

VIONiC™ RTLC20-S linear encoder system



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Legal notices

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

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

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Product compliance

Renishaw plc declares that the VIONiC™ encoder system complies with the applicable standards and regulations. A copy of the EU declaration of conformity is available from our website at www.renishaw.com/productcompliance

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.

Further information

Further information relating to the VIONiC encoder range can be found in the *VIONiC series encoder system* data sheet (Renishaw part no. L-9517-9678), *Advanced Diagnostic Tool ADTi-100* data sheet (Renishaw part no. L-9517-9699), *Advanced Diagnostic Tool ADTi-100 and ADT View software* quick-start guide (Renishaw part no. M-6195-9321), and the *Advanced Diagnostic Tool ADTi-100 and ADT View software* user guide (Renishaw part no. M-6195-9413). These can be downloaded from our website www.renishaw.com/vionicdownloads and are also available from your local Renishaw representative.

Legal notices (continued)

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

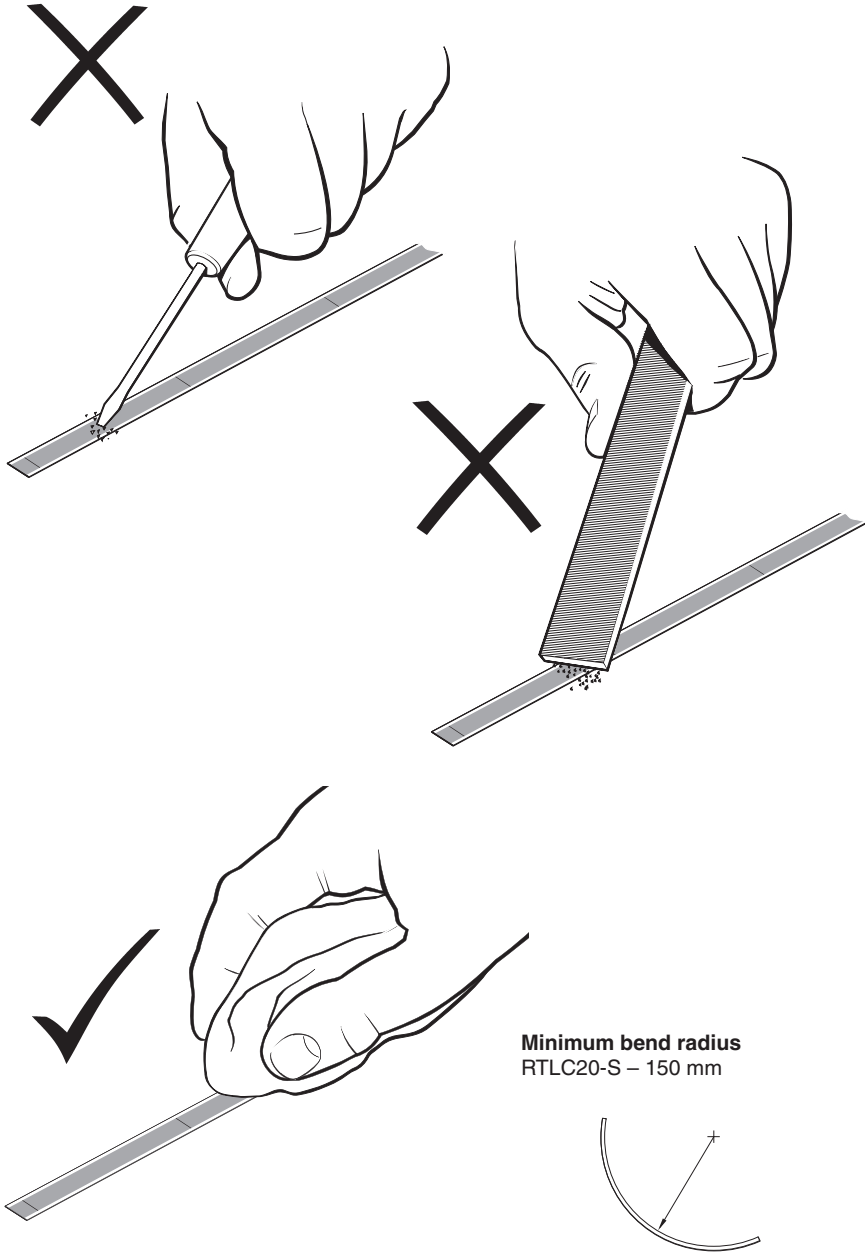
Information required by Article 33(1) of Regulation (EC) No. 1907/2006 (“REACH”) relating to products containing substances of very high concern (SVHCs) is available at www.renishaw.com/REACH

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.

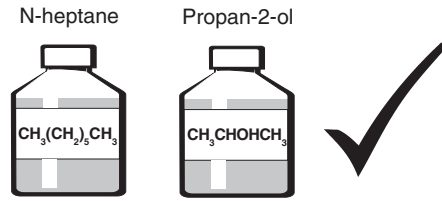
Storage and handling



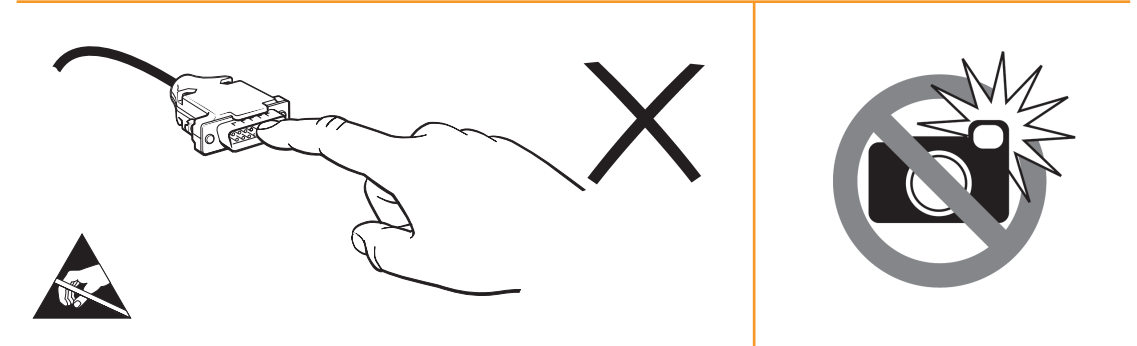
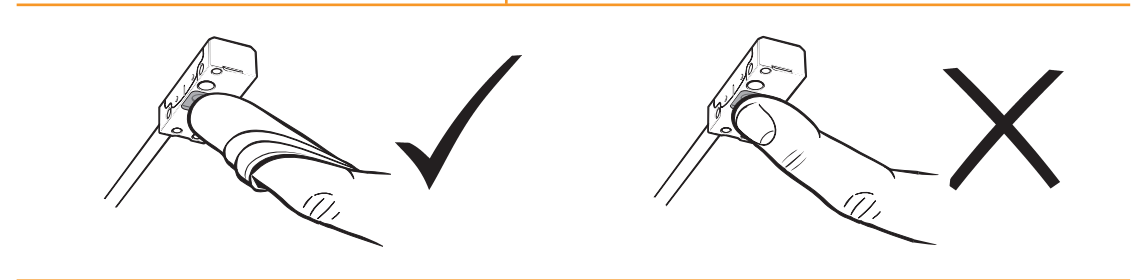
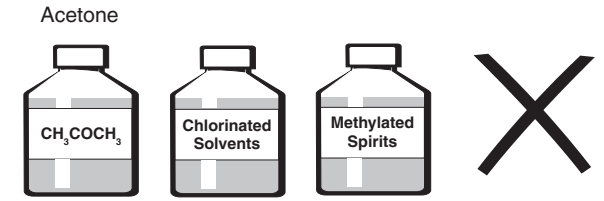
Minimum bend radius
RTLC20-S – 150 mm

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

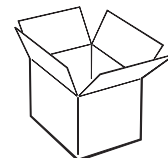
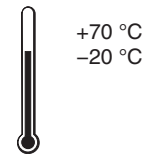
Scale and readhead



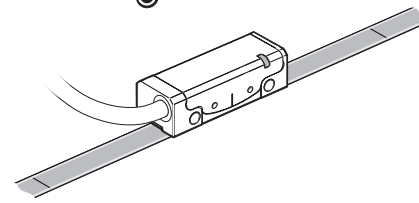
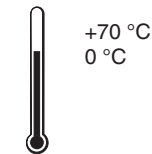
Readhead only



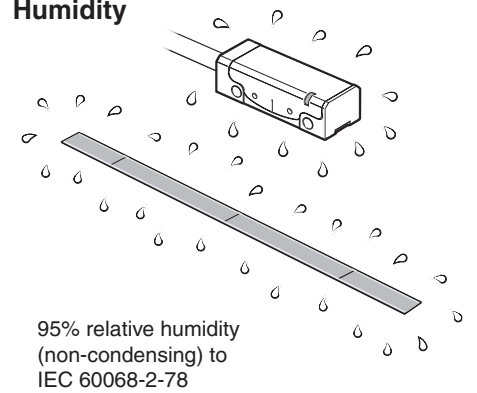
Storage



Operating

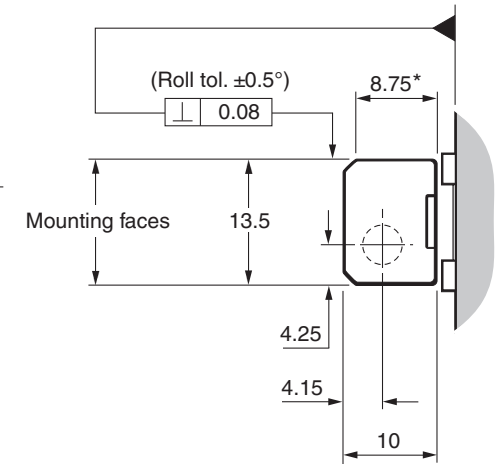
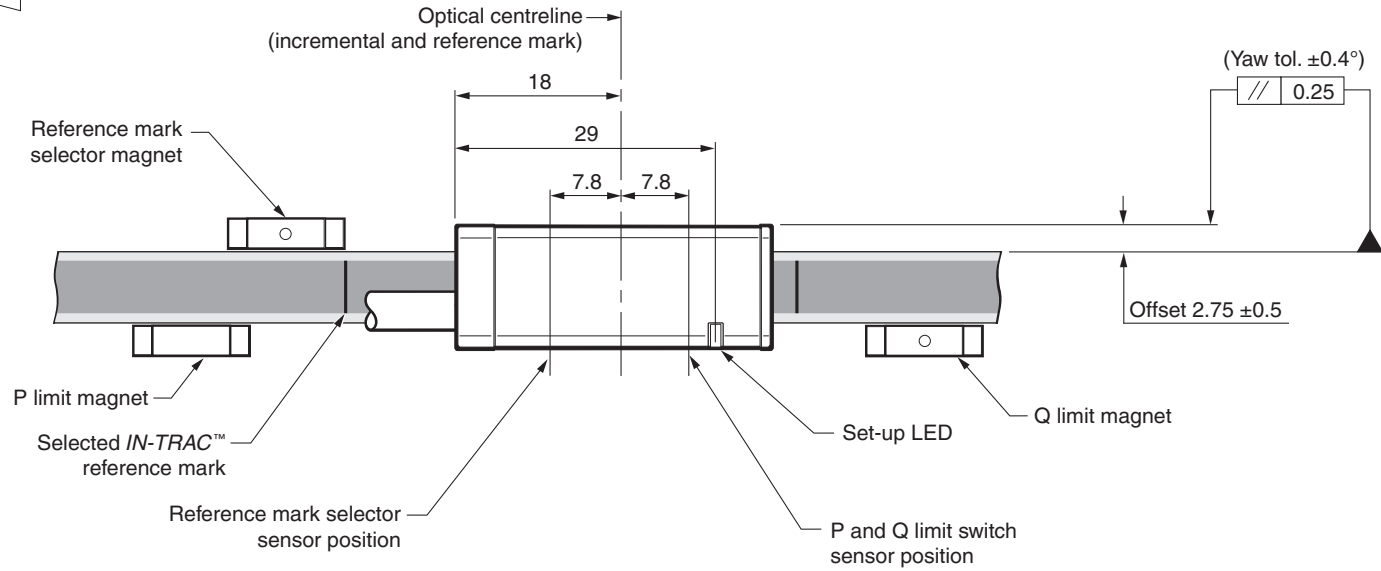
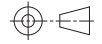


Humidity

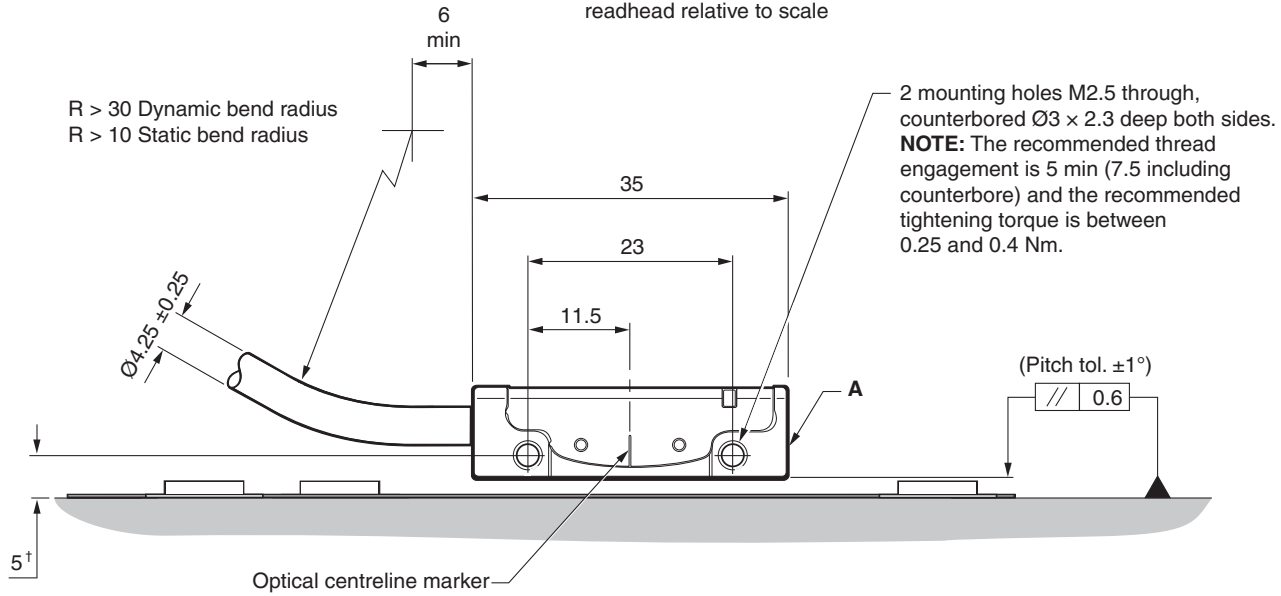


VIONiC readhead installation drawing

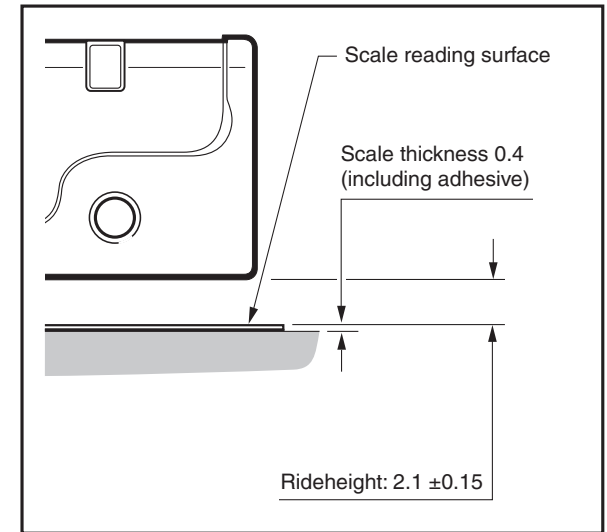
Dimensions and tolerances in mm



← Forward direction of readhead relative to scale



Detail A

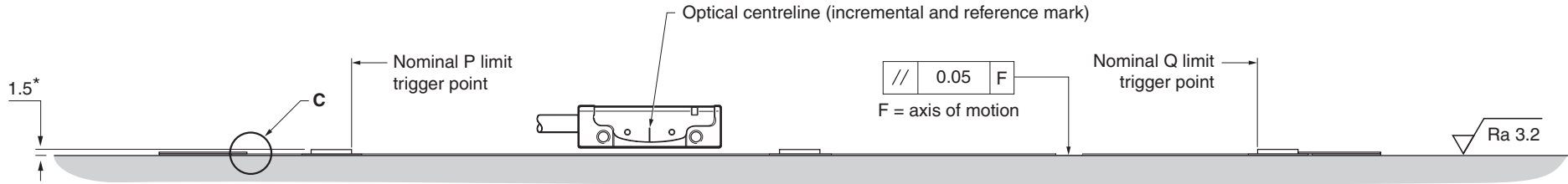
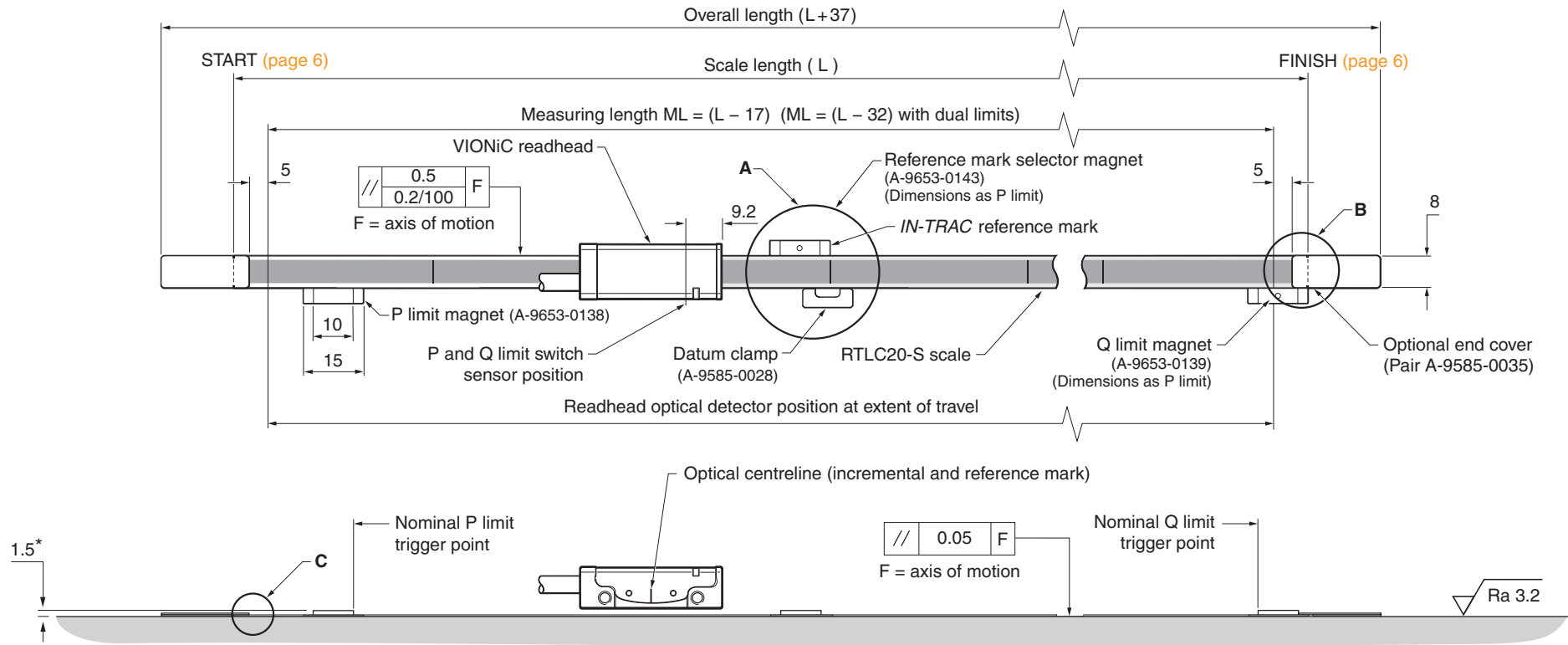


*Extent of mounting face. †Dimension from substrate surface.

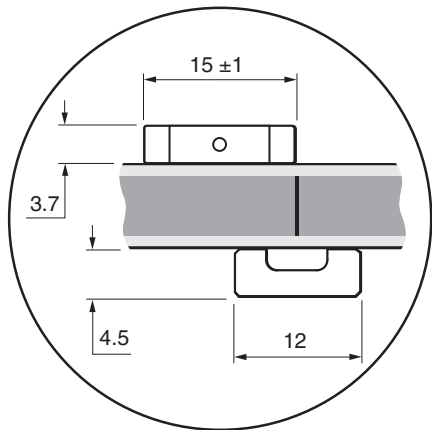
RTL20-S scale installation drawing

(Adhesive datum clamp)

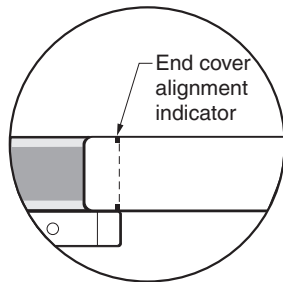
Dimensions and tolerances in mm



Detail A

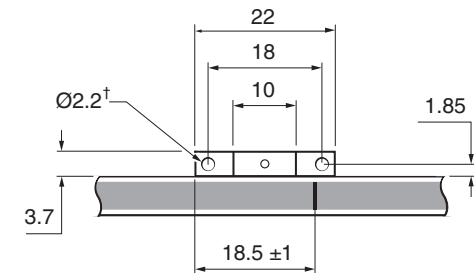


Detail B



Detail C

Optional bolted reference mark selector or limit magnets



Bolted magnet type	Part number
P limit	A-9653-0292
Q limit	A-9653-0291
Reference mark selector	A-9653-0290

*Dimension from substrate surface. † Supplied with 2 × M2 × 4 screws.

NOTES: 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.

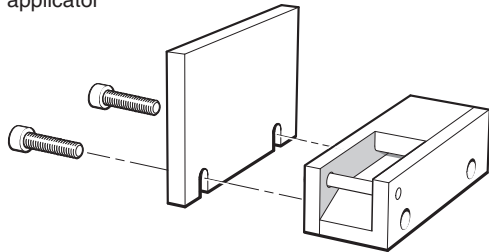
Scale application

The scale applicator (A-9589-0115) is designed for use with RTALC20-S scale.

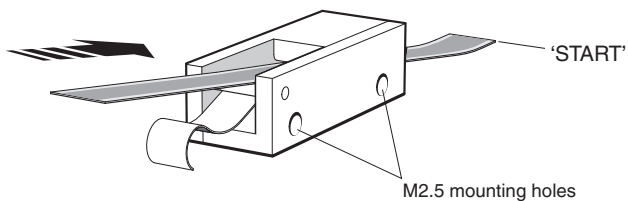
1. Allow the scale to acclimatise to the installation environment prior to installation.
2. Mark out the 'START' and 'FINISH' points for the scale on the axis substrate – ensure that there is room for the optional end covers if required ('RTALC20-S scale installation drawing', page 5).
3. Thoroughly clean and degrease the substrate using recommended solvents ('Storage and handling', page 3). Allow the substrate to dry before applying scale.
4. Mount the 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: The scale applicator can be mounted either way round to enable easiest orientation for scale installation.

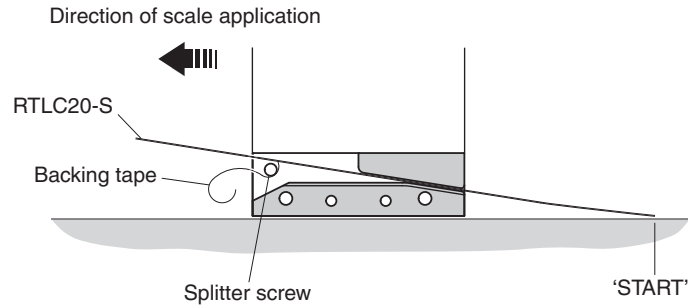
Side mounting scale applicator (A-9589-0115).



5. Move the axis to the scale 'START' position, leaving enough room for the scale to be inserted through the applicator, as shown below.
6. Begin to remove the backing paper from the scale and insert the scale into the applicator up to the 'START' point (as shown). Ensure the backing paper 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.



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.



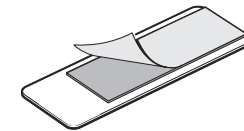
9. Remove the applicator and, if necessary, adhere the remaining scale manually. Apply firm finger pressure via a clean lint-free cloth along the length of the scale after application to ensure complete adhesion.
10. Clean the scale using Renishaw scale cleaning wipes (A-9523-4040) or a clean, dry, lint-free cloth.

End covers

The end cover kit (A-9585-0035) is designed to be used with RTALC20-S scale to provide protection for exposed ends.

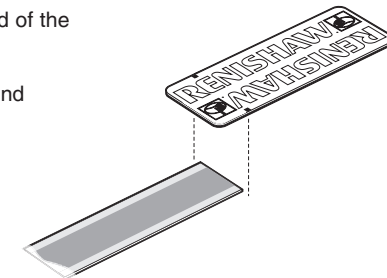
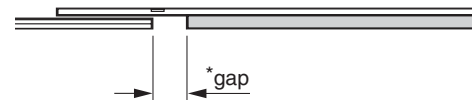
NOTE: End covers are optional and can be fitted before or after readhead installation.

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



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



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 selected *IN-TRAC* reference mark as shown.

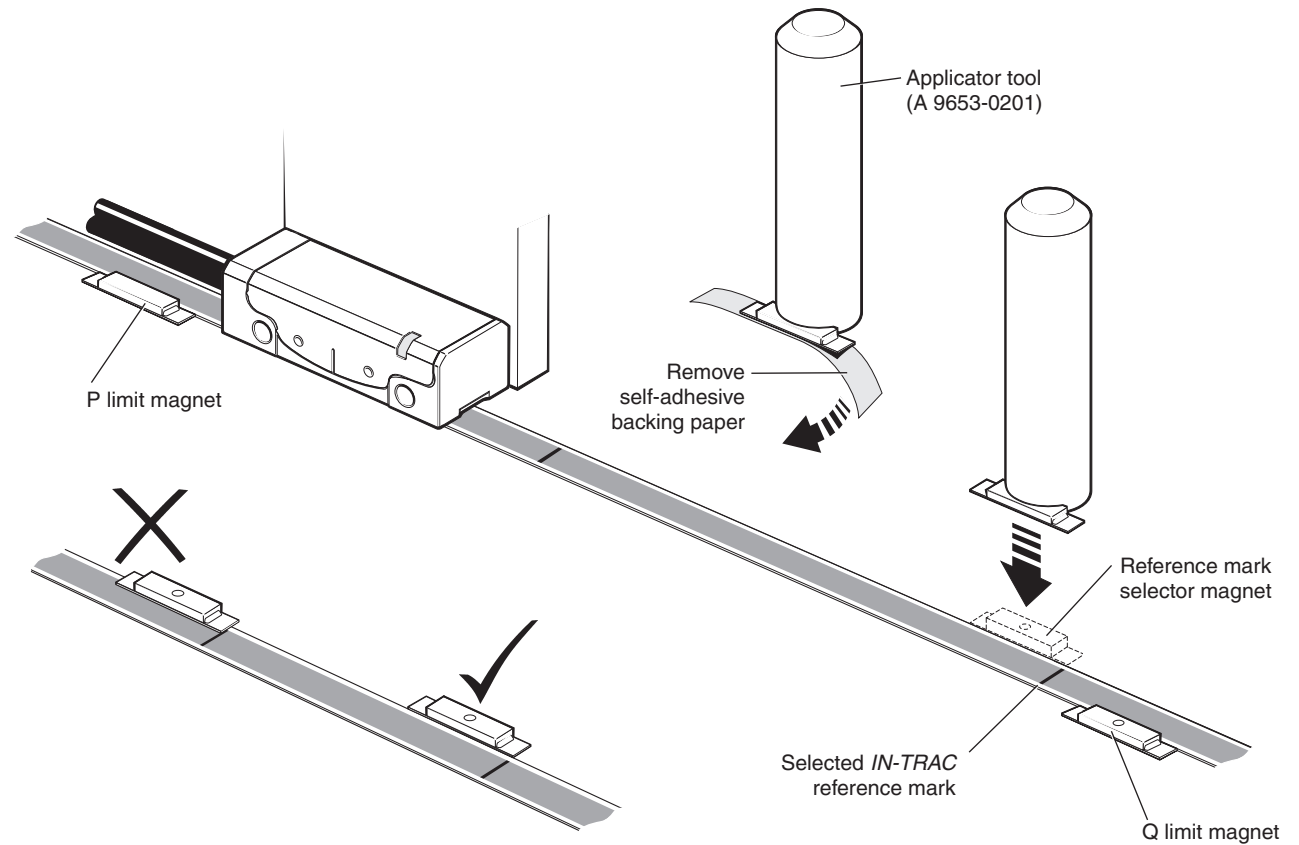
As the VIONiC readhead passes the reference mark selector magnet or limit switch magnet, a force of up to 0.2 N is generated between the magnet and the concentrators on the readhead. The design of the bracket should be sufficiently stiff so that it is able to tolerate such force without distorting. Following the clamping instructions on the scale installation will prevent this magnetic force from disturbing the scale.

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 ([‘RTL20-S scale installation drawing’, page 5](#)).

NOTES

- ▶ 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 ([‘RTL20-S scale installation drawing’, page 5](#)).
- ▶ The reference mark selector and limit actuator locations are correct for the readhead orientation shown.
- ▶ The reference mark selector magnet is only required for ‘Customer selectable reference mark’ readheads. For more information refer to *VIONiC series encoder system* data sheet (Renishaw part no. L-9517-9678).
- ▶ External magnetic fields greater than 6mT, in the vicinity of the readhead, may cause false activation of the limit and reference sensors.



Datum clamp

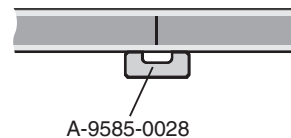
IMPORTANT: Allow 24 hours after scale application before fitting datum clamp.

The datum clamp (A-9585-0028) fixes the RTL20-S scale rigidly to the substrate at the location chosen.

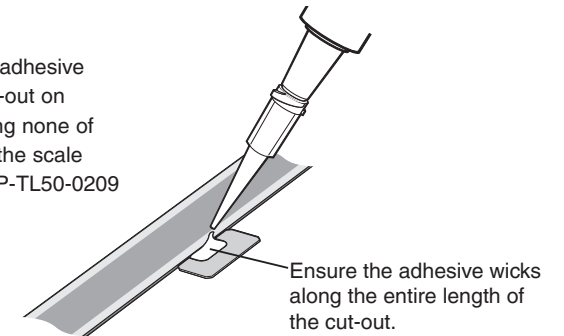
CAUTION: The metrology of the system may be compromised if the datum clamp is not used.

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.

1. Remove the backing paper from the datum clamp. Place the datum clamp with the 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.



VIONiC encoder system quick-start guide

This section is a quick-start guide to installing a VIONiC encoder system.

More detailed information on installing the system is contained on [page 9](#) and [page 10](#) of this installation guide.

The optional Advanced Diagnostic Tool ADTi-100* (A-6165-0100) and ADT View software† can be used to aid installation and calibration.

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 ('[RTL20-S scale installation drawing](#)', [page 5](#)).



Connect the readhead to 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 calibration fails, restore factory defaults by obscuring the readhead optical window on power-up ([page 11](#)). Repeat the installation and calibration routine.

*For more details refer to the *Advanced Diagnostic Tool ADTi-100 and ADT View software* quick-start guide (Renishaw part no. M-6195-9321) and *Advanced Diagnostic Tool ADTi-100 and ADT View software* user guide (Renishaw part no. M-6195-9413).

†The software can be downloaded for free from www.renishaw.com/adt

Readhead mounting and alignment

Mounting brackets

The bracket must have a flat mounting surface and should 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.

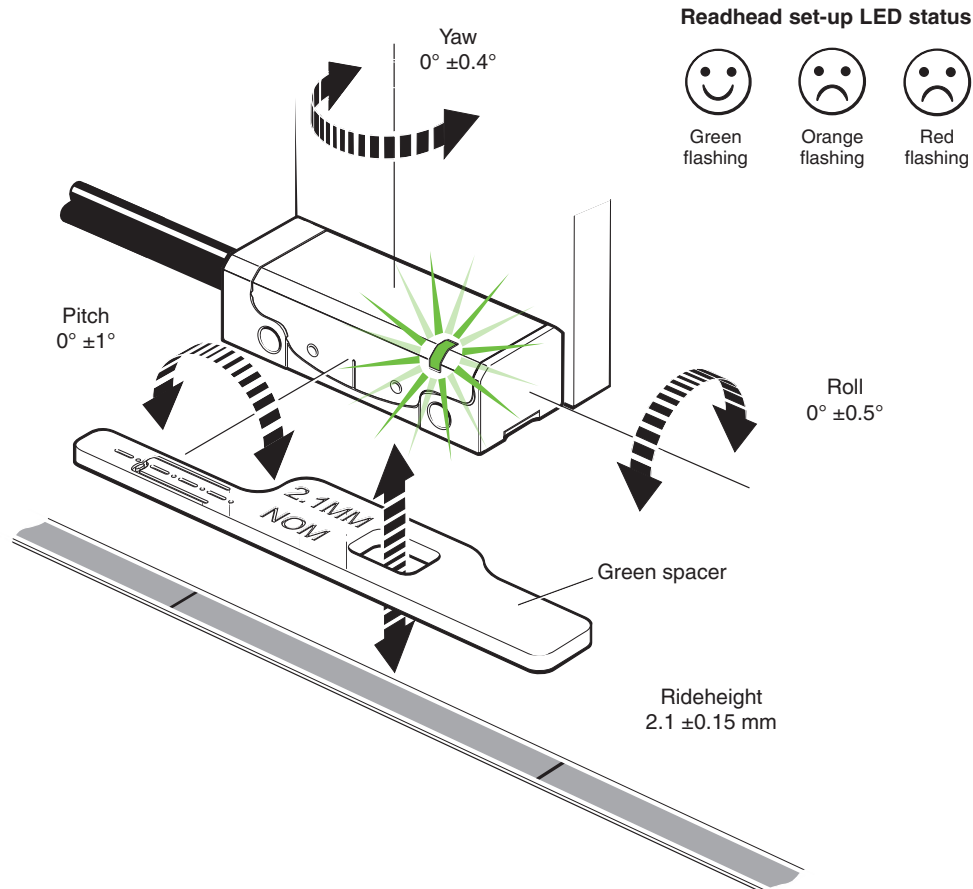
NOTE: When cleaning the readhead and scale apply cleaning fluid sparingly; do not soak.

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

NOTE: When re-installing the readhead, factory defaults should be restored (page 11).

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	4 red flashes	Low signal, over signal, or overspeed; system in error



System calibration

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

Ensure signal strength has been optimised along the full axis of travel; the LED will be flashing Green.

Cycle the power to the readhead or connect the 'Remote CAL' output pin to 0 V for < 3 seconds. The readhead will then single flash Blue to indicate it is in calibration mode as detailed in 'Readhead mounting and alignment', page 9. The readhead will only enter calibration mode if the LED is flashing Green.

Step 1 – Incremental signal calibration

- ▶ Move the readhead along the axis at slow speed (< 100 mm/s or less than the readhead maximum speed, whichever is slowest), 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.
- ▶ 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.
- ▶ 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 as detailed below, 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 LED stops flashing and remains solid Blue (or Green if AGC is disabled). The reference mark is now phased.
- ▶ The system automatically exits the calibration routine and is ready for operation.
- ▶ AGC and AOC are automatically switched on once calibration is complete. To switch off AGC refer to 'Enabling/disabling AGC', page 11.
- ▶ 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 reference mark selector magnet is fitted in the correct location relative to readhead orientation ('RTL20-S scale installation drawing', page 5).

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	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 re-installing the system, or in the case of continued calibration failure, factory defaults should be restored.

To restore factory defaults:

- ▶ Switch system off.
- ▶ Obscure the readhead optical window (using the spacer supplied with the readhead ensuring the cut-out is NOT under the optical window) or connect the 'Remote CAL' output pin to 0 V.
- ▶ Power the readhead.
- ▶ Remove the spacer or, if using, the connection from the 'Remote CAL' output pin to 0 V.
- ▶ The LED will start continuously flashing indicating factory defaults have been restored and the readhead is in installation mode (flashing set-up LED).
- ▶ Repeat '[Readhead set-up](#)' procedure on [page 9](#).

Enabling/disabling AGC

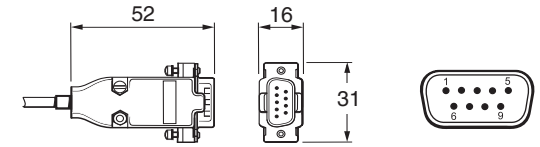
The AGC is switched on once the system has been calibrated indicated by a Blue LED. AGC can be manually switched off by connecting the 'Remote CAL' output pin to 0 V for > 3 seconds < 10 seconds. The LED will then be solid Green.

Output signals

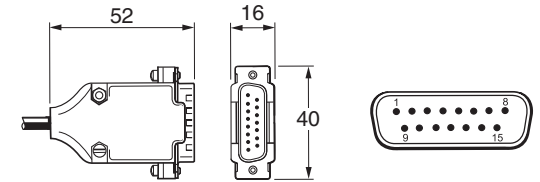
Digital outputs

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 *	CAL	Clear	9	1	5	C	4	
Shield	-	Screen	Case	Case	Case	Case	Ferrule	

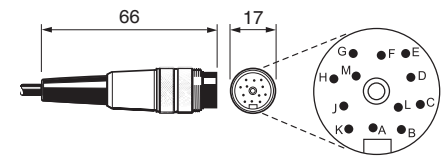
9-way D-type connector (termination code A)



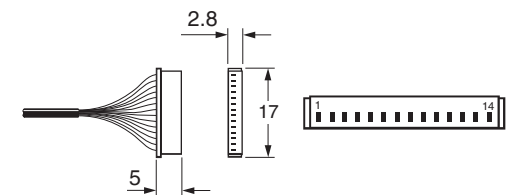
15-way D-type connector (termination code D, H)



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



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



* Remote CAL line must be connected for use with ADTi-100.

[†] 12-way circular Binder mating socket – A-6195-0105.

[‡] Pack of 5 14-way JST SH mating sockets:

A-9417-0025 – Bottom mount;

A-9417-0026 – Side mount.

Maximum of 20 insertion cycles for JST connector.

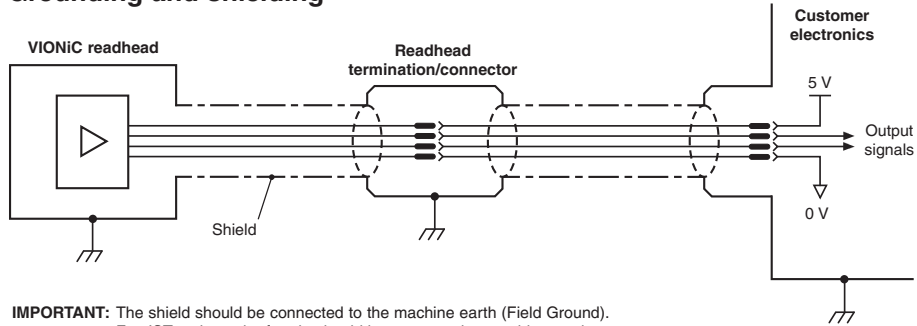
Speed

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

*For a readhead with a 1 m cable.

Electrical connections

Grounding and shielding



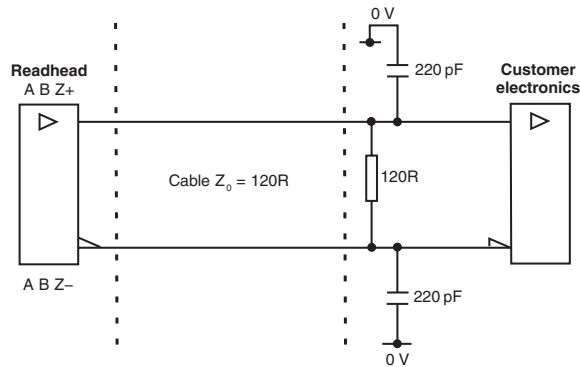
IMPORTANT: The shield should be connected to the machine earth (Field Ground).
For JST variants the ferrule should be connected to machine earth.

Maximum readhead cable length: 3 m

Maximum extension cable length: Dependent on cable type, readhead cable length and clock speed.
Contact your local Renishaw representative for more information.

NOTE: The maximum cable length between the readhead and the ADTI-100 is 3 m.

Recommended signal termination

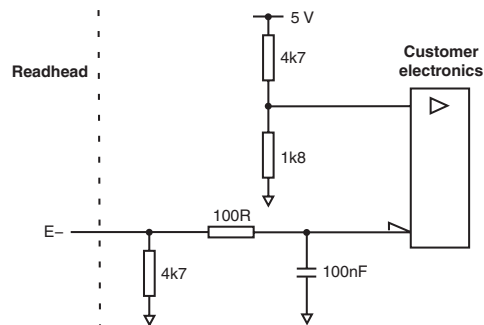


Standard RS422A line receiver circuitry.

Capacitors recommended for improved noise immunity.

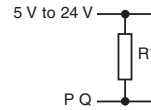
Single ended alarm signal termination

(Not available with 'A' cable termination)



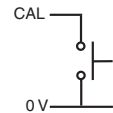
Limit output

(Not available with 'A' cable termination)



* Select R so that maximum current does not exceed 10 mA.
Alternatively, use a suitable relay or opto-isolator.

Remote CAL operation



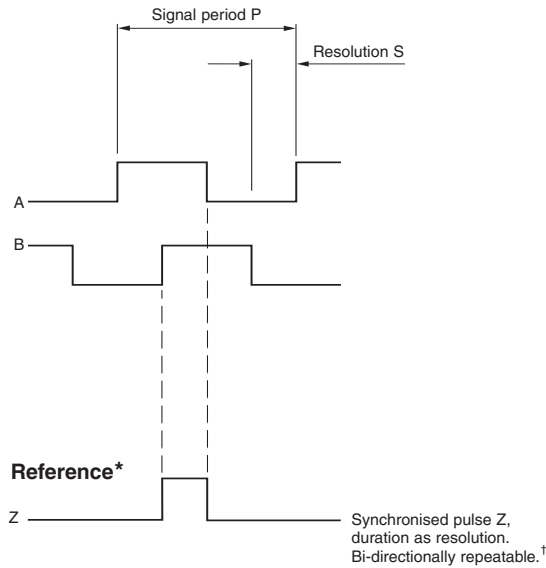
Remote operation of the CAL/AGC is possible via CAL signal.

Output specifications

Digital output signals

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

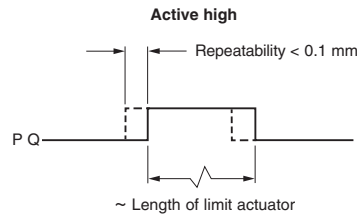
Incremental* 2 channels A and B in quadrature (90° phase shifted)



Resolution option code	P (µm)	S (µm)
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
M	0.16	0.04
P	0.1	0.025
I	0.08	0.02
O	0.04	0.01
Q	0.02	0.005
R	0.01	0.0025

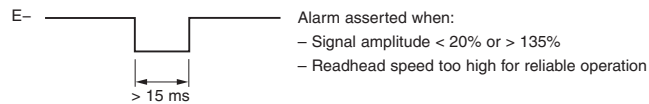
NOTE: A wide reference mark option, outputting a reference pulse for the duration of the signal period is available. Contact your local Renishaw representative for more information.

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



Alarm

Line driven (Asynchronous pulse)
(Not available with 'A' cable termination)




or 3-state alarm

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

* Inverse signals not shown for clarity.

† Only calibrated reference mark is bi-directionally repeatable.

General specifications

Power supply	5V -5%/+10%	Typically 200 mA fully terminated
		Power from a 5 Vdc supply complying with the requirements for SELV of standard IEC 60950-1
	Ripple	200 mVpp maximum @ frequency up to 500 kHz
Temperature	Storage	-20 °C to +70 °C
	Operating	0 °C to +70 °C
Humidity		95% relative humidity (non-condensing) to IEC 60068-2-78
Sealing		IP40
Acceleration (system)	Operating	400 m/s ² , 3 axes
Shock (system)	Operating	500 m/s ² , 11 ms, ½ sine, 3 axes
Vibration (system)	Operating	100 m/s ² max @ 55 Hz to 2000 Hz, 3 axes
Mass	Readhead	8.6 g
	Cable	26 g/m
Readhead cable		Single-shielded, outside diameter 4.25 ±0.25 mm
		Flex life > 20 × 10 ⁶ cycles at 30 mm bend radius
		UL recognised component 
Maximum readhead cable length*		3 m

*Extension cables available. Contact your local Renishaw representative for details.

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.

Scale technical specifications

Form (H × W)	0.4 mm × 8 mm (including adhesive)
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 lengths	20 mm to 10 m* (> 10 m available on request)
Material	Hardened and tempered martensitic stainless steel fitted with a self-adhesive backing tape
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 with A-9585-0028 clamp

* For lengths > 2 m *FASTRACK* with *RTL20* is recommended. Refer to the *VIONiC RTL20/FASTRACK linear encoder system* installation guide (Renishaw part no. M-6195-9225).

Reference mark

Type	Customer selected <i>IN-TRAC</i> reference mark, directly embedded into incremental track. Bi-directional position repeatability.
Selection	Single reference mark selection by selector magnet (A-9653-0143) 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 scale end)
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 (‘RTL20-S scale installation drawing’, page 5).
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

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

RENISHAW 
apply innovation™

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

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Registered office: New Mills, Wotton-under-Edge, Gloucestershire, GL12 8JR, UK.



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