Data sheet
L-9517-9677-01-H

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RGH24 encoder system

Renishaw's RGH24 series is a non-contact optical encoder system. The compact readhead features a set-up led indicator, unique filtering optics for excellent dirt immunity, and integral interpolation down to 10 nm. RGH24 offers proven reliable performance and value making it one of the of the most commonly applied encoder systems.

The RGH24 reads the 20 µm pitch RGS20-S gold tape-scale and outputs a choice of industry standard 1 Vpp analogue or RS442 digital signals. RGS20-S 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 a 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 throughout significant temperature swings.

The RGH24 range has also proven to be resilient to conditions considered challenging for most open optical encoders. They have been installed by many of the world's leading linear motion OEMs in a wide range of applications such as metrology, machine tool, electronics, semiconductor and FPD manufacturing.

RGH24 readhead:

- Compact size and low mass
- Non-contact open optical system
- Integral interpolation
- Industry standard digital and analogue options
- Resolutions from 5 µm to 10 nm
- Integral reference or limit sensor
- Integral set-up LED

RGS20-S scale:

- 'Cut-to-length' convenience
- Lengths from 100 mm to over 50 m
- 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

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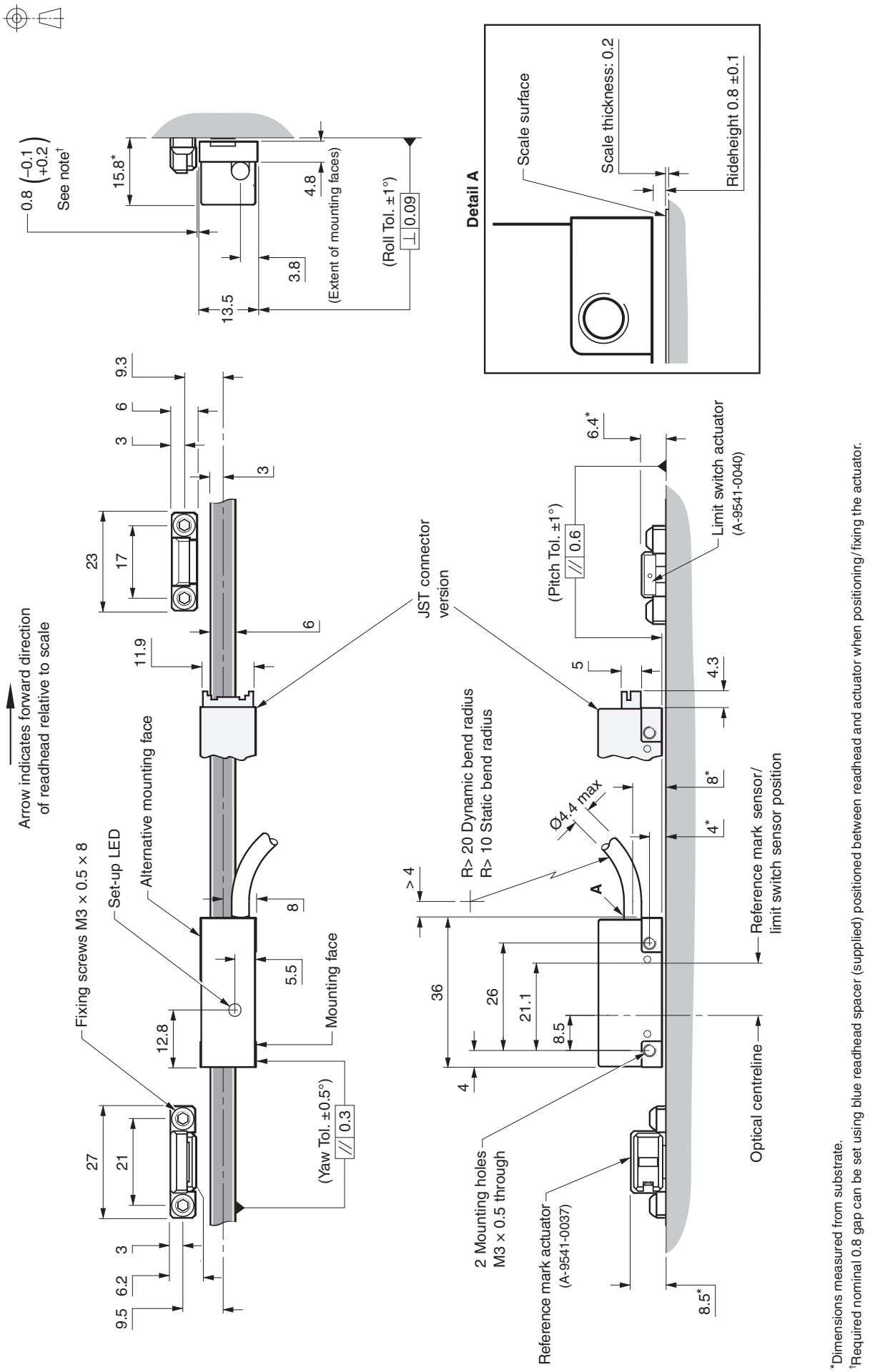
RGH24 readhead installation drawing

Dimensions and tolerances in mm



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

General specifications

Power supply	5 V ±5%	120 mA **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		IP40
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	11 g
	Cable	34 g/m
Cable		8 core, double shield, maximum diameter 4.4 mm Flex life > 20 × 10⁶ cycles at 20 mm bend radius

Connector options	**Code**	**Connector type**	**Application**
	A	9 way D type plug	all readheads
	D	15 way D type plug	RGH24D, X, Z, W, Y, H, I and O digital readheads
	L	15 way D type plug	RGH24B analogue readhead
	F	unterminated cable	all readheads
	Z	JST connector	all readheads

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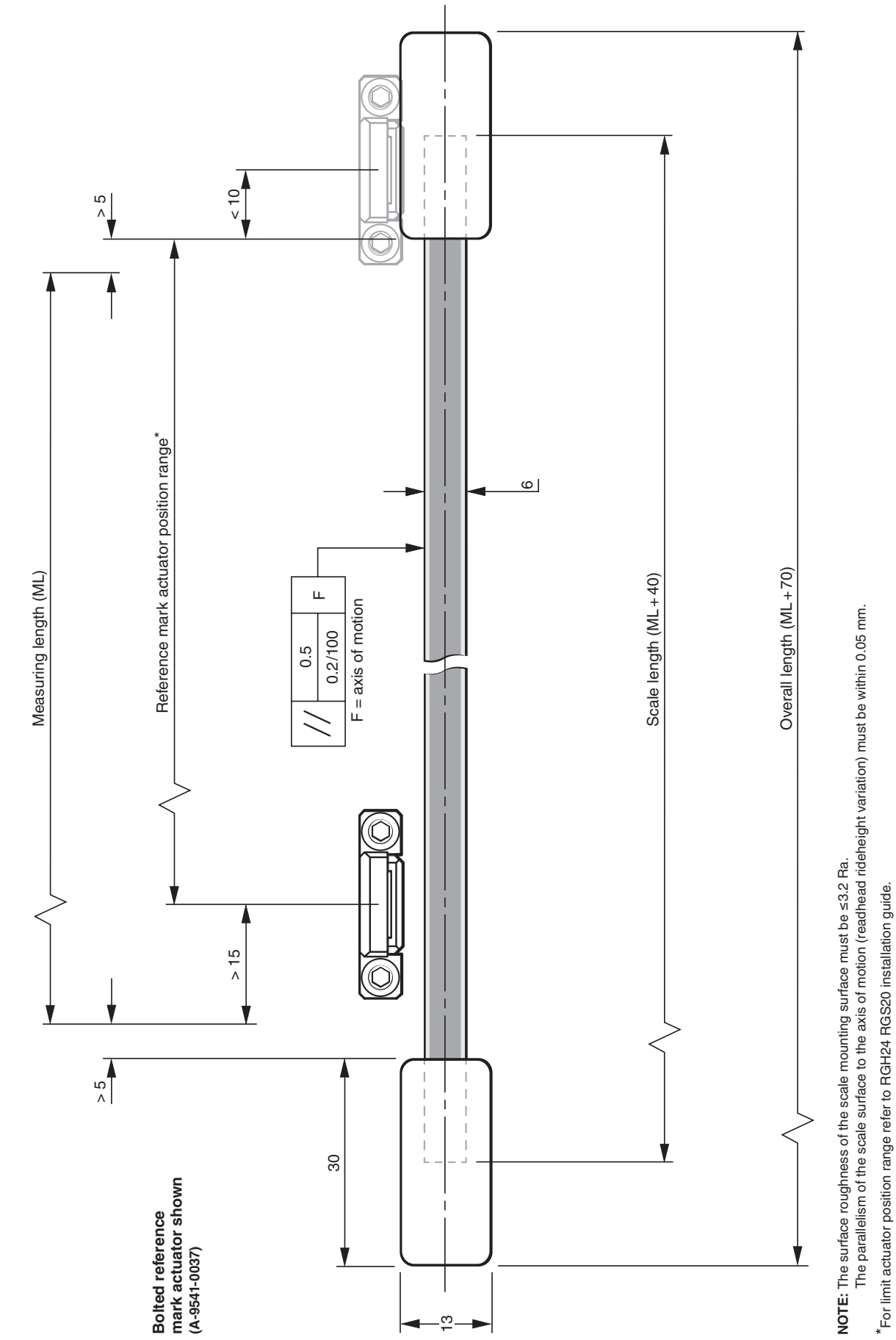
RGS20 scale installation drawing

Dimensions and tolerances in mm



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.

*For limit actuator position range refer to RGH24 RGS20 installation guide.

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

Speed performance

Digital readheads

Non-clocked output readheads

Head type	Maximum speed (m/s)	Lowest recommended counter input frequency (MHz)
D (5 µm)	8	$\left(\frac{\text{Encoder velocity (m/s)}}{\text{Resolution (µm)}}\right)$ × 4 safety factor
X (1 µm)	5	
Z (0.5 µm)	3	

Clocked output readheads

The RGH24W, Y, H, I and O readheads are available with a variety of different clocked outputs.
Customers must ensure they comply with the lowest recommended counter input frequency.

Standard connector options (A, D and F)	JST connector options (Z)	Maximum speed (m/s) Head type					Lowest recommended counter input frequency (MHz)
		W (0.2 µm)	**Y** (0.1 µm)	**H** (50 nm)	**I** (20 nm)	**O** (10 nm)	
60	**–**	–	3.0	–	–	–	50
61	**–**	3.0	1.6	–	–	–	20
62	**–**	1.3	0.8	–	–	–	10
30	**35**	–	0.7	0.35	0.13	0.065	12
31	**36**	–	0.5	0.25	0.09	0.045	8
32	**37**	0.7	–	–	–	–	6
33	**38**	0.5	0.25	0.12	0.04	0.02	4

NOTE: Maximum speeds of clocked output variants assume 3 m maximum cable length and minimum 5 V supply at readhead connector.

Analogue readheads

RGH24B - 4 m/s (–3dB)

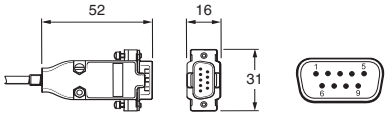
Output signals

Connections

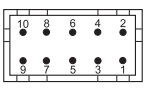
RGH24D, X, Z, W, Y, H, I and O RS422A digital

Function	Signal		Colour	9-way D-type (A)	JST (Z)	15-way D-type (D)
Power	5 V		Brown	5	9	7, 8
	0 V		White	1	10	2, 9
Incremental signals	A	+	Green	2	8	14
		–	Yellow	6	7	6
	B	+	Blue	4	2	13
		–	Red	8	1	5
Reference mark / limit switch	Z+ / Q–		Pink	3	5	12
	Z– / Q+		Grey	7	6	4
Shield	Inner		–	9	N/A	15
	Outer		–	Case	N/A	Case
Remote LED driver	Green		–	N/A	4	N/A
	Red		–	N/A	3	N/A

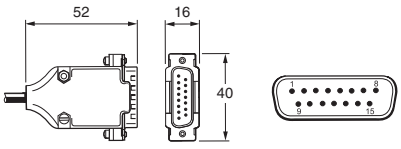
9-way D-type plug (termination code A)



10-way JST plug (termination code Z)



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

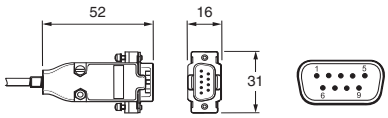


Connections

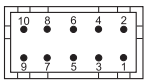
RGH24B 1 Vpp analogue

Function	Signal		Colour	9-way D-type (A)	JST (Z)	15-way D-type (L)
Power	5 V		Brown	5	9	4, 5
	0 V		White	1	10	12, 13
Incremental signals	V_1	+	Green	2	8	9
		–	Yellow	6	7	1
	V_2	+	Blue	4	6	10
		–	Red	8	5	2
Reference mark	V_0	+	Pink	3	2	3
		–	Grey	7	1	11
Shield	Inner		–	9	N/A	15
	Outer		–	Case	N/A	Case

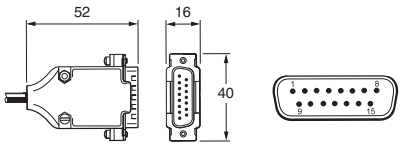
9-way D-type plug (termination code A)



10-way JST plug (termination code Z)

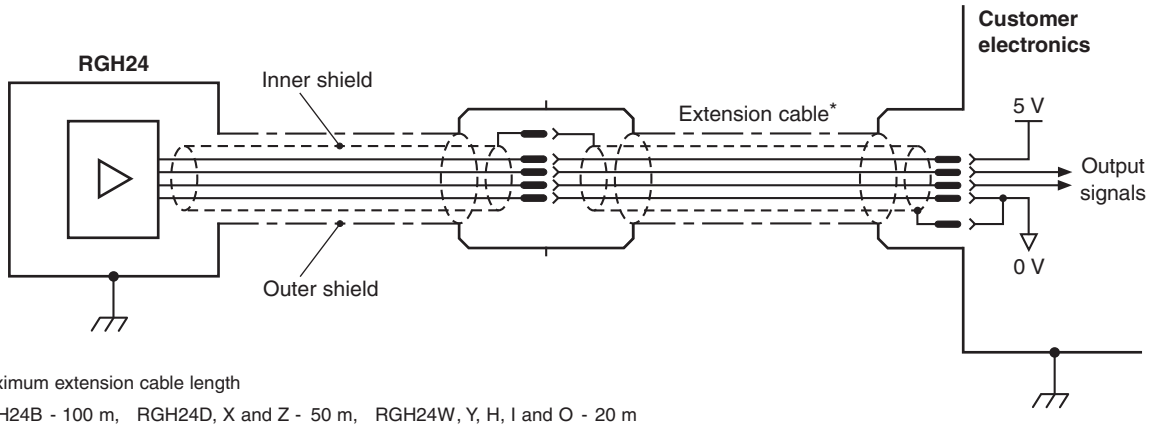


15-way D-type plug (termination code L)



Electrical connections

Grounding and shielding

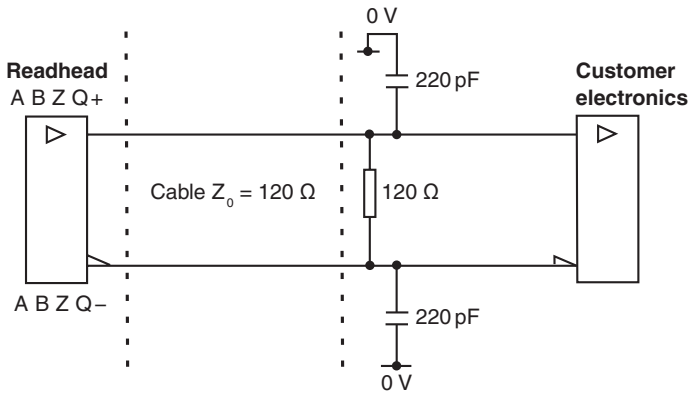


*Maximum extension cable length
RGH24B - 100 m, RGH24D, X and Z - 50 m, RGH24W, Y, H, I and O - 20 m

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.

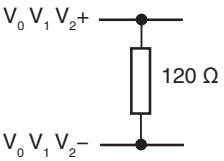
Recommended signal termination

Digital outputs - RGH24D, X, Z, W, Y, H, I and O



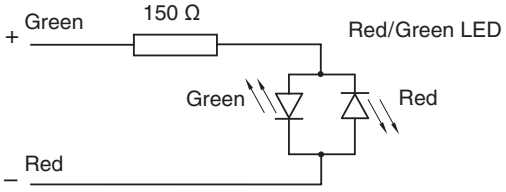
Standard RS422A line receiver circuitry.
Capacitors recommended for improved noise immunity.

Analogue output - RGH24B



Remote LED driver outputs

JST connector version allows for remote monitoring of readhead status.

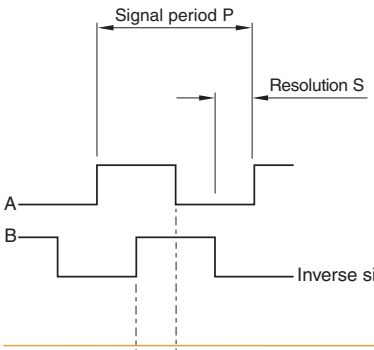


Output specifications

Digital output signals - type RGH24D, X, Z, W, Y, H, I and O

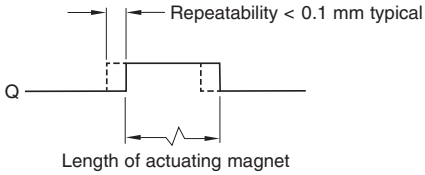
Form - Square wave differential line driver to EIA RS422A

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



Model	P (µm)	S (µm)
RGH24D	20	5
RGH24X	4	1
RGH24Z	2	0.5
RGH24W	0.8	0.2
RGH24Y	0.4	0.1
RGH24H	0.2	0.05
RGH24I	0.08	0.02
RGH24O	0.04	0.01

Limit Asynchronous pulse

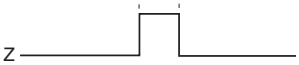


NOTE: RGH24 readheads are available with reference mark **or** limit switch detection. Select output at order.

Inverse signal not shown for clarity. Actuation device A-9541-0040.

NOTE: Limit output not available for readheads with option 60, 61 and 62.

Reference



Synchronised pulse Z, duration equal to the resolution. Repeatability of position (uni-directional) maintained within ±10 °C from installation temperature and for speed < 250 mm/s.

Inverse signal not shown for clarity. Actuation device A-9541-0037.

Alarm

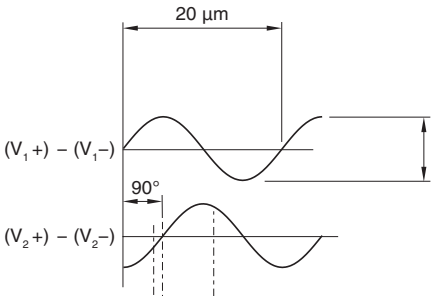
3-state alarm

Incremental channels forced open circuit for > 20 ms when signal too low for reliable operation.

For RGH24W, Y, H, I and O only, incremental channels forced open circuit for > 10 ms when signal too low or speed too high for reliable operation.

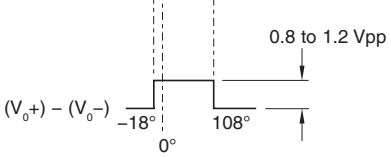
Analogue output signals type RGH24B (1 Vpp)

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-9531-0037

RGH24 system = readhead

+ scale

+ accessories

Readhead part numbers

RGH24 X 30 D 00 A

Readhead series

Output
B - analogue 1 Vpp
D - 5 µm digital
X - 1 µm digital
Z - 0.5 µm digital
W - 0.2 µm digital
Y - 0.1 µm digital
H - 50 nm digital
I - 20 nm digital
O - 10 nm digital

Cable length
00 - no cable
10 - 1.0 metres
15 - 1.5 metres
30 - 3.0 metres
50 - 5.0 metres

Connector types
A - 9-way D-type plug
D - 15-way D-type plug
F - flying lead (unterminated cable)
L - 15-way analogue D-type plug
Z - JST connector (direct output - no cable)

Options
00 - standard head (no clocked output)
60 - 50 MHz clocked output (reference mark only)
61 - 20 MHz clocked output (reference mark only)
62 - 10 MHz clocked output (reference mark only)
30 - 12 MHz clocked output
31 - 8 MHz clocked output
32 - 6 MHz clocked output
33 - 4 MHz clocked output
01 - JST (no clocked output)
35 - 12 MHz clocked output (JST head)
36 - 8 MHz clocked output (JST head)
37 - 6 MHz clocked output (JST head)
38 - 4 MHz clocked output (JST head)

Reference mark/limit switch
A - reference mark (not compatible with options 60, 61 and 62)
B - limit switch (digital output heads only)
H - reference mark (options 60, 61 and 62 only)

NOTE: Not all combinations are valid. Check valid options online at 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)

*Lengths above 50 m are special order only. Contact your local Renishaw representative.

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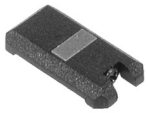
Accessory part numbers

Part number	Description	Image
A-9541-0037	RGM245S 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 RGM245S reference mark actuator magnet as the readhead passes it.	
A-9531-0250	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.	
A-9541-0040	RGP245S 90° limit switch actuator magnet – screw mounted. A limit sensor within the readhead detects end of travel by sensing the RGP245S limit switch actuator magnet.	
A-9531-0251	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.	
A-9523-4015	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.	
A-9531-0342	RGG-2 2 part epoxy adhesive. The RGG-2 epoxy is recommended for the mounting of reference marks, limit switches and end clamps.	
A-9541-0124	RGA245 scale applicator guide block kit (for RGS20-S lacquered scale). The RGA245 enables efficient and accurate scale application. Fixed to the customers readhead bracket it allows the correct placement of scale relative to where the readhead will be set.	

For worldwide contact details, visit www.renishaw.com/contact

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