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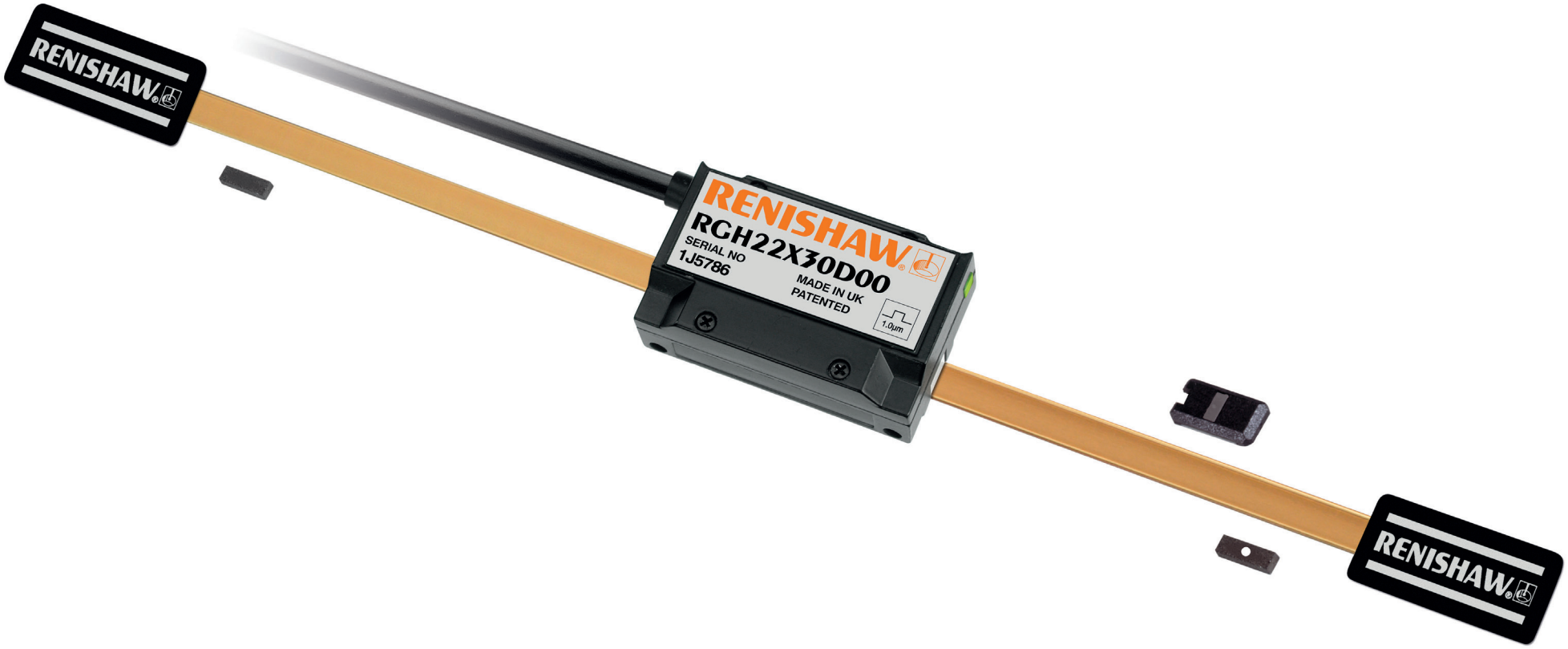
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Installation guide
M-9531-9818-01-E

RENISHAW
apply innovation™

RGH22 RGS20 linear encoder system



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Product compliance

CE

Renishaw plc declares that RGH22 complies with the applicable standards and regulations. A copy of the EU Declaration of Conformity is available from our website at www.renishaw.com/productcompliance.

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.

Further information

Further information relating to the RGH22 encoder range can be found in the *RGH22 encoder system* Data sheet (Renishaw part no. L-9517-9676). This can be downloaded from our website at www.renishaw.com/opticalencoders and is also available from your local representative.

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The packaging of our products contains the following materials and can be recycled.

Packaging Component	Material	ISO 11469	Recycling Guidance
Outer box	Cardboard	Not applicable	Recyclable
	Polypropylene	PP	Recyclable
Inserts	Low Density Polyethylene Foam	LDPE	Recyclable
	Cardboard	Not applicable	Recyclable
Bags	High Density Polyethylene Bag	HDPE	Recyclable
	Metalised Polyethylene	PE	Recyclable

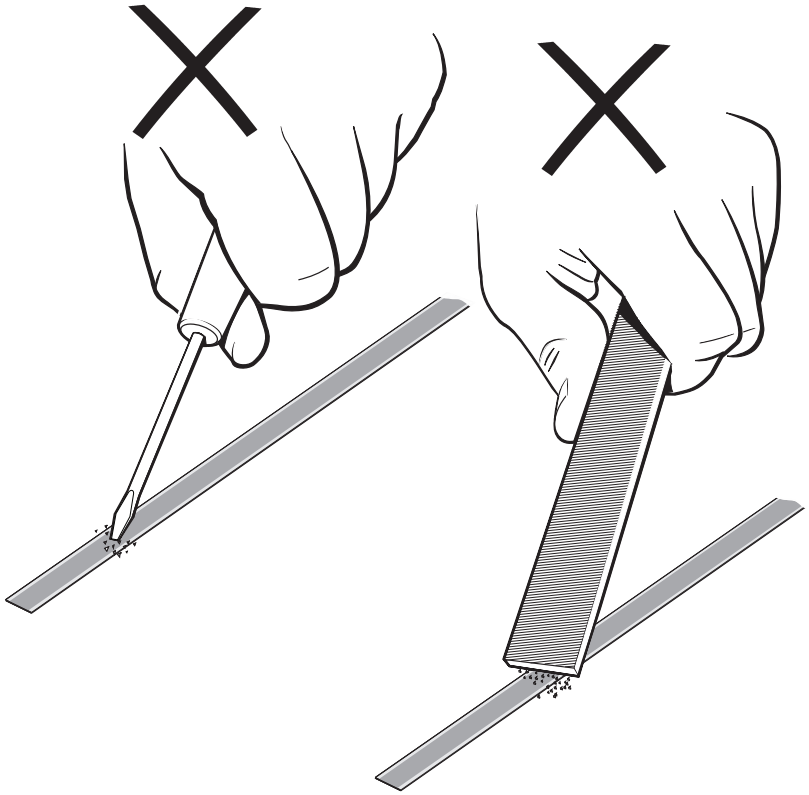
REACH regulation

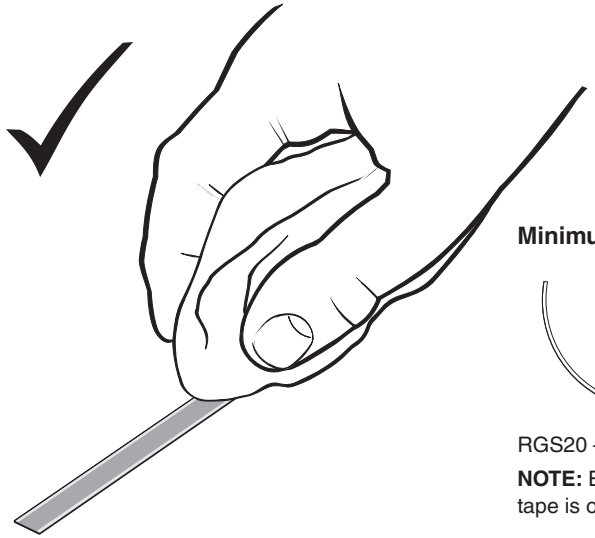
Information required by Article 33(1) of Regulation (EC) No. 1907/2006 ("REACH") relating to products containing substances of very high concern (SVHCs) is available at www.renishaw.com/REACH.



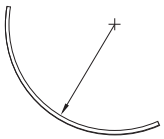
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Storage and handling



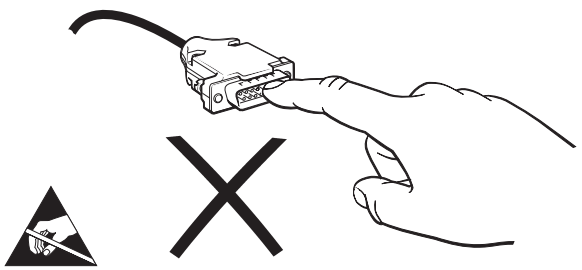


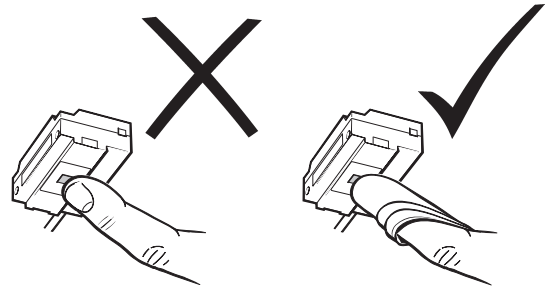
Minimum bend radius



RGS20 – 100 mm

NOTE: Ensure self-adhesive tape is on outside of bend.

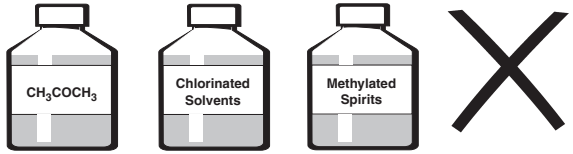


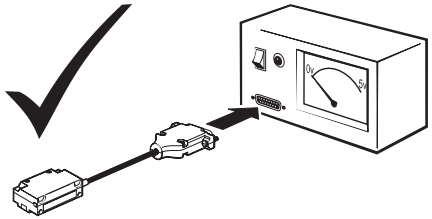


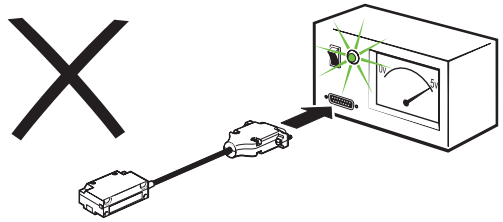
N-heptane Propan-2-ol



Acetone

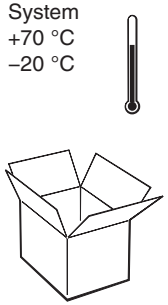






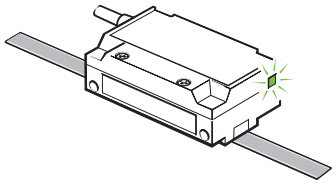
Storage

System
+70 °C
–20 °C



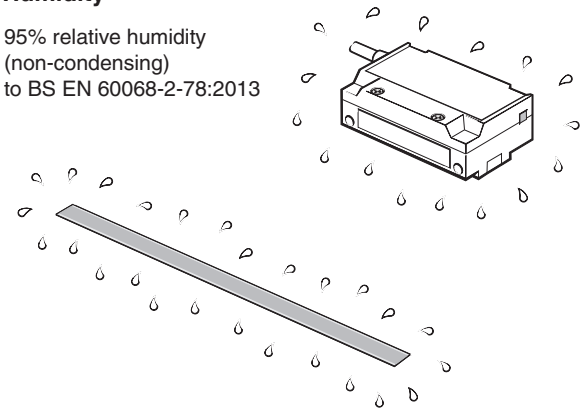
Operating

System
+55 °C
0 °C



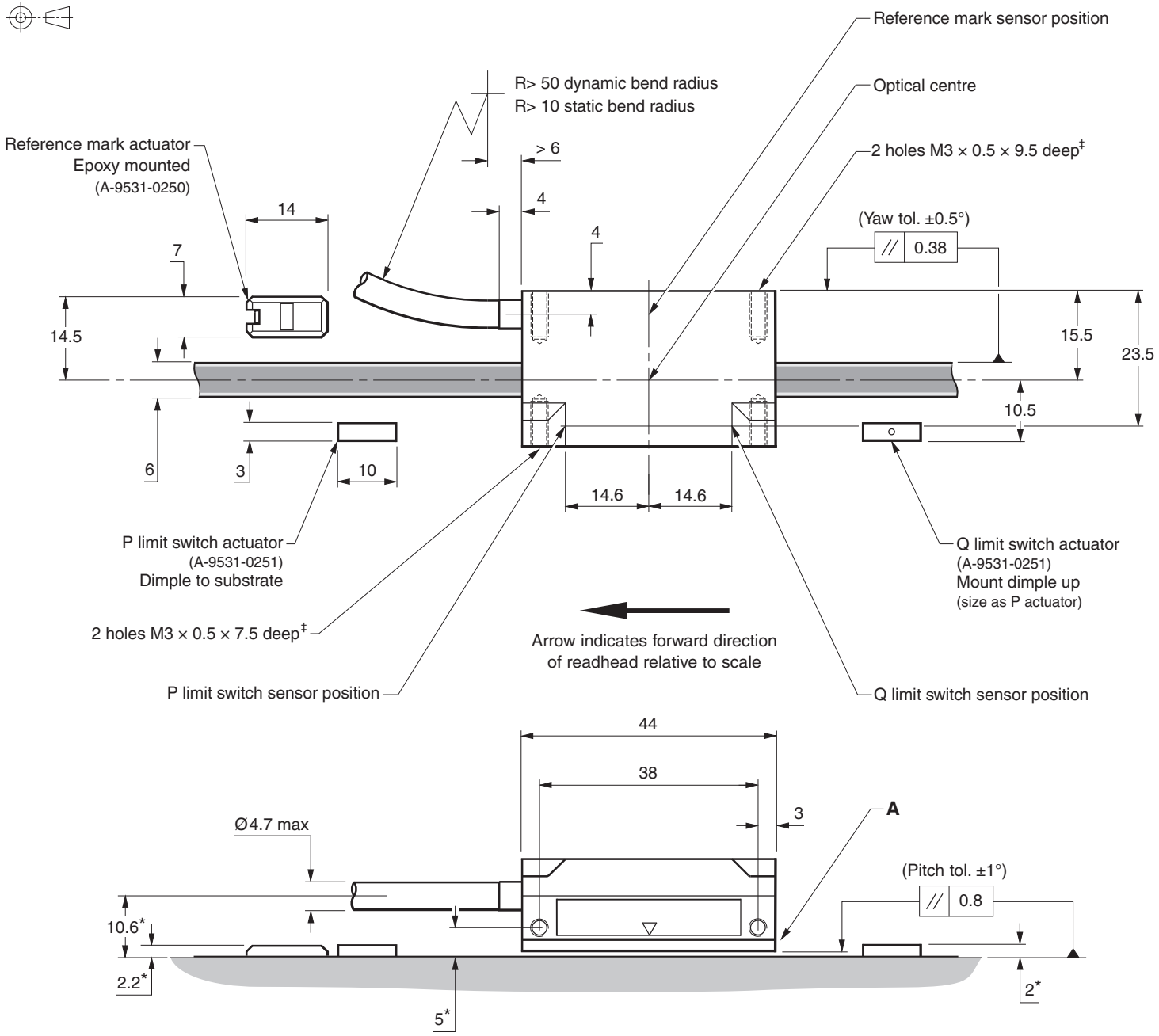
Humidity

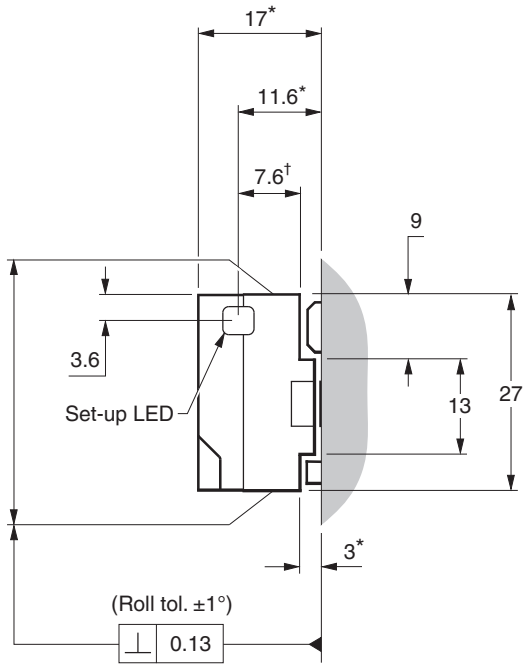
95% relative humidity
(non-condensing)
to BS EN 60068-2-78:2013



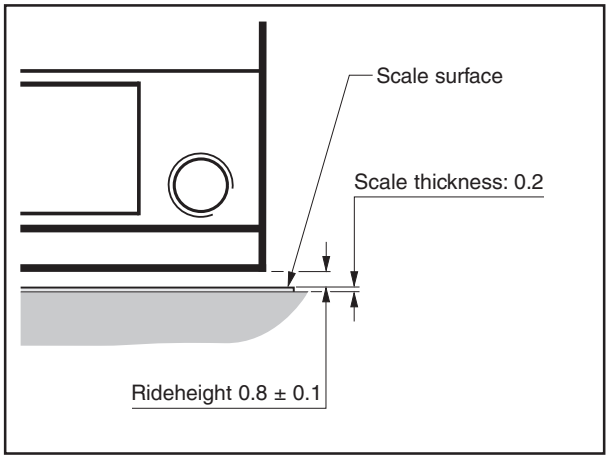
RGH22 readhead installation drawing

Dimensions and tolerances in mm





Detail A

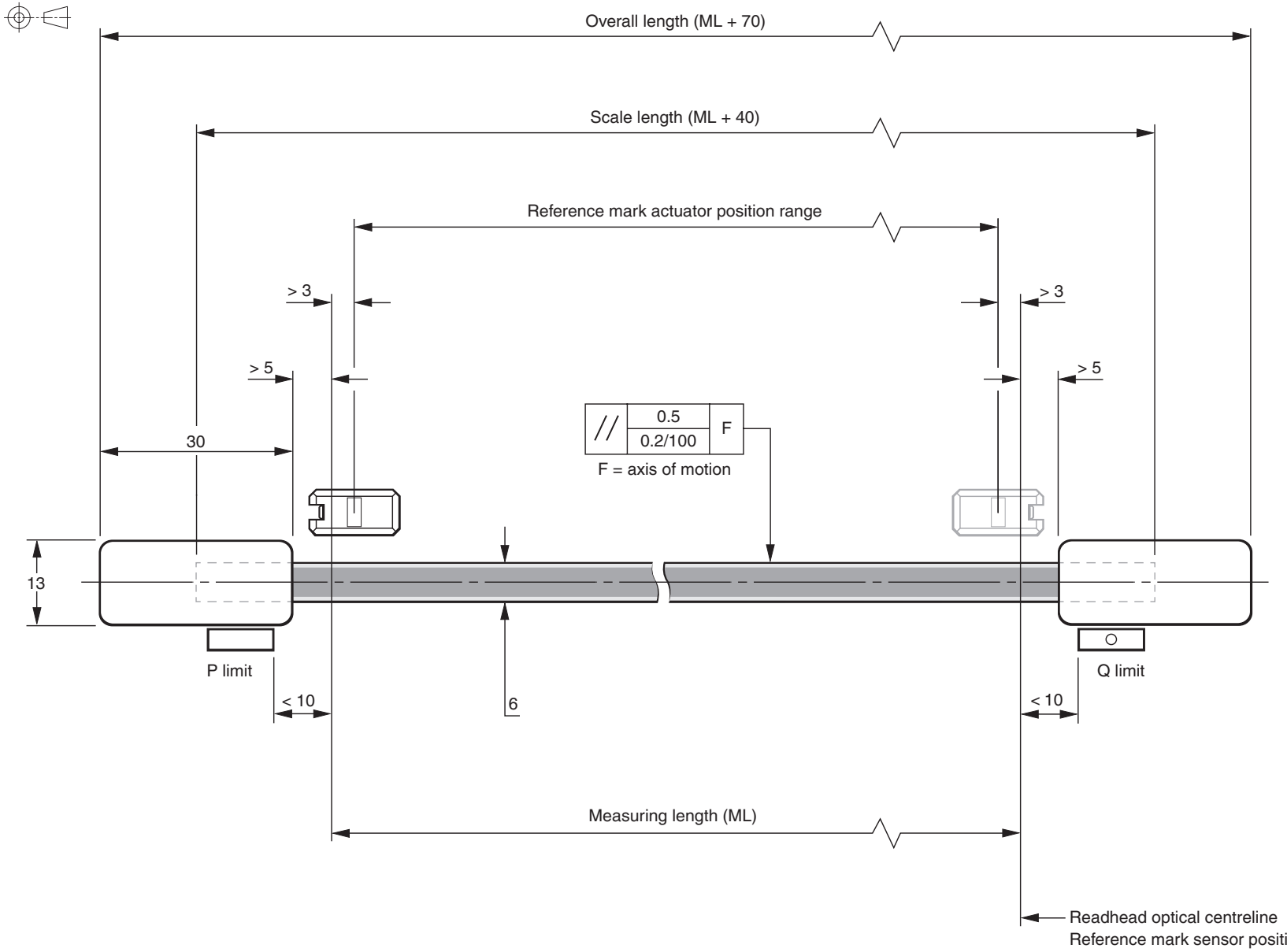


*Dimensions measured from substrate. †Alternative mounting faces

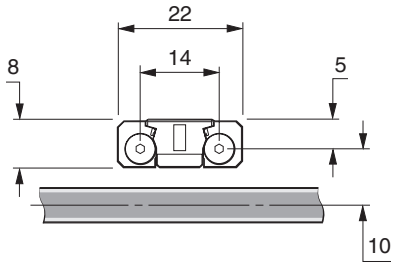
‡The recommended thread engagement is 5 mm. The recommended tightening torque is between 0.5 and 0.7 Nm.

RGS20 scale installation drawing

Dimensions and tolerances in mm



Optional bolted reference mark actuator
(A-9531-0287)



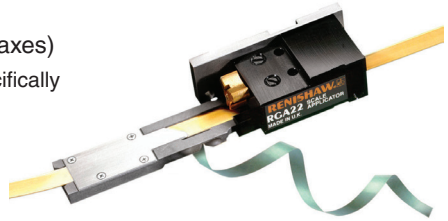
NOTE: The surface roughness of the scale mounting surface must be ≤ 3.2 Ra.
The parallelism of the scale surface to the axis of motion (readhead rideheight variation) must be within 0.05 mm.

Scale application

RGA22 - scale applicator (recommended for longer axes)

The RGA22 scale applicator kit (A-9531-0265) is designed specifically for installing RGS20-S scale for use with the RGH22 readhead.

For instructions on how to use the RGA22 please refer to the 'RGA22 scale applicator User's guide' (M-9531-0297).

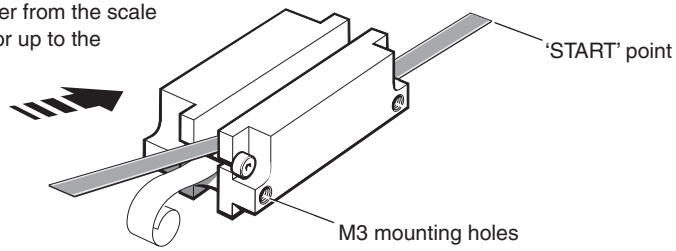


RGA22G - scale applicator (recommended for shorter axes or where space is limited)

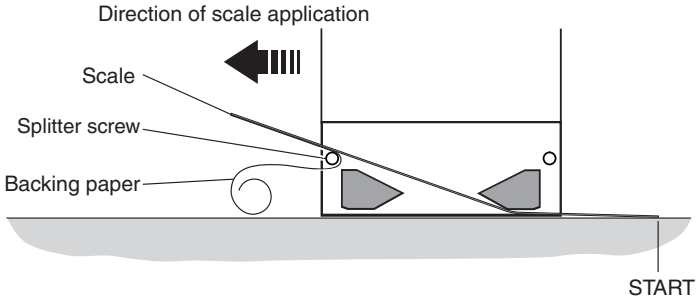
The RGA22G scale applicator (A-9531-0239) is designed specifically for installing RGS20-S scale for use with the RGH22 readhead.

1. Allow scale to acclimatize to installation environment prior to installation.
2. Mark out 'START' and 'FINISH' points for the scale on the axis substrate. Ensure that there is room for the end clamps (see 'RGS20 installation drawing').
3. Thoroughly clean and degrease the substrate using recommended solvents (see 'Storage and handling'). Allow substrate to dry before applying scale.
4. Mount the scale applicator to the readhead mounting bracket using M3 screws. Place the shim supplied with the readhead between the applicator and substrate to set the nominal height.

   NOTE: Scale applicator can be mounted either way round to enable easiest orientation for scale installation.
5. Move axis close to scale start position, leaving enough room for the scale to be inserted through the applicator, as shown below.
6. Begin to remove the backing paper from the scale and insert scale into the applicator up to the 'START' point (as shown). Ensure backing tape is routed under the splitter screw.



7. Apply finger pressure to the scale at the 'START' point, using a clean lint-free cloth, to ensure scale end adheres well to the substrate.



8. Slowly and smoothly move the applicator through the entire axis of travel, ensuring the backing paper is pulled manually from the scale and does not catch under the applicator.
9. Remove applicator and, if necessary, adhere the remaining scale manually. Apply firm finger pressure via a clean lint-free cloth along the length of the scale after application to ensure complete adhesion.
10. Clean scale using Renishaw scale cleaning wipes (A-9523-4040) or a clean, dry, lint-free cloth.
11. Fit end clamps (see 'End clamps' section).
12. Allow 24 hours for complete adhesion of scale before fitting reference mark and limit magnets.

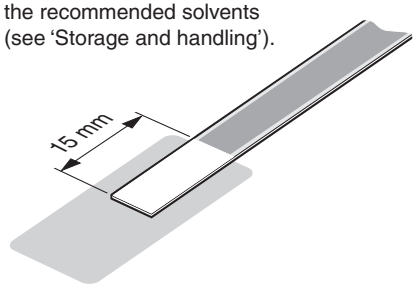
End clamps

A-9523-4015 is an end clamp kit designed to be used with Renishaw RGS scale.

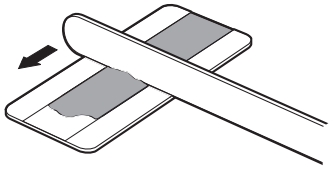
IMPORTANT: End clamps should be used to ensure positional stability of the scale and reference mark repeatability.

NOTE: End clamps can be mounted before or after readhead installation.

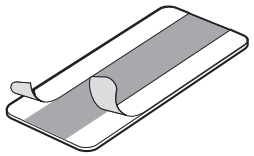
1. Remove the lacquer coating from the last 15 mm of each end of the scale with a knife and clean with one of the recommended solvents (see 'Storage and handling').



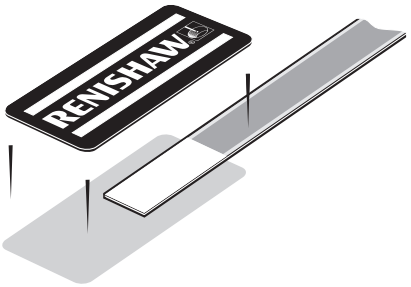
2. Thoroughly mix up a sachet of glue (A-9531-0342) and apply a small amount to the underside of the end clamp.



3. The end clamp features two small regions of contact adhesive. These will temporarily hold the end clamp in position while the glue cures. Remove the backing tape from either side.



4. Immediately position end clamp over the end of the scale. Allow 24 hours at 20 °C for full cure.

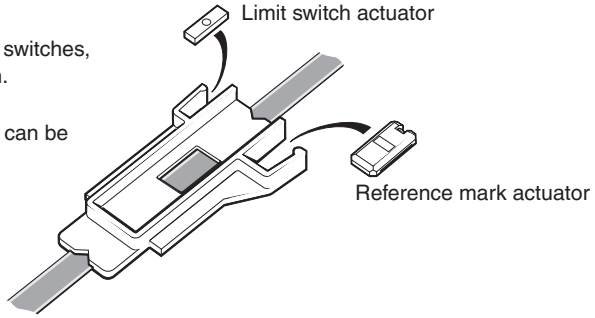


Ensure that excess glue is wiped away from scale as it may affect the readhead signal level.

Reference mark and limit switch actuator installation

To aid location of reference mark and limit switches, the orange shim should be used as shown.

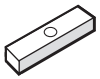
Reference mark and limit switch actuators can be mounted independently from each other, but within the limits specified by the relevant installation drawing.



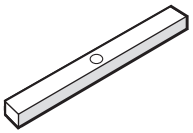
Ensure that excess glue does not enter the reference mark actuator adjustment mechanism.

Limit switch actuators

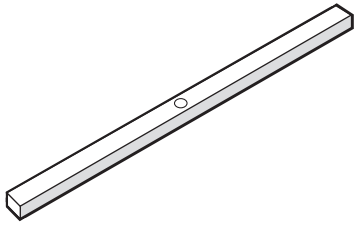
There are several different size limit switch actuators available:



A-9531-0251
10 mm limit switch actuator



A-9531-2052
24.4 mm limit switch actuator



A-9531-2054
50 mm limit switch actuator

Single limit switches

For single limit switch detection, limit switch actuator should be mounted with the dimple uppermost.

Dual limit switches

Some versions of the RGH22 are configured to detect dual limit switch actuators.

NOTE: Refer to RGH22 installation drawing for limit switch actuator positioning.

Reference mark actuators

Reference marks provide a repeatable 'datum position' for the readhead.
Actuators are available in either bolted or glued formats (see below)



A-9531-0250
Epoxy-mounted reference mark actuator



A-9531-0287
Screw-mounted reference mark actuator

Readhead mounting and alignment

Mounting brackets

The bracket must have a flat mounting surface and should provide adjustment to enable 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.

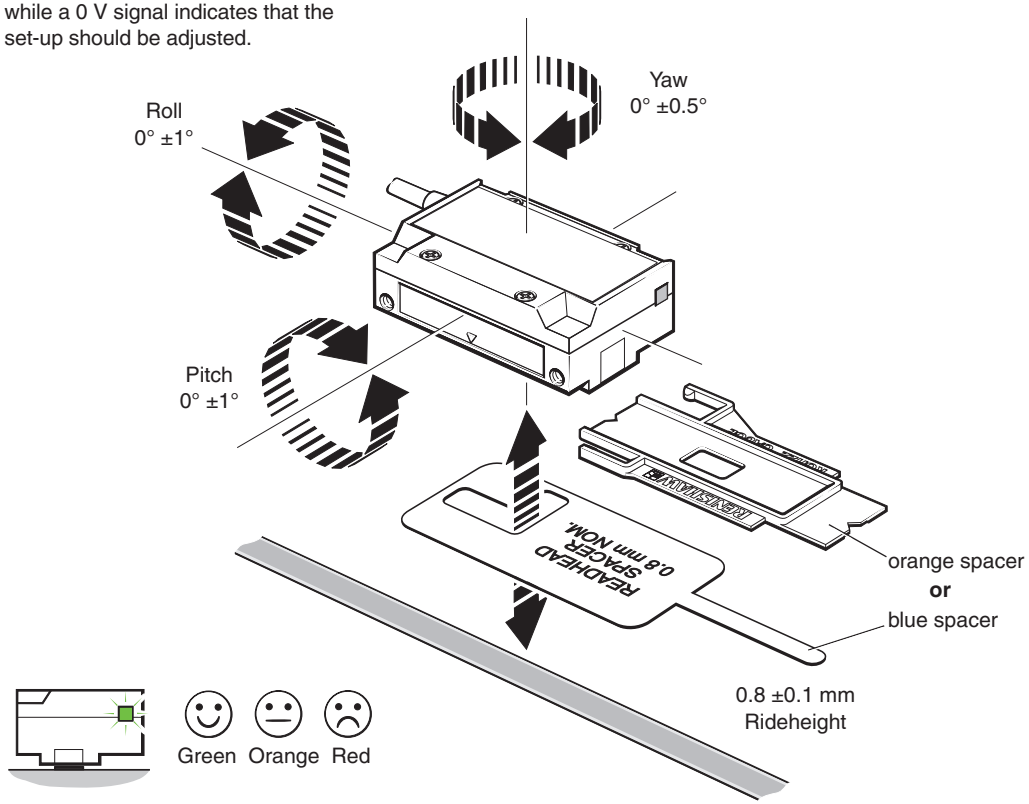
Readhead set-up

Ensure that the scale, readhead optical window and mounting face are clean and free from obstructions. To set nominal rideheight, place the blue or orange spacer with the aperture directly under the optical centre of the readhead to allow normal LED function during set-up procedure. The orange spacer also helps to position readhead with respect to offset and yaw relative to the scale

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

Adjust the readhead to achieve a solid Green LED. When correctly installed the set-up LED remains Green along the full axis of travel.

An external set-up signal (X or V_x) is also available on RGH22 readheads for use where the LED is not visible. In this case, 5 V indicates optimum set-up, while a 0 V signal indicates that the set-up should be adjusted.



Reference mark set-up

To ensure unidirectional repeatability, the reference mark requires phasing with the scale in the direction of normal datuming operation.

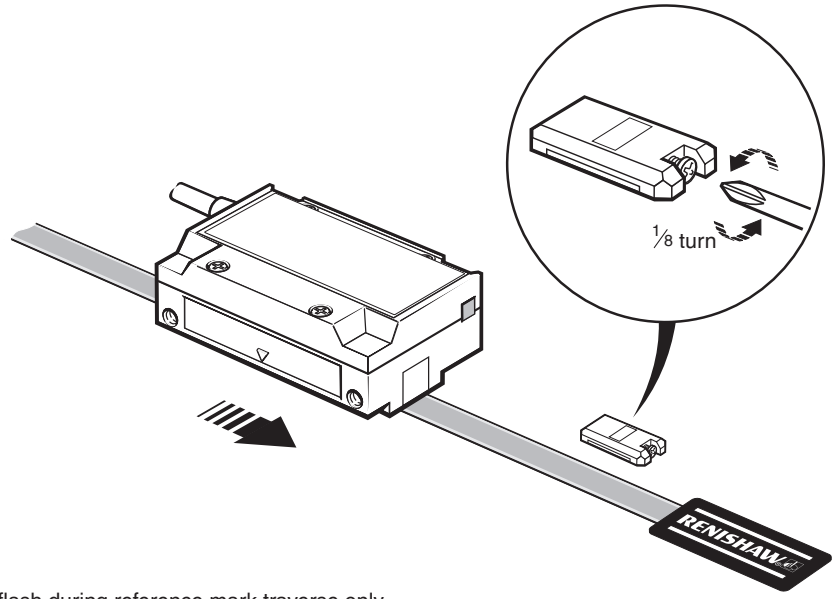
A reference pulse is output in both directions, but repeatability is guaranteed only in the phased direction. The readhead should be set up correctly ensuring a green LED indication over the full length of travel. The reference mark actuator should be installed as shown on the installation drawing.

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.

NOTE: Reference mark output is synchronised with the incremental channels, giving unit of resolution pulse width. For further details see *RGH22 encoder system* Data sheet (Renishaw part no. L-9517-9676).

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 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.



LED flash during reference mark traverse only



Limit switch

Limit switch detection is entirely independent of other readhead functions - the signal is only output when the readhead is positioned over the limit switch actuator.

Output signals

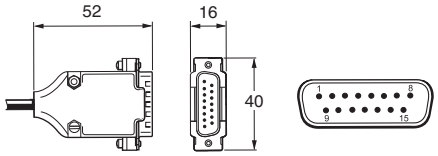
RGH22 D, X, Z, Y, H, P, Q, R, S, RS422A digital

Function	Signal		Colour	15-way D-type plug (D)	12-way circular (R)	16-way in-line connector (X)
Power	5 V		Brown	7	2	A
			Brown (link)	8	12	M
	0 V		White	2	10	B
			White (link)	9	11	N
Incremental signals	A	+	Green	14	5	G
		–	Yellow	6	6	D
	B	+	Blue	13	8	R
		–	Red	5	1	F
Reference mark	Z	+	Violet	12	3	K
		–	Grey	4	4	O
Limit switch*	Q		Pink	10	–	H
Alarm	E	+	Black	11	9	I
		–	Orange	3	7	P
External set-up	X		Clear	1	–	E
Shield	Inner		Green / Yellow	15	11 (link)	L
	Outer		–	Case	Case	Case

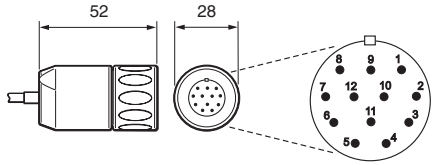
*Dual limit versions (RGH22P, Q, R, S and H) utilise the black wire (pin 11) as the P limit output.
The 'E' alarm signal on these versions is only available at the orange wire as a single-ended E– output.
Dual limit readheads are only available with F, D, or X terminations.

Alarm

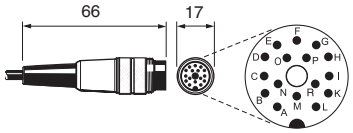
For RGH22D, X, Z, P, Q, R, - alarm asserted when signal amplitude < 15%.
For RGH22Y, S, H - alarm asserted when: - Signal amplitude > 150% - Readhead exceeds specified maximum speed
Also, outputs are 3-stated at signal amplitude < 15%



15-way D-type plug (termination code D)



12-way circular plug (termination code R)



In-line connector plug (termination code X)

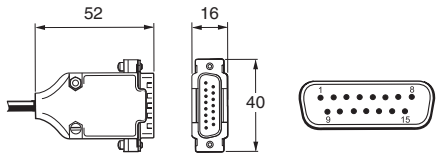
Output signals (continued)

RGH22 A, B 1 Vpp analogue

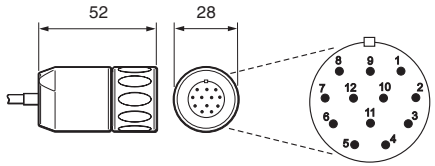
Function	Signal		Colour	15-way D-type plug (L)	12-way circular (V)	12-way circular coupling (W)	16-way in-line connector (X)
Power	5 V		Brown	4	2	2	A
			Brown (link)	5	12	12	M
	0 V		White	12	10	10	B
			White (link)	13	11	11	N
Incremental signals	V_1	+	Red	9	5	5	F
		–	Blue	1	6	6	R
	V_2	+	Yellow	10	8	8	D
		–	Green	2	1	1	G
Reference mark	V_0	+	Violet	3	3	3	K
		–	Grey	11	4	4	O
Limit switch*	V_q		Pink	8	N/C	N/C	H
External set-up	V_x		Clear	7	N/C	N/C	E
Reference mark uni-directional operation‡	BID		Black	6	9†	9††	I
	DIR		Orange	14	7†	7††	P
Shield	Inner		Green/Yellow	15	11 (link)	11 (link)	L
	Outer		–	Case	Case	Case	Case

*Dual limit versions (RGH22A) utilise the clear wire (pin 7) as the V_P limit output. The V_x external set-up signal on these versions is not available. Dual limit readheads are only available with F, L or X terminations.

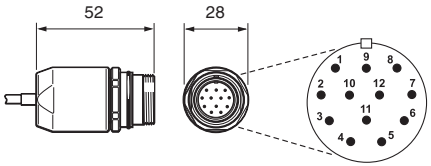
†Only connected with option 17 ††Only connected with option 18



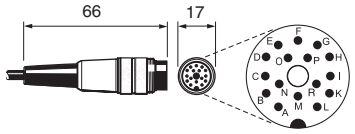
15-way D-type plug (termination code L)



12-way circular plug (termination code V)



12-way circular coupling plug (termination code W)



In-line connector plug (termination code X)

‡Reference mark uni-directional operation

The RGH22 reference mark output is not repeatable in both directions. Certain controllers will flag an error when they see different reference mark positions in the forward and reverse directions.
BID DIR pins allow the readhead to be configured to ignore the reference pulse output in the unphased direction (see section Reference mark set-up).

BID/DIR connections

BID / DIR connection For bi-directional operation (normal)	To:-	Reference mark output direction
BID	+5 V or not connected	Forward **and** reverse
DIR	Do not connect	

BID / DIR connection For uni-directional operation	To:-	Reference mark output direction
BID	0 V	
DIR	+5 V or not connected	Forward **only**
DIR	0 V	Reverse **only**

Speed

Digital readheads

Non-clocked output readheads

Head type	Maximum speed (m/s)	Lowest recommended counter input frequency (MHz)
D and P (5 µm)	10	$\left(\frac{\text{Encoder velocity (m/s)}}{\text{Resolution (µm)}}\right)$ × 4 safety factor
X and Q (1 µm)	5	
Z and R (0.5 µm)	3	

Clocked output readheads

The RGH22Y, S, and H readheads are available with a variety of different clocked outputs.
Customers must ensure they comply with the lowest recommended counter input frequency.

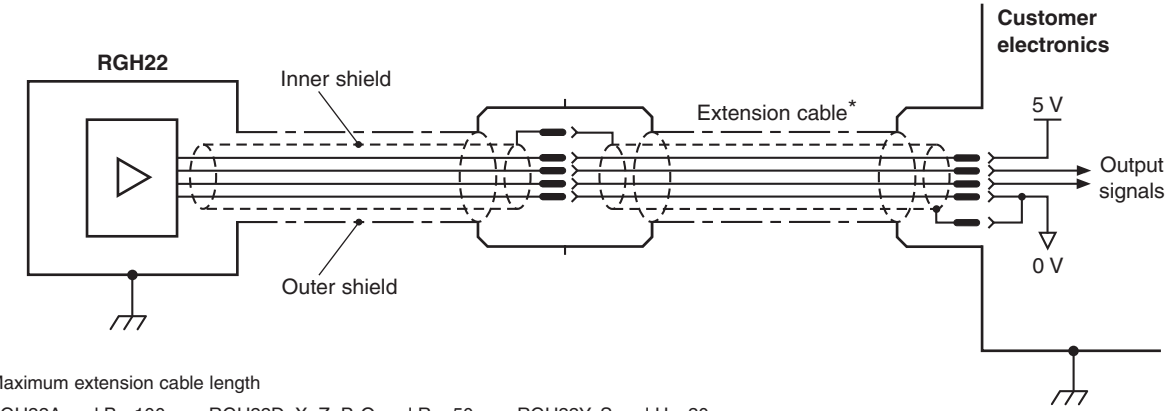
Options	Maximum speed (m/s)		Lowest recommended counter input frequency (MHz)
	Head type		
	Y and S (0.1 µm)	**H** (50 nm)	
61	1.3	0.6	20
62	0.7	0.3	10
63	0.35	0.15	5

Analogue readheads

RGH22A and B - 4 m/s (–3dB)

Electrical connections

Grounding and shielding



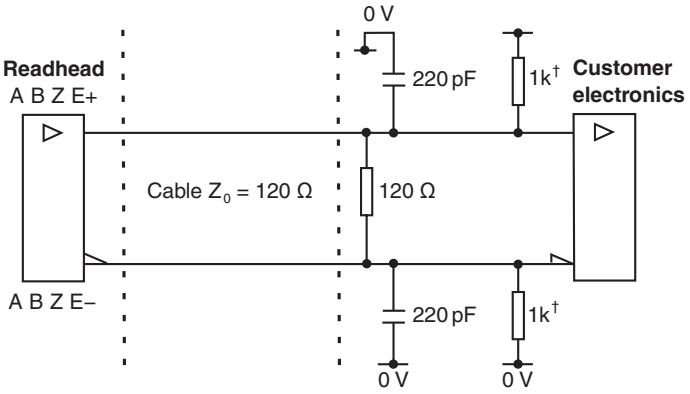
*Maximum extension cable length

RGH22A and B - 100 m, RGH22D, X, Z, P, Q and R - 50 m, RGH22Y, S and H - 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 - RGH22D, X, Z, Y, H, P, Q, R and S

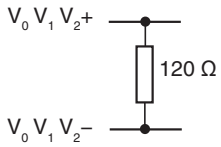


Standard RS422A line receiver circuitry.

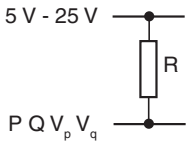
Capacitors recommended for improved noise immunity.

†Only required on alarm channel E for fail safe operation.

Analogue output - RGH22 A, B



Limit output



Select R so that maximum current does not exceed 20 mA.

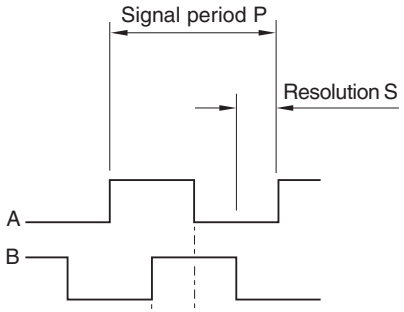
Alternatively, use a relay or opto-isolator.

Output specifications

Digital output signals - type RGH22D, X, Z, Y, H, P, Q, R and S

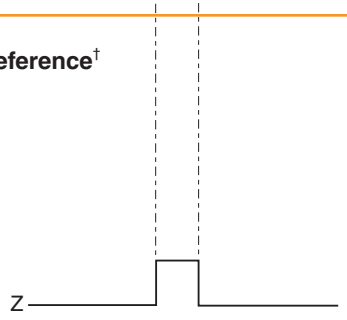
Form - Square wave differential line driver to EIA RS422A (except limit switches P, Q and external set-up signal X)

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



Model	P (µm)	S (µm)
RGH22D and P	20	5
RGH22X and Q	4	1
RGH22Z and R	2	0.5
RGH22Y and S	0.4	0.1
RGH22H	0.2	0.05

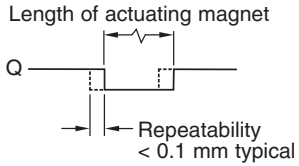
Reference†



Synchronised pulse Z, duration as resolution S.
Repeatability of position (uni-directional) maintained within ±10 °C from installation temperature and for speed < 250 mm/s.
For RGH22Y, S, H only Z pulse re-synchronised at power-up with any one of the quadrature states (00, 01, 11, 10).
Actuation device A-9531-0250 or A-9531-0287

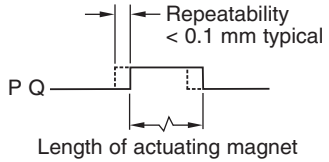
Limit open collector output

Single limit RGH22D, X, Z, Y



Asynchronous pulse Q

Dual limit RGH22P, Q, R, S, H*



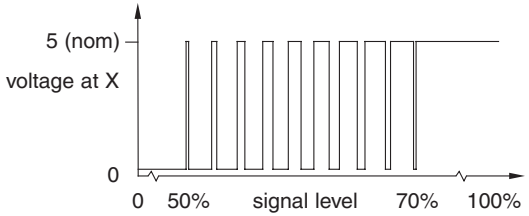
Asynchronous pulse P, Q

Actuation device A-9531-0251, A-9531-2052 or A-9531-2054.

*Dual limit available with flying lead, 15 pin D connector or in-line X connector only.

†Inverse signals not shown for clarity.

External set-up



Between 50% and 70% signal level, X is a duty cycle.
Time spent at 5 V increases with signal level.
At > 70% signal level X is nominal 5 V.

Alarm

RGH22D, P, X, Q, Z and R

Alarm output asserted when < 15% signal

Option	Alarm type
00A	Differential line driven output (RGH22D, X and Z only)
00A	Single ended line driven output (RGH22P, Q and R only)
20A	3-state output

RGH22Y, S and H

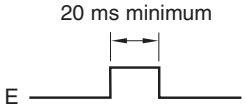
Options 61, 62 and 63

Single ended line driven output alarm asserted when > 150% signal or overspeed (RGH22S and H only).

Differential line driver output alarm asserted when > 150% signal or overspeed (RGH22Y only).

3-state output alarm asserted when < 15% signal.

Line driven alarm output†



E– only on dual limit readheads (RGH22P, Q, R, S and H only)

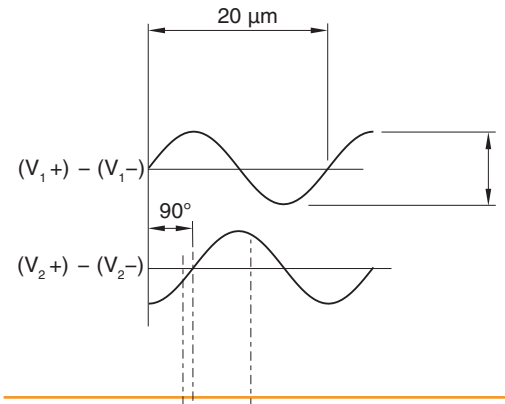
3-state output

Differentially transmitted signals forced open circuit for > 20 ms when alarm conditions valid.

Output specifications (continued)

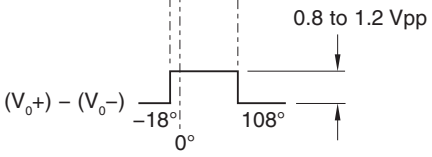
Analogue output signals - type RGH22B and A (1Vpp)

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



0.6 to 1.2 Vpp with green LED indication and 120 Ω termination.

Reference

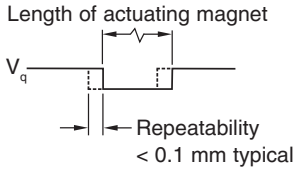


Differential pulse V_0 –18° to 108°.
Duration 126° (electrical).
Repeatability of position (uni-directional) maintained within ±10 °C from installation temperature and for speed < 250 mm/s.

Actuation device A-9531-0250 or A-9531-0037

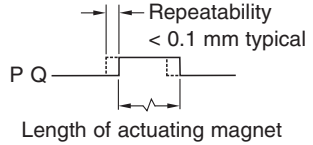
Limit open collector output

Single limit RGH22B



Asynchronous pulse V_q

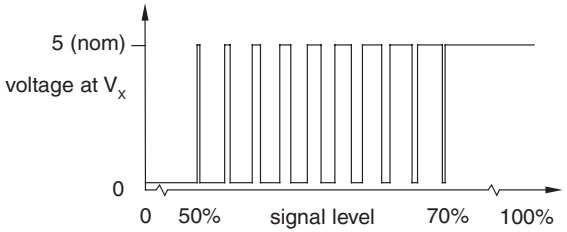
Dual limit RGH22A



Asynchronous pulse V_p V_q

Actuation device A-9531-0251, A-9531-2052 or A-9531-2054.

External set-up



Between 50% and 70% signal level, V_x is a duty cycle.
Time spent at 5 V increases with signal level.
At > 70% signal level V_x is nominal 5 V.

General specifications

Power supply	5 V ± 5%	120 mA (typical), 200 mA RGH22Y, S and H **NOTE:** Current consumption figures refer to unterminated readheads. For digital outputs a further 25 mA per channel pair (e.g. 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. Power from a 5 V dc supply complying with the requirements for SELV of standard IEC BS EN 60950-1.
	Ripple	200 mVpp@frequency up to 500 kHz maximum.
Temperature	Storage	–20 °C to +70 °C
	Operating	0 °C to +55 °C
Humidity		95% relative humidity (non-condensing) to EN 60068-2-78
Sealing		IP50
Acceleration	Operating	500 m/s², 3 axes
Shock	Non-operating	1000 m/s², 6 ms, ½ sine, 3 axes
Vibration	Operating	100 m/s² max @ 55 Hz to 2000 Hz, 3 axes
Mass	Readhead	45 g
	Cable	38 g/m
Cable		12 core, double shielded, maximum diameter 4.7 mm. Flex life > 20 × 10^6 cycles at 50 mm bend radius.

Renishaw encoder systems have been designed to the relevant EMC standards, but must be correctly integrated to achieve EMC compliance. In particular, attention to shielding arrangements is essential.

Scale specifications

Scale type		Reflective gold plated steel tape with protective lacquer coating. Adhesive backing tape allows direct mounting to the machine substrate.
Scale period		20 µm
Linearity		±3 µm/m
Scale length		Up to 50 m (> 50 m by special order)
Form (H × W)		0.2 mm × 6 mm (includes adhesive)
Substrate materials		Metals, ceramics and composites with expansion coefficients between 0 and 22 µm/m/°C (steel, aluminium, Invar, granite, ceramic etc.)
Coefficient of thermal expansion		Matches that of substrate material when scale ends are fixed by epoxy mounted end clamps
End fixing		Epoxy mounted end clamps (A-9523-4015) using 2 part epoxy adhesive (A-9531-0342). Scale end movement typically < 1 µm up to +40 °C.
Temperature	Operating	–10 °C to +120 °C
	Minimum installation	10 °C
	Storage	–20 °C to +70 °C
Humidity		95% relative humidity (non-condensing) to EN 60068-2-78

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M-9531-9818-01

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