Installation guide
M-9414-9447-01-C

RENISHAW
apply innovation™

ATOM DX™ and RCDM rotary encoder system

Contents

Product compliance

CE

Renishaw plc declares that ATOM DX complies with the applicable standards and regulations. A copy of the EU Declaration of Conformity is available from our website at **www.renishaw.com/productcompliance**

FCC compliance

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

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

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

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

ATOM DX top exit readhead

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

Patents

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

CN101300463	EP1946048	JP5017275	US7624513
CN101310165B	EP1957943	US7839296	CN105008865
US9952068	CN109477736	EP3465099	US2017203210

Further information

Further information relating to the ATOM DX encoder range can be found in the ATOM DX system Data sheet (L-9517-9736), Advanced Diagnostic Tool ADTi-100 Data sheet (L-9517-9699), Advanced Diagnostic Tool ADTi-100 and ADT View software quick-start guide (M-6195-9321), and the Advanced Diagnostic Tool ADTi-100 and ADT View software user guide (M-6195-9413). These can be downloaded from our website at **www.renishaw.com/opticalencoders** and are also available from your local representative.

Disclaimer

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

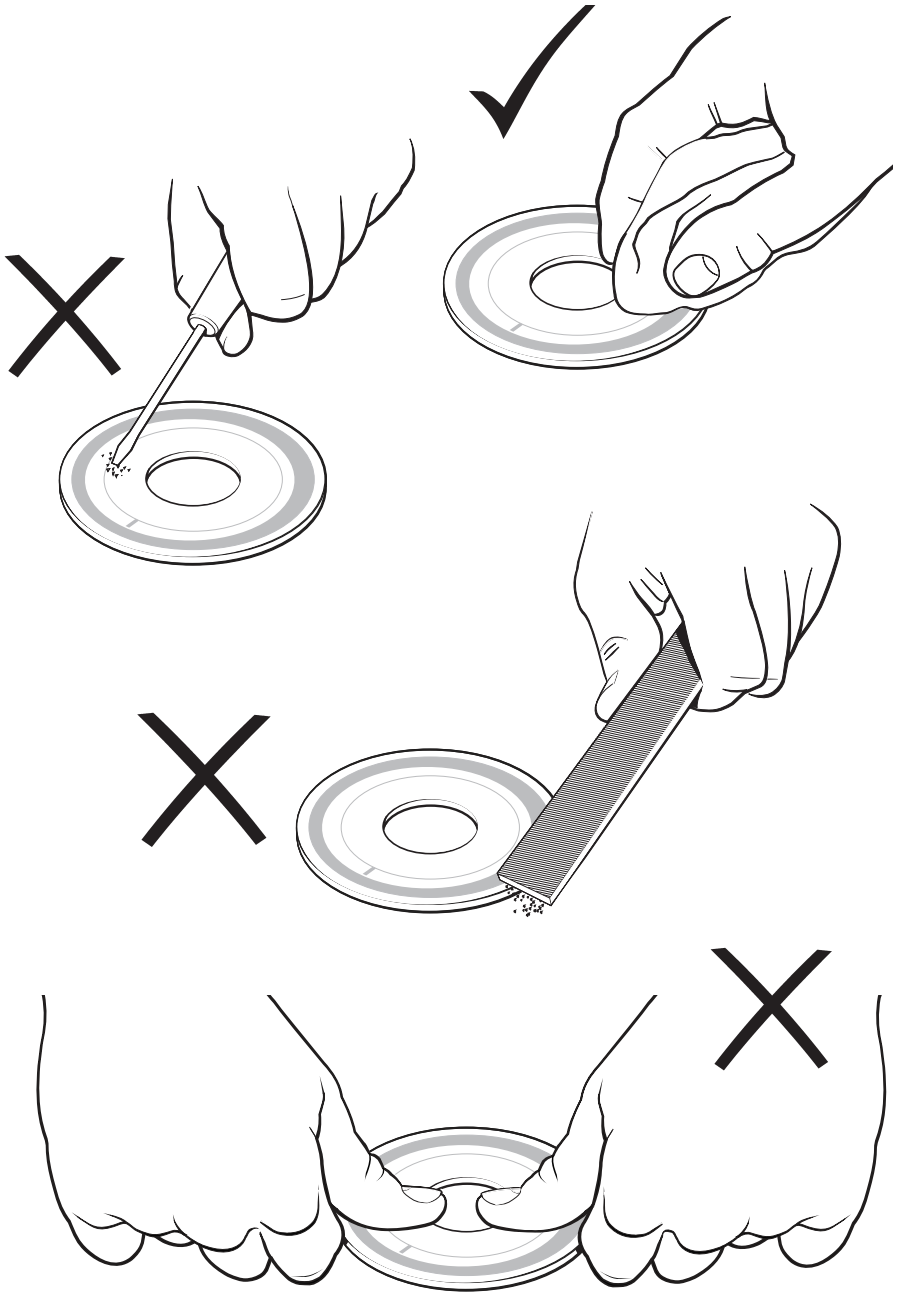
Packaging Component	Material	ISO 11469	Recycling Guidance
Outer box	Cardboard	Not applicable	Recyclable
	Polypropylene	PP	Recyclable
Inserts	Low Density Polyethylene Foam	LDPE	Recyclable
	Cardboard	Not applicable	Recyclable
Bags	High Density Polyethylene Bag	HDPE	Recyclable
	Metalised Polyethylene	PE	Recyclable

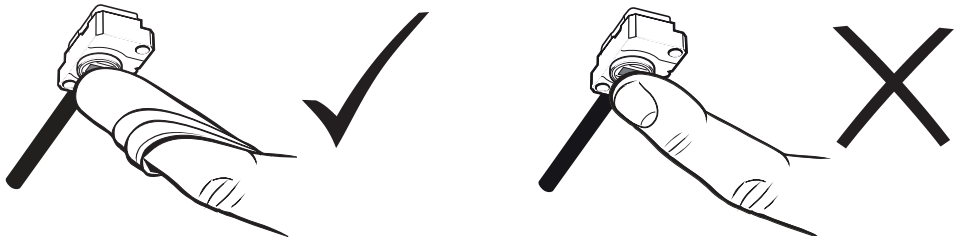
REACH regulation

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**

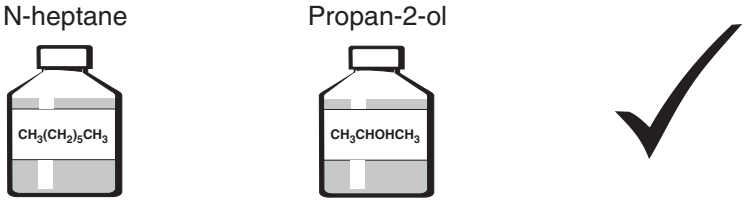
The use of this symbol on Renishaw products and/or accompanying documentation indicates that the product should not be mixed with general household waste upon disposal. It is the responsibility of the end user to dispose of this product at a designated collection point for waste electrical and electronic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

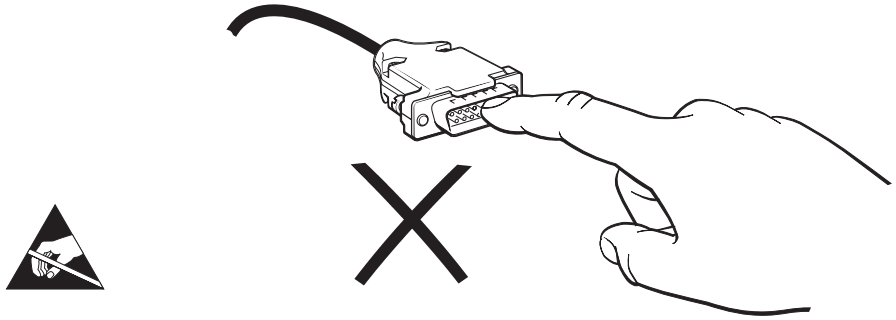
Storage and handling



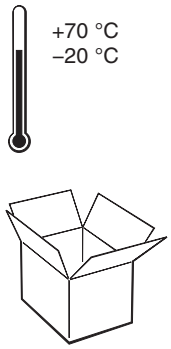


Disc and readhead

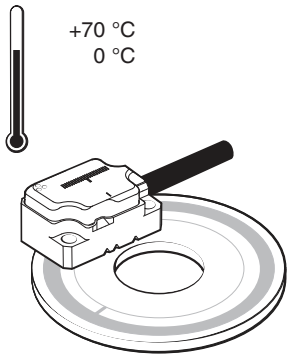




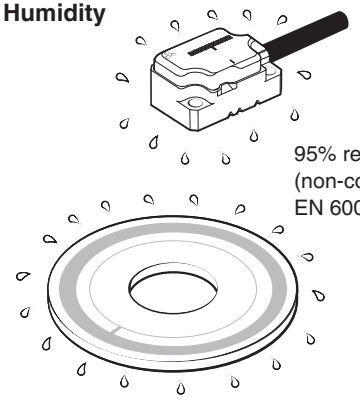
Storage



Operating



Humidity

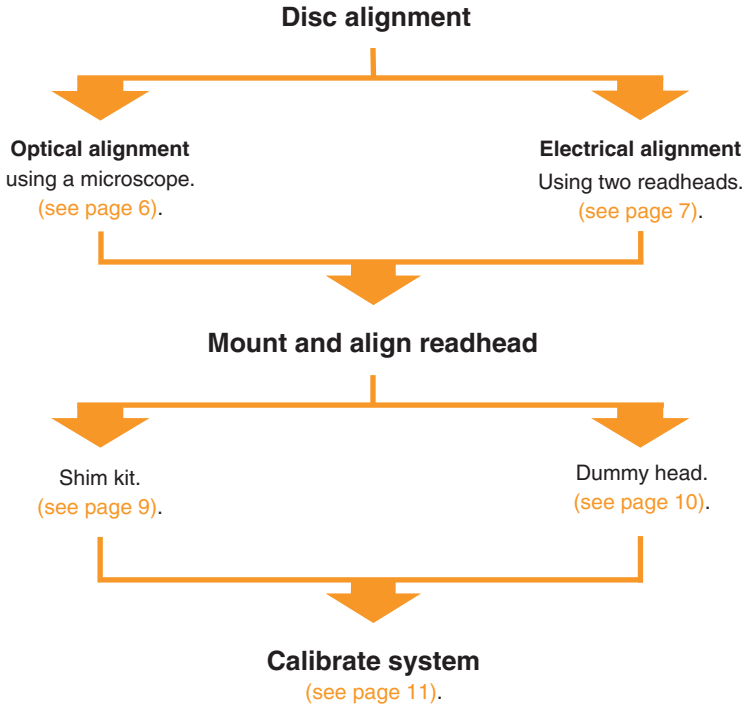


95% relative humidity (non-condensing) to EN 60068-2-78

ATOM DX system installation overview

This section gives an overview of the steps involved in installing, setting-up and calibrating an ATOM DX encoder system.
More detailed information is contained within the rest of the document.
For information on designing the readhead and disc into the system refer to the detailed installation drawings and 3D models at **www.renishaw.com/opticalencoders** or contact your local Renishaw representative.
For information on the ATOM DX product range refer to the ATOM DX data sheet L-9517-9736.

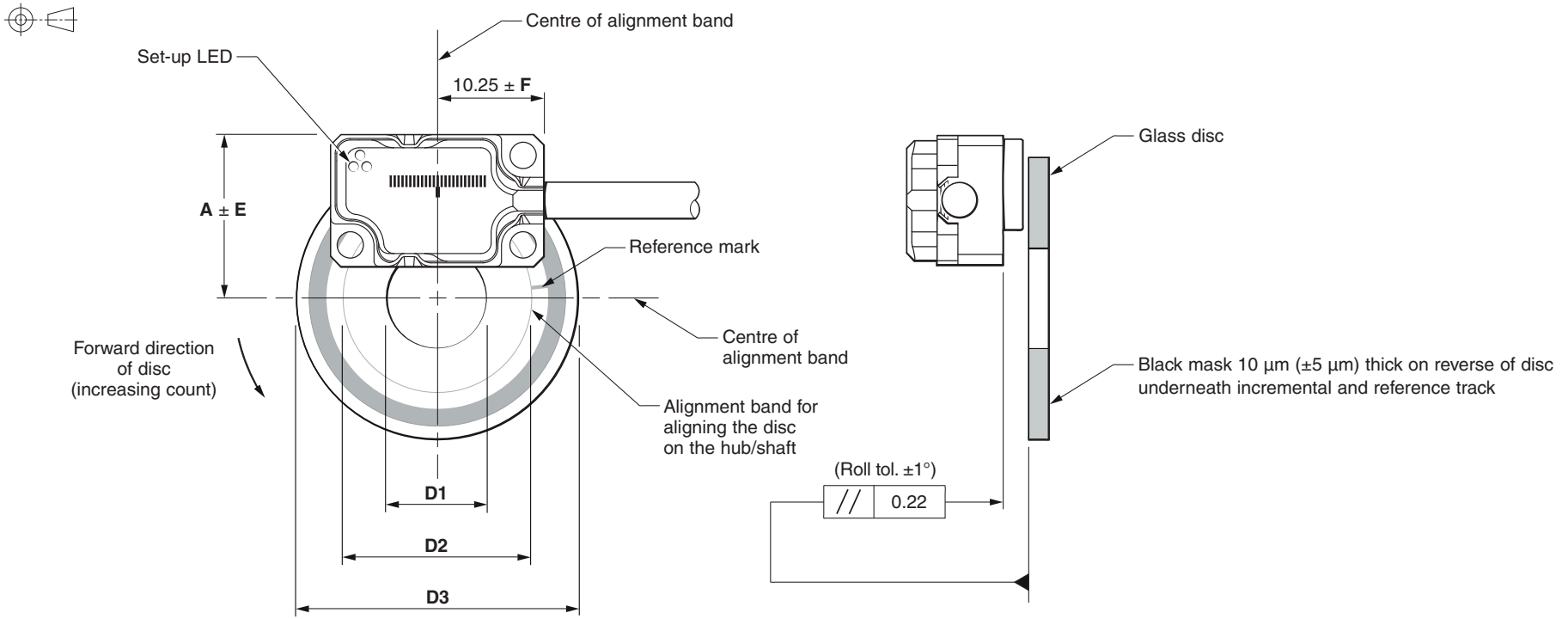
IMPORTANT: Prior to installing readhead and disc, installation drawings should be reviewed to ensure correct orientation of readhead relative to disc.

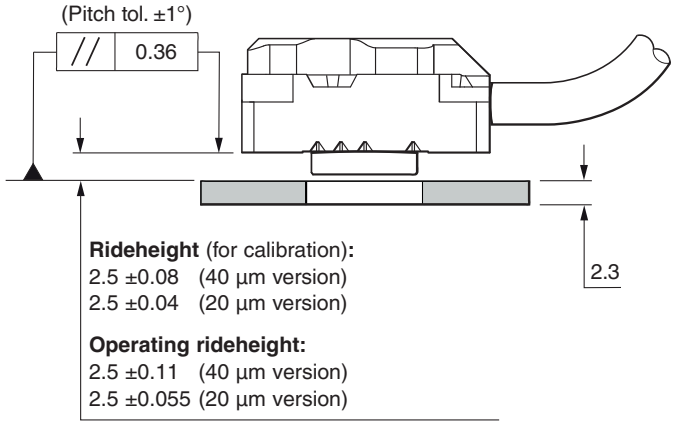


RCDM rotary disc: Installation drawing (Cabled readhead shown)

For dimensioned readhead drawings see pages 15 and 16.

Dimensions and tolerances in mm





Rideheight (for calibration):
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)

For detailed installation drawings, including tolerances, refer to **www.renishaw.com/opticalencoders**

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	67.9	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 the disc

Mounting surface design

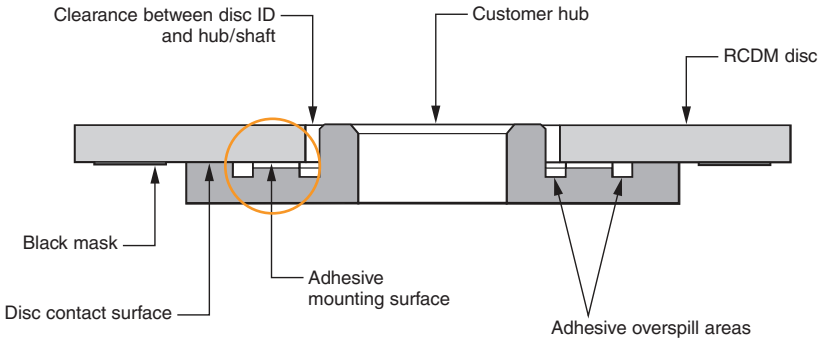
The recommended mounting surface (hub/shaft) profile must allow for the following features:

- Overspill areas either side of the adhesive mounting surface for excess adhesive to run-off.
- Sufficient clearance between the disc ID and 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)	*	9.52	14.2	16.12	19.28	25.04	39.04	45.36	56.66	97.3

*17 mm disc can be mounted on black mask due to space constraints. All other size discs the black mask must not impede the disc contact surface.

Cross section of typical hub and disc assembly

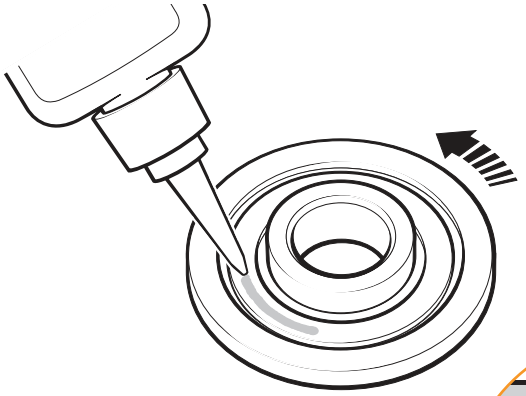


Contact your local Renishaw representative for more information on designing the mounting surface, suggested materials and adjustment methods.

Gluing the disc

There are 2 recommended types of adhesives for bonding the disc to the hub/shaft:

- UV cure adhesive (such as Dymax OP4, gel version)
- Room cure 2-part epoxy (such as Araldite 2014)

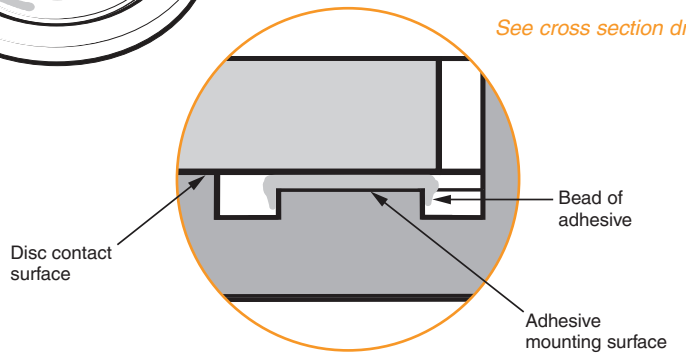


1. Apply a thin bead of adhesive to the adhesive mounting surface.

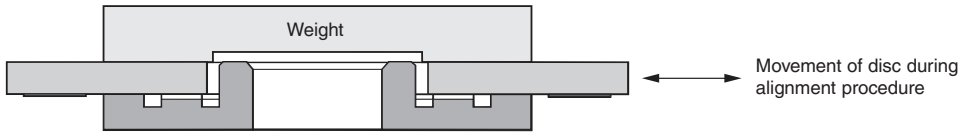
   It should be of sufficient quantity only to fill the gap between the hub and disc.

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

See cross section drawing



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



3. Align the disc so it is concentric with the hub/shaft.

4. Cure the adhesive.

Aligning the disc

There are two possible ways to accurately align the disc to minimise eccentricity:

- Optical alignment using a microscope
- Electrical alignment using two readheads

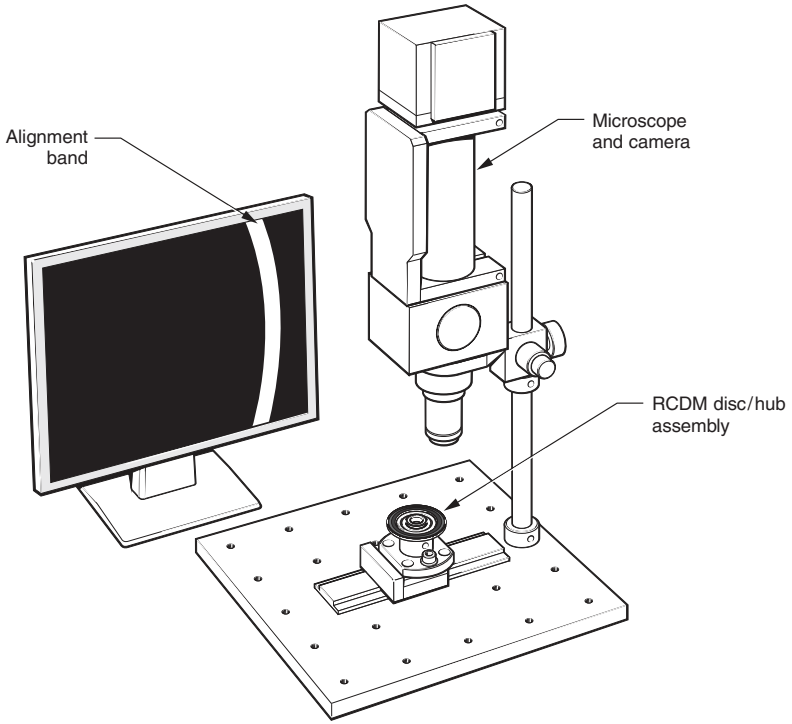
The method chosen to align the disc on the system depends upon the application and available space, etc. It should be noted that the graduations and alignment band are accurately concentric with each other but not with the glass disc. The following sections outline how to align the disc using these methods.

NOTE: The disc should not be mounted on the black mask on the reverse of the disc (apart from 17 mm disc).

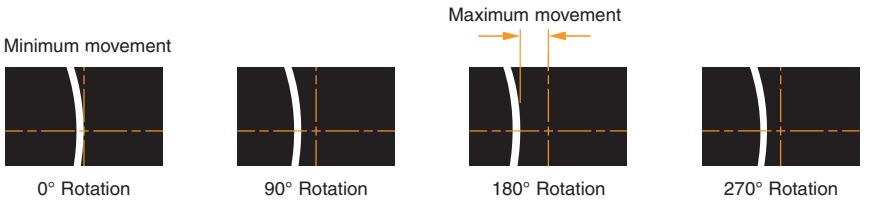
Optical alignment

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 observe the maximum and minimum limits of movement of the alignment band as shown below.

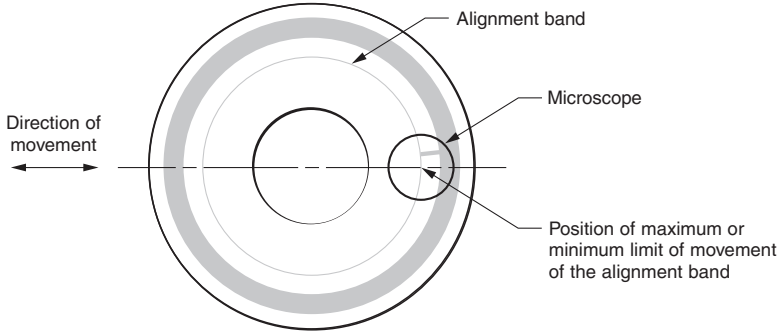


3. Note the axis position at the limits of movement.

4. Rotate the disc so either of these limits of movement is located under the microscope.

5. 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 disc at limit of movement of alignment band.



6. Rotate the assembly and repeat steps 3 to 5 until the total alignment band movement is within the design specifications.

7. Cure the adhesive.

8. Recheck the run-out.

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

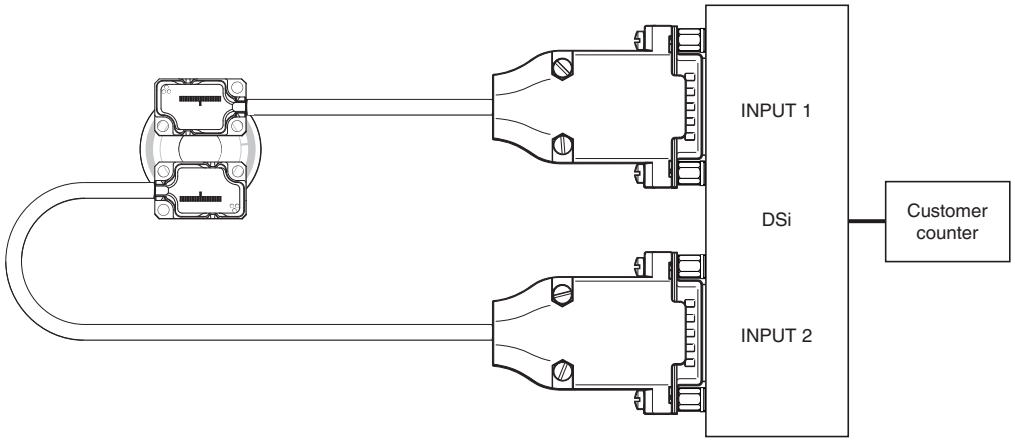
Electrical alignment

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.

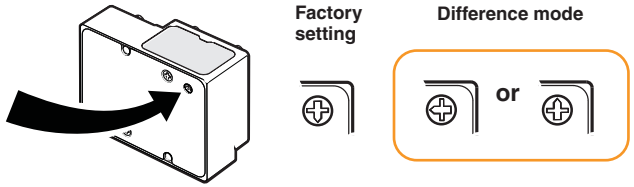
This requires:

- A DSi interface
- A digital counter

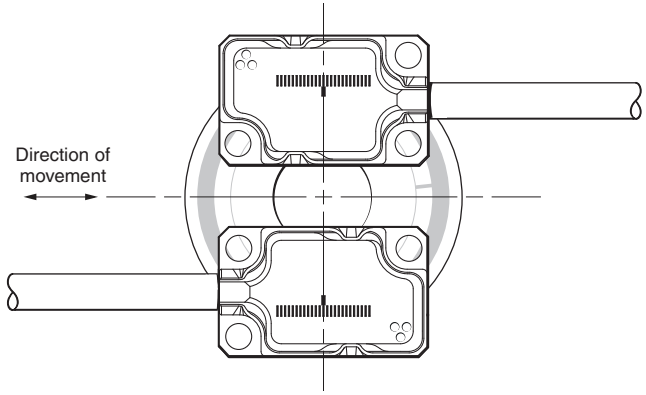
The clock frequency of the DSi, readheads and digital counter must be matched to ensure there is no miscounting. For more information on choosing appropriate DSi and readheads for your system contact your local Renishaw representative. For more information on the DSi refer to the TONiC DSi data sheet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



1. Connect 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 page 12 for more information.
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 customer 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

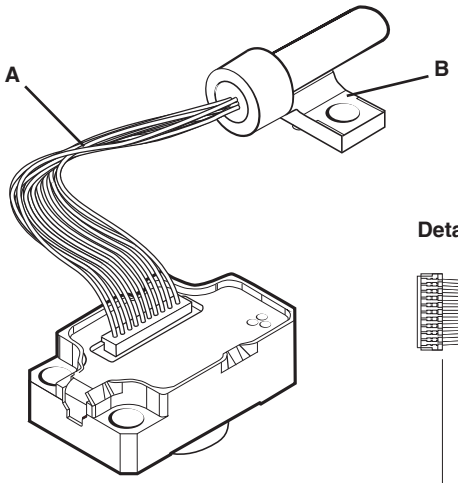
- Provide appropriate strain relief at the readhead. The Renishaw top exit cables are fitted with a P-clip to ensure appropriate cable strain relief.
- When using Renishaw's top exit cables ensure that the P-clip is mounted within a 50mm radius of the readhead cable exit.
- Minimum static bend radius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

Shielding

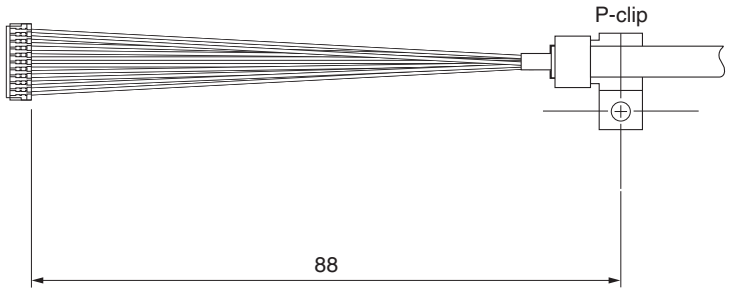
For optimum performance:

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

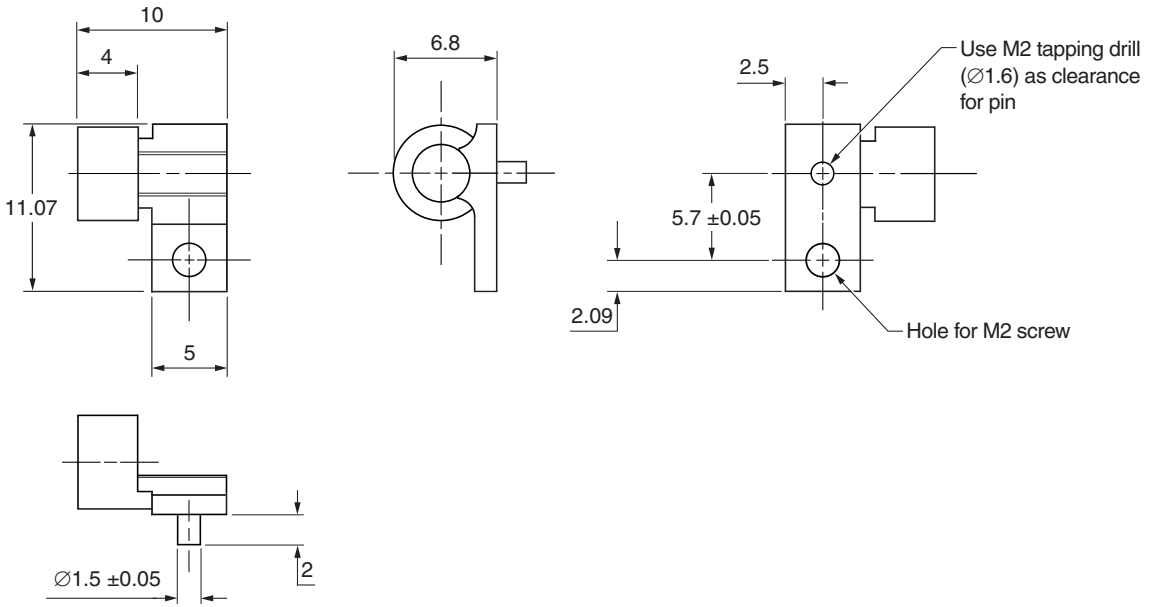
Top exit readhead (with readhead cable inserted)



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



Detail B: P-clip dimensions



Readhead mounting and alignment: Methods

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

- Shim kit.
- Dummy head.

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

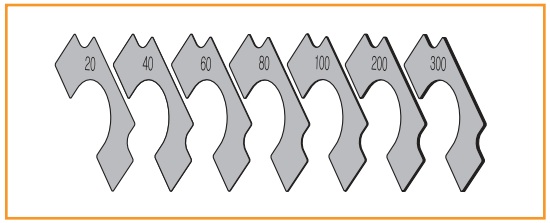
Ensure that the disc, readhead optical window and mounting face are clean and free from obstruction. Do not saturate the readhead window with cleaning solvent as this may cause contamination on the inside of the readhead window which then cannot be cleaned.

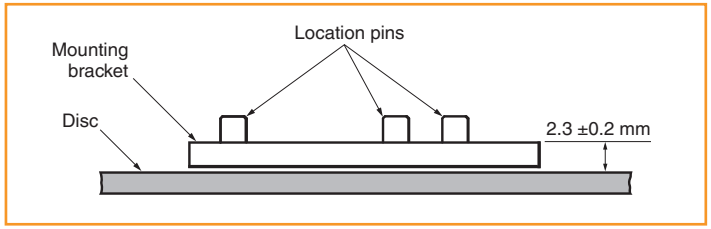
IMPORTANT: Whichever method is used to mount the readhead, care should be taken to ensure the disc surface is not damaged during this operation.

NOTE: Cabled readhead shown 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 (±0.2 mm).

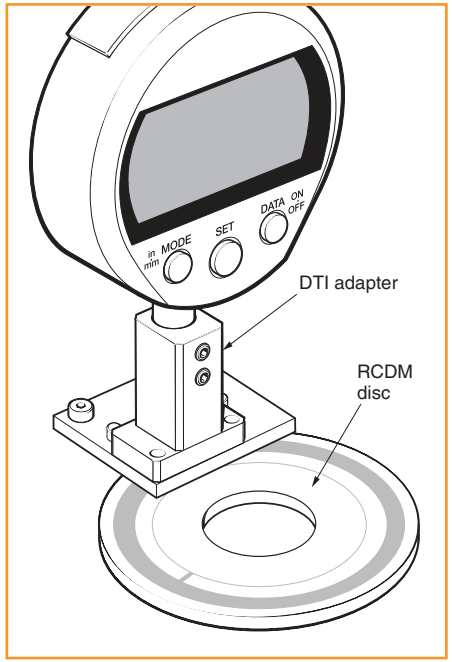
The kit consists of:

Part number:	A-9401-0041	A-9401-0042	A-9401-0043	A-9401-0044	A-9401-0045	A-9401-0046	A-9401-0047
Thickness (µm)	20	40	60	80	100	200	300
Quantity in pack	10	10	10	10	20	20	10

1. Using a digital dial gauge 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 (A-9401-0105) that can be used to assist with this process.
   - 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 disc 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 2 off M2 × 6 screws in diagonally opposite fixing holes ensuring that the readhead is tightened down evenly and parallel to the bracket face.
6. Connect the readhead to the receiving electronics and power-up.

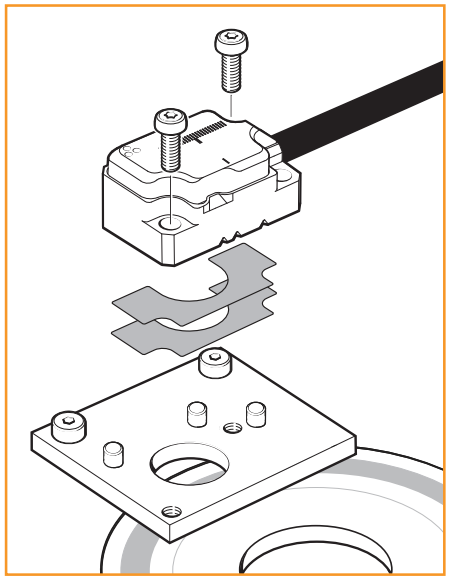


Using location pins/shoulder:

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' section (see page 12).

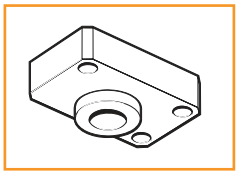
Not using location pins:

11. Adjust longitudinal and radial offset of the readhead to obtain a flashing Green readhead set-up LED around the full axis of rotation. An oscilloscope or Advanced Diagnostic Tool (ADTi-100) and ADT View software can be used to help maximise the signal size.*
12. Tighten the readhead fixing screws.
13. Proceed with 'System calibration' section (see page 12).



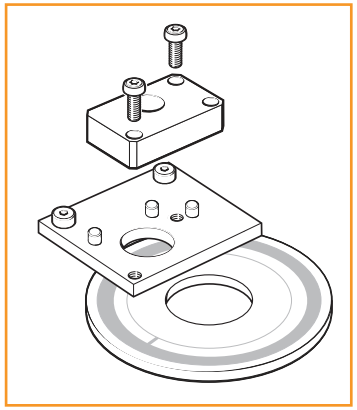
*For more details refer to the 'Advanced Diagnostic Tool ADTi-100 and ADT View software quick start guide' (M-6195-9321) and 'Advanced Diagnostic Tool ADTi-100 and ADT View software user guide' (M-6195-9413).

Dummy head (A-9401-0072)

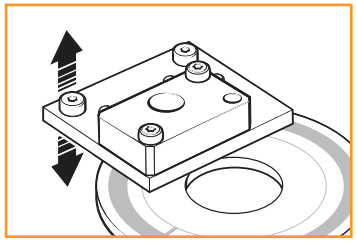


The reuseable dummy head has the same mounting holes as the ATOM DX readhead with a longer 'nose' that is machined to the optimum rideheight (2.5 mm ±0.02 mm). It is mounted in place of the readhead directly onto the bracket. The bracket should have location pins or a shoulder to control readhead yaw.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

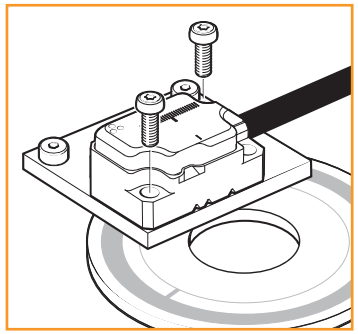
1. Mount the dummy head onto the bracket using 2 off M2 × 6 screws.



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 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 off 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' section (see page 12).

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. An ADTi and ADT View software can be used to help maximise the signal size.
13. Tighten the readhead fixing screws.
14. Proceed with 'System calibration' section (see page 12).

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 on page 12 of this installation guide.

The optional Advanced Diagnostic Tool ADTi-100* (A-6165-0100) and ADT View software† 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 9 and page 10 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 calibration fails (LED remains single flashing Blue), restore factory defaults by obscuring the readhead optical window on power-up (see page 12) then repeat the installation and calibration routine.

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

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

System calibration

NOTE: System calibration (CAL), restoring factory defaults, and enabling/disabling AGC functions can also be carried out using the optional ADTi-100 and ADT View software. See www.renishaw.com/adt for more information.

Ensure signal strength has been optimised around the full axis of rotation, the LED will be flashing Green. 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.

Step 1 – Incremental signal calibration

- Rotate the axis at slow speed (< 100 mm/s or less than the readhead maximum speed, whichever is slowest), ensuring 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.
- The system is now ready for reference mark phasing. For systems without a reference mark, cycle the power to the readhead or connect the 'Remote CAL' output pin to 0 V for <3 seconds to exit calibration mode.
- If the system does not automatically enter the reference mark phasing stage (LED continues single flashing) the calibration of the incremental signals has failed. After ensuring failure is not due to overspeed (>100 mm/s or exceeding the readhead maximum speed), exit the calibration routine, restore factory defaults as detailed below and check the readhead installation and system cleanliness before repeating the calibration routine.

Step 2 – Reference mark phasing

- Move the readhead back and forth over the reference mark until the LED stops flashing and remains solid Blue. The reference mark is now phased.
- The system automatically exits the calibration routine and is ready for operation.
- AGC is automatically switched on once calibration is complete. To switch off AGC refer to the 'Enabling/disabling AGC' section.
- If the LED continues double-flashing 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	Settings stored
Blue single flashing	None, restore factory defaults and recalibrate
Blue double flashing	Incremental only
Blue (auto-complete)	Incremental and reference mark

Restoring factory defaults

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

To restore factory defaults:

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

Enabling/disabling AGC

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

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 <100mm/s only)
Alarm	4 red flashes	Low signal or over signal; system in error

Troubleshooting

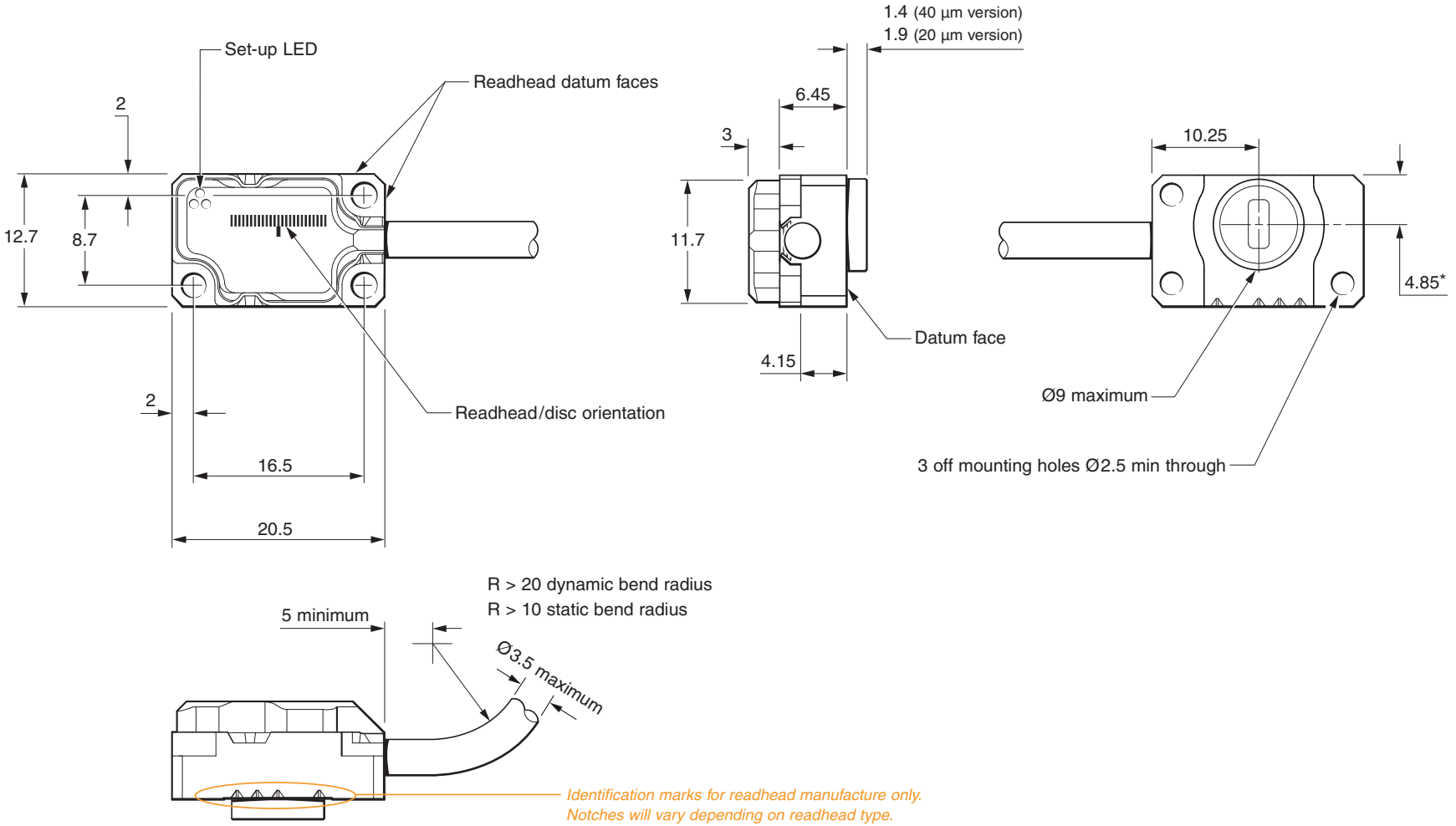
Fault	Cause	Possible solutions
LED on the readhead is Blank	There is no power to the readhead	▶ Check you have 5 V at the readhead ▶ For cable variants check correct wiring of connector
LED on the readhead is Red and I can't get a Green LED	The signal strength is <50%	▶ Check the readhead optical window and disc are clean and free from contamination ▶ Restore factory defaults (see page 12) 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 data sheet (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 data sheet (L-9517-9736) 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 (see page 12)
Can't initiate the calibration routine	Signal size is <70%	▶ Restore factory defaults ▶ Realign readhead to obtain a Green flashing LED
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 12) ▶ Check system set-up and realign the readhead to obtain a flashing Green LED around the full axis of rotation before recalibrating

Troubleshooting (continued)

Fault	Cause	Possible solutions
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 data sheet (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/sec) ▶ Calibrate the system (see page 12) – 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 readhead optical window and check for damage then recalibrate the system (see page 12).
LED on the readhead is flashing Red over the reference mark	The reference mark is not phased	▶ Clean the disc and readhead optical window and check for scratches then recalibrate the system (see page 12).

ATOM DX cabled readhead dimensions

Dimensions and tolerances in mm

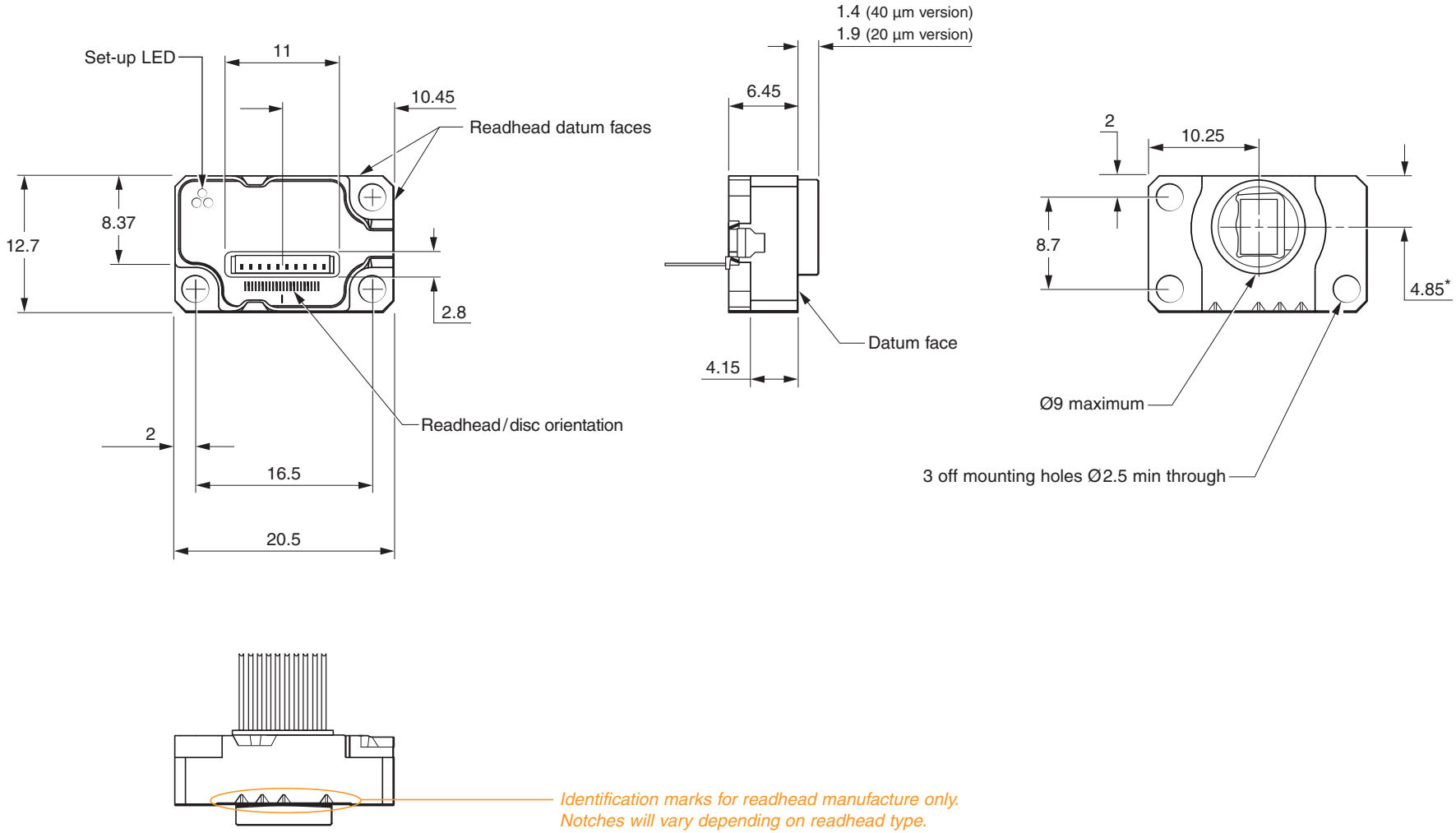


*Not optical centreline

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

ATOM DX top exit readhead dimensions

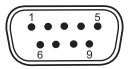
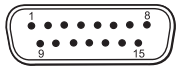
Dimensions and tolerances in mm



*Not optical centreline

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

Output signals

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

† PCB mount mating connectors - Top entry: BM10B-SRSS-TB Side entry: SM10B-SRSS-TB.
‡ Connector on top exit readhead only. Mating connector 10SUR - 32S.

Speed

20 µm encoder

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

40 µm encoder

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

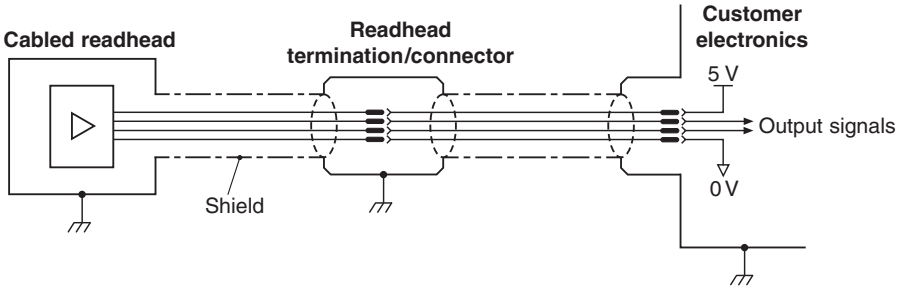
*For a readhead with a 1m cable.

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

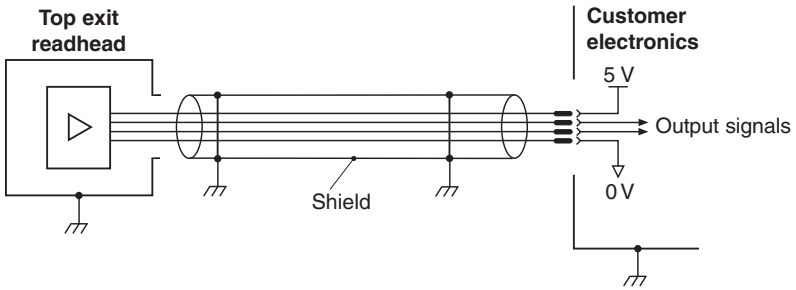
Angular speed (rev/min) = $\frac{V \times 1000 \times 60}{\pi D}$ Where V = maximum linear speed (m/s) and D = optical diameter of RCDM (mm)

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.



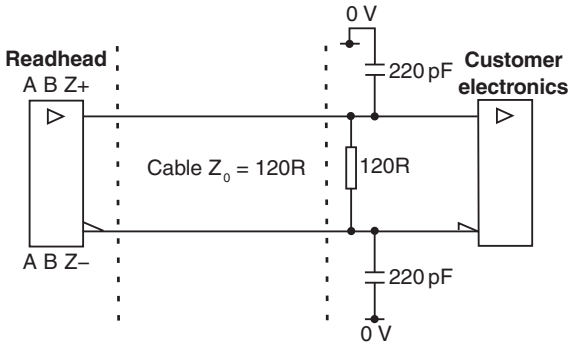
IMPORTANT: The shield should be connected to the machine earth (Field Ground).

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 subsidiary for more information.

Recommended signal termination

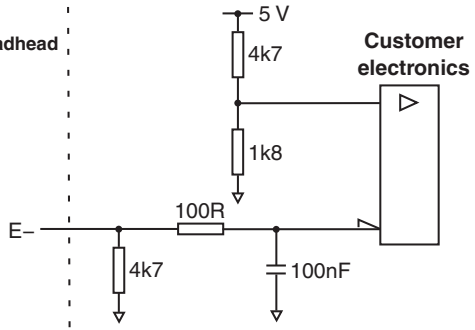
Digital outputs



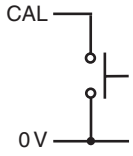
Standard RS422A line receiver circuitry
Capacitors recommended for improved noise immunity

Single ended alarm signal termination

(Not available with 'A' cable termination)



Remote CAL operation



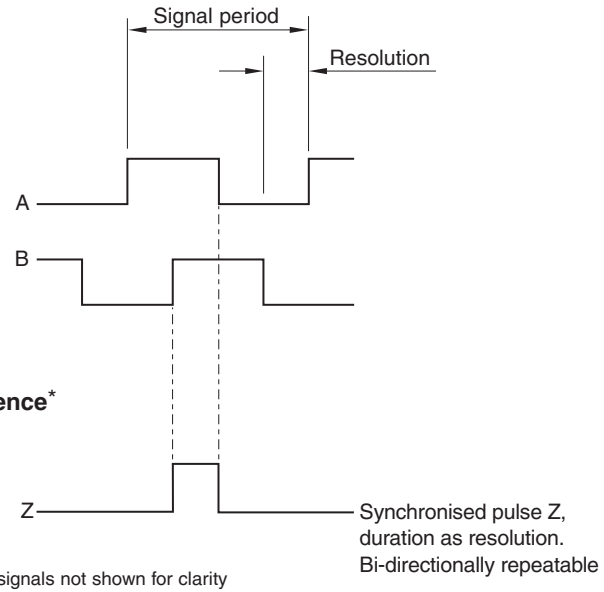
Remote system calibration (CAL) is possible via the CAL pin.

Output specifications

Digital output signals

Form – Square wave differential line driver to EIA RS422A

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



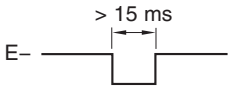
*Inverse signals not shown for clarity

Resolution option code	P (µm)	S (µm)
T†	40	10
D	20	5
G†	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‡	0.01	0.0025

†40 µm ATOM DX only ‡20 µm ATOM DX only

Alarm

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



Alarm asserted when:
– Signal amplitude < 20% or > 135%
– Readhead speed too high for reliable operation

or 3-state alarm
Differentially transmitted signals forced open circuit for > 15 ms when alarm conditions valid.

General specifications

Power supply	5 V –5/+10%	Typically < 200 mA fully terminated
		Power from a 5 V dc supply complying with the requirements for SELV of standard IEC BS EN 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 EN 60068-2-78
Sealing		IP40
Acceleration (system)	Operating	400 m/s², 3 axes
Shock (system)	Operating	1000 m/s², 6 ms, ½ sine, 3 axes
Vibration	Operating	100 m/s² max @ 55 Hz to 2000 Hz, 3 axes
Mass	Standard readhead	3.2 g
	Top exit readhead	2.9 g
	Cable	18 g/m
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 3 m
		(Extension cable up to 25 m when using Renishaw approved extension cable)
		UL recognised component
		Top exit cables available in lenghts from 0.5 m to 3 m with 15 way D-type or 10 way JST (SH) connector options.
Cabled connector options		9 way D-type
		15 way D-type (standard and alternative pin out)
		10 way JST (SH)
Top exit readhead connector		10 way JST (SUR)
Typical Sub-Divisional Error (SDE)	20 µm version	< ±75 nm
	40 µm version	< ±120 nm

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.

Disc specifications

Material	Soda lime glass	
Form	2.3 mm thick	
Reference mark	Single reference mark	
Graduation accuracy	Discs < 100 mm ±0.5 µm	
	Discs > 100 mm ±0.7 µm	

Disc size (mm)	**17**	**20**	**25**	**27**	**30**	**36**	**50**	**56**	**68**	**108**
Graduation accuracy (arc seconds)	15.81	12.95	9.82	9.0	7.91	6.49	4.5	3.95	3.24	2.78

Coefficient of thermal expansion	~8 µm/m/°C	
Nominal outer diameter (mm)	40 µm	17, 20, 25, 27, 30, 36, 50, 56, 68, 108
	20 µm	30, 36, 50, 56, 68, 108

Renishaw plc

New Mills, Wotton-under-Edge
Gloucestershire, GL12 8JR
United Kingdom

T +44 (0) 1453 524524
F +44 (0) 1453 524901
E uk@renishaw.com

www.renishaw.com

RENISHAW
apply innovation™

For worldwide contact details, visit www.renishaw.com/contact

Part no.: M-9414-9447-01-C
Issued: 05.2023