Data sheet
L-9517-9155-05-A

RENISHAW
apply innovation™

SiGNUM™ encoder system

Renishaw's SR readhead and Si interface are part of the SiGNUM range of optical encoders.

They have been designed for use with Renishaw's range of high accuracy RESM and REXM angle encoders and RSLM and RELM linear encoders which incorporate the *IN-TRAC*™ bi-directional reference mark.

Like all Renishaw encoders, the SiGNUM range offers high speed, reliable operation and open, non-contact performance with excellent immunity to dirt and electrical noise.

The interface incorporates dynamic signal control which, combined with the patented filtering optics, ensure excellent signal integrity and exceptionally low cyclic error.

The Si interface can be mounted remotely and a small connector on the readhead cable allows it to be fed easily through machines where access is restricted.

Readhead (SR)

SR005A – 0.5 m cable
SR010A – 1.0 m cable
SR015A – 1.5 m cable
SR030A – 3.0 m cable
SR050A – 5.0 m cable
SR100A – 10.0 m cable

Interface unit (Si)

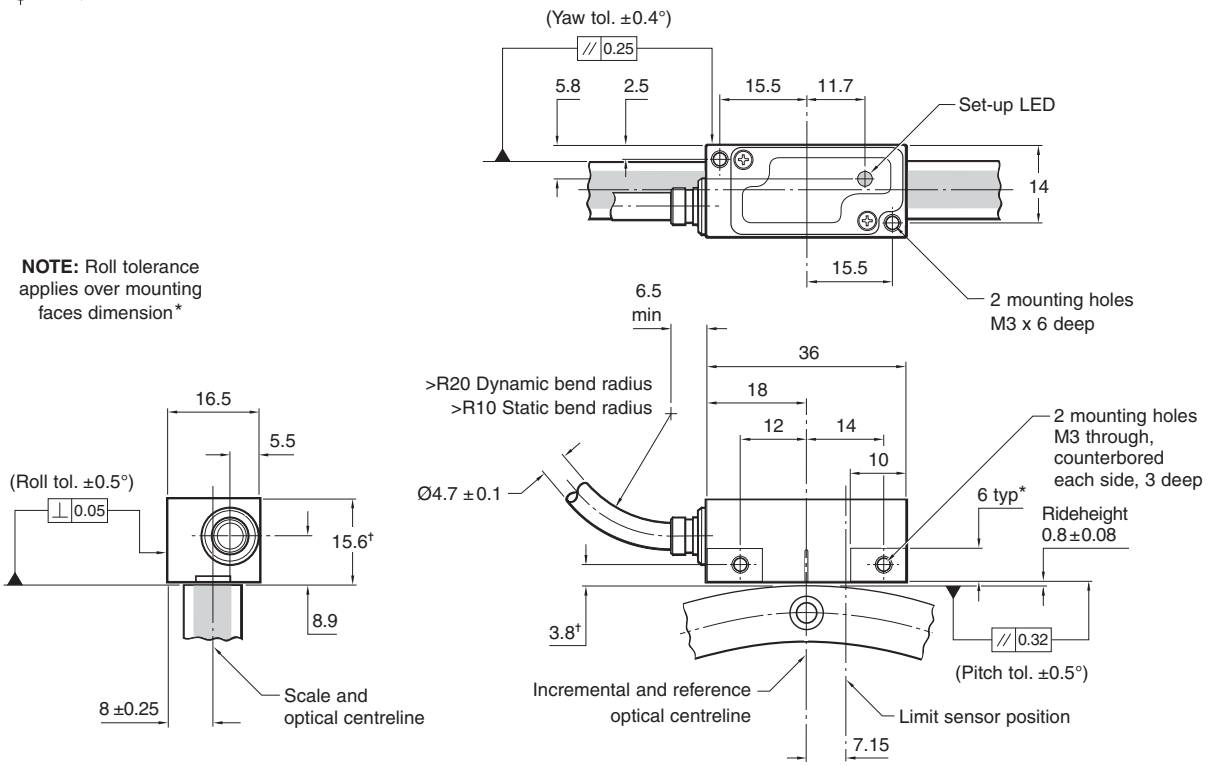
Si-NN-0004 – 5 µm
Si-NN-0020 – 1 µm
Si-NN-0040 – 0.5 µm
Si-NN-0100 – 0.2 µm
Si-NN-0200 – 0.1 µm
Si-NN-0400 – 50 nm
Si-NN-1000 – 20 nm
Si-HN-2000 – 10 nm
Si-HN-4000 – 5 nm
Si-NN-0000 – Analogue
Si-NN-0001 – Low noise analogue

- ***IN-TRAC*** **bi-directional reference mark and on-scale dual limit outputs**
- **Compatible with RESM, REXM (rotary) and RELM and RSLM (linear) scales**
- **Operating temperature up to 85 °C**
- **Speeds up to 12.5 m/s (4 591 rev/min @ Ø52 mm)**
- **Dynamic signal control to give cyclic error of typically ±30 nm**
- **SiGNUM software for easy installation and system diagnostics**
- **Integral LEDs for optimum set-up and system diagnostics**
- **Industry standard analogue and digital outputs with resolutions from 5 µm to 5 nm (40 to 0.0038 arc seconds)**
- **Non-contact open optical system**
- **Filtering optics provide excellent dirt immunity**
- **High flex, UL approved cable**

SR installation drawing (on RESM scale)

Dimensions and tolerances in mm

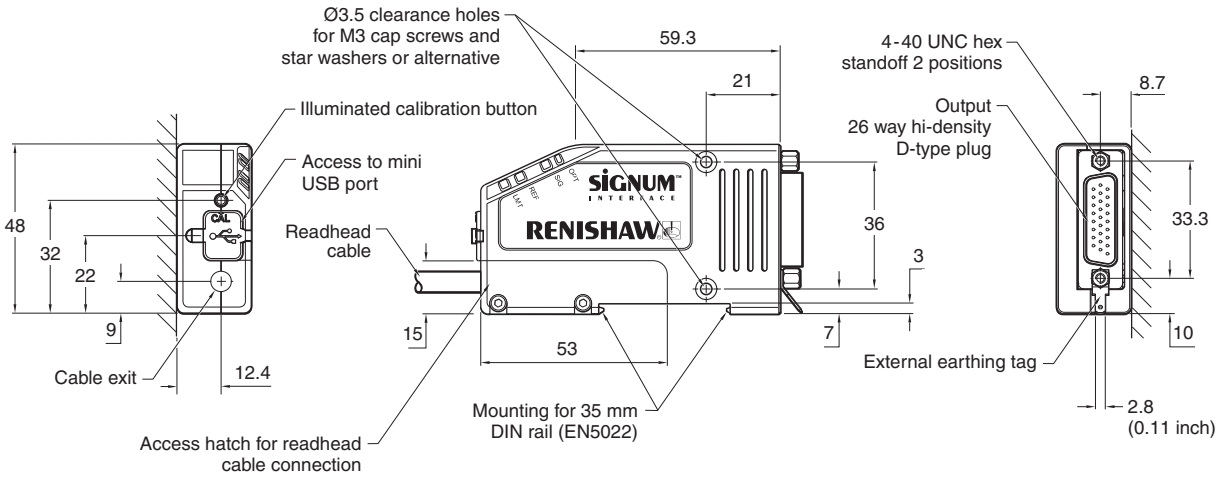
For detailed drawings, please refer to the SiGNUM linear or rotary encoder installation guides

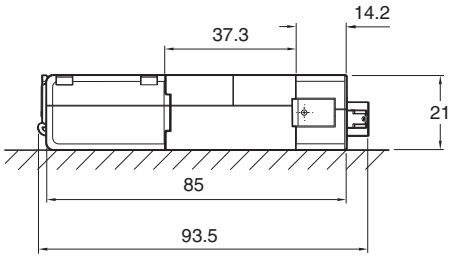


†Dimensions from scale surface

Si installation drawing

Dimensions and tolerances in mm





Operating and electrical specifications

Power supply	5 V ±10%	<250 mA (typical) **NOTE:** Current consumption figures refer to unterminated SiGNUM systems. For digital outputs a further 25 mA per channel pair (eg A+, A-) will be drawn when terminated with 120R. For analogue outputs a further 20 mA will be drawn when terminated with 120R. Power from a 5 V dc supply complying with the requirements for SELV of standard EN (IEC) 60950.
	Ripple	200 mVpp maximum @ frequency up to 500 kHz maximum
Temperature (system)	Storage	-20 °C to +70 °C
(readhead)	Operating	0 °C to +85 °C
(interface)	Operating	0 °C to +70 °C
Humidity		Rated up to +40 °C, 95% maximum relative humidity (non-condensing)
Sealing (readhead)		IP64
(interface)		IP30
Acceleration (readhead)	Operating	500 m/s² BS EN 60068-2-7:1993 (IEC 68-2-7:1983)
Shock (system)	Non-operating	1000 m/s², 6 ms, ½ sine BS EN 60068-2-27:1993 (IEC 68-2-27:1987)
Vibration (system)	Operating	100 m/s² max @ 55 Hz to 2000 Hz BS EN 60068-2-6:1996 (IEC 68-2-6:1995)
Mass	Readhead	15 g
	Interface	205 g
	Cable	35 g/m
Environmental		Compliant with EU Directive 2002/95/EC (RoHS)
EMC compliance (system)		BS EN 61326-1: 2006
Readhead cable		Double-shielded, outside diameter 4.7 ±0.1 mm maximum Flex life >20 x 10^6 cycles at 20 mm bend radius UL recognised component

NOTE: Class 1M LED product. LED radiation. Do not view directly with optical instruments.

Speed

Digital systems:

Minimum counter clock frequency (MHz)	Maximum speed (m/s)								
	Si-NN-0004 5 µm	Si-NN-0020 1 µm	Si-NN-0040 0.5 µm	Si-NN-0100 0.2 µm	Si-NN-0200 0.1 µm	Si-NN-0400 50 nm	Si-NN-1000 20 nm	Si-HN-2000 10 nm	Si-HN-4000 5 nm
40	12.5	12.5	12.5	5	2.5	1.25	0.5	0.27	0.135
20	12.5	12.5	6.5	2.7	1.25	0.6	0.25	0.135	0.068
12	12.5	8	4	1.5	0.8	0.4	0.15	0.09	0.045
10	12.5	6.5	3	1.25	0.6	0.3	0.12	0.068	0.034
8	12.5	5	2.5	1	0.5	0.25	0.1	0.054	0.027
6	12.5	4	2	0.8	0.4	0.2	0.08	0.045	0.023
4	12.5	3	1.5	0.6	0.3	0.15	0.06	0.034	0.017
1	4	0.8	0.4	0.15	0.075	0.04	0.02	0.008	0.004
Analogue output	12.5 m/s					3.0 m/s			

Additional decimal and binary interpolation factors are available on request

Analogue systems:

Si-NN-0000 – 12.5 m/s Si-NN-0001 (bandwidth limited for lower noise) – 3.0 m/s

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 RESM (mm)

System features

IN-TRAC optical reference mark

- Integrated within the graduation for compact dimensions and simplified alignment
- Electronically phased, requiring no physical adjustment
- Sub micron repeatability in both directions of travel over full operating temperature and speed range
- Located at mid point (RELM and RSLM), end point (RELE and RSLE) or customer selectable (RSLC)

The maximum speed for referencing is as per the speed table or 5 m/s whichever is the lowest

Dynamic signal control

- Real time signal conditioning for optimised performance across a range of operating conditions
- Includes Auto Gain Control (AGC), Auto Offset Control (AOC) and Auto Balance Control (ABC)
- Ultra low cyclic errors, typically ±30 nm

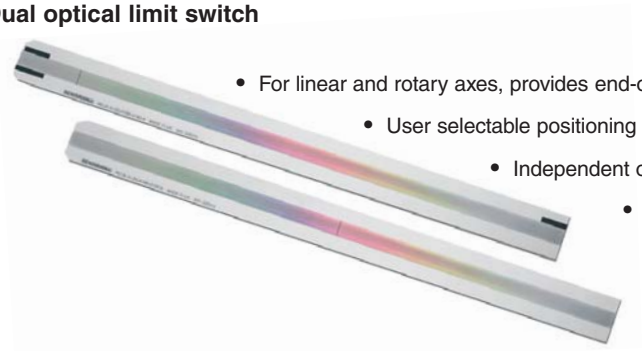
Calibration at the touch of a button

- Click of a mouse via SiGNUM software or CAL button on Si interface
- Optimization for all output signals

Integrated LED diagnostics

- Simplifies initial alignment and set-up
- Reference mark and limit status

Dual optical limit switch



- For linear and rotary axes, provides end-of-travel indication
- User selectable positioning
- Independent output for each limit position
- Ideal for linear and partial arc rotary applications

In-line connector (option)

- In-line connector between readhead and interface for easy connectivity
- IP68
- Protective caps available

SiGNUM software

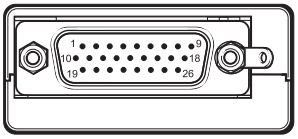
- PC based, providing real-time set-up, calibration and diagnostics
- USB connection to SiGNUM Si interface
- Simultaneous multiple axis connectivity
- Can be connected during full servo-loop operation
- Latest version of software available for download from www.renishaw.com

Recommended minimum PC requirements for the software:

- USB1.1
- .NET Framework 1.1 (redistributable version included with the software)
- Microsoft® Windows® 2000, Vista, XP or Windows® 7
- Microsoft® Internet Explorer 5.01 or later
- Pentium® II processor
- 128 MB RAM
- Screen resolution 800 x 600, 16-bit colours

Connections Si output (analogue and digital versions)

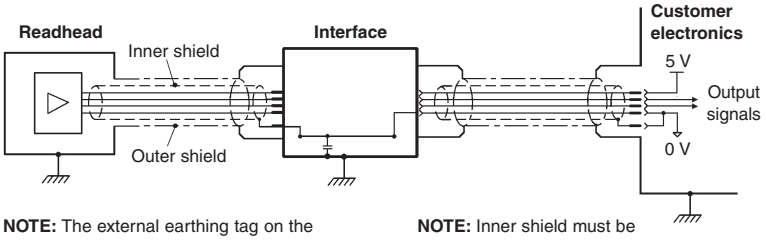
Function	Output type		Signal	Pin
Power			5 V Power	26
			5 V Sense	18
			0 V Power	9
			0 V Sense	8
Incremental signals	RS422A digital		A+	24
			A-	6
			B+	7
			B-	16
	Analogue	Cosine	V_1+	1
			V_1-	19
		Sine	V_2+	2
			V_2-	11
Reference mark	RS422A digital		Z+	15
			Z-	23
	Analogue		V_0+	12
			V_0-	20
Customer selected reference mark	RS422A digital		S+	5
			S-	14
	Analogue		V_0S+	21
			V_0S-	3
Alarm	RS422A digital		E+	25
			E-	17
Limits	Open collector		P	4
			Q	13
Warning	Open collector		W	22
Readhead pitch adjustment	–		XS	10
Shield	–		Inner shield	Not connected
	–		Outer shield	Case



26 pin high density D type plug

Electrical connections

Si and SR grounding and shielding



NOTE: The external earthing tag on the interface should be used when mounting the interface on a DIN rail

NOTE: Inner shield must be connected to 0 V at customer electronics only

Maximum cable length

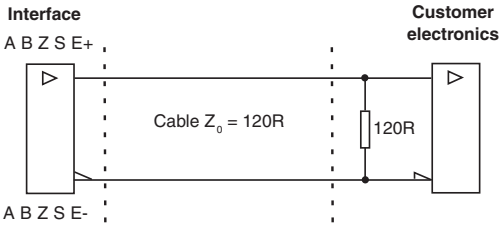
Readhead to interface: 10 m

Interface to controller: Dependent on output frequency. See table below for details.

Receiver clock frequency (MHz)	Maximum cable length (m)
21 to 40	10
13 to 20	25
⩽12	50
analogue	50

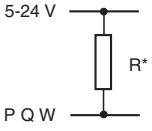
Recommended signal termination

Digital outputs
- all Si interfaces except Si-NN-0000 and Si-NN-0001



Standard RS422A line receiver circuitry

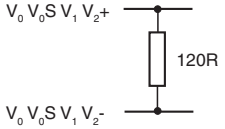
Limits and warning outputs
- all Si interfaces



*Select R so max. current does not exceed 20 mA

Alternatively, use a suitable relay or opto-isolator

Analogue outputs
- all Si interfaces



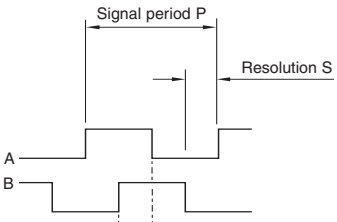
Output specifications

Digital output signals - available from all Si interfaces except Si-NN-0000 and Si-NN-0001

All digital SiGNUM interfaces also offer analogue outputs as standard

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

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



Model	P (µm)	S (µm)
Si-NN-0004	20	5
Si-NN-0020	4	1
Si-NN-0040	2	0.5
Si-NN-0100	0.8	0.2
Si-NN-0200	0.4	0.1
Si-NN-0400	0.2	0.05
Si-NN-1000	0.08	0.02
Si-HN-2000	0.04	0.01
Si-HN-4000	0.02	0.005

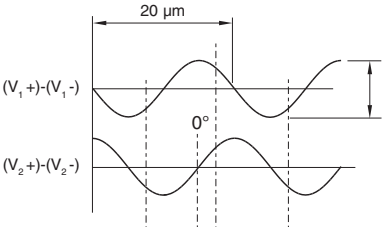
Reference†

S (Customer selected reference mark)

Bi-directionally repeatable pulse Z, with duration equal to the resolution

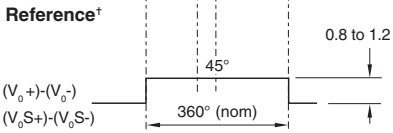
Analogue output signals - available from all Si interfaces

Incremental 2 channels V_1 and V_2 differential sinusoids in quadrature (90° phase shifted)†



0.7 to 1.35 Vpp with green LED indication, 0.95 to 1.05 Vpp with blue LED indication and 120R termination centred on ~1.65 V

Reference†



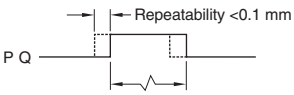
Bi-directionally repeatable Differential pulse V_0 centred on 45°

All units

End of travel limit and warning outputs can be selected as 'active high' or 'active low' at time of ordering.
The alarm signal can be output as a differential line driven signal or 3-state. Again, please select the preferred option at time of ordering.

Limits Open collector output, asynchronous pulse

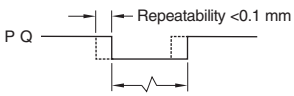
Active high



Length of limit actuator

or

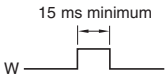
Active low



Length of limit actuator

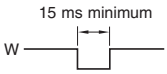
Warning Open collector output, asynchronous pulse

Active high



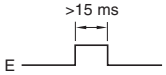
or

Active low



Warning asserted when 50% $>V_1/V_2>130\%$. Other warning triggers available on request, please contact your Renishaw representative for further details.

Alarm† Asynchronous pulse



Alarm asserted when signal level is less than 20% or greater than 135% and overspeed. Alarm is also asserted if readhead speed is too high for reliable operation. Other alarm triggers available on request, please contact your Renishaw representative for further details.

or 3-state alarm

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

†Inverse signals not shown for clarity

SiGNUM readhead

Readhead part number **SR-005-A**

Readhead series

Cable length
005 = 0.5 m
010 = 1 m
015 = 1.5 m
030 = 3 m
050 = 5 m
100 = 10 m

Type
A = Standard

SiGNUM interface

Interface part number **Si-NN-0000-00-0-0N-003-003-3**

Interface series
Si-NN = Standard digital, analogue and low noise analogue interfaces
Si-HN = High resolution interfaces

Interpolation factor and resolution
0000 = Analogue
0001 = Low noise analogue
0004 = x 4 interpolation, 5 µm resolution
0016 = x 16 interpolation, 1.25 µm resolution
0020 = x 20 interpolation, 1µm resolution
0032 = x 32 interpolation, 0.625 µm resolution
0040 = x 40 interpolation, 0.5 µm resolution
0064 = x 64 interpolation, 0.3125 µm resolution
0100 = x 100 interpolation, 0.2 µm resolution
0128 = x 128 interpolation, 0.15625 µm resolution
0200 = x 200 interpolation, 0.1 µm resolution
0400 = x 400 interpolation, 50 nm resolution
0512 = x 512 interpolation, 39.062 nm resolution
1000 = x 1000 interpolation, 20 nm resolution
2000 = x 2000 interpolation, 10 nm resolution (Si-HN only)
4000 = x 4000 interpolation, 5 nm resolution (Si-HN only)

Receiver clock frequency
00 = Analogue 1 Vpp
01 = 1 MHz customer clock
04 = 4 MHz customer clock
06 = 6 MHz customer clock
08 = 8 MHz customer clock
10 = 10 MHz customer clock
12 = 12 MHz customer clock
20 = 20 MHz customer clock
40 = 40 MHz customer clock

Alarm, warning and limit outputs
0 = 3 state alarm, active high warning output, active high limit output
1 = Line driven alarm, active high warning output, active high limit output

Count direction and readhead mounting
0N = Normal mounting (analogue only)
FN = Forward counting, normal mounting (digital only)

Alarms
003 = High signal & low signal alarms (analogue only)
403 = High signal, low signal & over speed alarms (digital only)

Warnings
003 = High signal & low signal warnings

ABC / AOC/ Limits
3 = All enabled

NOTE: Not all combinations are valid. For valid options and to acquire a part number for any combinations of the nomenclature above, please visit the product configurator at **www.renishaw.com/epc**

Renishaw plc
New Mills, Wotton-under-Edge,
Gloucestershire GL12 8JR
United Kingdom

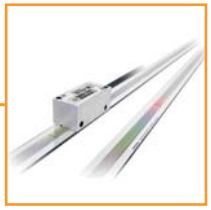
T +44 (0)1453 524524
F +44 (0)1453 524901
E uk@renishaw.com
www.renishaw.com

RENISHAW
apply innovation™

SiGNUM compatible products:

SiGNUM

RELM



Installation guide M-9572-9110

Data sheet L-9517-9219

RSLM

Installation guide M-9572-9110

Data sheet L-9517-9305

RESM

Installation guide M-9572-9106

Data sheet L-9517-9154

REXM

Installation guide M-9671-0021

Data sheet L-9517-9318

DSi

Installation guide M-9568-0200

Data sheet L-9517-9231

For worldwide contact details, please visit our main website at www.renishaw.com/contact

RENISHAW HAS MADE CONSIDERABLE EFFORTS TO ENSURE THE CONTENT OF THIS DOCUMENT IS CORRECT AT THE DATE OF PUBLICATION BUT MAKES NO WARRANTIES OR REPRESENTATIONS REGARDING THE CONTENT. RENISHAW EXCLUDES LIABILITY, HOWSOEVER ARISING, FOR ANY INACCURACIES IN THIS DOCUMENT.

RENISHAW® and the probe emblem used in the RENISHAW logo are registered trademarks of Renishaw plc in the UK and other countries. **apply innovation** is a trademark of Renishaw plc.

© 2004-2011 Renishaw plc All rights reserved Issued 0711

L-9517-9155-05