

RGH20 RESR angle encoder system





Renishaw plc declares that RGH20, REF & RESR complies with the applicable standards and regulations. A copy of the EC Declaration of Conformity is available on request.

FCC compliance

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The user is cautioned that any changes or modifications not expressly approved by Renishaw plc or authorised representative could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment.

This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

NOTE: This unit was tested with shielded cables on the peripheral devices. Shielded cables must be used with the unit to ensure compliance.

RoHS compliance

Compliant with EC directive 2002/95/EC (RoHS)

Patents

Features of Renishaw's encoder systems and similar products are the subjects of the following patents and patent applications:

EP 0514081	US 5241173	EP 0543513	US 5302820
EP 0748436	US 5861953	EP 0826138	US 6051971
JP 3676819	US 6481115	IL 138995	CN 1293983
GB 2397040	US 7723629	US 7367128	JP 4423196

Further information

Further information relating to the RGH20 encoder range can be found in the RGH20 system Data sheet. This can be downloaded from our website www.renishaw.com/encoder and is also available from your local representative. This document may not be copied or reproduced in whole or in part, transferred to any other media or language, by any means without the written prior permission of Renishaw. The publication of material within this document does not imply freedom from the patent rights of Renishaw plc.

Disclaimer

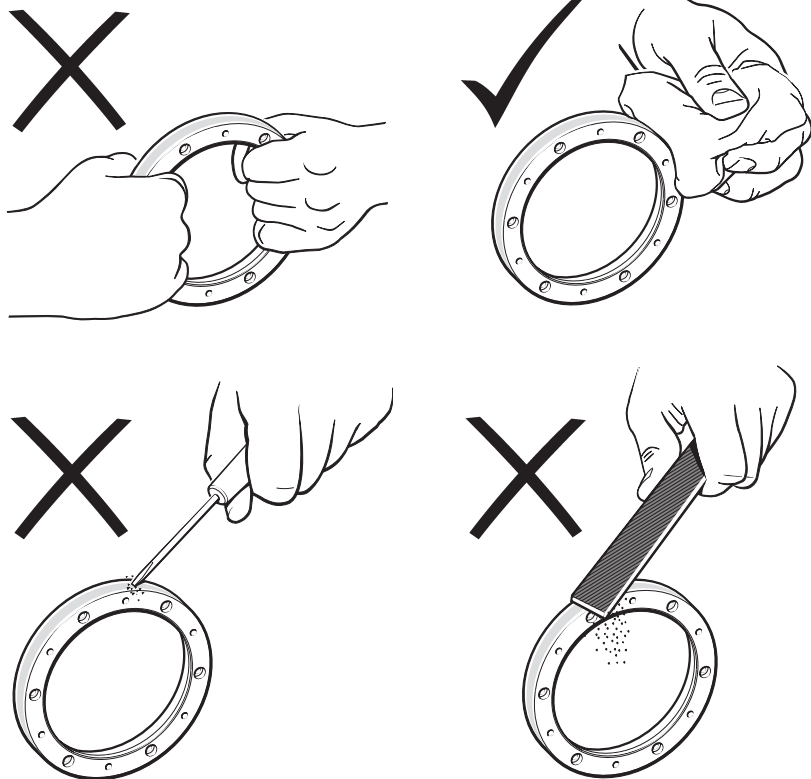
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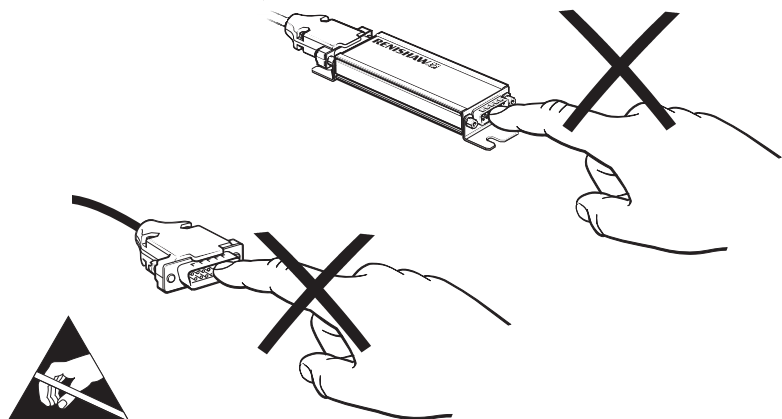
The use of this symbol on Renishaw products and/or accompanying documentation indicates that the product should not be mixed with general household waste upon disposal. It is the responsibility of the end user to dispose of this product at a designated collection point for waste electrical and electronic equipment (WEEE) to enable reuse or recycling. Correct disposal of this product will help to save valuable resources and prevent potential negative effects on the environment. For more information, please contact your local waste disposal service or Renishaw distributor.

Storage and handling

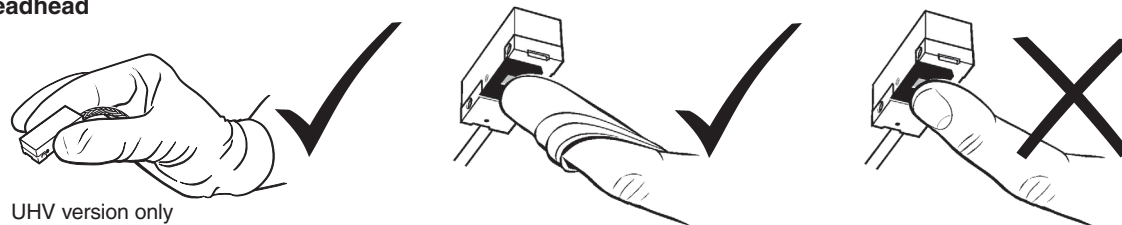
Ring



System



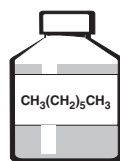
Readhead



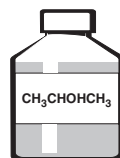
UHV version only

Ring and readhead

N-heptane

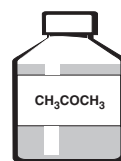


Propan-2-ol



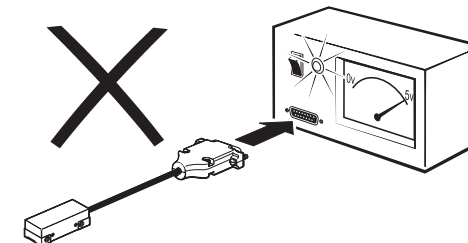
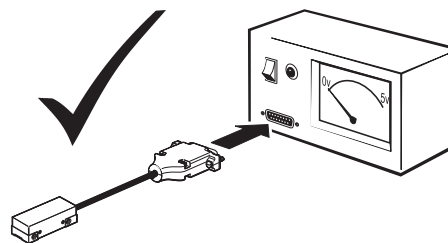
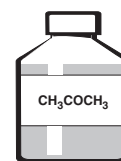
Ring only

Acetone

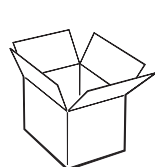


Readhead only

Acetone

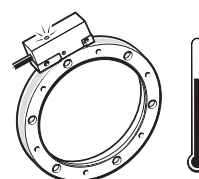


Storage



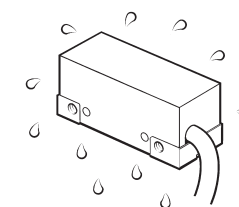
+70 °C
-20 °C

Operating



+55 °C
0 °C

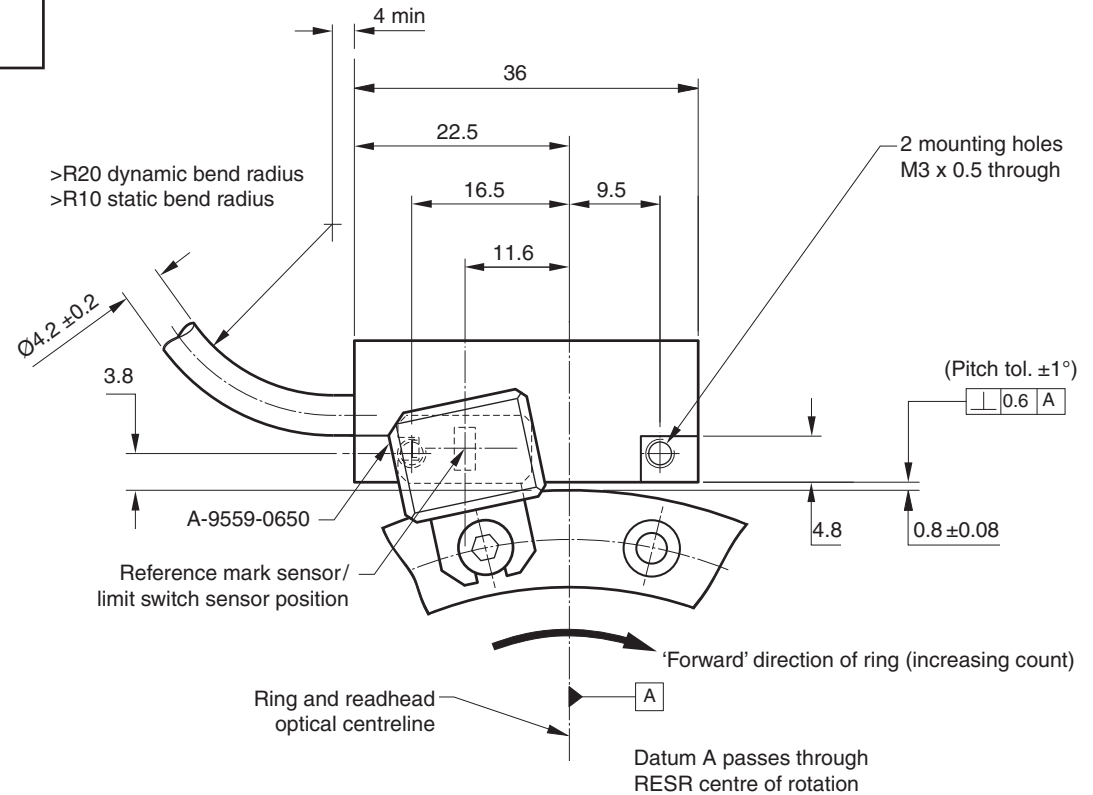
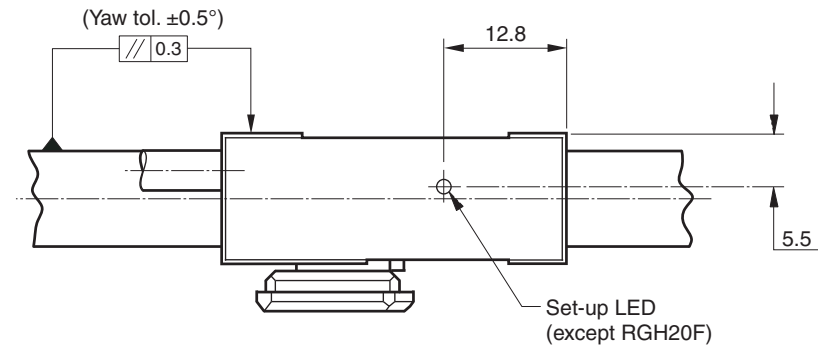
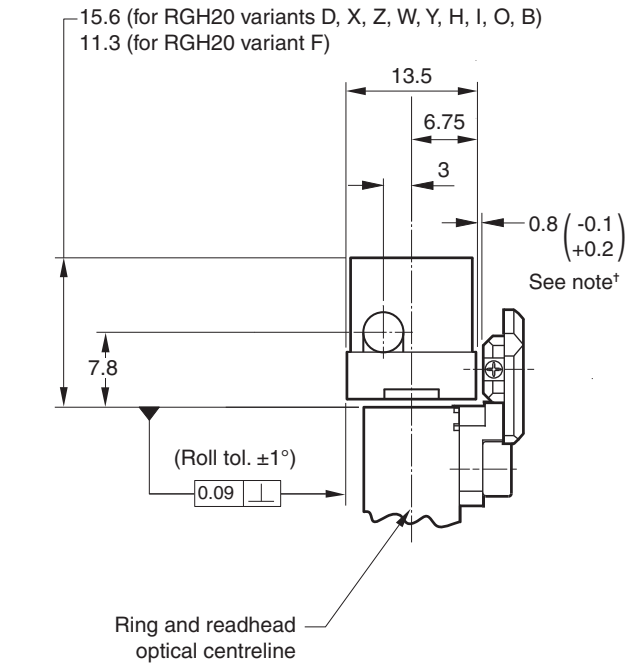
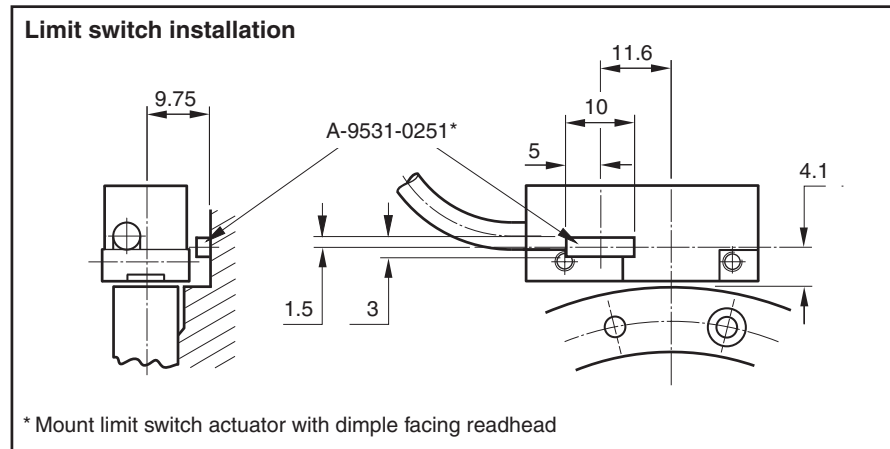
Humidity



Rated up to +40 °C,
<95% relative humidity
(non-condensing)

RGH20 installation drawing (RESR 'A' section ring shown)

Dimensions and tolerances in mm

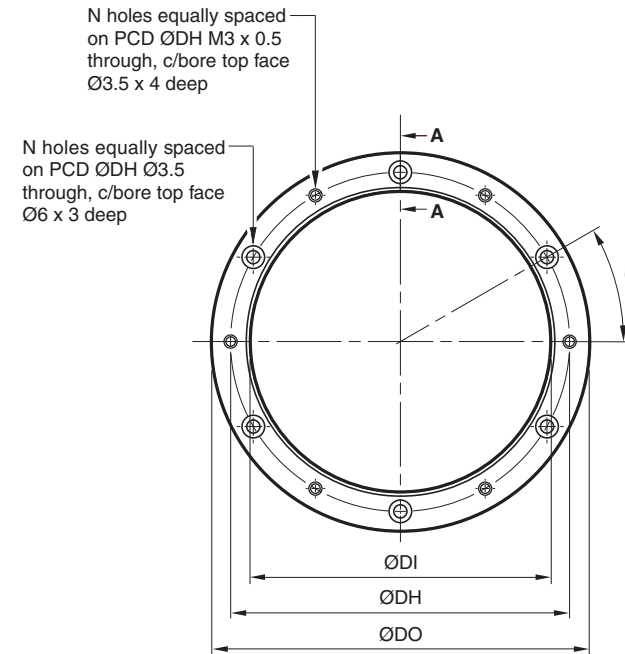


*Required nominal 0.8 gap can be set using blue readhead spacer (supplied) positioned between readhead and actuator when positioning/fixing the actuator.

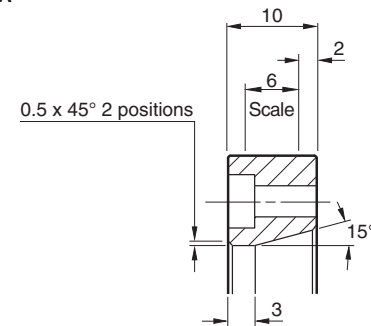
Installation drawing ('A' section RESR)

Dimensions and tolerances in mm

Nominal external diameter (mm)	Line count		DO (mm)	DI (mm)	Mounting holes		
	20 μ m pitch	40 μ m pitch			DH (mm)	N	θ
52	8 192	4 096	52.20 52.10	30.04 30.00	40	6	30°
57	9 000	4 500	57.35 57.25	37.04 37.00	47	6	30°
75	11 840	5 920	75.40 75.30	55.04 55.00	65	6	30°
100	15 744	7 872	100.30 100.20	80.04 80.00	90	6	30°
103	16 200	8 100	103.20 103.00	80.04 80.00	90	6	30°
104	16 384	8 192	104.40 104.20	80.04 80.00	90	6	30°
115	18 000	9 000	114.70 114.50	95.04 95.00	105	6	30°
150	23 600	11 800	150.40 150.20	130.04 130.00	140	9	20°
200	31 488	15 744	200.40 200.20	180.04 180.00	190	12	15°
206	32 400	16 200	206.50 206.10	186.05 186.00	196	12	15°
209	32 768	16 384	208.80 208.40	186.05 186.00	196	12	15°
229	36 000	18 000	229.40 229.00	209.05 209.00	219	12	15°
255	40 000	20 000	254.80 254.40	235.06 235.00	245	12	15°
300	47 200	23 600	300.40 300.20	280.06 280.00	290	16	11.25°
350	55 040	27 520	350.40 350.20	330.06 330.00	340	16	11.25°
413	64 800	32 400	412.70 412.30	392.08 392.00	402	18	10°
417	65 536	32 768	417.40 417.00	380.10 380.00	390	18	10°
550	86 400	43 200	550.20 549.80	510.10 510.00	520	20	9°



Section A-A

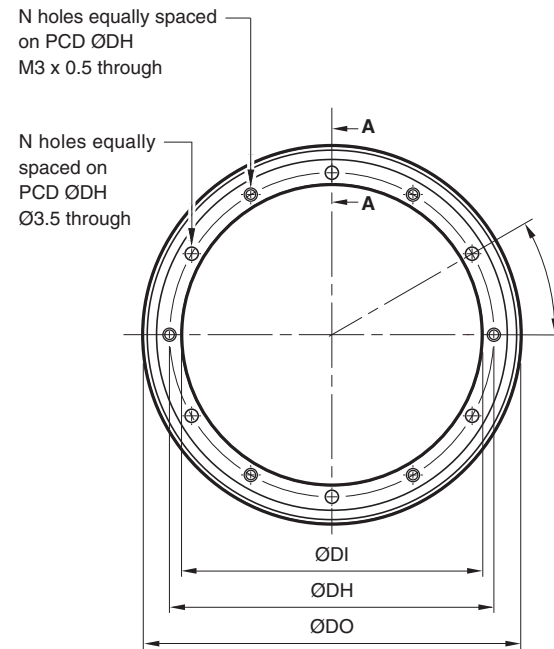


NOTE: θ is the angle between one tapped hole and the adjacent clearance hole. For example, the angle between two clearance holes is 2θ .

Installation drawing ('B' section RESR)

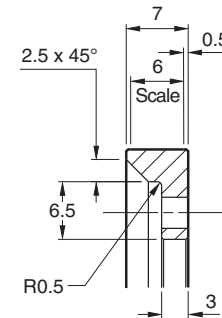
Dimensions and tolerances in mm

Nominal external diameter (mm)	Line count		DO (mm)	DI (mm)	Mounting holes		
	20 μ m pitch	40 μ m pitch			DH (mm)	N	θ
75	11 840	5 920	75.40 75.30	55.04 55.00	61	6	30°
100	15 744	7 872	100.30 100.20	80.04 80.00	86	6	30°
150	23 600	11 800	150.40 150.20	130.04 130.00	136	9	20°
200	31 488	15 744	200.40 200.20	180.04 180.00	186	12	15°

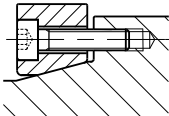
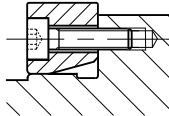
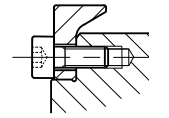


NOTE: θ is the angle between one tapped hole and the adjacent clearance hole. For example, the angle between two clearance holes is 2θ .

Section A-A

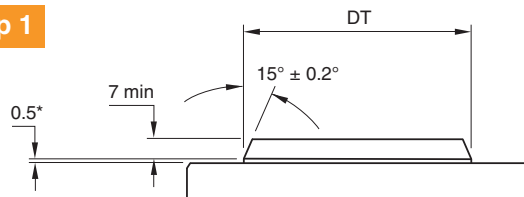


Select a mounting option

	Taper mount	Interference fit
'A' section		
'B' section	Not applicable	
Notes	<p>Recommended for all installations</p> <ul style="list-style-type: none"> Enables simplest adjustment. Offers highest accuracy. Enables eccentricity to be compensated. Offers excellent mechanical stability against thermal cycling, shock and vibration. Minimises cost of substrate preparation. 	<p>Alternative installation</p> <p>Will not correct eccentricity of the supporting shaft.</p>

Taper mount method Step 1

Mounting shaft specifications



*For 417 mm and 550 mm rings only, 1.0

Recommended taper roundness

Diameter (mm)	Roundness value (mm TIR)
≤ 115	0.025
150 to 255	0.050
≥ 300	0.075

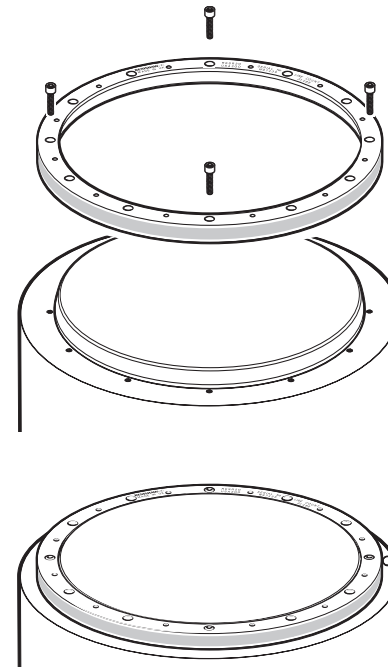
Recommended taper diameter (DT)

DO (mm)	DT (mm)	DO (mm)	DT (mm)	DO (mm)	DT (mm)
52	33.85 33.65	115	98.85 98.65	255	238.85 238.65
57	40.85 40.65	150	133.85 133.65	300	283.85 283.65
75	58.85 58.65	200	183.85 183.65	350	333.85 333.65
100	83.85 83.65	206	189.85 189.65	413	395.85 395.65
103	83.85 83.65	209	189.85 189.65	417	383.85 383.65
104	83.85 83.65	229	212.85 212.65	550	513.85 513.65

DO = Nominal external diameter

Recommended surface finish
Ra value is 1.2 µm or better

Taper mount method Step 2



▶ Clean shaft taper and internal taper of RESR as recommended in the storage and handling section.

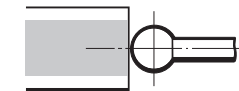
▶ Use 4 equally spaced M3 screws (on RESR sizes 52 mm to 150 mm use 3 screws).

NOTE: Do not lubricate screws.

▶ Insert the screws so that the RESR is loosely connected to the shaft, then roughly align the ring by eye and touch.

▶ Lightly tighten the screws. Use a Dial Test Indicator (DTI) to check the radial displacement at the screw locations.

NOTE: Disregard the radial displacement between the screw locations.

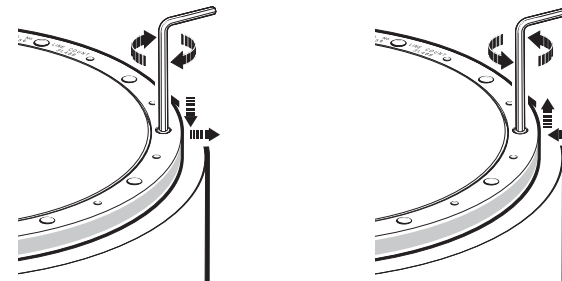


Use a DTI with low exertion force to avoid scratching the scale surface. A DTI with a ruby ball stylus is recommended as a further precaution against scratches.

▶ Adjust the screws so the radial displacement is the same at each screw location.

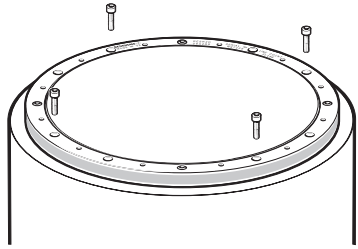
▶ When adjusting, identify the screw location with the lowest radial displacement and tighten that screw, aiming for the average of the highest and lowest indicator readings.

▶ Repeat this process until the DTI readings are within ±15 µm at the screw locations.



NOTE: At this stage, the screws should only be lightly tightened (approximately 0.5 Nm) to allow further final adjustment.

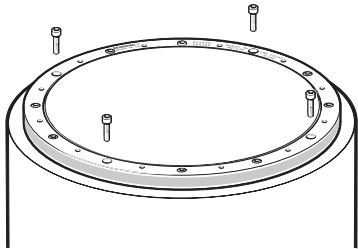
Taper mount method Step 3



- ▶ Insert the next 4 screws (on RESR sizes 52 mm to 150 mm insert the next 3 screws).
- ▶ Adjust all the screws inserted thus far, so that the radial displacement at each screw location is within $\pm 15 \mu\text{m}$.
- ▶ Again, at this stage, the screws should only be lightly tightened.

NOTE: You may notice that the torque required to achieve the radial displacement tolerance will be slightly higher during step 3 than during step 2. This is normal.

Taper mount method Step 4



- ▶ Insert the remaining screws.
- ▶ Adjust all of the screws inserted thus far, so that the radial displacement at each screw location is within $\pm 15 \mu\text{m}$.

Taper mount method Step 5

- ▶ Rotate the RESR ring, measuring the radial displacement at all of the screw locations.
- ▶ Tighten the screw with the lowest radial displacement so that it matches the average radial displacement.
- ▶ Again, rotate the RESR ring and re-check the radial displacement at all of the screw locations, tightening the screw with the lowest radial displacement so that it matches the average.
- ▶ Repeat this process until the radial displacement at all of the screw locations is within $\pm 3 \mu\text{m}$.

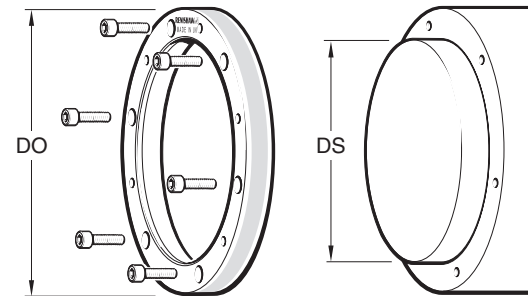
Taper mount method Step 6

Diameter (mm)	Torque (Nm)
	min
≤ 115	1.5
150 to 255	1.25
300 to 413	0.5
≥ 417	1.2

- ▶ Finally, ensure that all the screws are tightened to the torque recommendations (see table).
- ▶ When torquing-up the screws, follow the method used in Step 5.
- ▶ Continue the torquing process until all of the screws are set to the minimum recommended torque.
- ▶ If some of the screws seem loose, continue the torquing process, but aim to adjust the screw with the lowest radial deflection to a point which is just above the average radial deflection.
- ▶ Ensure that the radial deflection at the screw locations is within $\pm 3 \mu\text{m}$.
- ▶ Further fine tuning can improve the installed accuracy.
- ▶ Excessive tightening of screws can have a small effect on accuracy. Please contact your local representative for more details.

Interference fit method

Mounting shaft specifications



DO (mm)	DS (mm)	DO (mm)	DS (mm)
52	30.028 30.015	200	180.052 180.027
57	37.028 37.015	206	186.060 186.031
75	55.039 55.020	209	186.060 186.031
100	80.045 80.023	229	209.060 209.031
103	80.045 80.023	255	235.060 235.031
104	80.045 80.023	300	280.066 280.034
115	95.045 95.023	350	330.073 330.037
150	130.052 130.027	413	392.073 392.037

NOTE: 417 and 550 mm rings should be taper mounted only.

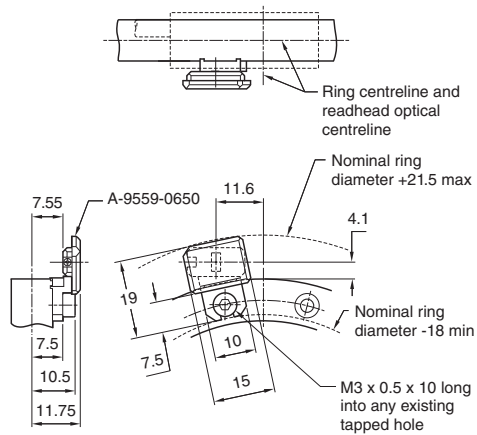
DO = Nominal external diameter

DS = Recommended shaft diameter to enable transition fit

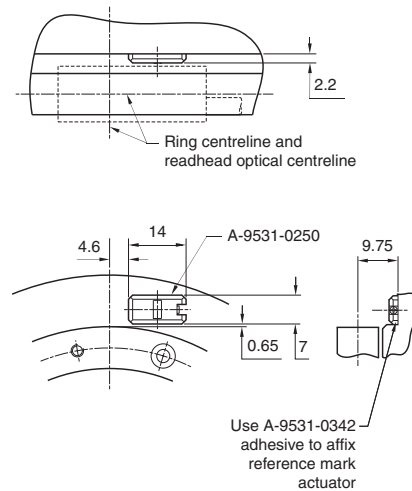
RGH20 reference mark options

Dimensions and tolerances in mm.

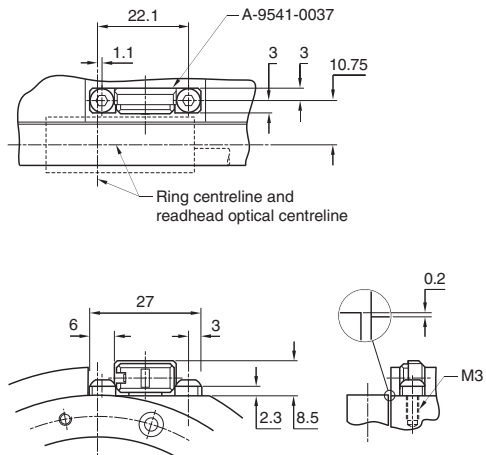
1. Using A-9559-0650



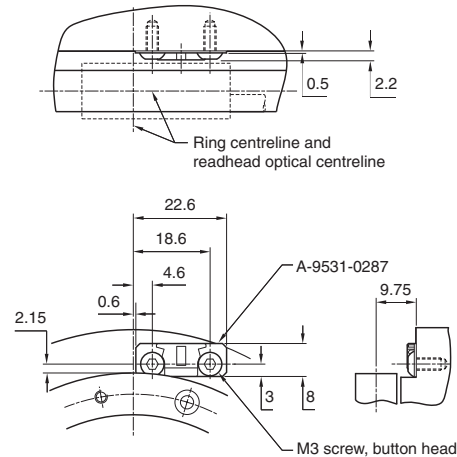
2. Using A-9531-0250



3. Using A-9541-0037



4. Using A-9531-0287



This section is a quick-start guide to installing RGH20 and RGH20F/REF systems. More detailed information on installing the system is contained in the following sections of the installation guide.

RGH20 direct output quick-start guide

Ensure scale, readhead optical window and mounting faces are clean and free from obstruction.

Connect readhead to receiving electronics and power-up.

Install and align the readhead to maximise the signal strength over the full axis of travel as indicated by the LED on the readhead (green).

Move the readhead slowly (<100mm/s) past the reference mark in the direction used for the datuming operation.

If fitted, ensure correct reference mark magnet is fitted and positioned.

Adjust the phasing of the reference mark to give a red flash on the readhead LED as the readhead passes the reference mark

The system is now ready for use.

RGH20F/REF quick-start guide INSTALLATION

Ensure scale, readhead optical window and mounting faces are clean and free from obstruction.

If fitted, ensure correct reference mark magnet is fitted and positioned.

Plug the readhead cable into the REF interface. Connect the interface to the receiving electronics and power-up.

Ensure AGC is switched off – the CAL/AGC LED on the interface should be off (if not press and hold the CALIBRATE button on the interface for >3 seconds).

Install and align the readhead to maximise the signal strength over the full axis of travel as indicated by the interface LED (SETUP LED – green, ideally blue or purple).

Move the readhead slowly (<100mm/s) past the reference mark in the direction used for the datuming operation.

Adjust the phasing of the reference mark to give a red flash on the SETUP LED on the interface as the readhead passes the reference mark.

CALIBRATION

Press and release the CALIBRATE button on the interface.

The CAL/AGC LED will flash slowly.

Move the readhead slowly along the scale (<100 mm/s) until the CAL/AGC LED stops flashing.

The system is now calibrated and ready for use.

AGC can now be switched on if required by pressing and holding the CALIBRATE button for >3 seconds. The CAL/AGC LED will be on.

Readhead mounting and alignment

Mounting brackets

The bracket must have a flat mounting surface, ensure conformance to the installation tolerances, allow adjustment to the rideheight of the readhead, and be sufficiently stiff to prevent deflection or vibration of the readhead during operation.

Readhead set-up

Ensure that the scale surface, readhead optical window and mounting face are clean and free from obstructions. To set nominal rideheight, position readhead spacer with the 'L' shaped aperture under the optical centre to allow normal LED function during set-up procedure. Adjust the readhead to maximise the signal strength. On RGH20 direct output you should achieve a Green LED on the readhead over the full rotation. For RGH20F/REF systems the SETUP LED on the interface should be at least Green, ideally Blue or Purple over the full rotation.

NOTE: When using REF system ensure that Automatic Gain Control (AGC) is switched off. (CAL/AGC LED on the interface is off).

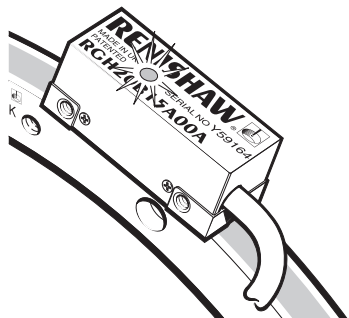
NOTE: Ensure readhead fixing screws are tightened to 0.5 Nm to 0.7 Nm.

RGH20

LED colour, except at reference mark position.



Green Orange Red



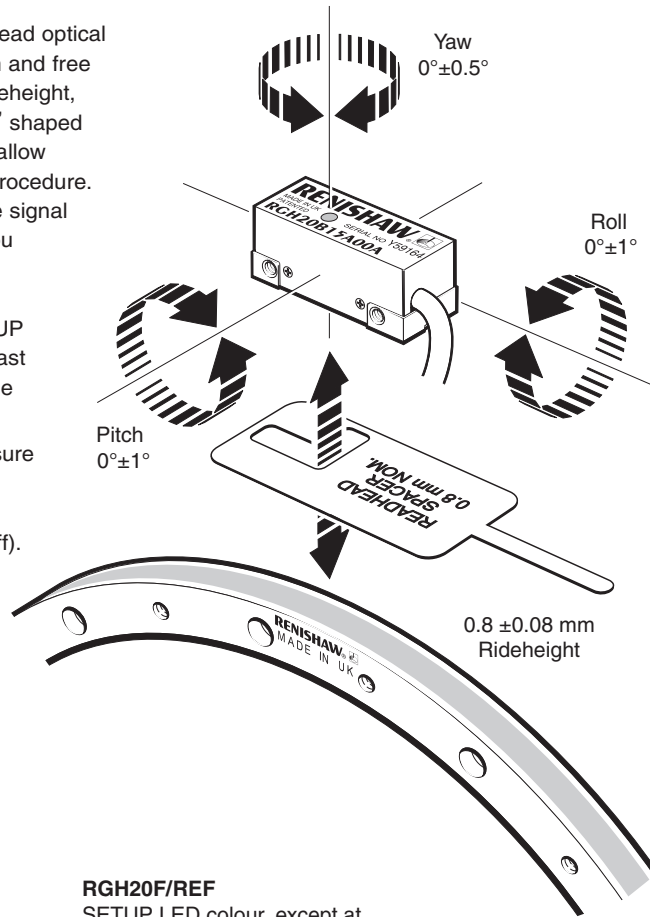
RGH20F/REF

SETUP LED colour, except at reference mark position.



Green Orange Red
Blue
Purple

NOTE: The RGH20F readhead does not have an LED.



Limit switch

A limit switch signal is output when the readhead sensor passes over the magnetic actuator.

Reference mark set-up

To ensure unidirectional repeatability, the reference mark requires phasing with the scale in the direction of normal datuming operation. A reference pulse is output in both directions, but repeatability is guaranteed only in the phased direction. Ensure readhead is set-up correctly with a Green LED indication over the full rotation and that the reference mark actuator is fitted correctly.

NOTE: It is recommended that a datum procedure is performed as part of any power-up sequence to ensure the correct datum position is recorded.

Phasing procedure

The readhead must be moved over the reference mark in the direction to be used for the datuming operation. The reference mark is phased correctly when the set-up LED on the readhead or interface flashes red for 0.25 seconds. If it flashes Orange or goes Blank, the reference mark adjuster screw should be turned anti-clockwise by 1/8 turn and the procedure repeated until a red flash is obtained.

RGH20

LED colour, except at reference mark position.



Red Orange Blank

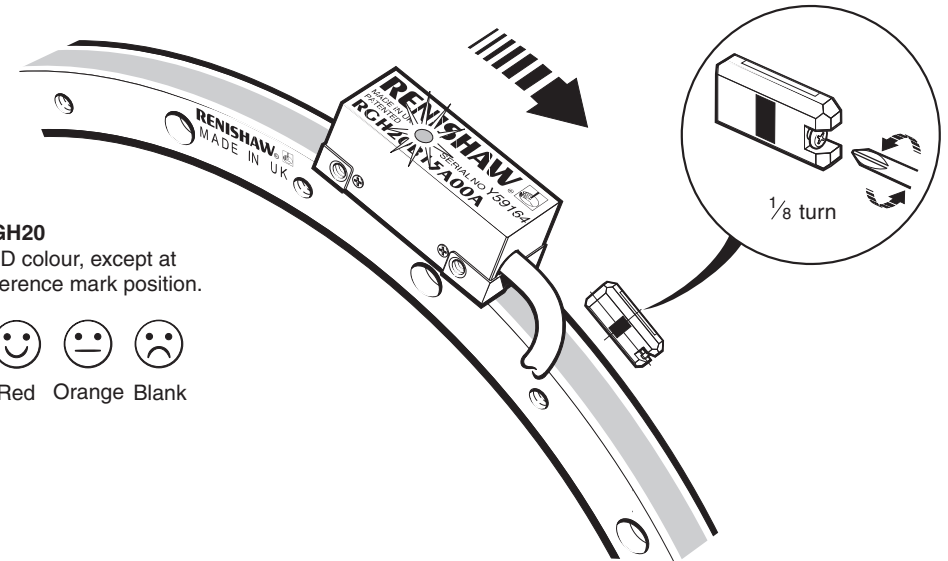
RGH20F/REF

SETUP LED colour, except at reference mark position.



Red Orange Blank

NOTE: The RGH20F readhead does not have an LED.



NOTE: Reference mark flashes only occur up to 100 mm/s traverse speed.

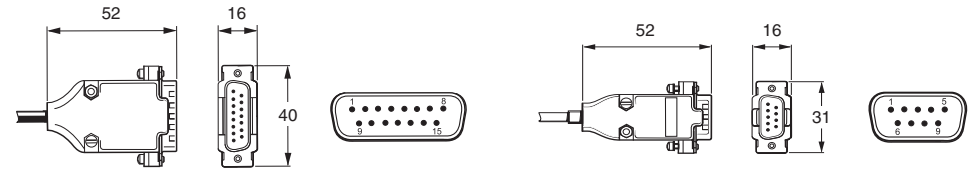
SECTION 1 - RGH20 direct output readheads

General specifications

Power supply	5 V ±5%	RGH20D, X, Z <90 mA
		RGH20W, Y, H, I, O <120 mA
		RGH20B <110 mA
		NOTE: Current consumption figures refer to unterminated readheads.
		For digital outputs a further 35 mA per channel pair (eg A+,A-) will be drawn when terminated with 120 Ω.
		For analogue outputs a further 20 mA will be drawn when terminated with 120 Ω.
	Ripple	200 mVpp@ frequency up to 500 kHz
		Power from a 5 V dc supply complying with the requirements for SELV of standard EN (IEC) 60950.
Sealing		IP40
Acceleration	Operating	500 m/s ² BS EN 60068-2-7:1993 (IEC 68-2-7:1983)
Shock	Non-operating	1000 m/s ² , 6 ms, ½ sine BS EN 60068-2-27:1993 (IEC 68-2-27:1987)
Vibration	Operating	100 m/s ² , 55 Hz to 2000 Hz BS EN 60068-2-6:1996 (IEC 68-2-6:1995)
Mass	Readhead	11 g
	Cable	34 g/m
Cable	Standard	Double-shielded, outside diameter 4.2 ±0.2 mm.
		Flex life >20 x 10 ⁶ cycles at 20 mm bend radius.

The RGH20 readheads have been designed to the relevant EMC standards but must be correctly integrated to achieve EMC compliance. In particular, attention to shielding and earthing arrangements is essential.

Output signals



15 pin D type plug (termination code D, L)

9 pin D type plug (termination code A)
Flying lead (termination code F)

RGH20 D, X, Z, W, Y, H, I, O RS422A digital

Function	Signal	Colour (F)	9 pin D type (A)	15 pin D type (D)
Power	5 V	Brown	5	7, 8
	0 V	White	1	2, 9
Incremental signals	A	+	Green	2
		-	Yellow	6
	B	+	Blue	4
		-	Red	8
Reference mark/limit switch	Z+/Q-	Pink	3	12
	Z-/Q+	Grey	7	4
Shield	Inner	Inner shield	9	15
	Outer	Outer shield	Case	Case

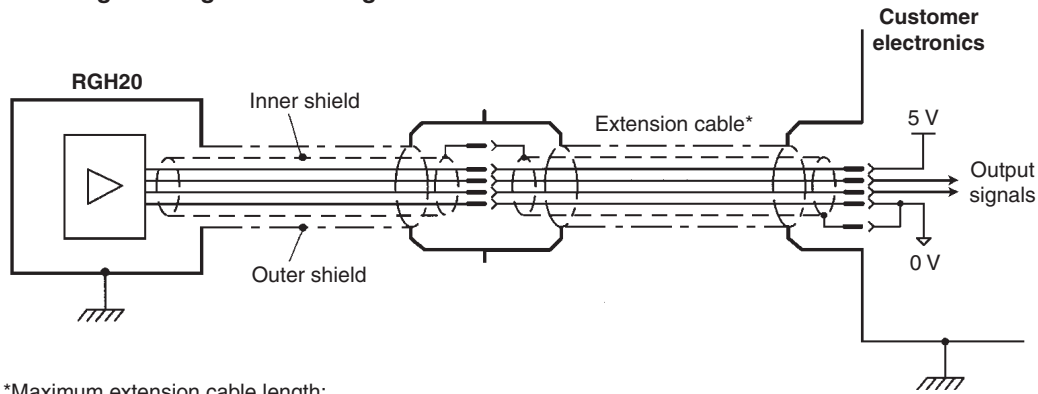
RGH20 B, 1 Vpp analogue

Function	Signal	Colour (F)	9 pin D type (A)	15 pin D type (L)
Power	5 V	Brown	5	4, 5
	0 V	White	1	12, 13
Incremental signals	V ₁	+	Green	2
		-	Yellow	6
	V ₂	+	Blue	4
		-	Red	8
Reference mark/limit switch	V ₀ + / V _q -	Pink	3	3
	V ₀ - / V _q +	Grey	7	11
Shield	Inner	Inner shield	9	15
	Outer	Outer shield	Case	Case

SECTION 1 - RGH20 direct output readheads (continued)

Electrical connections

RGH20 grounding and shielding



*Maximum extension cable length:

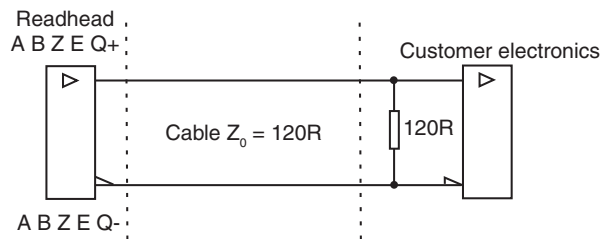
RGH20B - 100 m, RGH20D, X, Z - 50 m RGH20W, Y, H, I, O - 20 m

IMPORTANT: The outer shield should be connected to the machine earth (Field Ground).

The inner shield should be connected to 0 V. Care should be taken to ensure that the inner and outer shields are insulated from each other. If the inner and outer shields are connected together, this will cause a short between 0 V and earth, which could cause electrical noise issues.

Recommended signal termination

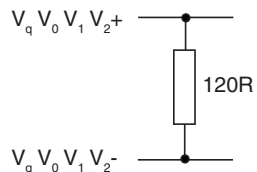
Digital outputs RGH20D, X, Z, W, Y, H, I, O



Standard RS422A line receiver circuitry.

Contact Renishaw for further details on receiver termination for 3-state output.

Analogue output - type RGH20B



Speed

Digital readheads

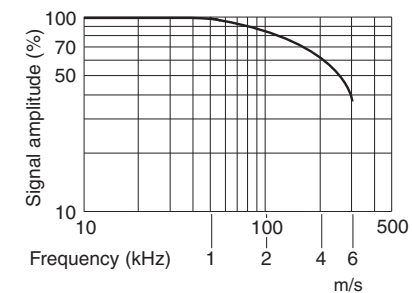
The tables below show the maximum speed and associated minimum receiver clock frequency for all digital output readheads.

Head type	Maximum speed (m/s)	Minimum receiver clock frequency (MHz)
RGH20D (5 μm)	8	$\left(\frac{\text{encoder velocity (m/s)}}{\text{resolution (μm)}} \right) \times 4 \text{ safety factor}$
RGH20X (1 μm)	5	
RGH20Z (0.5 μm)	3	

The RGH20Y, RGH20W, RGH20H, RGH20I and RGH20O digital output readheads have clocked outputs. These are designed to prevent fine edge separations being missed by receiving electronics utilising slower clock speeds.

Option code	Maximum speed (mm/s)					Minimum receiver clock frequency (MHz)
	RGH20W (0.2 μm)	RGH20Y (0.1 μm)	RGH20H (50 nm)	RGH20I (20 nm)	RGH20O (10 nm)	
30	–	700	350	130	65	12
31	–	500	250	90	45	8
32	700	–	–	–	–	6
33	500	250	120	40	20	4

Analogue readhead (1Vpp) RGH20B

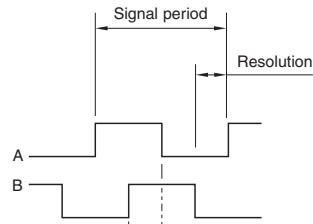


SECTION 1 - RGH20 direct output readheads (continued)

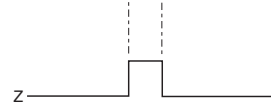
Output specifications

Digital output signals - type RGH20D, X, Z, W, Y, H, I, O
Form - Square wave differential line driver to EIA RS422A

Incremental[†] 2 channels A and B in quadrature (90° phase shifted)

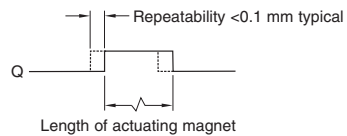


Reference[†]



Synchronised pulse Z, duration as resolution.
 Repeatability of position (uni-directional) maintained within $\pm 10^\circ\text{C}$ from installation temperature and for speed $< 250\text{ mm/s}$

Limit[†] Asynchronous pulse Q



NOTE: RGH20 readheads are available with reference mark **or** limit switch output. Select output option at order.

Alarm

3-state alarm

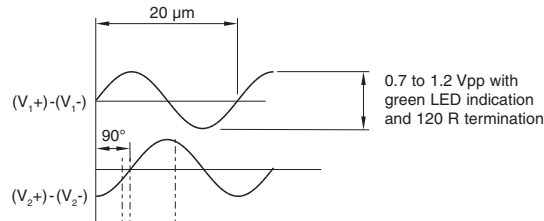
For RGH20D, X, Z readheads only, differentially transmitted signals forced open circuit for $> 20\text{ ms}$ when signal too low for reliable operation.

For RGH20W, Y, H, I, O readheads only, differentially transmitted signals forced open circuit for $> 10\text{ ms}$ when signals too low or speed too high for reliable operation.

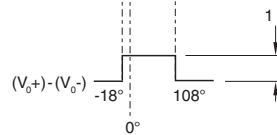
[†]Inverse signals not shown for clarity

Analogue output signals - type RGH20B
Form - 1 Vpp differential

Incremental 2 channels V_1 and V_2 differential sinusoids in quadrature (90° phase shifted)

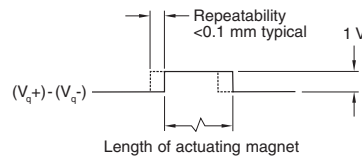


Reference



Differential pulse V_0 - 18° to 108°
 Duration 126° (electrical)
 Repeatability of position (uni-directional) maintained within $\pm 10^\circ\text{C}$ from installation temperature and for speed $< 250\text{ mm/s}$

Limit Asynchronous pulse V_q



NOTE: RGH20 readheads are available with reference mark **or** limit switch output. Select output option at order.

SECTION 2 - RGH20F/REF system

REF interface features

Self-tuning active correction

The REF interface actively corrects for input signal imperfections to improve system accuracy.

Corrections are made for the following:

Automatic Offset Control (AOC) – adjusts offset independently for the sine and cosine signals.

Automatic Gain Control (AGC) – ensures consistent 1 Vpp signal amplitude.

Automatic Balance Control (ABC) – adjusts the gain to equalise the sine and cosine signals.

These correction mechanisms operate over the full working speed range of the readhead.

System calibration

Calibration is an essential operation that optimises the gain, balance and offset of the analogue input signals in the REF interface. These values are stored for initial use at start-up. Before system calibration, install the readhead to maximise the signal strength around the full ring travel as described in 'Readhead mounting and alignment' section.

Incremental signal calibration

- ▶ Ensure Automatic Gain Control (AGC) is switched off (CAL/AGC LED on interface is off) before beginning calibration.
- ▶ Press and release the CALIBRATE button on the interface.
- ▶ The CAL/AGC LED will now flash slowly.
- ▶ Rotate the ring at slow speed until the CAL/AGC LED stops flashing.
- ▶ The calibration cycle is now complete.

If the calibration fails the CAL/AGC LED will flash quickly instead of switching off. In this case manually exit the calibration routine, restore factory defaults and repeat the calibration procedure.

Calibration routine manual exit

- ▶ To exit the calibration routine at any time press the CALIBRATE button.
- ▶ The CAL/AGC LED will stop flashing and values will not be stored.
- ▶ To complete the calibration procedure restore factory defaults and repeat the calibration procedure.

Restoring factory defaults

When re-installing the system, or in the case of calibration failure, the factory defaults should be restored.

To restore factory defaults.

- ▶ Switch the system off.
- ▶ Press and hold the CALIBRATE button whilst switching on the power.
- ▶ Release the CALIBRATE button.
- ▶ Repeat the 'Readhead mounting and alignment' procedure and re-calibrate the system.

NOTE: The system must be re-calibrated after restoring factory defaults.

Switching Automatic Gain Control on or off

AGC can be switched on via the REF interface CALIBRATE button.

- ▶ Press and hold the CALIBRATE button on the interface for >3 seconds to switch AGC on or off. The CAL/AGC LED on the interface will be illuminated when AGC is active.

NOTE: The system must be calibrated before switching AGC on.

LED indicators

REF LED	Indication	Status	Alarm output
Set-up	Purple	Normal set-up; signal level 110% to 135%	No
	Blue	Optimum set-up; signal level 90% to 110%	No
	Green	Normal set-up; signal level 70% to 90%	No
	Orange	Acceptable set-up; signal level 50% to 70%	No
	Red	Poor set-up; signal may be too low for reliable operation; signal level <50%	No
	Purple/blank -flashing	Over signal; signal level >135%; system in error	Yes
	Red/blank -flashing	Poor set-up; signal level <20%; system in error	Yes
	Red flash when traversing reference mark*	Normal phasing of reference mark	No
	Orange flash when traversing reference mark*	Acceptable phasing of reference mark	No
	Blank flash when traversing reference mark*	Poor phasing of reference mark; recalibrate	No
CAL/AGC	On	Automatic Gain Control - On	No
	Off	Automatic Gain Control - Off	No
	Slow flashing	Calibrating system	No
	Fast flashing	Calibration failed	No

*NOTE: Reference mark flashes only occur up to 100 mm/s traverse speed

Alarms can also be output for the following conditions, depending on REF alarm option:

- ▶ Readhead speed in excess of specification
- ▶ Automatic Offset Control excessive

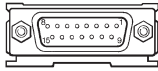
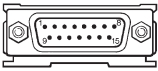
SECTION 2 - RGH20F/REF system (continued)

General specifications

Power supply	5 V - 5% +10%	200 mA maximum (system) The interface will be fully active <300 ms after power is applied. The interface and readhead are protected from reverse voltage and over voltage of up to 12 V. NOTE: Current consumption figures refer to unterminated interfaces. For digital outputs a further 35 mA per channel pair (eg A+, A-) will be drawn when terminated with 120 Ω. For analogue outputs a further 20 mA will be drawn when terminated with 120 Ω. Powered from a 5 V dc supply complying with the requirements for SELV of standard EN (IEC) 60950. RGH20F UHV (readhead only) 50 mA
	Ripple	200 m Vpp @ frequency up to 500 kHz
Bake-out temperature		120 °C (RGH20F UHV only)
Sealing (readhead)		IP40
Acceleration (readhead)	Operating	500 m/s ² BS EN 60068-2-7:1993 (IEC 68-2-7:1983)
Shock (readhead)	Non-operating	1000 m/s ² , 6 ms, ½ sine BS EN 60068-2-27:1993 (IEC 68-2-27:1987)
Vibration (readhead)	Operating	100 m/s ² , 55 to 2000 Hz BS EN 60068-2-6:1996 (IEC 68-2-6:1995)
Mass	Readhead	9 g
	Interface	100 g
	Cable (standard)	34 g/m
	(UHV)	23 g/m
Readhead cable	Standard	Double shielded, outside diameter 4.2 ±0.2 mm. Flex life >20 x 10 ⁶ cycles at 20 mm bend radius.
	UHV	Single tinned copper braided shield over PTFE insulated cores. NOTE: Standard 15 pin D type connector fitted is not vacuum compatible.

The RGH20F readheads have been designed to the relevant EMC standards, but must be correctly integrated to achieve EMC compliance. In particular, attention to shielding and earthing arrangements is essential.

Output signals

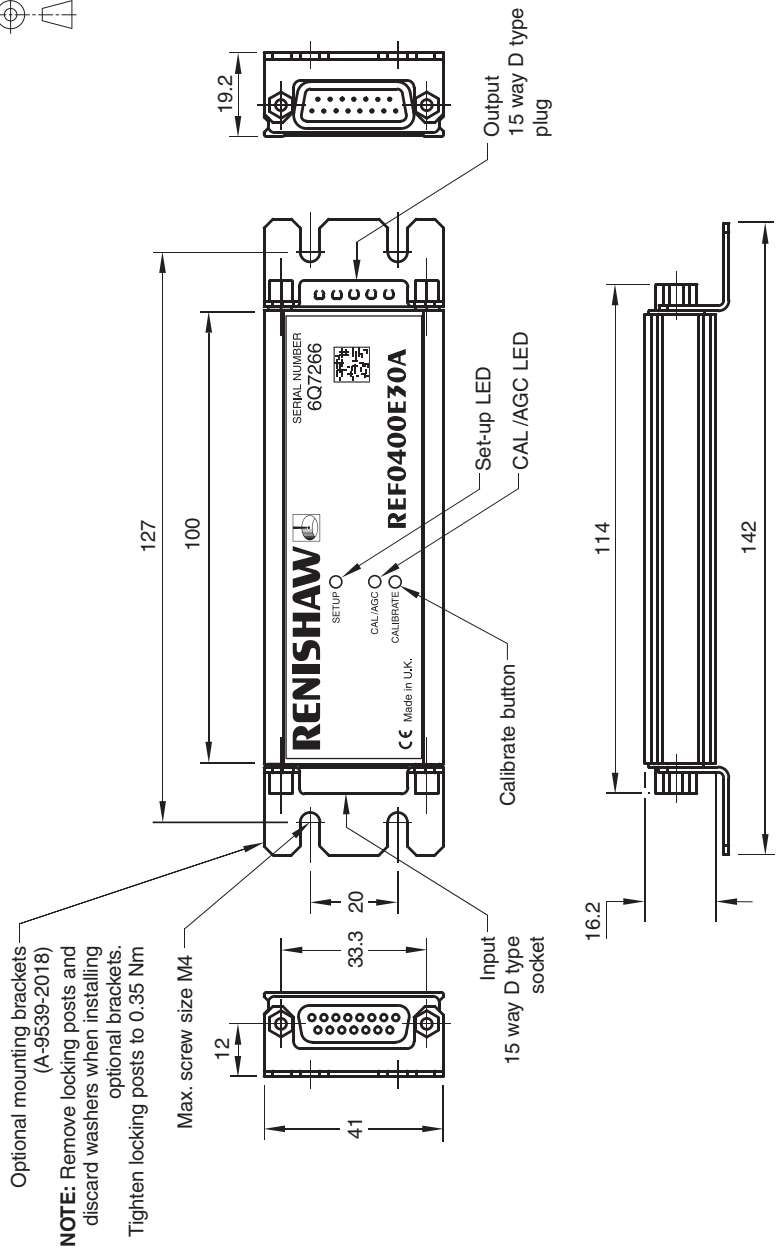
		Input		Output			
							
		15 way D type socket		15 way D type plug			
		Analogue input		Digital output		Analogue output	
Function	Wire colours from readhead	Signal	Pin	Signal	Pin	Signal	Pin
Power	Red	5 V	8	5 V	7, 8	5 V	4, 5
	White	0 V	9	0 V	2, 9	0 V	12, 13
Incremental signals	Green	A	6	A+	14	V ₁₊	9
	Yellow	B	5	A-	6	V ₁₋	1
	Blue	C	4	B+	13	V ₂₊	10
	–	–	–	B-	5	V ₂₋	2
Reference mark/limit	Pink	Hall	1	Z+/Q+	12	V ₀₊ /V _{q+}	3
				Z-/Q-	4	V ₀₋ /V _{q-}	11
Alarm	–	–	–	E+	11	–	–
				E-	3	–	–
ired servo	Brown	Servo	3	–	–	–	–
External set-up	Interface outputs only	V _x	13	X	1	–	–
V _{MID}		V _{MID}	7	–	–	–	–
Sin monitor*		Sin monitor	11	–	–	–	–
Cos monitor*		Cos monitor	10	–	–	–	–
Shield	–	Inner	15	–	–	–	–
		Outer	Case	Outer	Case	Outer	Case
Do not connect	–	–	14	–	10	–	8
Not connected	–	–	2, 12	–	15	–	6, 14, 15

*2.25 Vpp @ 100% signal amplitude centred on 1.65 V

SECTION 2 - RGH20F/REF system (continued)

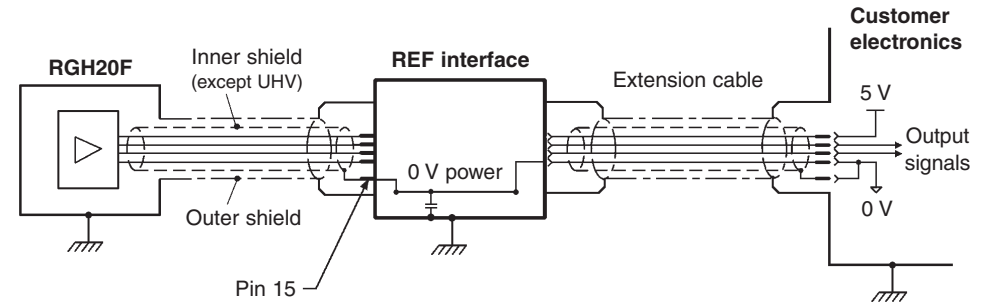
REF installation drawing

Dimensions in mm



NOTE: For installation details see the Interface mounting bracket installation guide (M-9539-2012)

Electrical connections Grounding and shielding



Maximum cable length:

Readhead to interface 5 m

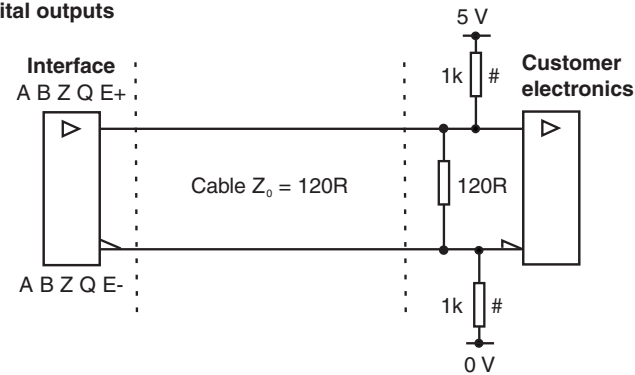
Interface to controller

Receiver clock frequency (MHz)	Maximum cable length (m)
≥ 25	20
≤ 20	50
Analogue	100

IMPORTANT: The outer shield should be connected to the machine earth (Field Ground). The inner shield should be connected to 0 V at customer electronics. Care should be taken to ensure that the inner and outer shields are insulated from each other. If the inner and outer shields are connected together, this will cause a short between 0 V and earth, which could cause electrical noise issues.

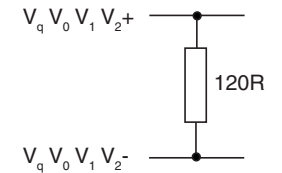
Recommended signal termination

Digital outputs



Only required on alarm channel E for fail safe operation.
Standard RS422A line receiver circuitry.

Analogue output, REF0000 only

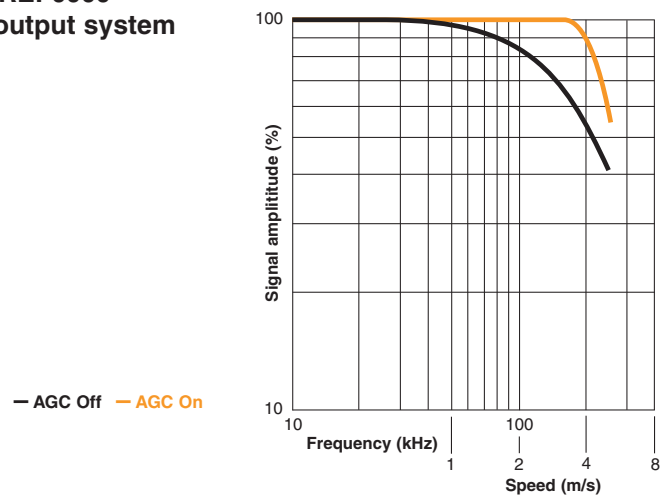


SECTION 2 - RGH20F/REF systems (continued)

Speed Digital systems, maximum speed (m/s)

Minimum receiver clock frequency (MHz)	Resolution (μm)										Internal clock frequency (MHz)
	5	1	0.5	0.2	0.1	50 nm	20 nm	10 nm	5 nm		
50	5.000	5.000	5.000	5.000	3.24	1.620	0.648	0.324	0.162		36
40	5.000	5.000	5.000	5.000	2.700	1.350	0.540	0.270	0.135		30
25	5.000	5.000	5.000	3.240	1.620	0.810	0.324	0.162	0.081		18
20	5.000	5.000	5.000	2.700	1.350	0.675	0.270	0.135	0.068		15
12	5.000	5.000	4.500	1.800	0.900	0.450	0.180	0.090	0.045		10
10	5.000	5.000	4.050	1.620	0.810	0.405	0.162	0.081	0.041		9
8	5.000	5.000	3.240	1.296	0.648	0.324	0.130	0.065	0.032		7.2
6	5.000	4.500	2.250	0.900	0.450	0.225	0.090	0.045	0.023		5
5	5.000	4.050	2.025	0.810	0.405	0.203	0.081	0.041	0.020		4.5
3	5.000	2.250	1.125	0.450	0.225	0.113	0.045	0.023	0.011		2.5
1	4.219	0.844	0.422	0.169	0.084	0.042	0.017	0.008	0.004		0.9
	4	20	40	100	200	400	1000	2000	4000		
Interpolation factor (period to resolution)											

RGH20F + REF0000
analogue output system



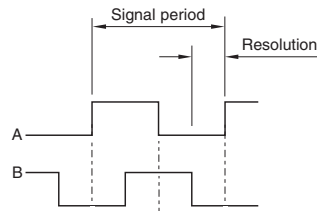
SECTION 2 - RGH20F/REF systems (continued)

Output specifications

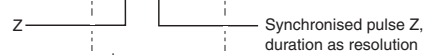
Digital output signals - type REF digital

Form - Square wave differential line driver to EIA RS422A

Incremental[†] 2 channels A and B in quadrature
(90° phase shifted)



Reference[†]



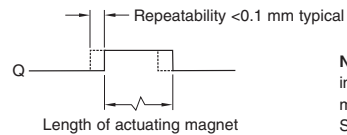
Wide reference[†] (option C)



Repeatability of position (uni-directional) maintained within $\pm 10^\circ\text{C}$ from installation temperature and for speed $< 250\text{ mm/s}$.

NOTE: Wide reference mark option useful when using long cable lengths and/or high speed operation to overcome effects of skew.

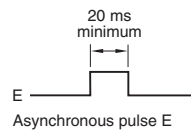
Limit[†]



Asynchronous pulse Q

NOTE: RGH20F readheads and REF interfaces are available with reference mark **or** limit switch output. Select output option at order.

Alarm[†]



Depending on REF alarm option, alarm asserted when:

- 20% > signal amplitude > 135%
- Readhead exceeds specified maximum speed
- Signal offset excessive

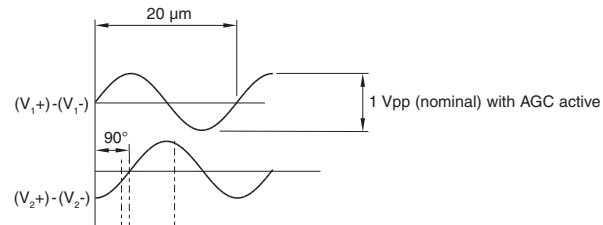
NOTE: 3-state alarm options also available for REF digital interfaces.

[†]Inverse signals not shown for clarity.

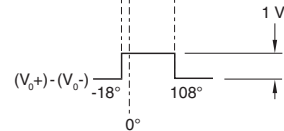
Analogue output signals - type REF0000

Form - 1 Vpp differential

Incremental 2 channels V_1 and V_2 differential sinusoids in quadrature
(90° phase shifted)



Reference

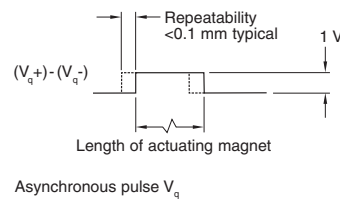


Differential pulse V_0 -18° to 108° .

Duration 126° (electrical).

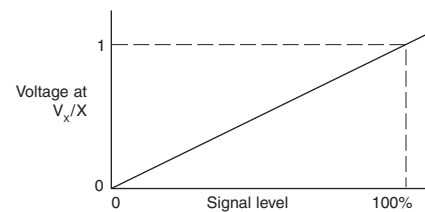
Repeatability of position (uni-directional) maintained within $\pm 10^\circ\text{C}$ from installation temperature and for speed $< 250\text{ mm/s}$

Limit



NOTE: RGH20F readheads and REF interfaces are available with reference mark **or** limit switch output. Select output option at order.

Set-up signal - all REF interfaces



Set-up signal voltage proportional to signal amplitude.

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