Data sheet
L-9517-9678-06-C

RENISHAW
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VIONiC™ incremental optical encoder system



The VIONiC encoder series is Renishaw's highest performing incremental optical encoder. It provides digital position feedback with superior metrology, high speeds and high reliability.

VIONiC reads a wide range of linear, partial arc and rotary scales, with *IN-TRAC*™ auto-phase optical reference mark.

The VIONiC readhead integrates Renishaw's market proven filtering optics and advanced interpolation technology. This provides excellent dirt immunity, ultra-low sub-divisional error (SDE), and the benefit of eliminating the need for additional adaptors or separate interfaces.

Designed with intuitive auto calibration mode, VIONiC is easy to install. In addition, it is compatible with a range of optional Advanced Diagnostic Tools to assist in system set-up and planned maintenance and help minimise unscheduled machine downtime.

- **Compact, all-in-one, digital output, optical encoder**
- **Dynamic signal processing provides ultra-low sub-divisional error of typically < ±15 nm**
- **Compatible with a wide range of linear, partial arc and rotary scales with *IN-TRAC* auto-phase optical reference mark (datum)**
- **Auto Gain Control (AGC), Auto Balance Control (ABC) and Auto Offset Control (AOC) ensure consistent signal strength for long-term reliability**
- **Integrated set-up LED for ease of installation**
- **Maximum speed to 12 m/s (3.63 m/s at 0.1 µm resolution)**
- **Digital signals direct from the readhead: Resolutions from 5 µm to 2.5 nm**
- **Integrated dual limits (linear only)**
- **Filtering optics optimised for excellent dirt immunity**
- **Optional ADTpro-100 or ADTi-100 Advanced Diagnostic Tool to optimise set-up and assist with system diagnostics**

www.renishaw.com/vionicdownloads

#renishaw

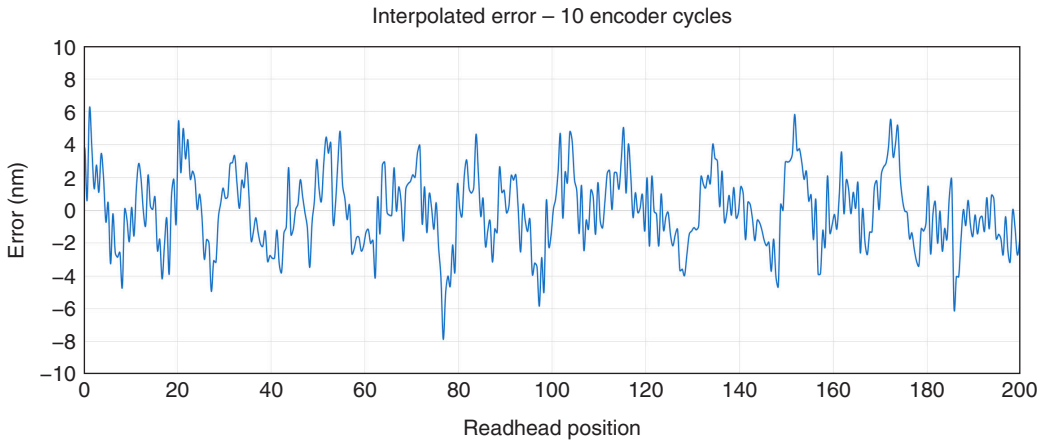
System features

- **Need superior motion control?**

  VIONiC implements our latest interpolation algorithms and signal processing techniques to achieve a sub-divisional error (SDE) below ±15 nm. Low SDE directly equates to low velocity ripple which is important for constant velocity applications, such as scanning measurement systems. VIONiC's intelligent interpolation chip can achieve 8000 × interpolation which equates to 2.5 nm resolution directly out of the readhead. This system is used when precision and repeatability is of paramount importance.

System type	SDE
Linear	< ± 15 nm [1]
Rotary > Ø135 mm	< ± 15 nm [1]
Rotary ≤ Ø135 mm	< ± 20 nm

Typical SDE graph for VIONiC linear readheads



- **Need higher speed?**

  At its highest clock rate (50 MHz counter speed) the VIONiC readhead outputs quadrature edges with a minimum separation of 25.3 ns to allow the maximum possible speed at fine resolutions.

- **Need higher accuracy?**

  VIONiC readheads are compatible with a range of linear and rotary scales, from ±1 µm/m low expansion linear spar scales to ±1 arc second total installed accuracy rings.

[1] < ±10 nm SDE can be achieved with optimised set-up. Contact your local Renishaw representative for further details.

Optional Advanced Diagnostic Tools

The VIONiC encoder system is compatible with a range of Advanced Diagnostic Tools to assist in system set-up and planned maintenance to help minimise unscheduled machine downtime.

The **ADTpro-100** is a handheld, standalone encoder diagnostic tool featuring an integral colour touch screen. The ADTpro-100:



- Requires no computer or additional set-up equipment to display comprehensive real-time encoder information.
- Is easy and intuitive to use with plug-and-play functionality to aid system set-up and calibration.
- Interfaces with the optional ADT View computer software, which allows encoder data to be saved as a record of the system setup and performance. ADT View can also be used to update the ADTpro-100 firmware.

The **ADTi-100**, in conjunction with the intuitive ADT View computer software:





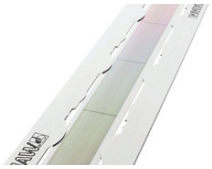
- Provides comprehensive real-time encoder data feedback to aid more challenging installations and diagnostics.
- Assists system set-up, calibration and signal optimisation along the entire axis.
- Allows data, such as signal strength vs position along the axis, to be saved as a record of the system setup and performance.

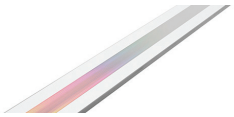
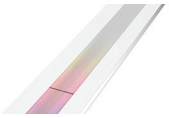
Both the ADTpro-100 and ADTi-100 are ideal for aiding system optimisation and diagnostics, particularly for installations when the readhead LED is not visible. They can be used standalone or in-line, connected between the readhead and the controller as part of the control loop.

For more information on the Advanced Diagnostic Tools, refer to the *ADTpro-100 Advanced Diagnostic Tool* data sheet (Renishaw part no. L-9518-0078), *ADTi-100 Advanced Diagnostic Tool* data sheet (Renishaw part no. L-9517-9699), and *ADT View software* user guide (Renishaw part no. M-6195-9413).

Compatible scales

Linear scales

	RTLC20-S	RTLC20 / *FASTRACK*™	RKLC20-S [1]
	Self-adhesive mounted stainless steel tape scale	**Stainless steel tape scale and self-adhesive mounted carrier**	**Self-adhesive mounted stainless steel tape scale**
			
Form (height × width)	0.4 mm × 8 mm including adhesive	RTLC20 scale: 0.2 mm × 8 mm *FASTRACK* carrier: 0.4 mm × 18 mm including adhesive	0.15 mm × 6 mm including adhesive
Accuracy (includes slope and linearity)	±5 µm/m	±5 µm/m	±5 µm/m
Linearity (Figures achievable with two-point error correction)	±2.5 µm/m	±2.5 µm/m	±2.5 µm/m
Maximum length	10 m [2] (> 10 m available on request)	10 m (> 10 m available on request)	20 m (> 20 m available on request)
Coefficient of thermal expansion (at 20 °C)	10.1 ±0.2 µm/m/°C	10.1 ±0.2 µm/m/°C	Matches that of substrate material when scale ends fixed by epoxy mounted end clamps

	RSLM20	RELM20
	Self-adhesive or clip/clamp mounted stainless steel spar scale	**Self-adhesive or clip/clamp mounted low-expansion ZeroMet spar scale**
		
Form (height × width)	1.5 mm × 14.9 mm	1.6 mm × 14.9 mm
Accuracy (includes slope and linearity)	±4 µm (Total accuracy over a complete 5 m length)	±1 µm (Total accuracy up to 1 m
Maximum length	5 m	1.5
Coefficient of thermal expansion (at 20 °C)	10.1 ±0.2 µm/m/°C	0.75 ±0.35 µm/m/°C

For more information about the scales refer to the relevant scale data sheet which can be downloaded from www.renishaw.com/vionicdownloads.

[1] Suitable for partial arc applications. For more information refer to *RKL scale for partial arc applications* data sheet (Renishaw part no. L-9517-9897).

[2] For RTLC20-S axis lengths > 2 m, *FASTRACK* carrier with RTLC20 is recommended.

Rotary scales

	RESM20	REXM20
	Stainless steel ring	**Ultra-high accuracy stainless steel ring**
		
Typical installed accuracy [1]	±1.9 arc second (550 mm diameter RESM20 ring)	±1 arc second [2] (417 mm diameter REXM20 ring)
Ring diameters	52 mm to 550 mm	52 mm to 417 mm
Coefficient of thermal expansion (at 20 °C)	15.5 ±0.5 µm/m/°C	15.5 ±0.5 µm/m/°C

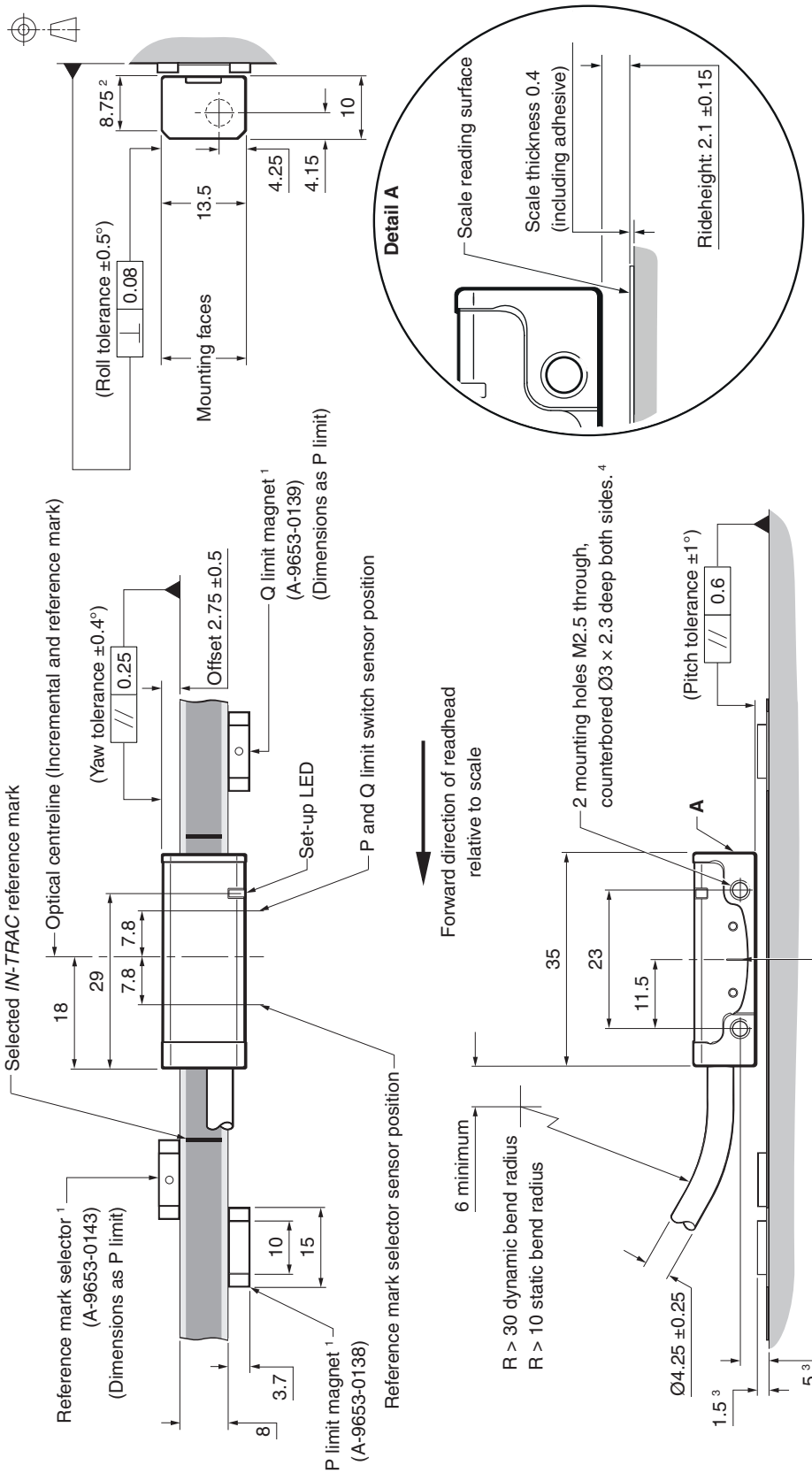
For more information about the scales refer to the relevant scale data sheet which can be downloaded from www.renishaw.com/vionicdownloads.

1 'Typical' installations are a result of graduation and installation errors combining and, to some magnitude, cancelling.

2 When using two VIONiC readheads and an additional DSi interface.

VIONiC encoder system installation drawing

Dimensions and tolerances in mm



NOTES:

- VIONiC readhead and RTLC20-S linear scale shown. For detailed installation drawings for other scale types, refer to the relevant VIONiC encoder system installation guide or scale data sheet.
- External magnetic fields greater than 6 mT, in the vicinity of the readhead, may cause false activation of the limit and reference sensors.

1 Bolted reference mark selector magnet and limit magnet available. See the relevant VIONiC encoder system installation guide for further details.

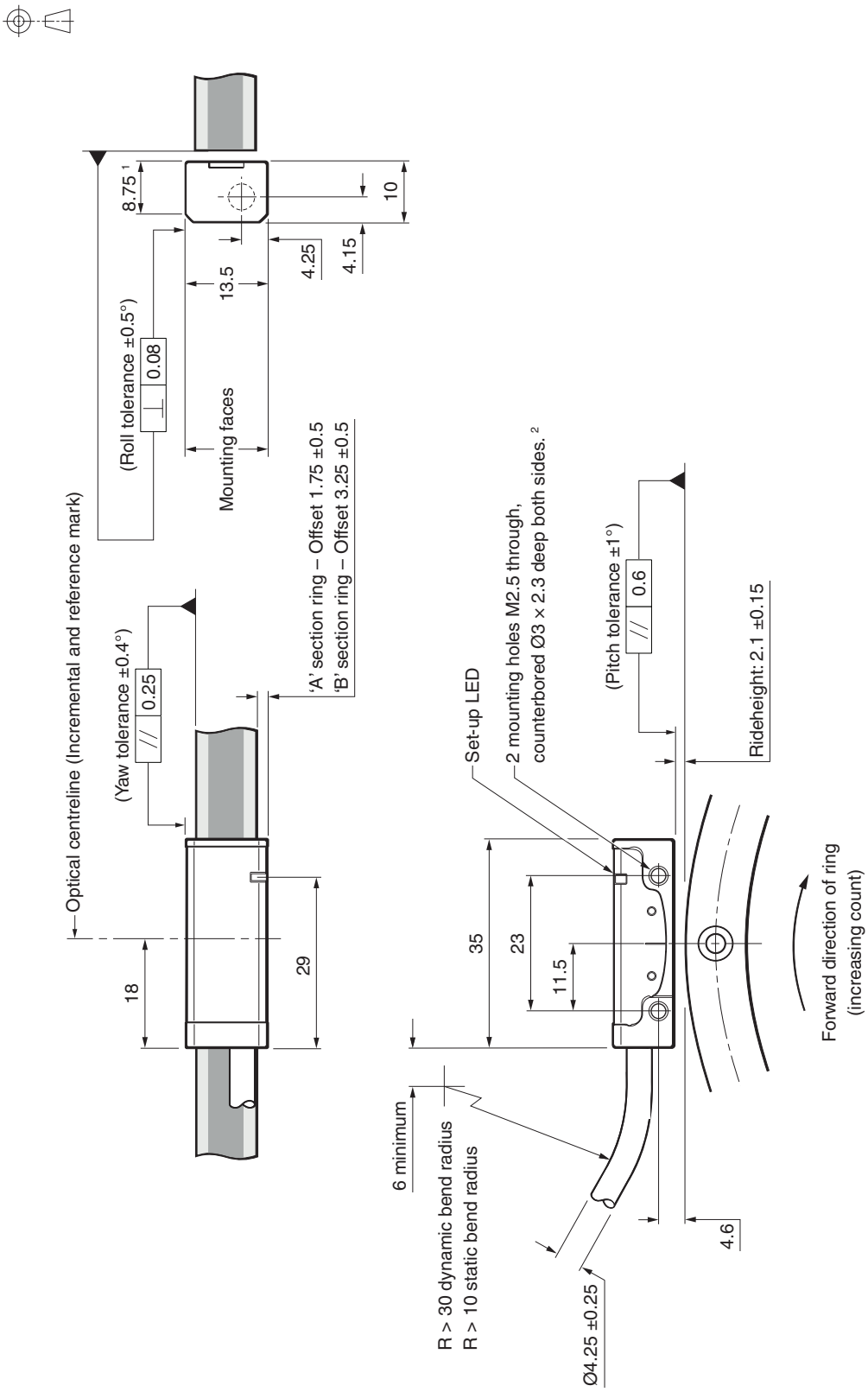
2 Extent of mounting faces.

3 Dimensions from substrate surface.

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

VIONiC encoder system installation drawing

Dimensions and tolerances in mm



NOTES:

- VIONiC readhead and RESM20 ring shown. For detailed installation drawings for other scale types, refer to the relevant VIONiC encoder system installation guide or scale data sheet.
- External magnetic fields greater than 6 mT, in the vicinity of the readhead, may cause false activation of the limit and reference sensors.

1 Extent of mounting faces.

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

General specifications

Power supply	5 V –5% /+10%	Cable lengths ≤ 3 m, typically 200 mA fully terminated Cable lengths > 3 m, typically 250 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/s², 3 axes
Shock (system)	Operating	500 m/s², 11 ms, ½ sine, 3 axes
Vibration	Operating	Sinusoidal 100 m/s² max @ 55 Hz to 2000 Hz, 3 axes
Mass	Readhead	8.6 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 cable length [1]	10 m
Connector options		**Code - connector type** A - 9-way D-type D - 15-way D-type (standard pin-out) H - 15-way D-type (alternative pin-out) X - 12-way circular connector J - 14-way JST connector
Typical sub-divisional error (SDE)	Linear	< ±15 nm
	Rotary > Ø135 mm	< ±15 nm
	Rotary ≤ Ø135 mm	< ±20 nm

[1] Extension cables available. Contact your local Renishaw representative for further details.

Speed

Clocked output option (MHz)	Maximum speed (m/s)						Minimum edge separation [1] (ns)
	D (5 µm)	X (1 µm)	Z (0.5 µm)	W (0.2 µm)	Y (0.1 µm)	H (50 nm)	
50	12	12	12	7.25	3.63	1.81	25.3
40	12	12	12	5.80	2.90	1.45	31.8
25	12	12	9.06	3.63	1.81	0.906	51.2
20	12	12	8.06	3.22	1.61	0.806	57.7
12	12	10.36	5.18	2.07	1.04	0.518	90.2
10	12	8.53	4.27	1.71	0.850	0.427	110
08	12	6.91	3.45	1.38	0.690	0.345	136
06	12	5.37	2.69	1.07	0.540	0.269	175
04	12	3.63	1.81	0.730	0.360	0.181	259
01	4.53	0.910	0.450	0.180	0.090	0.045	1038

Clocked output option (MHz)	Maximum speed (m/s)						Minimum edge separation [1] (ns)
	M (40 nm)	P (25 nm)	I (20 nm)	O (10 nm)	Q (5 nm)	R (2.5 nm)	
50	1.45	0.906	0.725	0.363	0.181	0.091	25.3
40	1.16	0.725	0.580	0.290	0.145	0.073	31.8
25	0.725	0.453	0.363	0.181	0.091	0.045	51.2
20	0.645	0.403	0.322	0.161	0.081	0.040	57.7
12	0.414	0.259	0.207	0.104	0.052	0.026	90.2
10	0.341	0.213	0.171	0.085	0.043	0.021	110
08	0.276	0.173	0.138	0.069	0.035	0.017	136
06	0.215	0.134	0.107	0.054	0.027	0.013	175
04	0.145	0.091	0.073	0.036	0.018	0.009	259
01	0.036	0.023	0.018	0.009	0.005	0.002	1038

Angular speeds

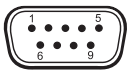
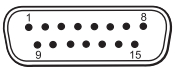
Angular speed depends on ring diameter – use the following equation to convert to rev/min:

$$\text{Angular speed (rev/min)} = \frac{V \times 1000 \times 60}{\pi D}$$

Where V = maximum linear speed (m/s) and D = external diameter of RESM20 or REXM20 ring (mm).

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

Output signals

							
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 [1] (X)**	**14-way JST [2] (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 [3]	CAL		Clear	9	1	5	C	4
Shield	-		Screen	Case	Case	Case	Case	Ferrule

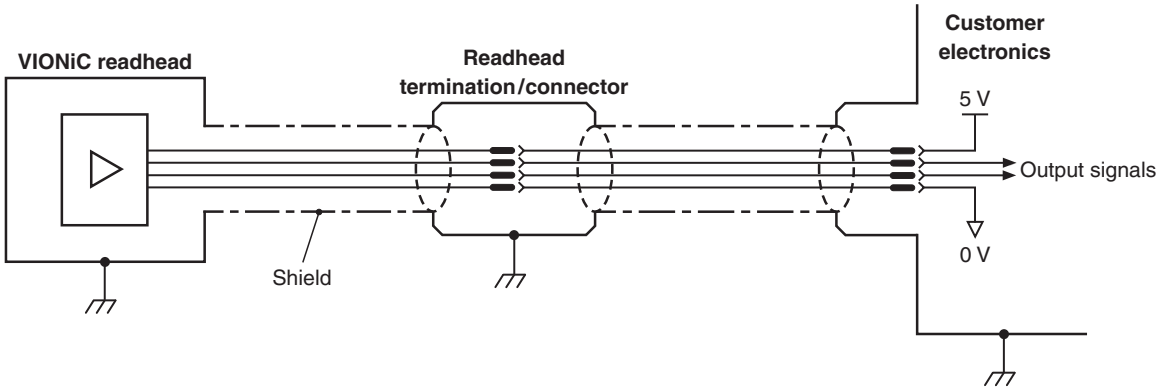
1 12-way circular Binder mating socket - A-6195-0105.

2 Pack of 5 14-way JST SH mating sockets: A-9417-0025 - Bottom mount; A-9417-0026 - Side mount.

3 Remote CAL line must be connected for use with the Advanced Diagnostic Tools.

Electrical connections

Grounding and shielding



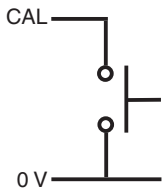
IMPORTANT: The shield should be connected to the machine earth (Field Ground). For JST variants the ferrule should be connected to the machine earth.

Maximum readhead cable length: 10 m. [1]

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

NOTE: The maximum cable length between the readhead and the Advanced Diagnostic Tool is 10 m.

Remote CAL operation

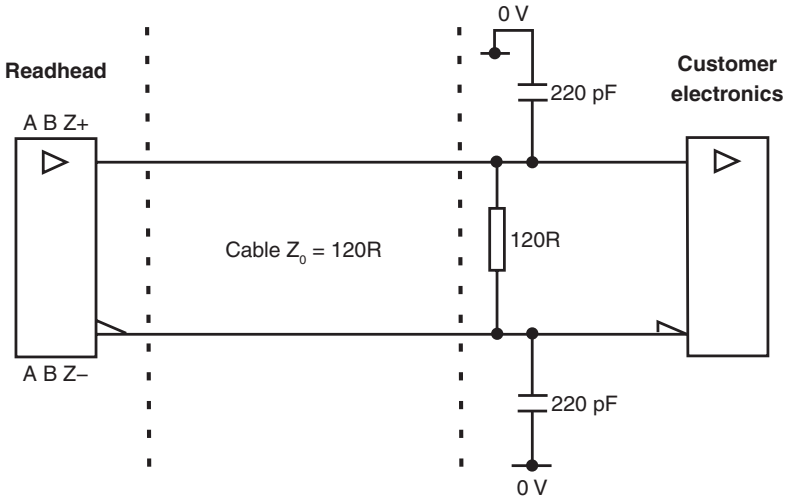


Remote operation of the CAL/AGC is possible via CAL signal.

[1] Cable lengths > 3 m are fitted with either a 15-way or 9-way D-type connector. The connector contains an active PCB and must not be removed.

Recommended signal termination

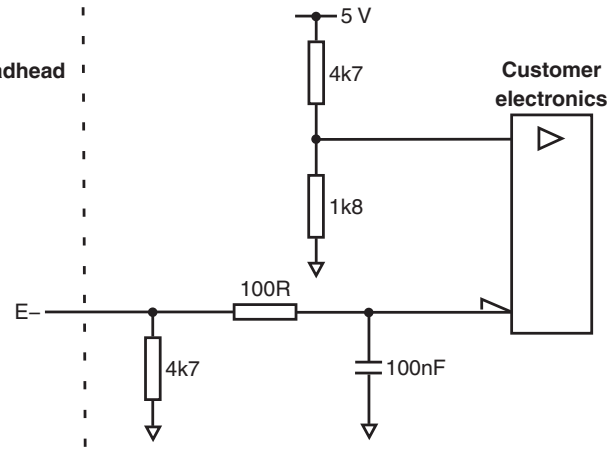
Digital outputs



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

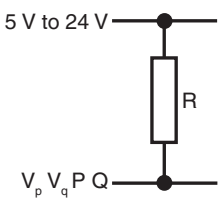
Single ended alarm signal termination

(Not available with 'A' cable termination)



Limit output

(Not available with 'A' cable termination)



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

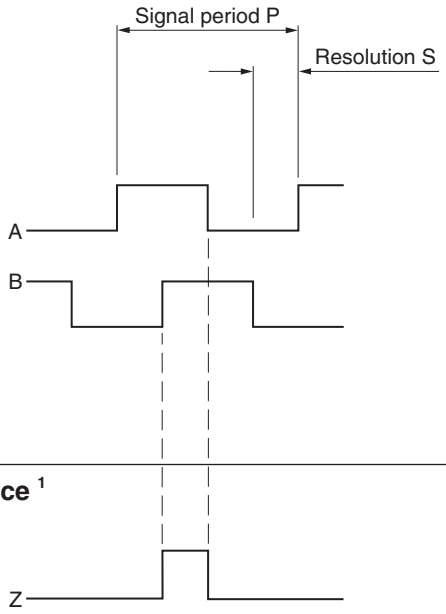
Output specifications

Digital output signals

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

Incremental [1]

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



Resolution option code	P (µm)	S (µm)
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

Reference [1]

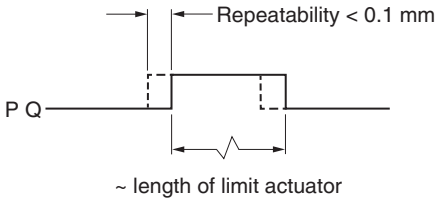
NOTE: A wide reference mark option, outputting a reference pulse for the duration of the signal period is available. Contact your local Renishaw representative for more information.

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

Limits

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

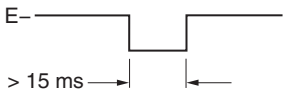
Active high



Alarm

Line driven (asynchronous pulse)

(not available with 'A' cable termination)



The alarm is asserted when:

- The signal amplitude is < 20% or > 135%
- The readhead speed is too high for reliable operation

or 3-state alarm

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

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

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

Linear readhead part numbers

V2 B C X 30 D 50 A

Series

V2 = 20 µm VIONiC

Readhead type

B = Linear

Scale type compatibility

B = RSLM20 / RELM20

C = RTLC20 / RTLC20-S / RKLC20-S

Resolution

D = 5 µm
X = 1 µm
Z = 0.5 µm
W = 0.2 µm
Y = 0.1 µm
H = 50 nm
M = 40 nm
P = 25 nm
I = 20 nm
O = 10 nm
Q = 5 nm
R = 2.5 nm

Cable length [1]

05 = 0.5 m
10 = 1 m
15 = 1.5 m
30 = 3 m
50 = 5 m ('A' or 'D' cable termination only) [2]
99 = 10 m ('A' or 'D' cable termination only) [2]

Cable termination

A = 9-way D-type plug (‘E’ and ‘F’ Reference mark options / Alarm format only)

D = 15-way D-type plug (standard pin-out)

H = 15-way D-type plug (alternative pin-out) (0.5 m, 1 m, 1.5 m, and 3 m cables only)

X = 12-way circular connector (0.5 m, 1 m, 1.5 m, and 3 m cables only)

J = 14-way JST connector (0.5 m, 1 m, 1.5 m, and 3 m cables only)

Clocked output options [3]

50 = 50 MHz
40 = 40 MHz
25 = 25 MHz
20 = 20 MHz
12 = 12 MHz
10 = 10 MHz
08 = 8 MHz
06 = 6 MHz
04 = 4 MHz
01 = 1 MHz

Reference mark options [4] **/ Alarm format**

A = Customer selectable reference mark / Line driven alarm (not available with ‘A’ cable termination)

B = All reference marks are output / Line driven alarm (not available with ‘A’ cable termination)

E = Customer selectable reference mark / 3-state alarm

F = All reference marks are output / 3-state alarm

Valid system configurations (readheads and scale) can be checked at **www.renishaw.com/epc**.

1 Extension cables are available. Contact your local Renishaw representative for further details.

2 The cable termination must not be removed.

3 Additional clocked output options are available. Contact your local Renishaw representative for further details.

4 A or E – ‘Customer selectable reference mark’ - A reference pulse is triggered only when a selector magnet is detected. This allows the activation of a specific reference mark when the scale has multiple *IN-TRAC* reference marks.

B or F – ‘All reference marks are output’ - A reference pulse is triggered whenever an *IN-TRAC* reference mark is passed. No selector magnet is required. This is recommended for scale with a single *IN-TRAC* reference mark.

Only the calibrated reference mark is bi-directionally repeatable.

Rotary readhead part numbers

V2 B J X 30 D 50 B

Series

V2 = 20 µm VIONiC

Readhead type

B = Rotary > Ø135 mm ('J' scale type compatibility only)

C = Rotary ≤ Ø135 mm ('K' and 'L' scale compatibility only)

Scale type compatibility

J = RESM20 / REXM20 > Ø135 mm ('B' readhead type only)

K = RESM20 / REXM20 Ø60 mm to Ø135 mm ('C' readhead type only)

L = RESM20 / REXM20 < Ø60 mm ('C' readhead type only)

Resolution

D = 5 µm

X = 1 µm

Z = 0.5 µm

W = 0.2 µm

Y = 0.1 µm

H = 50 nm

M = 40 nm

P = 25 nm

I = 20 nm

O = 10 nm

Q = 5 nm

R = 2.5 nm

Cable length [1]

05 = 0.5 m

10 = 1 m

15 = 1.5 m

30 = 3 m

50 = 5 m ('A' or 'D' cable termination only) [2]

99 = 10 m ('A' or 'D' cable termination only) [2]

Cable termination

A = 9-way D-type plug ('F' Reference mark options / Alarm format only)

D = 15-way D-type plug (standard pin-out)

H = 15-way D-type plug (alternative pin-out) (0.5 m, 1 m, 1.5 m, and 3 m cables only)

X = 12-way circular connector (0.5 m, 1 m, 1.5 m, and 3 m cables only)

J = 14-way JST connector (0.5 m, 1 m, 1.5 m, and 3 m cables only)

Clocked output options [3]

50 = 50 MHz

40 = 40 MHz

25 = 25 MHz

20 = 20 MHz

12 = 12 MHz

10 = 10 MHz

08 = 8 MHz

06 = 6 MHz

04 = 4 MHz

01 = 1 MHz

Reference mark options / Alarm format

B = All reference marks are output / Line driven alarm (not available with 'A' cable termination)

F = All reference marks are output / 3-state alarm

Valid system configurations (readheads and scale) can be checked at www.renishaw.com/epc.

1 Extension cables are available. Contact your local Renishaw representative for further details.

2 The cable termination must not be removed.

3 Additional clocked output options are available. Contact your local Renishaw representative for further details.

Partial arc readhead part numbers

V2 B R X 30 D 50 B

Series

V2 = 20 µm VIONiC

Readhead type

B = Partial arc radius > 67.5 mm ('R' scale type compatibility only)

C = Partial arc radius ≤ 67.5 mm ('S' scale type compatibility only)

Scale type compatibility

R = RKLC20-S partial arc radius > 67.5 mm ('B' readhead type only)

S = RKLC20-S partial arc radius 30 mm to 67.5 mm ('C' readhead type only)

Resolution

D = 5 µm
X = 1 µm
Z = 0.5 µm
W = 0.2 µm
Y = 0.1 µm
H = 50 nm
M = 40 nm
P = 25 nm
I = 20 nm
O = 10 nm
Q = 5 nm
R = 2.5 nm

Cable length [1]

05 = 0.5 m
10 = 1 m
15 = 1.5 m
30 = 3 m
50 = 5 m ('A' or 'D' cable termination only) [2]
99 = 10 m ('A' or 'D' cable termination only) [2]

Cable termination

A = 9-way D-type plug ('F' Reference mark options / Alarm format only)

D = 15-way D-type plug (standard pin-out)

H = 15-way D-type plug (alternative pin-out) (0.5 m, 1 m, 1.5 m, and 3 m cables only)

X = 12-way circular connector (0.5 m, 1 m, 1.5 m, and 3 m cables only)

J = 14-way JST connector (0.5 m, 1 m, 1.5 m, and 3 m cables only)

Clocked output options [3]

50 = 50 MHz
40 = 40 MHz
25 = 25 MHz
20 = 20 MHz
12 = 12 MHz
10 = 10 MHz
08 = 8 MHz
06 = 6 MHz
04 = 4 MHz
01 = 1 MHz

Reference mark options [4] **/ Alarm format**

B = All reference marks are output / Line driven alarm (not available with 'A' cable termination)

F = All reference marks are output / 3-state alarm

For more information on partial arcs refer to *RKL scale for partial arc applications* data sheet (Renishaw part no. L-9517-9897).

Valid system configurations (readheads and scale) can be checked at **www.renishaw.com/epc**.

1 Extension cables are available. Contact your local Renishaw representative for further details.

2 The cable termination must not be removed.

3 Additional clocked output options are available. Contact your local Renishaw representative for further details.

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

Adaptor cables

The listed adaptor cables enable readheads with different terminations to be connected to the Advanced Diagnostic Tools.

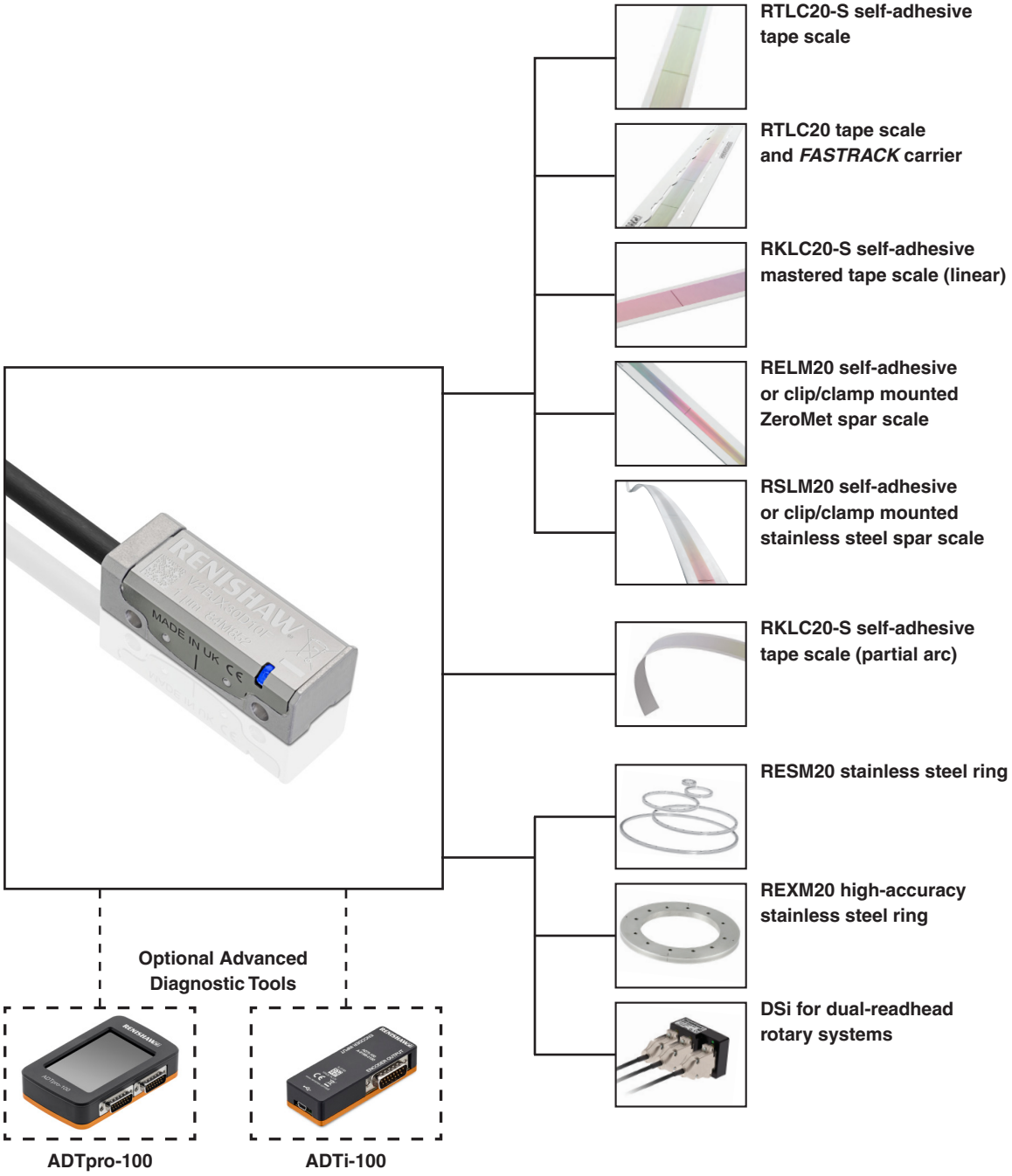
Each kit consists of two cables:

- Readhead cable to the ADT
- ADT to the controller cable, for in-line use

Cable termination	Pin-out	Part number
A	9-way D-type	A-6195-0102
D	15-way D-type (Standard pin-out	Direct connection
H	15-way D-type (alternative pin-out)	A-6195-0103
J	14 way JST	A-6195-2073
X	12-way circular	A-6195-0104

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For more information about the Advanced Diagnostic Tools and scales refer to the relevant data sheets and installation guides which can be downloaded from **www.renishaw.com/vionicdownloads**.

www.renishaw.com/contact **#renishaw**

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Part no.: L-9517-9678-06-C
Issued: 06.2025