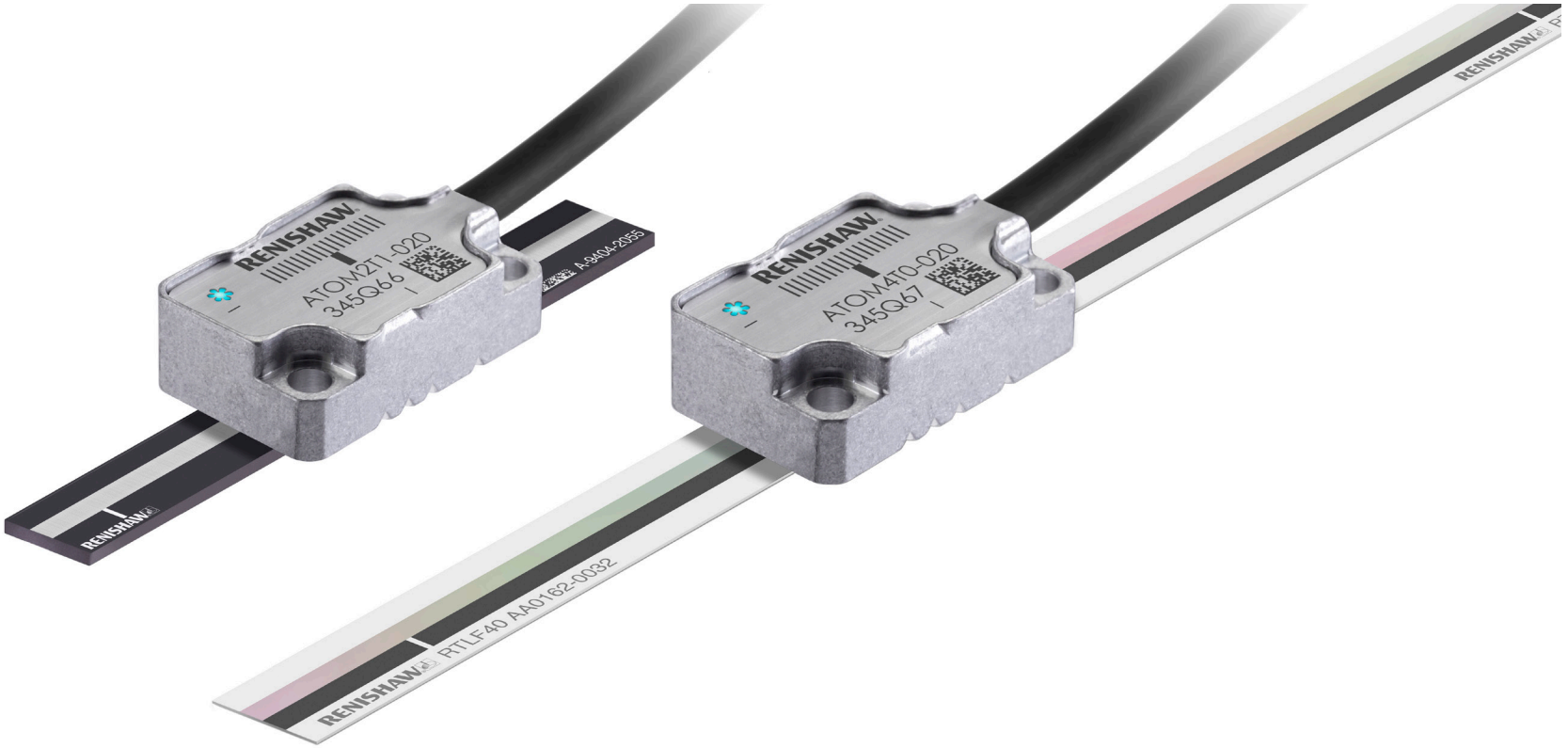
Installation guide
M-9693-9723-07-D

RENISHAW
apply innovation™

ATOM™ linear encoder system



www.renishaw.com/atomdownloads

#renishaw

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Contents

Legal notices

Patents

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

CN1314511C	EP1469969	JP5002559	US8466943
CN101300463B	EP1946048	JP5017275	US7624513B2
CN101310165B	EP1957943	US7839296	WO2014096764

Terms and conditions and warranty

Unless you and Renishaw have agreed and signed a separate written agreement, the equipment and/or software are sold subject to the Renishaw Standard Terms and Conditions supplied with such equipment and/or software, or available on request from your local Renishaw office.

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.

Declaration of Conformity

Renishaw plc hereby declares that the encoder system is in compliance with the essential requirements and other relevant provisions of:

- the applicable EU directives
- the relevant statutory instruments under UK law

The full text of the declaration of conformity is available at: www.renishaw.com/productcompliance.

Compliance

Federal Code Of Regulation (CFR) FCC Part 15 – RADIO FREQUENCY DEVICES

47 CFR Section 15.19

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.

47 CFR Section 15.21

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.

47 CFR Section 15.105

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.

47 CFR Section 15.27

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

Supplier's Declaration of Conformity

47 CFR § 2.1077 Compliance Information

Unique Identifier: ATOM

Responsible Party - U.S. Contact Information
Renishaw Inc.
1001 Wesemann Drive
West Dundee
Illinois
IL 60118
United States
Telephone number: +1 847 286 9953
Email: usa@renishaw.com

ICES-003 – Information Technology Equipment (including Digital Apparatus)

This ISM device complies with Canadian ICES-003(A).

Cet appareil ISM est conforme à la norme ICES-003(A).

ATOM FPC readhead and ACi

The ATOM FPC readhead and ACi have been designed as system components and to be compliant with EMC regulations for products of their 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 compliance for the whole machine.

Intended use

The ATOM linear encoder system is designed to measure position and provide that information to a drive or controller in applications requiring motion control. It must be installed, operated, and maintained as specified in Renishaw documentation and in accordance with the Standard Terms and Conditions or the Warranty and all other relevant legal requirements.

Further information

Further information relating to the ATOM encoder range can be found in the *ATOM™ miniature encoder system* data sheet (Renishaw part no. L-9517-9563). This can be downloaded from our website at www.renishaw.com/atomdownloads and is also available from your local Renishaw representative.

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

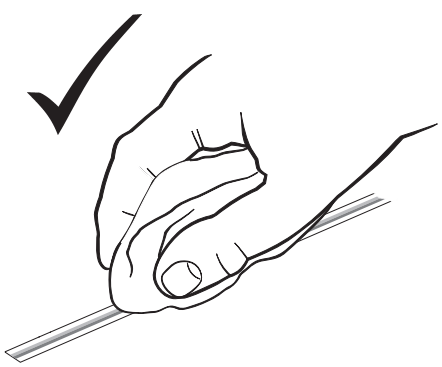
Information required by Article 33(1) of Regulation (EC) No. 1907/2006 ("REACH") relating to products containing substances of very high concern (SVHCs) is available at www.renishaw.com/REACH.

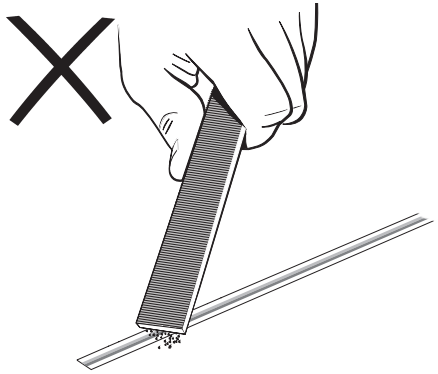
Disposal of waste electrical and electronic equipment

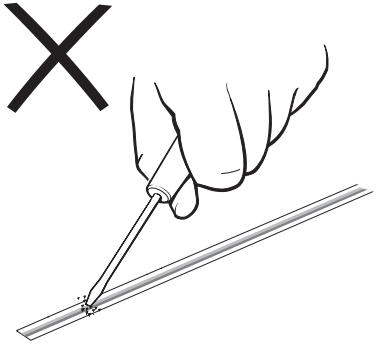
The use of this symbol on Renishaw products and/or accompanying documentation indicates that the product should not be mixed with general household waste upon disposal. It is the responsibility of the end user to dispose of this product at a designated collection point for waste electrical and electronic 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, contact your local waste disposal service or Renishaw distributor.

Storage and handling

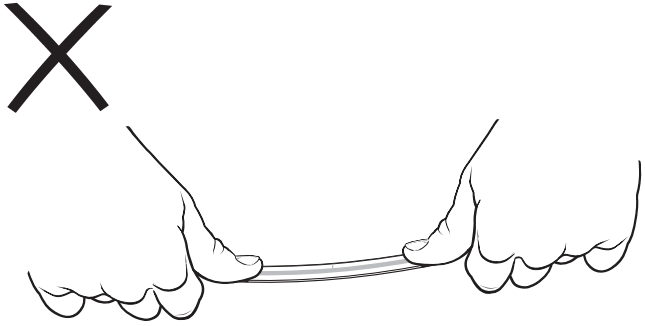
Scale







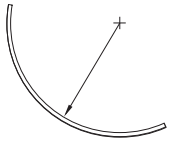
RCLC scale only



Minimum storage bend radius

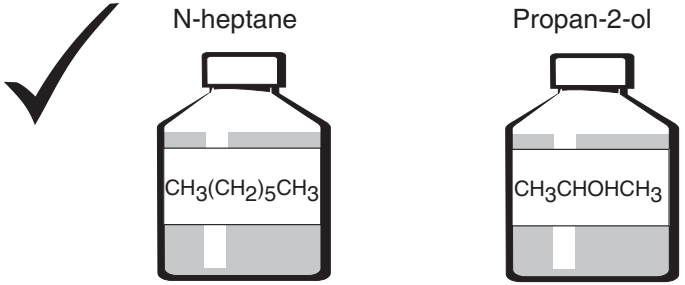
RTLF – 150 mm

RKLF – 50 mm

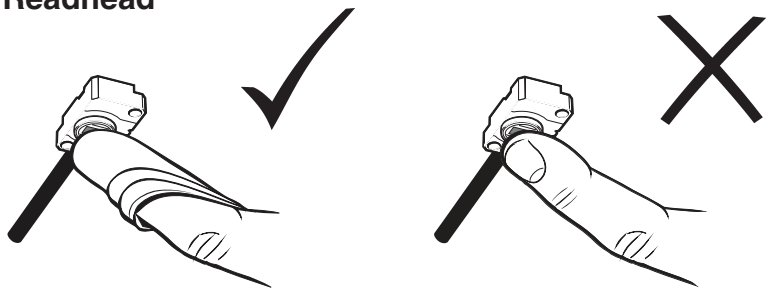


NOTE: During storage, ensure self-adhesive tape is on the outside of the bend.

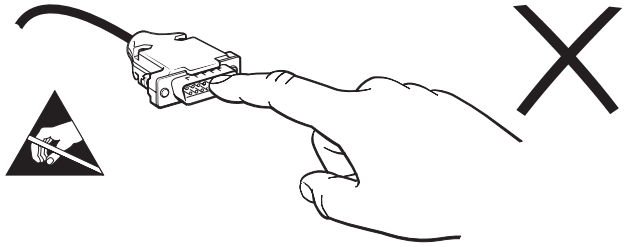
Scale and readhead

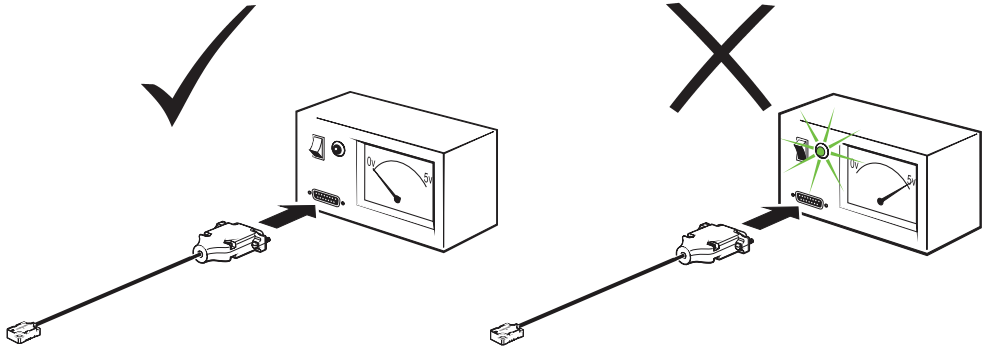


Readhead



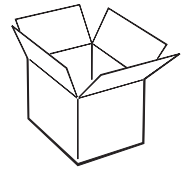
Readhead and interface





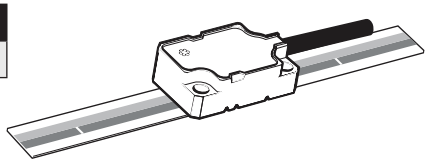
Temperature

Storage	
System	–20 °C to +70 °C



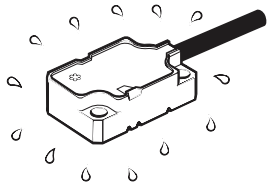
Installation	
RKLF scale	+10 °C to +35 °C

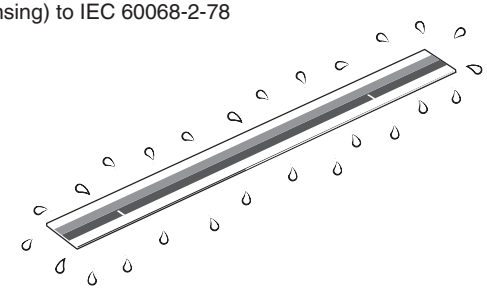
Operating	
System	0 °C to +70 °C



Humidity

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

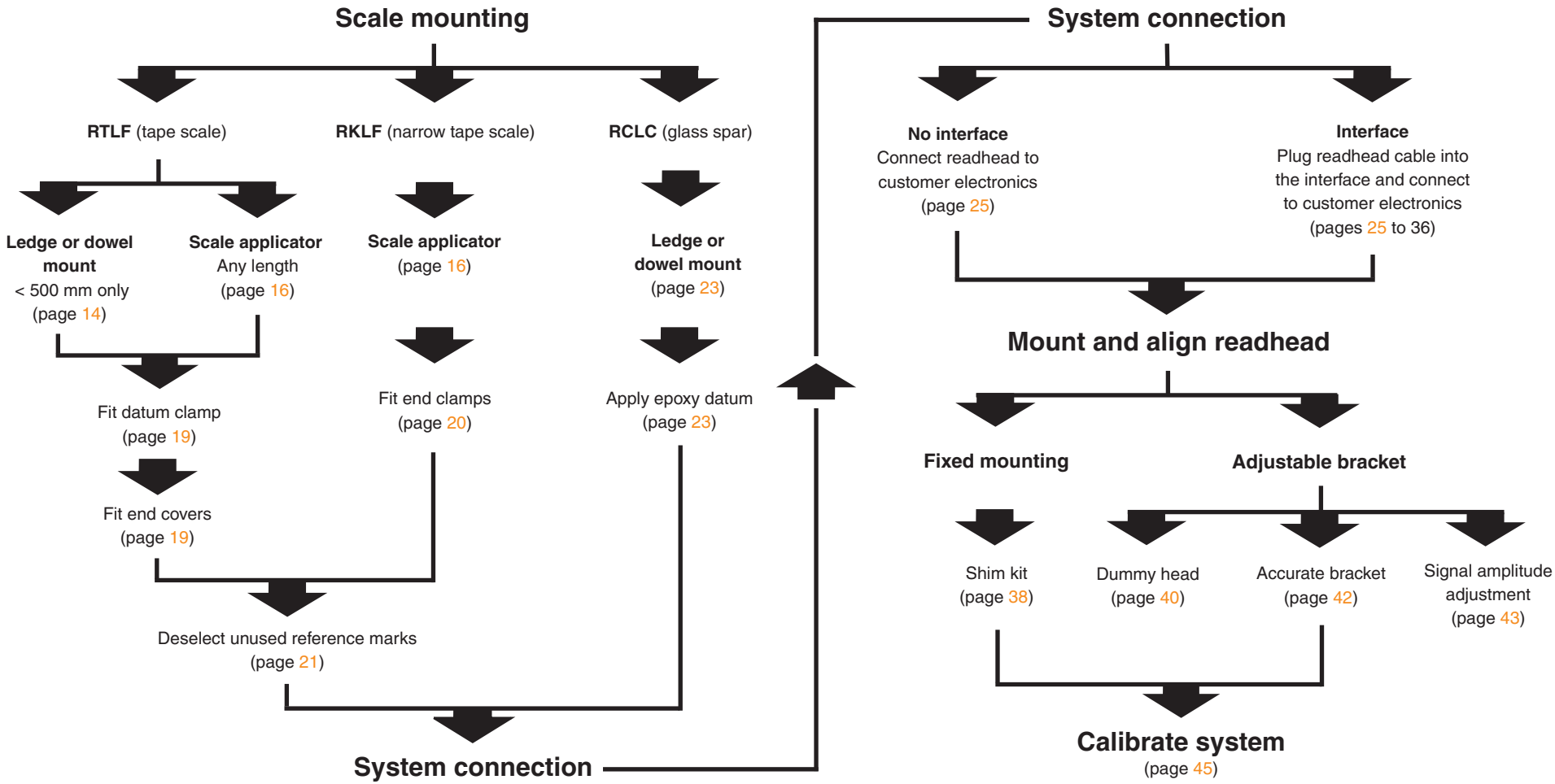




ATOM system installation overview

This section gives an overview of the steps involved in installing, setting-up and calibrating an ATOM 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 installation drawings and 3D models at **www.renishaw.com/atomdownloads** or contact your local Renishaw representative.

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

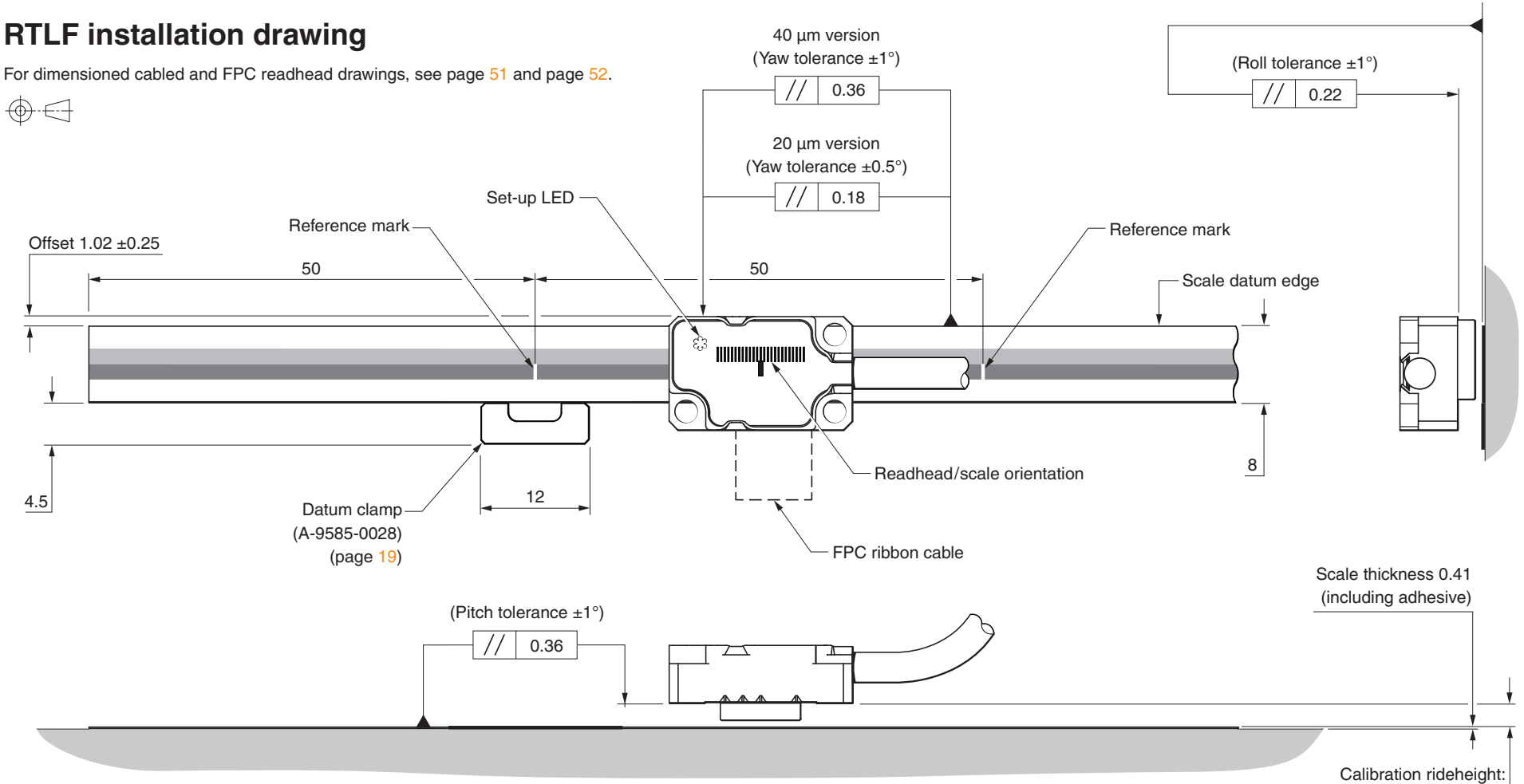


RTLF / RKLF tape scale

Dimensions and tolerances in mm

RTLF installation drawing

For dimensioned cabled and FPC readhead drawings, see page 51 and page 52.



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
For detailed installation drawings refer to **www.renishaw.com/atomdownloads**

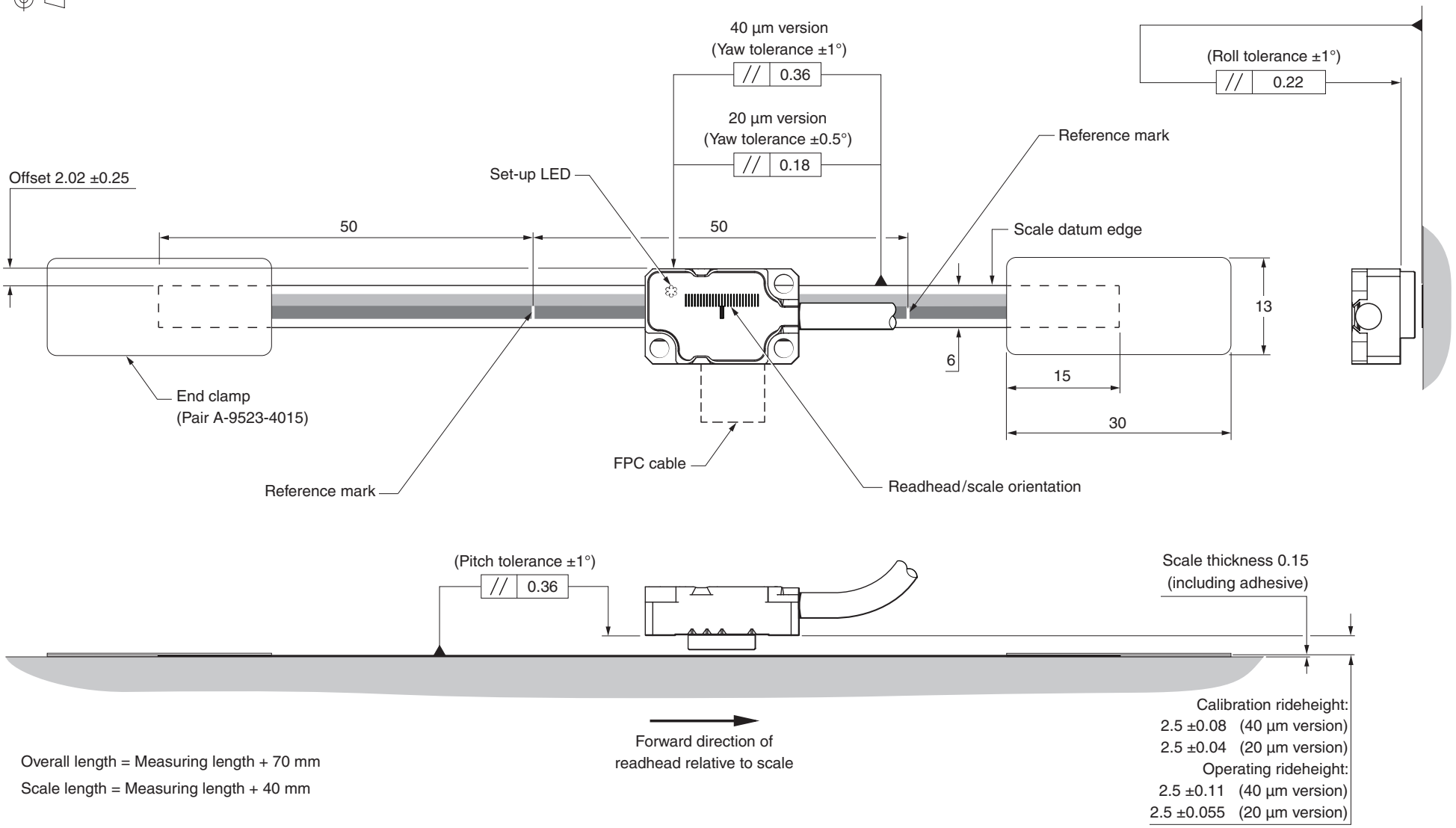
Forward direction of readhead relative to scale

Calibration rideheight:
2.5 ±0.08 (40 µm version)
2.5 ±0.04 (20 µm version)
Operating rideheight:
2.5 ±0.11 (40 µm version)
2.5 ±0.055 (20 µm version)

RKLF installation drawing

Dimensions and tolerances in mm

For dimensioned cabled and FPC readhead drawings, see page 51 and page 52.



Overall length = Measuring length + 70 mm

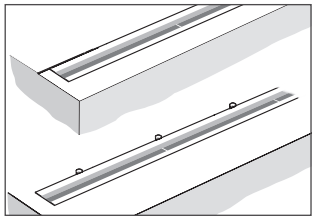
Scale length = Measuring length + 40 mm

RTLF / RKLF application methods

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

RTLF / RKLF tape scale

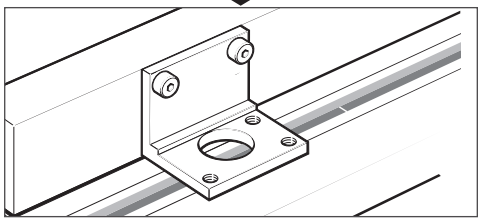
Mounting (RTLF < 500 mm only)



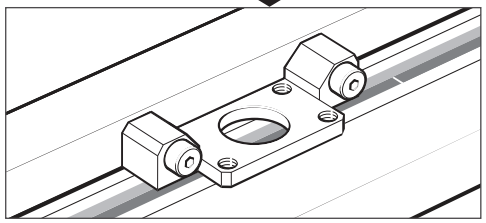
Ledge or dowel mounting (page 14).

Application (RTLF / RKLF any length)

Adjustable bracket

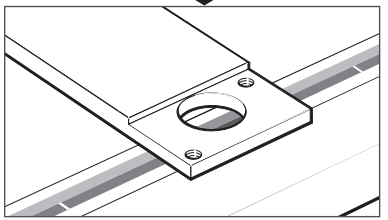


Datum edge of readhead located against a ledge on the bracket to control yaw. For use with 'L' mounting bracket A-9402-0037 or customer-designed bracket.

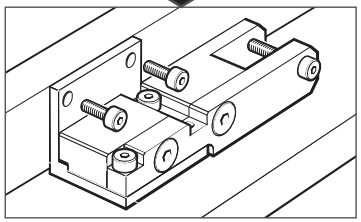


Datum edge of readhead mounted against machine axis. For use with side mounting bracket A-9401-0103 or customer-designed bracket.

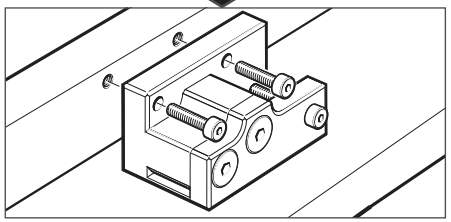
Fixed mounting



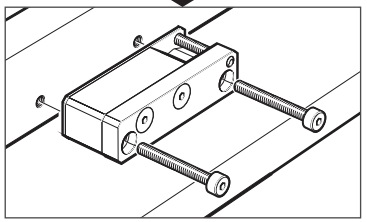
Readhead mounting is integral to the machine and does not allow rideheight adjustment.



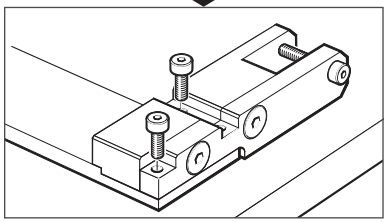
Top mount applicator A-9402-0028 (RTLF), A-6547-1939 (RKLF) (page 16).



Side-mounted applicator A-9402-0034 (RTLF), A-6547-1943 (RKLF). Only for use with 'L' mounting bracket A-9402-0037 (page 16).

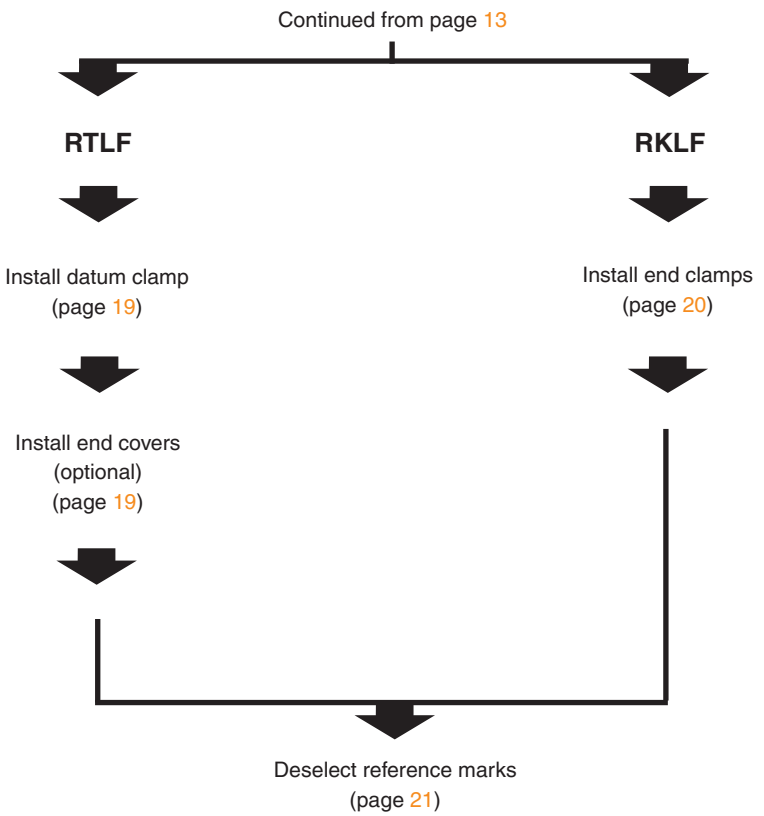


Slim applicator A-9402-0060 (RTLF), A-6547-1947 (RKLF) (page 16).



Top mount applicator A-9402-0028 (RTLF), A-6547-1939 (RKLF) (page 16).

Continues on page 14



RTLF ledge or dowel mounting

Suitable for:

RTLF tape scale < 500 mm long.

Required parts:

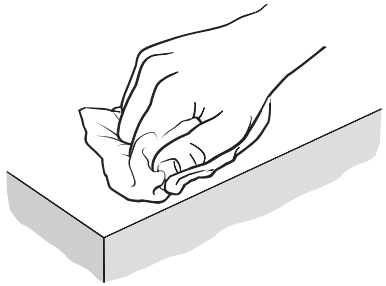
- Appropriate length of RTLF scale (see 'RTLF installation drawing' on page 11)
- Appropriate cleaning solvents (see 'Storage and handling' on page 8)
- Datum clamp (A-9585-0028)
- Loctite® 435™ (P-AD03-0012)

Optional parts:

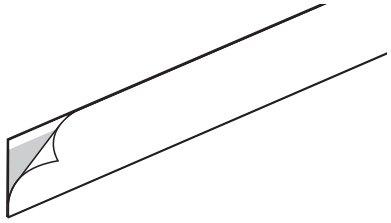
- Renishaw scale wipes (A-9523-4040)
- Loctite 435 dispensing tip (P-TL50-0209)
- End cover kit (A-9585-0035)
- Reference mark deselection stickers (A-9402-0049 for a sheet of 20)
- Lint-free cloth

RTLF mounting (for lengths < 500 mm only)

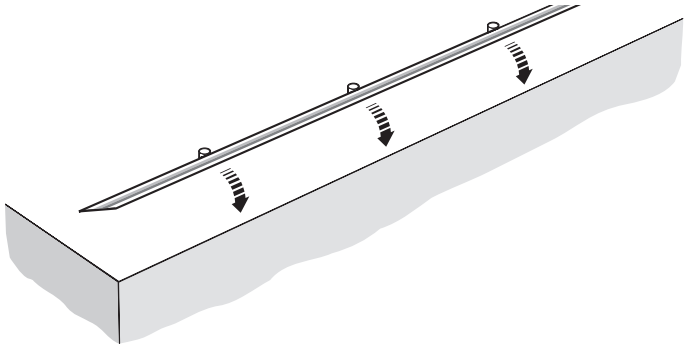
1. Thoroughly clean and degrease the substrate using recommended solvents (see 'Storage and handling' on page 8). Allow substrate to dry before applying scale.

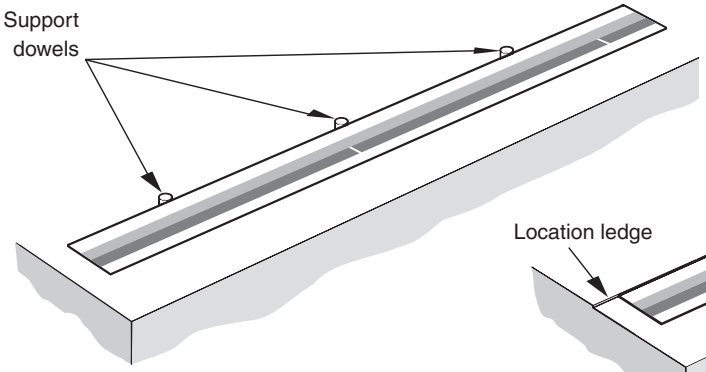


2. Remove backing paper from scale.

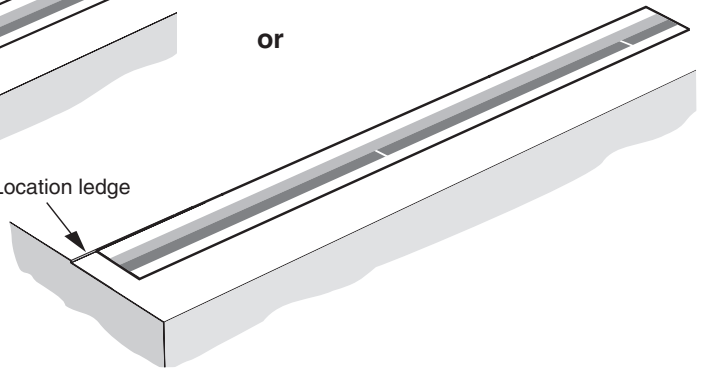


3. Locate scale against dowels or ledge and rotate down onto substrate. [1]

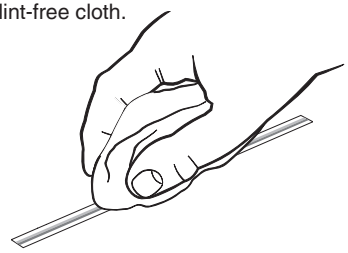




or



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



5. Fit datum clamp and end covers (page 19) and, if needed, deselect reference marks that are not required as detailed (page 21).

6. Remove temporary dowels (if fitted).

[1] If dowels or ledge are permanent, their maximum height above substrate is 0.6 mm.

RTLF / RKLF scale applicator

Suitable for:

- RTLF tape scale, any length
- RKLF narrow tape scale, any length

Required parts:

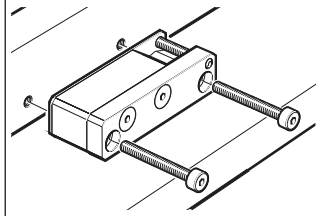
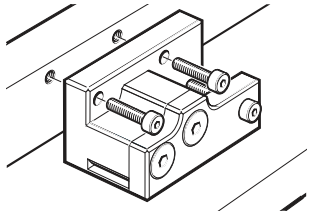
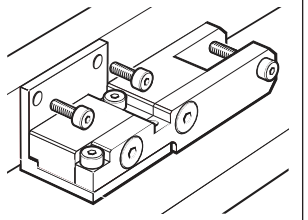
- Appropriate length of scale (see 'RTLF installation drawing' on page 11 or 'RKLF installation drawing' on page 12)
- End clamp kit, RKLF only (A-9523-4015)
- RGG-2 two part epoxy adhesive, RKLF only (A-9531-0342)
- Datum clamp, RTLF only (A-9585-0028)
- Loctite 435, RTLF only (P-AD03-0012)
- Appropriate cleaning solvents (see 'Storage and handling' on page 8)
- 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, RTLF 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
			
Mounting	In place of the readhead bracket	In place of the readhead bracket	In place of the readhead
Applicable bracket	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
RTLF	A-9402-0060	A-9402-0034	A-9402-0028
RKLF	A-6547-1947	A-6547-1943	A-6547-1939

RTLF / RKLF application (any length)

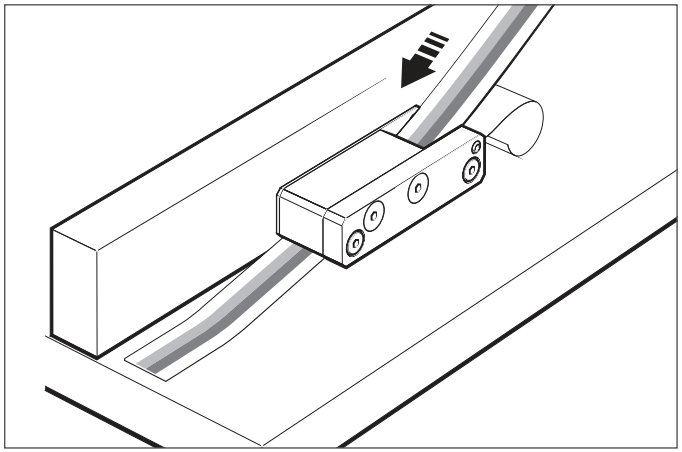
1. Allow scale to acclimatise to installation environment prior to installation.

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.

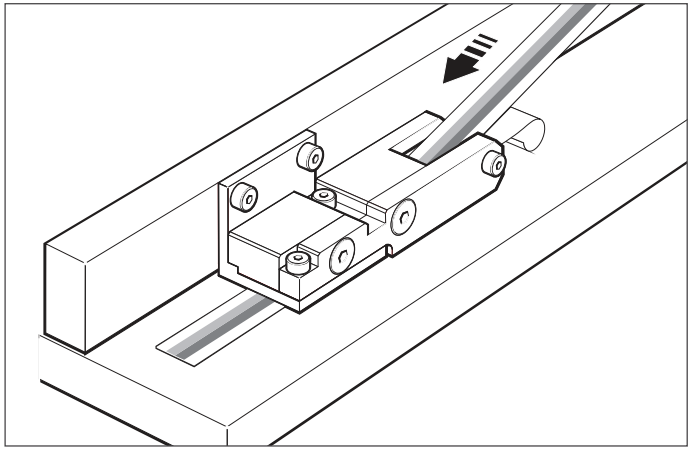
NOTE: For RKLF scale ensure that there is room for the end clamps. See 'RKLF installation drawing' on page 12.

3. Thoroughly clean and degrease the substrate using recommended solvents (see 'Storage and handling' on page 8). 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.



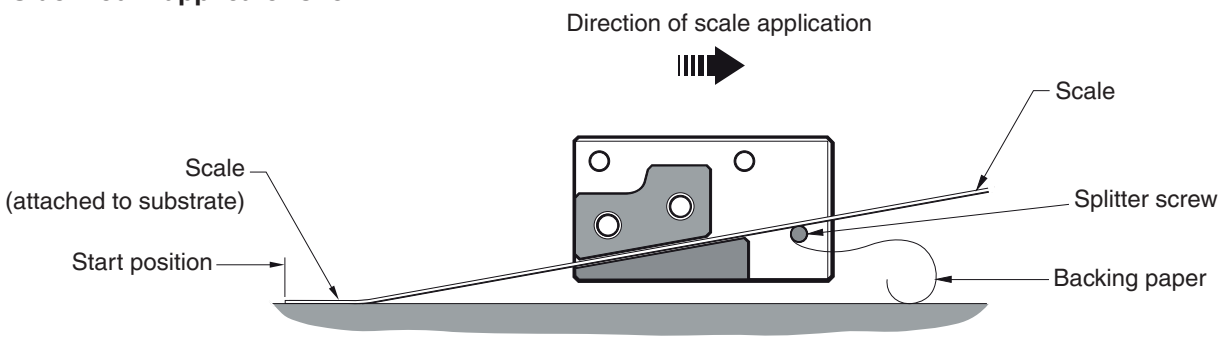
Top mount applicator:

- 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.

Side mount applicator shown



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. **RTLF:** Fit datum clamp and end covers (page 19) and, if needed, deselect reference marks that are not required as detailed (page 21).
    RKLF: Fit end clamps and, if needed, deselect reference marks that are not required (page 20).

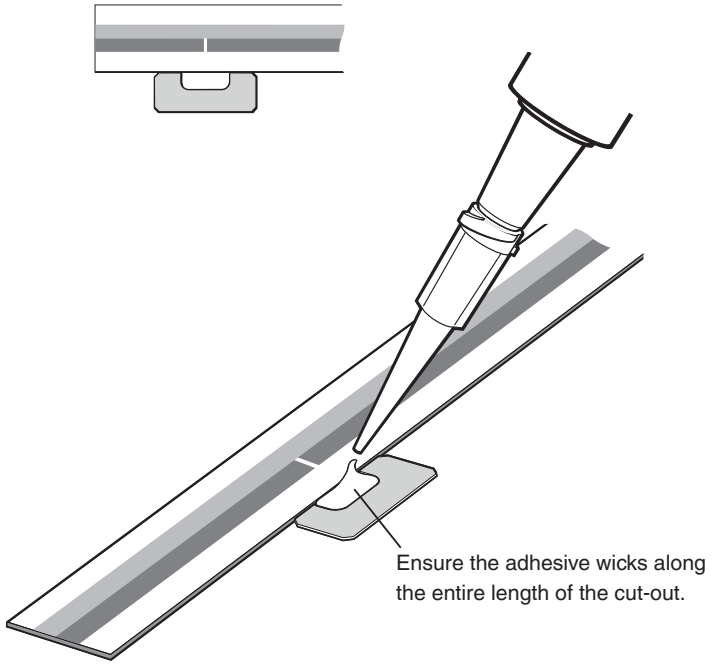
RTLF datum clamp

The datum clamp fixes the RTLF 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.



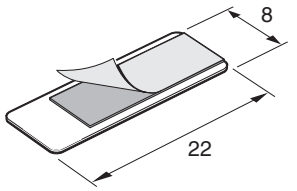
RTLF end covers

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

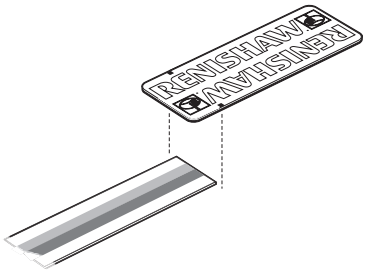
NOTE: End covers are optional and can be fitted before or after readhead installation.

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

Dimensions in mm



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.



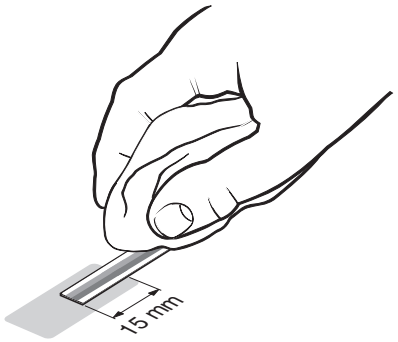
NOTE: There will be a gap between the end of the scale and the adhesive tape on the end cover.

RKLF end clamps

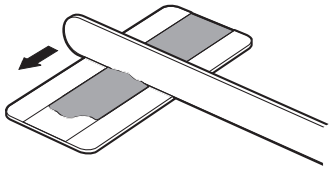
The end clamp kit is designed to be used with Renishaw RKLF scale to ensure the scale is mastered to the substrate. Alternative narrow 6 mm wide end clamps (A-9523-4111) are also available.

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

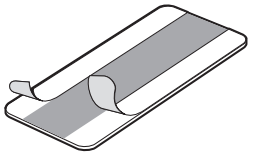
1. Clean ends of scale and the area where end clamps are to be fitted using Renishaw scale wipes or one of the recommended solvents (see 'Storage and handling' on page 8).



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.

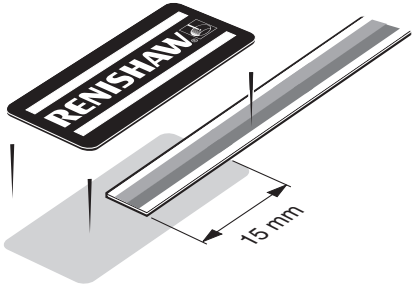


3. The end clamp features two small regions of contact adhesive. These will temporarily hold the end clamp in position while the epoxy cures.



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

4. Remove the backing tape from either side. 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. [1]

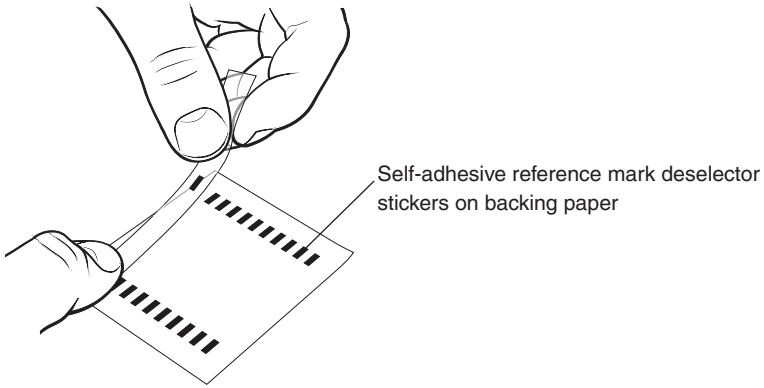


[1] To ensure scale end movement of typically < 1 µm, stabilise the system at least 5 °C higher than the maximum customer application temperature for a minimum of 8 hours. For example: Customer application = 23 °C axis temperature. Stabilise the system at 28 °C for a minimum of 8 hours.

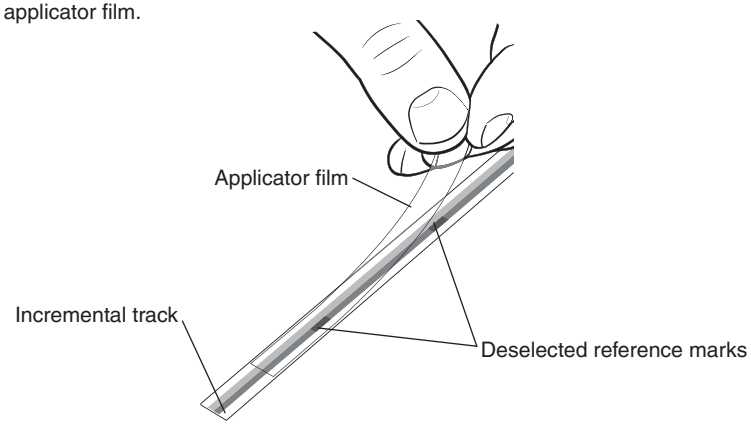
RTLF / RKLF reference mark deselection

RTLF 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 (see 'Storage and handling' on page 8).
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.

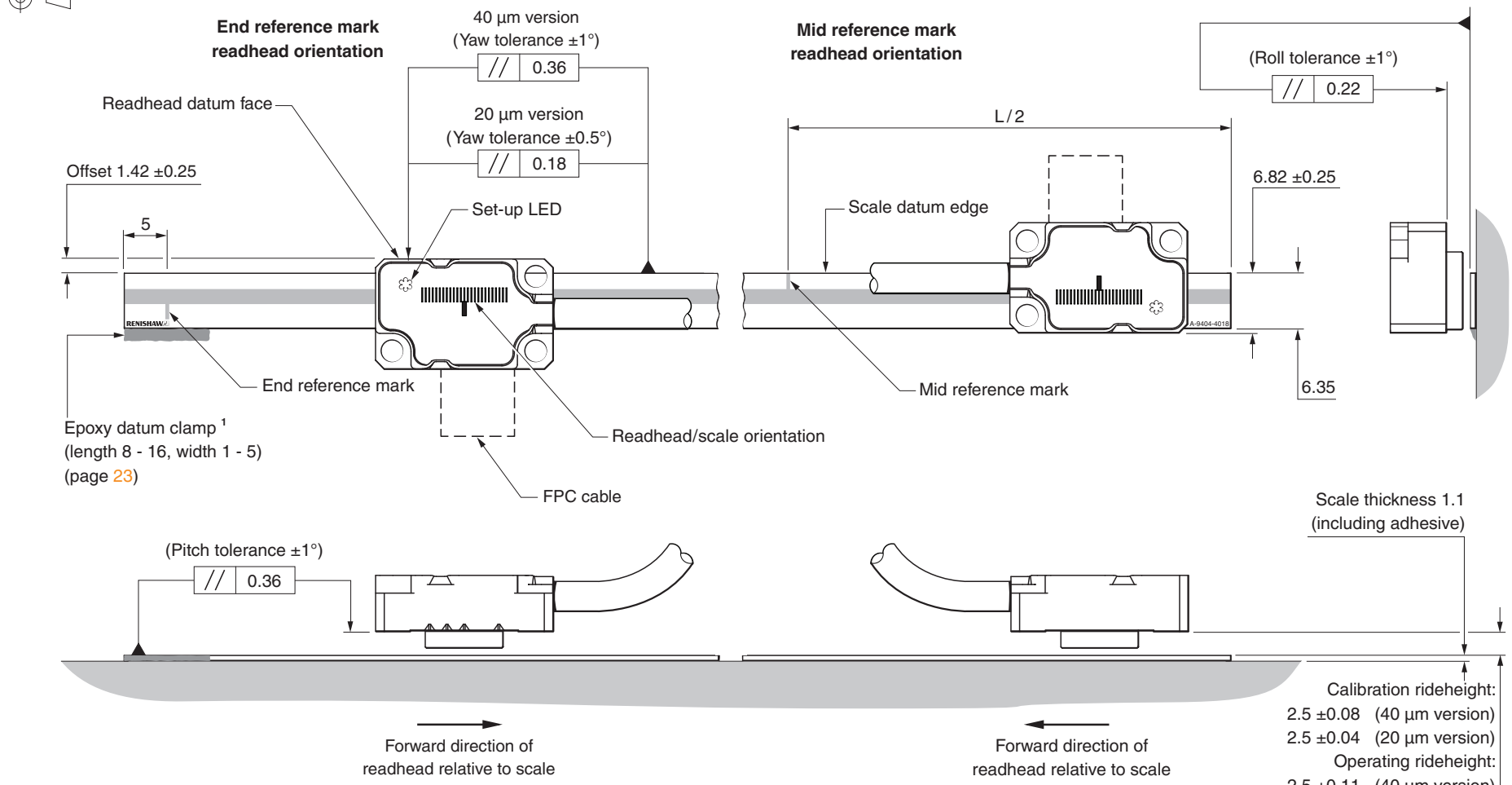


RCLC glass spar scale

RCLC installation drawing

For dimensioned cabled and FPC readhead drawings, see page 51 and page 52.

Dimensions and tolerances in mm



Overall length	10	18	30	55	80	100	105	130
Measuring length	7	15	27	52	77	97	102	127

[1] Can be applied on one or both sides of the scale.

For detailed installation drawings refer to **www.renishaw.com/atomdownloads**

RCLC mounting

Suitable for:

RCLC glass spar scale, any length.

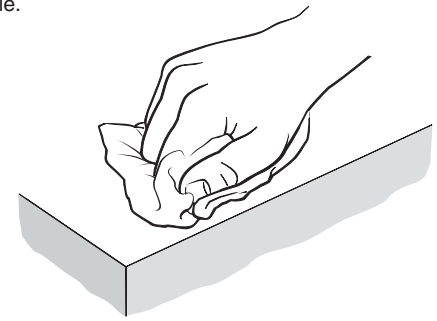
Required parts:

- RCLC scale (see 'RCLC installation drawing' on page 22)
- RGG-2 two part epoxy adhesive (A-9531-0342)
- Appropriate cleaning solvents (see 'Storage and handling' on page 8)

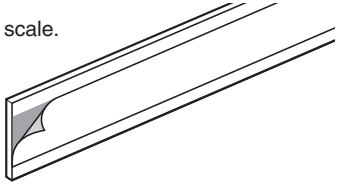
Optional parts:

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

1. Thoroughly clean and degrease the substrate using recommended solvents (see 'Storage and handling' on page 8). Allow substrate to dry before applying scale.

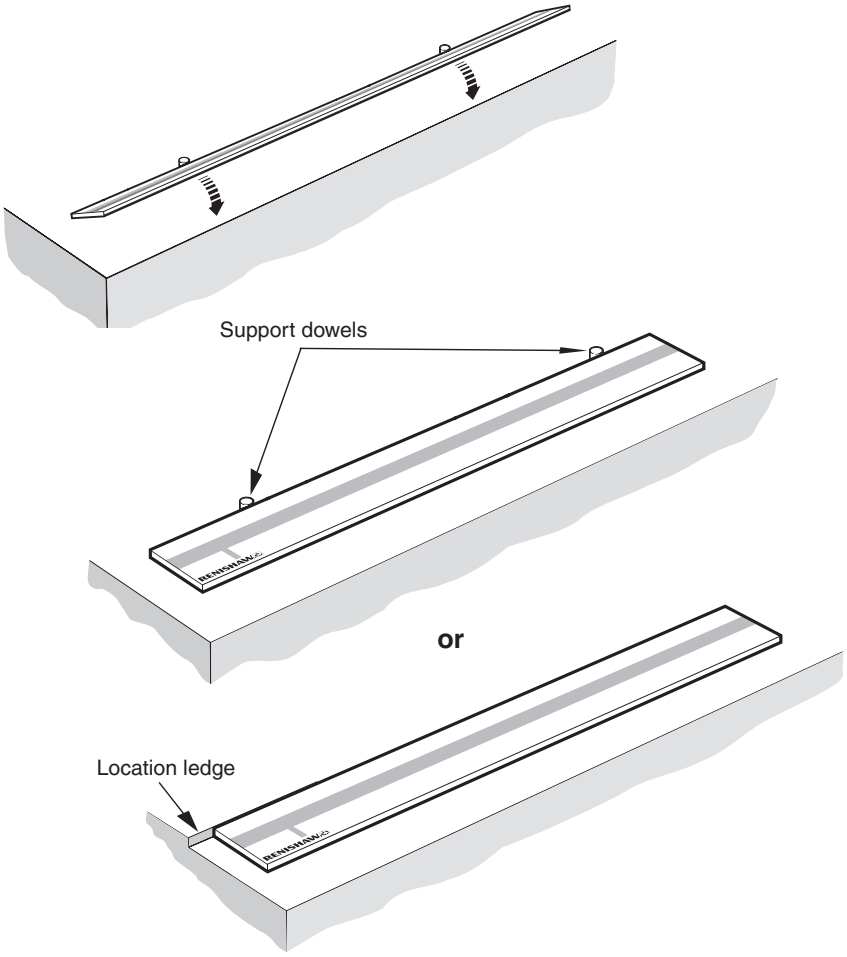


2. Remove backing paper from scale.



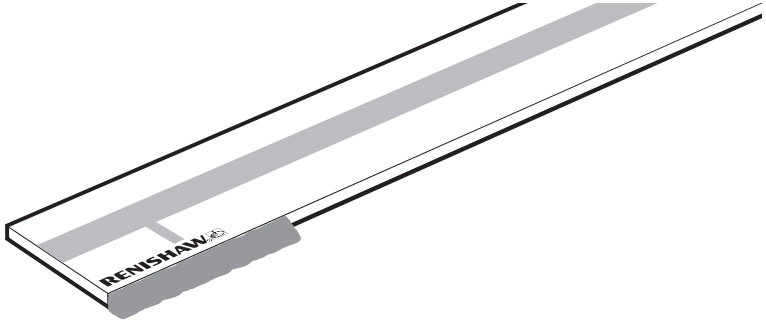
3. Ensure correct orientation of the scale for chosen reference mark location (middle or end of scale) and readhead orientation. See 'RCLC installation drawing' on page 22 for details.

4. Locate scale against dowels or ledge and rotate down onto the substrate. [1]

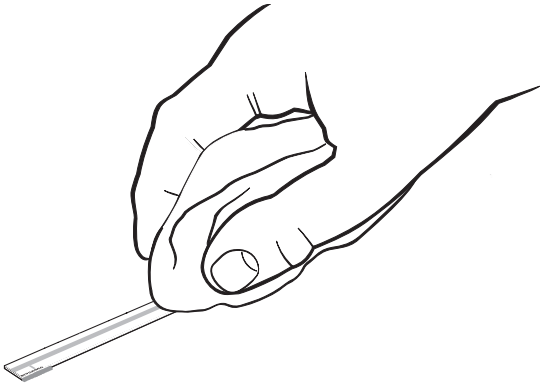


[1] If dowels or ledge are permanent, their maximum height above substrate is 1.2 mm.

5. 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.



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



7. Remove temporary dowels (if fitted).

System connection

Readhead only (no interface)

The ATOM readhead is available in several variants:

- Cable variant with a 15-way D-type connector
- Cable variant with interboard connector
- FPC variant

None of these readhead variants has an integral calibration (CAL) button. Provision should be made in the customers' electronics for momentarily connecting the CAL line to 0 V to initiate the calibration routine, switch AGC on/off or restore factory defaults. See page 54 for pin-out information.

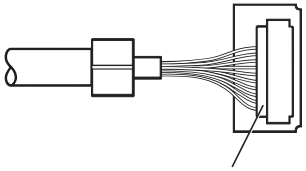
Calibration is an essential part of system set-up that optimises the incremental signals and phases the reference mark. See page 45 for information on the calibration routine.

For cable variant with interboard connector

Ensure that the interboard connector is inserted into the connector on the customers' electronics.

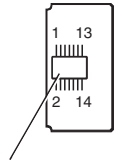
NOTE: Care should be taken to ensure correct orientation

- Use a metal clamp around the cable ferrule to ground the readhead cable and ensure continuity of the shields
- Provide appropriate strain relief
- Ensure suitable clamping to retain interboard connector to the mating connector



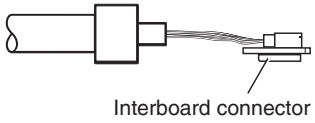
JST 12-way, single row 12SUR-32S.

JST mating connector: P-CN10-0051 (SM12B-SURS-TF).



Hirose Interboard connector 14-way, dual row DF23C-14DP-0.5 V

Hirose mating connector: P-CN03-0024 (DF23-14DS-0.5 V)



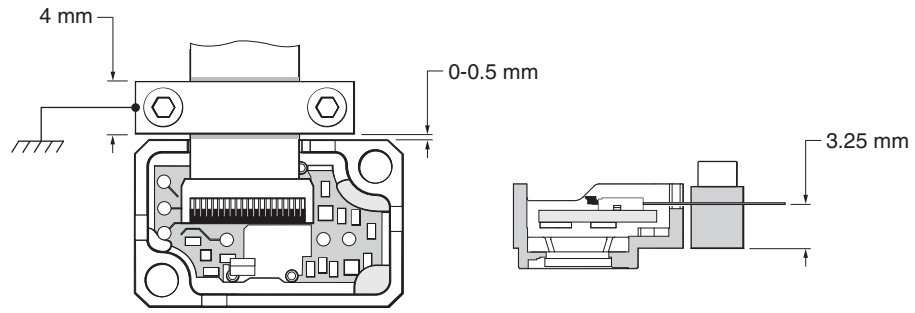
For FPC variants

Ensure that the FPC cable being used has the following specifications:

- 16 core
- Conductor pitch 0.5 mm
- Minimum exposed conductor strip length 1.5 mm
- Maximum exposed conductor strip length 2.5 mm (to ensure isolation from the body)

Contact your local Renishaw representative for more information regarding FPC design requirements.

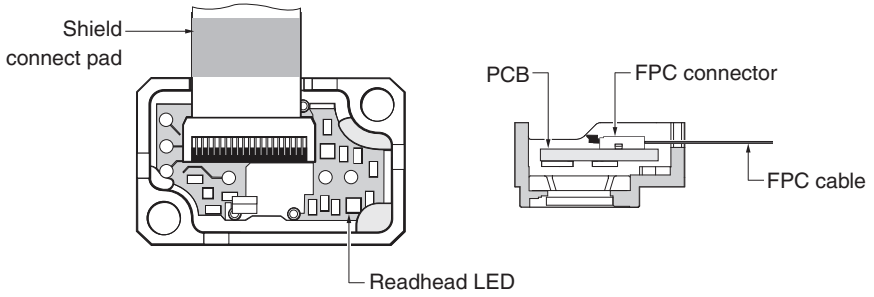
Example of strain relief



Shielding

For optimum performance:

- Ensure 100% shielding
- Ground the mounting brackets
- Ensure continuity of all shields
- Maximise the distance between the encoder and motor cables
- Provide appropriate strain relief at the readhead

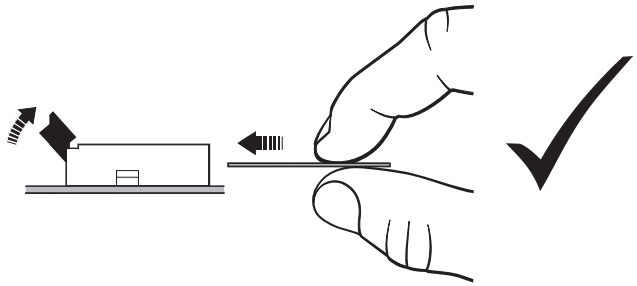


Approved ESD precautions must be followed at all times during readhead electrical connection.

NOTE: The FPC cable must be connected before fitting the readhead lid. The lid is secured by the readhead mounting screws.

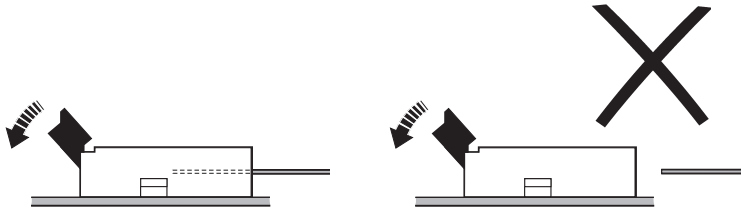
Inserting the FPC cable

1. Ensure the locking lever is up (open) before fully inserting the FPC cable into the connector.



CAUTION: Check the correct orientation of the cable before inserting into the connector. The readhead will be shipped with the connector in the open position.

2. Applying pressure to the whole locking lever, push it down to lock the FPC cable in place.



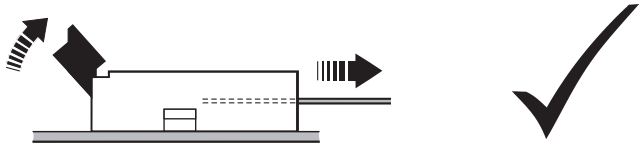
CAUTION: Do not push the locking lever down if no FPC cable is inserted as this will damage the locking mechanism.

3. When the system has been connected, proceed with 'Readhead mounting and alignment' on page 37 and 'System calibration' on page 45.

Approved ESD precautions must be followed at all times during readhead electrical connection.

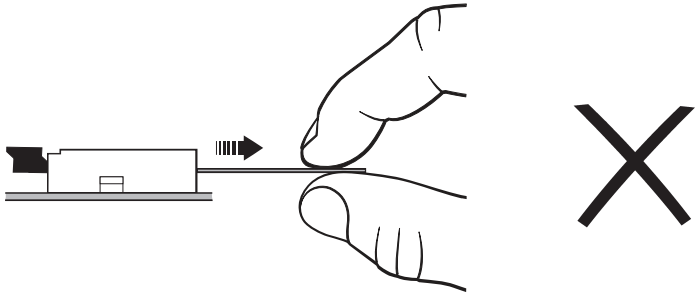
Removing the FPC cable

1. Placing your finger on the whole of the locking lever, slowly lift it up and away to disengage the locking mechanism.

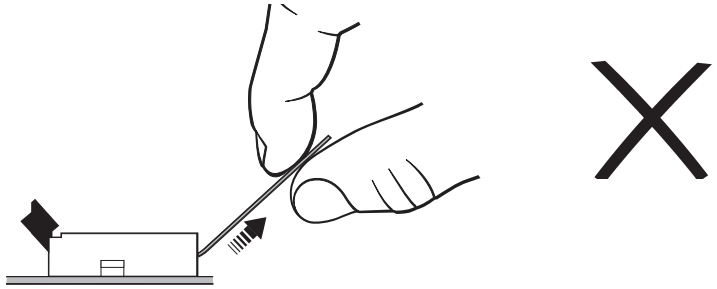


CAUTION: Do not use tools such as screwdrivers or tweezers to open the locking lever as this may cause damage to the connector or PCB.

2. Ensure locking lever is fully open before removing the FPC cable.



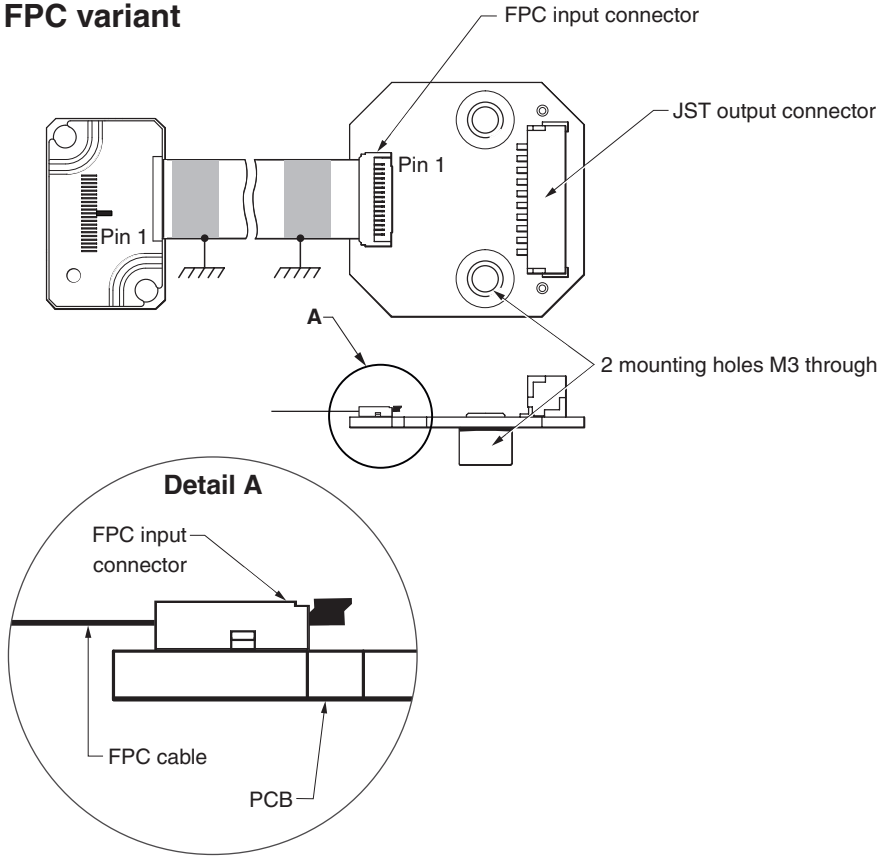
3. Pull the FPC cable straight back to remove it.



CAUTION: Do not pull upwards or sideways as this may damage the readhead.

ACi interface

FPC variant



Ensure that the FPC cable being used has the following specifications:

- 16 core
- Conductor pitch 0.5 mm
- Minimum exposed conductor strip length 1.5 mm
- Maximum exposed conductor strip length 2.5 mm (to ensure isolation from the body).

Contact your local Renishaw representative for more information regarding FPC design requirements.

Shielding

For optimum performance:

- Ensure 100% shielding
- Ground the mounting brackets, readhead and FPC cable clamp
- Ensure continuity of all shields
- Maximise the distance between the encoder and motor cables
- Provide appropriate strain relief at the readhead and interface
- The ACi should be contained within a shielded enclosure

Mounting

The ACi can be mounted to customers' system using two M3 screws or two M2.5 screws for through mounting.

Output

The output connector is a 10-way JST, GH crimp connector with 1.25 mm pitch. It is suitable for cable size 26 to 30 AWG. See page 56 for pin-out information.

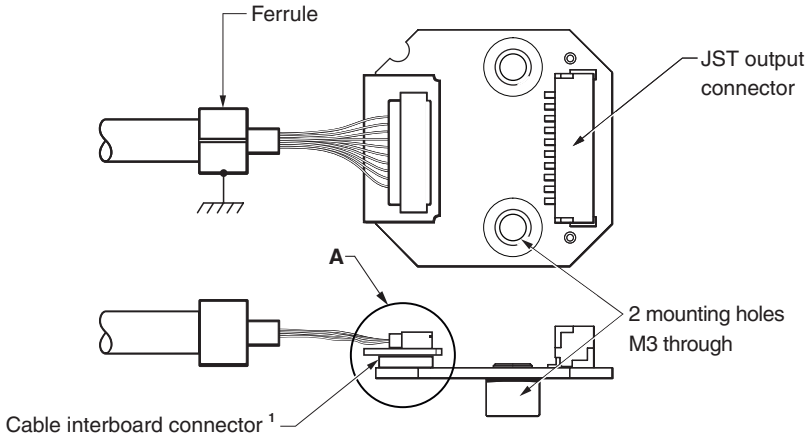
Connection

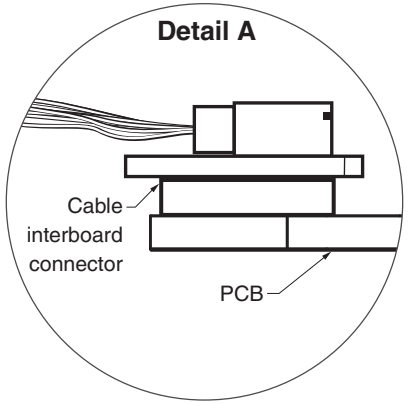
For information on inserting and removing the FPC cable to the ACi and readhead, see page 27 and page 28.

Approved ESD precautions must be followed at all times during readhead and interface electrical connection.

NOTE: The FPC cable must be connected to the readhead before fitting the lid. The lid is secured by the readhead mounting screws.

Cable variant





[1] Ensure suitable clamping to retain interboard connector on ACi.

Shielding

For optimum performance:

- Ensure 100% shielding
- Ground the mounting brackets
- Use a metal clamp around the cable ferrule to ground the readhead cable
- Ensure continuity of all shields
- Maximise the distance between the encoder and motor cables
- Provide appropriate strain relief at the readhead and interface
- The ACi should be contained within a shielded enclosure
- Ensure suitable clamping to retain interboard connector to the mating connector

Mounting

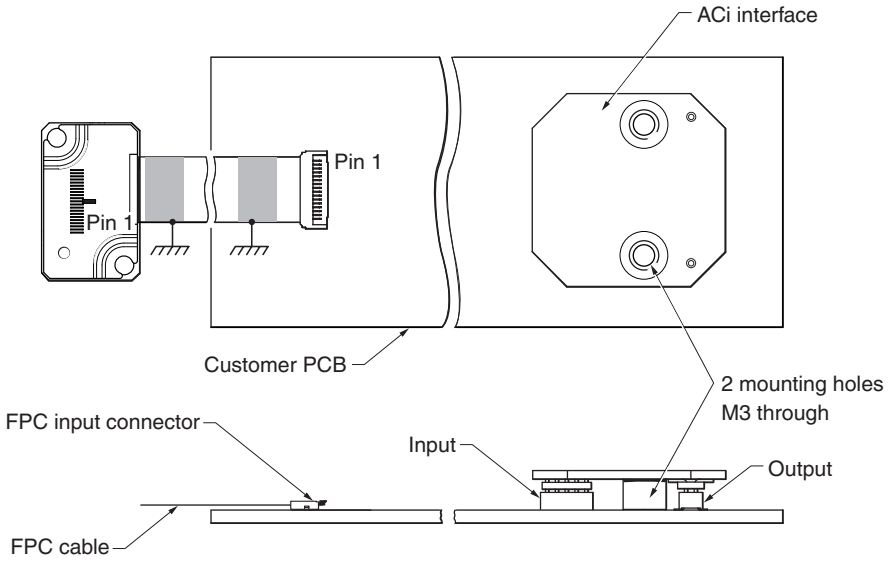
The ACi can be mounted to customers' system using two M3 screws or two M2.5 screws for through mounting.

Output

The output connector is a 10-way JST, GH crimp connector with 1.25 mm pitch. It is suitable for cable size 26 to 30 AWG. See page 58 for pin-out information.

Approved ESD precautions must be followed at all times during readhead and interface electrical connection.

PCB mounting: connecting an FPC variant ATOM readhead



Ensure that the FPC cable being used has the following specifications:

- 16 core
- Conductor pitch 0.5 mm
- Minimum exposed conductor strip length 1.5 mm
- Maximum exposed conductor strip length 2.5 mm (to ensure isolation from the body)

Contact your local Renishaw representative for more information regarding FPC design requirements.

Shielding

For optimum performance:

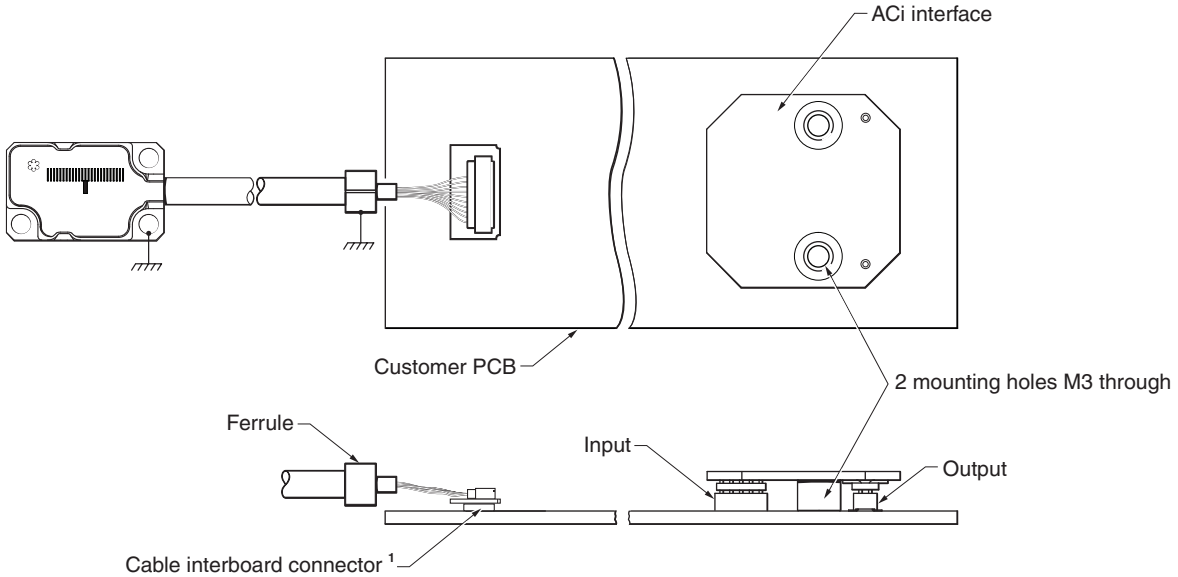
- Ensure 100% shielding
- Ground the mounting brackets, readhead and FPC cable clamp
- Ensure continuity of all shields
- Maximise the distance between the encoder and motor cables
- Provide appropriate strain relief at the readhead and interface
- The ACi should be contained within a shielded enclosure

Connection

For information on inserting and removing the FPC cable to the mating socket, see page 27 and page 28.

Approved ESD precautions must be followed at all times during readhead and interface electrical connection.

PCB mounting: connecting a cable variant ATOM readhead



Shielding

For optimum performance:

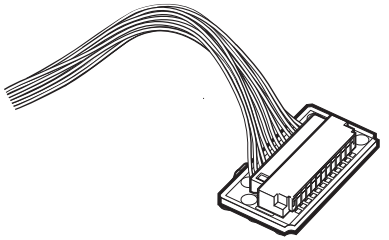
- Ensure 100% shielding
- Ground the mounting brackets
- Use a metal clamp around the cable ferrule to ground the readhead cable
- Ensure continuity of all shields
- Maximise the distance between the encoder and motor cables
- Provide appropriate strain relief at the readhead and interface
- The ACi should be contained within a shielded enclosure
- Ensure suitable clamping to retain interboard connector to the mating connector

Approved ESD precautions must be followed at all times during readhead and interface electrical connection.

[1] Ensure suitable clamping to retain interboard connector on PCB.

Ri interface

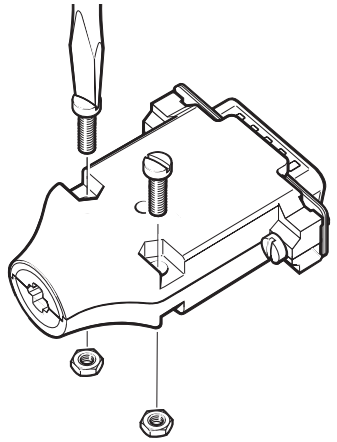
Approved ESD precautions must be followed at all times during readhead and interface electrical connections.



The readhead is connected to the Ri interface via a small, rugged connector to allow for easy feed-through during installation.

NOTE: An optional Ri cable guide (A-9693-2577) is available to simplify assembly.

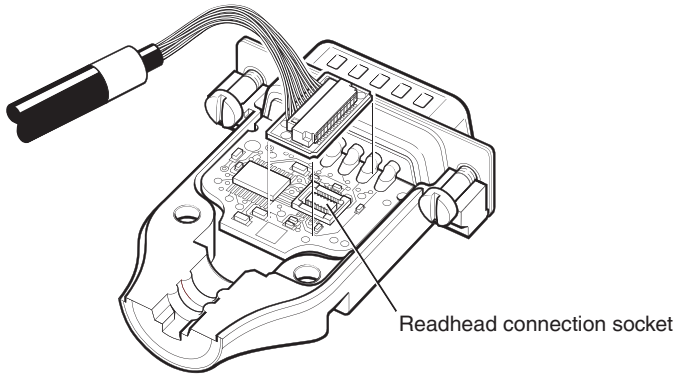
For instructions on how to install the Ri cable guide, download the *Ri interface cable guide* (Renishaw part no. M-9770-9478) from the website at **www.renishaw.com/atomdownloads**.

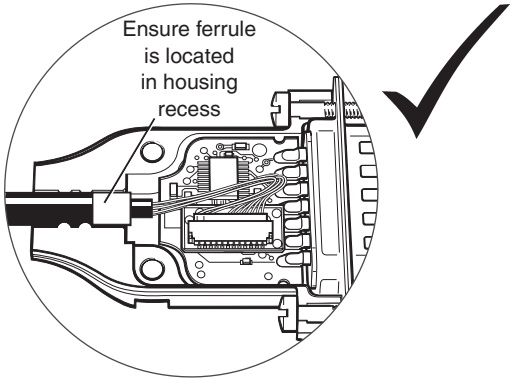


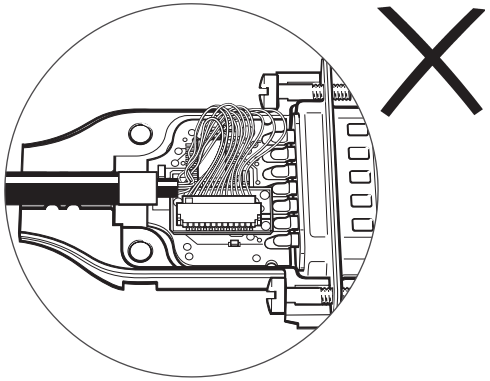
Connecting the readhead

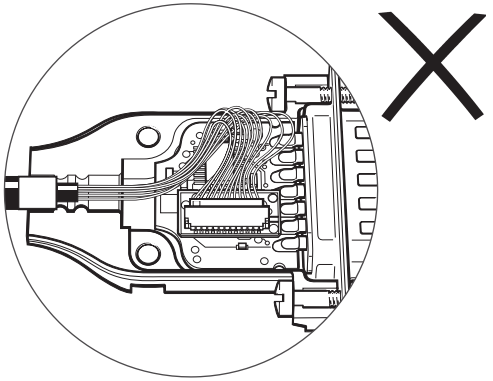
1. Open the interface housing by removing the two screws shown (4-40 UNC screws and nuts).
2. With the plain side facing up, remove the top half of the housing, so that the interface PCB is exposed and the readhead connection socket is visible.
3. Taking care not to touch the pins, plug the connector into the socket in the interface, ensuring correct orientation as shown.

NOTE: Care is required to hold the assembly together as the PCB is fixed only to the 15-way connector and the jack screws are loose.





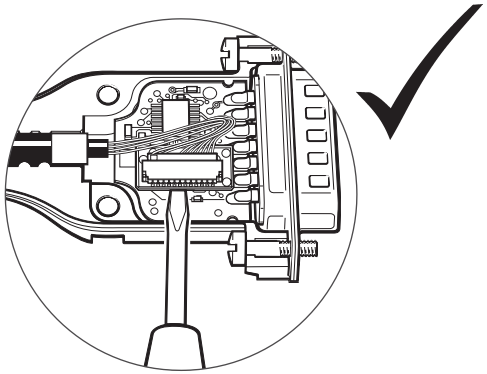


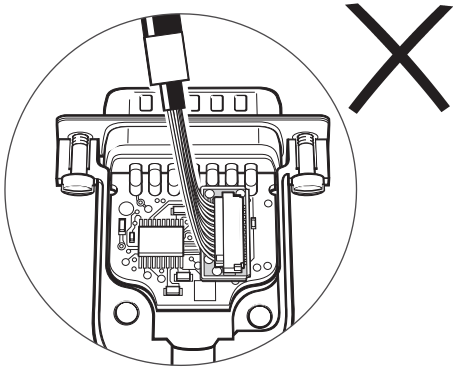


4. Re-assemble the housing ensuring the cable ferrule is located in the recess on the inside and no wires are trapped.
5. Refit the screws.
6. When the system has been connected, proceed with 'Readhead mounting and alignment' on page 37 and 'System calibration' on page 45.

Disconnecting the readhead

1. Disconnect power.
2. Open the interface housing as detailed earlier in this section.
3. Gently lever the connector PCB (on the end of the cable) out of the socket.
4. Place the connector in an anti-static bag.
5. Re-assemble the interface.





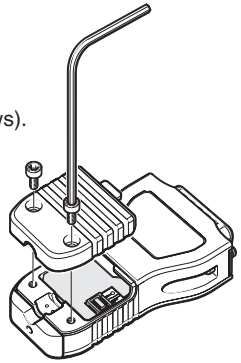
Ti interface

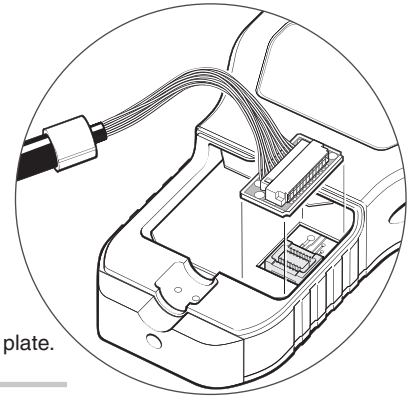
Approved ESD precautions must be followed at all times during readhead and interface electrical connection.

The readhead is connected to the Ti interface via a small, rugged interboard connector to allow for easy feed-through during installation.

Connecting the readhead

1. Remove the cover plate as shown (two M2.5 hex head screws).

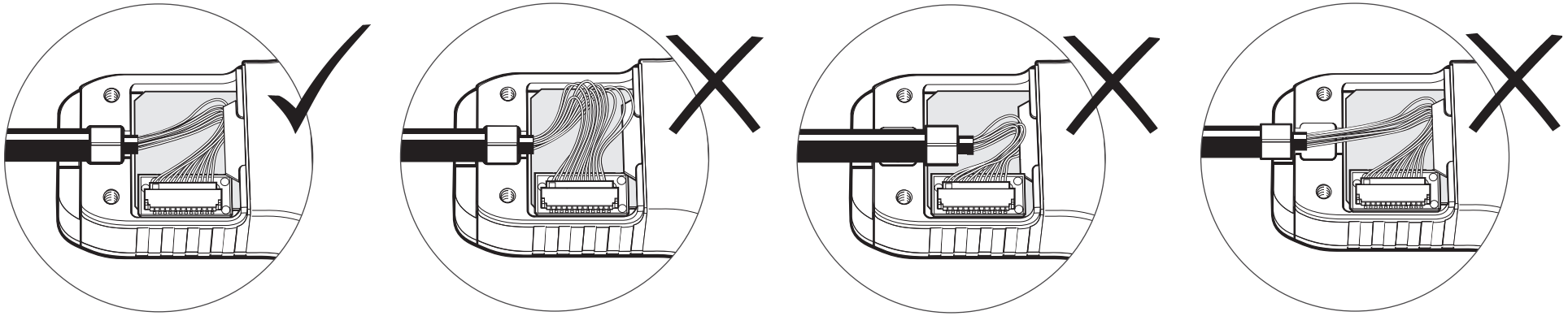




2. Taking care not to touch the pins, plug the connector into the socket in the interface, ensuring correct orientation as shown.

3. Refit the cover plate, ensuring the cable ferrule is located in the recess on the inside, and no wires are trapped under the cover plate.

NOTE: The tightening torque should be between 0.25 Nm and 0.4 Nm.



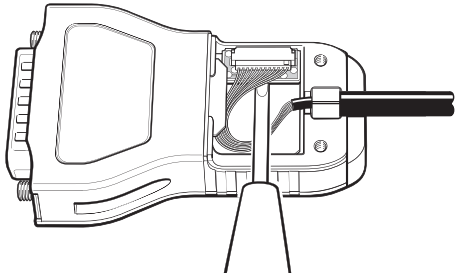
4. Proceed with 'Readhead mounting and alignment' on page 37 and 'System calibration' on page 45.

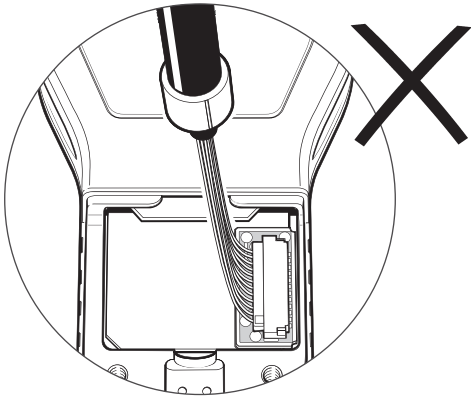
Disconnecting the readhead

1. Disconnect power.
2. Remove the cover plate on the interface (two M2.5 hex head screws).
3. Gently lever the connector PCB (on the end of the cable) out of the socket.

CAUTION: Do not pull the cable to remove the connector.

4. Place the connector in an anti-static bag.
5. Refit the cover plate.





Readhead mounting and alignment

Methods

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

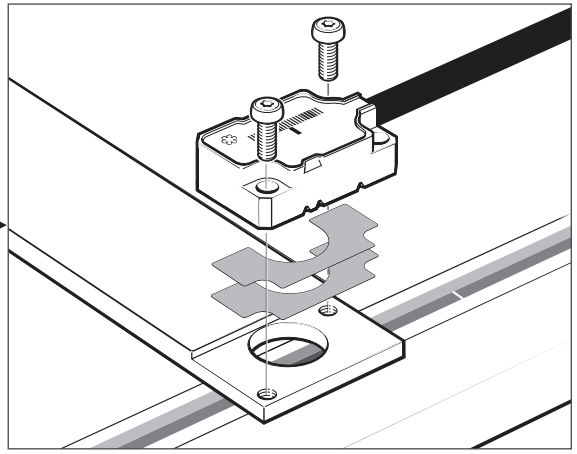
Ensure that the scale, readhead optical window and mounting face are clean and free from obstruction.

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.

NOTE: For FPC readheads, the FPC cable must be fitted prior to mounting the readhead. See page 27 for more details.

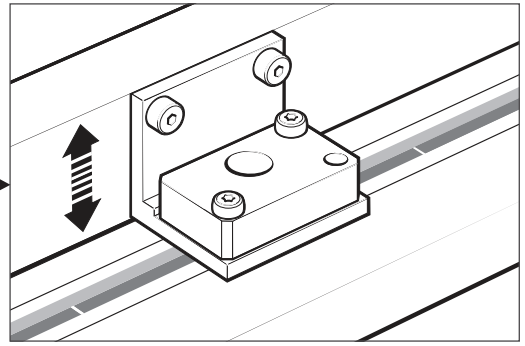
IMPORTANT: Whichever method is used to mount the readhead, care should be taken to ensure the scale surface is not damaged during this operation, particularly when metal-to-metal contact is necessary.

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

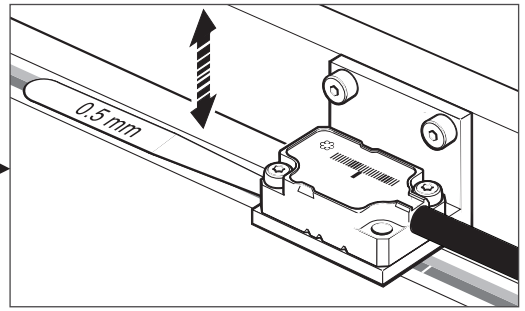


Shim kit (page 38).

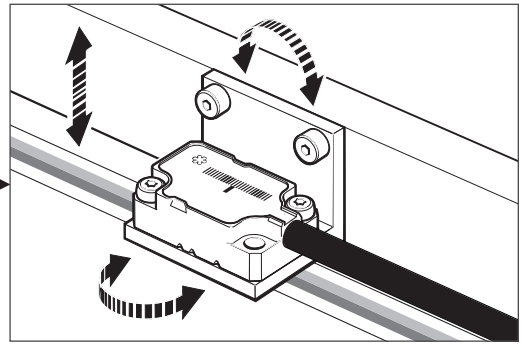
Adjustable bracket
Readhead mounting bracket allows adjustment of rideheight



Dummy head (page 40).



Accurate bracket and feeler gauge (page 42).

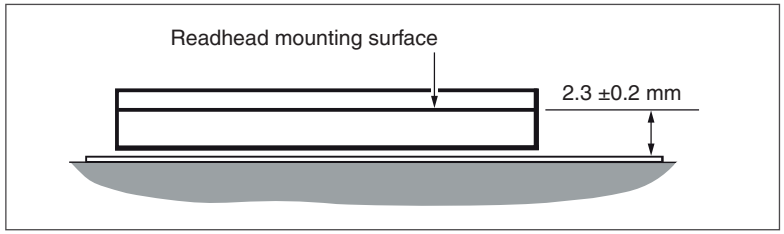


Signal amplitude adjustment (page 43).

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 (±0.2 mm) from the readhead mounting surface to the top of the scale.

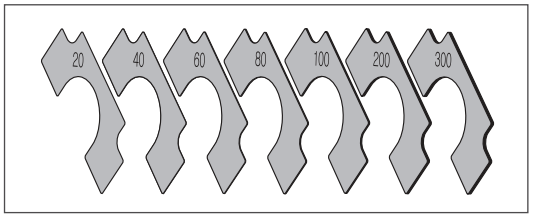


Shims of a known thickness are inserted between the mounting face of the readhead and the bracket to give the correct rideheight.

Required parts:

- Shim kit (A-9401-0050) constisting of:

Part number	Thickness (µm)	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 × M2 × 6 screws
- ATOM readhead

Optional parts:

- DTi adaptor (A-9401-0105)

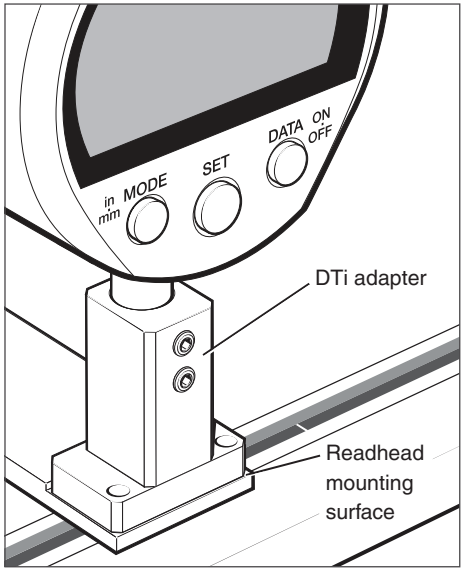
1. Using a digital dial gauge or similar, measure the distance from the readhead mounting surface to the scale surface.

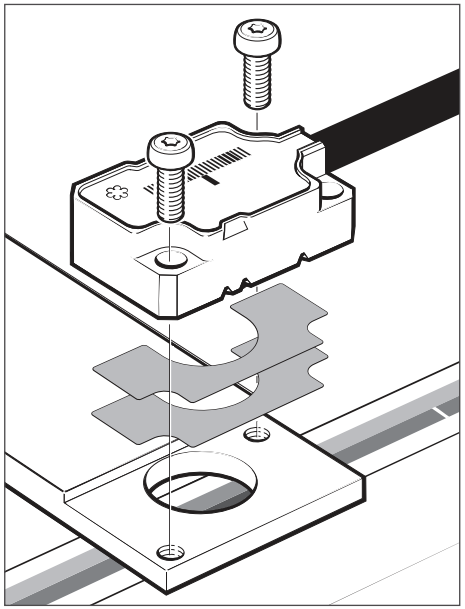
   Care must be taken to ensure the scale surface is not scratched.

   - Insert the gauge into the adapter and zero the gauge on a flat surface.
   - Position or fix the gauge/adapter 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 guage.

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 µm.
3. Select a combination of two shims that gets within 10 µm of the difference. For distances less than 100 µm a single shim should be used; for distances greater than 100 µm select one thick (≥ 100 µm) and one thin (< 100 µm) shim. In the above example this could either be 1 × 100 µm shim and 1 × 40 µm shim or 1 × 100 µm shim and 1 × 20 µm 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 system up. See pages 25 to 36 for relevant system connection.
7. Check the readhead set-up LED is green along the full axis of travel.
8. Proceed with 'System calibration' on page 45.



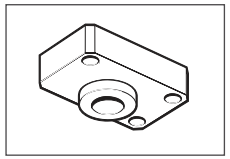


Dummy kit

Suitable for:

Applications where the readhead mounting bracket allows adjustment of rideheight.

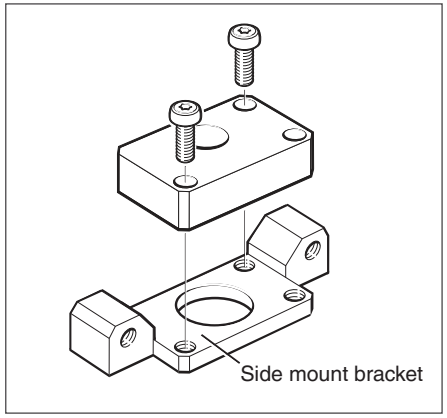
The reusable dummy head is mounted directly onto the bracket in place of the readhead. It has the same dimensions as the ATOM readhead with a longer 'nose' that is machined to the optimum rideheight (2.5 mm ±0.02 mm).

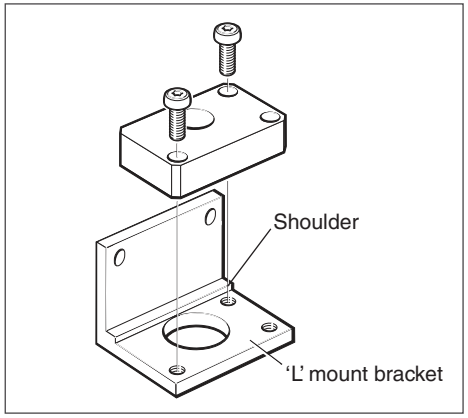


Required parts:

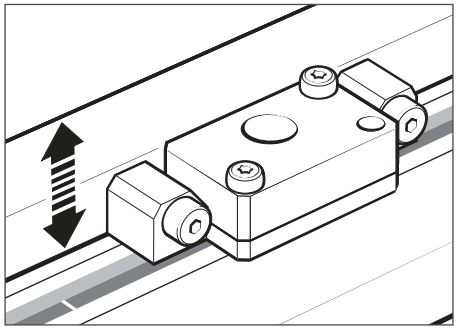
- Dummy head (A-9401-0072)
- 2 × M2 × 6 screws
- Side mount bracket (A-9401-0103) , 'L' mount bracket (A-9402-0037) or customer designed bracket [1]
- 2 × bracket mounting screws
- ATOM readhead

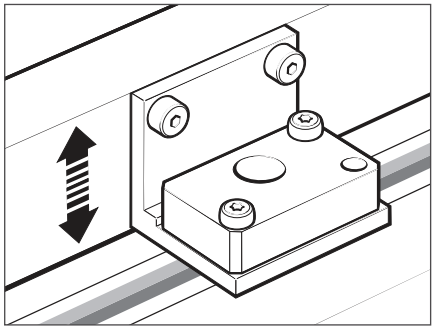
1. Mount the dummy head onto the bracket using two screws.





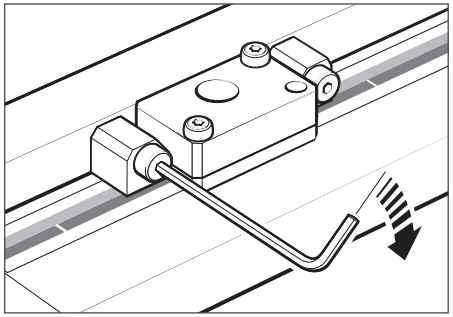
2. Loosely mount the readhead bracket onto the axis.

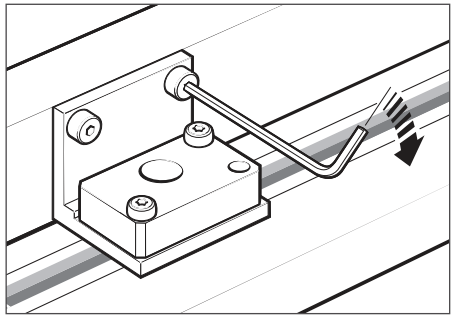




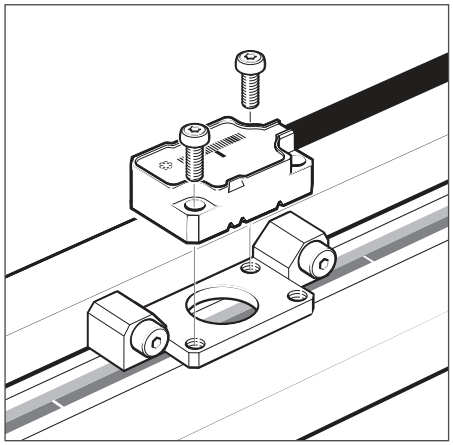
[1] The bracket should have a shoulder to control readhead yaw. Contact your local Renishaw representative for more information on bracket design.

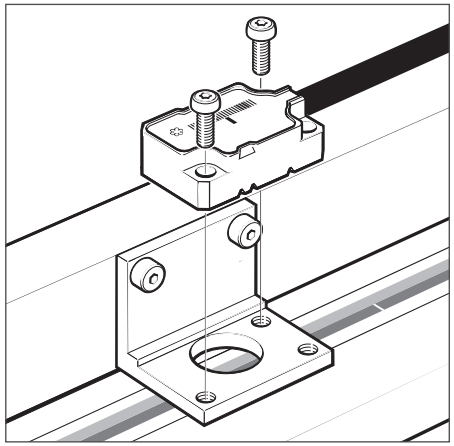
3. Adjust the height of the bracket until the ‘nose’ of the dummy head touches the scale.
4. Tighten the bracket fixing screws whilst ensuring good contact between the ‘nose’ of the dummy head and the surface of the scale.





5. Remove the dummy head.
6. Install the ATOM 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 system up. See pages 25 to 36 for relevant system connection.
8. Check the readhead set-up LED is green along the full axis of travel.
9. Proceed with 'System calibration' on page 45.

Accurate bracket and feeler gauge

Suitable for:

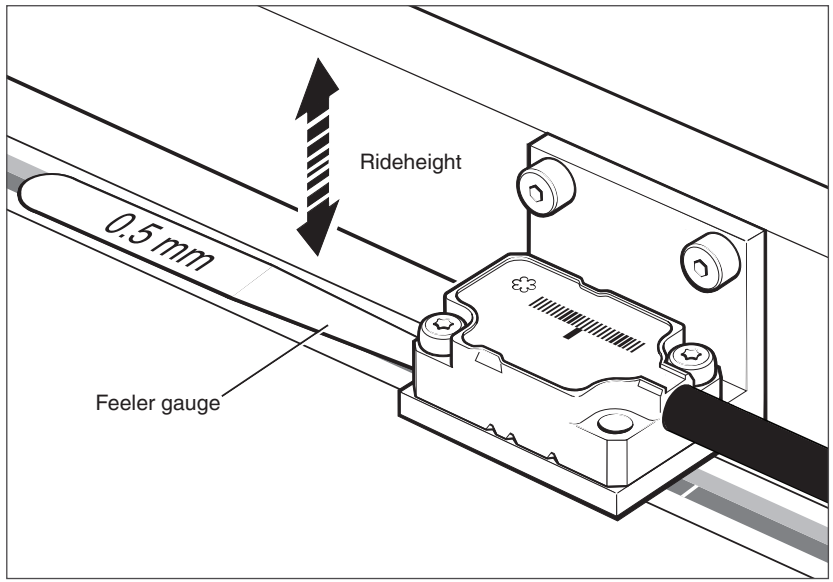
Applications where the readhead mounting bracket allows adjustment of rideheight with a bracket thickness of 2 ±0.02 mm.

Required parts:

- 'L' mount bracket (A-9402-0037) or customer designed bracket with a thickness of 2 ±0.02 mm [1]
- 2 × bracket mounting screws
- 0.5 mm feeler gauge
- 2 × M2 × 6 screws
- ATOM readhead

For more information on system tolerances refer to the installation drawings on **www.renishaw.com/atomdownloads**.

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 system up. See pages 25 to 36 for relevant system connection.
6. Check the readhead set-up LED is green along the full axis of travel.
7. Proceed with 'System calibration' on page 45.

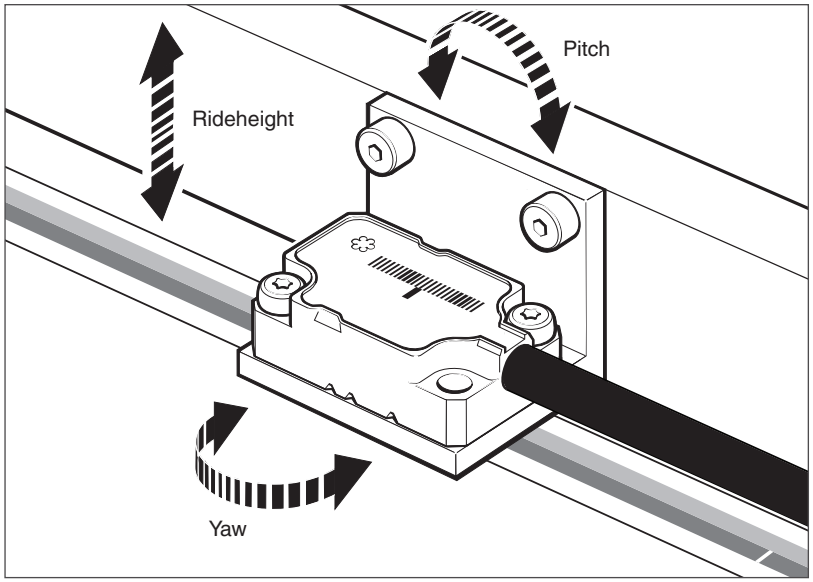


[1] For more information on bracket design, contact your local Renishaw representative.

Signal amplitude adjustment

Suitable for:

Applications where the readhead mounting bracket allows full adjustment of the readhead and the Renishaw USB set-up tool kit and software or an oscilloscope can be used to monitor the output signals.



Required parts:

- 'L' mount bracket (A-9402-0037) or customer designed bracket [1]
- 2 × bracket mounting screws
- 2 × M2 × 6 screws
- ATOM readhead
- Oscilloscope or Renishaw USB set-up tool kit and software

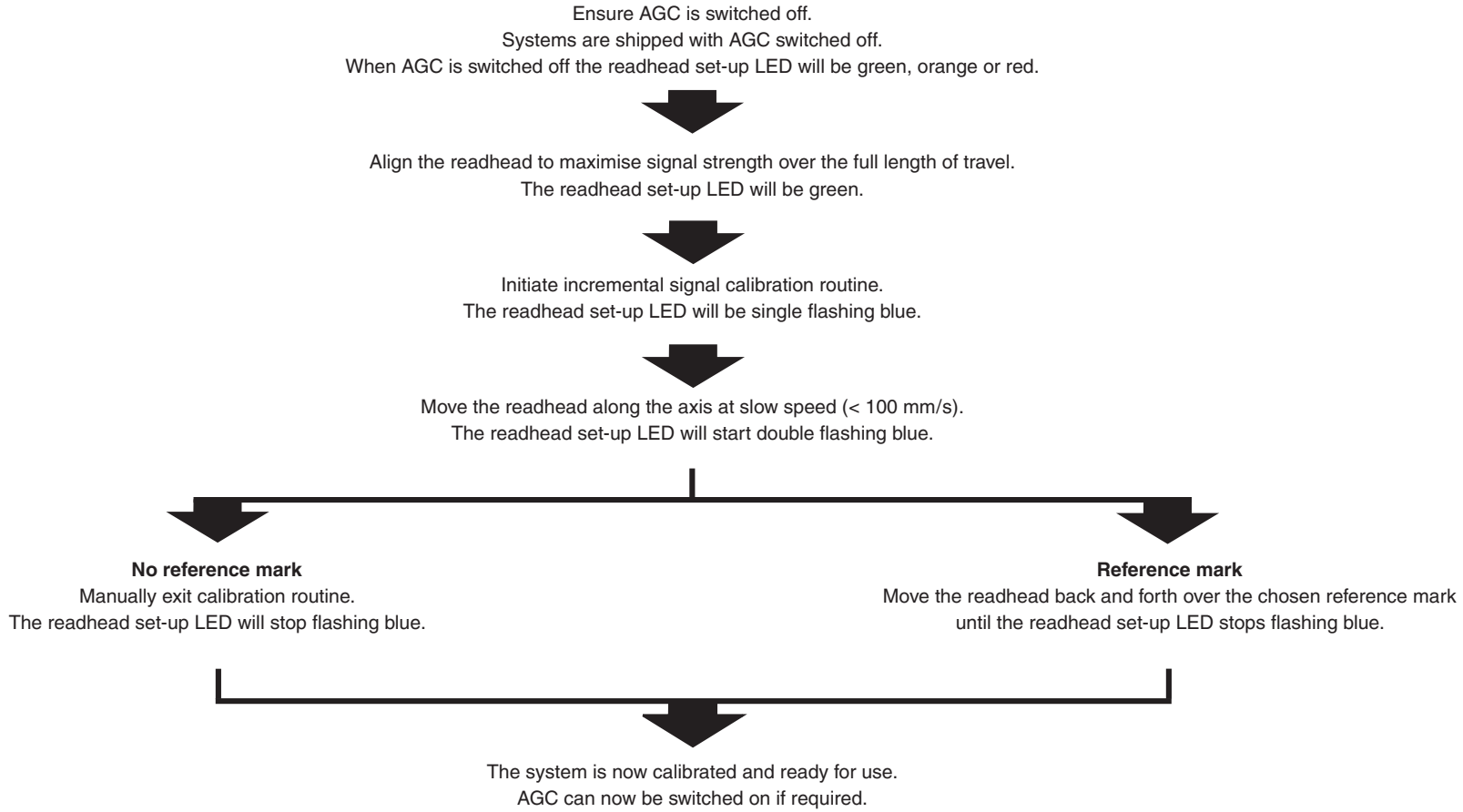
For more information on system tolerances refer to the installation drawings at **www.renishaw.com/atomdownloads**.

1. Mount the readhead onto the bracket.
2. Loosely mount the readhead bracket onto the axis.
3. Using the Renishaw USB set-up tool kit or an oscilloscope adjust the yaw, pitch and rideheight of the readhead to maximise the signal strength.
4. Tighten the bracket and readhead fixing screws.
5. Connect the system up. See pages 25 to 36 for relevant system connection.
6. Check the readhead set-up LED is green along the full axis of travel.

[1] For more information on bracket design and the Renishaw USB set-up tool kit, contact your local Renishaw representative.

Calibration overview

Calibration is an essential operation that completes readhead set-up, with the optimum incremental and reference mark signal settings stored in the readhead's non-volatile memory. This section is an overview of the calibration procedure for an ATOM system. For more detailed information on calibrating the system see 'System calibration' on page 45.



NOTE: If calibration fails (readhead set-up LED continues flashing blue), restore factory defaults, see page 47, and repeat the installation and calibration routine.

System calibration

Calibration (CAL) is an essential operation that completes readhead set-up, with the optimum incremental and reference mark signal settings stored in the readhead's non-volatile memory.

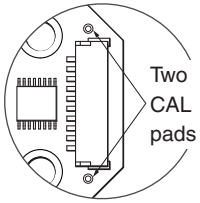
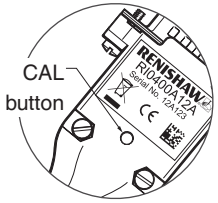
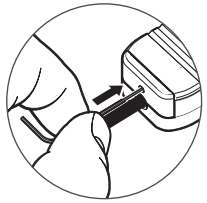
Before system calibration:

- Clean the scale and readhead optical window
- If reinstalling, restore factory defaults (see 'Restoring factory defaults' on page 47)
- Ensure AGC is switched off (readhead set-up LED is green, red or orange)
- Maximise the signal strength along full length of travel (readhead set-up LED is green)

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

Step 1 – Incremental signal calibration

- Initiate calibration routine.

No interface	ACi interface	Ri interface	Ti interface
Ground the CAL pin for < 2 seconds.	Connect the CAL pads together or ground the remote CAL line (pin 8) for < 2 seconds. 	Press the CAL button on the side of the interface for < 2 seconds using a 2 mm Allen key or similar tool.  **WARNING:** Activating the CAL switch only requires 2.5 N force. Applying excess force may permanently damage the switch.	Press the CAL button on the end of the interface for < 2 seconds using a 2 mm Allen key or similar tool. 

- The readhead set-up LED will now periodically single-flash blue to indicate that it is in the incremental signal calibration routine. The set-up signal (V_x) will be a nominal 0 V.
- Slowly move the readhead along the axis, ensuring you do not pass a reference mark, until the readhead set-up LED starts double-flashing blue. This indicates the incremental signal is now calibrated and the new settings are stored in the readhead memory. The set-up signal (V_x) will be a nominal 1.65 V.
- The system is now ready for reference mark phasing.
- For systems without a reference mark, go to 'Calibration routine – manual exit' on page 46.
- If the system does not automatically enter the reference mark phasing stage (no double-flashing blue of the readhead set-up LED) the calibration of the incremental signals has failed. After ensuring failure is not due to overspeed (> 100 mm/s), exit the calibration routine, restore factory defaults and check the readhead installation and system cleanliness before repeating the calibration routine.

Step 2 – Reference mark phasing

- Slowly move the readhead back and forth over the chosen reference mark until the readhead set-up LED stops flashing and remains green. The reference mark is now phased. The set-up signal (V_x) will be a nominal 3.3 V depending upon system set-up (see 'Output specifications' on page 70).

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

- The system automatically exits the CAL routine and is ready for operation.
- If the readhead set-up LED continues double-flashing blue after passing the chosen reference mark many times, it is not detecting the reference mark. Ensure that the readhead orientation and lateral offset are correct.

Calibration routine – manual exit

- The calibration routine can be exited at any stage. Depending upon the interface used follow the relevant section in the table below to exit CAL mode.

No interface	ACi interface	Ri interface	Ti interface
Ground the CAL pin for < 2 seconds.	Connect the CAL pads together or ground the remote CAL line (pin 8) for < 2 seconds.	Press and hold the CAL button on the side of the interface for < 2 seconds.	Press the CAL button on the end of the interface for < 2 seconds.

- On successful exit, the readhead set-up LED will stop flashing blue and remain green.

Restoring factory defaults

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 the system off, then switch on again using the following methods depending on interface used.

No interface	ACi interface	Ri interface	Ti interface
Ground and hold the CAL pin whilst switching the system on.	Connect the CAL pads together or ground the remote CAL line (pin 8) whilst switching the system on.	Press and hold the CAL button on the side of the interface whilst switching the system on.	Press and hold the CAL button on the end of the interface whilst switching the system on.

- The readhead set-up LED will flash blue four times on switch on.
- Release CAL button, CAL pads link or CAL pin ground.
- Check the readhead mounting/installation and recalibrate the system.

NOTE: System must be recalibrated after restoring factory defaults.

Switching Automatic Gain Control (AGC) on or off

AGC can be switched on or off via the interface or the CAL line.

No interface	ACi interface	Ri interface	Ti interface
Ground the CAL pin for > 3 seconds then remove ground link.	Connect the CAL pads together or ground the remote CAL line (pin 8) for > 3 seconds then disconnect.	Press and hold the CAL button on the side of the interface for > 3 seconds then release.	Press and hold the CAL button on the end of the interface for > 3 seconds then release.

- The readhead set-up LED will be green with the addition of blue when AGC is enabled.

NOTE: The system must be calibrated before switching AGC on.

LED diagnostics

Readhead

The readhead set-up LED consists of a tri-coloured LED which can display any combination of red, blue or green.

Signal	Indication	Status
Incremental (AGC off) [1]	Green	Normal set-up; signal level > 70%, AGC off
	Orange [2]	Acceptable set-up; signal level 50% to 70%, AGC off
	Red	Poor set-up; signal may be too low for reliable operation; signal level < 50%, AGC off
CAL	Single-blue flashing	Calibrating incremental signals
	Double-blue flashing	Calibrating reference mark
Reference mark	Green (flash) [3]	Normal phasing
	Blank (flash)	Acceptable phasing
	Red (flash)	Poor phasing; clean scale and recalibrate if required
Restore factory defaults	Four blue flashes on switch on	Factory defaults restored

Ti interface

Signal	Indication	Status	Alarm output [4]
Incremental	Purple	Normal set-up; signal level 110% to 135%	No
	Blue	Optimum set-up; signal level 90% to 110%	No
	Green	Normal set-up: signal level 70% to 90%	No
	Orange	Acceptable set-up; signal level 50% to 70%	No
	Red	Poor set-up; signal may be too low for reliable operation; signal level < 50%	No
	Red / blank - flashing	Poor set-up; signal level < 20%; system in error	Yes
	Blue / blank - flashing	Overspeed; system in error	Yes
	Purple / blank - flashing	Over signal; system in error	Yes
Reference mark	Blank flash	Reference mark detected (speed < 100 mm/s only)	No

NOTE: See 'Troubleshooting' on page 49 for more information on diagnosing faults.

[1] When AGC is enabled the LED indication will be as shown but with the addition of a blue indication.

[2] When stationary will be green or red.

[3] Flash will effectively be invisible when incremental signal level is > 70% when passing reference mark.

[4] Alarm output will take the form of 3-state or line driven E– signal depending on interface configuration. Also, some configurations do not output overspeed alarm. See the *ATOM™ miniature encoder system* data sheet (Renishaw part no. L-9517-9563) for more details.

- Momentary status only, while fault condition remains.
- Alarm may result in axis position error, re-datum to continue.

Troubleshooting

Fault	Cause	Possible solutions
LED on the readhead is blank	There is no power to the readhead	• Ensure 5 V supplied at the readhead. • For cable variants check correct wiring of connector. **NOTE:** Analogue and digital systems have different pin-outs • When using Ti, Ri or cabled ACi interfaces check the interboard connector that plugs in the interface is properly seated and the correct orientation. • For FPC variants check correct insertion and orientation of the FPC cable.

LED on the readhead is red and I cannot get a green LED	The signal strength is < 50%	• Check the readhead optical window and scale are clean and free from contamination.
		• Restore factory defaults (page 47) and check alignment of the readhead. In particular;
		  • Rideheight
		  • Yaw
		  • Offset
		• Check the scale and readhead orientation.
		• Check that the readhead variant is the correct type for the chosen scale (see the *ATOM™ miniature encoder system* data sheet (Renishaw part no. L-9517-9563) for details of readhead configuration).

Unable to get a green LED over the complete axis length	System run-out is not within specification	• Check that the readhead variant is the correct type for the chosen scale (see the *ATOM™ miniature encoder system* data sheet (Renishaw part no. L-9517-9563) for details of readhead configuration). • Use a DTi gauge and check the run-out is within specifications. • Restore factory defaults. • Realign readhead to obtain a green LED at the mid-point of the run-out. • Recalibrate the system (page 45).
Cannot initiate the calibration routine	Cabled D-type readhead does not have CAL button	• If not using an interface with a CAL button, check that the correct pin is being shorted to 0 V for < 2 seconds. • Check that the signal size is > 70% before initiating calibration.
LED on the readhead remains single flashing blue even after moving it along the full axis length	The system has failed to calibrate the incremental signals due to the signal strength being < 70% before the calibration routine was initiated	• Exit CAL mode and restore factory defaults (page 47). • Check system set-up and realign the readhead to obtain a green LED along the full axis of travel before recalibrating.
LED on the readhead appears purple	This is blue and red combined. AGC is switched on and signal level is < 50%	• Check the readhead optical window and scale are clean and free from contamination. • Restore factory defaults (page 47) then check the LED is green along the full axis and recalibrate the system (page 45). If it is not green, check the alignment of the readhead.

Fault	Cause	Possible solutions
LED on the readhead appears white with flashes of other colours as the readhead is moved along the axis	AGC is switched on and the signal level is < 70%	• Check the readhead optical window and scale are clean and free from contamination. • Restore factory defaults (page 47) then check the LED is green along the full axis and recalibrate the system (page 45). If it is not green check the alignment of the readhead.
LED on the readhead is double flashing blue even after moving it past the reference mark several times	The readhead is not seeing a reference mark	• Ensure you are moving the readhead past your chosen reference mark several times. • Check the scale/readhead orientation. • Check the scale/readhead alignment. • Check the readhead optical window and scale are clean and free from contamination. • Check that the readhead variant is the correct type for the chosen scale (see the *ATOM™ miniature encoder system* data sheet (Renishaw part no. L-9517-9563) for details of readhead configuration).

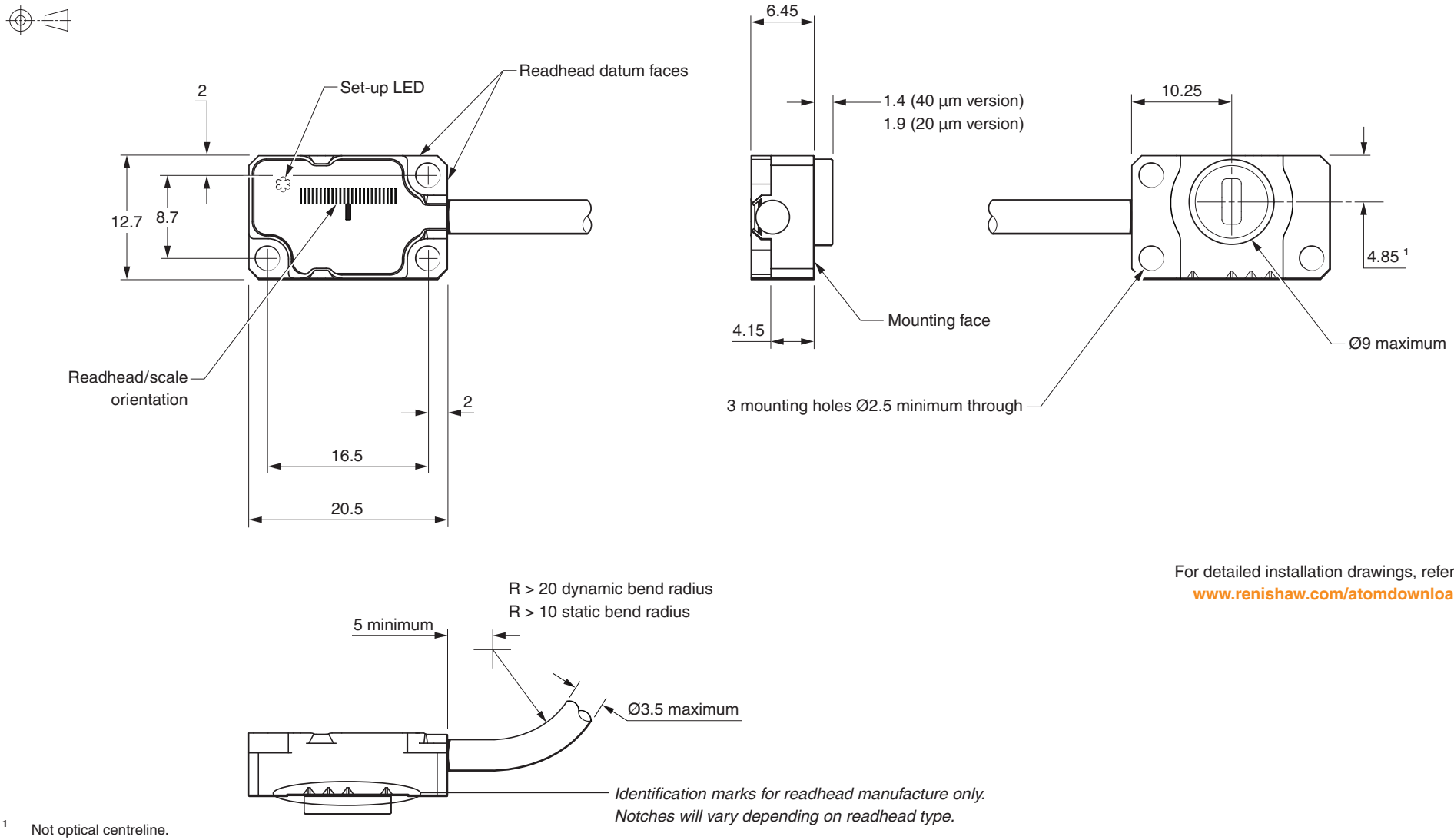
No reference mark output		• Ensure you are not moving the readhead too fast during calibration mode (maximum speed < 100 mm/sec).
		• Calibrate the system (page 45)
		  • If the system completes calibration mode, then it has successfully seen and calibrated the reference mark. If you still cannot see a reference mark then check the system wiring.
		  • If the system does not calibrate the reference mark (LED on the readhead double flashes blue), see above for possible solutions.

Reference mark is not repeatable	Only the chosen reference mark that has been used in the calibration sequence is repeatable, other reference marks may not be phased	• Ensure you are using the reference mark that has been calibrated for referencing your system. • The readhead bracket must be stable and not allow any mechanical movement of the readhead. • Check any unused reference marks have been deselected. • Clean the scale and readhead optical window and check for damage then recalibrate the system over the chosen reference mark.
LED on the readhead is flashing red or blank over the reference mark	The reference mark is not phased	• 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 blank or red when passing other reference marks if they have not been deselected (page 21). • Clean the scale and readhead optical window and check for scratches then recalibrate the system over the chosen reference mark (page 45).
Multiple reference marks output	Unused reference marks have not been deselected or FPC is damaged	• All unused reference marks should be deselected (page 21) as only the calibrated reference mark will be repeatable. • Check alignment of deselection stickers. • Replace damaged FPC (if applicable).

ATOM readhead

Cabled readhead dimensions

Dimensions and tolerances in mm

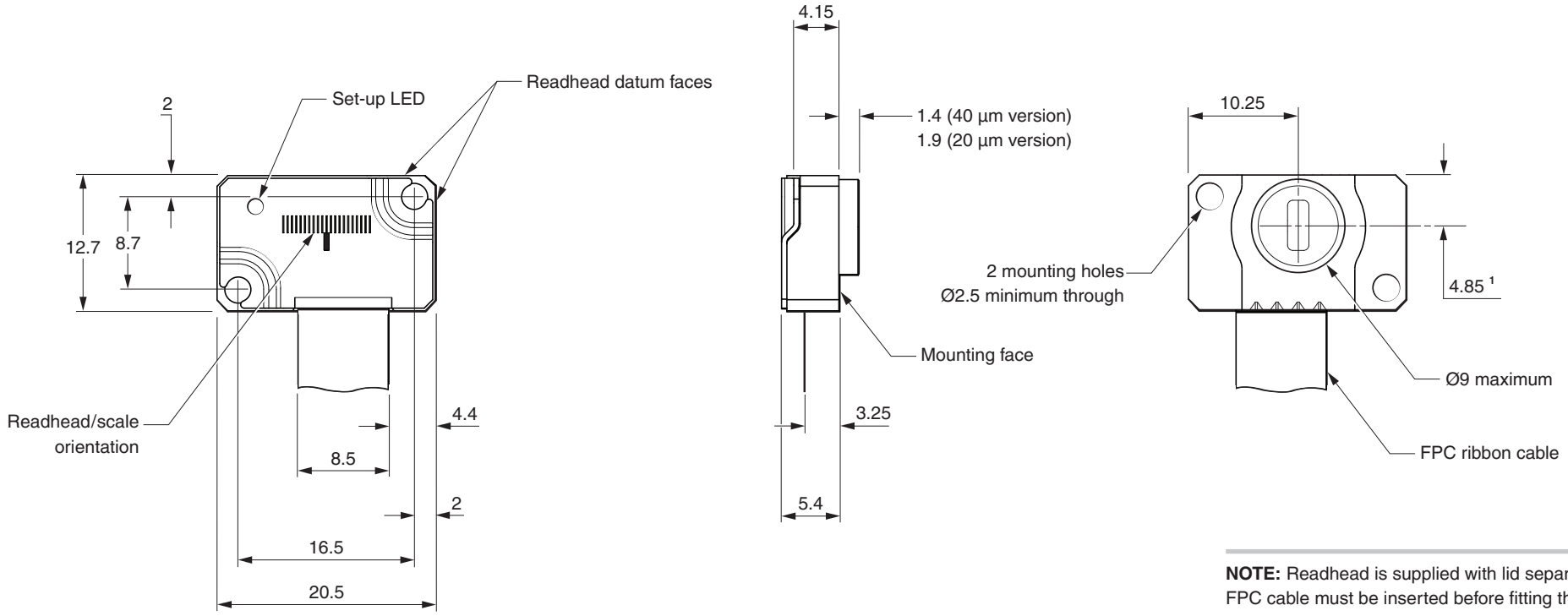


For detailed installation drawings, refer to
www.renishaw.com/atomdownloads

[1] Not optical centreline.

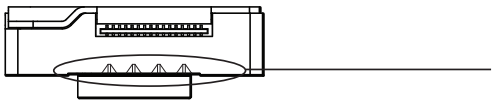
FPC readhead dimensions

Dimensions and tolerances in mm



NOTE: Readhead is supplied with lid separate. FPC cable must be inserted before fitting the lid.

For detailed installation drawings, refer to **www.renishaw.com/atomdownloads**



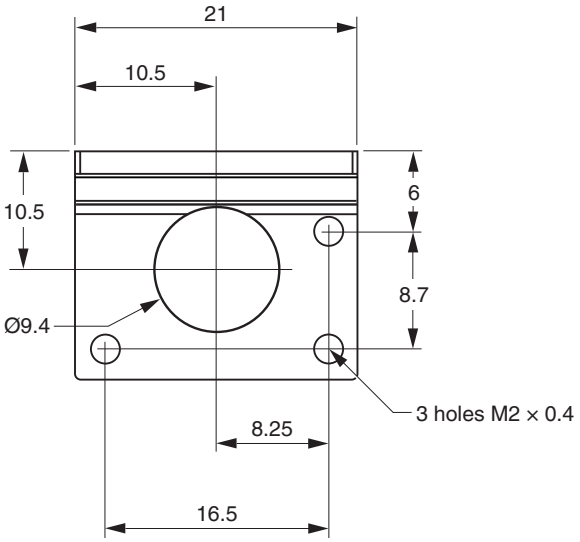
Identification marks for readhead manufacture only. Notches will vary depending on readhead type.

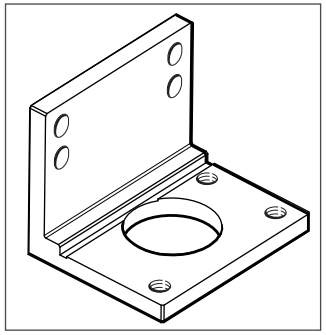
[1] Not optical centreline.

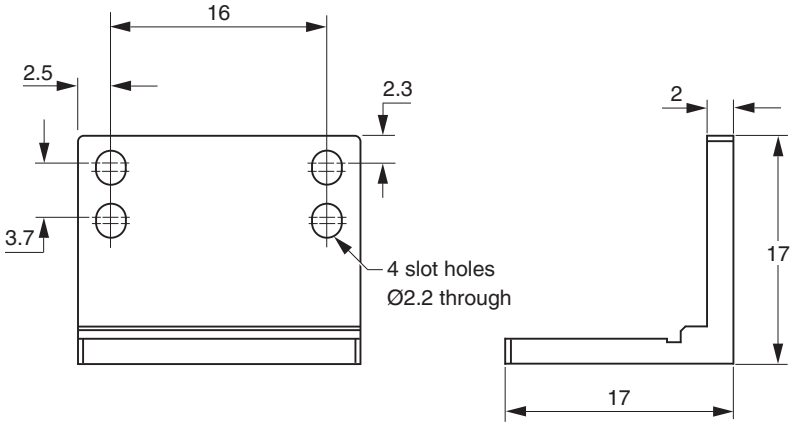
Bracket dimensions

Dimensions and tolerances in mm

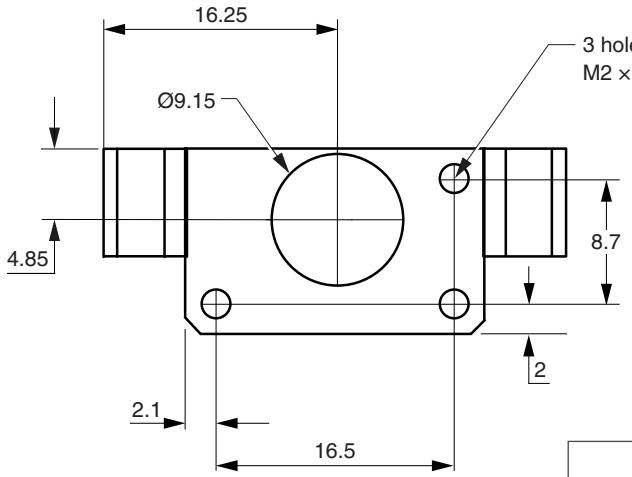
‘L’ mount bracket (A-9402-0037)

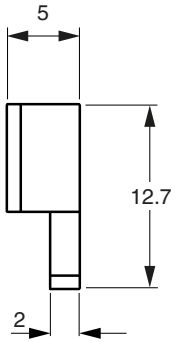


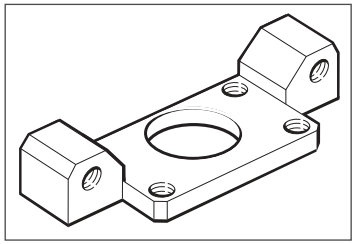


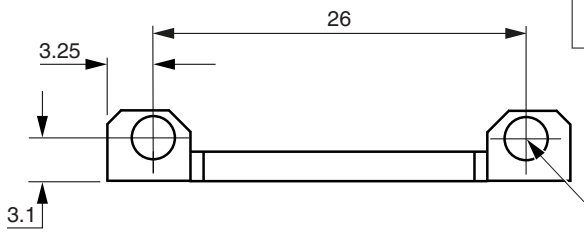


Side mount bracket (A-9401-0103)



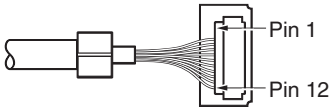




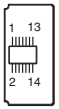


Output signals

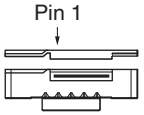
					JST [2] (on interboard)	Interboard connector (T)	FPC (F)	15-way D-type (D)
Function		**Signal**		**Colour**	**Pin**	**Pin**	**Pin**	**Pin**
Power [1]		5 V		Brown	11	4	9, 10	4, 5
		0 V		White	5	13	3, 6, 11, 14	12, 13
Incremental	**Cosine**	V_1	+	Red	4	9	5	9
			–	Blue	3	5	4	1
	Sine	V_2	+	Yellow	7	12	2	10
			–	Green	6	14	1	2
Reference mark		V_0	+	Violet	10	2	13	3
			–	Grey	9	8	12	11
Set-up		V_X		Clear	12	6	16	6
Remote CAL		CAL		Orange	8	10	15	14
Shield		-		Screen	Cable ferrule	Cable ferrule	Readhead body	Case
Do not connect		-		-	1, 2	1, 3, 7, 11	7, 8	7, 8, 15



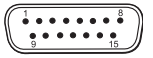
JST connector



Interboard connector for connection to Ri, Ti and cabled ACi interfaces



FPC connection



15-way D-type plug

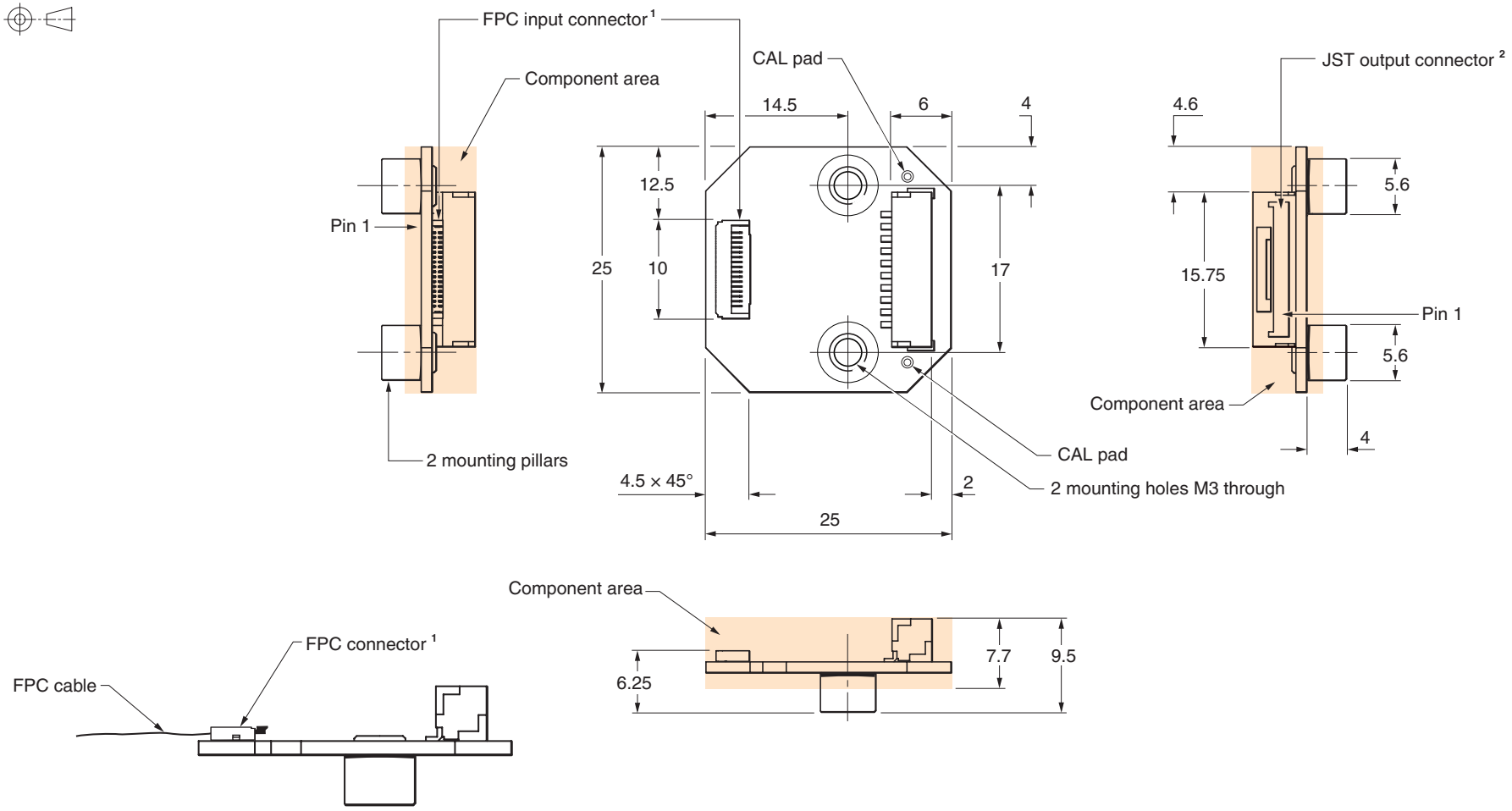
[1] All power connections should be used either to minimise voltage drop down the cable or incorporate voltage sensing.

[2] Only available on interboard connector.

ACi interface

Dimensions and tolerances in mm

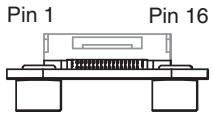
FPC variant installation drawing



1 Care must be taken not to damage the FPC connector when fitting/removing the cable.

2 10-way JST, GH crimp connector. 1.25 mm pitch. Suitable for cable size 26 to 30 AWG. 3 m JST to 15-way D-type cable A-9412-1001.

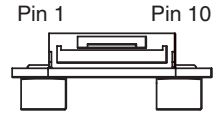
Input signals



ACi FPC input connector

Function	Signal		Pin
Power [1]	5 V		7, 8
	0 V		3, 6, 11, 14
Incremental	V_1	+	12
		–	13
	V_2	+	15
		–	16
Reference mark	V_0	+	4
		–	5
Set-up	V_X		1
Remote CAL	CAL		2
Do not connect	-		9, 10

Output signals



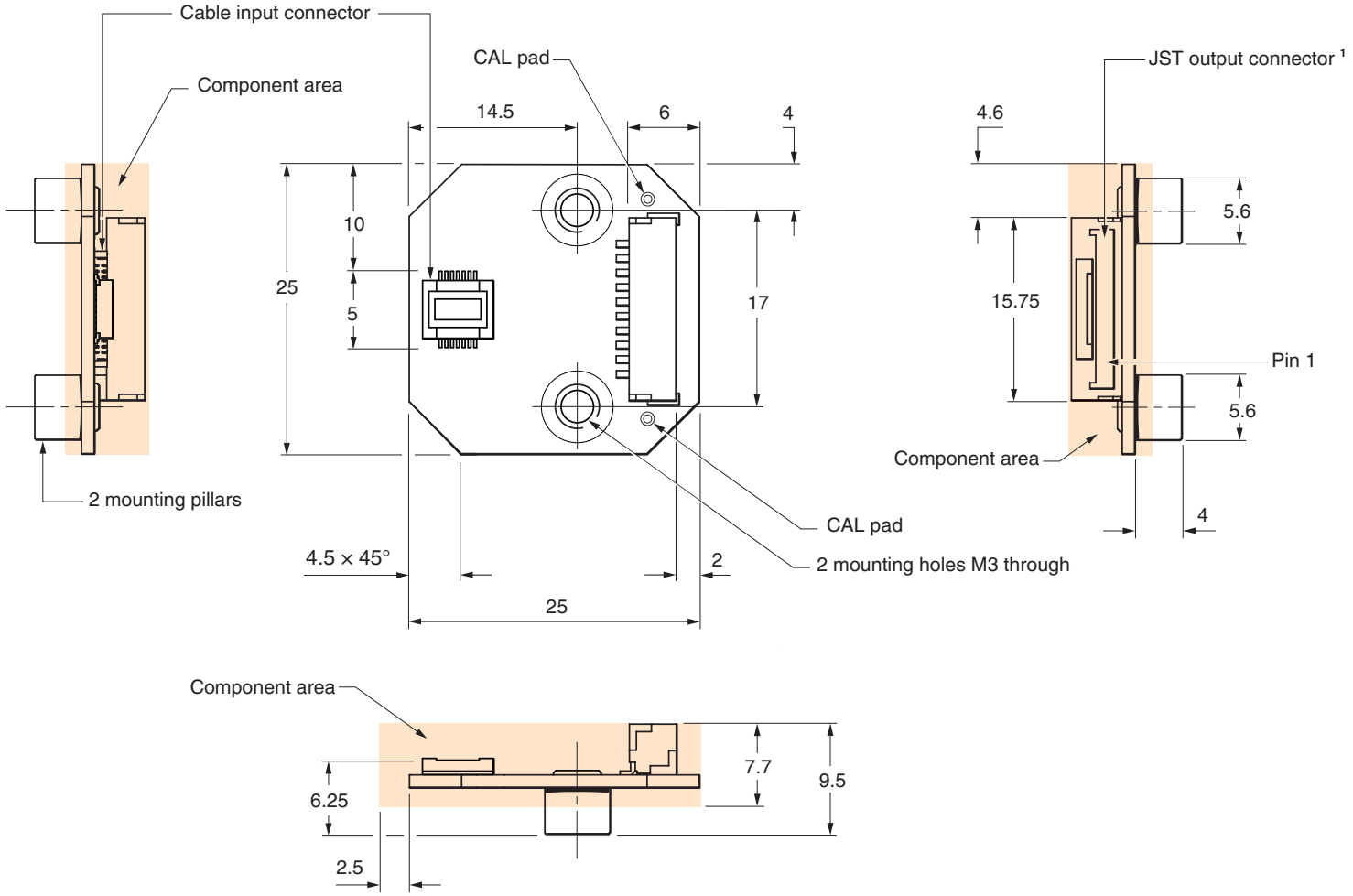
ACi JST output connector

			Pin	
Function	**Signal**		**JST connector**	**A-9412-1001 cable (15-way D-type)**
Power	5 V		9	7, 8
	0 V		10	2, 9
Incremental	A	+	1	14
		–	2	6
	B	+	3	13
		–	4	5
Reference mark	Z	+	5	12
		–	6	4
Set-up	X		7	1
Remote CAL	CAL		8	11

[1] All power connections should be used either to minimise voltage drop down the cable or incorporate voltage sensing.

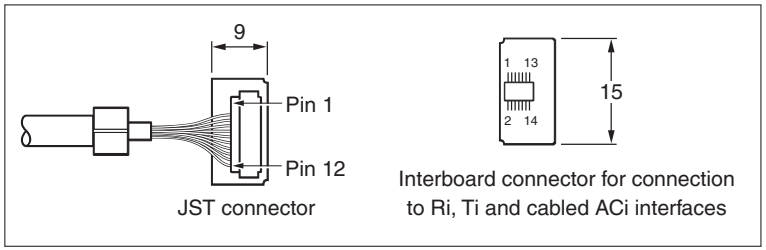
Cable variant installation drawing

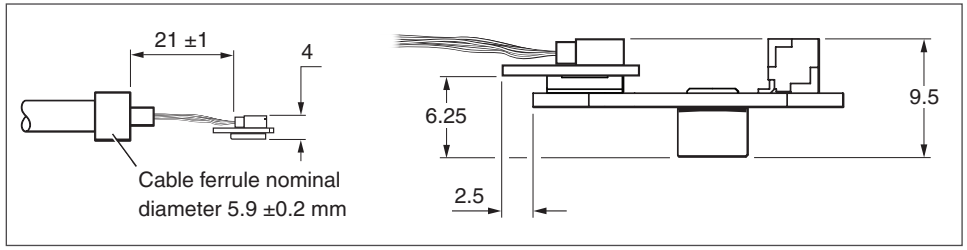
Dimensions and tolerances in mm



1 10-way JST, GH crimp connector. 1.25 mm pitch. Suitable for cable size 26 to 30 AWG. 3 m JST to 15-way D-type cable A-9412-1001.

Readhead cable input connector





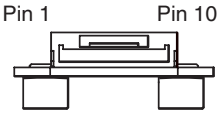
Input signals

Function		Signal		Colour	JST [2] (on interboard) Pin	Interboard connector (T) Pin
Power [1]		5 V		Brown	11	4
		0 V		White	5	13
Incremental	**Cosine**	V_1	+	Red	4	9
			–	Blue	3	5
	Sine	V_2	+	Yellow	7	12
			–	Green	6	14
Reference mark		V_0	+	Violet	10	2
			–	Grey	9	8
Set-up		V_X		Clear	12	6
Remote CAL		CAL		Orange	8	10
Shield		-		Screen	Cable ferrule	Cable ferrule
Do not connect		-		-	1, 2	1, 3, 7, 11

[1] All power connections should be used either to minimise voltage drop down the cable or incorporate voltage sensing.

[2] Only available on interboard connector.

Output signals

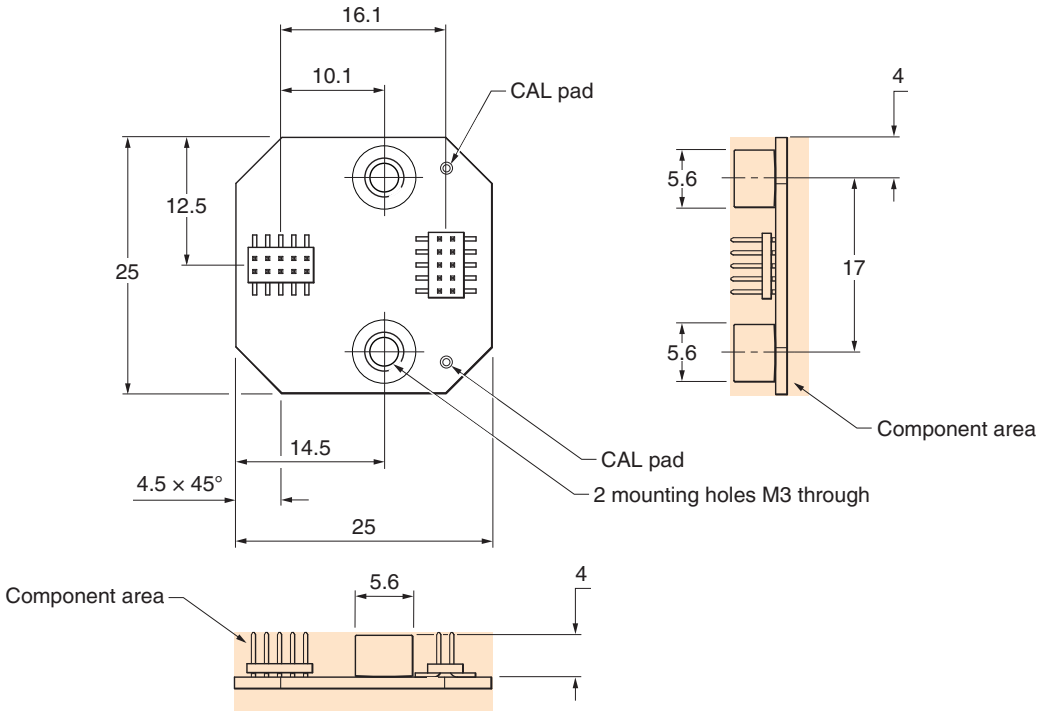


ACi JST output connector

Function	Signal		Pin: JST connector	Pin: A-9412-1001 cable (15-way D-type)
Power	5 V		9	7, 8
	0 V		10	2, 9
Incremental	A	+	1	14
		–	2	6
	B	+	3	13
		–	4	5
Reference mark	Z	+	5	12
		–	6	4
Set-up	X		7	1
Remote CAL	CAL		8	11

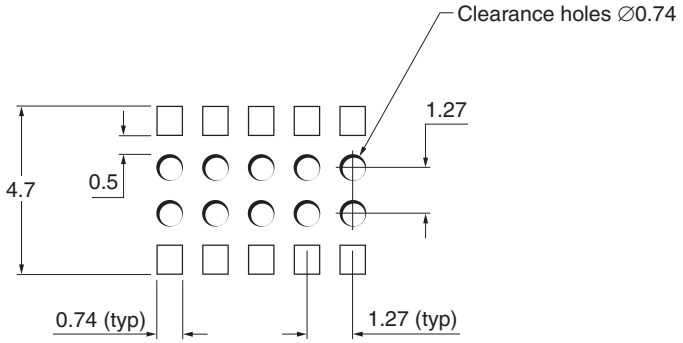
PCB mounting variant installation drawing

Dimensions and tolerances in mm



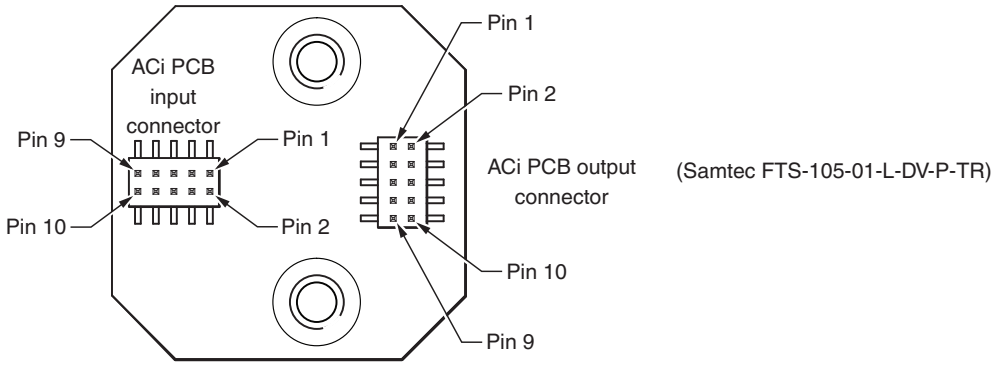
Recommended mating connector
Samtec CLP-105-02-F-D-P-TR

PCB footprint



ACi PCB mounting variant interface (digital output only)

	Input			Output		
Function	**Signal**		**Pin**	**Signal**		**Pin**
Power	5 V		9	5 V		6
	0 V		2	0 V		5
Incremental	V_1	+	4	A	+	8
		–	6		–	10
	V_2	+	3	B	+	7
		–	1		–	9
Reference mark	V_0	+	8	Z	+	3
		–	10		–	1
Set-up	V_X		7	X		4
Remote CAL	CAL		5	CAL		2



(Samtec FTS-105-01-L-DV-P-TR)

Speed

20 µm system

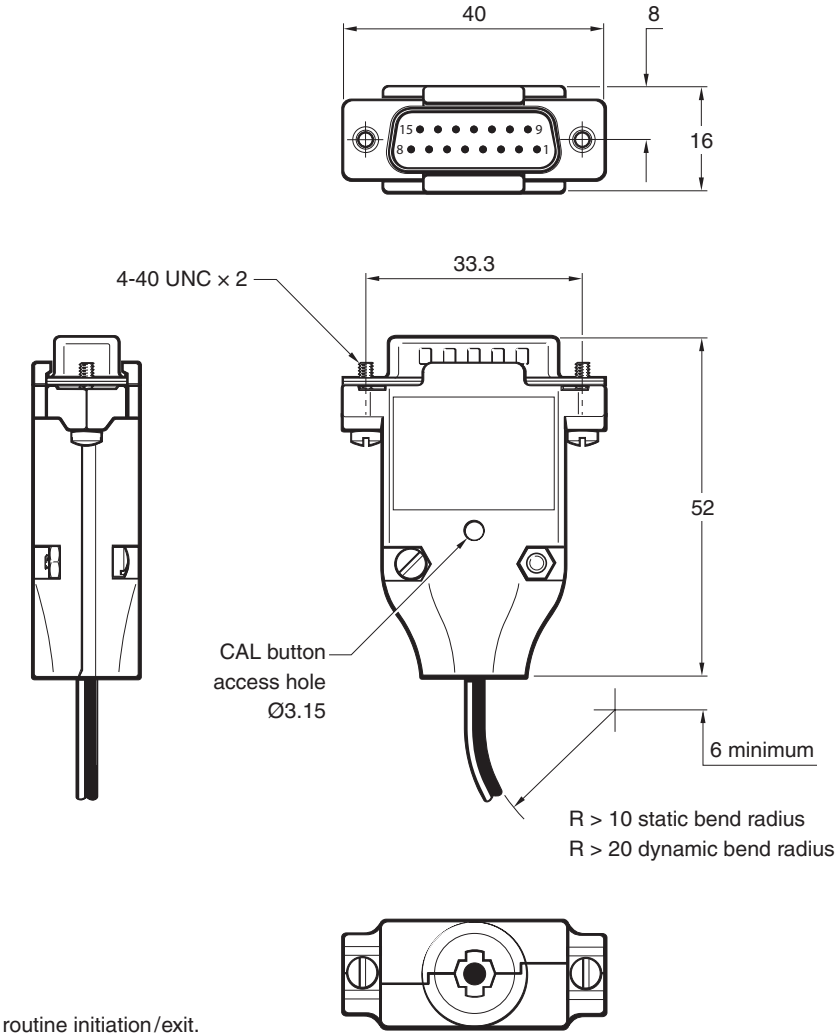
Maximum speed (m/s)								Lowest recommended counter input frequency (MHz)
0020 (1 µm)	0040 (0.5 µm)	0080 (0.25 µm)	0100 (0.2 µm)	0200 (0.1 µm)	0400 (50 nm)	1000 (20 nm)	2000 (10 nm)	
6.5	6.5	6.5	5.8	3	-	-	-	**40**
6.5	6.5	4	3.2	1.6	-	-	-	**20**
-	-	-	-	-	0.35	0.13	0.065	**12**
6.5	4	2	1.6	0.8	-	-	-	**10**
-	-	-	-	-	0.18	0.06	0.03	**6**
4	2	1	0.8	0.4	-	-	-	**5**
-	-	-	-	-	0.12	0.04	0.02	**4**

40 µm system

Maximum speed (m/s)								Lowest recommended counter input frequency (MHz)
0020 (2 µm)	0040 (1 µm)	0080 (0.5 µm)	0100 (0.4 µm)	0200 (0.2 µm)	0400 (0.1 µm)	1000 (40 nm)	2000 (20 nm)	
13	13	13	11.6	6	-	-	-	**40**
13	13	8	6.4	3.2	-	-	-	**20**
-	-	-	-	-	0.7	0.26	0.13	**12**
13	8	4	3.2	1.6	-	-	-	**10**
-	-	-	-	-	0.36	0.12	0.06	**6**
8	4	2	1.6	0.8	-	-	-	**5**
-	-	-	-	-	0.24	0.08	0.04	**4**

Ri interface drawing

Dimensions and tolerances in mm



CAL button operation

Push and release (< 2 seconds) – Calibration (CAL) routine initiation/exit.
Push and release (> 3 seconds) – Automatic Gain Control (AGC) initiation/exit.
Push and hold during power 'Off/On' cycle – Restore factory defaults.

Output signals

Digital

Function	Signal		Pin
Power [1]	5 V		7, 8
	0 V		2, 9
Incremental	A	+	14
		–	6
	B	+	13
		–	5
Reference mark	Z	+	12
		–	4
Alarm [2]	E	+	11
		–	3
Set-up	X		1
Shield	-		Case
Do not connect	-		10, 15

Analogue

Function		Signal		Pin
Power [1]		5 V		4, 5
		0 V		12, 13
Incremental	**Cosine**	V_1	+	9
			–	1
	Sine	V_2	+	10
			–	2
Reference mark		V_0	+	3
			–	11
Set-up		V_X		6
Remote CAL		CAL		14
Shield		-		Case
Do not connect		-		7, 8, 15

[1] All power connections should be used either to minimise voltage drop down the cable or incorporate voltage sensing.

[2] The alarm signal can be output as a line driven signal or 3-state. Select the preferred option at time of ordering.

Speed

Clocked outputs

Ri0100, Ri0200 and Ri0400 interfaces have clocked outputs.

Customers must ensure they comply with the lowest recommended counter input frequency.

Maximum speed (m/s)						Lowest recommended counter input frequency (MHz)
20 µm system			40 µm system			
0100 (0.2 µm)	0200 (0.1 µm)	0400 (50 nm)	0100 (0.4 µm)	0200 (0.2 µm)	0400 (0.1 µm)	
-	0.8	0.4	-	1.6	0.8	**12**
-	0.5	0.25	-	1.0	0.5	**10**
0.8	0.4	0.2	1.6	0.8	0.4	**6**
0.5	0.25	0.12	1.0	0.5	0.24	**4**

Non-clocked outputs

Ri0004, Ri0008, Ri0020 and Ri0040 interfaces have non-clocked outputs.

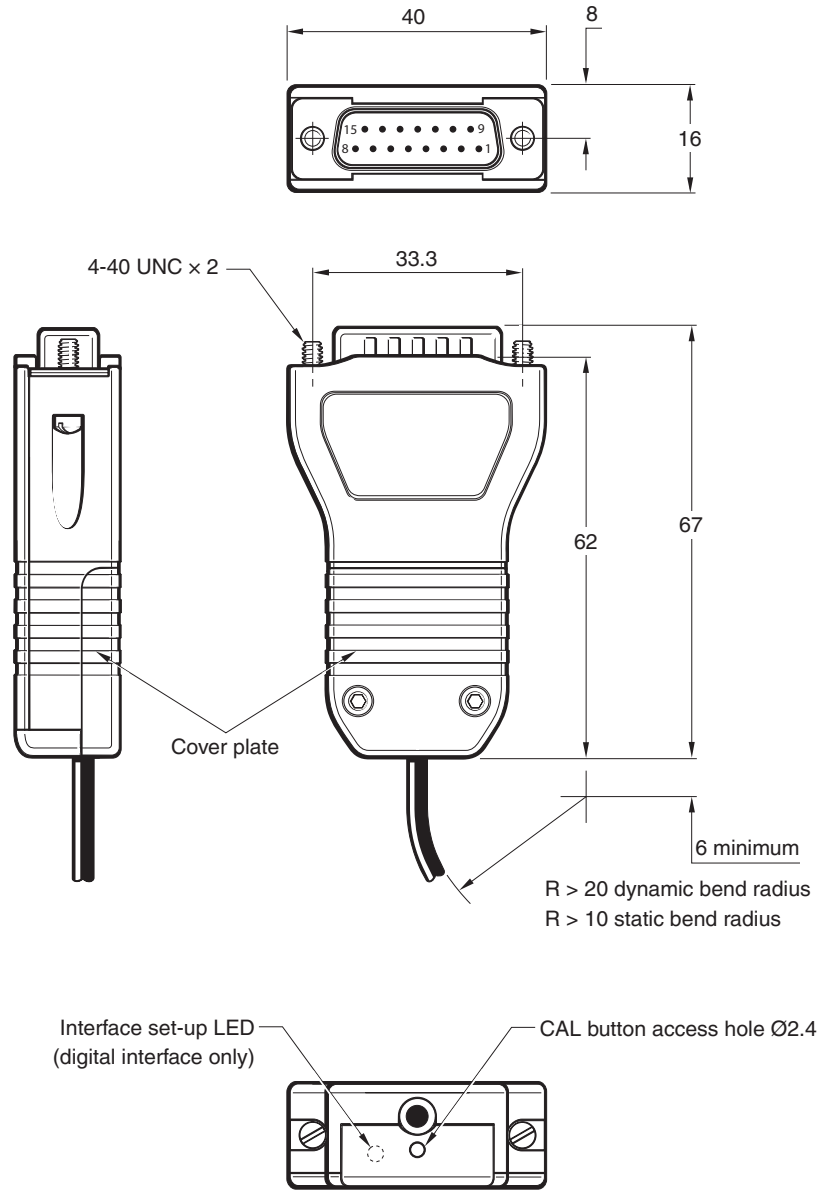
20 µm system		40 µm system		Lowest recommended counter input frequency (MHz)
Interface type	Maximum speed (m/s)	Interface type	Maximum speed (m/s)	
0004 (5 µm)	10	**0004** (10 µm)	20	$\left(\frac{\text{Encoder velocity (m/s)}}{\text{Resolution (µm)}}\right) \times 4$ safety factor
0008 (2.5 µm)	10	**0008** (5 µm)	20	
0020 (1 µm)	10	**0020** (2 µm)	20	
0040 (0.5 µm)	10	**0040** (1 µm)	20	

Analogue speed

40 µm system - 20 m/s (–3dB)
20 µm system - 10 m/s (–3dB)

Ti interface drawing

Dimensions and tolerances in mm



CAL button operation

Push and release (< 2 seconds) - Calibration (CAL) routine initiation/exit.
Push and release (> 3 seconds) - Automatic Gain Control (AGC) initiation/exit.
Push and hold during power 'Off/On' cycle - Restore factory defaults.
Refer to 'Readhead LED diagnostics' and 'Ti LED diagnostics' for LED indications.

Output signals

Digital

Function	Signal		Pin
Power[1]	5 V		7, 8
	0 V		2, 9
Incremental	A	+	14
		–	6
	B	+	13
		–	5
Reference mark	Z	+	12
		–	4
Alarm[2]	E	+	11
		–	3
Set-up	X		1
Shield	-		Case
Do not connect	-		10, 15

Analogue

Function		Signal		Pin
Power[1]		5 V		4, 5
		0 V		12, 13
Incremental	**Cosine**	V_1	+	9
			–	1
	Sine	V_2	+	10
			–	2
Reference mark		V_0	+	3
			–	11
Set-up		V_X		6
Remote CAL		CAL		14
Shield		-		Case
Do not connect		-		7, 8, 15

[1] All power connections should be used either to minimise voltage drop down the cable or incorporate voltage sensing.

[2] The alarm signal can be output as a line driven signal or 3-state. Select the preferred option at time of ordering.

Speed

Digital

20 µm system

Maximum speed (m/s)											Lowest recommended counter input frequency (MHz)
0004 (5 µm)	0020 (1 µm)	0040 (0.5 µm)	0100 (0.2 µm)	0200 (0.1 µm)	0400 (50 nm)	1000 (20 nm)	2000 (10 nm)	4000 (5 nm)	10KD (2 nm)	20KD (1 nm)	
10	10	10	6.48	3.24	1.62	0.648	0.324	0.162	0.0654	0.032	**50**
10	10	10	5.4	2.7	1.35	0.54	0.27	0.135	0.054	0.027	**40**
10	10	8.1	3.24	1.62	0.81	0.324	0.162	0.081	0.032	0.016	**25**
10	10	6.75	2.7	1.35	0.675	0.27	0.135	0.068	0.027	0.013	**20**
10	9	4.5	1.8	0.9	0.45	0.18	0.09	0.045	0.018	0.009	**12**
10	8.1	4.05	1.62	0.81	0.405	0.162	0.081	0.041	0.016	0.0081	**10**
10	6.48	3.24	1.29	0.648	0.324	0.13	0.065	0.032	0.013	0.0065	**8**
10	4.5	2.25	0.9	0.45	0.225	0.09	0.045	0.023	0.009	0.0045	**6**
10	3.37	1.68	0.67	0.338	0.169	0.068	0.034	0.017	0.0068	0.0034	**4**
4.2	0.84	0.42	0.16	0.084	0.042	0.017	0.008	0.004	0.0017	0.0008	**1**

Analogue

20 µm system

10 m/s (–3dB)

Speed

Digital

40 µm system

Maximum speed (m/s)											Lowest recommended counter input frequency (MHz)
0004 (10 µm)	0020 (2 µm)	0040 (1 µm)	0100 (0.4 µm)	0200 (0.2 µm)	0400 (0.1 µm)	1000 (40 nm)	2000 (20 nm)	4000 (10 nm)	10KD (4 nm)	20KD (2 nm)	
20	20	20	12.96	6.48	3.25	1.296	0.648	0.324	0.013	0.064	**50**
20	20	20	10.8	5.4	2.7	1.08	0.54	0.27	0.108	0.054	**40**
20	20	16.2	6.48	3.24	1.62	0.648	0.324	0.162	0.064	0.032	**25**
20	20	13.5	5.4	2.7	1.34	0.54	0.27	0.136	0.054	0.026	**20**
20	18	9	3.6	1.8	0.9	0.36	0.18	0.09	0.036	0.018	**12**
20	16.2	8	3.24	1.62	0.8	0.324	0.162	0.082	0.032	0.0162	**10**
20	12.96	6.48	2.58	1.296	0.648	0.26	0.13	0.064	0.026	0.013	**8**
20	9	4.5	1.8	0.9	0.45	0.18	0.09	0.046	0.018	0.009	**6**
20	6.74	3.36	1.34	0.676	0.338	0.136	0.068	0.034	0.0136	0.0068	**4**
8.4	1.68	0.84	0.32	0.168	0.084	0.034	0.016	0.008	0.0034	0.0016	**1**

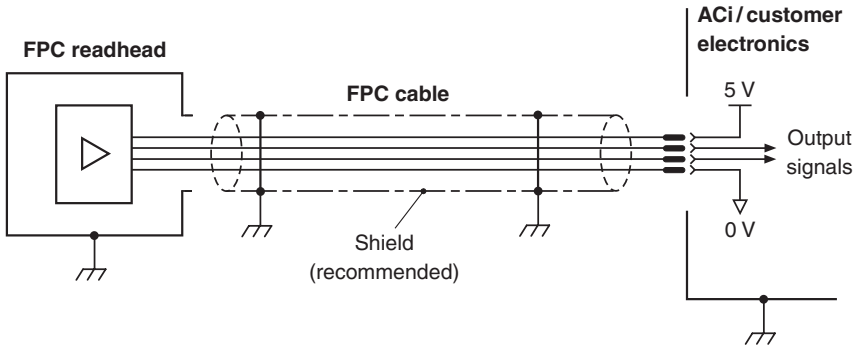
Analogue

40 µm system

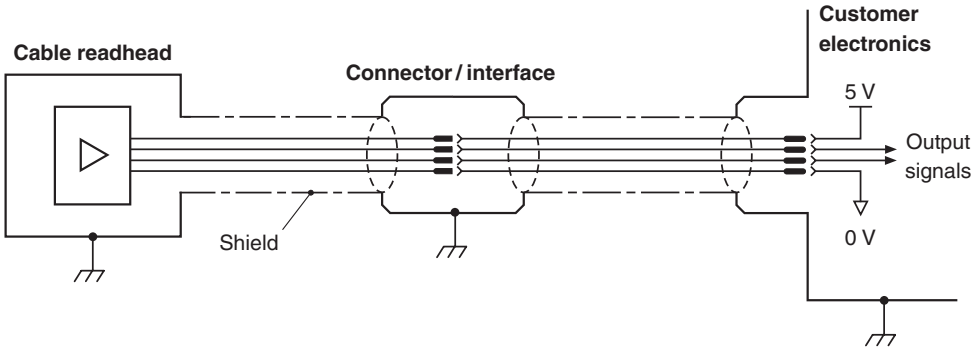
20 m/s (–3dB)

Electrical connections

Grounding and shielding



For more information on FPC contact your local Renishaw representative.

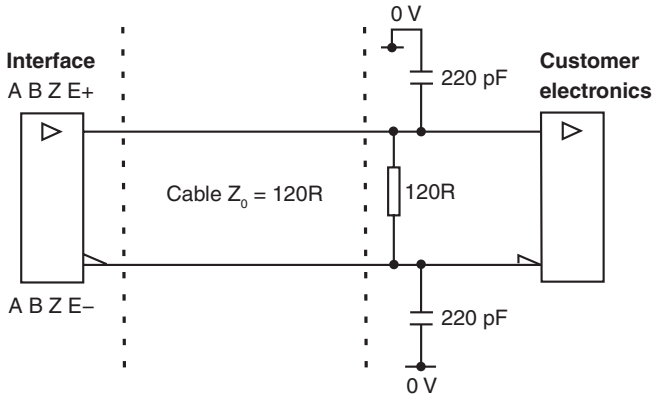


IMPORTANT: The shield should be connected to the machine earth (Field Ground).

NOTE: Maximum cable length between interface and customer electronics is 25 m for ACi and Ri and 50 m for Ti (Maximum length for Ti with 40 or 50 MHz clocked output is 25 m).

Recommended signal termination

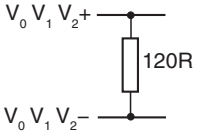
Digital outputs



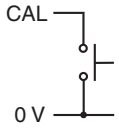
Standard RS422A line receiver circuitry.

Capacitors recommended for improved noise immunity.

Analogue outputs



Remote CAL operation



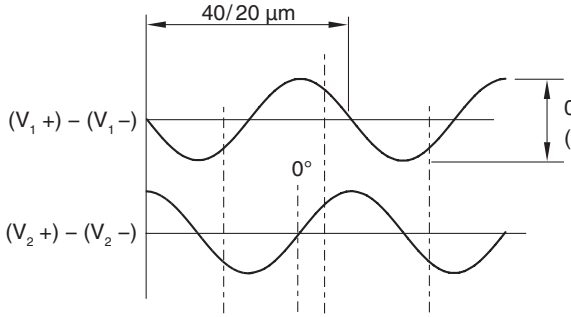
Remote CAL operation is possible via the CAL pin. For applications where no interface is used, remote CAL operation is essential.

Output specifications

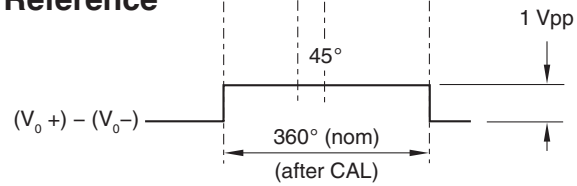
Analogue output signals

All ATOM readheads and Ri and Ti analogue interfaces.

Incremental 2 channels V_1 and V_2 differential sinusoids in quadrature, centred ~ 1.65 V (90° phase shifted)



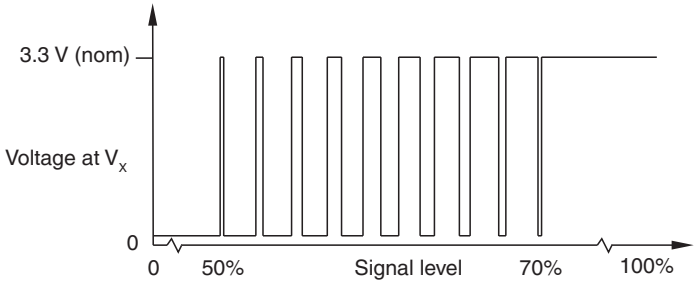
Reference



Differential signals V_0+ and V_0– centred on ~ 1.65 V.

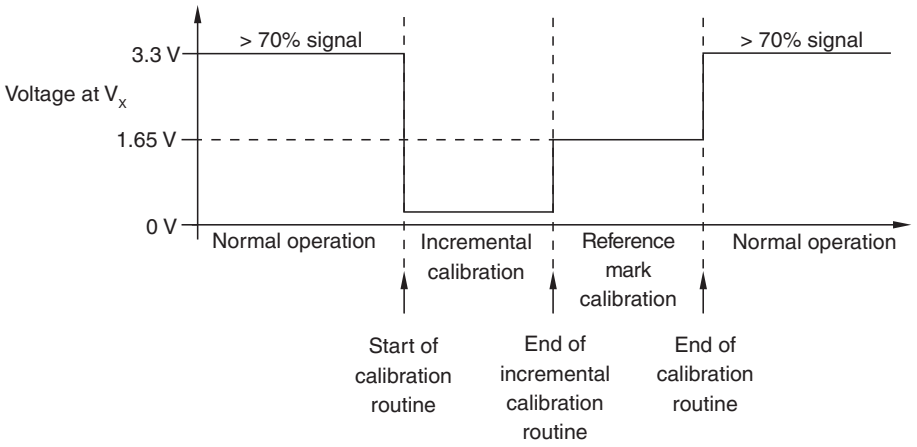
Set-up (Readhead, ACi, Ri and Ti analogue)

During normal operation



Between 50% and 70% signal level, V_x is a duty cycle.
Time spent at 3.3 V increases with incremental signal level.
At > 70% signal level V_x is nominal 3.3 V.

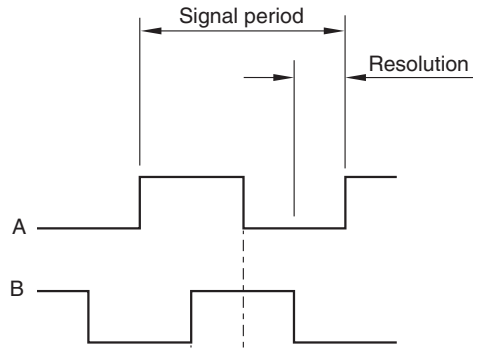
During CAL routine (Readhead, Ri analogue and Ti analogue only)



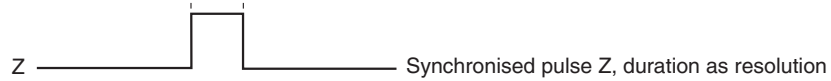
Digital output signals

Form – Square wave differential line driver to EIA RS422A.
All ACi interfaces, Ri interfaces and Ti digital interfaces.

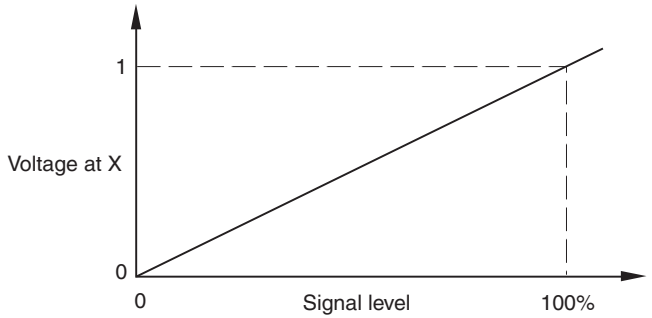
Incremental [1] 2 channels A and B in quadrature (90° phase shifted)



Reference [1]

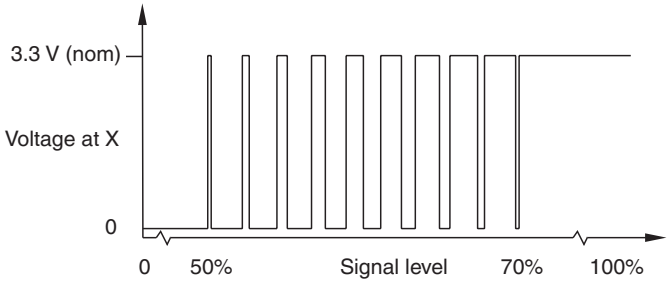


Set-up [2] (Ti digital interfaces)



Set-up signal voltage proportional to incremental signal amplitude

During normal operation (ACi interfaces and Ri digital interfaces)



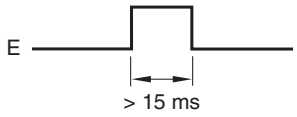
Between 50% and 70% signal level, X is a duty cycle.
Time spent at 3.3 V increases with incremental signal level.
At > 70% signal level X is nominal 3.3 V.

[1] Inverse signals not shown for clarity.

[2] Set-up signals as shown are not present during calibration routine.

Alarm [1]

Differential line driven output (Ri and Ti digital interfaces)



Interface model	Alarm asserted when
Ri0004	• < 40% signal • Overspeed
Ri0008	
Ri0020	
Ri0040	
Ri0100	• < 20% signal • > 130% signal
Ri0200	
Ri0400	

Interface model	Alarm asserted when
Ti	• < 20% signal • > 135% signal • Overspeed

3-state alarm (ACi, Ri and Ti digital interfaces)

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

(Ri and Ti alarm conditions same as differential line driven output. ACi alarm conditions: < 40% signal or overspeed.)

[1] Inverse signals not shown for clarity.

General specifications

Power supply	5 V ±10%	ATOM readhead typically < 50 mA ATOM with ACi typically < 100 mA ATOM with Ri typically < 100 mA ATOM with Ti typically < 200 mA For analogue outputs a further 10 mA in total will be drawn when terminated with 120R. For digital outputs a further 25 mA per channel pair (e.g. A+, A–) will be drawn when terminated with 120R. Power from a 5 Vdc supply complying with the requirements for SELV or standard IEC 60950-1.
	Ripple	200 mVpp maximum @ frequency up to 500 kHz
Temperature	Storage	–20 °C to +70 °C
	Installation (RKLF)	+10 °C to +35 °C [1]
	Operating	0 °C to +70 °C
Humidity		95% relative humidity (non-condensing) to IEC 60068-2-78
Sealing		Cable variant IP40 Ri interface IP20 FPC variant IP20 (with lid fitted) Ti interface IP20
Acceleration (scale and readhead)	Operating	400 m/s², 3 axes
Shock (scale and readhead)	Operating	1000 m/s², 6 ms, ½ sine, 3 axes
Vibration	Operating	100 m/s² max @ 55 Hz to 2000 Hz, 3 axes
Mass		FPC readhead 2.3 g Cable readhead 4 g Cable 18 g/m ACi 4 g Ri 70 g Ti 100 g
Readhead cable		10 core, high flex, EMI screened cable Outside diameter 3.5 mm maximum Flex life > 20 × 10^6 cycles at 20 mm bend radius Maximum length 5 m (Extension cable up to 25 m when using Renishaw approved extension cable) UL recognised component
FPC cable		16 core, 0.5 mm pitch Minimum exposed conductor length 1.5 mm Maximum exposed conductor length 2.5 mm Maximum length 1 m
Connector options	Cable variants	Interboard connector compatible with the Ri, Ti and ACi (cable variant) series interfaces 15-way, D-type connector
	FPC	16 core, 0.5 mm pitch, compatible with ACi (FPC variant)
Typical sub-divisional error (SDE) (analogue)		40 µm version < ±120 nm 20 µm version < ±75 nm

NOTE: Current consumption figures refer to unterminated systems.

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.

[1] To limit maximum tension in the scale $(CTE_{substrate} - CTE_{scale}) \times (T_{use\ extreme} - T_{install}) \leq 550$ µm/m where CTE_{scale} = ~ 10.1 µm/m/°C.

RTLF scale specifications

Material		Hardened and tempered martensitic stainless steel fitted with a self-adhesive backing tape
Form (height × width)		0.41 mm × 8 mm (including adhesive)
Datum fixing		Adhesive datum clamp (A-9585-0028) secured with Loctite 435
Reference mark		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.
Accuracy (at 20 °C)	RTLF20-S / RTLF40H-S	±5 µm/m
	RTLF40-S	±15 µm/m
Coefficient of thermal expansion (at 20 °C)		10.1 ±0.2 µm/m/°C
Length[1]		20 mm to 1 m in 10 mm increments 1 m to 10 m in 1 m increments
Mass		12.2 g/m

[1] For information on how the substrate affects the axis, contact your local Renishaw representative.

RCLC scale specifications

Material	Soda-lime glass fitted with a self-adhesive backing tape
Form (height × width)	1.1 mm × 6.35 mm (including adhesive)
Datum fixing	Fillet of RGG-2 two part epoxy adhesive (A-9531-0342)
Reference mark	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.
Accuracy (at 20 °C)	±3 µm
Coefficient of thermal expansion	~8 µm/m/°C
Length (mm)	10, 18, 30, 55, 80, 100, 105, 130
Mass	13.9 g/m

RKLF scale specifications

Material		Hardened and tempered martensitic stainless steel fitted with a self-adhesive backing tape
Form (height × width)		0.15 mm × 6 mm (including adhesive)
Scale pitch		20 µm and 40 µm
Reference mark		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
Accuracy (at 20 °C)	RKLF20-S / RKLF40H-S	±5 µm/m
	RKLF40-S	±15 µm/m
Coefficient of thermal expansion (at 20 °C)		Matches that of substrate material when scale ends fixed by epoxy mounted end clamp
Length		20 mm to 1 m in 10 mm increments 1 m to 10 m in 1 m increments [1]
Mass		4.6 g/m
End fixing		Epoxy mounted end clamps (A-9523-4015) RGG-2 two part epoxy adhesive (A-9531-0342) Scale end movement typically < 1 µm [2]

[1] Maximum recommended axis length 1 m for 20 µm systems.

[2] The scale and end clamps must be installed following the installation process, see page 17 and page 20.

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