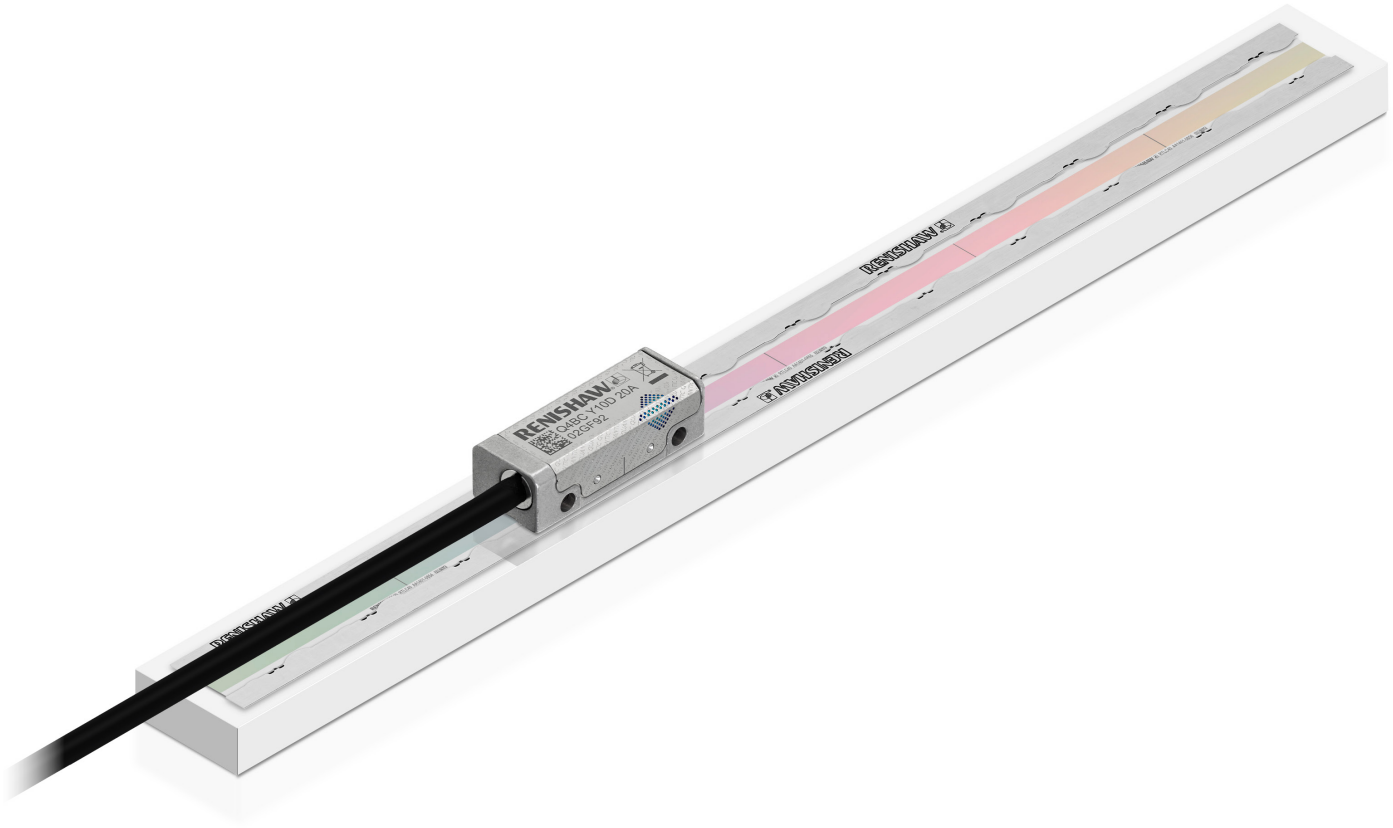
Installation guide
M-9417-9248-05-A

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QUANTiC™ RTLC40/FASTRACK™ incremental linear encoder system



www.renishaw.com/quanticdownloads

#renishaw

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Legal notices

Patents

Features of Renishaw's QUANTiC™, RTLC40, and FASTRACK™ encoder systems are the subjects of the following patents and patent applications:

EP1173731	US6775008	JP4750998	CN100543424	EP1766334
JP4932706	US7659992	CN100507454	EP1766335	IN281839
JP5386081	US7550710	CN101300463	EP1946048	JP5017275
US7624513	CN101310165	EP1957943	US7839296	CN108351229
EP3347681	JP2018530751	KR20180052676	US20180216972	WO2017203210
CN1314511	EP1469969	EP2390045	JP5002559	US8987633
US8466943	CN102057256	EP2294363	EP2894438	JP5475759
JP5755299	KR1550483	US8141265		

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.

Declaration of Conformity

Renishaw plc hereby declares that the QUANTiC 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: QUANTiC

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 QUANTiC 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 QUANTiC encoder range can be found in the following documents:

QUANTiC™ incremental optical encoder system data sheet (Renishaw part no. L-9517-9778)
RTLC incremental linear scale data sheet (Renishaw part no. L-9517-9417)
ADTpro-100 Advanced Diagnostic Tool data sheet (Renishaw part no. L-9518-0078)
ADTi-100 Advanced Diagnostic Tool data sheet (Renishaw part no. L-9517-9699)
ADTpro-100 Advanced Diagnostic Tool user guide (Renishaw part no. M-6647-9138)
ADT View software user guide (Renishaw part no. M-6195-9413)

These can be downloaded from our website at **www.renishaw.com/quanticdownloads** 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**.

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.

QUANTiC software notices

Third party licences

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

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US government notice

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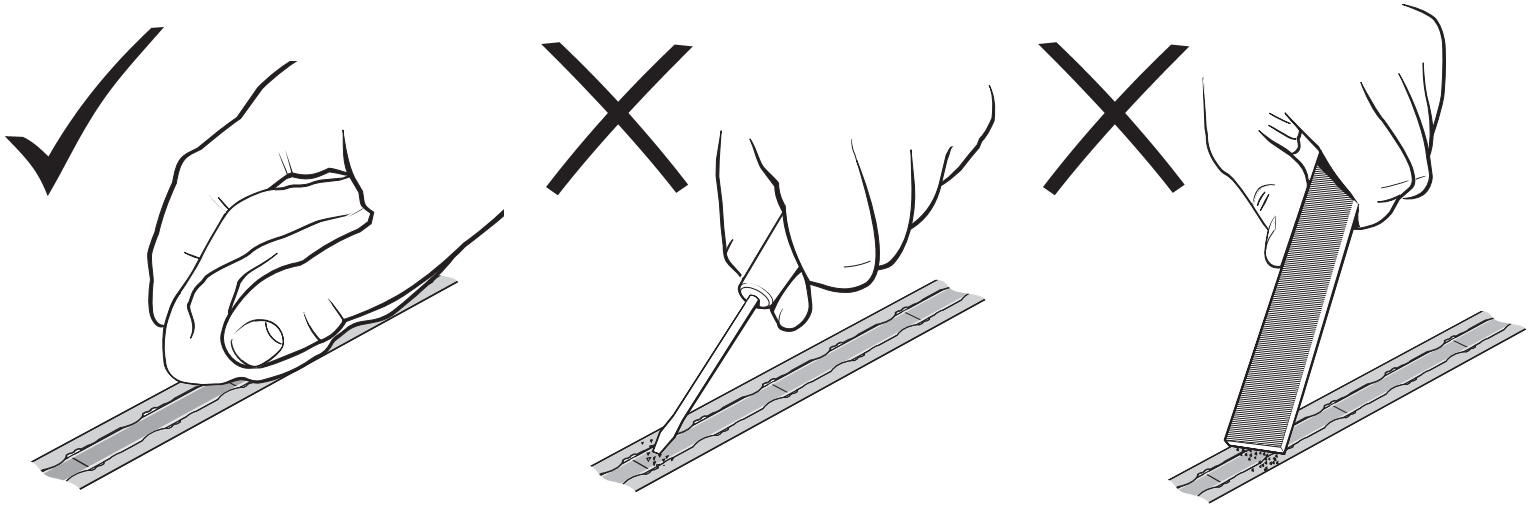
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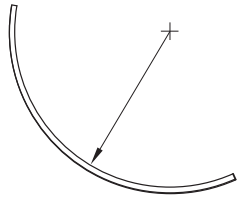
Renishaw software is licensed in accordance with the Renishaw licence at: **www.renishaw.com/legal/softwareterms**.

Storage and handling

QUANTiC 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.



Minimum bend radius

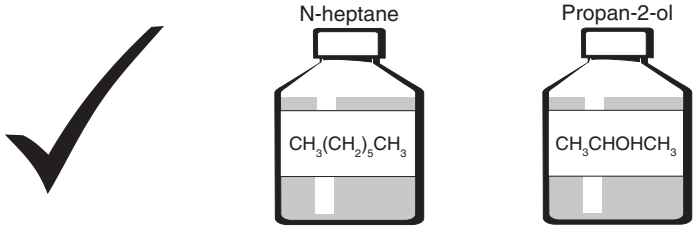


RTLC40 – 50 mm

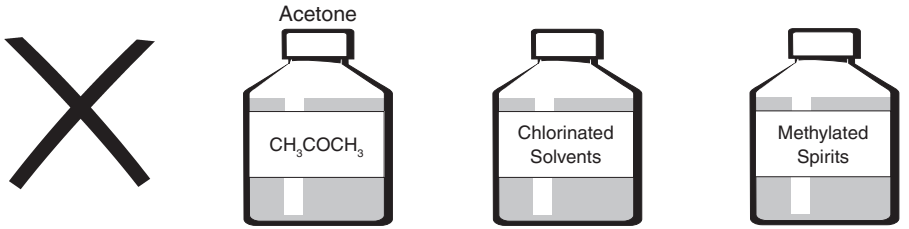
FASTRACK™ – 200 mm

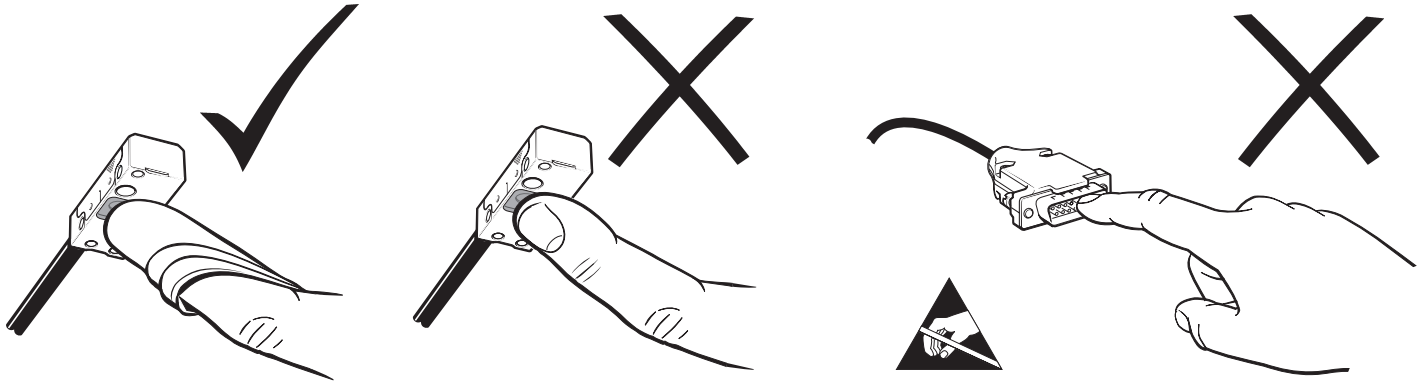
NOTE: During storage ensure the self-adhesive tape is on the outside of the bend.

Scale and readhead



Readhead only



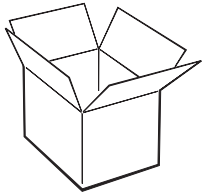


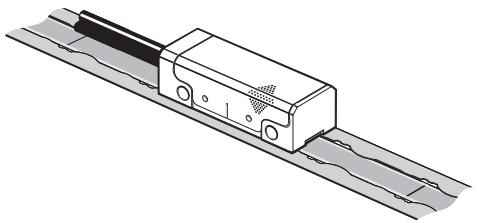


Temperature

Storage	
System	–20 °C to +70 °C

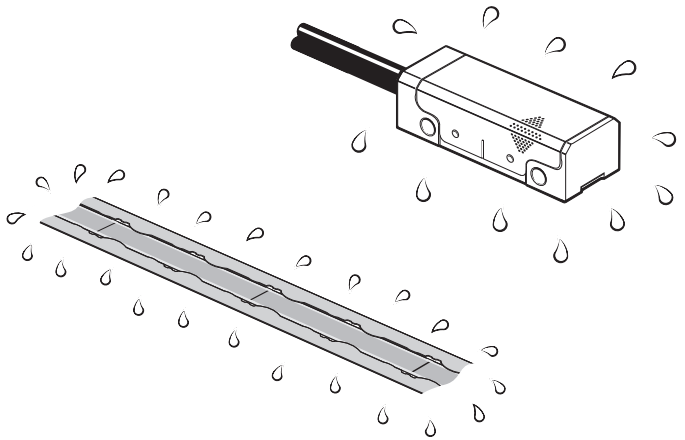
Operating	
System	0 °C to +70 °C





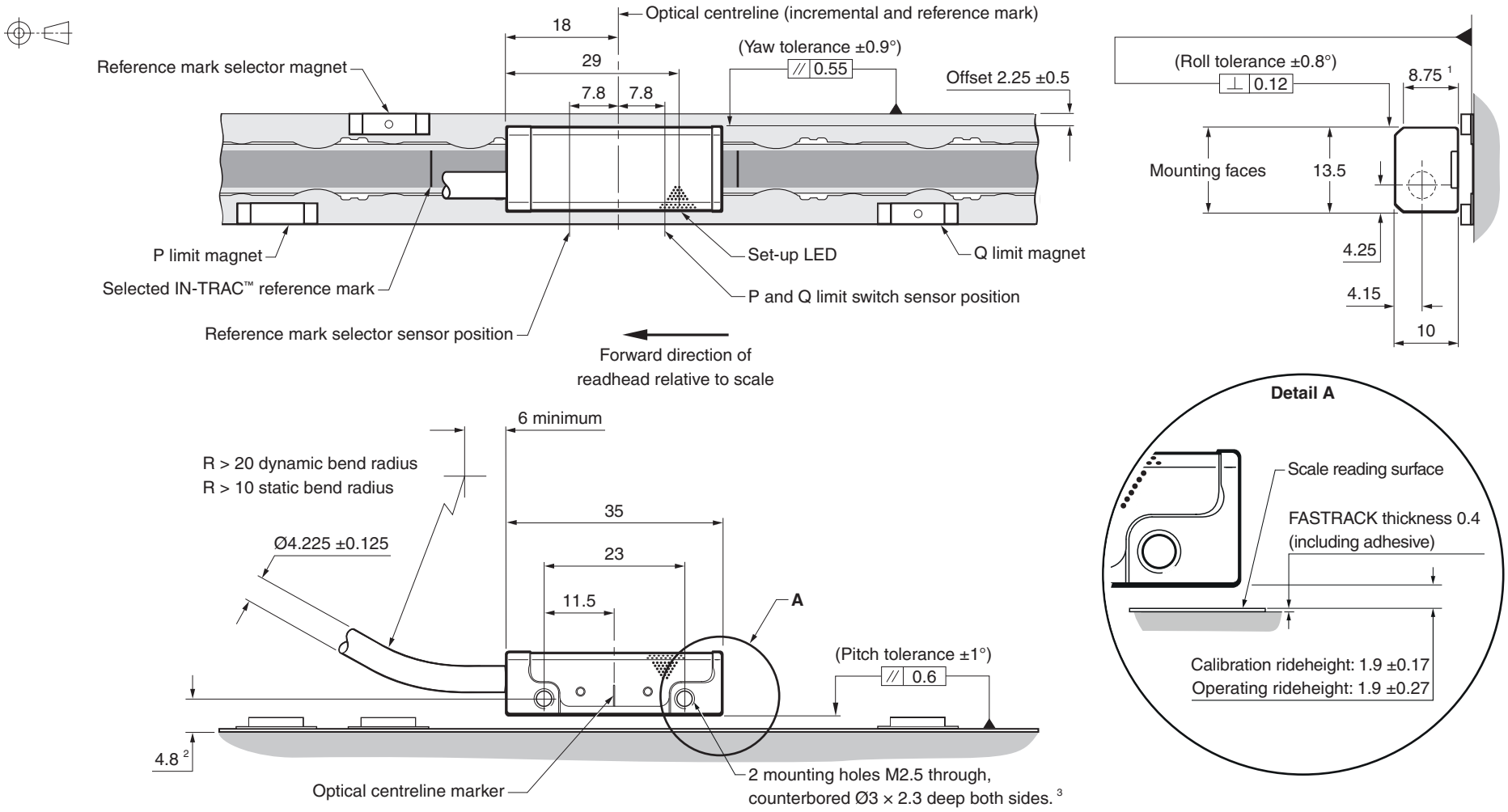
Humidity

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



QUANTiC readhead installation drawing

Dimensions and tolerances in mm



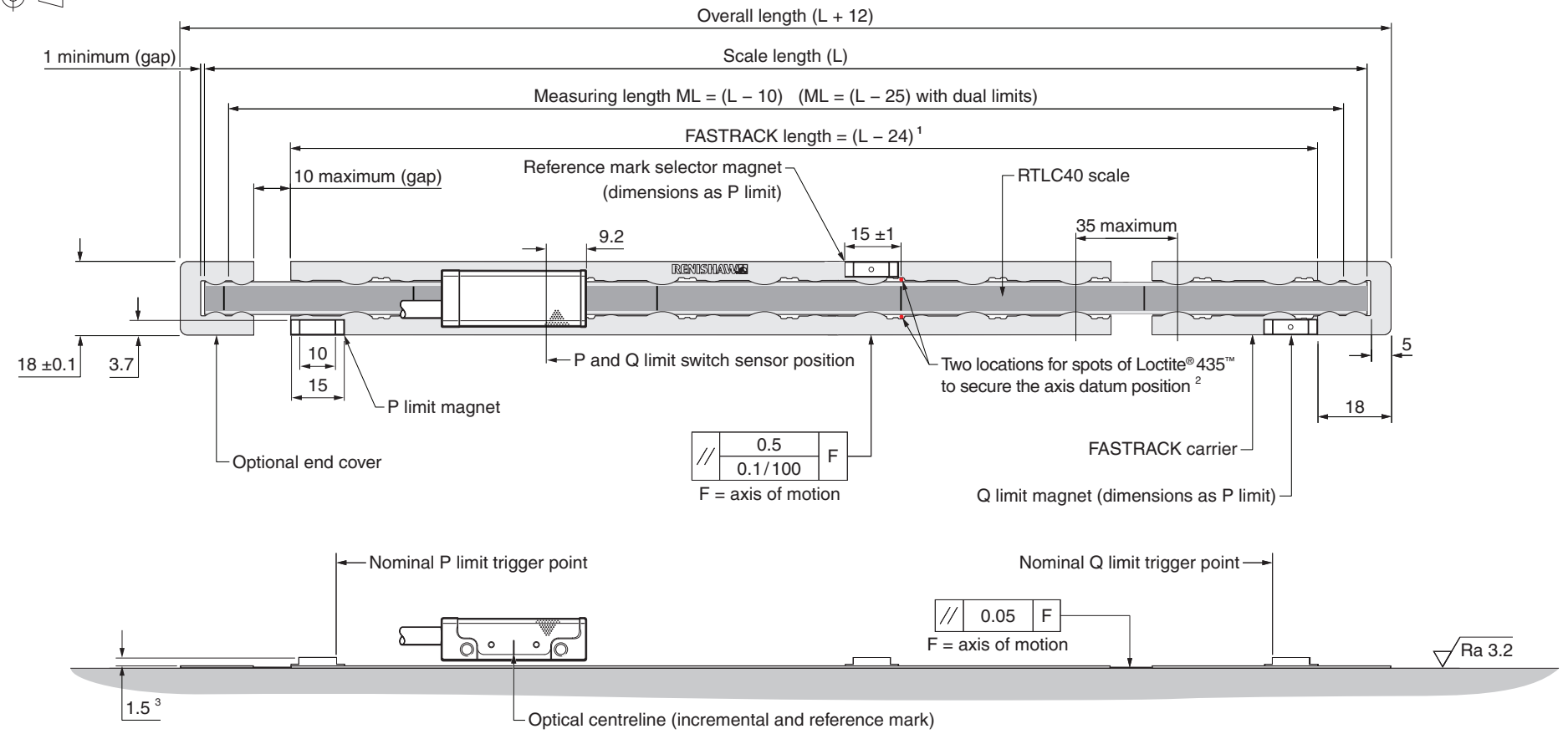
1 Extent of mounting faces.

2 Dimension from substrate.

3 The recommended thread engagement is 5 mm minimum (7.5 mm including counterbore) and the recommended tightening torque is 0.25 Nm to 0.4 Nm.

RTLC40 / FASTRACK system installation drawing

Dimensions and tolerances in mm



NOTES:

- The minimum recommended FASTRACK carrier length is 100 mm.
- The reference mark selector and limit actuator locations are correct for the readhead orientation shown.
- External magnetic fields greater than 6 mT, in the vicinity of the readhead, may cause false activation of the limit and reference sensors.

1 Assumes a 1 mm gap between the scale and the end covers and a zero gap between the FASTRACK carrier and the end covers.

2 For alternative mechanical datum clamp methods see 'Fitting the datum clamp' on page 18.

3 Dimension from the FASTRACK carrier surface.

Equipment required for installing the RTLC40 scale and the *FASTRACK* carrier

Required parts:

- Appropriate length of RTLC40 scale (see 'RTLC40 / FASTRACK system installation drawing' on page 12)
- Appropriate length of FASTRACK carrier (see 'RTLC40 / FASTRACK system installation drawing' on page 12)
- Loctite® 435™ (P-AD03-0012) or bolted datum clamp (A-9589-0077) [1]
- Appropriate cleaning solvents (see 'Storage and handling' on page 9)
- FASTRACK carrier centre section removal tool (A-9589-0122)
- Small pair of pliers
- Dial Test Indicator (DTI)
- Protective gloves

Optional parts:

- Renishaw scale wipes (A-9523-4040)
- Lint free cloth
- Reference mark selector magnet [2] (A-9653-0143)
- P limit magnet (A-9653-0138)
- Q limit magnet (A-9653-0139)
- Magnet applicator tool (A-9653-0201)
- Guillotine (A-9589-0071) or shears (A-9589-0133) for cutting the RTLC40 scale and the FASTRACK carrier to the length required
- Loctite 435 dispensing tip (P-TL50-0209)
- RTL scale installation tool (A-9589-0420)
- A pair of scale end covers (A-9589-0058)

[1] Used to secure the axis datum position.

[2] The reference mark selector magnet is only required for 'Customer selectable reference mark' readheads. For more information refer to *QUANTiC™ incremental optical encoder system* data sheet (Renishaw part no. L-9517-9778).

Cutting the RTLC40 scale and the FASTRACK carrier

CAUTION: During handling or installation of the FASTRACK carrier, suitable gloves should be worn to protect against injury from sharp edges.

If required, cut the FASTRACK carrier and the RTLC40 scale to length (separately) using the guillotine or the shears. Refer to the 'RTLC40/FASTRACK system installation drawing' on page 12.

Using the guillotine

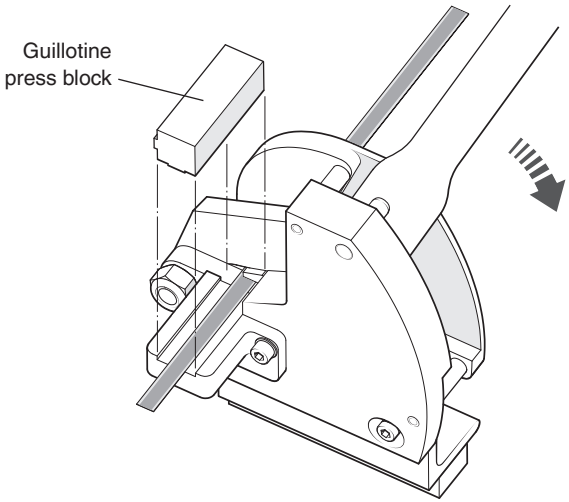
The guillotine should be held securely in place, using a suitable vice or clamping method.

Once secured, feed the FASTRACK carrier or the RTLC40 scale through the guillotine as shown, and place the guillotine press block down onto the FASTRACK/scale.

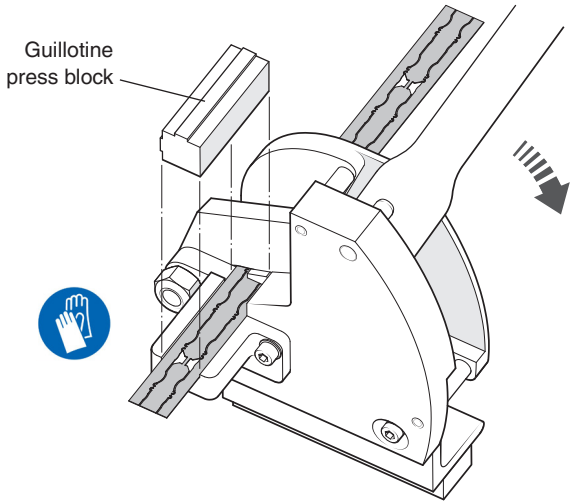
NOTE: Ensure the block is in the correct orientation (as shown below).

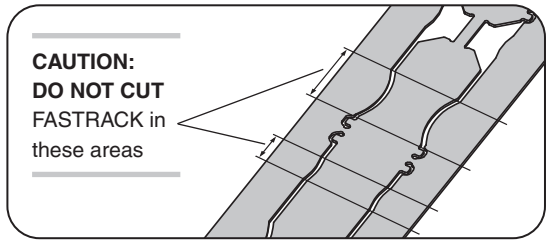
Whilst holding the block in place, in a smooth motion, pull down the lever to cut through the FASTRACK/scale.

Guillotine press block orientation when cutting the RTLC40 scale



Guillotine press block orientation when cutting the FASTRACK carrier



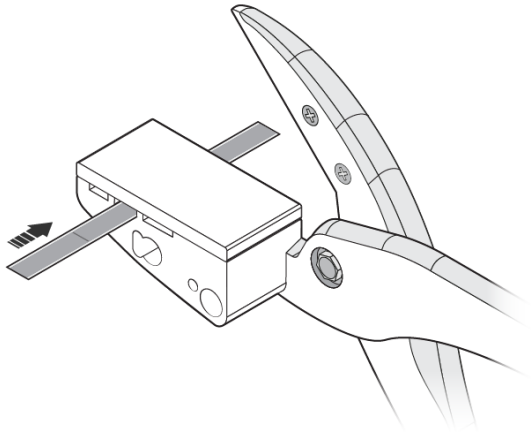


Using the shears

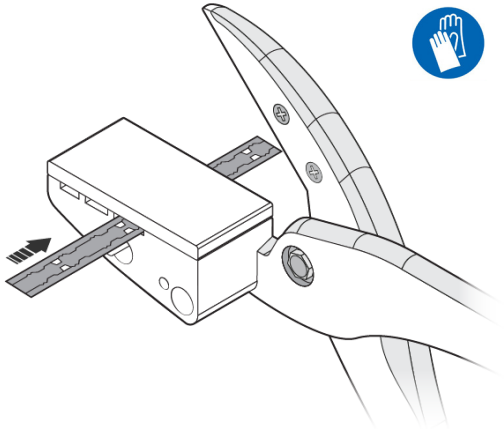
Feed the FASTRACK carrier of the RTLC40 scale through the appropriately sized aperture on the shears (as shown below).

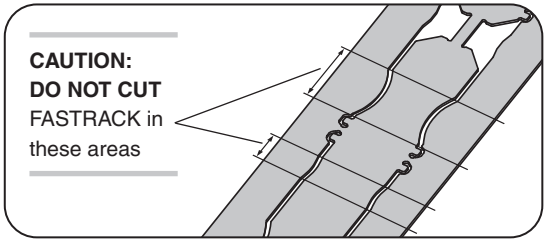
Hold the scale in place and close the shears in a smooth motion to cut through the scale.

Insertion of RTLC40 scale through the middle apperture



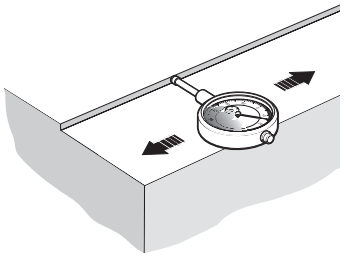
Insertion of FASTRACK carrier through the widest apperture



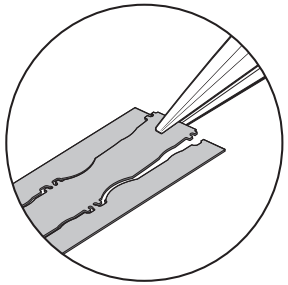


Applying the RTLC40 and FASTRACK scale system

1. Thoroughly clean and degrease the substrate and allow to dry. For locating the FASTRACK carrier, a ledge, separate straight edge(s) or dowels can be used.

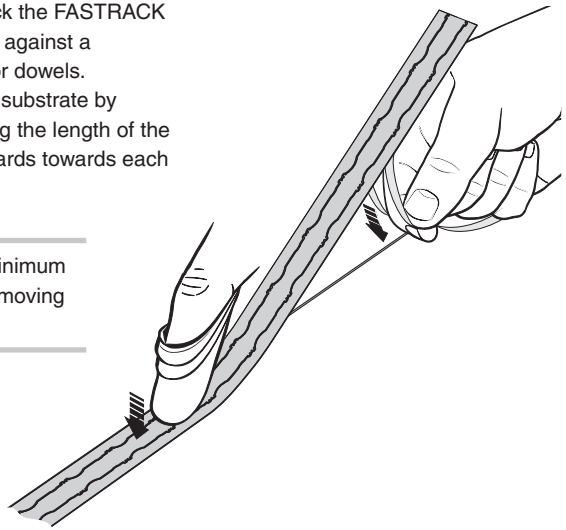


2. Check the alignment of the ledge / separate straight edge(s) with respect to axis of motion (see 'RTLC40 / FASTRACK system installation drawing' on page 12).



3. Before sticking the FASTRACK carrier to the substrate bend the centre section upwards slightly using a small pair of pliers.

4. Remove the backing liner and stick the FASTRACK carrier to the substrate, locating it against a ledge / separate straight edge(s) or dowels. Ensure complete adhesion to the substrate by applying firm finger pressure along the length of the FASTRACK from the centre outwards towards each end using a lint-free cloth.



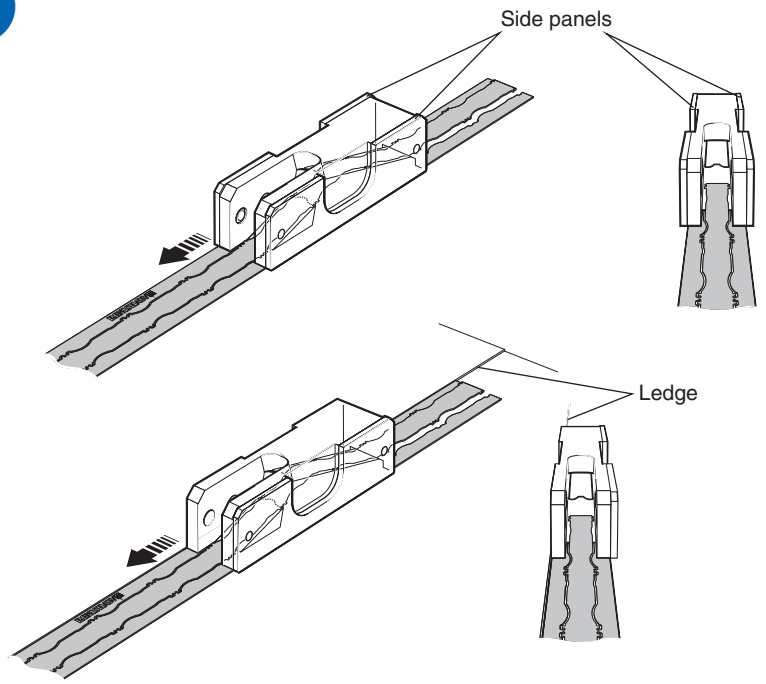
NOTE: Allow the FASTRACK a minimum of 20 minutes to adhere before removing the centre section.

5. Engage the centre section removal tool and, with a consistent forward pressure, remove the centre section of the FASTRACK carrier.

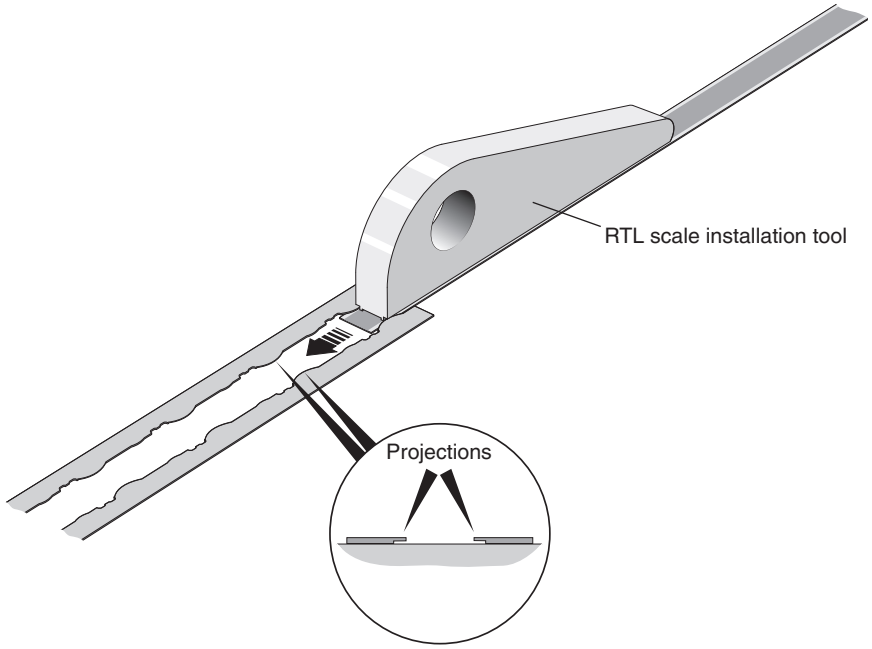
   If the ledge method or similar is used then the appropriate side panel on the removal tool will need to be removed as shown below.

IMPORTANT: Wear suitable protective gloves whilst carrying out this procedure to avoid risk of cuts.





6. Slide the RTLC40 scale into the FASTRACK carrier, ensuring the scale is fed under the projections as shown below. The RTLC40 scale can be installed manually by either pulling or pushing it through the FASTRACK carrier. Alternatively use the optional RTL scale installation tool as shown below.



NOTE: For instructions on how to use the scale installation tool, download the *RTL* scale installation tool* user guide (Renishaw part no. M-9589-9101) from the website at **www.renishaw.com/quanticdownloads**.

IMPORTANT: If manually installing the scale using fingers, suitable gloves should be worn to protect against injury from sharp edges.



7. Clean the FASTRACK carrier and the RTLC40 scale using Renishaw scale wipes or a clean, dry, lint-free cloth.

Fitting the datum clamp

The datum clamp fixes the RTLC40 scale rigidly to the substrate at the location chosen.

CAUTION: The metrology of the system may be compromised if the datum clamp is not used.

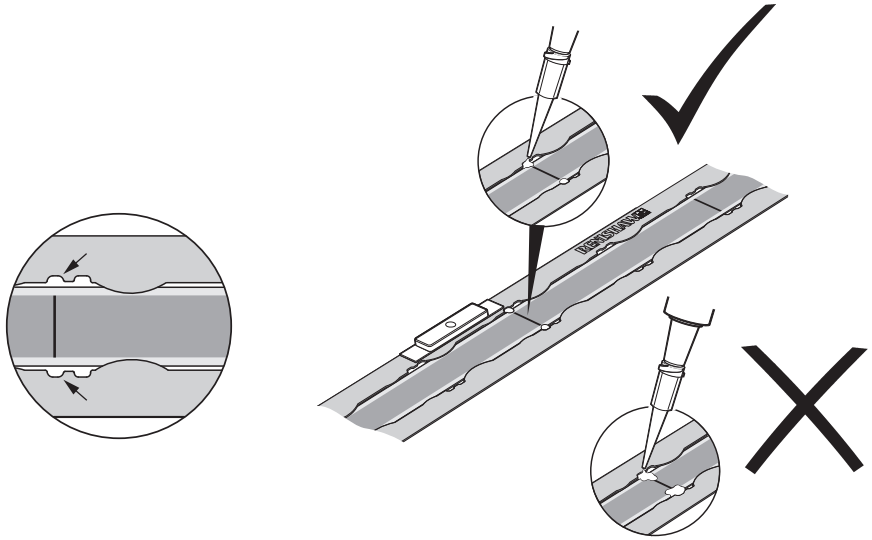
The datum clamp does not need to be fitted adjacent to a reference mark. It can be positioned anywhere along the axis depending upon the customers' requirements.

NOTE: When the reference mark and datum clamp are aligned as shown below, the reference output will be positionally repeatable with respect to the substrate.

Adhesive clamp

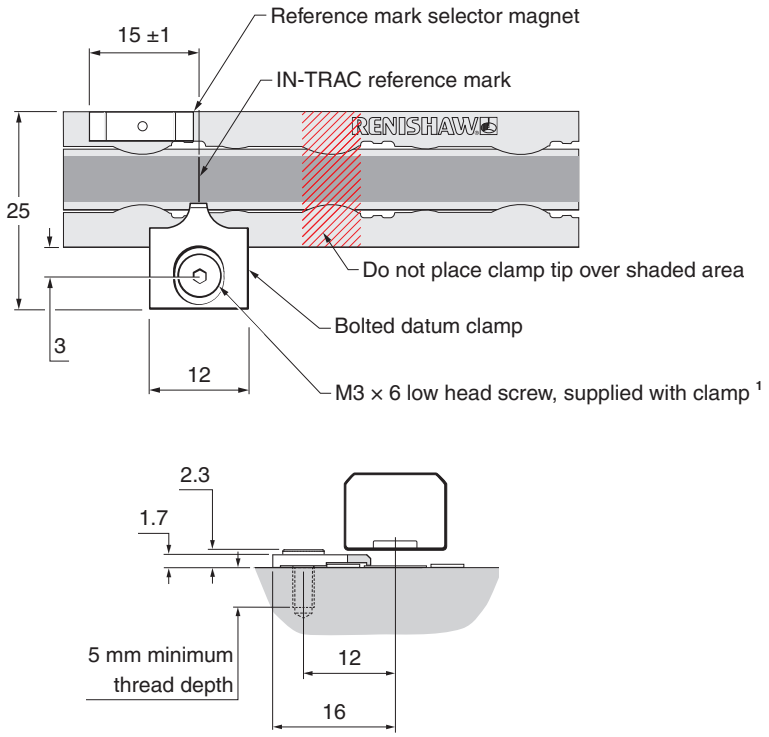
Use a dispensing tip to apply Loctite 435 between the scale and the FASTRACK so it wicks underneath, adjacent to the user selected datum location, as shown.

NOTE: The drawing shows the scale datum adjacent to the chosen reference mark.



NOTE: Only apply Loctite 435 in these gaps to ensure the best bond. Loctite 435 will wick under the scale to lock it to the substrate.

Mechanical clamp



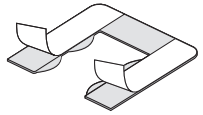
[1] Additional screws available (pack of 25 A-9584-2047)

Fitting the end covers

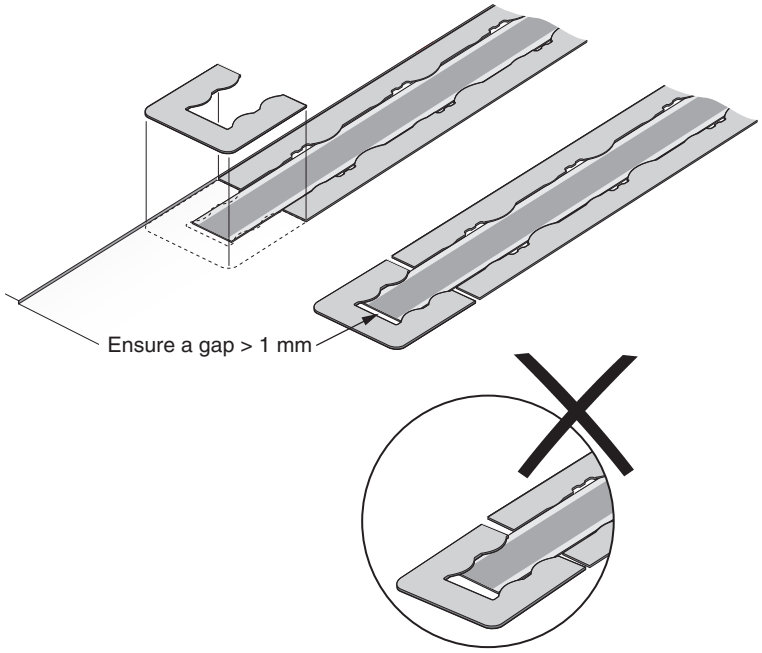
The end cover kit is designed to be used with FASTRACK to provide protection for exposed scale ends.

NOTE: End covers are optional and can be fitted before or after readhead installation.

1. Remove the backing tape from the adhesive tape on the back of the end cover.



2. Place the end cover at the end of the FASTRACK ensuring a gap of at least 1 mm between the end of the scale and the end cover.



Reference mark selector and limit magnet installation

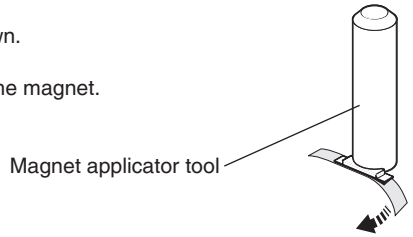
IMPORTANT: Allow 24 hours after the scale application before fitting the magnets.

As the readhead passes the reference mark selector magnet or limit switch magnet, a force of up to 0.2 N is generated between the magnet and the concentrators on the readhead.

- The design of the bracket should be sufficiently stiff so that it is able to tolerate such force without distorting.
- Fitting the scale and the FASTRACK carrier according to the instructions in this manual prevents the magnetic force from disturbing the scale.

For accuracy and ease of positioning of the reference mark selector and limit magnets, the applicator tool should be used.

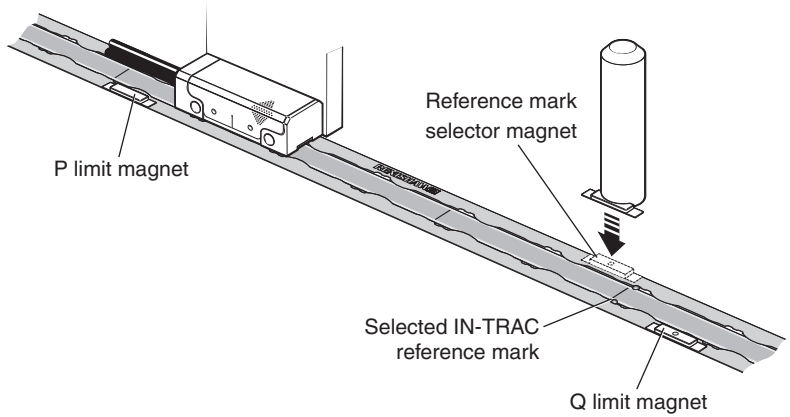
1. Attach the magnet to the applicator tool as shown.
2. Remove the self-adhesive backing paper from the magnet.



NOTES:

- The limit output is nominally asserted when the readhead limit switch sensor passes the limit magnet leading edge, but can trigger up to 3 mm before that edge (see 'RTLC40 / FASTRACK system installation drawing' on page 12).
- The reference and limit magnets may creep when influenced by magnetic materials in close proximity. In such cases, they should be held in place using an additional fillet of epoxy glue or similar along the outer edge of the magnet assembly.
- External magnetic fields greater than 6 mT, in the vicinity of the readhead, may cause false activation of the limit and reference sensors.

3. Place the magnet in the chosen location, aligned with the outer edges of the FASTRACK carrier ensuring that it is not mounted on the scale.
   - Limit magnets can be positioned at any user defined location along the axis length.
   - The reference mark selector magnet should be positioned adjacent to the selected IN-TRAC reference mark as shown. [1]



NOTE: The reference mark selector and limit actuator locations are correct for the readhead orientation shown.

4. Apply firm finger pressure to the magnet via a clean, dry, lint-free cloth to ensure complete adhesion

[1] The reference mark selector magnet is only required for 'Customer selectable reference mark' readheads. For more information refer to *QUANTiC™ incremental optical encoder system* data sheet (Renishaw part no. L-9517-9778).

QUANTiC readhead quick-start guide

This section is a quick-start guide to installing a QUANTiC readhead. More detailed information on installing the readhead is contained on page 22 to page 26 of this installation guide.

The Advanced Diagnostic Tools, ADTpro-100 or ADTi-100 with ADT View software, can be used to aid installation and calibration. See **www.renishaw.com/adt** for more information about the advanced diagnostic tools.

INSTALLATION

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

↓

If required, ensure the reference mark selector magnet is correctly positioned (see 'RTLC40 / FASTRACK system installation drawing' on page 12).

↓

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 signal strength over the full axis of travel as indicated by a green flashing LED.

CALIBRATION

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

↓

Move the readhead along the scale 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

Move the readhead back and forth over the selected 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 (LED remains single-flashing blue), restore the readhead factory defaults (see 'Restoring factory defaults' on page 26) and repeat the installation and calibration routine.

Readhead mounting and alignment

Mounting brackets

The bracket must have a flat mounting surface and should provide adjustment to 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 scale, readhead optical window and mounting face are clean and free from obstructions.

NOTE: When cleaning the readhead and the scale apply the cleaning fluid sparingly, do not soak.

1. Mount the readhead to the bracket using 2 M2.5 screws.
2. To set the nominal rideheight, place the black spacer with the aperture under the optical centre of the readhead to allow normal LED function during the set-up procedure.
3. Adjust the readhead to achieve a flashing green LED along the full axis of travel. The faster the flash rate, the closer it is to optimum set-up.

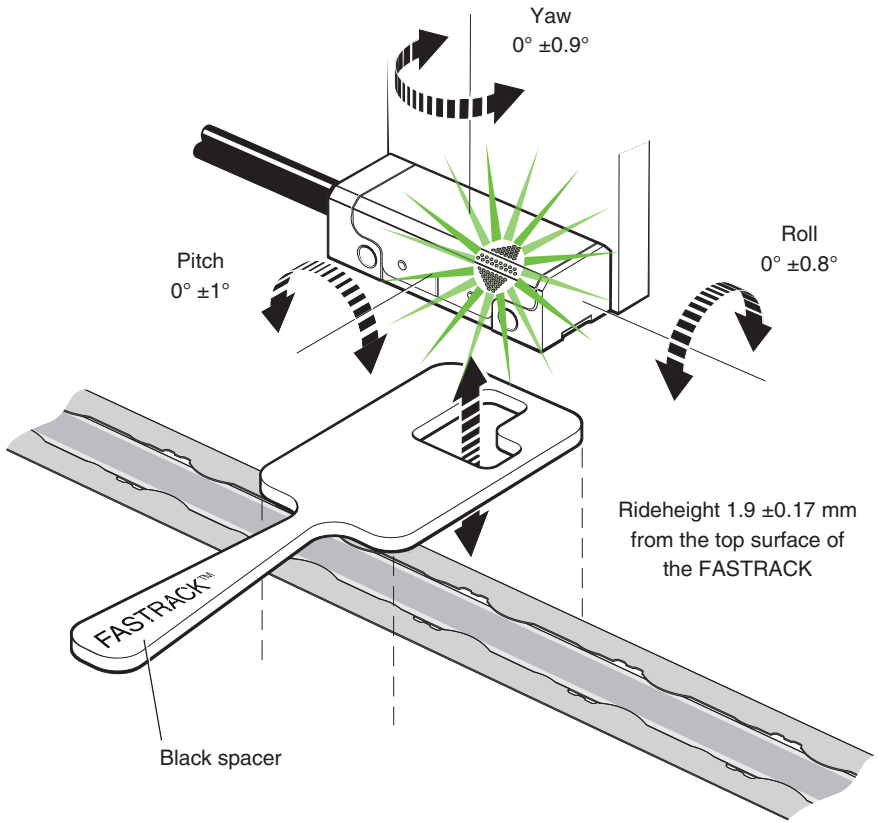
The Advanced Diagnostic Tools, ADTpro-100 or ADTi-100 and ADT View software, can also be used to help optimise signal strength in challenging installations. Refer to the ADTpro-100 user guide (Renishaw part no. M-6647-9138) or ADT View user guide (Renishaw M-6195-9413) for more information.

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

Readhead set-up LED status

Green flashing | Orange flashing | Red flashing

NOTE: For full readhead LED diagnostics, see 'Readhead LED diagnostics' on page 23.



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	Four red flashes	Low signal, over signal, or overspeed; system in error
	Red and purple flashing (analogue variant only)	AGC out of normal operating range

NOTE: See 'Troubleshooting' on page 27 for more information on diagnosing faults.

System calibration

NOTE: The system calibration can also be carried out using the Advanced diagnostic tools ADTpro-100 or ADTi-100 and ADT View software. Refer to the ADTpro-100 user guide (Renishaw part no. M-6647-9138) or ADT View user guide (Renishaw M-6195-9413) for more information.

Before system calibration:

1. Clean the scale and readhead optical window.
2. If reinstalling, restore the factory defaults (see 'Restoring factory defaults' on page 26).
3. Maximise the signal strength along the full length of travel (set-up LED is flashing green).

NOTE: During calibration the speed should not exceed 100 mm/s or the readheads' 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 periodically single-flash blue to indicate it is in calibration mode as detailed in 'Readhead mounting and alignment' on page 22. The readhead will only enter calibration mode if the LED is flashing green.
2. Move the readhead at slow speed along the axis, ensuring it does not pass a reference mark, until the LED starts double-flashing indicating 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. For systems without a reference mark, cycle the power to the readhead or connect the 'Remote CAL' output pin to 0 V for < 3 seconds to exit calibration mode.
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 (> 100 mm/s, or exceeding the readhead maximum speed), exit the calibration routine, restore factory defaults (see 'Restoring factory defaults' on page 26) and check the readhead installation and system cleanliness before repeating the calibration routine.

NOTE: For analogue variants of QUANTiC ensure the correct termination of output signals (see 'Recommended signal termination' on page 35).

Reference mark phasing

1. Move the readhead back and forth over the selected reference mark until the LED stops flashing and remains solid blue. The reference mark is now phased.

   NOTE: Only the chosen reference mark that has been used in the calibration routine is guaranteed to remain 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 chosen reference mark it is not being detected.
   - Ensure that the correct readhead configuration is being used. Readheads can either output all reference marks or only output a reference mark where a reference selector magnet is fitted depending on the options chosen when ordering.
   - Check that the reference mark selector magnet is fitted in the correct location relative to the readhead orientation (see 'RTLC40 / FASTRACK system installation drawing' on page 12).

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

Restoring factory defaults

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

NOTE: Factory defaults can also be restored using the ADTpro-100 or ADTi-100 and ADT View software. Refer to the ADTpro-100 user guide (Renishaw part no. M-6647-9138) or ADT View user guide (Renishaw M-6195-9413) for more information.

To restore factory defaults:

1. Switch the system off.
2. Obscure the readhead optical window (using the black 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 22.

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 also be switched on or off using the ADTpro-100 or ADTi-100 and ADT View software. Refer to the ADTpro-100 user guide (Renishaw part no. M-6647-9138) or ADT View user guide (Renishaw M-6195-9413) for more information.

Troubleshooting

Fault	Cause	Possible solutions
LED on the readhead is blank	There is no power to the readhead	• Ensure 5 V is supplied at the readhead • For cable variants check the correct wiring of the connector • If using the analogue variant of QUANTiC with the ADTi-100 ensure the appropriate adaptor cables are connected

LED on the readhead is flashing red during installation mode	The signal strength is < 50%	• Check the readhead optical window and scale are clean and free from contamination
		• Restore factory defaults (see page 26) and check the alignment of the readhead. In particular:
		  • Rideheight
		  • Yaw
		  • Offset
		• Ensure the correct scale and readhead combination

Unable to get a green LED over the complete axis length	System run-out is not within specification	• Use a DTi gauge and check the run-out is within specifications • Restore factory defaults (see page 26) • Realign the readhead to obtain a green flashing LED at the mid-point of the run-out • Recalibrate the system (see page 24)
Can't initiate the calibration routine	Signal size is < 70%	• Realign the readhead to obtain a green flashing LED

Fault	Cause	Possible solutions
During calibration the LED on the readhead remains single-flashing blue even after moving it along the full axis length	The system has failed to calibrate the incremental signals due to the signal strength being < 70%	• Exit CAL mode and restore factory defaults (see page 26) • Check the readhead set-up and alignment (see page 22)
	Incorrect termination (analogue variant only)	• Check the output signal termination (see page 35) • When using the readhead with the ADTi-100 in stand-alone mode ensure the Termination tool (A-6195-2132) is connected • Exit CAL mode and restore factory defaults (see page 26) • Check the readhead set-up and alignment (see page 22)
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	• Ensure correct position of the reference mark selector magnet • Ensure you are moving the readhead past your chosen reference mark several times • Check the readhead/selector magnet orientation • Check the readhead optical window and scale are clean and free from contamination

No reference mark output		• Ensure you are not moving the readhead too fast during calibration mode (maximum speed < 100 mm/sec)
		• Calibrate the system (see page 24)
		  • If the system completes the 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 (LED on the readhead remains double-flashing blue) see above for possible solutions.

Reference mark is not repeatable	Only the chosen reference mark that has been used in the calibration sequence is repeatable, other reference marks may not be phased	• Ensure you are using the reference mark that has been calibrated for referencing your system • The readhead bracket must be stable and not allow any mechanical movement of the readhead • Clean the scale and readhead optical window and check for damage then recalibrate the system over the chosen reference mark (see page 24)

Fault	Cause	Possible solutions
LED on the readhead is flashing red over the reference mark	The reference mark is not phased	• Ensure you are using the reference mark that has been calibrated for referencing your system as only this reference mark will be guaranteed to remain phased • Clean the scale and readhead optical window and check for scratches then recalibrate the system over the chosen reference mark (see page 24)
Multiple reference marks are being output	The readhead reference mark option is either option B or F, 'All reference marks are output'	• Calibrate the system ensuring all the incremental signal calibration steps and the reference mark phasing steps are completed (see page 24) • Ensure you calibrate the reference mark used for referencing your system as only this reference mark will be guaranteed to remain phased
LED on the readhead is flashing red and purple (analogue variant only)	AGC is outside of the normal operating range	• Check the output signal termination (see page 35) • When using the readhead with the ADTi-100 in stand-alone mode ensure the Termination tool (A-6195-2132) is connected • Check the cable continuity • Ensure the correct scale and readhead combination
LED on the readhead is flashing red four times upon switch on	Low signal, over signal, or the readhead speed is too fast. The system is in error.	• Check the readhead set-up and alignment (see page 22)
	Incorrect termination (analogue variant only)	• Check the output signal termination (see page 35) • When using the readhead with the ADTi-100 in stand-alone mode ensure the Termination tool (A-6195-2132) is connected • Exit the CAL mode and restore factory defaults (see page 26) • Check the readhead set-up and alignment (see page 22)

Output signals

Digital outputs

Function	Signal		Colour	9-way D-type (A)	15-way D-type (D)	15-way D-type alternative pin-out (H)	12-way circular connector (X)	14-way JST (J)
Power	5 V		Brown	5	7, 8	4, 12	G	10
	0 V		White	1	2, 9	2, 10	H	1
Incremental	A	+	Red	2	14	1	M	7
		–	Blue	6	6	9	L	2
	B	+	Yellow	4	13	3	J	11
		–	Green	8	5	11	K	9
Reference mark	Z	+	Violet	3	12	14	D	8
		–	Grey	7	4	7	E	12
Limits	P		Pink	-	11	8	A	14
	Q		Black	-	10	6	B	13
Alarm	E	–	Orange	-	3	13	F	3
Remote CAL [1]	CAL		Clear	9	1	5	C	4
Shield	-		Screen	Case	Case	Case	Case	Ferrule

[1] The remote CAL line must be connected for use with the ADTi-100.

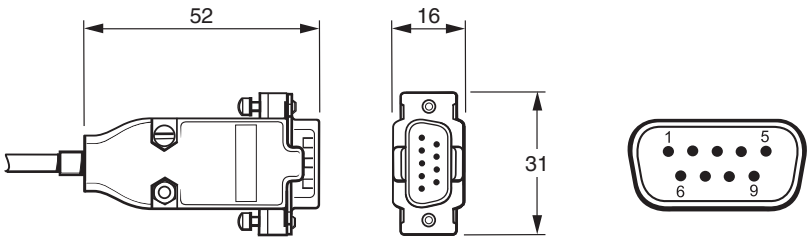
Analogue outputs

Function		Signal		Colour	15-way D-type (L)	15-way D-type alternative pin-out (H)	14-way JST (J)
Power		5 V		Brown	4, 5	4, 12	10
		0 V		White	12, 13	2, 10	1
Incremental	**Cosine**	V_1	+	Red	9	1	7
			–	Blue	1	9	2
	Sine	V_2	+	Yellow	10	3	11
			–	Green	2	11	9
Reference mark		V_0	+	Violet	3	14	8
			–	Grey	11	7	12
Limits		V_p		Pink	7	8	14
		V_q		Black	8	6	13
Setup		V_x		Clear	6	13	6
Remote CAL [1]		CAL		Orange	14	5	4
Shield		-		Screen	Case	Case	Ferrule

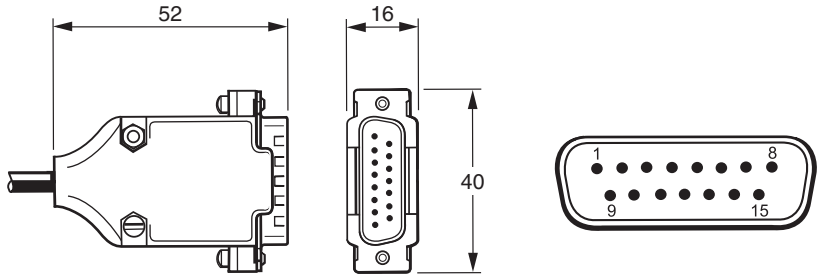
[1] The remote CAL line must be connected for use with ADTi-100.

QUANTiC readhead termination options

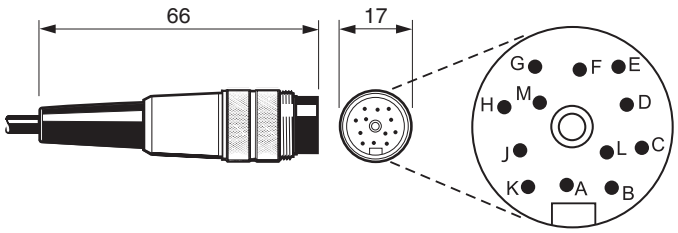
9-way D-type connector (termination code A)



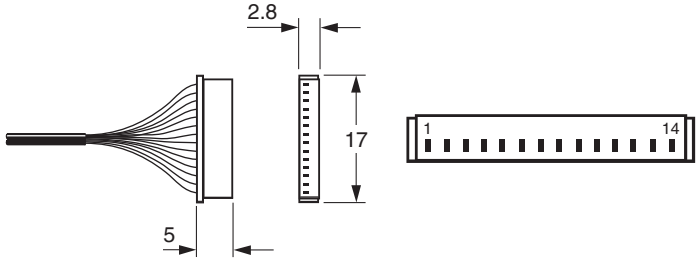
15-way D-type connector (termination code D, L, H)



12-way in-line circular connector (termination code X) [1]



14-way JST connector (termination code J) [2]



[1] 12-way circular Binder mating socket (A-6195-0105).

[2] Pack of 5 14-way JST SH mating sockets:
Bottom mount (A-9417-0025);
Side mount (A-9417-0026).
Maximum of 20 insertion cycles for JST connector.

Speed

Digital readheads

Clocked output option (MHz)	Maximum speed (m/s)							Minimum edge separation [1] (ns)
	T (10 µm)	D (5 µm)	X (1 µm)	Z (0.5 µm)	W (0.2 µm)	Y (0.1 µm)	H (50 nm)	
50	24	24	24	18.13	7.25	3.626	1.813	25.1
40	24	24	24	14.50	5.80	2.900	1.450	31.6
25	24	24	18.13	9.06	3.63	1.813	0.906	51.0
20	24	24	16.11	8.06	3.22	1.611	0.806	57.5
12	24	24	10.36	5.18	2.07	1.036	0.518	90.0
10	24	24	8.53	4.27	1.71	0.853	0.427	109
08	24	24	6.91	3.45	1.38	0.691	0.345	135
06	24	24	5.37	2.69	1.07	0.537	0.269	174
04	24	18.13	3.63	1.81	0.73	0.363	0.181	259
01	9.06	4.53	0.91	0.45	0.18	0.091	0.045	1038

Analogue readheads

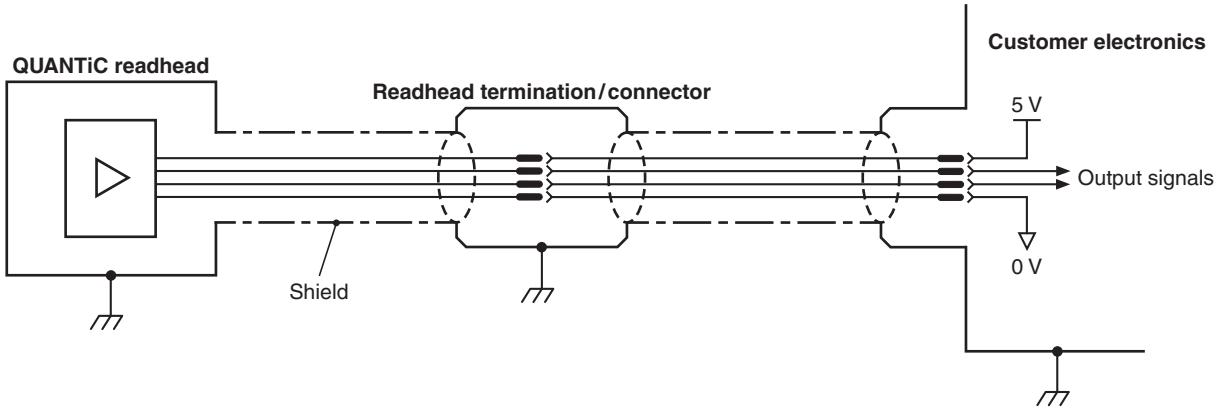
Maximum speed: 20 m/s (–3dB) [2]

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

[2] If the speed exceeds 20 m/s, SDE performance cannot be guaranteed.

Electrical connections

Grounding and shielding

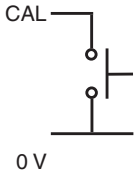


IMPORTANT: The shield should be connected to the machine earth (Field Ground). For JST variants the ferrule should be connected to the machine earth.

Maximum cable length

Readhead cable	10 m
Maximum extension cable length	Dependent on the cable type, the readhead cable length and the clocked output option. Contact your local Renishaw representative for more information.
Readhead to Advanced Diagnostic Tool	10 m

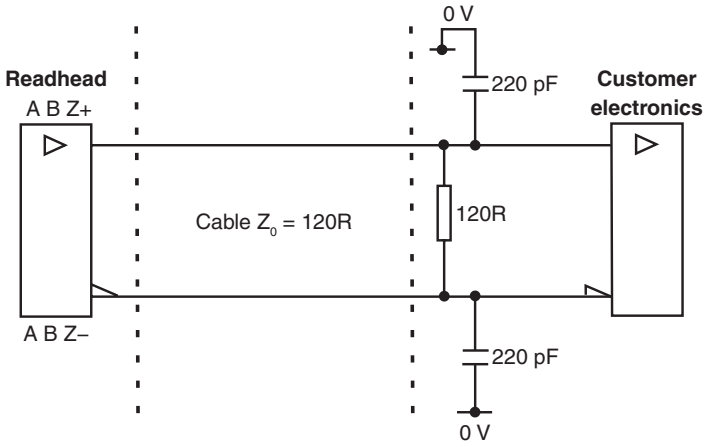
Remote CAL operation



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

Recommended signal termination

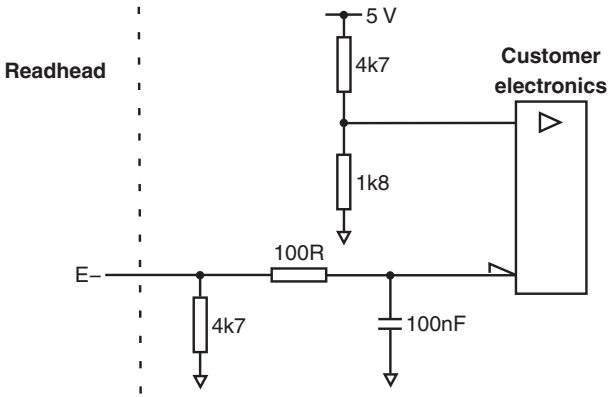
Digital outputs



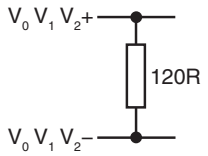
Standard RS422A line receiver circuitry.
The capacitors are recommended for improved noise immunity.

Single-ended alarm signal termination

(not available with 'A' cable termination)



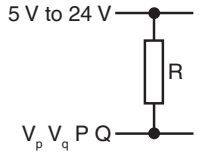
Analogue outputs



NOTE: 120R termination on the analogue output signals is essential for correct AGC operation.

Limit output

(not available with 'A' cable termination)



NOTE: Select R so that the maximum current does not exceed 20 mA. Alternatively, use a suitable relay or opto-isolator.

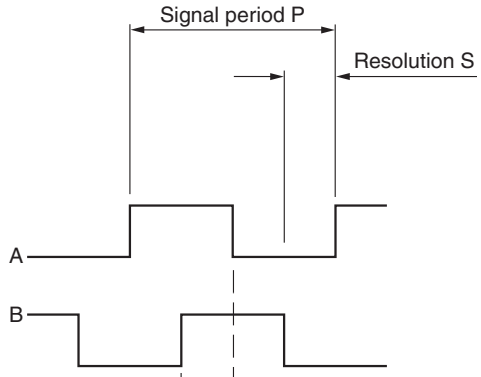
Output specifications

Digital output signals

Form – Square wave differential line driver to EIA RS422A (except limits P and Q)

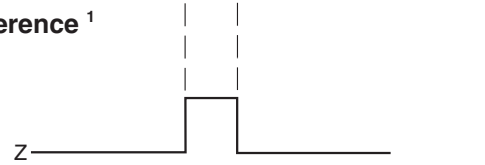
Incremental [1]

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



Resolution option code	P (µm)	S (µm)
T	40	10
D	20	5
X	4	1
Z	2	0.5
W	0.8	0.2
Y	0.4	0.1
H	0.2	0.05

Reference [1]



Synchronised pulse Z, duration as resolution. Bi-directionally repeatable. [2]

NOTE: A wide reference mark option, outputting a reference pulse for the duration of the signal period is available. Contact your local Renishaw representative for more information.

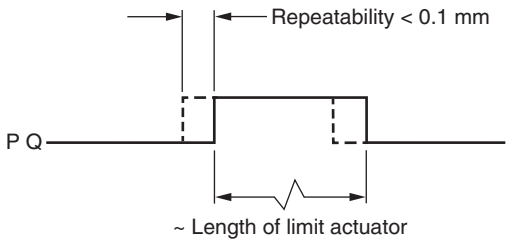
[1] For clarity, the inverse signals are not shown.

[2] Only the calibrated reference mark is bi-directionally repeatable.

Limits

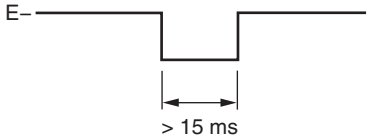
Open collector output, asynchronous pulse (not available with 'A' cable termination)

Active high



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

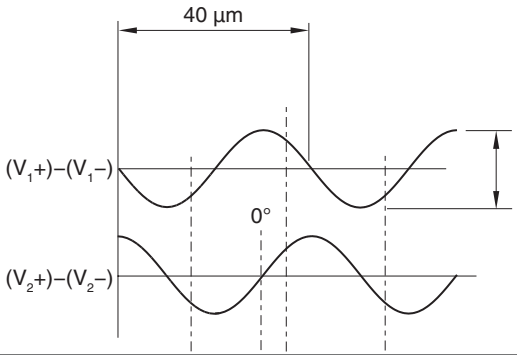
or 3-state alarm

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

Analogue output signals

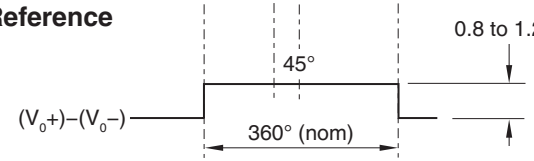
Incremental

2 channels V_1 and V_2 differential sinusoids in quadrature, centred on ~1.65 V (90° phase shifted)



0.7 to 1.35 Vpp with green LED (AGC off) and blue LED (AGC on) indication (readhead) and 120R termination.

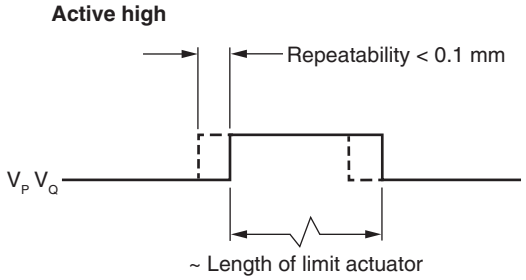
Reference



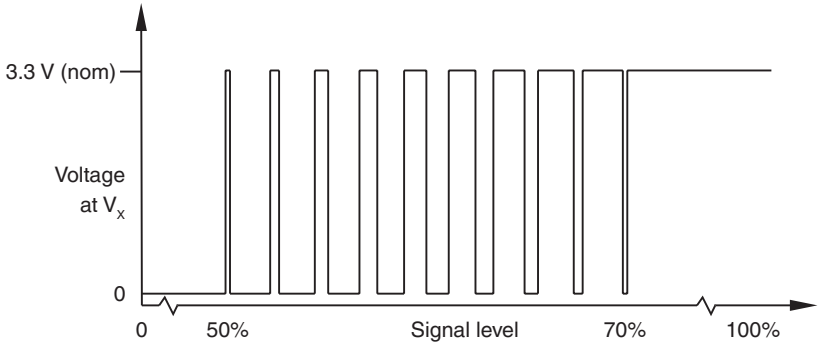
Bi-directionally repeatable. [1]
Differential pulse V_0 centred on 45°.

Limits

Open collector output, asynchronous pulse



Set-up [2]



Between 50% and 70% the signal level, V_x is a duty cycle. Time spent at 3.3 V increases with incremental signal level. At > 70% the signal level V_x is nominal 3.3 V.

1 Only the calibrated reference mark is bi-directionally repeatable.

2 The set-up signal as shown is not present during the calibration routine.

General specifications

Power supply	5V –5%/+10%	Typically 150 mA fully terminated (analogue output) Typically 200 mA fully terminated (digital output) 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	System (storage)	–20 °C to +70 °C
	System (operating)	0 °C to +70 °C
Humidity	System	95% relative humidity (non-condensing) to IEC 60068-2-78
Sealing		IP40
Acceleration	System (operating)	400 m/s², 3 axes
Shock	System (operating)	500 m/s², 11 ms, ½ sine, 3 axes
Vibration	Readhead (operating)	Sinusoidal 100 m/s² max @ 55 Hz to 2000 Hz, 3 axes
	Scale (operating)	Sinusoidal 300 m/s² max @ 55 Hz to 2000 Hz, 3 axes
Mass	Readhead	9 g
	Cable	32 g/m
EMC compliance		IEC 61326-1
Readhead cable		Single-shielded, 28 AWG cores, outside diameter 4.225 ±0.125 mm Flex life > 20 × 10^6 cycles at 20 mm bend radius UL recognised component
	Maximum length	10 m
Connector options		**Code - connector type - output type** A - 9-way D-type - digital output only L - 15-way D-type (standard pin-out) - analogue output only D - 15-way D-type (standard pin-out) - digital output only H - 15-way D-type (alternative pin-out) - analogue and digital output X - 12-way circular connector - digital output only J - 14-way JST connector - analogue and digital output
Typical sub-divisional error (SDE)	Analogue output	< ±120 nm
	Digital output	< ±80 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.

RTLC40 scale specifications

Form (height × width)		0.2 mm × 8 mm
Pitch		40 µm
Accuracy (at 20 °C) (includes slope and linearity)	RTLC40	±15 µm/m calibration traceable to International Standards
	RTLC40H	±5 µm/m calibration traceable to International Standards
Linearity	RTLC40	±5 µm/m (achievable with 2 point error correction)
	RTLC40H	±2.5 µm/m (achievable with 2 point error correction)
Supplied length		20 mm to 10 m (> 10 m available on request)
Material		Hardened and tempered martensitic stainless steel
Mass		12.2 g/m
Coefficient of thermal expansion (at 20 °C)		10.1 ±0.2 µm/m/°C
Installation temperature		+15 °C to +35 °C
Datum fixing		Loctite 435 or mechanical clamp (A-9589-0077)
Mounting		Sits in the FASTRACK carrier

FASTRACK technical specifications

Form (height × width)	0.4 mm × 18 mm (including adhesive)
Minimum recommended length	100 mm
Supplied length	100 mm to 25 m
Material	Hardened and tempered martensitic stainless steel
Mass	24 g/m
Coefficient of thermal expansion (at 20 °C)	10.1 ±0.2 µm/m/°C
Installation temperature	+15 °C to +35 °C
Mounting	Self-adhesive backing tape

Reference mark

Type	Customer selected IN-TRAC reference mark, directly embedded into the incremental track. Bi-directional position repeatability
L ≤ 100 mm	Single reference mark at scale centre
L > 100 mm	Reference marks at 50 mm spacing (first reference mark 50 mm from scale end)
Selection	Customer positioned selector magnet (A-9653-0143) for selecting desired IN-TRAC reference mark
Repeatability	Unit of resolution repeatability (bi-directional) across full system rated speed and temperature ranges

Limit switches

Type	Magnetic actuators; with dimple triggers Q limit, without dimple triggers P limit (see 'RTLC40 / FASTRACK system installation drawing' on page 12)
Trigger point	The limit output is nominally asserted when the readhead limit switch sensor passes the limit magnet leading edge, but can trigger up to 3 mm before that edge
Mounting	Customer placed at desired locations
Repeatability	< 0.1 mm

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www.renishaw.com/contact

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+44 (0) 1453 524524 uk@renishaw.com

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