

# FORTIS-N™ Functional Safety enclosed encoder system



## Specification

<b>Measuring standard</b>	Renishaw stainless-steel scale with single track absolute encoding
<b>Coefficient of thermal expansion</b> (at 20 °C)	10.1 ±0.2 µm/m/°C
<b>Thermal datum</b>	At centre position (encoder position of 0.5 × measuring length)
<b>Measuring lengths available (mm)</b>	70, 120, 170, 220, 270, 320, 370, 420, 470, 520, 570, 620, 670, 720, 770, 820, 920, 1020, 1140, 1240, 1340, 1440, 1540, 1640, 1740, 1840, 2040 (mounting spar available – recommended for > 620 mm length)
<b>Accuracy grades</b>	High grade: ≤ ±3 µm    Standard grade: ≤ ±5 µm
<b>Resolution <sup>1</sup></b>	1 nm, 10 nm, 50 nm
<b>Sub-Divisional Error (typical)</b>	±40 nm
<b>Jitter (RMS)</b>	10 nm
<b>Absolute position serial interface</b>	BiSS Safety, Siemens DRIVE-CLiQ (with external interface)
<b>Encoder electrical connection</b>	Cable connector M12 custom
<b>Controller electrical connection</b>	8-way M12, 9-way D-type, flying lead
<b>Cable length</b>	Multiple options available
<b>Power supply</b>	Dependent on protocol
<b>Set-up LED</b>	Signal strength indicator
<b>Maximum speed</b>	4 m/s
<b>Acceleration</b> (readhead relative to scale)	< 200 m/s <sup>2</sup> in measuring direction
<b>Moving force</b> (maximum force required to move the readhead through the seals)	< 4 N
<b>Vibration</b> (55 Hz to 2 000 Hz)	Readhead: < 300 m/s <sup>2</sup> to IEC 60068-2-6 Housing without mounting spar: < 200 m/s <sup>2</sup> to IEC 60068-2-6 Housing with mounting spar: < 300 m/s <sup>2</sup> to IEC 60068-2-6
<b>Shock 11 ms half-sine</b>	< 300 m/s <sup>2</sup> IEC 60068-2-27
<b>Operating temperature</b>	0 °C to 50 °C
<b>Storage temperature</b>	-20° C to 70 °C
<b>Environment protection</b>	IP53 when installed correctly, IP64 with air purge Protection class III    Pollution degree    II Altitude 2000 m
<b>EMC immunity</b>	IEC 61800-5-2:2016 <i>Electromagnetic immunity requirement for safety related systems – Annex E, second environment</i>
<b>Air purge requirements</b>	Air supply pressure = 1 bar at encoder At correct supply pressure the supplied air connection fitting restricts the air flow rate to 2 l/min
<b>Weight</b>	0.11 kg + 0.45 kg/m

<sup>1</sup> See page 2.

# Resolution per accuracy grade and serial interface – standard options

Accuracy grade	Serial interface	Resolution nm
		Single
3 µm	BiSS Safety, Siemens DRIVE-CLiQ	1
5 µm	BiSS Safety, Siemens DRIVE-CLiQ	10
		50

# The FORTiS-N FS enclosed encoder system

FORTiS-N FS encoders are for use in Functional Safety applications and are certified to:

- ISO 13849 Category 3 PLd
- IEC 61508 SIL2
- IEC 61800-5-2 SIL2

The FORTiS-N FS enclosed encoder system is suitable for use in a Category 3 performance level d (PLd) application in compliance with ISO 13849-1 and in a safety integrity level 2 (SIL2) application in compliance with IEC 61508 and IEC 61800-5-2. <sup>1</sup>

The FORTiS-N FS encoder system provides safe position data that supports the following safety sub-functions defined by IEC 61800-5-2:

- Safe stop 1 (SS1) and Safe stop 2 (SS2) <sup>2</sup>
- Safe operating stop (SOS) <sup>2</sup>
- Safe limited acceleration (SLA)  $\leq 200 \text{ m/s}^2$
- Safe acceleration range (SAR)  $\leq 200 \text{ m/s}^2$
- Safe limited speed (SLS)  $\leq 4 \text{ m/s}$
- Safe speed range (SSR)  $\leq 4 \text{ m/s}$
- Safely limited position (SLP) <sup>2</sup>
- Safely limited increment (SLI) <sup>2</sup>
- Safe direction (SDI)
- Safe speed monitor (SSM)  $\leq 4 \text{ m/s}$

<sup>1</sup> The system must be installed and operated in accordance with the instructions defined in the relevant installation guide. Failure to follow the correct use instructions and failure to heed the limitations may result in PLd and /or SIL2 not being achieved and will invalidate the Functional Safety certification.

<sup>2</sup> See the safety function restrictions for the safe position figure for each FORTiS-N FS encoder system variant.

For further details see the *FORTiS-N FS enclosed encoder system Functional Safety installation guide and safety manual* (Renishaw part no. M-6725-9026). Available from: [www.renishaw.com/fortisdownloads](http://www.renishaw.com/fortisdownloads)

# Functional Safety data declaration

## Product identification : FORTiS-N FS with BiSS Safety and Siemens DRIVE-CLiQ serial interfaces

### IEC 61508 safety data

Safety integrity level	2	
Random hardware failures (per hour) – BiSS Safety serial interface	$\lambda_s = 2.60E-07$	
	$\lambda_D = 4.08E-07$	
	$\lambda_{DD} = 3.67E-07$	
	$\lambda_{DU} = 4.08E-08$	
Random hardware failures (per hour) – Siemens DRIVE-CLiQ serial interface	$\lambda_s = 3.46E-07$	
	$\lambda_D = 6.02E-07$	
	$\lambda_{DD} = 5.42E-07$	
	$\lambda_{DU} = 6.02E-08$	
PFD <sub>avg</sub>	Not applicable due to continuous demand mode	
PFH (per hour) – BiSS Safety serial interface	$\lambda_{DU} = 4.08E-08$	
PFH (per hour) – Siemens DRIVE-CLiQ serial interface	$\lambda_{DU} = 6.02E-08$	
Architectural constraints	Type	B
	HFT	0
	SFF	94%
Hardware safety integrity compliance	Route 1H	
Systematic safety integrity compliance	Route 1S	
Systematic capability	SC 2	
Demand mode	Continuous	
Proof test interval	Not required for continuous demand mode	

### ISO 13849 safety data

MTTF <sub>D</sub> – BiSS Safety serial interface	292 years
MTTF <sub>D</sub> – Siemens DRIVE-CLiQ serial interface	189 years
Diagnostic coverage	Medium (90%)
Category	3
Performance level	d
Lifetime/replacement limits	20 years

### Safety function

The FORTiS-N FS encoder shall provide a safe position when requested by the controller.

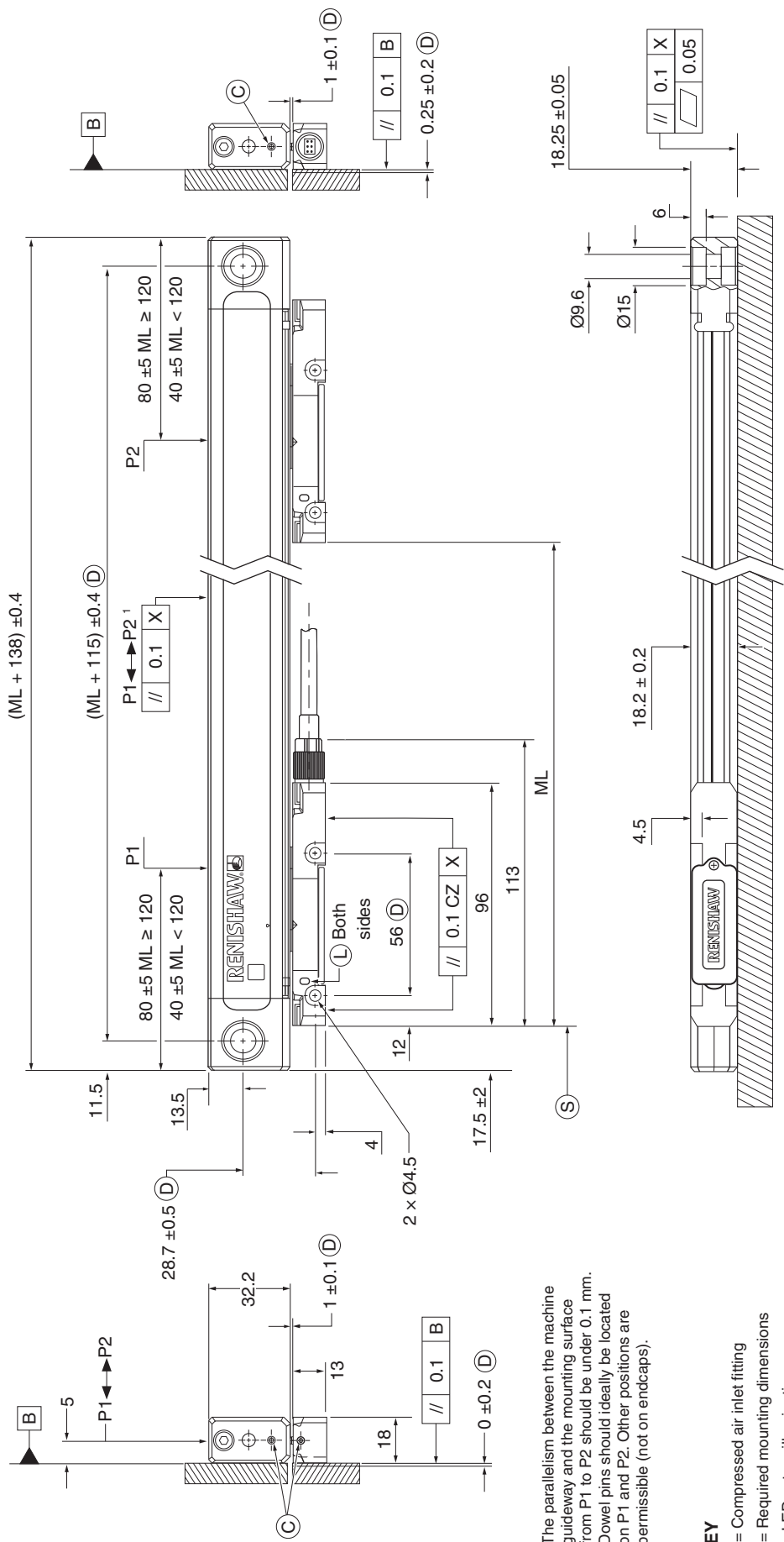
When installed correctly, the FORTiS-N FS encoder, with or without mounting spar, has a mechanical safe position of  $\pm 1$  mm.

In addition to any safety requirements defined by the communication protocol, to achieve full system integrity the evaluation unit must continuously monitor the error condition of the FORTiS-N FS encoder system,<sup>1</sup> and in the case of fault detection place the system into a safe state within the process safety time.

<sup>1</sup> Maximum request rate supported is 32 kHz and 16 kHz for DRIVE-CLiQ.

# System installation drawing – standard end caps (ML 320 mm shown)

Dimensions and tolerances in mm



<sup>1</sup> The parallelism between the machine guideway and the mounting surface from P1 to P2 should be under 0.1 mm. Dowel pins should ideally be located on P1 and P2. Other positions are permissible (not on endcaps).

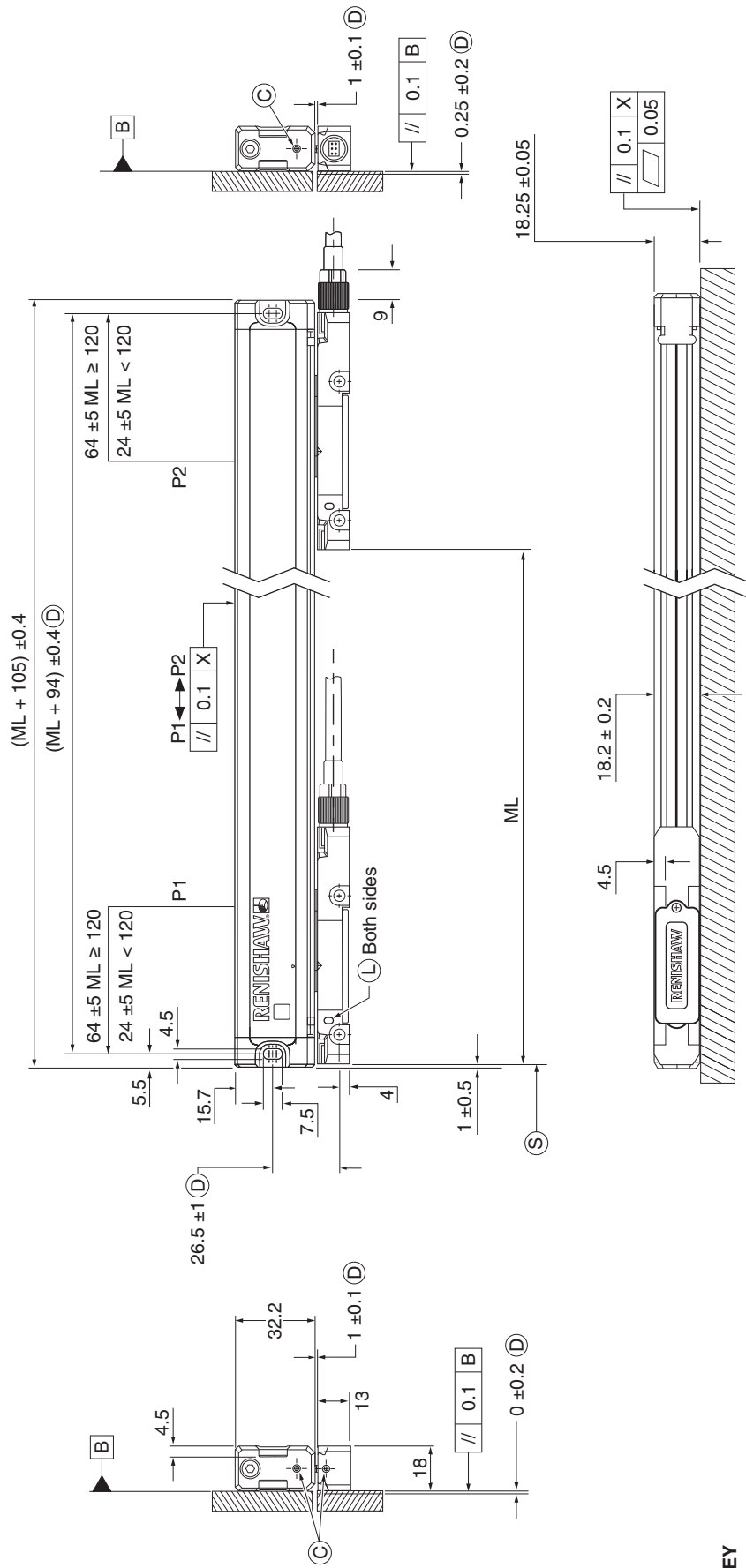
## KEY

- C = Compressed air inlet fitting
- D = Required mounting dimensions
- L = LED set-up illumination
- ML = Measuring length
- P = Gauging points for alignment
- S = Start of measuring length
- X = Machine guideway/axis datum

ML	70	120	170	220	270	320	370	420	470	520	570	620	670	720	770	820	920	1020	1140	1240	1340	1440	1540	1640	1740	1840	2040
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# System installation drawing – short end caps (ML 320 mm shown)

Dimensions and tolerances in mm



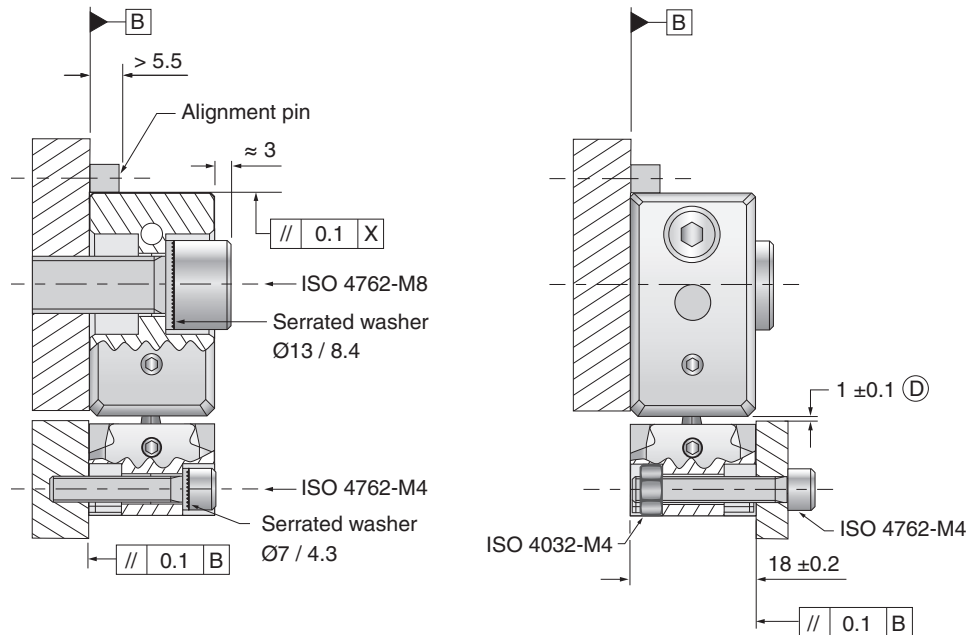
## KEY

- C = Compressed air inlet fitting
- D = Required mounting dimensions
- L = LED set-up illumination
- ML = Measuring length
- P = Gauging points for alignment
- S = Start of measuring length
- X = Machine guideway/axis datum

ML	70	120	170	220	270	320	370	420	470	520	570	620	670	720	770	820	880	920	1020	1140	1240	1340	1440	1540	1640	1740	1840	2040
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## Mounting orientations – standard end caps

Dimensions and tolerances in mm



**KEY**

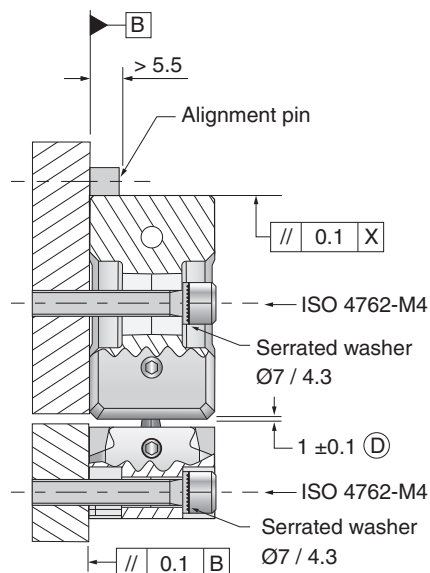
D = Required mounting dimensions

X = Machine guideway/axis datum

**NOTES:**

1. Side elevations show alternative mounting orientations.
2. Alignment pin and machine edge mounting options to mate directly to the top face of the extrusion.

## Mounting orientations – short end caps



**KEY**

D = Required mounting dimensions

X = Machine guideway/axis datum

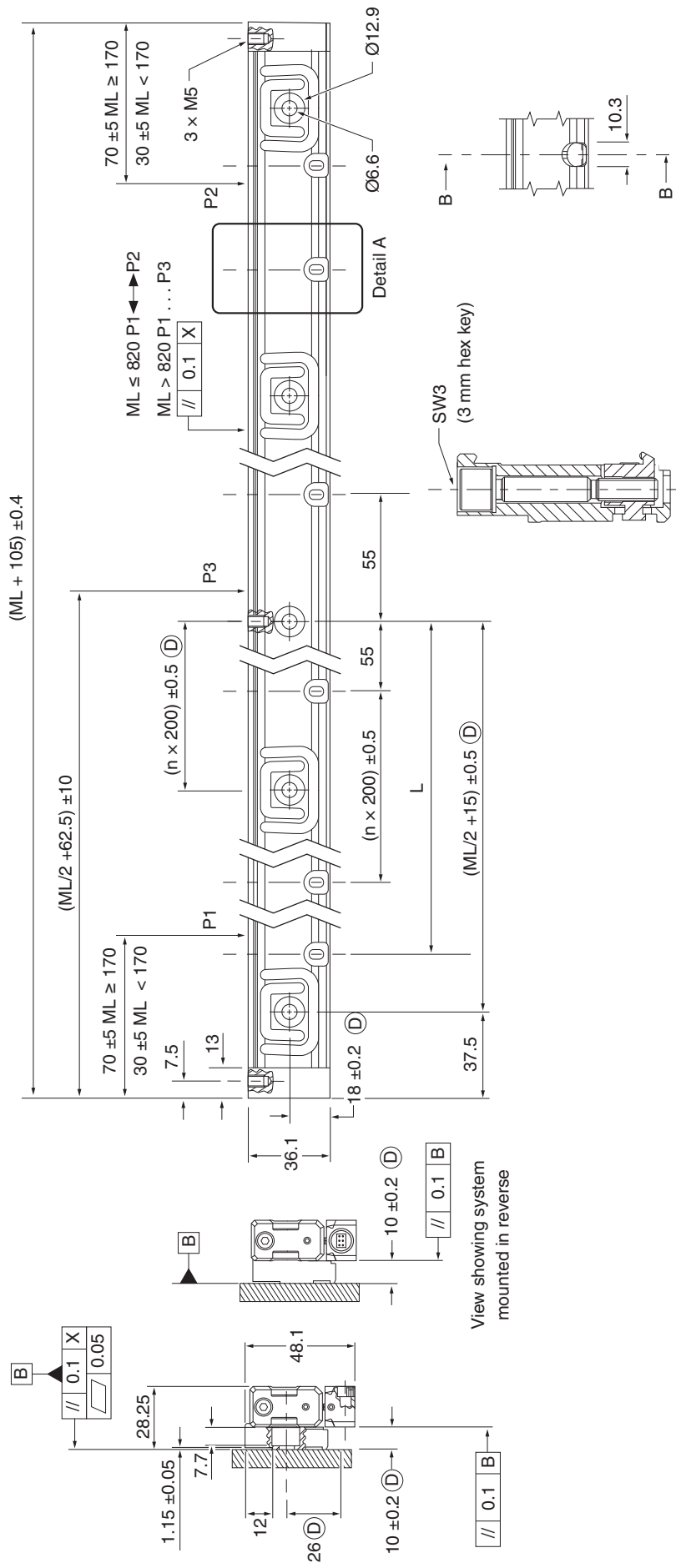
**NOTES:**

1. Side elevation shows alternative mounting orientation.
2. Extrusion mounting can be machine edge or dowel pins.

# Mounting spar installation drawing

(ML 620 mm shown)

Dimensions and tolerances in mm



Section B-B through the spar

Detail A  
Showing clamp installed

## KEY

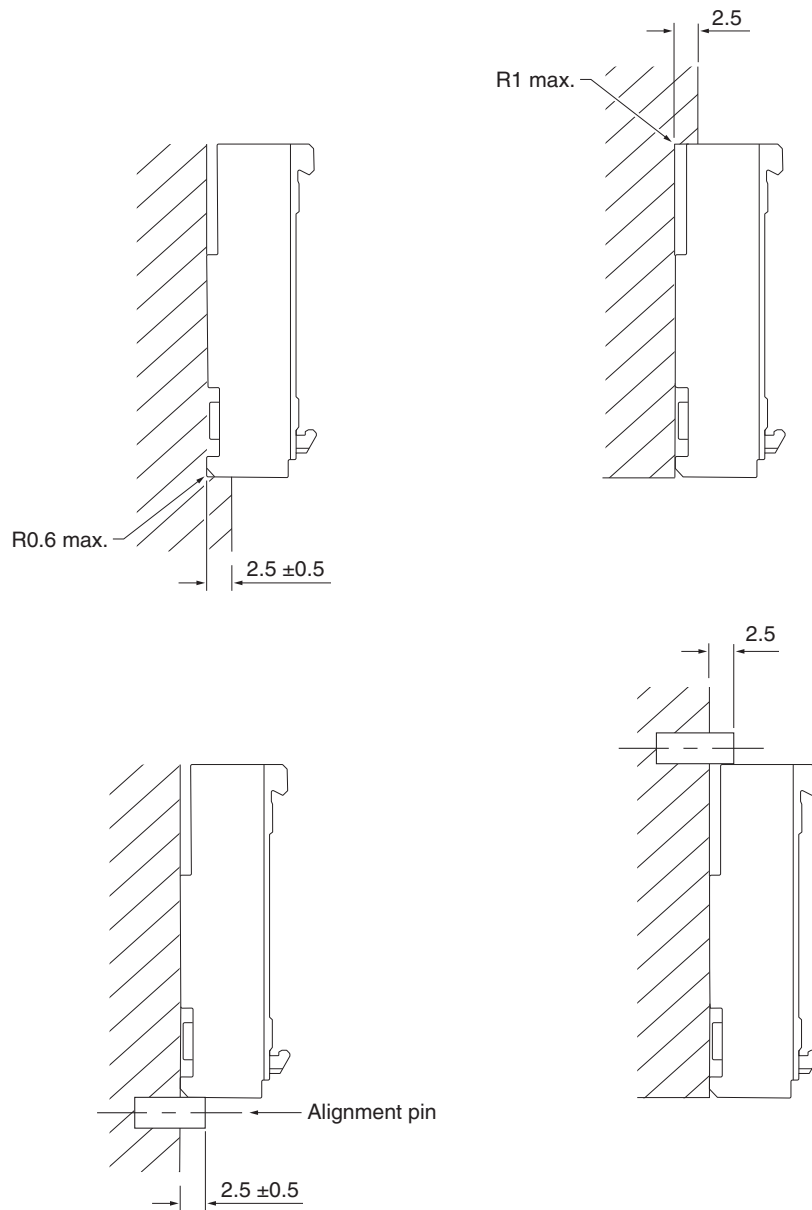
- D = Required mounting dimensions
- ML = Measuring length
- P = Gauging points for alignment
- X = Machine guideway/axis datum

ML	70	120	170	220	270	320	370	420	470	520	570	620	670	720	770	820	920	1020	1140	1240	1340	1440	1540	1640	1740	1840	2040	
L	37.5	55	75	100	115	140	175	200	225	250	275	300	325	350	375	400	450	500	550	640	655	710	760	810	855	910	1010	
n	-	-	-	-	-	-	-	-	-	-	1	1	1	1	1	1	1	2	2	2	2	3	3	3	3	3	4	4

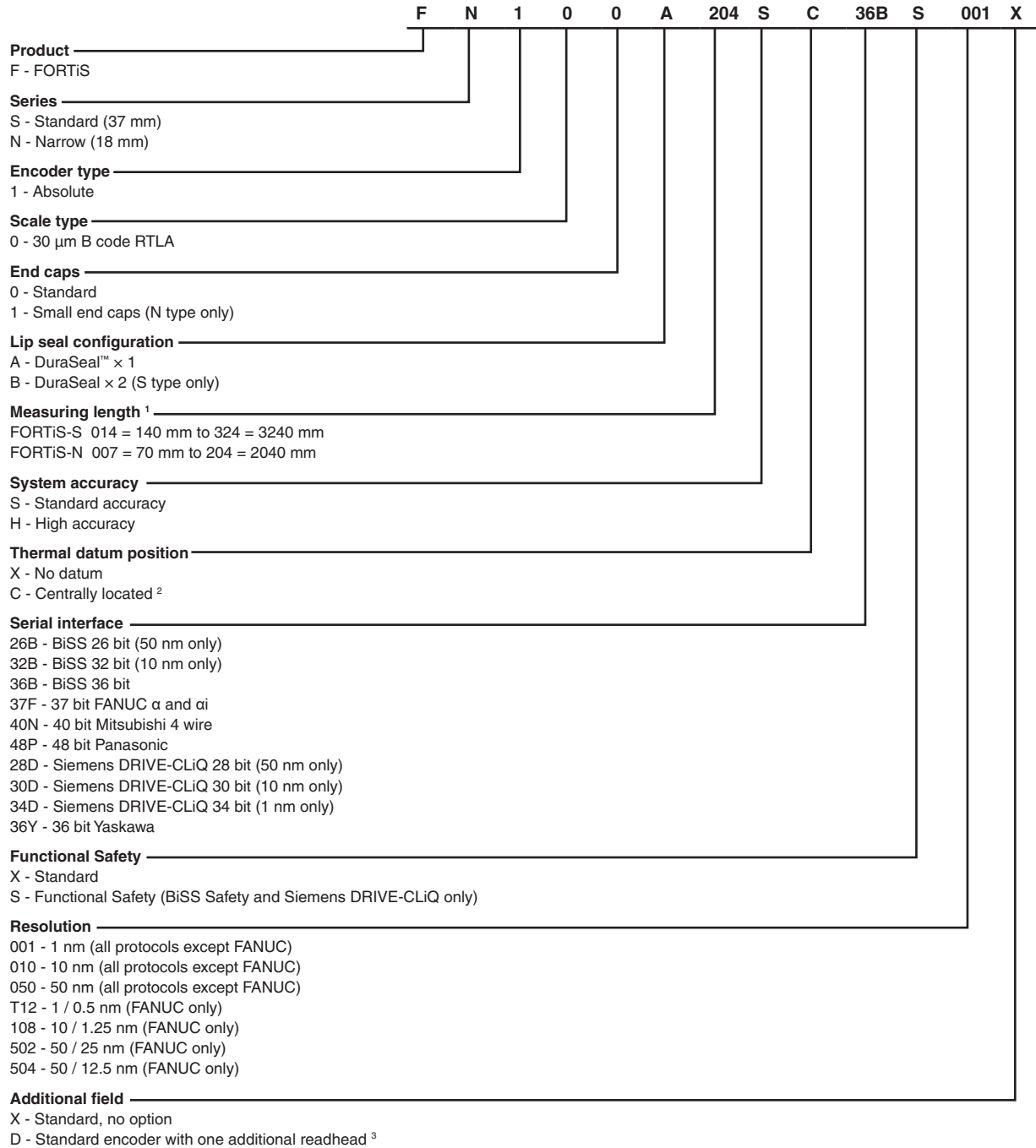


# Spar mounting options

Dimensions and tolerances in mm



# Nomenclature




<sup>1</sup> For all permissible measuring length options refer to specification table.

<sup>2</sup> For other datum requirements contact your local Renishaw representative.

<sup>3</sup> For further information see the manual *FORTiS-N FS enclosed encoder system with multiple readheads* (Renishaw part no. M-6725-9212).

[www.renishaw.com/contact](http://www.renishaw.com/contact)

 #renishaw

 +44 (0) 1453 524524

 [uk@renishaw.com](mailto:uk@renishaw.com)

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