended use is at the user's own risk.

Mounting

For the work steps and dimensions to be complied with during mounting, the information in this brochure and the downloadable videos at www.renco.com are applicable.

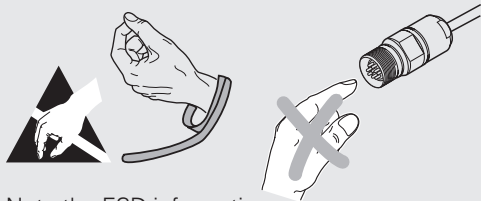
Modifications to the encoder

Proper functioning of the R35i and R35iL rotary encoders is ensured only when they are not modified. Any modification, even a minor one, can impair the proper functioning, reliability, and safety of the encoders, and result in a loss of warranty. This also includes the use of any additional or non-prescribed locking varnishes, lubricants (e.g., for screws), or adhesives. If you are in doubt, we recommend that you consult with HEIDENHAIN in Traunreut, Germany.

Mounting

Mounting and initial configuration must be conducted by a qualified specialist in compliance with local safety regulations. In addition, the machine manufacturer or design engineer must specify any additional information required for final mounting. Do not engage or disengage any connection element while under power. The system must be disconnected from power!

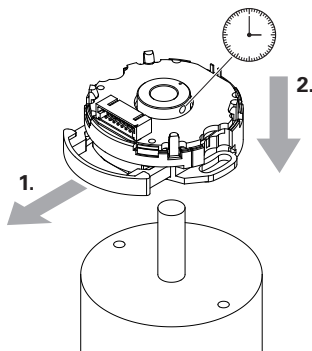
Do not allow the rotary encoder and connecting element to come into contact with aggressive media. Do not clean the encoder with organic solvents such as thinners, alcohol, or mineral spirits. Perform disassembly in reverse order under identical mounting conditions (mounting tolerances and temperature). You can also download mounting instructions on the Internet at www.renco.com.



Note the ESD information

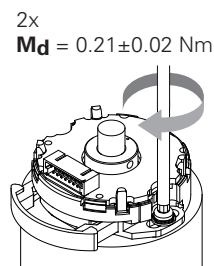
Comply with the general electrical and mechanical information.

Mounting the R35i



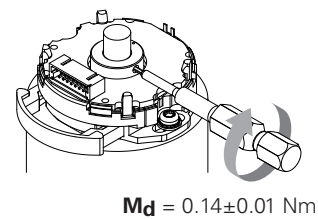
1st step

Ensure that the setscrew for shaft fastening is at 3 o'clock (*reference mark position is within $\pm 10^\circ$ mech.*) and that the integrated mounting aid (1) is pulled out as far as it will go. Slide the encoder (2) onto the motor shaft.



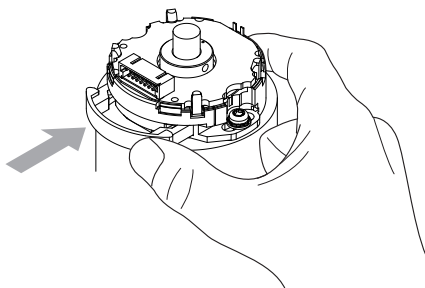
2nd step

Initially tighten the mounting screws finger-tight on both sides. Then tighten them with the required torque.



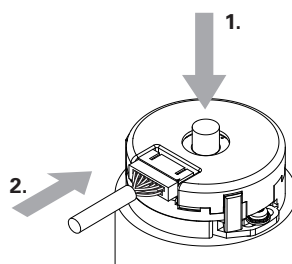
3rd step

Tighten the setscrew with the required torque.



4th step

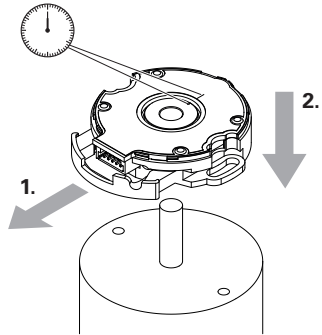
Push in the integrated mounting aid completely while providing opposing support on the other side of the rotary encoder's flange.



5th step

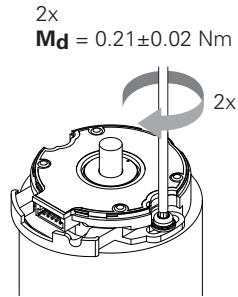
Mount the encoder housing (1), and connect the output cable (2). Do not engage or disengage any connections while under power.

Mounting the R35iL



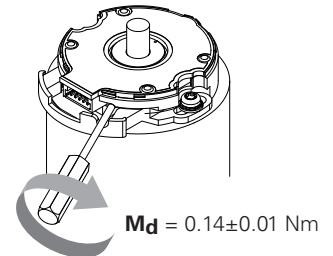
1st step

Ensure that the marking on the rotary encoder shaft (*dot*) is in alignment with the marking on the flange (*line*) (*reference mark position is within $\pm 10^\circ$ mech.*). Also ensure that the integrated mounting aid (1) is pulled out as far as it will go. Slide the encoder (2) onto the motor shaft.



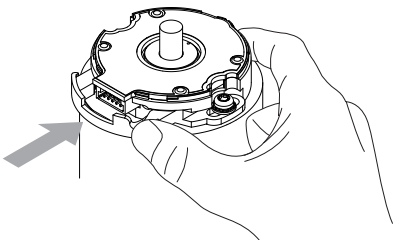
2nd step

Initially tighten the mounting screws finger-tight on both sides. Then tighten them with the required torque.



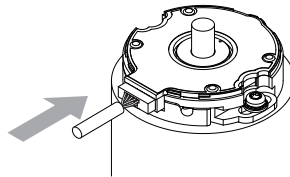
3rd step

Tighten the setscrew with the required torque.



4th step

Push in the integrated mounting aid completely while providing opposing support on the other side of the rotary encoder's flange.



5th step

Connect the cable. Do not engage or disengage any connections while under power.

Adjustment for motor commutation

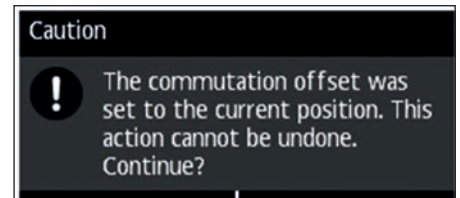
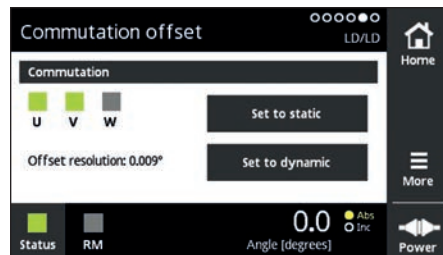
You can program the position of the commutation signals U, V, and W using the PWT 101. There are two methods to choose from:

- Static adjustment while the motor is at standstill
- Dynamic adjustment while the motor is rotating

Static adjustment

With the power off, connect the testing cable to the encoder, and supply power to the rotary encoder with the PWT 101. Rotate the motor to the preferred position, and lock the rotor in place. Provide the motor winding with sufficient DC voltage and current. Then tap *Set to static*

Tapping *Yes* programs the position of the commutation signals U, V, and W at the preferred motor position (rising edge of the U signal).



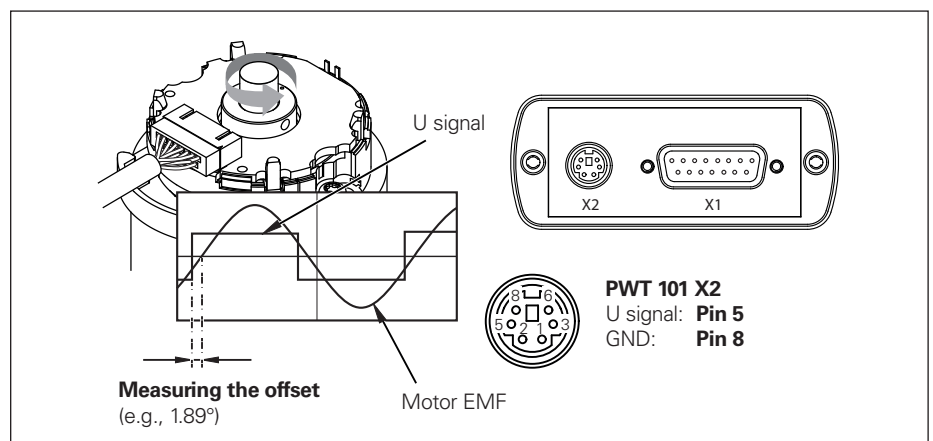
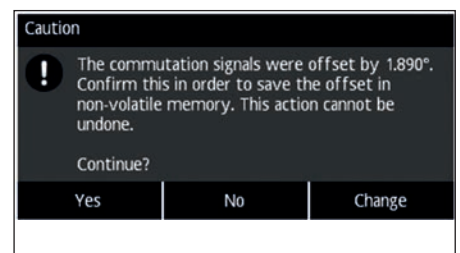
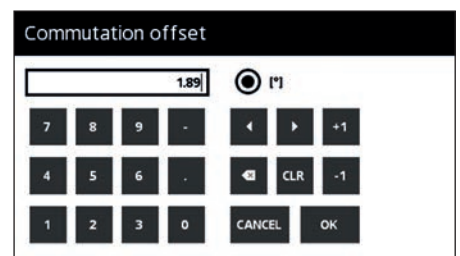
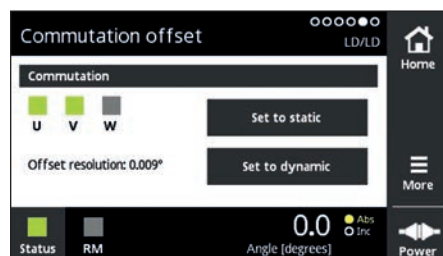
Dynamic adjustment

With the power off, connect the testing cable on the encoder, and supply power to the rotary encoder with the PWT 101 and to the motor. For the direction of shaft rotation for rising position values of the rotary encoder, see the specifications.

Tap *Set to dynamic* in order to measure the offset between the motor EMF and the U signal (U signal applied to the X2 connector of the PWT 101).

Enter the measured offset value into the input field, and confirm with *OK*. Initially, the position of the commutation signals U, V, and W is merely shifted, with further fine adjustment still possible. To perform a further fine adjustment, tap *Change*, and enter a new offset value (repeat until the switching edge of the U signal and of the motor-EMF voltage's zero crossover coincide). Tapping *Yes* permanently programs the position of the commutation signals.

Please note: Programming can be performed only once! Any further configuration of the motor commutation requires mechanical adjustment (by turning the rotary encoder flange).



Adhesive bond for shaft coupling

For angular accelerations $\geq 10^4 \text{ rad/s}^2$, HEIDENHAIN recommends the use of an adhesive bond on the shaft.

Proceed as follows:

- Remove any oil, grease, or other contaminants from the shaft.
- Apply Loctite Primer T to the motor shaft.
- Mount the rotary encoder in accordance with the instructions. For an R35i, do not mount the housing at this time.
- Apply a small amount of Loctite 290 to the gap between the encoder shaft and the motor shaft on the side opposite of the setscrew. Remove any excessive adhesive.
- If you use Loctite 290 adhesive along with Primer T, a hardness of approximately 25 % will be reached within 15 minutes. Final hardness is reached within one hour. For more information on the application and hardening of the adhesive, visit the manufacturer's website: <http://tds.loctite.com/tds5/docs/290-EN.pdf>
- *R35i*: Mount the encoder housing, and connect the cable.

To loosen an adhesive bond for the shaft connection, proceed as follows:

- *R35i*: Remove the encoder housing.
- Apply the Debonder Cleanup Agent X / 8, P / N 06100 from Pacer Technology to the adhesive seam between the motor and the encoder shaft. Allow the debonding agent to penetrate the Loctite adhesive bond for roughly 30 to 40 minutes.
- To remove the encoder, follow the mounting steps in reverse.
- Remove any remaining debonding agent and adhesive from the motor shaft and encoder shaft.
- Electrical testing of the rotary encoder by means of the testing and measuring equipment is recommended in order to exclude potential damage.

Mounting accessories

Be sure to regularly check the torque setting and level of bit wear.

Screwdriver

When using screwdrivers with adjustable torque, ensure that they comply with DIN EN ISO 6789 and thus meet the required torque tolerances.

Adjustable torque
0.02 Nm to 0.3 Nm
ID 350379-10



Screwdriver bit (4-spline)

For shaft fastening

R35iL: For all shaft diameters

R35i: For the following shaft diameters:
4 mm, 5 mm, 6 mm, 8 mm
1/8, 1/8+, 3/16, 3/16+, 1/4, 1/4+,
5/16, 5/16+ inch



The screwdriver bit set contains the following parts:

- 4-spline 1/4-inch adapter bit (0.048) from Bristol Wrench Co.
- Wrench for changing the bits
- Ten "4-spline" replacement bits (0.048)

ID 825869-01

Screwdriver bit hexagonal, width A/F 0.89 mm

For R35i shaft clamping with the following shaft diameters: 3/8 or 3/8+ inch
ID 756768-43



Torx T8 screwdriver bit

For flange fastening screws of the R35i (Ø 32.5 mm) and R35iL
ID 350378-11

Screwdriver bit hexagonal, width A/F 3/32 inch

For flange fastening screws of the R35i (Ø 46.03 mm)
ID 756768-48

For replacement setscrews for shaft clamping, please consult your sales agency.

Testing equipment and diagnostics

PWT 101

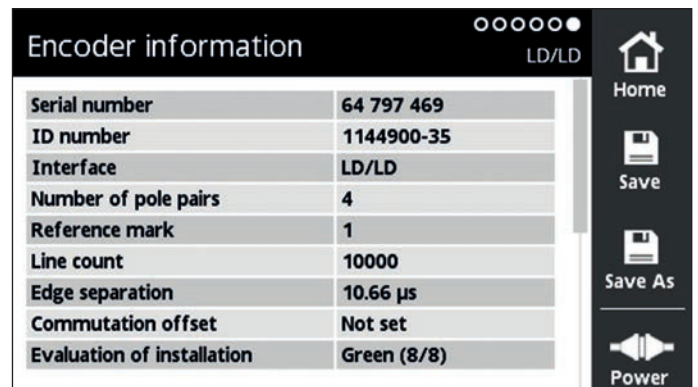
The PWT 101 is a testing device for performing mounting inspections and functional testing of the RENCO R35i and R35iL rotary encoders.



Block commutation

This module allows you to perform the following inspections and settings:

- Mounting inspection
- Output signals
- Level display
- Counts
- Commutation offset
- Encoder information



HEIDENHAIN Filebase

You can download the block commutation module and user's manual at www.heidenhain.de/de_EN/ > Software > Inspection and testing devices > PWT 100 / PWT 101 > Software.



Further information:

For more information, please refer to the *PWT 101 Block Commutation Module User's Manual*.

Miscellaneous testing accessories

Testing cable for the R35i/R35iL rotary encoders

Comes with three 15-pin adapter cables for the R35i and three 9-pin adapter cables for the R35iL.

ID 1314747-01



Replacement cable

Three 15-pin adapter cables: ID 1314702-01

Three 9-pin adapter cables: ID 1314702-02

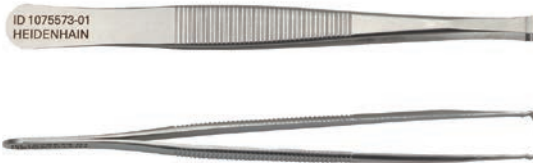


Mounting tool

For disengaging the PCB connector.

ID 1075573-01

To avoid damaging the cable, apply pulling force only to the connector and never to the wires.





HEIDENHAIN

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