RENISHAW®
apply innovation™

VIONiC™ REXM20/REXT20 ultra-high accuracy angle encoder system

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Contents

Legal notices

Patents

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

EP1173731	IL146001	JP4750998	US6775008	CN100543424
EP1766334	JP4932706	US7659992	CN100507454	JP5386081
US7550710	CN101300463	EP1946048	JP5017275	US7624513
CN101310165	EP1957943	US7839296	CN1293983	GB2397040
JP4813018	US7723639	CN1314511	EP1469969	JP5002559
US8987633	US8466943			

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.

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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 VIONiC 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: VIONiC

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 VIONiC 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 VIONiC encoder range can be found in the *VIONiC series encoder system* data sheet (Renishaw part no. L-9517-9678), *REXM20 ultra-high accuracy angle encoder* Data sheet (Renishaw part no. L-9517-9318), *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 **www.renishaw.com/vionicdownloads** and are also available from your local Renishaw representative.

Packaging

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

Packing component	Material	ISO 11469	Recycling guidance
Outer box	Cardboard	Not applicable	Recyclable
	Polypropylene	PP	Recyclable
Inserts	Low density polyethylene foam	LDPE	Recyclable
	Cardboard	Not applicable	Recyclable
Bags	High density polyethylene bag	HDPE	Recyclable
	Metalised polyethylene	PE	Recyclable

REACH regulation

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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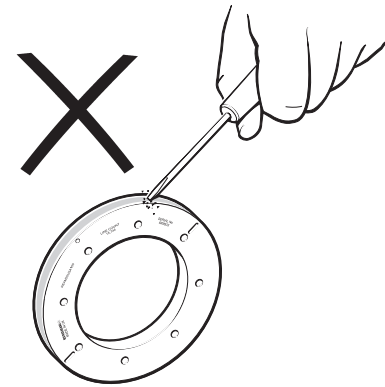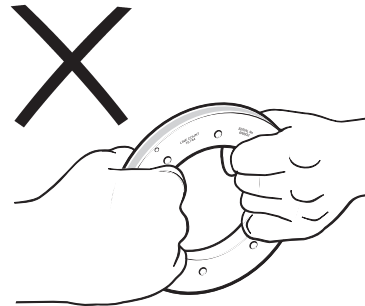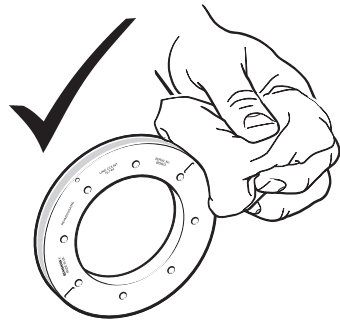
Renishaw End User Licence Agreement (EULA)

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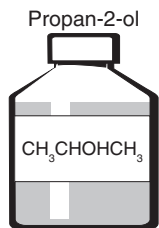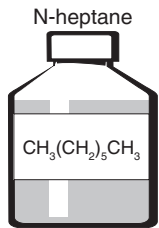
Storage and handling

VIONiC non-contact optical encoder systems provide good immunity against contaminants such as dust, fingerprints and light oils.
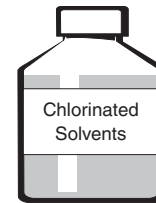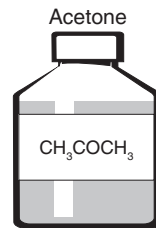
However, in harsh environments such as machine tool applications, protection should be provided to prevent ingress of coolant or oil.
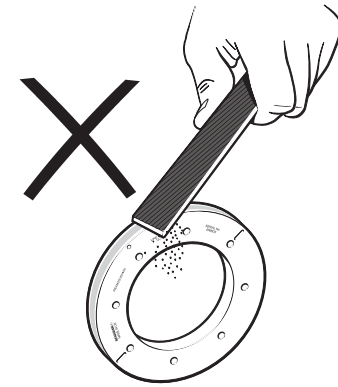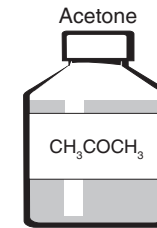

System	Ring only	Readhead only

System

N-heptane

$CH_3(CH_2)_5CH_3$

Propan-2-ol

$CH_3CHOHCH_3$

✓

Ring only

Acetone

CH_3COCH_3

Chlorinated Solvents

Methylated Spirits

✓

Readhead only

Acetone

CH_3COCH_3

Chlorinated Solvents

Methylated Spirits

✗
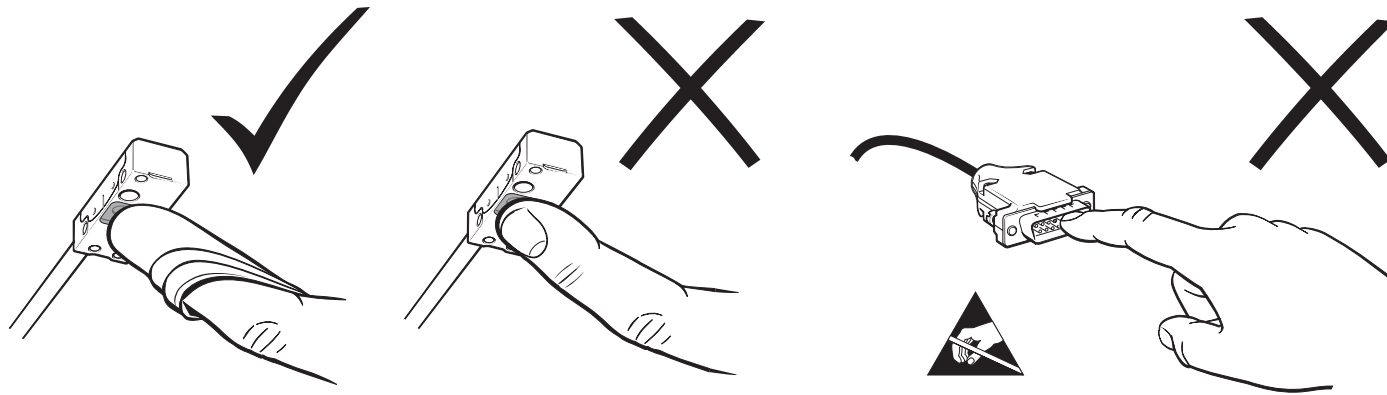
Temperature

Storage

Storage	
System	–20 °C to +70 °C

Operating	
System	0 °C to +70 °C
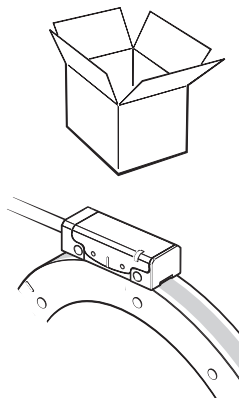
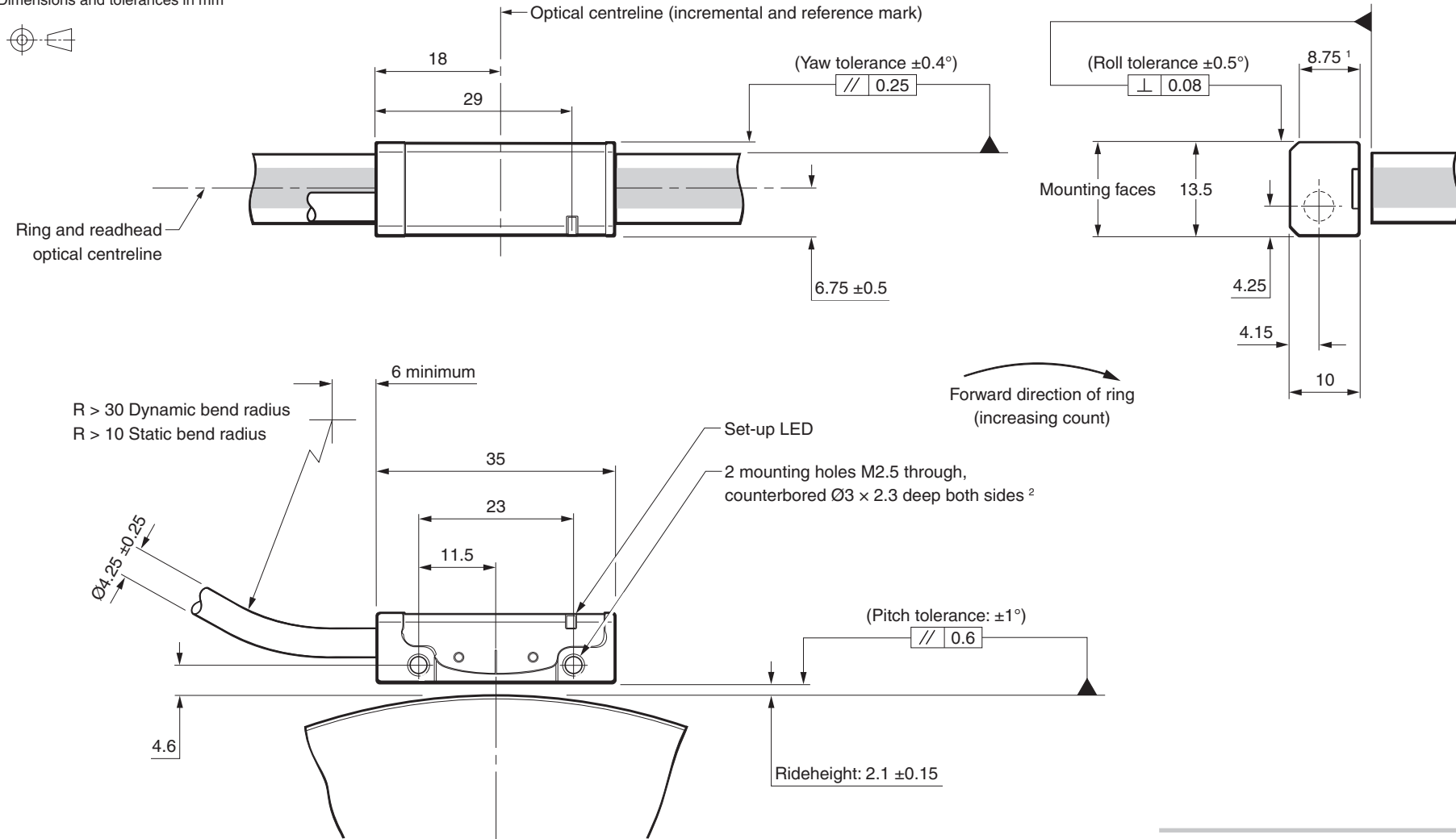## Humidity

95% relative humidity (non-condensing) to IEC 60068-2-78
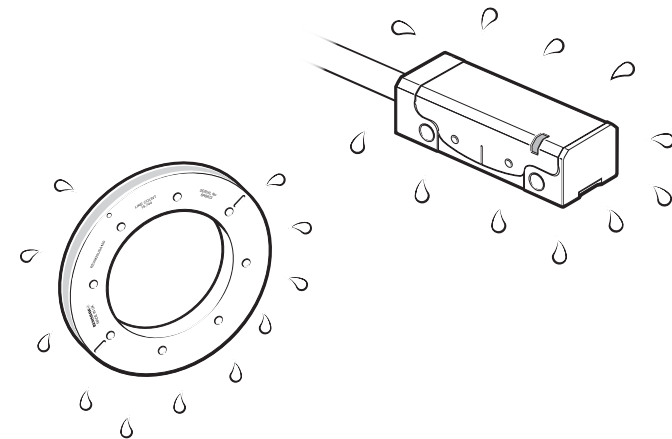
VIONiC readhead installation drawing

Dimensions and tolerances in mm

Optical centreline (incremental and reference mark)

18

29

(Yaw tolerance ±0.4°)
// 0.25

(Roll tolerance ±0.5°)
⊥ 0.08

8.75 [1]

Mounting faces   13.5

Ring and readhead
optical centreline

6.75 ±0.5

4.25

4.15

10

6 minimum

R > 30 Dynamic bend radius
R > 10 Static bend radius

35

23

11.5

Ø4.25 ±0.25

Forward direction of ring
(increasing count)

Set-up LED

2 mounting holes M2.5 through,
counterbored Ø3 × 2.3 deep both sides [2]

(Pitch tolerance: ±1°)
// 0.6

4.6

Rideheight: 2.1 ±0.15

NOTE: Ring centreline refers to the centre of the ring based on the full thickness, i.e., including the raised flat portion.
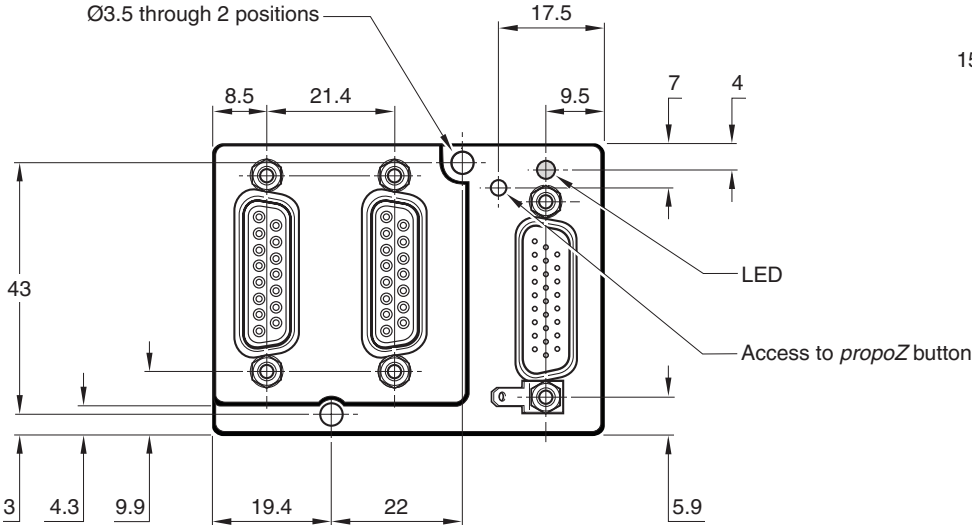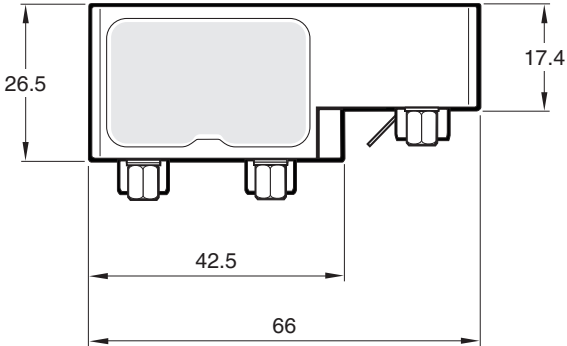
[1]   Extent of mounting faces.

[2]   The recommended thread engagement is 5 min (7.5 mm including counterbore) and the recommended tightening torque is between 0.25 Nm and 0.4 Nm.
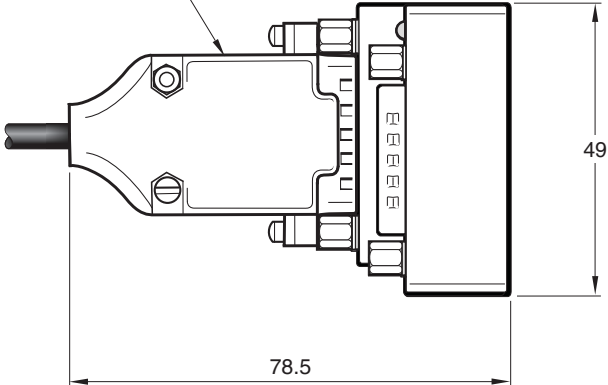
DSi drawing

Dimensions and tolerances in mm

Ø3.5 through 2 positions

17.5

8.5   21.4   9.5   7   4

43

15-way D-type readhead connector
(plugged into DSi)

LED

Access to *propoZ* button

3   4.3   9.9   19.4   22   5.9

49

78.5

26.5   17.4

42.5

66

REXM20/REXT20 installation drawing

Dimensions and tolerances in mm

Section A-A

REXM20/REXT20 reference mark location

REXT20 second reference mark location

Fiducial marks, 4 positions, to aid installation [3]

N holes Ø6 through equispaced [2]

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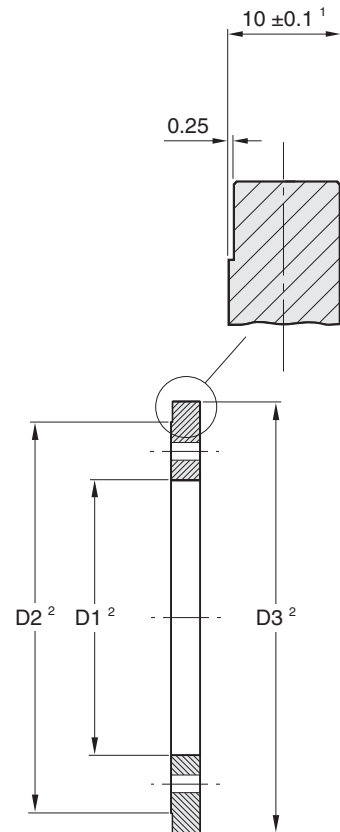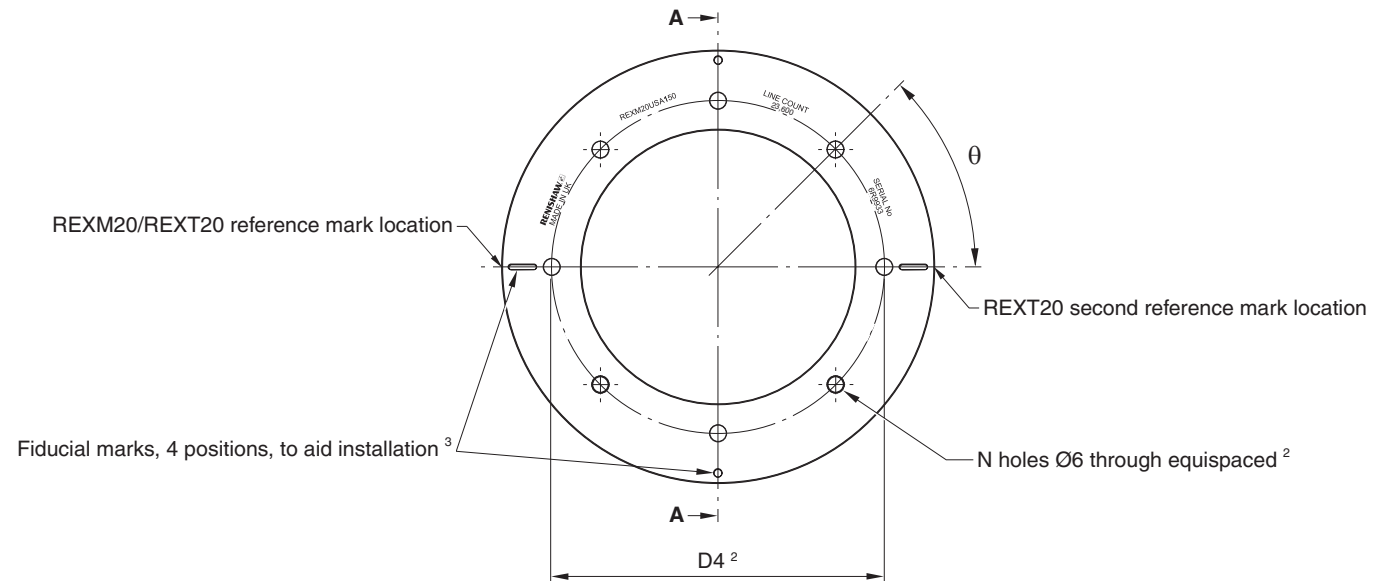
[1]   Graduations are centred within this dimension.

[2]   Refer to page 14 for dimension and hole information.

[3]   52 mm and 57 mm rings have dimple fiducial features and no slots.

REXM20/REXT20 specifications

Nominal external diameter (mm)	Line count	Dimensions				Holes	
		D1 (mm)	D2 (mm)	D3 (mm)	D4 (mm)	N	θ
52	8 192	26	50	52.1 - 52.2	38	4	90°
57	9 000	26	50	57.25 - 57.35	38	4	90°
75	11 840	40.5	64.5	75.3 - 75.4	52.5	8	45°
100	15 744	57.5	97.5	100.2 - 100.3	77.5	8	45°
103	16 200	57.5	97.5	103.0 - 103.2	77.5	8	45°
104	16 384	57.5	97.5	104.2 - 104.4	77.5	8	45°
115	18 000	68	108	114.5 - 114.7	88	8	45°
150	23 600	96	136	150.2 - 150.4	116	8	45°
183	28 800	122.5	162.5	183.2 - 183.4	142.5	12	30°
200	31 488	136	176	200.3- 200.5	156	12	30°
206	32 400	140.5	180.5	206.1 - 206.5	160.5	12	30°
209	32 768	140.5	180.5	208.4 - 208.8	160.5	12	30°
229	36 000	160.5	200.5	229.0 - 229.4	180.5	12	30°
255	40 000	180.5	220.5	254.4 - 254.8	200.5	12	30°
300	47 200	216	256	300.4 - 300.6	236	12	30°
350	55 040	256	296	350.3 - 350.5	276	16	22.5°
417	65 536	305	345	417.0 - 417.4	325	16	22.5°

Equipment for REXM20/REXT20 mounting

Suitable for:

- REXM (full rotation)

- REXT (3° to 357° partial rotation). For partial rotation check orientation of the ring before installation (see 'Mounting the REXT (partial rotation)' on page 18).

Required parts:

- Appropriate REXM/REXT ring (see 'REXM20/REXT20 specifications' on page 14)

- Appropriate number of screws for ring size (see 'REXM20/REXT20 specifications' on page 14) [1]

- Appropriate number of M5 flat washers for ring size (see 'REXM20/REXT20 specifications' on page 14)

- Dial Test Indicator (DTI) with a ruby ball stylus

- Rubber mallet

- Appropriate cleaning solvents (see 'Storage and handling' on page 9)

- 4 mm hex key

- Torque wrench

Optional parts:

- Renishaw scale wipes (A-9523-4040)

- Lint-free cloth

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[1] Recommended screw type M5 × 0.8: ISO 4762/DIN 912 grade 10.9 minimum / ANSI B18.3.1M.

REXM20/REXT20 ring mounting

- The REXM/REXT ring should be flange mounted onto a flat surface to minimise 2-per-rev distortion.

- Taper mounting is not suitable for thick cross-section REXM/REXT rings.

- To avoid distorting the ring, the REXM/REXT should not be interference fitted.

- Some eccentricity of the ring is acceptable because it will be compensated using two readheads.
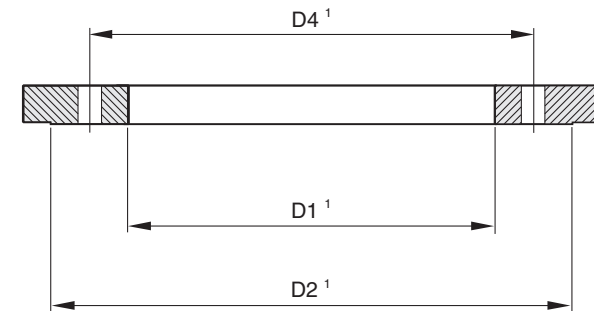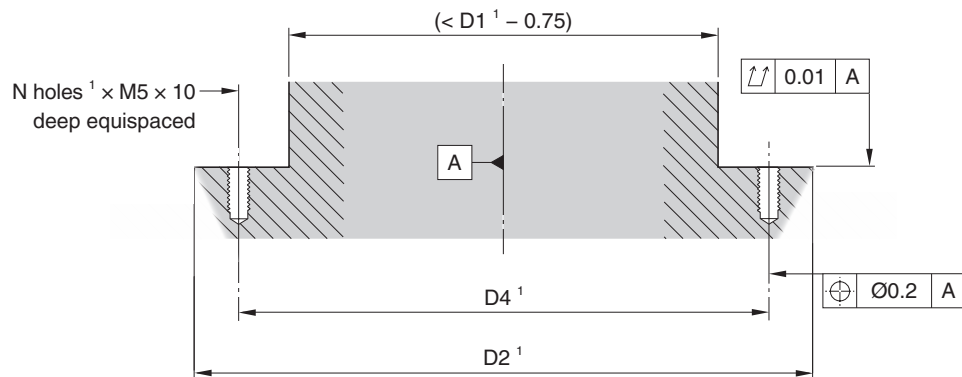
Dimensions and tolerances in mm

≥ 0.375
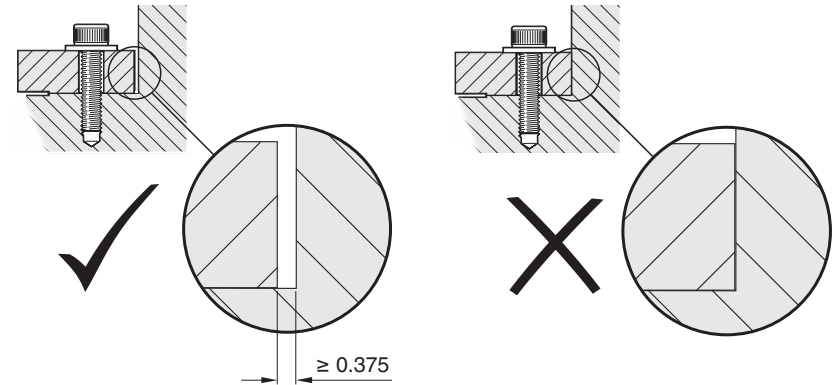
Mounting shaft geometry

The shaft must have a flat mounting surface to match the diameter of the mounting face (D2 [1]) on the lower side of the REXM20/REXT20.

The total axial run-out of the mounting surface should be within 10 µm.

$(< D1\ ^1 - 0.75)$

N holes [1] × M5 × 10 deep equispaced

| � | 0.01 | A |

A

| ⊕ | Ø0.2 | A |

D4 [1]

D2 [1]

D4 [1]

D1 [1]

D2 [1]

---

[1]   Refer to 'REXM20/REXT20 specifications' on page 14 for dimension and hole information.

Mounting the REXM (full rotation)

1. Clean the REXM mounting face as recommended in 'Storage and handling' on page 9.

2. Clean the mating surface on the mounting shaft / hub as recommended in 'Storage and handling' on page 9.

3. Place the REXM onto the mounting shaft.

4. Insert four M5 screws with flat washers into the four screw holes by the fiducial marks.

   IMPORTANT: DO NOT tighten the screws at this point; simply engage the threads ensuring that the screw heads do not touch the ring.

5. See 'Adjusting the REXM/REXT ring (full and partial rotation)' on page 20 for the next steps.

Dimple or slot indicates fiducial mark
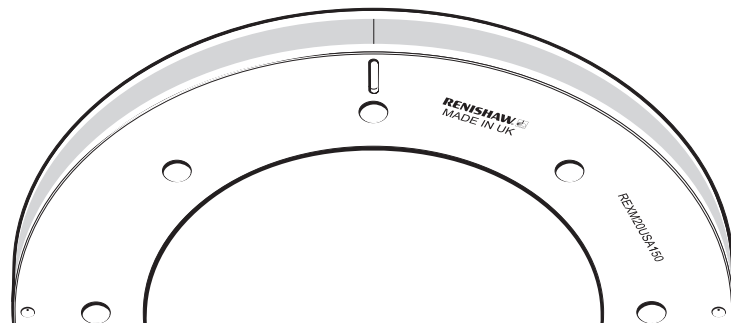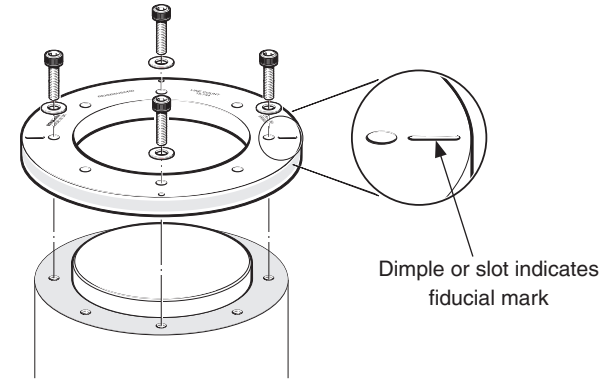
NOTE: The *IN-TRAC*™ reference mark is integrated in the scale, radially aligned with the centre of the mounting hole to the left of the 'Renishaw' logo within ±0.5 mm. No external actuators or physical adjustments are required. For REXT20, the second reference mark is 180° from the first.

Mounting the REXT (partial rotation)

IMPORTANT:

- For partial rotation applications using a DSi, a REXT ring (two reference marks opposite each other) is required.

- The ring must be installed so that, when the ring is rotated, each readhead only sees a single reference mark.

- Both readheads must see a single reference mark to complete the initialisation sequence, see 'Initialisation' on page 30.

- The maximum angle of rotation of the rotor / hub is 357° (Figure 1).

- The minimum angle of rotation of the rotor / hub is 3° (Figure 2).

- The reference mark is output at 0° and will be the average detected difference between readhead (H1) and readhead (H2).

- The position of the reference mark output can be set by the user, see 'Selecting a new reference mark output position (propoZ)' on page 31.
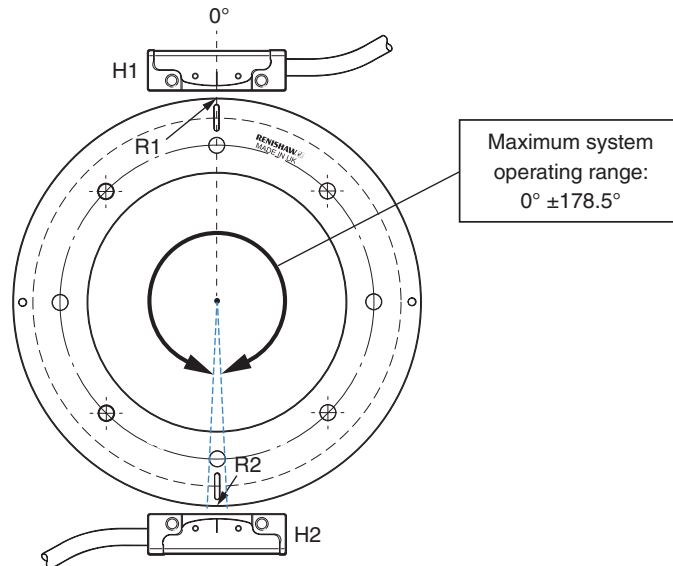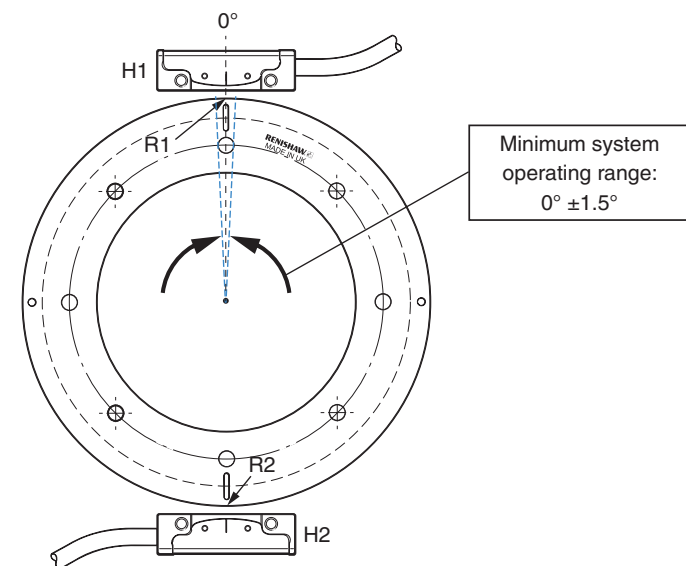
Figure 1: Maximum angle of rotation

Maximum system operating range: 0° ±178.5°

Figure 2: Minimum angle of rotation

Minimum system operating range: 0° ±1.5°

1. Clean the REXT mounting face as recommended in 'Storage and handling' on page 9.

2. Clean the mating surface of the mounting shaft/hub as recommended in 'Storage and handling' on page 9.

3. Move the axis to the mid-point of the required rotation, Φ.

4. Locate the ring so that the reference mark R1 is as close to possible to the centre of the readhead, H1 (see figure 1).

5. Rotate the axis to the full extent of required movement in the counter clockwise direction. Ensure that the readhead, H1, does not pass the other reference mark, R2 (see figure 2).

6. Rotate the axis to the full extent of required movement in the clockwise direction. Ensure that the readhead, H1, passes reference mark R1, but does not pass the other reference mark, R2 (see figure 3).

7. Insert four M5 screws with flat washers into the four screw holes by the fiducial marks.

   IMPORTANT: DO NOT tighten the screws at this point; simply engage the threads ensuring that the heads do not touch the ring.

8. The ring is positioned correctly and can be adjusted. See 'Adjusting the REXM/REXT ring (full and partial rotation)' on page 20.
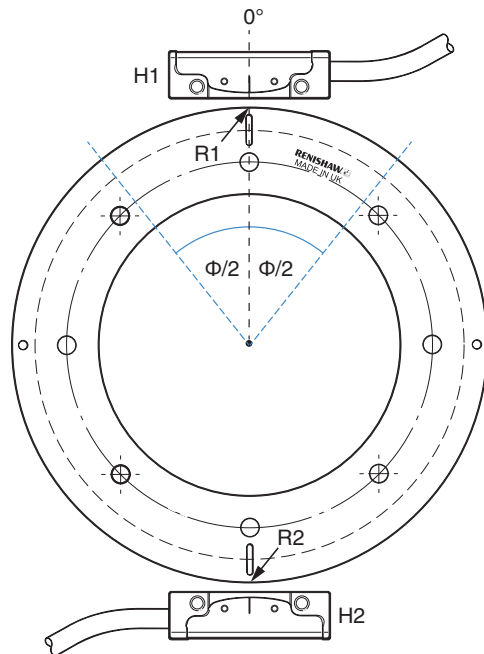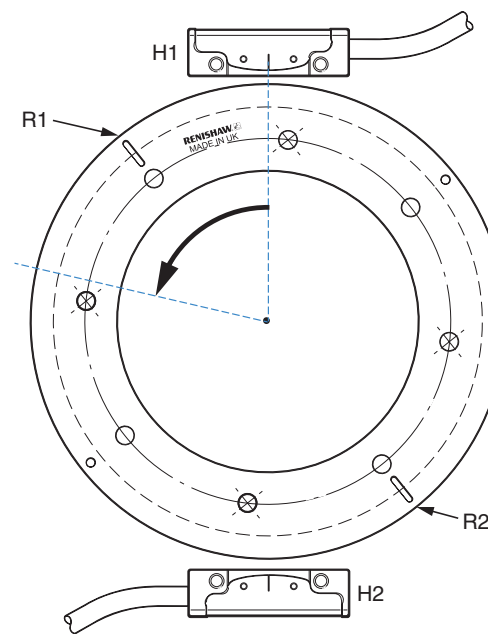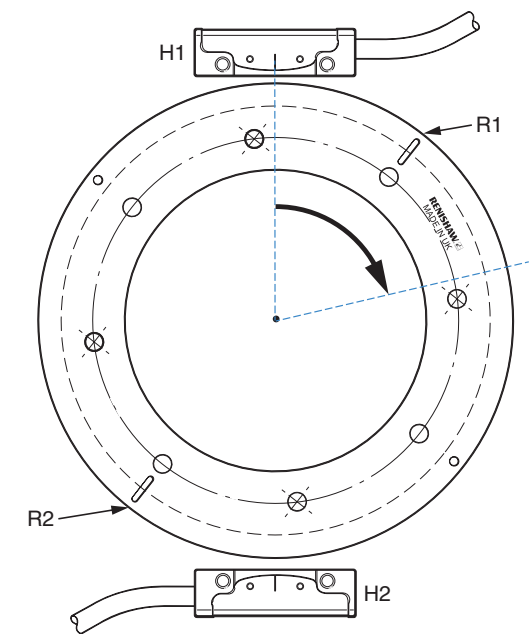
Figure 1


Figure 2

Figure 3

Adjusting the REXM/REXT ring
(full and partial rotation)

1. Remove the protective film from the surface of the ring.

2. Measure the run-out on the ring using a Dial Test Indicator (DTI).

   CAUTION: Use a DTI with low exertion force to avoid scratching the ring surface. A DTI with a ruby ball stylus is recommended as a further precaution against scratches.

   NOTE: At this stage the ring is not firmly fixed so, to avoid causing the ring to shift position, rotate the ring slowly and smoothly.

3. Where the DTI shows the lowest radius reading, gently tap the opposite side of the ring on the edge using a rubber mallet, until the DTI reading is approximately at the 'mid-point' of the run-out.

4. Find the new lowest radius reading.

5. Tap the opposite side of the ring with a rubber mallet until the DTI reading is at the 'mid-point' of the run-out.

6. Repeat this process until the run-out of the ring is approximately 30 μm TIR.
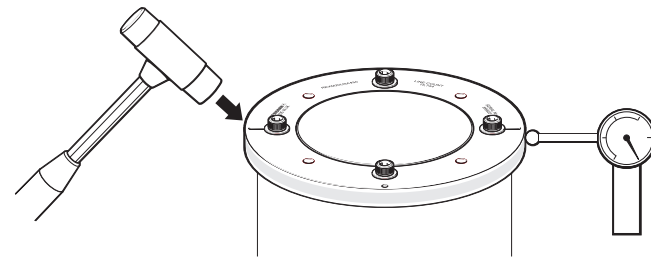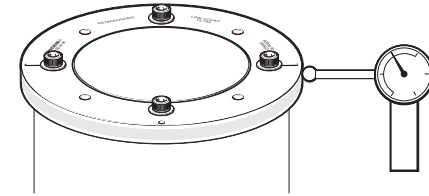
7. Adjust ring position until the DTI reading at these points agrees to 10 µm TIR.

    NOTE: 52 mm and 57 mm rings do not have 'slot' fiducials marked.

'Slot' fiducial
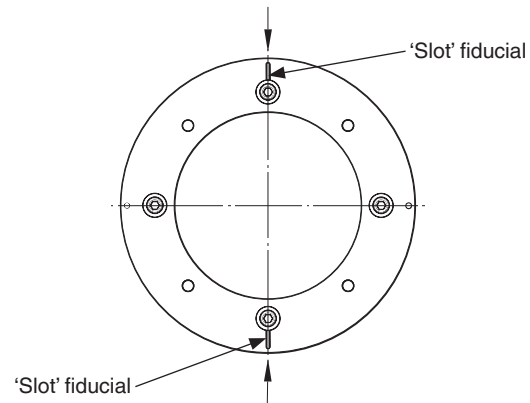
'Slot' fiducial

8. Rotate the ring by 90°.

9. Adjust the ring position until the DTI reading at these points agrees to 10 µm TIR.

'Dimple' fiducial
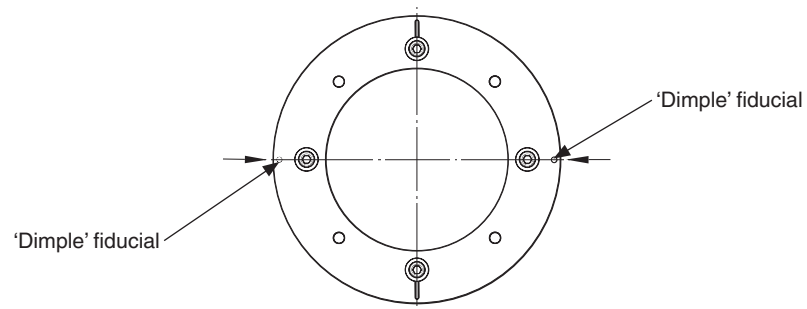
'Dimple' fiducial

10. Recheck the run-out at the two 'slot' fiducial points, to ensure the run-out is still within 10 µm TIR. Adjust if necessary.

11. Gradually tighten the 4 screws in turn, enough to grip and lightly secure the ring so as to avoid moving the position of the ring.

12. Insert the remaining M5 screws and, in a sequential pattern, gradually tighten them to a torque of approximately 4 Nm.

13. Recheck the run-out at the two 'slot' fiducial points, then at the two 'dimple' fiducial points.

    NOTE: The run-out values at the 'slot' fiducial points do not have to match the run-out values at the 'dimple' fiducial points.

14. If the ring has moved position outside the 10 µm limit, the screws must be loosened and the ring adjusted.

15. Clean ring using Renishaw scale cleaning wipes or a clean, dry, lint-free cloth.

System compatibility

VIONiC readhead and ring compatibility

VIONIC readhead models are compatible with a range of REXM/REXT ring sizes. The optical configuration is optimised for the following conditions:

Readhead model	REXM/REXT diameter range (mm)
V2BJ	> 135
V2CK	60 to 135
V2CL	< 60

Ensure readhead part number and REXM/REXT size range compatibility at the time of ordering and installation.

NOTE: Published accuracy specifications only apply when 2 readheads are used and the output combined and blended using either a DSi or with the customers own electronics. For optimum accuracy performance, the readheads should be mounted diametrically opposite each other so that the optical centrelines are 180 ±1° apart.

VIONiC readhead and DSi compatibility

When connecting a DSi the VIONiC readhead must:

• Be configured with line driven alarm outputs.

• Have the same interpolation factor/resolution.

• Have a clocked output option the same or lower than the connected DSi.

For details on readhead configuration, refer to the *VIONiC™ series encoder system* data sheet (Renishaw part no. L-9517-9678).

VIONiC encoder system quick-start guide

This section is a quick-start guide to installing a VIONiC encoder system. More detailed information on installing the VIONiC encoder system is contained on pages 24 to 25 of this installation guide.

The optional Advanced Diagnostic Tool ADTi-100 [1] (A-6165-0100) and ADT View software [2] can be used to aid installation and calibration of the individual readheads. The ADTi100 cannot be connected to the output of the DSi.

NOTE: To meet accuracy specifications two readheads are required connected either to a DSi or to customers own electronics.

INSTALLATION

Ensure the ring, readhead optical window and mounting faces are clean and free from obstructions.

⬇

Connect the readhead to the receiving electronics and power-up. The set-up LED on the readhead will flash.

⬇

Install and align the readhead to maximise the signal strength over the full axis of rotation as indicated by a green flashing LED.

⬇

Move to the CALIBRATION steps.

CALIBRATION

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

⬇

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

⬇

Rotate the axis back and forth ensuring the reference mark passes the readhead 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, restore factory defaults by obscuring the readhead optical window on power-up (see 'Restoring factory defaults' on page 26). Repeat the installation and calibration routine.

⬇

Repeat the installation and calibration process for the second readhead.

⬇

Connect the readheads to the DSi (see 'DSi quick-start guide' on page 27) or customers output blending electronics.

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

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

Readhead mounting and alignment

Mounting brackets

The bracket must have a flat mounting surface and should enable conformance to the installation tolerances, allow adjustment to the rideheight of the readhead, and be sufficiently stiff to prevent deflection or vibration of the readhead during operation.

Readhead set-up

Ensure that the ring, readhead optical window and mounting face are clean and free from obstructions.
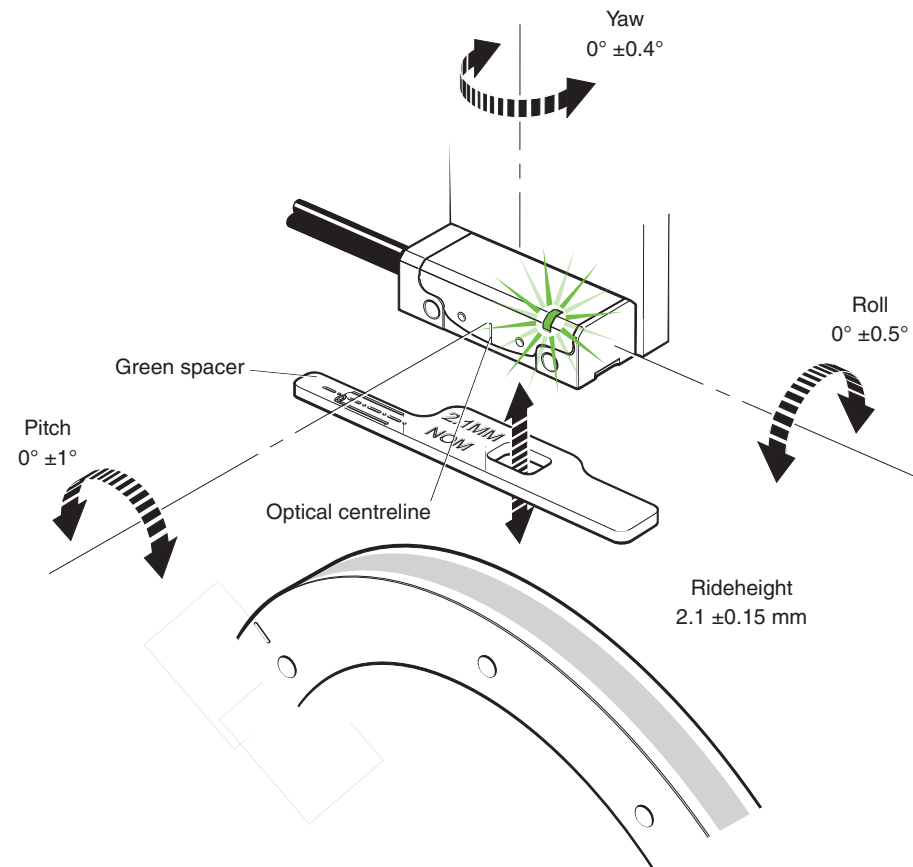

NOTES:

- Ensure that the protective film is removed from the ring before installing the readhead.

- When cleaning the readhead and ring apply cleaning fluid sparingly, do not soak.

To set nominal rideheight, place the green spacer with the aperture under the optical centre of the readhead to allow normal LED function during set-up procedure. Adjust the readhead to achieve a flashing green LED for the full distance of rotation. The faster the flash rate, the closer it is to optimum set-up. The optional Advanced Diagnostic Tool ADTi-100 (A-6195-0100) and ADT View software can be used to optimise signal strength in challenging installations. See **www.renishaw.com/adt** for more details.

NOTE: When reinstalling, factory defaults should be restored (see 'Restoring factory defaults' on page 26).

Readhead set-up LED status

Green flashing Orange flashing Red flashing

Yaw 0° ±0.4°

Roll 0° ±0.5°

Green spacer

Pitch 0° ±1°

Optical centreline

2.1MM NOM

Rideheight 2.1 ±0.15 mm

System calibration

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

Calibration must be carried out for both of the VIONiC readheads before connecting them to the DSi.

Before system calibration:

- Ensure the ring and readhead optical window are clean.

- If reinstalling, restore factory defaults (see 'Restoring factory defaults' on page 26).

- Ensure the signal strength has been optimised over the full axis of rotation; the LED will be flashing green.

    NOTE: The readhead will only enter calibration mode if the LED is flashing green.

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 as detailed in 'Readhead mounting and alignment' on page 24.

2. 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.

3. The system is now ready for reference mark phasing.

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.

    - Ensure the failure is not due to overspeed (> 100 mm/s or exceeding the readhead maximum speed)

    - Exit the calibration routine and restore factory defaults (see 'Restoring factory defaults' on page 26).

    - Check the readhead installation and system cleanliness and repeat the calibration routine.

Reference mark phasing

1. Rotate the axis back and forth ensuring the reference mark passes the readhead 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 and AOC are automatically switched on once calibration is complete. To switch off AGC refer to 'Switching Automatic Gain Control (AGC) on or off' on page 26.

4. If the LED continues double-flashing after repeatedly passing the reference mark it is not being detected. Ensure correct readhead alignment.

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 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

Restoring factory defaults

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

NOTE: Factory defaults can also be restored 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 (using the spacer supplied with the readhead ensuring the cut-out is NOT under the optical window) or connect the 'Remote CAL' output pin to 0 V.

3. Power the readhead.

4. Remove the spacer or, if using, the connection from the 'Remote CAL' output pin to 0 V.

5. The LED will start continuously flashing indicating factory defaults have been restored and the readhead is in installation mode.

6. Repeat the 'Readhead set-up' procedure on page 24.

Switching Automatic Gain Control (AGC) on or off

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.

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.

DSi quick-start guide

This section is a quick-start guide to installing and calibrating a DSi system. More detailed information on installing, calibrating, and initialising a DSi is contained on pages 28 to 30 of this installation guide.

Complete rotation

Install (see 'Readhead mounting and alignment' on page 24) and calibrate (see 'System calibration' on page 25) both of the VIONiC encoder readheads.

⬇

Connect the VIONiC readheads to the DSi (see 'DSi connection' on page 28).

⬇

Select the correct head orientation switch position on the DSi (see 'Readhead orientation' on page 29).

⬇

Calibrate the DSi (see 'Calibration' on page 29).

⬇

Optional: Select a new *propoZ* reference (index) position if desired (see 'Selecting a new reference mark output position (propoZ)' on page 31).

Initialisation

(see 'Initialisation' on page 30).
(Upon subsequent power-ups of the DSi)

⬇

Rotate the axis in one direction until the LED on the DSi goes solid green (Initialisation status, 'K', goes 'high'). This may require up to 1 full turn.

⬇

The *propoZ* reference (index) output will now be given when the axis passes the *propoZ* output position.

Partial rotation

IMPORTANT: Ensure the REXT ring is installed so that the reference marks are positioned correctly relative to the readheads (see 'Mounting the REXT (partial rotation)' on page 18).

Install and calibrate each VIONiC encoder system separately on their respective reference marks (see 'System calibration' on page 25).

⬇

Connect the VIONiC readheads to the DSi (see 'DSi connection' on page 28).

⬇

Select the correct head orientation switch position on the DSi (see 'Readhead orientation' on page 29).

⬇

Calibrate the DSi (see 'Calibration' on page 29).

⬇

Optional: Select a new *propoZ* reference (index) position if desired (see 'Selecting a new reference mark output position (propoZ)' on page 31).

Initialisation

(see 'Initialisation' on page 30).
(Upon subsequent power-ups of the DSi)

⬇

Rotate the axis to its maximum travel in both directions.
The LED on the DSi will go solid green (Initialisation status, 'K', goes 'high') when initialized.

⬇

The *propoZ* reference (index) output will now be given when the axis passes the *propoZ* output position.

DSi connection

Ensure that both VIONiC readheads are calibrated before connecting them to the DSi.

NOTE: The DSi should be placed as close to the power supply as possible to minimise voltage drop.

Plug the VIONiC readheads directly into the DSi.

Compatible DSi's	
Rotation	**DSi type [1]**
Full rotation	DSi-QTR
	DSi-QTS
Partial rotation	DSi-QUR
	DSi-QUS

NOTE: The remote DSi has an additional 120 ohm termination resistor on the quadrature outputs.

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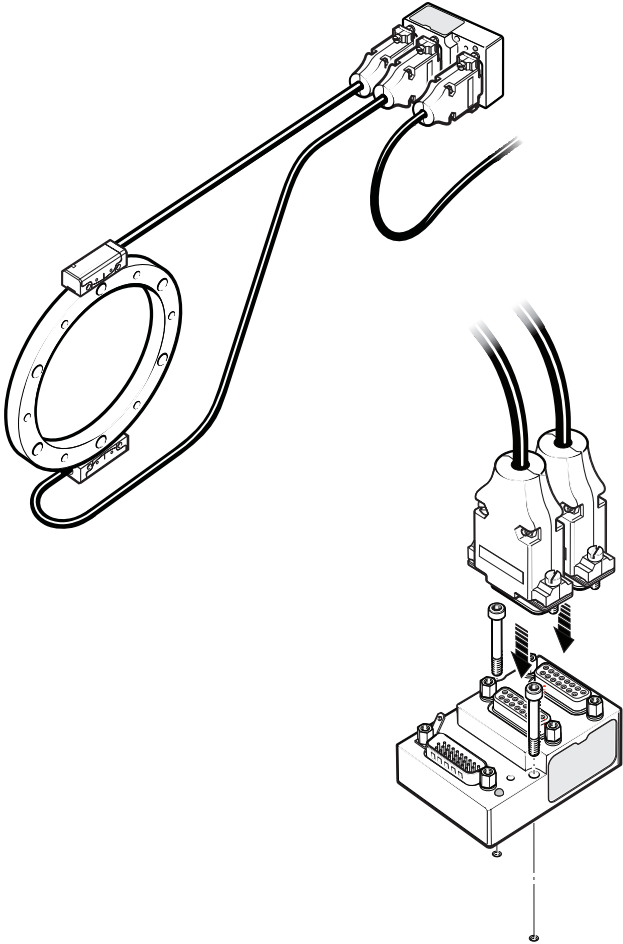
[1]   See the *DSi dual readhead angle encoder system* data sheet (Renishaw part no. L-9517-9466) for more information.

Readhead orientation

IMPORTANT: Select the correct head orientation switch position.

This switch can be found on the rear of the DSi. The DSi must be recalibrated if the switch position is changed.
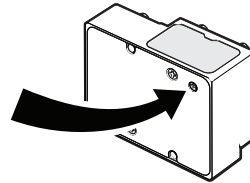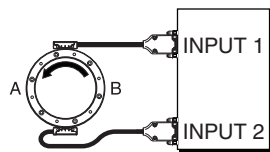

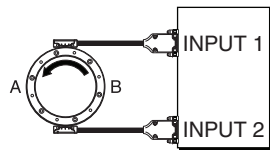Encoder forward rotation direction

Factory setting

Option 1: recommended

INPUT 1
INPUT 2
A B

	Factory setting			
Output count direction	FWD	-	-	REV
Factory default *propoZ* position	A	-	-	B

Option 2: alternative

INPUT 1
INPUT 2
A B

Output count direction	-	FWD	REV	-
Factory default *propoZ* position	-	A	B	-

Calibration

Calibration is an essential operation that completes system set-up. The system must be recalibrated if the installation is disturbed or if the DSi has been moved to a different axis.

Using a small hex-key (or other suitable implement) press and hold the recessed *propoZ* button on the front of the DSi as the power is switched on. The LED on the DSi will go red, release the button and the LED will go orange, then start to flash green. The initialisation status, 'K', will be 'low'.
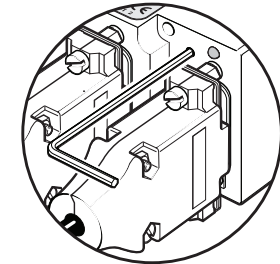
For complete rotation:

1. Rotate the axis in one direction until the LED on the DSi stops flashing (the initialisation status, 'K', will go 'high').

   NOTE: The axis may need up to two full rotations to achieve this.

2. The DSi has now memorised the number of counts per revolution and determined the factory default *propoZ* position.

For partial rotation:

1. Ensure the ring is installed so the reference marks are positioned correctly (see).

2. Rotate the axis in both directions to its maximum travel until the LED on the DSi stops flashing (the initialisation status, 'K', will go 'high').

3. The factory default *propoZ* position has now been determined.

NOTE: For optimum system accuracy and performance at higher speeds ensure that the AGC is switched off (see).

Initialisation

Initialisation is required at each power-up and after an error has occurred.

If an alarm occurs, DSi will automatically re-enter initialisation mode when the alarm condition is removed.

For complete rotation:

1. Rotate the axis in one direction (either clockwise or anti-clockwise) until both readheads pass the reference mark. The LED on the DSi will then go solid green and the initialisation status, 'K', will go 'high'.

2. Initialisation is now complete. The reference mark will be output when the axis next passes the factory default *propoZ* position.
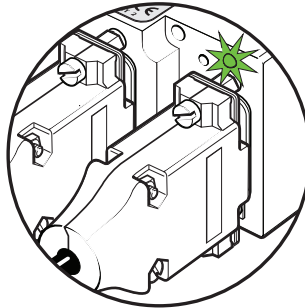
NOTE: For a complete rotation the default *propoZ* position is 90 degrees i.e. half way between the two readheads mounted opposite each other on the ring.

For partial rotation:

1. Ensure the ring is installed so the reference marks are positioned correctly (see 'Mounting the REXT (partial rotation)' on page 18).

2. Rotate the axis in both directions to its maximum travel. The LED on the DSi will then go solid green and the initialisation status, 'K', will go 'high'.

3. Initialisation is now complete. The reference mark will be output when the axis next passes the factory default *propoZ* position.

NOTE: For a partial rotation the default *propoZ* position is 0 degrees, i.e., inline with the two readheads mounted opposite each other on the ring.

Selecting a new reference mark output position (*propoZ*)

The position of the reference mark output (*propoZ*) can be set by the user and can be reprogrammed as many times as required.

Ensure the DSi is calibrated and has completed the initialisation routine before setting a new reference mark output position.

The LED on the DSi flashes 'blank' as it passes the last programmed *propoZ* position.

## Changing the *propoZ* position

1. Rotate the axis to the required reference (index) position.

2. Using a hex-key or other suitable tool, press the recessed *propoZ* button on the front of the DSi. The LED on the DSi will show orange while the button is pressed. The new *propoZ* position is stored as the button is released. If the axis remains at that position, the LED shows blank after the button is released, indicating that the axis is at the *propoZ* position.

    HINT: You may find it useful to press and hold the *propoZ* button while you adjust the axis position slightly, then release the button at the optimum point.

3. The controller may now 'emergency stop' as the reference (index) is output at a new position. The controller should be restarted to ensure it is using the new reference (index) position.

4. After the controller has been restarted, the DSi will start the initialisation routine, indicated by a flashing green LED on the DSi and a 'low' initialisation status, 'K'. Rotate the axis in one direction (either clockwise or anti-clockwise) until the LED goes solid green and the initialisation status, 'K' goes 'high'. The new *propoZ* position will be indicated by a blank flash of the LED.

    NOTE: You can select a new *propoZ* position at any time when the LED is solid green, simply by pressing the *propoZ* button.

5. Small black adhesive covers are provided for the *propoZ* button and head orientation switch to reduce ingress of dust.
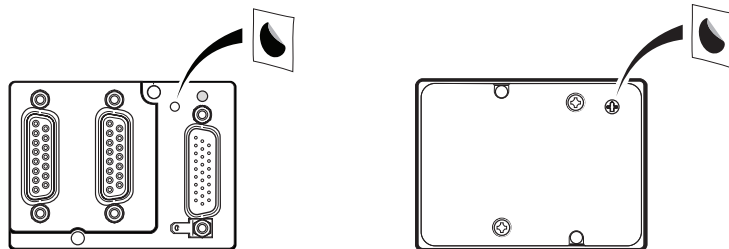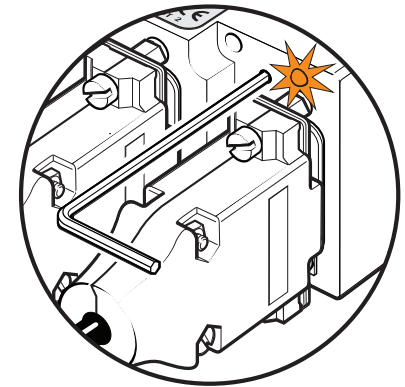
System LEDs

VIONiC 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 [1]	4 red flashing	Low signal, over signal, or overspeed; system in error

DSi LED diagnostics

LED colour	Meaning
Green (flashing)	DSi is in initialisation mode. Rotate the axis in one direction until the LED turns solid green to exit initialisation mode. [2]
Green (solid)	DSi is in normal working mode.
Blank	Axis is at the *propoZ* reference (index) output position. [3]
Orange (*propoZ* button is being pressed)	A new *propoZ* position is being programmed. When the *propoZ* button is released, the LED will normally show blank unless the axis is moved from the *propoZ* position.
Red (solid)	Pulse count alarm has been asserted. The number of counts in the last revolution is different to the value stored during the automatic calibration routine when the DSi was first installed. This could be caused by a miscount from one of the VIONiC encoders. If the pulse count alarm is asserted repeatedly, it is possible that an incorrect count is stored inside the DSi, in which case the DSi should be powered-up with the *propoZ* button pushed in to restore factory defaults. Recalibrate the DSi as per the initial installation. [4]
Red (flashing)	An alarm has occurred on one or both of the VIONiC readheads.
Red, then **orange**, then flashing **green**	The DSi has returned to factory default settings. This is triggered by pressing and holding the *propoZ* button while the DSi is being powered up.

[1]   The alarm output will take the form of 3-state or line driven E signal depending on DSi configuration. The VIONiC readheads connected to the DSi must be configured with line driven alarm format.

  •   The alarm output is a momentary status only. It is only present while the fault condition remains.

  •   The alarm may result in axis position error, redatum to continue.

[2]   During high-speed rotation, the blank flash of the LED as the axis passes the propoZ position may appear like a flashing green LED. If the LED continues flashing green check for correct position of the orientation switch and press and hold the *propoZ* button on switch-on.

[3]   If you drive the axis past the *propoZ* position, the blank LED will appear as a 0.25 second flash.
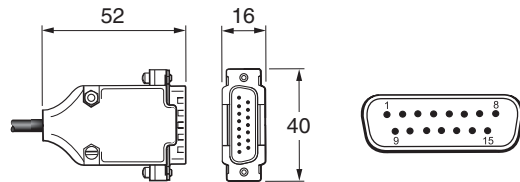
[4]   On recalibration, the old *propoZ* position will be lost.

Output signals

VIONiC readhead output

Function	Signal		Colour	Pin
Power	5 V		Brown	7, 8
	0 V		White	2, 9
Incremental	A	+	Red	14
		–	Blue	6
	B	+	Yellow	13
		–	Green	5
Reference mark	Z	+	Violet	12
		–	Grey	4
Limits	P		Pink	11
	Q		Black	10
Alarm [1]	E	–	Orange	3
Remote CAL [2]	CAL		Clear	1
Shield	-		Screen	Case

15-way D-type connector (termination code D)

DSi output

Function	Output type	Signal		Pin
Power	-	5 V power		26
		5 V sense		18
		0 V power		9
		0 V sense		8
Incremental signals	RS422A digital	A	+	24
			–	6
		B	+	7
			–	16
Reference mark	RS422A digital	Z	+	15
			–	23
Alarm [3]	RS422A digital	E+		25
		E–		17
Limits [4]	Open collector	P		4
		Q		13
Initialisation status	Open collector	K		3
Shield	-	Inner		Not connected
	-	Outer		Case
Do not connect	-	-		1, 2, 5, 10, 11, 12, 14, 19, 20, 21, 22
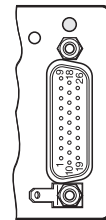
26-way high-density
D-type plug

NOTE: VIONiC readheads are fitted with P and Q 'end of travel' limit switch sensors, typically used for linear motion applications. P and Q limit actuators are not suitable for ring encoder installations. Limit switch signal detail is included here for information only. Please contact your local Renishaw representative if you require limits on your rotary installation.

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[1] The VIONiC readhead must be configured for line driven alarm.

[2] Remote CAL must be connected for use with ADTi-100.

[3] DSi alarm formats can be 3-state or line driven. Please specifiy at time of ordering.

[4] Limit switch outputs are taken directly from the readhead connected to input 1.

Speed

Clocked output option (MHz)	Maximum speed (m/s)												Minimum edge separation [1] (ns)
	5 µm (D)	1 µm (X)	0.5 µm (Z)	0.2 µm (W)	0.1 µm (Y)	50 nm (H)	40 nm (M)	25 nm (P)	20 nm (I)	10 nm (O)	5 nm (Q)	2.5 nm (R)	
50	12	12	12	7.25	3.63	1.81	1.45	0.906	0.725	0.363	0.181	0.091	25.3
40	12	12	12	5.80	2.90	1.45	1.16	0.725	0.580	0.290	0.145	0.073	31.8
25	12	12	9.06	3.63	1.81	0.906	0.725	0.453	0.363	0.181	0.091	0.045	51.2
20	12	12	8.06	3.22	1.61	0.806	0.645	0.403	0.322	0.161	0.081	0.040	57.7
12	12	10.36	5.18	2.07	1.04	0.518	0.414	0.259	0.207	0.104	0.052	0.026	90.2
10	12	8.53	4.27	1.71	0.850	0.427	0.341	0.213	0.171	0.085	0.043	0.021	110
08	12	6.91	3.45	1.38	0.690	0.345	0.276	0.173	0.138	0.069	0.035	0.017	136
06	12	5.37	2.69	1.07	0.540	0.269	0.215	0.134	0.107	0.054	0.027	0.013	175
04	12	3.63	1.81	0.730	0.360	0.181	0.145	0.091	0.073	0.036	0.018	0.009	259
01	4.53	0.910	0.450	0.180	0.090	0.045	0.036	0.023	0.018	0.009	0.005	0.002	1038

Angular speed depends on ring diameter. Use the following equation to convert to rev/min.

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

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

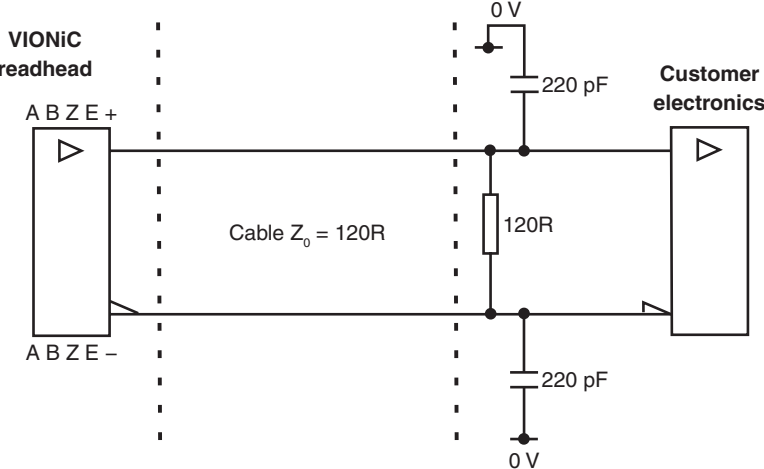# Electrical connections

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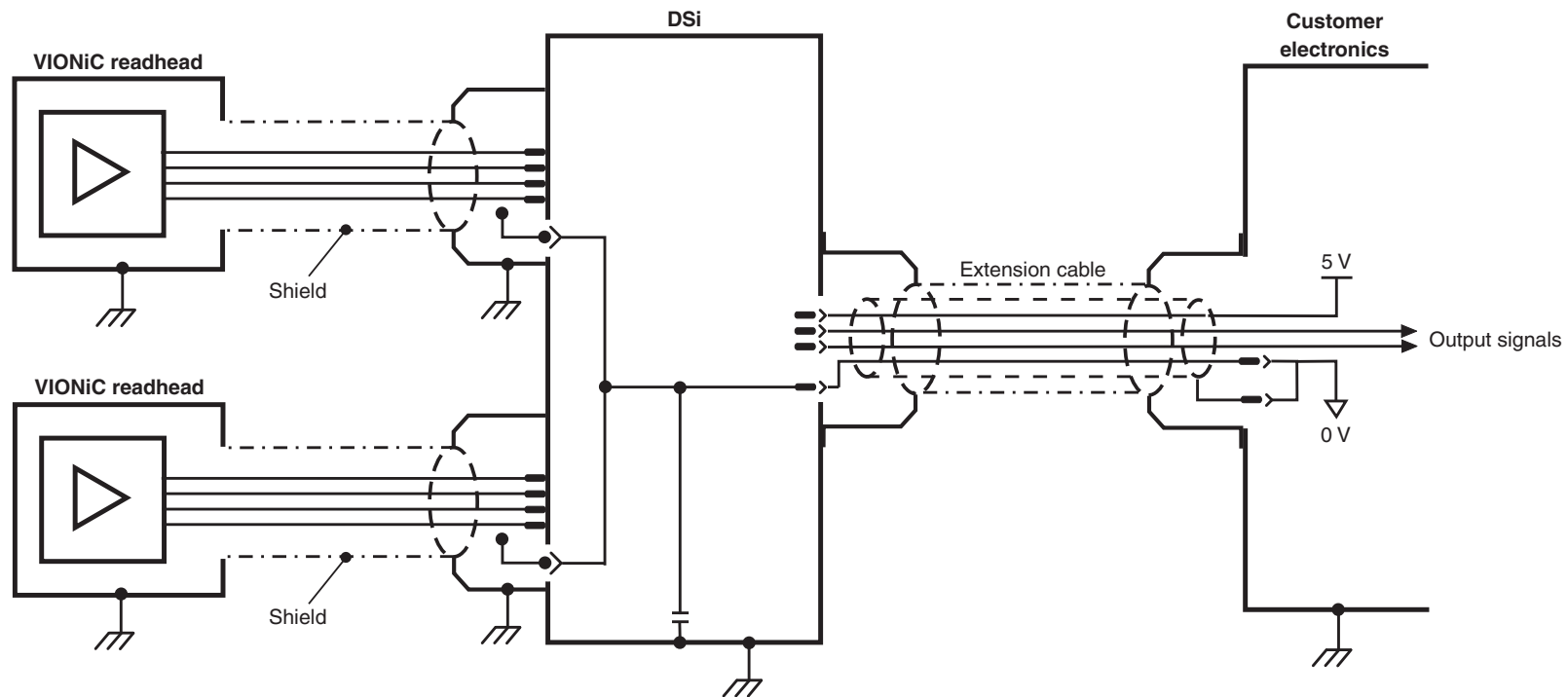
**IMPORTANT:** The shield should be connected to the machine earth (Field Ground).

NOTE: Maximum cable lengths as detailed in 'General specifications' on page 39.

Recommended signal termination

VIONiC readhead

A B Z E +

Cable Z_0 = 120R

A B Z E −

0 V

220 pF

120R

Customer electronics

220 pF

0 V

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

Initialisation status output

5 V to 24 V

R [1]

K
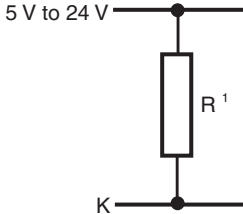
[1]   Select R so max. current does not exceed 10 mA. Alternatively, use a suitable relay or opto-isolator.

Remote CAL operation

CAL

0 V
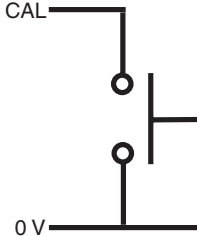
Remote operation of the CAL/AGC is possible via CAL signal.

Connecting a separate power supply

Many controllers cannot supply 1 amp at 5 volts, so it may be necessary to connect a separate power supply. To ensure correct operation, the separate power supply should be connected as per the diagram below. The 0 V of the separate power supply should be connected to the 0 V of the controller to ensure that the line driver in the DSi and line receiver in the controller are using the same reference voltage. The 10 ohm resistor minimises current flow due to different 0 V potentials.
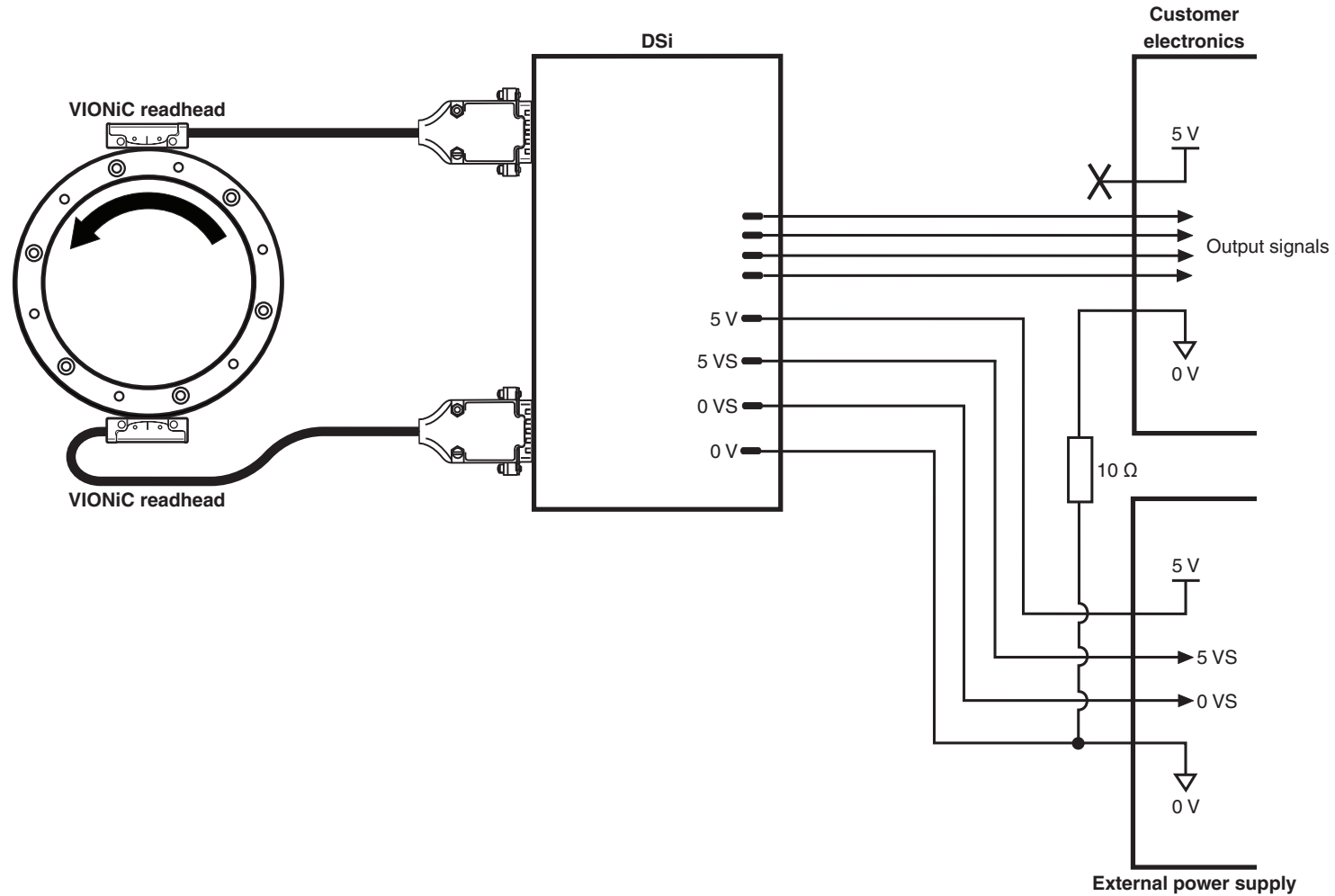
DSi output specifications

Digital output signals

Form - Square wave differential line driver to EIA RS422A

Incremental [1]

2 channels A and B in quadrature (90° phase shifted)
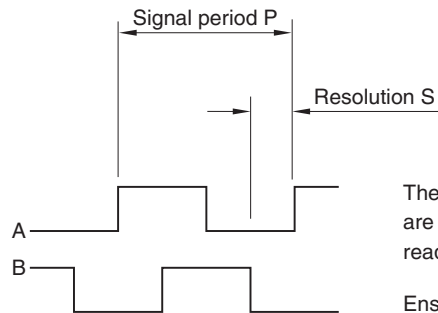
The resolution and retiming frequency are determined by the VIONIC readheads connected to the DSi.

Ensure that the two readheads have the same part numbers.

propoz reference [1]

Duration as resolution S.

Customer-positionable.

NOTE: The *propoz* reference mark is resynchronised at power-up and can be output in any quadrature state.

Alarm [1]

Line driven (Asynchronous pulse)
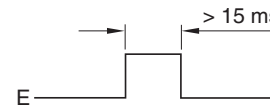
An alarm is asserted when either VIONiC readhead goes into an alarm condition, or when the DSi detects that a miscount has occurred.

The miscount alarm will be cleared when the DSi detects correct count.

or 3-state alarm [2]

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

Initialisation status

Open collector output
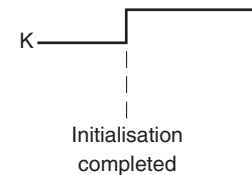
The initialisation status goes low when the DSi is in initialisation mode (occurs when the DSi is powered-up or when an alarm condition has been cleared). When initialization is complete, the signal will go high.

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[1]   For clarity, the inverse signals are not shown.

[2]   Connected encoders must be configured with line dirven alarm output.

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
Sealing	(VIONiC readhead)	IP40
	(DSi)	IP20
Acceleration	Operating (System)	400 m/s^2, 3 axes
Shock	Operating (System)	500 m/s^2, 11 ms, ½ sine, 3 axes
Vibration	Operating (VIONiC readhead)	100 m/s^2, 55 Hz to 2000 Hz, 3 axes
Mass	(VIONiC readhead)	8.6 g
	(DSi)	85 g
	(VIONiC readhead cable)	26 g/m
Readhead cable		Single-shielded, outside diameter 4.25 ±0.25 mm
		Flex life > 20×10^6 cycles at 30 mm bend radius
		UL recognised component **𝖀𝕃**
Maximum cable length [1]		3 m

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.

REXM20/REXT20 ring specifications

Pitch	20 µm
Material	303/304 stainless steel
Coefficient of thermal expansion (at 20 °C)	15.5 ±0.5 µm/m/°C

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[1] Extension cables available. Contact your local Renishaw representative for further details. The maximum cable length between the readhead and the ADTi-100 is 3 m.

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