SAFETY SYMBOLS

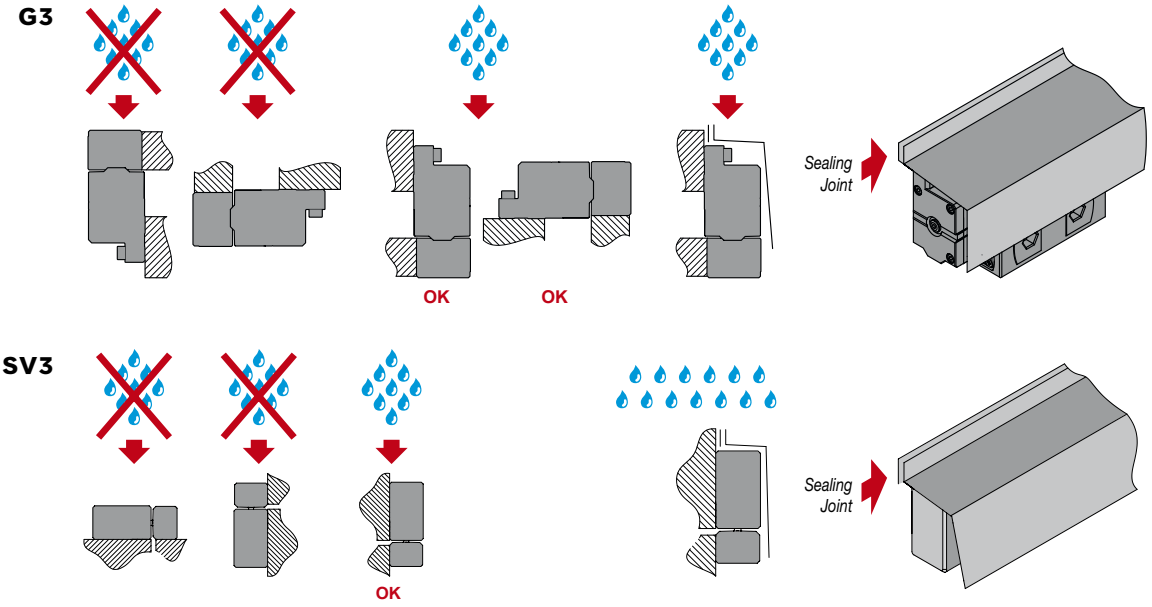
SYMBOLS THAT MAY APPEAR IN THIS CATALOG

WARNING or caution symbol.
It warns about a potentially dangerous situation. Ignoring this warning may cause serious injuries (even fatal) or damages to the unit.

MANDATORY symbol.
It warns about actions and operations that MUST BE carried out. THEY ARE NOT RECOMMENDATIONS. Ignoring this warning may mean non-compliance of some safety regulation.

Mounting

In the application, the encoder must be protected against solids and liquids ingress. Do not orient the sealing lips against pollution sources. See other protection considerations in the Protection section.



Mechanical fault exclusion for the fixation to the machine

In a safety application the fault of loosening or losing of attachment of the encoder readhead and the encoder profile to the machine must be eliminated because it cannot be guaranteed that these faults will be detected by the control. For this reason the mounting instructions in the mounting manual must be strictly followed and an adhesive screw lock (medium strength adhesive) must be used for the screws to fix the encoder readhead and the encoder profile to the machine. Also, the specified maximum acceleration and vibration must not be exceeded for the encoder readhead and for the encoder profile.

Thermal fixed point - Thermal expansion

The error in position due to thermal expansion is not included in the Safe Position Tolerance and must be taken into account for a safety related application. The graduated pattern substrate is made of glass with α_{therm}: 8 ppm/K aprox.

For the G3 and SV3 scale

The system for fixation of the scale profile to the machine is designed so that the thermal fix point used in the profile or spar determines which point of the graduated scale is fixed. At a temperature different from 20ºC the rest of the scale suffers line thermal expansion (or contraction) in the measurement lenght. The expansion or contraction is that of the glass scale inside the scale profile (and is not dependant on the expansion coefficient of the machine material). Thermal expansion or contraction of the graduated scale leads to an error in position.

For the S3 scale

The scale profile is fixed to the machine at both ends. At a temperature different from 20ºC the scale suffers line thermal expansion (or contraction) in the measurement length that leads to an error in position that depends on the construction of the machine.

For the readhead

Additional error due to thermal expansion of the part of the machine where the readhead of the encoder is fixed is dependant on the thermal expansion coefficient of the material of the machine and could lead to further position error.

The specific application must account for the corresponding position error related to thermal displacement of the readhead and whether it might lead to a dangerous error or not.

Replaceable parts

The encoders have a service life of 20 years. Maintenance is not required. However, several components may suffer from wear or degradation depending on the application.

In particular, due to the wide range of chemical compositions of lubricant and coolant fluids available, it cannot be ensured that the sealing lips will not lose performance. For this reason the sealing lips must be replaced when inspection shows wear or degradation.

The following components must be replaced when inspection shows wear or degradation:
- cables with frequent flexing
- sealing lips

Fault reaction time

The fault reaction time for the encoder system is the time elapsed from the occurrence of a fault in the encoder and the corresponding reaction takes place in the control Unit.
It can be calculated as:
- Time to communicate the fault to the Control Unit + Time needed for the Control Unit to react.
- Time to communicate the fault to the Control Unit ≤ 2 * The DRIVE-CLiQ® cycle time used to operate the encoder.
- Time needed for the Control Unit to react: This is competence of the builder of the Control Unit or the machine.

The overall fault reaction time for the encoder system may be suitable or not depending on the application or safety concept of the overall machine.

Installation manual

There is important information in the installation manual to ensure the correct installation of the encoder.
- Installation manual: LINEAR ENCODER MODEL G3BD-FS: 14460305
- Installation manual: LINEAR ENCODER MODEL S3BD-FS: 14460331
- Installation manual: LINEAR ENCODER MODEL SV3BD-FS: 14460332
- Installation manual: SPAR FOR LINEAR ENCODER SV3: B3 14460319

Startup time

The encoder is ready to answer to DRIVE-CLiQ® requests 2s after power supply of the encoder.

Electrical Safety

The power supply must be SELV (Safety Extra Low Voltage) or PELV (Protective Extra Low Voltage).

System Test

The encoder is a component for integration in a larger system. The specifications in this catalog only apply to the specific encoder, not to the whole system. Installation or operation of the encoder outside of the specified conditions is at the user's own risk.
Comprehensive tests of the whole system must be carried out in order to ensure that the encoder works in the range of specified conditions. In particular, **vibration** conditions depend on the whole system, so the whole system must be tested to ensure operation within the limits specified for vibration.

Site Acceptance Test

The Site Acceptance Test is mandatory in order to guarantee the safety capability of the installed encoder system. The following points must be additionally checked in order to pass the Site Acceptance Test:
- The encoder serial number displayed in the Control Unit matches the serial number printed in the encoder label.
- The encoder resolution parameter shown in the Control Unit matches the values in the encoder label.

Safety symbols

Safety functions

The safety functions of the encoder are:

– **Safe Absolute Position:** The encoder always provides a safe absolute position value. This means that the encoder always provides an absolute value for the position that is correct within the safe position tolerance when the error bits are not set.

– **Safe Communication:** The encoder communicates two independently generated position values and error bits.

This allows a wide range of safety functions to be implemented in the control.

Functional Safety

Safety Capability

The encoder system with Functional Safety has the following characteristics related to the safety according to ISO13849-1:2015 and IEC61508:2010 norms.

Safety Capability according ISO 13849-1: 2015 and IEC61508: 2010

	EC-PA-DQS + G3BD-FS **EC-PA-DQS + S(V)3BD-FS**
MTTFd (years) (2000 m above sea level)	66.75 years
DC (%)	99
Category	3
Performance level, PL	d
PFH (2000 m above sea level)	$19{,}48 \cdot 10^{-9}$
Safe Position Tolerance	+1738 µm, -210 µm (safety-related measuring step 200 µm)
For applications up to	SIL 2

The encoder system also complies with IEC61800-5-2:2017

Protection

Enclosed **linear encoders** meet the protection requirements IP 53 of the **IEC 60529** standard when mounted so water splashes don't hit the sealing lips directly. For further protection, a separate protection guard must be mounted.

If the encoder is exposed to liquids and vapor, compressed air has to be used to achieve a protection degree of IP 64 and prevent any contamination from getting inside. For these cases, Fagor Automation recommends their Air Filter unit AI-1000.

The **quality of air** supplied to the encoder must be 1/4/1 according to **ISO 8573-1**:2010. To achieve this air class, the air supplied to the AI-1000 unit must fulfil class 5/6/4 according to ISO 8573-1:2010.

For more information see the AI-1000 catalog and manual.

Safety switch

In order to guarantee the air flux it is necessary to install a **safety switch** capable of activating an alarm when the pressure gets below 60 % of the nominal pressure.

G3B series

Linear encoder with small reader head, air purge and connector at both ends, with threaded head for different mounting options without the need for nuts.

Its special mechanical extrusion design, protective lips and securing points on the linear encoder, the high quality optical components and powerful FPGA-based electronics using advanced embedded algorithms allow for the reduction of errors to ensure the accuracy and repeatability of linear encoders.

This results in linear encoders especially suited for hostile work environments in settings requiring high speed and vibration standards.

Measuring lengths in millimeters

140 • 240 • 340 • 440 • 540 • 640 • 740 • 840 • 940 • 1 040 • 1 140 • 1 240 • 1 340 • 1 440 • 1 540 • 1 640 • 1 740 • 1 840 • 2 040 • 2 240 • 2 440 • 2 640 • 2 840 • 3 040

Model description:

G3B: Absolute linear encoders with SSI protocol for FAGOR and others.
G3BS: Absolute linear encoders with SSI protocol for SIEMENS® (Solution Line).
G3BF: Absolute linear encoders with FANUC® (α and αi) protocol.
G3BM: Absolute linear encoders with MITSUBISHI® CNC protocol.
G3BP: Absolute linear encoders with PANASONIC® (Matsushita) protocol.
G3BD + EC-PA-DQ1-M: Absolute linear encoders with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One).
G3BD-FS + EC-PA-DQS-M: Absolute linear encoders with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One) with Functional Safety.
G3BD: Absolute linear encoders with FeeDat® protocol for FAGOR and others.
G3BBC: Absolute linear encoders with BiSS® C protocol.

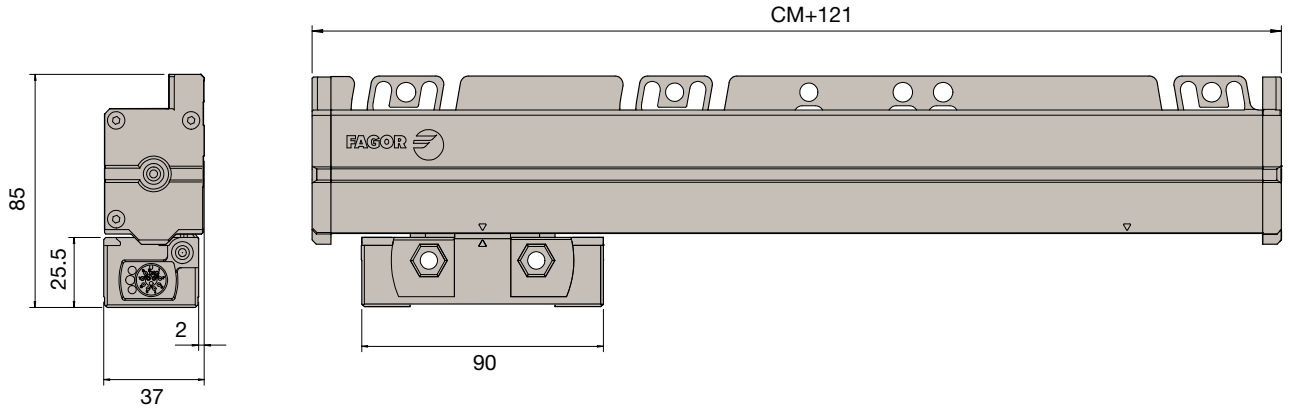
Characteristics

	G3B / G3BS	G3BF	G3BM / G3BP / G3BD+ EC-PA-DQ1-M	G3BD-FS+ EC-PA-DQS-M	G3BD	G3BBC
Measurement	**Incremental:** By means of a 20 µm-pitch graduated glass **Absolute:** Optical reading of sequential binary code					
Glass thermal expansion coefficient	α_{therm}: 8 ppm/K aprox.					
Measuring resolution	0.1 µm	Interface α: 0,05 µm / 0.01 µm Interface αi: 0.0125 µm / 0.00125 µm	0.001 µm / 0.01 µm	0.01 µm / 0.05 µm	0.001 µm / 0.01 µm	0.001 µm / 0.01 µm
Output signals	~ 1 Vpp	–	–	–	–	(**)
Incremental signal period	20 µm	–	–	–	–	–
Limit frequency	< 150 kHz for 1 Vpp	–	–	–	–	–
Maximum cable length	75 m (*) / 100 m	30 m	30 m	30 m	100 m	(***)
Supply voltage	5V ± 10 %, < 250 mA (without load)					
Accuracy	± 5 µm/m ± 3 µm/m					
Maximum speed	180 m/min					
Maximum vibration	300 m/s² (55 ... 2000 Hz) IEC 60068-2-6 / 200 m/s² [for **G3BD-FS** model]					
Maximum shock	300 m/s² (11 ms) IEC 60068-2-27					
Maximum acceleration	100 m/s² in the measuring direction					
Required moving force	< 5 N					
Operating temperature	0 °C ... 50 °C					
Storage temperature	-20 °C ... 70 °C					
Weight	0.25 kg + 2.25 kg/m					
Relative humidity	20 ... 80 %					
Protection	IP 53 (standard) IP 64 (DIN 40050) using pressurized air at 0.8 ± 0.2 bar in linear encoders					
Reader head	With built-in connector Connection at both ends of the reader head					

(*) Contact Fagor Automation for other lengths.
(**) Consult Fagor Automation for analog output signals.
(***) Contact Fagor Automation for maximum cable length.

G3B model

Dimensions in mm



Additional information can be found in the technical documentation and installation manual available on the website ***www.fagorautomation.com***

Order identification

Example of Linear Encoder: G3BD10-1640-5-T-FS

G3	B	D	10	1640	5	T	FS
Type of profile for ample space, small head	***Letter identifying the absolute encoder***	***Type of communications protocol (1):*** • Blank space: SSI protocol (FAGOR) • **D: FeeDat® protocol (FAGOR) (*)** • S: SSI SIEMENS® (SL) protocol • F: FANUC® (α and αi) protocol • M: MITSUBISHI® CNC protocol • P: PANASONIC® (Matsushita) protocol • BC: BiSS® C protocol	***Resolution (2):*** • Blank space: up to 0.1 µm (**) • 01: 0.001 µm • 50: 0.05 µm • **10: 0.01 µm**	***Measuring lengths in millimeters:*** In the example (1640) = 1 640 mm	***Accuracy of the linear encoder:*** • **5: ± 5 µm** • 3: ± 3 µm	***Threaded head:*** • Blank space: M8 • **T: M6**	***Safety:*** • Blank space: No • **FS: Functional Safety** (***)

(1): contact Fagor Automation for availability.

(2): not all combinations of protocol and resolution are possible.
The characteristics table indicates the resolutions available for each protocol.

(*) plus EC-PA-DQ1-M with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One).

(**) only for SSI models.

(***) only for G3BD + EC-PA-DQS-M with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One) with Functional Safety.

S3B series

Linear encoder with small reader head, with threaded head for different mounting options without the need for nuts.

The linear encoder special mechanical extrusion design, protective lips and end caps, its high quality optical components and powerful FPGA-based electronics using advanced embedded algorithms allow for the reduction of errors to ensure accuracy and repeatability for the linear encoders.

This results in linear encoders especially suited for hostile work environments in settings requiring high speed and vibration standards.

Measuring lengths in millimeters

70 • 120 • 170 • 220 • 270 • 320 • 370 • 420 • 470 • 520 • 570 • 620 • 670 • 720 • 770 • 820 • 870 • 920 • 1 020 • 1 140 • 1 240

Model description:

S3B: Absolute linear encoders with SSI protocol for FAGOR and others.
S3BS: Absolute linear encoders with SSI protocol for SIEMENS® (Solution Line).
S3BF: Absolute linear encoders with FANUC® (α and αi) protocol.
S3BM: Absolute linear encoders with MITSUBISHI® CNC protocol.
S3BP: Absolute linear encoders with PANASONIC® (Matsushita) protocol.
S3BD + EC-PA-DQ1-M: Absolute linear encoders with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One).
S3BD-FS + EC-PA-DQS-M: Absolute linear encoders with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One) with Functional Safety.
S3BD: Absolute linear encoders with FeeDat® protocol for FAGOR and others.
S3BBC: Absolute linear encoders with BiSS® C protocol.

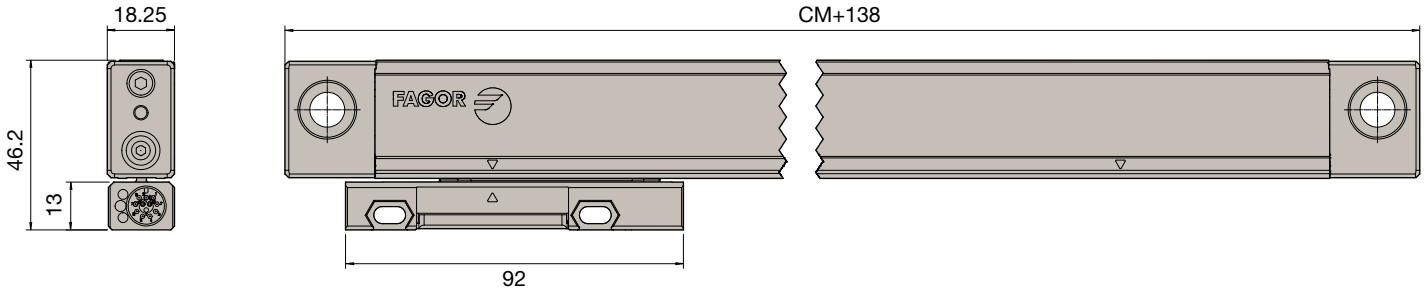
Characteristics

	S3B / S3BS	S3BF	S3BM / S3BP / S3BD+ EC-PA-DQ1	S3BD-FS+ EC-PA-DQS-M	S3BD	S3BBC
Measurement	**Incremental:** By means of a 20 µm-pitch graduated glass **Absolute:** Optical reading of sequential binary code					
Glass thermal expansion coefficient	α_{therm}: 8 ppm/K aprox.					
Measuring resolution	0.1 µm	Interface α: 0.05 µm / 0.01 µm Interface αi: 0.0125 µm / 0.00125 µm	0.001 µm / 0.01 µm	0.01 µm / 0.05 µm	0.001 µm / 0.01 µm	0.001 µm / 0.01 µm
Output signals	~ 1 Vpp	–	–	–	–	(**)
Incremental signal period	20 µm	–	–	–	–	–
Limit frequency	< 150 kHz for 1 Vpp	–	–	–	–	–
Maximum cable length	75 m (*) / 100 m	30 m	30 m	30 m	100 m	(***)
Supply voltage	5V ± 10 %, < 250 mA (without load)					
Accuracy	± 5 µm/m ± 3 µm/m					
Maximum speed	180 m/min					
Maximum vibration	Profile: 100 m/s² (55 ... 2000 Hz) IEC 60068-2-6 Reader head: 200 m/s² (55 ... 2000 Hz) IEC 60068-2-6					
Maximum shock	300 m/s² (11 ms) IEC 60068-2-27					
Maximum acceleration	100 m/s² in the measuring direction					
Required moving force	< 4 N					
Operating temperature	0 °C ... 50 °C					
Storage temperature	-20 °C ... 70 °C					
Weight	0.2 kg + 0.50 kg/m					
Relative humidity	20 ... 80 %					
Protection	IP 53 (standard) IP 64 (DIN 40050) using pressurized air at 0.8 ± 0.2 bar in linear encoders					
Reader head	With built-in connector					

(*) Contact Fagor Automation for other lengths.
(**) Consult Fagor Automation for analog output signals.
(***) Contact Fagor Automation for maximum cable length.

S3B model

Dimensions in mm



Additional information can be found in the technical documentation and installation manual available on the website ***www.fagorautomation.com***

Order identification

Example of Linear Encoder: S3BD10-1140-5-T-FS

S3	B	D	10	1140	5	T	FS
Type of profile for reduced space: • **S3: Standard mounting for vibrations of up to 100 m/s²**	***Letter identifying the absolute encoder***	***Type of communications protocol (1):*** • Blank space: SSI protocol (FAGOR) • **D: FeeDat® protocol (FAGOR) (*)** • S: SSI SIEMENS® (SL) protocol • F: FANUC® (α and αi) protocol • M: MITSUBISHI® CNC protocol • P: PANASONIC® (Matsushita) protocol • BC: BiSS® C protocol	***Resolution (2):*** • Blank space: up to 0.1 µm (**) • 01: 0.001 µm • 50: 0.05 µm • **10: 0.01 µm**	***Measuring lengths in millimeters:*** In the example (1140) = 1 140 mm	***Accuracy of the linear encoder:*** • **5: ± 5 µm** • 3: ± 3 µm	***Threaded head:*** • Blank space: No • **T: M4**	***Safety:*** • Blank space: No • **FS: Functional Safety** (***)

(1): contact Fagor Automation for availability.

(2): not all combinations of protocol and resolution are possible.
The characteristics table indicates the resolutions available for each protocol.

(*) plus EC-PA-DQ1-M with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One).

(**) only for SSI models.

(***) only for S3BD + EC-PA-DQS-M with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One) with Functional Safety.

SV3B series

Linear encoder with small reader head, with threaded head for different mounting options without the need for nuts.

The linear encoder special mechanical extrusion design, protective lips and end caps, its high quality optical components and powerful FPGA-based electronics using advanced embedded algorithms allow for the reduction of errors to ensure accuracy and repeatability for the linear encoders.

The mounting spar has small dimensions and also a particular design of the fixing points. To ease the installation top or bottom alternatives are provided to secure the encoder.

This results in linear encoders especially suited for hostile work environments in settings requiring high speed and vibration standards.

Measuring lengths in millimeters

70 • 120 • 170 • 220 • 270 • 320 • 370 • 420 • 470 • 520 • 570 • 620 • 670 • 720 • 770 • 820 • 870 • 920 • 970 • 1.020 • 1.070 • 1.140 • 1.240 • 1.340 • 1.440 • 1.540 • 1.640 • 1.740 • 1.840 • 2.040

Model description:

SV3B: Absolute linear encoders with SSI protocol for FAGOR and others.

SV3BS: Absolute linear encoders with SSI protocol for SIEMENS® (Solution Line).

SV3BF: Absolute linear encoders with FANUC® (α and αi) protocol.

SV3BM: Absolute linear encoders with MITSUBISHI® CNC protocol.

SV3BP: Absolute linear encoders with PANASONIC® (Matsushita) protocol.

SV3BD + EC-PA-DQ1-M: Absolute linear encoders with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One).

SV3BD-FS + EC-PA-DQS-M: bsolute linear encoders with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One) with Functional Safety.

SV3BD: Absolute linear encoders with FeeDat® protocol for FAGOR and others.

SV3BBC: Absolute linear encoders with BiSS® C protocol.

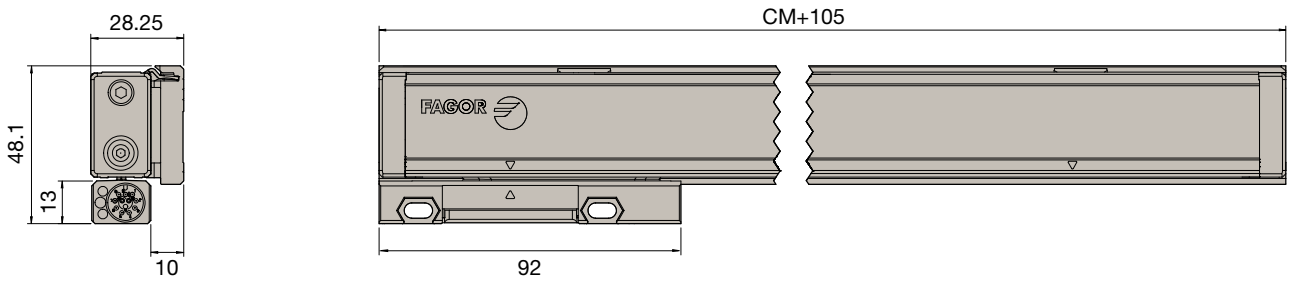
Characteristics

	SV3B / SV3BS	SV3BF	SV3BM / SV3BP / SV3BD+ EC-PA-DQ1	SV3BD-FS+ EC-PA-DQS-M	SV3BD	SV3BBC
Measurement	**Incremental:** By means of a 20 µm-pitch graduated glass **Absolute:** Optical reading of sequential binary code					
Glass thermal expansion coefficient	α_{therm}: 8 ppm/K aprox.					
Measuring resolution	0.1 µm	Interface α: 0.05 µm / 0.01 µm Interface αi: 0.0125 µm / 0.00125 µm	0.001 µm / 0.01 µm	0.01 µm / 0.05 µm	0.001 µm / 0.01 µm	0.001 µm / 0.01 µm
Output signals	~ 1 Vpp	–	–	–	–	(**)
Incremental signal period	20 µm	–	–	–	–	–
Limit frequency	< 150 kHz for 1 Vpp	–	–	–	–	–
Maximum cable length	75 m (*) / 100 m	30 m	30 m	30 m	100 m	(***)
Supply voltage	5V ± 10 %, < 250 mA (without load)					
Accuracy	± 5 µm/m ± 3 µm/m					
Maximum speed	180 m/min					
Maximum vibration	Reader head: 200 m/s² (55 ... 2000 Hz) IEC 60068-2-6 Housing with mounting support and cable outlet right 150 m/s²; or left 100 m/s² (55 ... 2000 Hz) IEC 60068-2-6					
Maximum shock	300 m/s² (11 ms) IEC 60068-2-27					
Maximum acceleration	100 m/s² in the measuring direction / 60 m/s² [for **SV3BD-FS** model]					
Required moving force	< 4 N					
Operating temperature	0 °C ... 50 °C					
Storage temperature	-20 °C ... 70 °C					
Weight	0.25 kg + 1.55 kg/m					
Relative humidity	20 ... 80 %					
Protection	IP 53 (standard) IP 64 (DIN 40050) using pressurized air at 0.8 ± 0.2 bar in linear encoders					
Reader head	With built-in connector					

(*) Contact Fagor Automation for other lengths.
(**) Consult Fagor Automation for analog output signals.
(***) Contact Fagor Automation for maximum cable length.

SV3B model

Dimensions in mm



Additional information can be found in the technical documentation and installation manual available on the website ***www.fagorautomation.com***

Order identification

Example of Linear Encoder: SV3BF10-320-3-T + B3-320

SV3	B	F	10	320	3	T	FS
Type of profile for reduced space and securing to the mounting spar	***Letter identifying the absolute encoder***	***Type of communications protocol (1):*** • Blank space: SSI protocol (FAGOR) • D: FeeDat® protocol (FAGOR) (*) • S: SSI SIEMENS® (SL) protocol • **F: FANUC® (α and αi) protocol** • M: MITSUBISHI® CNC protocol • P: PANASONIC® (Matsushita) protocol • BC: BiSS® C protocol	***Resolution (2):*** • Blank space: up to 0.1 µm (**) • 01: 0.001 µm • 50: 0.05 µm • **10: 0.01 µm**	***Measuring lengths in millimeters:*** In the example (320) = 320 mm	***Accuracy of the linear encoder:*** • 5: ± 5 µm • **3: ± 3 µm**	***Threaded head:*** • Blank space: No • **T: M4**	***Safety:*** • **Blank space: No** • FS: Functional Safety (***)

(1): contact Fagor Automation for availability.

(2): not all combinations of protocol and resolution are possible. The characteristics table indicates the resolutions available for each protocol.

(*) plus EC-PA-DQ1-M with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One).

(**) only for SSI models.

(***) only SV3BD + EC-PA-DQS-M with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One) with Functional Safety.

Example Spar: B3-320

B3	320
Mounting spar	***Measuring length of the linear encoder in milimeters:*** In the example (320) = 320 mm