

RGH20 series readhead



The RGH20 is a compact readhead for use with Renishaw's range of 20 µm RESR rotary encoders and RSLR high accuracy linear scale.

Like all Renishaw encoders, the RGH20 offers reliable, high speed, open, non-contact performance with excellent immunity to dust, scratches and light oils on the scale.

The RGH20 also benefits from Renishaw's patented readhead set-up LED which simplifies installation and monitors signal condition during operation.

The ultra compact RGH20F connects to the REF interface to give high accuracy digital and analogue outputs. The REF interface incorporates advanced signal processing and offers high speed and resolution.

Digital and analogue RGH20

RGH20D - 5 µm resolution
RGH20X - 1 µm resolution
RGH20Z - 0.5 µm resolution
RGH20W - 0.2 µm resolution
RGH20Y - 0.1 µm resolution
RGH20H - 50 nm resolution
RGH20I - 20 nm resolution
RGH20O - 10 nm resolution
RGH20B - 1 Vpp differential

RGH20F/REF system options

REF0004 - 5 µm resolution
REF0020 - 1 µm resolution
REF0040 - 0.5 µm resolution
REF0100 - 0.2 µm resolution
REF0200 - 0.1 µm resolution
REF0400 - 50 nm resolution
REF1000 - 20 nm resolution
REF2000 - 10 nm resolution
REF4000 - 5 nm resolution
REF0000 - 1 Vpp differential

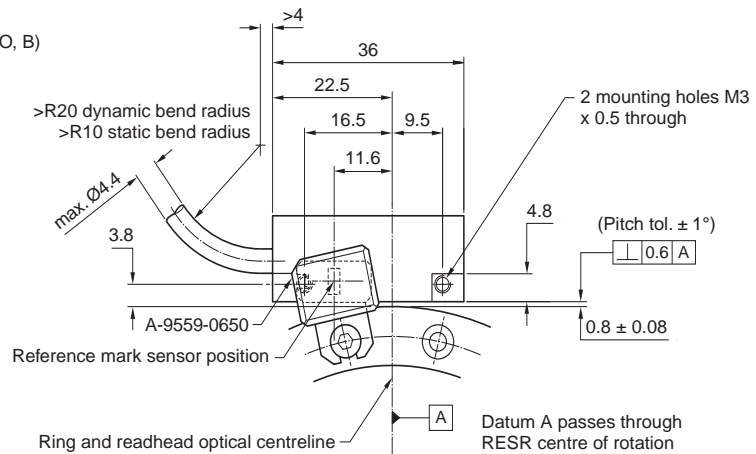
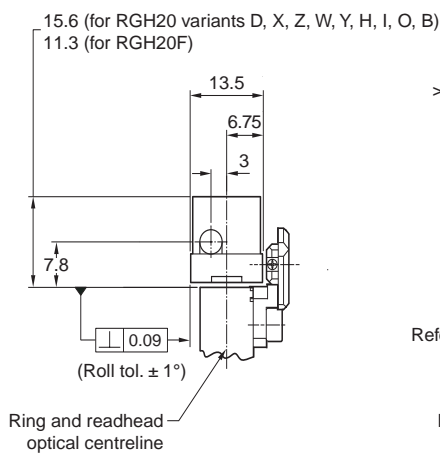
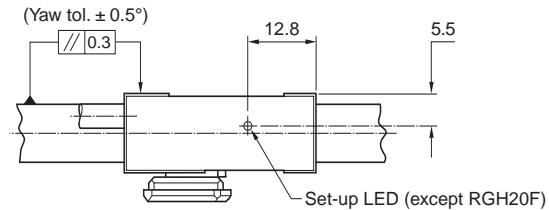
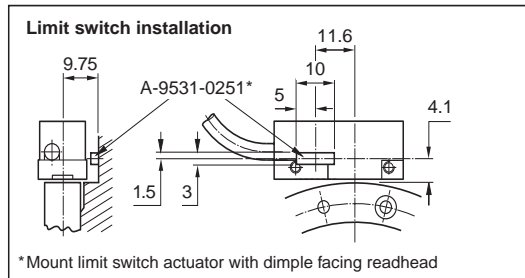
- Compatible with 20 µm RESR angle encoder and RSLR high accuracy linear scales
- Filtering optics provide excellent dirt immunity
- Compact and robust housing
- Industry standard digital and analogue outputs
- Integral interpolation and set-up LED on RGH20 option
- Ultra-compact RGH20F/REF system gives high accuracy and high resolution
- Resolutions from 5 µm to 5 nm
- Reference mark or single limit switch sensor
- Hi-flex double screen 8 core cable

Introduction

For clarity, SECTION 1 contains information relating to direct output RGH20 readheads only (RGH20D, X, Z, W, Y, H, I, O and B) Section 2 contains information relating to RGH20F readhead and associated REF interfaces only.

RGH20/RESR Installation drawing

Dimensions and tolerances in mm



NOTE: For RGH20/RSLR installation see Installation guide M-9672-9030

SECTION 1 - RGH20 direct output readheads

Speed

Digital readheads

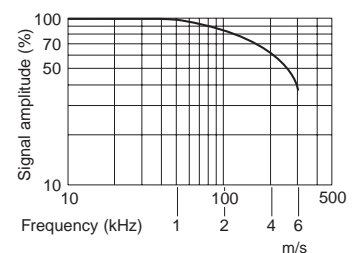
The tables below show the maximum speed and associated minimum recommended counter clock frequency for all digital output readheads.

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

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

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

Analogue readhead (1Vpp) RGH20B



SECTION 1 - RGH20 direct output readheads (continued)

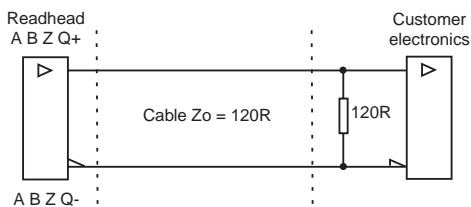
Operating and electrical specifications

Power supply	5V ± 5%	90 mA RGH20D, X, Z 120 mA RGH20W, Y, H, I, O 110 mA RGH20B	NOTE: Current consumption figures refer to unterminated readheads. For digital outputs a further 25 mA per channel pair (eg A+, A-) will be drawn when terminated with 120 Ω. For analogue outputs, a further 20 mA will be drawn when terminated with 120 Ω. 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 max	

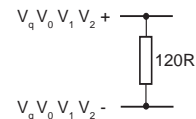
Connector options	Code - connector type	Application
	A - 9 pin D type plug	RGH20D, X, Z, W, Y, H, I, O, B
	D - 15 pin D type plug	RGH20D, X, Z, W, Y, H, I, O
	L - 15 pin D type plug	RGH20B
	F - Flying lead	RGH20D, X, Z, W, Y, H, I, O, B
Temperature (system)	Storage -20 °C +70 °C Operating 0 °C to +55 °C	
Humidity (system)	Storage 95 % maximum relative humidity (non condensing) Operating 80 % maximum relative humidity (non-condensing)	
Sealing (system)	IP40	
Acceleration (system)	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 RGH20D, X, Z, W, Y, H, I, O, B: Cable	11 g 34 g/m
Cable	Double-shielded, maximum outside diameter 4.4 mm Flex life >20 x 10 ⁶ cycles at 20 mm bend radius	
EMC compliance (system)	BS EN 61000 BS EN 55011	

Recommended signal termination

Digital Readheads
- RGH20D, X, Z, W, Y, H, I, O



Analogue readhead
RGH20B

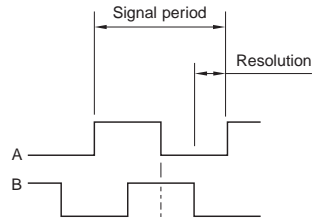


SECTION 1 - RGH20 direct output readheads (continued)

Output specifications

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

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



†Reference

Synchronised pulse Z, duration as resolution.
Repeatability of position (uni-directional) maintained within $\pm 10^\circ\text{C}$ from installation temperature and for speed $< 250\text{ mm/s}$
Actuation device A-9541-0037/A-9559-0650



†Limit

Repeatability $< 0.1\text{ mm}$ typical
Length of actuating magnet

Asynchronous pulse Q

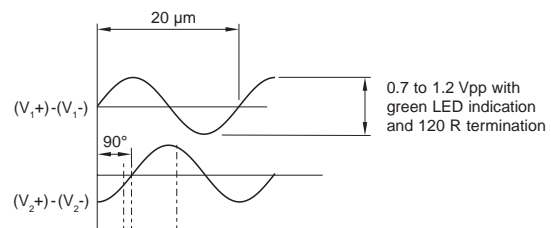
Asynchronous pulse Q

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

Actuation device A-9541-0040/A-9531-0251

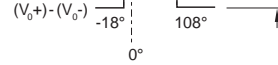
Analogue output signals - type RGH20B
Form - 1 Vpp differential

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



Reference

Differential pulse V_0 -18° to 108°
Duration 126° (electrical)
Repeatability of position (uni-directional) maintained within $\pm 10^\circ\text{C}$ from installation temperature and for speed $< 250\text{ mm/s}$
Actuation device A-9541-0037/A-9559-0650



Limit

Repeatability $< 0.1\text{ mm}$ typical
Length of actuating magnet

Asynchronous pulse V_q

Asynchronous pulse V_q

NOTE: RGH20 readheads are available with reference mark or limit switch output. Select output option at order.
Actuation device A-9541-0040/A-9531-0251

Alarm

3-state alarm

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

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

[†]Inverse signals not shown for clarity

Readhead part numbers

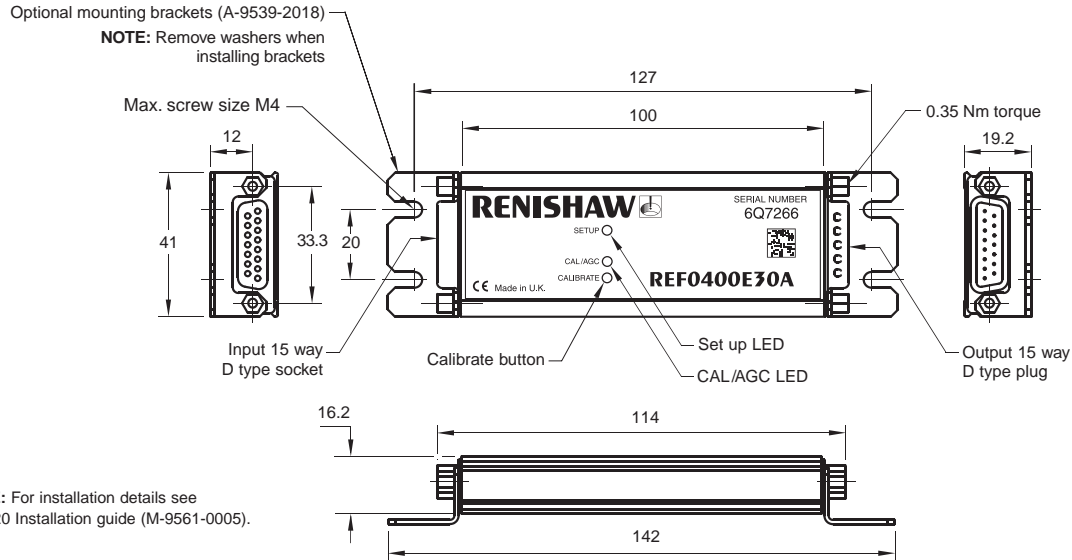
RGH20	B	30	L	00	A
Output	Analogue	Cable length	Termination	Options	Datum
	B - 1 Vpp	15 - 1.5 m	A - 9 pin D type plug (RGH20B, D, H, W, X, Y, I, O and Z)	00 - standard head (RGH20B, D, X and Z only)	A - reference mark
	Digital	30 - 3 m	D - 15 pin D type plug (RGH20D, H, W, X, Y, I, O and Z only)	30 - 12 MHz customer clock (RGH20Y, H, I and O only)	B - limit switch
	D - 5 μm	50 - 5 m	F - unterminated cable (RGH20B, D, H, W, X, Y, I, O and Z)	31 - 8 MHz customer clock (RGH20Y, H, I and O only)	
	X - 1 μm		L - 15 pin D type plug (RGH20B only)	32 - 6 MHz customer clock (RGH20W only)	
	Z - 0.5 μm			33 - 4 MHz customer clock (RGH20W, Y, H, I and O only)	
	W - 0.2 μm				
	Y - 0.1 μm				
	H - 50 nm				
	I - 20 nm				
	O - 10 nm				

NOTE: Not all combinations are valid. Check valid options online at www.renishaw.com/epc

SECTION 2 - RGH20F/REF systems

REF Installation drawing - interface required for use with RGH20F only

Dimensions and tolerances in mm

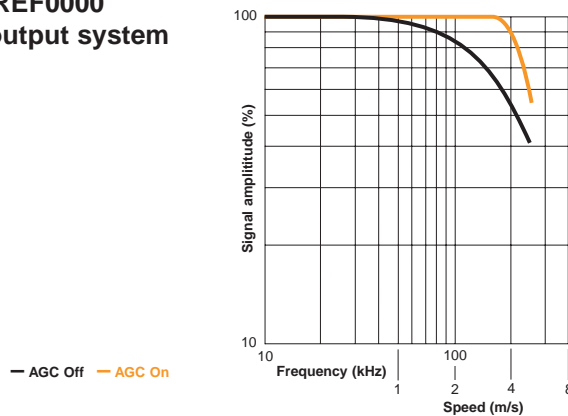


NOTE: For installation details see RGH20 Installation guide (M-9561-0005).

Speed Digital systems, maximum speed (m/s)

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

RGH20F + REF0000 analogue output system



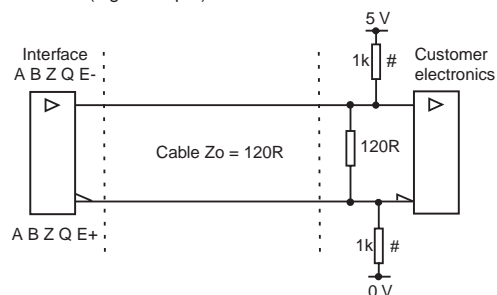
SECTION 2 - RGH20F/REF systems (continued)

Operating and electrical specifications

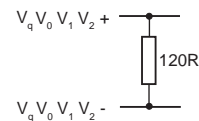
Power supply	5V -5% +10%	200 mA maximum (system)	The interface will be fully active <300 ms after power is applied. The interface and readhead are protected from reverse voltage and over voltage up to 12 V. NOTE: Current consumption figures refer to unterminated interfaces. For digital interfaces a further 25 mA per channel pair (eg A+, A-) will be drawn when terminated with 120 Ω. For analogue outputs, a further 20 mA will be drawn when terminated with 120 Ω. 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 max	
Temperature (system)	Storage -20 °C +70 °C Operating 0 °C to +55 °C		
Humidity (system)	Storage 95 % maximum relative humidity (non condensing) Operating 80 % maximum relative humidity (non-condensing)		
Sealing (system)	IP40		
Acceleration (system)	Operating 500 m/s ² BS EN 60068-2-7:1993 (IEC 68-2-7:1983)		
Shock (system) non-operating	1000 m/s ² , 6 ms, ½ sine BS EN 60068-2-27:1993 (IEC 68-2-27:1987)		
Vibration (system) operating	100 m/s ² max @ 55 Hz to 2000 Hz BS EN 60068-2-6:1996 (IEC 68-2-6:1995)		
Mass	Readhead RGH20F:	9 g	
	Interface REF:	100 g	
	Cable:	34 g/m	
Cable	Double-shielded, maximum outside diameter 4.4 mm Flex life >20x10 ⁶ cycles at 20 mm bend radiuse		
EMC compliance (system)	BS EN 61000 BS EN 55011		

Recommended signal termination

REF interfaces (digital output)



REF0000 interface (analogue output)



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

SECTION 2 - RGH20F/REF systems

REF interface features

Self-tuning active correction

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

Corrections are made for the following:

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

Automatic Gain Control (AGC) – ensures consistent 1 V_{pp} signal amplitude

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

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

The user can disable/enable the AGC by pressing the CALIBRATE button for greater than 3 seconds.

LED indicators

The REF interface SETUP LED provides visual feedback of signal strength, error condition and reference mark phasing, for setup and diagnostic use.

Flashing **Purple** indicates high signal alarm condition >135%

Purple indicates high signal >110% and <135%

Blue indicates optimum signal >90% and <110%

Green indicates acceptable signal >70% and <90%

Orange indicates low signal >50% and <70%

Red indicates unacceptable signal >20% and <50%

Flashing **Red** indicates low signal alarm condition <20%

Flashing **Blue** indicates overspeed alarm condition

Red flash when traversing reference mark indicates good phasing*

Orange flash when traversing reference mark indicates poor phasing*

Blank flash when traversing reference mark indicates phasing unacceptable*

The **Yellow** CAL/AGC LED indicates when the REF is in a calibration routine and whether or not AGC is active

LED on indicates AGC active

LED off indicates AGC inactive

LED slow flashing indicates calibration routine

LED fast flashing indicates calibration failure

Alarm output

The REF interface asserts the alarm output (E) for the following conditions:-

Incremental signal level below 20%

Incremental signal level above 135%

Readhead speed in excess of specification

Signal offset compensation of sine and cosine excessive

Signal balance compensation excessive

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

Interface part numbers (digital output) for use with RGH20F

REF	0100	E	25	A
				Options A - Reference mark B - Limit switch C - Wide reference mark
				Clocked output 50 - 50 MHz customer clock 40 - 40 MHz customer clock 25 - 25 MHz customer clock 20 - 20 MHz customer clock 12 - 12 MHz customer clock 10 - 10 MHz customer clock 08 - 8 MHz customer clock 06 - 6 MHz customer clock 05 - 5 MHz customer clock 03 - 3 MHz customer clock 01 - 1 MHz customer clock
				Alarms <u>Standard alarm E</u> A - All alarms B - High and low signal alarms only <u>3 - state alarms</u> E - All alarms F - High and low signal alarms only
				Interpolation factor* 0004 - 5 μm 0020 - 1 μm 0040 - 0.5 μm 0100 - 0.2 μm 0200 - 0.1 μm 0400 - 50 nm 1000 - 20 nm 2000 - 10 nm 4000 - 5 nm
				Interface series

*Binary interpolation factors from x4 to x4096 also available

Readhead part numbers

RGH20F	30	J	02	A
				Datum standard A - standard reference mark B - limit switch C - vacuum reference mark
				Options 02 - standard head 03 - vacuum head
				Termination J - 15 pin D type plug (standard head) M - 15 pin D type plug (vacuum head)
				Cable length 15 - 1.5 m 30 - 3 m 50 - 5 m

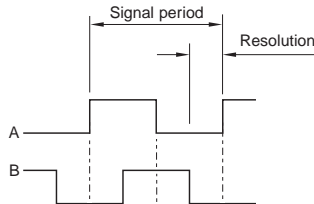
NOTE: Not all combinations are valid.
Check valid options online at www.renishaw.com/epc

SECTION 2 - RGH20F/REF systems

Output specifications

Digital output signals - type REF digital Form - Square wave differential line driver to EIA RS422A

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



†Reference
 Z — Synchronised pulse Z,
 duration as resolution

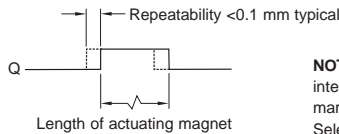
†Wide reference (option C)
 Z — Synchronised pulse Z,
 duration as signal period

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

Actuation device A-9541-0037/A-9559-0650

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

†Limit

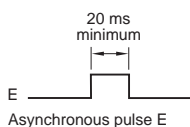


Asynchronous pulse Q

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

Actuation device A-9541-0040/
 A-9531-0251

†Alarm



Asynchronous pulse E

Alarm asserted when:

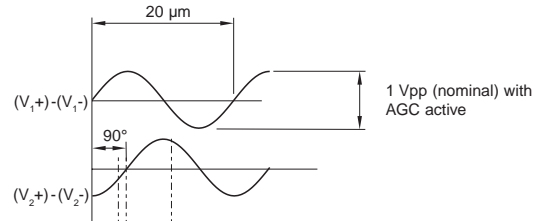
- 20% > signal amplitude > 135%
- Readhead exceeds specified maximum speed
- Signal offset excessive

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

†Inverse signals not shown for clarity

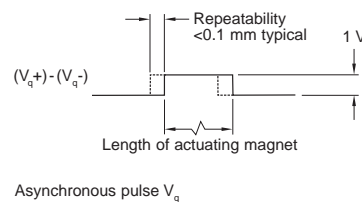
Analogue output signals - type REF0000 Form - 1 Vpp differential

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



Reference
 $(V_0+) - (V_0-)$ -18° 0° 108°
 Differential pulse V_0 -18° to 108°. Duration 126° (electrical)
 Repeatability of position (uni-directional) maintained within $\pm 10^\circ\text{C}$ from installation temperature and for speed $< 250\text{ mm/s}$
 Actuation device A-9541-0037/
 A-9559-0650

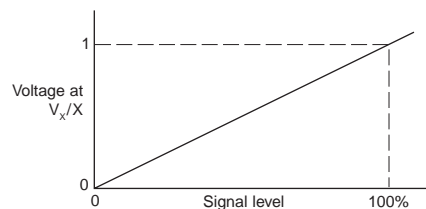
Limit



Asynchronous pulse V_q

NOTE: RGH20F readheads and REF interfaces are available with reference mark or limit switch output. Select output option at order.
 Actuation device A-9541-0040/
 A-9531-0251

Set-up signal - all REF interfaces



Setup signal voltage proportional to signal amplitude

For worldwide contact details, please visit our main website at www.renishaw.com/contact

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