Magnetic length and angle measuring system **MPI-15**

Software version E0.2

Subject to modification in technic and design.

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1. Safety instruction

The product has been developed and built in accordance with the recognized rules of technology. The units have left the manufacturing plant ready to operate and in safe condition.

To keep the units in this condition, it is necessary that the units are installed and operated properly, in a safety and hazard-conscious manner, under observance of this operating manual and in particular of the following safety precautions.

Make sure that the personnel has read and understood the operating manual and in particular the "Safety Instructions" chapter.

In addition to the operating manual, the generally applicable legal and other binding regulations for accident prevention and environmental protection must be observed and ensured.

This manual is intended as a supplement to already existing documentation (catalogues, data sheets and assembly instructions).

Proper use

The units may only be operated:

- in the properly installed state and
- in accordance with the specifications of the technical data.

⚠ Operation not covered by the specified descriptions/parameters, in conjunction with the systems/machines/processes to be controlled/monitored, is improper and can lead to:

- fatal injuries,
- serious damage to health,
- property damage or
- damage to the units

⚠ As a result of a failure/malfunction or incorrect operation of the units,

- a life-threatening danger,
- health risks or
- a danger of property or environmental damage

could result, if the units are used to control/monitor machines or processes. Then appropriate safety precautions must be taken.

Do not open the housing of the units or make any changes to it. Tampering with the units can have a negative effect on their operating safety, causing danger. Do not make repairs on the units. Return defective units to the manufacturer.

The correct behaviour of the **MPI-15** is assured when the device is used in combination with the magnetic band M-BAND-10. The manufacturer is not responsible for possible malfunctions caused by the use of a different magnetic band.

2. System description

The **MPI-15**, made of a LCD multifunction display with integrated position sensor, combined with the magnetic band M-BAND-10, is a complete system for the measurement of linear and angular displacement. Characterised by extremely easy assembly, it allows precise alignment and positioning, reducing times and machining procedures to a minimum.

- Multifunction LCD with 5 function keys.
- Absolute/ incremental mode.
- Programmable offset function.
- External battery power supply 1.5 VDC.
- Buffered memory during battery substitution.
- Accidental polarity inversion protection.
- Magnetic sensor envelope material: anodized aluminium.

MPI-15 Technical data	
Battery life	1.5 years (C-type battery)
Resolution (1)	0.1 mm - 0.01 in - 0.01°
Accuracy (2)	0.1 mm
Repeatability (3)	0.01 mm
Operating speed	max 5 m/s
Self-diagnostic	battery check, sensor check, magnetic tape check
Programmable measuring unit	millimetres, inches, degrees (angles)
Working temperature	from 0°C to 50°C
Storage temperature	from -20°C to 70°C
Humidity	max 95% at 25°C without condensation
Protection level	IP40 whole device IP54 front side according to IEC 529 IP67 magnetic sensor
Interference protection	class 3 according to IEC 801

(1) Resolution: the smallest change in length that the system is capable of displaying.
(2) Precision: the maximum deviation of the value measured by the system from the actual one.
(3) Repeat accuracy: the degree of closeness between a series of measures of the same sample, when the single measurements are carried out leaving the measurement conditions unchanged.

Display

Battery case

Magnetic sensor
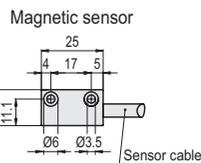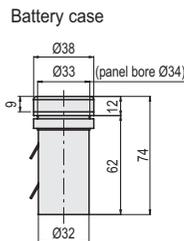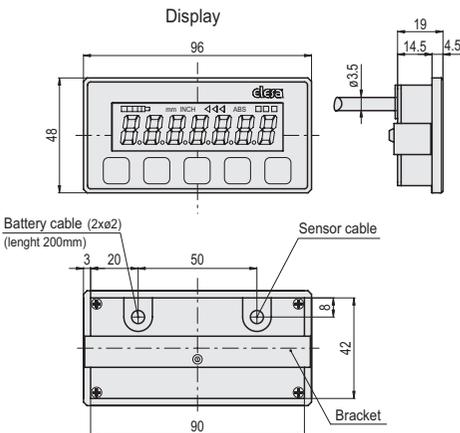
The magnetic band M-BAND-10 is made of two separate parts: the magnetic band and the cover strip. The magnetic band is made of a magnetic tape, a carrier strip and an adhesive tape (Fig. 1). The cover strip is made of a protection strip and an adhesive tape (Fig. 2).

Fig.1
Cover strip

Protection strip (0.1 mm)

Adhesive tape (0.13 mm)

Fig.2
Magnetic band

Magnetic tape (1 mm)

Carrier strip (0.3 mm)

Adhesive tape (0.13 mm)

Fig.3
Proper assembling

Cover strip
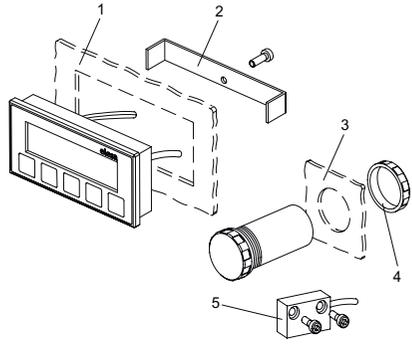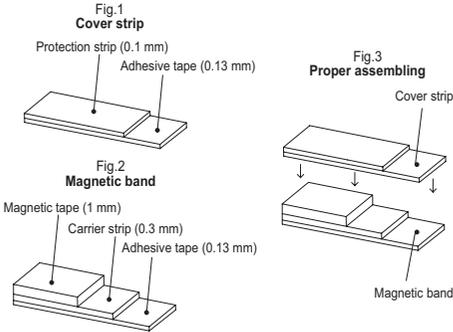
Magnetic band

M-BAND-10 Technical data	
Accuracy class	± 40 µm
Material	magnetic tape: nitrilic rubber
	carrier strip: stainless steel
	cover strip: stainless steel
	acrylic adhesive tape
Width	magnetic band: 10 mm ± 0.20 mm
	cover strip: 10 mm ± 0.20 mm
Thickness	magnetic band: 1.43 ± 0.15 mm
	cover strip: 0.23 mm
Magnetic pole pitch	5 mm
Operating and storage temperature	min -40°C max +100°C
Linear thermic expansion factor	17×10^{-6}/K

3. Installation

3.1 Display and battery case installation
1) Make a drilling of 42 $^{+0.2/+0.5}$ mm x 90 $^{+0.2/+0.5}$ mm in the metal sheet for the installation of the display.
2) Fix the display to the panel by using the specific mounting bracket (the screw is included in the supply).
3) Make a drilling of diameter 34 $^{+0.2/+0.5}$ mm in the metal sheet for the installation of the battery case.
4) Fix the battery case to the panel by using the specific nut.
5) Fix the magnetic sensor by using M3 screws (not included in the supply). Distance between sensor and magnetic tape to ensure a correct reading of the displacement: max 2.5 mm.

Drilling template for display

Drilling template for battery case

(remove all drilling burrs before fitting the display / battery case)

$90 \, ^{+\,0.5}_{+\,0.2}$

$R_{\max 1}$

$42 \, ^{+\,0.5}_{+\,0.2}$

$34 \, ^{+\,0.5}_{+\,0.2}$
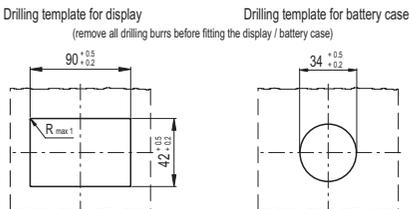
The cable layout should be outlined to prevent damages due to cable strain or contacts of the cable with other machine components. It is recommended that the cable is installed sufficiently far from magnetic / electromagnetic sources.

Battery type
Batteries are not supplied together with the MPI-15. The following standard battery is recommended: 1 x C battery

Battery substitution
When the display shows the battery symbol, the battery should be replaced as soon as possible. After the removal of the battery, the display memory is buffered for approximately 60 seconds. Substitute the battery within this time frame.

3.2 Magnetic band installation
The cover strip must be installed over the magnetic band to protect it from possible mechanical damages.
1) Clean the mounting surface carefully.
2) Remove the protective foil from the adhesive tape of the magnetic band.
3) Stick the magnetic band on the mounting surface.
4) Clean the surface of magnetic band carefully.
5) Remove the protective foil from the adhesive tape of the cover strip.
6) Stick the cover strip on the magnetic band.
7) In the absence of a seat for the housing of M-BAND-10, secure the ends of the cover strip to prevent unintentional peeling.

The mounting surface must be flat. Buckles or bumps will lead to measuring inaccuracies.
To guarantee an optimal adhesion of the adhesive tapes, the mounting surfaces must be perfectly cleaned, dry and smooth.
The following surface roughness is recommended: Ra <= 3,2 N8 (Rz <= 25). To maximize the adhesion install the strip applying pressure. Gluing should preferably be carried out at temperatures between 20 °C to 30 °C and in dry atmosphere.

Once the installation is completed, the calibration procedure must be carried out as shown at Paragraph 7.

4. Keys' function

Programming

Display:
battery change, unit of measure,
incremental mode, absolute mode,
processing, digits

Select value
Select incremental
mode or absolute mode

Select digit
Select unit of measure

Set
function
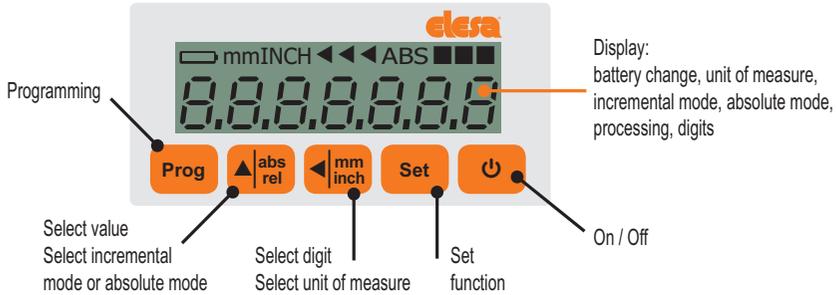
On / Off

5. Operating mode

5.1 Commissioning

Use the [⏻] key to switch on / off the system.

5.2 Absolute mode / incremental mode selection

Press the [▲ abs/rel] key to switch from absolute mode to incremental mode and vice versa. The selected mode is indicated on the display by the symbols:

ABS - absolute

◄◄◄ - incremental

When the incremental mode (◄◄◄) is selected, the incremental counter is automatically set to zero.

5.3 Unit of measure selection

If parameter $unitS$ is enabled ($EnAbLE$), the unit of measure is selected by pressing the [◄ mm/inch] key. The available options are the following: mm (0.1), inch (0.001), degrees (0.01), degrees (0.1), degrees (1).

If parameter $unitS$ is disabled ($diSAbLE$), the unit of measure cannot be changed in the operating mode.

5.4 Direct loading of the absolute reference value

If parameter $LoAd0rG$ is enabled ($EnAbLE$) and the absolute mode is selected (ABS), the reference value is directly loaded by pressing the [Set] key.

If parameter $LoAd0rG$ is disabled ($diSAbLE$) and the absolute mode is selected (ABS), the reference value is loaded by pressing the [Prog] + [Set] keys.

ℹ️ The reference value is loaded according to the selected unit of measure.

5.5 Direct reset of incremental reference value

If parameter CLr_rEL is enabled ($EnAbLE$) and the incremental mode is selected (◄◄◄), the display can be set to zero by pressing the [Set] key.

If parameter CLr_rEL is disabled ($diSAbLE$), the display can be set to zero only by switching from absolute mode (ABS) to incremental mode (◄◄◄).

5.6 Access the absolute reference value setting procedure

If parameter $ProG0rG$ is enabled ($EnAbLE$) and the absolute mode is selected (ABS), the absolute reference value setting procedure is directly run by pressing the [Prog] + [◄ mm/inch] keys.

If parameter $ProG0rG$ is disabled ($diSAbLE$), the absolute reference value setting procedure can be run only accessing the programming mode.

5.7 Access the offset value setting procedure

If parameter $ProG0FS$ is enabled ($EnAbLE$) and the absolute mode is selected (ABS), the offset value setting procedure is directly run by pressing the [Prog] + [▲ abs/rel] keys.

If parameter $ProG0FS$ is disabled ($diSAbLE$), the offset value setting procedure is directly run only accessing the programming mode.

5.8 Switching the device ON and OFF

If parameter $on\text{-}0FF$ is set to $dirECt$, the display is immediately switch off by pressing the [⏻] key.

If parameter $on\text{-}0FF$ is set to $dEL'd$, the display is switch off by pressing the [⏻] key for 4 seconds.

> ℹ️ The display is immediately switched on by pressing the ⏻ key independently from the value of the $on\text{-}OFF$ parameter.

The battery tension is shown on the display by pressing the **Prog** + ⏻ keys. The display automatically switch to the normal mode after a few seconds.

6. Programming mode

Press **Prog** for about 4 seconds **to enter** the programming mode. The time remaining to enter the programming mode is shown on the display.

Press ◀ mm inch (forward) ▲ abs rel (backward) **to scroll** the function parameters described below.

Press **Set** **to access** the current function parameters.

Press the **Set** **to store** the parameters value or press **Prog** **to exit** from the selected function without saving.

Press **Prog** **to leave** the programming mode. The device will exit from the programming mode automatically 30 seconds after the last key is pressed.

The available parameters and their description are reported in the table (see pages 7, 8).

7. Sensor calibration procedure

The sensor calibration procedure must be carried out at the initial machine setting and in case of substitution of the position indicator.

a. Install the position indicator as described in Paragraph 3.

b. Enter the programming mode and run the sensor calibration procedure by means of the parameter $SEtUP$.

c. A confirmation message is displayed: press **Set** to confirm, **Prog** to exit the procedure.

d. The following message is displayed: PRESS SET TO START SETUP. Press **Set** to confirm.

e. Move the sensor for about 100 mm. The display shows the procedure progress.

f. Once the procedure is completed, the display switch to the operating mode.

8. Angle measurement

For angle measurement on a circular track, one of the available angular unit of measure (degrees (0.01), degrees (0.1), degrees (1)) must be selected by means of the ◀ mm inch key or by means of the **rES** parameter. When an angular unit of measure is selected, the measured distance is multiplied by the coefficient defined by the parameter AnG_cor, which must be set as follows:

$$AnG\_cor = \frac{3600}{2\,\pi\,R}$$

Where R is the radius of the circular track measured in mm.

> ℹ️ The AnG_cor parameter is neglected when a linear unit of measure is selected (mm, inch)

Example: circular track with radius R=1000 mm

$$AnG\_cor = \frac{3600}{2\,\pi\,1000} = 0.57324$$

Parameter	Description	Available options	Std Value
dir	Counting Direction	Press [▲abs/rel] to choose between *-dir* (negative) and *dir-* (positive).	*-dir*
OriGin	Reference Value	The parameter value is shown on the display. Press [▲abs/rel] to increase the flashing number/ mark. Press [◄mm/inch] to select the next number. Programmable value **0.00000 +/- 9.99999**.	*0.0*
OFFSEt	Offset Value	The parameter value is shown on the display. Press [▲abs/rel] to increase the flashing number/ mark. Press [◄mm/inch] to select the next number. Programmable value **0.00000 +/- 9.99999**.	*0.0*
UnitS	Unit of measure	The parameter enables or disables the units of measure key in the operating mode. Press [▲abs/rel] or [◄mm/inch] to choose between: *EnAbLE*: the unit of measure can be changed by pressing the [◄mm/inch] key in the operating mode. *diSAbLE*: the unit of measure cannot be changed in the operating mode.	*diSAbLE*
rES	Resolution	The parameter allows defining the resolution of the display. Press [▲abs/rel] or [◄mm/inch] to choose between the available options: **mm (0.1), inch (0.001), degrees (0.01), degrees (0.1), degrees (1)**.	*mm 0.1*
Lin_cor	Linear scale coefficient	The parameter value is shown on the display. Press [▲abs/rel] to increase the flashing number/ mark. Press [◄mm/inch] to select the next number. Programmable value **0.00001 +/- 9.99999.** 0.00000 cannot be accepted (the coefficient is automatically set to 1.00000).	*1.00000*
AnG_cor	Angular scale coefficient	The parameter value is shown on the display. Press [▲abs/rel] to increase the flashing number/ mark. Press [◄mm/inch] to select the next number. Programmable value **0.00000 +/- 9.99999.** 0.00000 cannot be accepted (the coefficient is automatically set to 1.00000). See Par. 8 for angle measurement description.	*1.00000*
AutoOFF	Automatic Switch-off	The parameter enables or disables the automatic switch-off. Use [▲abs/rel] and [◄mm/inch] to choose between: *EnAbLE*: the display automatically switches off after the selected period of time (parameter *t-out*). *diSAbLE*: display does not switch-off automatically.	*diSAbLE*
t-out	Switch-off time	Use [▲abs/rel] and [◄mm/inch] to choose between the available values (in hours). Select **0.2;0.5;1;2;4;8** (in hours). When unused, the display automatically switch off after the **switch-off time**.	*0.2 h*
on-OFF	Switch-off mode	The parameter allows defining the switch-off mode. Use [▲abs/rel] and [◄mm/inch] to choose between: *dirECt*: the display switches off immediately by pressing [⏻] *dEL'd*: the display switches off by pressing [⏻] for about 4 seconds	*dirECt*
LoadOrG	Reference value loading mode	The parameter allows defining the reference value loading mode. Use [▲abs/rel] and [◄mm/inch] to choose between: *EnAbLE*: in the absolute mode (*ABS*) the absolute reference value is loaded by pressing [Set] *diSAbLE*: in the absolute mode (*ABS*) the absolute reference value is loaded by pressing [Prog] + [Set]	*diSAbLE*
CLr_reL	Incremental counter reset mode.	The parameter allows defining the incremental counter reset mode. Use [▲abs/rel] and [◄mm/inch] to choose between: *EnAbLE*: in the incremental mode (◄◄◄) the incremental counter is set to zero by pressing [Set] *diSAbLE*: in the incremental mode (◄◄◄) the incremental counter cannot be set to zero (the incremental counter is set to zero when the incremental mode is selected).	*diSAbLE*

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Parameter	Description	Available options	Std Value
ProG0rG	Direct reference value setting	The parameter allows enabling the direct reference value setting procedure. Use [▲abs/rel] and [◀mm/inch] to choose between: *EnAbLE*: in the operating mode the parameter *OriGin* can be modified by pressing [Prog] + [◀mm/inch] *diSAbLE*: the parameter *OriGin* can be modified only by entering the programming mode.	*diSAbLE*
ProG0FS	Direct offset value setting	The parameter allows enabling the direct offset value setting procedure. Use [▲abs/rel] and [◀mm/inch] to choose between: *EnAbLE*: in the operating mode the parameter *OFFSEt* can be modified by pressing [Prog] + [▲abs/rel] *diSAbLE*: the parameter *OFFSEt* can be modified only by entering the programming mode.	*diSAbLE*
LanG	Language	The parameter allows selecting the language. Use [▲abs/rel] and [◀mm/inch] to choose between: *ItALiAn* *ENGLiSH* *dEutSCH*	*ItALiAn*
SEtUP	Sensor calibration procedure	The parameter allows running the calibration procedure. Press [Set] to start the procedure. See Par. 7 for detailed procedure description.	
dEFAULt	Reset parameters to factory value	Press [Set] to reset the parameters. A confirmation message is displayed: press [Set] to confirm, [Prog] to exit the procedure.	
reL	Software release	The software release is displayed.	*E02*