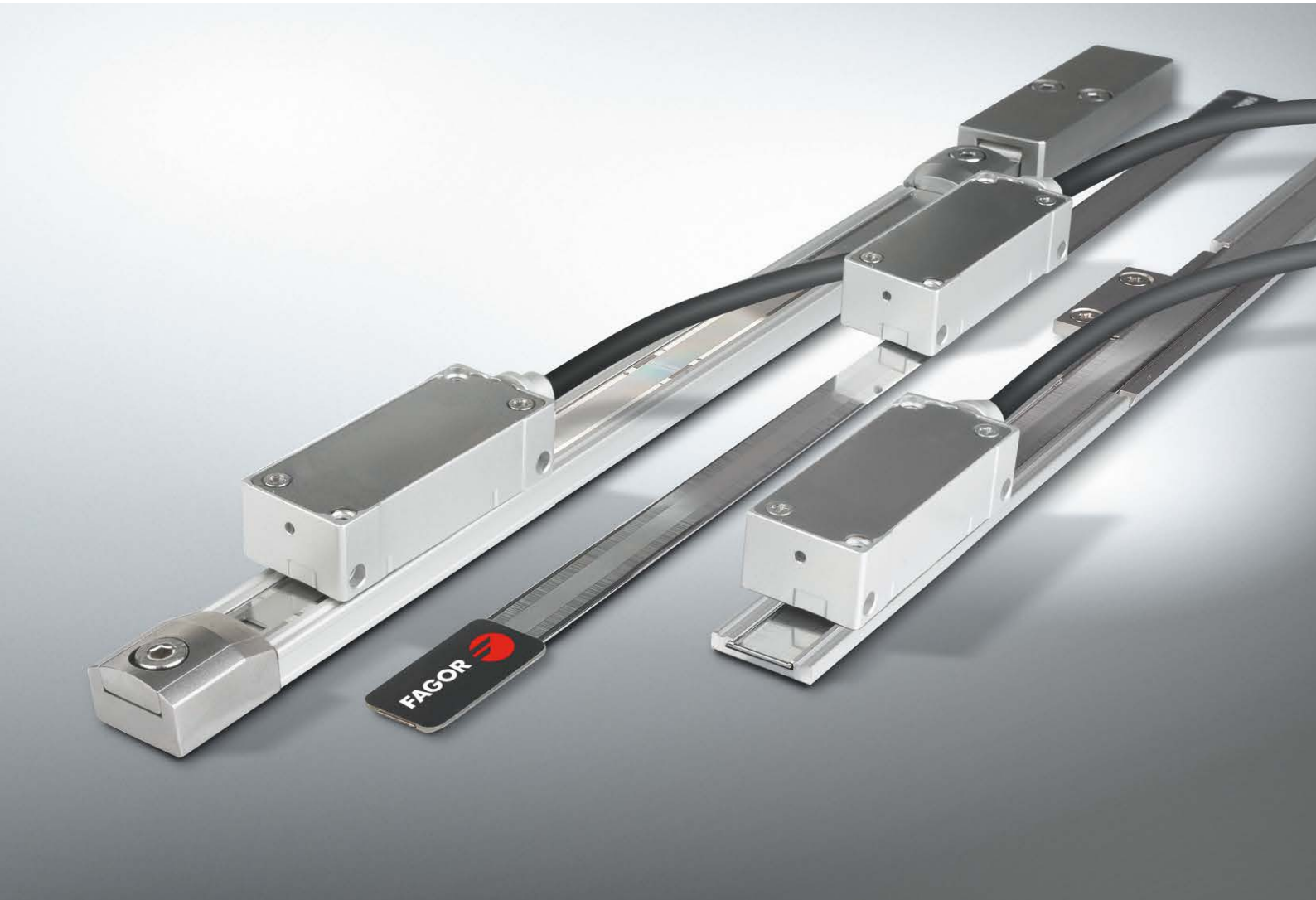
Non-contact open

LINEAR ENCODERS

FAGOR AUTOMATION

Open to your world



NON-CONTACT OPEN LINEAR
ENCODERS

OVER 40 YEARS OF CONTINUOUS EVOLUTION

Fagor Automation has been manufacturing high quality angular and rotary encoders using precision optical technology for more than 40 years.

Over the years Fagor has created, developed and patented systems, components and technologies that allow us to offer best quality and features over the complete range of product utilizing innovative production methods.

Hence making Fagor Automation the most efficient alternative in the world of feedback systems.

MODERN FACILITIES AND INNOVATIVE PROCESSES

In order to ensure quality and reliability in all its products Fagor Automation utilizes the most advanced technology and testing and manufacturing facilities. From centralized computer control temperature monitoring, cleanliness and relative humidity control, a must for the feedback system manufacturing process, to laboratories for climate, vibration and EMC testing to certify the designs.

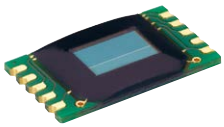
WITH STATE-OF-THE-ART TECHNOLOGY

Fagor Automation's commitment to this technology and quality is evident by creation of **Aotek** in 2002, a dedicated research center providing various technological breakthroughs. This investment has resulted in large number of patents and customized solutions in electrical, optical and mechanical fields.

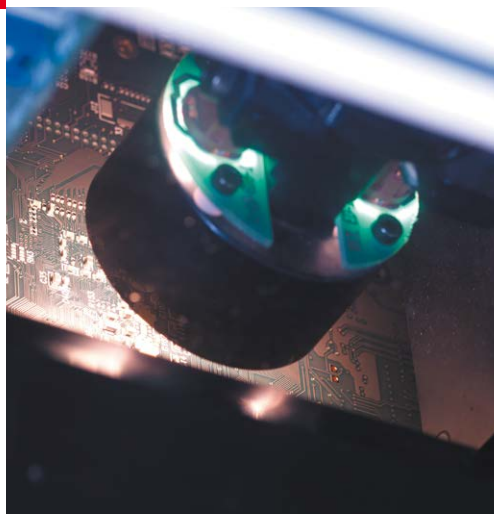
PATENTED BY FAGOR

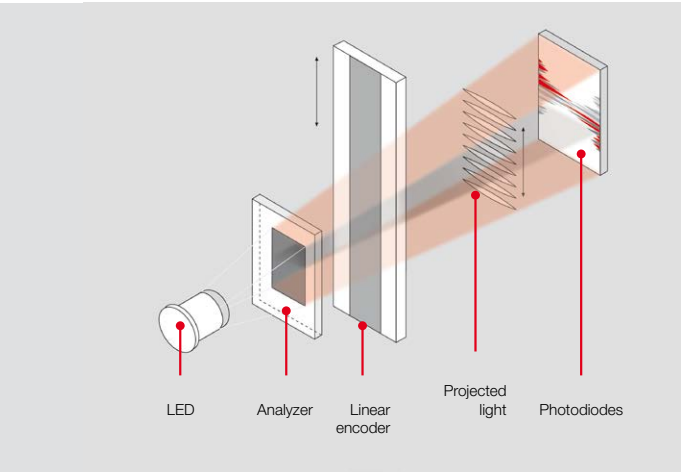
SIR reference marks

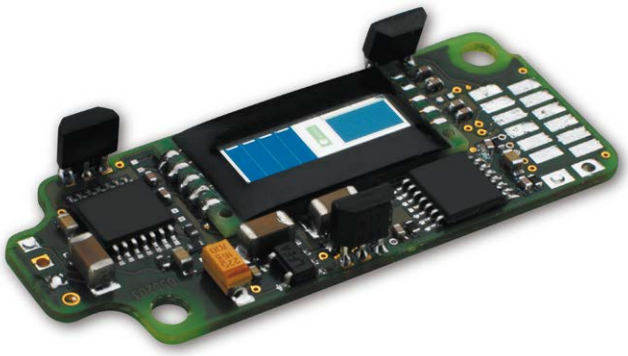
PATENTED BY FAGOR



Single-window scanning







SUPERIOR TECHNOLOGY AND INNOVATIVE DESIGN

Fagor Automation develops with maximum professionalism the three cornerstones in encoder design: optical design, electronic design and mechanical design that result in a state-of-the-art product.

Optical design

In the vanguard of measuring technology, Fagor Automation uses transmission and reflective optics in its range of encoders.
With new scanning techniques, such as the new single-window scanning technology , more immune to contamination, which is critical for operations in extreme conditions, and contributes to attaining high quality signals that minimize interpolation errors, resulting in improved accuracy of the measurement system.

Electronic design

Fagor Automation uses latest generation integrated electronic components in their design. Owing to that, the optimization of the signals at high traversing speeds is achieved, with micrometric accuracy and nanometric resolution.

Mechanical design

Fagor Automation designs and manufactures the most innovative and reliable measuring systems using its advanced mechanical designs. These designs, together with the materials used contribute to the required product robustness to ensure the best performance in their different applications.

ABSOLUTE

INCREMENTAL

Technology

The absolute measurement system is a direct digital measure of machine position. It is fast, accurate and does not require homing of the machine. The position value is available from the moment the machine is turned on and may be requested by the connected device (CNC) at any time.

The absolute encoders provide direct measure of machine position without using any intermediate device.
The positioning errors originating from machine mechanics are minimized as the encoder is directly mounted to the machine surface and the guide ways. Some of the potential sources of such errors in a machine tool such as lead screw pitch, certain amount of backlash and thermal behavior can be minimized using these encoders.

The open design allows transmitting the machine movement and reading its position accurately and without contact; therefore without friction between the reader head and the graduated scale. All the electronics, including interpolation, is integrated into the reader head. The technology used provides a robust and compact solution with high accuracy and resolution at high speed.

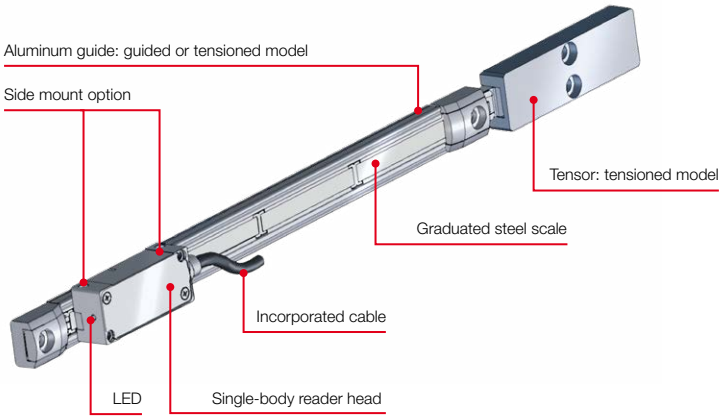
Linear Encoders

Fagor's non-contact open absolute linear encoders use the auto imaging principle which uses diffuse light reflected from the graduated steel tape. The reading system consists of an LED, as the light source of the linear encoder; a reticule that makes the image and a monolithic photo detector element in the plane of the image especially designed and patented by Fagor Automation.

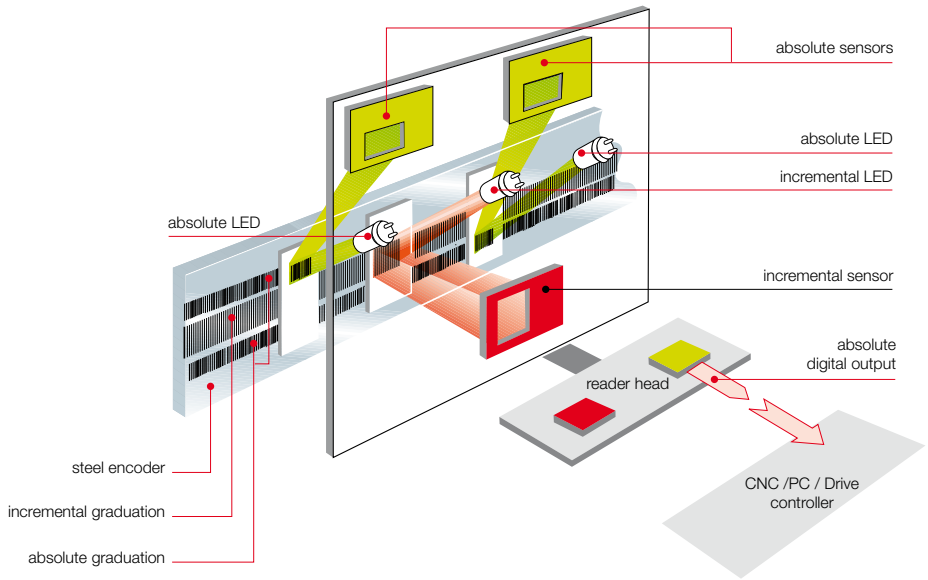
The measuring method has two different etchings:

- **Incremental graduation:** Used to generate incremental signals that are counted inside the reader head.
- **Absolute graduation:** It is a binary code with a special sequence that avoids repetition all along the measuring length of the encoder.

On Fagor absolute encoders, the absolute position is calculated using the data of that code read by means of a high precision optical sensor.



Graduated steel encoder



ELECTRICAL OUTPUT
SIGNALS

They are defined according to the communication protocol. Protocols are specific communication languages used by linear or angular encoders to communicate with the machine controller (CNC, drive, PLC, etc.).

There are different communication protocols depending on the CNC manufacturer: FAGOR, FANUC®, MITSUBISHI®, SIEMENS®, PANASONIC® and others.

PANASONIC® systems
A5 series

PANASONIC® systems
Serial Communication

These systems only use digital signals. These systems only use digital signals. The absolute encoder is connected through the MINAS series drive.

- The systems can be connected to linear motors, rotary motors and DD motors.
- Automatic drive/motor matching software available.
- Vibration, resonance suppression filters available with setting done automatically / manually.
- Drive range from 50 W to 15 kW at AC 100 V / 200 V / 400 V.
- Safety Torque Off feature available.

MITSUBISHI® systems
High Speed Serial Interface - HSSI

These systems only use digital signals. The absolute encoder is connected through the MDS or MR-J4 Series drives and it is valid for MITSUBISHI® communication protocol versions Mit 03-2/4.

YASKAWA® Systems
Linear Encoder Serial Communication Interface

These systems only use digital signals. The absolute encoder is connected through the Sigma 5 and Sigma 7 series drive.

Systems with Serial Synchronous Interface - SSI

These systems only use digital signals. The absolute encoder is connected through the drive or system with SSI interface, only for digital signals.

Please contact FAGOR for information on compatibility of the encoders with these systems.

Systems with BiSS® interface
Fast Serial Interface for sensors

These systems only use digital signals. The absolute encoder with BiSS® C BP3 protocol is compatible with BiSS® C Unidirectional.

The absolute encoder is connected to the drive or system with BiSS® C BP3 or BiSS® C unidirectional interface. Please contact FAGOR for information on compatibility of the encoders with these systems.

Other systems

Please contact FAGOR for information on compatibility of the encoders with other systems.

Range

Analyze the application to make sure that the proper encoder will be selected for the machine.

To do this, bear in mind the following considerations:

Installation

Consider the physical length of the installation and the space available for it.

These aspects are crucial to determine the type of linear encoder to use.

Mechanical Design:

EXA: adhesive model with the smallest cross section for constraint spaces, it consists of an engraved steel tape glued directly onto the machine surface, recommended if the tape is under thermally stable conditions.

EXG: guided model for long measuring lengths it comprises an aluminium extrusion glued to the surface and an engraved steel tape. The steel tape is guided in the extrusion and secured in the mid point to the machine surface that allows the tape to expand/contract freely at its ends and ensures a defined thermal behaviour.

EXT: tensioned model for very long measuring lengths and high accuracy it comprises an aluminium extrusion glued or screwed to the surface, an engraved steel tape and tensioning system. The steel tape is guided in the extrusion and tensioned between its ends. The tensioned steel tape is fixed on the machine base so it replicates the thermal behaviour of the surface.

Accuracy

Each linear encoder is subjected to quality control showing its accuracy along its measuring length.

Signal

The signal selection considers the communication protocols compatible with the main CNC and drives manufacturers.

Resolution

The resolution of the control of machine depends on the linear encoder.

Cable length

The length of the cable depends on the type of signal.

Compatibility

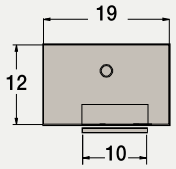
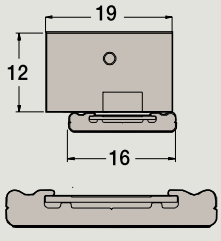
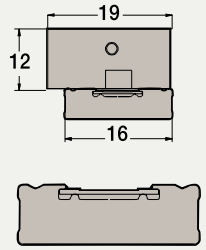
The signal must be compatible with the control system.

Speed

The speed requirements for the application must be analyzed before choosing the linear encoder.

Shock and Vibration

Fagor linear encoders withstand vibrations of up to 200 m/s^2 and shocks of up to 1000 m/s^2.

Series	Section
Absolute **EXA** Adhesive	
Absolute **EXG** Guided	
Absolute **EXT** Tensioned	

	Measuring lengths	Accuracy	Signals	Pitch Resolution up to	Model
	70 mm up to 3 020 mm (*)	± 10 µm/m	SSI	0.01 µm	TAA + L2A
			PANASONIC®	0.01 µm	TAA + L2AP
			MITSUBISHI®	0.01 µm	TAA + L2AM / L2AMH
			BiSS®	0.01 µm	TAA + L2ABC
			FAGOR	0.01 µm	TAA+L2AD
			SIEMENS® (*)	0.01 µm	TAA+L2AD + XC-C8-PA-DQ-M
			YASKAWA®	0.009765625 µm	TAA + L2AK
	240 mm up to 3 040 mm (*)	± 10 µm/m	SSI	0.01 µm	PG+TGA + L2A
			PANASONIC®	0.01 µm	PG+TGA + L2AP
			MITSUBISHI®	0.01 µm	PG+TGA + L2AM / L2AMH
			FAGOR	0.01 µm	PG+TGA+L2AD
			SIEMENS® (*)	0.01 µm	PG+TGA+L2AD + XC-C8-PA-DQ-M
			BiSS®	0.01 µm	PG+TGA + L2ABC
			YASKAWA®	0.009765625 µm	PG+TGA + L2AK
	140 mm up to 3 040 mm (*)	± 5 µm/m	SSI	0.01 µm	PT + TTA + L2A
			PANASONIC®	0.01 µm	PT + TTA + L2AP
			MITSUBISHI®	0.01 µm	PT + TTA + L2AM / L2AMH
			FAGOR	0.01 µm	PT+TTA+L2AD
			SIEMENS® (*)	0.01 µm	PT+TTA+L2AD + XC-C8-PA-DQ-M
			BiSS®	0.01 µm	PT + TTA + L2ABC
			YASKAWA®	0.009765625 µm	PT + TTA + L2AK

(*) contact Fagor Automation for other lengths.

EXA series ADHESIVE

Non-contact open linear encoder for high accuracy, high speed applications.

It consists of a compact reader head with all the electronics and optics integrated into a single body that may be mounted from the side or from the top.

It has an LED to help mounting it and includes a 1 or 3 meter cable with a connector, a 10 mm wide adhesive reflective stainless steel tape that is highly resistant to solvents.

Measuring lengths in millimeters:

Available from 70 mm to 3,020 mm in 50 mm (*) increments.

Model description:

TAA + L2A: non-contact open linear encoder with a reader head that uses SSI protocol and an adhesive absolute tape.

TAA + L2AM: non-contact open linear encoder with a reader head that uses MITSUBISHI® CNC full duplex protocol and an adhesive absolute tape.

TAA + L2AMH: non-contact open linear encoder with a reader head that uses MITSUBISHI® CNC half duplex protocol and an adhesive absolute tape.

TAA + L2AP: non-contact open linear encoder with a reader head that uses PANASONIC® (Matsushita) protocol and an adhesive absolute tape.

TAA + L2ABC: non-contact open linear encoder with a reader head that uses BiSS® protocol and an adhesive absolute tape.

TAA+L2AD: non-contact open linear encoder with a reader head that uses FeeDat® protocol for FAGOR and others and an adhesive absolute tape.

TAA+L2AD + XC-C8-PA-DQ-M: non-contact open linear encoder with a reader head that uses DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One) and an adhesive absolute tape.

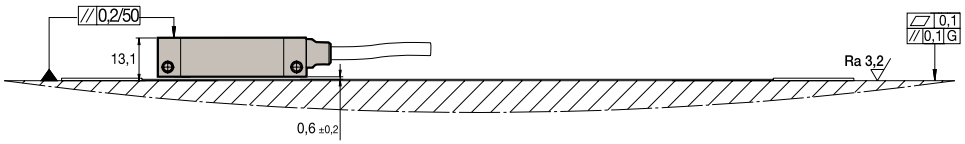
TAA + L2AK: non-contact open linear encoder with a reader head that uses YASKAWA® protocol and an adhesive absolute tape.

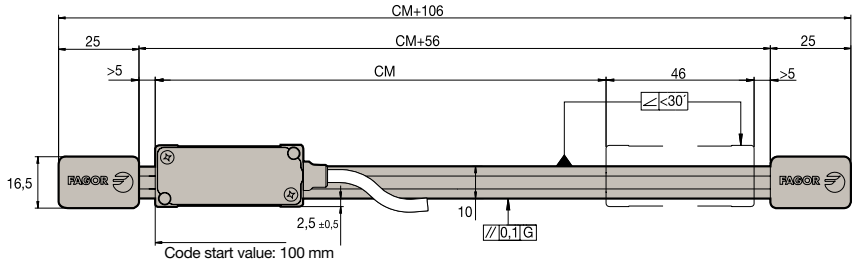
Characteristics

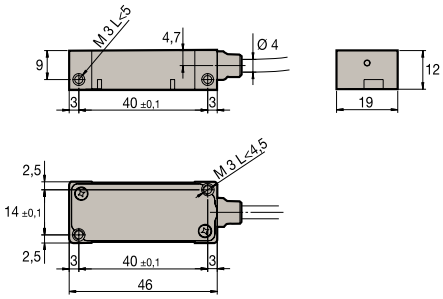
	TAA + L2A	TAA + L2AM / L2AMH	TAA-L2AP / TAA+L2AD + XC-C8-PA-DQ-M	TAA + L2ABC	TAA + L2AD	TAA + L2AK
Measurement	**Incremental:** By means of a 20 µm-pitch stainless steel tape **Absolute:** Optical reading of sequential binary code					
Steel tape thermal expansion coefficient	α_{therm}: ≈ 11 ppm/K.					
Measuring resolution	0.01 µm / 0.05 µm	0.01 µm / 0.05 µm	0.01 µm / 0.05 µm	0.01 µm / 0.05 µm	0.01 µm / 0.05 µm	0.009765625 µm / 0.078125 µm
Maximum speed	480 m/min					
Maximum cable length	75 m (*)	30 m	30 m	(**)	100 m	50 m
Supply voltage	5V ± 10 %. < 250 mA (without load)					
Reader head	1 or 3 meter cable with a connector					
Reader head protection	IP 40					
Accuracy	± 10 µm/m					
Maximum vibration	200 m/s² (55 … 2000 Hz) IEC 60068-2-6					
Maximum shock	1000 m/s² (11 ms) IEC 60068-2-27					
Operating temperature	0 °C … 50 °C					
Storage temperature	-20 °C ... 70 °C					
Weight	0.17 kg + 0.025 kg/m					
Relative humidity	20 … 80 %					

(*) Contact Fagor Automation for other lengths.
(**) Contact Fagor Automation for maximum cable length.

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 Non-contact linear Encoder: TAA-62 + L2AP10-3C9D

Tape

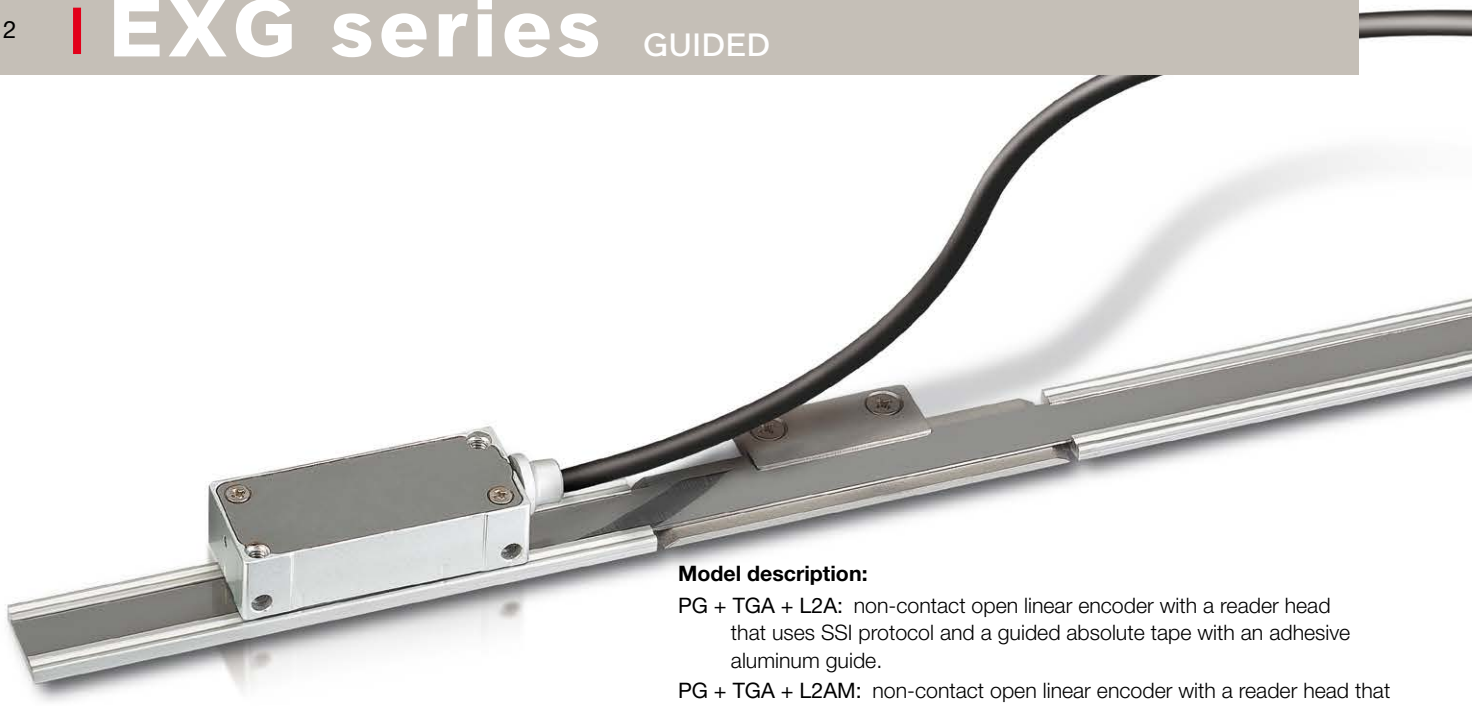
TAA	62
Absolute graduated tape for the adhesive model	***Measuring lengths in centimeters:*** In the example 62 = 620 mm

Reader head

L2	A	P	10	3	C9D
Single-body reader head with LED	***Letter identifying the absolute encoder***	***Type of communications protocol:*** • Blank space: SSI protocol (FAGOR) • M: MITSUBISHI® CNC protocol full duplex • MH: MITSUBISHI® CNC protocol half duplex • **P: PANASONIC® (Matsushita) protocol** • B: BiSS® protocol • D: FeeDat® protocol (FAGOR) (*) • K: YASKAWA® protocol	***Resolution:*** 50: 0.05 µm **10: 0.01 µm** 211: 0.009765625 µm (**) 208: 0.078125 µm (**)	**Cable length:** 1: 1 meter **3: 3 meters**	***Connector:*** • DA: Sub D HD 15 M • MB: MITSUBISHI® • PN5: PANASONIC® • PN: YASKAWA® • **C9D: 17-pin round connector** (***)

(*): plus XC-C8-PA-DQ-M with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One).
(**): only for YASKAWA® model.
(***): Mitsubishi® models with ferrite. Description C9D-F.

EXG series GUIDED



Non-contact open linear encoder for high accuracy, high speed applications.

It consists of a compact reader head with all the electronics and optics integrated into a single body that may be mounted from the side or from the top.

It has an LED to help mounting it and includes a 1 or 3 meter cable with a connector, a 10 mm wide reflective stainless steel tape that is highly resistant to solvents on an adhesive aluminum guide.

Measuring lengths in millimeters:

Available from 240 mm to 3,040 mm in 100 mm (*) increments.

Model description:

PG + TGA + L2A: non-contact open linear encoder with a reader head that uses SSI protocol and a guided absolute tape with an adhesive aluminum guide.

PG + TGA + L2AM: non-contact open linear encoder with a reader head that uses MITSUBISHI® CNC full dupllex protocol and a guided absolute tape with an adhesive aluminum guide.

PG + TGA + L2AMH: non-contact open linear encoder with a reader head that uses MITSUBISHI® CNC half duplex protocol and a guided absolute tape with an adhesive aluminum guide.

PG + TGA + L2AP: non-contact open linear encoder with a reader head that uses PANASONIC® (Matsushita) protocol and a guided absolute tape with an adhesive aluminum guide.

PG +TGA + L2ABC: non-contact open linear encoder with a reader head that uses BiSS® protocol and a guided absolute tape with an adhesive aluminum guide.

PG +TGA + L2AD: non-contact open linear encoder with a reader head that uses FeeDat® protocol for FAGOR and others and a guided absolute tape with an adhesive aluminum guide.

PG +TGA + L2AD + XC-C8-PA-DQ-M: non-contact open linear encoder with a reader head that uses DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One) and a guided absolute tape with an adhesive aluminum guide.

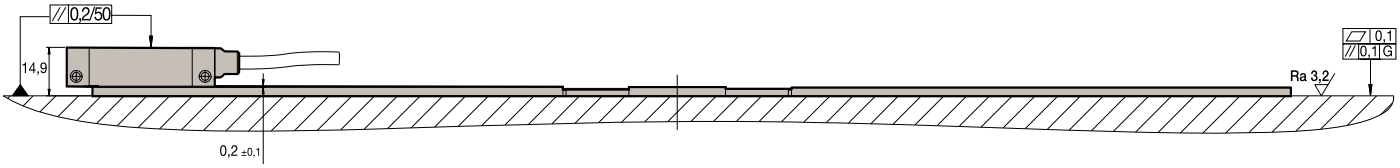
PG + TGA + L2AK: non-contact open linear encoder with a reader head that uses YASKAWA® protocol and a guided absolute tape with an adhesive aluminum guide.

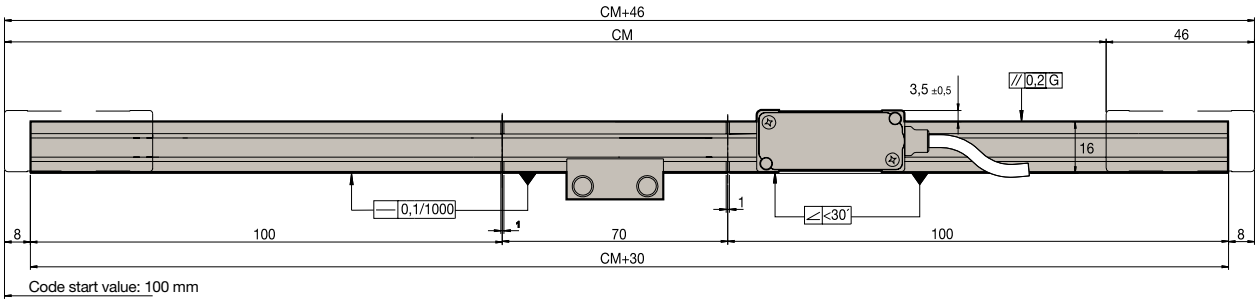
Characteristics

	PG + TGA + L2A	PG + TGA + L2AM / L2AMH	PG + TGA + L2AP / PG +TGA + L2AD + XC-C8-PA-DQ-M	PG + TGA + L2ABC	PG + TGA + L2AD	PG + TGA + L2AK
Measurement	**Incremental:** By means of a 20 µm-pitch stainless steel tape **Absolute:** Optical reading of sequential binary code					
Steel tape thermal expansion coefficient	α_{therm}: ≈ 11 ppm/K.					
Measuring resolution	0.01 µm / 0.05 µm	0.01 µm / 0.05 µm	0.01 µm / 0.05 µm	0.01 µm / 0.05 µm	0.01 µm / 0.05 µm	0.009765625 µm / 0.078125 µm
Maximum speed	480 m/min					
Maximum cable length	75 m (*)	30 m	30 m	(**)	100 m	50 m
Supply voltage	5V ± 10 %. < 250 mA (without load)					
Reader head	1 or 3 meter cable with a connector					
Reader head protection	IP 40					
Accuracy	± 10 µm/m					
Maximum vibration	200 m/s² (55 … 2000 Hz) IEC 60068-2-6					
Maximum shock	1000 m/s² (11 ms) IEC 60068-2-27					
Operating temperature	0 °C … 50 °C					
Storage temperature	-20 °C ... 70 °C					
Weight	0.27 kg + 0.05 kg/m					
Relative humidity	20 … 80 %					

(*) Contact Fagor Automation for other lengths.
(**) Contact Fagor Automation for maximum cable length.

Dimensions in mm





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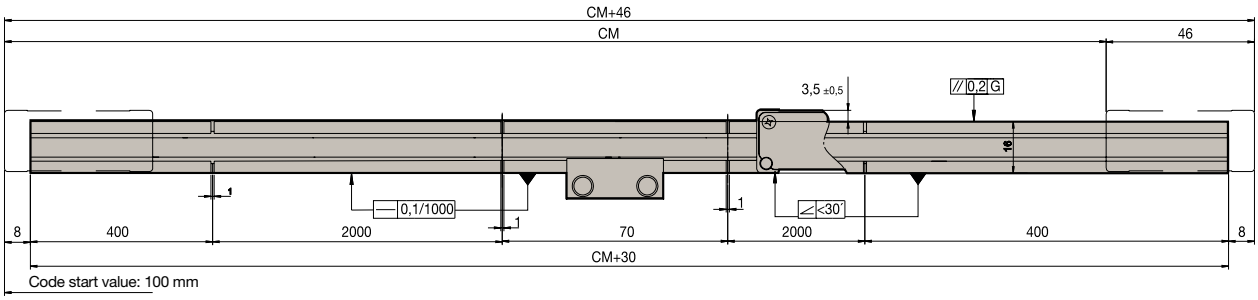

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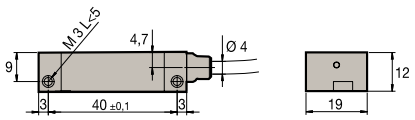

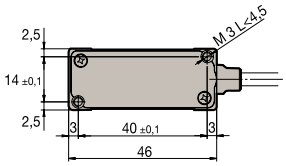

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Order identification

Example of Non-contact linear Encoder: PG-30 + TGA-64 + L2AP10-3C9D

Guide		Tape	
PG	**30**	**TGA**	**64**
Adhesive guide for guided tape	***Lengths in centimeters:*** In the example 30 = 300 mm	Absolute graduated tape for the guided model	***Measuring lengths in centimeters:*** In the example 64 = 640 mm

Cabeza lectora

L2	A	P	10	3	C9D
Single-body reader head with LED	***Letter identifying the absolute encoder***	***Type of communications protocol:*** • Blank space: SSI protocol (FAGOR) • M: MITSUBISHI® CNC protocol full duplex • MH: MITSUBISHI® CNC protocol half duplex • **P: PANASONIC® (Matsushita) protocol** • B: BiSS® protocol • D: FeeDat® protocol (FAGOR) (*) • K: YASKAWA® protocol	***Resolution:*** 50: 0.05 µm **10: 0.01 µm** 211: 0.009765625 µm (**) 208: 0.078125 µm (**)	***Cable length:*** 1: 1 meter **3: 3 meters**	***Connector:*** • DA: Sub D HD 15 M • MB: MITSUBISHI® • PN5: PANASONIC® • PN: YASKAWA® • **C9D: 17-pin round connector** (***)

(*): plus XC-C8-PA-DQ-M with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One).

(**): only for YASKAWA® model.

(***): Mitsubishi® models with ferrite. Description C9D-F.

EXT series TENSIONED

Non-contact open linear encoder for high accuracy, high speed applications.

It consists of a compact reader head with all the electronics and optics integrated into a single body that may be mounted from the side or from the top.

It has an LED to help mounting it and includes a 1 or 3 meter cable with a connector, a 10 mm wide reflective stainless steel tape that is highly resistant to solvents on an adhesive or bolted aluminum guide.

Measuring lengths in millimeters:

Available from 140 mm to 3,040 mm in 100 mm (*) increments.

Model description:

PT + TTA + L2A: non-contact open linear encoder with a reader head that uses SSI protocol and a tensioned absolute tape with an adhesive aluminum guide. Indicate PTS for bolted guided.

PT + TTA + L2AM: non-contact open linear encoder with a reader head that uses MITSUBISHI® CNC full duplex protocol and a tensioned absolute tape with an adhesive aluminum guide. Indicate PTS for bolted guided.

PT + TTA + L2AMH: non-contact open linear encoder with a reader head that uses MITSUBISHI® CNC hald duplex protocol and a tensioned absolute tape with an adhesive aluminum guide. Indicate PTS for bolted guided.

PT + TTA + L2AP: non-contact open linear encoder with a reader head that uses PANASONIC® (Matsushita) protocol and a tensioned absolute tape with an adhesive aluminum guide. Indicate PTS for bolted guided.

PT + TTA + L2ABC: non-contact open linear encoder with a reader head that uses BiSS® protocol and a tensioned absolute tape with an adhesive aluminum guide. Indicate PTS for bolted guided.

PT +TTA + L2AD: non-contact open linear encoder with a reader head that uses FeeDat® protocol for FAGOR and others and a tensioned absolute tape with an adhesive aluminum guide. Indicate PTS for bolted guided.

PT +TTA + L2AD + XC-C8-PA-DQ-M: non-contact open linear encoder with a reader head that uses DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One) and a tensioned absolute tape with an adhesive aluminum guide. Indicate PTS for bolted guided.

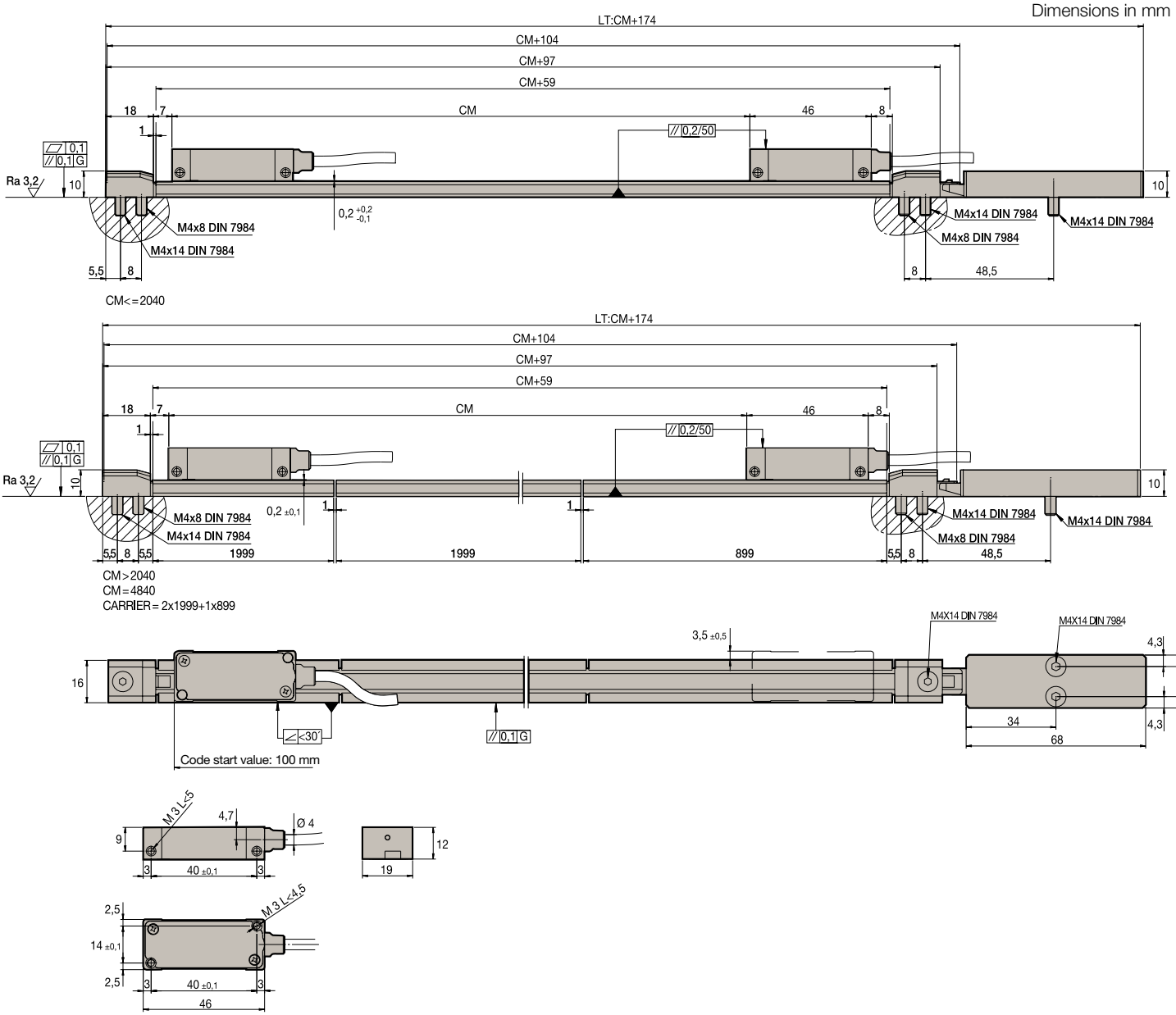
PT + TTA + L2AK: non-contact open linear encoder with a reader head that uses YASKAWA® protocol and a tensioned absolute tape with an adhesive aluminum guide. Indicate PTS for bolted guided.

Characteristics

	PT + TTA + L2A	PT + TTA + L2AM / L2AMH	PT + TTA + L2AP / PT +TTA + L2AD + XC-C8-PA-DQ-M	PT + TTA + L2ABC	PT + TTA + L2AD	PT + TTA + L2AK
Measurement	**Incremental:** By means of a 20 µm-pitch stainless steel tape **Absolute:** Optical reading of sequential binary code					
Steel tape thermal expansion coefficient	α_{therm}: ≈ 11 ppm/K.					
Measuring resolution	0.01 µm / 0.05 µm	0.01 µm / 0.05 µm	0.01 µm / 0.05 µm	0.01 µm / 0.05 µm	0.01 µm / 0.05 µm	0.009765625 µm / 0.078125 µm
Maximum speed	480 m/min					
Maximum cable length	75 m (*)	30 m	30 m	(**)	100 m	50 m
Supply voltage	5V ± 10 %. < 250 mA (without load)					
Reader head	1 or 3 meter cable with a connector					
Reader head protection	IP 40					
Accuracy	± 5 µm /m					
Maximum vibration	200 m/s² (55 … 2000 Hz) IEC 60068-2-6					
Maximum shock	1000 m/s² (11 ms) IEC 60068-2-27					
Operating temperature	0 °C … 50 °C					
Storage temperature	-20 °C ... 70 °C					
Weight	0.27 kg + 0.26 kg/m					
Relative humidity	20 … 80 %					

(*) Contact Fagor Automation for other lengths.
(**) Contact Fagor Automation for maximum cable length.

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 Non-contact linear Encoder: PTS-70 + TTA-64 + L2AP10-3C9D

Guide		Tape	
PTS	**70**	**TTA**	**64**
PT: adhesive guide for tensioned tape **PTS: bolted guide for tensioned tape**	***Lengths in centimeters -1:*** In the example 70 = 699 mm	Absolute graduated tape for the tensioned model	***Measuring lengths in centimeters:*** In the example 64 = 640 mm

Reader head

L2	A	P	10	3	C9D
Single-body reader head with LED	***Letter identifying the absolute encoder***	***Type of communications protocol:*** • Blank space: SSI protocol (FAGOR) • M: MITSUBISHI® CNC protocol full duplex • MH: MITSUBISHI® CNC protocol half duplex • **P: PANASONIC® (Matsushita) protocol** • B: BiSS® protocol • D: FeeDat® protocol (FAGOR) (*) • K: YASKAWA® protocol	***Resolution:*** 50: 0.05 µm **10: 0.01 µm** 211: 0.009765625 µm (**) 208: 0.078125 µm (**)	***Cable length:*** 1: 1 meter **3: 3 meters**	***Connector:*** • DA: Sub D HD 15 M • MB: MITSUBISHI® • PN5: PANASONIC® • PN: YASKAWA® • **C9D: 17-pin round connector** (***)

(*): plus XC-C8-PA-DQ-M with DRIVE-CLiQ® protocol for SIEMENS® (Solution Line and Sinumerik One).

(**): only for YASKAWA® model.

(***): Mitsubishi® models with ferrite. Description C9D-F.

CONNECTION TO FAGOR CNC

UP TO 3 METERS

Connector for direct connection to FAGOR

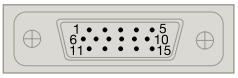
L2A...-DA

Lengths: 1 and 3 meters

Cable included

SUB D 15 HD connector (male Pin ■)

Pin	Signal	Color
5	Data	Grey
6	/Data	Pink
7	Clock	Black
8	/Clock	Purple
9	+5 V	Brown + Green
10	+5 V sensor	Blue + Blue/Red (Orange)
11	0 V	White + Yellow
12	0 V sensor	Red + Grey/Pink
Housing	Ground	Shield



FROM 3 METERS ON

L2A...-C9D cable + XC-C8-...F-D extension cable

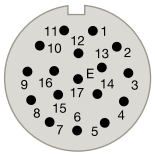
L2A...-C9D

Lengths: 1 and 3 meters

Cable included

M23 17 connector (male Pin ■)

Pin	Signal	Color
14	Data	Grey
17	/Data	Pink
8	Clock (Request)	Black
9	/Clock (Request)	Purple
7	+5 V	Brown + Green
1	+5 V sensor	Blue + Blue/Red (Orange)
10	0 V	White + Yellow
4	0 V sensor	Red + Grey/Pink
Housing	Ground	Shield



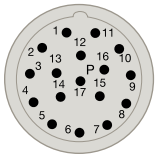
XC-C8-...F-D extension cable

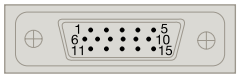
Lengths: 5, 10, 15, 20 and 25 meters

M23 17 connector (female Pin ⊃)

SUB D 15 HD connector (male Pin ■)

Pin	Pin	Signal	Color
15	1	A	Green/Black
16	2	/A	Yellow/Black
12	3	B	Blue/Black
13	4	/B	Red/Black
14	5	Data	Grey
17	6	/Data	Pink
8	7	Clock	Purple
9	8	/Clock	Yellow
7	9	+5 V	Brown/Green
1	10	+5 V sensor	Blue
10	11	0 V	White/Green
4	12	0 V sensor	White
11	15	Ground	Internal shield
Housing	Housing	Ground	External shield





CONNECTION TO OTHER CNC'S

UP TO 3 METERS

Connector for direct connection to PANASONIC® MINAS A5

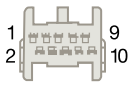
L2AP...-PN5

Lengths: 1 and 3 meters

Cable included

PANASONIC 10 pin connector (female Pin ⊀)

⊀ Pin	Signal	Color
3	Data	Grey
4	/Data	Pink
1	+5 V	Brown + Green + Blue + Blue/Red (Orange)
2	0 V	White + Yellow + Red + Grey/Pink
Housing	Ground	Shield



Connector for direct connection to MITSUBISHI®

L2AM...-MB / L2AMH...-MB

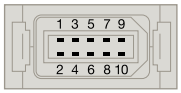
Lengths: 1 and 3 meters

Cable included

10-pin MOLEX/3M RECTANGULAR connector (female Pin ⊀)

⊀ Pin	Signal
7	SD (MD) (*)
8	/SD (MD) (*)
3	RQ (MR)
4	/RQ (MR)
1	+5 V
2	0 V
Housing	Ground

(*) : only used in full duplex model L2AM-MB



Connector for direct connection to YASKAWA®

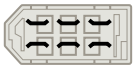
L2AK...-PN

Lengths: 1 and 3 meters

Cable included

6-pin MOLEX connector (female Pin ⊀)

⊀ Pin	Signal	Color
5	Data	Grey
6	/Data	Pink
1	+5 V	Brown + Green + Blue + Blue/Red (Orange)
2	0 V	White + Yellow + Red+ Grey/Pink
Housing	Ground	Shield



CONNECTION TO OTHER CNC'S

FROM 3 METERS ON

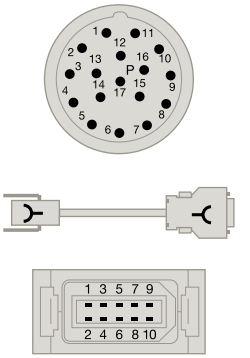
For connection to MITSUBISHI® full duplex: **L2AM...-C9D-F Cable + XC-C8-...-MB extension cable**
For connection to MITSUBISHI® half duplex: **L2AMH...-C9D-F Cable + XC-C8-...-MB extension cable**
For connection to PANASONIC®: **L2AP...-C9D Cable + XC-C8...A-PN5 extension cable**
For connection to YASKAWA®: **L2AK...-C9D Cable + XC-C8-...A-PN extension cable**

XC-C8-...-MB extension cable

Lengths: 5, 10, 15, 20 and 25 meters

M23 17 connector (female Pin)
10-pin MOLEX/3M RECTANGULAR connector (female Pin)

Pin	Pin	Signal	Color
8	7	SD (MD)	Purple
9	8	/SD (MD)	Yellow
14	3	RQ (MR)	Grey
17	4	/RQ (MR)	Pink
7	1	+5 V	Brown/Green
1	1	+5 V sensor	Blue
10	2	GND	White/Green
4	2	0 V sensor	White
12	2	SEL	Black
Housing	Housing	Ground	Shield

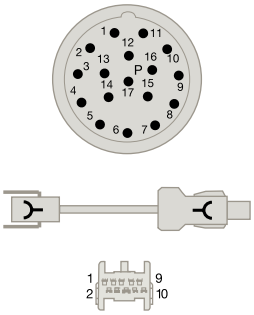


XC-C8-...A-PN5 extension cable

Lengths: 5, 10, 15, 20 and 25 meters

M23 17 connector (female Pin)
PANASONIC 10 pin connector (female Pin)

Pin	Pin	Signal	Color
14	3	Data	Grey
17	4	/Data	Pink
7	1	+5 V	Brown+ Black
1	1	+5 V sensor	Green+ Yellow
10	2	GND	White+ Purple
4	2	GND sensor	Blue+ Red
Housing	Housing	Ground	Shield

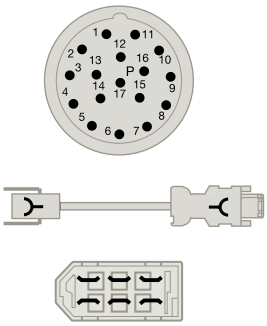


XC-C8-...A-PN extension cable

Lengths: 5, 10, 15, 20 and 25 meters

M23 17 connector (female Pin)
6-pin MOLEX connector (female Pin)

Pin	Pin	Signal	Color
14	5	Data	Grey
17	6	/Data	Pink
7		+5 V	Brown+ Black
10	2	GND	White+ Purple
Housing	Housing	Ground	Shield



Technology

The incremental encoders provide direct measure of machine position without using any intermediate device. The positioning errors originating from machine mechanics are minimized as the encoder is directly mounted to the machine surface and the guide ways. Some of the potential sources of such errors in a machine tool such as lead screw pitch, certain amount of backlash and thermal behavior can be minimized using these encoders.

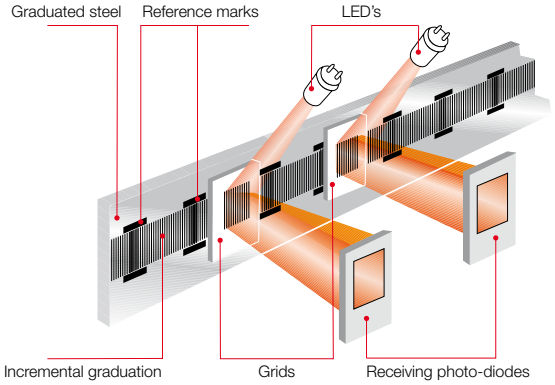
Fagor's non-contact open incremental linear encoders use the auto imaging principle which uses diffuse light reflected from the graduated steel tape. This optical reading system consists of an LED as a light source, a reticule that creates the image and a monolithic photo detector element in the image plane, which is specially designed and patented by Fagor.

Reference signals (I_0)

The reference signal is a specially etched mark along the graduated steel tape, which when scanned generates a pulse signal. They are used to set/recover the machine zero position and avoid possible errors after powering up the DRO or CNC system.

Fagor Automation open encoders have reference marks integrated into the incremental track providing reference signals I_0 in two versions:

Graduated steel encoder



- **Incremental:** The reference signal is synchronized with the feedback pulses to ensure perfect measuring repeatability. One every 50 mm of travel.
- **Selectable:** With selectable linear encoders the customer can select one or more reference points and ignore the rest by simply inserting a magnet at the selected point or points.

Open design:

The open design allows transmitting the machine movement and reading its position accurately and without contact; therefore without friction between the reader head and the graduated scale. All the electronics, including interpolation, is integrated into the reader head as well as double detectors for limit switch and alarm signal. The reference marks are synchronized and integrated into the incremental track. The technology used provides a robust and compact solution with high accuracy and resolution at high speed.

ELECTRICAL OUTPUT
SIGNALS

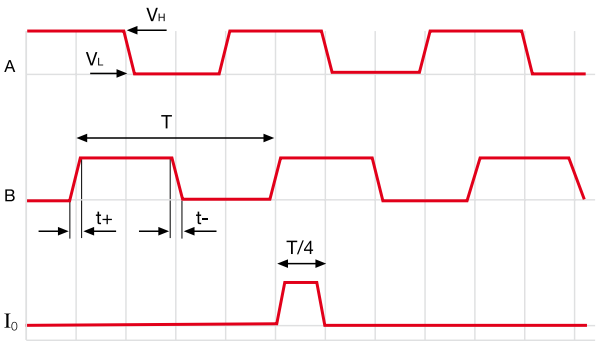
Differential TTL

1 These are complementary signals in compliance with the EIA standard RS-422. This characteristic together with a line termination of 120 Ω, twisted pair, and an overall shield provide greater immunity to electromagnetic noise caused by their environment.

Characteristics

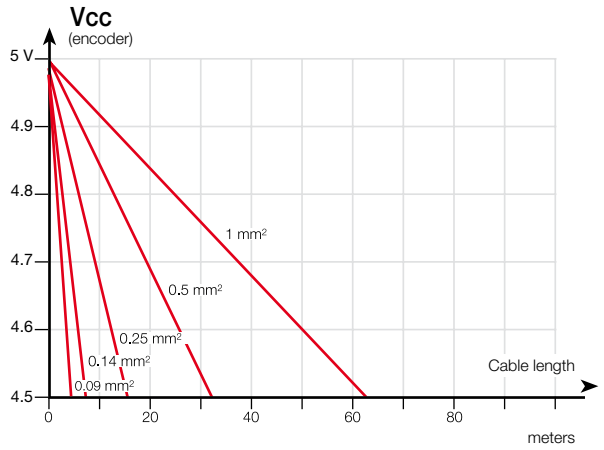
Signals	A, /A, B, /B, I_0, / I_0
Signal level	$V_H \geq 2.5V$ $I_H = 20$ mA $V_L \leq 0.5V$ $I_L = 20$ mA With 1 m cable
90° reference signal (I_0)	Synchronized with A and B
Switching time	t+/t-< 30 ns With 1 m cable
Supply voltage and consumption	5 V ± 5 %, < 150 mA
T period	20, 4, 2, 0.4, 0.2 µm
Max. cable length	50 meters
Load impedance	Zo= 120 Ω between differential

1



Electrical output signals

❷



❷ Voltage drop across cable

The voltage required for a TTL encoder must be 5V ± 5 %. A simple formula may be used to calculate the maximum cable length depending on the section of the supply cables.

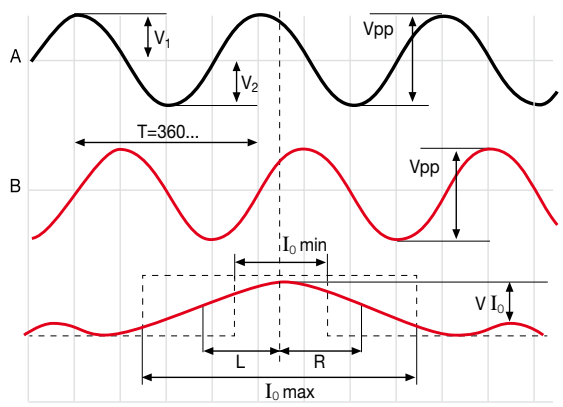
L_{max} = (V_{CC}-4.75)* 500 / ($Z_{CABLE/Km}$* I_{MAX})

Example

Vcc = 5V, IMAX = 0.1 Amp			
Z (1 mm²)	=	16.6 Ω/Km	**(L_{max}= 75 m)**
Z (0.5 mm²)	=	32 Ω/Km	**(L_{max}= 39 m)**
Z (0.25 mm²)	=	66 Ω/Km	**(L_{max}=19 m)**
Z (0.14 mm²)	=	132 Ω/Km	**(L_{max}= 9 m)**
Z (0.09 mm²)	=	232 Ω/Km	**(L_{max}= 5 m)**

Differential 1 Vpp

❸

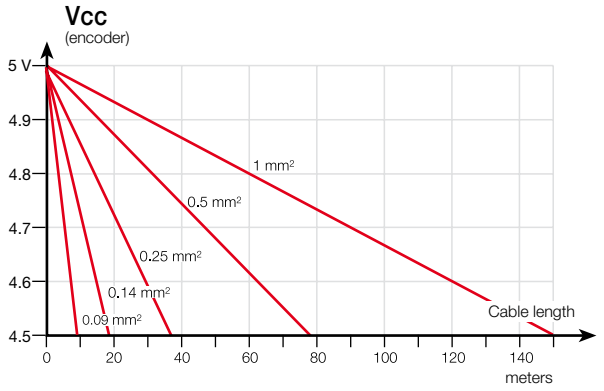


❸ They are complementary sinusoidal signals whose differential value is 1 Vpp centered on $V_{CC/2}$. This characteristic together with a line termination of 120 Ω, twisted pair, and an overall shield provide greater immunity to electromagnetic noise caused by their environment.

Characteristics

Signals	A, /A, B, /B, I_0, / I_0
V_{App}	1 V +20 %, -40 %
V_{Bpp}	1 V +20 %, -40 %
DC offset	2.5 V ± 0.5 V
Signal period	20 µm, 40 µm
Supply V	5 V ± 10 %, < 150 mA
Max. cable length	150 meters
A, B centered: $\|V_1-V_2\| / 2 V_{pp}$	≤ 0.065
A&B relationship: V_{App} / V_{Bpp}	0.8 ÷ 1.25
A&B phase shift:	90° ± 10°
I_0 amplitude: V_{I_0}	0.2 ÷ 0.8 V
I_0 width: L + R	I_0_min: 180° I_0_typ: 360° I_0_max: 540°
I_0 synchronism: L, R	180° ± 90°

❹



❹ Voltage drop across cable

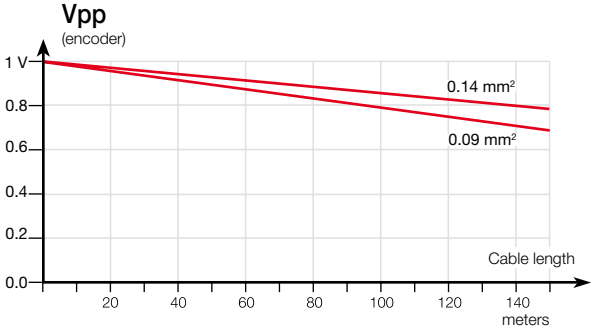
The voltage required for a 1 Vpp encoder must be 5 V ± 10 %. A simple formula may be used to calculate the maximum cable length depending on the section of the supply cables:

L_{max} = (V_{CC}-4.5)* 500 / ($Z_{CABLE/Km}$* I_{MAX})

Example

Vcc = 5V, IMAX= 0.1Amp			
Z (1 mm²)	=	16.6 Ω/Km	**(L_{max}= 150 m)**
Z (0.5 mm²)	=	32 Ω/Km	**(L_{max}= 78 m)**
Z (0.25 mm²)	=	66 Ω/Km	**(L_{max}= 37 m)**
Z (0.14 mm²)	=	132 Ω/ Km	**(L_{max}= 18 m)**
Z (0.09 mm²)	=	232 Ω/ Km	**(L_{max}= 10 m)**

❺



❺ 1 Vpp signal damping due to the cable section

Besides attenuation due to signal frequency, there is another signal attenuation caused by the section of the cable connected to the encoder.

Range

Analyze the application to make sure that the proper encoder will be selected for the machine.

To do this, bear in mind the following considerations:

Installation

Consider the physical length of the installation and the space available for it.

These aspects are crucial to determine the type of linear encoder to use.

Mechanical Design:

EXA: adhesive model with the smallest cross section for constraint spaces, it consists of an engraved steel tape glued directly onto the machine surface, recommended if the tape is under thermally stable conditions.

EXG: guided model for long measuring lengths it comprises an aluminium extrusion glued to the surface and an engraved steel tape. The steel tape is guided in the extrusion and secured in the mid point to the machine surface that allows the tape to expand/contract freely at its ends and ensures a defined thermal behaviour.

EXT: tensioned model for very long measuring lengths and high accuracy it comprises an aluminium extrusion glued or screwed to the surface, an engraved steel tape and tensioning system. The steel tape is guided in the extrusion and tensioned between its ends. The tensioned steel tape is fixed on the machine base so it replicates the thermal behaviour of the surface.

Accuracy

Each linear encoder is subjected to quality control showing its accuracy along its measuring length.

Signal

Consider the following variables for selecting the type of signal: resolution, cable length and compatibility.

Resolution

The resolution of the control of machine depends on the linear encoder.

Cable length

The length of the cable depends on the type of signal.

Speed

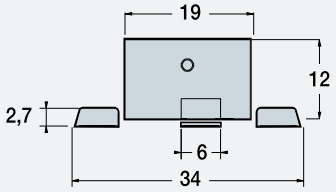
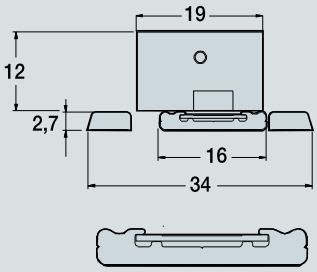
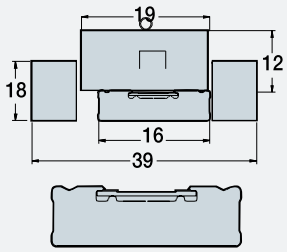
The speed requirements for the application must be analyzed before choosing the linear encoder.

Shock and Vibration

Fagor linear encoders withstand vibrations of up to 200 m/s^2 and shocks of up to 1000 m/s^2.

Alarm signal

All TTL and 1 Vpp models offer an alarm signal.

Series	Section
Incremental **EXA** Adhesive	
Incremental **EXG** Guided	
Incremental **EXT** Tensioned	

	Measuring lengths	Accuracy	Signals	Pitch Resolution up to	Model
	70 mm up to 16 020 mm	± 10 µm/m	~ 1 Vpp	0.1 µm	TA + L2RP / L2SP
			⊓ TTL	5 µm	TA + L2RD / L2SD
			⊓ TTL	1 µm	TA+ L2RX / L2SX
			⊓ TTL	0.5 µm	TA + L2RY / L2SY
			⊓ TTL	0.1 µm	TA + L2RW / L2SW
			⊓ TTL	0.1 µm	TA + L2RW1/L2SW1
	240 mm up to 6 040 mm	± 10 µm/m	~ 1 Vpp	0.1 µm	PG + TG + L2RP / L2SP
			⊓ TTL	5 µm	PG + TG + L2RD / L2SD
			⊓ TTL	1 µm	PG + TG + L2RX / L2SX
			⊓ TTL	0.5 µm	PG + TG + L2RY / L2SY
			⊓ TTL	0.1 µm	PG + TG + L2RW / L2SW
			⊓ TTL	0.1 µm	PG + TG + L2RW1/L2SW1
	140 mm up to 30 040 mm	± 5 µm/m	~ 1 Vpp	0.1 µm	PT + TT + L2RP / L2SP
			⊓ TTL	5 µm	PT + TT + L2RD / L2SD
			⊓ TTL	1 µm	PT + TT + L2RX / L2SX
			⊓ TTL	0.5 µm	PT + TT + L2RY / L2SY
			⊓ TTL	0.1 µm	PT + TT + L2RW / L2SW
			⊓ TTL	0.1 µm	PT + TT + L2RW1/L2SW1

EXA series ADHESIVE

Non-contact open linear encoder for high accuracy, high speed applications.

It consists of a compact reader head with all the electronics and optics integrated into a single body that may be mounted from the side or from the top.

It has an LED to help mounting it and includes a 1 or 3 meter cable with a connector, a 6 mm wide adhesive reflective stainless steel tape that is highly resistant to solvents and reference signal synchronized on line.

Measuring lengths in millimeters:

Available from 70 mm to 16,020 mm in 50 mm increments.

Model description:

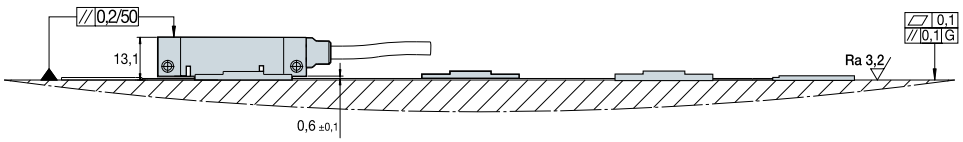
TA + L2R: non-contact open linear encoder with an incremental reader head, incremental I_0 (every 50 mm) and an adhesive incremental tape.

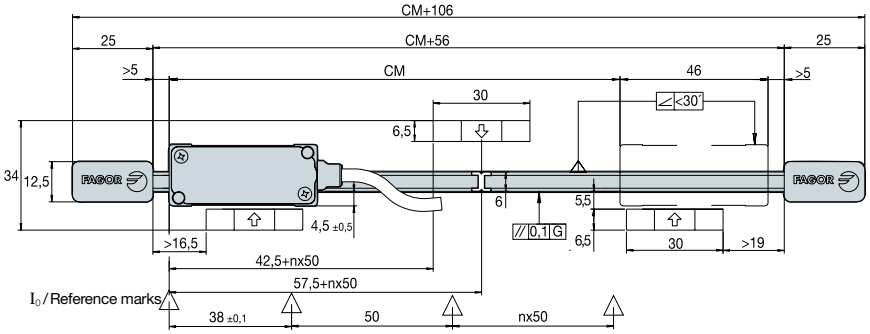
TA + L2S: non-contact open linear encoder with an incremental reader head, I_0 that may be selected with a magnet and an adhesive incremental tape.

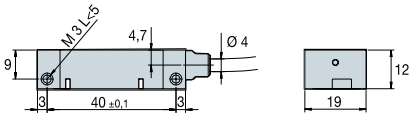
Characteristics

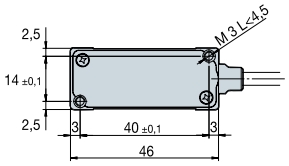
	TA +L2RD	TA +L2RX	TA +L2RY	TA +L2RW	TA +L2RW1	TA +L2RP
Measurement	**Incremental:** By means of a 20 µm-pitch graduated steel tape					
Steel thermal expansion coefficient	α_{therm}: ≈ 11 ppm/K.					
Measuring resolution	5 µm	1 µm	0.5 µm	0.1 µm	0.1 µm	Up to 0.1 µm
Output signals	⊓⊓ TTL differential	⊓⊓ TTL differential	⊓⊓ TTL differential	⊓⊓ TTL differential	⊓⊓ TTL differential	∿ 1 Vpp
Incremental signal period	20 µm	4 µm	2 µm	0.4 µm	0.4 µm	20 µm
Limit frequency	200 kHz	1 MHz	1 Mhz	1.5 Mhz	2.5 Mhz	400 Khz
Maximum speed	240 m/min	240 m/min	120 m/min	36 m/min	60 m/min	480 m/min
Minimum distance between flanks	1.2 µs	0.2 µs	0.2 µs	0.2 µs	0.05 µs	–
Reference marks I_0	L2RD, L2RX, L2RY, L2RW, L2RW1, L2RP: every 50 mm L2SD, L2SX, L2SY, L2SW, L2SW1, L2SP: I_0 that may be selected with a magnet					
Limits	Open collector, active low. Activation by magnets					
Maximum cable length	50 m	50 m	50 m	50 m	50 m	150 m
Supply voltage	5V ±5 %, < 150 mA (without load)	5V ±5 %, < 150 mA (without load)	5V ±5 %, < 150 mA (without load)	5V ±5 %, < 150 mA (without load)	5V ±5 %, < 150 mA (without load)	5V ±10 %, < 150 mA (without load)
Reader head	1 or 3 meter cable with a connector					
Reader head protection	IP 40					
Accuracy	± 10 µm/m					
Maximum vibration	200 m/s² (55 … 2000 Hz) IEC 60068-2-6					
Maximum shock	1000 m/s² (11 ms) IEC 60068-2-27					
Operating temperature	0 °C … 50 °C					
Storage temperature	-20 °C ... 70 °C					
Weight	0.17 kg + 0.025 kg/m					
Relative humidity	20 … 80 %					

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 Non-contact linear Encoder: TA-62 + L2RX-3C1

Tape

TA	62
Incremental graduated tape for the adhesive model	***Measuring lengths in centimeters:*** In the example 62 = 620 mm

Reader head

L2	R	X	3	C1
Single-body reader head with LED	***Type of reference mark*** I_0**:** **R: incremental every 50 mm** S: may be selected with a magnet	***Type of signal:*** D: 5 µm resolution differential TTL **X: 1 µm resolution differential TTL** Y: 0. 5 µm resolution differential TTL W/W1: 0.1 µm resolution differential TTL P: 1 Vpp sinusoidal	***Cable length:*** 1: 1 meter **3: 3 meters**	***Connector:*** D: Sub D HD 15 M H2: YASKAWA® **C1: M-F threaded 12-pin round connector** C5: M-M threaded 12-pin round connector

EXG series GUIDED

Non-contact open linear encoder for high accuracy, high speed applications.

It consists of a compact reader head with all the electronics and optics integrated into a single body that may be mounted from the side or from the top.

It has an LED to help mounting it and includes a 1 or 3 meter cable with a connector, a 10 mm wide reflective stainless steel tape that is highly resistant to solvents on an adhesive aluminum guide.

Measuring lengths in millimeters:

Available from 240 mm to 6,040 mm in 100 mm increments.

Model description:

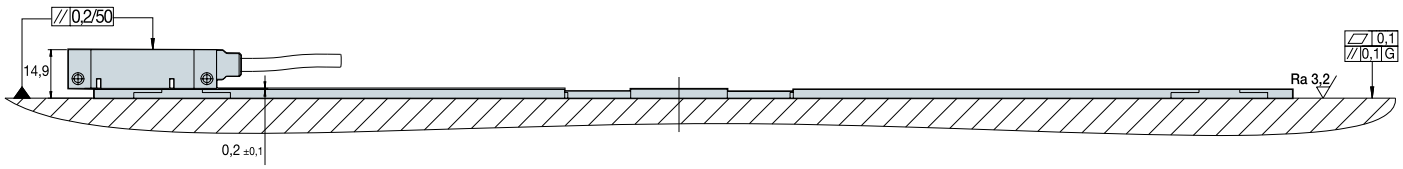
PG + TG + L2R: non-contact open linear encoder with an incremental reader head, incremental I_0 (every 50 mm) and an incremental tape with an aluminum adhesive guide.

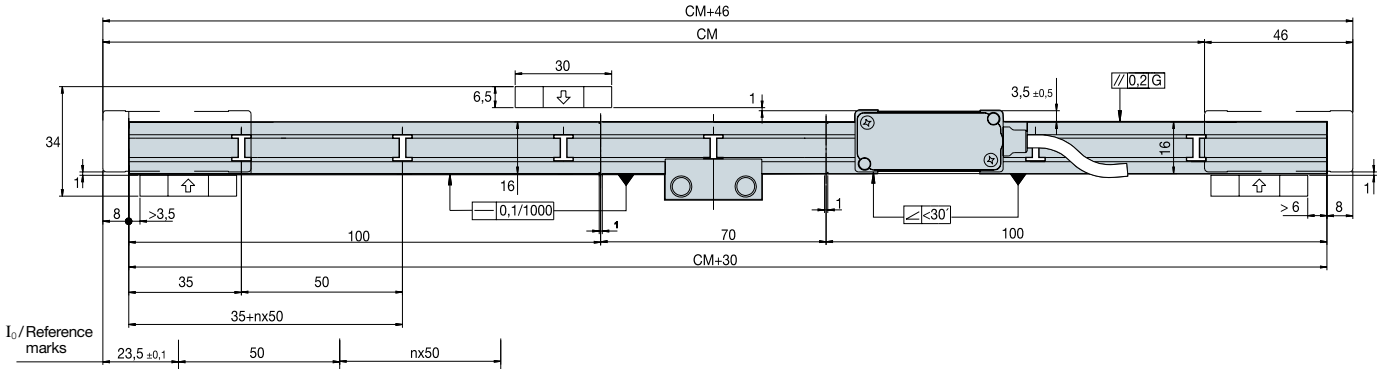
PG + TG + L2S: non-contact open linear encoder with an incremental reader head, I_0 that may be selected with a magnet and an incremental tape with an aluminum adhesive guide.

Characteristics

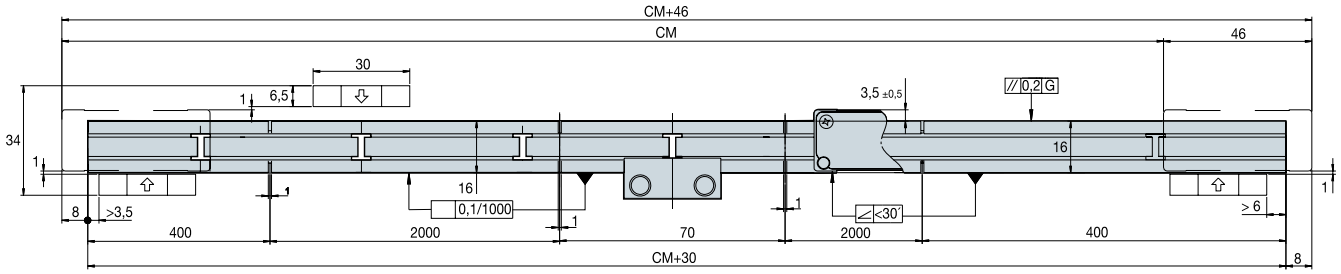
	PG+TG+L2RD	PG+TG+L2RX	PG+TG+L2RY	PG+TG+L2RW	PG+TG+L2RW1	PG+TG+L2RP
Measurement	**Incremental:** By means of a 20 µm-pitch graduated steel tape					
Steel thermal expansion coefficient	α_{therm}: ≈ 11 ppm/K.					
Measuring resolution	5 µm	1 µm	0.5 µm	0.1 µm	0.1 µm	Up to 0.1 µm
Output signals	⊔⊓ TTL differential	⊔⊓ TTL differential	⊔⊓ TTL differential	⊔⊓ TTL differential	⊔⊓ TTL differential	∿ 1 Vpp
Incremental signal period	20 µm	4 µm	2 µm	0.4 µm	0.4 µm	20 µm
Limit frequency	200 kHz	1 MHz	1 Mhz	1.5 Mhz	2.5 Mhz	400 Khz
Maximum speed	240 m/min	240 m/min	120 m/min	36 m/min	60 m/min	480 m/min
Minimum distance between flanks	1.2 µs	0.2 µs	0.2 µs	0.2 µs	0.05 µs	–
Reference marks I_0	L2RD, L2RX, L2RY, L2RW, L2RW1, L2RP: every 50 mm L2SD, L2SX, L2SY, L2SW, L2SW1, L2SP: I_0 that may be selected with a magnet					
Limits	Open collector, active low. Activation by magnets					
Maximum cable length	50 m	50 m	50 m	50 m	50 m	150 m
Supply voltage	5V ±5%, < 150 mA (without load)	5V ±5%, < 150 mA (without load)	5V ±5%, < 150 mA (without load)	5V ±5%, < 150 mA (without load)	5V ±5%, < 150 mA (without load)	5V ±10%, < 150 mA (without load)
Reader head	1 or 3 meter cable with a connector					
Reader head protection	IP 40					
Accuracy	± 10 µm/m					
Maximum vibration	200 m/s² (55 … 2000 Hz) IEC 60068-2-6					
Maximum shock	1000 m/s² (11 ms) IEC 60068-2-27					
Operating temperature	0 °C … 50 °C					
Storage temperature	-20 °C ... 70 °C					
Weight	0.27 kg + 0.05 kg/m					
Relative humidity	20 … 80 %					

Dimensions in mm

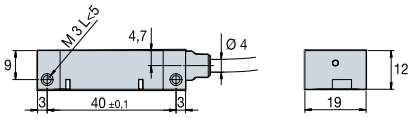


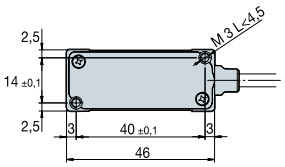


CM<=2040
CM=240



CM>=2040
CM=4840





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

Order identification

Example of Non-contact linear Encoder: PG30 + TG-64 + L2RX-3C1

Guide		**Tape**	
PG	**30**	**TG**	**64**
Adhesive guide for guided tape	***Lengths in centimeters:*** In the example 30 = 300 mm	Incremental graduated tape for the guided model	***Measuring lengths in centimeters:*** In the example 64 = 640 mm

Reader head

L2	**R**	**X**	**3**	**C1**
Single-body reader head with LED	***Type of reference mark*** I_0**:** **R: incremental every 50 mm** S: may be selected with a magnet	***Type of signal:*** D: 5 µm resolution differential TTL **X: 1 µm resolution differential TTL** Y: 0.5 µm resolution differential TTL W/W1: 0.1 µm resolution differential TTL P: 1 Vpp sinusoidal	***Cable length:*** 1: 1 meter **3: 3 meters**	***Connector:*** D: Sub D HD 15 M H2: YASKAWA® **C1: M-F threaded 12-pin round connector** C5: M-M threaded 12-pin round connector

EXT series TENSIONED

Non-contact open linear encoder for high accuracy, high speed applications.

It consists of a compact reader head with all the electronics and optics integrated into a single body that may be mounted from the side or from the top.

It has an LED to help mounting it and includes a 1 or 3 meter cable with a connector, a 10 mm wide reflective stainless steel tape that is highly resistant to solvents on an adhesive or bolted aluminum guide.

Measuring lengths in millimeters:

Available from 140 mm to 30,040 mm in 100 mm increments.

Model description:

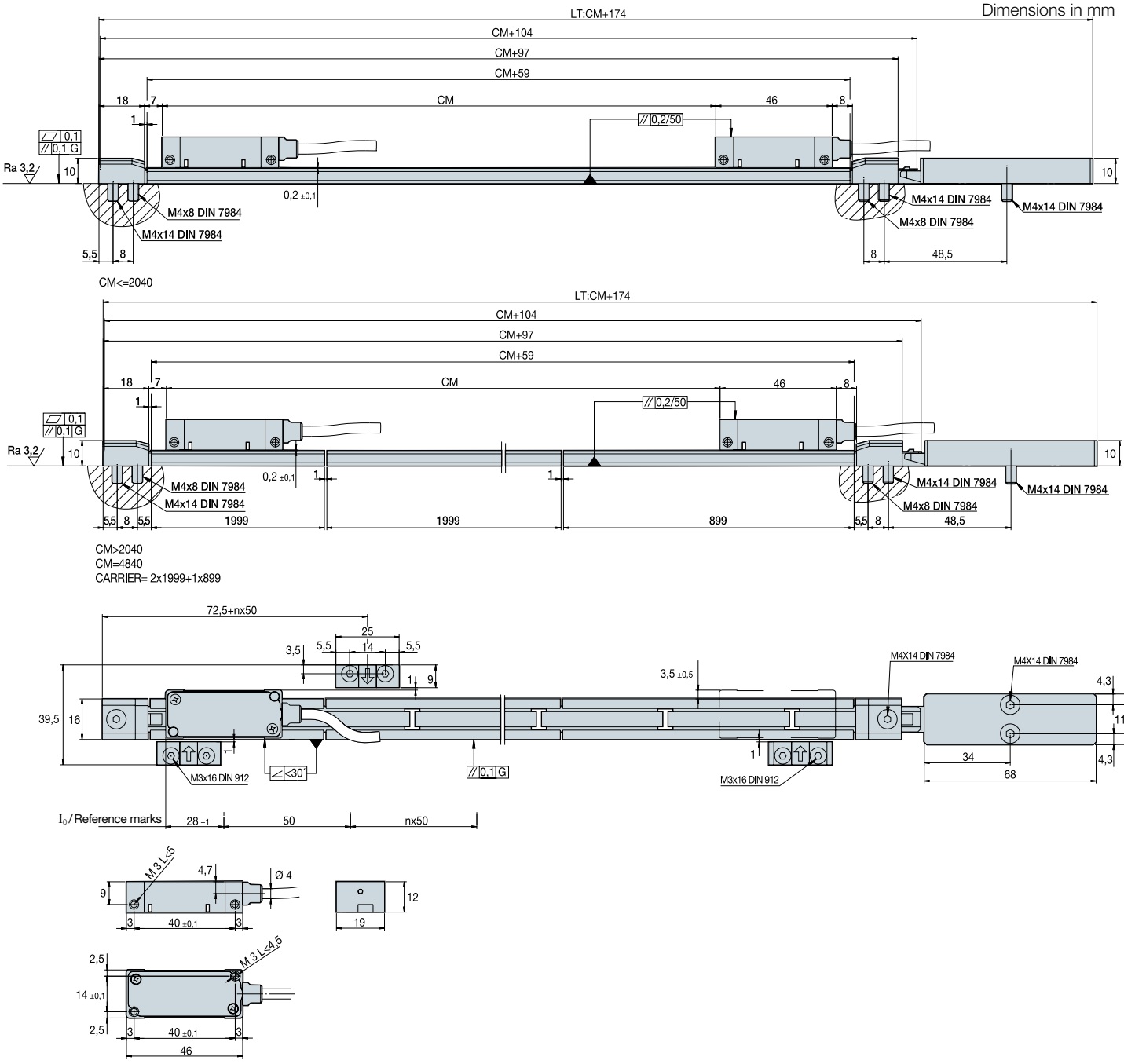
PT + TT + L2R: non-contact open linear encoder with an incremental reader head, incremental I_0 (every 50 mm) and a tensioned incremental tape with an aluminum adhesive guide. Indicate PTS for bolted guided.

PT + TT + L2S: non-contact open linear encoder with an incremental reader head, I_0 that may be selected with a magnet and a tensioned incremental tape with an aluminum adhesive guide. Indicate PTS for bolted guided.

Characteristics

	PT +TT +L2RD	PT +TT +L2RX	PT +TT +L2RY	PT +TT +L2RW	PT +TT +L2RW1	PT +TT +L2RP
Measurement	Incremental: By means of a 20 µm-pitch graduated steel tape					
Steel thermal expansion coefficient	α_{therm}: ≈ 11 ppm/K.					
Measuring resolution	5 µm	1 µm	0.5 µm	0.1 µm	0.1 µm	Up to 0.1 µm
Output signals	⊔⊓ TTL differential	⊔⊓ TTL differential	⊔⊓ TTL differential	⊔⊓ TTL differential	⊔⊓ TTL differential	∿ 1 Vpp
Incremental signal period	20 µm	4 µm	2 µm	0.4 µm	0.4 µm	20 µm
Limit frequency	200 kHz	1 MHz	1 Mhz	1.5 Mhz	2.5 Mhz	400 Khz
Maximum speed	240 m/min	240 m/min	120 m/min	36 m/min	60 m/min	480 m/min
Minimum distance between flanks	1.2 µs	0.2 µs	0.2 µs	0.2 µs	0.05 µs	–
Reference marks I_0	L2RD, L2RX, L2RY, L2RW, L2RW1, L2RP: every 50 mm L2SD, L2SX, L2SY, L2SW, L2SW1, L2SP: I_0 that may be selected with a magnet					
Limits	Open collector, active low. Activation by magnets					
Maximum cable length	50 m	50 m	50 m	50 m	50 m	150 m
Supply voltage	5V ±5 %, < 150 mA (without load)	5V ±5 %, < 150 mA (without load)	5V ±5 %, < 150 mA (without load)	5V ±5 %, < 150 mA (without load)	5V ±5 %, < 150 mA (without load)	5V ±10 %, < 150 mA (without load)
Reader head	1 or 3 meter cable with a connector					
Reader head protection	IP 40					
Accuracy	± 5 µm /m					
Maximum vibration	200 m/s² (55 … 2000 Hz) IEC 60068-2-6					
Maximum shock	1000 m/s² (11 ms) IEC 60068-2-27					
Operating temperature	0 °C … 50 °C					
Storage temperature	-20 °C ... 70 °C					
Weight	0.27 kg + 0.26 kg/m					
Relative humidity	20 … 80 %					

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 Non-contact linear Encoder: PT70 + TT-62 + L2RX-3C1

Guide		Tape	
PT	**70**	**TT**	**64**
PT: adhesive guide for tensioned tape PTS: bolted guide for tensioned tape	***Lengths in centimeters -1:*** In the example 70 = 699 mm	Incremental graduated tape for the tensioned model	***Measuring lengths in centimeters:*** In the example 64 = 640 mm

Reader head

L2	R	X	3	C1
Single-body reader head with LED	***Type of reference mark*** I_0: **R: incremental every 50 mm** S: may be selected with a magnet	***Type of signal:*** D: 5 µm resolution differential TTL **X: 1 µm resolution differential TTL** Y: 0.5 µm resolution differential TTL W/W1: 0.1 µm resolution differential TTL P: 1 Vpp sinusoidal	***Cable length:*** 1: 1 meter **3: 3 meters**	***Connector:*** D: Sub D HD 15 M H2: YASKAWA® **C1: M-F threaded 12-pin round connector** C5: M-M threaded 12-pin round connector

CONNECTION TO FAGOR CNC

UP TO 3 METERS

For direct connection to FAGOR

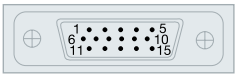
L2...-D

Lengths: 1 and 3 meters

Cable included

SUB D 15 HD connector (male Pin)

Pin	Signal	Color
1	A	Green
2	/A	Yellow
3	B	Blue
4	/B	Red
5	I_0	Grey
6	$/I_0$	Pink
7	L2	Black
8	/AL (L1)	Purple
9	+5 V	Brown
10	+5 V sensor	Blue/Red (Orange)
11	0 V	White
12	0 V sensor	Grey/Pink (colorless)
Housing	Ground	Shield



FROM 3 METERS ON

L2...-C1 cable + XC-C2-...D extension cable

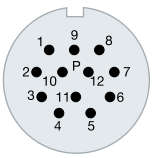
L2...-C1

Lengths: 1 and 3 meters

Cable included

M23 12 connector (male Pin)

Pin	Signal	Color
5	A	Green
6	/A	Yellow
8	B	Blue
1	/B	Red
3	I_0	Grey
4	$/I_0$	Pink
7	/AL (L1)	Purple
12	+5 V	Brown
2	+5 V sensor	Blue/Red (Orange)
10	0 V	White
11	0 V sensor	Grey/Pink (colorless)
9	L2	Black
Housing	Ground	Shield



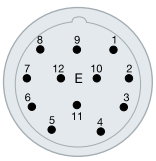
XC-C2-...D extension cable

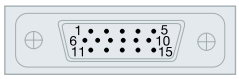
Longitudes: 5, 10, 15, 20 y 25 metros

M23 17 connector (female Pin)

SUB D 15 HD connector (male Pin)

Pin	Pin	Signal	Color
5	1	A	Brown
6	2	/A	Green
8	3	B	Grey
1	4	/B	Pink
3	5	I_0	Red
4	6	$/I_0$	Black
7	8	/AL (L1)	Purple
9	7	L2	Yellow
12	9	5 V	Brown/ Green
2	9	+5 V sensor	Blue
10	11	0 V	White/ Green
11	11	0 V sensor	White
Housing	Housing	Ground	Shield





CONNECTION TO OTHER CNC'S

UP TO 3 METERS

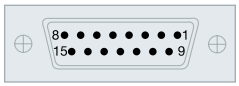
For direct connection to YASKAWA®

L2...-H2

Lengths: 1 and 3 meters

Cable included
SUB D 15 connector (male Pin ■)

Pin	Signal	Color
1	A	Green
9	/A	Yellow
3	B	Blue
11	/B	Red
14	I_0	Grey
7	$/I_0$	Pink
8-13	/AL (L1)	Purple
6	L2	Black
4	+5 V	Brown
12	+5 V sensor	Blue/Red (Orange)
2	0 V	White
10	0 V sensor	Grey/Pink
Housing	Ground	Shield



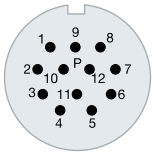
For direct connection to SIEMENS® Solution Line SME20 (1 Vpp only)

L2...-C5

Lengths: 1 and 3 meters

Cable included
M23 12 connector (male Pin ■)

Pin	Signal	Color
5	A	Green
6	/A	Yellow
8	B	Blue
1	/B	Red
3	I_0	Grey
4	$/I_0$	Pink
7	/AL (L1)	Purple
12	+5 V	Brown
2	+5 V sensor	Blue/Red (Orange)
10	0 V	White
11	0 V sensor	Grey/Pink (colorless)
9	L2	Black
Housing	Ground	Shield



FROM 3 METERS ON

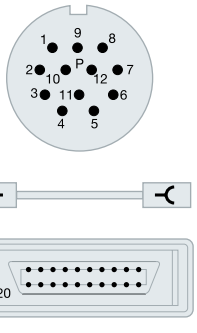
p 31 For connection to FANUC® (for Separate Detector Unit SDU): **L2...-C1 Cable + XC-C2...-FN1 extension cable**
For connection to SIEMENS® SME20 (1 Vpp only): **L2...-C5 Cable + XC-C4...-C5 extension cable**
p 32 For connection to SIEMENS® SMC20 (1 Vpp only): **L2...-C5 Cable + XC-C4...-S3 extension cable**
For connection to SIEMENS® SMC30 (differential TTL only): **L2...-C5 Cable + XC-C4...-S2 extension cable**
Without connector for other applications: **L2...-C1 Cable + XC-C2...-O extension cable**

XC-C2-...-FN1 extension cable

Lengths: 5, 10, 15, 20 and 25 meters

M23 12 connector (female Pin ⊁)
HONDA / HIROSE connector (female Pin ⊀)

Pin ⊁	Pin ⊀	Signal	Color
5	1	A	Brown
6	2	/A	Green
8	3	B	Grey
1	4	/B	Pink
3	5	I_0	Red
4	6	$/I_0$	Black
12	9	+5 V	Brown/ Green
2	18-20	+5 V sensor	Blue
10	12	0 V	White/ Green
11	14	0 V sensor	White
Housing	16	Ground	Shield

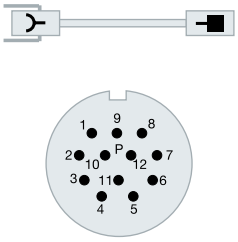


XC-C4-...-C5 extension cable

Lengths: 5, 10, 15, 20 and 25 meters

M23 12 connector (female Pin ⊁)
M23 12 connector (male Pin ■)

Pin ⊁	Pin ■	Signal	Color
5	5	A	Brown
6	6	/A	Green
8	8	B	Grey
1	1	/B	Pink
3	3	I_0	Red
4	4	$/I_0$	Black
12	12	+5 V	Brown/ Green
2	2	+5 V sensor	Blue
10	10	0 V	White/ Green
11	11	0 V sensor	White
7	7	/Alarm	Purple
Housing	Housing	Ground	Shield



Direct connection cables

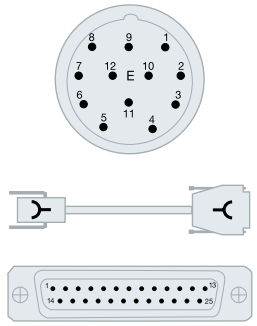
CONNECTION TO OTHER CNC'S

XC-C4-...-S3 extension cable

Lengths: 5, 10, 15, 20 and 25 meters

M23 12 connector (female Pin)
SUB D25 connector (female Pin)

Pin	Pin	Signal	Color
5	3	A	Brown
6	4	/A	Green
8	6	B	Grey
1	7	/B	Pink
3	17	I_0	Red
4	18	/I_0	Black
12	1	+5 V	Brown/ Green
2	14	+5 V sensor	Blue
10	2	0 V	White/ Green
11	16	0 V sensor	White
Housing	Housing	Ground	Shield

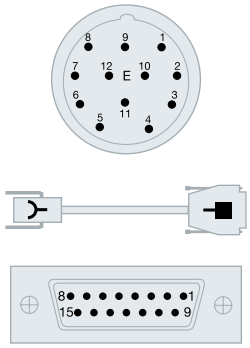


XC-C4-...-S2 extension cable

Lengths: 5, 10, 15, 20 and 25 meters

M23 12 connector (female Pin)
SUB D15 connector (male Pin)

Pin	Pin	Signal	Color
5	15	A	Brown
6	14	/A	Green
8	13	B	Grey
1	12	/B	Pink
3	10	I_0	Red
4	11	/I_0	Black
12	4	+5 V	Brown/ Green
	5	+5 V	
2	6	+5 V sensor	Blue
10	2	0 V	White/ Green
11	16	0 V sensor	White
Housing	Housing	Ground	Shield

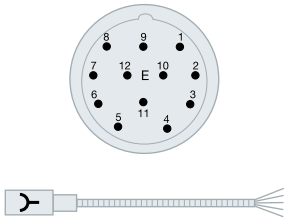


XC-C2...O extension cable

Lengths: 5, 10, 15, 20 and 25 meters

M23 12 connector (female Pin)

Pin	Signal	Color
5	A	Brown
6	/A	Green
8	B	Grey
1	/B	Pink
3	I_0	Red
4	/I_0	Black
7	/AL (L1)	Purple
9	L2	Yellow
12	+5 V	Brown/Green
2	+5 V sensor	Blue
10	0 V	White/Green
11	0 V sensor	White
Housing	Ground	Shield

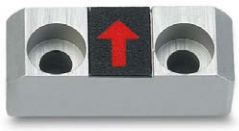
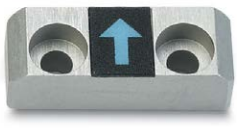


ACCESSORIES

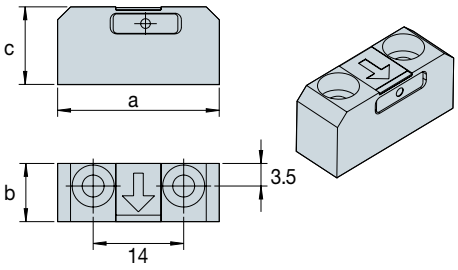
Magnets

Magnetic actuators are used to activate the limit switches, and to select the reference-marks.
The magnetic actuators can have either a metal or plastic housing.

– Adhesive or screw on metal housing.

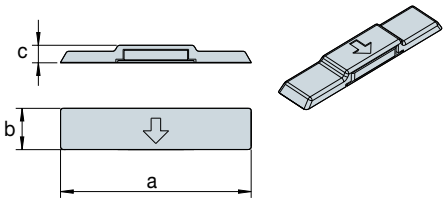

Encoder and signal	Arrow color	Description	a	b	c
Adhesive, limit 1	Red	MA-L1	25	9	8
Adhesive, limit 2	Blue	MA-L2			
Adhesive, reference	Grey	MA-R			
Guided, limit 1	Red	MG-L1	25	9	9.5
Guided, limit 2	Blue	MG-L2			
Guided, reference	Grey	MG-R			
Tensioned, limit 1	Red	MT-L1	25	9	12
Tensioned, limit 2	Blue	MT-L2			
Tensioned, reference	Grey	MT-R			



– Adhesive plastic housing.



Encoder and signal	Arrow color	Descripción	a	b	c
Adhesive and guided, limit 1	Red	MAG-L1	30	6.5	2.7
Adhesive and guided, limit 2	Blue	MAG-L2			
Adhesive and guided, reference	Grey	MAG-R			



AA or AAA applier

The applier is used to stick the adhesive tape onto the machine surface for proper alignment with the reader head.

Other languages are available in the Downloads section from Fagor Automation's website.

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