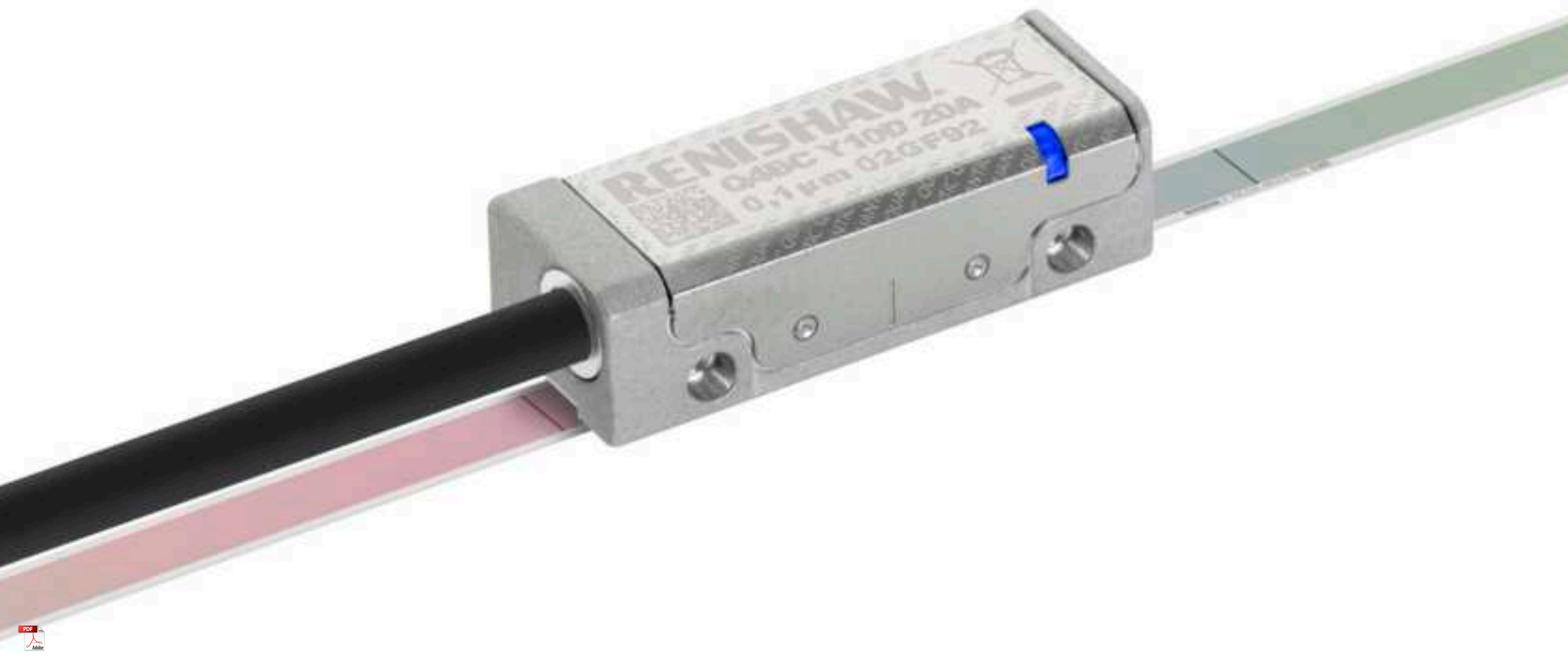


QUANTiC™ RKLC40-S incremental linear encoder system



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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	US6775008	JP4750998	CN100543424	EP1766334
JP4932706	US7659992	CN100507454	EP1766335	IN281839
JP5386081	US7550710	CN101300463	EP1946048	JP5017275
US7624513	CN101310165	EP1957943	US7839296	CN108351229
EP3347681	JP2018530751	KR20180052676	US20180216972	WO2017203210
CN1314511	EP1469969	EP2390045	JP5002559	US8987633
US8466943				

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Product compliance

Renishaw plc declares that QUANTiC™ 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 QUANTiC encoder range can be found in the *QUANTiC™ series encoder system* Data sheet (Renishaw part no. L-9517-9778), *Advanced Diagnostic Tool ADTi-100* Data sheet (Renishaw part no. L-9517-9699), *Advanced Diagnostic Tool ADTi-100 and ADT View software* User guide (Renishaw part no. M-6195-9413) and *Advanced Diagnostic Tool ADTi-100 and ADT View software* Quick-start guide (Renishaw part no. M-6195-9321). These can be downloaded from our website at www.renishaw.com/quanticdownloads and are also available from your local representative.

Packaging

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

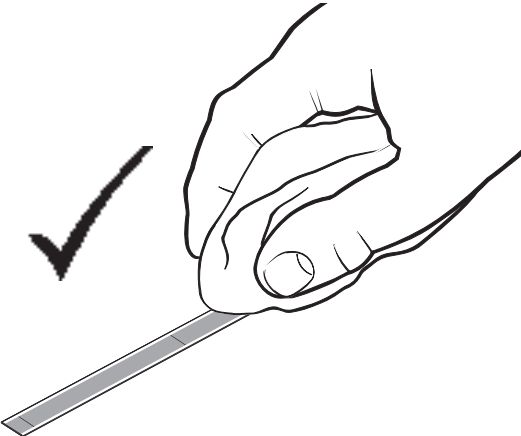
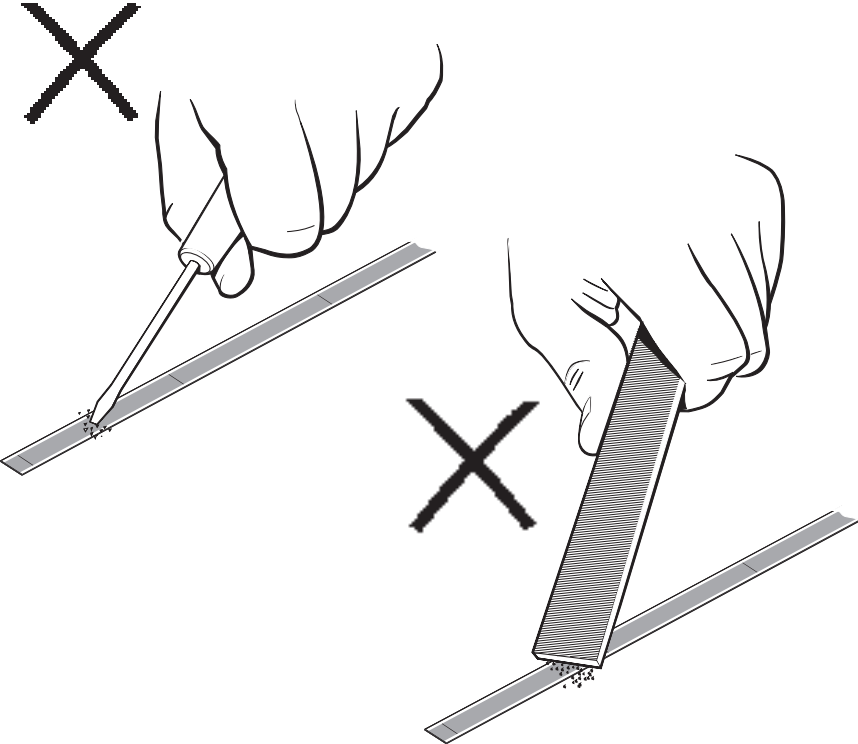
Information required by Article 33(1) of Regulation (EC) No. 1907/2006 ("REACH") relating to products containing substances of very high concern (SVHCs) is available at www.renishaw.com/REACH.

WEEE recycling guidelines

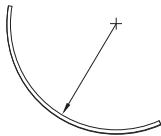


The use of this symbol on Renishaw products and/or accompanying documentation indicates that the product should not be mixed with general household waste upon disposal. It is the responsibility of the end user to dispose of this product at a designated collection point for waste electrical and electronic 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



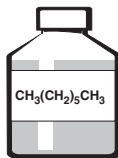
Minimum bend radius
RKLC40-S – 50 mm



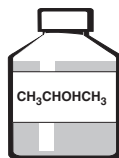
NOTE: During storage, ensure self-adhesive tape is on the outside of the bend.

Scale and readhead

N-heptane

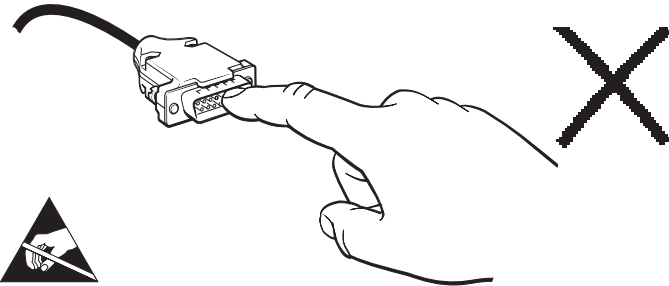
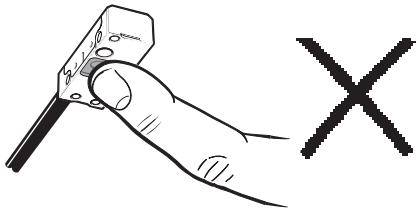
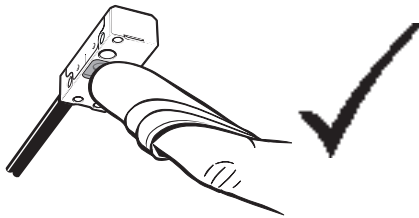
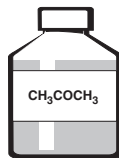


Propan-2-ol



Readhead only

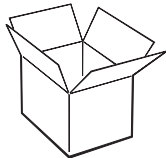
Acetone



Storage



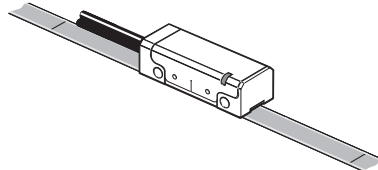
+70 °C
–20 °C



Installation



+35 °C
+10 °C

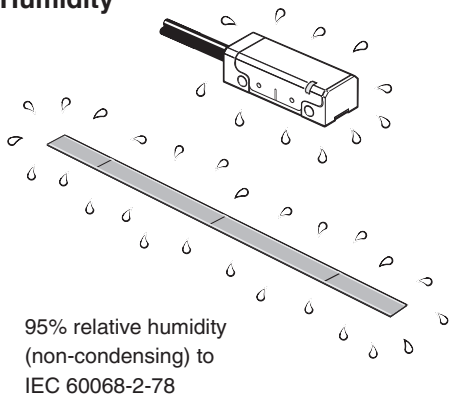


Operating



+70 °C
0 °C

Humidity

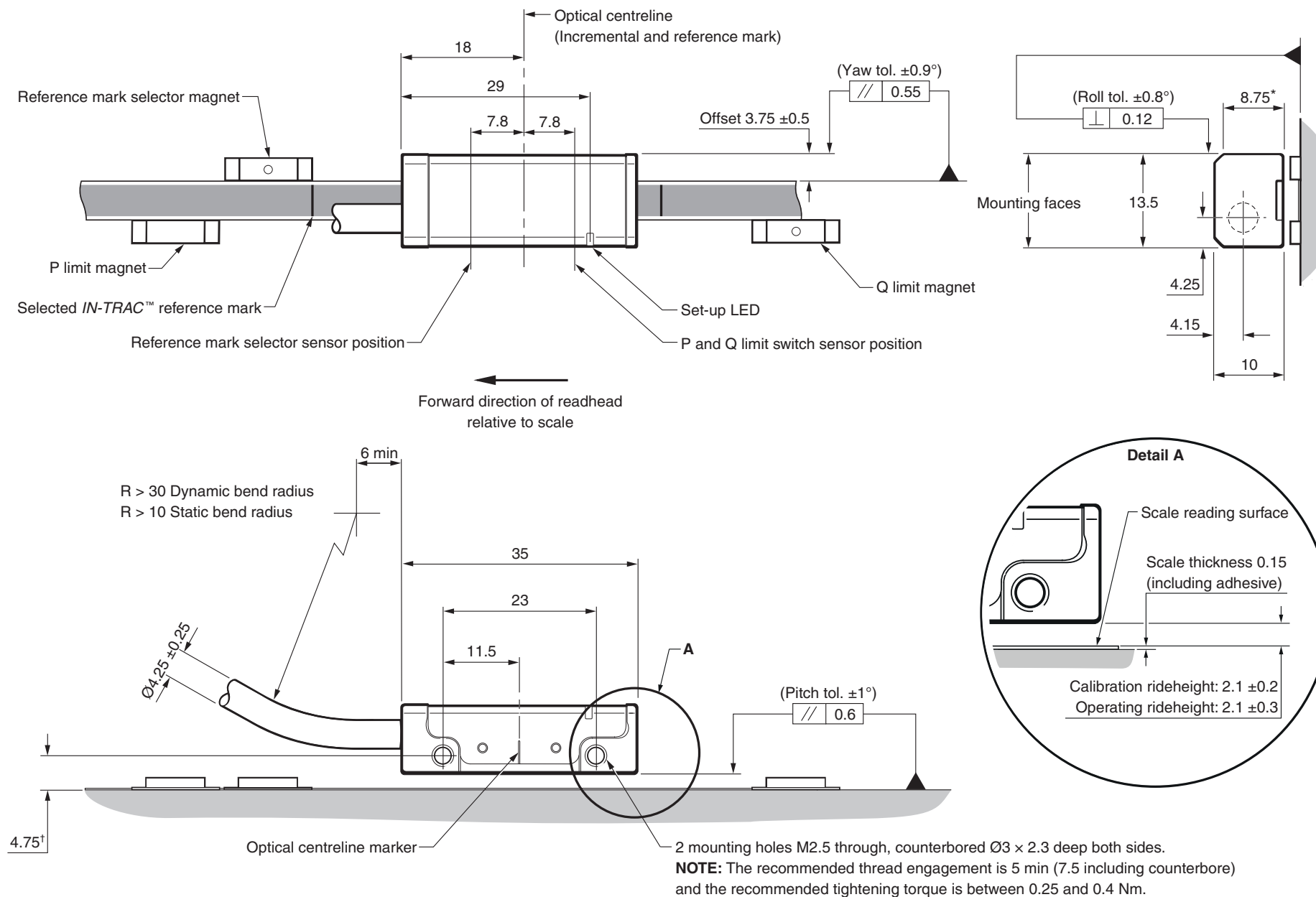


95% relative humidity
(non-condensing) to
IEC 60068-2-78

QUANTiC readhead installation drawing

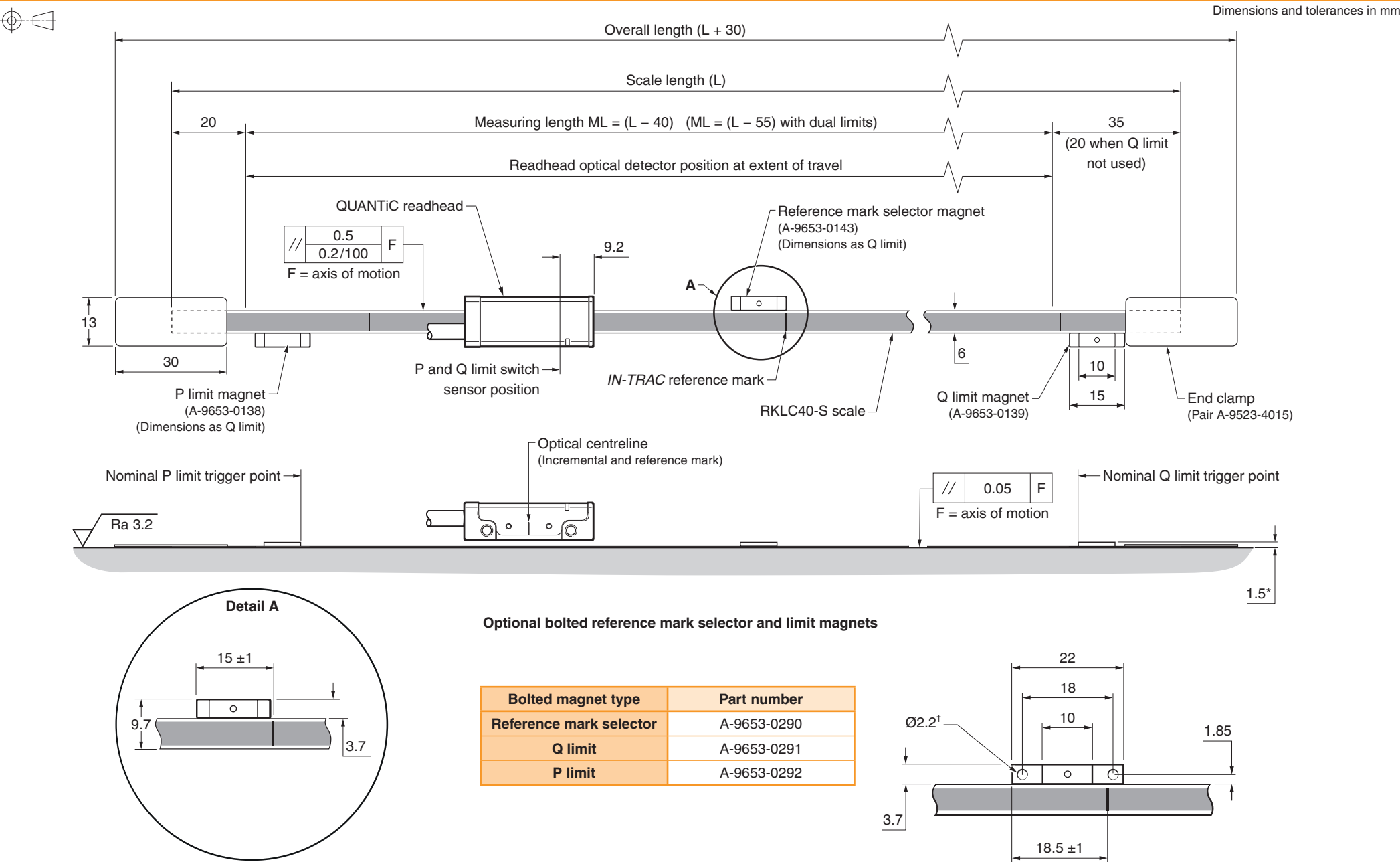


Dimensions and tolerances in mm



* Extent of mounting faces. † Dimension from substrate.

RKLC40-S scale installation drawing



* Dimension from substrate † 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.

RKLC40-S scale application

Suitable for:

- ▶ RKLC tape scale (any length)

Required parts:

- ▶ Appropriate length of RKLC40-S scale ('RKLC40-S scale installation drawing', page 4)
- ▶ Scale applicator (A-6547-1912)
- ▶ End clamp kit (A-9523-4015)
- ▶ RGG-2 two part epoxy adhesive (A-9531-0342)
- ▶ Appropriate cleaning solvents ('Storage and handling', page 2)
- ▶ 2 × M2.5 screws

Optional parts:

- ▶ Renishaw scale wipes (A-9523-4040)
- ▶ Lint-free cloth
- ▶ Magnet applicator tool (A-9653-0201)
- ▶ Limit magnets (P limit - A-9653-0138, Q limit - A-9653-0139)
- ▶ Reference mark selector magnet* (A-9653-0143)
- ▶ Guillotine (A-9589-0071) or shears (A-9589-0133) for cutting RKLC40-S to length required

* The reference mark selector magnet is only required for 'Customer selectable reference mark' readheads.

RKLC40-S scale application (continued)

Cutting scale

If required cut scale to length using guillotine or shears.

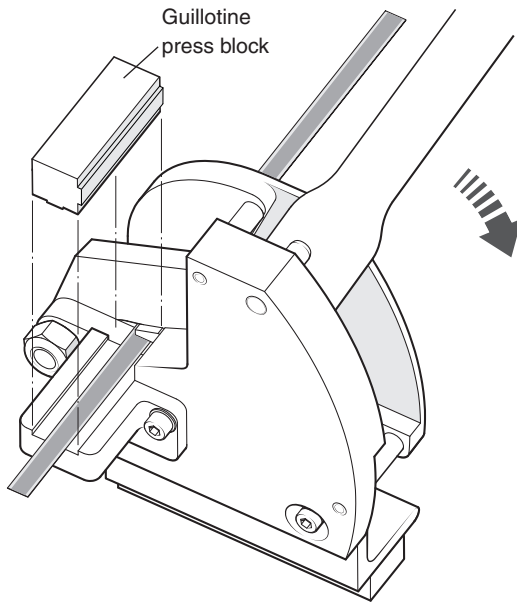
Using the guillotine

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

Once secured, feed the RKLC40-S scale through the guillotine as shown, and place guillotine press block down onto the scale. Ensure the block is in the correct orientation (as shown).

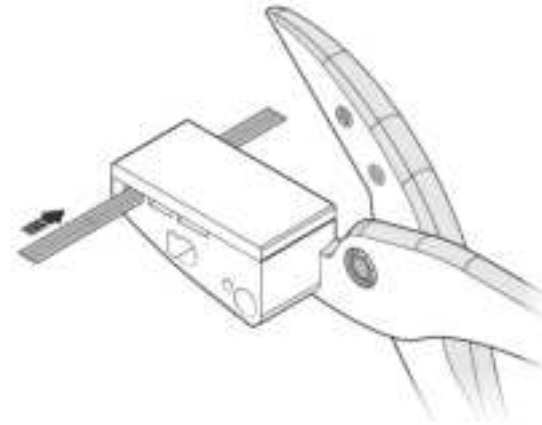
Whilst holding the block in place, in a smooth motion, pull down the lever to cut through the scale.

Guillotine press block orientation when cutting RKLC40-S scale



Using the shears

Feed the RKLC40-S scale through the first aperture on the shears (as shown).



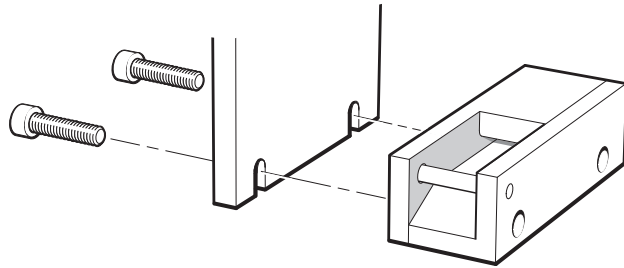
Hold the scale in place and close the shears in a smooth motion to cut through the scale.

RKLC40-S scale application (continued)

1. Allow scale to acclimatise to installation environment prior to installation.

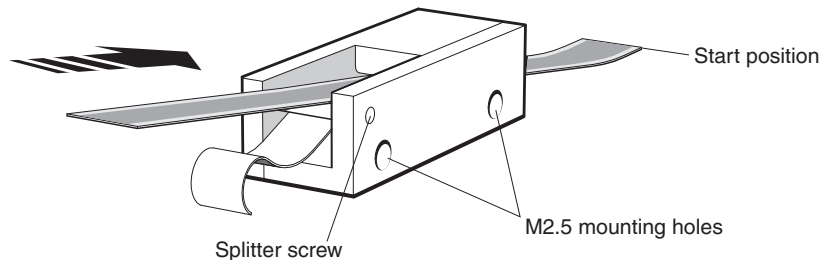
NOTE: RKLC scale should be installed between +10 °C and +35 °C to ensure scale mastering.

2. Mark out the start position for the scale on the axis substrate – ensure that there is room for the end clamps ('RKLC40-S scale installation drawing', page 4).
3. Thoroughly clean and degrease the substrate using recommended solvents ('Storage and handling', page 2). Allow substrate to dry before applying scale.
4. Mount the scale applicator to the readhead mounting bracket. Place the shim supplied with the readhead between the applicator and substrate to set the nominal height.



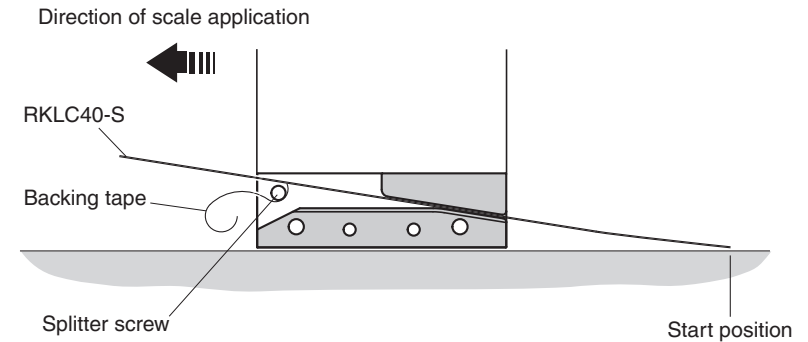
NOTE: Scale applicator can be mounted either way round to enable easiest orientation for scale installation.

5. Move axis to 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 scale into the applicator up to the start position (as shown). Ensure backing paper is routed under the splitter screw.



7. Apply firm finger pressure via a clean, dry, 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.



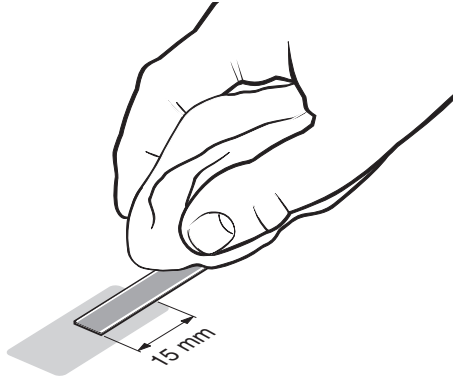
9. During installation ensure scale is adhered to substrate using light finger pressure.
10. Remove applicator carefully. Apply firm finger pressure via a clean lint-free cloth along the length of the scale after application to ensure complete adhesion.
11. Clean the scale using Renishaw scale wipes or a clean, dry, lint-free cloth.
12. Fit end clamps ('End clamps', page 8).

End clamps

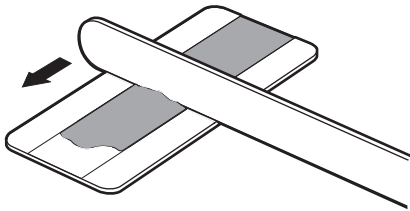
The end clamp kit is designed to be used with Renishaw RKLC40-S scale. Alternative, narrow 6 mm wide end clamps (A-9523-4111), are also available.

NOTE: End clamps can be mounted before or after readhead installation.

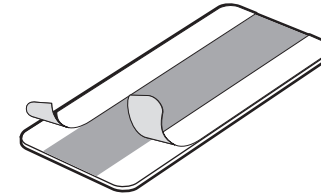
1. Clean ends of scale and the area where end clamps are to be fitted using Renishaw scale wipes or one of the recommended solvents ('Storage and handling', page 2).



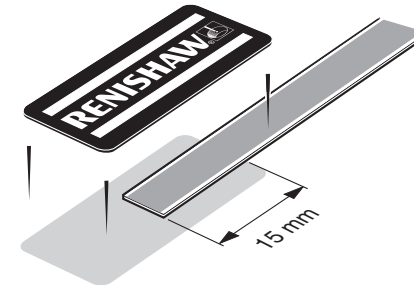
2. Thoroughly mix up a sachet of RGG-2 two part epoxy adhesive and apply a small amount to the underside of the end clamp.



3. The end clamp features two small regions of contact adhesive. These will temporarily hold the end clamp in position while the adhesive cures. Remove the backing tape from either side.



4. Immediately position end clamp over the end of the scale and push down to ensure complete adhesion. Allow 24 hours at 20 °C for full cure.*



CAUTION: Ensure that excess adhesive is wiped away from scale as it may affect the readhead signal level.

* To ensure scale end movement of typically < 1 µm, stabilise the system at least 5 °C higher than the maximum customer application temperature for a minimum of 8 hours.
For example: Customer application = 23 °C axis temperature. Stabilise the system at 28 °C for a minimum of 8 hours.

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 should be used. The magnet should be attached to the applicator tool as shown. 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 QUANTiC 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.

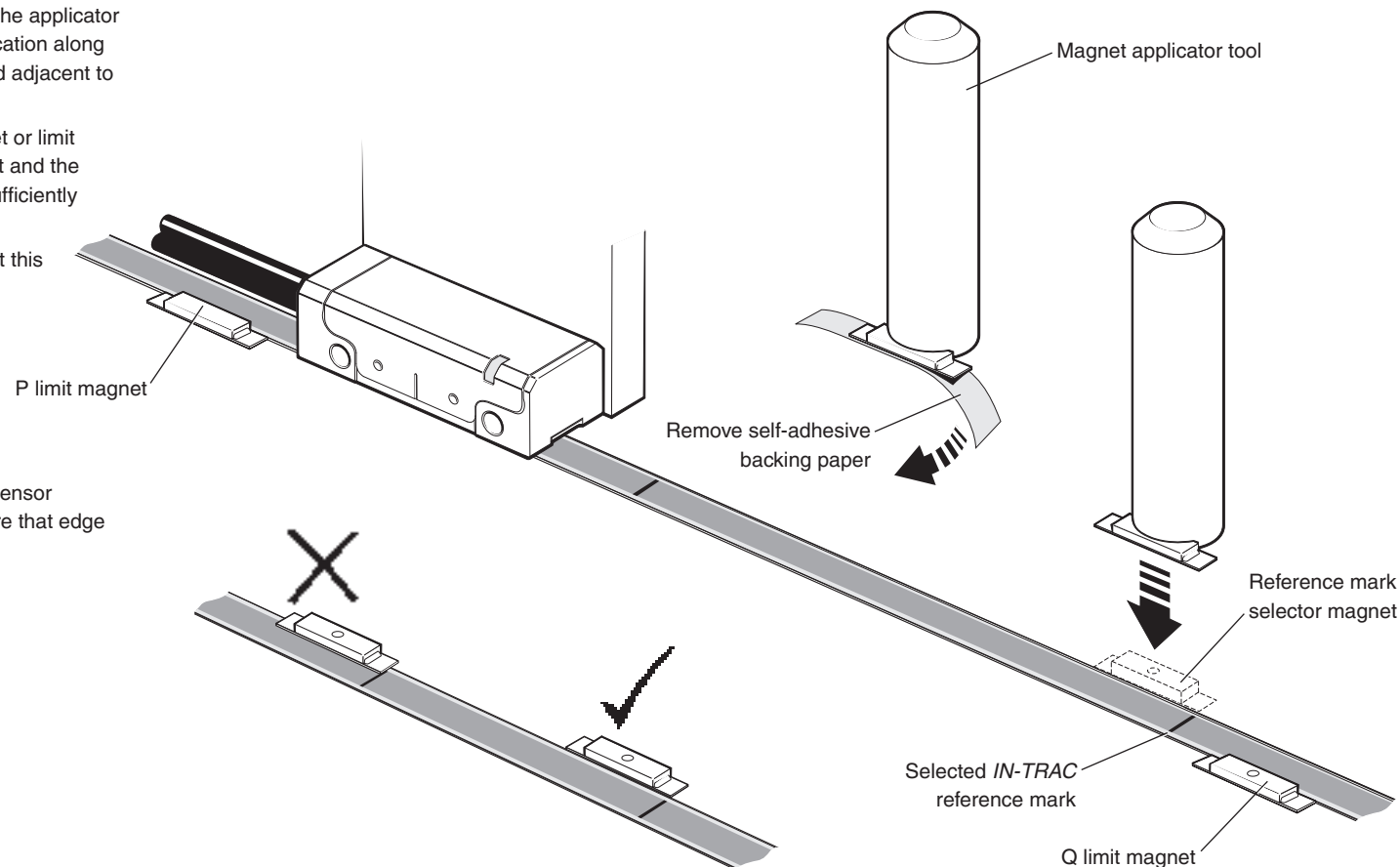
Following the clamping instructions on the scale installation will prevent this magnetic force from disturbing the scale.

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 ('RKLC40-S scale installation drawing', page 4).

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 ('RKLC40-S scale installation drawing', page 4).
- ▶ 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 *QUANTiC™ series encoder system data sheet* (Renishaw part no. L-9517-9778).
- ▶ External magnetic fields greater than 6 mT, in the vicinity of the readhead, may cause false activation of the limit and reference sensors.



QUANTiC quick-start guide

This section is a quick-start guide to installing a QUANTiC readhead. More detailed information on installing the readhead is contained on [page 11](#) and [page 12](#) 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 ('RKLC40-S scale installation drawing', [page 4](#)).



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 (LED remains single flashing Blue), restore factory defaults by obscuring the readhead optical window on power-up ([page 13](#)). Repeat the installation and calibration routine.

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

† 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.

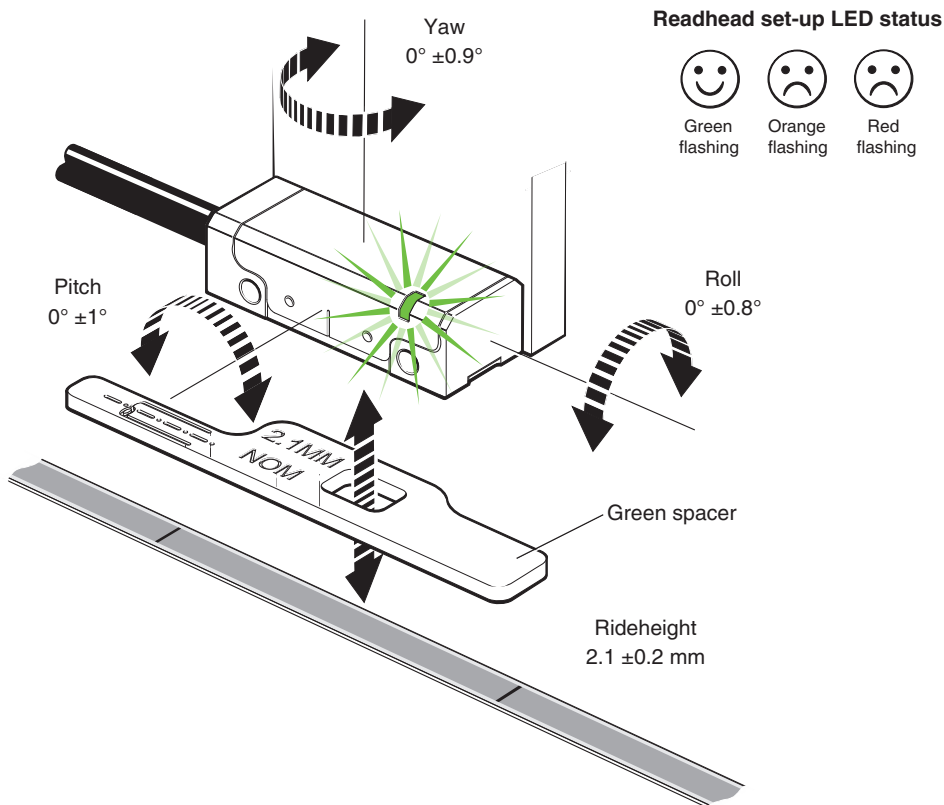
Readhead set-up

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

NOTE: When cleaning 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/adti for more information.

NOTE: When re-installing the readhead factory defaults should be restored (page 13).



Readhead LED diagnostics*

Mode	LED	Status
Installation mode	Green flashing	Good set-up, maximise flash rate for optimum set-up
	Orange flashing	Poor set-up, adjust readhead to obtain Green flashing LED
	Red flashing	Poor set-up, adjust readhead to obtain Green flashing LED
Calibration mode	Blue single flashing	Calibrating incremental signals
	Blue double flashing	Calibrating reference mark
Normal operation	Blue	AGC on, optimum set-up
	Green	AGC off, optimum set-up
	Red	Poor set-up; signal may be too low for reliable operation
	Blank flash	Reference mark detected (visible indication at speed < 100 mm/s only)
Alarm	Four red flashes	Low signal, over signal, or overspeed; system in error
	Red and Purple flashing (analogue variant only)	AGC out of normal operating range

* See 'Troubleshooting', page 14 for more information on diagnosing faults.

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.

Before system calibration:

- ▶ Clean the scale and readhead optical window.
- ▶ If reinstalling, restore factory defaults ('Restoring factory defaults', page 13).
- ▶ Maximise the signal strength along full length of travel (readhead set-up LED is flashing Green).

NOTE: Maximum calibration speed 100 mm/s or less than the readhead maximum, whichever is slowest.

Step 1 – Incremental signal calibration

- ▶ 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 11. The readhead will only enter calibration mode if the LED is flashing Green.
- ▶ Move the readhead at slow speed along the axis ensuring it does not pass a reference mark, until the LED starts double-flashing indicating the incremental signals are now calibrated and the new settings are stored in the readhead memory.
- ▶ 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.

NOTE: For analogue variants of QUANTiC ensure correct termination of output signals ('Recommended signal termination', page 18).

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. 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 calibration routine and is ready for operation.
- ▶ AGC and AOC are automatically switched on once calibration is complete. To switch off AGC refer to 'Switching Automatic Gain Control (AGC) on or off', page 13.
- ▶ 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 ('RKLC40-S scale installation drawing', page 4).

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

NOTE: Restoring factory defaults can also be carried out using the optional ADTi-100 and ADT View software. See www.renishaw.com/adt for more information.

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 11](#).

Switching Automatic Gain Control (AGC) on or off

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

NOTE: AGC can be switched on or off using the optional ADTi-100 and ADT View software. See www.renishaw.com/adt for more information.

Troubleshooting

Fault	Cause	Possible solutions
LED on the readhead is Blank	There is no power to the readhead	▶ Ensure 5 V supplied at the readhead ▶ For cable variants check correct wiring of connector ▶ If using the analogue variant of QUANTiC with the ADTi ensure appropriate adaptor cables are connected
LED on the readhead is Red flashing during installation mode	The signal strength is < 50%	▶ Check the readhead optical window and scale are clean and free from contamination ▶ Restore factory defaults (page 13) and check alignment of the readhead. In particular: • Rideheight • Yaw • Offset ▶ Ensure the correct scale and readhead combination
Unable to get a Green LED over the complete axis length	System run-out is not within specification	▶ Use a DTi gauge and check the run-out is within specifications ▶ Restore factory defaults (page 13) ▶ Realign readhead to obtain a Green flashing LED at the mid-point of the run-out ▶ Recalibrate the system (page 12)
Can't initiate the calibration routine	Signal size is < 70%	▶ Realign readhead to obtain a green flashing LED
During calibration the LED on the readhead remains single flashing Blue even after moving it along the full axis length	The system has failed to calibrate the incremental signals due to the signal strength being < 70%	▶ Exit CAL mode and restore factory defaults (page 13) ▶ Check readhead set-up and alignment (page 11)
	Incorrect termination (analogue variant only)	▶ Check output signal termination (page 18) ▶ When using with ADTi-100 in stand- alone mode ensure Termination tool is connected, Renishaw part number A-6195-2132 ▶ Exit CAL mode and restore factory defaults (page 13) ▶ Check readhead set-up and alignment (page 11)
During calibration the LED on the readhead is double flashing Blue even after moving it past the reference mark several times	The readhead is not seeing a reference mark	▶ Ensure correct position of reference mark selector magnet ▶ Ensure you are moving the readhead past your chosen reference mark several times ▶ Check the readhead/selector magnet orientation ▶ Check the readhead optical window and scale are clean and free from contamination

Troubleshooting (continued)

Fault	Cause	Possible solutions
No reference mark output		▶ Ensure you are not over-speeding the readhead during calibration mode (maximum speed < 100 mm/sec) ▶ Calibrate the system (page 12) • If the system completes calibration mode then it has successfully seen and calibrated the reference mark. If you still don't see a reference mark then check the system wiring. • If the system does not calibrate the reference mark (LED on the readhead remains double flashing Blue) see above for possible solutions
Reference mark is not repeatable	Only the chosen reference mark that has been used in the calibration sequence is repeatable, other reference marks may not be phased	▶ Ensure you are using the reference mark that has been calibrated for referencing your system ▶ The readhead bracket must be stable and not allow any mechanical movement of the readhead ▶ Clean the scale and readhead optical window and check for damage then recalibrate the system over the chosen reference mark (page 12)
LED on the readhead is flashing Red over the reference mark	The reference mark is not phased	▶ Ensure you are using the reference mark that has been calibrated for referencing your system as only this reference mark will be guaranteed to remain phased ▶ Clean the scale and readhead optical window and check for scratches then recalibrate the system over the chosen reference mark (page 12)
Multiple reference marks are being output	The readhead reference mark option is either option B or F, 'All reference marks are output'	▶ Calibrate the system ensuring both Step 1 and Step 2 are completed (page 12) ▶ Ensure you calibrate the reference mark used for referencing your system as only this reference mark will be guaranteed to remain phased
LED on the readhead is flashing Red and Purple (analogue variant only)	AGC out of normal operating range	▶ Check output signal termination (page 18) ▶ When using with ADTi-100 in stand-alone mode ensure Termination tool is connected Renishaw part number A-6195-2132 ▶ Check cable continuity ▶ Ensure the correct scale and readhead combination
LED on the readhead flashing Red four times on switch on	Low signal, over signal, or overspeed; system in error	▶ Check readhead set-up and alignment (page 11)
	Incorrect termination (analogue variant only)	▶ Check output signal termination (page 18) ▶ When using with ADTi-100 in stand-alone mode ensure Termination tool is connected, Renishaw part number A-6195-2132 ▶ Exit CAL mode and restore factory defaults (page 13) ▶ Check readhead set-up and alignment (page 11)

Output signals

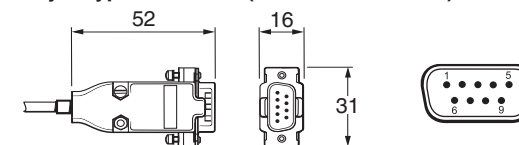
Digital outputs

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

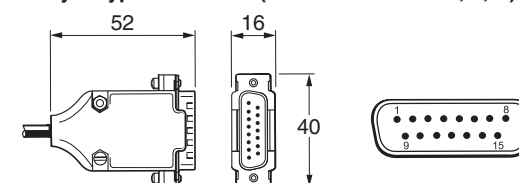
Analogue outputs

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

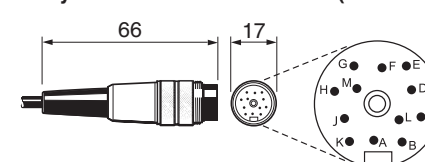
9-way D-type connector (termination code A)



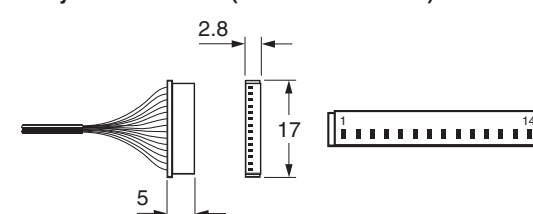
15-way D-type connector (termination code D, L, H)



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



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

Digital readheads

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

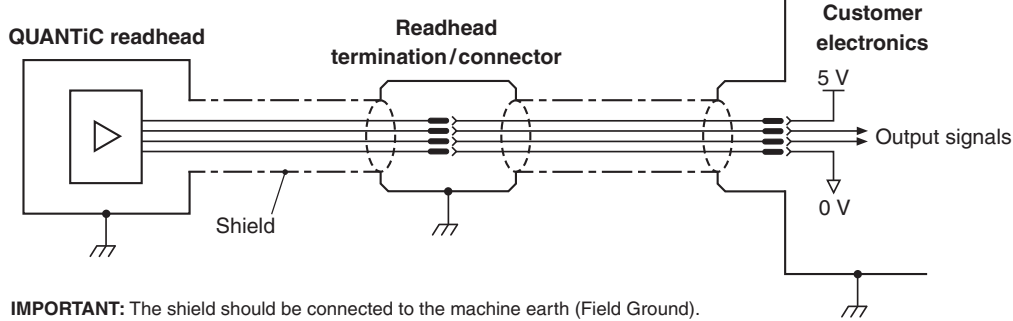
Analogue readheads

Maximum speed: 20 m/s (–3dB)[†]

* For a readhead with a 1 m cable.
[†] If the speed exceeds 20 m/s, SDE performance cannot be guaranteed.

Electrical connections

Grounding and shielding



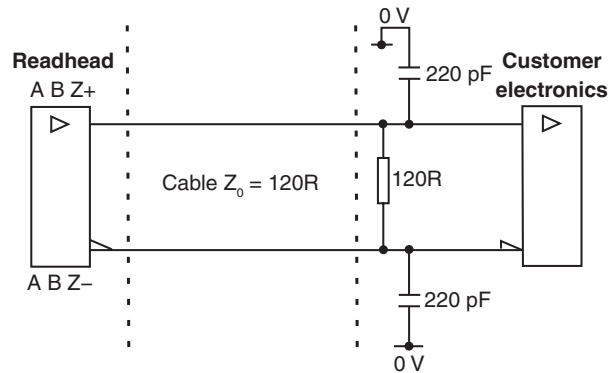
IMPORTANT: The shield should be connected to the machine earth (Field Ground).
For JST variants the ferrule should be connected to the machine earth.

Maximum cable length

	Analogue	Digital
Readhead cable	5 m	3 m
Maximum extension cable length	Dependent on cable type, readhead cable length and clocked output option. Contact your local Renishaw representative for more information.	
Readhead to ADTi-100	5 m	3 m

Recommended signal termination

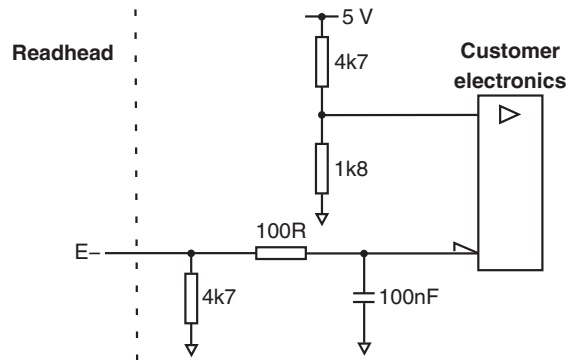
Digital outputs



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

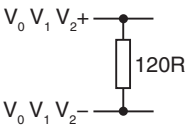
Single ended alarm signal termination

(Not available with 'A' cable termination)



Recommended signal termination (continued)

Analogue outputs

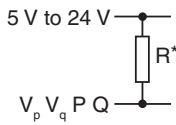


NOTE: 120R termination on the analogue output signals is essential for correct AGC operation.

Analogue and digital outputs

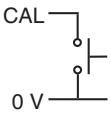
Limit output

(Not available with 'A' cable termination)



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

Remote CAL operation



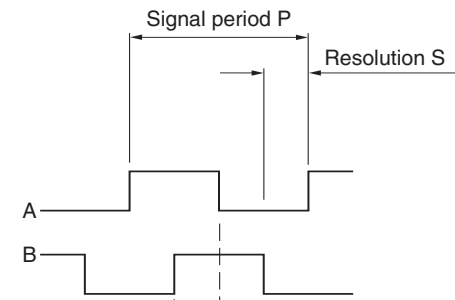
Remote operation of the CAL/AGC is possible via CAL signal.

Output specifications

Digital output signals

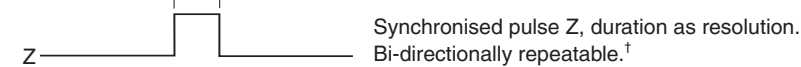
Form – Square wave differential line driver to EIA RS422A (except limits P and Q)

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



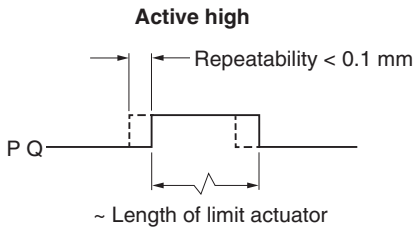
Resolution option code	P (µm)	S (µm)
T	40	10
D	20	5
X	4	1
Z	2	0.5
W	0.8	0.2
Y	0.4	0.1
H	0.2	0.05

Reference*



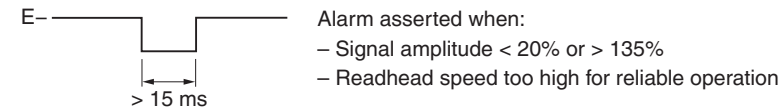
NOTE: A wide reference mark option, outputting a reference pulse for the duration of the signal period is available. Contact your local Renishaw representative for more information.

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

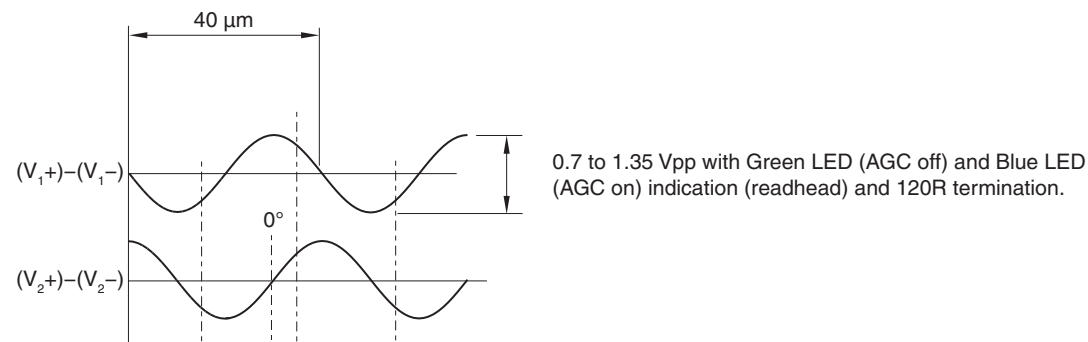
Differentially transmitted signals forced open circuit for > 15 ms when alarm conditions valid.

* Inverse signals not shown for clarity † Only calibrated reference mark is bi-directionally repeatable

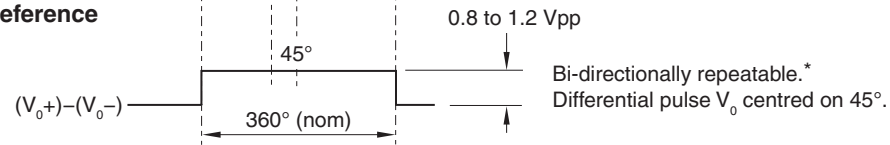
Output specifications (continued)

Analogue output signals

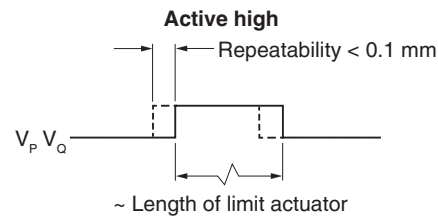
Incremental 2 channels V_1 and V_2 differential sinusoids in quadrature, centred on ~1.65 V (90° phase shifted)



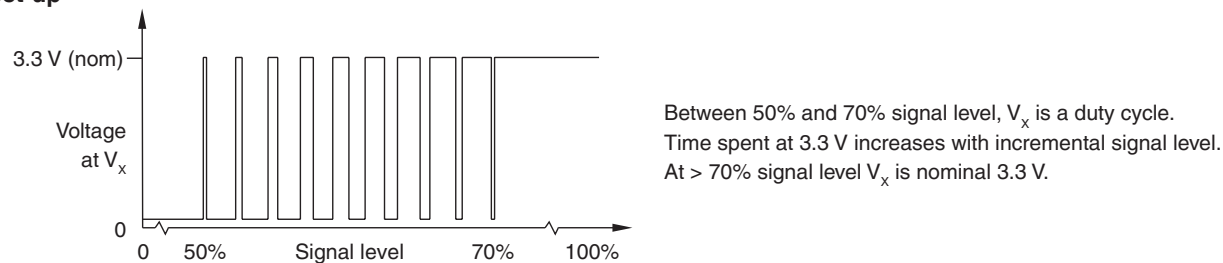
Reference



Limits Open collector output, asynchronous pulse



Set-up†



* Only calibrated reference mark is bi-directionally repeatable † Set-up signal as shown is not present during calibration routine

General specifications

Power supply	5V -5%/+10%	Typically 150 mA fully terminated (analogue output) Typically 200 mA fully terminated (digital output) Power from a 5 Vdc supply complying with the requirements for SELV of standard IEC 60950-1
	Ripple	200 mVpp maximum @ frequency up to 500 kHz
	Storage	-20 °C to +70 °C
	Installation	+10 °C to +35 °C*
Temperature (system)	Operating	0 °C to +70 °C
Humidity (system)		95% relative humidity (non-condensing) to IEC 60068-2-78
Sealing		IP40
Acceleration (system)	Operating	400 m/s ² , 3 axes
Shock (system)	Operating	500 m/s ² , 11 ms, ½ sine, 3 axes
Vibration (readhead) (scale)	Operating	100 m/s ² max @ 55 Hz to 2000 Hz, 3 axes
	Operating	300 m/s ² max @ 55 Hz to 2000 Hz, 3 axes
Mass	Readhead	9 g
	Cable	26 g/m
EMC compliance		IEC 61326-1
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 length	5 m (analogue) 3 m (digital)
Connector options	Code - connector type A - 9-way D-type - Digital output only L - 15-way D-type (standard pin-out) - Analogue output only D - 15-way D-type (standard pin-out) - Digital output only H - 15-way D-type (alternative pin-out) X - 12-way circular connector - Digital output only J - 14-way JST connector	
Typical sub-divisional error (SDE)	Analogue output	Digital output
	< ±120 nm	< ±80 nm

CAUTION: Renishaw encoder systems have been designed to the relevant EMC standards, but must be correctly integrated to achieve EMC compliance. In particular, attention to shielding arrangements is essential.

* To limit maximum tension in the scale $(CTE_{\text{substrate}} - CTE_{\text{scale}}) \times (T_{\text{use extreme}} - T_{\text{install}}) \leq 550 \mu\text{m/m}$ where $CTE_{\text{scale}} = \sim 10.1 \mu\text{m/m/}^{\circ}\text{C}$

RKLC40-S scale specifications

Form (H × W)	0.15 mm × 6 mm (including adhesive)
Pitch	40 µm
Accuracy (at 20 °C) (includes slope and linearity)	RKLC40-S ±15 µm/m
	RKLC40H-S ±5 µm/m
Linearity	RKLC40-S ±3 µm/m achievable with 2 point error correction
	RKLC40H-S ±2.5 µm/m achievable with 2 point error correction
Supplied length	20 mm to 20 m (> 20 m available on request)
Material	Hardened and tempered martensitic stainless steel fitted with a self-adhesive backing tape
Mass	4.6 g/m
Coefficient of thermal expansion (at 20 °C)	Matches that of substrate material when scale ends fixed by epoxy mounted end clamps
Installation temperature	+10 °C to +35 °C
End fixing	Epoxy mounted end clamps (A-9523-4015)
	Approved epoxy adhesive (A-9531-0342)
	Scale end movement typically < 1 µm*

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 (‘RKLC40-S scale installation drawing’, page 4)
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

* The scale and end clamps must be installed following the installation process, see [page 7](#) and [page 8](#).

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