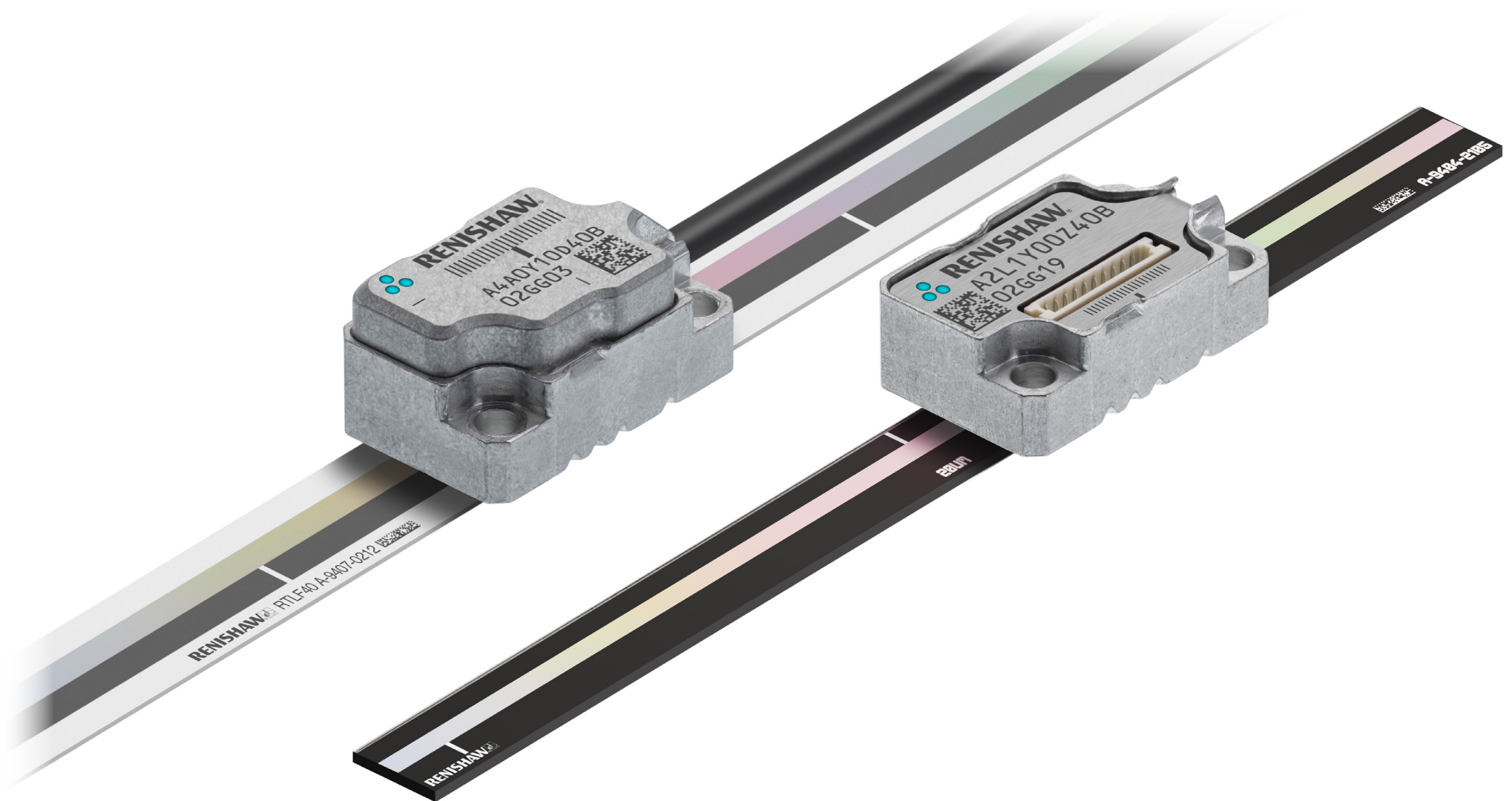


# ATOM DX™ linear encoder systems



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## Legal notices

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### Patents

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

CN1314511	EP1469969	EP2390045	JP5002559
US8987633	US8466943	CN101300463	EP1946048
JP5017275	US7624513	CN101310165	EP1957943
US7839296	CN105008865	US9952068	CN109477736
EP3465099	US2017203210		

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Renishaw warrants its equipment and software for a limited period (as set out in the Standard Terms and Conditions), provided that they are installed and used exactly as defined in associated Renishaw documentation. You should consult these Standard Terms and Conditions to find out the full details of your warranty.

Equipment and/or software purchased by you from a third-party supplier is subject to separate terms and conditions supplied with such equipment and/or software. You should contact your third-party supplier for details.

### Product compliance



Renishaw plc declares that ATOM DX™ complies with the applicable standards and regulations. A copy of the EU Declaration of Conformity is available from our website at [www.renishaw.com/productcompliance](http://www.renishaw.com/productcompliance).

#### ATOM DX cabled readhead compliance

This device complies with part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) This device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

The user is cautioned that any changes or modifications not expressly approved by Renishaw plc or authorised representative could void the user's authority to operate the equipment.

This equipment has been tested and found to comply with the limits for a Class A digital device, pursuant to part 15 of the FCC Rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses, and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

**NOTE:** This unit was tested with shielded cables on the peripheral devices. Shielded cables must be used with the unit to ensure compliance.

#### ATOM DX top exit readhead compliance

The ATOM DX top exit readhead has been designed as a system component and to be compliant with EMC regulations for products of its type. Care must be taken with shielding and grounding arrangements to ensure EMC performance once installed. It is the system integrator's responsibility to implement, test and prove EMC compatibility for the whole machine

### Further information

This further information relating to the ATOM DX encoder range can be found in the *ATOM DX™ miniature encoder system* Data sheet (Renishaw part no. L-9517-9736), *Advanced Diagnostic Tool ADTi-100* Data sheet (Renishaw part no. L-9517-9699), *Advanced Diagnostic Tool ADTi-100 and ADT View software* User guide (Renishaw part no. M-6195-9413) and *Advanced Diagnostic Tool ADTi-100 and ADT View software* Quick-start guide (Renishaw part no. M-6195-9321). These can be downloaded from our website at [www.renishaw.com/atomdxdownloads](http://www.renishaw.com/atomdxdownloads) and are also available from your local representative.

## Legal notices (continued)

### Packaging

The packaging of our products contains the following materials and can be recycled.

Packaging Component	Material	ISO 11469	Recycling Guidance
Outer box	Cardboard	Not applicable	Recyclable
	Polypropylene	PP	Recyclable
Inserts	Low density polyethylene foam	LDPE	Recyclable
	Cardboard	Not applicable	Recyclable
Bags	High density polyethylene bag	HDPE	Recyclable
	Metalised polyethylene	PE	Recyclable

### REACH regulation

Information required by Article 33(1) of Regulation (EC) No. 1907/2006 (“REACH”) relating to products containing substances of very high concern (SVHCs) is available at [www.renishaw.com/REACH](http://www.renishaw.com/REACH).

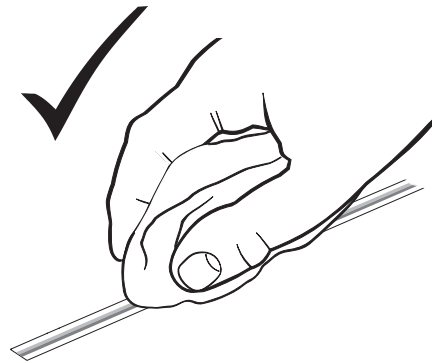
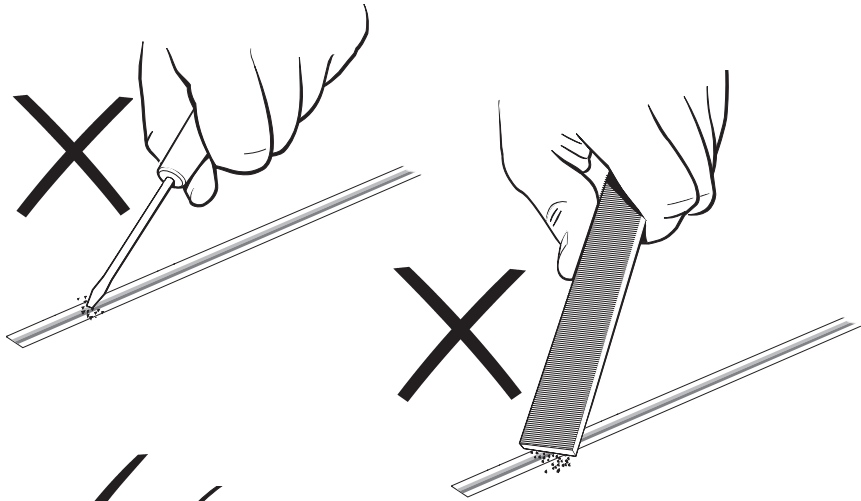
### WEEE recycling guidelines



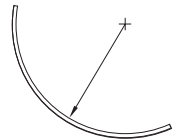
The use of this symbol on Renishaw products and/or accompanying documentation indicates that the product should not be mixed with general household waste upon disposal. It is the responsibility of the end user to dispose of this product at a designated collection point for waste electrical and electronic equipment (WEEE) to enable reuse or recycling. Correct disposal of this product will help to save valuable resources and prevent potential negative effects on the environment. For more information, please contact your local waste disposal service or Renishaw distributor.

# Storage and handling

## Scale

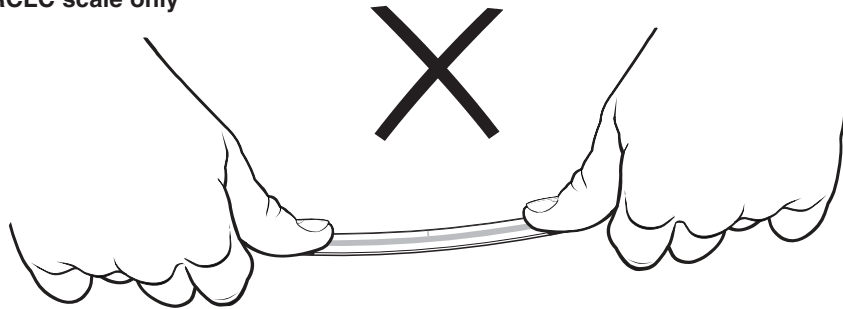


**Minimum storage bend radius**  
 RTLF – 150 mm  
 RKLF – 50 mm



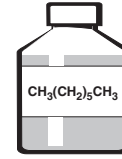
**NOTE:** During storage, ensure self-adhesive tape is on the outside of the bend.

## RCLC scale only

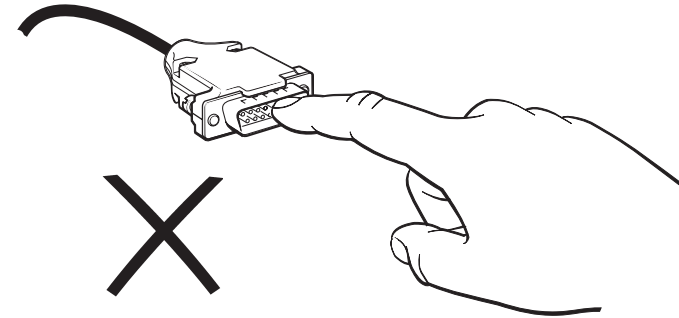
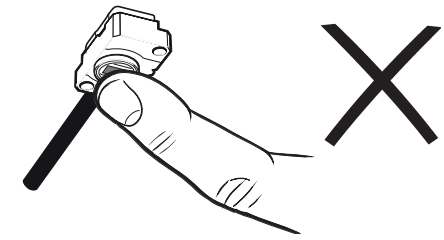
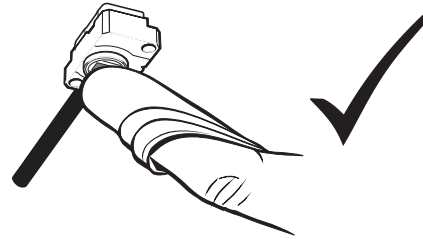
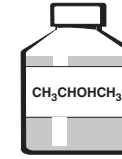


## Scale and readhead

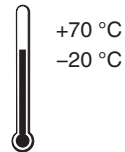
N-heptane



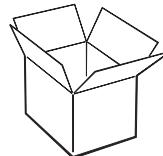
Propan-2-ol



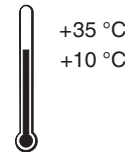
## Storage



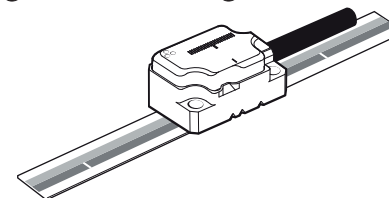
+70 °C  
-20 °C



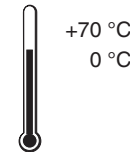
## Installation (RKLF)



+35 °C  
+10 °C

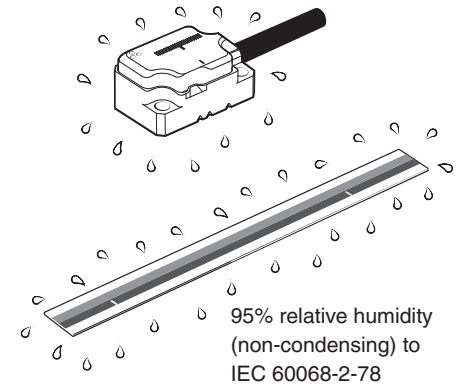


## Operating



+70 °C  
0 °C

## Humidity

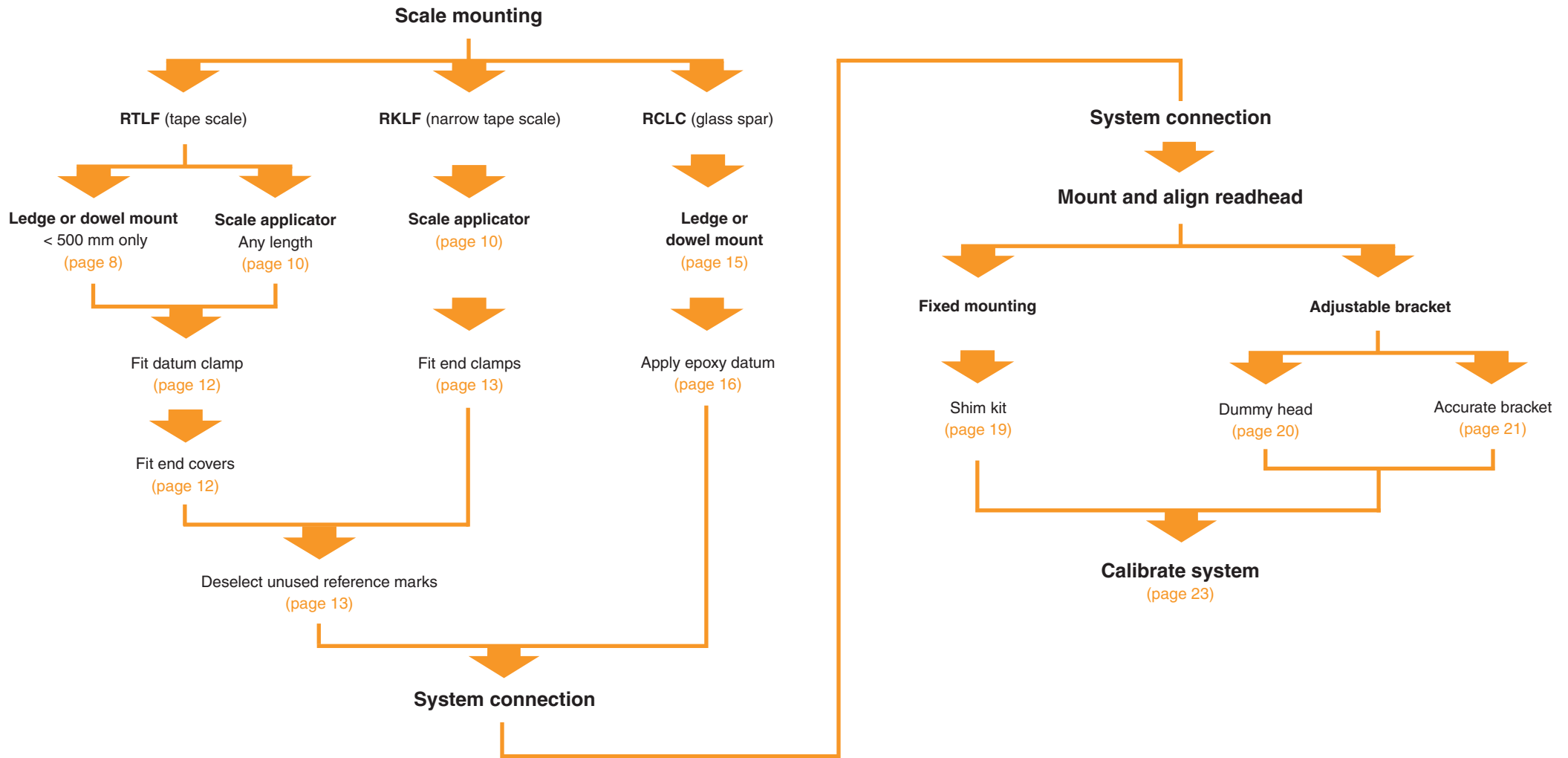


95% relative humidity (non-condensing) to IEC 60068-2-78

## ATOM DX system installation overview

This section gives an overview of the steps involved in installing, setting-up and calibrating an ATOM DX encoder system. More detailed information is contained within the rest of the document. For information on designing the readhead and scale into the system refer to the detailed 3D models at [www.renishaw.com/atomdxdownloads](http://www.renishaw.com/atomdxdownloads) or contact your local Renishaw representative.

**IMPORTANT:** Prior to installing readhead and scale, installation drawings should be reviewed to ensure correct orientation of readhead relative to scale.

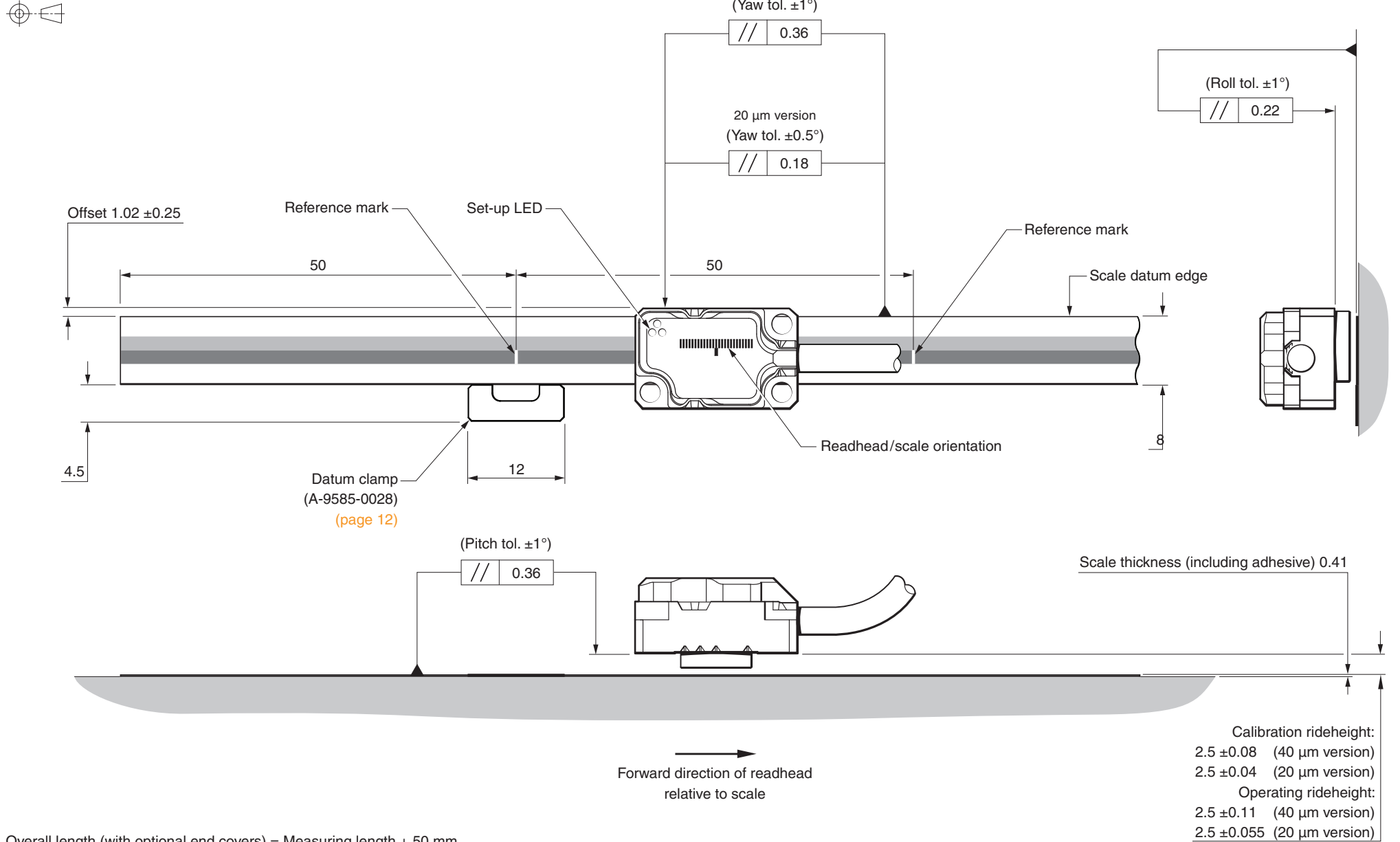


# RTLFL/RKLF tape scale

## RTLFL installation drawing (cabled readhead shown)

For dimensioned readhead drawings see page 27 and page 28.

Dimensions and tolerances in mm



Overall length (with optional end covers) = Measuring length + 50 mm

Scale length (with optional end covers) = Measuring length + 13 mm

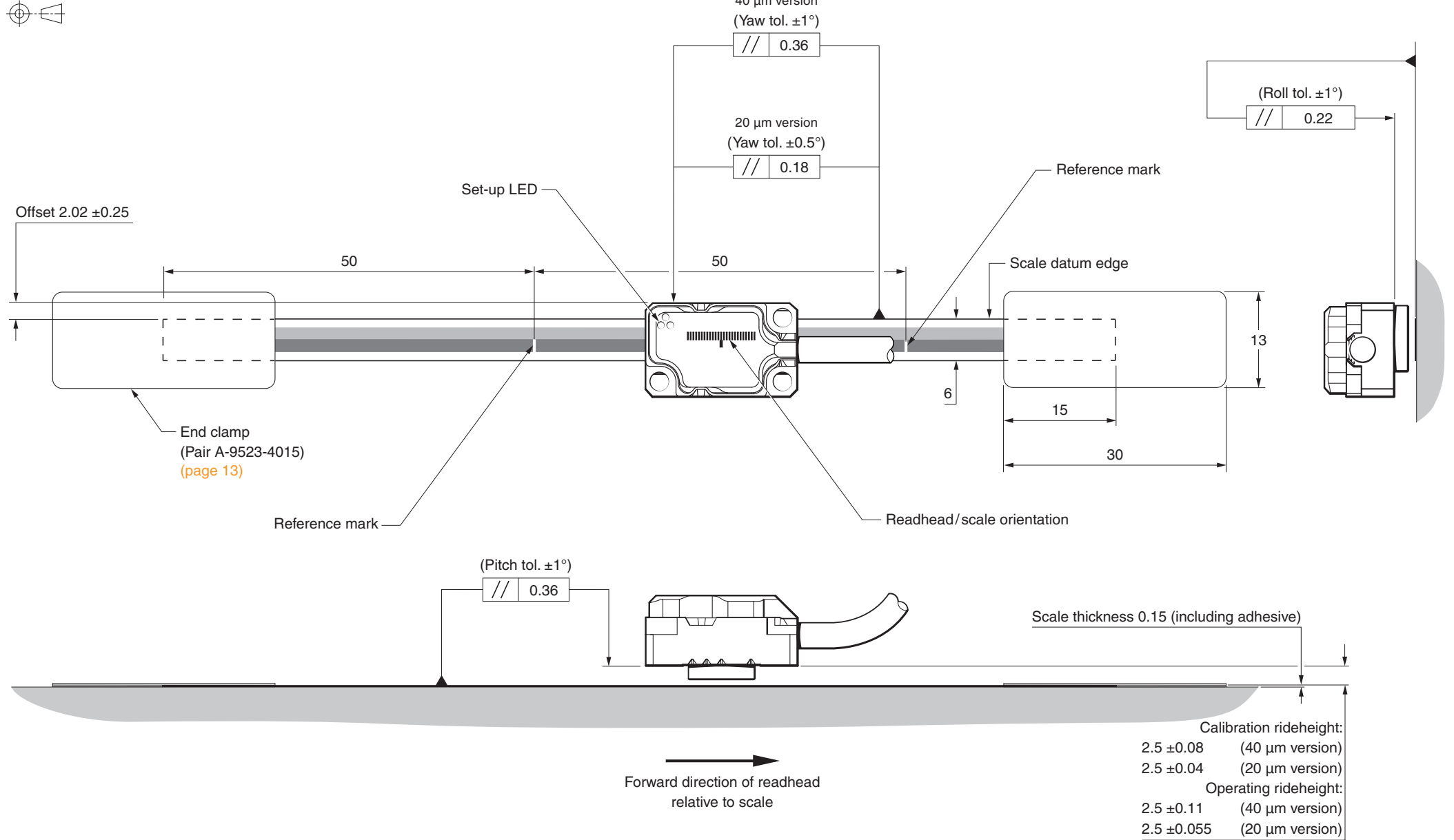
Scale length (without end covers) = Measuring length + 6 mm

# RTLF/RKLF tape scale (continued)

## RKLF installation drawing (cabled readhead shown)

Dimensions and tolerances in mm

For dimensioned cabled and FPC readhead drawings see [page 27](#) and [page 28](#).



Overall length = Measuring length + 70 mm  
Scale length = Measuring length + 40 mm



# RTLTF/RKLF tape scale (continued)

## RTLTF/RKLF application methods

RTLTF/RKLF scale application depends upon scale length and bracket type.

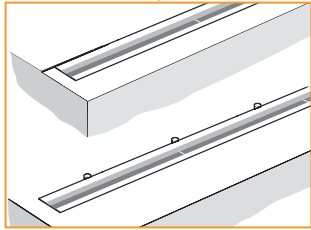
### RTLTF/RKLF tape scale

#### Mounting (RTLTF < 500 mm only)

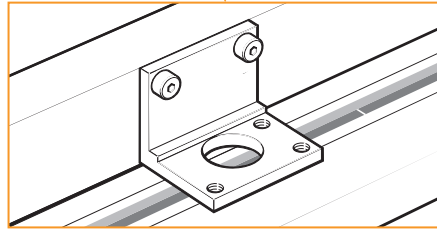
#### Application (RTLTF/RKLF any length)

#### Adjustable bracket

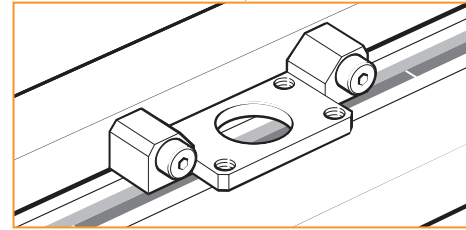
#### Fixed mounting



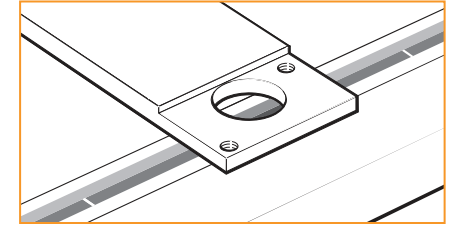
Ledge or dowel mounting (page 8).



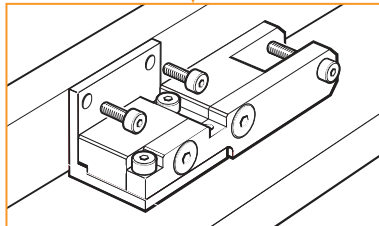
Datum edge of readhead located against a ledge on the bracket to control yaw. For use with 'L' mounting bracket A-9402-0037 or customer-designed bracket.



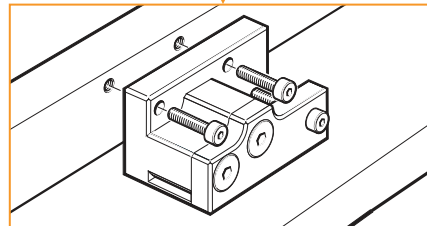
Datum edge of readhead mounted against machine axis. For use with side mounting bracket A-9401-0103 or customer-designed bracket.



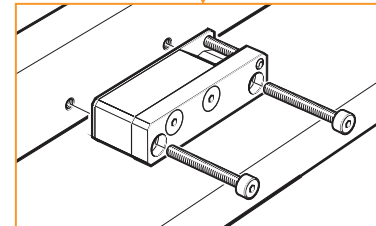
Readhead mounting is integral to the machine and does not allow rideheight adjustment.



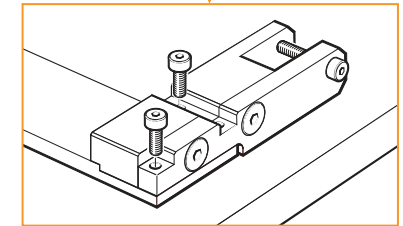
Top mount applicator A-9402-0028 (RTLTF), A-6547-1939 (RKLF) (page 10).



Side-mounted applicator A-9402-0034 (RTLTF), A-6547-1943 (RKLF). Only for use with 'L' mounting bracket A-9402-0037 (page 10).



Slim applicator A-9402-0060 (RTLTF), A-6547-1947 (RKLF) (page 10).



Top mount applicator A-9402-0028 (RTLTF), A-6547-1939 (RKLF) (page 10).

#### RTLTF

#### RKLF

Install datum clamp (page 12)

Install end covers (optional) (page 12)

Install end clamps (page 13)

Deselect reference marks (page 13)

## RTLTF/RKLF tape scale (continued)

---

### RTLTF ledge or dowel mounting

#### Suitable for:

- ▶ RTLTF tape scale < 500 mm long

#### Required parts:

- ▶ Appropriate length of RTLTF scale ('RTLTF installation drawing', page 5)
- ▶ Appropriate cleaning solvents ('Storage and handling', page 3)
- ▶ Datum clamp (A-9585-0028)
- ▶ Loctite® 435™ (P-AD03-0012)

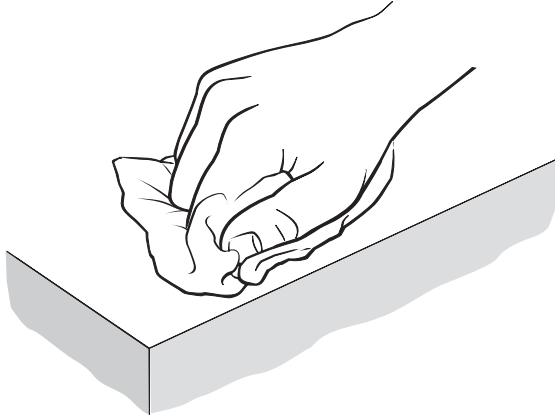
#### Optional parts:

- ▶ Renishaw scale wipes (A-9523-4040)
- ▶ Loctite 435 dispensing tip (P-TL50-0209)
- ▶ End cover kit (A-9585-0035)
- ▶ Reference mark deselection stickers (A-9402-0049 for a sheet of 20)
- ▶ Lint-free cloth

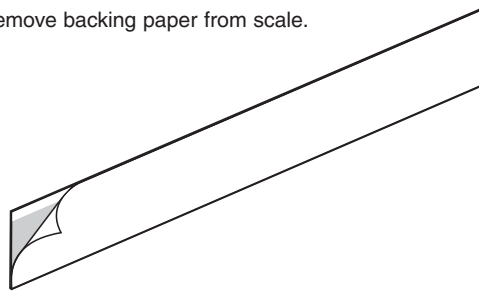
## RTLF/RKLF tape scale (continued)

### RTLF mounting (for lengths < 500 mm only)

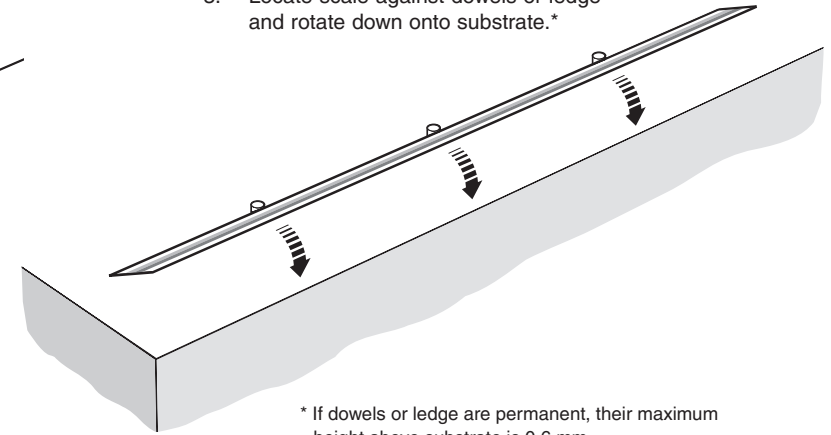
1. Thoroughly clean and degrease the substrate using recommended solvents ('Storage and handling', page 3). Allow substrate to dry before applying scale.



2. Remove backing paper from scale.

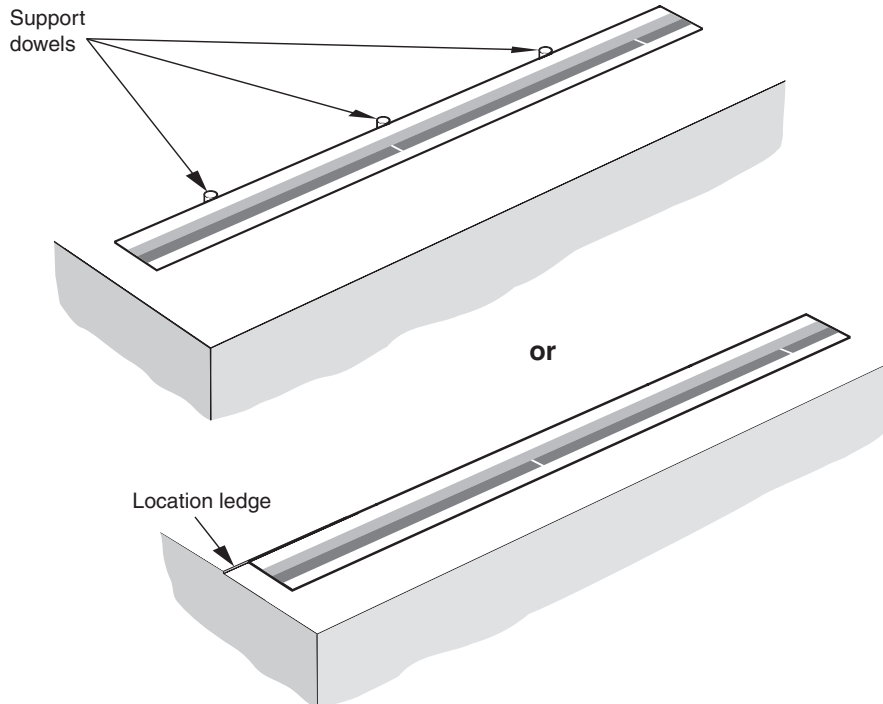


3. Locate scale against dowels or ledge and rotate down onto substrate.\*

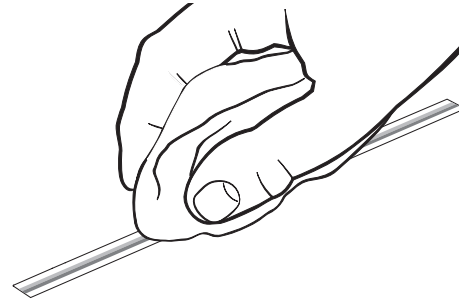


\* If dowels or ledge are permanent, their maximum height above substrate is 0.6 mm.

4.



5. Clean scale using Renishaw scale wipes or a clean, dry, lint-free cloth.



6. Fit datum clamp and end covers (page 12) and, if needed, deselect reference marks that are not required as detailed (page 13).

7. Remove temporary dowels (if fitted).

## RTLTF/RKLF tape scale (continued)

### RTLTF/RKLF scale applicator

#### Suitable for:

- ▶ RTLTF tape scale, any length
- ▶ RKLF narrow tape scale, any length

#### Required parts:

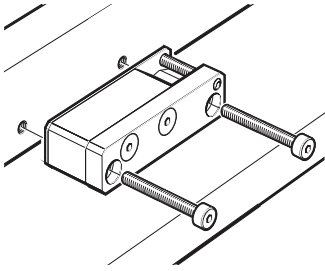
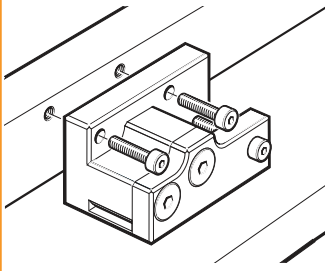
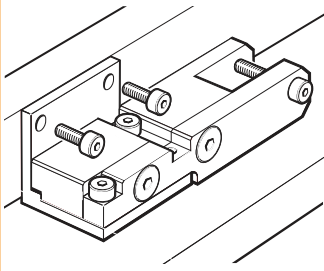
- ▶ Appropriate length of scale ('RTLTF installation drawing', page 5) or ('RKLF installation drawing', page 6)
- ▶ End clamp kit, RKLF only (A-9523-4015)
- ▶ RGG-2 two part epoxy adhesive, RKLF only (A-9531-0342)
- ▶ Datum clamp, RTLTF only (A-9585-0028)
- ▶ Loctite 435, RTLTF only (P-AD03-0012)
- ▶ Appropriate cleaning solvents ('Storage and handling', page 3)
- ▶ Readhead mounting bracket (see table below)
- ▶ Appropriate scale applicator (see table below)
- ▶ 2 × applicator mounting screws
- ▶ 2 × M2 × 6 screws, top mount applicator only

#### Optional parts:

- ▶ End cover kit, RTLTF only (A-9585-0035)
- ▶ Renishaw scale wipes (A-9523-4040)
- ▶ Lint-free cloth
- ▶ Reference mark deselection stickers (A-9402-0049 for a sheet of 20)
- ▶ Loctite 435 dispensing tip (P-TL50-0209)

#### Readhead mounting bracket and scale applicator:

There are different versions of the applicator depending upon the scale and design of the readhead mounting bracket. For more information on designing your bracket, contact your local Renishaw representative.

	Slim applicator	Side mount applicator	Top mount applicator
			
<b>Mounting</b>	In place of the readhead bracket	In place of the readhead bracket	In place of the readhead
<b>Applicable bracket</b>	Side mounting bracket (A-9401-0103) Customer-designed bracket	'L' mounting bracket (A-9402-0037) Customer-designed bracket	'L' mounting bracket (A-9402-0037) Customer-designed bracket
<b>RTLTF</b>	A-9402-0060	A-9402-0034	A-9402-0028
<b>RKLF</b>	A-6547-1947	A-6547-1943	A-6547-1939

## RTLTF/RKLF tape scale (continued)

### RTLTF/RKLF application (any length)

1. Allow scale to acclimatise to installation environment prior to installation.

**NOTE:** RKLF scale should be installed between +10 °C and +35 °C to ensure scale mastering.

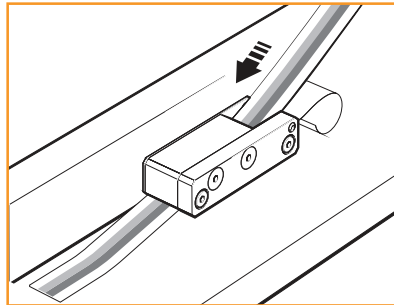
2. Mark out the start position for the scale on the axis substrate.

**NOTE:** For RKLF scale ensure that there is room for the end clamps, see 'RKLF installation drawing', page 6.

3. Thoroughly clean and degrease the substrate using recommended solvents ('Storage and handling', page 3). Allow substrate to dry before applying scale.
4. Mount the chosen scale applicator.
5. Move axis to start of travel leaving enough room for the scale to be inserted through the applicator, as shown below.
6. Check correct scale orientation.

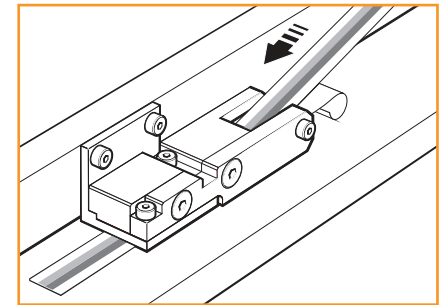
7. **Slim or side mount applicators:**

- ▶ Begin to peel off the backing paper from the end of the scale and insert the scale into the applicator up to the start position.
- ▶ Ensure the backing paper feeds out of the back of the applicator around the splitter screw as shown.



7. **Top mount applicator:**

- ▶ Cut the backing paper approximately 30 mm from the end of the scale.
- ▶ Leaving the end piece adhering to the scale, begin to peel off the remaining backing paper.
- ▶ Insert the scale into the applicator up to the start position.
- ▶ Ensure the backing paper feeds out of the back of the applicator round the splitter screw as shown.



8. Apply firm finger pressure via a clean, dry, lint-free cloth to ensure scale end adheres well to the substrate.
9. Slowly and smoothly move the applicator through the entire length of travel, ensuring the backing paper is pulled manually from the scale and does not catch under the applicator.
10. Remove the applicator and, if necessary, adhere the remaining scale manually.

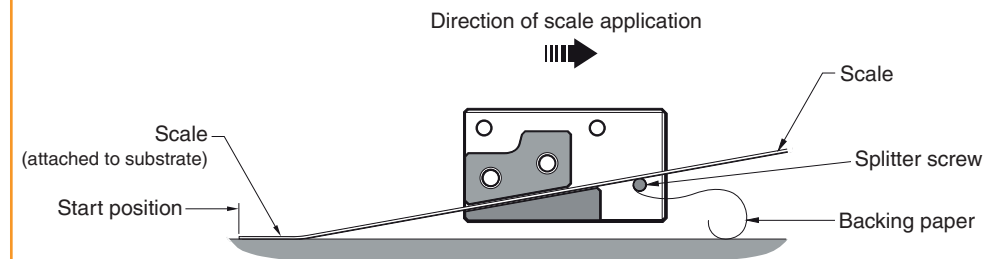
**NOTE:** When using the top mount applicator ensure the backing paper left at the start of the axis is removed.

11. Apply firm finger pressure via a clean, dry, lint-free cloth along the length of the scale after application to ensure complete adhesion.
12. Remove the applicator and, if necessary, adhere the remaining scale manually.

**Slim and side mount applicators:** Fit readhead mounting bracket after removal of scale applicator.

13. Clean the scale using Renishaw scale wipes or a clean, dry, lint-free cloth.
14. **RTLTF:** Fit datum clamp and end covers (page 12) and, if needed, deselect reference marks that are not required as detailed (page 13).  
**RKLF:** Fit end clamps and, if needed, deselect reference marks that are not required (page 13).

#### Side mount applicator shown



## RTLTF/RKLF tape scale (continued)

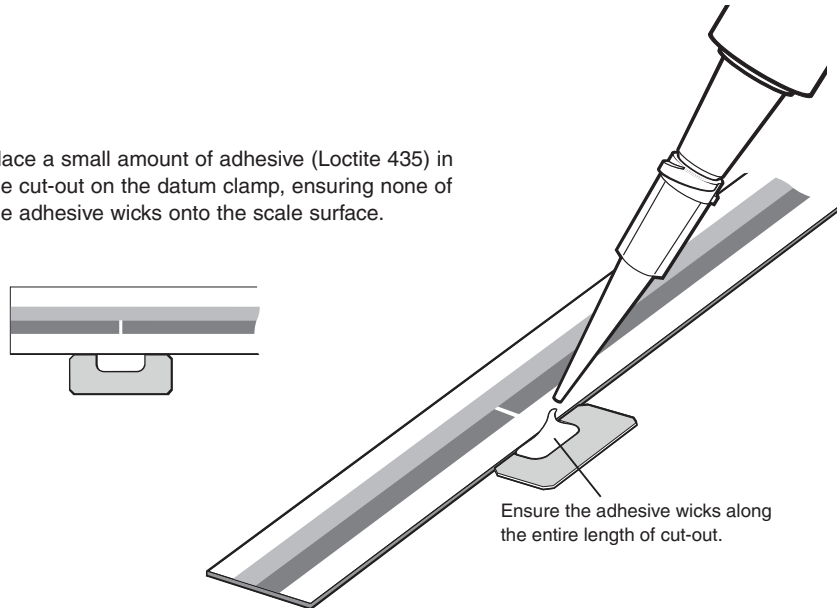
### RTLTF datum clamp

The datum clamp fixes the RTLTF scale rigidly to the substrate at the location chosen.

**CAUTION:** The metrology of the system may be compromised if the datum clamp is not used. It can be positioned anywhere along the axis depending upon the customers' requirements.

1. Remove the backing paper from the datum clamp. Place the datum clamp with cut-out against the scale at the chosen location.

2. Place a small amount of adhesive (Loctite 435) in the cut-out on the datum clamp, ensuring none of the adhesive wicks onto the scale surface.

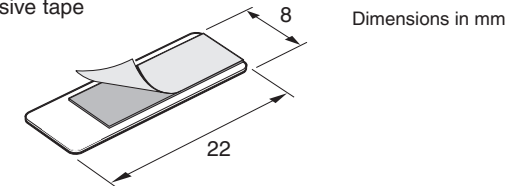


### RTLTF end covers

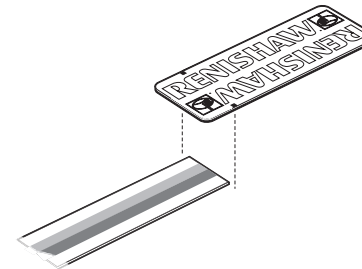
The end cover kit is designed to be used with RTLTF scale to provide protection for exposed scale ends.

**NOTE:** End covers are optional and can be fitted before or after readhead installation.

1. Remove the backing paper from the adhesive tape on the back of the end cover.



2. Align the markers on the edges of the end cover with the end of the scale and place the end cover over the scale.



**NOTE:** There will be a gap\* between the end of the scale and the adhesive tape on the end cover.

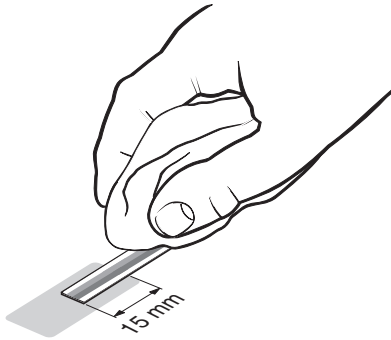
## RTLTF/RKLF tape scale (continued)

### RKLF end clamps

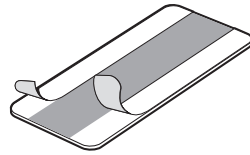
The end clamp kit is designed to be used with Renishaw RKLF scale to ensure the scale is mastered to the substrate. Alternative narrow 6 mm wide end clamps (A-9523-4111) are also available.

**NOTE:** End clamps can be mounted before or after readhead installation.

1. Clean ends of scale and the area where end clamps are to be fitted using Renishaw scale wipes or one of the recommended solvents ('Storage and handling', page 3).

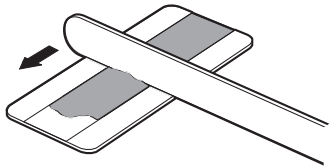


3. The end clamp features two small regions of contact adhesive. These will temporarily hold the end clamp in position while the epoxy cures. Remove the backing tape from either side.

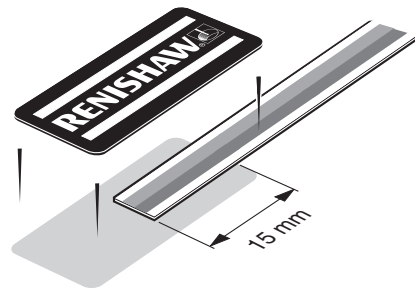


**CAUTION:** Ensure that excess epoxy is wiped away from scale as it may affect the readhead signal level.

2. Thoroughly mix up a sachet of RGG-2 two part epoxy adhesive and apply a small amount to the underside of the end clamp.



4. Immediately position end clamp over the end of the scale and push down to ensure complete adhesion. Allow 24 hours at 20 °C for full cure.\*

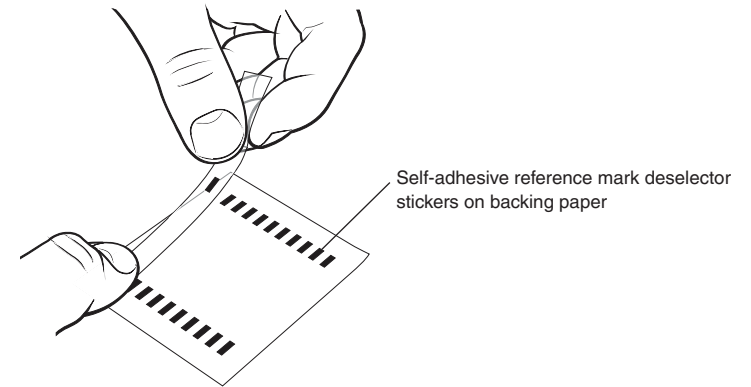


\* To ensure scale end movement of typically <math>1 \mu\text{m}</math>, stabilise the system at least 5 °C higher than the maximum customer application temperature for a minimum of 8 hours. For example: Customer application = 23 °C axis temperature. Stabilise the system at 28 °C for a minimum of 8 hours.

### RTLTF/RKLF reference mark deselection

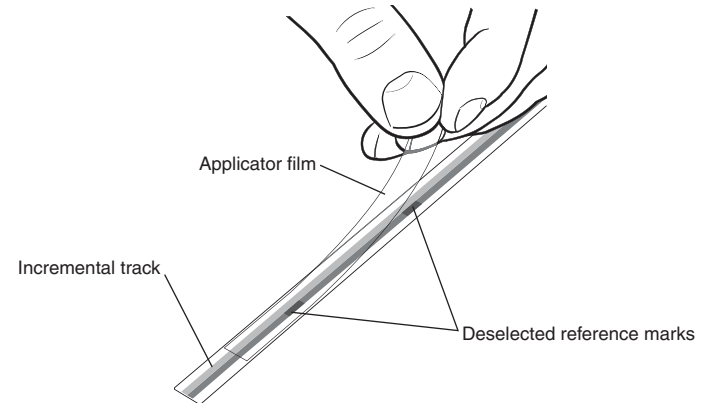
RTLTF and RKLF scale > 100 mm in length has reference marks every 50 mm. Stickers can be used to deselect all unused reference marks. The stickers are aligned on the backing paper with a 50 mm spacing so two can be selected at once for deselecting two reference marks.

1. Ensure the scale is free from dirt and grease by cleaning with a Renishaw scale wipe or one of the recommended solvents ('Storage and handling', page 3).
2. Place the transparent applicator film over the reference mark deselector stickers and rub firmly until the sticker adheres to the applicator film. Two stickers can be selected at once.
3. Remove the applicator film, complete with the stickers, from the backing paper.



4. Align the stickers on the scale over the reference marks that are not required, as shown in the diagram, then rub firmly on the applicator film until the stickers adhere to the scale.

Care should be taken to ensure the stickers fully cover the reference mark and do not obscure any of the incremental track.



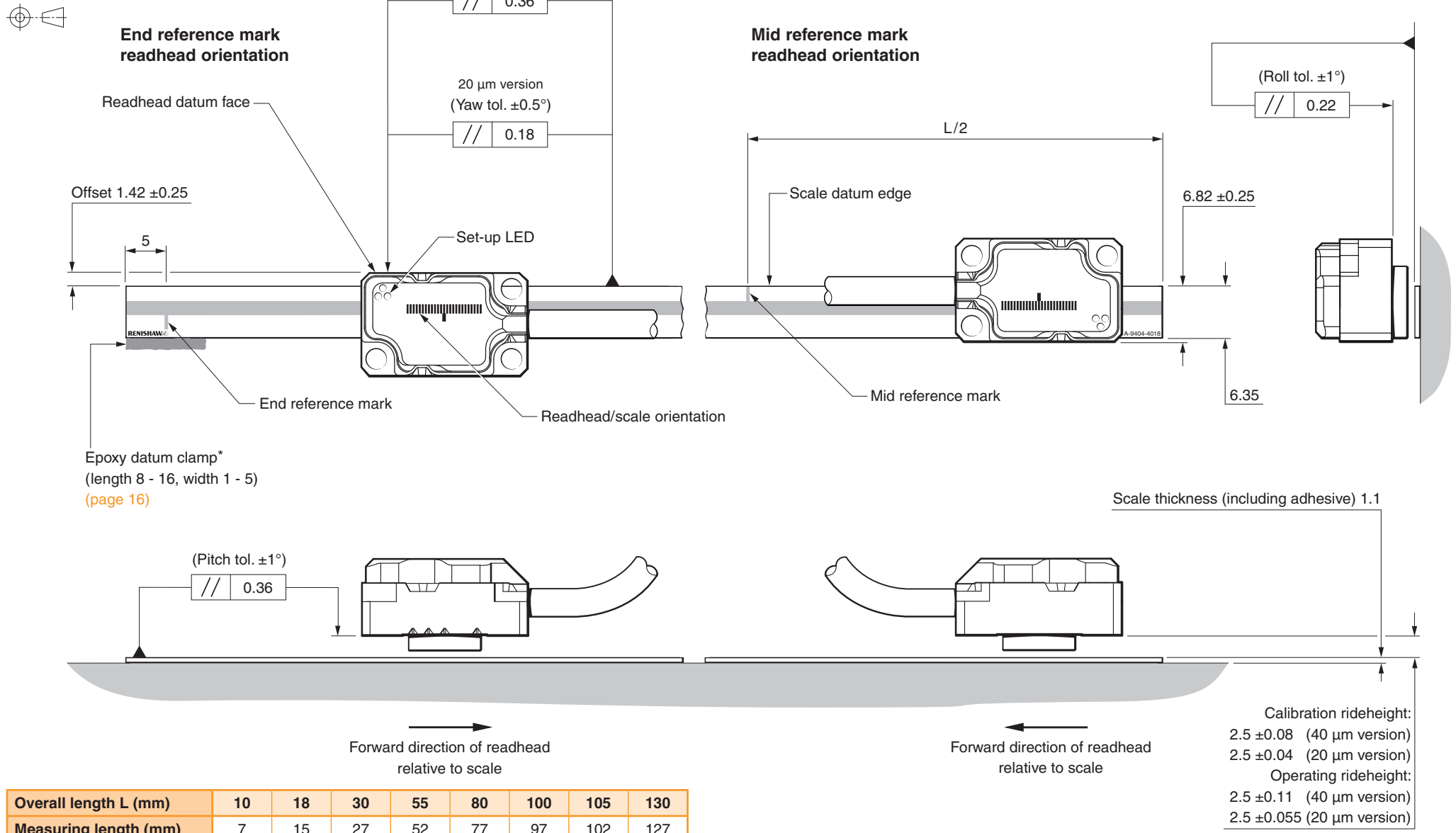
5. Remove applicator film.

# RCLC glass spar scale

## RCLC installation drawing

For dimensioned cabled and FPC readhead drawings see [page 27](#) and [page 28](#).

Dimensions and tolerances in mm



<b>Overall length L (mm)</b>	10	18	30	55	80	100	105	130
<b>Measuring length (mm)</b>	7	15	27	52	77	97	102	127

\* Can be applied on one or both sides of the scale.



## RCLC glass spar scale (continued)

---

### RCLC mounting

#### Suitable for:

- ▶ RCLC glass spar scale, any length

#### Required parts:

- ▶ RCLC scale ('RCLC installation drawing', page 14)
- ▶ RGG-2 two part epoxy adhesive (A-9531-0342)
- ▶ Appropriate cleaning solvents ('Storage and handling', page 3)

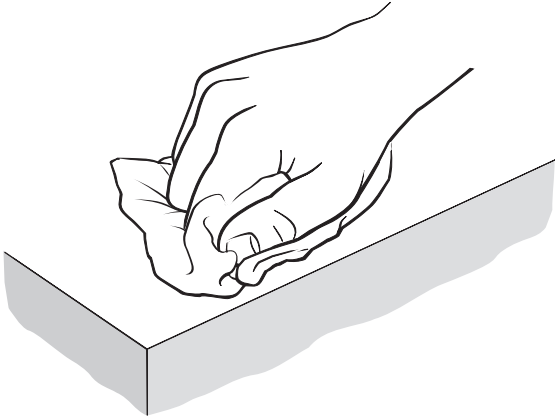
#### Optional parts:

- ▶ Renishaw scale wipes (A-9523-4040)
- ▶ Lint-free cloth

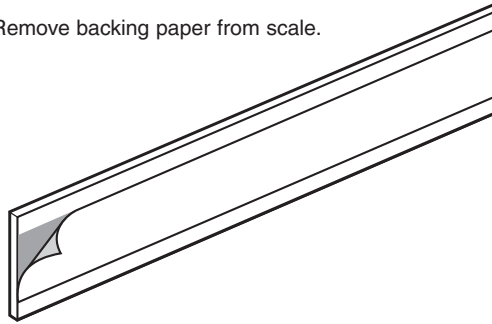
## RCLC glass spar scale (continued)

### RCLC mounting (continued)

1. Thoroughly clean and degrease the substrate using recommended solvents ('Storage and handling', page 3). Allow substrate to dry before applying scale.



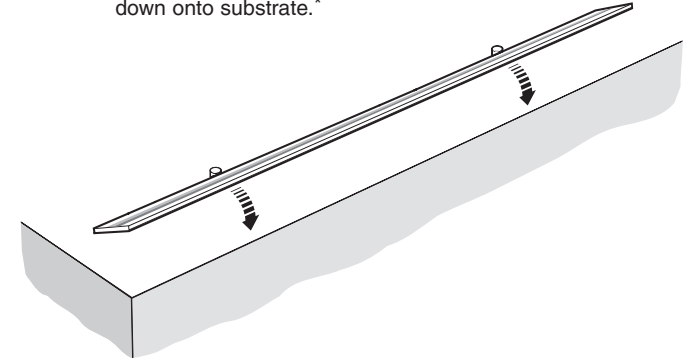
2. Remove backing paper from scale.



3. Ensure correct orientation of the scale for chosen reference mark location (middle or end of scale) and readhead orientation.

See 'RCLC installation drawing', page 14 for details.

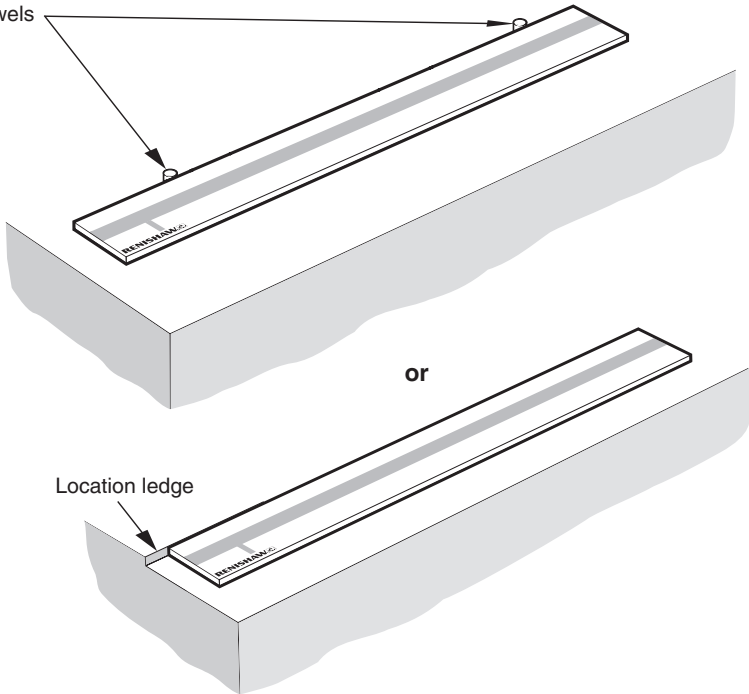
4. Locate scale against dowels or ledge and rotate down onto substrate.\*



\* If dowels or ledge are permanent, their maximum height above substrate is 1.2 mm.

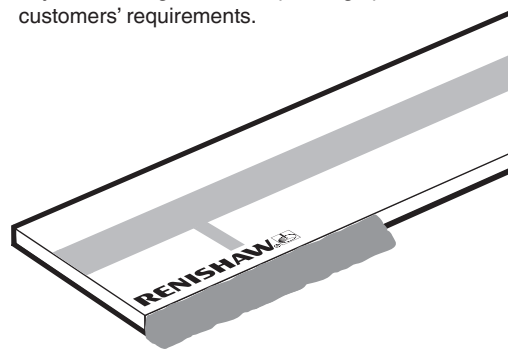
- 5.

Support  
dowels



6. Apply fillet of RGG-2 two part epoxy adhesive. Epoxy can be applied to one or both sides of the scale. Ensure epoxy does not wick onto scale surface. (End reference mark shown).

The datum clamp does not need to be positioned adjacent to a reference mark. It can be positioned anywhere along the axis depending upon the customers' requirements.



7. After 24 hours when epoxy is cured, clean scale using Renishaw scale wipes or a clean, dry, lint-free cloth.



8. Remove temporary dowels (if fitted).

# System connection

## Top exit readhead

A range of cables for top exit readheads are available;

### 15-way D-type connector

Cable length (m)	Part number
0.5	A-9414-1223
1.0	A-9414-1225
1.5	A-9414-1226
3.0	A-9414-1228

### 10-way JST

Cable length (m)	Part number
0.5	A-9414-1233
1.0	A-9414-1235
1.5	A-9414-1236
3.0	A-9414-1238

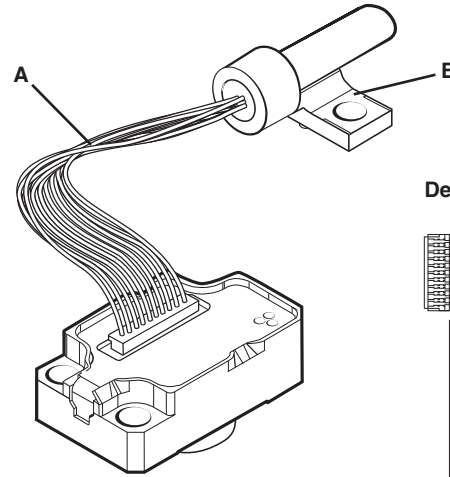
- ▶ Provide appropriate strain relief at the readhead. The Renishaw top exit cables are fitted with a P-clip to ensure appropriate cable strain relief.
- ▶ When using Renishaw's top exit cables ensure that the P-clip is mounted within a 50 mm radius of the readhead cable exit.
- ▶ Minimum static bend radius of cores is 3 mm.
- ▶ For challenging dynamic applications consider additional strain relief of the cores.
- ▶ Ensure there is no relative movement between the readhead and the P-clip.
- ▶ The maximum number of insertions for the readhead connector is 20 cycles. Care should be taken when removing the connector to avoid pulling out cores from the cable connector.

### Shielding

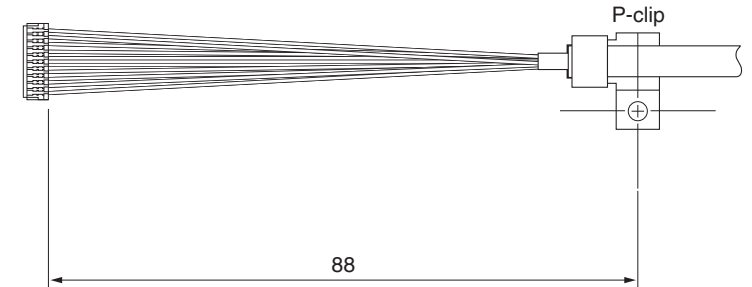
For optimum performance:

- ▶ Ensure 100% shielding.
- ▶ Ground the mounting brackets.
- ▶ Ensure continuity between the readhead body and cable shield. For Renishaw top exit cables the P-clip provides electrical connection to the cable shield.
- ▶ Maximise the distance between the encoder and motor cables.

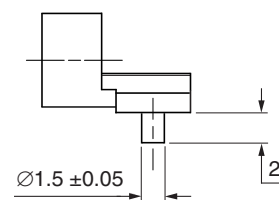
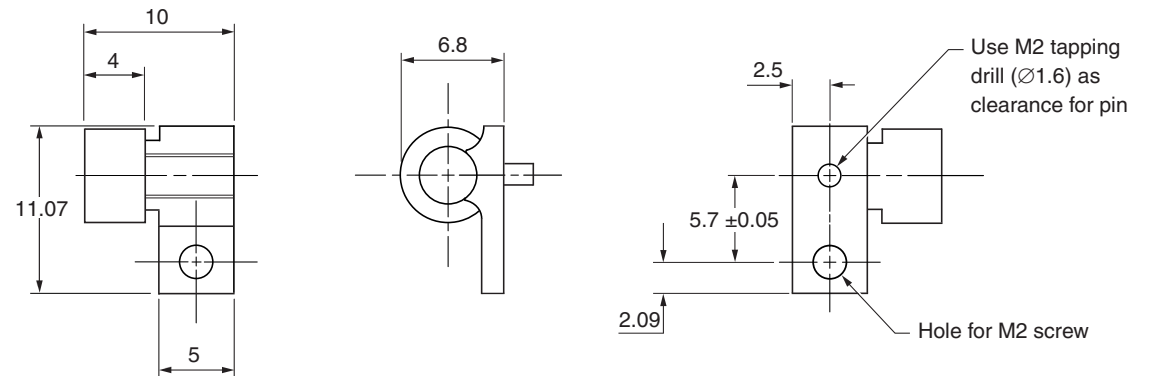
### Top exit readhead (with readhead cable inserted)



Detail A: Connector (readhead end) and P-clip



Detail B: P-clip dimensions



## Readhead mounting and alignment

### Methods

There is a range of tools available to assist with readhead installation depending upon the system design and these are detailed below. For more details on designing the mounting bracket and selecting the appropriate mounting tools contact your local Renishaw representative.

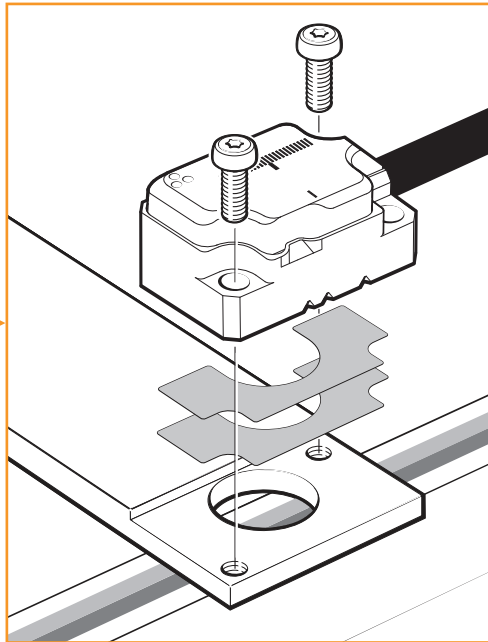
Ensure that the scale, readhead optical window and mounting face are clean and free from obstruction.

**CAUTION:** Do not saturate the readhead window with cleaning solvent as this may cause contamination on the inside of the readhead window which cannot be cleaned.

**IMPORTANT:** Whichever method is used to mount the readhead, care should be taken to ensure the scale surface is not damaged during this operation, particularly when metal-to-metal contact is necessary.

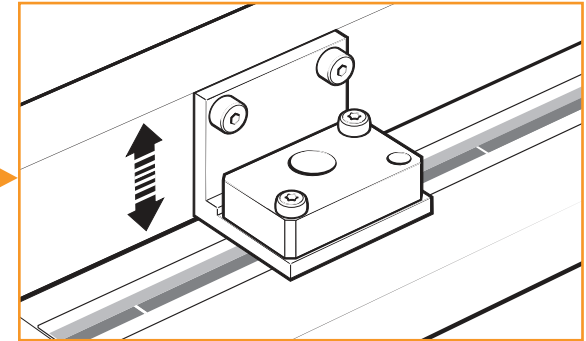
**NOTE:** Cabled readhead shown but the same readhead mounting and alignment methods are applicable for top exit readheads.

**Fixed mounting**  
Readhead mounting bracket does not allow for adjustment of rideheight

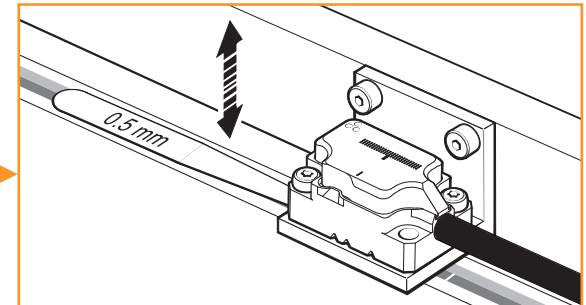


Shim kit (page 19).

**Adjustable bracket**  
Readhead mounting bracket allows adjustment of rideheight



Dummy head (page 20).



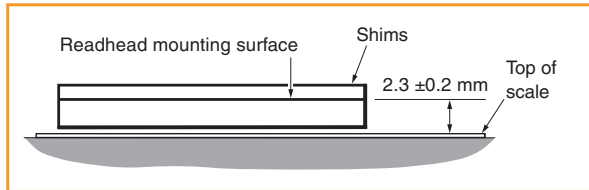
Accurate bracket and feeler gauge (page 21).

## Readhead mounting and alignment (continued)

### Shim kit

#### Suitable for:

- ▶ Applications where the rideheight of the readhead cannot be adjusted. The system should be designed to achieve a nominal distance of 2.3 mm ( $\pm 0.2$  mm) from the readhead mounting surface to the top of the scale.

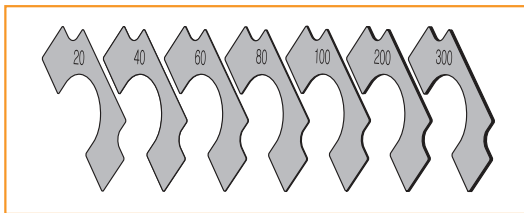


Shims of a known thickness are inserted between the mounting face of the readhead and the bracket to give the correct rideheight.

#### Required parts:

- ▶ Shim kit (A-9401-0050) consisting of:

Part Number	Thickness ( $\mu\text{m}$ )	Quantity in pack
A-9401-0041	20	10
A-9401-0042	40	10
A-9401-0043	60	10
A-9401-0044	80	10
A-9401-0045	100	20
A-9401-0046	200	20
A-9401-0047	300	10



- ▶ Digital dial gauge (DTi) or similar
- ▶ 2 x M2 x 6 screws
- ▶ ATOM DX readhead

#### Optional parts:

- ▶ DTi adaptor (A-9401-0105)

1. Using a digital dial gauge or similar, measure the distance from the readhead mounting surface to the scale surface.

Care must be taken to ensure the scale surface is not scratched.

- Insert the gauge into the adapter and zero the gauge on a flat surface.
- Position or fix the gauge/adaptor in place of the readhead and measure the distance to the scale surface.

Contact your local Renishaw representative for details of the DTi adapter and digital dial gauge.

2. Subtract the distance measured from the nominal rideheight of 2.5 mm to calculate the required shim thickness.

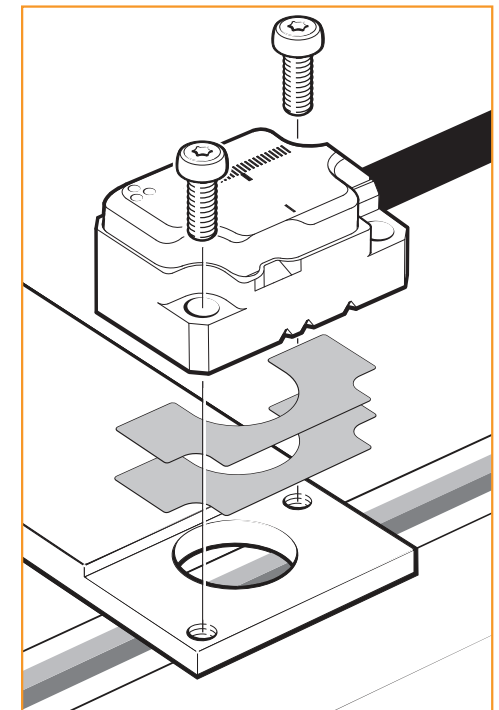
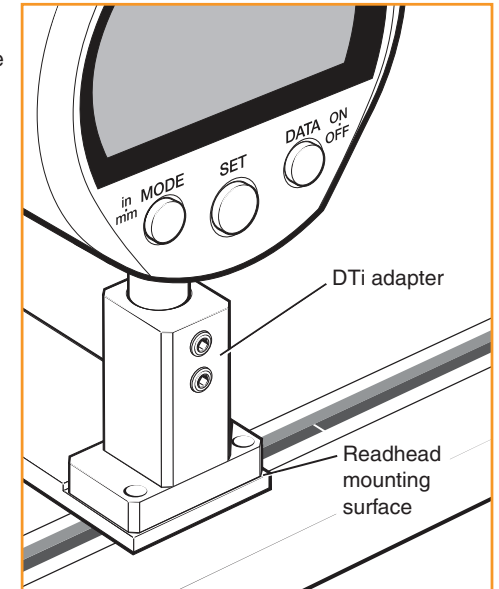
For example if the distance measured is 2.37 mm the required shim thickness is 130  $\mu\text{m}$ .

3. Select a combination of two shims that gets within 10  $\mu\text{m}$  of the difference.

For distances less than 100  $\mu\text{m}$  a single shim should be used, for distances greater than 100  $\mu\text{m}$  select one thick ( $\geq 100$   $\mu\text{m}$ ) and one thin ( $< 100$   $\mu\text{m}$ ) shim.

In the above example this could either be 1 x 100  $\mu\text{m}$  shim and 1 x 40  $\mu\text{m}$  shim or 1 x 100  $\mu\text{m}$  shim and 1 x 20  $\mu\text{m}$  shim.

4. Place the chosen shim(s) between the readhead and the bracket.
5. Fix the readhead to the bracket using screws in diagonally opposite fixing holes, ensuring readhead is tightened down evenly and parallel to the bracket face.
6. Connect the readhead to the receiving electronics and power-up.
7. Check the readhead set-up LED is flashing Green along the full axis of travel.
8. Proceed with 'System calibration', page 23.



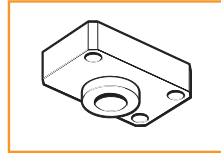
## Readhead mounting and alignment (continued)

### Dummy kit

#### Suitable for:

- ▶ Applications where the readhead mounting bracket allows adjustment of rideheight

The reusable dummy head is mounted directly onto the bracket in place of the readhead. It has the same dimensions as the ATOM DX readhead with a longer 'nose' that is machined to the optimum rideheight (2.5 mm ±0.02 mm).

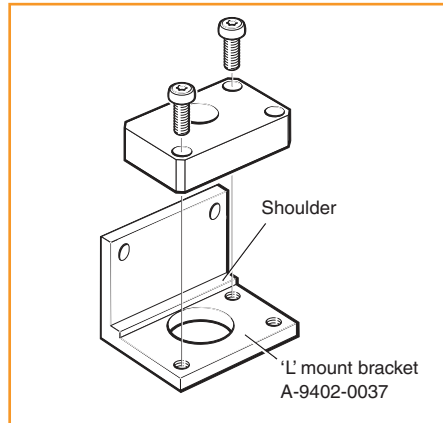
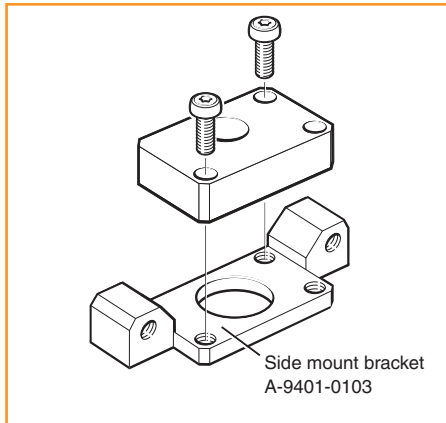


#### Required parts:

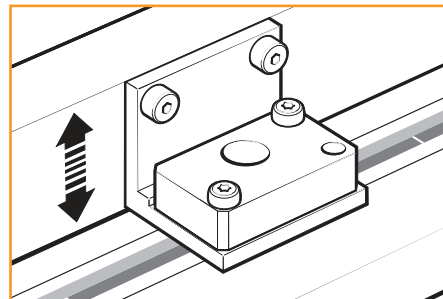
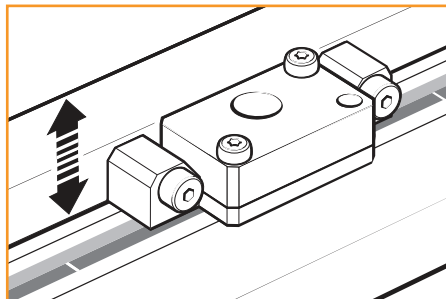
- ▶ Dummy head (A-9401-0072)
- ▶ 2 × M2 × 6 screws
- ▶ Side mount bracket (A-9401-0103), 'L' mount bracket (A-9402-0037) or customer designed bracket\*
- ▶ 2 × bracket mounting screws
- ▶ ATOM DX readhead

\*The bracket should have a shoulder to control readhead yaw. Contact your local Renishaw representative for more information on bracket design.

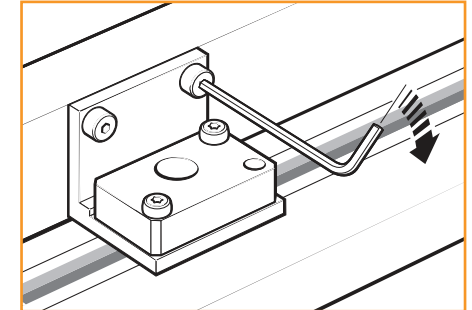
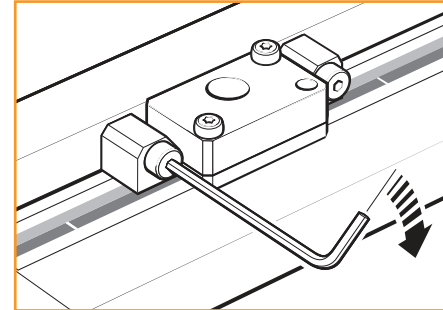
1. Mount the dummy head onto the bracket using two screws.



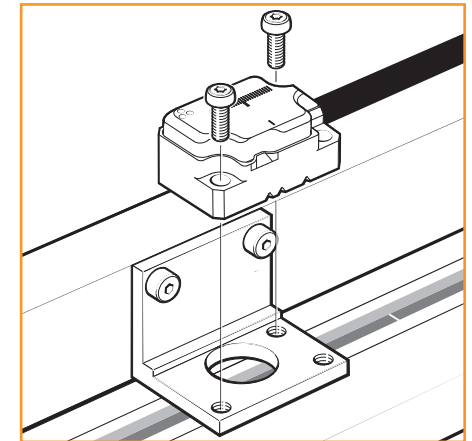
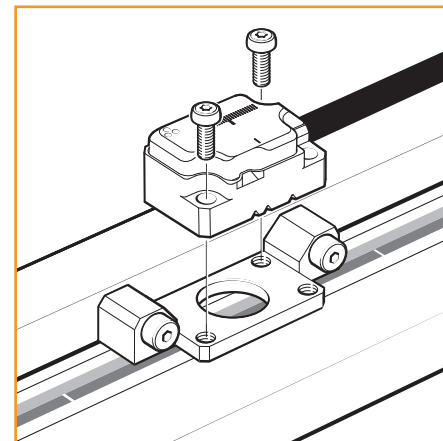
2. Loosely mount the readhead bracket onto the axis.



3. Adjust the height of the bracket until the 'nose' of the dummy head touches the scale.
4. Tighten the bracket fixing screws whilst ensuring good contact between the 'nose' of the dummy head and the surface of the scale.



5. Remove the dummy head.
6. Install the ATOM DX readhead in place of the dummy head using screws in diagonally opposite fixing holes. Ensure the readhead is pushed back against the shoulder of the bracket or mounting face.



7. Connect the readhead to the receiving electronics and power-up.
8. Check the readhead set-up LED is flashing Green along the full axis of travel.
9. Proceed with 'System calibration', page 23.

## Readhead mounting and alignment (continued)

### Accurate bracket and feeler gauge

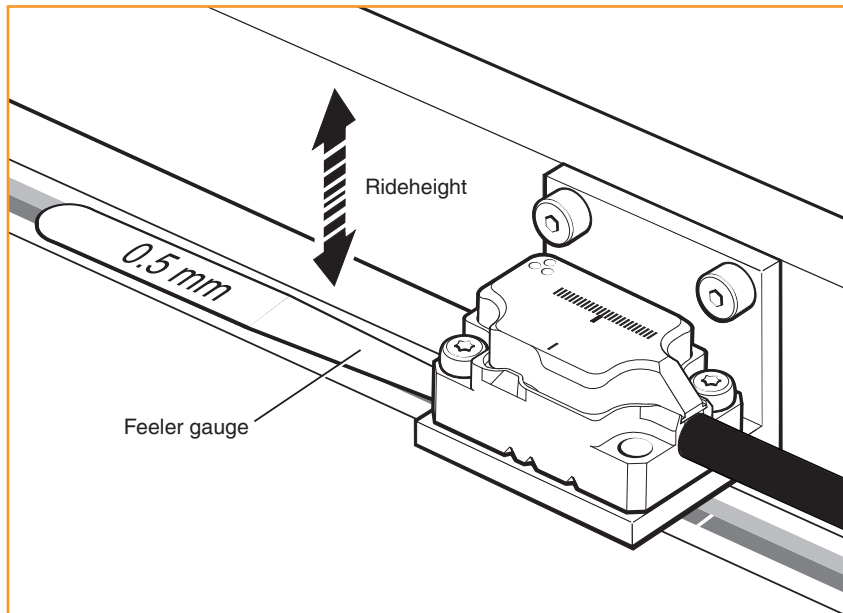
#### Suitable for:

- ▶ Applications where the readhead mounting bracket allows adjustment of rideheight with a bracket thickness of  $2 \pm 0.02$  mm

#### Required parts:

- ▶ 'L' mount bracket (A-9402-0037) or customer designed bracket with a thickness of  $2 \pm 0.02$  mm\*
- ▶ 2 × bracket mounting screws
- ▶ 0.5 mm feeler gauge
- ▶ 2 × M2 × 6 screws
- ▶ ATOM DX readhead

1. Mount the readhead onto the bracket.
2. Loosely mount the readhead bracket onto the axis.
3. Place the feeler gauge between the readhead bracket and the scale.

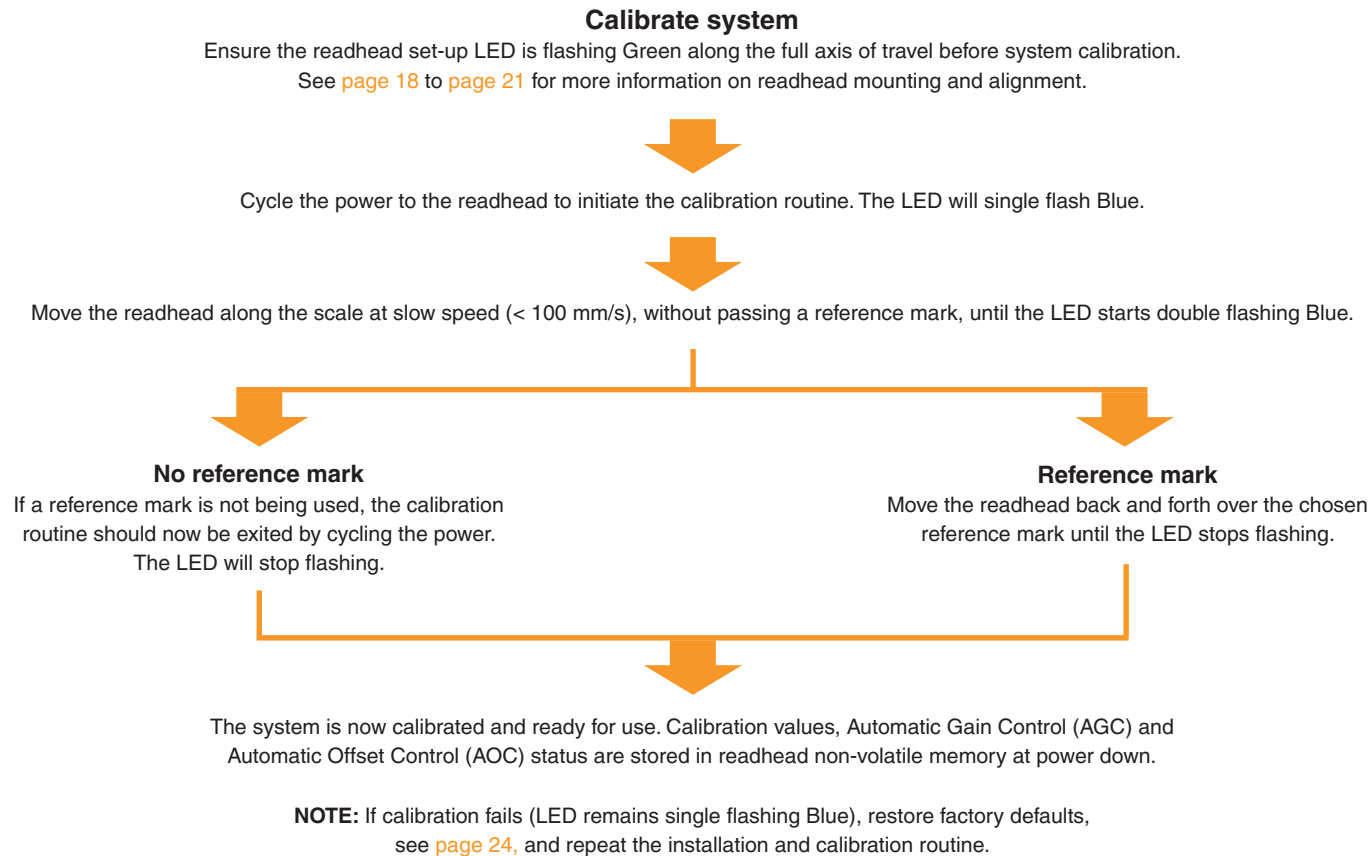


4. Tighten the bracket fixing screws whilst ensuring good contact between bracket, shim and surface of the scale.
5. Connect the readhead to the receiving electronics and power-up.
6. Check the readhead set-up LED is flashing Green along the full axis of travel.
7. Proceed with '[System calibration](#)', page 23.

\* For more information on bracket design contact your local Renishaw representative.

## ATOM DX calibration overview

This section is a quick-start guide to calibrating an ATOM DX encoder system. For more detailed information on calibrating the readhead see 'System calibration', page 23. The optional Advanced Diagnostic Tool ADTi-100\* (A-6165-0100) and ADT View software† can be used to aid installation and calibration.



\* For more details refer to the *Advanced Diagnostic Tool ADTi-100 and ADT View software* quick start guide (M-6195-9321) and *Advanced Diagnostic Tool ADTi-100 and ADT View software* user guide (M-6195-9413).

† The software can be downloaded for free from [www.renishaw.com/adt](http://www.renishaw.com/adt).



## System calibration

**NOTE:** System calibration (CAL), can also be carried out using the optional ADTi-100 and ADT View software. See [www.renishaw.com/adt](http://www.renishaw.com/adt) for more information.

### Before system calibration:

- ▶ Clean the scale and readhead optical window
- ▶ If reinstalling, restore factory defaults ('Restoring factory defaults', page 24)
- ▶ Maximise the signal strength along full length of travel (readhead set-up LED is flashing Green)

**NOTE:** Maximum calibration speed 100 mm/s or less than the readhead maximum speed, whichever is slowest.

### Step 1 – Incremental signal calibration

- ▶ Cycle the power to the readhead or connect the 'Remote CAL' output pin to 0 V for < 3 seconds. The readhead will then single flash Blue to indicate it is in calibration mode. The readhead will only enter calibration mode if the LED is flashing Green.
- ▶ Move the readhead at slow speed along the axis, ensuring it does not pass a reference mark, until the LED starts double-flashing indicating the incremental signals are now calibrated and the new settings are stored in the readhead memory.
- ▶ The system is now ready for reference mark phasing. For systems without a reference mark, cycle the power to the readhead or connect the 'Remote CAL' output pin to 0 V for < 3 seconds to exit calibration mode.
- ▶ If the system does not automatically enter the reference mark phasing stage (LED continues single flashing) the calibration of the incremental signals has failed. After ensuring failure is not due to overspeed (> 100 mm/s or exceeding the readhead maximum speed), exit the calibration routine, restore factory defaults, see page 24 and check the readhead installation and system cleanliness before repeating the calibration routine.

### Step 2 – Reference mark phasing

- ▶ Move the readhead back and forth over the chosen reference mark until the LED stops flashing and remains solid Blue. The reference mark is now phased.

**NOTE:** Only the chosen reference mark that has been used in the calibration routine is guaranteed to remain phased.

- ▶ The system automatically exits the calibration routine and is ready for operation.
- ▶ AGC is automatically switched on once calibration is complete. To switch off AGC refer to the 'Switching Automatic Gain Control (AGC) on or off', page 24.
- ▶ If the LED continues double-flashing after repeatedly passing the chosen reference mark it is not being detected.
  - Ensure that the readhead orientation and lateral offset are correct.

### Calibration routine manual exit

- ▶ To exit the calibration routine at any stage cycle the power to the readhead or connect the 'Remote CAL' output pin to 0 V for < 3 seconds. The LED will then stop flashing.

LED	Settings stored
Blue single flashing	None, restore factory defaults and recalibrate
Blue double flashing	Incremental only
Blue	Incremental and reference mark

## Restoring factory defaults

**NOTE:** Restoring factory defaults can also be carried out using the optional ADTi-100 and ADT View software.

See [www.renishaw.com/adt](http://www.renishaw.com/adt) for more information.

When realigning the readhead, reinstalling the system, or in the case of continued calibration failure, factory defaults should be restored.

### To restore factory defaults:

- ▶ Switch system off.
- ▶ Obscure the readhead optical window or connect the 'Remote CAL' output pin to 0 V.
- ▶ Power the readhead.
- ▶ Remove the obstruction or, if using, the connection from the 'Remote CAL' output pin to 0 V.
- ▶ The LED will start continuously flashing indicating factory defaults have been restored and the readhead is in installation mode (flashing set-up LED).
- ▶ Check the readhead mounting / installation and recalibrate the system.

## Switching Automatic Gain Control (AGC) on or off

**NOTE:** AGC can also be switched on or off using the optional ADTi-100 and ADT View software.

See [www.renishaw.com/adt](http://www.renishaw.com/adt) for more information.

The AGC is automatically enabled once the system has been calibrated (indicated by a Blue LED). AGC can be manually switched off by connecting the 'Remote CAL' output pin to 0 V for > 3 seconds < 10 seconds. The LED will then be solid Green.

## LED diagnostics

Mode	LED	Status
Installation mode	Green flashing	Good set-up, maximise flash rate for optimum set-up
	Orange flashing	Poor set-up, adjust readhead to obtain Green flashing LED
	Red flashing	Poor set-up, adjust readhead to obtain Green flashing LED
Calibration mode	Blue single flashing	Calibrating incremental signals
	Blue double flashing	Calibrating reference mark
Normal operation	Blue	AGC on, optimum set-up
	Green	AGC off, optimum set-up
	Red	Poor set-up; signal may be too low for reliable operation
	Blank flash	Reference mark detected (visible indication at speed < 100 mm/s only)
Alarm	4 red flashes	Low signal or over signal; system in error

**NOTE:** See 'Troubleshooting', page 25 for more information on diagnosing faults.

## Troubleshooting

Fault	Cause	Possible solutions
<b>LED on the readhead is Blank</b>	There is no power to the readhead	<ul style="list-style-type: none"> <li>▶ Check you have 5 V at the readhead</li> <li>▶ For cable variants check correct wiring of connector</li> </ul>
<b>LED on the readhead is Red and I can't get a Green LED</b>	The signal strength is < 50%	<ul style="list-style-type: none"> <li>▶ Check the readhead optical window and scale are clean and free from contamination</li> <li>▶ Restore factory defaults (page 24) and check alignment of the readhead. In particular;               <ul style="list-style-type: none"> <li>– Rideheight</li> <li>– Yaw</li> <li>– Offset</li> </ul> </li> <li>▶ Check the scale and readhead orientation</li> <li>▶ Check that the readhead variant is the correct type for the chosen scale (see the <i>ATOM DX™ miniature encoder system</i> data sheet (Renishaw part no. L-9517-9736) for details of readhead configuration)</li> </ul>
<b>Unable to get a flashing Green LED over the complete axis length</b>	System run-out is not within specification	<ul style="list-style-type: none"> <li>▶ Check that the readhead variant is the correct type for the chosen scale (see the <i>ATOM DX™ miniature encoder system</i> data sheet (Renishaw part no. L-9517-9736) for details of readhead configuration)</li> <li>▶ Use a DTI gauge and check the run-out is within specifications</li> <li>▶ Restore factory defaults</li> <li>▶ Realign readhead to obtain a flashing Green LED at the mid-point of the run-out</li> <li>▶ Recalibrate the system (page 23)</li> </ul>
<b>Can't initiate the calibration routine</b>	Signal size is < 70%	<ul style="list-style-type: none"> <li>▶ Restore factory defaults</li> <li>▶ Realign readhead to obtain a flashing Green LED</li> </ul>
<b>LED on the readhead remains single flashing Blue even after moving it along the full axis length</b>	The system has failed to calibrate the incremental signals due to the signal strength being < 70%	<ul style="list-style-type: none"> <li>▶ Exit CAL mode and restore factory defaults (page 24)</li> <li>▶ Check system set-up and realign the readhead to obtain a flashing Green LED along the full axis of travel before recalibrating</li> </ul>

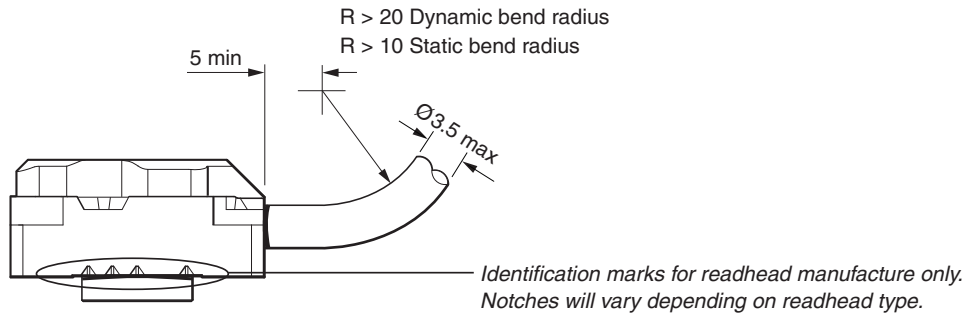
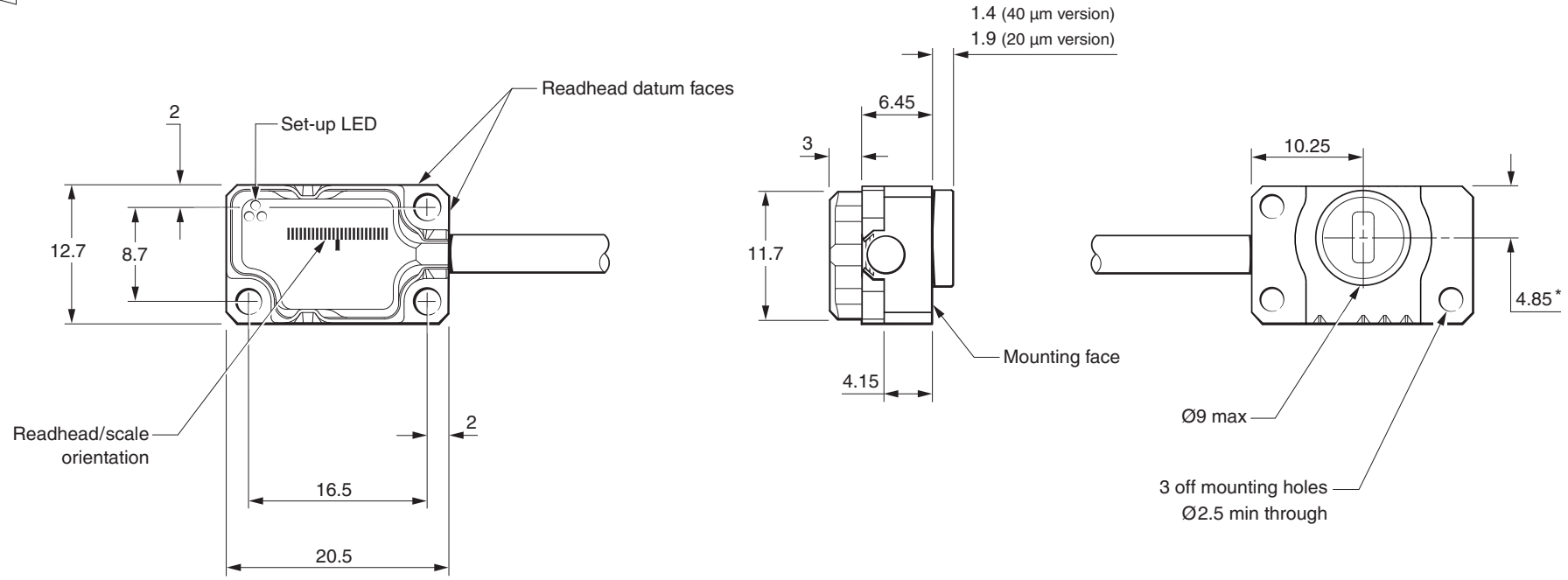
## Troubleshooting (continued)

Fault	Cause	Possible solutions
<p><b>During calibration the LED on the readhead is double flashing Blue even after moving it past the reference mark several times</b></p>	<p>The readhead is not seeing a reference mark</p>	<ul style="list-style-type: none"> <li>▶ Ensure you are moving the readhead past your chosen reference mark several times</li> <li>▶ Check the scale/readhead orientation</li> <li>▶ Check the scale readhead alignment</li> <li>▶ Check the readhead optical window and scale are clean and free from contamination</li> <li>▶ Check that the readhead variant is the correct type for the chosen scale (see the <i>ATOM DX™ miniature encoder system</i> data sheet (Renishaw part no. L-9517-9736) for details of readhead configuration)</li> </ul>
<p><b>No reference mark output</b></p>		<ul style="list-style-type: none"> <li>▶ Ensure you are not over-speeding the readhead during calibration mode (maximum speed &lt; 100 mm/sec)</li> <li>▶ Calibrate the system (page 23) <ul style="list-style-type: none"> <li>– If the system completes calibration mode then it has successfully seen and calibrated the reference mark. If you still don't see a reference mark then check the system wiring.</li> <li>– If the system does not calibrate the reference mark (readhead set-up LED remains double flashing Blue) see above for possible solutions</li> </ul> </li> </ul>
<p><b>Reference mark is not repeatable</b></p>	<p>Only the chosen reference mark that has been used in the calibration sequence is repeatable; other reference marks may not be phased</p>	<ul style="list-style-type: none"> <li>▶ Ensure you are using the reference mark that has been calibrated for referencing your system</li> <li>▶ The readhead bracket must be stable and not allow any mechanical movement of the readhead</li> <li>▶ Check any unused reference marks have been deselected</li> <li>▶ Clean the scale and readhead optical window and check for damage then recalibrate the system over the chosen reference mark</li> </ul>
<p><b>LED on the readhead is flashing Red over the reference mark</b></p>	<p>The reference mark is not phased</p>	<ul style="list-style-type: none"> <li>▶ Ensure you are using the reference mark that has been calibrated for referencing your system as only this reference mark will be guaranteed to remain phased. The LED may flash Red when passing other reference marks if they have not been deselected (page 13)</li> <li>▶ Clean the scale and readhead optical window and check for scratches then recalibrate the system over the chosen reference mark (page 23)</li> </ul>
<p><b>Multiple reference marks output</b></p>	<p>Unused reference marks have not been deselected</p>	<ul style="list-style-type: none"> <li>▶ All unused reference marks should be deselected (page 13) as only the calibrated reference mark will be repeatable</li> <li>▶ Check alignment of deselection stickers</li> </ul>

# ATOM DX readhead

## Cabled readhead dimensions

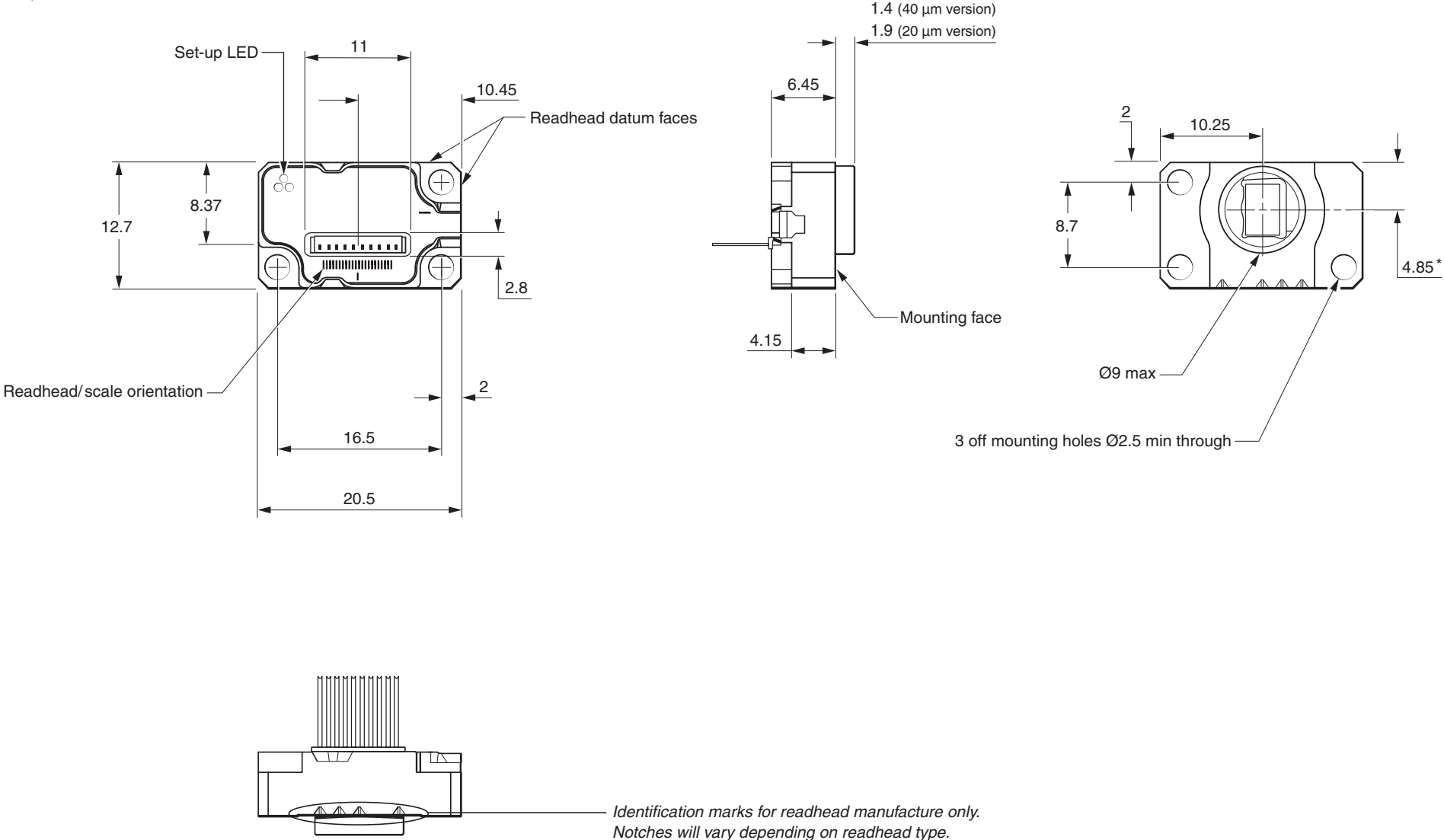
Dimensions and tolerances in mm



\* Not optical centreline

Top exit readhead dimensions

Dimensions and tolerances in mm

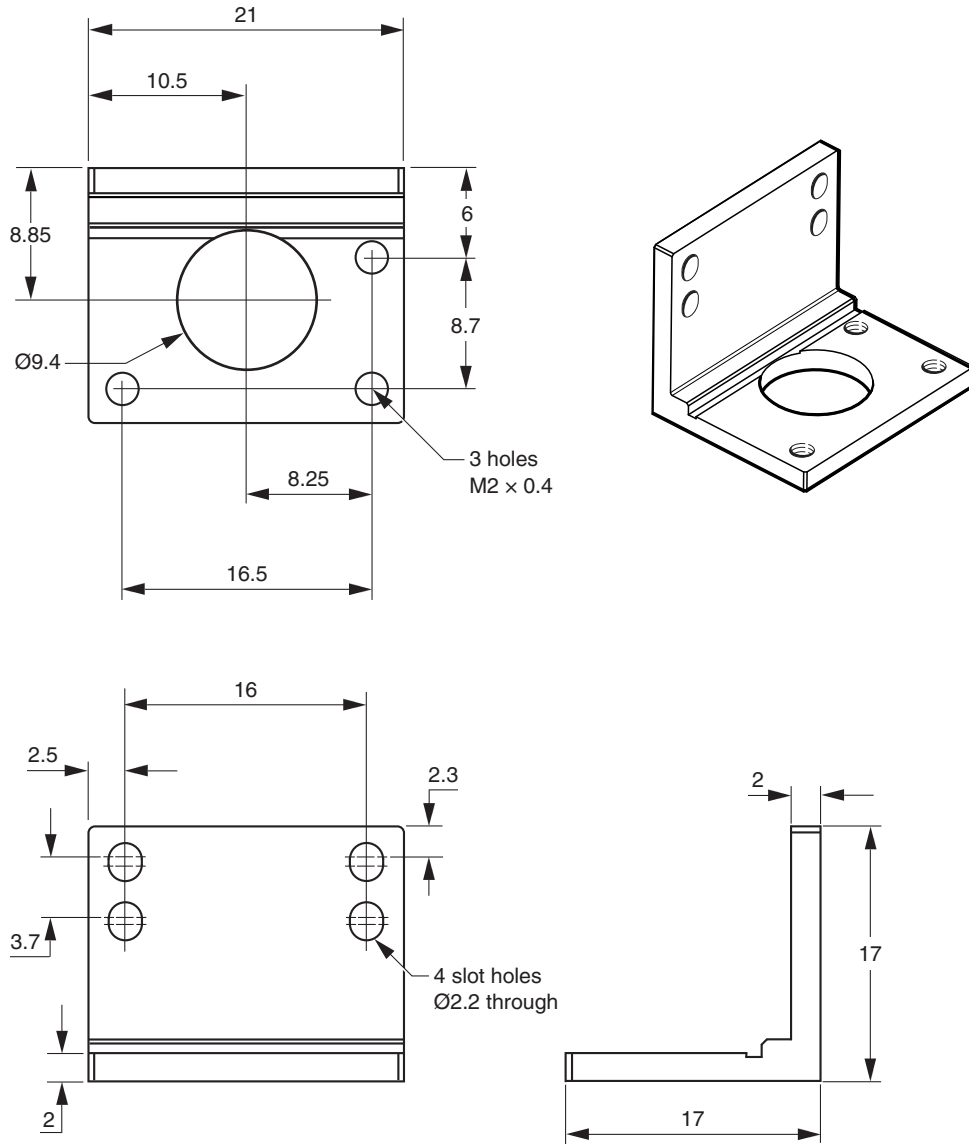


\* Not optical centreline

Bracket dimensions

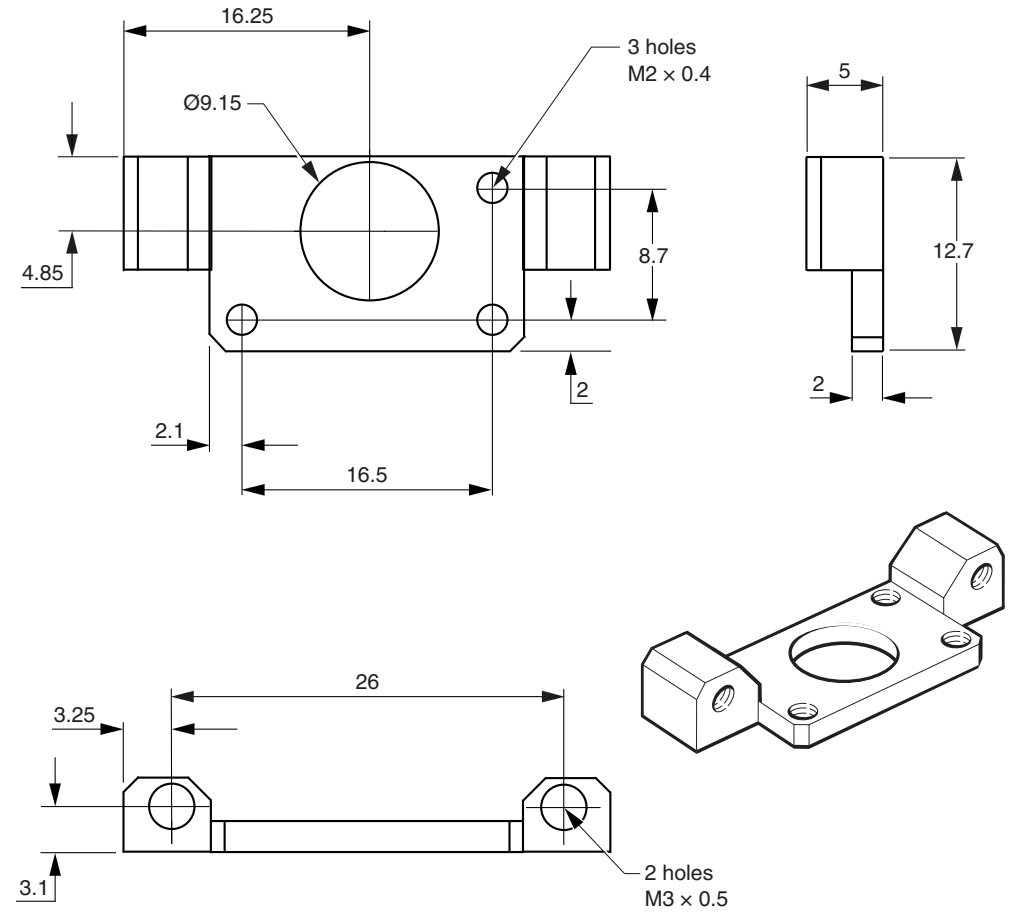


'L' mount bracket (A-9402-0037)

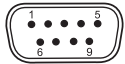






Dimensions and tolerances in mm

Side mount bracket (A-9401-0103)



## Output signals

			Cabled				Top Exit	
								
Function	Signal	Colour	9-way D-type (A)	15-way D-type (D)	15-way D-type alternative pin-out (H)	10-way JST* (K)	10-way JST† (Z)	
Power	5 V	Brown	5	7, 8	4, 12	10	10	
	0 V	White	1	2, 9	2, 10	2	9	
Incremental	A	+	Red	2	14	1	9	5
		-	Blue	6	6	9	7	6
	B	+	Yellow	4	13	3	4	8
		-	Green	8	5	11	1	7
Reference mark	Z	+	Violet	3	12	14	8	4
		-	Grey	7	4	7	5	3
Alarm	E	-	Orange	-	3	13	6	2
Remote CAL	CAL	Clear	9	1	5	3	1	
Shield	-	Screen	Case	Case	Case	Ferrule	-	

\* PCB mount mating connectors - Top entry: BM10B-SRSS-TB Side entry: SM10B-SRSS-TB.

† Connector on top exit readhead only. Mating connector 10SUR - 32S.



## Speed

### 20 µm encoder

Clocked output option (MHz)	Maximum speed (m/s)											Minimum edge separation* (ns)
	Readhead type											
	D (5 µm)	X (1 µm)	Z (0.5 µm)	W (0.2 µm)	Y (0.1 µm)	H (50 nm)	M (40 nm)	I (20 nm)	O (10 nm)	Q (5 nm)	R (2.5 nm)	
50	10	10	10	7.25	3.63	1.813	1.450	0.725	0.363	0.181	0.091	25.1
40	10	10	10	5.80	2.90	1.450	1.160	0.580	0.290	0.145	0.073	31.6
25	10	10	9.06	3.63	1.81	0.906	0.725	0.363	0.181	0.091	0.045	51.0
20	10	10	8.06	3.22	1.61	0.806	0.645	0.322	0.161	0.081	0.040	57.5
12	10	10	5.18	2.07	1.04	0.518	0.414	0.207	0.104	0.052	0.026	90.0
10	10	8.53	4.27	1.71	0.85	0.427	0.341	0.171	0.085	0.043	0.021	109
08	10	6.91	3.45	1.38	0.69	0.345	0.276	0.138	0.069	0.035	0.017	135
06	10	5.37	2.69	1.07	0.54	0.269	0.215	0.107	0.054	0.027	0.013	174
04	10	3.63	1.81	0.73	0.36	0.181	0.145	0.073	0.036	0.018	0.009	259
01	4.53	0.91	0.45	0.18	0.09	0.045	0.036	0.018	0.009	0.005	0.002	1038

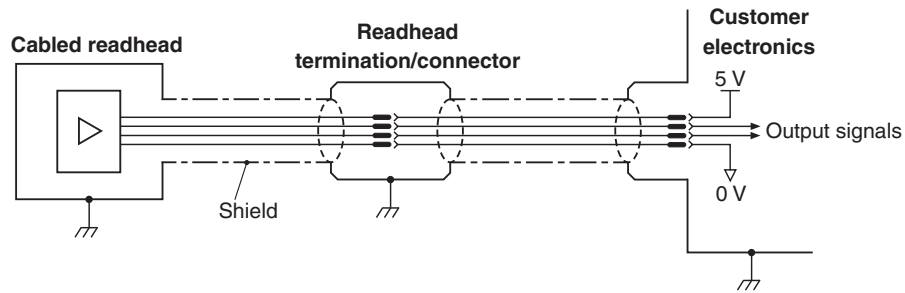
### 40 µm encoder

Clocked output option (MHz)	Maximum speed (m/s)											Minimum edge separation* (ns)	
	Readhead type												
	T (10 µm)	D (5 µm)	G (2 µm)	X (1 µm)	Z (0.5 µm)	W (0.2 µm)	Y (0.1 µm)	H (50 nm)	M (40 nm)	I (20 nm)	O (10 nm)		Q (5 nm)
50	20	20	20	20	18.13	7.25	3.63	1.813	1.450	0.725	0.363	0.181	25.1
40	20	20	20	20	14.50	5.80	2.90	1.450	1.160	0.580	0.290	0.145	31.6
25	20	20	20	18.13	9.06	3.63	1.81	0.906	0.725	0.363	0.181	0.091	51.0
20	20	20	20	16.11	8.06	3.22	1.61	0.806	0.645	0.322	0.161	0.081	57.5
12	20	20	20	10.36	5.18	2.07	1.04	0.518	0.414	0.207	0.104	0.052	90.0
10	20	20	17.06	8.53	4.27	1.71	0.85	0.427	0.341	0.171	0.085	0.043	109
08	20	20	13.81	6.91	3.45	1.38	0.69	0.345	0.276	0.138	0.069	0.035	135
06	20	20	10.74	5.37	2.69	1.07	0.54	0.269	0.215	0.107	0.054	0.027	174
04	20	18.13	7.25	3.63	1.81	0.73	0.36	0.181	0.145	0.073	0.036	0.018	259
01	9.06	4.53	1.81	0.91	0.45	0.18	0.09	0.045	0.036	0.018	0.009	0.005	1038

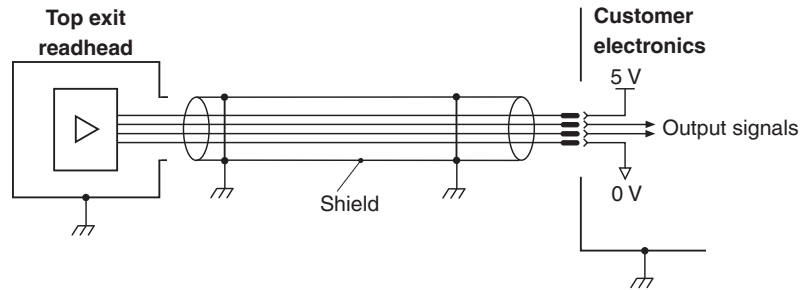
\* For a readhead with a 1 m cable.

## Electrical connections

### Grounding and shielding



**IMPORTANT:** The shield should be connected to the machine earth (Field Ground).  
For JST variants the ferrule should be connected to the machine earth.



**IMPORTANT:** The shield should be connected to the machine earth (Field Ground).

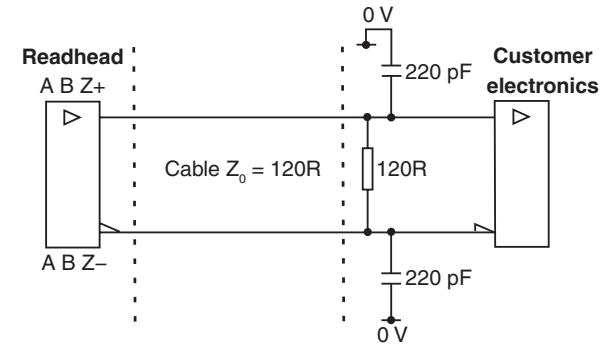
**NOTE:** For Renishaw top exit readhead cables the shield connection is provided by the P-clip.

**Maximum readhead cable length:** 3 m

**Maximum extension cable length:** Dependent on cable type, readhead cable length and clock speed.  
Contact your local Renishaw representative for more information.

### Recommended signal termination

#### Digital outputs

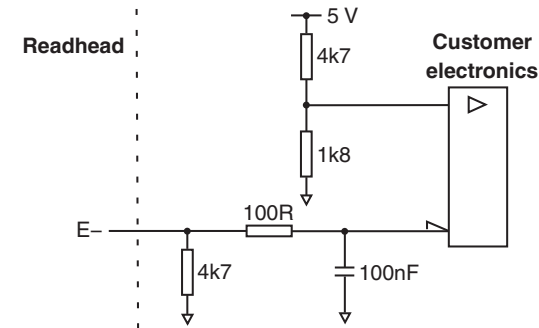


Standard RS422A line receiver circuitry.

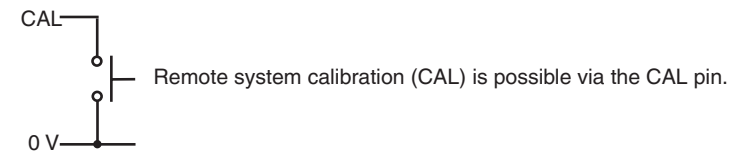
Capacitors recommended for improved noise immunity.

#### Single ended alarm signal termination

(Not available with 'A' cable termination)



### Remote CAL operation



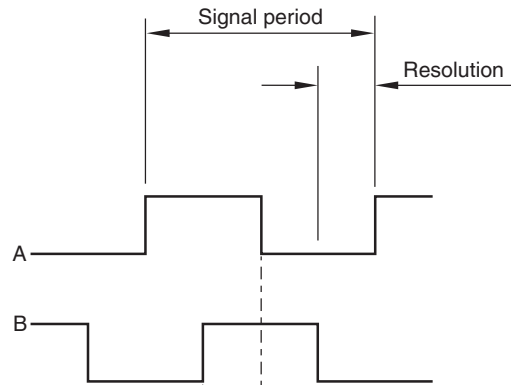
Remote system calibration (CAL) is possible via the CAL pin.

## Output specifications

### Digital output signals

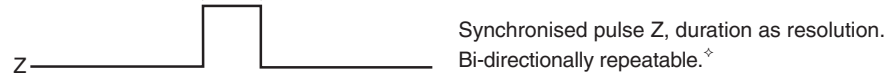
Form – Square wave differential line driver to EIA RS422A

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



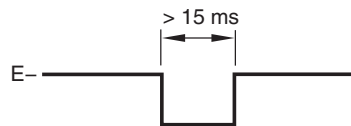
Resolution option code	P (µm)	S (µm)
T <sup>†</sup>	40	10
D	20	5
G <sup>†</sup>	8	2
X	4	1
Z	2	0.5
W	0.8	0.2
Y	0.4	0.1
H	0.2	0.05
M	0.16	0.04
I	0.08	0.02
O	0.04	0.01
Q	0.02	0.005
R <sup>‡</sup>	0.01	0.0025

### Reference\*



### Alarm

**Line driven** (Asynchronous pulse)  
(Not available with 'A' cable termination)



Alarm asserted when:

- Signal amplitude < 20% or > 135%
- Readhead speed too high for reliable operation

### or 3-state alarm

Differentially transmitted signals forced open circuit for > 15 ms when alarm conditions valid.


\* Inverse signals not shown for clarity.

<sup>†</sup> 40 µm ATOM DX only.

<sup>‡</sup> 20 µm ATOM DX only.

<sup>◇</sup> Only calibrated reference mark is bi-directionally repeatable.

## General specifications

<b>Power supply</b>	5 V -5/+10%	Typically < 200 mA fully terminated
		Power from a 5 Vdc supply complying with the requirements for SELV of standard IEC 60950-1
<b>Temperature</b>	Ripple	200 mVpp maximum@frequency up to 500 kHz
	Storage	-20 °C to +70 °C
	Installation (RKLF)	+10 °C to +35 °C*
	Operating	0 °C to +70 °C
<b>Humidity</b>		95% relative humidity (non-condensing) to IEC 60068-2-78
<b>Sealing</b>		IP40
<b>Acceleration</b> (system)	Operating	400 m/s <sup>2</sup> , 3 axes
<b>Shock</b> (system)	Operating	1000 m/s <sup>2</sup> , 11 ms, ½ sine, 3 axes
<b>Vibration</b>	Operating	100 m/s <sup>2</sup> max @ 55 Hz to 2000 Hz, 3 axes
<b>Mass</b>	Standard readhead	3.2 g
	Top exit readhead	2.9 g
	Cable	18 g/m
<b>Cable</b>		10 core, high flex, EMI screened cable, outside diameter 3.5 mm maximum Flex life > 20 × 10 <sup>6</sup> cycles at 20 mm bend radius, maximum length 3 m (Extension cable up to 25 m when using Renishaw approved extension cable)  UL recognised component  Top exit cables available in lengths from 0.5 m to 3 m with 15-way D-type or 10-way JST (SH) connector options.
<b>Cabled connector options</b>		9-way D-type 15-way D-type (standard and alternative pin out) 10-way JST (SH)
<b>Top exit readhead connector</b>		10-way JST (SUR)
<b>Typical sub-divisional error (SDE)</b>	20 µm version	< ±75 nm
	40 µm version	< ±120 nm

\* To limit maximum tension in the scale  $(CTE_{\text{substrate}} - CTE_{\text{scale}}) \times (T_{\text{use extreme}} - T_{\text{install}}) \leq 550 \mu\text{m/m}$  where  $CTE_{\text{scale}} = \sim 10.1 \mu\text{m/m/}^\circ\text{C}$

**CAUTION:** Renishaw encoder systems have been designed to the relevant EMC standards, but must be correctly integrated to achieve EMC compliance. In particular, attention to shielding arrangements is essential.

## Scale specifications

### RTLFL

<b>Material</b>	Hardened and tempered martensitic stainless steel fitted with a self-adhesive backing tape	
<b>Form (H × W)</b>	0.41 mm × 8 mm (including adhesive)	
<b>Datum fixing</b>	Adhesive datum clamp A-9585-0028 secured with Loctite® 435™	
<b>Reference mark</b>	Auto-phase optical reference mark repeatable to unit of resolution throughout specified speed and temperature range. Customer deselectable reference marks at 50 mm spacing. Reference mark in the centre for lengths < 100 mm.	
<b>Accuracy (at 20 °C)</b>	RTLFL20-S / RTLFL40H-S	±5 µm/m
	RTLFL40-S	±15 µm/m
<b>Coefficient of thermal expansion (at 20 °C)</b>	10.1 ±0.2 µm/m/°C	
<b>Length*</b>	20 mm to 1 m in 10 mm increments 1 m to 10 m in 1 m increments†	
<b>Mass</b>	12.2 g/m	

### RCLC

<b>Material</b>	Soda-lime glass fitted with a self-adhesive backing tape	
<b>Form (H × W)</b>	1.1 mm × 6.35 mm (including adhesive)	
<b>Datum fixing</b>	Fillet of RGG-2 two part epoxy adhesive (A-9531-0342)	
<b>Reference mark</b>	Auto-phase optical reference mark repeatable to unit of resolution throughout specified speed and temperature range. Either mid or end of travel, determined by orientation of the readhead.	
<b>Accuracy (at 20 °C)</b>	±3 µm	
<b>Coefficient of thermal expansion</b>	~8 µm/m/°C	
<b>Length (mm)</b>	10, 18, 30, 55, 80, 100, 105, 130	
<b>Mass</b>	13.9 g/m	

\* For information on how the substrate affects the axis, contact your local Renishaw representative.

### RKLF

<b>Material</b>	Hardened and tempered martensitic stainless steel fitted with a self-adhesive backing tape	
<b>Form (H × W)</b>	0.15 mm × 6 mm (including adhesive)	
<b>Scale pitch</b>	20 µm and 40 µm	
<b>Reference mark</b>	Auto-phase optical reference mark repeatable to unit of resolution throughout specified speed and temperature range. Customer de-selectable reference marks at 50 mm spacing. Reference mark in the centre of scale for lengths < 100 mm.	
<b>Accuracy (at 20 °C)</b>	RKLF20-S / RKLF40H-S	±5 µm/m
	RKLF40-S	±15 µm/m
<b>Coefficient of thermal expansion (at 20 °C)</b>	Matches that of substrate material when scale ends fixed by epoxy mounted end clamp.	
<b>Length</b>	20 mm to 1 m in 10 mm increments 1 m to 10 m in 1 m increments†	
<b>Mass</b>	4.6 g/m	
<b>End fixing</b>	Epoxy mounted end clamps (A-9523-4015) RGG-2 two part epoxy adhesive (A-9531-0342) Scale end movement typically < 1 µm‡	

† Maximum recommended axis length 1 m for 20 µm systems.

‡ The scale and end clamps must be installed following the installation process, see [page 11](#) and [page 13](#).

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Registered office: New Mills, Wotton-under-Edge, Gloucestershire, GL12 8JR, UK.



M - 9414 - 9446 - 02

Part no.: M-9414-9446-02-B  
Issued: 11.2021