

Operating Manual

SERIES Z60-014

Quasi-absolute Triple-Axis Measuring and Display System with RS485



- Quasi-absolute measuring and display system with 3 magnetic sensors for axis X, Y and Z on throughfeed drilling machines
- Due to the internal rechargeable battery, the actual position is detected permanently (also at power-off condition)
- Indicates actual position, target position and difference
- Well legible graphical LCD display with units & symbols, e. g. directional arrows and sign for indicated positions
- Specific parameters for each axis separately programmable, e. g. offset, tolerance window and measurement unit
- With serial RS485 interface for PLC communication
- Power supply 14 ... 30 VDC

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1 Contents

1	Contents	3
1.1	List of Figures	4
1.2	List of Tables	4
2	General, Safety, Transport and Storage	5
2.1	Information about the Operating Manual	5
2.2	Explanation of Symbols	5
2.3	Statement of Warranties	6
2.4	Demounting and Disposal	6
2.5	General Causes of Risk.....	6
2.6	Personal Protective Equipment.....	6
2.7	Conventional Use	7
2.8	Safety Instructions for Transport, Unpacking and Loading	7
2.9	Handling of Packaging Material	7
2.10	Inspection of Transport	7
2.11	Storage	7
3	Product Features	8
3.1	General Information.....	8
3.2	Magnetic Tape and MS2060 Sensors.....	8
3.3	Principle of Scanning	8
3.4	The quasi-absolute Measuring Principle	8
4	Technical Data	9
4.1	Identification	9
4.2	Dimensions Indicator	9
4.3	Dimensions Magnet Sensors	10
4.4	Dimensions Sensor Round Connectors	10
4.5	Technical Data Z60-014.....	11
4.6	Technical Data Magnetic Tape.....	12
5	Installation and First Start-Up.....	13
5.1	Operating Area	13
5.2	Installation of the Magnetic Tape.....	14
5.3	Installation of the Magnet Sensors	17
5.4	Installation of the Position Indicator.....	17
6	Key Functions	18
7	Normal Mode	19
7.1	Display Window and Symbols	19
7.2	Display Switchover	19
7.3	Resolution Switchover	19
7.4	Influencing Parameters.....	19

8	Parameter Level	20
8.1	Axis Parameters X / Y / Z.....	20
8.2	Settings	21
8.3	Default Parameters.....	21
8.4	Diagnosis	21
9	PLC Commands via RS485	22
9.1	Commands.....	22
9.2	Calculation of the CRC.....	24
10	Connections.....	25
10.1	Connector Arrangement.....	25
10.2	Pin Assignment of the PHOENIX Connectors.....	25
10.3	Sockets for Sensor Round Connectors	26
11	Disturbances, Maintenance, Cleaning.....	27
11.1	Fault Clearance.....	27
11.2	Re-start after Fault Clearance.....	27
11.3	Maintenance.....	27
11.4	Cleaning	27
12	Type Designation	28
12.1	Z60 Position Indicator	28
12.2	MS2060 Magnet Sensor	28
12.3	Accessories	28
13	Index	31

1.1 List of Figures

Figure 1: Z60 indicator	8
Figure 2: MS2060 sensors.....	8
Figure 3: Magnetic tape coding	8
Figure 4: Dimensions Indicator	9
Figure 5: Dimensions Magnet Sensors	10
Figure 6: Components of the magnetic tape	14
Figure 7: Handling	15
Figure 8: Angular tolerances of the Magnet Sensor.....	17
Figure 9: Installing the position indicator.....	17
Figure 10: Display overview in normal mode.....	19
Figure 11: Parameter level and its submenus	20
Figure 12: Calculation of CRC	24
Figure 13: Connector Arrangement.....	25

1.2 List of Tables

Table 1: Resistance against chemical influence.....	16
Table 2: Connection of S1 (power supply and RS485)	25
Table 3: Connection of S2 (control outputs)	25
Table 4: Connection of BU1, BU2, BU3 (sensors sockets)	26
Table 5: Accessories	28

2 General, Safety, Transport and Storage

2.1 Information about the Operating Manual

This manual contains important information regarding the handling of the device. For your own safety and operational safety, please observe all safety warnings and instructions. Precondition for safe operation is the compliance with the specified safety and handling instructions. Moreover, the existing local accident prevention regulations and the general safety rules at the site of operation have to be observed. Please read the operating manual carefully before starting to work with the device! It is part of the product and should be kept close to the device and accessible for the staff at any time. The illustrations in the manual are for better demonstration of the facts. They are not necessarily to scale and can slightly differ from the actual design.

2.2 Explanation of Symbols

Special notes in this manual are characterized by symbols. The notes are introduced by signal words which express the magnitude of danger. Please follow this advice and act carefully in order to avoid accidents, damage, and injuries.

Warning notes:

	DANGER! This symbol in connection with the signal word "Danger" indicates an immediate danger for the life and health of persons. Failure to heed these instructions can result in serious damage to health and even fatal injury.
	WARNING! This symbol in connection with the word „Warning“ means a possibly impending danger for the life and health of persons. Failure to heed these instructions can result in serious damage to health and even fatal injury.
	CAUTION! This symbol in connection with the signal word "Caution" indicates a possibly dangerous situation. Failure to heed these instructions can lead to minor injuries or damage of property.

Special safety instructions:

	DANGER! This symbol in connection with the signal word "Danger" indicates an immediate danger for the life and health of persons due to voltage. Failure to heed these instructions can result in serious damage to health and even fatal injury. The operations may only be carried out by a professional electrician.
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Tips and recommendations:

	NOTE! ...points out useful tips and recommendations as well as information for an efficient and trouble-free operation.
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Reference marks:

-  Marks a reference to another chapter of this manual.
-  Marks a reference to another chapter of another document.

2.3 Statement of Warranties

The producer guarantees the functional capability of the process engineering and the selected parameters.

2.4 Demounting and Disposal

Unless acceptance and disposal of returned goods are agreed upon, demount the device considering the safety instructions of this manual and dispose it with respect to the environment.

Before demounting, disconnect the power supply and secure against re-start. Then disconnect the supply lines physically and discharge remaining energy. Remove operational supplies and other material.

Disposal: Recycle the decomposed elements: Metal components in scrap metal, Electronic components in electronic scrap, Recycle plastic components, dispose the remaining components according to their material consistence.



CAUTION!

Wrong disposal causes environmental damages!
Electronic scrap, electronic components, lubricants and other auxiliary materials are subject to special refuse and can only be disposed by authorized specialists!

Local authorities and waste management facilities provide information about environmentally sound disposal.

Safety



CAUTION!

Please read the operating manual carefully, before using the device! Observe the installation instructions! Only start up the device if you have understood the operating manual. The operating company is obliged to take appropriate safety measure. The initial operation may only be performed by qualified and trained staff. Selection and installation of the devices as well as their embedding into the controlling system require qualified knowledge of the applicable laws and normative requirements on the part of the machine manufacturer.

2.5 General Causes of Risk

This chapter gives an overview of all important safety aspects to guarantee an optimal protection of employees and a safe and trouble-free operation. Non-observance of the instructions mentioned in this operating manual can result in hazardous situations.

2.6 Personal Protective Equipment

Employees have to wear protective clothing during the installation of the device to minimize danger of health.

Therefore:

Change into protective clothing before performing the works and wear them throughout the process. Additionally observe the labels regarding protective clothing in the operating area.

Protective clothing:

	<p>PROTECTIVE CLOTHING ... is close-fitting working clothing with light tear strength, tight sleeves and without distant parts. It serves preliminarily for protection against being gripped by flexible machine parts. Do not wear rings, necklaces or other jewelry.</p>
	<p>PROTECTIVE GLOVES ...for protecting the hands against abrasion, wear and other injury of the skin.</p>
	<p>PROTECTIVE HELMET ...for protection against injuries of the head.</p>

2.7 Conventional Use

The ELGO-device is only conceived for the conventional use described in this manual.
The ELGO Z60-014 measuring and display system only serves to measure and visualize lengths resp. axis positions.



CAUTION!

Danger through non-conventional use!
Non-intended use and non-observance of this operating manual can lead to dangerous situations.
Therefore:

- Only use the device as described
- Strictly follow the instructions of this manual

Avoid in particular:

- Remodeling, refitting or changing of the construction or single components with the intention to alter the functionality or scope of the device.

Claims resulting from damages due to non-conventional use are not possible.
Only the operator is liable for damages caused by non-conventional use.

2.8 Safety Instructions for Transport, Unpacking and Loading



CAUTION!

Transport the package (box, palette etc.) professionally.
Do not throw, hit or fold it.

2.9 Handling of Packaging Material

Notes for proper disposal: ↗ 2.4

2.10 Inspection of Transport

Check the delivery immediately after the receipt for completeness and transport damage.
In case of externally recognizable transport damages:

- Do not accept the delivery or only accept under reserve.
- Note the extent of damages on the transportation documents or delivery note.
- File complaint immediately.



NOTE!

Claim any damage immediately after recognizing it. The claims for damage must be filed in the lawful reclaim periods.

2.11 Storage

Store the device only under the following conditions:

- Do not store outside
- Keep dry and dust-free
- Do not expose to aggressive media
- Protect from direct sun light
- Avoid mechanical shocks
- Storage temperature (↗ 4) needs to be observed
- Relative humidity (↗ 4) must not be exceeded
- Inspect packages regularly if stored for an extensive period of time (>3 months)

3 Product Features

3.1 General Information

The compact position indicator Z60-014 has a graphical LCD display which allows a comfortable and accurate reading of the actual position, target position and the difference (delta) of axes X, Y and Z on throughfeed drilling machines. One axis is used to measure the position of the drilling aggregate while the other two axes measure the positions of the drilling groups.

On the back of the position indicator there are 3 round plug sockets for connecting the incremental MS2060 Magnet Sensors, which are required for position measurement of the 3 axes.

Specific parameters like offset, tolerance window and measurement unit (mm/inch) can be individually programmed for each axis.

An external PLC transmits required positions to the Z60-014. For this purpose, the Z60-014 system is equipped with a serial RS485 interface (☞ 9).



Figure 1: Z60 indicator

3.2 Magnetic Tape and MS2060 Sensors

For the measurement of the axis X, Y and Z positions, a coded magnetic tape of the type MB20-50-10-1-R is glued along the distance to be measured. The magnetic tape supplies the necessary information (actual position) to the incremental MS2060 sensors.

The sensors are guided contactless and absolutely wear-free over the magnetic tape. The maximum permissible mounting distance between sensor and magnetic tape is 2.0 mm.



Figure 2: MS2060 sensors

3.3 Principle of Scanning

The incremental MS2060 magnet sensor consists of a scanning technology, which scans the north and south poles on the magnetic tape and produces a single sine/cosine wave for each pole. The complete sine/cosine signal process is interpolated electronically. Depending on refinement of the interpolation, together with the pole pitch of the magnetic tape, the resolution of the measuring system is determined. The pole pitch of the magnetic tape MB20.50 is 5 mm.

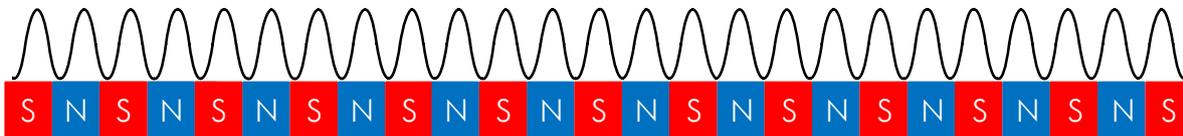


Figure 3: Magnetic tape coding

3.4 The quasi-absolute Measuring Principle

A rechargeable battery line integrated in the housing of the position indicator transforms the incremental measurement into a quasi-absolute measurement, as the current positions are permanently detected even in the de-energized state and further processed internally.

Under optimal charging and ambient conditions, the operating time of the batteries up to 6 weeks after disconnection of the supply voltage.

By using the energy safe mode (see ☞ 8.2.5) the operating time can be extended up to 12 weeks after power-off. With this setting, the maximum operating speed is reduced from 2.0 m/s to 0.5 m/s.

4 Technical Data

4.1 Identification

The type label serves for the identification of the unit. It is located on the housing of the unit and gives the exact type designation (☞ 12) with the corresponding part number. Furthermore, the type label contains a unique, traceable device number. When corresponding with ELGO always indicate this data.

4.2 Dimensions Indicator

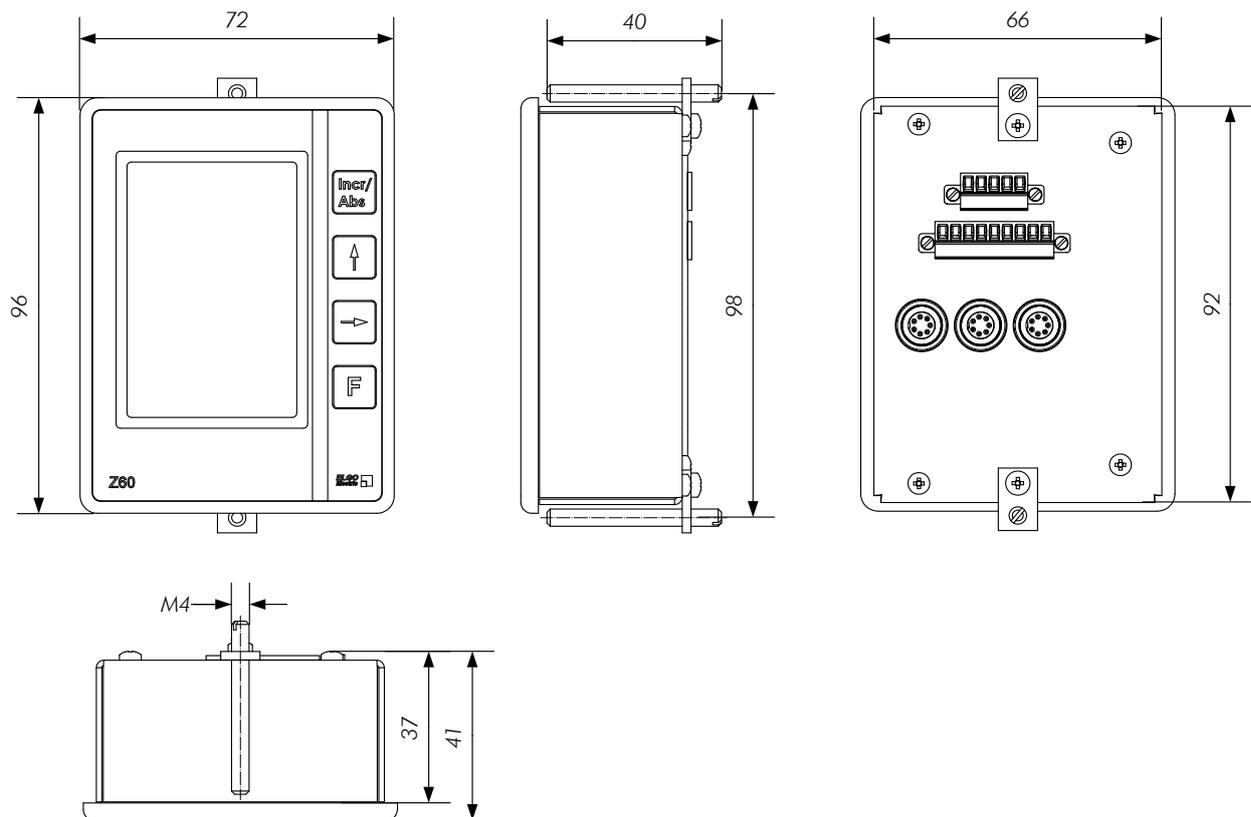


Figure 4: Dimensions Indicator

4.3 Dimensions Magnet Sensors

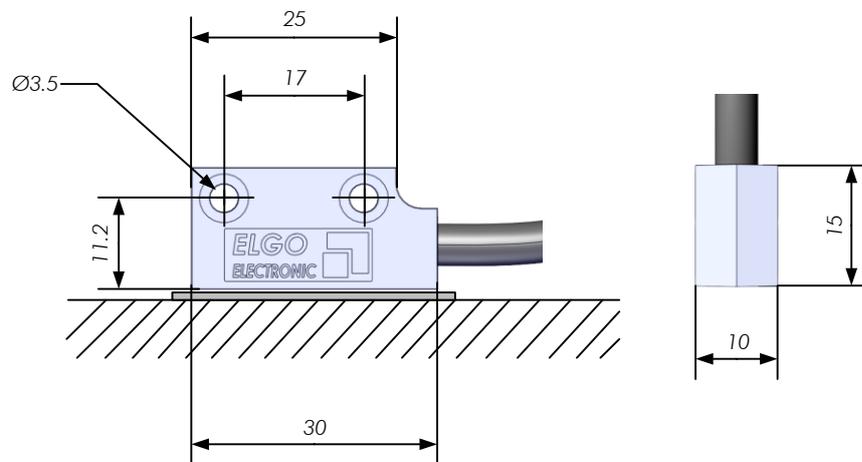


Figure 5: Dimensions Magnet Sensors

4.4 Dimensions Sensor Round Connectors

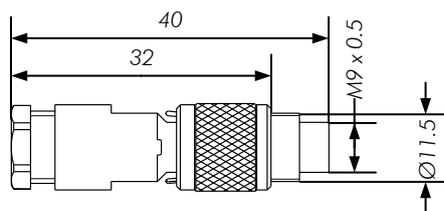


Figure 6: Dimensions Sensor Round Connector s

4.5 Technical Data Z60-014

Mechanical Data Indicator:

Housing	panel housing, aluminium
Housing dimensions	W x H = 72 x 96 mm
Installation depth	100 mm (with connectors) resp. 37 mm (without connectors)
Panel cut out	W x H = 67 x 93 mm
Keyboard	foil with short stroke keys

Electrical Data Indicator:

Display	graphical LCD (80 x 120 pixels)
Measurement units	mm or inch
Accuracy	± 1 digit
Power supply voltage	14 ... max. 30 VDC
Reverse polarity protection	integrated
Current consumption	max. 600 mA (incl. sensor load)
Interface	RS485 for communication with PLC
External inputs	3 control inputs 24 V, PNP
External outputs	3 control outputs 24 V, PNP
Connections	1 x 5-pin and 1 x 9-pin pluggable PHOENIX connector (type GF-3.81) 3 x 7-pin M9 round connector sockets for sensor connections
Power down memory	FRAM for parameters
Battery operating time	sensor supply up to 6 or 12 weeks after power-off (selectable ☞ 8.2.5)
Battery standby current	approx. 160 µA

Mechanical Data Sensor MS2060:

Housing material	zinc die cast
Dimensions (L x W x H)	30 x 10 x 15 mm
Measuring principle	magnetic, quasi-absolute
Required magnetic tape	MB20-50-10-1-R (☞ 4.6)
Magnetic tape pole pitch	5.0 mm
Distance sensor / tape	max. 2.0 mm
Maximum measuring length	theoretically unlimited
Operating speed	max. 2.0 m / s resp. 0.5 m/s in energy safe mode (☞ 8.2.5)
Connections	3 screwable 7-pin M9 plugin round connectors
Sensor cable	drag-chain suitable, 6-wire, twisted pairs and double-shielded
Sensor cable length	1.5 m (standard) others on request (☞ 12.2)
Sensor cable bending radius	min. 60 mm
Weight	approx. 30 g (without cable), cable: approx. 60 g/m

Electrical Data Sensor MS2060:

Resolution	0.01 mm
Repeat accuracy	± 0.05 mm
System accuracy in µm at 20 °C	± (25 + 20 x L) L= measuring length in meters

Environmental conditions (entire system):

Operating temperature	0 ... +50 °C
Storage temperature	-20 ... +70 °C
Humidity	max. 80 %, non-condensing
Protection class (indicator front)	IP43 (installed state)
Protection class (indicator rear)	IP20
Protection class (sensors)	IP67
Influence of external magnetic fields on the Magnet Sensors	External magnetic fields > 1 mT, which directly impinge upon the sensor, can affect the system accuracy

4.6 Technical Data Magnetic Tape

The magnetic tape consists of two components:

- The actual magnetic tape which carries the position information
- A mechanical stainless steel back iron

Magnetic Tape MB20-50-10-1-R

Coding	incremental, single track system
Pole pitch	5 mm
Operation temperature installed	-20 ... +65° C (-20 ... +80° C when using without adhesive tape, options „B“ or „D“)
Storage temperature uninstalled	Short-term: -10 ... +60° C Medium-term: 0 ... +40° C Long-term: +18° C (-20 ... +80° C when using without adhesive tape, options „B“ or „D“)
Gluing temperature:	+18 ... +30° C
Relative humidity	max. 95 %, non-condensing
Accurateness at 20°C in μm	$\pm (25 + 20 \times L)$ L = measuring length in meters
Material carrier tape	Precision strip 1.4310 / X10CrNi 18-8 (EN 10088-3)
Double-faced adhesive tape	3M-9088 (observe instructions), others on request
Dimensions	<ul style="list-style-type: none"> ➔ with carrier tape, without adhesive tape: 10 mm ($\pm 0,1$) x 1.35 mm (± 0.11) ➔ with carrier tape + adhesive tape, without protection foil: 10 mm ($\pm 0,1$) x 1.56 mm (± 0.13) ➔ with carrier tape + adhesive tape + protection foil: 10 mm ($\pm 0,1$) x 1.63 mm (± 0.14)
Length expansion coefficient	$\alpha \approx 16 \times 10^{-6} 1/\text{K}$
Thermal length expansion	$\Delta L[\text{m}] = L[\text{m}] \times \alpha[1/\text{K}] \times \Delta \vartheta[\text{K}]$ (L = tape length in meters, $\Delta \vartheta$ = relative temperature change)
Bending radius	min. 150 mm
Available lengths	up to 32 m (up to 70m on request)
Weight magnetic tape	ca. 62 g/m (incl. magnetic tape and cover tape)
Tape imprint	ELGO standard, printing color black, digit height ≥ 5 mm
Influence of external magnets	External magnetic fields must not exceed 64 mT (640 Oe; 52 kA/m) on the surface of the magnetic tape because this could damage or destroy the code on the tape
Protection class	IP65

5 Installation and First Start-Up

**CAUTION**

Please read the operating manual carefully before using the device! Strictly observe the Installation instructions! In case of damage caused by failure to observe this operating manual, the warranty expires.

ELGO is not liable for any secondary damage and for damage to persons, property or assets.

The operator is obliged to take appropriate safety measures. The first start-up may only be performed by staff that has been trained and authorized by the operator.

5.1 Operating Area

**WARNING!**

Do not use the device in explosive or corrosive environments! The device must not be installed close to sources of strong inductive or capacitive interference or strong electrostatic fields!

**CAUTION!**

The electrical connections must be made by suitably qualified personnel in accordance with local regulations.



The device may be designed for switchboard mounting. During work on the switchboard, all components must be de-energized if there is a danger of touching the energized parts! (protection against contacts)



Wiring works may only be performed in the de-energized state!



Thin cable strands have to be equipped with end sleeves!

Before switching on the device, connections and plug connectors have to be checked!

The device must be mounted in a way that it is protected against harmful environmental influences such as splashing water, solvents, vibration, shock and severe pollution and the operating temperature must not be exceeded.

5.2 Installation of the Magnetic Tape



NOTE External Magnetic Fields

The magnetic tape must not be influenced by external magnetic fields! The magnetic tape must not come into direct contact with other magnetic fields (e.g. permanent magnets, magnetic clamps, electromagnets, magnetic stands)! This may cause irreparable damage, which will compromise the measuring accuracy or even the functioning.

5.2.1 The Magnetic Tape MB20-50-10-1-R

In the standard case, the magnetic tape is delivered as described
It is installed by gluing it to the respective mounting surface.

The magnetic tape consists of 2 pre-assembled components:

- A magnetized, flexible plastic tape (Pos. 3), which is connected with a magnetically conductive steel tape as inference band (Pos. 4) and is supplied with an adhesive tape (Pos. 5).
- A magnetized permeable cover tape (Pos. 1), which serves for the mechanical protection of the plastic tape (not required for the measurement) and is supplied with an adhesive tape (Pos. 2).

Therefore a divergent tape structure and scope of delivery is also possible.
The cover tape is also available separately

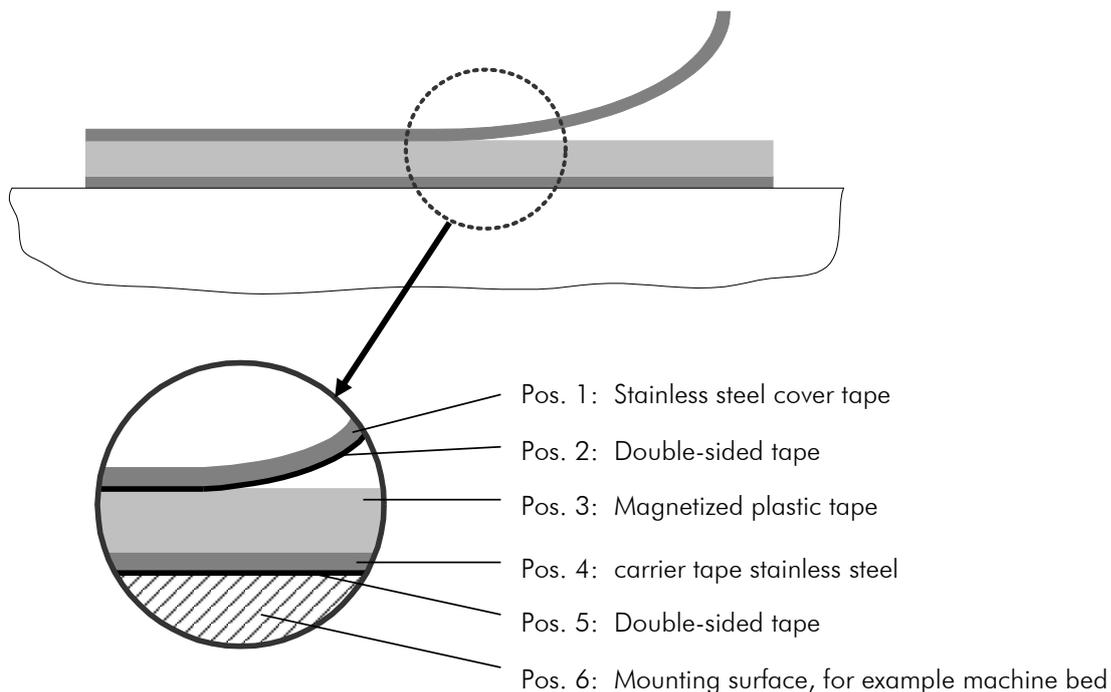


Figure 7: Components of the magnetic tape

5.2.2 Handling

In order to avoid tension in the tape, it must not be stretched, compressed or twisted. It should be stored with the magnetized plastic tape to the outside (see figure below). The minimum bending radius must be noted here.



Figure 8: Handling

5.2.3 Processing hint for the gluing of magnetic tapes

Surface-Preparation: In order to guarantee optimal adhesion, all anti-adhesive contamination (e.g. oil, grease, dust, separating agents) has to be removed using solvents with residue-free evaporation. Suitable agents are ketones or alcohols. Typical solvents for cleaning the surface are a 50/50 isopropyl alcohol/water mixture or heptane. Those agents are offered by Loctite and 3M among others as surface cleaners. When using solvents, always observe the manufacturer instructions! If the surface is copper, brass etc., it should be sealed to avoid oxidation.

Contact-Pressure: The strength of the adhesion is directly dependent on the contact the adhesive can form with the surface. Therefore it is important to use as much pressure as possible when gluing the tape, possibly by using aids such as draw rolls. The optimum contact pressure is 4 ... 5 kg/cm².

Gluing temperature: The optimal gluing temperature is between + 18° C and 30° C. Avoid colder sticking surfaces than + 10°C, because in this case the adhesive becomes too hard and perhaps a sufficient immediate adhesion is hardly to achieve. After proper sticking, the stability of the connection is ensured also when the temperature is below zero. The final tackiness of a sticking is from experience reached after approximately 72 hours (at + 21° C). For gluing use only the supplied adhesive tape.

5.2.4 Cutting and Gluing

Before starting the gluing process, both the magnetic and the cover tape have to be cut to the required length

Length cover tape = measuring length + sensor length + 50mm (end caps)



NOTE!

When sticking the magnetic tape pay attention to the markings on the tape and the Sensor. Improper installation does not provide the correct values. A already glued magnetic tape is destroyed after the removal, and cannot be used again. Note also the direction of counting of the measuring system

Preferably the magnetic tape should be glued close to an edge or into a groove, which should be deep enough to embed the magnetic tape and the cover tape.

When unprotected, the cover tape may peel off!

Therefore: Use tape end caps (☞ 12.2) or let the cover tape overlap the end of the magnetic tape and fix it with a screw.

The tape must be glued smoothly on the surface. The measuring accuracy decreases if the tape is not even! Before gluing the magnetic tape and the cover tape onto the surface, they should be left lying on the mounting surface for ca. 30 minutes so that the temperature matches. This prevents strain in the tape due to thermal expansion.

Mounting steps:

1. Thoroughly clean surface (☞ 5.2.3)
2. Let magnetic tape and cover tape adjust their temperature
3. Remove protection foil of adhesive tape on magnetic tape
4. Glue magnetic tape using great pressure
5. Thoroughly clean surface of magnetic tape
6. Remove protection foil of adhesive tape on cover tape
7. Glue cover tape using great pressure
8. Safeguard the ends of the cover tape against peeling off (☞ 12.3)

5.2.5 Resistance against Chemical Influence

Table 1: Resistance against chemical influence

Show no or little effect in constant contact after 2-5 years:

formic acid	glycerol 93°C	linseed oil	soy beans oil
cotton seed oil	N-hexane	lactic acid	
formaldehyde 40%	Iso octane	petroleum	

Show weak to moderate effects in constant contact after approximately 1 year:

acetone	gasoline	acetic acid 30%	oleic acid
acetylene	steam	acetic acid, pure acetic acid	sea water
ammonia	acetic acid 20%	isopropyl ether	stearic acid 70°C, anhydrous
kerosene			

Have strong effects when contacting permanently after 1-5 months:

benzene	nitric acid 70%	turpentine	toluene
lacquer solvent	nitric acid, red, vitriolic	carbon tetrachloride	tetrahydrofuran
trichloroethylene	nitrobenzene	hydrochloric acid 37%, 93°C	xylene

5.3 Installation of the Magnet Sensors

The Magnet Sensors can be mounted via the mounting holes (see figure below) by using two M3 screws.

The permissible reading distance of the sensor to the magnetic tape surface is **max. 2.0 mm**.

Furthermore, the following maximum angular tolerances must be observed over the entire measuring distance:

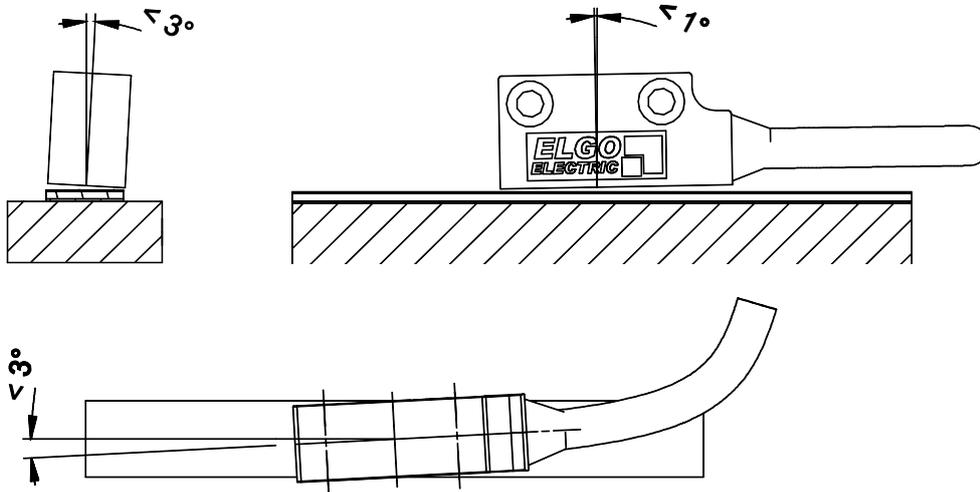


Figure 9: Angular tolerances of the Magnet Sensor



NOTE!

- The cable should be routed so that there is no risk of damage, e. g. by pulling or crushing.
- If necessary, use a drag chain or protective hose and provide strain relief.

5.4 Installation of the Position Indicator

1. The position indicator is installed in a control panel cut-out with the dimensions 67 x 93 mm. Required tools: 1 Phillips screw driver and 1 slot screw driver.

2. After the device has been inserted into the cut-out, the two Phillips screws on the side mounting brackets are loosened.

3. Turn every mounting bracket so that the tapped hole points outwards and then retighten the Phillips screw.

4. Then use the tapped holes of the mounting brackets to turn both slotted set screws (included in delivery) in the direction of the control panel so that the housing is pressed with its front frame against the control panel.

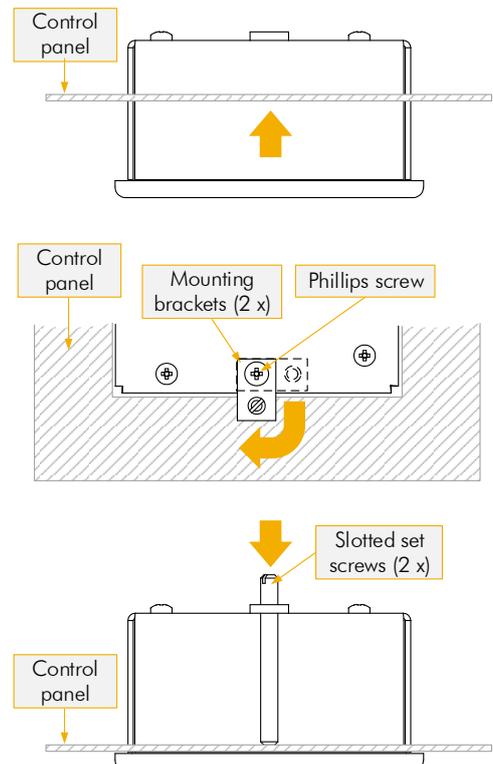


Figure 10: Installing the position indicator

6 Key Functions

The key functions of the device are divided into 2 levels with different functions:

1. **Normal mode** (↻ 7): For configuration of the main operating functions during normal operation
2. **Parameter level** (↻ 8): Allows to edit parameters and settings, run diagnosis and to set default values

Normal mode:

-  Press for a short time to select the desired axis (highlighted in black)
-  +  Press for 3 seconds together to set the actual position of the selected axis to the defined offset value (see parameter ↻ 8.1.2)
-  Press for 3 seconds to change the resolution of the selected axis
-  +  Press both keys shortly together to set the target position of the selected axis to the defined offset value (see parameter ↻ 8.1.2)

Enter parameter level:

-  +  Press for 3 seconds to enter the parameter level

Parameter level:

-  Select the desired parameter (cursor moves down)
-  Used as ENTER or to change the decade (depending on the parameter)
-  Change values and signs
- 
 - Save entries and jump back to previous selection
 - By renewed pressing exit to normal mode

7 Normal Mode

7.1 Display Window and Symbols

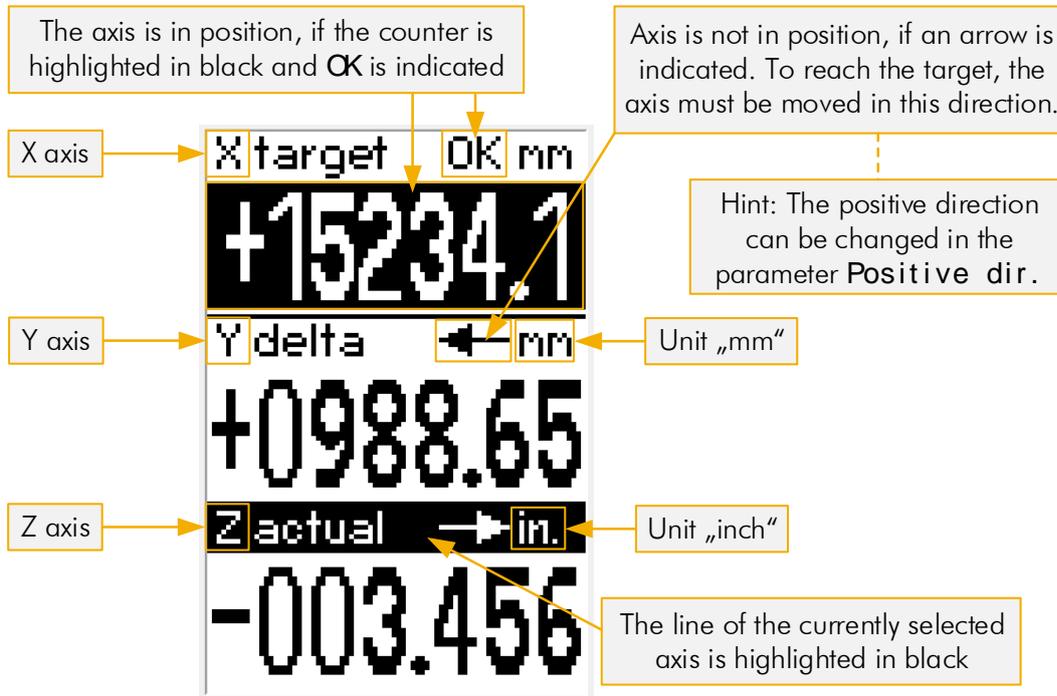


Figure 11: Display overview in normal mode

7.2 Display Switchover

By external PLC command via RS485 interface, the display can be switched to 3 states during normal mode:

1. **Delta:** Indicates the difference between target position and actual position with sign and arrows. The sign and the arrows show the direction in which the axis must be moved to reach the target.
2. **Actual:** Shows the current position at which the corresponding axis is currently located.
3. **Target:** Shows the target position which has been defined by PLC command.

7.3 Resolution Switchover

The resolution (decimal places) of each selected axis can be changed by pressing the **F** button:

- In millimeter mode from 0.00 to 0.0 and vice versa
- In inch mode from 0.000 to 0.00 and vice versa

This does not affect the internal calculation. Only the last digit will be shown or hidden.

7.4 Influencing Parameters

In addition to the displayed values, there are 3 parameters which can influence them and which can be set separately for each axis (☞ 8.1):

1. **Tolerance:** The entered tolerance range is always active in the + and – range around the target position. The actual value is stored in the processor, i. e. no positioning errors will add up. An output is set, if the difference between target and actual position is within the defined window. The available outputs are Output 1 for X axis, Output 2 for Y axis and Output 3 for Z axis (☞ 10).
2. **Offset:** By pressing **➡+⬆**, this value is taken over into the target position window of the selected axis.
3. **Unit:** The measurement unit mm or inch influences the number of decimal places and the scaling factor.

8 Parameter Level

The parameter level consists of the submenus and parameters as shown in the figure below:

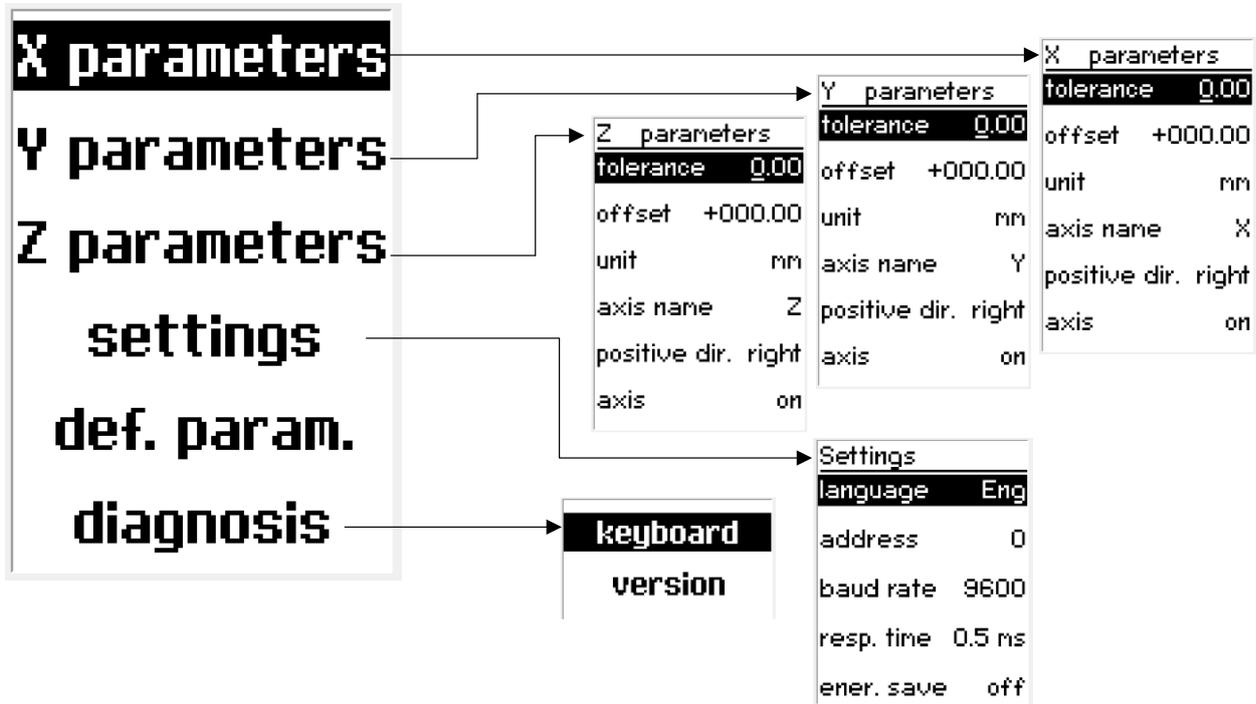


Figure 12: Parameter level and its submenus



NOTE! All entries are saved automatically when leaving the parameter with the **Incr/Abs** button.

8.1 Axis Parameters X / Y / Z

The axis parameters are identical for all 3 axes. This means that the functions described here are valid for axis X, Y and Z. After selecting an axis with button **F**, the following parameters are accessible by pressing the **➡** button:

8.1.1 Tolerance

It is possible to set the display of the actual value of the corresponding axis to the target position within the tolerance window entered in this submenu. The entered tolerance range is always active in the + and - range around the target position (hysteresis). The actual value is stored in the processor, i. e. no positioning errors will add up. The setting range is 0.00 ... +9.99 mm resp. 0.000 ... +0.999 inch.

Example: Entered tolerance value = 0.2 mm (i. e. tolerance window ± 0.2 mm)

Target value: 100.0 mm \rightarrow internal actual value: 99.8 mm \rightarrow displayed actual value: 100.0 mm

8.1.2 Offset

An offset for each axis (range -999.99 ... +999.99 mm resp. -99.999 ... +99.999 inch) can be defined here.

- By pressing **➡+↑** together in normal mode, this value will be written into the target position display of the selected axis.
- By pressing **F+↑** together for 3 seconds, this value will be overtaken as actual value for the selected axis.

8.1.3 Unit

This menu is used to switchover the measurement unit of the selected axis between mm and inch.

8.1.4 Axis Name

This menu can be used to select the name of the corresponding axis:

- Axis X cannot be changed
- Axis Y can be changed to Y1
- Axis Z can be changed to Y2 or G

8.1.5 Positive dir.

This parameter is used to set which is the positive measuring direction. By default "right" is selected. If the selection is changed to "left", the arrow for readjustment as well as the signs change their direction.

8.1.6 Axis (on/off)

With this parameter the selected axis can be switched on or off. If the axis is set to "off", the position for this axis is hidden in normal operation.

8.2 Settings

8.2.1 Language

This parameter is used to select the menu language. Available are English, Italian and German.

8.2.2 Address

A device address from 0 ... Z can be defined here. This is used for communication with the PLC.

8.2.3 Baud rate

A baud rate for serial communication with the PLC can be selected here (9600, 19200 or 38400).

8.2.4 Resp. time

The PLC waits for the selected time (0.5, 5, 10, 25, 50 or 100 ms) to get a response from Z60-014.

8.2.5 Ener. save

Depending on the the selected option, the unit works with different maximum sampling frequencies, which have direct influence to the battery operating time after power-off. The following options are available:

OFF → battery operating time after power-off: up to 6 weeks at full operating speed of max. 2 m/s

ON → battery operating time after power-off: up to 12 weeks at reduced operating speed of max. 0.5 m/s

8.3 Default Parameters

This parameter is used to set the device back to its default settings.



NOTE!

- This process cannot be undone.
- Customer-specific changed settings will be overwritten by the default parameters!
- It is recommended to make a note of existing settings before using this function.

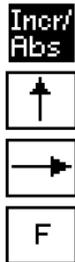
8.4 Diagnosis

This menu is used to test the keypad and to display the current installed hardware and software version.

8.4.1 Keyboard

As shown in the figure on the right, the correspondingly pressed key is highlighted in black on the display when testing the keyboard.

To exit this parameter, the **Incr/Abs** button must be pressed for min. 3 seconds.



8.4.2 Version

This informational function indicates the software and hardware version of the position indicator.

9 PLC Commands via RS485

Interface data:

- Type: RS485 asynchronous, half duplex (☞ 10)
- Data format: 8 data bits, 1 start bit, 1 stop bit, no parity
- Baud rate: 9600, 19200 or 38400 (selectable ☞ 8.2.3)
- Termination: The RS485 interface requires a single, external 120 Ω Terminating resistor (☞ 10.2)



IMPORTANT NOTE!

The CRC checksum is generated as a single byte (CRC-8). The check polynomial 0xD8 is used ($x^7 + x^6 + x^4 + x^3$). The PLC needs to know that, otherwise errors will occur. Information about the internal CRC calculation can be found in section ☞ 9.2.

9.1 Commands

The PLC transmits for command 1:

- P = command to write to Z60-014
- F = feedback from Z60-014
- T = command **target position**
- C = Z60 address 0 ... F
- X = axis X, Y or Z

STX	,P'	,T'	,C'	,X'	,+'	,1'	,2'	,3'	,4'	,5'	,6'	,7'	CRC	ETX
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Z60 will answer:

STX	,F'	,T'	,C'	,X'	,+'	,1'	,2'	,3'	,4'	,5'	,6'	,7'	CRC	ETX
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

The PLC transmits for command 2:

- R = command to read from Z60
- F = feedback from Z60
- D = command **difference**
- C = Z60 address 0 ... F
- X = axis X, Y or Z

STX	,R'	,D'	,C'	,X'	,-'	,-'	,-'	,-'	,-'	,-'	,-'	,-'	CRC	ETX
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Z60 will answer:

STX	,F'	,D'	,C'	,X'	,+'	,1'	,2'	,3'	,4'	,5'	,6'	,7'	CRC	ETX
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

The PLC transmits for command 3:

- R = command to read from Z60
 F = feedback from Z60
 A = command **actual position**
 C = Z60 address 0 ... F
 X = axis X, Y or Z

STX	,R'	,A'	,C'	,X'	,-'	,-'	,-'	,-'	,-'	,-'	,-'	,-'	CRC	ETX
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

Z60 will answer:

STX	,F'	,A'	,C'	,X'	,+'	,1'	,2'	,3'	,4'	,5'	,6'	,7'	CRC	ETX
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

The PLC transmits for command 4:

- P = command to write to the Z60
 F = feedback from Z60
 a = command **show actual position** on display
 t = command **show target position** on display
 d = command **show difference** on display
 C = Z60 address 0 ... F
 X = axis X, Y or Z

STX	,P'	,a'	,C'	,X'	,-'	,-'	,-'	,-'	,-'	,-'	,-'	,-'	CRC	ETX
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

(,t' or ,d')

Z60 will answer:

STX	,P'	,a'	,C'	,X'	,-'	,-'	,-'	,-'	,-'	,-'	,-'	,-'	CRC	ETX
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

(,t' or ,d')

The PLC transmits for command 5:

- P = command to write to the Z60
 F = feedback from Z60
 1 = command **show 1 decimal digit** on display
 2 = command **show 2 decimal digits** on display
 3 = command **show 3 decimal digits** on display
 C = Z60 address 0 ... F
 X = axis X, Y or Z

STX	,P'	,1'	,C'	,X'	,-'	,-'	,-'	,-'	,-'	,-'	,-'	,-'	CRC	ETX
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

(,2' or ,3')

Z60 will answer:

STX	,P'	,1'	,C'	,X'	,-'	,-'	,-'	,-'	,-'	,-'	,-'	,-'	CRC	ETX
-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----

(,2' or ,3')

9.2 Calculation of the CRC

"A cyclic redundancy check (CRC) is an error-detecting code commonly used in digital networks and storage devices to detect accidental changes to raw data. Blocks of data or messages entering these systems get a short check value attached, based on the remainder of a polynomial division of their contents. On retrieval, the calculation is repeated and, in the event the check values do not match, corrective action can be taken against data corruption" (source: https://en.wikipedia.org/wiki/Cyclic_redundancy_check).

9.2.1 The Algorithm

- The Message (M) to be transmitted can be formed from any sequence of bits
- The message to be transmitted, that contains also the CRC, will be M' which is given by M with the CRC appended to the end of the message
- The receiver calculates the CRC on the received message M' ($M' = M + \text{CRC}$) and will get the rest as 0 (zero) if the transfer of data occurred without error
- To create M' it is sufficient to concatenate the CRC obtained to the M (message) to be transmitted
- In general, the algorithm used can be represented as shown in the figure below
- The loop is repeated until the last bit of M'

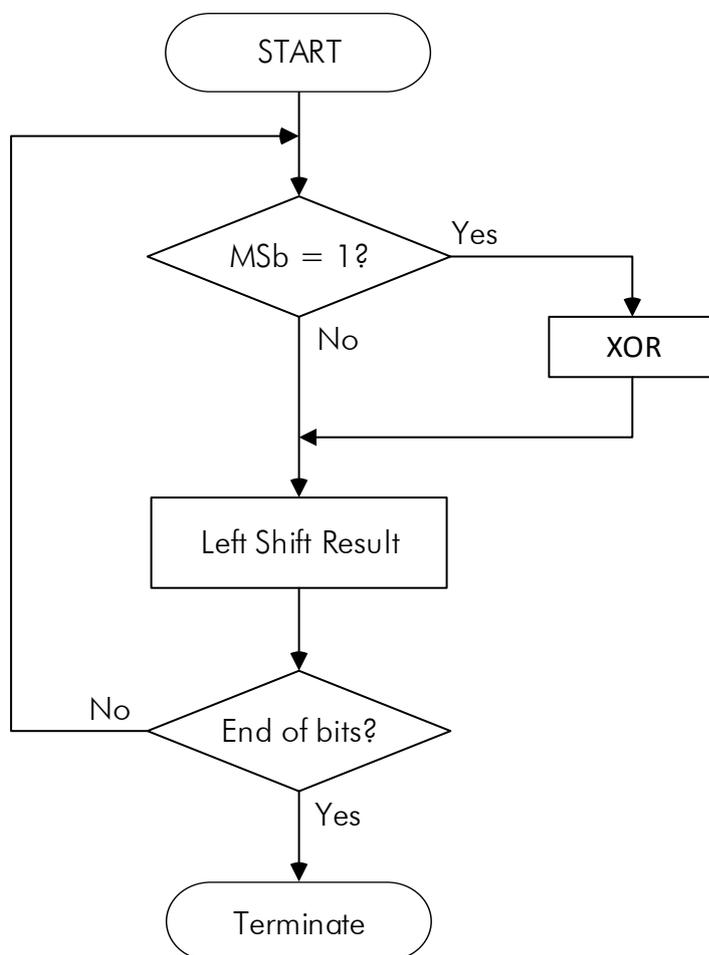


Figure 13: Calculation of CRC

A method to calculate a CRC is to use pre-calculated values and XOR them to the data received. The idea behind a table-driven CRC implementation is that instead of calculating the CRC bit by bit, precomputed bytes are XORed to the data. The CRC is generated by reading a precomputed value from a table and XORed.

10 Connections

10.1 Connector Arrangement

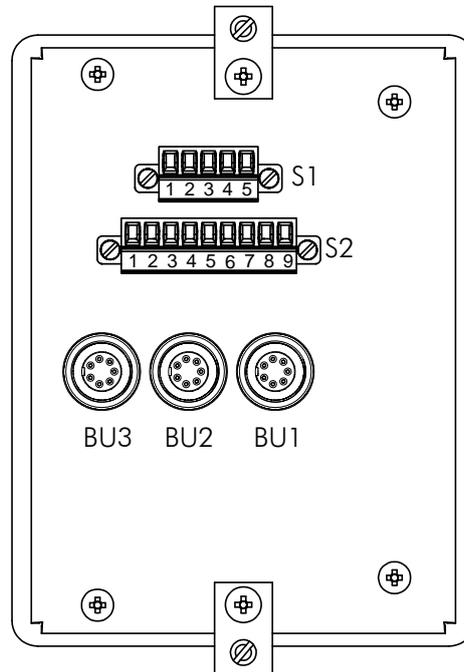


Figure 14: Connector Arrangement

10.2 Pin Assignment of the PHOENIX Connectors

The voltage supply as well as the serial interface and the control outputs must be wired via the 5- resp. 9-pin PHOENIX connectors. These connectors are marked as S1 and S2.

Table 2: Connection of S1 (power supply and RS485)

S1 Connector type	Drawing	Pin	Function
5-pin "PHOENIX" connector 5-GF-3.81		1	PE / shield
		2	0 V / GND
		3	+ 24 VDC power supply
		4	RS485 A
		5	RS485 B

*) The 120 Ω terminating resistor only has to be connected once to the RS485 interface, even if several Z60-014 indicators are connected.

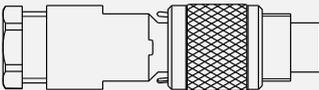
Table 3: Connection of S2 (control outputs)

S2 Connector type	Drawing	Pin	Function
9-pin "PHOENIX" connector 9-GF-3.81		1	PE / shield
		2	0 V / GND
		3	Common +24 V
		4	Input 3 (reserve)
		5	Input 2 (reserve)
		6	Input 1 (reserve)
		7	Output 1 (X axis) 24 V, PNP
		8	Output 2 (Y axis) 24 V, PNP
		9	Output 3 (Z axis) 24 V, PNP

10.3 Sockets for Sensor Round Connectors

For connecting the three MS2060 sensors of measuring axis X, Y and Z, no wiring is necessary. They are connected via screwable 7-pin M9 plugin round connectors. The corresponding round connector sockets on the rear of the device are marked as BU1, BU2 and BU3.

Table 4: Connection of BU1, BU2, BU3 (sensors sockets)

Connector type	Drawing	Socket	Function
7-pin "Binder" M9 round connector (screwable, strain-relieved)		BU1	MS2060 sensor axis X
		BU2	MS2060 sensor axis Y
		BU3	MS2060 sensor axis Z

11 Disturbances, Maintenance, Cleaning

This chapter describes possible causes for disturbances and measures for their removal. In case of increased disturbances, please follow the measures for fault clearance in chapter 11.1. In case of disturbances that cannot be eliminated by following the advice and the fault clearance measures given here, please contact the manufacturer (see second page).

11.1 Fault Clearance



CAUTION!

The device, the connection line and the signal cable must not be installed next to sources of interference that emit strong inductive or capacitive interference or strong electrostatic fields.

External perturbations can be avoided through suitable cable routing.



The screen of the signal output cable should only be connected to the following circuit on one side. The screens should not be grounded on both sides. Signal cables always have to be routed separately from the load power line. A safety distance of at least 0.5 m has to be kept from inductive and capacitive sources of interference such as contactors, relays, motors, switching power supplies, clocked controllers etc.!

If interferences occur in spite of all the items stated above being observed, please proceed as follows:

1. Installation of RC-circuits via contactor coils of AC-contactors (e.g. 0,1 μ F / 100 Ω)
2. Installation of recovery diodes via DC-inductors
3. Installation of RC-circuits via the different motor phases (in the terminal box of the motor)
4. Do not connect protective earth and ground
5. Connect a mains filter ahead of the external power pack

11.2 Re-start after Fault Clearance

After the fault clearance:

1. Reset the emergency stop mechanism if necessary
2. Reset the error report at the super-ordinate system if necessary
3. Ensure that there are no persons in the danger area
4. Follow the instructions from chapter 5



WARNING!

Danger of injury through non-conventional fault clearance!

Non-conventional fault clearance can lead to severe injuries and damage of property.

Therefore:

- Any work to clear the faults may only be performed by sufficiently qualified staff
- Arrange enough space before starting the works
- Make sure that the mounting area is clean and tidy. Loose components and tools are sources of accidents.

If components need to be replaced:

- Pay attention to a correct installation of the spare parts.
- Reinstall all the fixing elements properly
- Before turning on the device, ensure that all covers and safety equipment is installed correctly and functions properly

11.3 Maintenance

The device is maintenance-free.

11.4 Cleaning

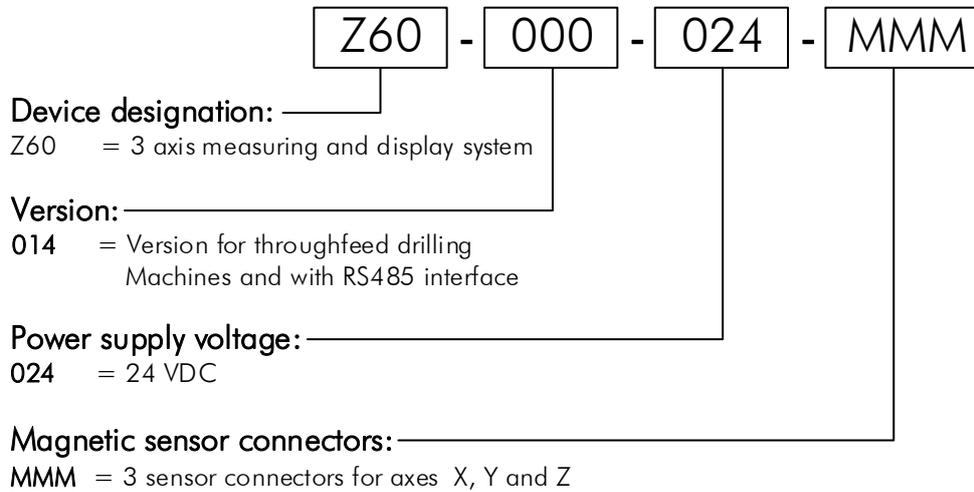


WARNING!

The device can only be cleaned with a damp cloth, do not use aggressive cleanser!

12 Type Designation

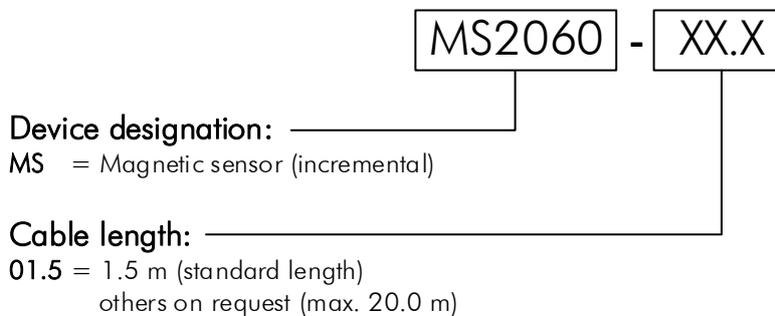
12.1 Z60 Position Indicator



NOTE

When ordering, please use the here described ordering code (Type Designation). Indicate options that are not required with „-“.

12.2 MS2060 Magnet Sensor



12.3 Accessories

Table 5: Accessories

Order Designation	Description
NG24.0	External 24 VDC power pack (primary 115/230 VAC) for supply of the Z60-014
MB20-50-10-1-R	Magnetic tape for the Z60-014 measuring and display system (pole pitch: 5 mm)
End cap set 10 mm	End cap set for fix the magnetic tape

Notes:

Notes:

13 Index

Accessories	28	Magnet Sensor Dimensions	10
Accident prevention regulations.....	5	Magnetic Tape and MS2059 Sensors.....	8
Axis Parameters (X / Y / Z)	20	Magnetic tape structure	12
Calculation of the CRC	24	Maintenance.....	27
Causes of risk.....	6	Normal Mode	19
Cleaning.....	27	Operating area	13
Connections	25	Operational safety.....	5
Conventional use.....	7	Order reference	9
Default Parameters	21	Packaging material.....	7
Demounting	6	Parameter Level.....	20
Device number	9	PLC Commands via RS485	22
Diagnosis.....	21	Principle of Scanning	8
Display Switchover	19	Product Features	8
Display Window and Symbols	19	Protection against contact	13
Disposal.....	6	Protective equipment	6
Disturbances	27	Resistance against chemical influence	16
Explanation of symbols.....	5	Resolution Switchover	19
Fault clearance.....	27	Safety	5, 6
First start-up	13	Safety instructions	5
General Information	8	Safety rules	5
Identification	9	Settings	21
Indicator Dimensions.....	9	Start-up	13
Influencing Parameters	19	Storage	7
Installation	13	Technical Data Z60-014.....	11
Installation Magnetic Sensor	17	The quasi-absolute Measuring Principle.....	8
Installation of the Magnetic Tape	14	Transport	7
Installation of the Position Indicator	17	Transport damage	7
Key Functions	18	Type Designation	28

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