

RGH20 encoder system



SECTION 1 - RGH20 direct output readheads

Readhead description

RGH20 direct output readheads give industry standard digital (5 μm to 5 nm) and analogue (1 Vpp) differential outputs. They can be used with either RESR rings or RSLR linear scale.

Readhead mounting/installation

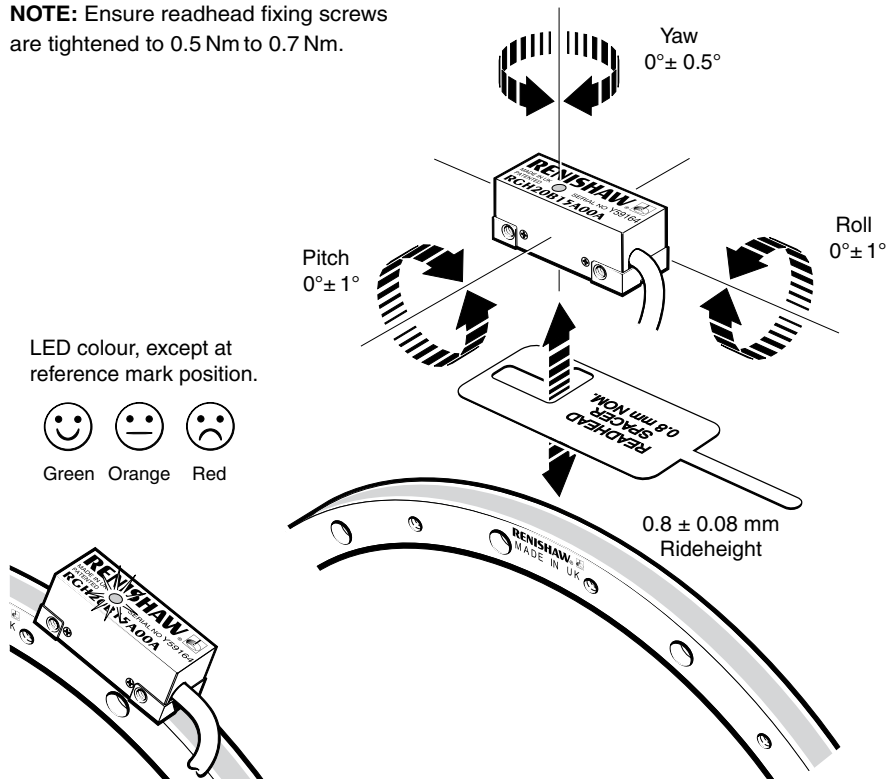
Mounting brackets

The bracket must have a flat mounting surface, ensure conformance to the installation tolerances, allow adjustment to the rideheight of the readhead, and be sufficiently stiff to prevent deflection of the readhead during operation. For easier installation, the bracket should be adjusted for roll and yaw with respect to the axis of readhead travel before the RGH20 is attached. This can be done with a clock gauge and a precision square.

Readhead set-up

To set nominal rideheight, position readhead spacer with the 'L' shaped aperture under the optical centre to allow normal LED function during set-up procedure. Ensure that the scale surface, readhead optical window and mounting face are clean and free from obstructions.

NOTE: Ensure readhead fixing screws are tightened to 0.5 Nm to 0.7 Nm.



Limit switch

A limit switch signal is output when the readhead sensor passes over the magnetic actuator. For full output specification refer to RGH20 Data sheet (L-9517-9125).

Reference mark set-up

To ensure unidirectional repeatability, the reference mark requires phasing with the scale in the direction of normal datuming operation.

A reference pulse is output in both directions, but repeatability is guaranteed only in the phased direction.

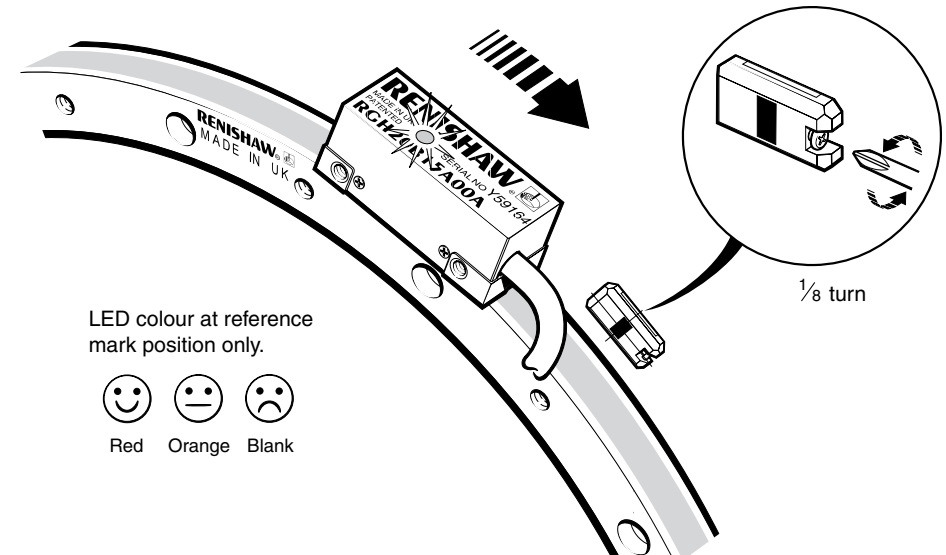
Ensure readhead is set up correctly with a green LED indication over the full rotation or axis length and that the reference mark actuator is fitted correctly.

NOTE: It is recommended that a datum procedure is performed as part of any power-up sequence to ensure the correct datum position is recorded.

NOTE: Reference mark output is synchronised with the incremental channels, giving unit of resolution pulse width. For further details see RGH20 Data sheet (L-9517-9125).

Phasing procedure

The readhead must be moved over the reference mark in the direction to be used for the datuming operation. The reference mark is phased correctly when the set-up LED flashes red for 0.25 seconds. If it flashes orange or goes blank, the reference mark adjuster screw should be turned anti-clockwise by $\frac{1}{8}$ turn and the procedure repeated until a red flash is obtained.



SECTION 1 - RGH20 direct output readheads (continued)

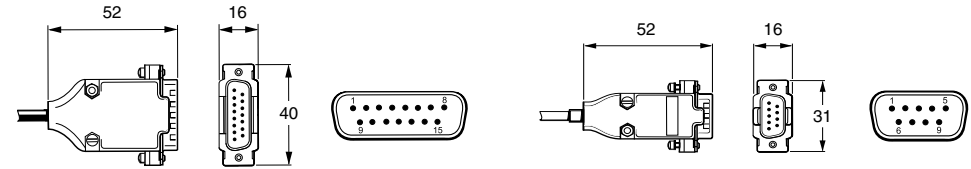
General specifications

Power supply	5 V ± 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.
	Ripple	200 mVpp maximum @ frequency up to 500 kHz maximum
		Renishaw encoder systems must be powered from a 5 V dc supply complying with the requirements for SELV of standard EN (IEC) 60950.
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 , 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: 11 g
	Cable	34 g/m
Cable	Standard	Double-shielded, maximum diameter 4.4 mm. Flex life >20 x 10 ⁶ cycles at 20 mm bend radius.

The RGH20 readheads have been designed to the relevant EMC standards (BS EN 61000 BS EN 55011) but must be correctly integrated to achieve EMC compliance. In particular, attention to shielding and earthing arrangements is essential.

NOTE: Class 1M LED product. LED radiation. Do not view directly with optical instruments.

Connections



15 pin 'D' type plug (termination code D, L)

9 pin 'D' type plug (termination code A)
Flying lead (termination code F)

RGH20 D, X, Z, W, Y, H, I, O RS422A digital

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

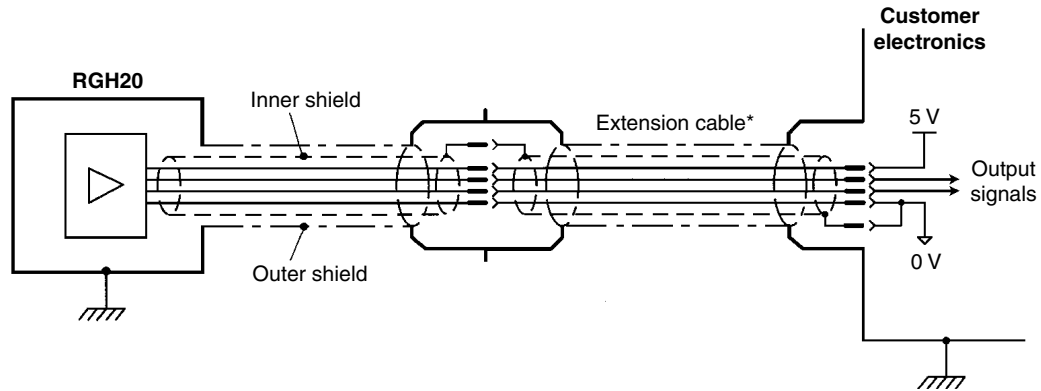
RGH20 B, 1 Vpp analogue

Function	Signal	Colour (F)	9 pin D type (A)	15 pin D type (L)	
Power	5 V	Brown	5	4, 5	
	0 V	White	1	12, 13	
Incremental signals	V ₁	+	Green	2	9
		-	Yellow	6	1
	V ₂	+	Blue	4	10
		-	Red	8	2
Reference mark/limit switch	V ₀ + / V _q -	Pink	3	3	
	V ₀ - / V _q +	Grey	7	11	
Shield	Inner	Inner shield	9	15	
	Outer	Outer shield	Case	Case	

SECTION 1 - RGH20 direct output readheads (continued)

Electrical connections

RGH20 grounding and shielding

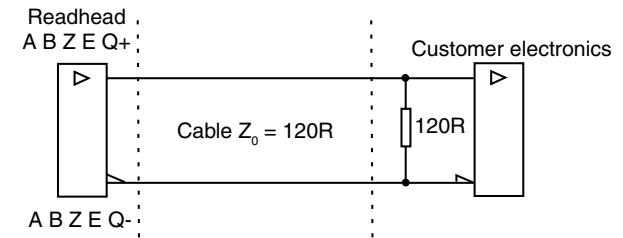


*Maximum extension cable length:
 RGH20B - 100 m, RGH20D, X, Z - 50 m RGH20W, Y, H, I, O - 20 m

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.

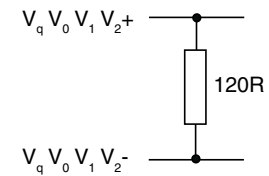
Recommended signal termination

Digital outputs RGH20D, X, Z, W, Y, H, I, O



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

Analogue output - type RGH20B



SECTION 2 - RGH20F/REF system

System description

The RGH20F encoder system consists of a common readhead in standard or UHV compatible form, coupled to the interface, which gives accurate, industry standard outputs. There are 10 versions of the REF interface, offering digital resolutions of 5 µm to 5 nm, and an analogue version giving 1 Vpp output. The digital REF interfaces are available with a variety of different clocked outputs, each interface option having a different maximum speed and minimum customer counter clock frequency, ranging from 1 to 50 MHz. The RGH20F readheads can be used with either RESR rings or RSLR linear scale.

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 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 unacceptable 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 the 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

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

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

System installation/calibration

The calibration procedure is required to optimise the gain, balance and offset of the analogue input signals in the REF interface. These settings are then stored and recalled for initial use at startup.

To calibrate the system, the following sequence should be carried out:

- ▶ Prior to calibration, AGC should be off. To switch AGC on or off, the CALIBRATE button should be pressed for more than 3 seconds. When AGC is on, the CAL/AGC LED will be on and when AGC is off, the CAL/AGC LED will be off.
- ▶ Install the readhead according to the readhead installation section below.
- ▶ Enter the calibration routine by pressing the CALIBRATE button momentarily. The calibration routine is indicated by slow flashing of the CAL/AGC LED.
- ▶ Traverse the readhead slowly past the scale until the CAL/AGC LED stops flashing. The calibration cycle is now complete.

If calibration fails, the CAL/AGC LED will flash quickly instead of switching off. If this happens the CALIBRATE button should be pressed momentarily to exit the calibration routine. The calibration procedure should then be re-tried.

If the unit continues to fail calibration, factory default settings should be restored by powering down, then pressing the CALIBRATE button as power is re-applied. The calibration procedure should then be repeated.

NOTE: To exit the calibration routine at any time, the CALIBRATE button should be pressed momentarily.

If fitted, the reference mark should be phased (see reference mark phasing)

Mounting brackets

The bracket must have a flat mounting surface, enable conformance to the installation tolerances, allow adjustment to the rideheight of the readhead, and be sufficiently stiff to prevent deflection of the readhead during operation. For easier installation, adjust the roll and yaw of the bracket with respect to the axis of readhead travel before the readhead is attached. This can be done with a clock gauge and a precision square.

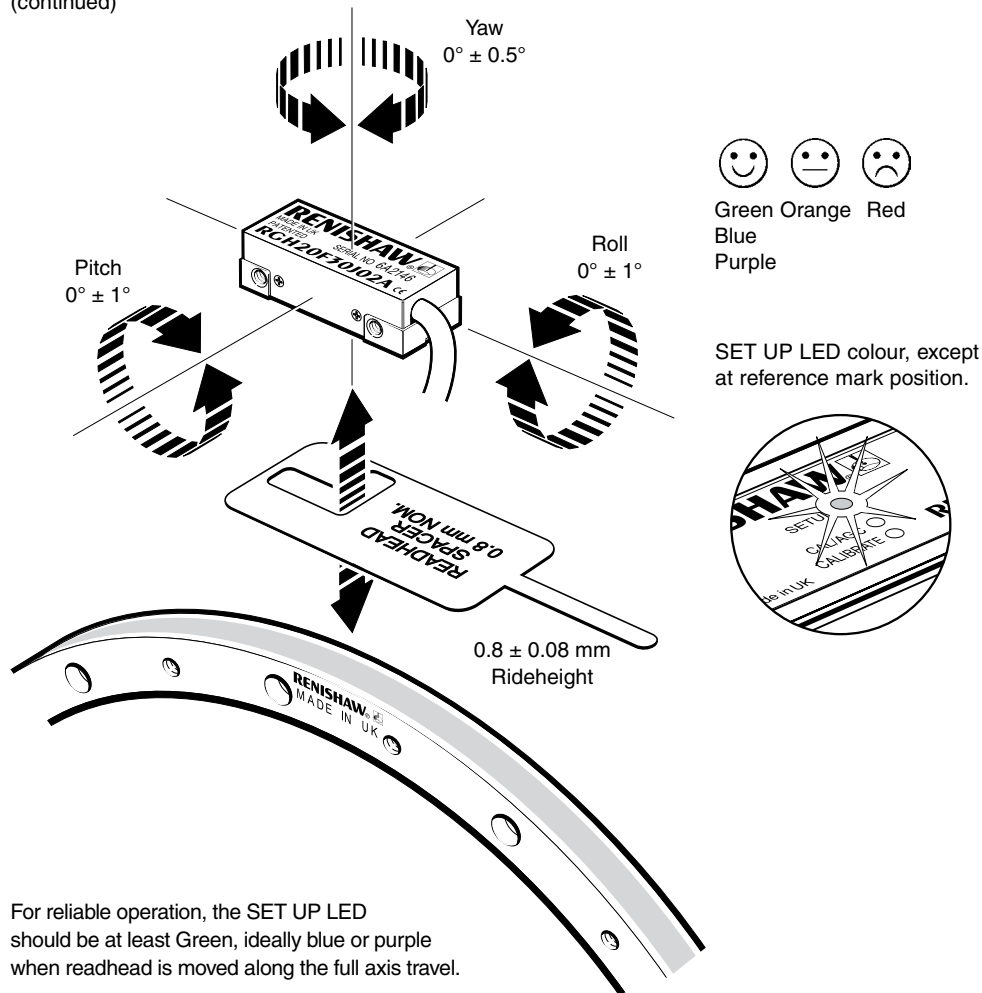
Readhead installation

To set nominal rideheight, position readhead spacer with 'L' shaped aperture under the optical centre of the readhead to allow normal LED function during set-up procedure. Ensure that the scale, readhead optical window and mounting face are clean and free from obstructions.

NOTE: Ensure readhead fixing screws are tightened to 0.5 Nm-0.7 Nm.

SECTION 2 - RGH20F/REF system (continued)

Readhead installation (continued)



For reliable operation, the SET UP LED should be at least Green, ideally blue or purple when readhead is moved along the full axis travel.

Limit switch

A limit switch signal is output when the readhead sensor passes over the magnetic actuator. For full output specification refer to RGH20 Data sheet (L-9517-9125).

Reference mark phasing

To ensure unidirectional repeatability, the reference mark requires phasing with the scale in the direction of normal datuming operation.

A reference pulse is output in both directions, but repeatability is guaranteed only in the phased direction.

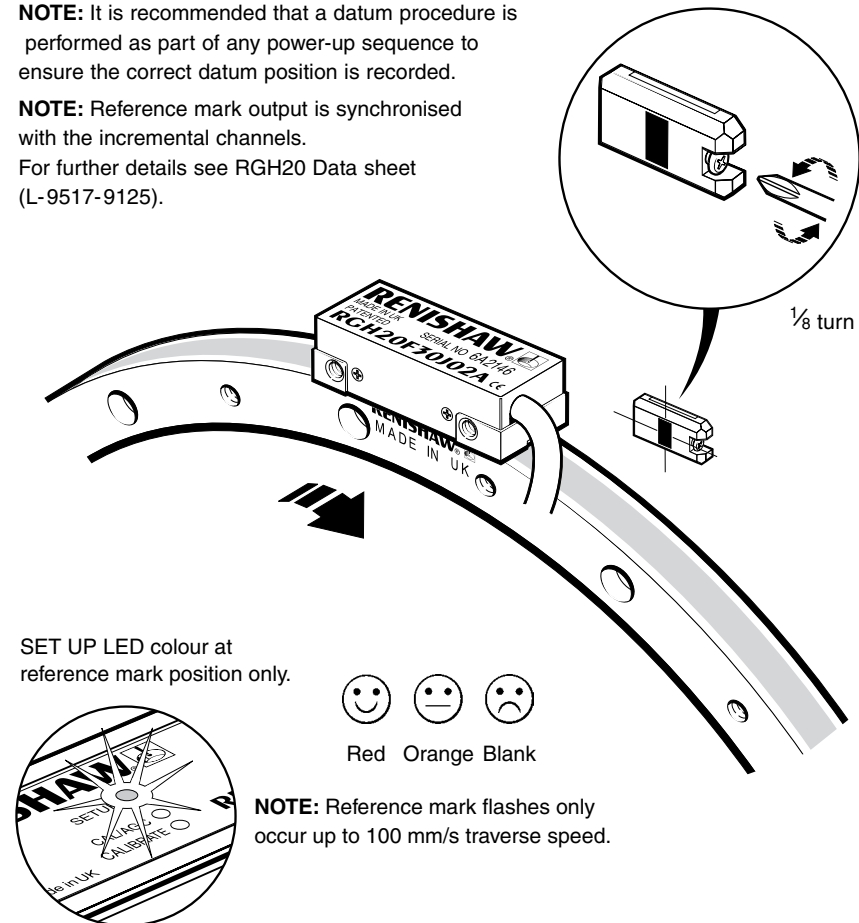
Ensure system is installed and calibrated correctly and that the reference mark actuator is fitted as shown in the installation drawing.

The readhead must be moved over the reference mark in the direction to be used for the datuming operation. The reference mark is phased correctly when the SET UP LED flashes red for 0.25 seconds. If it flashes orange or goes blank, the reference mark adjuster screw should be turned anti-clockwise by $\frac{1}{8}$ turn and the procedure repeated until a red flash is obtained.

NOTE: It is recommended that a datum procedure is performed as part of any power-up sequence to ensure the correct datum position is recorded.

NOTE: Reference mark output is synchronised with the incremental channels.

For further details see RGH20 Data sheet (L-9517-9125).



SECTION 2 - RGH20F/REF system (continued)

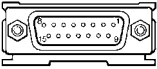
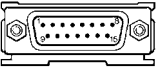
General operating specifications

Power supply	5 V - 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 of up to 12 V.
		NOTE: Current consumption figures refer to unterminated interfaces.
		For digital outputs further 25 mA per channel pair (eg A+, A-) will be drawn when terminated with 120 Ω.
		For analogue outputs 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.
RGH20F UHV (readhead only)		50 mA
	Ripple	200 m Vpp maximum @ frequency up to 500 kHz maximum
Bake-out temperature		120 °C (RGH20F UHV only)
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 , 55 to 2000 Hz BS EN 60068-2-6:1996 (IEC 68-2-6:1995).
Mass		Readhead: 9 g REF Interface: 100 g Cable (standard): 34 g/m (UHV): 23 g/m
Readhead cable	Standard	Double shielded, maximum outside diameter 4.4 mm. Flex life >20 x 10 ⁶ cycles at 20 mm bend radius.
	UHV	Single tinned copper braided shield over PTFE insulated cores.
		NOTE: standard 15 pin 'D' type connector fitted is not vacuum compatible.

The RGH20F readheads have been designed to the relevant EMC standards (BS EN 61000 BS EN 55011), but must be correctly integrated to achieve EMC compliance. In particular, attention to shielding and earthing arrangements is essential.

NOTE: Class 1M LED product. LED radiation. Do not view directly with optical instruments.

Output signals

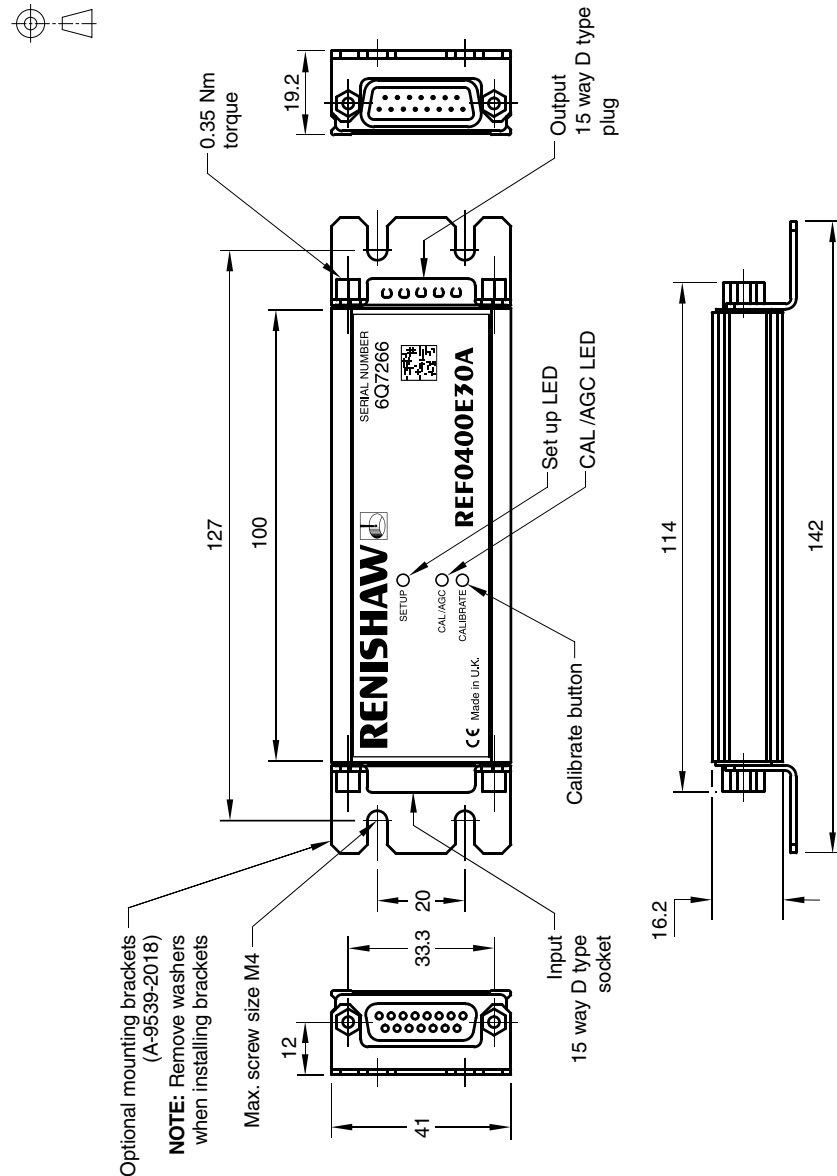
		Input		Output			
							
		15 way D type socket		15 way D type plug			
		Analogue input		Digital output		Analogue output	
Function	Wire colours from readhead	Signal	Pin	Signal	Pin	Signal	Pin
Power	Red	5 V	8	5 V	7, 8	5 V	4, 5
	White	0 V	9	0 V	2, 9	0 V	12, 13
Incremental signals	Green	A	6	A+	14	V ₁₊	9
	Yellow	B	5	A-	6	V ₁₋	1
	Blue	C	4	B+	13	V ₂₊	10
	–	–	–	B-	5	V ₂₋	2
Reference mark/limit	Pink	Hall	1	Z+/Q+	12	V ₀₊ /V _{q+}	3
				Z-/Q-	4	V ₀₋ /V _{q-}	11
Alarm	–	–	–	E+	11	–	–
				E-	3	–	–
Ired servo	Brown	Servo	3	–	–	–	–
External set-up	Interface outputs only	V _x	13	X	1	–	–
V _{MID}		V _{MID}	7	–	–	–	–
Sin monitor*		Sin monitor	11	–	–	–	–
Cos monitor*		Cos monitor	10	–	–	–	–
Shield	–	Inner	15	–	–	–	–
		Outer	Case	Outer	Case	Outer	Case
Do not connect	–	–	14	–	10	–	8
Not connected	–	–	2, 12	–	15	–	6, 14, 15

*2.25 Vpp @ 100% signal amplitude centred on 1.65 V

SECTION 2 - RGH20F/REF system (continued)

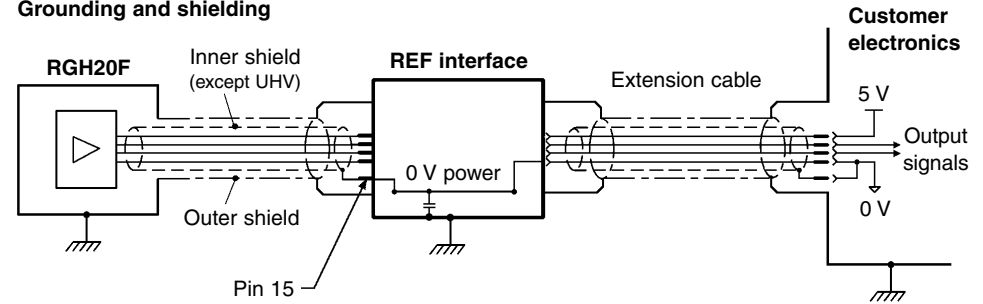
REF Installation drawing

Dimensions in mm



Electrical connections

Grounding and shielding



NOTE: Maximum cable length of 5 m between RGH20F and REF

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

NOTE: Maximum extension cable length:

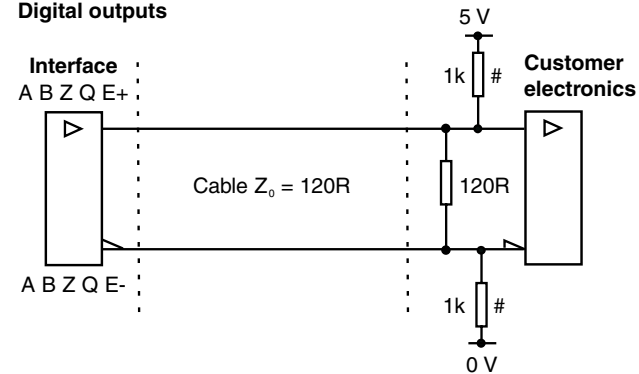
- analogue output (REF0000) - 100 m
- digital outputs, see table below

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

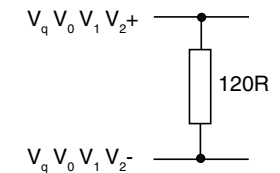
IMPORTANT: The outer shield should be connected to the machine earth (Field Ground). The inner shield should be connected to 0V. Care should be taken to ensure that the inner and outer shields are insulated from each other. If the inner and outer shields are connected together, this will cause a short between 0V and earth, which could cause electrical noise issues.

Recommended signal termination

Digital outputs



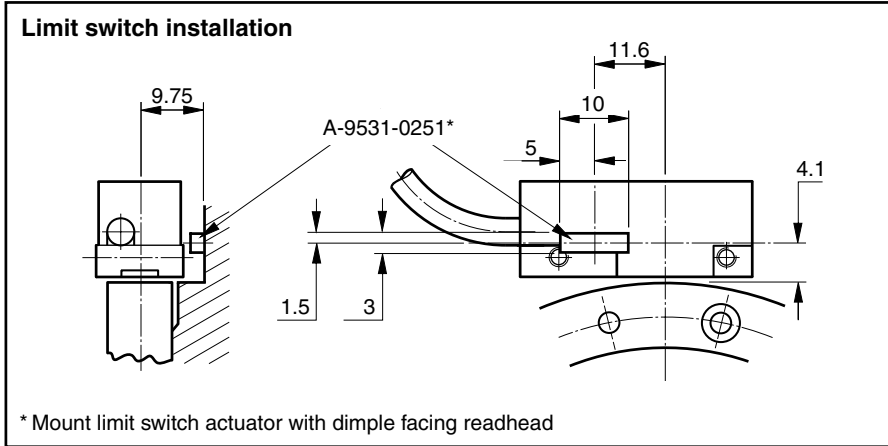
Analogue output, REF0000 only



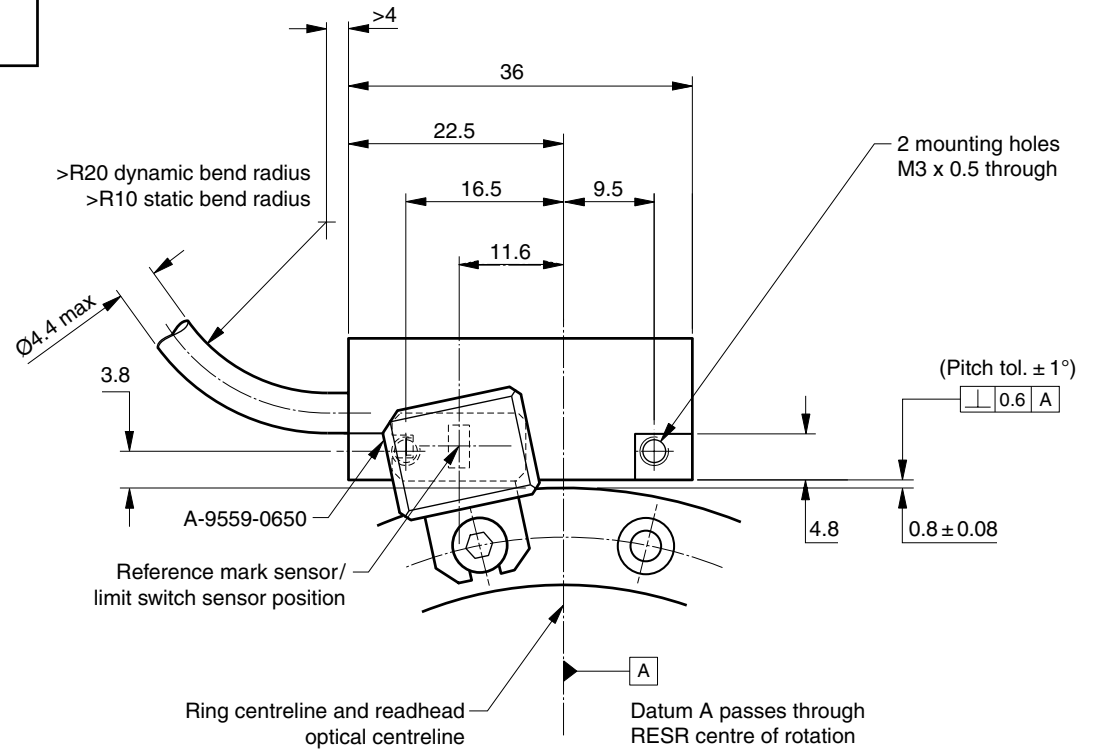
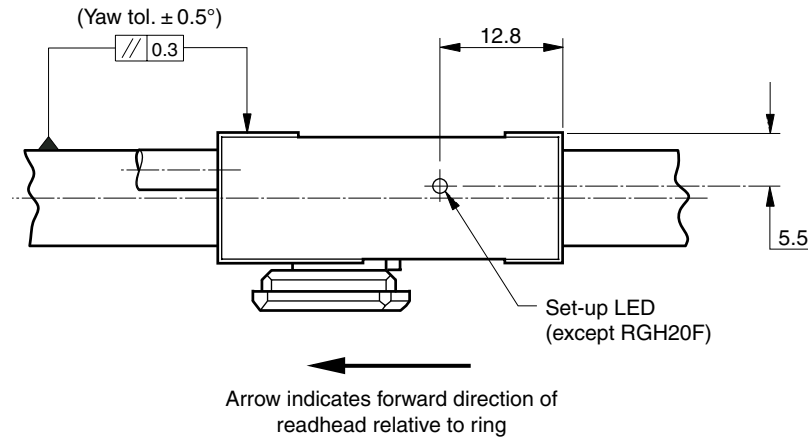
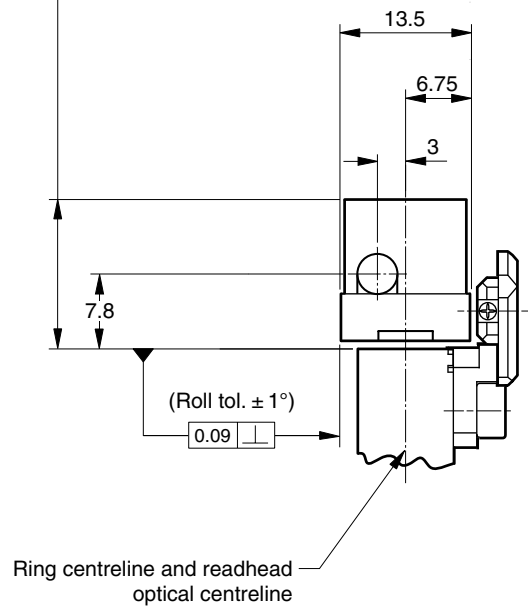
Only required on alarm channel E for fail safe operation.
Standard RS422A line receiver circuitry.

RGH20 installation drawing, RESR

Dimensions and tolerances in mm



15.6 (for RGH20 variants D, X, Z, W, Y, H, I, O, B)
11.3 (for RGH20 variant F)

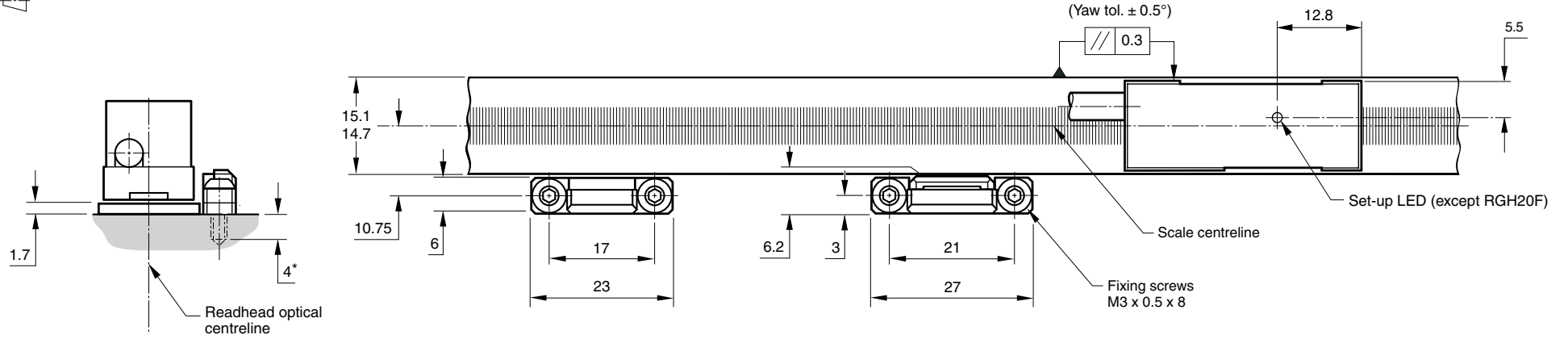


NOTE: For reference mark installation please refer to RESR Installation guide (M-9559-0675).

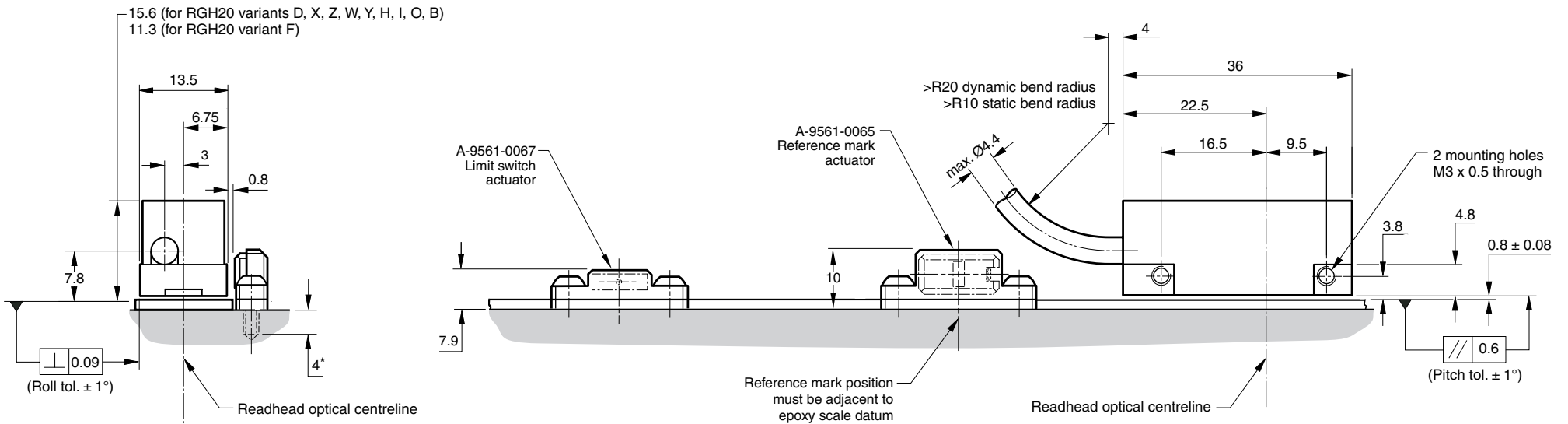
RGH20 Installation drawing, RSLR adhesive mount

Contact your local representative for information on clip/clamp mount.

Dimensions and tolerances in mm.



*Minimum full thread depth



Readhead part numbers

RGH20 B 30 L 00 A

Datum

- A - standard reference mark
- B - limit switch
- C - vacuum reference mark

Options

- 00 - standard head (RGH20B, D, X and Z only)
- 02 - standard head (RGH20F only)
- 03 - vacuum head (RGH20F only)
- 30 - 12 MHz customer clock (RGH20Y, H, I and O only)
- 31 - 8 MHz customer clock (RGH20Y, H, I and O only)
- 32 - 6 MHz customer clock (RGH20W only)
- 33 - 4 MHz customer clock (RGH20W, Y, H, I and O only)

Termination

- A - 9 pin D type plug (RGH20B, D, H, I, O, W, X, Y and Z)
- D - 15 pin D type plug (RGH20D, H, I, O, W, X, Y and Z only)
- F - unterminated cable (RGH20B, D, H, I, O, W, X, Y and Z)
- J - 15 pin D type plug for REF interface (RGH20F only)
- L - 15 pin D type plug (RGH20B only)
- M - 15 pin D type plug for REF interface (RGH20F vacuum version only)

Cable length

- 15 - 1.5 m
- 30 - 3 m
- 50 - 5 m

Output

Analogue

- B - 1 Vpp
- F - Phase output for use with REF only

Digital

- D - 5 μ m
- X - 1 μ m
- Z - 0.5 μ m
- W - 0.2 μ m
- Y - 0.1 μ m
- H - 50 nm
- I - 20 nm
- O - 10 nm

Readhead series

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

Standard alarm E

- A - All alarms
 - B - High and low signal alarms only
 - C - High and low signal, and overspeed alarms only
- #### 3 - state alarms
- E - All alarms
 - F - High and low signal alarms only
 - G - High and low signal, and overspeed alarms only

Interpolation factor*

- 0004 - 5 μ m
- 0020 - 1 μ m
- 0040 - 0.5 μ m
- 0100 - 0.2 μ m
- 0200 - 0.1 μ m
- 0400 - 50 nm
- 1000 - 20 nm
- 2000 - 10 nm
- 4000 - 5 nm

Interface series

*Binary interpolation factors from x4 to x4096 also available

Interface part numbers (analogue output) for use with RGH20F

REF 0000 A 00 A

Options

- A - Reference mark
- B - Limit switch

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



EMC compliance

The RG2 encoder system conforms to the relevant harmonised European standards for electromagnetic compatibility as detailed below.

BS EN 61000 BS EN 55011

Patents

Features of Renishaw's encoder systems and similar products are the subjects of the following patents and patent applications:

EP 0207121	JP 1549396	US 4959542	EP 0274491
JP 501381/88	US 4,974,962	EP 0274492	US 4926566
EP 0383901	JP 2,963,926	US 5,088,209	EP 0388453
JP 2837483	US 5,063,685	EP 0514081	JP 3,202,316
US 5,241,173	EP 0543513	JP 248,895/1993	US 5,302,820
EP 0748436	US 5,861,953	EP 826138 B	JP 506,211/1999
US 6,051,971	EP 1094302	US 6,481,115 B1	EP 1147377
JP 2003-512,611	US 6,588,333 B1	WO 03/041905	

Further information

For further information relating to the installation of RGH20 readheads, see also the RGH20 Data sheet (L-9517-9125), RESR Installation guide (M-9559-0675), RESR Data sheet (L-9517-9128) and RSLM Installation guide (M-9672-9030). These can be downloaded from our website www.renishaw.com/encoder and is also available from your local representative.

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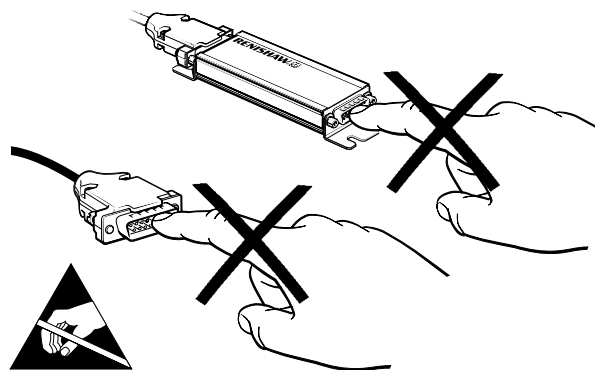
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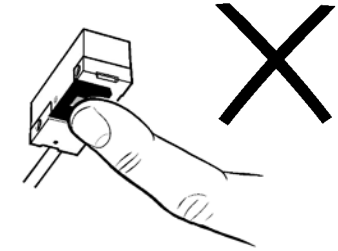
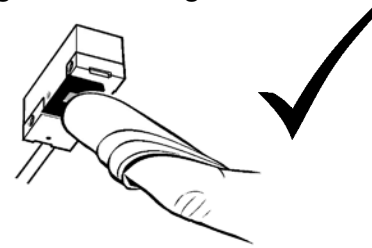
Storage and handling



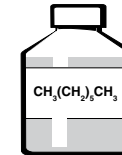
UHV version only



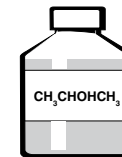
Storage and handling continued



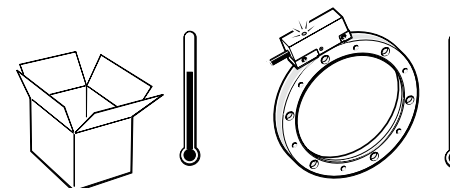
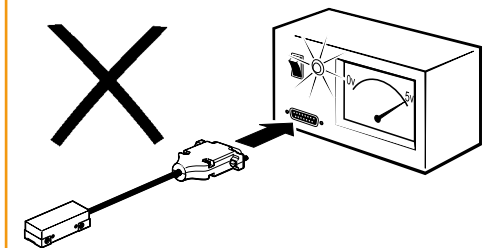
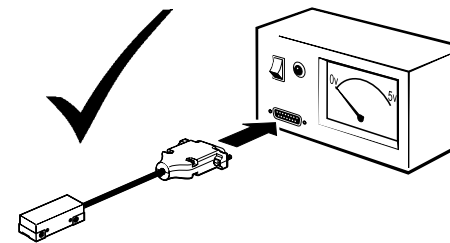
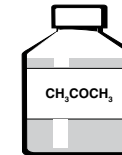
N-heptane



Propan-2-ol

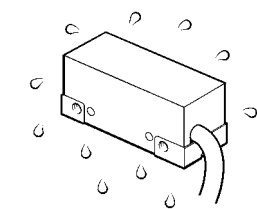


Acetone



+70 °C
-20 °C
System

+55 °C
0 °C
System



Storage: <95 % RH
Operating: <80 % RH

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