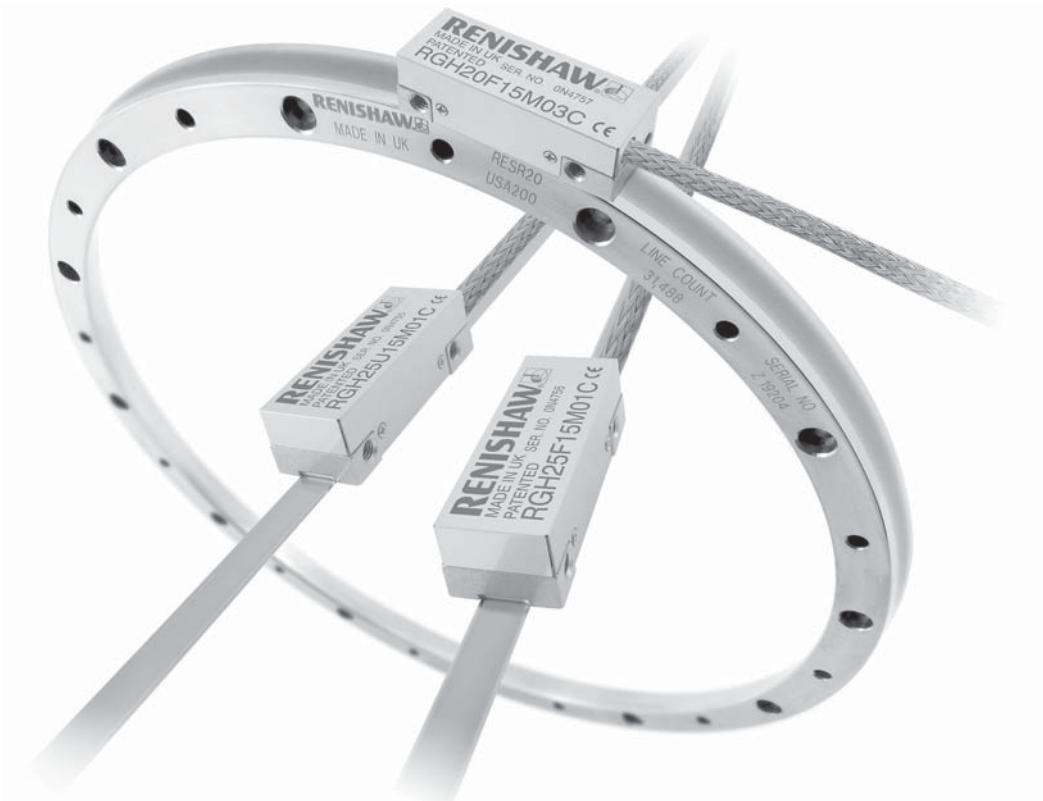


# RGH25F UHV, RGH20F UHV

## Ultra high vacuum compatible readhead systems



**Renishaw's vacuum compatible optical encoders offer all the benefits of the established RG2 linear and angle encoder systems; non-contact patented filtering optical scheme, high accuracy and high speed.**

Renishaw's vacuum range has been specially constructed from clean UHV compatible materials and adhesives to give low outgassing rates and a clean RGA. These readheads also feature reduced current consumption to minimise heat dissipation.

The RGH20F UHV is designed for use with Renishaw's 20  $\mu\text{m}$  RESR angle encoder and high accuracy RSLR linear scale to provide precision feedback for motion in UHV environments.

The RGH20F UHV and RGH25F UHV readheads are used with the REF interface which incorporates automatic gain control and unique self-tuning adaptive electronics. Combined with filtering optics, these ensure excellent signal integrity and low cyclic error.

The REF interfaces are available with resolution options of 5  $\mu\text{m}$  to 5 nm, as well as 1 Vpp analogue output.

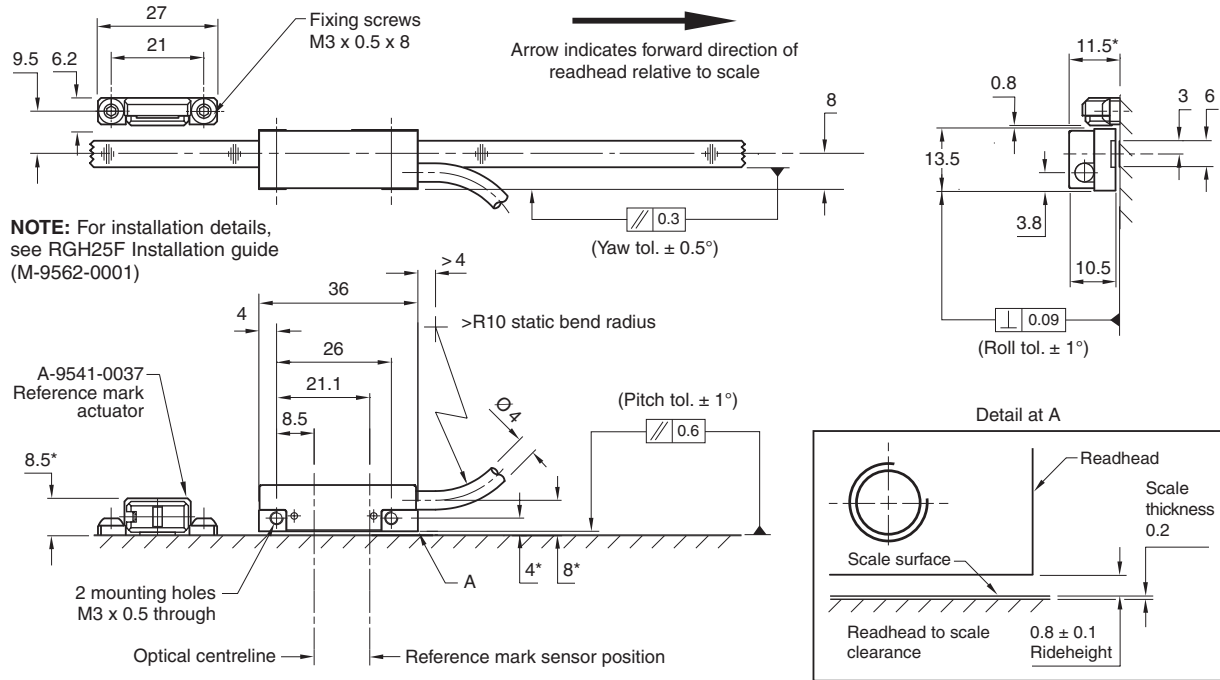
An integral tri-coloured set-up LED enables quick and easy installation. All of these readheads are supplied with an RFI screened UHV compatible cable as standard.

- Clean RGA
- Low outgassing rates
- High bake-out temperature of 120 °C
- Low power consumption readheads
- Non-contact open optical system
- Resolution to 5 nm
- Low cyclic error, <50 nm
- Self-tuning adaptive electronics give high accuracy and long-term reliability
- Reads RGS20-S tape scale, 20  $\mu\text{m}$  RESR angle encoder or RSLR linear scale

**Readhead/interface/scale compatibility**

<b>Readhead</b>	RGH25F UHV	RGH20F UHV
<b>Compatible interface</b>	REF	REF
<b>Compatible scale</b>	RGS20-S	RESR or RSLR

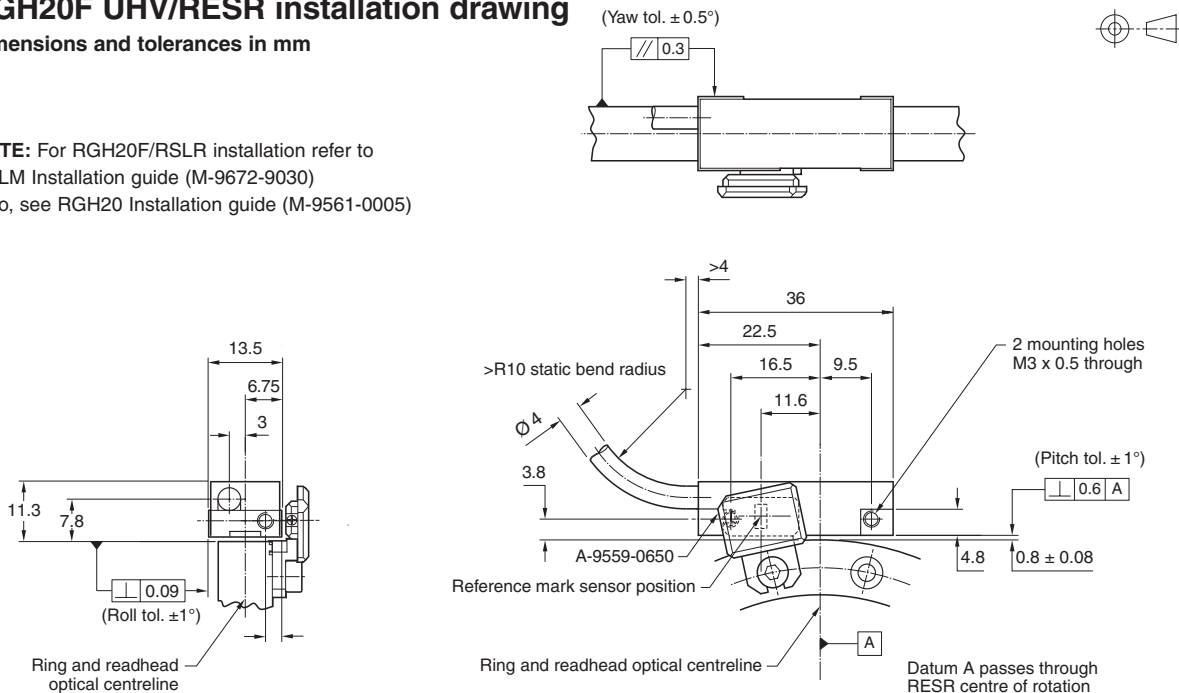
**RGH25F UHV installation drawing** Dimensions and tolerances in mm



**RGH20F UHV/RESR installation drawing**

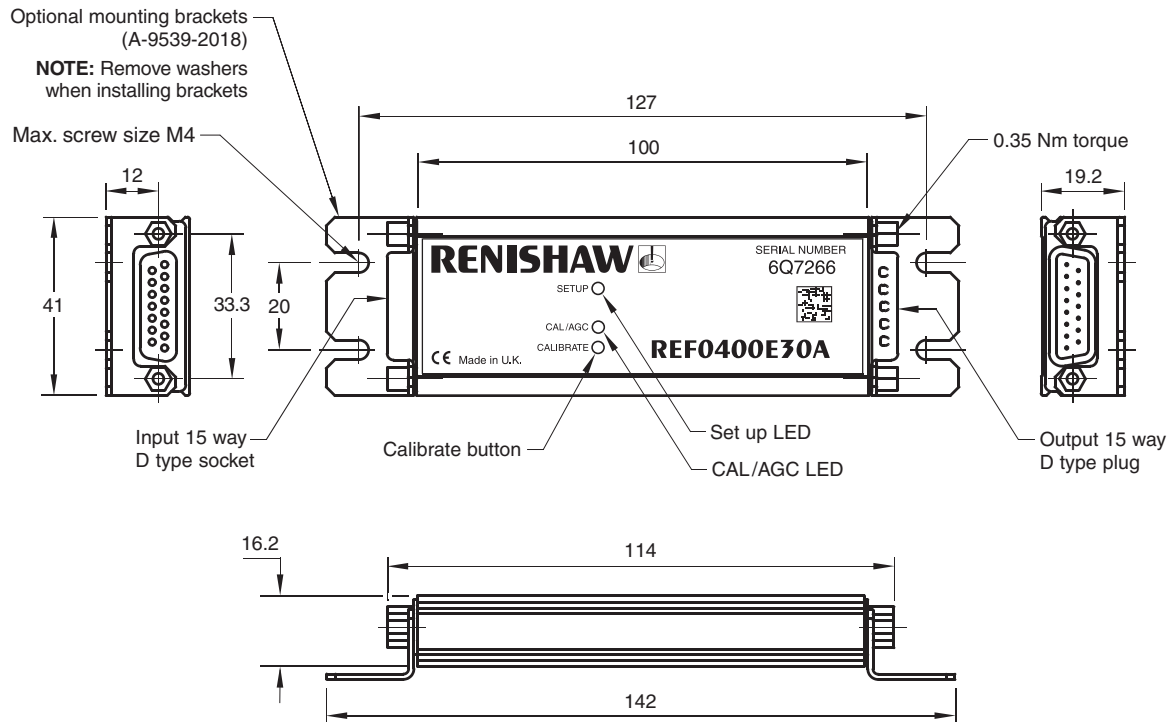
Dimensions and tolerances in mm

NOTE: For RGH20F/RSLR installation refer to RSLM Installation guide (M-9672-9030)  
 Also, see RGH20 Installation guide (M-9561-0005)



## REF installation drawing - interface for use with RGH20F/RGH25F UHV

Dimensions and tolerances in mm

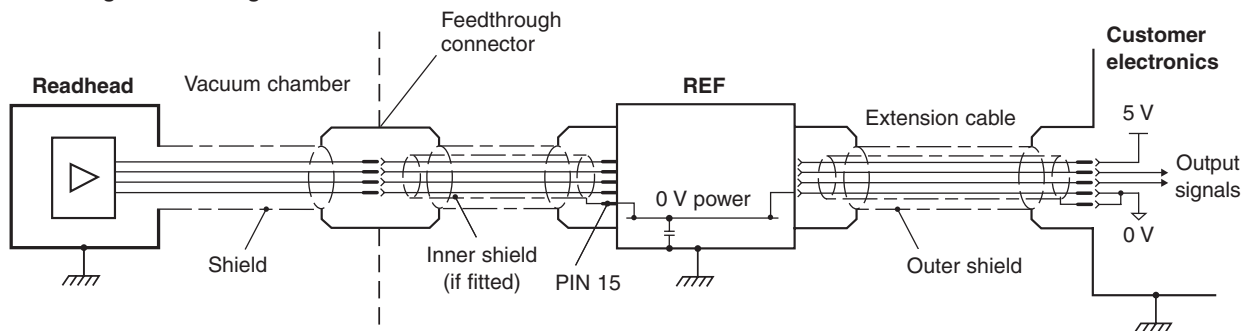


**NOTE:** For installation details, see RGH25F Installation guide (M-9532-0001)

**NOTE:** REF interfaces are **not** vacuum compatible

## Electrical connections

### Grounding and shielding



**NOTE:** Maximum cable length of 5 m between readhead and REF

**NOTE:** Inner shield must be connected to 0V at customer electronics only

**NOTE:** Maximum extension cable length:  
 - analogue output (REF0000) - 100 m  
 - digital outputs, see table below

Recommended clock frequency (MHz)	Maximum cable length (m)
≥ 25	20
≤ 20	50

**IMPORTANT:** The outer shield should be connected to the machine earth (Field Ground). The inner shield should be connected to 0V. 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 0V and earth, which could cause electrical noise issues.

## Operating and electrical specifications

<b>Power supply</b>	5 V - 5% +10%	System fully active < 300 ms after power applied. Interface and readhead are protected from reverse voltage and over voltage up to 12 V. Renishaw encoder systems must be powered from a 5 V dc supply complying with the requirements for SELV of standard EN (IEC) 60950. 200 mVpp maximum @ frequency up to 500 kHz maximum
	Ripple	
<b>Current consumption</b>		Readhead only, 50 mA System, 200mA maximum Current consumption figures refer to unterminated interfaces. (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.
<b>Temperature</b> (system)		Storage -20 °C +70 °C Operating 0 °C to +55 °C Bakeout 120 °C (readhead only)
<b>Humidity</b> (system)		Storage 95% maximum relative humidity (non-condensing) Operating 80% maximum relative humidity (non-condensing)
<b>Sealing</b>		Readhead IP40    Interface IP20
<b>Acceleration</b> (system)		Operating 500 m/s <sup>2</sup> BS EN 60068-2-7:1993    (IEC 68-2-7:1983)
<b>Shock</b> (system) non-operating		1000 m/s <sup>2</sup> , 6 ms, ½ sine    BS EN 60068-2-27:1993    (IEC 68-2-27:1987)
<b>Vibration</b> (system) operating		100 m/s <sup>2</sup> max @ 55 to 2000 Hz    BS EN 60068-2-6:1996    (IEC 68-2-6:1995)
<b>Mass</b>		Readhead 9 g    Readhead cable 23 g/m    Interface 100 g
<b>EMC compliance</b> (system)		BS EN 61000    BS EN 55011
<b>Readhead cable</b>		Tinned copper braided single screen. PTFE core insulation. Terminated in 15 way D type plug (not UHV compatible) for connection to REF interface
<b>Maximum cable lengths</b>		Readhead to interface 5 m Interface to receiving electronics; Analogue output - 100 m Digital output see table below

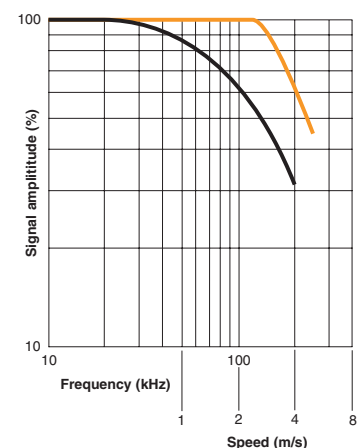
Recommended clock frequency (MHz)	Maximum cable length (m)
≥ 25	20
≤ 20	50

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

Analogue systems  
RGH20F/25F (UHV) + REF000



— AGC Off — AGC On

## REF interface features

### Self-tuning active correction

The REF interface actively corrects for input signal imperfections to optimise 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 Vpp 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 <b>Purple</b> indicates high signal alarm condition	>135%
<b>Purple</b> indicates high signal	>110% and <135%
<b>Blue</b> indicates optimum signal	>90% and <110%
<b>Green</b> indicates acceptable signal	>70% and <90%
<b>Orange</b> indicates low signal	>50% and <70%
<b>Red</b> indicates unacceptable signal	>20% and <50%
Flashing <b>Red</b> indicates unacceptable signal alarm condition	<20%
Flashing <b>Blue</b> indicates overspeed alarm condition	
<b>Red</b> flash when traversing reference mark indicates good phasing*	
<b>Orange</b> flash when traversing reference mark indicates poor phasing*	
<b>Blank</b> 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.

## Data sheet

RGH25F UHV, RGH20F UHV

## RGA results

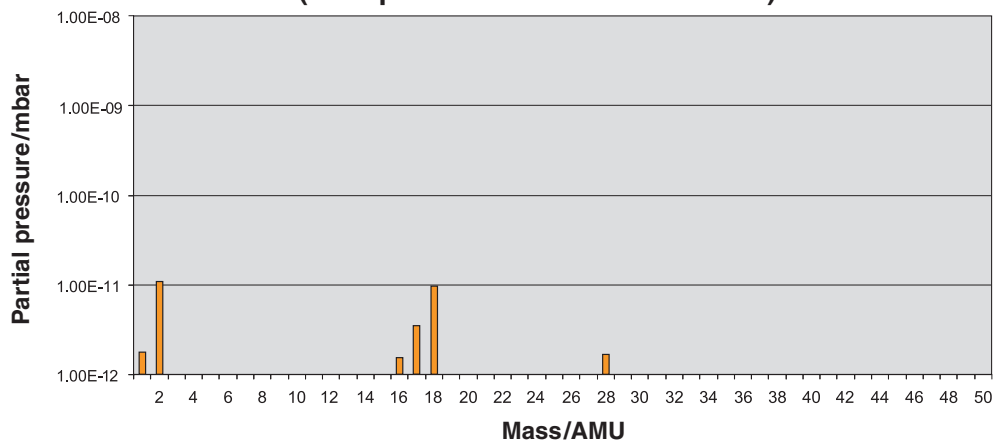
### Test schedule

A quadrupole mass spectrometer (Thermo Onix Smart IQ+ fitted with a triple filter 300D UHV head), set to 250AMU scan range, was used to collect RGA (residual gas analysis) data and to measure total chamber pressure. After initial conditioning of the system, a background spectrum was recorded together with the total pressure in the test chamber.

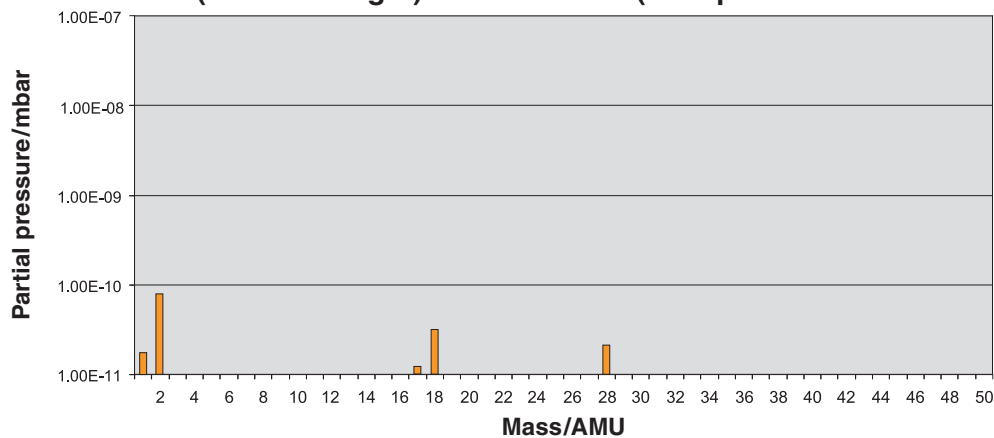
The component was placed in the vacuum chamber (0.015 m<sup>3</sup>) and the system was then pumped using an Edwards E2M18 rotary pump and a Seiko Seiki STP300 Mag Lev turbo-molecular pump (300 l/s) at ambient temperature for 24 hours, after which a background scan and the total pressure in the test chamber were recorded again. If the system pressure was better than  $5 \times 10^{-9}$  mbar, the test specimen was baked at 120 °C for 48 hours. The system was then allowed to cool to ambient temperature before a final mass spectrum and the total pressure in the test chamber were recorded. These final RGA scans are shown below.

**Note:** Exact reproduction of these results should not be expected, as RGA data depends on many factors including environmental factors and initial chamber conditions. However, the data is fully representative of vacuum performance.

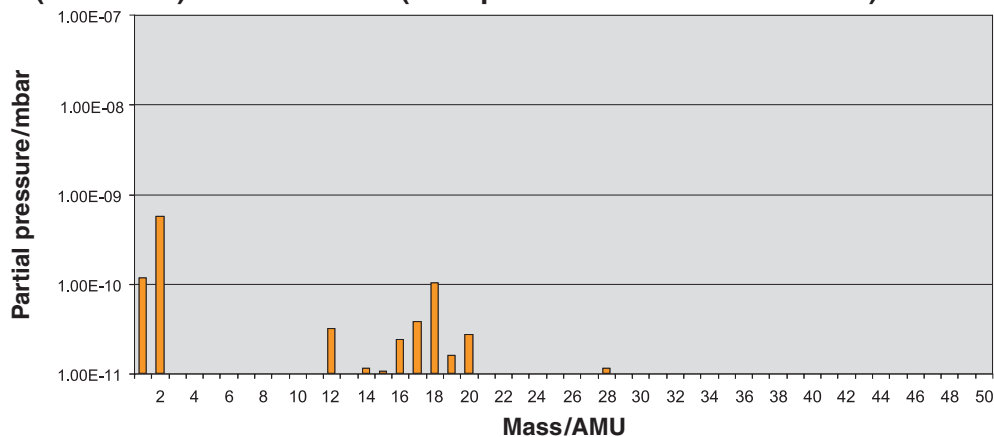
### Readhead after bake-out (total pressure = $1.29 \times 10^{-11}$ mbar)



### RGS Linear scale (300 mm length) after bake-out (total pressure = $1.69 \times 10^{-10}$ mbar)



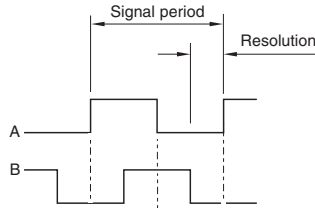
### RESR (Ø115 mm) after bake-out (total pressure = $7.76 \times 10^{-10}$ mbar)



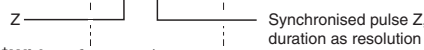
## Output specifications

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

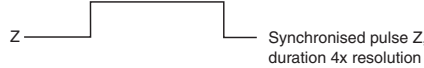
†**Incremental** 2 channels A and B in quadrature (90° phase shifted)



†**Reference**



†**Wide reference** (option C)

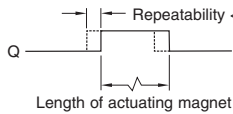


Repeatability of position (uni-directional) maintained within  $\pm 10^\circ\text{C}$  from installation temperature and for speed  $< 250\text{ mm/s}$

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

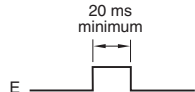
†**Limit**



Asynchronous pulse Q

**NOTE:** RGH25F vacuum readheads and REF interfaces are available with reference mark **or** limit switch detection. RGH20F vacuum readheads are **only** available with reference mark detection. Actuation device A-9541-0040/A-9531-0251

†**Alarm**

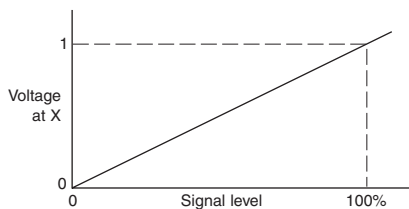


Asynchronous pulse E

Alarm asserted when:  
-  $> 20\%$  signal amplitude  $> 135\%$   
- Readhead exceeds specified maximum speed  
- Signal offset excessive

Note: 3-state alarm option also available

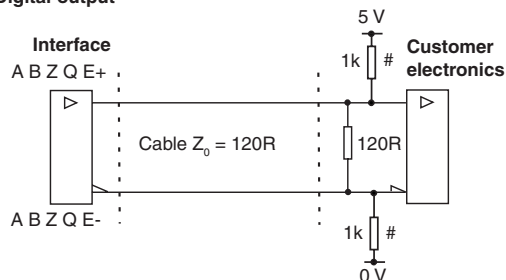
**Set-up**



Setup signal voltage proportional to signal amplitude

**Recommended signal termination**

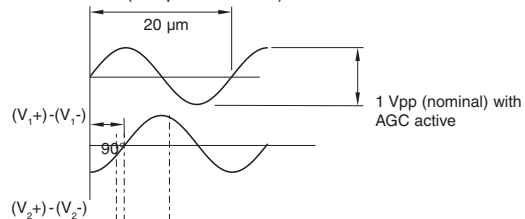
**Digital output**



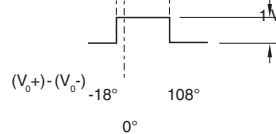
# Only required on alarm channel E for fail safe operation. Standard RS422A line receiver circuitry. Contact Renishaw for further details on receiver circuitry.

**Analogue output signals - type REF0000**  
Form - 1 Vpp differential

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

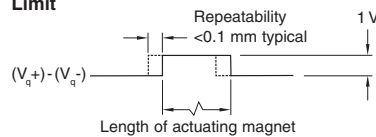


**Reference**



Differential pulse  $I_{\theta}$  -  $18^\circ$  to  $108^\circ$ .  
Duration  $126^\circ$  (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

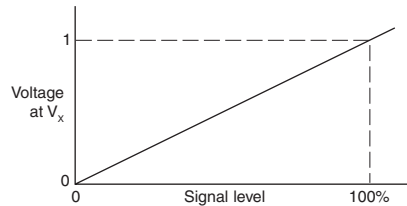
**Limit**



Asynchronous pulse  $V_q$

**NOTE:** RGH25F vacuum readheads and REF interfaces are available with reference mark **or** limit switch detection. RGH20F vacuum readheads are **only** available with reference mark detection. Actuation device A-9541-0040/A-9531-0251

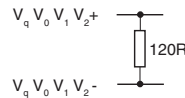
**Set-up**



Setup signal voltage proportional to signal amplitude

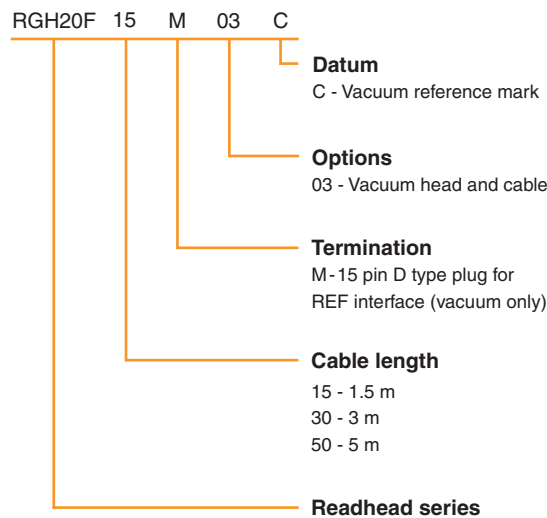
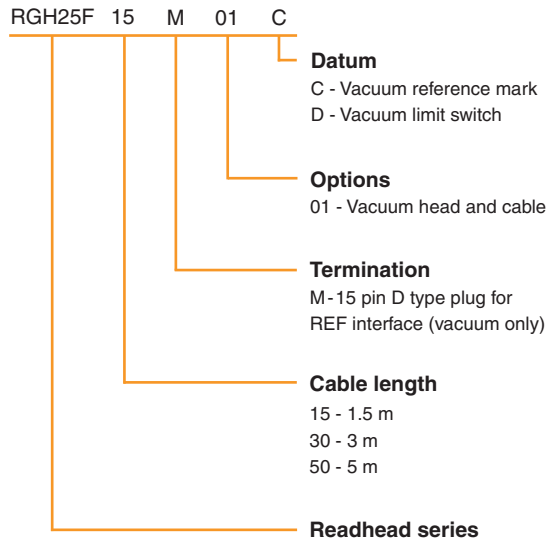
**Recommended signal termination**

**Analogue output**

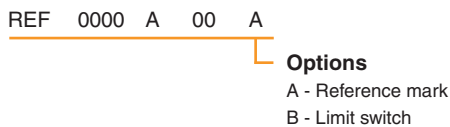


† Inverse signals not shown for clarity.

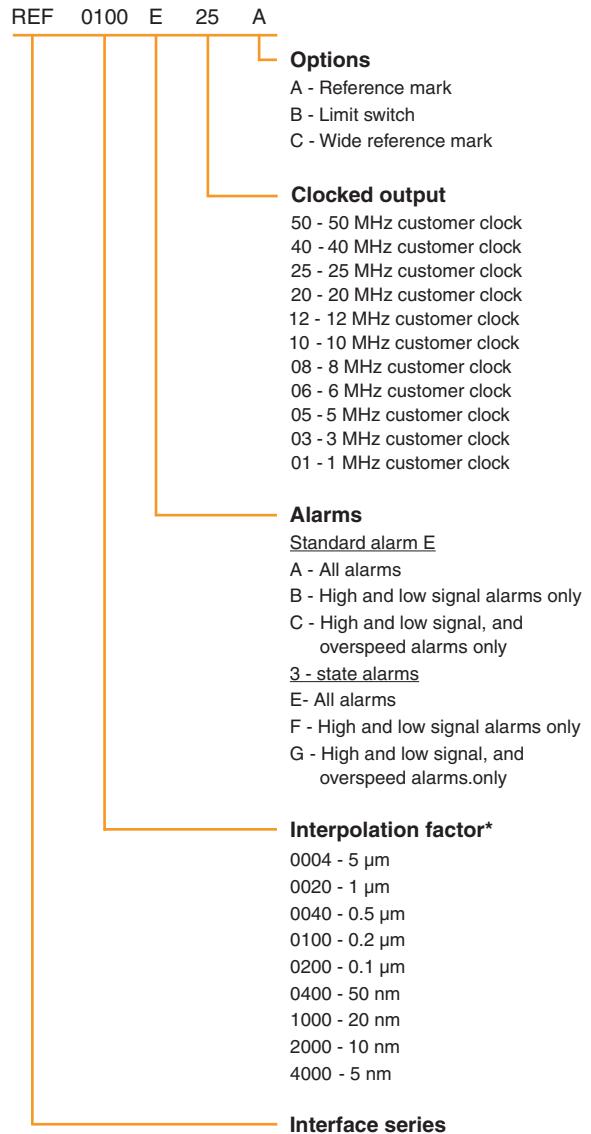
**UHV readhead part numbers**



**Interface part numbers (analogue output) for use with RGH25F/RGH20F**



**Interface part numbers (digital output) for use with RGH25F/RGH20F**



\*Binary interpolation factors from x4 to x4096 also available

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

**For worldwide contact details, please visit our main website at [www.renishaw.com/contact](http://www.renishaw.com/contact)**

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