

RGH22 series readhead



Renishaw's RG2 linear encoder system is a non-contact optical encoder designed for position feedback solutions.

The system uses a common reflective tape scale scanned by a readhead chosen from a range of options offering industry standard digital square wave or analogue sinusoidal output signal formats.

Renishaw's patented optical scheme is used in all readhead series and gives proven performance benefits together with high tolerance to scale contamination.

The RGH22 range is suitable for use in a broad range of applications, offering high resolution and high speed with stability and reliability.

A dual limit sensor option is also available offering two dedicated signal outputs, left and right end-of-axis travel indication.

RGH22 is an ideal feedback solution wherever precision controlled movement is required. The RGH22 readheads offer the full set of RG2 features and integral interpolation in a robust package, with an integral set-up LED for quick and easy installation.

Common applications include co-ordinate measuring and layout machines, semi-conductor/electronics manufacturing and inspection, height gauges, electronics assembly and test, linear motors, digital image setters and a variety of custom linear motion solutions.

Single limit range

RGH22D - 5 µm resolution
RGH22X - 1 µm resolution
RGH22Z - 0.5 µm resolution
RGH22Y - 0.1 µm resolution
RGH22B - 1 Vpp differential
RGH22C - 12 µA differential (no limit)

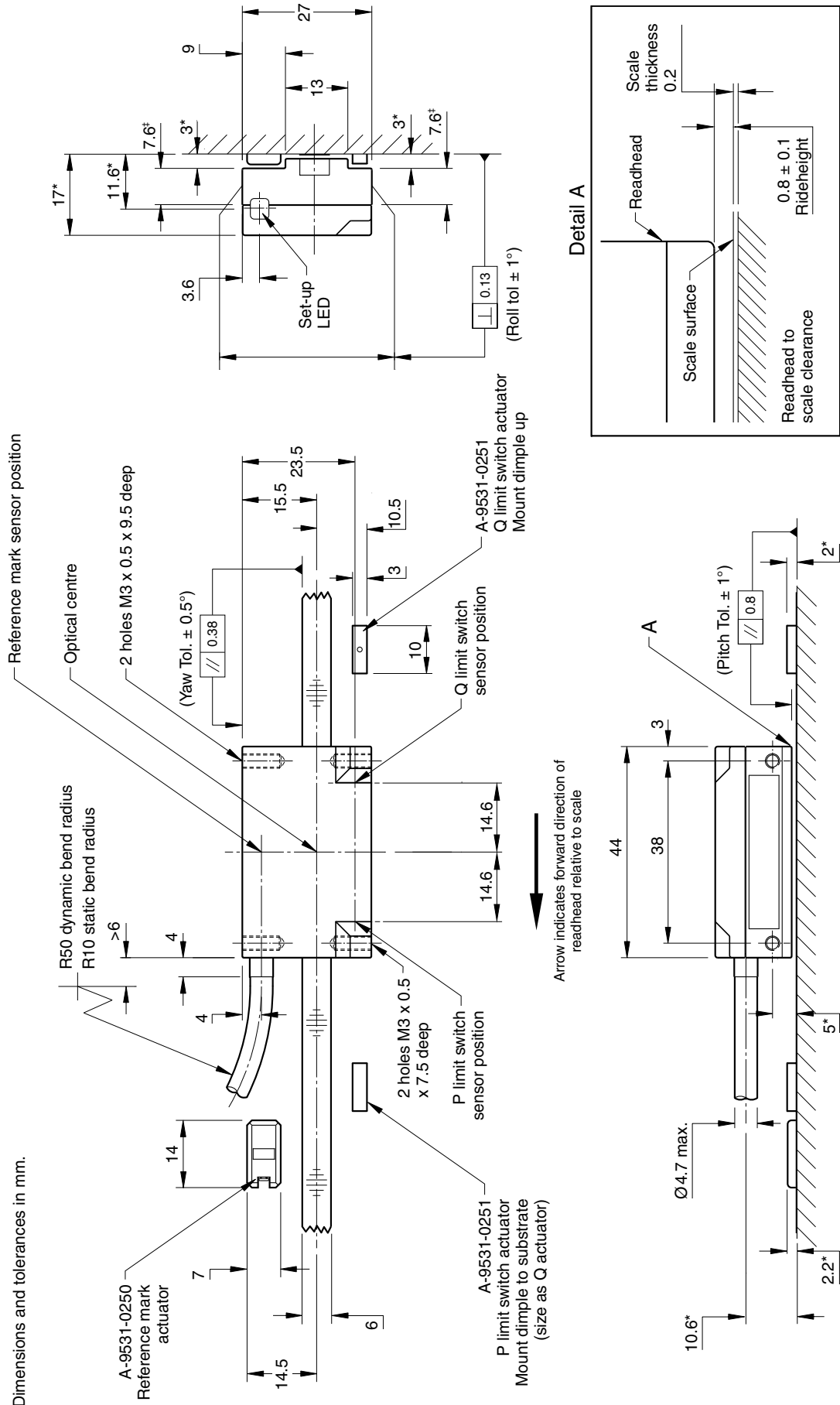
Dual limit range

RGH22P - 5 µm resolution
RGH22Q - 1 µm resolution
RGH22R - 0.5 µm resolution
RGH22S - 0.1 µm resolution
RGH22H - 50 nm resolution
RGH22A - 1 Vpp differential

- Non-contact open optical system
- Integral interpolation
- Industry standard digital and analogue output options
- Resolutions from 5 µm to 50 nm
- Integral reference and limit sensors
- Dual limit sensor option
- Integral set-up LED
- Uses RGS20-S self-adhesive scale

RGH22 Installation drawing

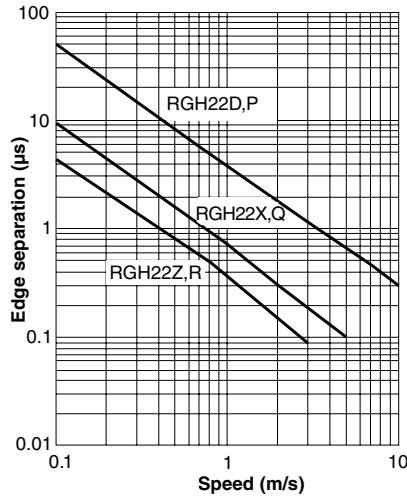
Dimensions and tolerances in mm.



* Dimensions measured from substrate. † Alternative mounting faces

Operating and electrical specifications

Edge separation - digital readheads

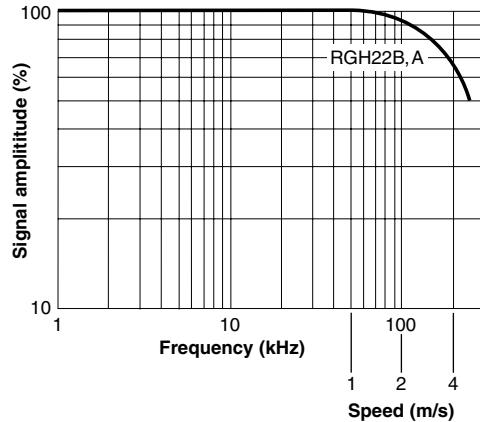


Clocked output readheads.

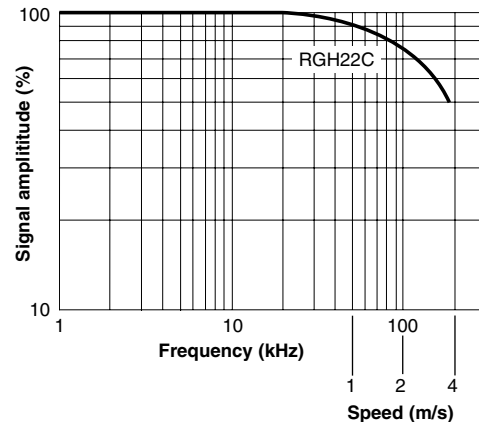
The RGH22Y, S, H readheads are available with a variety of different clocked outputs. The clocked options have been designed to prevent fine edge separations being missed by receiving electronics utilising slower clock speeds. Depending on the clock frequency chosen, each option has a different maximum speed and associated minimum recommended counter clock frequency.

Digital readheads			
Head type	Maximum speed (m/s)		Minimum recommended counter clock frequency (MHz)
D	10		$\left(\frac{\text{Encoder velocity (m/s)}}{\text{Resolution (}\mu\text{m)}} \right) \times 4$ safety factor
X	5		
Z	3		
Y, S, H option	Y, S	H	
61	1.3	0.6	20
62	0.7	0.3	10
63	0.35	0.15	5

Speed - analogue type B, A readheads (1Vpp)



Speed - analogue type C readheads (12µA)



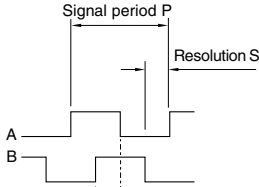
Power supply	5 V ± 5%	120 mA (typical), 200 mA RGH22Y, S, H NOTE: For digital outputs, current consumption figures refer to unterminated readheads. A further 25 mA per channel pair (eg A+, A-) will be drawn when terminated with 120 Ω. Renishaw encoder systems must be powered from a 5 V dc supply complying with the requirements for SELV of standard EN (IEC) 60950.
	Ripple	200 mVpp @ frequency up to 500 kHz maximum.
Temperature	Storage -20 °C to +70 °C	Operating 0 °C to +55 °C
Humidity	Storage 95% maximum relative humidity (non-condensing)	Operating 80% maximum relative humidity (non-condensing)
Sealing	IP50	
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 max @ 55 Hz to 2000 Hz BS EN 60068-2-6:1996 (IEC 68-2-6:1995)	
Mass	Readhead 45 g	Cable 38 g/m
EMC compliance (system)	BS EN 61000 BS EN 55011	
Cable	12 core, double shield, maximum diameter 4.7 mm. Flex life >20 x 10 ⁶ cycles at 50 mm bend radius.	
Connector options	Code - connector type	Application
	D - 15 pin D type plug	RGH22D X, Z, Y, H, P, Q, R, S
	R - 12 pin circular plug	RGH22D X, Z, Y, H, P, Q, R, S
	C - 9 pin circular plug	RGH22C
	L - 15 pin D type plug	RGH22B, A
	V - 12 pin circular plug	RGH22B
	W - 12 pin circular coupling	RGH22B
	F - unterminated cable	all readheads
	X - 16 pin in-line connector	all readheads

Output specifications

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

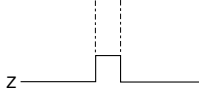
Form - Square wave differential line driver to EIA RS422A (except limit switches P, Q and external set-up signal X)

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



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

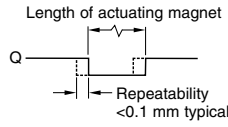
†Reference



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).

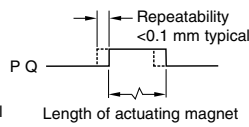
Limit open collector output

Single limit D, X, Z, Y



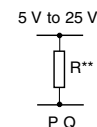
Asynchronous pulse Q
 Actuation device A-9531-0251, A-9531-2052, A-9531-2054.

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



Asynchronous pulse P, Q

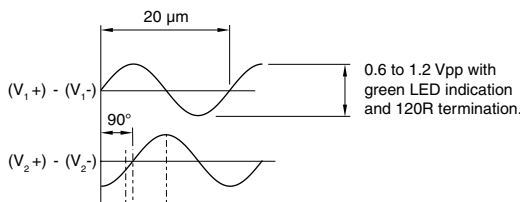
Termination



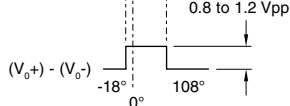
*Dual limit available with flying lead, 15 pin D connector or in-line X connector only.

Analogue output signals type RGH22B, A (1Vpp)

Incremental 2 channels V₁ and V₂ differential sinusoids in quadrature (90° phase shifted)



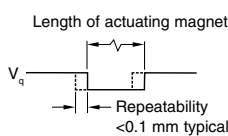
Reference



Differential pulse V₀ - 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.

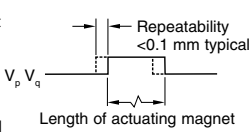
Limit open collector output

Single limit RGH22B



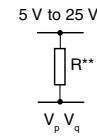
Asynchronous pulse V_q
 Actuation device A-9531-0251, A-9531-2052, A-9531-2054.

Dual limit RGH22A



Asynchronous pulse V_p, V_q

Termination

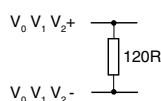


**Select R so that maximum current does not exceed 20 mA. Alternatively, use a relay or opto-isolator.

Set-up

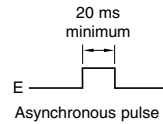
Refer to RGH22C set-up information opposite.

Termination



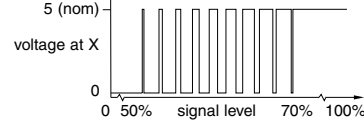
†Inverse signals not shown for clarity.

†Alarm differential line driven output for single limit readheads single ended (E-only) line driven output for dual limit readheads



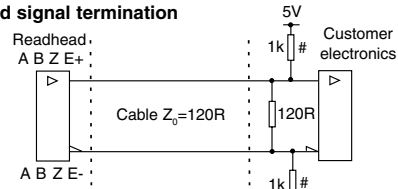
For RGH22D, X, Z, P, Q, R, - alarm asserted when signal amplitude <15%.
 For RGH22Y, S, H - alarm asserted when:
 - Signal amplitude >150%
 - Readhead exceeds specified maximum speed
 Also, outputs are 3-stated at signal amplitude <15%

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 5V.

Recommended signal termination

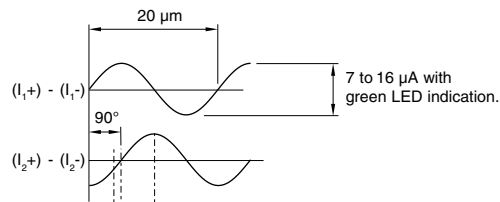


Standard RS422A line receiver circuitry.

#Only required on alarm channel E for fail safe operation and to ensure alarm signal is asserted at low signal amplitude on RGH22Y, S, H when output is 3-stated.

Analogue output signals type RGH22C (12µA)

Incremental 2 channels I₁ and I₂ differential sinusoids in quadrature (90° phase shifted)

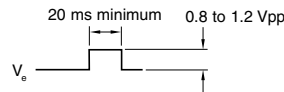


Reference



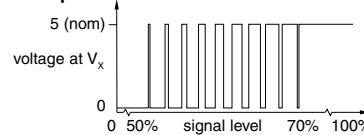
Differential pulse V₀ - 18° to 108°. Duration 126° (electrical). Repeatability of position (uni-directional) maintained within ±10 °C from installation temperature and for speed <250 mm/s. Actuation device A-9531-0250.

Alarm



Asynchronous pulse V₀
 Trigger level 15% nominal analogue signal.

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 5V.

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RGH24 series readhead



Renishaw's RG2 linear encoder system is a non-contact optical encoder designed for position feedback solutions.

The system uses a common reflective tape scale scanned by a readhead chosen from a range of options offering industry standard digital square wave or analogue sinusoidal output signal formats.

Renishaw's unique patented optical scheme is used in all readhead series to provide high tolerance to scale contamination.

RGH24 is an ideal feedback solution wherever precision controlled movement is required.

The RGH24 readheads offer a wide selection of output configurations and their compact size and low mass makes the system ideal for small XY stages and actuators.

An integral set-up LED enables quick and easy installation.

Common applications include semiconductor/electronics manufacturing and inspection, coordinate measuring and layout machines, height gauges, linear motors, pre-press printing and a variety of custom linear motion solutions.

Digital range

RGH24D - 5 μm resolution

RGH24X - 1 μm resolution

RGH24Z - 0.5 μm resolution

RGH24W - 0.2 μm resolution

RGH24Y - 0.1 μm resolution

RGH24H - 50 nm resolution

RGH24I - 20 nm resolution

RGH24O - 10 nm resolution

Analogue range

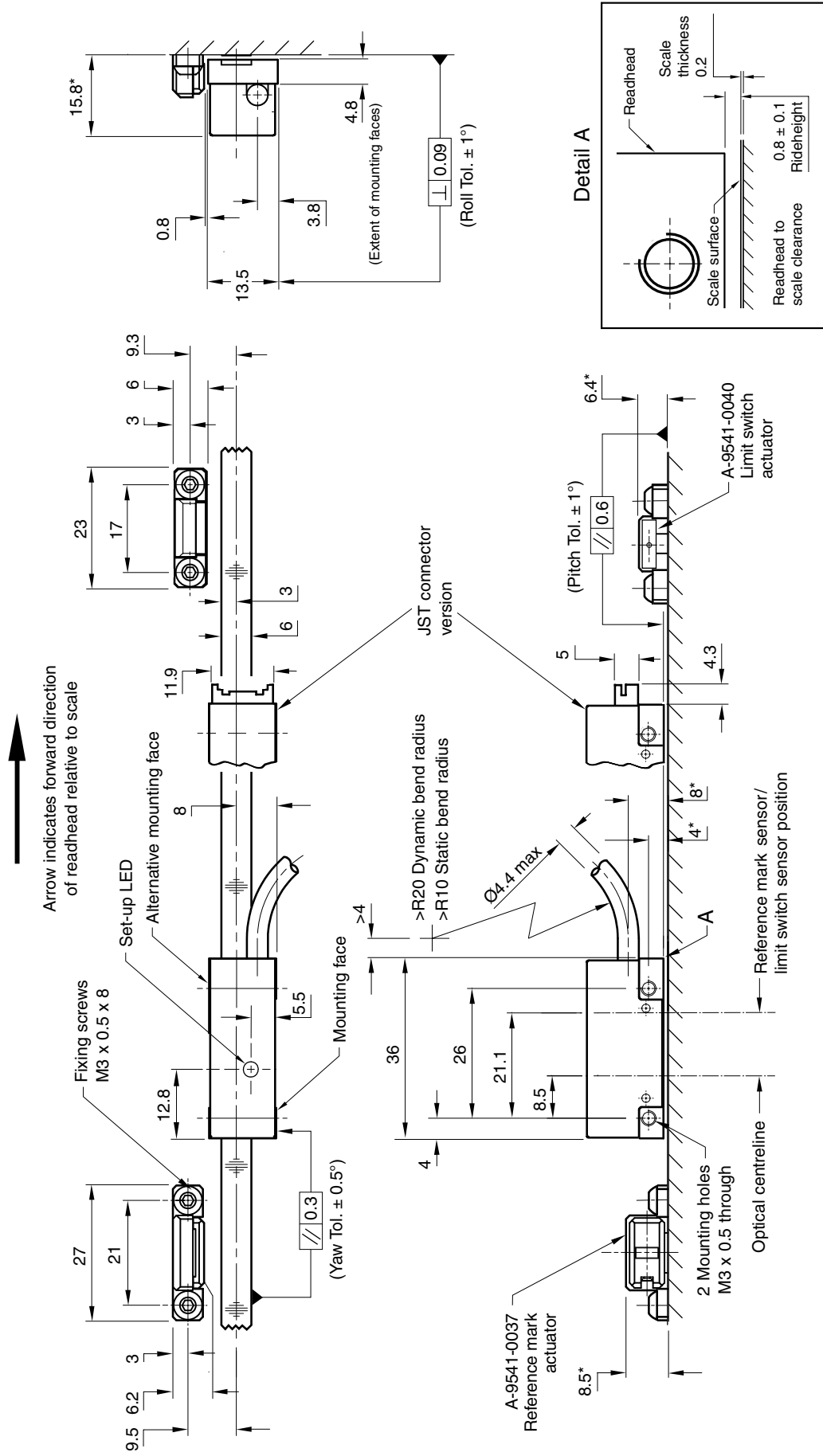
RGH24B - 1 Vpp differential

RGH24C - 12 μA differential

- Non-contact open optical system
- Compact size
- Low mass
- Integral interpolation
- Digital and analogue output options
- Resolutions from 5 μm to 10 nm
- Integral set-up LED
- Uses RGS20-S self-adhesive scale
- Reference mark or limit switch capability

RGH24 installation drawing

Dimensions and tolerances in mm



*Dimensions measured from substrate.

Operating and electrical specifications

Clocked outputs

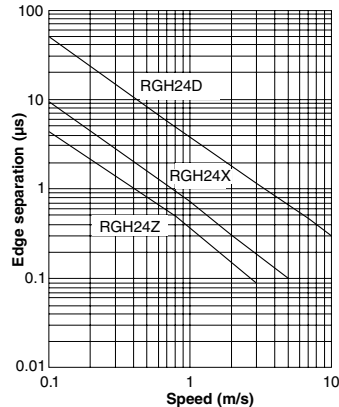
The RGH24W (0.2 µm), RGH24Y (0.1 µm), RGH24H (50 nm), RGH24I (20 nm) and RGH24O (10 nm) readheads have clocked outputs. These are designed to prevent fine edge separations being missed by receiving electronics utilising slower clock speeds. The table below shows the maximum speed and associated minimum recommended counter clock frequency for these readheads.

Head type	Maximum speed (m/s)	Minimum recommended counter clock frequency (MHz)
D (5 µm)	10	$\left(\frac{\text{encoder velocity (m/s)}}{\text{resolution (µm)}} \right) \times 4 \text{ safety factor}$
X (1 µm)	5	
Z (0.5 µm)	3	

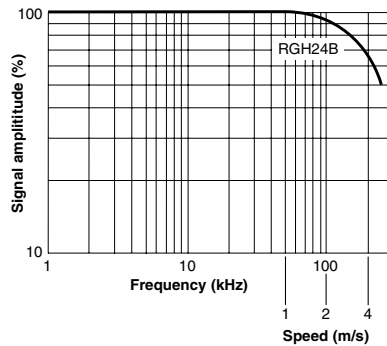
Std. option	JST option	Maximum speed (mm/s)					Minimum recommended counter clock frequency (MHz)
		W (0.2 µm)	Y (0.1 µm)	H (50 nm)	I (20 nm)	O (10 nm)	
30	35	–	700	350	130	65	12
31	36	–	500	250	90	45	8
32	37	700	–	–	–	–	6
33	38	500	250	120	40	20	4

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

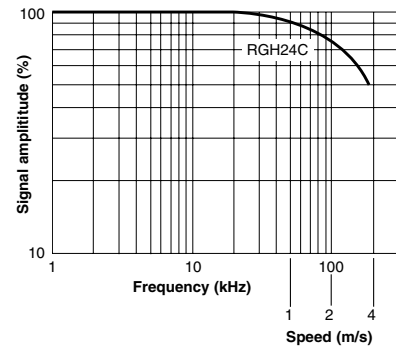
Edge separation - digital readheads



Speed - analogue type B readheads (1Vpp)



Speed - analogue type C readheads (12µA)

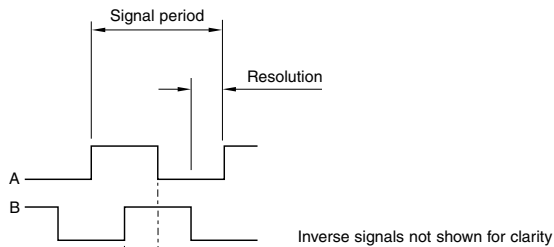


Power supply	5 V ± 5% 120 mA Ripple 200 mVpp maximum @ frequency up to 500 kHz maximum NOTE: For digital outputs, current consumption figures refer to unterminated readheads. A further 25 mA per channel pair (eg A+, A-) will be drawn when terminated with 120 Ω. For analogue type B readheads, a further 20 mA will be drawn when terminated with 120 Ω. Renishaw encoder systems must be powered from a 5 V dc supply complying with the requirements for SELV of standard EN (IEC) 60950.														
Temperature	Storage -20 °C to +70 °C Operating 0 °C to +55 °C														
Humidity	Storage 95% maximum relative humidity (non-condensing) Operating 80% maximum relative humidity (non-condensing)														
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 max @ 55 Hz to 2000 Hz BS EN 60068-2-6:1996 (IEC 68-2-6:1995)														
Mass	Readhead 11 g Cable 34 g/m														
EMC compliance (system)	BS EN 61000 BS EN 55011														
Cable	Double-shielded maximum diameter 4.4 mm cable. Flex life >20 x 10 ⁶ cycles at 20 mm bend radius														
Connector options	<table border="0"> <thead> <tr> <th>Code - connector type</th> <th>Application</th> </tr> </thead> <tbody> <tr> <td>A - 9 pin D type plug</td> <td>All readheads</td> </tr> <tr> <td>C - 9 pin circular plug</td> <td>RGH24C</td> </tr> <tr> <td>D - 15 pin D type plug</td> <td>RGH24D, X, Z, W, Y, H, I, O</td> </tr> <tr> <td>L - 15 pin D type plug</td> <td>RGH24B</td> </tr> <tr> <td>F - Flying lead</td> <td>All readheads</td> </tr> <tr> <td>Z - JST Connector</td> <td>RGH24D, X, Z, W, Y, H, I, O</td> </tr> </tbody> </table>	Code - connector type	Application	A - 9 pin D type plug	All readheads	C - 9 pin circular plug	RGH24C	D - 15 pin D type plug	RGH24D, X, Z, W, Y, H, I, O	L - 15 pin D type plug	RGH24B	F - Flying lead	All readheads	Z - JST Connector	RGH24D, X, Z, W, Y, H, I, O
Code - connector type	Application														
A - 9 pin D type plug	All readheads														
C - 9 pin circular plug	RGH24C														
D - 15 pin D type plug	RGH24D, X, Z, W, Y, H, I, O														
L - 15 pin D type plug	RGH24B														
F - Flying lead	All readheads														
Z - JST Connector	RGH24D, X, Z, W, Y, H, I, O														
Electrical integration (JST connector versions)	The RGH24 JST connector series 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 critical. Renishaw recommends the use of a double screened cable as used in the cable variants of the RGH24. Refer to RGH24 readhead installation guide for electrical connection information for these readheads.														

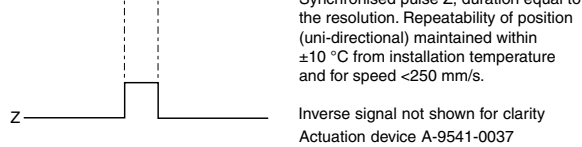
Output specifications

Digital output signals - type RGH24D, X, Z, W, Y, H, I, O Form - Square wave differential line driver to EIA RS422A

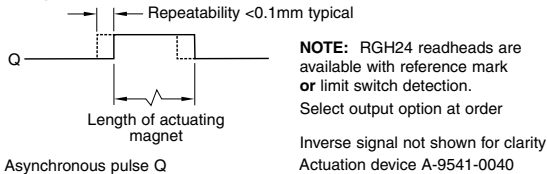
Incremental 2 channels A and B in quadrature (90° phase shifted)



Reference



Limit



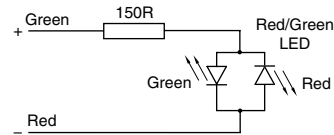
Alarm

3-state alarm

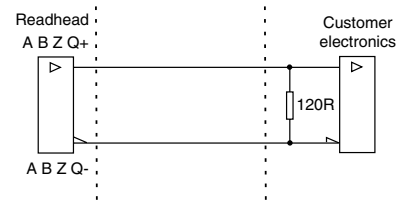
Incremental channels forced open circuit for >20 ms when signal too low for reliable operation. For RGH24W, Y, H, I and O only, incremental channels forced open circuit for >10ms when signal, too low or speed too high for reliable operation.

Remote LED driver

Recommended termination



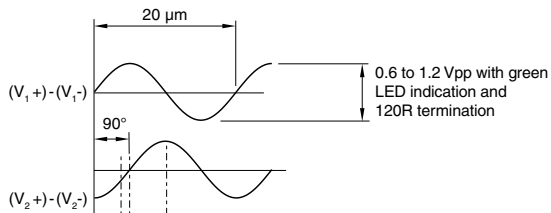
Recommended signal termination



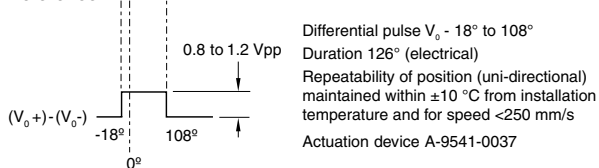
Standard RS422A line receiver circuitry. Contact Renishaw for further details on receiver termination for 3-state output

Analogue output signals type RGH24B (1Vpp)

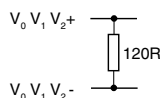
Incremental 2 channels V_1 and V_2 differential sinusoids in quadrature (90° phase shifted)



Reference

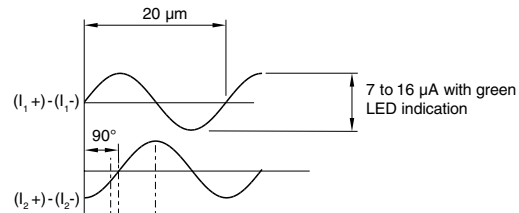


Termination

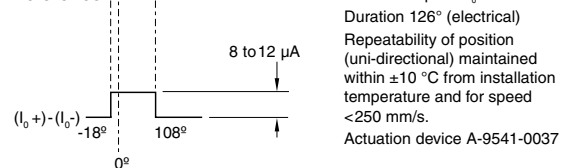


Analogue output signals type RGH24C (12µA)

Incremental 2 channels I_1 and I_2 differential sinusoids in quadrature (90° phase shifted)



Reference



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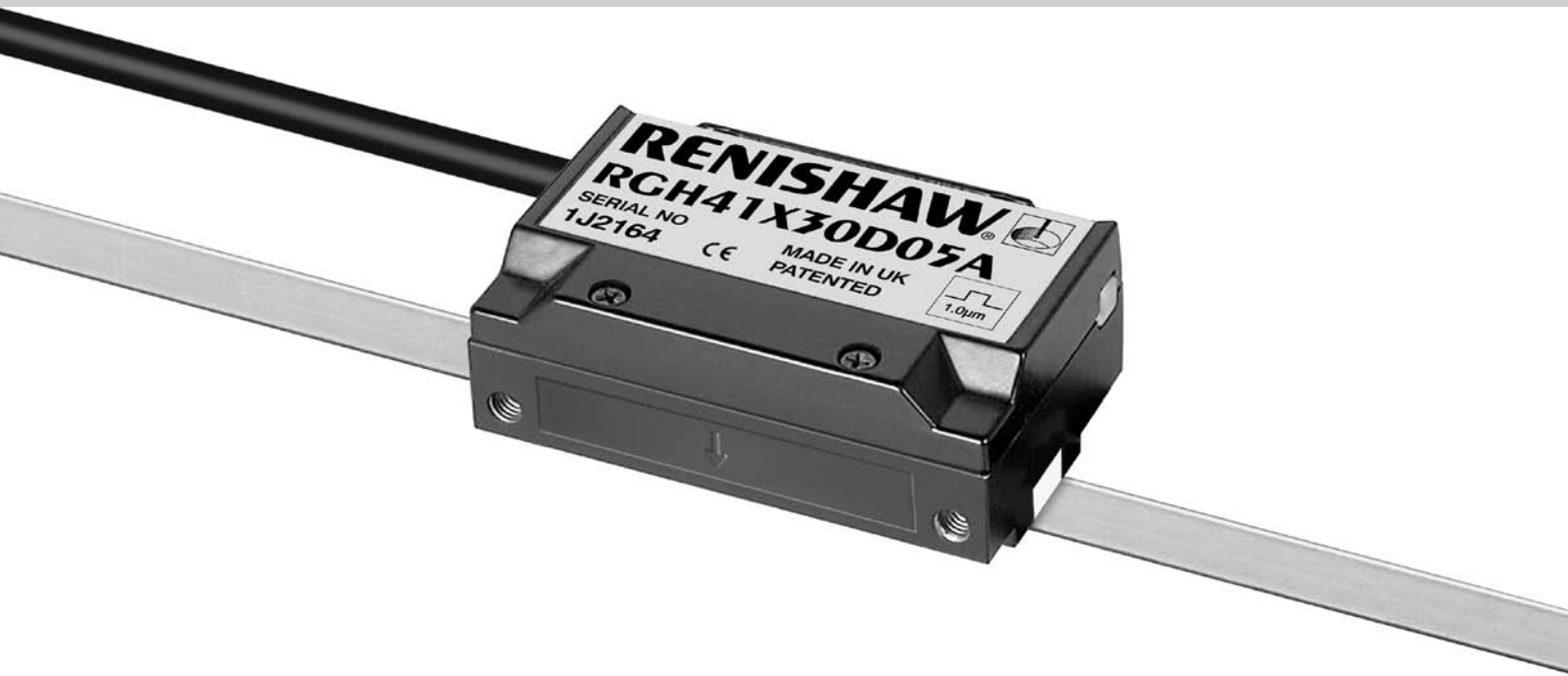
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RGH41 series readhead



Renishaw's 40 µm RGH41 series readheads offer all the benefits of the established 20 µm RG2 linear encoder system, such as reflective tape scale, patented filtering optics, set-up LED, good dirt immunity and high speed.

These compact readheads with integral interpolation provide an increased range of resolutions to match the demands of a wide range of applications, whilst their high speed enables an increase in the productivity of the end-user's system.

The 40 µm RGH41 increases the already generous set-up tolerances of the RG2, whilst maintaining Renishaw's famous contamination immunity.

For added flexibility, dual limit switch sensing is included as standard to enable dedicated signals for each end-of-axis indication, along with a repeatable reference or datum mark.

These benefits give the RGH41 greater flexibility complementing the breadth of applications in which the RG2 is already used, from co-ordinate measuring and layout machines to electronics assembly and test, linear motors and a host of custom linear motor solutions.

Digital range

RGH41T - 10 µm resolution

RGH41D - 5 µm resolution

RGH41G - 2 µm resolution

RGH41X - 1 µm resolution

RGH41N - 0.4 µm resolution

RGH41W - 0.2 µm resolution

RGH41Y - 0.1 µm resolution

RGH41H - 50 nm resolution

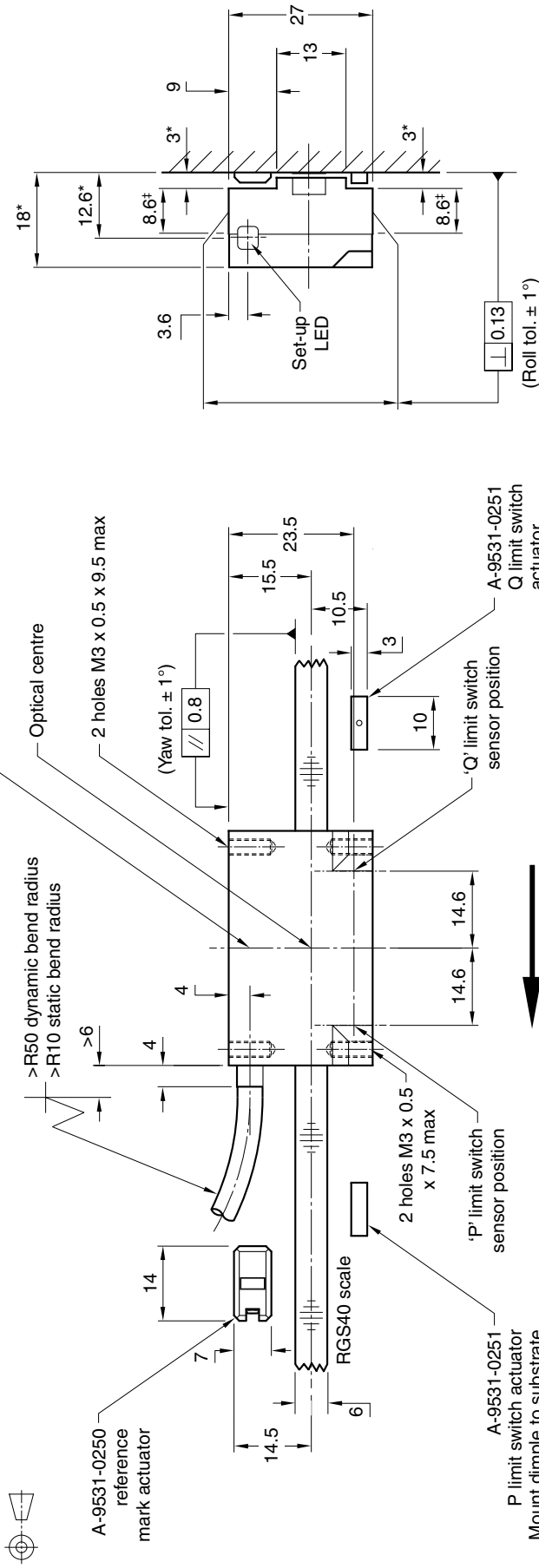
Analogue range

RGH41B - 1 Vpp differential (single limit)

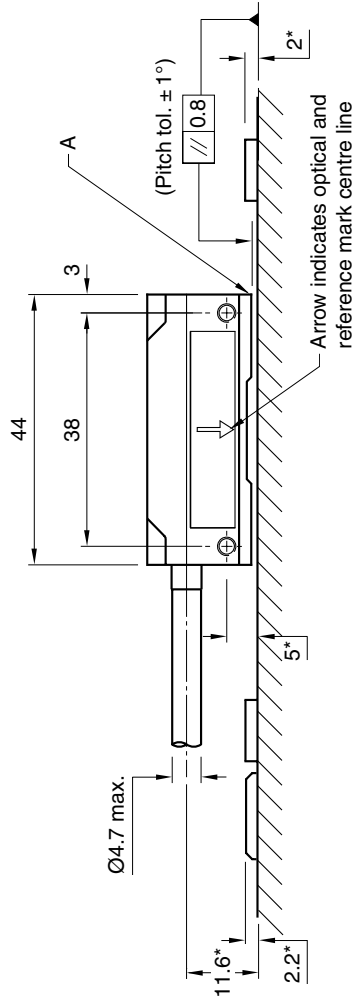
RGH41A - 1 Vpp differential (dual limit)

- **Non-contact open optical system**
- **Large installation tolerances**
- **High speed operation up to 15 m/s**
- **Industry standard digital and analogue output options**
- **Resolutions from 10 µm to 50 nm**
- **Integral reference and dual limit sensors**
- **Integral set-up LED**
- **Uses Renishaw RGS40-S self-adhesive scale**

RGH41 Installation drawing
Dimensions and tolerances in mm.



Arrow indicates forward direction of readhead relative to scale



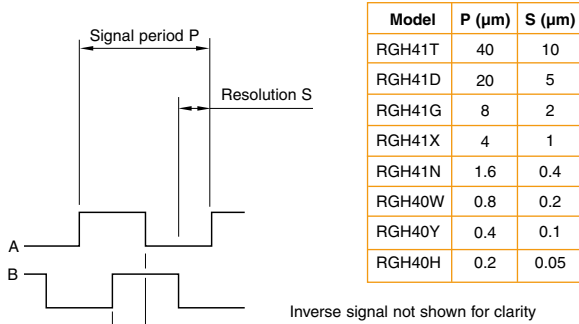
*Dimension measured from substrate
† Alternative mounting faces

Output specifications

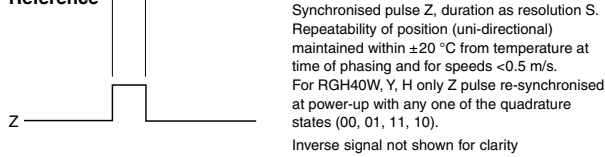
Digital output signals - RGH41T, D, G, X, N, W, Y, H

Form - square wave differential line driver to EIA RS422A (except limit switch P, Q, Alarm E- and external set-up signal X)

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

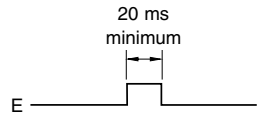


Reference



Alarm

single limit readheads - differential line driven output
dual limit readheads - single-ended line driven output



Inverse signal not shown for clarity
E- only on dual limit readheads (option 05/06)

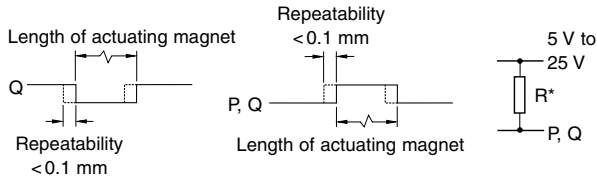
For RGH41T, G, X alarm asserted for signal amplitude <15%. Either asynchronous pulse E as shown (options 03/05) or line driver channels 3-state (options 04-06).

For RGH41N, W, Y, H - alarm E- asserted when:
- Signal amplitude >150%
- Readhead exceeds specified maximum speed

Also, outputs are 3-stated at signal amplitude <15%

Limit open collector output

Single limit (option 03/04) Dual limit (option 05/06) Termination

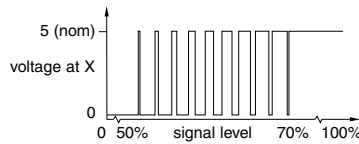


Asynchronous pulse P, Q.

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

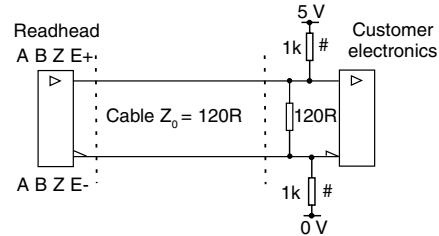
*Select R so that the maximum current does not exceed 20 mA. Alternatively, a suitable relay or opto-isolator may be used.

External set-up



Between 50% and 70% signal level, X is a duty cycle, 40 µm duration. Time spent at 5 V increases with signal level. At >70% signal level X is nominal 5V.

Recommended signal termination

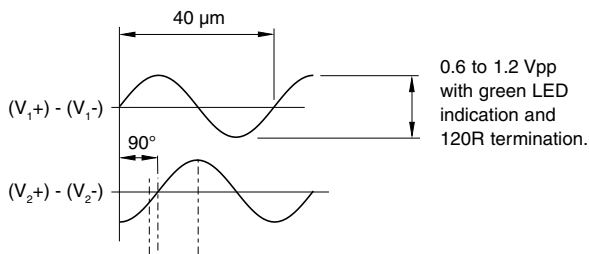


Standard RS422A line receiver circuitry.

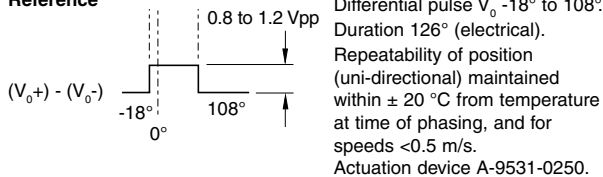
#Only required on alarm channel E for fail safe operation and to ensure alarm signal is asserted at low signal amplitude on RGH41N, W, Y, H when output is 3-stated

Analogue output signals - RGH41A, B (1Vpp)

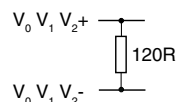
Incremental 2 channels V₁ and V₂ differential sinusoids in quadrature (90° phase shifted)



Reference

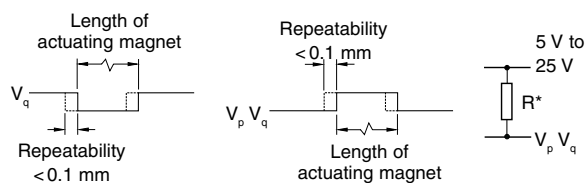


Recommended signal termination



Limit open collector output

Single limit RGH41B Dual limit RGH41A Termination

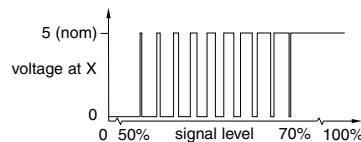


Asynchronous pulse P, Q.

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

*Select R so that the maximum current does not exceed 20 mA. Alternatively, a suitable relay or opto-isolator may be used.

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 5V.

Operating and electrical specifications

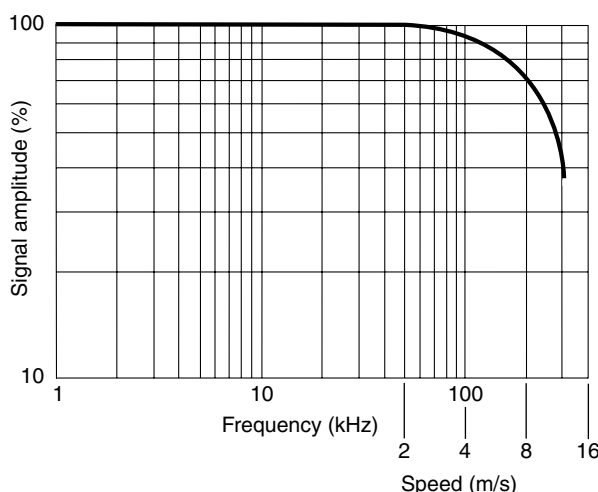
Speed performance

Clocked output readheads

The RGH41N, W, Y, H readheads are available with a variety of different clocked outputs. The clocked options have been designed to prevent fine edge separations being missed by receiving electronics utilising slower clock speeds. Depending on the clock frequency chosen, each option has a different maximum speed and associated minimum recommended counter clock frequency.

Digital readheads					
Head type	Maximum speed (m/s)		Minimum recommended counter clock frequency (MHz)		
T	15		$\left(\frac{\text{Encoder velocity (m/s)}}{\text{Resolution } (\mu\text{m})} \right) \times 4$ safety factor		
D	12				
G	10				
X	6				
N, W, Y, H option	N	W	Y	H	Minimum recommended counter clock frequency (MHz)
61	3.0	2.5	1.3	0.6	20
62	2.6	1.3	0.7	0.3	10
63	1.3	0.7	0.35	0.15	5

Analogue type A/B readheads



Power supply

5 V ± 5% 120 mA (typical), 175 mA (RGH41N, W, Y, H)

NOTE: For digital outputs, current consumption figures refer to unterminated readheads/interfaces. A further 25 mA per channel pair (eg A+, A-) will be drawn when terminated with 120 Ω. Renishaw encoder systems must be powered from a 5 V dc supply complying with the requirements for SELV of standard EN (IEC) 60950.

Ripple <200 mVpp maximum @ frequency up to 500 kHz maximum

Temperature

Storage -20 °C to +70 °C Operating 0 °C to +55 °C

Humidity

Storage 95% maximum relative humidity (non-condensing)
Operating 80% maximum relative humidity (non-condensing)

Sealing

IP50

Acceleration

Operating 500 m/s² BS EN 60068-2-7:1993 (IEC 68-2-7:1983)

Shock (non-operating)

1000 m/s², 6 ms, ½ sine BS EN 60068-2-27:1993 (IEC 68-2-27:1987)

Vibration (operating)

100 m/s² max @ 55 Hz to 2000 Hz BS EN 60068-2-6:1996 (IEC 68-2-6:1995)

Mass

Readhead 50 g Cable 38 g/m

EMC compliance (system)

BS EN 61000 BS EN 55011

Cable

12 core, double-shielded, maximum outside diameter 4.7 mm
Flex life >20 x 10⁶ cycles at 50 mm bend radius

Connector options

Code - connector type	Application
D - 15 pin 'D' type plug	RGH41T, D, G, X, N, W, Y, H
L - 15 pin 'D' type plug	RGH41A, B
V - 12 pin circular plug	RGH41B
W - 12 pin circular coupling plug	RGH41B
F - Flying lead	All readheads
X - 16 pin in line connector	All readheads

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