

FORTiS-S™ Functional Safety enclosed encoder system



Specification

Measuring standard	Renishaw stainless-steel scale with single track absolute encoding
Coefficient of thermal expansion (at 20 °C)	10.1 ±0.2 µm/m/°C
Thermal datum	At centre position (encoder position of 0.5 × measuring length)
Measuring lengths available (mm)	140, 240, 340, 440, 540, 640, 740, 840, 940, 1040, 1140, 1240, 1340, 1440, 1540, 1640, 1740, 1840, 2040, 2240, 2440, 2640, 2840, 3040, 3240, 3440, 3640, 3840, 4040, 4240
Accuracy grades	High grade: ≤ ±3 µm (available in lengths up to 3040 mm only) Standard grade: ≤ ±5 µm
Resolution ¹	1 nm, 10 nm, 50 nm
Sub-Divisional Error (typical)	±40 nm
Jitter (RMS)	10 nm
Absolute position serial interface	BiSS Safety, Siemens DRIVE-CLiQ (with external interface)
Encoder electrical connection	Cable connector M12 custom (customer configurable exit direction)
Controller electrical connection	8-way M12, 9-way D-type, flying lead
Cable length	Multiple options available
Power supply	Dependent on protocol
Set-up LED	Signal strength indicator
Maximum speed	4 m/s
Acceleration (readhead relative to scale)	< 200 m/s ² in measuring direction
Moving force (maximum force required to move the readhead through the seals)	< 5 N
Vibration (55 Hz to 2 000 Hz)	Housing: < 300 m/s ² to IEC 60068-2-6 Readhead: < 300 m/s ² to IEC 60068-2-6
Shock 11 ms half-sine	< 300 m/s ² IEC 60068-2-27
Operating temperature	0 °C to 50 °C
Storage temperature	-20 °C to 70 °C
Environment protection	IP53 when installed correctly, IP64 with air purge Protection class III Pollution degree II Altitude 2000 m
EMC immunity	IEC 61800-5-2:2016 <i>Electromagnetic immunity requirement for safety related systems – Annex E, second environment</i>
Air purge requirements	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
Weight	0.27 kg + 2.0 kg/m

¹ 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-S FS enclosed encoder system

FORTiS-S 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-S 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. ¹

The FORTiS-S 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) ²
- Safe operating stop (SOS) ²
- 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) ²
- Safely limited increment (SLI) ²
- Safe direction (SDI)
- Safe speed monitor (SSM) $\leq 4 \text{ m/s}$

¹ 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.

² See the safety function restrictions for the safe position figure for each FORTiS-S FS encoder system variant.

For further details see the *FORTiS-S FS enclosed encoder system Functional Safety installation guide and safety manual* (Renishaw part no. M-6725-9016). Available from: www.renishaw.com/fortisdownloads

Functional Safety data declaration

Product identification: FORTiS-S 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	λ_s	= 2.60E-07
	λ_D	= 4.08E-07
	λ_{DD}	= 3.67E-07
	λ_{DU}	= 4.08E-08
Random hardware failures (per hour) – Siemens DRIVE-CLiQ serial interface	λ_s	= 3.46E-07
	λ_D	= 6.02E-07
	λ_{DD}	= 5.42E-07
	λ_{DU}	= 6.02E-08
PFD _{avg}	Not applicable due to continuous demand mode	
PFH (per hour) – BiSS Safety serial interface	λ_{DU}	= 4.08E-08
PFH (per hour) – Siemens DRIVE-CLiQ serial interface	λ_{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 _D – BiSS Safety serial interface	292 years
MTTF _D – Siemens DRIVE-CLiQ serial interface	189 years
Diagnostic coverage	Medium (90%)
Category	3
Performance level	d
Lifetime/replacement limits	20 years

Safety function

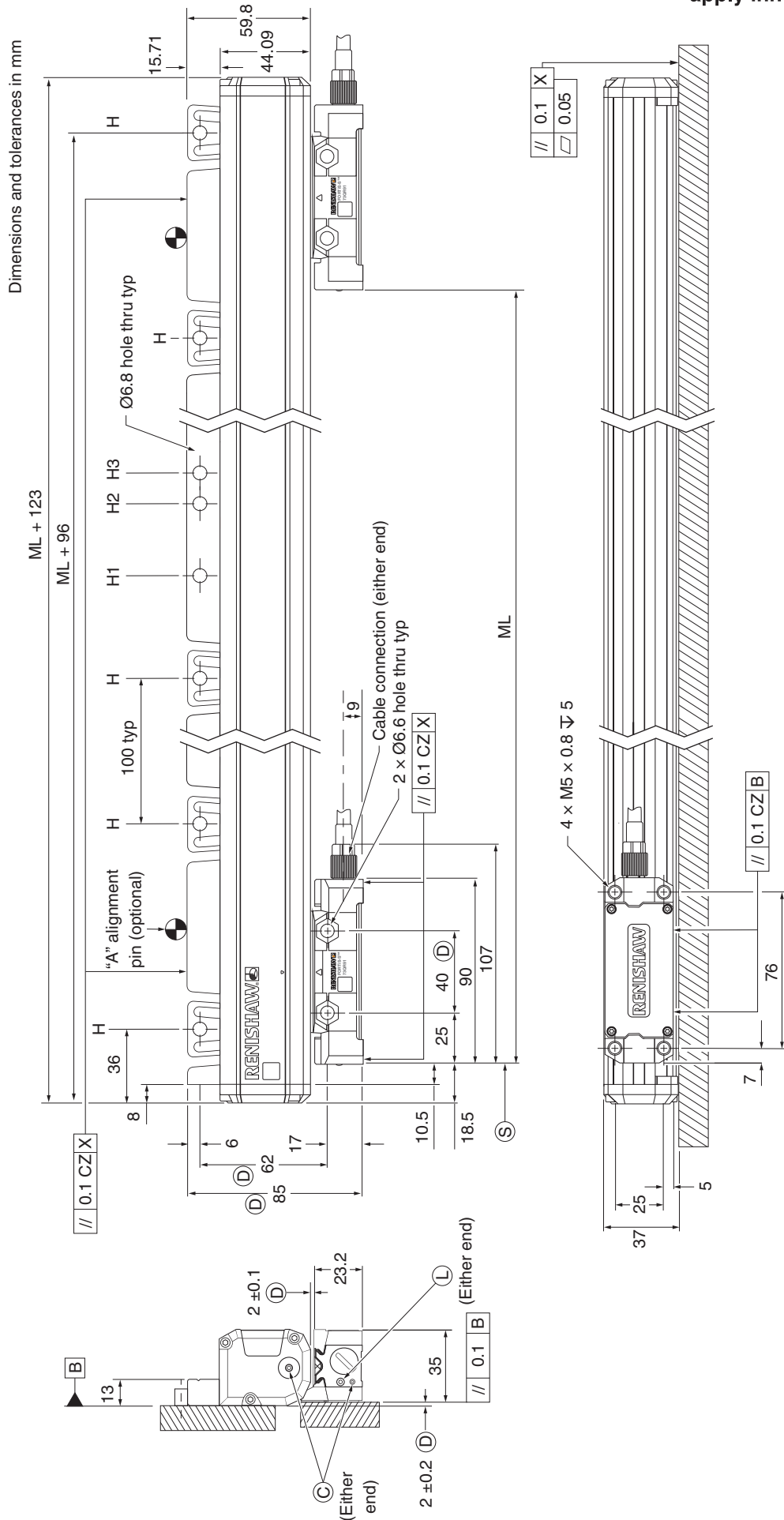
The FORTiS-S FS encoder shall provide a safe position when requested by the controller.

When installed correctly, the FORTiS-S FS encoder has mechanical safe position of ± 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-S FS encoder system,¹ and in the case of fault detection place the system into a safe state within the process safety time.

¹ Maximum request rate supported is 32 kHz and 16 kHz for DRIVE-CLiQ.

System installation drawing

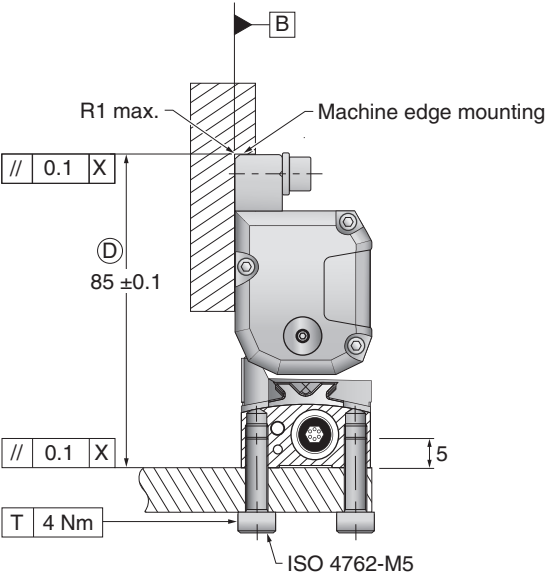
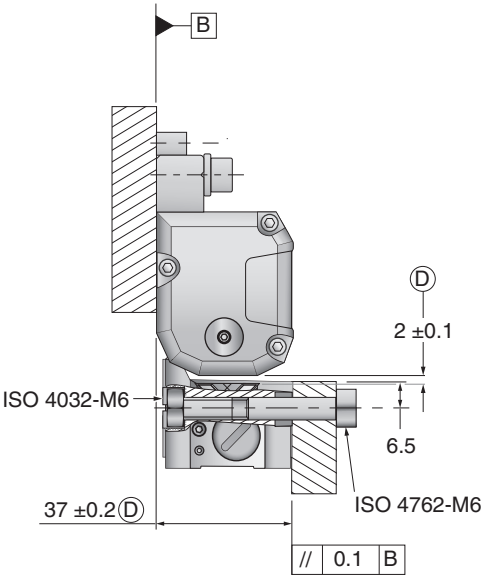
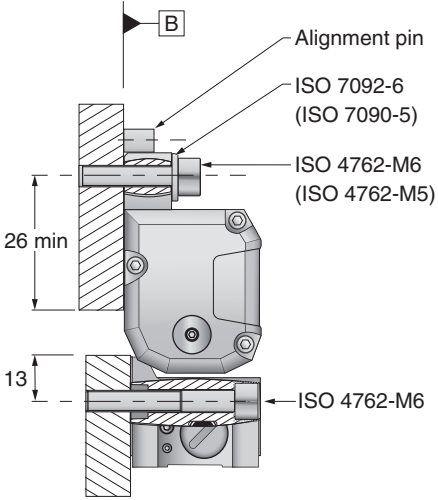


KEY

- A = Recommended extrusion alignment pin locations (if required)
Adjacent to first and last flexure holes plus every 300-500 mm
- C = Compressed air inlet fitting
- D = Required mounting dimensions
- H = Flexure mounting holes
- H1 = Fixed mounting hole (preferred)
- H2 and H3 = Alternative mounting holes (non-preferred)
- L = LED set-up illumination
- ML = Measuring length
- S = Start of measuring length
- X = Machine guideway/axis datum

Mounting orientations

Dimensions and tolerances in mm



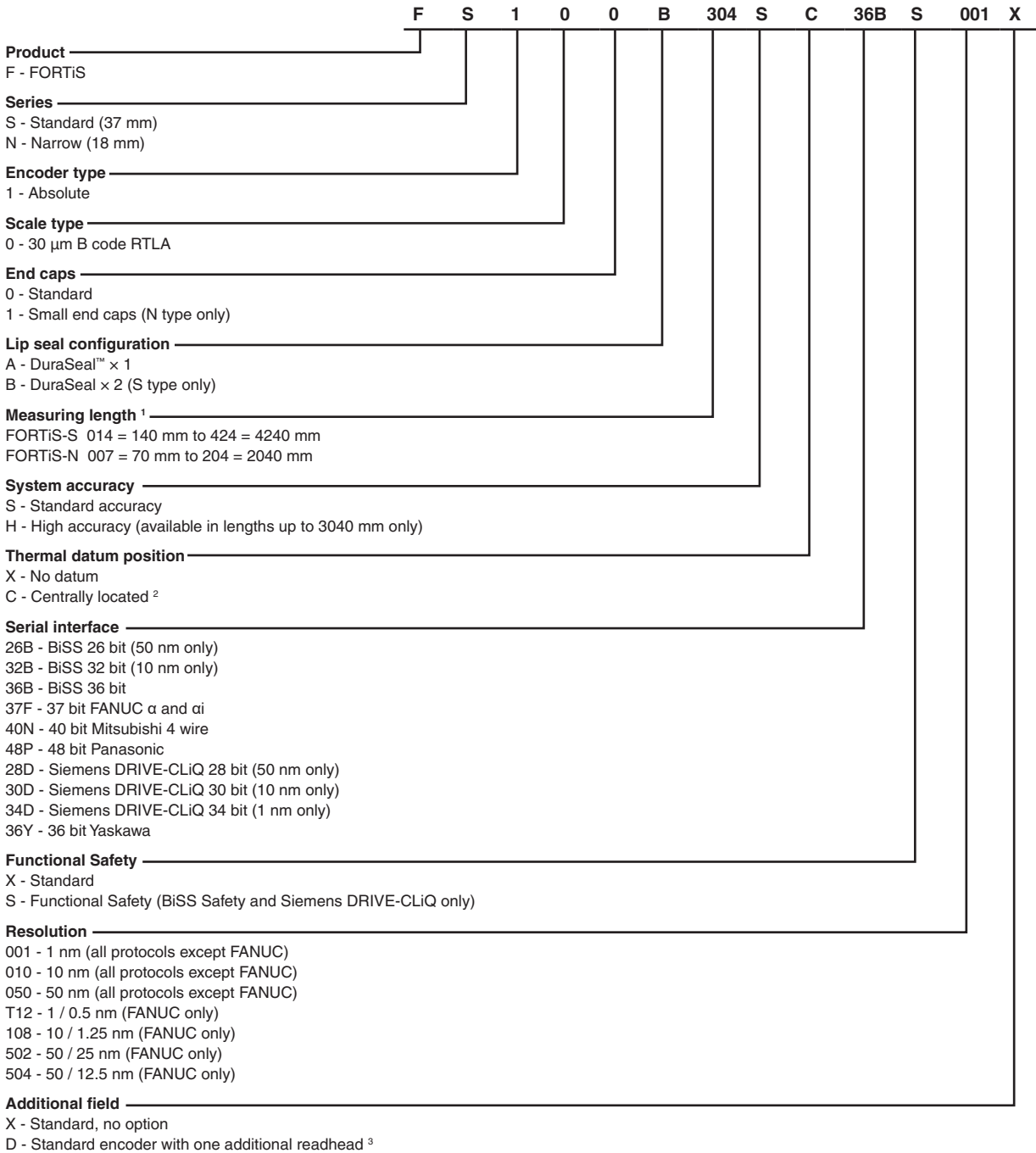
KEY

- D = Required mounting dimensions
- X = Machine guideway/axis datum

NOTES:

1. Side elevations show alternative mounting orientations.
2. Screws sizes in brackets are permissible alternatives.

Nomenclature






¹ For all permissible measuring length options refer to specification table.

² For other datum requirements contact your local Renishaw representative.

³ For further information see the manual *FORTiS-S FS enclosed encoder system with multiple readheads* (Renishaw part no. L-6725-9188).

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