**Installation guide**
M-9589-9013-03-C

RENISHAW
apply innovation™

# TONiC™ T103x RTLC-S linear encoder system

# Contents

## Product compliance

CE

Renishaw plc declares that TONiC complies with the applicable standards and regulations.
A copy of the EC Declaration of Conformity is available on request.

### FCC compliance

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.

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.

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.

NOTE: This unit was tested with shielded cables on the peripheral devices. Shielded cables must be used with the unit to ensure compliance.

### RoHS compliance

Compliant with EC directive 2011/65/EU (RoHS)

### 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 | |

### Further information

Further information relating to the TONiC encoder range can be found in the TONiC system Data sheet (L-9517-9337). This can be downloaded from our website www.renishaw.com/encoder and is also available from your local representative. 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 written prior permission of Renishaw. The publication of material within this document does not imply freedom from the patent rights of Renishaw plc.

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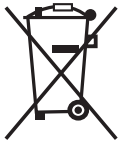
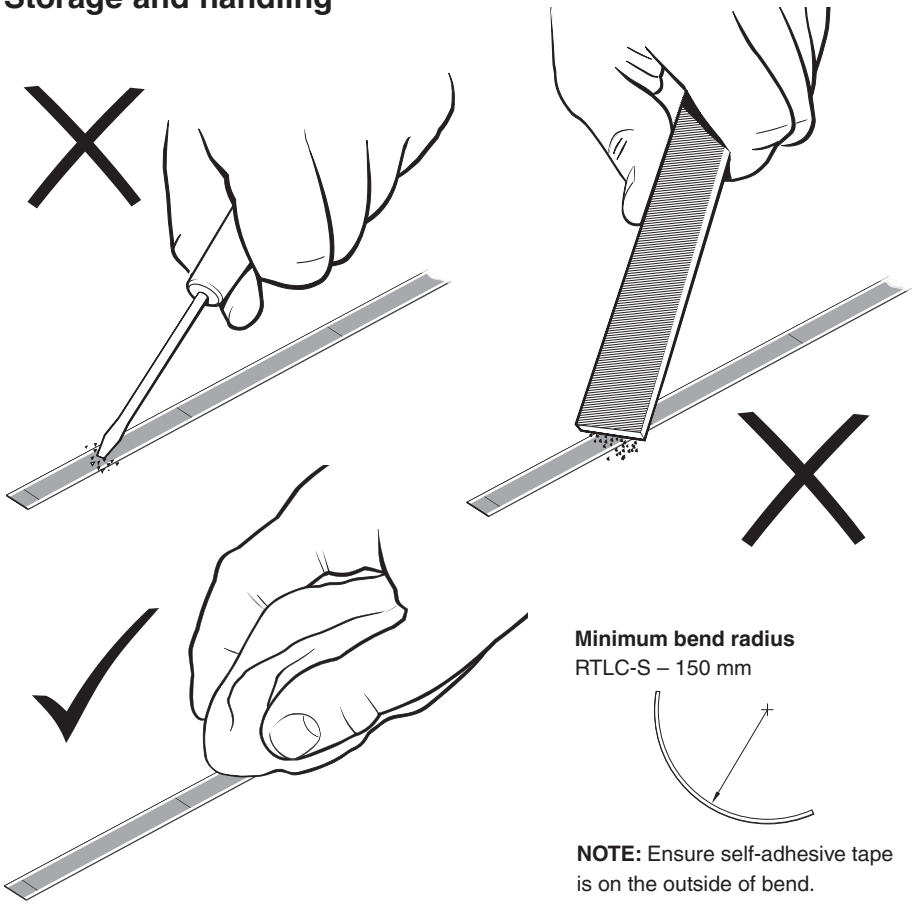
The packaging of our products contains the following materials and can be recycled.

| 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 |



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.

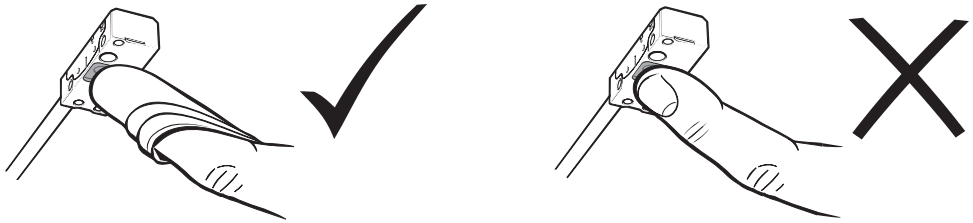
## Storage and handling

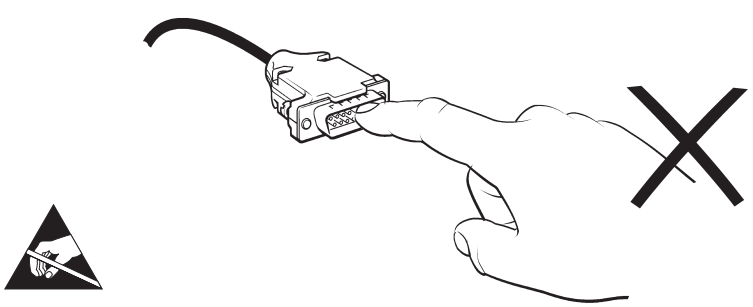


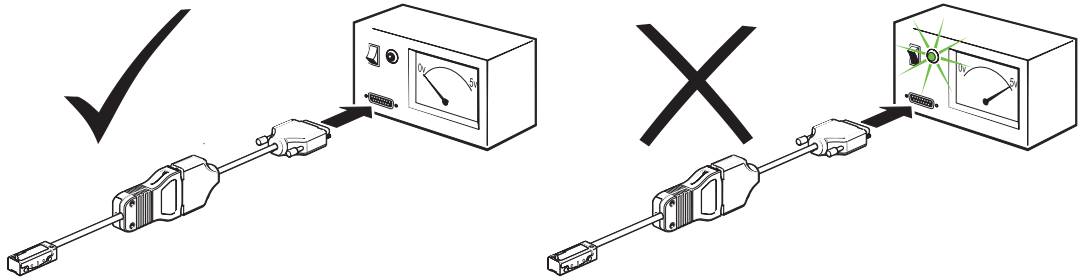
**Minimum bend radius**
RTLC-S – 150 mm



**NOTE:** Ensure self-adhesive tape is on the outside of bend.

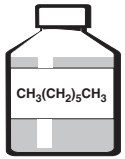




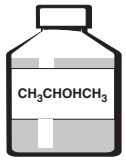


### Scale and readhead

N-heptane

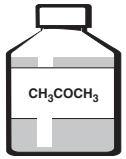



Propan-2-ol




### Readhead only

Acetone

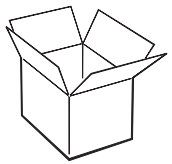





### Storage

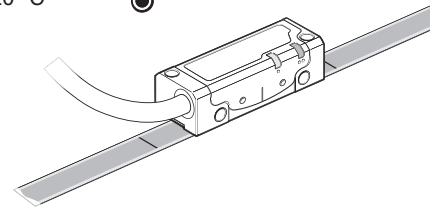
+70 °C
-20 °C

UHV readhead
Bakeout +120 °C

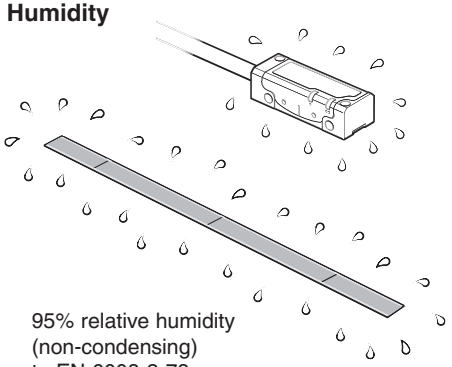


### Operating

+70 °C
0 °C



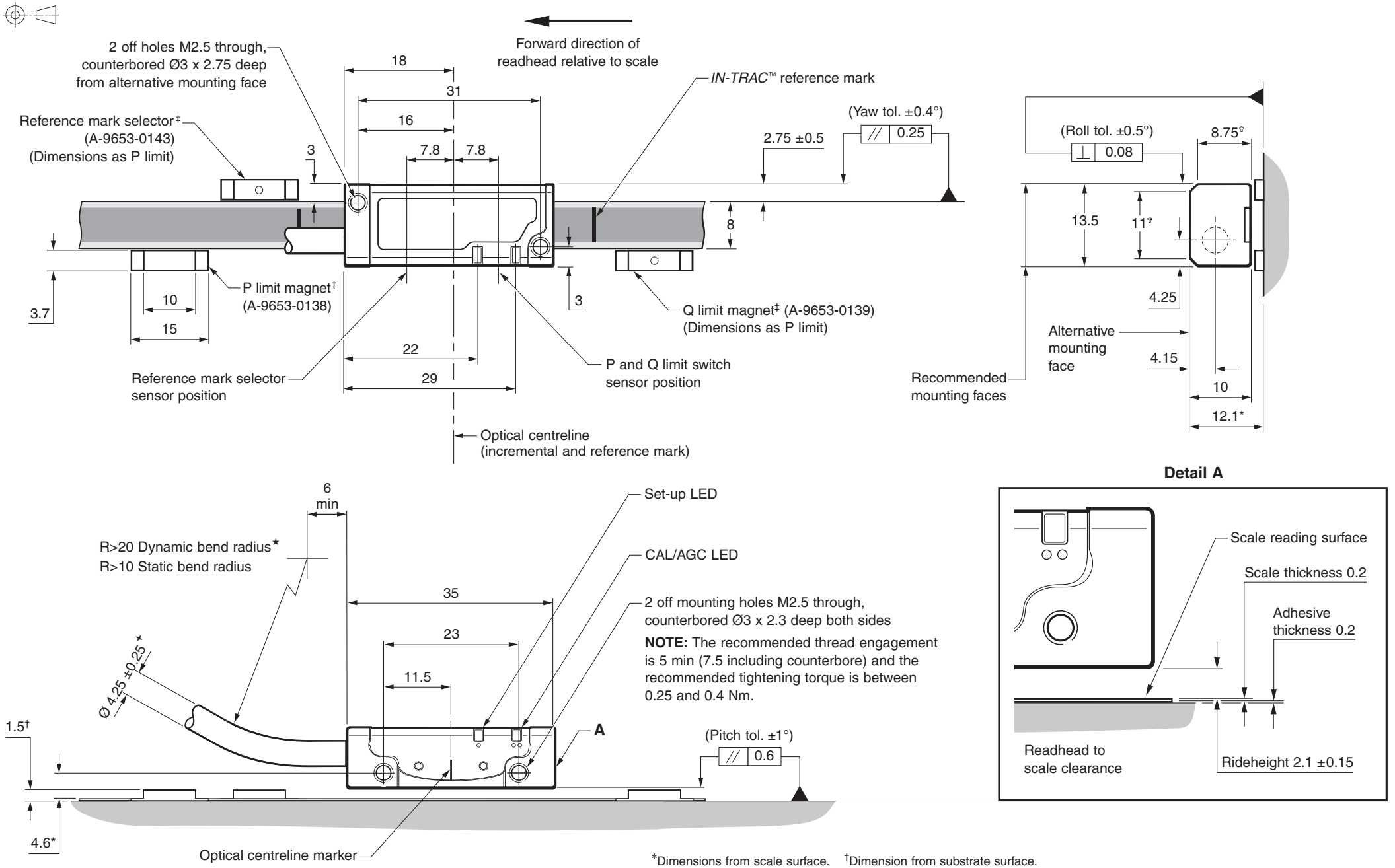
### Humidity



95% relative humidity
(non-condensing)
to EN 6008-2-78

# TONiC T103x readhead installation drawing

Dimensions and tolerances in mm




*Dimensions from scale surface. †Dimension from substrate surface.

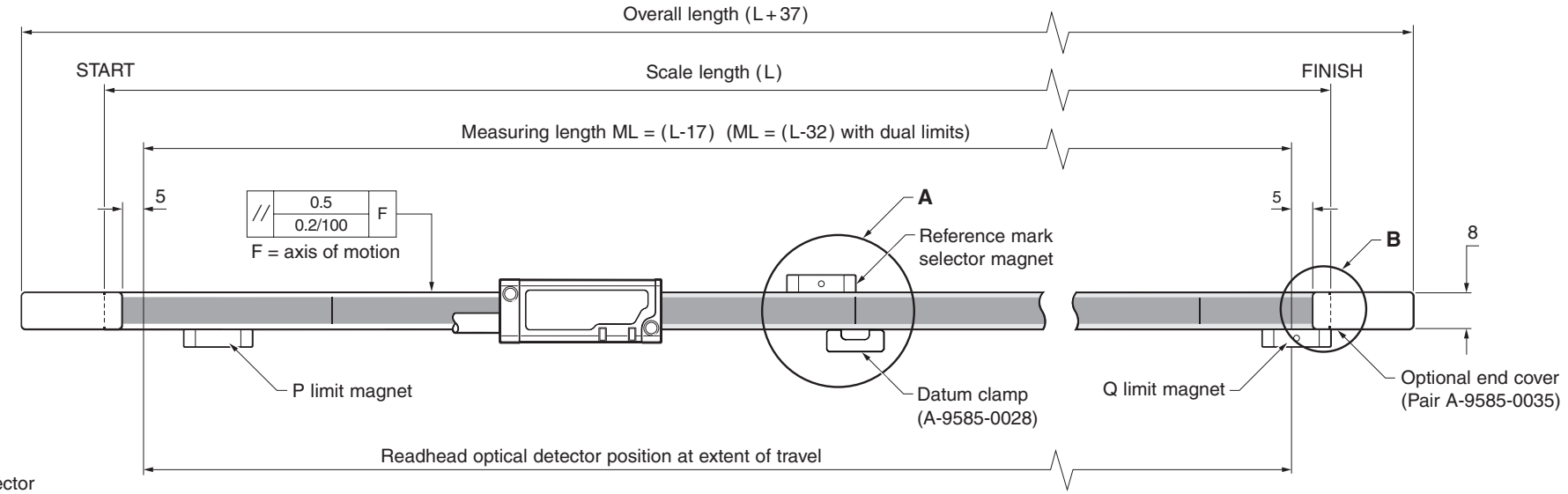
‡Bolted reference mark selector magnet and limit magnet available. See RTLC-S installation drawing for details.

✞Extent of mounting faces. ★Dynamic bend radius not applicable for UHV cables. ✦UHV cable diameter 3 approx.

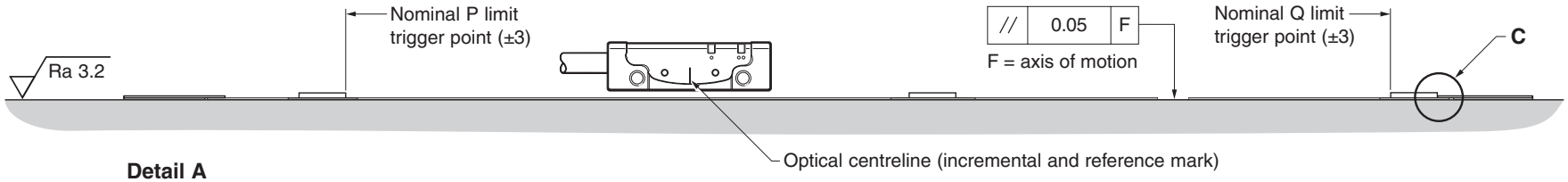
**NOTE:** External magnetic fields greater than 6 mT, in the vicinity of the readhead, may cause false activation of the limit sensor.

## **RTLC-S installation drawing** (adhesive datum clamp)

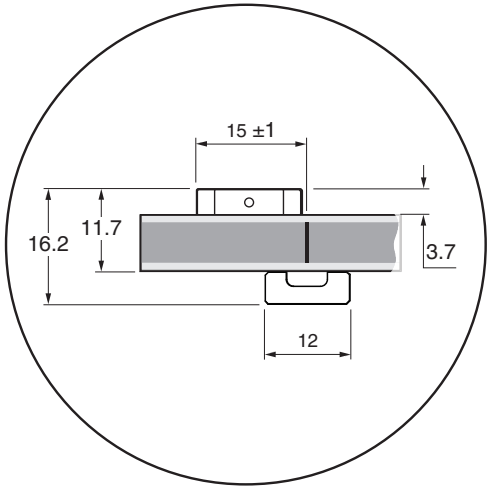
Dimensions and tolerances in mm



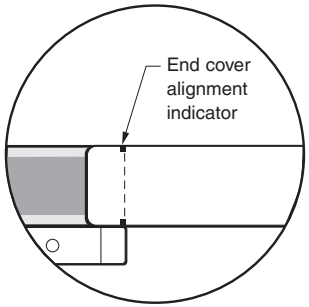

**NOTE:** The reference mark selector and limit actuator locations are correct for the readhead orientation shown.



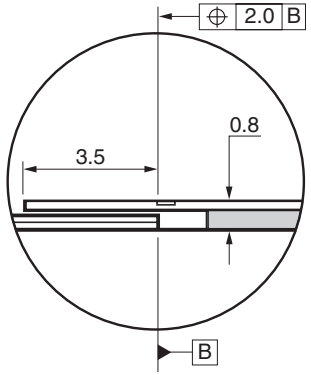

**Detail A**



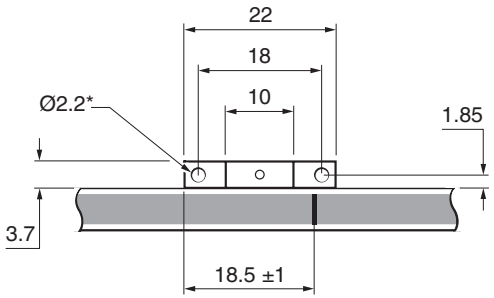

**Detail B**




**Detail C**




**Optional bolted reference mark selector (A-9653-0290) or limit magnets (Q limit A-9653-0291, P limit A-9653-0292)**



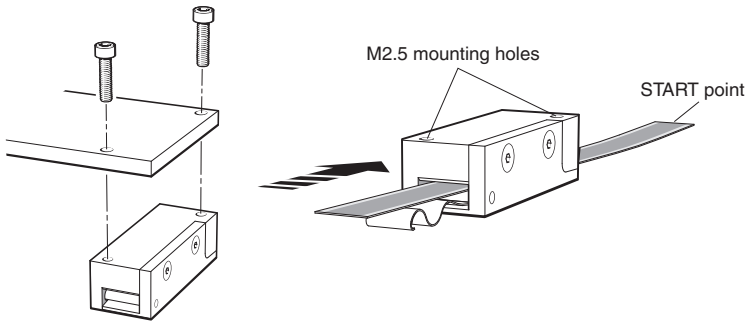

*Supplied with 2 x M2 x 4 Triffix screws.

## Scale application

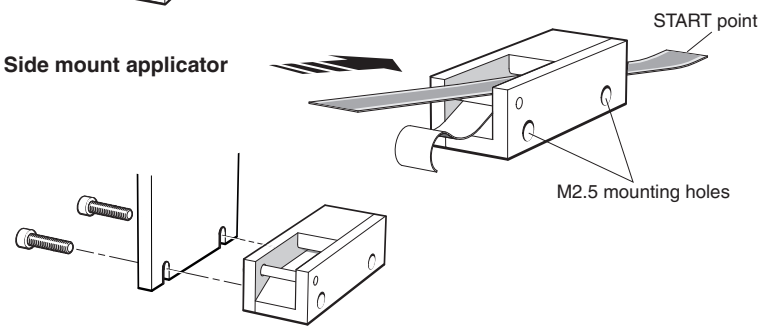
There are two versions of applicator for use with RTLC-S scale: side mounted (A-9589-0115) and top mounted (A-9589-0094)

1. Allow scale to acclimatize to installation environment prior to installation.
2. Mark out the 'START' and 'FINISH' points for the scale on the axis substrate – ensure that there is room for the optional end covers if required (see 'RTLC-S installation drawing').
3. Thoroughly clean and degrease the substrate using recommended solvents (see 'Storage and handling'). Allow substrate to dry before applying scale.
4. Mount the appropriate scale applicator to the readhead mounting bracket using M2.5 screws. Place the shim supplied with the readhead between the applicator and substrate to set the nominal height.
   **NOTE:** Scale applicator can be mounted either way round to enable easiest orientation for scale installation.
5. Move axis to 'START' of travel.
6. Begin to remove the backing paper from the scale and insert scale into the applicator up to the 'START' point (as shown). Ensure backing tape is routed under the splitter screw.
7. Apply finger pressure to the scale at the 'START' point, using a clean lint-free cloth, to ensure scale end adheres well to the substrate.

**Top mount applicator**

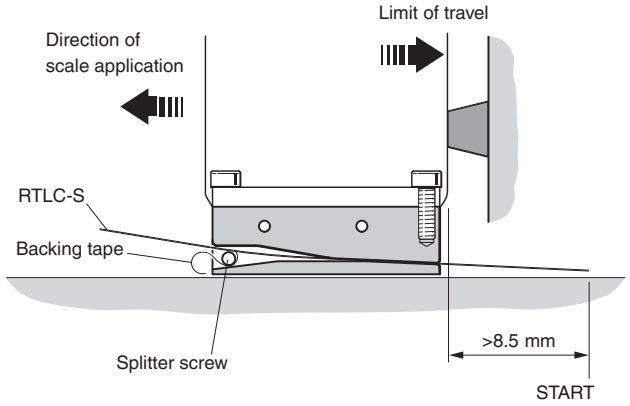



**Side mount applicator**



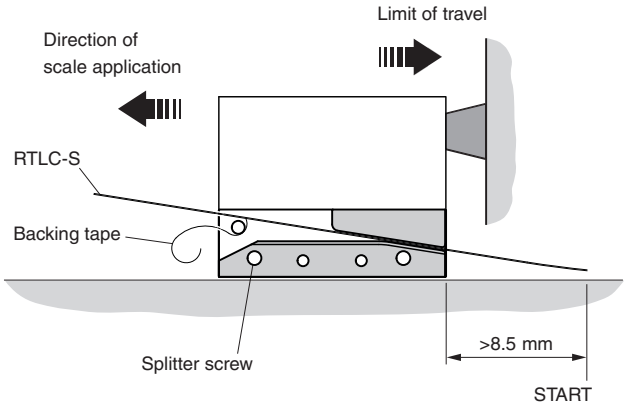

8. Slowly and smoothly move the applicator through the entire axis of travel, ensuring the backing paper is pulled manually from the scale and does not catch under the applicator.

**Top mount applicator**




9. Remove applicator and, if necessary, adhere the remaining scale manually. Apply firm finger pressure via a clean lint-free cloth along the length of the scale after application to ensure complete adhesion.

**Side mount applicator**



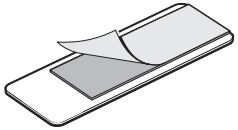

10. Clean scale using Renishaw scale cleaning wipes (A-9523-4040) or a clean, dry, lint-free cloth.
11. Fit end covers.
12. Allow 24 hours for complete adhesion of scale before fitting reference mark selector magnet, limits and datum clamps.

## End covers

The end cover kit (A-9585-0035) is designed to be used with RTLC-S scale.

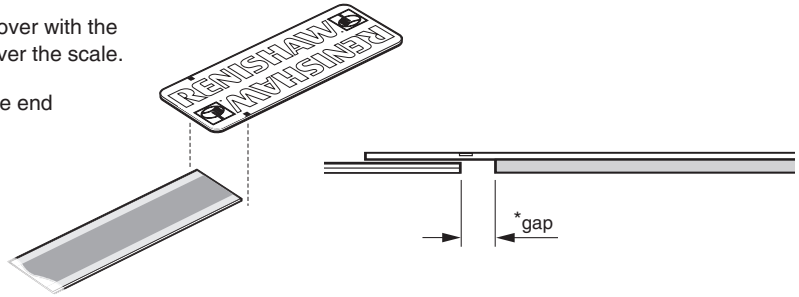
**NOTE:** End covers are optional and can be fitted before or after readhead installation.

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



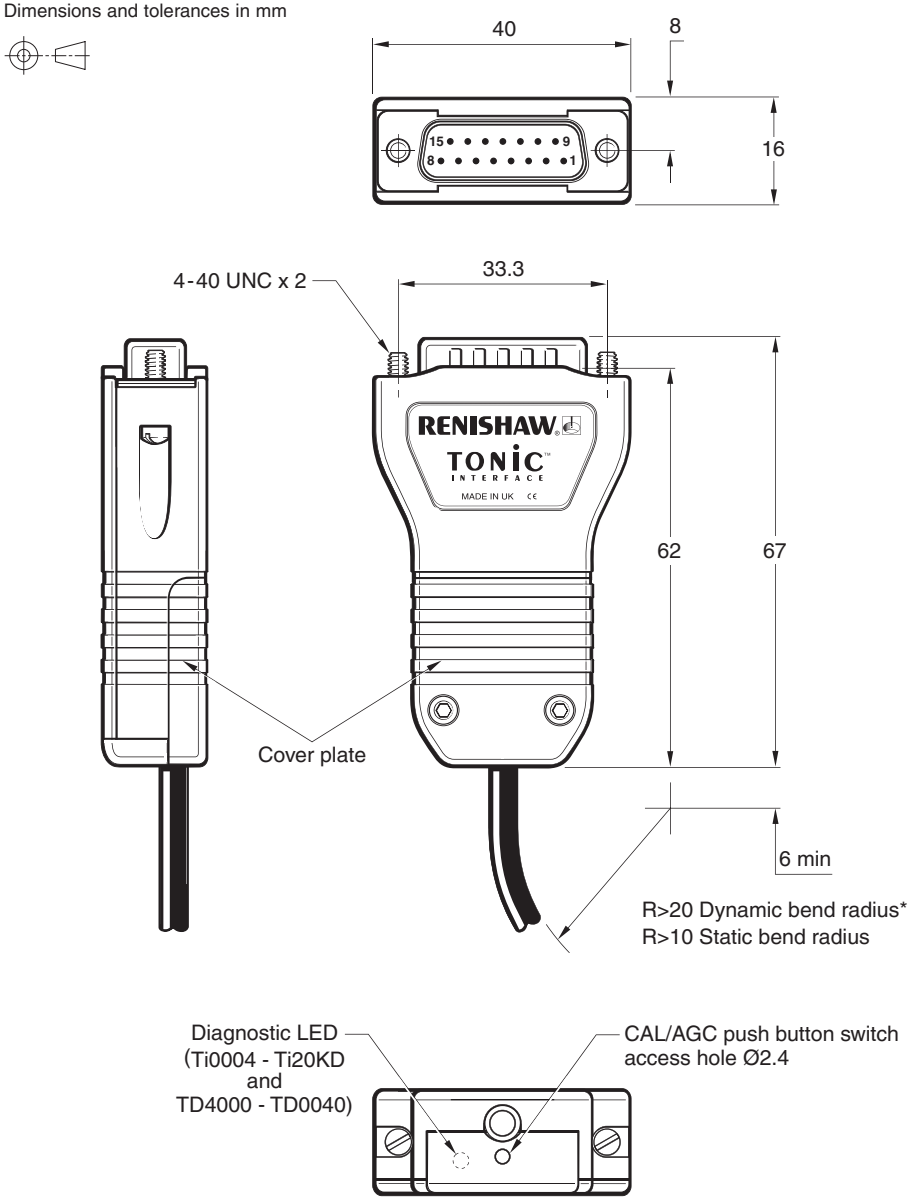
2. Align marker on the edges of the end cover with the end of the scale and place end cover over the scale.

   **NOTE:** There will be a gap* between the end of the scale and the adhesive tape on the end cover.



## TONiC interface drawing

Dimensions and tolerances in mm




*Dynamic bend radius not applicable for UHV cables.

**CAL button operation**

Push and release (<3 seconds) - Calibration (CAL) routine enable/disable
Push and release (>3 seconds) - Automatic Gain Control (AGC) enable/disable
Push and hold during power 'Off/On' cycle - Restore factory defaults
Refer to readhead LED functionality chart for CAL LED indications

## 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.

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 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.

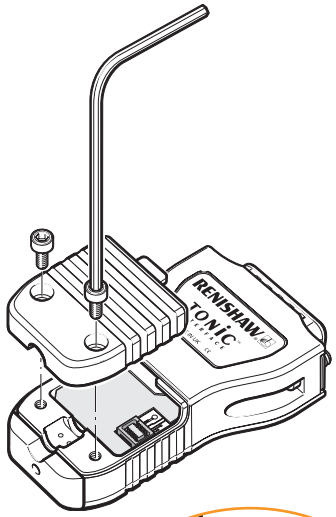
**NOTE:** If calibration fails, restore factory defaults by pressing and holding the CAL button whilst switching on. Then repeat the installation and calibration routine.

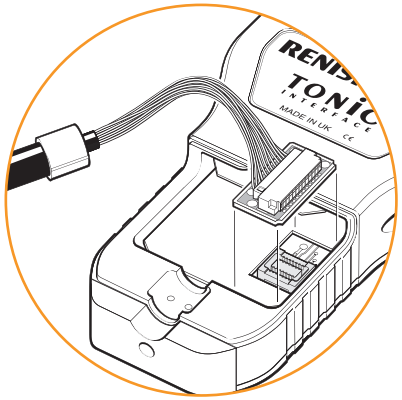
## System connection

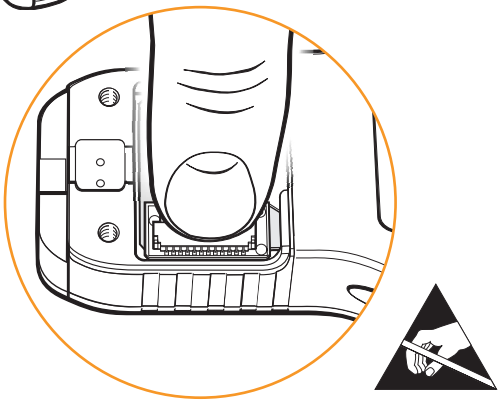
Approved ESD precautions must be followed at all times during readhead and interface electrical connections. The readhead is connected to the Ti/TD interface via a small, rugged connector to allow for easy feed-through during installation.

### Connecting the readhead

1. Remove the cover plate as shown (2 x 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.



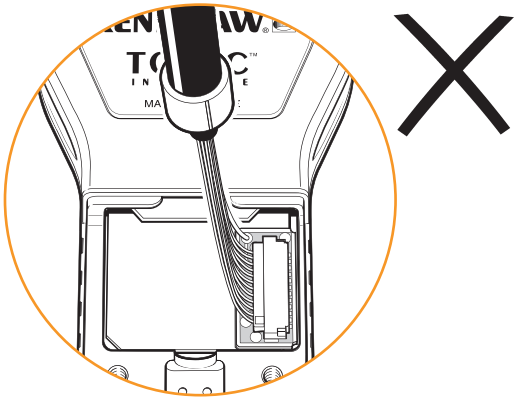



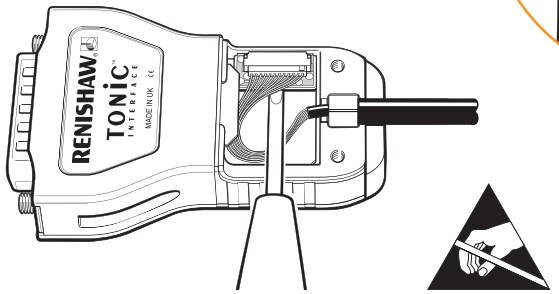
3. Refit the cover plate ensuring the cable ferrule is located in the recess on the inside and no wires are trapped under the cover plate.

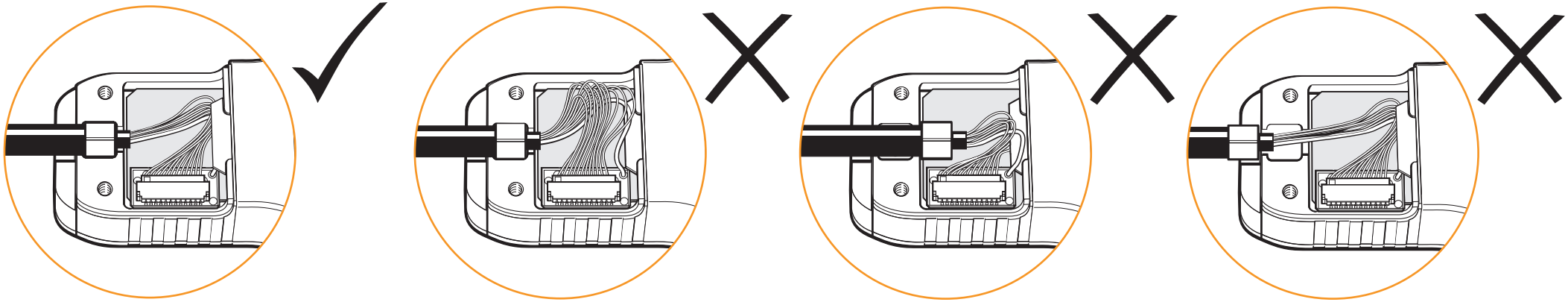
**NOTE:** The tightening torque should be between 0.25 Nm and 0.4 Nm.

### Disconnecting the readhead

1. Remove the cover plate on the interface (2 x 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**

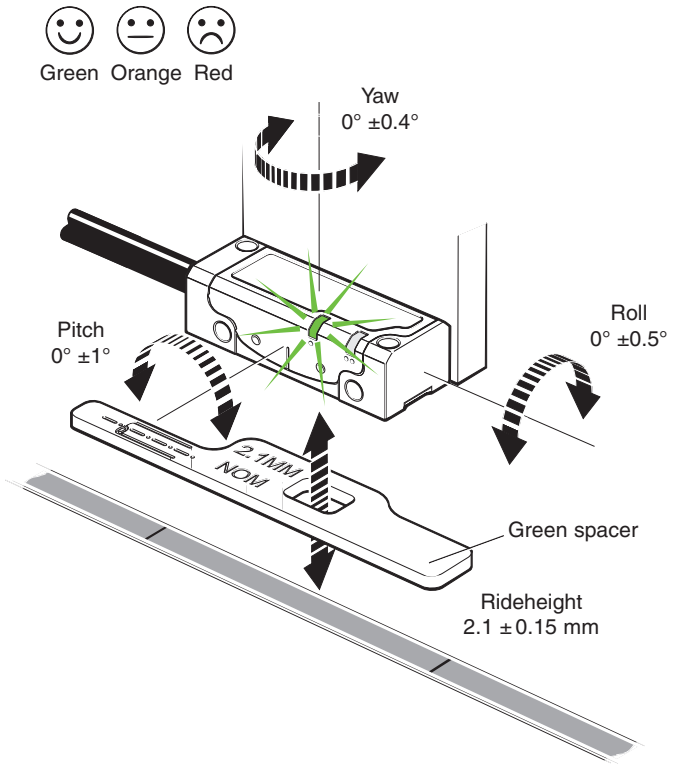
The bracket must have a flat mounting surface and should provide adjustment to enable conformance to the installation tolerances, allow adjustment to the rideheight of the readhead, and be sufficiently stiff to prevent deflection or vibration of the readhead during operation.

**Readhead set-up**

Ensure that the scale, readhead optical window and mounting face are clean and free from obstructions. To set nominal rideheight, place the green spacer with the aperture under the optical centre of the readhead to allow normal LED function during set-up procedure. Adjust the readhead to 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 readhead should be installed and set-up with the AGC switched off (CAL LED off). When reinstalling factory defaults should be restored.

**Readhead set-up LED status**

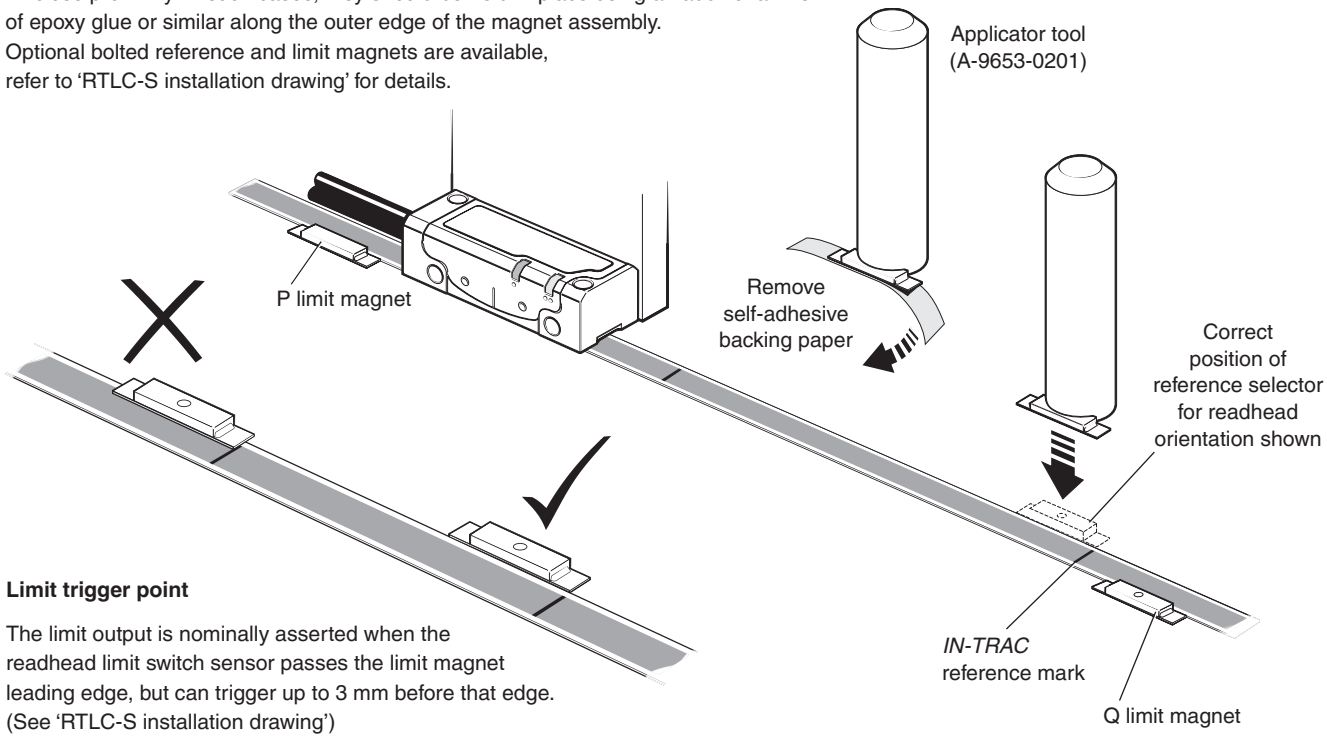



## Reference mark selector and limit magnet installation

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

For accuracy and ease of positioning of reference mark selector and limit magnets, the applicator tool (A-9653-0201) should be used. The magnet should be attached to the applicator tool as shown below. Limit magnets can be positioned at any user defined location along the scale, but the reference mark selector magnet should be positioned adjacent to the chosen *IN-TRAC* reference mark as shown below.

**NOTE:** 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.
Optional bolted reference and limit magnets are available, refer to 'RTLC-S installation drawing' for details.



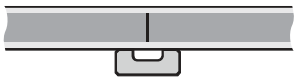

**Limit trigger point**

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. (See 'RTLC-S installation drawing')

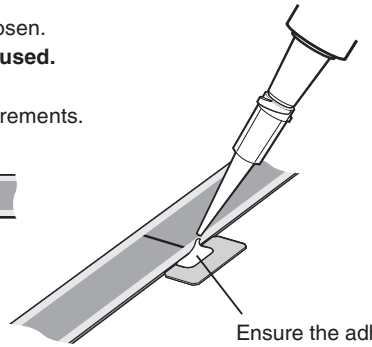
## Datum clamp (A-9585-0028)

The datum clamp fixes the RTLC-S 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 upon the customers' requirements.

1. Place the datum clamp with cut-out against the scale at the chosen location.



2. Place a small amount of adhesive (Loctite® 435™) in the cut-out on the datum clamp, ensuring none of the adhesive wicks onto the scale surface. Dispensing tips P-TL50-0209 are available.



# System calibration

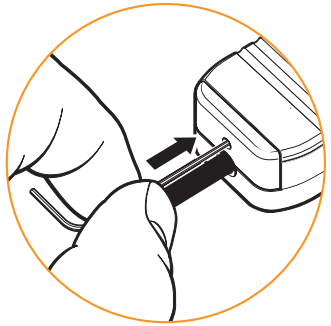
Calibration is an essential operation that completes readhead set-up, with the optimum incremental and reference mark signal settings stored in the readhead's non-volatile memory.

**Before system calibration**:

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

**NOTE:** 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 only requires 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 readhead 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 mark, 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 and check the readhead installation and system cleanliness before repeating the calibration routine.

**Step 2 – Reference mark phasing**

- Move the readhead 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 passing the chosen reference mark many times it is not detecting the reference mark. 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.

## Calibration routine – manual exit

- The calibration routine can be exited at any stage. To exit the calibration routine press the CAL button. On successful exit the CAL button will stop flashing.

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

## Restoring factory defaults

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

**To restore factory defaults:**

- Switch system off.
- Press and hold the CAL button whilst switching the system on. The CAL LED on the readhead will flash several times, indicating that the factory defaults have been restored.
- Release CAL button.
- Check the 'Readhead mounting/installation' and recalibrate the system.

**NOTE**: System must be recalibrated after restoring factory defaults.

## Switching Automatic Gain Control (AGC) on or off

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 readhead will be illuminated when AGC is active.

**NOTE:** The system must be calibrated before switching AGC on.

### 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 | Automatic Gain Control – On |
| | | Off | Automatic Gain Control – 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 incremental signal level is >70% when passing 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 signal; system in error | Yes |
| **Reference mark** | Blank flash | Reference mark detected (speed <100 mm/s only) | No |

*Alarm output will take the form of 3-state or line driven E- signal depending on interface configuration.
Also, some configurations do not output overspeed alarm. See product nomenclature for details.
-Momentary status only, while fault condition remains.
-Alarm may result in axis position error, re-datum to continue.

## Output signals

### Interface output (analogue) Ti0000 only

| Function | Output type | | Signal | | Interface Ti0000 Pin |
|---|---|---|---|---|---|
| **Power** | | | 5 V Power | | 4 |
| | | | 5 V Sense | | 5 |
| | | | 0 V Power | | 12 |
| | | | 0 V Sense | | 13 |
| **Incremental signals** | Analogue | Cosine | $V_1$ | + | 9 |
| | | | | - | 1 |
| | | Sine | $V_2$ | + | 10 |
| | | | | - | 2 |
| **Reference mark** | Analogue | | $V_0$ | + | 3 |
| | | | | - | 11 |
| **Limits** | Open collector | | $V_p$ | | 7 |
| | | | $V_q$ | | 8 |
| **Set-up** | – | | $V_X$ | | 6 |
| **Calibrate** | – | | CAL | | 14 |
| **Shield** | – | | Inner shield | | Not connected |
| | – | | Outer shield | | Case |

### Readhead output

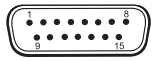
| Function | Output type | | Signal | | Colour |
|---|---|---|---|---|---|
| **Power** | | | 5 V | | Brown |
| | | | 0 V | | White |
| **Incremental signals** | Analogue | Cosine | $V_1$ | + | Red |
| | | | | - | Blue |
| | | Sine | $V_2$ | + | Yellow |
| | | | | - | Green |
| **Reference mark** | Analogue | | $V_0$ | + | Violet |
| | | | | - | Grey |
| **Limits** | Open collector | | $V_p$ | | Pink |
| | | | $V_q$ | | Black |
| **Set-up** | – | | $V_X$ | | Clear |
| **Calibrate** | – | | CAL | | Orange |
| **Shield** | – | | Inner shield* | | Green/Yellow |
| | – | | Outer shield | | Outer screen |

*No inner shield on UHV cables.

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

| Function | Output type | Signal | | Interface Ti0004 - Ti20KD Pin | Interface TD4000 - TD0040 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 | – |
| | | Q | | 10 | – |
| **Set-up** | RS422A digital | X | | 1 | 1 |
| **Alarm‡** | – | E | + | – | 11 |
| | | | - | 3 | 3 |
| **Resolution switching♆** | – | – | | – | 10 |
| **Shield** | – | Inner shield | | – | – |
| | – | Outer shield | | Case | Case |

†Becomes alarm (E+) for Ti options E, F, G, H
‡The alarm signal can be output as a line driver signal or 3-state. Please select the preferred option at time of ordering.
♆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

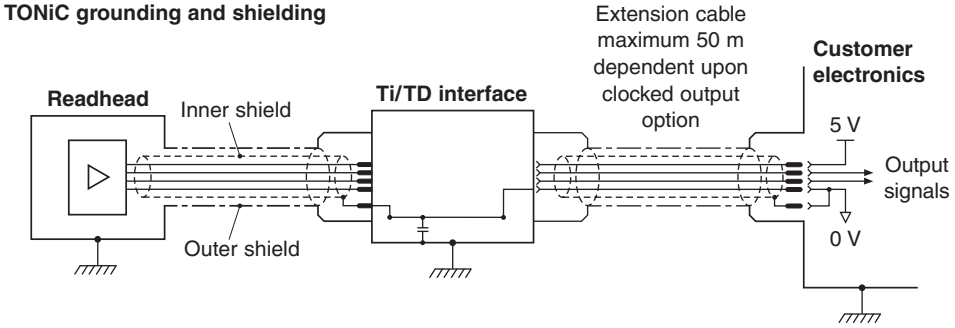
## Speed

| Clocked output 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

**TONiC grounding and shielding**

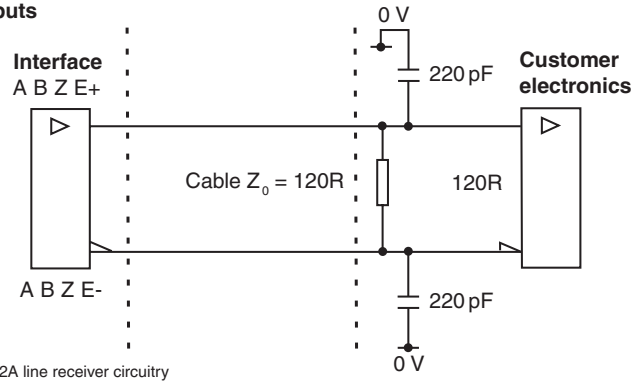



**IMPORTANT:** The outer shield should be connected to the machine earth (Field Ground). The inner shield should be connected to 0 V at receiving electronics only. Care should be taken to ensure that the inner and outer shields are insulated from each other. If the inner and outer shields are connected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

**NOTE:** Maximum cable length between readhead and Ti/TD interface is 10 m

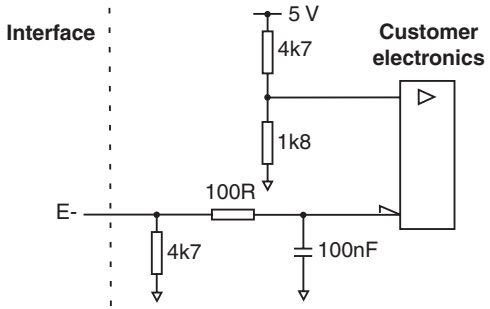
## Recommended signal termination

**Digital outputs**

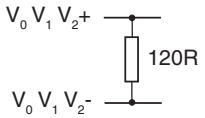



Standard RS422A line receiver circuitry
Capacitors recommended for improved noise immunity

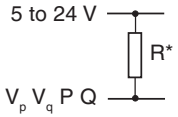
**Single ended alarm signal termination** (Ti options A, B, C, D)




**Analogue outputs**

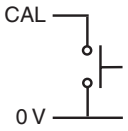



**Limit output** (No limits on TD interfaces)



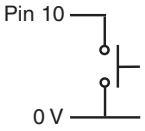

*Select R so maximum current does not exceed 20 mA.
Alternatively use a suitable relay or opto-isolator.

**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**



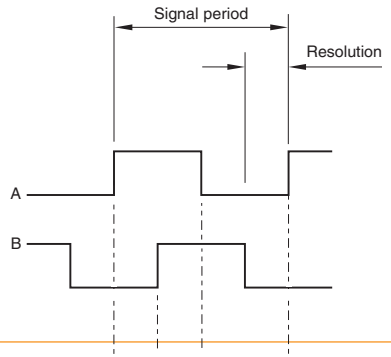

Connect pin 10 to 0 V to switch to lower resolution.

# Output specifications

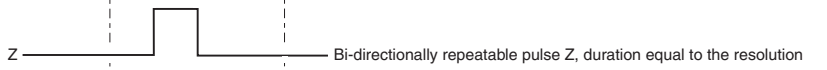
## Digital output signals

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

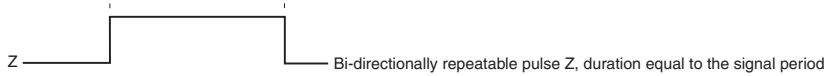
**Incremental**† 2 channels A and B in quadrature (90° phase shifted)




**Reference**†



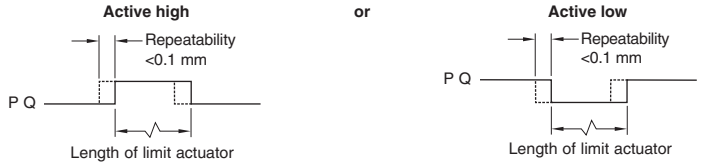

**Wide reference**†




**NOTE:** Select 'standard' or 'wide' reference at time of ordering, to match the requirements of the controller being used. Wide reference mark not available on Ti0004 interfaces.

**Limits** Open collector output, asynchronous pulse

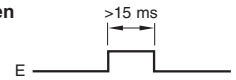
**Digital Ti interfaces only**




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

**Alarm**† Asynchronous pulse

**Line driven**



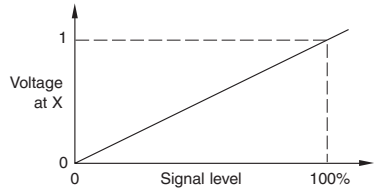

Alarm asserted when signal level is less than 20% or greater than 135%. Alarm is also asserted if readhead speed is too high for reliable operation.

E- output only for Ti options A, B, C, D

**or 3-state alarm**

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

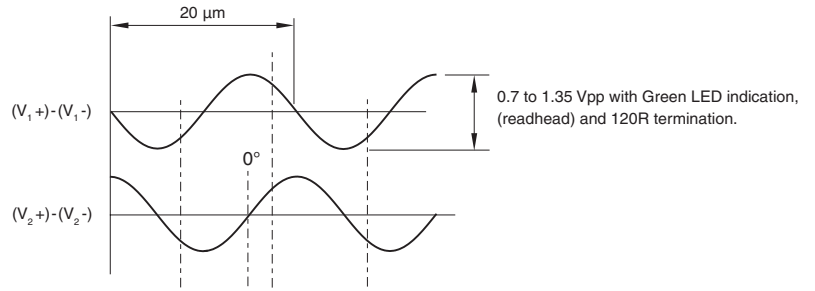
**Set-up***



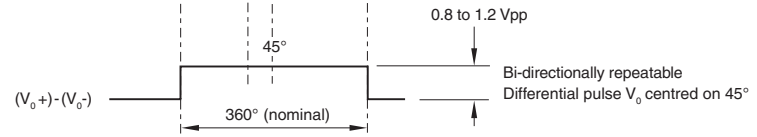

Set-up signal voltage proportional to incremental signal amplitude

## Analogue output signals

**Incremental** 2 channels $V_1$ and $V_2$ differential sinusoids in quadrature centred on 1.65 V (90° phase shifted)
**NOTE:** Ti0000A00V centred on 2.5 V



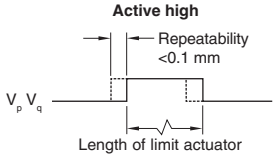

**Reference**



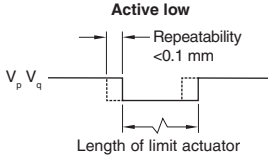

Differential signals $V_0$+ and $V_0$- centred on ~1.65 V
**NOTE:** Ti0000A00V centred on 2.5 V

**Limits** Open collector output, asynchronous pulse

**Ti0000 interface only**

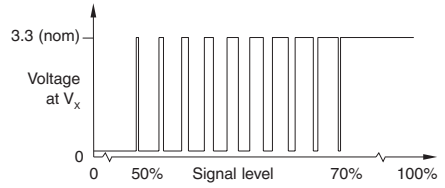



**T103x readhead only**




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

**Set-up***




Between 50% and 70% signal level, $V_x$ is a duty cycle, 20 µm duration.
Time spent at 3.3 V increases with incremental signal level.
At >70% signal level $V_x$ is nominal 3.3 V.

*Set-up signals as shown are not present during calibration routine.

†Inverse signals not shown for clarity

## General specifications

| | | |
|---|---|---|
| **Power supply** | 5 V ±10% | Readhead only <100 mA<br>T103x with Ti0000 <100 mA<br>T103x with Ti0004 – Ti20KD or TD4000 – TD0040 <200 mA<br>**NOTE:** Current consumption figures refer to unterminated systems.<br>For digital outputs a further 25 mA per channel pair (eg A+, A-) will be drawn when terminated with 120R.<br>For analogue outputs a further 20 mA in total will be drawn when terminated with 120R.<br>Power from a 5 V dc supply complying with the requirements for SELV of standard IEC BS EN 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 readhead) | Bakeout | +120 °C |
| **Sealing** (readhead) | | IP40 |
| (interface) | | IP20 |
| **Acceleration** (readhead) | Operating | 500 m/s², 3 axes |
| **Shock** (system) | Operating | 500 m/s², 11 ms, ½ sine, 3 axes |
| **Vibration** (system) | Operating | 100 m/s², 55 Hz to 2000 Hz, 3 axes |
| **Mass** | | Readhead 10 g<br>Interface 100 g<br>Cable 26 g/m<br>UHV cable 14 g/m |
| **Readhead cable** (standard) | | Double shielded, outside diameter 4.25 ±0.25 mm<br>Flex life >20 x $10^6$ cycles at 20 mm bend radius<br>UL recognised component |
| (UHV) | | Tin coated braided single screen FEP core insulation |
| **Maximum cable length** | | |
| Readhead to interface | | 10 m |
| Interface to controller | | |

| Clocked output option (MHz) | Maximum cable length (m) |
|---|---|
| 40 to 50 | 25 |
| <40 | 50 |
| analogue | 50 |

**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.**

## Scale technical specifications

| | | |
|---|---|---|
| **Form** | | 0.4 mm x 8 mm (H x W) includes adhesive |
| **Datum fixing** | | Loctite 435 |
| **Reference mark** | | Customer selected *IN-TRAC* auto phase optical reference mark repeatable to unit of resolution throughout specified temperature and speed range |
| | L <100 mm | Single reference mark at scale centre |
| | L ⩾100 mm | Reference marks at 50 mm spacing |
| **Material** | | Hardened and tempered martensitic stainless steel fitted with a self-adhesive backing tape |
| **Accuracy** (at 20 °C) | | ±5 µm/m calibration traceable to International Standards |
| **Coefficient thermal expansion** | | 10.1 ±0.2 µm/m/°C@20 °C |
| **Maximum length** | | 5 m* |
| **Installation temperature** | | 15 °C to 35 °C |

*For lengths >2 m RTLC with *FASTRACK* is recommended.

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