Installation guide
M-9756-9351-01-B

RENISHAW
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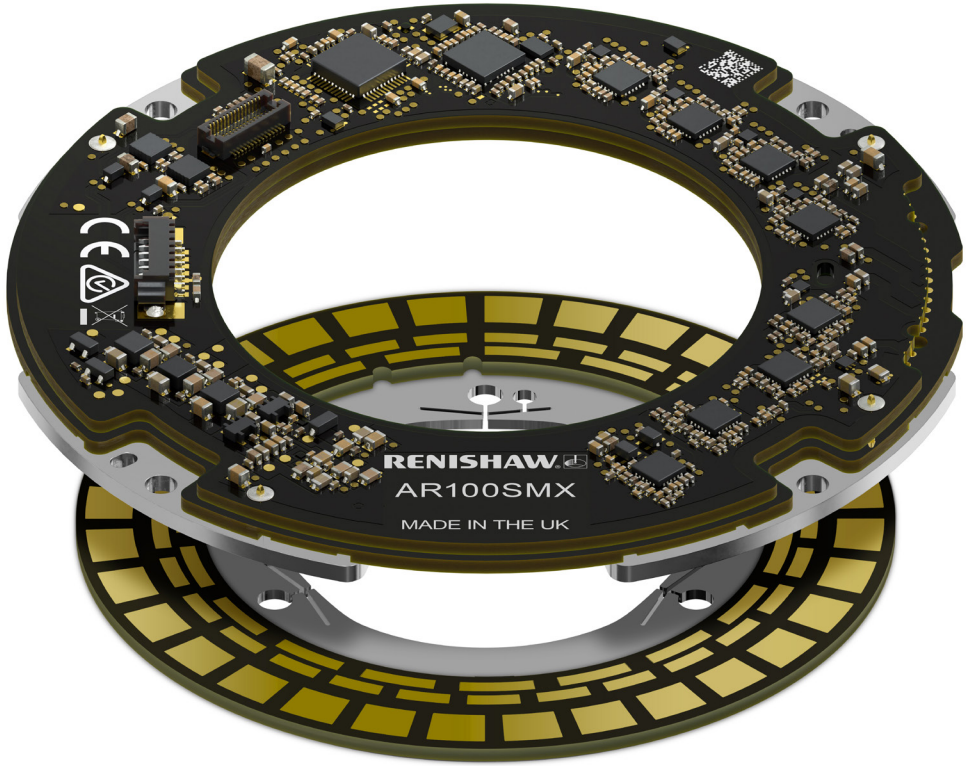
ASTRiA™ absolute inductive encoder system



www.renishaw.com/astria-downloads

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Contents

1. Legal notices

1.1 Terms and conditions and warranty

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

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

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

1.2 Declaration of Conformity

Renishaw plc hereby declares that the ASTRiA™ 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**.

1.3 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: ASTRiA

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).

1.4 Intended use

The ASTRiA 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.

1.5 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

1.6 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**.

1.7 Disposal of waste electrical and electronic equipment

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

1.8 Software notices

The ASTRiA product includes embedded software to which the following notices apply:

Copyright and Trade Marks

EULA

The software is subject to the terms and conditions of the software licence agreement at **www.renishaw.com/legal/softwareterms**.

US government notice

Notice to United States Government Contract and Prime Contract Customers

This software is commercial computer software that has been developed by Renishaw exclusively at private expense. Notwithstanding any other lease or licence agreement that may pertain to, or accompany the delivery of, this computer software, the rights of the United States Government and/or its prime contractors regarding its use, reproduction and disclosure are as set forth in the terms of the contract or subcontract between Renishaw and the United States Government, civilian federal agency or prime contractor respectively. Please consult the applicable contract or subcontract and the software licence incorporated therein, if applicable, to determine your exact rights regarding use, reproduction and/or disclosure.

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2. Overview of the ASTRiA encoder system

ASTRiA™ is a true-absolute inductive encoder, combining fit-and-forget robustness with high accuracy, easy installation and low power consumption.

Designed for use in extremely harsh environments, ASTRiA encoders use a multi-track inductive scanning principle that does not require line-of-sight between the stator and rotor. Contaminants like dirt, oils and humidity are invisible to the encoder.

The inductive scanning principle is combined with Renishaw's advanced signal processing to achieve high accuracy and enable 23 bit resolution (100 mm diameter version).

The use of self-centring alignment features on the rotor, along with steel mounting points on the stator, combined with wide mounting tolerances and an integral signal level LED, mean installation is quick and easy.

Position information is taken from the full 360 degrees of scale, minimising eccentricity errors to help achieve accuracy of ±40 arc seconds (±0.194 mrad), with low SDE and jitter.

2.1 Commissioning test

The following checks **MUST** be performed following installation and commissioning of the ASTRiA encoder system for the first time, and also following repair of the system (replacement systems parts):

Error bit check	With the axis motor(s) not energised, power the encoder and confirm that the error bit as received by the controller is clear. Remove the stator from the axis with the encoder still powered. Confirm that the error bit as received by the controller is active.
Scale code check	Re-install the stator, align it so that the LED is green or flashing green, tighten the screws to the torques specified on page 23 (for rotor) and page 25 (for stator). Cycle power to the system to clear the LED flashing. Move axis over its full travel and check that no errors are triggered in the controller.
Position count direction	Clear any error bit and check that the position count direction is as expected.
Resolution check	Rotate the axis by a known angle and confirm that the position count changes as expected, to a tolerance determined by the axis manufacturer's risk assessment.
Ground continuity check	With the axis switched off, check that the resistance between the ASTRiA stator steel mounting points and the chassis ground at the controller is less than 1 Ohm. Check that the resistance between the earth wire at the encoder end of the cable and the chassis ground at the controller is less than 1 Ohm. See page 30 for details.
LED status check	Power the ASTRiA encoder system and confirm that the LED of the encoder is solid green. If the LED is not solid green, follow the recommendations shown on page 29.

2.2 Maintenance

The maintenance check intervals will be defined by the system manufacturer according to their risk assessment. There are no user-serviceable parts within the ASTRiA encoder system.

The following maintenance actions are advised:

- Check the rotor and stator screws are correctly tightened.
- Check for worn or damaged cables and connectors.
- Check the cable connectors are correctly tightened/located.

2.3 Repair

- Repair of the ASTRiA encoder system is only by replacement of parts.
- The replacement parts must have the same part number as the original parts.
- The replacement encoder system must be installed and commissioned in accordance with the “Commissioning test”, see section 2.1.
- In the event of failure the affected parts should be returned to Renishaw for further analysis.
- Using damaged parts invalidates the warranty.

2.4 Correct use includes:

- Operating the ASTRiA encoder system within the limits defined in this document and the *ASTRiA™ absolute inductive encoder system* data sheet (Renishaw part no. L-9518-0087).
- Installing the system as described in this document.
- Maintaining the system as described in this document.
- **DO NOT** modify the ASTRiA encoder system in any way.

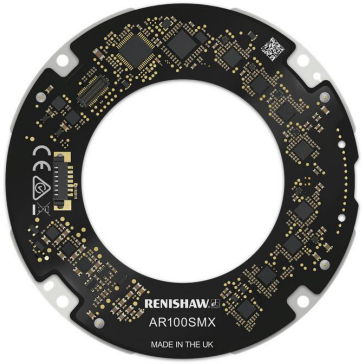
2.5 Further information

Further information relating to the ASTRiA encoder range can be found in the *ASTRiA™ absolute inductive encoder system* data sheet (Renishaw part no. L-9518-0087). This can be downloaded from our website at **www.renishaw.com/astria-downloads** and is also available from your local Renishaw representative.

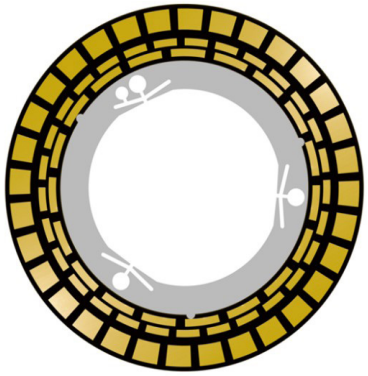
3. Parts list

3.1 Included in the box

ASTRiA stator



ASTRiA rotor



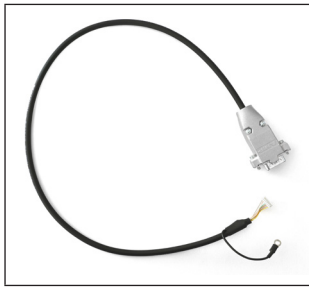
3.2 Not included / required tools

Item	Description
Torque wrench	Used to tighten the screws on the rotor and stator to the correct torque.
2 mm hex key	Used to tighten DIN 7984 low profile M3 × 6 mm screws on the rotor.
2.5 mm hex key	Used to tighten DIN 912 M3 × 8 mm screws on the stator.
3 × DIN 7984 low profile M3 x 6 mm screws. Material = A4-80	Used to fix the rotor to the axis.
4 × DIN 912 M3 x 8 mm screws. Material = A2-70	Used to fix the stator to the axis.
3 × DIN 7 dowel pin ø2 (m6) x 8 mm	1 dowel pin is used for the alignment of the rotor. 2 dowel pins are used for the alignment of the stator.
Loctite 243	It is recommended that the screws on the rotor and the stator should be secured with Loctite 243.
Loctite 638	It is recommended that the dowels on the rotor and the stator should be secured with Loctite 638.

3.3 Cable options

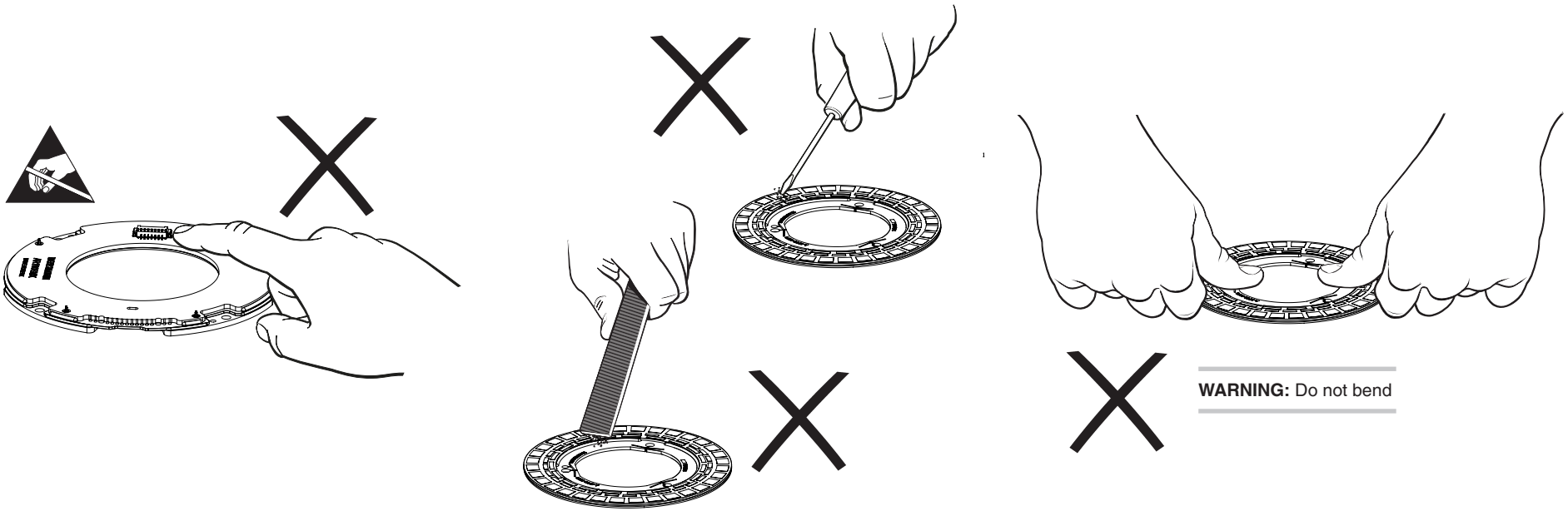
NOTE: Cables are sold separately.

Further information relating to cables for the ASTRiA encoder range can be found in *Cables for ASTRiA absolute encoders* data sheet (Renishaw part no. L-9518-0094). This can be downloaded from our website **www.renishaw.com/astria-downloads** and is also available from your local Renishaw representative.

	Item	Description
	Encoder cable type A	7 core, 28 AWG, black jacket Single-shielded, outside diameter 4.7 mm

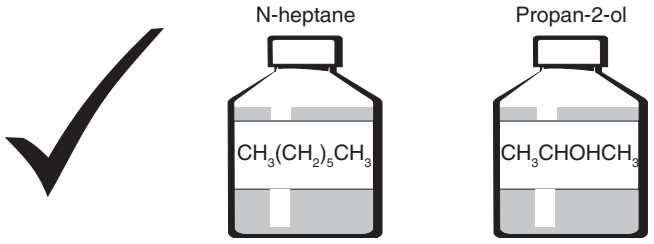
4. Storage and handling

CAUTION: Observe precautions for handling electrostatic sensitive devices.

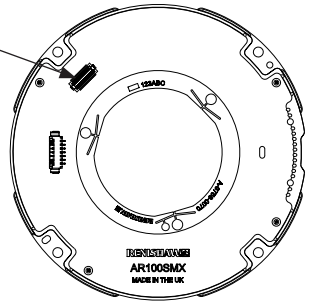


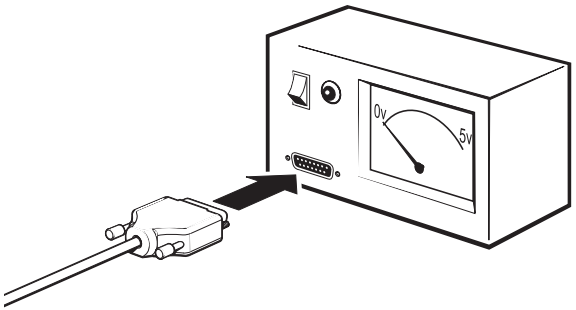
WARNING: Do not bend

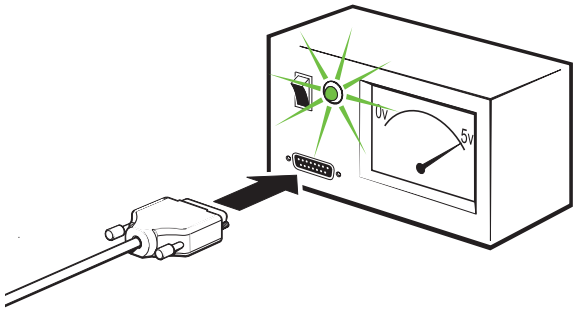
Stator and rotor cleaning



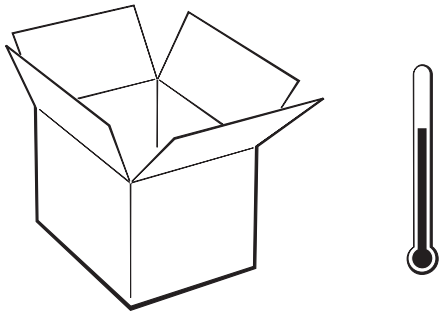
DO NOT attempt to connect to this black socket.
Renishaw production/QA use only.



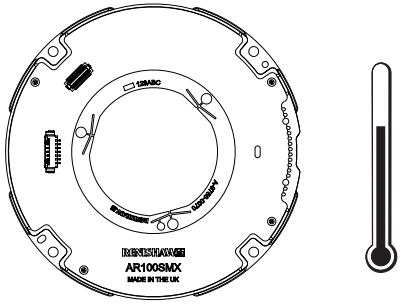


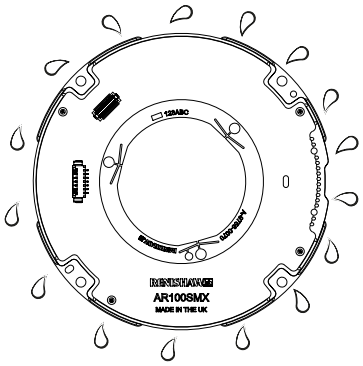


Storage temperature
–40 °C to +85 °C



Operating temperature
–40 °C to +85 °C

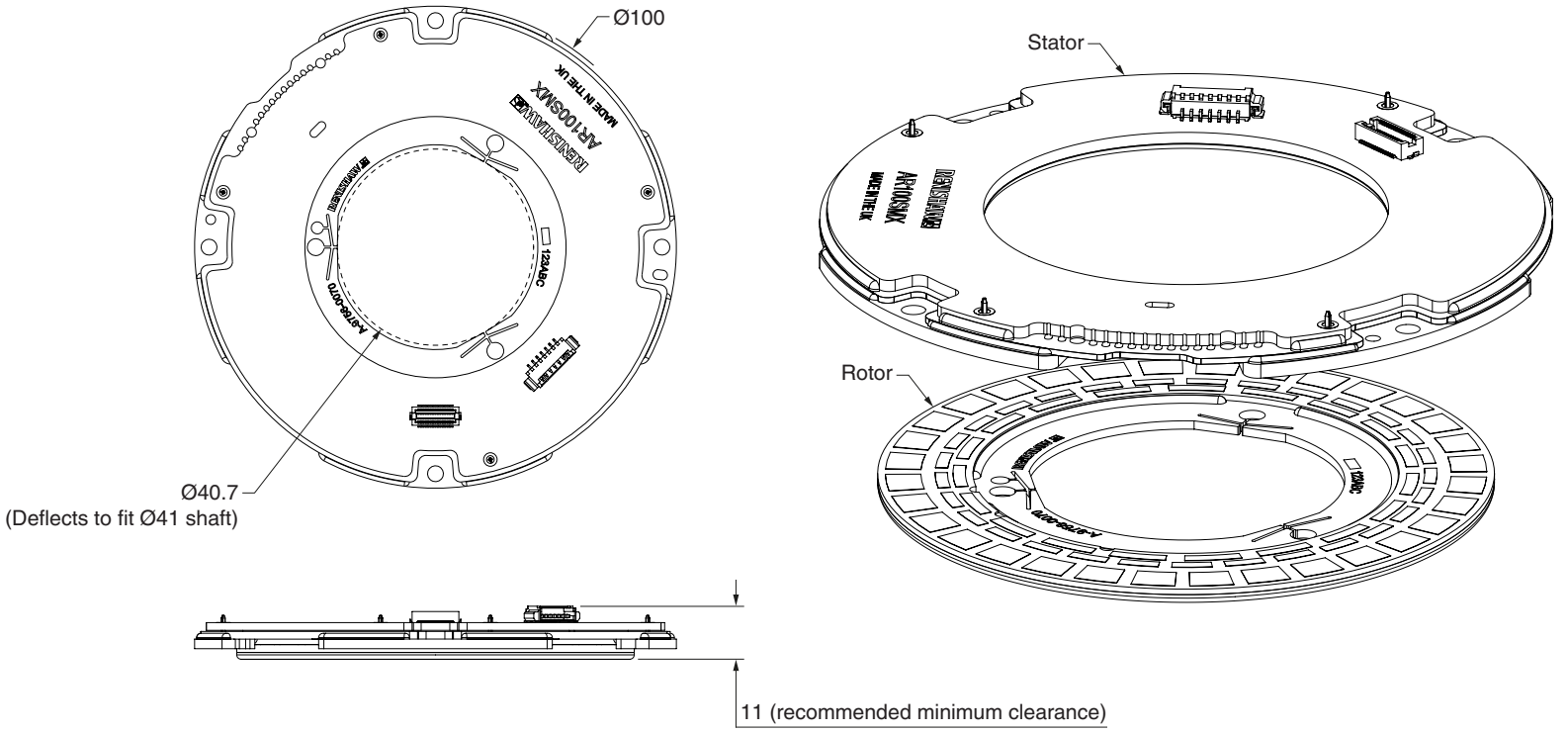




5. Installation drawings

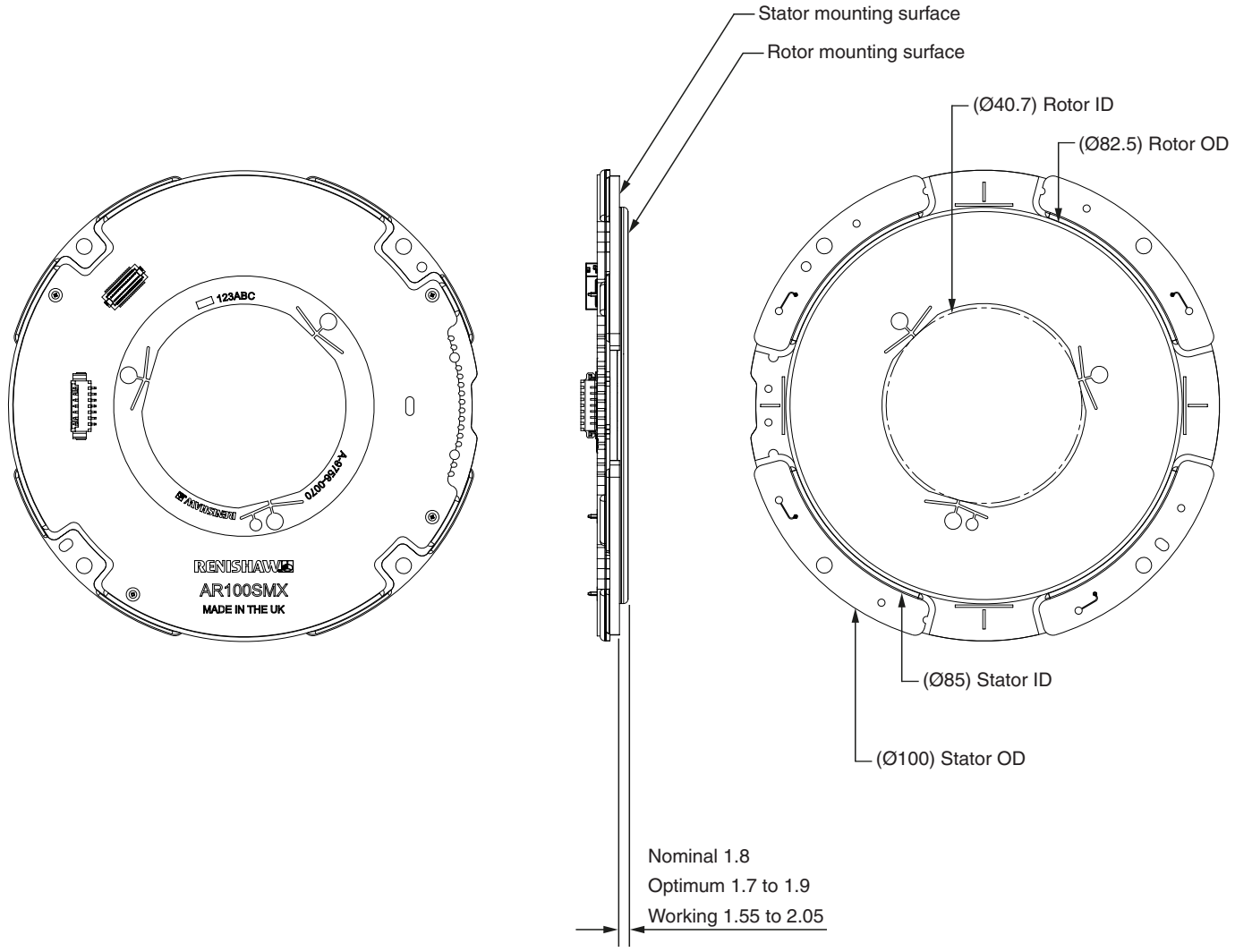
5.1 Overall dimensions

Dimensions in mm



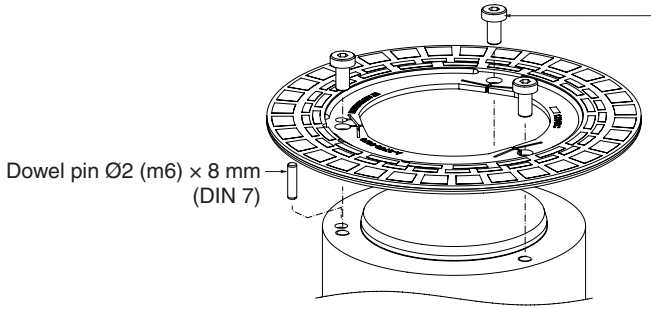
5.2 Overall system dimensions

Dimensions in mm



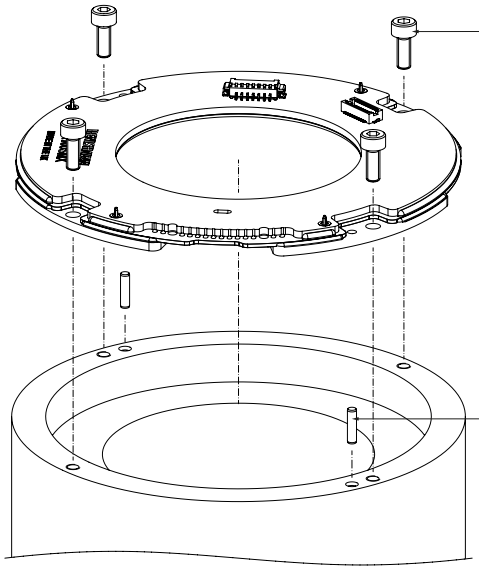
5.3 Screw and alignment pin locations

Rotor sub-assembly



IMPORTANT: Use screws made from A4-80 stainless steel (ISO 3506-1 A4 Class 80)

Stator sub-assembly



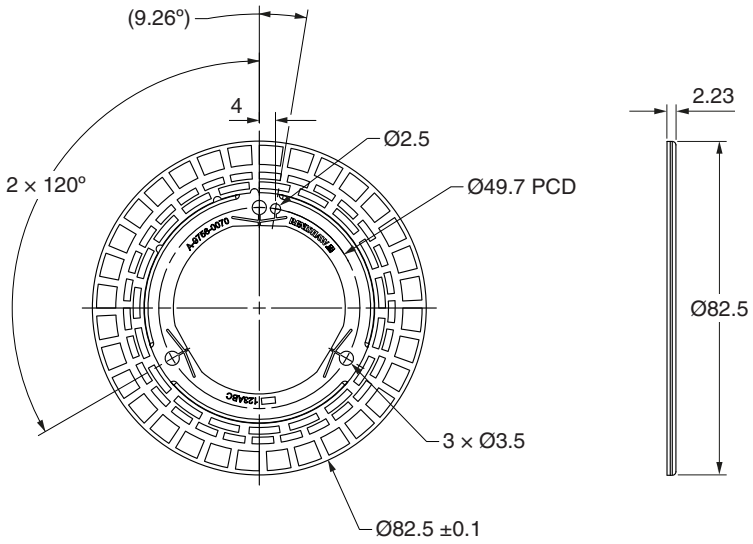
IMPORTANT: Use screws made from A2-70 stainless steel (ISO 3506-1 A2 Class 70)

NOTES:

- Retain dowel pins in holes using Loctite® 638. Secure mounting screws using Loctite® 243.
- Do not use washers on either the rotor or stator

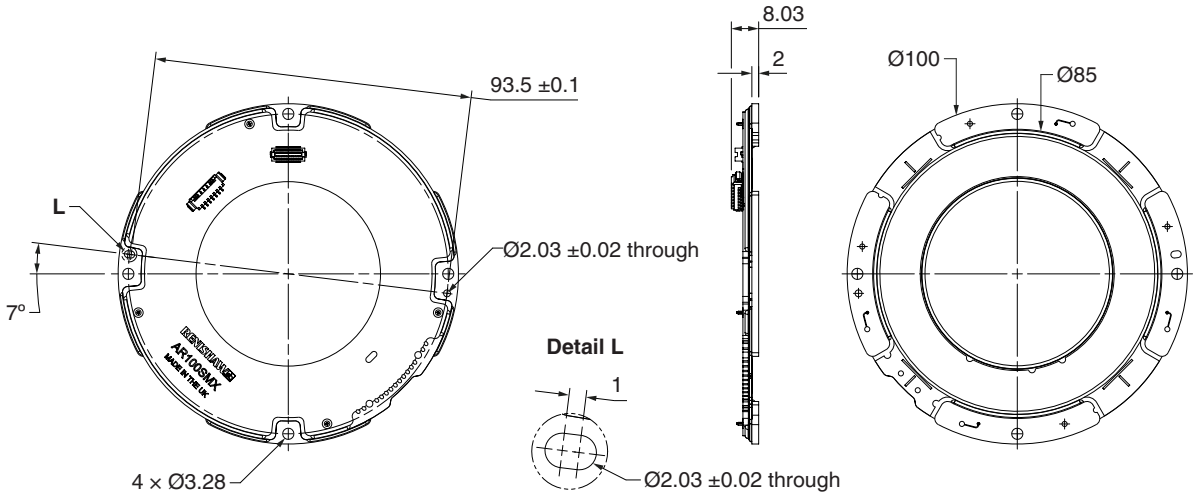
5.4 Detailed rotor dimensions

Dimensions and tolerances in mm



5.5 Detailed stator dimensions

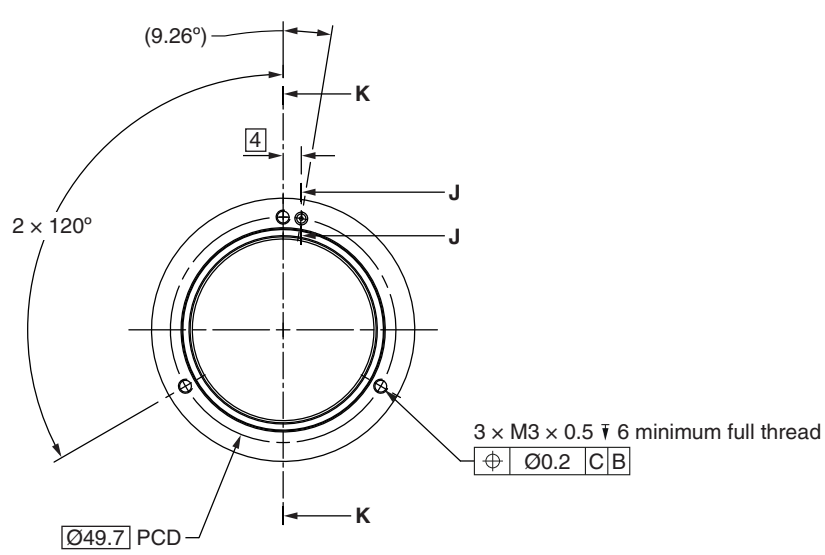
Dimensions and tolerances in mm

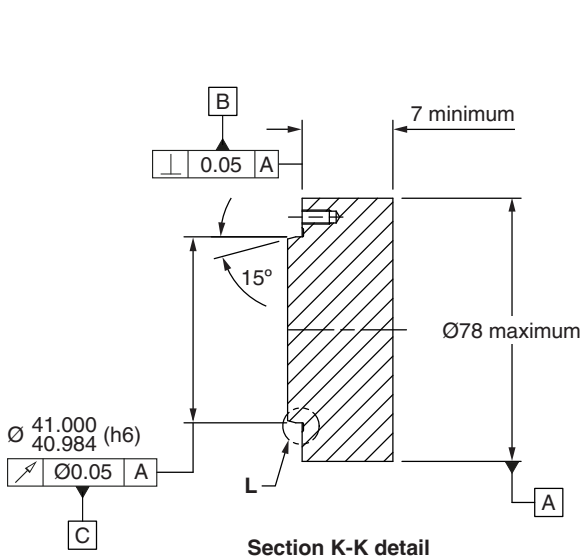


6. Mounting surface drawings

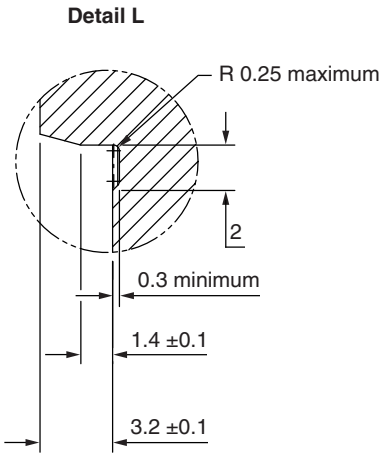
6.1 Suggested rotor mounting bracket dimensions

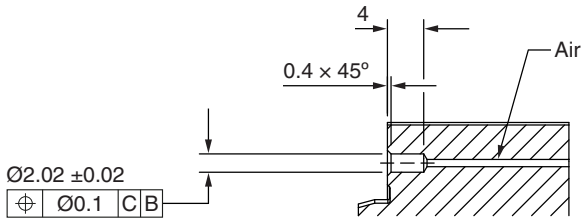
Dimensions and tolerances in mm





Section K-K detail





Section J-J detail

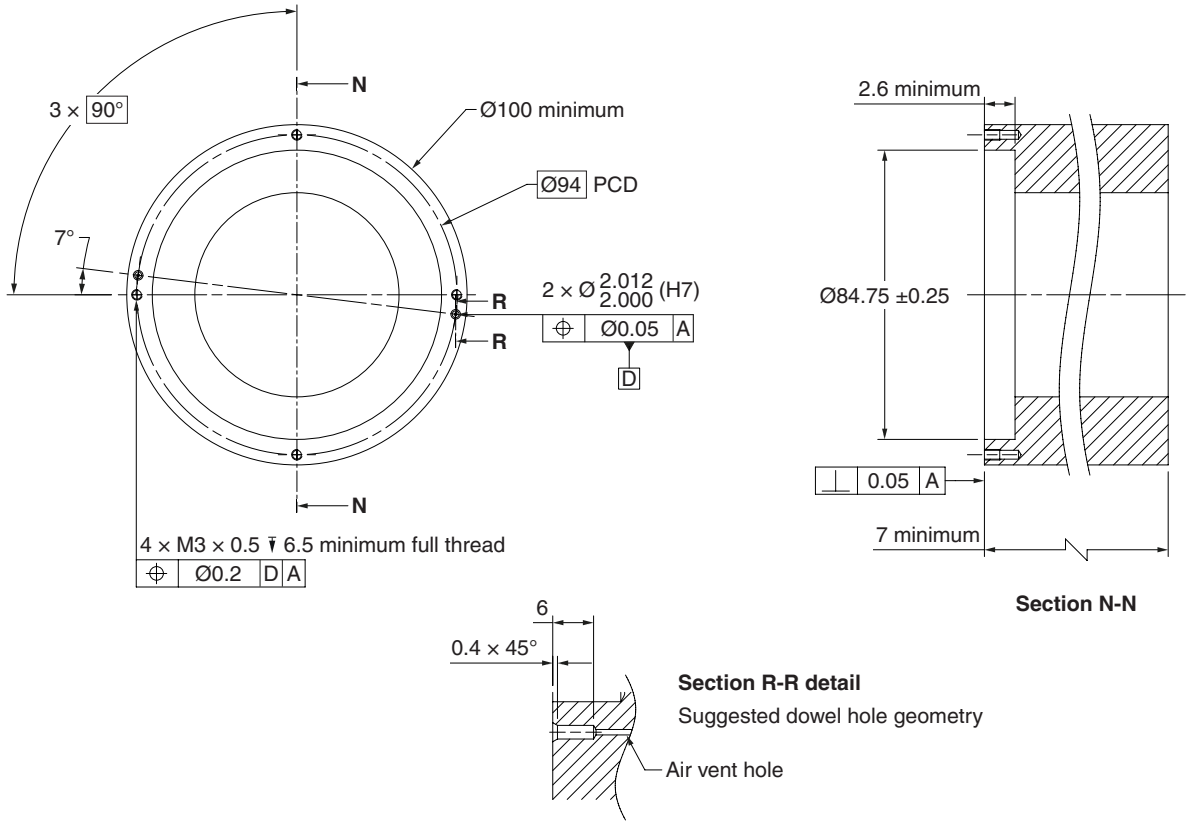
Suggested dowel hole geometry

NOTES:

- The 15° chamfer is required to ensure the correct fitment of the rotor onto the shaft.
- In order for the flexures to function as intended, it is recommended that the rotor mounting bracket is manufactured from a material with a minimum hardness of 40 HRC.

6.2 Suggested stator mounting bracket dimensions

Dimensions and tolerances in mm



NOTE: Customer earth connection via stator metal mounting plates.

7. Installation technique

7.1 Installation principle

ASTRiA encoders are designed to make installation and alignment easier. One aspect is that the ASTRiA system is supplied factory calibrated **as a matched pair** to compensate for variability such as the thickness of PCB material.

This means that the alignment is set by the mounting surfaces, not the air gap between the rotor and stator. As long as the mounting surfaces achieve the required alignment tolerances, no further adjustment or calibration is required. The result is a faster, reliable installation that is easier to optimise. This also means that field replacement of the encoder is very simple, with no need for fine adjustment or the use of specialist tools.

Alignment direction	Nominal	Tolerance for optimum performance	Tolerance for acceptable performance
Axial	1.8 mm	±0.1 mm	±0.25 mm
Radial	0 mm	±0.1 mm	±0.2 mm

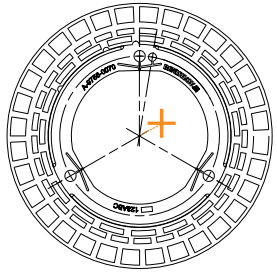
7.2 Optimising installed accuracy

Installed error of an inductive rotary encoder with a 360 degree reading principle is a function of:

Error = scale error + reading errors + (rotor eccentricity × stator swash) + (rotor swash × stator eccentricity)

Encoder system errors — Installation errors

Rotor eccentricity



Radial offset between centre of rotor and centre of axis rotation

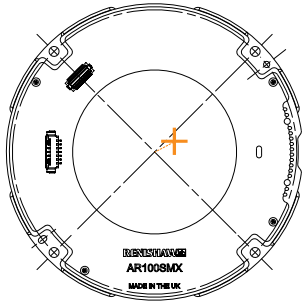
Stator swash

Stator is not perpendicular to the axis of rotation

Rotor swash

Rotor is not perpendicular to the axis of rotation

Stator eccentricity



Radial offset between centre of stator and centre of axis rotation

7.3 Rotor alignment principle

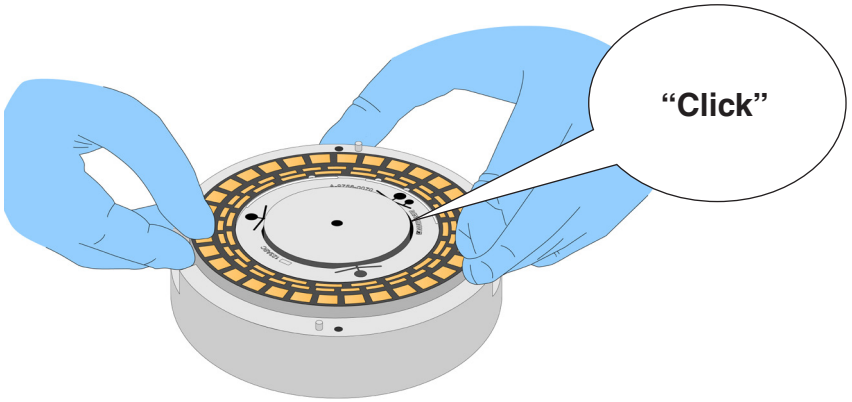
During manufacture at Renishaw, the rotor's specially flattened steel backing plate is mounted using the self-aligning flexures. The PCB with the scale tracks is placed onto the rotor's backing plate, then a precision alignment stage is used to centre the rotor's scale tracks to the centre of rotation, after which the PCB is rigidly bonded to the steel backing plate. This ensures two things:

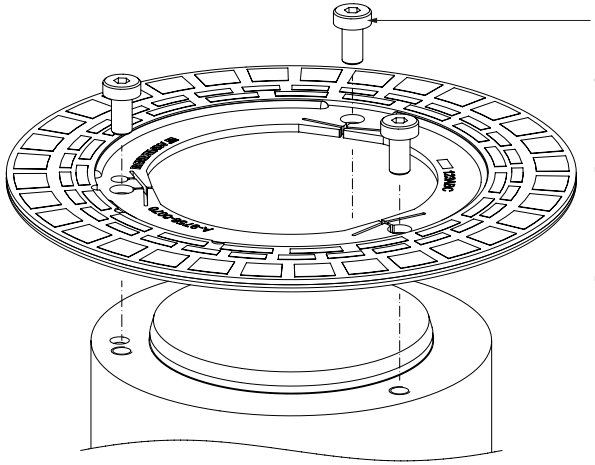
- When the rotor is installed using the self-aligning flexures, the scale tracks will be aligned to the centre of rotation, thus minimising eccentricity error.
- The rotor's flat steel backing plate ensures that the PCB and scale tracks are fixed parallel to the shaft's mounting surface, thus minimising swash error.

A dowel hole in the rotor's steel backing plate is provided as a poka-yoke feature to provide correct orientation of the rotor's zero point.

7.4 Rotor installation

1. Clean the shaft and hub using iso-propyl alcohol.
2. Visually align the bolt holes and reference dowel hole on the rotor with bolt holes and reference dowel hole on the hub.
3. Press the rotor down onto the shaft as evenly as possible until it sits flat on the hub.
4. Insert the low profile M3 x 6 mm screws (DIN 7984), lightly tighten by hand, then **torque them to 0.9 Nm**.





3 × low profile M3 × 6 mm (DIN 7984)

Torque = 0.9 Nm

Secure screws with Loctite® 243

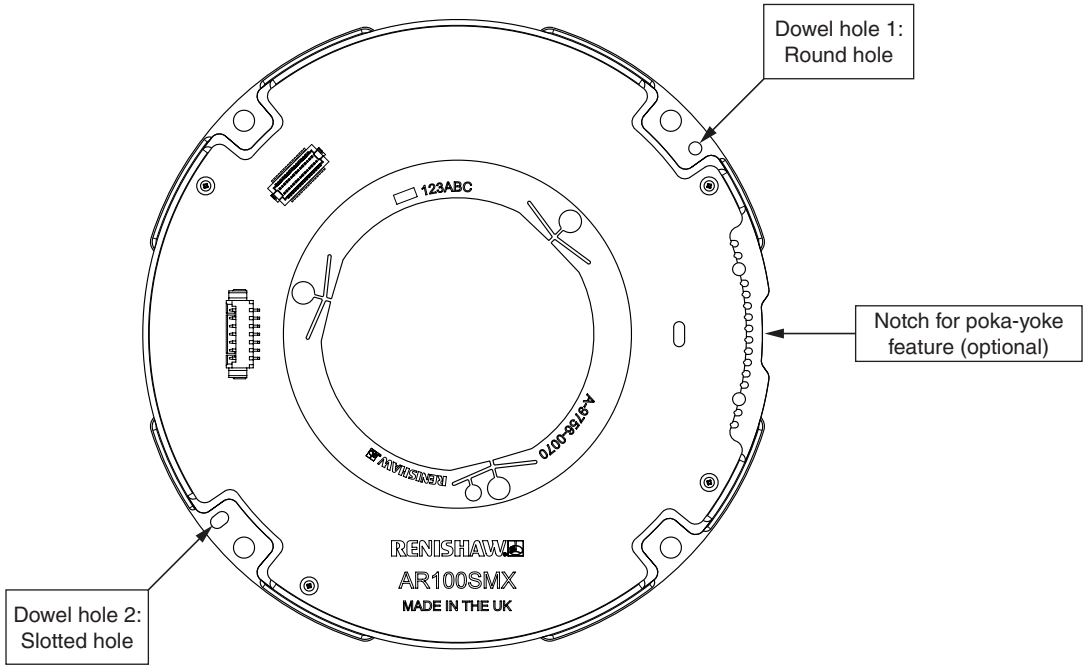
IMPORTANT: Use screws made from A4-80 stainless steel (ISO 3506-1 A4 Class 80)

7.5 Stator alignment principle

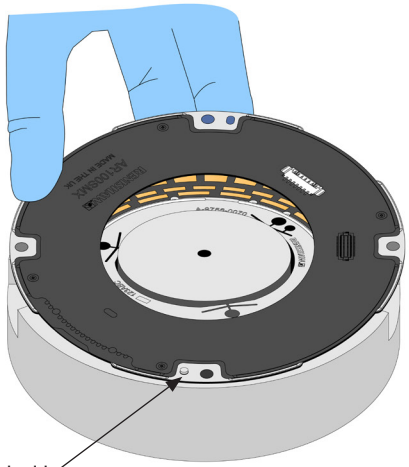
The stator has 4 steel mounting points. Two of the mounting points have a location for a dowel to aid alignment. The stator coils are precisely aligned during manufacture to the mounting points so good alignment can be achieved by using the dowel holes.

If a poka-yoke feature is required for correct orientation of the stator's zero point, there is a notch in one side of the PCB that can be used.

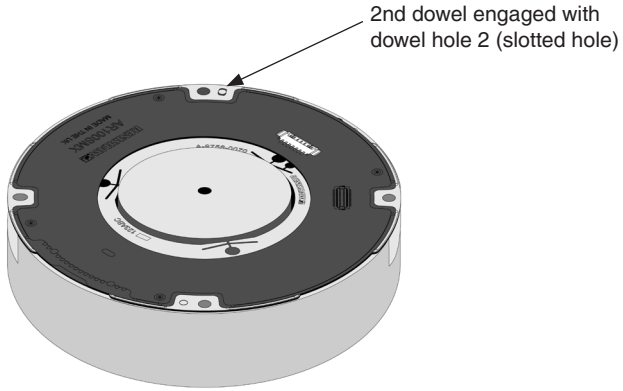
7.6 Stator installation



1. Clean the mounting surfaces of the stator and the axis with iso-propyl alcohol.
2. Tilt the stator slightly and engage dowel hole 1 (round hole) with the first dowel on the mounting surface.



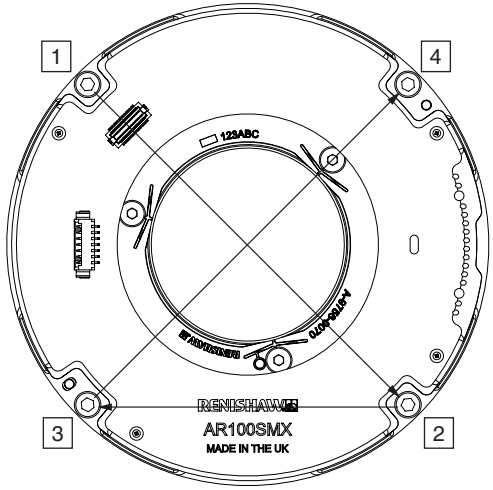
3. Lower the stator to bring it flat and engage dowel hole 2 (slotted hole) with the second dowel on the mounting surface.



4. **Using Loctite® 243** insert all 4 screws and tighten by hand until all 4 are making contact with the metal mounting points and pressing them against the stator mounting bracket.

IMPORTANT: Use screws made from A2-70 stainless steel (ISO 3506-1 A2 Class 70).

5. **Torque up the screws to 1.1 Nm** in a “criss-cross” pattern, as shown below.

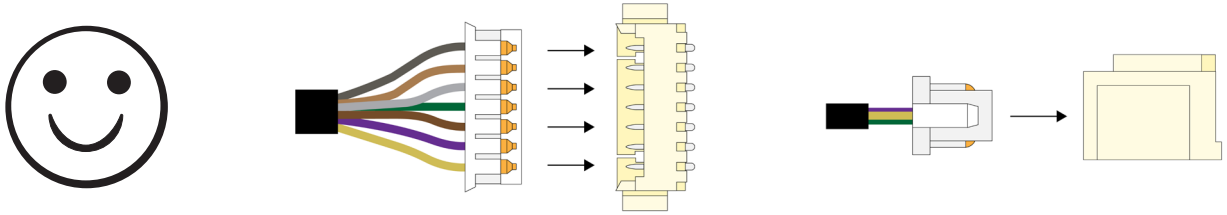


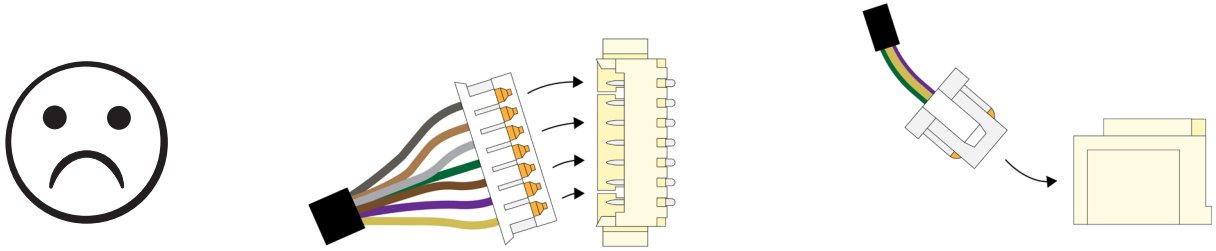
7.7 Cable connection and strain relief

NOTE: The connector is rated for 25 connect/disconnect cycles.

7.7.1 Cable connector insertion

The cable connector should be oriented as shown and then pushed firmly into the PCB connector. Keep the connector straight during insertion and take care not to damage components on the encoder.

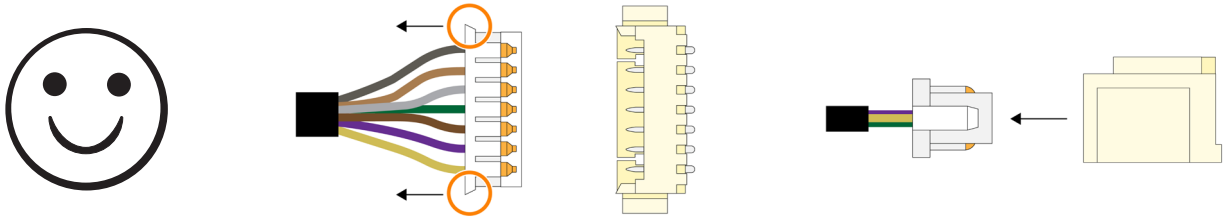


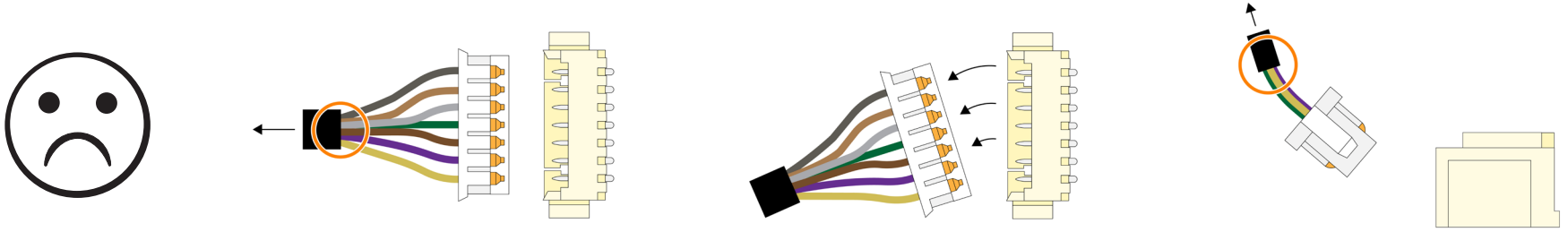


7.7.2 Cable connector removal

The connector must be removed by grasping the edges of the cable connector, then pulling the cable connector firmly away from the PCB mounted connector.

The connector must be kept straight during extraction. Do NOT pull by the cable.





7.7.3 Strain relief

Suitable strain relief must be applied to the cable, at both ends (encoder and controller), to achieve the following requirements:

- The weight of the cable must be fully supported and should not impart a pull force on the connector.
- The strain relief must ensure that any inertia generated in the cable as a result of vibration or shock, should not impart a pull force on the connector.
- Any force applied to the cable must not cause it to bend beyond the specified bend radius.
- The strain relief must not cut, crush or otherwise damage the cable.
- The strain relief must be suitable for use over the full temperature range and shock/vibration that it will be exposed to.
- Where applicable, the strain relief must comply with any relevant standards or regulations, for example flammability standards, etc.

7.8 LED status

To validate the encoder installation the set-up LED provides instant verification of the encoder's signal strength and therefore confirms that the encoder is working correctly.

The encoder requires power to enable the set-up LED; this can be via an appropriate cable plugged into the machine's controller. See section 8 on page 30 for encoder power supply requirements.

LED status	Description	Required action
 Green	The signal level is good	No adjustment required
 Orange	The signal level is acceptable	Ensure that the mounting surfaces meet the dimensional tolerances
 Red	The signal level is not acceptable	Encoder alignment is incorrect and must be adjusted. If the alignment of the mounting surfaces does not achieve the specifications laid out in section 7.1, adjustments must be made.
 Flashing red	An alarm has occurred and needs to be cleared. The signal level is currently unacceptable.	
 Flashing green	An alarm has occurred and needs to be cleared. The signal level is currently good.	The cause of the alarm should be investigated, then the encoder power supply should be cycled to clear the flashing LED. The encoder may have temporarily been misaligned, or may have gone beyond the maximum speed limit. A temporary misalignment may have been caused by an adjustment being made to alignment, or it may be due to loose screws, or a faulty bearing. An encoder with flashing orange LED would benefit from being adjusted to achieve better signal.
 Flashing orange	An alarm has occurred and needs to be cleared. The signal level is currently acceptable.	

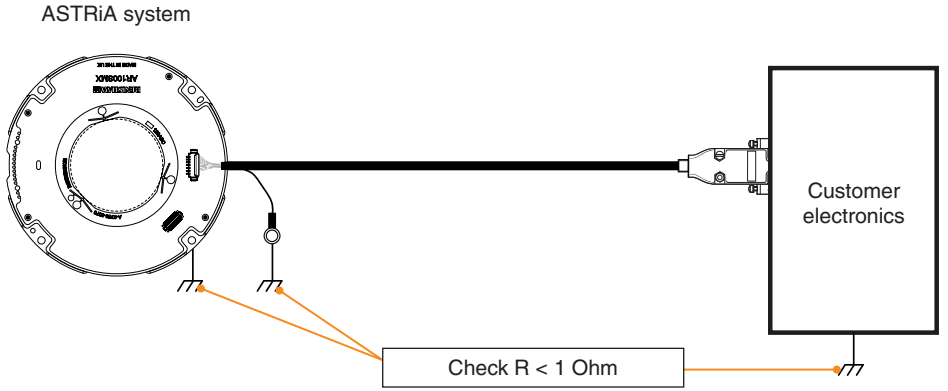
8. Electrical connections

8.1 Electrical preparation

For correct operation, the encoder should be connected to a suitable power supply.

- Input voltage at encoder cable: 5 Vdc ±10%.
- Operating current: 100 mA (maximum)

The system must be earthed as per the image opposite.



8.2 ASTRiA grounding and shielding

IMPORTANT:

- The mounting surfaces of the ASTRiA stator must provide a reliable connection to earth. If the mounting surface is a non-conductive material, a suitable earth connection must be made to the encoder's metal mounting point.
- The shield should be connected to the axis earth (chassis ground) at the controller end.
- The cable also features an earth wire at the encoder end. This must be connected to earth (chassis ground) close to the encoder.
- If the connector is modified or replaced, the customer must ensure that both 0 V cores (white and green) are connected to 0 V. In such situations, care should also be taken to ensure that 0 V and earth remain properly insulated from each other throughout the cable run.

The ASTRiA cable is fitted with an earth wire that is terminated with a ring connection that is suitable for a M3 screw. Care should be taken to ensure that this makes a reliable connection with earth (chassis ground). A suitable connection point may be at one of the nearby encoder mounting screws, or at a tapped M3 hole that has been prepared specifically for the earth wire connection.

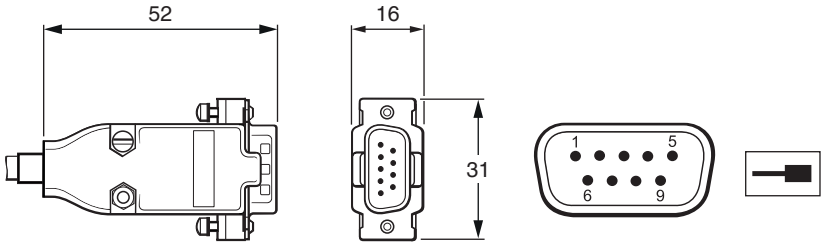
9. Connector pin allocations

9.1 BiSS C serial interface

9.1.1 Connector

Dimensions in mm

9-way D-type plug



9.1.2 Output signals

Function	Signal	Flying lead wire colour (F)	Pin-out
			9-way D-type (A)
Power	5 V	Brown	4, 5
	0 V	White, Green	8, 9
Serial interface	MA+	Violet	2
	MA–	Yellow	3
	SLO+	Grey	6
	SLO–	Pink	7
Shield	Shield	Shield	Case

NOTE: At the encoder end of the cable, the shield is connected to the earth wire. The earth wire is terminated with a loop for a M3 screw, which must be connected to earth (chassis ground).

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