Installation guide
M-9414-9447-02-A

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ATOM DX™ and RCDM rotary encoder system

www.renishaw.com/atomdxdownloads

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Contents

Legal notices

Patents

Features of Renishaw's ATOM DX™ encoder systems and similar products are the subjects of one or more of the following patents and patent applications:

CN101300463	EP1946048	JP5017275	US7624513	CN101310165
EP1957943	US7839296	CN105008865	EP3564628	EP2936073
JP6563813	KR2128135	US9952068	US10768026	CN106104216
EP3052898	JP7153997	US10281301	CN105814408	EP3052897
JP7032045	US10823587	CN106030251	EP3052895	JP6811610
EP3052900	IN399411	JP7083228	US11543270	

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

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Declaration of Conformity

Renishaw plc hereby declares that the ATOM DX 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 DX

Responsible Party - U.S. Contact Information

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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).

Intended use

The ATOM DX 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 of the Warranty and all other relevant legal requirements.

Further information

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

Packaging

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

Packing 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

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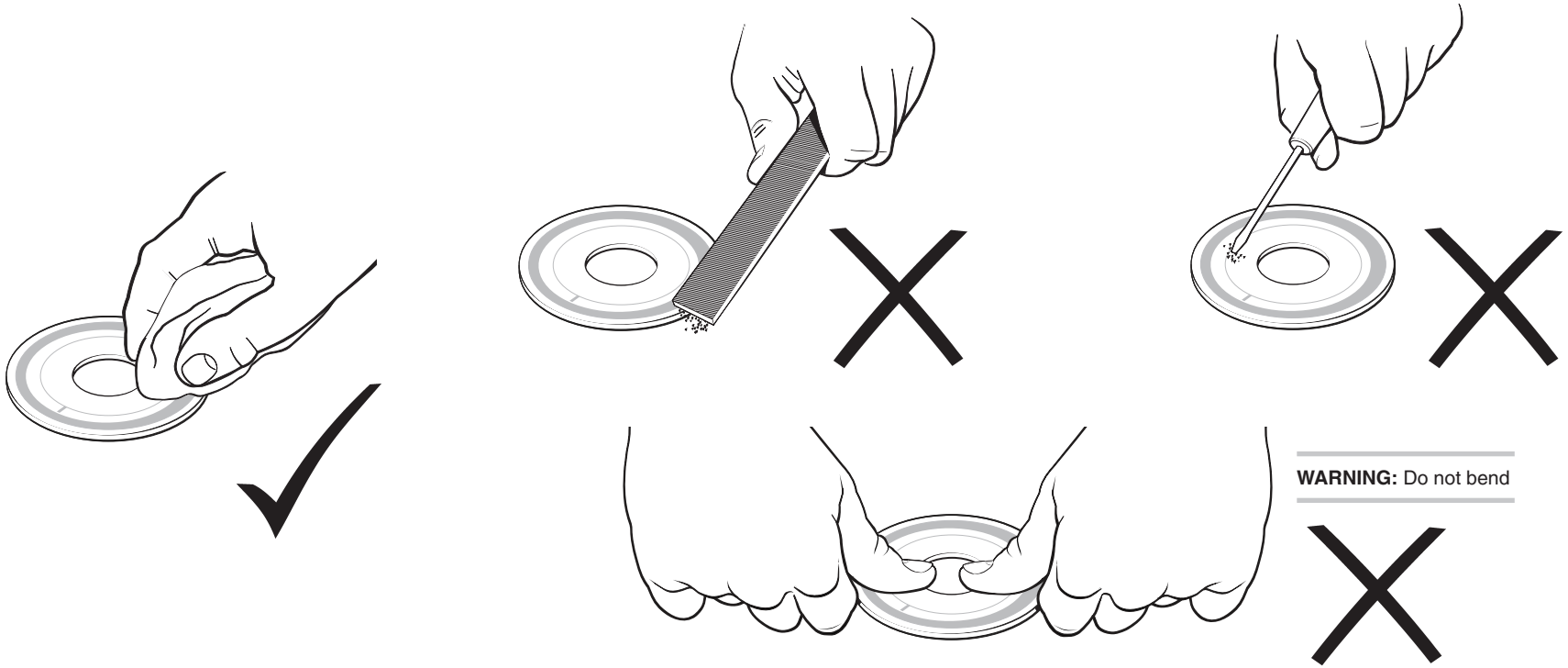
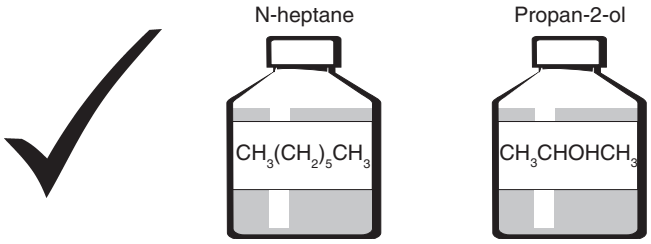
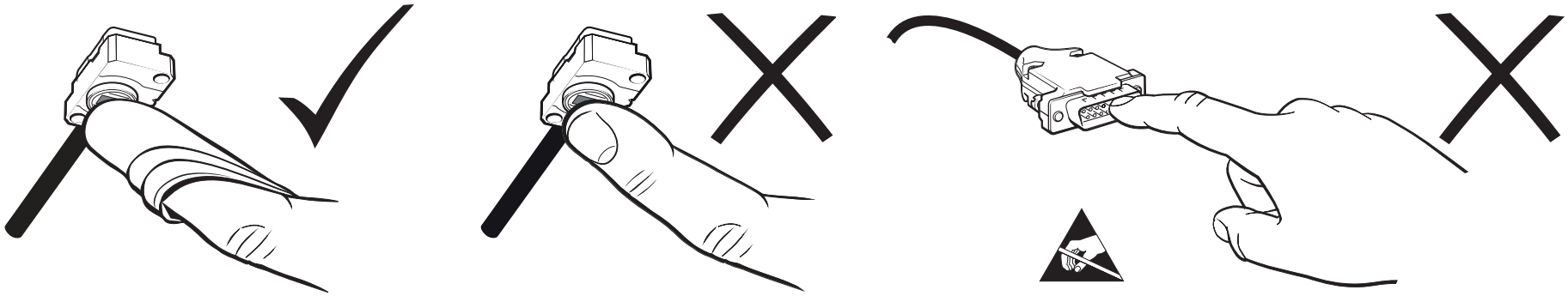
Storage and handling



WARNING: Do not bend

Disc and readhead

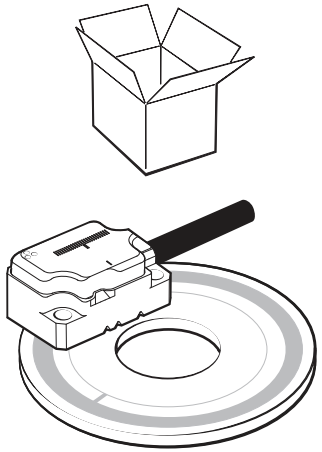




Temperature

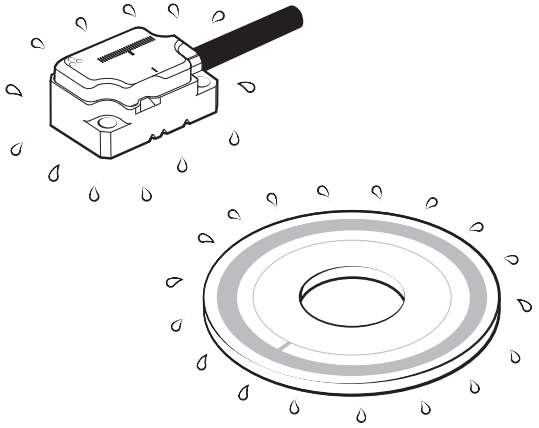
Storage	
System	–20 °C to +70 °C

Operating	
System	0 °C to +70 °C



Humidity

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



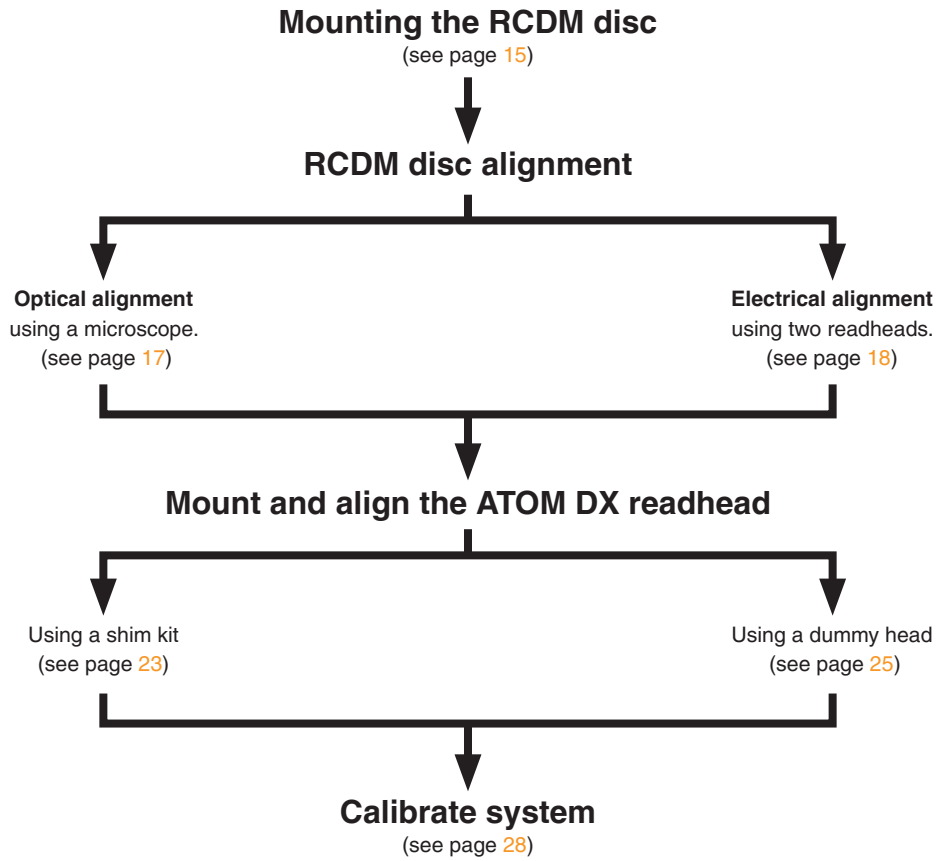
ATOM DX and RCDM system installation overview

This section gives an overview of the steps involved in installing, setting-up and calibrating an ATOM DX encoder system. More detailed information is contained within the rest of the document.

For information on designing the readhead and disc into the system refer to the detailed installation drawings and 3D models at **www.renishaw.com/atomdxdownloads** or contact your local Renishaw representative.

For information on the ATOM DX product range refer to the *ATOM DX™ miniature encoder system* data sheet (Renishaw part no. L-9517-9736).

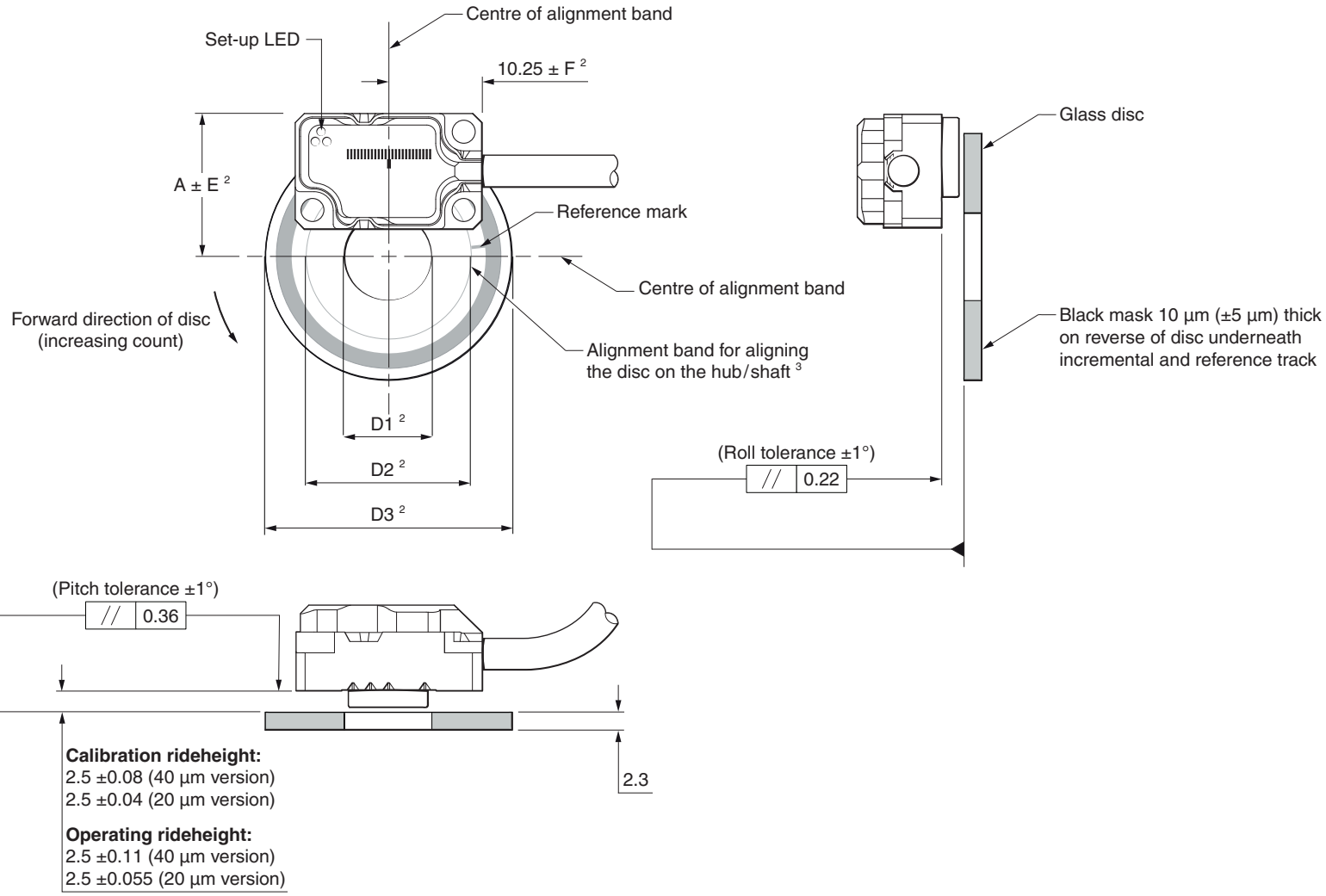
IMPORTANT: Prior to installing the readhead and the disc, the installation drawing should be reviewed to ensure correct orientation of the readhead relative to the disc (see page 13).



RCDM disc installation drawing

Dimensions and tolerances in mm

NOTE: ATOM DX cabled readhead variant shown. [1]



[1] For readhead dimensions see pages 33 and 34.

[2] The dimensions and tolerances are defined on page 14.

[2] The graduations and alignment band are accurately concentric with each other but not with the glass disc.

RCDM disc dimensions and tolerances

Disc size (mm)	Line count		D1 (mm)	D2 (mm)	D3 (mm)	Optical diameter (mm)	A (mm)	Radial tolerance E (mm)		Longitudinal tolerance F (mm)	
	20 µm version	40 µm version						20 µm version	40 µm version	20 µm version	40 µm version
17	-	1 024	3.275	8.10	16.9	13.04	10.63	-	0.1	-	0.1
20	-	1 250	3.275	11.00	19.9	15.92	12.07	-	0.1	-	0.1
25	-	1 650	6.46	16.10	24.9	21.01	14.62	-	0.125	-	0.075
27	-	1 800	9.625	18.00	26.9	22.92	15.57	-	0.125	-	0.075
30	4 096	2 048	12.8	21.15	29.9	26.08	17.15	0.1	0.125	0.075	0.125
36	5 000	2 500	12.8	26.90	35.9	31.83	20.03	0.125	0.175	0.075	0.2
50	7 200	3 600	25.5	40.90	49.9	45.84	27.03	0.125	0.2	0.075	0.2
56	8 192	4 096	25.5	47.25	55.9	52.15	30.19	0.125	0.2	0.1	0.225
68	10 000	5 000	25.5	58.55	63.66	63.66	35.94	0.15	0.2	0.125	0.3
108	16 384	8 192	50.9	99.20	107.9	104.30	56.26	0.2	0.2	0.225	0.3

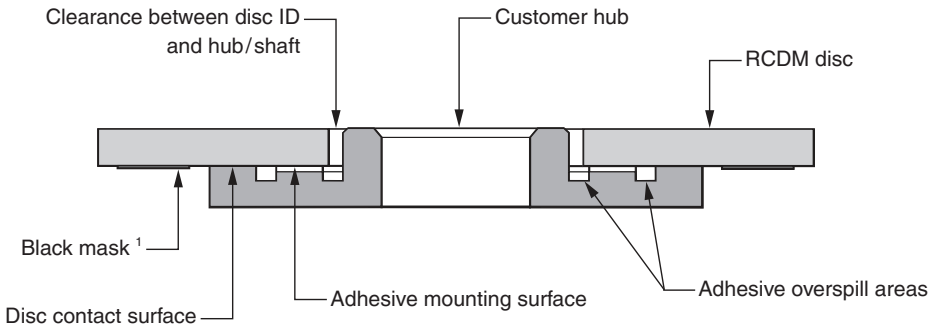
Mounting surface design

The recommended mounting surface (hub/shaft) profile must allow for the following features:

- Overspill areas either side of the adhesive mounting surface for excess adhesive to run-off.
- Sufficient clearance between the disc ID and the hub/shaft to allow correct alignment.
- A small height clearance between the disc contact surface and the adhesive mounting surface to allow application of a controlled thin film of adhesive.
- A maximum outer diameter of the disc contact surface to ensure it is not touching the black mask on the reverse of the disc. See table below for dimensions.

Disc size (mm)	17	20	25	27	30	36	50	56	68	108
Maximum OD of disc contact surface (mm)	N/A [1]	9.52	14.2	16.12	19.28	25.04	39.04	45.36	56.66	97.3

Cross section of typical hub and disc assembly



Contact your local Renishaw representative for more information on designing the mounting surface, suggested materials and adjustment methods.

[1] 17 mm disc can be mounted on the black mask due to space constraints. For all other disc sizes, the black mask must not impede the disc contact surface.

Mounting the RCDM disc

Required parts

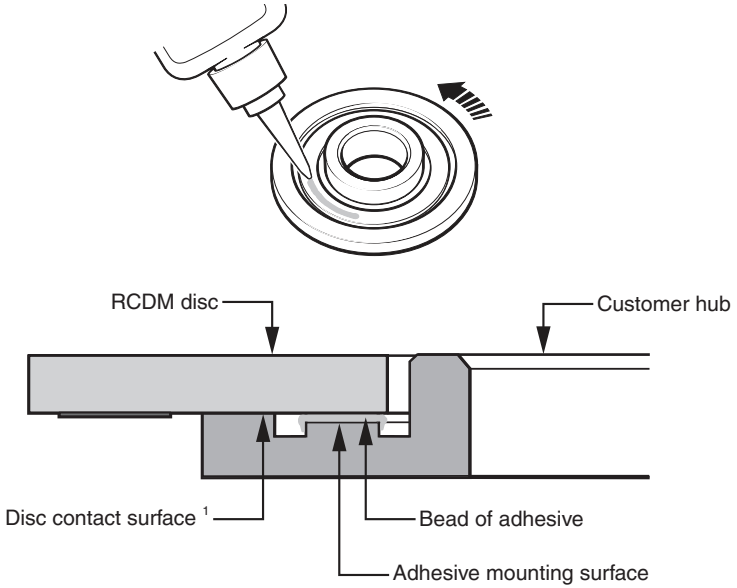
- Appropriate RCDM disc
- Adhesive to bond the disc to the hub/shaft. Either UV cure adhesive (such as Dymax OP4, gel version) or room cure 2-part epoxy (such as Araldite 2014).
- Appropriate cleaning solvents (see 'Storage and handling' on page 10).

Gluing the disc

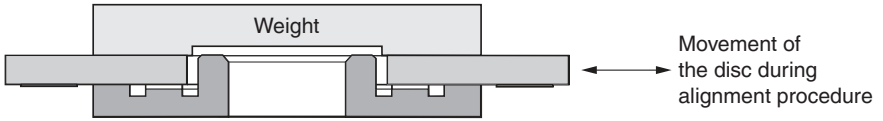
1. Clean the disc mounting surface as recommended in 'Storage and handling' on page 10.
2. Apply a thin bead of adhesive to the adhesive mounting surface.

   It should be of sufficient quantity only to fill the gap between the hub and the disc.

   Small amounts may run-off into adhesive overspill areas but these areas should not be filled with adhesive.



3. Using a weight (or similar), ensure the disc touches the hub/shaft over the entire disc contact surface.



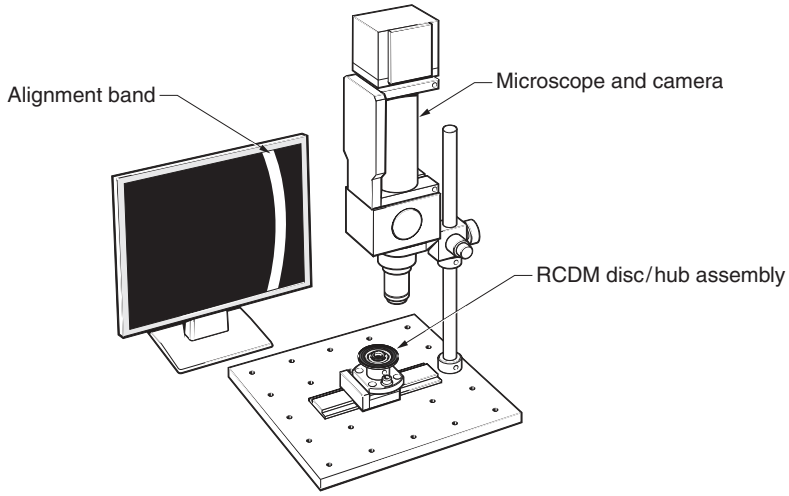
4. Align the disc so that it is concentric with the hub/shaft. There are two possible ways to accurately align the disc to minimise eccentricity:
   - Optical alignment, using a microscope to monitor the movement of the alignment band (see page 17)
   - Electrical alignment, monitoring the output signals of two ATOM DX readheads mounted 180 degrees apart (see page 18)
5. Once the disc has been aligned, cure the adhesive.

[1] See page 15 for the maximum outer diameter of the disc contact surface.

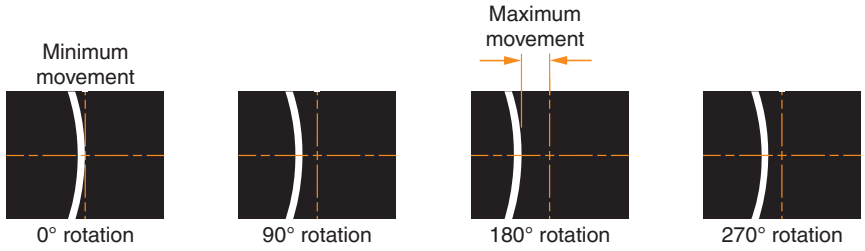
Optical alignment

This method uses a microscope, which could be connected to a camera, to monitor the movement of the alignment band as the disc is rotated.

1. Position the microscope/camera over the alignment band on the disc so that any displacement of the alignment band due to rotation of the disc/hub assembly can be observed.



2. Rotate the disc/hub assembly and record the axis position at the maximum and minimum movement of the alignment band as shown below.

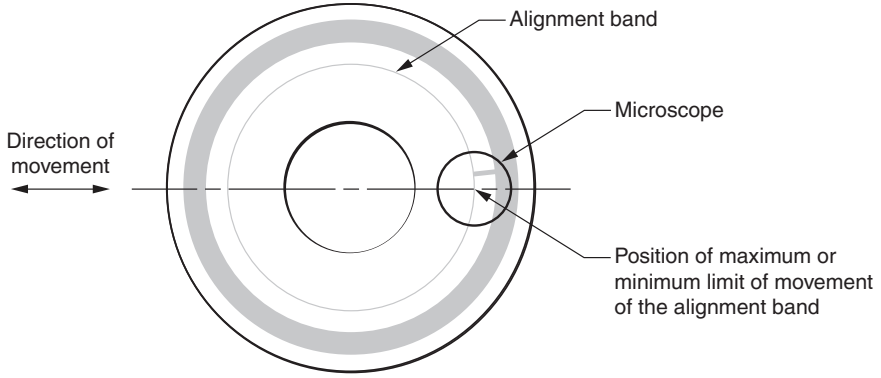


3. Rotate the disc so either the maximum or minimum movement is located under the microscope.

4. Gently move the disc relative to the hub in a radial direction so the alignment band moves half way between the limits of movement.

NOTE: The alignment band is 30 µm wide.

Position of the disc at limit of alignment band



5. Rotate the assembly and repeat steps 2 to 4 until the total alignment band movement is within the design specifications.

6. Cure the adhesive.

7. Recheck the run-out.

Contact your local Renishaw representative for more information on aligning the disc.

Electrical alignment

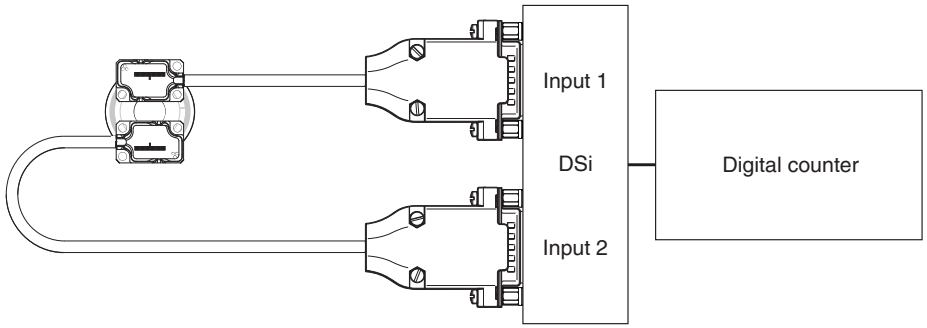
This method involves monitoring the output signals of two readheads mounted 180 degrees apart and adjusting the disc to minimise the difference in count between the two heads.

NOTE: Due to spacing it is not possible to use this method on discs smaller than 22 mm diameter.

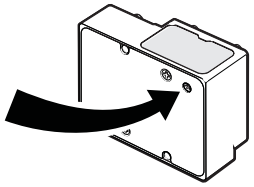
This requires:

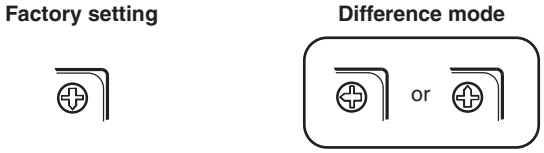
- A DSi interface
- A digital counter
- 2 ATOM DX readheads

NOTE: The clock frequency of the DSi, ATOM DX readheads and digital counter must be matched to ensure there is no miscounting. For more information on choosing appropriate DSi and readheads for your system contact your local Renishaw representative. For more information on the DSi refer to the *TONiC™ DSi dual readhead rotary encoder system* data sheet (Renishaw part no. L-9517-9466).



1. Connect the system as shown above.
2. Set the orientation switch on the reverse of the DSi to 'difference' mode.



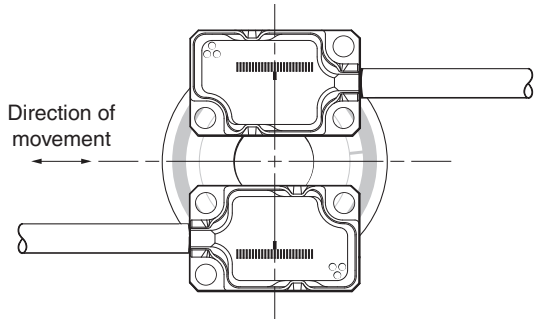


3. Power the system.
4. Restore factory defaults on both ATOM DX readheads by obscuring the readhead windows whilst switching the system on. This can be done individually or whilst the readheads are plugged into the DSi (see 'Restoring factory defaults' on page 29).
5. Using a custom designed bracket adjust both readheads to maximise the signal strength for a complete rotation of the axis (readhead set-up LED should be flashing green on both readheads).
6. Rotate the axis until the count displayed on the customer counter is at its minimum.

   NOTE: If the count continues to increase then the orientation switch on the DSi is not in the correct position.

7. Rotate the axis to the minimum count position and reset the counter to zero.
8. Rotate the axis until a maximum count is displayed. This should be ~180° from the position when the count is minimum.

9. Gently move the disc relative to the hub in a radial direction at 90° to the readheads, as shown below, until the count displayed on the counter is reduced by approximately half.



10. Repeat steps 6 to 9 until the difference in (maximum count) – (minimum count) is within the design specifications.

11. Cure the adhesive.

12. Recheck the run-out.

Contact your local Renishaw representative for more information on aligning the disc.

System connection: Top exit readhead

A range of cables for top exit readheads are available;

15-way D-type connector	
Cable length (m)	**Part number**
0.5	A-9414-1223
1.0	A-9414-1225
1.5	A-9414-1226
3.0	A-9414-1228

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

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

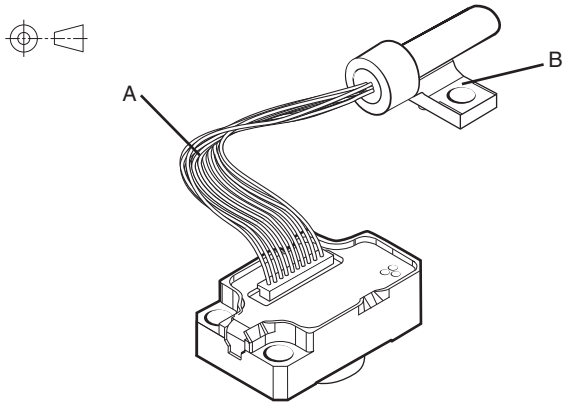
Shielding

For optimum performance:

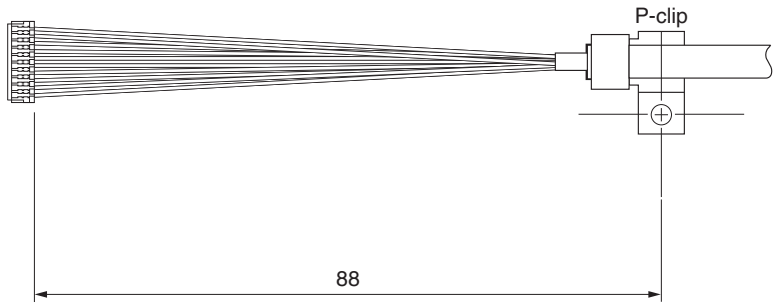
- Ensure 100% shielding.
- Ground the mounting brackets.
- Ensure continuity between the readhead body and cable shield. For Renishaw top exit cables the P-clip provides electrical connection to the cable shield.
- Maximise the distance between the encoder and motor cables.

Top exit readhead (with readhead cable inserted)

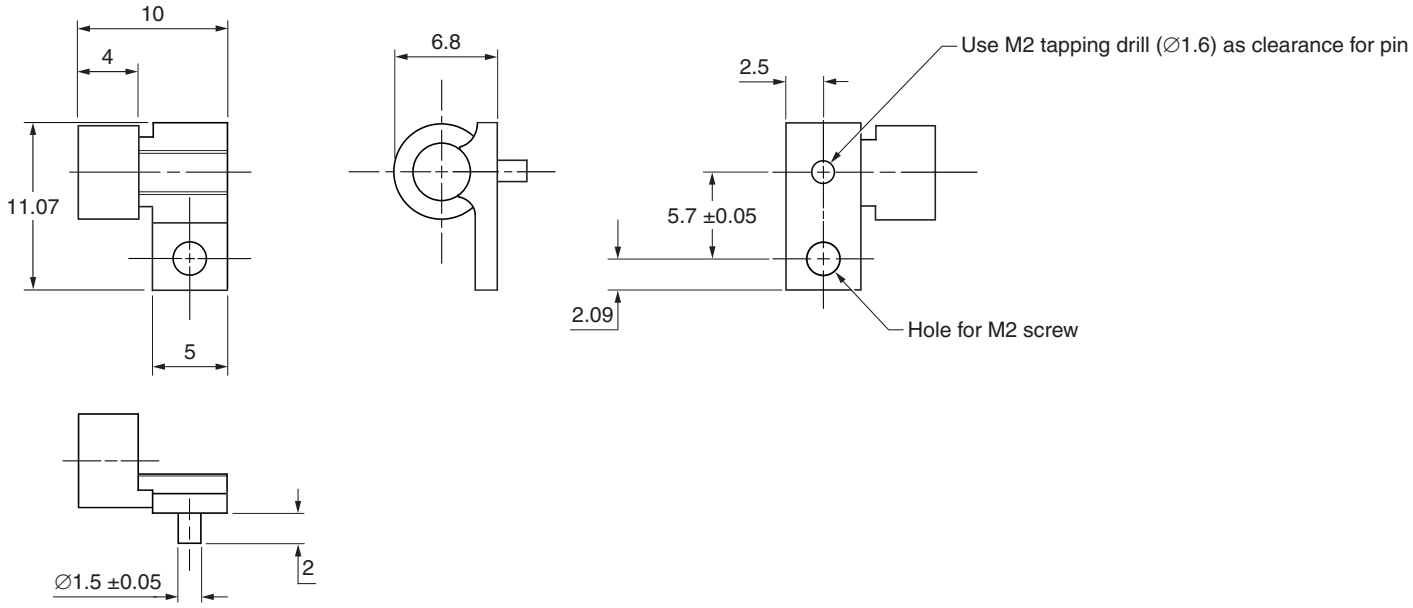
Dimensions and tolerances in mm



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



Detail B: P-clip dimensions



Readhead mounting and alignment: Methods

There is a range of tools available to assist with readhead installation depending upon the system design:

- Shim kit (see page 23).
- Dummy head (see page 25).

For more details on designing the mounting bracket and selecting the appropriate mounting tools contact your local Renishaw representative.

Ensure that the disc, 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 then cannot be cleaned.

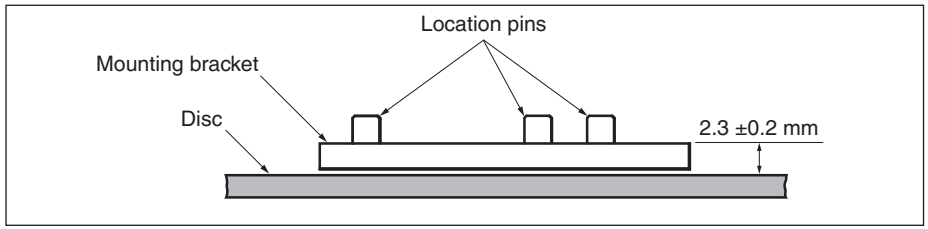
IMPORTANT: Whichever method is used to mount the readhead, care should be taken to ensure the disc surface is not damaged during this operation.

NOTE: Cabled readheads are shown in the following pages, but the same readhead mounting and alignment methods are applicable for top exit readheads.

Shim kit (A-9401-0050)

This method is intended for applications where the rideheight of the readhead cannot be adjusted.

The system should be designed to achieve a nominal 2.3 mm (±0.2 mm) from the readhead mounting surface to the disc surface.

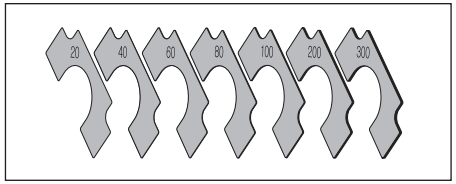


Shims of a known thickness are inserted between the mounting face of the readhead and the bracket to give the correct rideheight of 2.5 mm.

Required parts

- Dial test indicator (DTI) or similar
- 2 M2 × 6 screws
- ATOM readhead 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



Optional parts

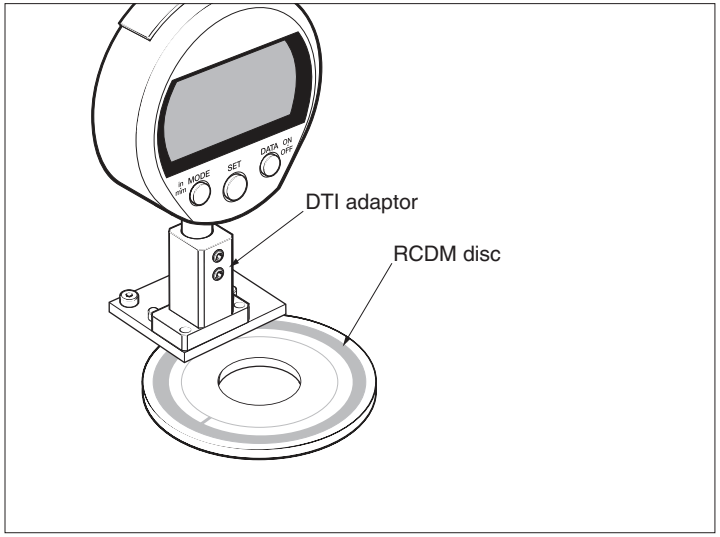
- DTI adaptor (A-9401-0105)

1. Using a dial test indicator or similar, measure the distance from the readhead mounting surface to the disc surface.

   Care must be taken to ensure the disc surface is not scratched. Renishaw offer a DTI adapter that can be used to assist with this process.

   - Insert the DTI into the adapter and zero it on a flat surface.
   - Position or fix the indicator/adapter in place of the readhead and measure the distance to the disc surface.

   Contact your local Renishaw representative for details of the DTI and adaptor.



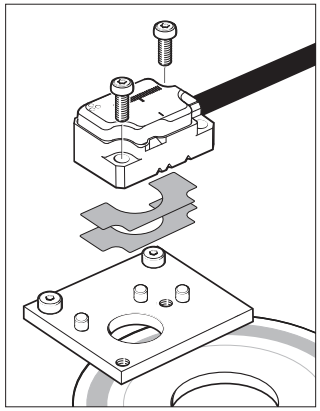
2. Subtract the distance measured from the nominal rideheight of 2.5 mm to calculate the required shim thickness. For example if the distance measured is 2.37 mm the required shim thickness is 130 µm.

3. Select the smallest number of 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 of a required shim thickness of 130 µm 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 2 M2 × 6 screws in diagonally opposite fixing holes, ensuring the readhead is tightened down evenly and parallel to the bracket face.



6. Connect the readhead to the receiving electronics and power-up.

Using location pins/shoulder:

7. Ensure the readhead is pushed back against the location pins or shoulder.

8. Tighten the readhead fixing screws.

9. Check the readhead set-up LED is flashing green around the full axis of rotation.

10. Proceed with 'System calibration' on page 28.

Not using location pins:

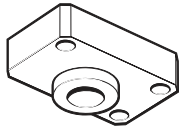
11. Adjust longitudinal and radial offset of the readhead to obtain a flashing green readhead set-up LED around the full axis of rotation. Renishaw's Advanced Diagnostic Tool (ADTi-100) and ADT View software can be used to help maximise the signal size. For more details refer to the 'Advanced Diagnostic Tool ADTi-100 and ADT View software quick start guide' (Renishaw part no. M-6195-9321).

12. Tighten the readhead fixing screws.

13. Proceed with 'System calibration' on page 28.

Dummy head

The reuseable dummy head has the same mounting holes as the ATOM DX readhead with a longer ‘nose’ that is machined to the optimum rideheight (2.5 mm ±0.02 mm). It is mounted in place of the readhead directly onto the bracket. The bracket should have location pins or a shoulder to control readhead yaw. Contact your local Renishaw representative for more information on bracket design.



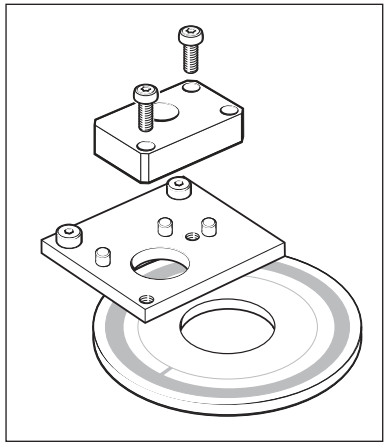
Required parts

- 2 M2 × 6 screws
- Dummy readhead (A-9401-0072)

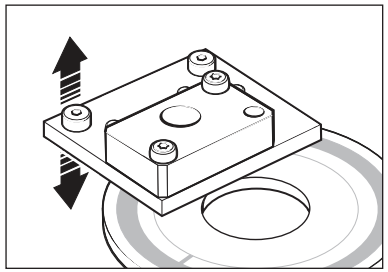
Optional parts

- Renishaw’s Advanced Diagnostic Tool (ADTi-100) and ADT View software

1. Mount the dummy head onto the bracket using 2 M2 × 6 screws.

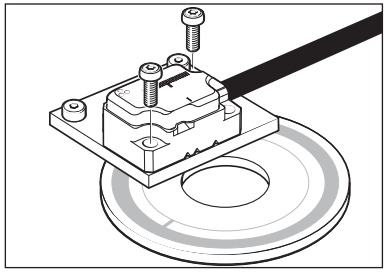


2. Loosely mount the readhead bracket onto the axis.
3. Adjust the height of the bracket or disc assembly until the ‘nose’ of the dummy head just touches the disc.



4. Tighten the bracket fixing screws whilst ensuring good contact between the ‘nose’ of the dummy head and the surface of the disc.
5. Remove the dummy head.

6. Install the ATOM DX readhead in place of the dummy head using 2 M2 × 6 screws in diagonally opposite fixing holes.



7. Connect the readhead to the receiving electronics and power-up.

Using location pins/shoulder:

8. Ensure the readhead is pushed back against the location pins or shoulder.
9. Tighten the readhead fixing screws.
10. Check the readhead set-up LED is flashing green around the full axis of rotation.
11. Proceed with 'System calibration' on page 28.

Not using location pins:

12. Adjust longitudinal and radial offset of the readhead to obtain a flashing green readhead set-up LED around the full axis of rotation. Renishaw's Advanced Diagnostic Tool (ADTi-100) and ADT View software can be used to help maximise the signal size. For more details refer to the 'Advanced Diagnostic Tool ADTi-100 and ADT View software quick start guide' (Renishaw part no. M-6195-9321).
13. Tighten the readhead fixing screws.
14. Proceed with 'System calibration' on page 28.

ATOM DX calibration overview

This section is an overview of the calibration procedure for an ATOM DX encoder system. More detailed information on calibrating the readhead is contained on pages 28 and 29 of this installation guide. The optional Advanced Diagnostic Tool ADTi-100 [1] (A-6195-0100) and ADT View software [2] can be used to aid installation and calibration.

Calibrate system

Ensure the readhead set-up LED is flashing green around the full axis of rotation before system calibration.
See page 22 to page 26 for more information on readhead mounting and alignment.

↓

Cycle the power to the readhead to initiate the calibration routine. The LED will single flash blue.

↓

Rotate the disc at slow speed (< 100 mm/s), without passing a reference mark, until the LED starts double flashing blue.

↓

No reference mark
If a reference mark is not being used, the calibration routine should now be exited by cycling the power. The LED will stop flashing.

Reference mark
Rotate the readhead back and forth over the reference mark until the LED stops flashing.

↓

The system is now calibrated and ready for use. Calibration values, Automatic Gain Control (AGC) and Automatic Offset Control (AOC) status are stored in readhead non-volatile memory at power down.

NOTE: If the calibration routine fails (the readhead LED remains single flashing blue), restore the readhead's factory defaults (see 'Restoring factory defaults' on page 29), and then repeat the installation and calibration routine.

1 For more details refer to the *Advanced Diagnostic Tool ADTi-100 and ADT View software* User guide (Renishaw part no. M-6195-9413) and *Advanced Diagnostic Tool ADTi-100 and ADT View software* Quick-start guide (Renishaw part no. M-6195-9321).

2 The software can be downloaded for free from **www.renishaw.com/adt**.

System calibration

NOTE: The functions described below can also be carried out by using the optional ADTi-100 and ADT View software. See **www.renishaw.com/adt** for more information.

Before system calibration:

1. Clean the disc and the readhead's optical window.
2. If reinstalling, restore the readhead's factory defaults (see 'Restoring factory defaults' on page 29).
3. Maximise the signal strength around the full axis of rotation (the readhead set-up LED is flashing green).

NOTE: During calibration the speed should not exceed 100 mm/s or the readhead's maximum speed, whichever is slowest.

Incremental signal calibration

1. Cycle the power to the readhead or connect the 'Remote CAL' output pin to 0 V for < 3 seconds. The readhead will then single flash blue to indicate it is in calibration mode. The readhead will only enter calibration mode if the LED is flashing green.
2. Rotate the axis at slow speed, ensuring that the readhead does not pass a reference mark, until the LED starts double-flashing. This indicates that the incremental signals are now calibrated and the new settings are stored in the readhead memory.
3. The system is now ready for the reference mark phasing. For systems without a reference mark, cycle the power to the readhead or connect the 'Remote CAL' output pin to 0 V for < 3 seconds to exit the calibration mode.
4. If the system does not automatically enter the reference mark phasing stage (LED continues single flashing) the calibration of the incremental signals has failed. After ensuring failure is not due to overspeed, exit the calibration routine, restore the readhead's factory defaults (see 'Restoring factory defaults' on page 29) and check the readhead installation and system cleanliness before repeating the calibration routine.

Reference mark phasing

1. Move the readhead back and forth over the reference mark until the LED stops flashing and remains solid blue. The reference mark is now phased.
2. The system automatically exits the calibration routine and is ready for operation.
3. AGC is automatically switched on once calibration is complete. To switch off AGC refer to 'Switching Automatic Gain Control (AGC) on or off' on page 29.
4. If the LED continues double-flashing blue after repeatedly passing the reference mark it is not being detected.
   - Ensure that the readhead orientation and alignment are correct.

Calibration routine manual exit

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

LED status during system calibration

LED	Settings stored
Blue single flashing	None, restore factory defaults and recalibrate
Blue double flashing	Incremental only
Blue (auto-complete)	Incremental and reference mark

NOTE: For full readhead LED diagnostics see page 30.

Restoring factory defaults

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

NOTE: Restoring factory defaults can also be carried out using the optional ADTi-100 and ADT View software. See **www.renishaw.com/adt** for more information.

To restore factory defaults:

1. Switch system off.
2. Obscure the readhead optical window or connect the 'Remote CAL' output pin to 0 V.
3. Power the readhead.
4. Remove the obstruction or, if using, the connection from the 'Remote CAL' output pin to 0 V.
5. The readhead set-up LED will start continuously flashing indicating factory defaults have been restored and the readhead is in installation mode.
6. Repeat the system calibration (see 'System calibration' on page 28).

Switching Automatic Gain Control (AGC) on or off

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

NOTE: AGC can be switched on or off using the optional ADTi-100 and ADT View software. See **www.renishaw.com/adt** for more information.

Readhead LED diagnostics

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

Troubleshooting

Fault	Cause	Possible solutions
LED on the readhead is blank	There is no power to the readhead	• Check you have 5 V at the readhead • For cable variants check correct wiring of connector

LED on the readhead is red and I can't get a green LED	The signal strength is < 50%	• Check the readhead optical window and disc are clean and free from contamination
		• Restore factory defaults (see page 29) and check alignment of the readhead. In particular;
		  • Rideheight
		  • Longitudinal and radial offset
		• Check the disc and readhead orientation
		• Check that the readhead variant is the correct type for the chosen disc (see the *ATOM DX™ miniature encoder system* data sheet (Renishaw part no. L-9517-9736) for details of readhead configuration)

Unable to get a flashing green LED around the full axis of rotation	System run-out is not within specification	• Check that the readhead variant is the correct type for the chosen disc (see the *ATOM DX™ miniature encoder system* data sheet (Renishaw part no. L-9517-9736) for details of readhead configuration) • Use a DTI gauge and check the run-out is within specifications • Restore factory defaults • Realign the readhead to obtain a flashing green LED at the mid-point of the run-out • Recalibrate the system (see page 28)
Can't initiate the calibration routine	Signal size is < 70%	• Restore factory defaults • Realign the readhead to obtain a flashing green LED

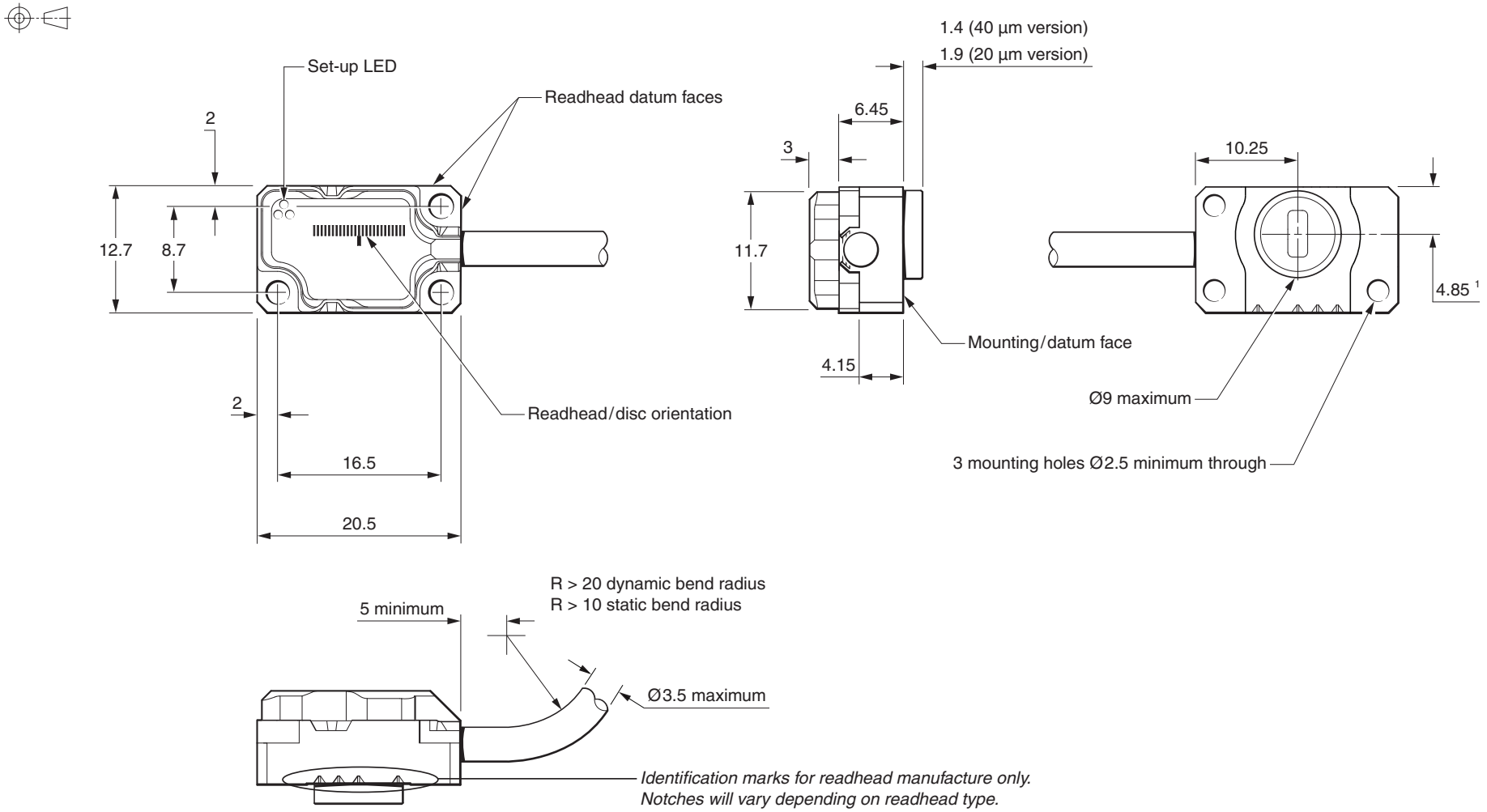
Fault	Cause	Possible solutions
LED on the readhead remains single flashing blue even after moving it around the full axis of rotation	The system has failed to calibrate the incremental signals due to the signal strength being < 70%	• Exit CAL mode and restore factory defaults (see page 29) • Check system set-up and realign the readhead to obtain a flashing green LED around the full axis of rotation before recalibrating
During calibration the 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	• Check the disc/readhead orientation • Check the disc/readhead alignment • Check the readhead optical window and disc are clean and free from contamination • Check that the readhead variant is the correct type for the chosen disc (see the *ATOM DX™ miniature encoder system* data sheet (Renishaw part no. L-9517-9736) for details of readhead configuration)

No reference mark output		• Ensure you are not over-speeding the readhead during calibration mode (maximum speed < 100 mm/s)
		• Calibrate the system (see page 28)
		  • If the system completes calibration mode then it has successfully seen and calibrated the reference mark. If you still don't see a reference mark then check the system wiring.
		  • If the system does not calibrate the reference mark (readhead set-up LED remains double flashing blue) see above for possible solutions

Reference mark is not repeatable	The reference mark is not calibrated	• The readhead bracket must be stable and not allow any mechanical movement of the readhead • Clean the disc and the readhead optical window and check for damage then recalibrate the system (see page 28)
LED on the readhead is flashing red over the reference mark	The reference mark is not phased	• Clean the disc and the readhead optical window and check for scratches then recalibrate the system (see page 28)

ATOM DX cabled readhead dimensions

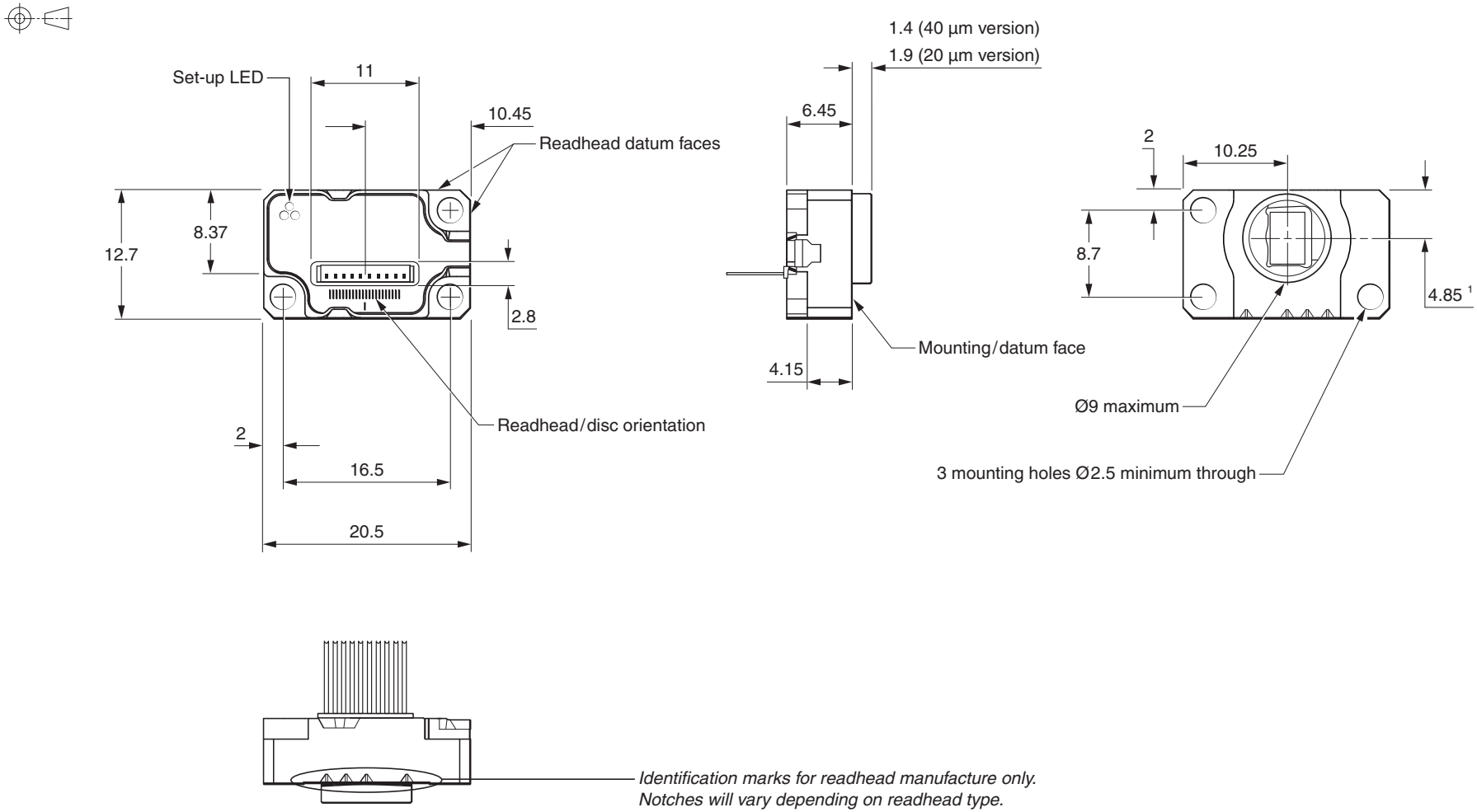
Dimensions and tolerances in mm



[1] Not the optical centreline

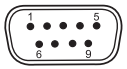
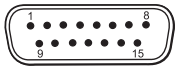
ATOM DX top exit readhead dimensions

Dimensions and tolerances in mm



[1] Not the optical centreline

Output signals

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

NOTE: Top exit cables are terminated with the 'K' pin-out or the 'D' pin-out dependent upon which top exit readhead cable is used.

1 PCB mount mating connectors: Top entry (BM10B-SRSS-TB); Side entry (SM10B-SRSS-TB).

2 Connector on top exit readhead only: Mating connector (10SUR - 32S).

3 Remote CAL line must be connected for use with the ADTi-100.

Speed

20 µm ATOM DX readhead

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

Angular speed depends on disc optical diameter - use the following equation to convert to rev/min.

$$\text{Angular speed (rev/min)} = \frac{V \times 1000 \times 60}{\pi D}$$

Where V = the maximum linear speed (m/s) and D = the optical diameter of the RCDM disc (mm)

[1] For a readhead with a 1 m cable.

40 µm ATOM DX readhead

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

Angular speed depends on disc optical diameter - use the following equation to convert to rev/min.

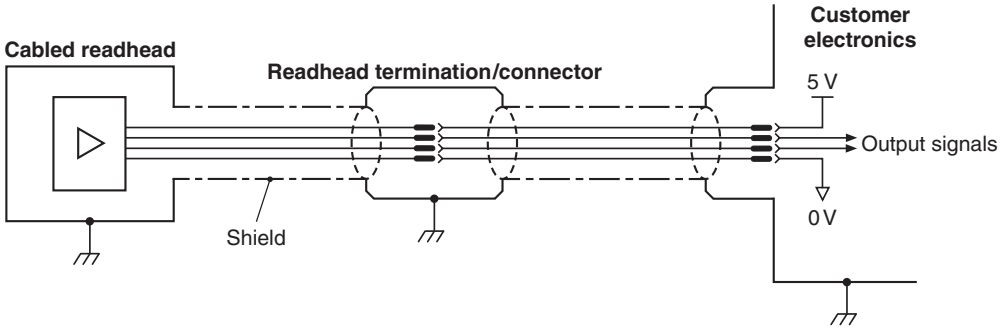
$$\text{Angular speed (rev/min)} = \frac{V \times 1000 \times 60}{\pi D}$$

Where V = the maximum linear speed (m/s) and D = the optical diameter of the RCDM disc (mm)

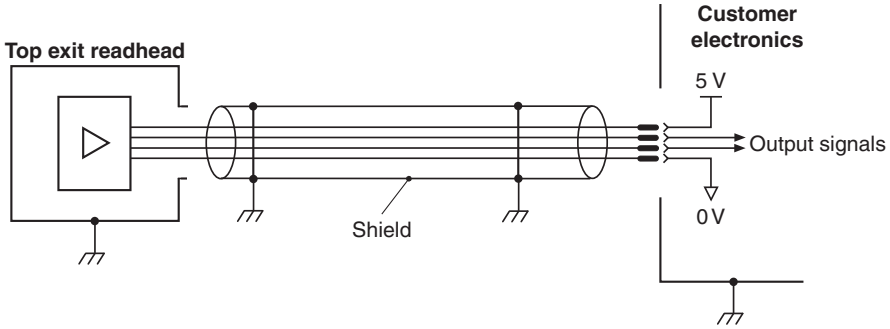
[1] For a readhead with a 1 m cable.

Electrical connections

Grounding and shielding



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



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

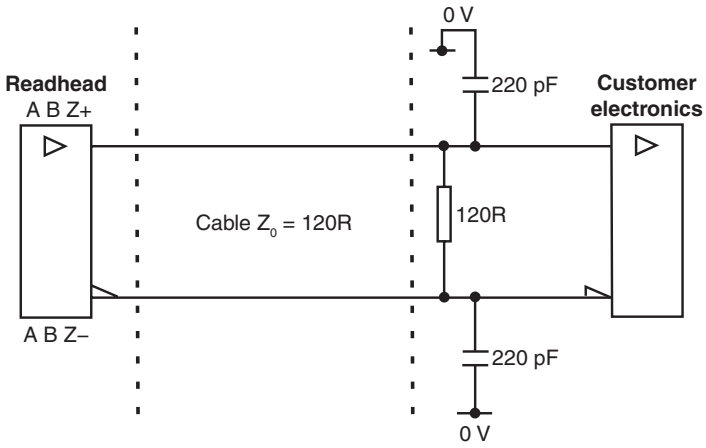
NOTE: For Renishaw top exit readhead cables the shield connection is provided by the P-clip.

Maximum readhead cable length: 3 m

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

Recommended signal termination

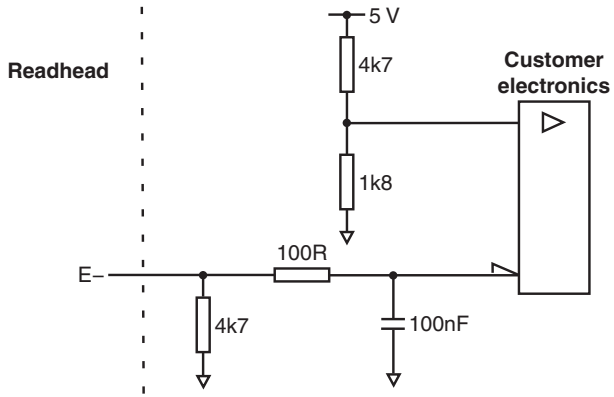
Digital outputs



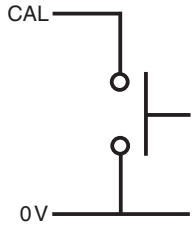
Standard RS422A line receiver circuitry.
The capacitors are recommended for improved noise immunity.

Single-ended alarm signal termination

(Not available with 'A' cable termination)



Remote CAL operation



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

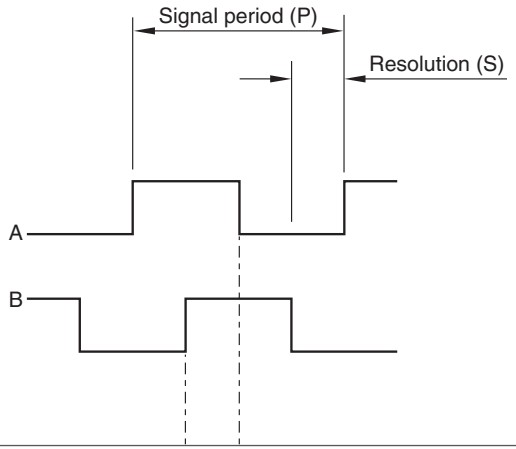
Output specifications

Digital output signals

Form – Square wave differential line driver to EIA RS422A

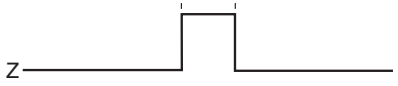
Incremental [1]

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



Resolution option code	P (µm)	S (µm)
T [2]	40	10
D	20	5
G [2]	8	2
X	4	1
Z	2	0.5
W	0.8	0.2
Y	0.4	0.1
H	0.2	0.05
M	0.16	0.04
I	0.08	0.02
O	0.04	0.01
Q	0.02	0.005
R [3]	0.01	0.0025

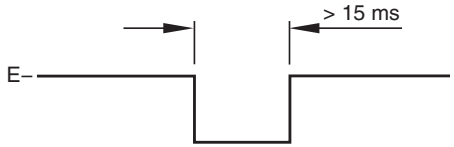
Reference [1]



Synchronised pulse Z, duration as resolution.
Bi-directionally repeatable.

Alarm

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



Alarm asserted when:

- The signal amplitude is < 20% or > 135%
- The readhead speed is too high for reliable operation

or 3-state alarm

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

1 For clarity, the inverse signals are not shown.

2 40 µm ATOM DX readheads only.

3 20 µm ATOM DX readheads only.

General specifications

Power supply	5 V –5%/+10%	Typically < 200 mA fully terminated
		Power from a 5 Vdc supply complying with the requirements for SELV of standard IEC 60950-1
	Ripple	200 mVpp maximum @frequency up to 500 kHz
Temperature	Storage	–20 °C to +70 °C
	Operating	0 °C to +70 °C
Humidity		95% relative humidity (non-condensing) to IEC 60068-2-78
Sealing		IP40
Acceleration (system)	Operating	400 m/s², 3 axes
Shock (system)	Operating	500 m/s², 11 ms, ½ sine, 3 axes
Vibration	Operating	100 m/s² max @ 55 Hz to 2000 Hz, 3 axes
Mass	Cabled readhead	3.2 g
	Top exit readhead	2.9 g
	Cable	18 g/m
Cable	Cabled readhead	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 3 m
		(Extension cable up to 25 m when using Renishaw approved extension cable)
		UL recognised component
	Top exit readhead	Cables available in lengths from 0.5 m to 3 m with 15-way D-type or 10-way JST (SH) connector options
Connector options	Cabled readhead	9-way D-type
		15-way D-type (standard and alternative pin out)
		10-way JST (SH)
	Top exit readhead	10-way JST (SUR)
Typical sub-divisional error (SDE)	20 µm version	< ±75 nm
	40 µm version	< ±120 nm

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.

RCDM disc technical specifications

Material		Soda-lime glass
Form		2.3 mm thick
Pitch		20 µm or 40 µm
Reference mark		Single internal reference mark
Coefficient of thermal expansion (at 20 °C)		~8 µm/m/°C
Graduation accuracy	Disc < 100 mm	±0.5 µm
	Disc > 100 mm	±0.7 µm

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