Renishaw T103x Tonic Incremental Encoder Installation Guide

Contents

RENISHAW
apply innovation™

Renishaw T103x Tonic Incremental Encoder

Product Information

Specifications

- **Model:** TONiC T103x RTLC20/FASTRACK linear encoder system
- **RTLC20 Scale Technical Specifications:** 23
- **FASTRACK Technical Specifications:** 23
- **Legal Notices:** Copyright, Trade Marks, Patents, Declaration of Conformity

Product Usage Instructions

- **Installation Guide**
  Follow the installation guide provided in the manual (M-9589-9002-04-C) for proper setup.
- **Storage and Handling**
  Store the encoder system in a dry and clean environment. Handle with care to avoid damage.
- **Readhead Mounting and Alignment**
  Mount the read-head securely to ensure accurate readings. Align it properly with the scale for optimal performance.
- **System Calibration**
  Calibrate the system according to the instructions provided to ensure precise measurements.
- **Restoring Factory Defaults**
  If needed, follow the steps to restore factory default settings as outlined in the manual.
- **Output Signals and Electrical Connections**
  Connect the system following the specified electrical connections to receive accurate output signals.
- **System Connection**
  Ensure proper system connection as described in the manual for seamless operation.

FAQ

- **Q: What should I do if I encounter interference during the operation?**
  A: If interference is encountered, ensure that the device is not causing harmful interference and accepts any received interference as per FCC rules.
- **Q: How can I find out the full details of my warranty?**
  A: Consult the Standard Terms and Conditions provided with the equipment and software for detailed warranty information.

Legal notices

Copyright
© 2009–2023 Renishaw plc. All rights reserved.

This document may not be copied or reproduced in whole or in part, or transferred to any other media or language by any means, without the prior written permission of Renishaw.

Trademarks

- RENISHAW® and the probe symbol are registered trademarks of Renishaw plc. Renishaw product names, designations and the mark ‘apply innovation’ are trademarks of Renishaw plc or its subsidiaries.
- Loctite® is a registered trade mark of the Henkel Corporation.
- Other brands, products or company names are trademarks of their respective owners.

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

- EP0748436 US5861953 EP1173731 US6775008B2 JP4750998
- CNCN100543424C US7659992 JP4932706 CNCN100507454C US7550710
- EP1766335 CNCN101300463B EP1946048 US7624513B2 JP5017275
- CNCN101310165B US7839296 EP1957943 US8141265 EP2294363
- CN102057256 JP5475759 JP5755299 KR20110033204 CN1314511
- EP1469969 JP5002559 US8466943 US8987633

Disclaimer
WHILE CONSIDERABLE EFFORT WAS MADE TO VERIFY THE ACCURACY OF THIS DOCUMENT AT PUBLICATION, ALL WARRANTIES, CONDITIONS, REPRESENTATIONS AND LIABILITY, HOWSOEVER ARISING, ARE EXCLUDED TO THE EXTENT PERMITTED BY LAW. RENISHAW RESERVES THE RIGHT TO MAKE CHANGES TO THIS DOCUMENT AND TO THE EQUIPMENT, AND/OR SOFTWARE AND THE SPECIFICATION DESCRIBED HEREIN WITHOUT OBLIGATION TO PROVIDE NOTICE OF SUCH CHANGES.

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 TONiC ™ encoder system complies 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 an 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, under 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 by 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.

ICES-001 — Industrial, Scientific and Medical (ISM) Equipment (Canada)

- This ISM device complies with Canadian ICES-001.

Further information
Further information relating to the TONiC encoder range can be found in the TONiC encoder system data sheet (L-9517-9337). This can be downloaded from our website www.renishaw.com/tonicdownloads and is also available from your local Renishaw representative.

Packaging

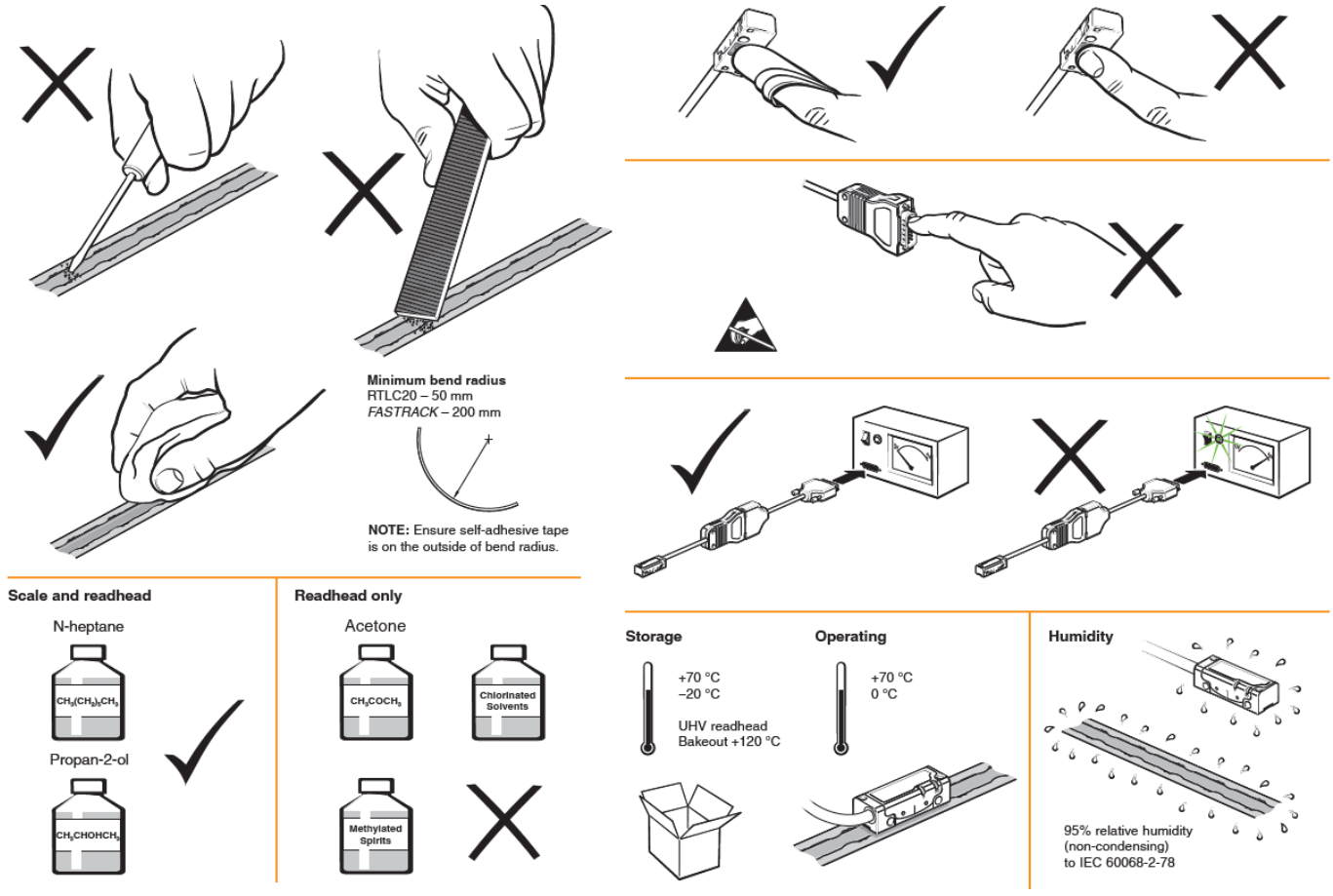
The packaging of our products contains the following materials and can be recycled.

Packaging Component	Material	ISO 11469	Recycling Guidance
Outer box	Cardboard	Not applicable	Recyclable
	Polypropylene	PP	Recyclable
Inserts	Low-density polyethylene foam	LDPE	Recyclable
	Cardboard	Not applicable	Recyclable
Bags	High-density polyethylene bag	HDPE	Recyclable
	Metalised polyethylene	PE	Recyclable

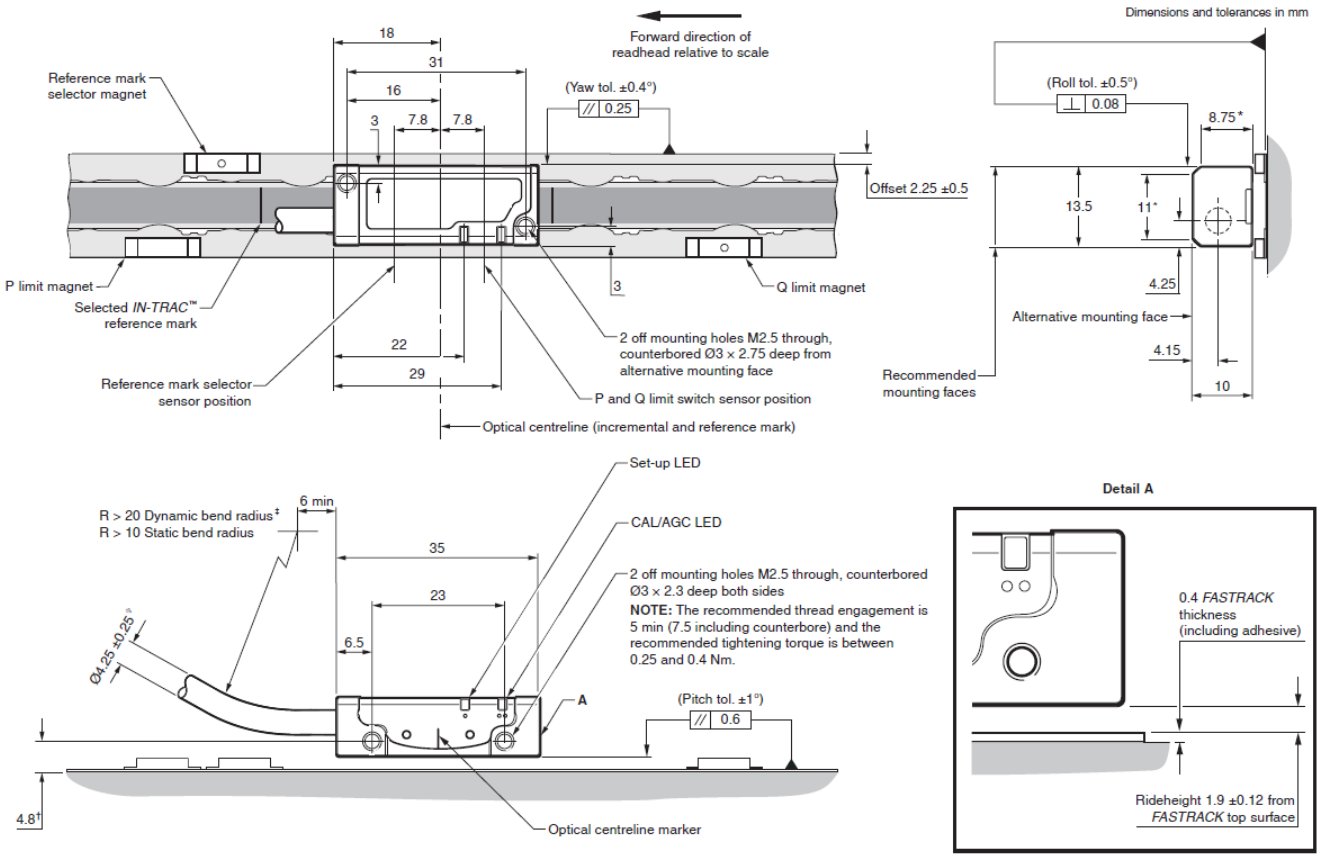
REACH regulation
Information required by Article 33(1) of Regulation (EC) No. 1907/2006 ('REACH') relating to products containing substances of very high concern (SVHCs) is available at: www.renishaw.com/REACH

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

Storage and handling

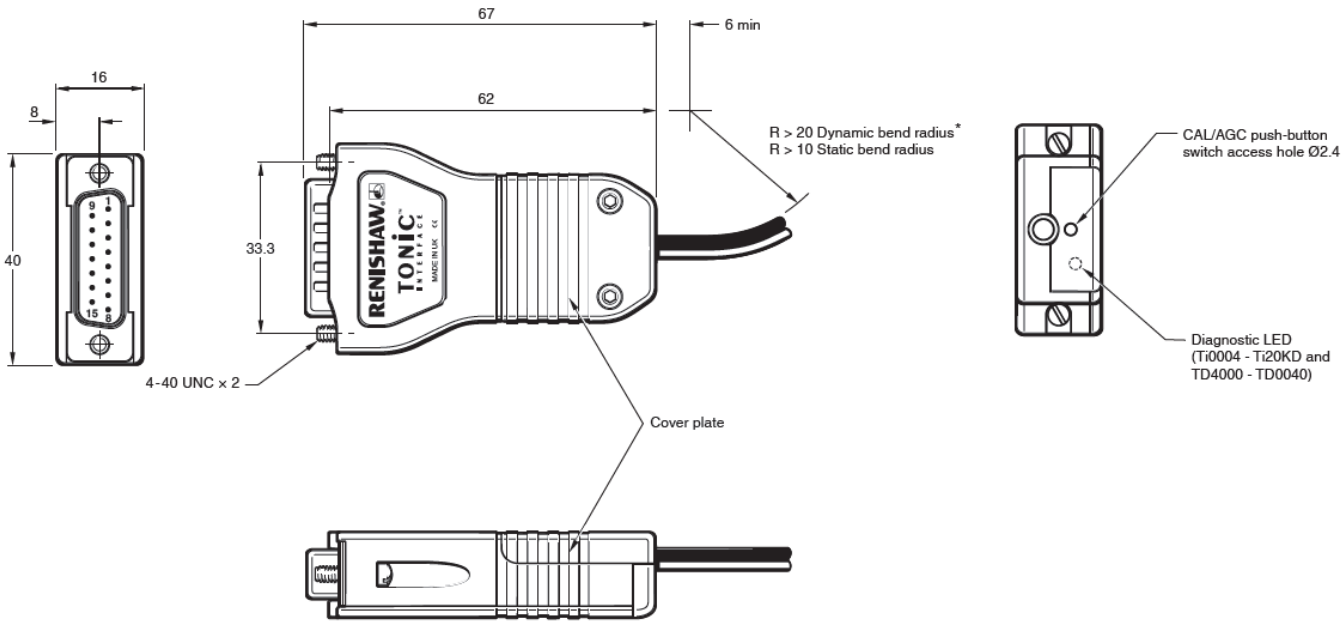


TONiC T1030 readhead installation drawing



- Extent of mounting faces.
- Dimensions from the substrate surface.
- Dynamic bend radius is not applicable for UHV cable.
- UHV cable diameter 3.0 approx.

TONiC interface drawing



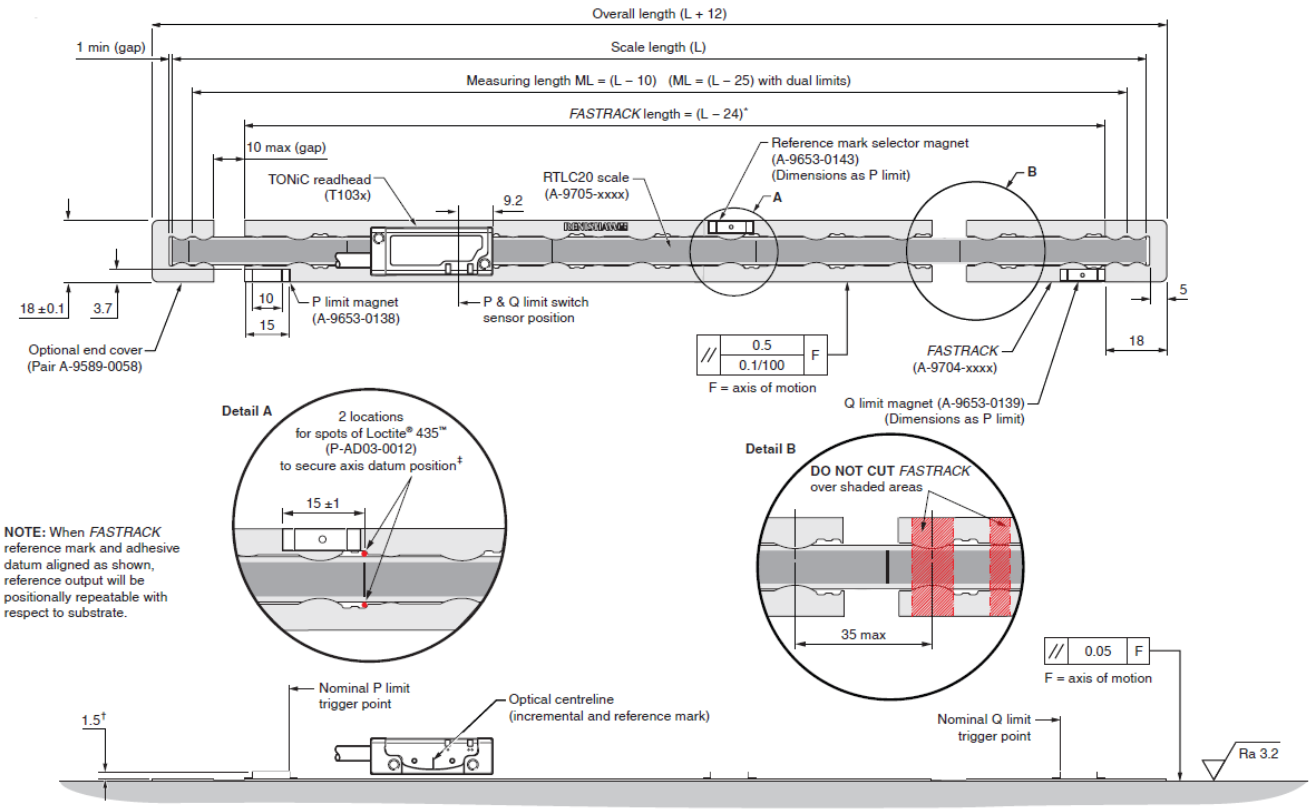
Dynamic bend radius is not applicable for UHV cables.

CAL/Calibration button operation

- Push and release (< 3 seconds) – CAL routine enable/disable.
- Push and release (> 3 seconds) – AGC enable/disable.
- Push and hold during the power ‘Off/On’ cycle – Restore factory defaults.
- Refer to the read-head LED functionality chart for CAL LED indications.

RTLC20/FASTRACK installation drawing

RTLC20/FASTRACK installation drawing (adhesive datum clamp *)



- Assumes a 1 mm gap between scale and end covers and zero gap between FASTRACK and end covers.
- Dimension from FASTRACK surface.
- For alternative mechanical datum clamp methods see ‘Scale datum’,.

NOTES:

- Minimum recommended FASTRACK length = 100 mm.
- The reference marks selector and limit actuator locations are correct for the read-head orientation shown.
- External magnetic fields greater than 6 mT, in the vicinity of the read-head, may cause false activation of the limit and reference sensors.

RTLC20/FASTRACK scale system installation

Equipment

Required parts

- Appropriate length of RTLC scale (‘RTLC20/FASTRACK installation drawing’, page 6)
- Appropriate length of FASTRACK carrier (‘RTLC20/FASTRACK installation drawing’, page 6)
- Loctite® 435™ (P-AD03-0012) *
- Appropriate cleaning solvents (‘Storage and handling’, page 3)
- Centre section removal tool (A-9589-0122)
- Small pair of pliers
- Dial test indicator (DTi)
- Protective gloves

* Used to secure axis datum position.

Optional parts

- Scale end cover (A-9589-0058)
- Renishaw scale wipes (A-9523-4040)
- Lint-free cloth
- Loctite® 435™ dispensing tip (P-TL50-0209)
- RTL scale installation tool (A-9589-0420)
- Guillotine (A-9589-0071) or shears (A-9589-0133) for cutting RTLC20 scale and FASTRACK carrier to length required

Cutting scale and FASTRACK carrier

- During handling or installation of FASTRACK, suitable gloves should be worn to protect against injury from sharp edges.
- If required, cut FASTRACK and scale to length (separately) using a guillotine or shears after referring to the installation drawing.

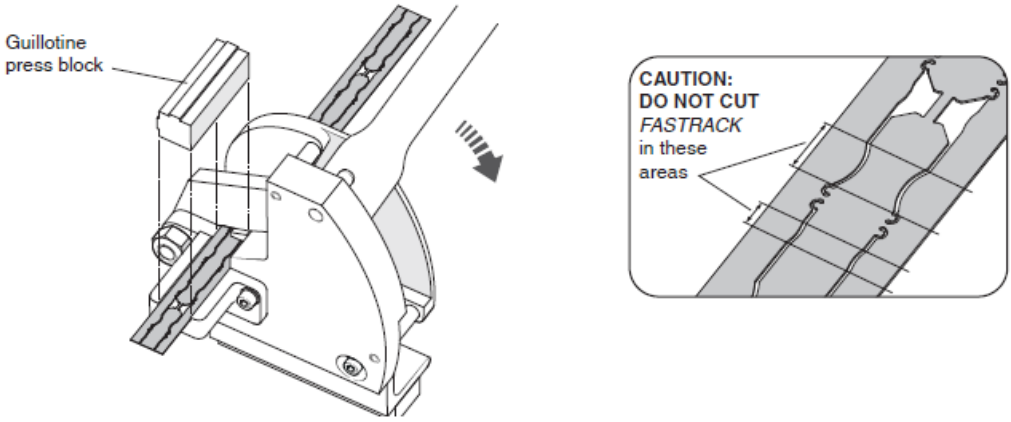
Using the guillotine

- The guillotine should be held securely in place, using a suitable vice or clamping method.
- Once secured, feed the FASTRACK or scale through the guillotine as shown, and place the guillotine press block down onto the FASTRACK /scale. Ensure the block is in the correct orientation (as shown).
- Whilst holding the block in place, in a smooth motion pull down the lever to cut through the FASTRACK /scale.

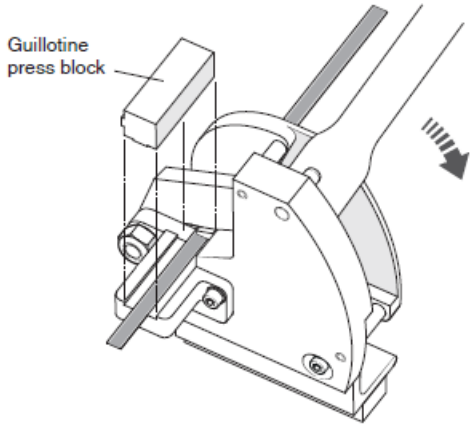
Using the shears

- Feed the FASTRACK or scale through the appropriately sized aperture on the shears (as shown below).
- Hold the FASTRACK /scale in place and close the shears in a smooth motion to cut through the scale.

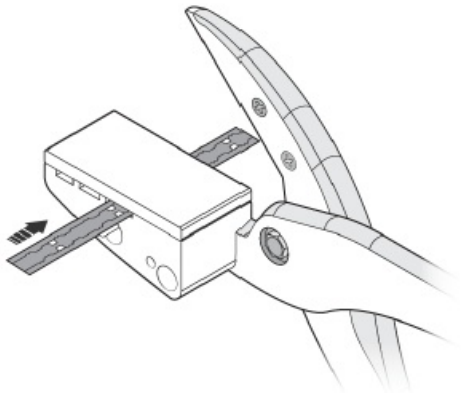
Guillotine press block orientation when cutting FASTRACK carrier



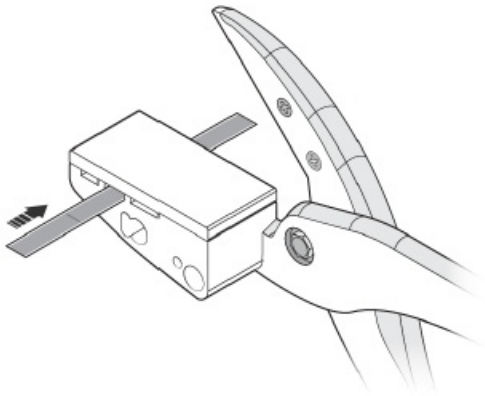
Guillotine press block orientation when cutting RTLC20 scale



Insertion of FASTRACK carrier through the widest aperture

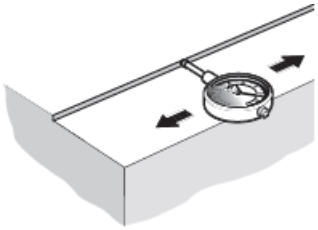


Insertion of RTLC20 scale through the middle aperture

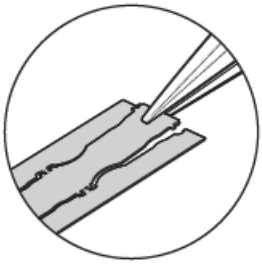


RTLC20 and FASTRACK application

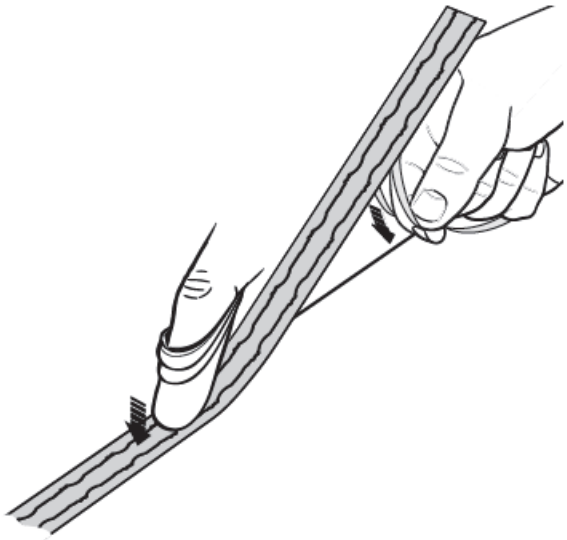
1. Thoroughly clean and degrease the substrate and allow it to dry.
   For FASTRACK location a ledge, separate straight edge(s) or dowels can be used.
   Check alignment of ledge/separate straight edge(s) concerning g axis of motion (‘RTLC20/FASTRACK installation drawing’,).



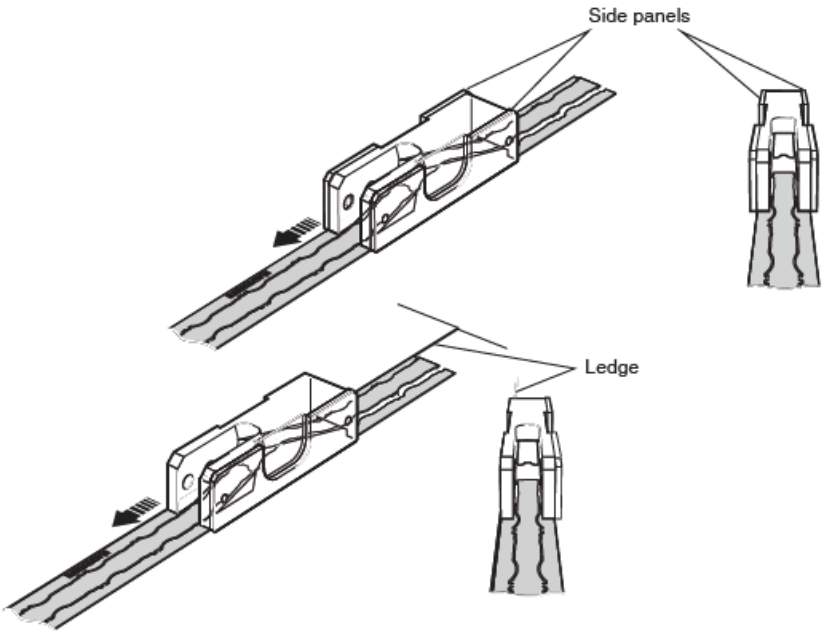
2. Before sticking FASTRACK to the substrate bend the centre section upwards slightly using a small pair of pliers.



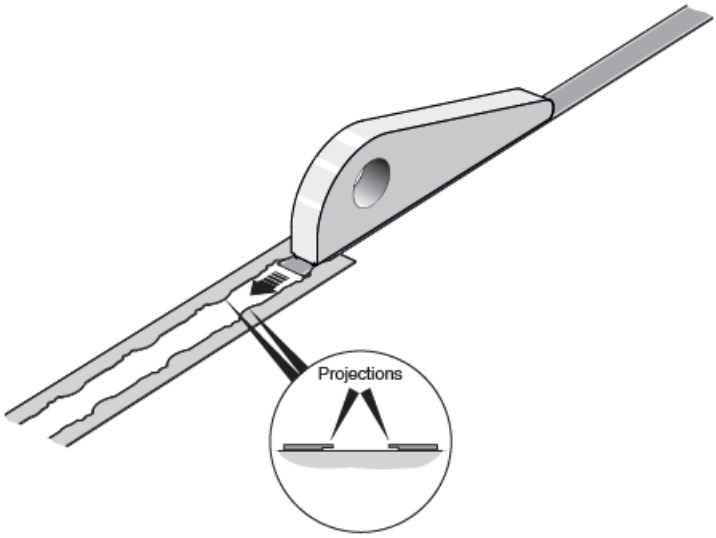
3. Remove the backing liner and stick it to the substrate, locating it against the ledge/separate straight edge(s) or dowels. Ensure complete adhesion to the substrate by applying firm finger pressure along the length of the FASTRACK from the centre outwards towards each end using a lint-free cloth if required.
   NOTE: Allow the FASTRACK a minimum of 20 minutes to adhere before removing the centre section.



4. Engage the centre section removal tool and with consistent forward pressure remove the centre section. If the ledge method or similar is used then the appropriate side panel on the removal tool will need to be removed as shown.
    - **IMPORTANT:** Wear suitable protective gloves whilst carrying out this procedure to avoid the risk of cuts.



5. Slide RTLC20 scale into the FASTRACK ensuring the scale is fed under the projections as shown. Scale can be installed manually by either pulling or pushing it through the FASTRACK carrier. Alternatively, use the optional scale installation tool as shown for easy installation.

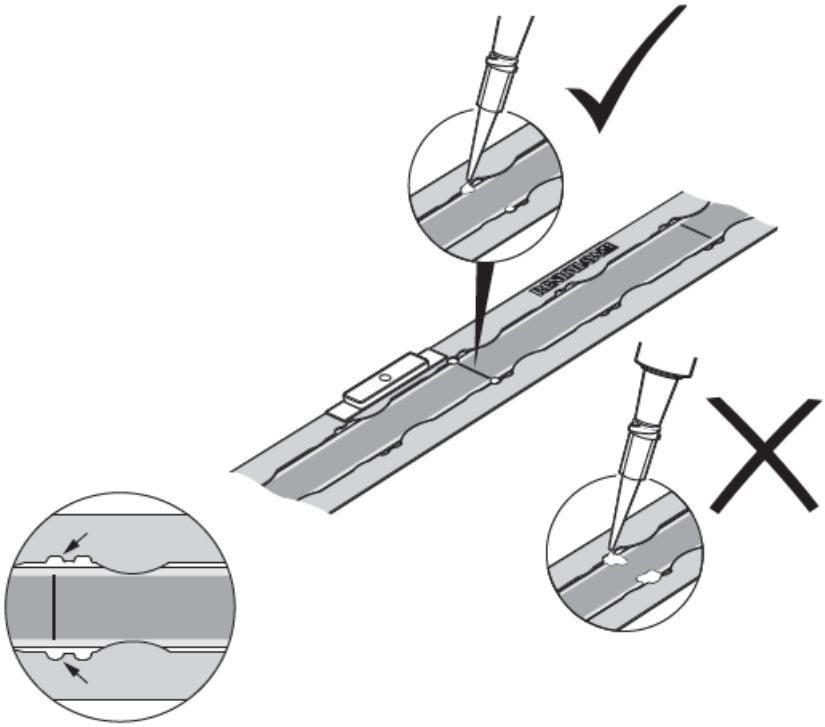


NOTE: For instructions on how to use the scale installation tool, download the RTL* scale installation tool (A-9589-0420) User guide (Renishaw part no. M-9589-9101) from the website at **www.renishaw.com/tonicdownloads**.

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

6. **Scale datum**
   - The datum clamp fixes the RTLC20 scale rigidly to the substrate at the location chosen.
   - 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 on the customer's requirements.

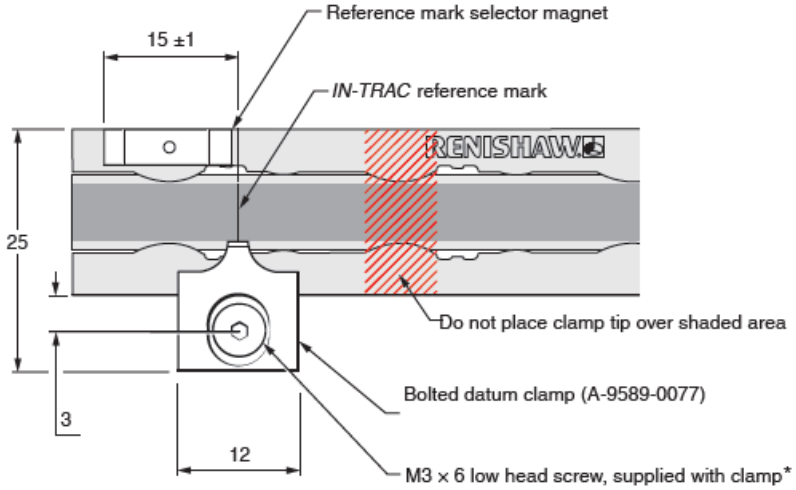
   Adhesive clamp
   - Using the dispensing tip apply Loctite 435 between the scale and FASTRACK so it wicks underneath adjacent to the user-selected datum location as shown.
   - NOTE: The drawing shows the scale datum adjacent to the chosen reference mark.



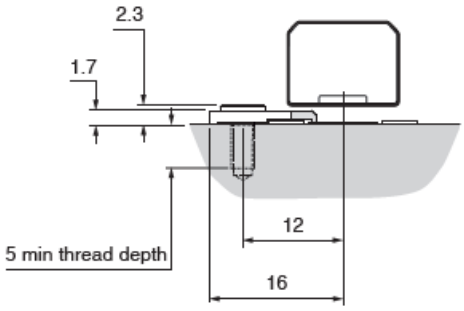
NOTE:

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

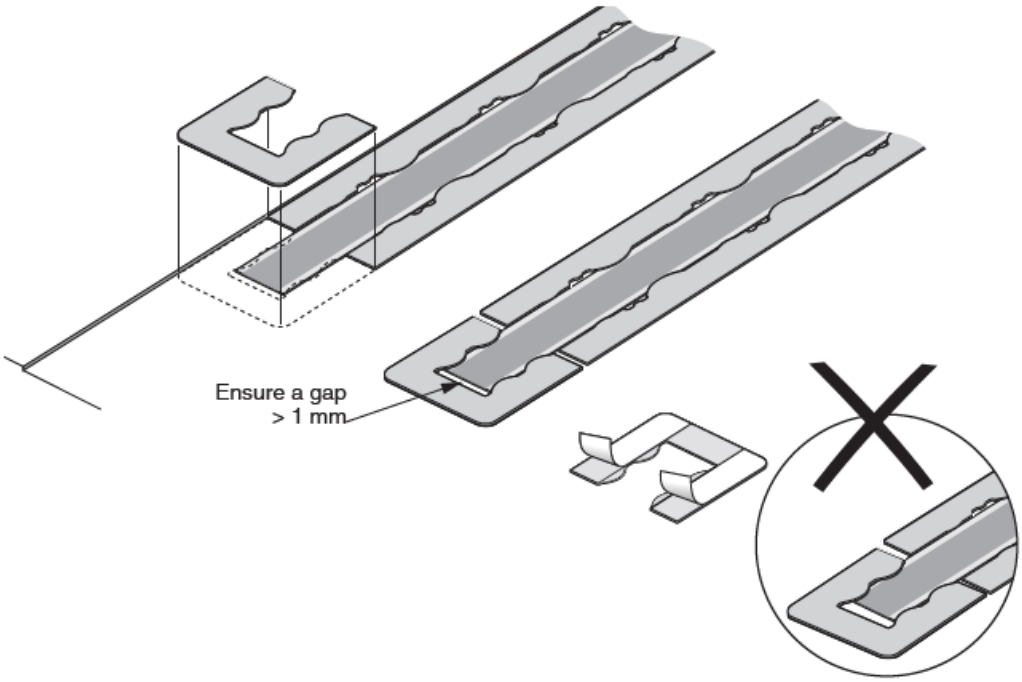


*** Additional screws available (pack of 25, A-9584-2047).**



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

7. **Optional:** fix self-adhesive end covers ensuring a gap of at least 1 mm between the end of the scale and the end cover.



8. Clean FASTRACK and scale using a lint-free cloth.

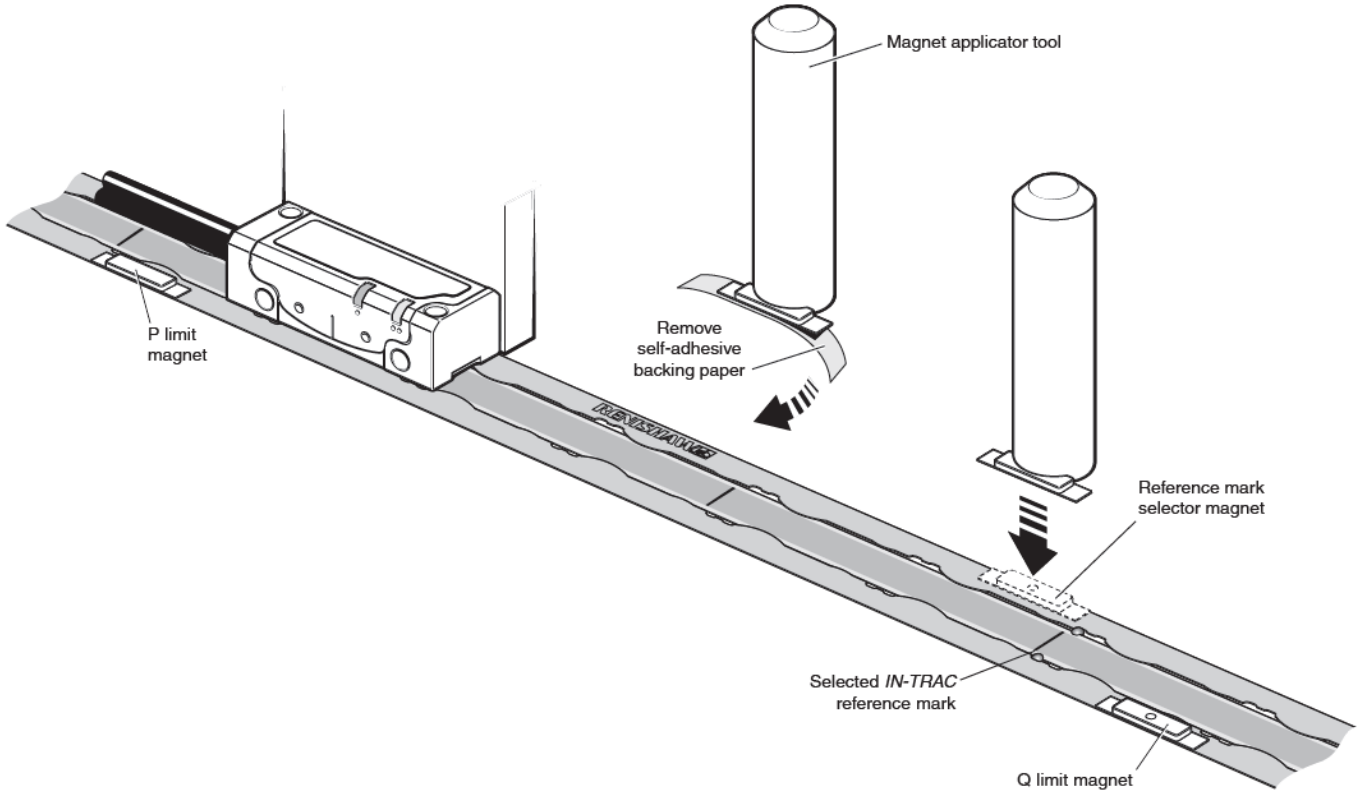
Reference mark selector and limit magnet installation

- **IMPORTANT:** Allow 24 hours after RTLC20 / FASTRACK application before fitting magnets.
- For accuracy and ease of positioning of reference mark selector and limit magnets, the applicator tool should be used. The magnet should be attached to the applicator tool as shown below and outlined with the outer edge of the
- FASTRACK. Limit magnets can be positioned at any user-defined location along the FASTRACK, but the reference mark selector magnet should be positioned adjacent to the chosen IN-TRAC reference mark as shown below.
- As the TONiC 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 readhead. The design of the bracket should be sufficiently stiff so that it can tolerate such force without distorting. Following the scale installation instructions will prevent this magnetic force from disturbing the scale.

Limit trigger point
The limit output is nominally asserted when the redhead limit switch sensor passes the limit magnet leading edge but can trigger up to 3 mm before that edge (‘RTLC20/FASTRACK installation drawing’, page 6).

NOTES

- Reference and limit magnets may creep when influenced by magnetic materials nearby. 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.
- The reference mark selector and limit actuator locations are correct for the read-head installation shown.
- All limit and reference selector magnets should be aligned with the outer edges of the FASTRACK.
- The reference mark selector magnet is only required for ‘Customer selectable reference mark’ redheads. For more information refer to the TONiC™ encoder system data sheet (Renishaw part no. L-9517-9337).
- External magnetic fields greater than 6mT, in the vicinity of the read-head, may cause false activation of the limit and reference sensors.



TONiC quick-start guide

- This section is a quick-start guide to installing a TONiC system.
- More detailed information on installing the system is contained in the following sections of the installation guide.

INSTALLATION

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

If required, ensure reference mark selector magnet is correctly positioned ('RTLC20/FASTRACK installation drawing', page 6).

Plug the readhead cable into the Ti/TD interface under the cover plate and reassemble interface. Connect to receiving electronics and power up.

Ensure AGC is switched off – the CAL LED on the readhead should be off (if not, press and hold the CAL button on the interface until the CAL LED on the readhead switches off).

Install and align the readhead to maximise signal strength over the full axis of travel as indicated by the readhead and interface set-up LEDs (readhead – Green; interface – ideally Blue/Purple).

CALIBRATION

Press and release the CAL button on the interface. The CAL LED on the readhead will be single-flashing.

Move the readhead along the scale at slow speed (< 100 mm/s), without passing a reference mark, until the CAL LED starts double-flashing.

No reference mark

If a reference mark is not being used, the calibration routine should now be exited by pressing and releasing the CAL button. The CAL LED will stop flashing. (Incremental CAL values are automatically stored.)

Reference mark

Move the readhead back and forth over the selected reference mark until the CAL LED stops flashing and remains 'off'. (Incremental and reference mark CAL values are automatically stored.)

The system is now calibrated and ready for use.

AGC can now be switched on if required by pressing and holding the CAL button until the CAL LED on the readhead switches on.

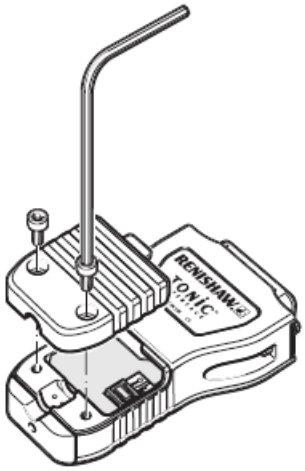
CAL values and AGC status are stored in readhead non-volatile memory at power down.

NOTE:
If calibration fails, restore factory defaults by pressing and holding the CAL button whilst switching on ('Restoring

factory defaults', page 17). Then repeat the installation and calibration routine.

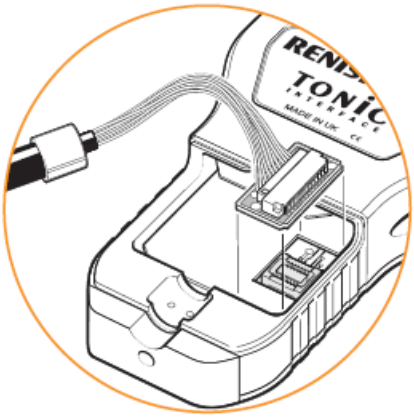
System connection

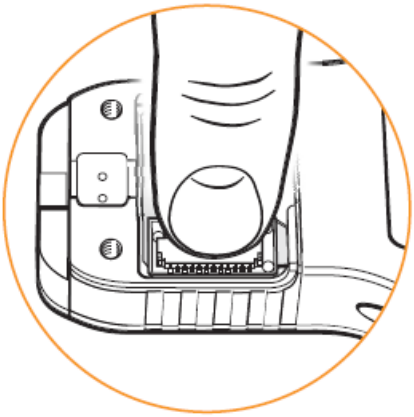
- Approved ESD precautions must be followed at all times during readhead and interface electrical connections.
- The redhead is connected to the Ti/TD interface via a small, rugged PCB connector to allow for easy feed-through during installation.



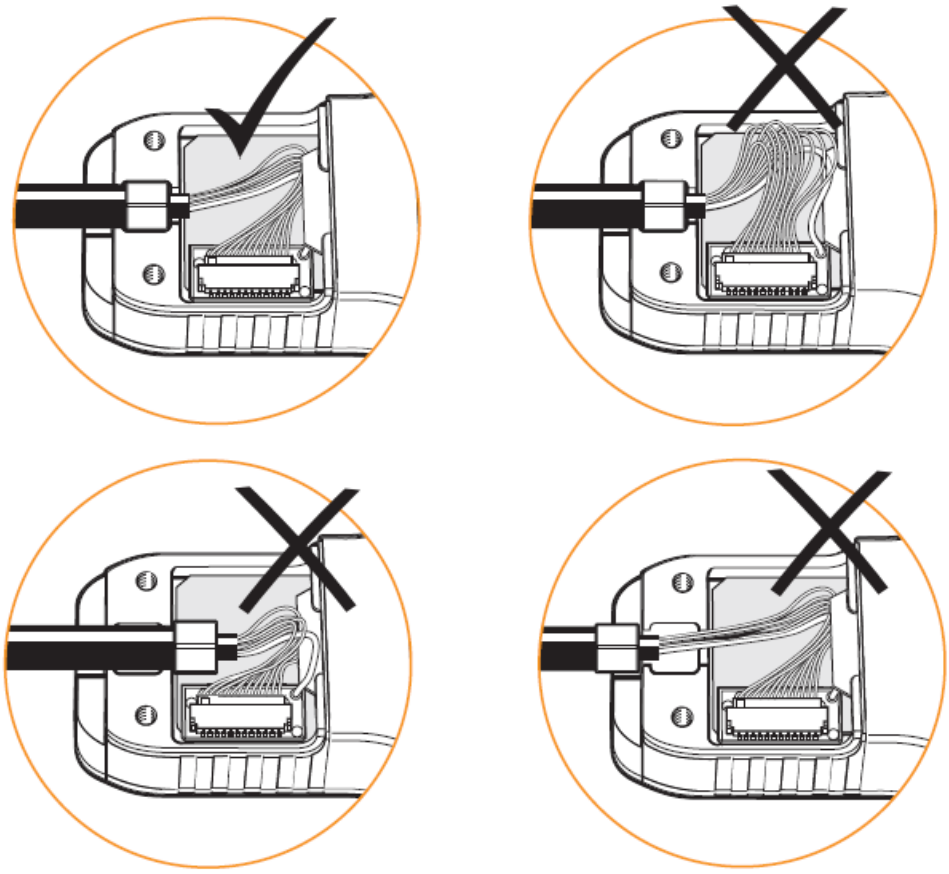
Connecting the redhead

1. Remove the cover plate as shown (2 × M2.5 hex head screws).
2. Taking care not to touch the pins, plug the connector into the socket in the interface, ensuring correct orientation as shown. Press-fit the PCB connector to ensure a good connection.



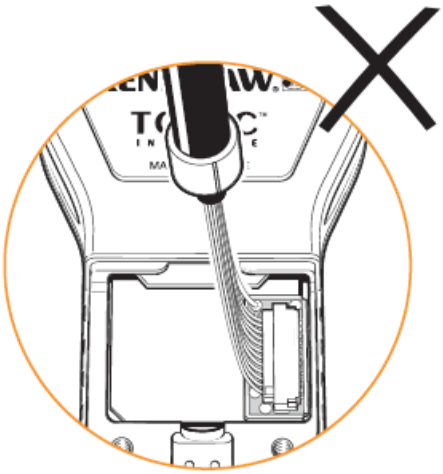


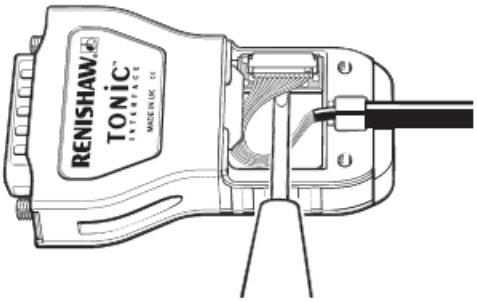
3. Refit the cover plate ensuring the cable ferrule is located in the recess on the inside and no wires are trapped under the cover plate.
   NOTE: The tightening torque should be between 0.25 Nm and 0.4 Nm.



Disconnecting the redhead

1. Remove the cover plate on the interface (2 × M2.5 hex head screws).
2. Gently lever the connector PCB (on the end of the cable) out of the socket. Do not pull the cable to remove the connector.
3. Place the connector in an anti-static bag.
4. Refit the cover plate.





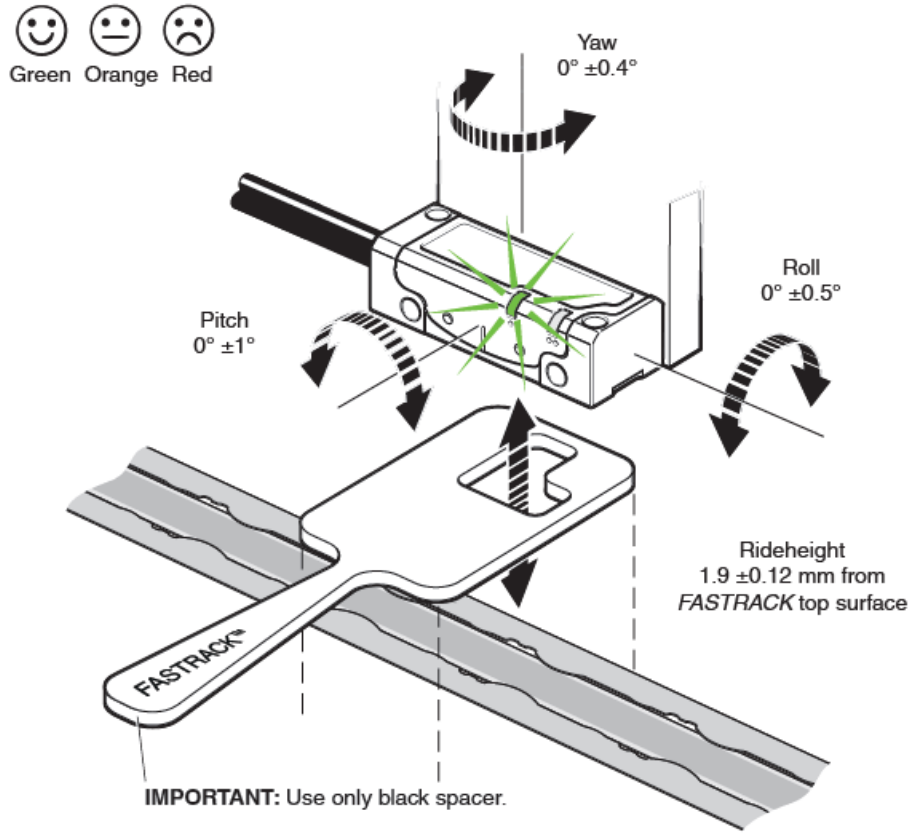
Readhead mounting and alignment
Mounting brackets
The bracket must have a flat mounting surface and should provide adjustment to enable conformance to the installation tolerances, allow adjustment to the height of the redhead, and be sufficiently stiff to prevent deflection or vibration of the read-head 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 scale apply cleaning fluid sparingly, do not soak.

To set the nominal ride height, place the black read-head spacer with the aperture under the optical centre of the readhead to allow normal LED function during the set-up procedure. Adjust the read-head to maximise the signal strength along the full axis of travel to achieve a Green set-up LED on the readhead (> 70% signal). If a digital Ti/TD interface is used, aim for a Blue LED on the interface.

NOTE:
The redhead should be installed and set up with the AGC switched off (CAL LED off). When reinstalling, the factory defaults should be restored (‘Restoring factory defaults’, page 17).

Readhead set-up LED status



T103X readhead LED diagnostics

LED		Indication	Status
Set-up	**Incremental**	Green	Normal set-up; signal level > 70%
		Orange	Acceptable set-up; signal level 50% to 70%
		Red	Poor set-up; signal may be too low for reliable operation; signal level < 50%
	Reference mark	Green (flash)*	Normal phasing
		Orange (flash)	Acceptable phasing
		Red (flash)	Poor phasing; clean scale and recalibrate if required
CAL	**Operating**	On	AGC – On
		Off	AGC – Off
	Calibration	Single-flashing	Calibrating incremental signals
		Double-flashing	Calibrating reference mark
	Reset	Flashing at power-up (< 2s)	Restore factory defaults

Flash will effectively be invisible when the incremental signal level is > 70% when passing the reference mark.

Ti0004 to Ti20KD and TD4000 to TD0040 interface LED diagnostics

Signal	Indication	Status	Alarm output*
Incremental	Purple	Normal set-up; signal level 110% to 135%	No
	Blue	Optimum set-up; signal level 90% to 110%	No
	Green	Normal set-up; signal level 70% to 90%	No
	Orange	Acceptable set-up; signal level 50% to 70%	No
	Red	Poor set-up; signal may be too low for reliable operation; signal level < 50%	No
	Red/blank – flashing	Poor set-up; signal level < 20%; system in error	Yes
	Blue/blank – flashing	Over speed; system in error	Yes
	Purple/blank – flashing	Over speed; system in error	Yes
Reference mark	Blank flash	Reference mark detected (speed < 100mm/s only)	No

Alarm output will take the form of a 3-state or line-driven E– E-E-E-E-signal depending on interface configuration. Also, some configurations do not output an overspeed alarm. See product nomenclature for details.

- Momentary output status only, while fault condition remains.
- The alarm may result in an axis position error, re-datum to continue.

See the TONiC encoder system Datasheet (Renishaw part no. L-9517-9337) for interface configuration details. This can be downloaded from our website at www.renishaw.com/tonicdownloads and is also available from your local Renishaw representative.

System calibration

Calibration is an essential operation that completes the readhead set-up, with the optimum incremental and reference mark signal settings stored in the read-head's non-volatile memory.

Before system calibration

- Clean the scale and readhead optical window (contamination around the reference mark may result in reference mark dephasing).
- If re-installing, restore factory defaults ('Restoring factory defaults', page 17).
- Ensure Automatic Gain Control (AGC) is switched off (CAL LED on redhead is not illuminated).
- Maximise the signal strength along the full axis of travel.

NOTES:

- CAL routine maximum speed < 100 mm/s (all Ti / TD interface models).

- TD interface can be calibrated in either resolution.

Step 1 – Incremental signal calibration

- Press the CAL button on the end of the interface for < 2 seconds using a 2 mm Allen key or similar tool.
  WARNING! Activating the CAL switch requires only 2.5 N force. Applying excess force may permanently damage the switch.
- The CAL LED will now periodically single-flash to indicate that it is in incremental signal calibration routine.
- Move the redhead along the axis, ensuring you do not pass the selected reference mark until the CAL LED starts double-flashing. This indicates the incremental signal is now calibrated and the new settings are stored in the readhead memory.
- The system is now ready for reference mark phasing.
- For systems without reference marks, go to ‘Calibration routine manual exit’.
- If the system does not automatically enter the reference mark phasing stage (no double-flashing of the CAL LED) the calibration of the incremental signals has failed. After ensuring failure is not due to overspeed (> 100 mm/s), exit the calibration routine, restore factory defaults (‘Restoring factory defaults’, page 17) and check the read-head installation and system cleanliness before repeating the calibration routine.

Step 2 – Reference mark phasing

- Move the redhead back and forth over the selected reference mark until the CAL LED stops flashing and remains off. 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.
- The system automatically exits the CAL routine and is ready for operation.
- If the CAL 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. Redheads 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 reference mark selector magnet is fitted in the correct location relative to read-head orientation (‘RTLC20/FASTRACK installation drawing’, page 6).

Calibration routine manual exit
To exit the calibration routine at any stage, press the CAL button. The CAL button will stop flashing.

CAL LED	Settings stored
Single-flashing	None, restore factory defaults and re-calibrate
Double-flashing	Incremental only
Off (auto-complete)	Incremental and reference mark

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

To restore factory defaults:

- Switch the system off.
- Press and hold the CAL button whilst switching the system on. The CAL LED on the read-head will flash several times, indicating that the factory defaults have been restored.
- Release the CAL button.
- Check ‘Readhead mounting and alignment’, page 15, and recalibrate the system (‘System calibration’, page 16).

NOTE: System must be re-calibrated after restoring factory defaults.

Enabling /disabling AGC
AGC can be switched on or off via the interface.

- Press and hold the CAL button on the interface for > 3 seconds to switch AGC on or off. The CAL LED on the read-head will be illuminated when AGC is active.

NOTE: The system must be calibrated before switching AGC on (‘System calibration’, page 16).

Output signals

Interface output (analogue) Ti0000 only

Interface output (analogue) Ti0000 only					Interface Ti0000
Function	**Output type**		**Signal**		**Pin**
Power	–		5 V Power		4
			5 V Sense		5
			0 V Power		12
			0 V Sense		13
Incremental signals	Analogue	Cosine	V1	+	9
				–	1
		Sine	V2	+	10
				–	2
Reference mark	Analogue		V0	+	3
				–	11
Limits	Open collector		Vp		7
			Vq		8
Set-up	–		Vx		6
Calibrate	–		CAL		14
Shield	–		Inner shield		Not connected
	–		Outer shield		Case

Readhead output

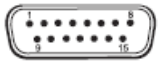
Function	Output type		Signal		Colour
Power	–		5 V		Brown
			0 V		White
Incremental signals	Analogue	Cosine	V1	+	Red
				–	Blue
		Sine	V2	+	Yellow
				–	Green
Reference mark	Analogue		V0	+	Violet
				–	Grey
Limits	Open collector		Vp		Pink
			Vq		Black
Set-up	–		Vx		Clear
Calibrate	–		CAL		Orange
Shield	–		Inner shield*		Green/Yellow
	–		Outer shield		Outer screen

No inner shield on UHV cases.

Interface output (digital) Ti0004 to Ti20KD and TD4000 to TD0040

Interface output (digital) Ti0004 to Ti20KD and TD4000 to TD0040				Interface	
				Ti0004 – Ti20KD	TD4000 – TD0040
Function	**Output type**	**Signal**		**Pin**	**Pin**
Power	–	5 V		7, 8	7, 8
		0 V		2, 9	2, 9
Incremental	RS422A digital	A	+	14	14
			–	6	6
		B	+	13	13
			–	5	5
Reference mark	RS422A digital	Z	+	12	12
			–	4	4
Limits	Open collector	P†		11	–
		QV		10	–
Set-up	RS422A digital	X		1	1
Alarm‡	–	E	+	–	11
			–	3	3
Resolution switching	–	–		–	10
Shield	–	Inner shield		–	–
	–	Outer shield		Case	Case

1. Becomes alarm (E+) for Ti options E, F, G, H.
2. The alarm signal can be output as a line driver signal or 3-state. Please select the preferred option at the time of ordering.
3. On TD interfaces pin 10 should be connected to 0 V to switch to lower resolution.



Output connector for all interfaces; 15-way D-type plug

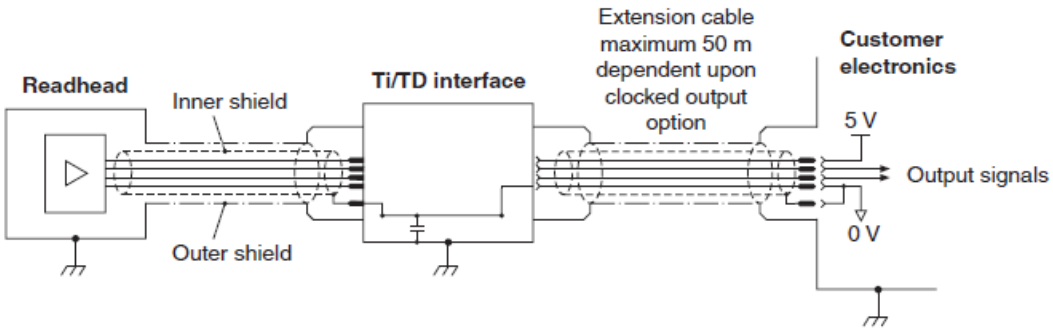
Speed

Clocked out put option (MHz)	Maximum speed (m/s)										
	Ti0004 5 µm	**Ti0020 1 µm**	**Ti0040 0.5 µm**	**Ti0100 0.2 µm**	**Ti0200 0.1 µm**	**Ti0400 50 nm**	**Ti1000 20 nm**	**Ti2000 10 nm**	**Ti4000 5 nm**	**Ti10KD 2 nm**	**Ti20KD 1 nm**
50	10	10	10	6.48	3.24	1.62	0.648	0.324	0.162	0.0654	0.032
40	10	10	10	5.40	2.70	1.35	0.540	0.270	0.135	0.054	0.027
25	10	10	8.10	3.24	1.62	0.810	0.324	0.162	0.081	0.032	0.016
20	10	10	6.75	2.70	1.35	0.675	0.270	0.135	0.068	0.027	0.013
12	10	9	4.50	1.80	0.900	0.450	0.180	0.090	0.045	0.018	0.009
10	10	8.10	4.05	1.62	0.810	0.405	0.162	0.081	0.041	0.016	0.0081
08	10	6.48	3.24	1.29	0.648	0.324	0.130	0.065	0.032	0.013	0.0065
06	10	4.50	2.25	0.90	0.450	0.225	0.090	0.045	0.023	0.009	0.0045
04	10	3.37	1.68	0.67	0.338	0.169	0.068	0.034	0.017	0.0068	0.0034
01	4.2	0.84	0.42	0.16	0.084	0.042	0.017	0.008	0.004	0.0017	0.0008
Analogue output	10 (–3dB)										

NOTE: TD maximum speeds are resolution-dependent as defined above.

Electrical connections

Grounding and shielding

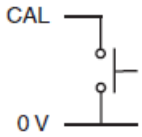


IMPORTANT:
The outer shield must be connected to the machine earth (Field Ground). The inner shield * must be connected to 0 V at receiving electronics only. Care should be taken to ensure that the inner and outer shields are insulated from each other. If the inner and outer shields are connected, this will cause a short between 0 V and earth, which could cause electrical noise issues.

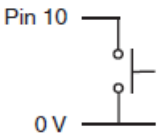
NOTE:
The maximum cable length between the read-head and Ti/TD interface is 10 m.

For UHV there is no inner shield to be connected.

Remote CAL operation (analogue versions only)
All Ti/TD interfaces include a push-button switch to enable CAL/AGC features. However, remote operation of the CAL/AGC is possible via pin 14 of analogue Ti0000 interfaces. For applications where no interface is used, remote operation of CAL/AGC is essential.

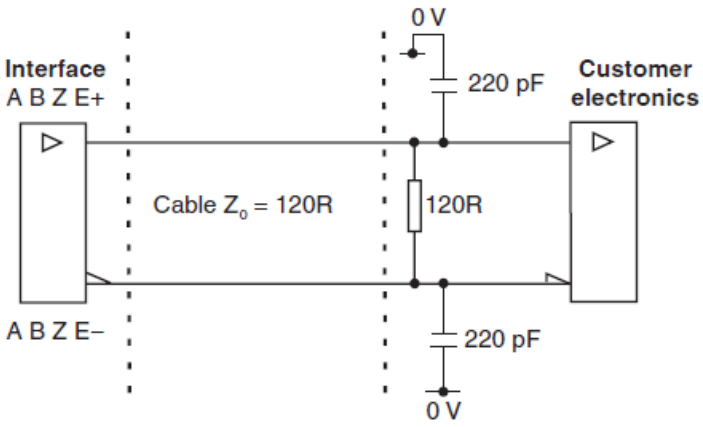


TD interface resolution switching
Connect pin 10 to 0 V to switch to lower resolution.



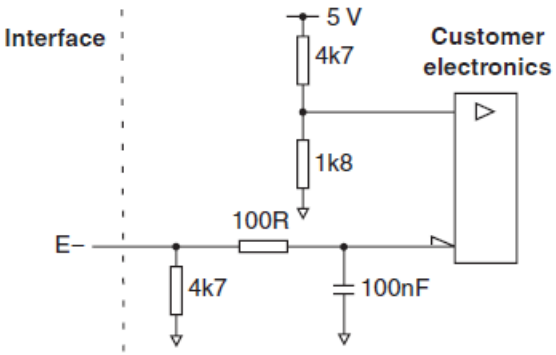
Recommended signal termination

Digital outputs

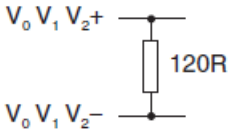


- Standard RS422A line receiver circuitry.
- Capacitors are recommended for improved noise immunity.

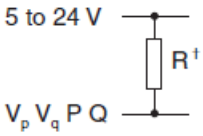
Single-ended alarm signal termination (Ti options A, B, C, D)



Analogue outputs



Limit output (no limits on TD interfaces)



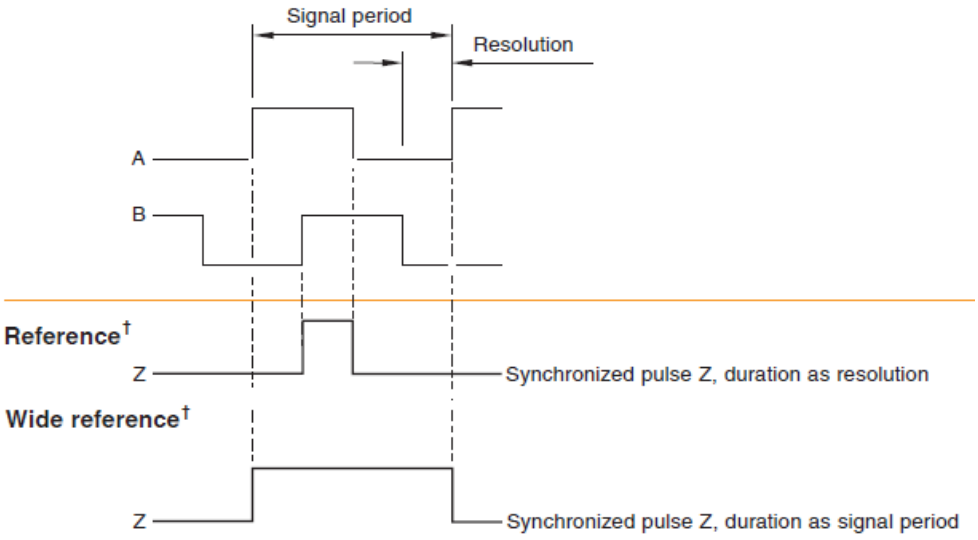
- Select R so the maximum current does not exceed 20 mA.
- Alternatively, use a suitable relay or opto-isolator.

Specifications

Output specifications

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

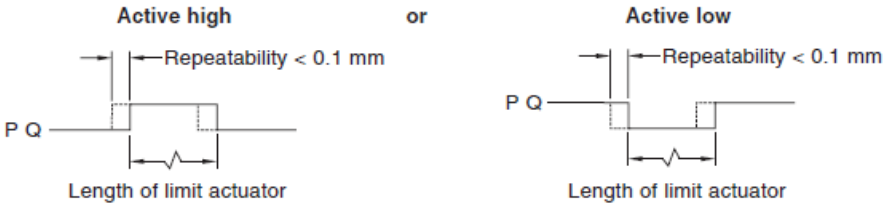
Incremental † 2 channels A and B in quadrature (90° phase shifted)



NOTE:
Select a ‘standard’ or ‘wide’ reference at time of order, to match the requirements of the controller being used. Wide reference mark not available on Ti0004 interfaces.

Limits Open collector output, asynchronous pulse

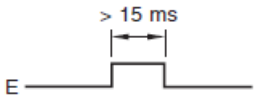
Digital Ti interfaces only



NOTE: No limits on TD interfaces. P limit becomes E+ for options E, F, G, and H.

Alarm † Asynchronous pulse

Line driven

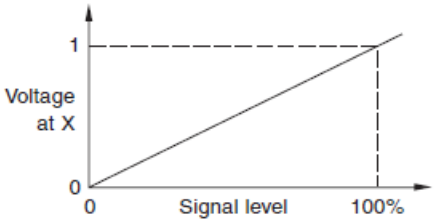


Alarm asserted when:

- Signal amplitude < 20% or > 135%The redheaded speed is too high for reliable operation.
- ◦ E– output only for Ti options A, B, C, and D.

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

Set-up *

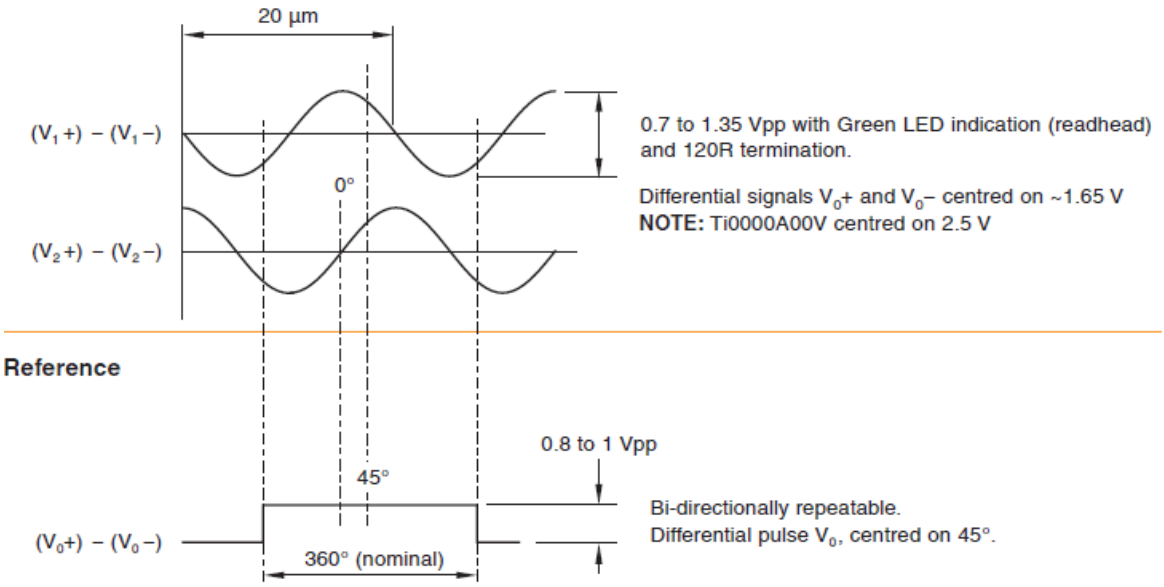


Set-up signal voltage proportional to incremental signal amplitude.

- Inverse signals are not shown for clarity.

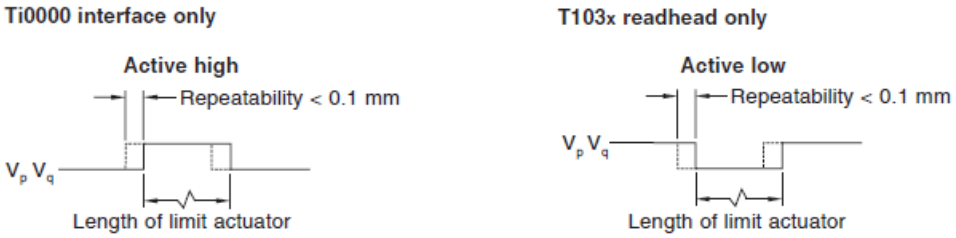
Analogue output signals

Incremental
2 channels V1 and V2 differential sinusoids in quadrature centred on 1.65 V (90° phase shifted).



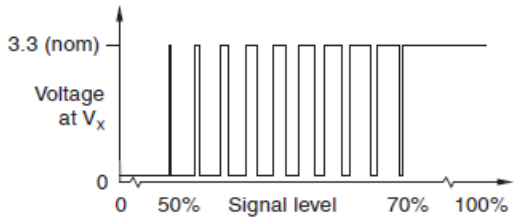
Limits Open collector output, asynchronous pulse

Ti0000 interface only



NOTE:
Ti0000 interface contains a transistor to invert the redhead's 'active low' signal to give an 'active high' output.

Set-up



- Between 50% and 70% signal level, VX is a duty cycle.
- Time spent at 3.3 V increases with incremental signal level.
- At > 70% signal level VX is nominal 3.3 V.
    - Set-up signals as shown are not present during the calibration routine.

General specifications

Power supply	5 V ±10%		Readhead only < 100 mA T103x with Ti0000 < 100 mA T103x with Ti0004 – Ti20KD and TD4000 – TD0040 < 200 mA **NOTE:** Current consumption figures refer to unterminated systems. For digital outputs, a further 25 mA per channel pair (e.g., A+, A–) wi ll be drawn when terminated with 120R. For analogue outputs, a further 20 mA in total will be drawn when terminated with 120R. Power from a 5 Vdc supply complying with the requirements for SEL V of standard IEC 60950-1.	
		Ripple	200 mVpp maximum @ frequency up to 500 kHz	
Temperature (system)		Storage	–20 °C to +70 °C	
		Operating	0 °C to +70 °C	
(UHV read-head) Bakeout			+120 °C	
Humidity (syste m)			95% relative humidity (non-condensing) to IEC 60068-2-78	
Sealing (read-head)			IP40	
(Ti interface)			IP20	
Acceleration (read-head)		Operating	500 m/s², 3 axes	
Shock (system)		Operating	500 m/s², 11 ms, ½ sine, 3 axes	
Vibration (syste m)		Operating	100 m/s², 55 Hz to 2000 Hz, 3 axes	
Mass		Readhead	10 g	
		Interface	100 g	
		Cable	26 g/m	
		UHV cabl e	14 g/m	
Readhead cable (standard)			Double-shielded, outside diameter 4.25 ±0.25 mm	
Flex life > 20 × 10^6 cycles at 20 mm bend radius				
			UL recognised component	
(UHV)			Tin-coated braided single screen, FEP core insulation	
Maximum cable length	Readhead to interfac e		10 m	
	Interface to controller		**Clocked output option (MHz)**	**Maximum cable length (m)**

		40 to 50	25
		< 40	50
		Analogue	50

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.

RTLC20 scale technical specifications

Form (H × W)	0.2 mm × 8 mm
Pitch	20 µm
Accuracy (at 20 °C) (includes slope and linearity)	±5 µm/m calibration traceable to International Standards
Linearity	2.5 µm/m achievable with 2-point error correction
Supplied length	20 mm up to 10 m (> 10 m available on request)
Material	Hardened and tempered martensitic stainless steel
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)

FASTRACK technical specifications

Form (H × W)	0.4 mm × 8 mm (including adhesive)
Minimum recommended length	100 mm
Supplied length	100 mm to 25 m
Material	Hardened and tempered martensitic stainless steel
Coefficient of thermal expansion (at 20 °C)	10 ±0.2 µm/m/°C
Installation temperature	15 °C to 35 °C
Mounting	Self-adhesive backing tape

Reference mark

Type	The customer selected the IN-TRAC reference mark, whic h is directly embedded into the incremental track. Bi-direct ional position repeatability.
Selection	Single reference mark selection by selector magnet (A-96 53-0143) customer-positioned
L ≤ 100 mm	Single reference mark at scale centre
L > 100 mm	Reference marks at 50 mm spacing (first reference mark 50 mm from the scale end)
Repeatability	Unit of resolution repeatability (bi-directional) across full s ystem-rated speed and temperature ranges

Limit switches

Type	Magnetic actuators; with dimple trigger Q limit, without dimple triggers P limit (‘RTLC20/FASTRACK installation drawing’,).
Trigger point	The limit output is nominally asserted when the redhead limit switch sensor passes the limit magnet leading edge, but can trigger up to 3 mm before that edge
Mounting	Customers placed at desired locations
Repeatability	< 0.1 mm

TONiC RTLC20/FASTRACK linear encoder system.

Renishaw plc

- New Mills, Wotton-under-Edge, Gloucestershire GL12 8JR United Kingdom
- **T.** +44 (0)1453 524524
- **F.** +44 (0)1453 524901
- **E.** uk@renishaw.com
- www.renishaw.com.

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

Renishaw plc. Registered in England and Wales. Company no: 1106260. Registered office: New Mills, Wotton-under-Edge, Gloucestershire, GL12 8JR, UK.

Documents / Resources

	**Renishaw T103x Tonic Incremental Encoder** [pdf] Installation Guide T103x Tonic Incremental Encoder, T103x, Tonic Incremental Encoder, Incremental Encoder, Encoder

References

- **Renishaw: enhancing efficiency in manufacturing and healthcare**
- **Contact us**
- **Product compliance**
- **User Manual**

Manuals+, **Privacy Policy**

This website is an independent publication and is neither affiliated with nor endorsed by any of the trademark owners. The "Bluetooth®" word mark and logos are registered trademarks owned by Bluetooth SIG, Inc. The "Wi-Fi®" word mark and logos are registered trademarks owned by the Wi-Fi Alliance. Any use of these marks on this website does not imply any affiliation with or endorsement.