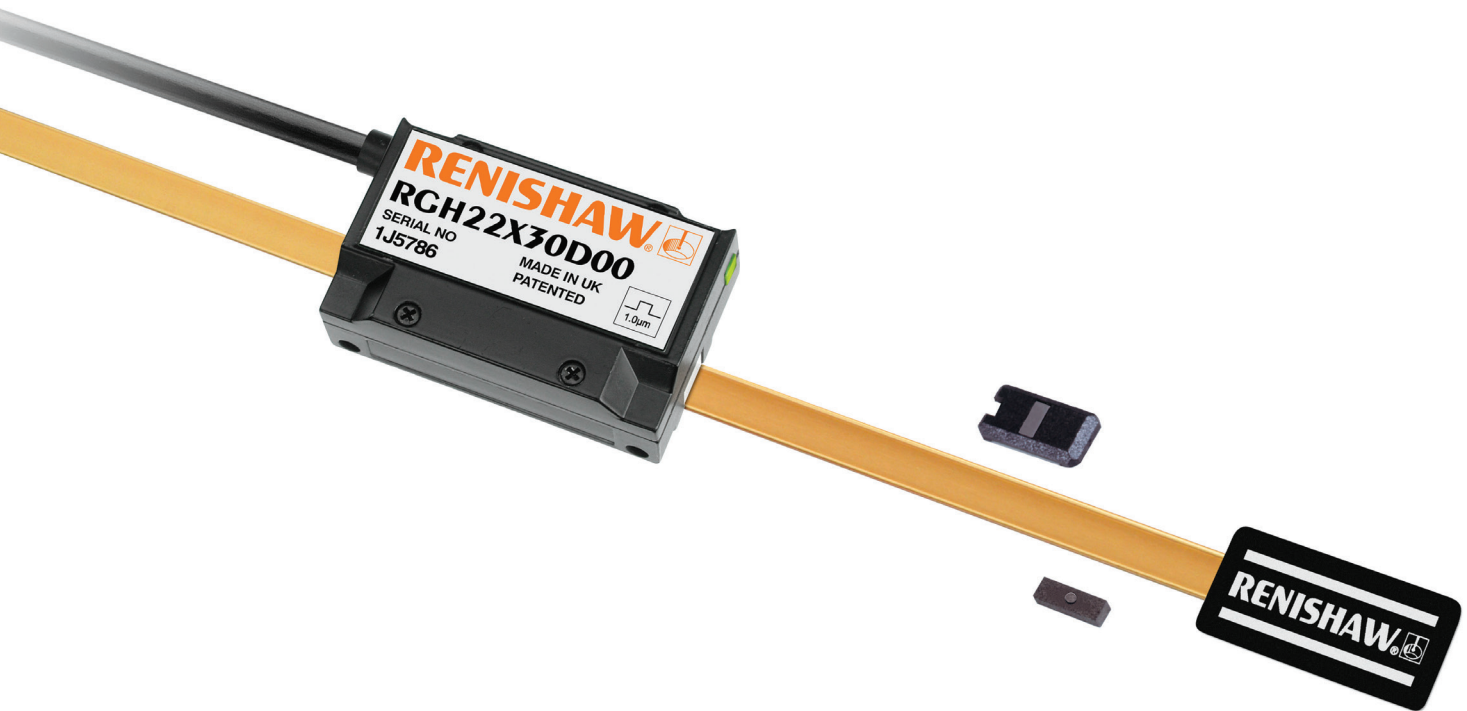


# RGH22 encoder system



The Renishaw RGH22 series is a non-contact optical encoder system, providing highly-reliable position feedback. The RGH22 readhead features a set-up LED indicator for easy installation, unique filtering optics for excellent dirt immunity, and integrated interpolation down to 50 nm.

RGH22 offers proven reliability, performance and value, which makes it one of the most commonly applied encoder systems.

The RGH22 reads the 20  $\mu\text{m}$  pitch RGS20 gold tape-scale and outputs a choice of industry standard 1Vpp analogue or RS422 digital signals. RGS20 is suitable for mounting to most common engineering materials including metals, granites, ceramics and composites.

The scale can be mastered to the axis substrate by means of specially formulated pre-applied adhesive and epoxy fastened 'end clamps'. This method ensures the differential movement between the scale and the substrate is close to zero, even with significant temperature swings.

The RGH22 range has also proven to be resilient to conditions considered challenging. They have been installed by many of the world's leading linear motion OEMs in a wide range of applications such as metrology, electronics, semiconductor and FPD manufacturing.

## RGH22 readhead

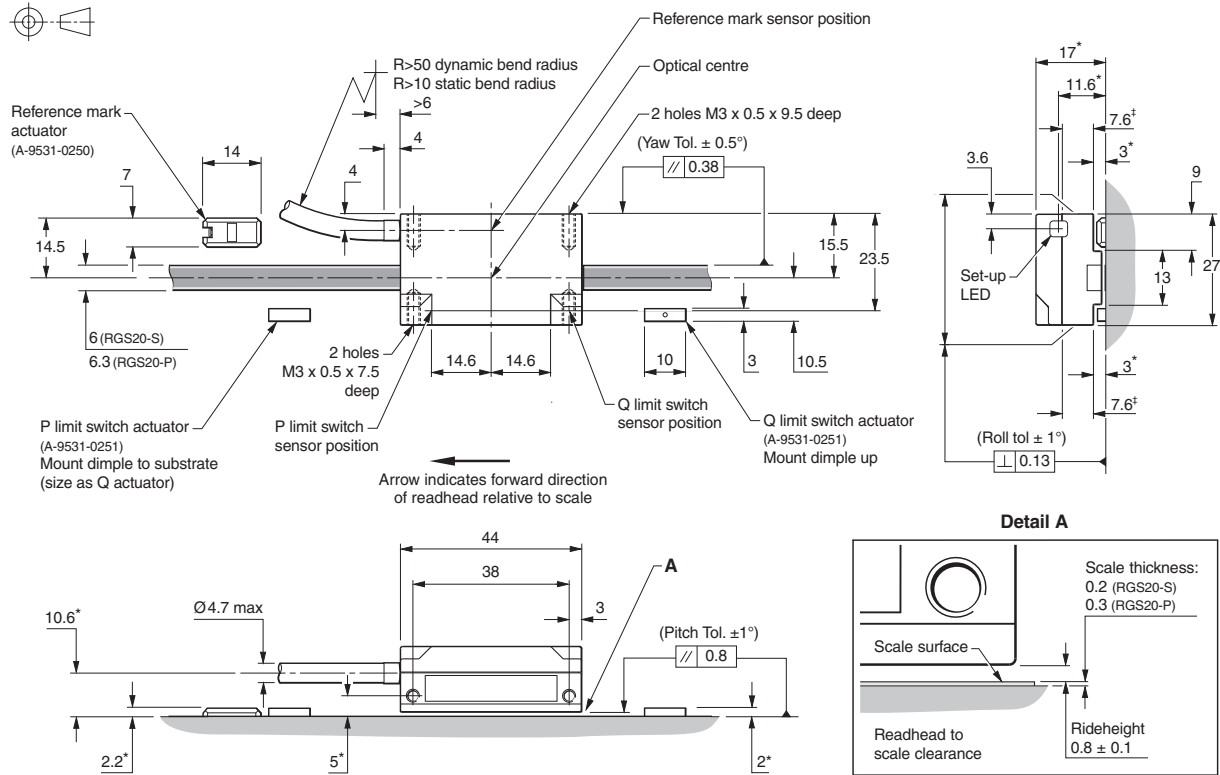
- Non-contact open optical system
- Integral interpolation
- Industry standard digital and analogue options
- Resolutions from 5  $\mu\text{m}$  to 50 nm
- Integral reference and limit sensors
- Integral set-up LED

## RGS20 scale

- 'Cut-to-length' flexibility
- Lengths from 100 mm to 50 m
- Protective lacquer or tough polyester coating option for applications using harsh solvents
- Efficient, accurate installation
- Affixes to most common engineering materials
- Self-adhesive backing tape
- Applicator tool allows scale to be installed using the motion of the axis

## RGH22 readhead installation drawing

Dimensions and tolerances in mm



\*Dimensions measured from substrate. †Alternative mounting faces

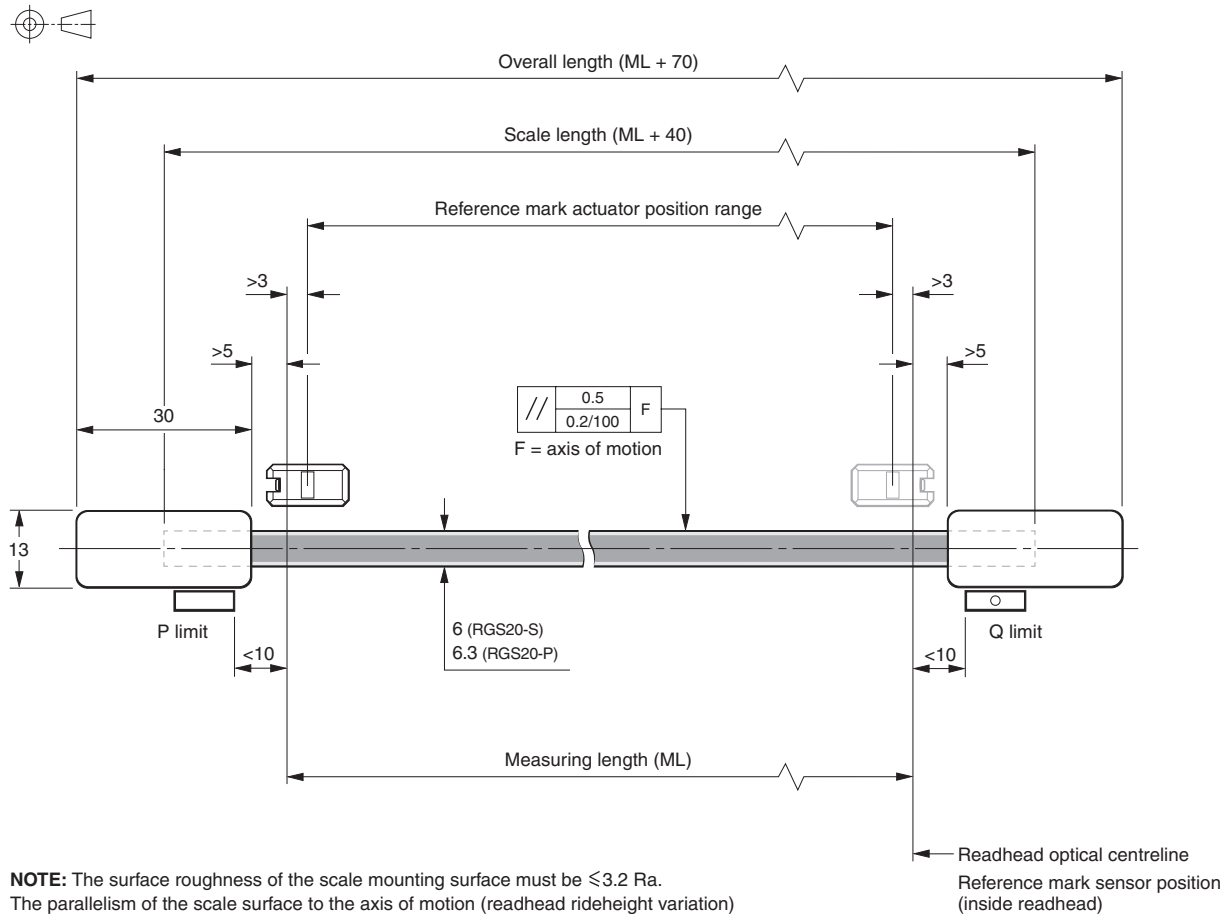
## General specifications

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

Connector options	Code	Connector type	Application
	D	15 way D type plug	RGH22D, X, Z, Y, H, P, Q, R and S
	R	12 way circular plug	RGH22D, X, Z, Y, H, P, Q, R and S
	L	15 way D type plug	RGH22A and B
	V	12 way circular plug	RGH22B
	W	12 way circular coupling	RGH22B
	F	unterminated cable	all readheads
	X	16 way in-line connector	all readheads

## RGS20 scale installation drawing

Dimensions and tolerances in mm



## Scale specifications

<b>Scale type</b>	RGS20-S	Reflective gold plated steel tape with protective lacquer coating. Adhesive backing tape allows direct mounting to the machine substrate.
	RGS20-P	Reflective gold plated steel tape with tough polyester coating for applications using harsh solvents. Adhesive backing tape allows direct mounting to the machine substrate.
<b>Scale period</b>		20 $\mu$ m
<b>Linearity</b>	RGS20-S	$\pm 3$ $\mu$ m/m
	RGS20-P	$\pm 5$ $\mu$ m/m
<b>Scale length</b>		Up to 50 m (>50 m by special order)
<b>Form (H x W)</b>	RGS20-S	0.2 mm x 6 mm (includes adhesive)
	RGS20-P	0.3 mm x 6.3 mm (includes adhesive)
<b>Substrate materials</b>		Metals, ceramics and composites with expansion coefficients between 0 and 22 $\mu$ m/m/ $^{\circ}$ C (steel, aluminium, Invar, granite, ceramic etc.)
<b>Expansion coefficient</b>		Matches that of substrate material when scale ends are fixed by epoxy mounted end clamps
<b>End fixing</b>		Epoxy mounted end clamps (A-9523-4015) using 2 part epoxy adhesive (A-9531-0342) Scale end movement <1 $\mu$ m over temperature range -20 $^{\circ}$ C to +50 $^{\circ}$ C
<b>Temperature</b>	Operating	-10 $^{\circ}$ C to +120 $^{\circ}$ C.
	Minimum installation	10 $^{\circ}$ C
	Storage	-20 $^{\circ}$ C to +70 $^{\circ}$ C.
<b>Humidity</b>		95% relative humidity (non-condensing) to EN 60068-2-78

## Speed performance

### Digital readheads

#### Non-clocked output readheads

Head type	Maximum speed (m/s)	Lowest recommended counter input frequency (MHz)
D and P (5 µm)	10	$\left( \frac{\text{Encoder velocity (m/s)}}{\text{Resolution (µm)}} \right) \times 4 \text{ safety factor}$
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)

## Output signals

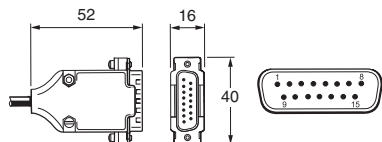
### Connections

#### Digital RS422A outputs - RGH22 D, X, Z, Y, H, P, Q, R and S

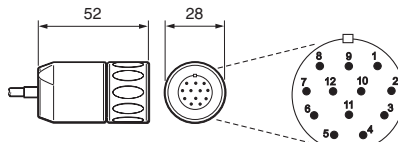
Function	Signal	Colour	15 way D-type plug (D)	12 way circular (R)	16 way in-line connector (X)
Power	5 V	Brown	7	2	A
		Brown (link)	8	12	M
	0 V	White	2	10	B
		White (link)	9	11	N
Incremental signals	A	+	14	5	G
		-	6	6	D
	B	+	13	8	R
		-	5	1	F
Reference mark	Z	+	12	3	K
		-	4	4	O
Limit switch*	Q	Pink	10	–	H
Alarm	E	+	11	9	I
		-	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. Please select the preferred option at time of ordering.

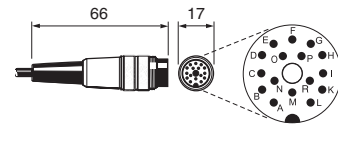
15 way D type plug (termination code D)



12 way circular plug (termination code R)



16 way in-line connector plug (termination code X)



## Connections

### Analogue 1 Vpp outputs - RGH22A and B

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 <sub>1</sub>	+	9	5	5	F
		-	1	6	6	R
	V <sub>2</sub>	+	10	8	8	D
		-	2	1	1	G
Reference mark	V <sub>0</sub>	+	3	3	3	K
		-	11	4	4	O
Limit switch**	V <sub>q</sub>	Pink	8	N/C	N/C	H
External set-up	V <sub>x</sub>	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

\*\*Dual limit versions (RGH22A) utilise the clear wire (pin 7) as the V<sub>p</sub> limit output. The V<sub>x</sub> 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  
Please select the preferred option at time of ordering.

### ‡Reference mark uni-directional operation

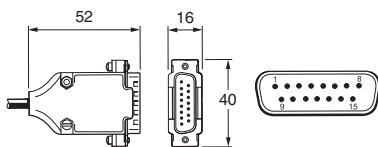
The RGH22 reference mark output is repeatable for one direction of travel only. Certain controllers will flag an error when they see different reference mark positions in the forward and reverse directions. BID DIR pins allow the readhead to be configured to ignore the reference pulse output in the unphased direction (see Installation guide for more information on reference mark set-up).

### BID / DIR connections

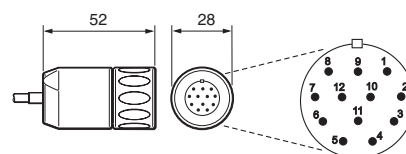
BID / DIR connection For bi-directional operation (normal)	To:-	Reference mark output direction
<b>BID</b>	+5 V or not connected	Forward <b>and</b> reverse
<b>DIR</b>	Do not connect	

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

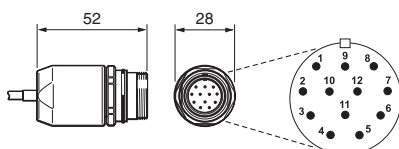
### 15 way D type plug (termination code L)



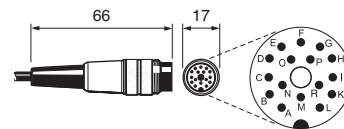
### 12 way circular plug (termination code V)



### 12 way circular coupling (termination code W)

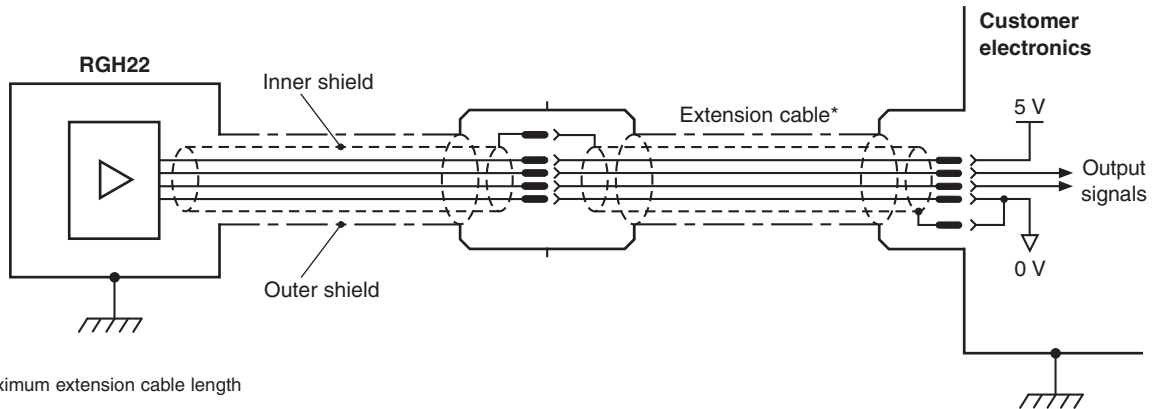


### 16 way in-line connector plug (termination code X)



## Electrical connections

### Grounding and shielding



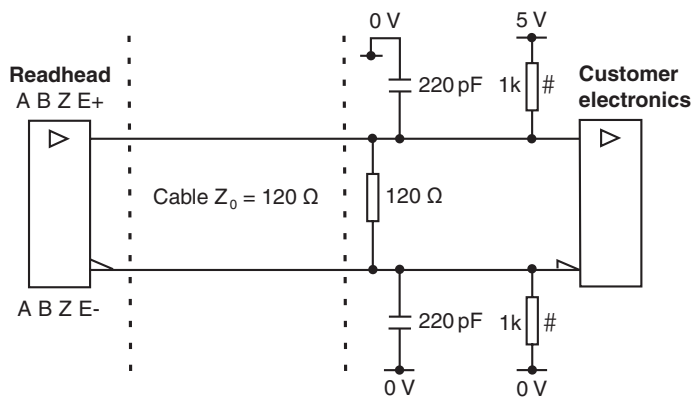
\*Maximum extension cable length

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 - RGH22 D, X, Z, Y, H, P, Q, R and S

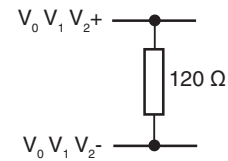


Standard RS422A line receiver circuitry.

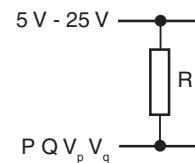
Capacitors recommended for improved noise immunity.

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

### Analogue output - RGH22 A and B



### Limit output



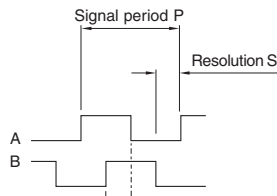
Select R so that maximum current does not exceed 20 mA.

Alternatively, use a relay or opto-isolator.

## Output specifications

### Digital output signals - 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)
<b>RGH22D and P</b>	20	5
<b>RGH22X and Q</b>	4	1
<b>RGH22Z and R</b>	2	0.5
<b>RGH22Y and S</b>	0.4	0.1
<b>RGH22H</b>	0.2	0.05

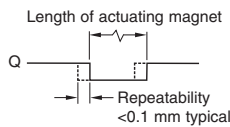
**Reference†**



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 and H only the Z pulse is 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.

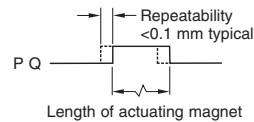
**Limit** open collector output

**Single limit D, X, Z and Y**



Asynchronous pulse Q

**Dual limit P, Q, R, S and H\***

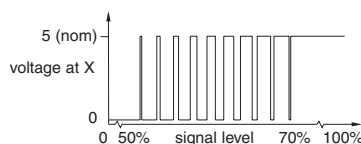


Asynchronous pulse P, Q

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.

**External set-up**



Between 50% and 70% signal level, X is a duty cycle, 20 µm duration. 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
<b>00A</b>	Differential line driven output (RGH22D, X and Z only)
<b>00A</b>	Single ended line driven output (RGH22P, Q and R only)
<b>20A</b>	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)

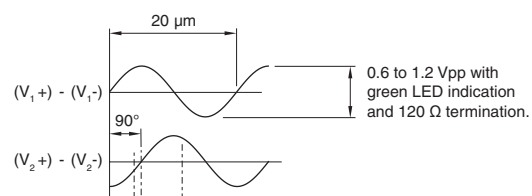
**3-state alarm output**

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

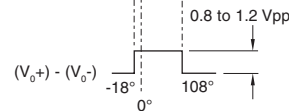
†Inverse signals not shown for clarity.

### Analogue 1 Vpp output signals - RGH22B and A

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



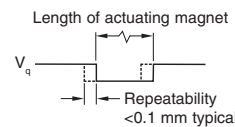
**Reference**



Differential pulse  $V_0$  - 18° to 108°. Duration 126° (electrical). Repeatability of position (uni-directional) maintained within ±10 °C from installation temperature and for speed <250 mm/s. Actuation device A-9531-0250 or A-9531-0287.

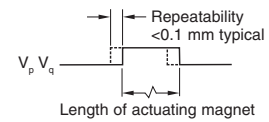
**Limit** open collector output

**Single limit RGH22B**



Asynchronous pulse  $V_q$

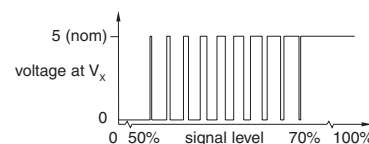
**Dual limit RGH22A**



Asynchronous pulse  $V_p, V_q$

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

**External set-up**



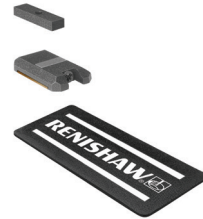
Between 50% and 70% signal level,  $V_x$  is a duty cycle, 20 µm duration. Time spent at 5 V increases with signal level. At >70% signal level  $V_x$  is nominal 5 V.



RGH22 system = readhead



+ scale



+ accessories

## Readhead part numbers

RGH22 D 15 D 00A

### Readhead series

#### Output

##### Analogue

- A - 1 Vpp (dual limits)
- B - 1 Vpp (single limit)

##### Digital

- D - 5 µm (single limit)
- P - 5 µm (dual limits)
- X - 1 µm (single limit)
- Q - 1 µm (dual limits)
- Z - 0.5 µm (single limit)
- R - 0.5 µm (dual limits)
- Y - 0.1 µm (single limit)
- S - 0.1 µm (dual limits)
- H - 50 nm (dual limits)

#### Cable length

- 05 - 0.5 m
- 10 - 1 m
- 15 - 1.5 m
- 20 - 2 m
- 30 - 3 m
- 50 - 5 m

#### Termination

- D - 15 pin D type plug (RGH22D, H, P, Q, R, S, X, Y, and Z only)
- F - unterminated cable
- L - 15 pin D type plug (RGH22A and B only)
- R - 12 pin circular plug (RGH22D, X, Y and Z only - limits not available)
- S - to be used in conjunction with options 17A and 18A (RGH22B only - limits not available)
- V - 12 pin circular plug for analogue (RGH22B only - limits not available)
- W - 12 pin circular coupling (RGH22B only - limits not available)
- X - 16 pin in-line connector

#### Options

- 00A - standard (RGH22A, B, D, P, Q, R, X, and Z only)
- 17A - analogue output 1 Vpp, V termination with BID/DIR (RGH22B only)
- 18A - analogue output 1 Vpp, W termination with BID/DIR (RGH22B only)
- 20A - 3-state error annunciation (RGH22D, P, Q, R, X and Z only)
- 61A - 20 MHz customer clock, (RGH22Y, S, and H only)
- 62A - 10 MHz customer clock, (RGH22Y, S, and H only)
- 63A - 5 MHz customer clock, (RGH22Y, S, and H only)

**NOTE:** Not all combinations are valid. Check valid options online at [www.renishaw.com/epc](http://www.renishaw.com/epc)



## Scale part numbers

### RGS20-S

20 µm pitch lacquered tape scale with self-adhesive backing tape.

Part number	Available lengths	Available in increments of	Ordering instructions
A-9517-0043	100 mm to 50,000 mm*	1 mm	Ordering a quantity of 2455 will result in a length of 2455 mm (multiple orders are required for multiple lengths)
A-9517-0004	1 m to 50 m*	1 m	Ordering a quantity of 15 will result in a length of 15 metres (multiple orders are required for multiple lengths)
A-9523-6xxx	10 cm to 999 cm	1 cm	xxx is the length in cm (ordering A-9523-6450 for example will result in a length of 450 cm)
A-9523-80xx	10 m to 50 m*	1 m	xx is the length in metres (ordering A-9523-8033 for example will result in a length of 33 metres)

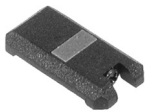








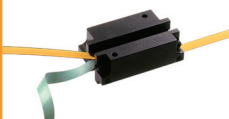
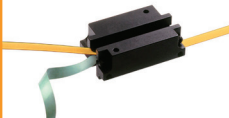
### RGS20-P

20 µm pitch polyester coated tape scale with self-adhesive backing tape.

Part number	Available lengths	Available in increments of	Ordering instructions
A-9517-0046	100 mm to 50,000 mm*	1 mm	Ordering a quantity of 2455 will result in a length of 2455 mm (multiple orders are required for multiple lengths)
A-9517-0045	1 m to 50 m*	1 m	Ordering a quantity of 15 will result in a length of 15 metres (multiple orders are required for multiple lengths)

\*Lengths above 50 m are special order only. Please contact your local Renishaw representative.

## Accessory part numbers

Part number	Description	Image
<b>A-9531-0250</b>	RGM22S reference mark actuator magnet – epoxy mounted. A reference sensor within the readhead is used to determine an absolute datum within an incremental measuring system. The sensor does this by detecting the external RGM22S reference mark actuator magnet as the readhead passes it.	
<b>A-9531-0287</b>	RGM22SB reference mark actuator magnet – screw mounted. A reference sensor within the readhead is used to determine an absolute datum within an incremental measuring system. The sensor does this by detecting the external RGM22SB reference mark actuator magnet as the readhead passes it.	
<b>A-9531-0251</b>	RGP22S limit switch actuator magnet 10 mm long – epoxy mounted. A limit sensor within the readhead detects end of travel by sensing the RGP22S limit switch actuator magnet.	
<b>A-9531-2052</b>	RGP22SM limit switch actuator magnet 24.35 mm long – epoxy mounted. A limit sensor within the readhead detects end of travel by sensing the RGP22SM limit switch actuator magnet.	
<b>A-9531-2054</b>	RGP22SL limit switch actuator magnet 50 mm long – epoxy mounted. A limit sensor within the readhead detects end of travel by sensing the RGP22SL limit switch actuator magnet.	
<b>A-9523-4015</b>	RGC-F end clamp kit – epoxy mounted. The RGC-F end clamps master the RGS scale to the substrate material to match its thermal expansion.	
<b>A-9531-0342</b>	RGG-2 2 part epoxy adhesive. The RGG-2 epoxy is recommended for the mounting of reference marks, limit switches and end clamps.	
<b>A-9531-0265</b>	RGA22 scale applicator kit (for RGS20-S lacquered scale). The RGA22 enables efficient and accurate scale application. It is particularly suited to long axes or limited access installations as the backing paper is automatically removed during scale application requiring minimal intervention.	
<b>A-9531-0280</b>	RGA22 scale applicator kit (for RGS20-P polyester coated scale). The RGA22 enables efficient and accurate scale application. It is particularly suited to long axes or limited access installations as the backing paper is automatically removed during scale application requiring minimal intervention.	
<b>A-9531-0239</b>	RGA22G scale applicator guide block (for RGS20-S lacquered scale). The RGA22G offers the benefits of RGA22 in a simplified form, and is ideally suited to shorter axes.	
<b>A-9531-3528</b>	RGA22P scale applicator guide block (for RGS20-P polyester coated scale). The RGA22P offers the benefits of RGA22 in a simplified form, and is ideally suited to shorter axes.	

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