MICRO-EPSILON

Instruction Manual

MSC710

MSC710-U
MSC710-I

Sensor controller for inductive displacement and gauging sensors series LVDT

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Certified acc. to DIN EN ISO 9001: 2008

Contents

1. Safety

The handling of the sensor assumes knowledge of the instruction manual.

1.1 Symbols Used

The following symbols are used in this instruction manual:

⚠ CAUTION	Indicates a hazardous situation which, if not avoided, may result in minor or moderate injury.
NOTICE	Indicates a situation which, if not avoided, may lead to property damage.
➡	Indicates a user action.
i	Indicates a user tip.

1.2 Warnings

⚠ CAUTION

Connect the power supply and the display/output device in accordance with the safety regulations for electrical equipment.
> Danger of injury

> Damage to or destruction of the controller and/or the sensor

NOTICE

Avoid banging and knocking the sensor.
> Damage to or destruction of the controller

The power supply may not exceed the specified limits
> Damage to or destruction of the controller and/or the sensor

Protect the sensor cable against damage
> Destruction of the sensor

> Failure of the measuring device

1.3 Notes on CE Identification

The following applies to the measuring device series 710:

- EU directive 2014/30/EU
- EU directive 2011/65/EU, “RoHS“ category 9

Products which carry the CE mark satisfy the requirements of the quoted directives and the European standards (EN) listed therein. The EC declaration of conformity is kept available according to EC regulation, article 10 by the authorities responsible at

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The measuring system is designed for use in industry and satisfies the requirements.

1.4 Proper Use

The MSC710 measuring system is designed for use in industrial areas.

It is used to operate inductive displacement sensors based on the LVDT principle (Linear Variable Differential Transformer).

The measuring system may only be operated within the limits specified in the technical data, see Chap. 2.3.

The system should only be used in such a way that in case of malfunction or failure personnel or machinery are not endangered.

Additional precautions for safety and damage prevention must be taken for safety-related applications.

1.5 Proper Environment

- Temperature: 0 to +70 °C (+32 to +158 °F) electronic
- Humidity: 5 - 95 % (no condensation)
- Ambient pressure: atmospheric pressure
- Protection class:
  - IP 67
  - IP 50 (DIN mounting rail)
- Storage temperature: -40 to +85 °C (-40 to 185 °F)
- Vibration/Shock: EN 60068-2

2. Functional Principle, Technical Data

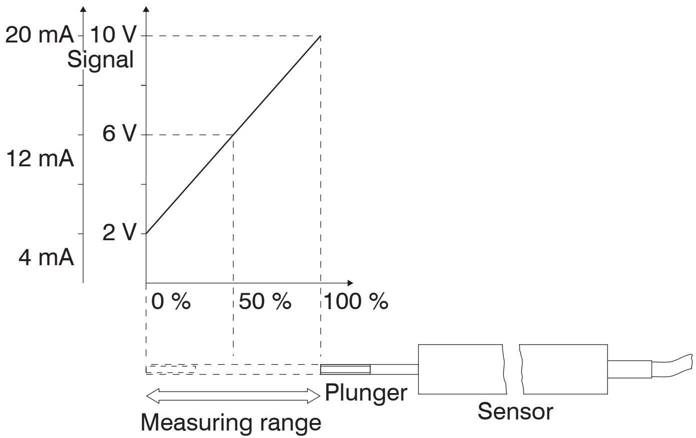
2.1 Functional Principle

The MSC710 is a single-channel miniature sensor controller for the operation of inductive displacement sensors based on the LVDT principle (Linear Variable Differential Transformer).

An electronic oscillator excites the primary coil with an alternating current of a constant frequency. The frequency, amplitude and the phase compensation can be set with DIP switches for best operation mode, see Chap. 5.

The electronic signal conditioning unit transforms the differential signal of the two secondary coils into a stable direct voltage output signal. With the setting possibilities for zero point and gain, see Chap. 5., the user can adapt the equipment to the task to be performed.

If the plunger is moved into the sensor, this results in an increase of the output voltage, if the plunger is pulled out further, this results in a decrease of the output signal. Change the inputs sec+ and sec-, see Chap. 4.3.2, if the output signal should decrease when the plunger is moved in.



2.2 Design

A complete measuring channel consists of

- Sensor
- Controller
- Sensor cable
- Power supply and output cable

The controller contains

- Oscillator, demodulator, and amplifier with low-pass filter;

- Setting options for oscillator frequency, amplitude and the phase compensation, zero point and gain.

Any displacement sensors that work by the LVDT principle can be connected to the amplifier electronics. However, if sensors of other manufacturers are used you should check their functionality in conjunction with the controller. MICRO-EPSILON recommends the inductive displacement sensors and gauging sensors of the induSENSOR LVDT series because they are optimally coordinated with the electronics.

2.3 Technical Data

Model		**MSC710-U**	**MSC710-I**
Power supply		18 ... 30 VDC	
Current input		18 ... 45 mA	
Supply protection		Reverse-polarity and overvoltage protection	
Sensors		for LVDT sensors	
Sensor excitation		150 ... 400 mV_{eff} 1/2/5 kHz	
Input impedance	Sensor	10 kOhm	
Adjustments (trim-pot)	Gain Zero	-20 ... +350 % FSO ±50 % FSO	
Output	Voltage Current	2 ... 10 VDC [1] ---	--- 4 ... 20 mA [2]
Linearity		< 0.02 % FSO	

Model		**MSC710-U**	**MSC710-I**
Noise		< 1.5 mV_{eff} [3] < 15 mV_{ss}	< 3 μA_{eff} [3] < 30 μA_{ss}
Output filter		Low pass, 300 Hz (-3 dB)	
Output protection		Protection against open circuit and short-circuit	
Operating temperature	Operation Storage	0 ... +70 °C (+32 ... +158 °F) -40 ... +85 °C (-40 ... +185 °F)	
Temperature stability		< 0.01 %/°C	
Protection class		IP 67 (Standard housing) IP 50 (Mounting rail)	
Dimensions	LxWxH	52 x 50 x 35 mm	
Weight		80 g	
Housing material		Copolymer ABS, interior coating: vaporized with aluminum	

i The output signal is limited to 4 mA up to 22 mA for controller with current output.

FSO = Full Scale Output
1) R_a = 1 kOhm
2) Load < 500 Ohm
3) RMS AC measuring, 3 Hz ... 300 kHz with 5 kHz sensor frequency

3. Delivery

3.1 Unpacking

1 Controller

1 Instruction manual

1 Screwdriver

➡ Check the delivery for completeness and shipping damage immediately after unpacking.

➡ In case of damage or missing parts, please contact the manufacturer or supplier immediately.

3.2 Storage

Storage temperature:	-40 up to +85 °C (-40 to +185 °F)
Humidity:	5 - 95 % (no condensation)

4. Installation and Assembly

4.1 Precautions

➡ The sensor cable and the power supply/output cable must not be exposed to sharp-edged or heavy objects.

➡ Check before the equipment is started all the plug connectors for tightness of fit.

4.2 Electronic Unit

➡ Fasten the compact electronic units of series MSC710 at the housing corners by means of two screws M4.

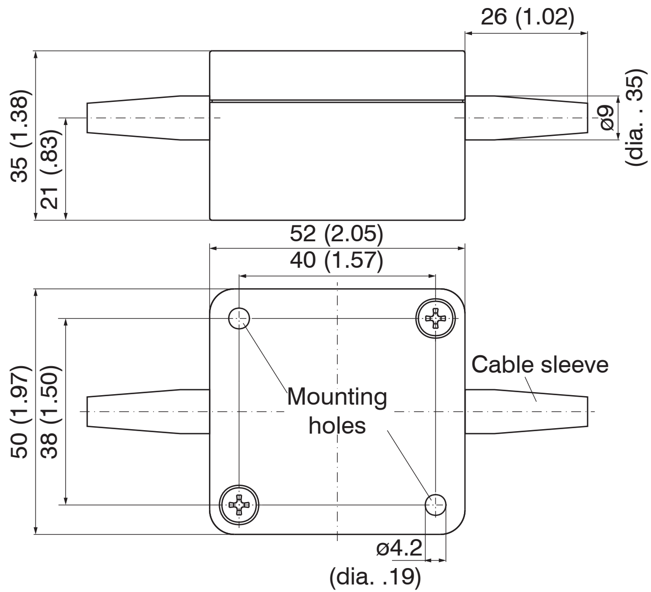


Fig. 1 Dimensions of the controller, dimensions in mm (inches), not to scale

4.3 Power Supply, Sensor and Signal Output

The power supply/output cable PC710-6/4 (available as an option) has a bend radius of 24 mm (minimum). All the connections for power supply / sensors / signal output are located on the electronics, see Fig. 7.

Cable characteristics

- Diameter cable: 3.5 ... 5.5 mm
- Diameter of wire: 0.09 ... 0.14 mm ^{2} (AWG 28 - 26)
- Diameter of wire isolation: 0.9 ... 1.45 mm

Wiring

The housing has to be opened in order to connect the sensors, see Chap. 4.3.2, and wire the output and supply cable, see Chap. 4.3.1.

➡ Undo the screws.

➡ Pass the sensor and signal cables through the cable sleeves.

➡ Install terminal.

Do not strip off the strands, see Fig. 4.

➡ Use proper pliers.

➡ Connect the shielding of the supply/output cable and sensor cable with a flat connector. Use crimping pliers to make the crimped connection.

➡ Assemble the unit and tighten the screws.

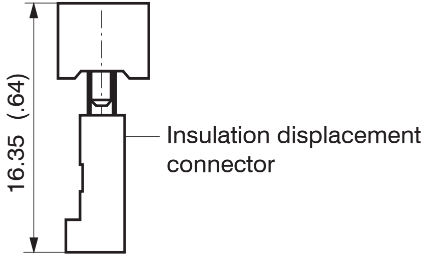


Fig. 2 Before cabling

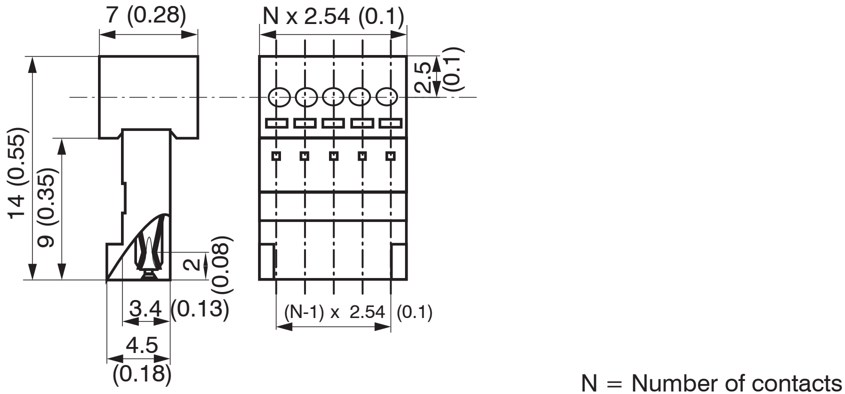
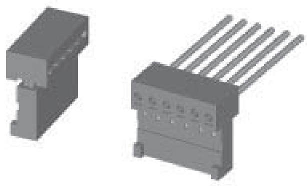
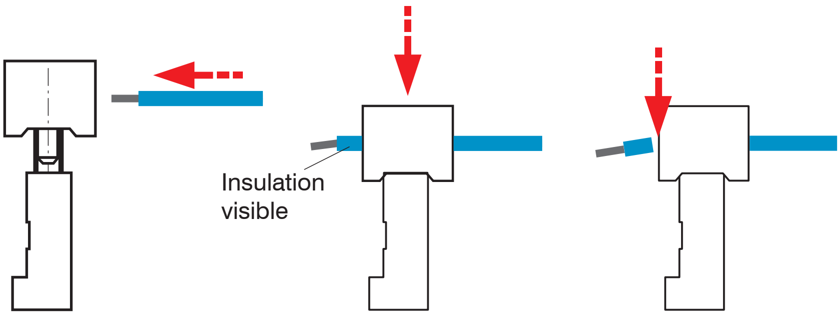


Fig. 3 After cabling

➡ Cut the strands off directly after the connector.





i The strands may not protrude!

Fig. 4 Installation sequence strands with insulation displacement connector

i The insulation displacement connector, see Fig. 2, see Fig. 3, see Fig. 4, may be pressed only once. A replacement connector kit is included. The insulation displacement connection must be made at the insulation.

➡ Shrink during shortening of the cable of DTA-xG8 series on each strand the enclosed shrinking hose (shrink temperature T_{max} = 130 °C) before assembly of the insulation displacement connector (IDC)

4.3.1 Power Supply and Signal

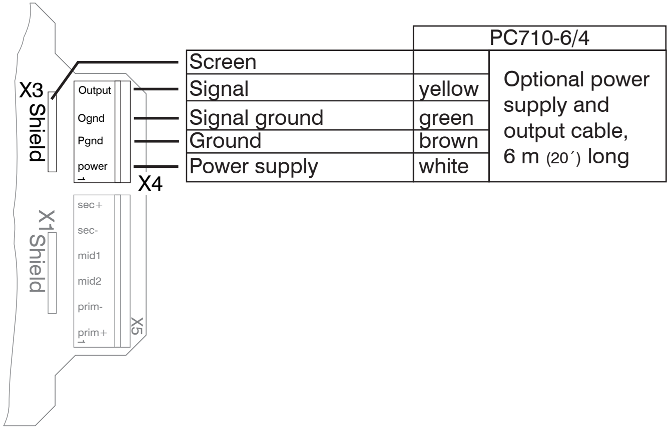


Fig. 5 Pin assignment terminal block X3, X4

4.3.2 Sensor

If the plunger is moved into the sensor, this results in an increase of the output voltage, if the plunger is pulled out further, this results in a decrease of the output signal. Change the inputs sec+ and sec- if the output signal should decrease when the plunger is moved in.

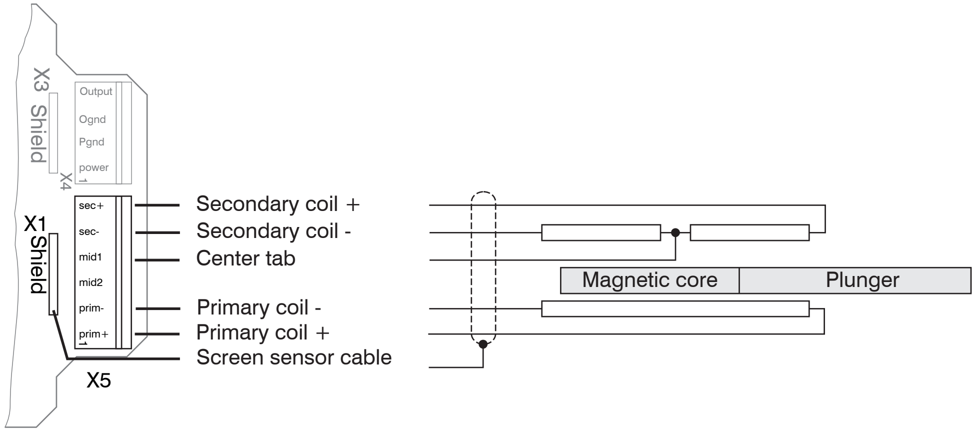


Fig. 6 Pin assignment terminal block X1, X5

i The standard sensor cable has a length of 3 m.

Terminal block X5		Coil	Cable [1] DTA-□-□-CA-□ DTA-□-□-CR-□ C701-x	Wire [1] DTA-□-□-LA-□	Solder pin [1] DTA-□-□-TA-□	Cable [1] DTA-□G8
sec+	Pin 6	Secondary	white	white	1	white
sec-	Pin 5		brown	black	2	black
mid1	Pin 4		grey	grey	5	grey
prim-	Pin 2	Primary	yellow	yellow	4	brown
prim+	Pin 1		green	green	3	blue

1) The colors and pins listed apply to MICRO-EPSILON displacement sensors.

5. Equipment Operation

5.1 Startup

- Check the correct wiring of the sensor connections, signal cables and voltage connections, before you connect the electronic unit to the power supply and before you turn on power, see Chap. 4.
- Perform the basic setting of the electronic unit, see Chap. 5.2. Turn on the power supply afterwards.

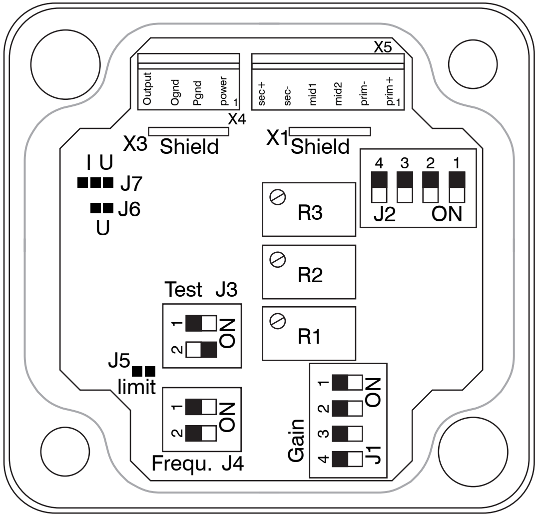


Fig. 7 Electronic unit

5.2 Setting

➡ Connect the sensor before starting, see Chap. 4.3.2. Set the controller to the specific type of sensor.

➡ Differentiate the cases:

- the plunger respectively the sensor can be adjusted mechanical during the settings (step 1 ... 4, 5a ... 8a)
- the plunger respectively the sensor is fixed to the target (step 1 ... 4, 5b ... 8b)

1. Set the frequency with J4, see Chap. 5.2.1. 2. Set the phase with J2, see Chap. 5.2.1. 3. Set the supply voltage for the sensor with J1, see Chap. 5.2.2. 4. Move switch S1 and S2 at J3, see Fig. 7, to ON.			
Plunger respectively the sensor can be adjusted mechanical during the settings. See the examples A and B, see Chap. 5.2.5.		Plunger respectively the sensor is fixed to the target during the settings. See the example C, see Chap. 5.2.5.	
5a.	Set the desired output signal with R1, see Fig. 7, for the sensor in middle-position.	5b.	Set the desired output signal with R1, see Fig. 7, for the start position.
6a.	Move switch S1 at J3 to OFF.	6b.	Move switch S1 and S2 at J3 to OFF.
7a.	Move plunger until the output signal is the same as set in point 5a. Magnetic core is in middle-position.	7b.	Displace the plunger respectively the sensor to the start position. Use R2 , see Fig. 7, to set the output to the same value as in point 5b.
8a.	Displace the plunger respectively the sensor to the end position and use R3 to set the amplification. End of setting.	8b.	Displace the plunger respectively the sensor to the end position and use R3 to set the amplification. End of setting.

5.2.1 Oscillator Frequency and Phase Compensation

➡ Set the frequency of the oscillator with the 2-pole DIP switch J4, see Fig. 7, for the position on the board.

➡ Set the phase with J2, see Fig. 7.

i Values are quoted for displacement sensors from MICRO-EPSILON. If other makes are used you must apply the data published by the manufacturer in question.

Sensor	Measuring range	Oscillator frequency	Switch J4 Frequency		Switch J2 Phase	
DTA-1x	±1 mm	5 kHz	1	OFF	1	ON
			2	ON	2	ON
					3	OFF
					4	OFF
DTA-1G8	±1 mm	5 kHz	1	OFF	1	OFF
			2	ON	2	OFF
					3	ON
					4	OFF
DTA-3x	±3 mm	5 kHz	1	OFF	1	OFF
			2	ON	2	ON
					3	OFF
					4	OFF

Sensor	Measuring range	Oscillator frequency	Switch J4 Frequency		Switch J2 Phase	
DTA-3G8	±3 mm	5 kHz	1	OFF	1	OFF
			2	ON	2	OFF
					3	ON
					4	OFF
DTA-5x	±5 mm	5 kHz	1	OFF	1	OFF
			2	ON	2	OFF
					3	OFF
					4	OFF
DTA-5G8	±5 mm	5 kHz	1	OFF	1	OFF
			2	ON	2	OFF
					3	ON
					4	OFF
DTA-10x	±10 mm	2 kHz	1	ON	1	OFF
			2	OFF	2	ON
					3	OFF
					4	OFF
DTA-10G8	±10 mm	5 kHz	1	OFF	1	OFF
			2	ON	2	OFF
					3	ON
					4	OFF

Sensor	Measuring range	Oscillator frequency	Switch J4 Frequency		Switch J2 Phase	
DTA-15x	±15 mm	1 kHz	1	OFF	1	OFF
			2	OFF	2	OFF
					3	ON
					4	OFF
DTA-25x	±25 mm	1 kHz	1	OFF	1	OFF
			2	OFF	2	OFF
					3	OFF
					4	ON

5.2.2 Sensor Excitation Voltage

➡ Set the supply voltage for the sensor with the 4-pole DIP switch J1, see Fig. 7, for the position on the board).

i Allow the measuring system to warm up for about two minutes before the first measurement or calibration.

Sensor	Measuring range	Switch J1	
DTA-1x	±1 mm	1	OFF
		2	OFF
		3	OFF
		4	ON
DTA-1G8	±1 mm	1	ON
		2	ON
		3	OFF
		4	OFF
DTA-3x	±3 mm	1	OFF
		2	OFF
		3	ON
		4	OFF
DTA-3G8	±3 mm	1	ON
		2	ON
		3	OFF
		4	OFF

Sensor	Measuring range	Switch J1	
DTA-5x	±5 mm	1	ON
		2	OFF
		3	ON
		4	OFF
DTA-5G8	±5 mm	1	ON
		2	OFF
		3	OFF
		4	OFF
DTA-10x	±10 mm	1	OFF
		2	ON
		3	OFF
		4	OFF
DTA-10G8	±10 mm	1	ON
		2	OFF
		3	OFF
		4	OFF

Sensor	Measuring range	Switch J1	
DTA-15x	±15 mm	1	ON
		2	OFF
		3	OFF
		4	OFF

Sensor	Measuring range	Switch J1	
DTA-25x	±25 mm	1	OFF
		2	OFF
		3	OFF
		4	OFF

5.2.3 Zero Point

Prior to calibration or measurement the sensor must be connected to the controller. The electrical zero point can be shifted about ±50 % of the measuring range. Examples for zero point adjustment, see Chap. 5.2.5.

5.2.4 Signal Gain

The signal gain can be shifted about -20 % up to +350 % of the measuring range. Examples for gain adjustment, see Chap. 5.2.5.

If the plunger is moved into the sensor, this results in an increase of the output voltage, if the plunger is pulled out further, this results in a decrease of the output signal. Move the plunger by a defined range, in the ideal case by the complete linear measuring range and adjust with R3 trim-pot the desired output voltage/current. It makes no difference, whether the plunger is pushed in or pulled out, except that this leads to a increase respectively decrease of the output signal.

5.2.5 Examples

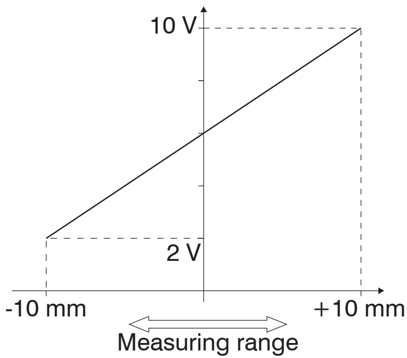
Example A

Measuring range: ±10 mm, used measuring range: -10 ... +10 mm,

Output signal: 2 ... 10 VDC (4 ... 20 mA)

- Set the frequency with J4, see Chap. 5.2.1.
- Set the phase with J2, see Chap. 5.2.1.
- Set the supply voltage for the sensor with J1, see Chap. 5.2.2.
- Set the S1 and S2 of J3, see Fig. 7, to „ON“.
- Adjust the output to 6.00 VDC respectively 12.00 mA (current output) with R1, see Fig. 7. Middle-position of the sensor.
- Set the S1 of J3 to „OFF“.
- Move the plunger until you get 6 VDC respectively 12 mA on the output (electrical and mechanical output are adjusted). Core is in center position.
- Move plunger about +10 mm.
- Adjust gain with R3 until the output has 10 VDC respectively 20 mA.

i The plunger respectively the sensor can be adjusted mechanical during the settings.



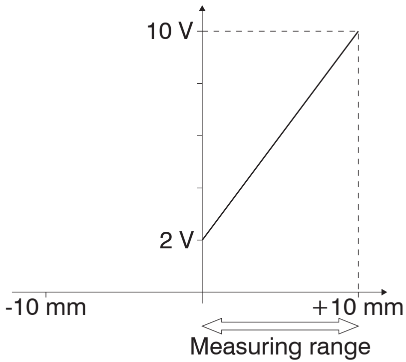
Example B

Measuring range: ±10 mm, used measuring range: 0 ... +10 mm,

Output signal: 2 ... 10 VDC (4 ... 20 mA)

- Set the frequency with J4, see Chap. 5.2.1.
- Set the phase with J2, see Chap. 5.2.1.
- Set the supply voltage for the sensor with J1, see Chap. 5.2.2.
- Set the S1 and S2 of J3, see Fig. 7, to „ON“.
- Adjust the output to 2.00 VDC respectively 4.00 mA (current output) with R1, see Fig. 7. Middle-position of the sensor.
- Set the S1 of J3 to „OFF“.
- Move the plunger until you get 2 VDC respectively 4 mA on the output (electrical and mechanical output are adjusted). Core is in center position respectively start of measuring range.
- Move the plunger about +10 mm.
- Adjust gain with R3 until the output has 10 VDC respectively 20 mA.

i The plunger respectively the sensor can be adjusted mechanical during the settings.



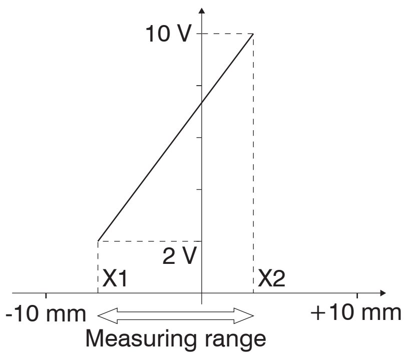
Example C

Measuring range: ±10 mm, start position X1 ... end position X2,

Output signal: 2 ... 10 VDC (4 ... 20 mA)

- Set the frequency with J4, see Chap. 5.2.1.
- Set the phase with J2, see Chap. 5.2.1.
- Set the supply voltage for the sensor with J1, see Chap. 5.2.2.
- Set the S1 and S2 of J3, see Fig. 7, to „ON“.
- Adjust the output to 2 VDC respectively 4 mA with R1, see Fig. 7.
- Set the S1 and S2 of J3 to „OFF“
- Move the plunger to start position X1.
- Adjust output to 2 VDC respectively 4 mA with R2.
- Move plunger to end position X2.
- Adjust gain with R3 until the output has 10 VDC respectively 20 mA.

i The plunger respectively the sensor are fixed to the target.



6. Operation

Prior to the start of a measurement or setting the amplifier unit with the sensor connected should warm up for approximately 2 minutes with the supply voltage turned on.

The operating instructions for the sensors that are used must always be followed. If a sensor is replaced, the channel must be calibrated new.

7. Service, Repair

In the event of a defect on the controller or sensor please send us the effected parts for repair or exchange.
In the case of faults the cause of which is not clearly identifiable, the whole measuring system must be sent back to:

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8. Warranty

All components of the device have been checked and tested for perfect function in the factory. In the unlikely event that errors should occur despite our thorough quality control, this should be reported immediately to MICRO-EPSILON MESSTECHNIK.

The warranty period lasts 12 months following the day of shipment. Defective parts, except wear parts, will be repaired or replaced free of charge within this period if you return the device to MICRO-EPSILON.

This warranty does not apply to damage resulting from abuse of the equipment and devices, from forceful handling or installation of the devices or from repair or modifications performed by third parties.

Repairs must be exclusively done by MICRO-EPSILON. No other claims, except as warranted, are accepted terms of the purchasing contract apply in full. MICRO-EPSILON will specifically not be responsible for any consequential damage.

MICRO-EPSILON always strives to supply customers with the finest and most advanced equipment.

Development and refinement is therefore performed continuously and the right for design changes without prior notice is accordingly reserved.

For translation in other languages the data and statements in the German language operation manual are to be taken as authoritative.

9. Decommissioning, Disposal

➡ Disconnect the power supply and output cable on the controller.

Incorrect disposal may cause harm to the environment.

➡ Dispose of the device, its components and accessories, as well as the packaging materials in compliance with the applicable country-specific waste treatment and disposal regulations of the region of use.

MICRO-EPSILON

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