

ATOM DX™ and CENTRUM™ CSF40 rotary encoder system



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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	US10281301	CN105814408	EP3052897	JP7032045
US10823587	CN106030251	EP3052895	JP6811610	EP3052900
IN399411	JP7083228	CN214843296		

Chinese Utility Model Patent No. ZL202022978708.8

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

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

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

Declaration of Conformity

Renishaw plc hereby declares that the 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

Renishaw Inc.
1001 Wesemann Drive
West Dundee
Illinois
IL 60118
United States
Telephone number: +1 847 286 9953
Email: usa@renishaw.com

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

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

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

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
	Metallised 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.

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ATOM DX software notices

Third party licences

The ATOM DX product includes embedded software (firmware) to which the following notices apply:

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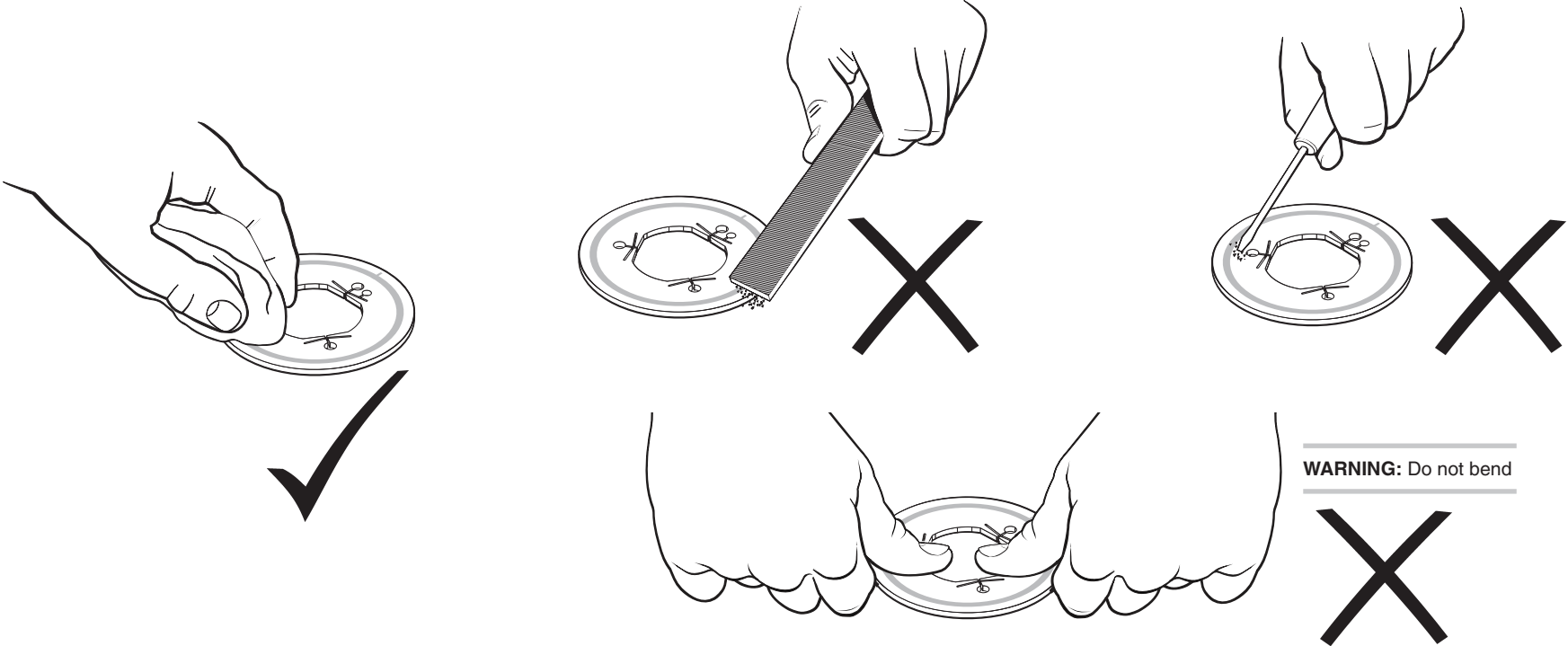
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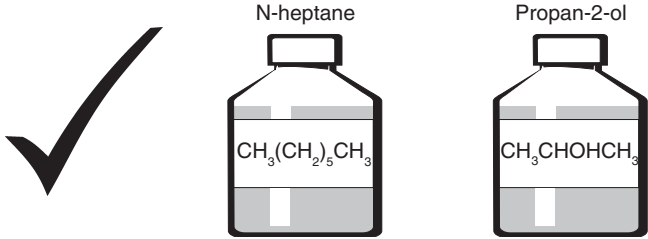
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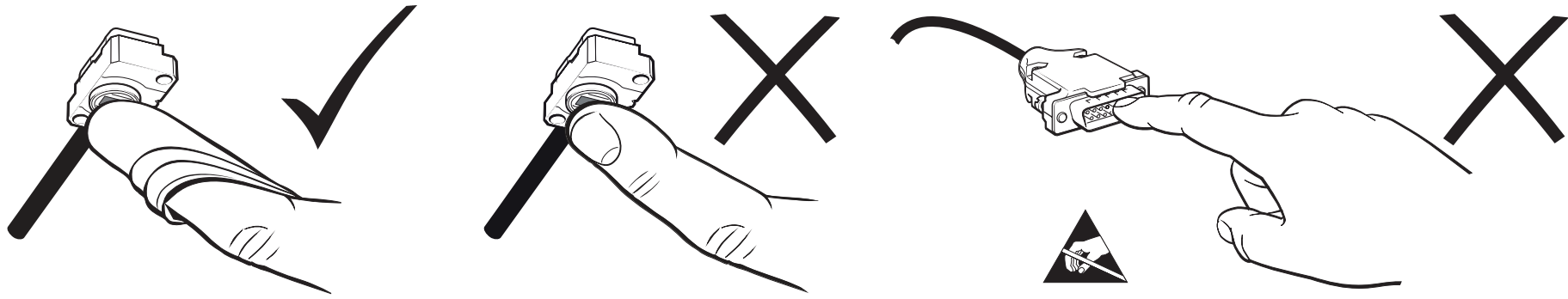
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Storage and handling



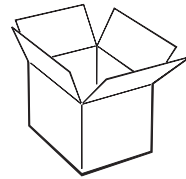
Disc and readhead



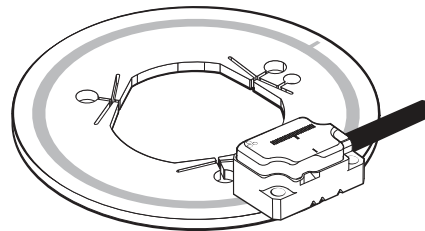


Temperature

Storage	
System	-20 °C to +70 °C

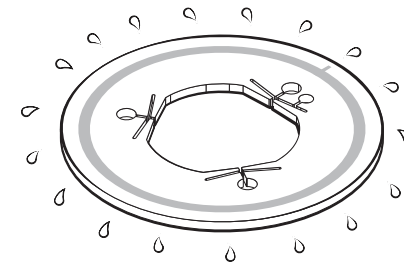
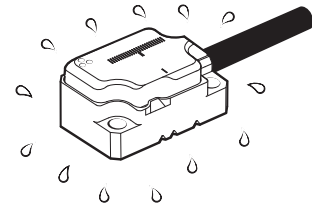


Operating	
System	0 °C to +70 °C



Humidity

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



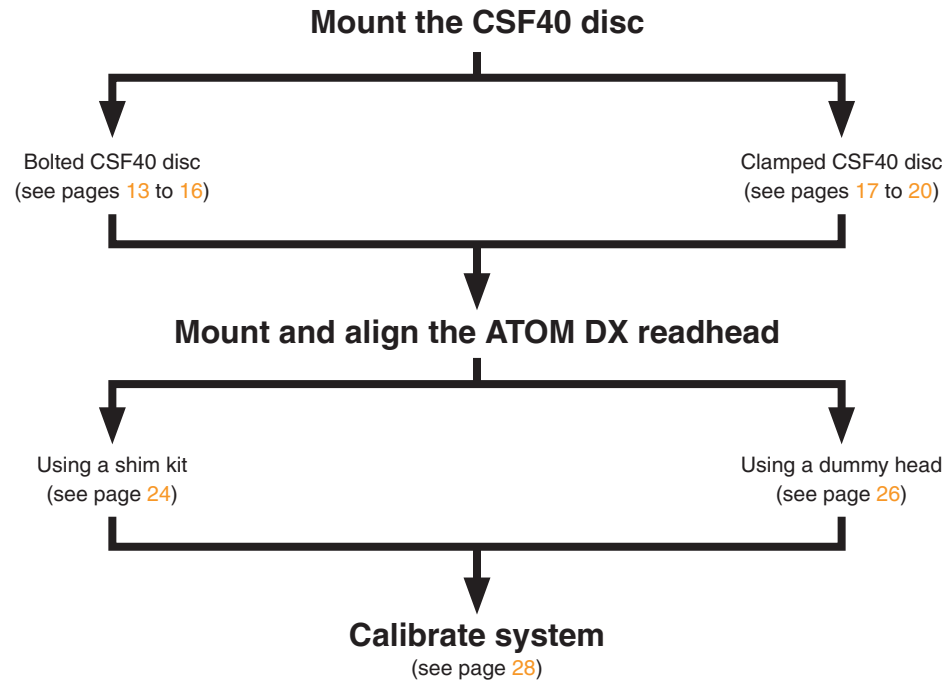
ATOM DX and CENTRUM system installation overview

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, installation drawings should be reviewed to ensure correct orientation of the readhead relative to the disc.



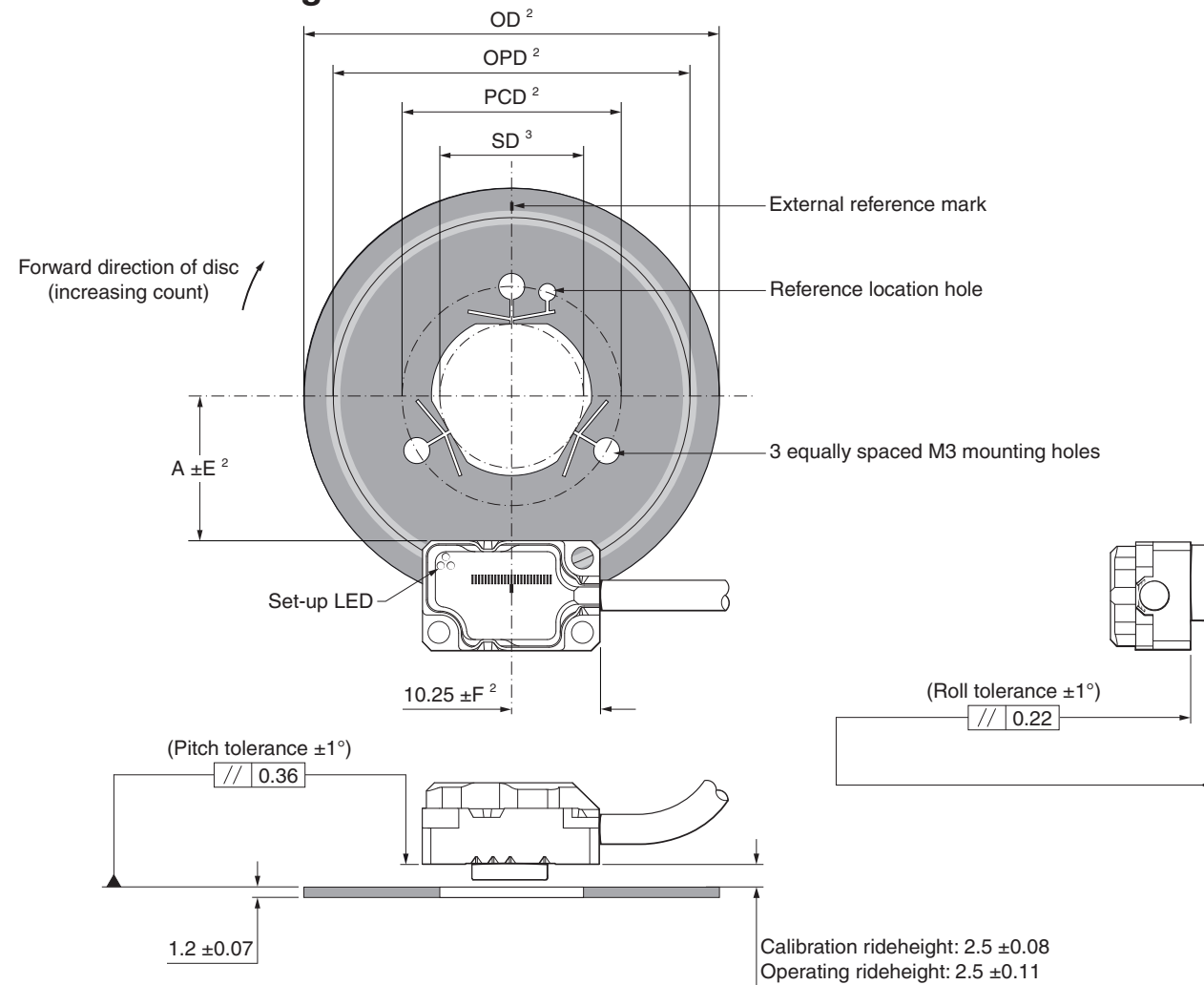
Bolted CSF40 disc

External reference mark 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 disc tolerances are defined on page 35 and the disc dimensions are defined on page 36.

³ The inner diameter of the disc is designed to fit a shaft diameter equal to SD with a tolerance of h6. The dimension of SD is defined on page 36.

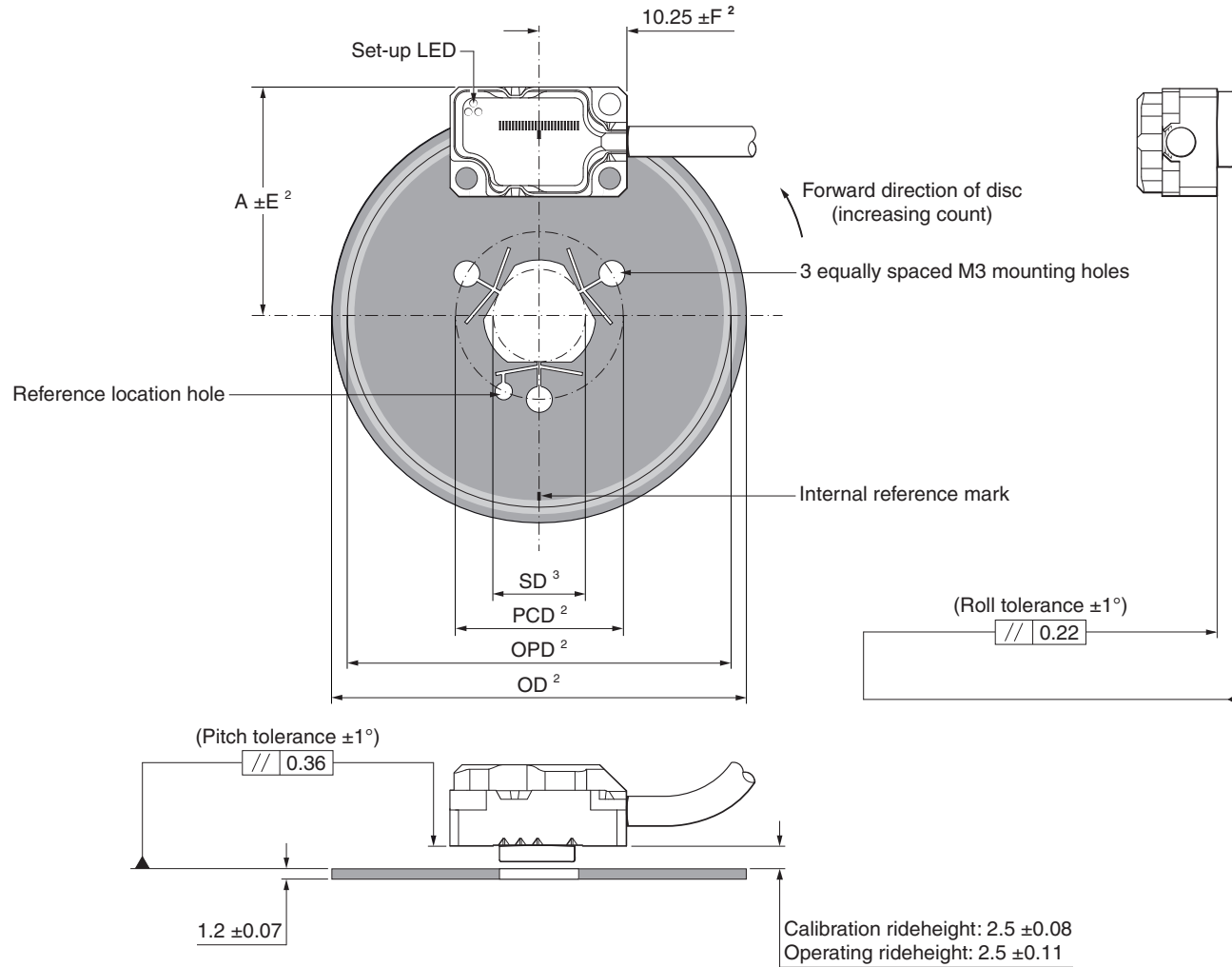
Bolted CSF40 disc

Internal reference mark installation drawing

Dimensions and tolerances in mm



NOTE: ATOM DX cabled readhead variant shown.¹



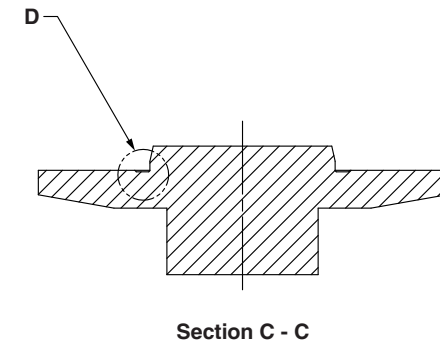
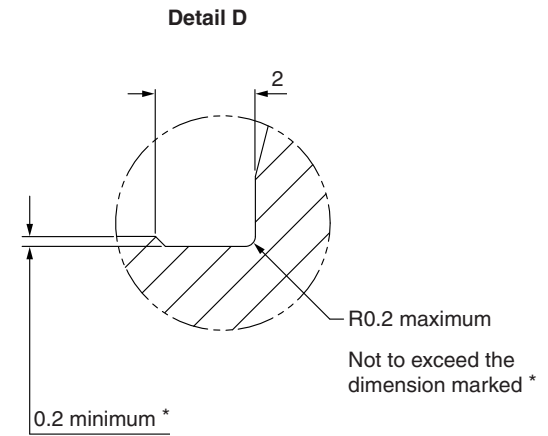
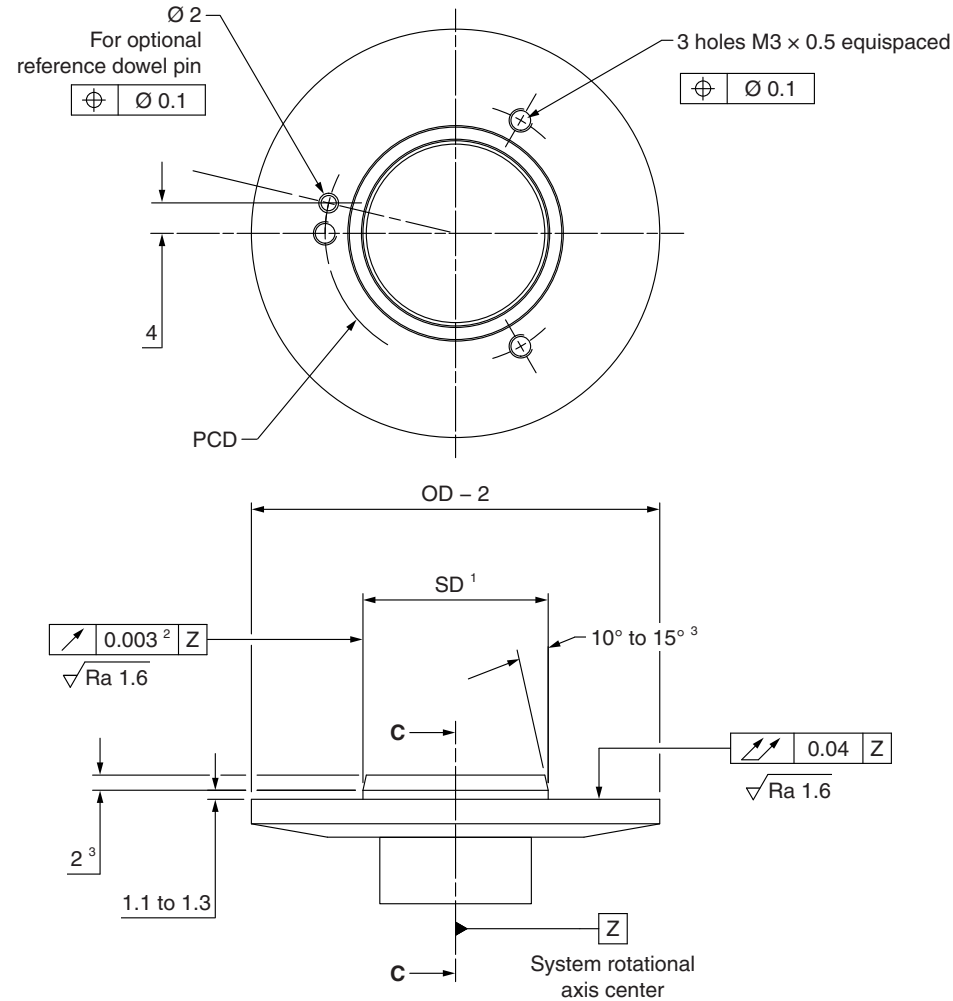
¹ For readhead dimensions see pages 33 and 34.

² The disc tolerances are defined on page 35 and the disc dimensions are defined on page 36.

³ The inner diameter of the disc is designed to fit a shaft diameter equal to SD with a tolerance of h6. The dimension of SD is defined on page 36.

Bolted CSF40 disc Recommended shaft geometry

Dimensions and tolerances in mm



- ¹ Shaft diameter tolerance h6.
- ² Runout and shaft diameter impact the installed accuracy of the system.
- ³ A chamfer is required to ensure the safe fitment of the disc onto the shaft.

Bolted CSF40 disc

Required parts

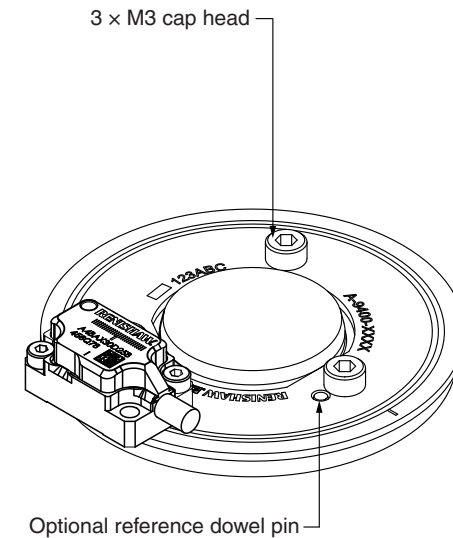
- Appropriate CSF40 disc
- 3 × M3 cap head screws
- Appropriate cleaning solvents (see 'Storage and handling' on page 10).
- Hex key
- Thread-locking compound
- Torque wrench

Mounting the disc

- Clean the shaft and hub as recommended in 'Storage and handling' on page 10.
- Visually align the bolt holes and reference pin on the disc with the bolt holes and reference pin on the hub.
- Press the disc down onto the shaft as evenly as possible until it sits flat on the hub.
- Insert the cap head screws into the mounting holes to hold the disc in place.

NOTES:

- Do not lubricate the screws.
 - Do not use washers as this may affect the environmental performance.
 - It is recommended to use a thread-locking compound on the screws.
-
- Lightly tighten the 3 screws by hand.
 - Once all 3 screws have been lightly tightened, torque the 3 screws to between 1.2 Nm and 1.5 Nm.



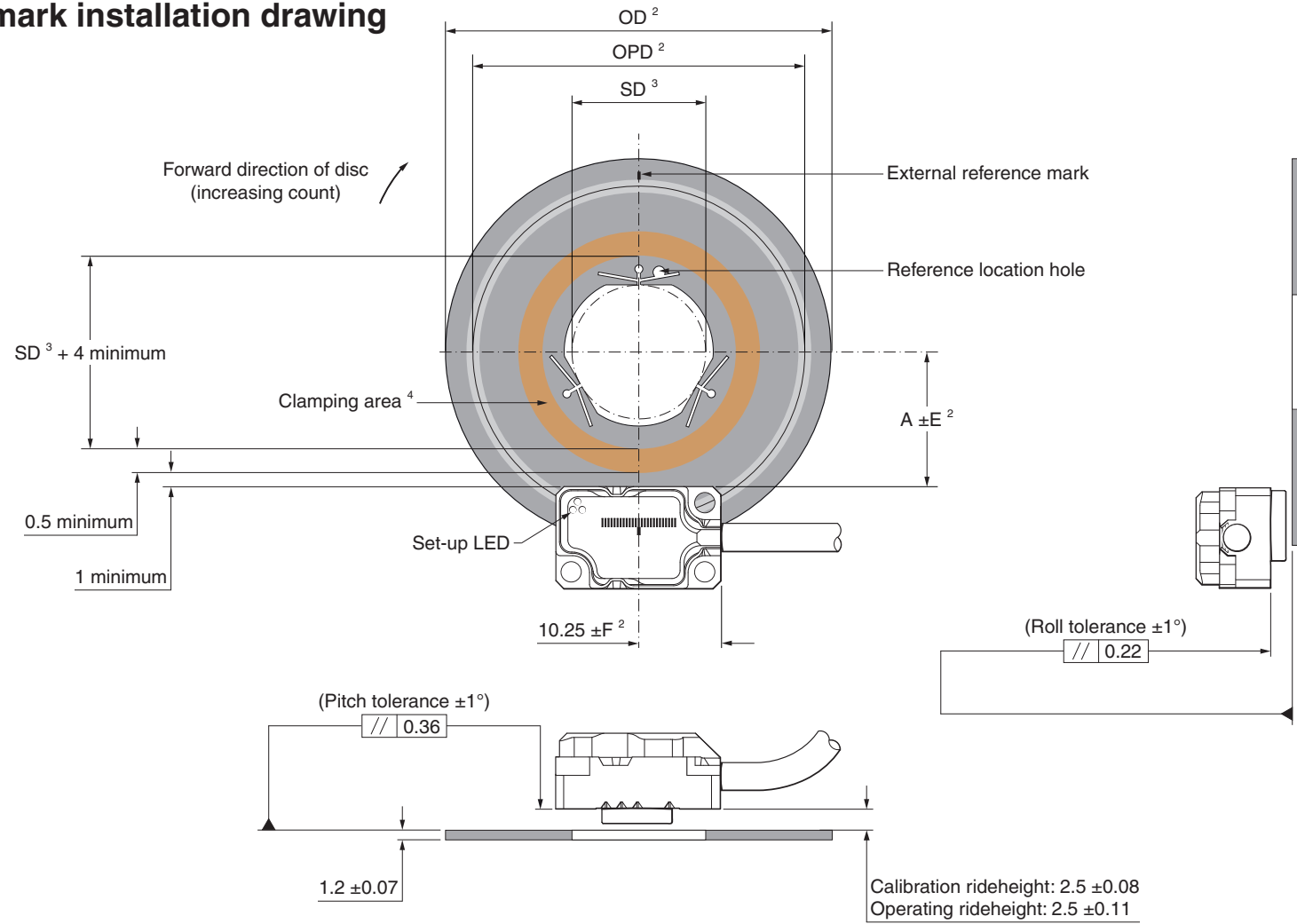
Clamped CSF40 disc

External reference mark 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 disc tolerances are defined on page 35 and the disc dimensions are defined on page 36.

³ The inner diameter of the disc is designed to fit a shaft diameter equal to SD with a tolerance of h6. The dimension of SD is defined on page 36.

⁴ See page 20 for details of clamping area.

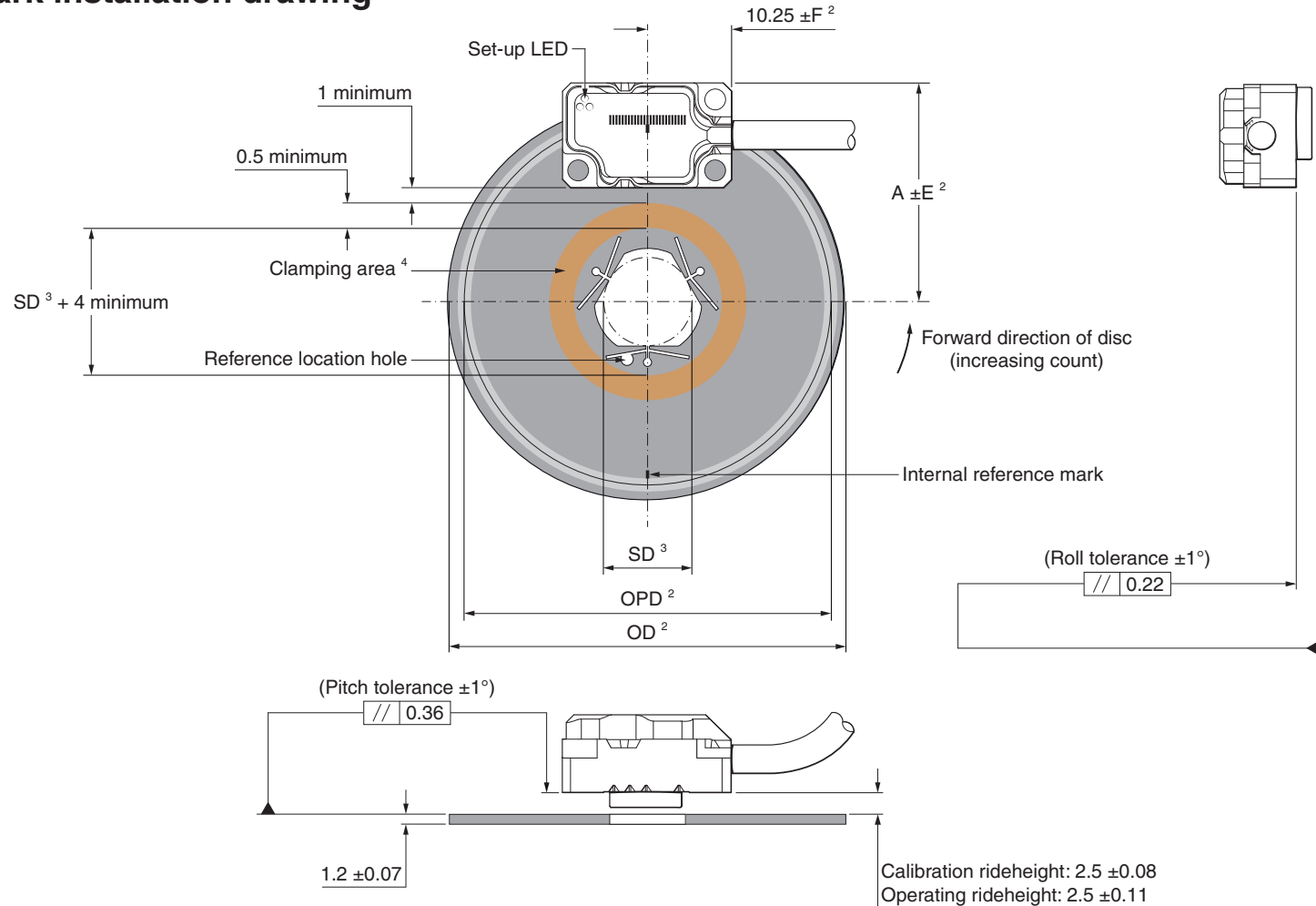
Clamped CSF40 disc

Internal reference mark installation drawing

Dimensions and tolerances in mm



NOTE: ATOM DX cabled readhead variant shown.¹



¹ For readhead dimensions see pages 33 and 34.

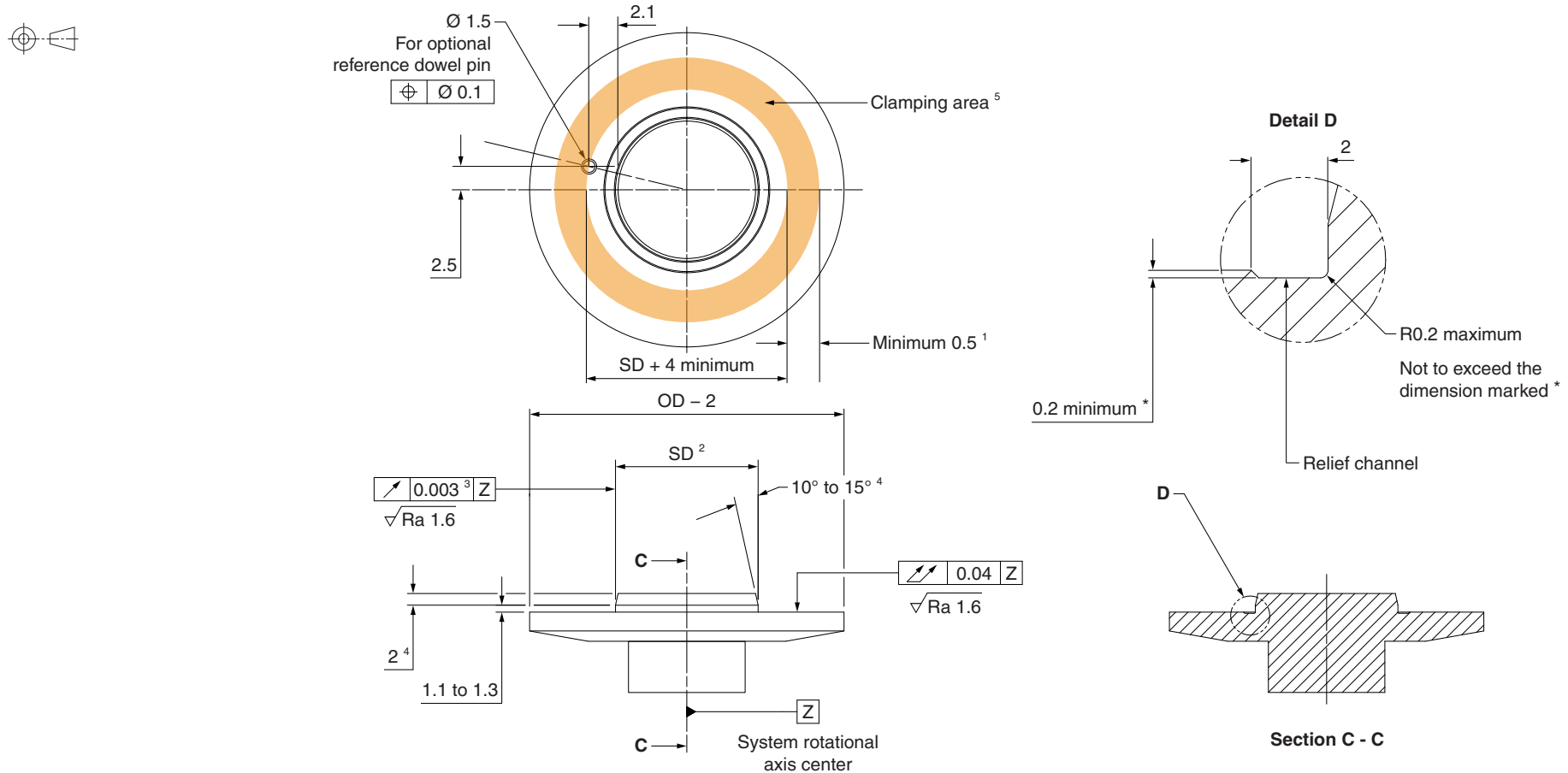
² The disc tolerances are defined on page 35 and the disc dimensions are defined on page 36.

³ The inner diameter of the disc is designed to fit a shaft diameter equal to SD with a tolerance of h6. The dimension of SD is defined on page 36.

⁴ See page 20 for details of clamping area.

Clamped CSF40 disc Recommended shaft geometry

Dimensions and tolerances in mm



¹ Ensure 1 mm clearance between the outer diameter of the clamp and the readhead.

² Shaft diameter tolerance h6.

³ Runout and shaft diameter impact the installed accuracy of the system.

⁴ A chamfer is required to ensure the safe fitment of the disc onto the shaft.

⁵ See page 20 for details of clamping area.

Clamped CSF40 disc

Required parts

- Appropriate CSF40 disc
- Appropriate cleaning solvents (see 'Storage and handling' on page 10).
- Appropriate mechanical clamp

The clamp must:

- Hold the disc between the clamp and the mounting hub
- Form a complete ring around the surface of the disc
- Clamp outside of the relief channel on the hub (suggested clamp ID is SD + 4)
- Have a wall thickness of ≥ 0.5 mm
- Ensure a minimum of 1 mm clearance from the clamp to the readhead
- Provide a clamping force of ≥ 250 N

Mounting the disc

- Clean the shaft and hub as recommended in 'Storage and handling' on page 10.
- If using, visually align the reference pin on the disc with the reference pin on the hub. Ensure the reference pin does not impede the clamp.
- Press the disc down onto the shaft as evenly as possible until it is flat on the hub
- Clamp the disc in place with a clamping force of ≥ 250 N

NOTE: If using a nut-style clamp, it is recommended to add a washer between the clamp and the disc to minimise the chance of eccentricity shift during tightening.

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.

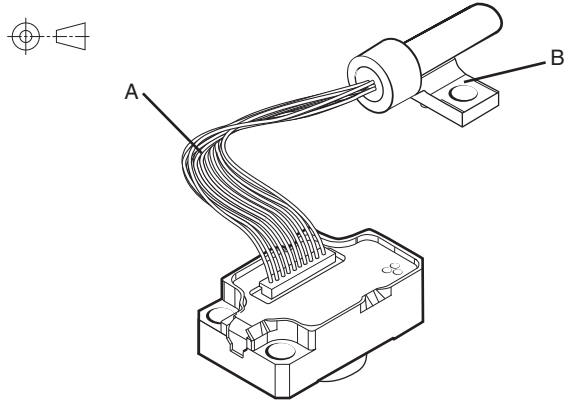
Shielding

For optimum performance:

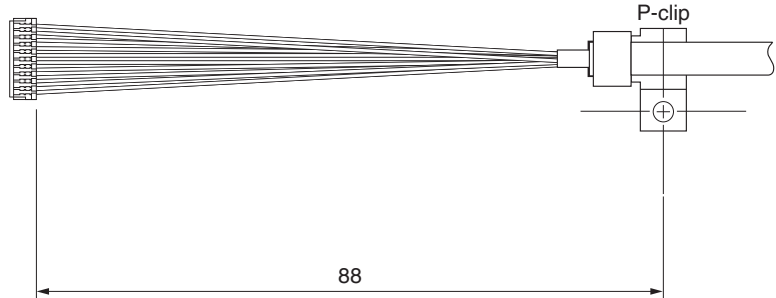
- Ensure 100% shielding.
- Ground the mounting brackets.
- Ensure continuity between the readhead body and cable shield. For Renishaw top exit cables the P-clip provides electrical connection to the cable shield.
- Maximise the distance between the encoder and motor cables.

Top exit readhead (with readhead cable inserted)

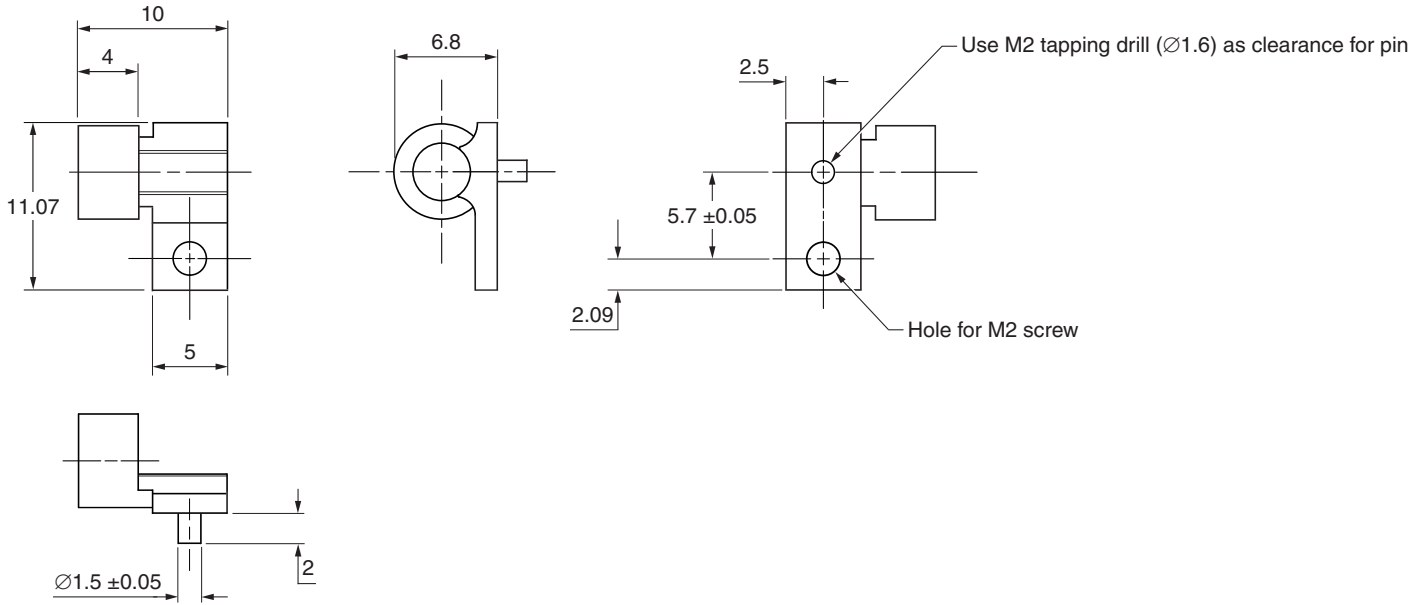
Dimensions and tolerances in mm



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 24).
- Dummy head (see page 26).

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.

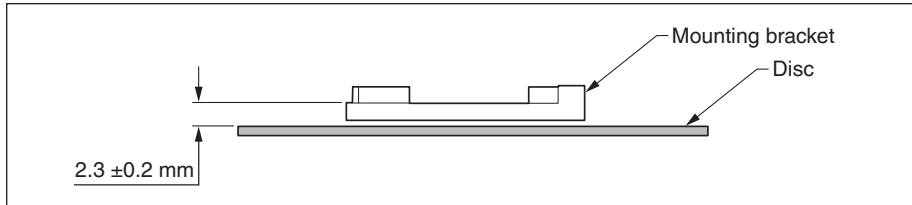
IMPORTANT: Whichever method is used to mount the readhead, care should be taken to ensure the disc surface is not damaged during this operation.

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.

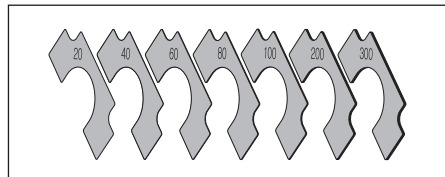


Shims of a known thickness are inserted between the mounting face of the readhead and the bracket to give the correct rideheight of 2.5 mm.

Required parts

- Dial test indicator (DTI) or similar
- 2 M2 × 6 screws
- ATOM readhead shim kit (A-9401-0050) consisting 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

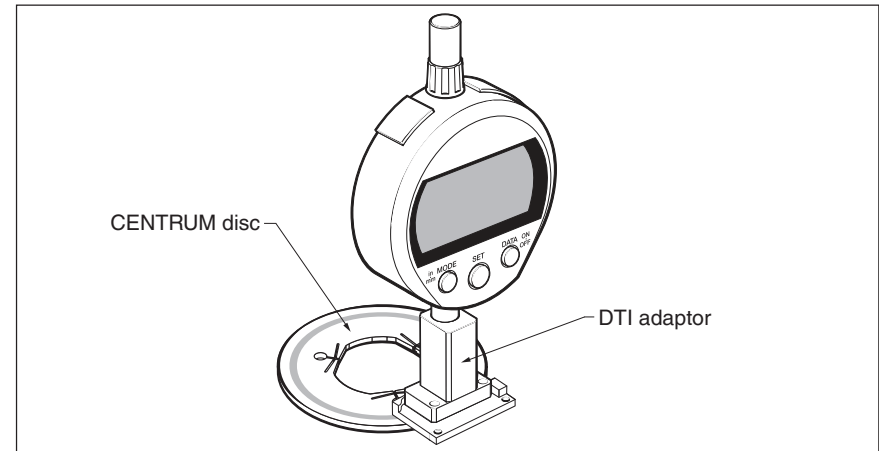
- DTI adaptor (A-9401-0105)

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 adaptor that can be used to assist with this process.

- Insert the DTI into the adaptor and zero it on a flat surface.
- Position or fix the indicator/adaptor 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.

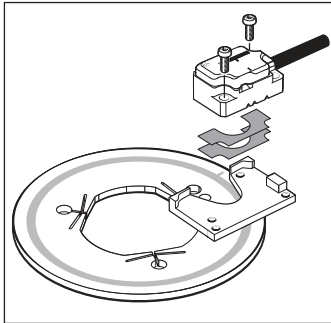


2. Subtract the distance measured from the nominal rideheight of 2.5 mm to calculate the required shim thickness. For example if the distance measured is 2.37 mm the required shim thickness is 130 µm.
3. Select the smallest number of shims that gets within 10 µm of the difference. For distances less 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.

- Place the chosen shim(s) between the readhead and the bracket.
- 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.



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

Using location pins/shoulder:

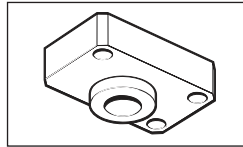
- Ensure the readhead is pushed back against the location pins or shoulder.
- Tighten the readhead fixing screws.
- Check the readhead set-up LED is flashing green around the full axis of rotation.
- Proceed with 'System calibration' on page 28.

Not using location pins:

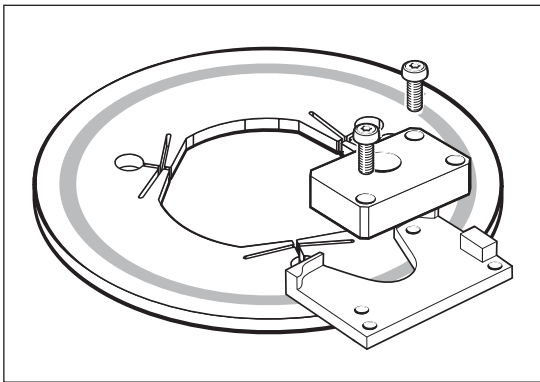
- Adjust longitudinal and radial offset of the readhead to obtain a flashing green readhead set-up LED around the full axis of rotation. Renishaw's Advanced Diagnostic Tool (ADTi-100) and ADT View software can be used to help maximise the signal size. For more details refer to the 'Advanced Diagnostic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

Dummy head (A-9401-0072)

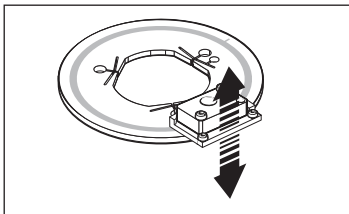
The reusable dummy head has the same mounting holes as the ATOM DX readhead with a longer 'nose' that is machined to the optimum rideheight (2.5 mm \pm 0.02 mm). It is mounted in place of the readhead directly onto the bracket. The bracket should have location pins or a shoulder to control readhead yaw.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



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

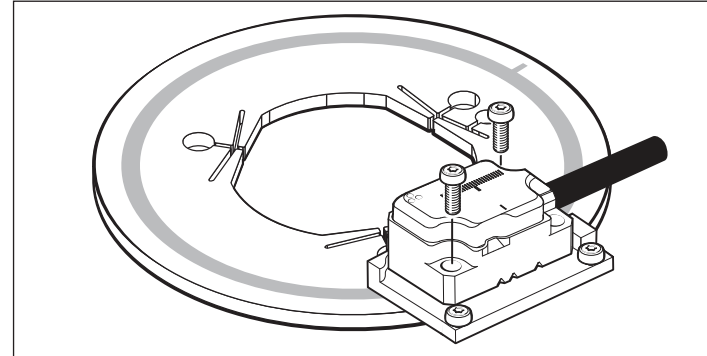


2. Loosely mount the readhead bracket onto the axis.
3. Adjust the height of the bracket or disc assembly until the 'nose' of the dummy head just touches the disc.



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 M2 \times 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-100¹ (A-6195-0100) and ADT View software² 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 23 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 by obscuring the readhead optical window on power-up (see page 29), 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

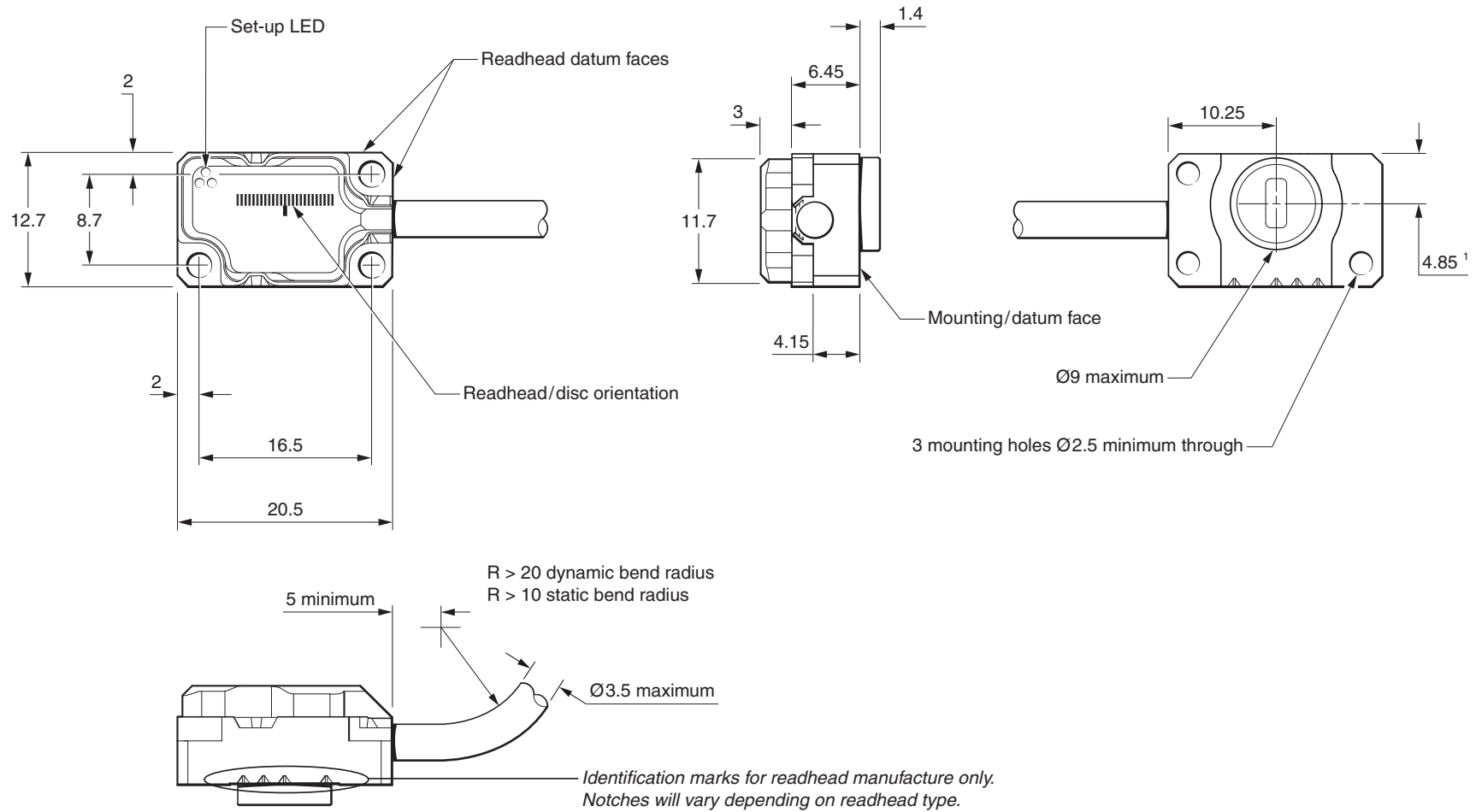
Troubleshooting

Fault	Cause	Possible solutions
LED on the readhead is blank	There is no power to the readhead	<ul style="list-style-type: none"> • 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%	<ul style="list-style-type: none"> • 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; <ul style="list-style-type: none"> • 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 <i>ATOM DX™ miniature encoder system</i> 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	<ul style="list-style-type: none"> • Check that the readhead variant is the correct type for the chosen disc (see the <i>ATOM DX™ miniature encoder system</i> 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%	<ul style="list-style-type: none"> • 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%	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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 <i>ATOM DX™ miniature encoder system</i> data sheet (Renishaw part no. L-9517-9736) for details of readhead configuration)
No reference mark output		<ul style="list-style-type: none"> • Ensure you are not over-speeding the readhead during calibration mode (maximum speed < 100 mm/s) • Calibrate the system (see page 28) <ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • 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	<ul style="list-style-type: none"> • Clean the disc and the readhead optical window and check for scratches then recalibrate the system (see page 28)

ATOM DX cabled readhead dimensions

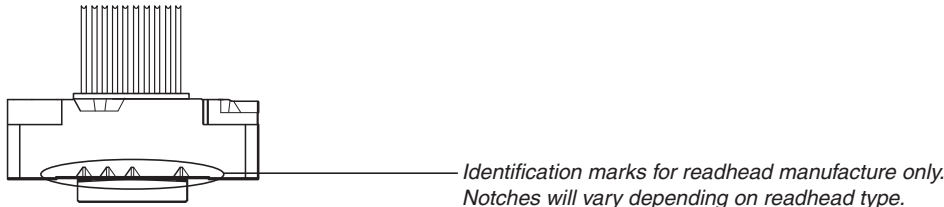
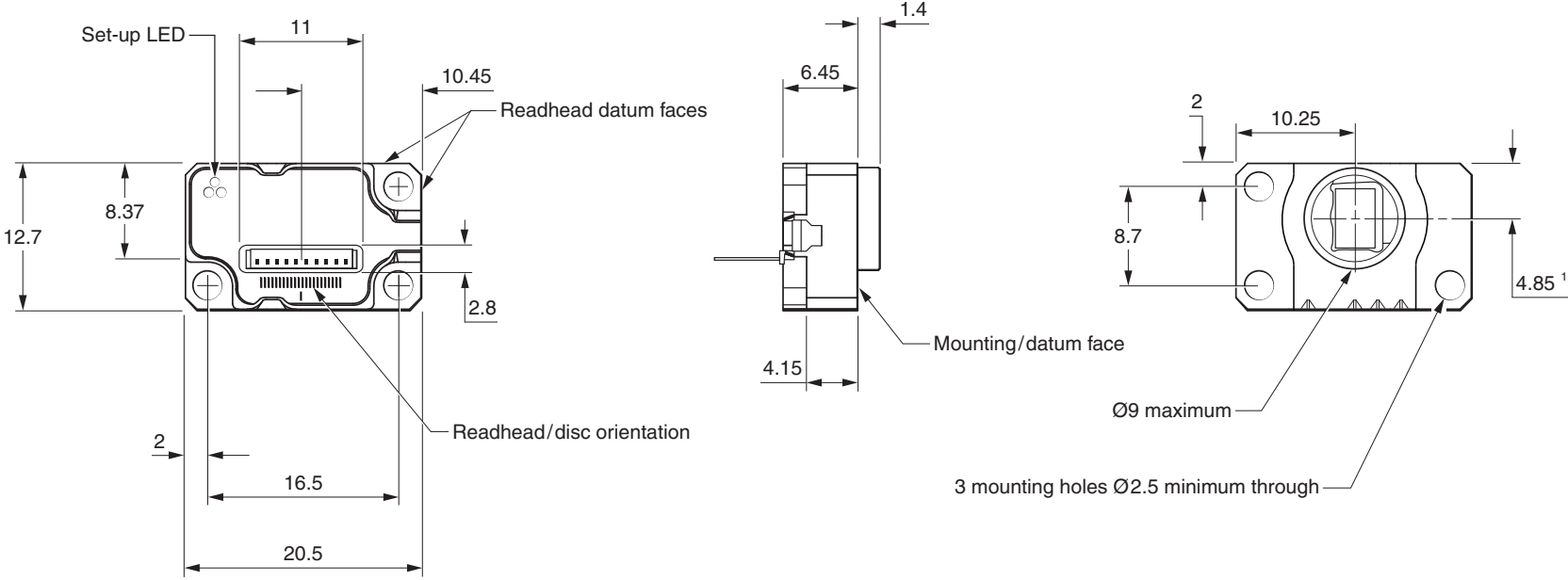
Dimensions and tolerances in mm



¹ Not the optical centreline

ATOM DX top exit readhead dimensions

Dimensions and tolerances in mm



¹ Not the optical centreline

CENTRUM CSF40 disc tolerances

Radial and longitudinal tolerances

Optical diameter (mm)	Radial tolerance (mm)
OPD	E
< 20	0.100
< 30	0.125
< 40	0.175
≥ 40	0.200

Optical diameter (mm)	Longitudinal tolerance (mm)
OPD	F
< 30	0.100
< 45	0.150
< 60	0.200
≥ 60	0.300

CENTRUM CSF40 disc dimensions

CSF40 discs can be customised to fit most applications. The limits and dependencies specified below can be used to create a dimensionally representative approximation of a custom CSF40 disc.

The absolute limits are the physical limitations that dictate the maximum and minimum possible size for a CSF40 disc. The dependencies limit the parameter values in relation to each other.

NOTE: This information does not provide a total and comprehensive guide on how to design a disc. Contact your local Renishaw representative for additional support.

Absolute limits

Mounting	Reference mark	Line count		OPD ¹ (mm)		SD ¹ (mm)		OD ¹ (mm)	
		Minimum	Maximum	Minimum	Maximum	Minimum	Maximum	Minimum	Maximum
Bolted	External	2 482	8 890	31.6	113.2	7.0	88.6	38.4	120
	Internal	3 204	9 142	40.8	116.4	7.0	82.6	44.4	120
Clamped	External	1 900	8 890	24.2	113.2	7.0	95.0	31.0	120
	Internal	2 624	9 142	33.4	116.4	7.0	90.0	37.0	120

Dependencies

IMPORTANT: The line count (LC) must always be a whole number.

General

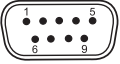
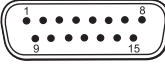


- All dimensions in mm.
- The outer diameter (OD) – the shaft diameter (SD) must be ≤ 40 mm.
- The shaft diameter (SD) must be $\leq 19/24 \times OD$.
- The optical diameter (OPD) = $\frac{LC \times 0.04}{\pi}$

Mounting specific

Mounting	Reference mark	SD ¹	OD ¹	PCD ¹	Readhead (A)
Bolted	External	$\leq OPD - 24.6$	$\geq OPD + 6.8$	$\leq OPD - 15.9$ and $\geq SD + 8.7$	$OPD/2 - 4.11$
	Internal	$\leq OPD - 33.8$	$\geq OPD + 3.6$	$\leq OPD - 25.1$ and $\geq SD + 8.7$	$OPD/2 + 4.11$
Clamped	External	$\leq OPD - 17.2$	$\geq OPD + 6.8$	N/A	$OPD/2 - 4.11$
	Internal	$\leq OPD - 26.4$	$\geq OPD + 3.6$	N/A	$OPD/2 + 4.11$

¹ OD = outer diameter; SD = shaft diameter; OPD = optical diameter; PCD = bolt hole diameter.

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	+	2	14	1	9	5
		-	6	6	9	7	6
	B	+	4	13	3	4	8
		-	Green	8	5	11	1
Reference mark	Z	+	3	12	14	8	4
		-	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

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

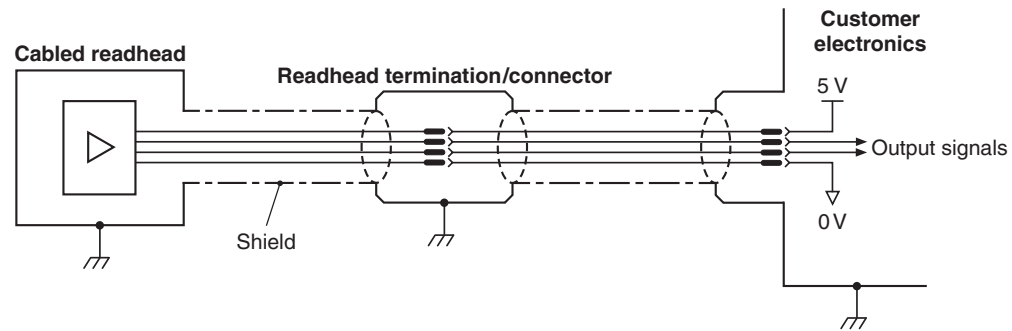
Angular speed depends on disc optical diameter - use the following equation to convert to rev/min.

$$\text{Angular speed (rev/min)} = \frac{V \times 1000 \times 60}{\pi D} \quad \text{Where } V = \text{the maximum linear speed (m/s) and } D = \text{the optical diameter of the CSF40 disc (mm)}$$

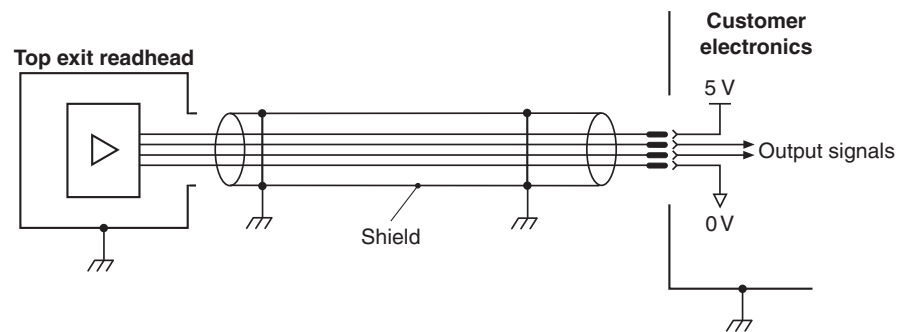
¹ For a readhead with a 1 m cable.

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).

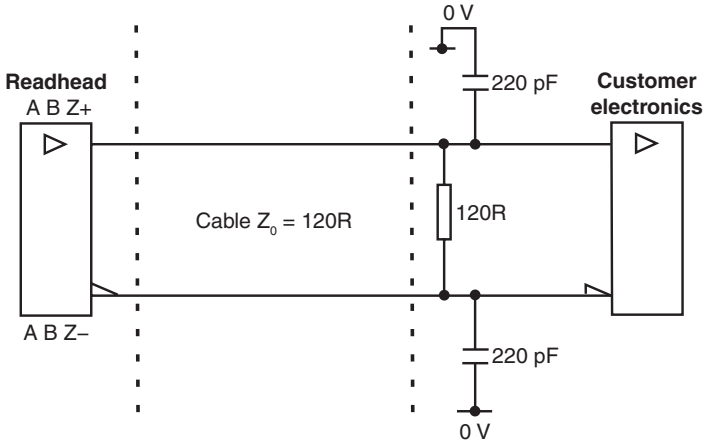
NOTE: For Renishaw top exit readhead cables the shield connection is provided by the P-clip.

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

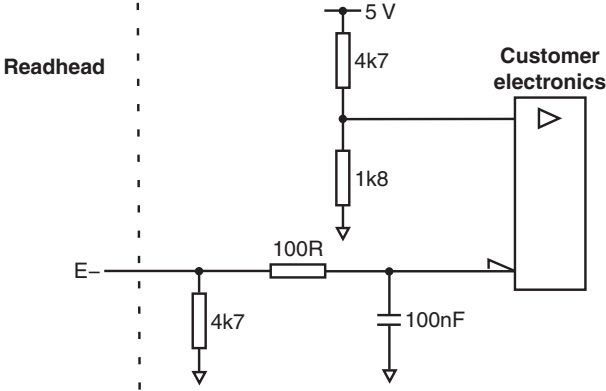
Digital outputs



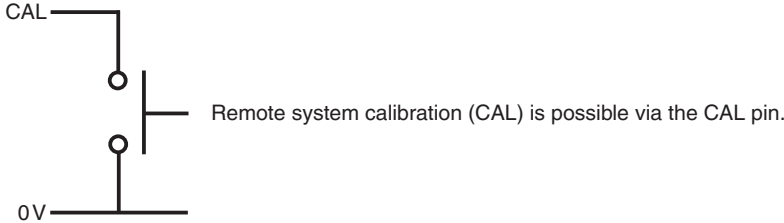
Standard RS422A line receiver circuitry.
The capacitors are recommended for improved noise immunity.

Single-ended alarm signal termination

(Not available with 'A' cable termination)



Remote CAL operation



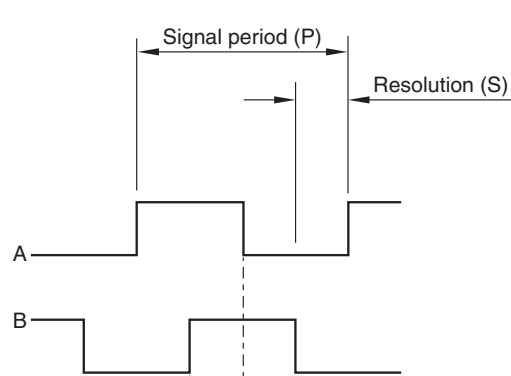
Output specifications

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	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

Reference ¹

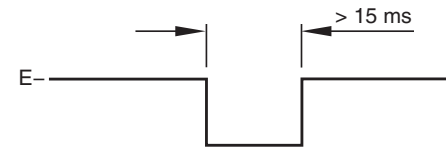


Synchronised pulse Z, duration as resolution.
Bi-directionally repeatable.

¹ For clarity, the inverse signals are not shown.

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.

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	100 m/s ² radial, 50 m/s ² axial
Shock (system)	Operating	500 m/s ² , 11 ms, ½ sine, 3 axes
Vibration	Operating	100 m/s ² 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)		< ±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.

CENTRUM CSF40 disc technical specifications

Material	304 grade stainless-steel
Form	1.2 mm thick
Pitch	40 μm
Reference mark	Single reference mark, external or internal
Installed accuracy (scale to shaft)	$\leq \pm 10 \mu\text{m}$
Eccentricity (scale to shaft)	Typically $\leq \pm 5 \mu\text{m}$
Graduation accuracy	Typically $\leq \pm 0.5 \mu\text{m}$
Coefficient of thermal expansion (at 20 °C)	$15.5 \pm 0.5 \mu\text{m/m/}^\circ\text{C}$
Density	8000 kg/m^3

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 #renishaw

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Part no.: M-9414-9814-02-A
Issued: 09.2023