Single Channel LVDT/ RVDT Amplifier
MC-KP-12E/24E-xxx

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Content

1 General Information

To ensure reliable and safe operation, the measuring amplifier must be operated in compliance with the specifications according to this technical description only. These regulations must also be observed if using accessories, that have been ordered from Althen Mess- & Sensortechnik GmbH together with the measuring amplifier.

Notice: Every person who is in charge for the start-up or service of this measuring amplifier must have read this technical manual and must have understood the safety instructions in particular.

1.1 Safety Instructions

When using the amplifier, the legal- and safety regulations for each case of application must be observed. To avoid risks for the system or the operator the following points are to be considered.

- If any visual damage or malfunctions are noticed, the measuring system must be switched off and marked appropriately.
- Disconnect the supply voltage before opening the device.
- The complete measuring unit must be protected against contact and influence of unauthorised persons.
- In the case of a safety-relevant application, where a potential malfunction could cause damage to property or persons, it is imperative that an additional, independent monitor is provided.

To prevent damage caused by condensate, give the amplifier some time to acclimate after changing the environmental conditions, temperature in particular.

If you have reasons to assume that safe operation is no longer possible, immediately take the device out of operation and secure it against unintentional operation.

1.2 Qualified Personnel

This measuring system must be operated by qualified personnel and in compliance with the relevant technical specifications only. Qualified personnel include such persons who are conversant with the setting up, mounting and starting up of the measuring system and who have qualifications that are appropriate for the tasks they're about to perform.

1.3 Intended Use

Amplifiers from Althen Mess- & Sensortechnik GmbH serve to measure the intended measurand and the evaluation thereof in combination with one or more sensors. Any other use over and above that is regarded as non-intended use.

2 Instructions for use of the amplifier

Notice: The parameterizations, further information concerning the scaling as well as the customized analogue output can be found on the additional sheet "Device-Configuration".

Since this amplifier is a highly sensitive measurement technology product, it must be used for its intended use as well as the described operating conditions only. Initial start-up and changes in setup and settings must be done by qualified personnel only. To prevent interventions / modifications made by unauthorized personnel, suitable measures must be taken. Both function and calibration must be checked regularly.

The amplifier must be connected to clean earth-potential. To avoid possible potential equalization currents over the shield of the cable to the following evaluation unit, this shield should be connected over a suitable capacitor (10 nF / 200 V).

The amplifier is contained in a plastic housing (IP20) designed for DIN top hat rail montage. The electrical connections are made via screw-clamps.

Overall the shield connections must be done properly to EMC-standards (as short as possible with large wire cross-section) and connected to a central point (star grounding). In order to not increase the disturbance sensitivity of the amplifier, all cables should be kept as short as possible and should not be extended. Possible cable-bound disturbances must be blocked very near the cable ends (evaluation unit) by suitable measures.

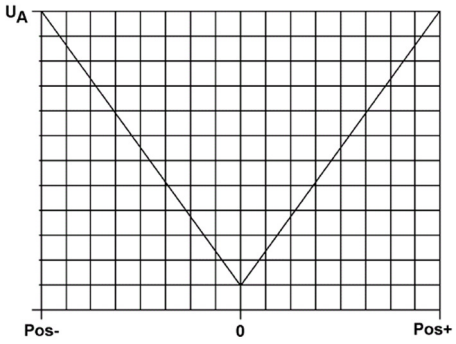
To increase immunity to disturbances (i.e. noise), shielded cables, preferably twisted in pairs should be used only. All connection cables and the amplifier must not be installed in proximity to disturbance emitting devices or cables. The amplifier must be operated with a separate power source used for measurement devices only.

Notice: Changes of the amplifier of any kind demand for the explicit approval of Althen Mess- & Sensortechnik GmbH. Changes of any kind done without that approval exclude all possible warranty and/or liability of Althen Mess- & Sensortechnik GmbH.

2.1 Instructions for use of LVDT/RVDT- sensors

The sensor has to be mounted to a grounded part of the machine.

All electrical connections must be done with shielded cables preferably twisted in pairs, only. Same applies to cable extensions.



An LVDT is a differential transformer with a primary coil and 2 secondary coils coiled in opposite direction, which are mounted symmetrically and connected to each other. An alternating current (typically 1 to 10 kHz) drives the primary coil and causes a voltage to be induced in each secondary coil. As the core moves, the primary's linkage to the two secondary coils changes and causes the induced voltages to change. Because the secondary coils are connected, the output voltage (i.e. signal) now is the difference between these two voltages. This output signal is, depending on the direction the core moves, either in phase or 180° shifted to the excitation voltage. When the core is in central position between the two secondary coils, the 2 voltages cancel each other out, except for a small voltage will always be there due to minor asymmetries.

3 Technical description

The LVDT/inductive half bridge/RVDT- measuring amplifier, contained in a plastic housing designed for DIN top hat rail mounting, serves to supply a LVDT displacement sensor or a RVDT rotary sensor with an alternating excitation voltage of 2,2 Volts with a frequency of 4,8 or 10 kHz (depending on order). If more than one amplifier is used in a setup, the excitation voltages can be synchronized and they should be synchronized for stability and vulnerability to disturbances (i.e. noise) reasons. Synchronized means one amplifier is designed as master. The masters oscillating voltage is connected to the slaves Sync + N and – IN, so that all amplifiers are working in phase and with the exact same frequency. The oscillators of the slaves have to be deactivated (refer to paragraph 4.2.1).

Standard analogue outputs are available for further evaluation.

The coarse amplification is determined by an internal DIP-switch and can be fine adjusted by a potentiometer on front of the amplifier. A second potentiometer on front allows the correction of the zero point.

4 Terminal Assignment

The electrical connections are made via screw-clamps. The numbering can be found on the front side of the clamps. The maximum wire cross section is 2,5 mm². The EMC-installation instruction is to be complied with. Maximum interference immunity is achieved by direct connection of the cable screen with "clean" and low resistance protective ground (PG). A lengthening of the cable screen results in a considerably worse interference immunity. The connection of the screen should be done directly with a cable clamp.

If, however, a connection to a PG is not possible, the cable screen may be connected to clamp 15 of the amplifier (analogue ground/screen). Anyhow, enough interference immunity is to be ensured.

Clamp	*Description*
1	Supply voltage
2	Supply Ground
3	Supply Ground
4	PG (int. connection to top hat rail)
5	n.c. (Midpoint LVDT/RVDT)
6	Analogue Ground
7	Analogue Ground
8	Analogue output (for version check page "configuration")

Clamp	*Description*
9	+ Oscillator voltage LVDT/RVDT
10	– Oscillator voltage LVDT/RVDT
11	+Signal LVDT/RVDT
12	-Signal LVDT/RVDT
13	Option Synchronization +IN
14	Option Synchronization – IN
15	Analogue Ground / (cable screen – see above)
16	Analogue Ground

Notice: Terminals "supply ground" and "analogue ground" are isolated galvanically. To unset this isolation clamp 3 and 6 are to be bridged.

4.1 Supply voltage

The supply voltage of version -24E is in the range of 18 to 30 VDC and version –E12 within 10 to 18 VDC. The presence of the supply voltage is indicated by a green LED on the front.

To protect the electronics an internal (to the supply voltage version corresponding) self-healing "polyswitch-resettable®" fuse is built in. Whether an external additional fuse is necessary has to be considered. However, an additional external delay fuse of 0,315 A is recommended.

If the indicator LEDs go off, the supply voltage and possibly existing external protection has to be checked.

Notice: During switch-on phase the amplifier is capacitive. Thus, the switch-on current is greater than the operating current. This must be taken into consideration when dimensioning and selecting the power pack, especially if several amplifiers are being wired to the same power source.

4.1.1 Galvanic isolation

The supply voltage of the amplifier is galvanically isolated from analogue output, sensor supply and sensor signal. To unset this isolation, clamp 3 and 6 have to be bridged.

4.2 Oscillator voltage

The amplifier is equipped with a highly stable alternating voltage of 2,2 V (adjustable with potentiometer P-4 between 2 to 5 VAC) and a frequency of either 4,8 or 10 kHz. Other voltages and frequencies possible on request. If more than one amplifier is used in a setup, the excitation voltages can be synchronized and they should be synchronized for stability and vulnerability to disturbances (i.e. noise) reasons.

4.2.1 Synchronizing amplifiers

If more than one amplifier is used in a setup, the excitation voltages can be synchronized and they should be synchronized for stability and vulnerability to disturbances (i.e. noise) reasons. Synchronized means one amplifier is designed as master. The masters oscillating voltage is connected to the slaves Sync + IN and – IN, so that all amplifiers are working in phase and with the exact same frequency. The oscillators of the slaves have to be deactivated.

The label on front provides the information if the amplifier is designed as master or slave.

External bridges:

	Master		Slave-1…		Slave-n
Clamp	9	…	13	…	13
	10	…	14	…	14
	15	…	15	…	15

Notice: In addition, the clamps "analogue ground" (e.g. clamp 16) have to be bridged. This way all amplifiers have the same potential.

Changing a Master (standard) to slave:

In order to deactivate the oscillator, the solder pads underneath C-69 must be bridged and a solder point near R-2 and R-9 has to be opened.

4.3 Analogue output

The following standardized analogue outputs, depending on the ordered option, are available:

Version ...010:
The output is: 0 ... +10 Volts (max 1 mA)

Version ...B10:
The output is: ± 10 Volts (max 1 mA)

Version ...420:
The output is: 4 ... 20 mA (max 500 ohms)

Other analogue outputs available on request. For parameter settings, further information concerning scaling, or customized analogue outputs, please refer to the additional sheet "Allocation / Device Configuration).

4.3.1 Analogue output voltage

The analogue voltage output can be picked up on the corresponding clamps. See chapter 4 "Terminal Assignment".

4.3.2 Analogue output current

The analogue current output can be picked up on the corresponding clamps. See chapter 4 "Terminal Assignment":

The analogue current output is not capable of going below 4 mA, therefore when adjusting the designated zero-point, the output signal has to be set slightly higher than that, just in order to check if said signal does not virtually hang below 4 mA.

5 Starting up

If an adjustment (A-W-1K) has been ordered in combination with the amplifier(-s) and/or transducers(-s) it may be necessary for a slight fine adjustment nonetheless. This is due to possible various environmental influences as well as to mounting etc.

If any visual damage or malfunctions are noticed, the measuring system must be switched off and marked appropriately.

- Mounting transducer and amplifier
- Connect transducer to the amplifier
- Connect multimeter to analogue output
- Connect supply voltage – consider pin assignment
- Allow the system about 30 min. to warm up
- Check function and calibration of the system. Displace measurement systems usually require a fine adjustment.

Notice: The allocation of transducer / amplifier is to be complied with. After replacing a transducer, the calibration has to be checked. It is to be noted that there is a slight dependence between zero-point adjustment and amplification (gain).

In the following, the measuring range in correlation with the analogue outputs of an example transducer. In this case a 1000HR. The transducers range is ± 25 mm. That's a range of 0 … 50 mm.

There are 2 different types of analogue output: unipolar and bipolar.

a) Unipolar

MD* LVDT	-1/2 Total MD*	…0…	+1/2 Total MD*
Example 1000HR	-25mm	…0…	+25mm
Analogue output voltage	0 V	5V	+10V (20mA)
Analogue output current	0 / 4 mA	10 / 12 mA	20 mA
MD* LVDT	0 mm	+ 25 mm	+50 mm

To set the zero to 5 V (12 mA) the soldering point LP-10 has to be closed.

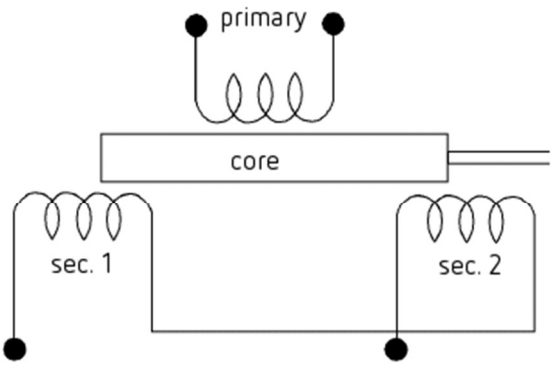
b) Bipolar

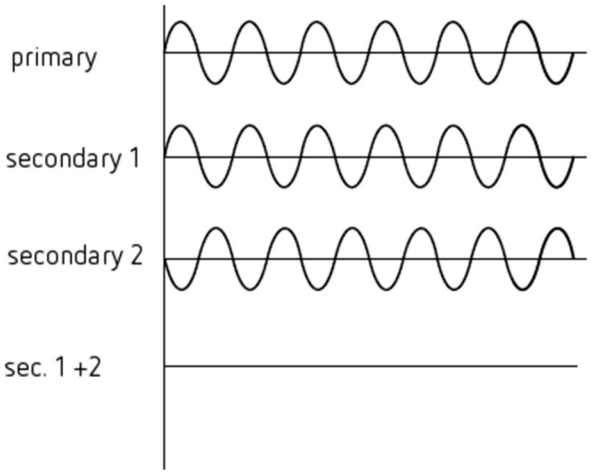
MD* LVDT	-1/2 Total MD*	…0…	+1/2 Total MD*
Example 1000HR	-25mm	…0…	+25mm
Analogue output	-10V	0 V	+10V
MD* LVDT	-25 mm	0 mm	+25 mm

* MD = measured displacement

5.1 Zero point adjustment

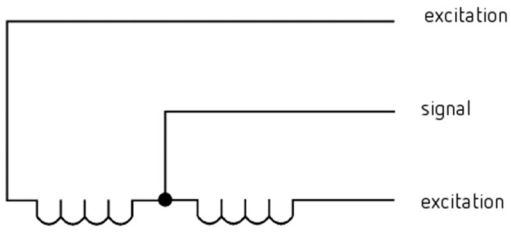
Due to linearity reasons it is very important to take care of a correct mounting of the sensor. Because the sensor is only linear within each half of its measuring range around the electrical zero point, which is the centric position of the core within the LVDT.





Comment on inductive half bridges

Besides LVDT's, inductive half bridges are used regularly too. An inductive half bridge consists of a coil with a center pickup or 2 coils connected to each other with a center pickup too. By moving the core, the amplitude changes. With the core in the middle of the overall measuring range, the signal equals half the excitation voltage. So, this voltage has to be suppressed by a switch.



If either a LVDT or an inductive half bridges is used, the DIP switch has to be set accordingly:

DIP-switch S2-4	Used Type
ON	inductive half-bridge
OFF	LVDT-Transducer

5.2 Adjustment / calibration of the amplifier

- Mount the sensor
- Set the coarse amplification according to the table in chapter 5.3 "Setting the coarse amplification".
- Find the electrical middle of the sensor by finding the lowest output signal (clamp 11 & 12)
- Adjust the desired zero-point by using the zero potentiometer (P1). (See table page 9
- Move the core by half of all over range in direction of final value.
- Adjust the desired analogue output by using the gain potentiometer
- Now move the core by full range in the opposite direction and check the result.
- Adjust both zero and gain again until no significant deviation is notable.

Notice: The sensitivity of a displacement sensor is not exactly symmetrically. Thus, there may be a deviation noticeable in the opposite half of full range. This slight flaw can be minimized by using the gain potentiometer to share that flaw evenly to each side of the zero point.

5.2.1 Correction of the analogue current output

The calibration of the amplifier in general can be done with the potentiometers on the front. This basic calibration adjusts the analogue voltage output. The analogue current output follows the voltage output. Thus, the analogue current output does not need to be corrected – it is been done right in the factory. If, however, the current output does need an adjustment, it can be done by a potentiometer (P2) inside the amplifier.

5.3 Setting the coarse amplification

In order to determine the adjustable range in which the gain potentiometer may be operated, the coarse amplification must be set. For this the necessary amplification has to be calculated. For example:

Exc: 2,2VAC | Sens: 10 mV/V_{RMS}/mm | 50 mm full range

For 0 … 10 V / 4 … 20 mA ➔ $x=\frac{5\ V}{2{,}2V \times 0{,}01V \times 25mm}$ ➔ x=9,09

For ± 10 V ➔ $x=\frac{10\ V}{2{,}2V \times 0{,}01\ V \times 25\ mm}$ ➔ x=18,18

DIP-switch			Adjustable amplification with potentiometer P2
1 Rg=15kΩ	2 Rg=30kΩ	3 Rg=68kΩ	
ON	ON	ON	2,5 … 6
ON	ON	OFF	3 … 7
ON	OFF	ON	3,5 … 8,5
ON	OFF	OFF	4,5 … 10,5
OFF	ON	ON	6 … 14,5
OFF	ON	OFF	8,5 … 21,5
OFF	OFF	ON	19,5 … 27,5

In addition, if these amplifications are not sufficient, the amplitude of the excitation voltage can be changed too. In this case 2 things have to be minded: First the maximum operating voltage of the sensor. And second the table above is not valid anymore.

Notice: For maximum operating voltage of the sensor refer to its datasheet.

6 Maintenance

The flawless function and calibration of the whole measuring system is to be checked regularly. This inspection is also necessary after every repair or change of any component of the measurement system.

7 Old appliances disposal

According to European and German law, it is prohibited to dispose of old electronic devices by household waste, but must be collected and disposed of separately.

Amplifiers and measurement units manufactured and sold by Althen Mess- & Sensortechnik GmbH serve B2B purposes only. Therefore, those old appliances must not be given to the communal disposer, but must be given back to the seller or disposed of properly. If you need any further information, please contact your local authorities.

These measures serve to protect the environment and allow recycling and recovery of valuable materials. Furthermore, do electronic devices contain substances that may cause damage to the environment if burned or dumped with normal household waste.

Appendix

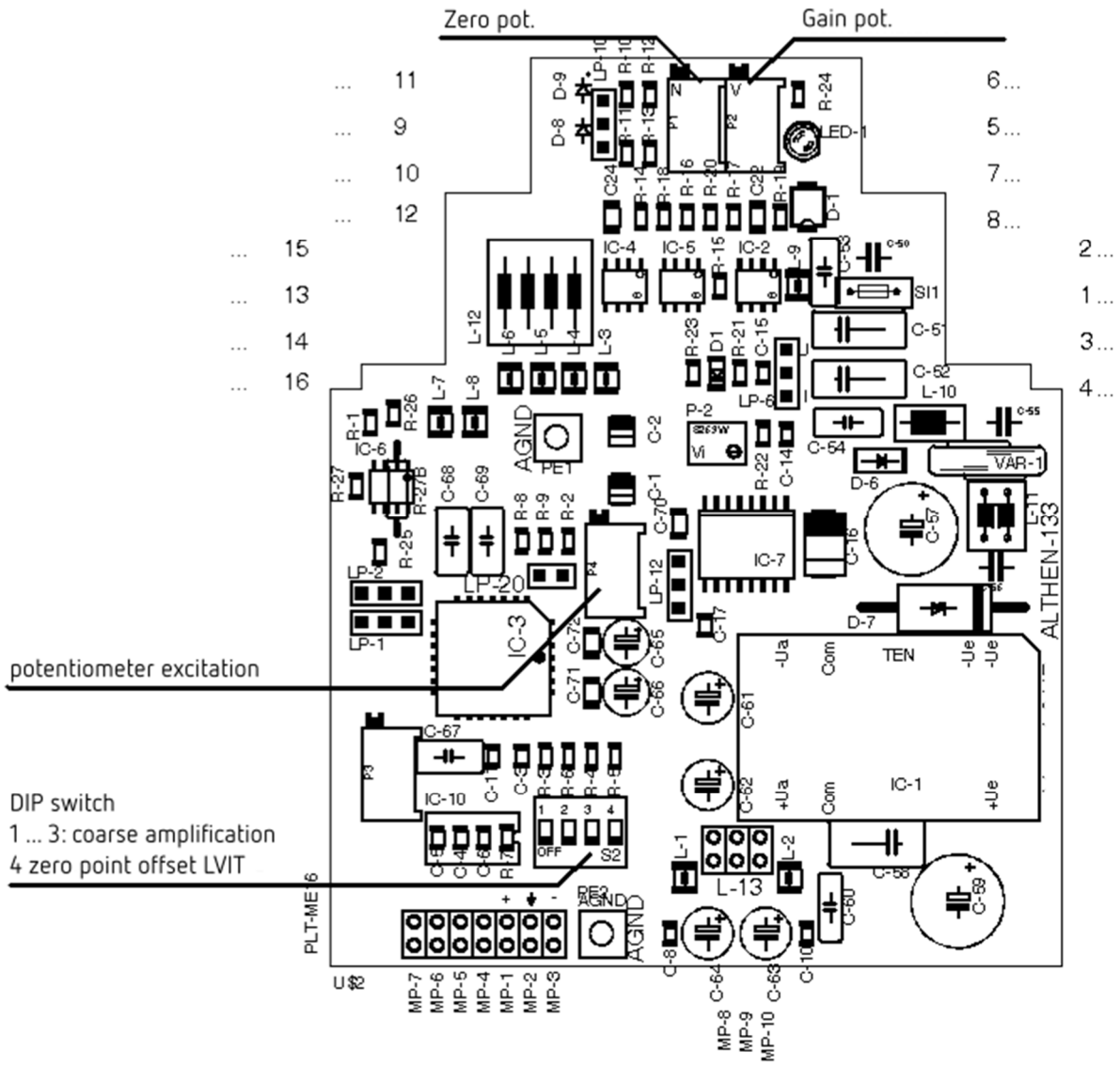
Datasheet

Number of measuring channels:	1	
Supply voltage:	10 ... 18 VDC 18 ... 30 VDC	Electronics protected against voltage reversal
Isolating proof voltage input to output:	200 V	Higher isolated proof voltage on request
Power consumption: :	max. 3 W	
LVDT/RVDT-oscillating voltage (excitation):	2,2 VAC	Voltages in the range of 2 ... 5 V possible on request
Oscillator frequencies:	4,8 kHz (±5%) 10 kHz [±5%)	Other frequencies possible on request
LVDT/RVDT-sensor primary impedance:	>160 Ohm	
Analogue output / rating	0 ... 10 V / ±10 V 4 ... 20 mA	max. 1 mA (short period short circuit proof max. 500 Ω
Frequency limit (-3 dB):	Oscillator voltage divided by 10	
Range of amplification	4 ... 27	via DIP-switch
Demodulator linearity deviation:	±0,05 % F.S.	
Temperature error	25 ppm/K (typ.)	
Electrical connection:	Pluggable Screw clamps	
Housing:	Plastic enclosure for top hat rail mounting (IP20)	
Dimension (W x H x D):	23 x 99 x 115 mm	
Weight:	150 g	
Temperature, storage:	-20 °C ... +60 °C	
Temperature, operating:	0 °C ... +50 °C	

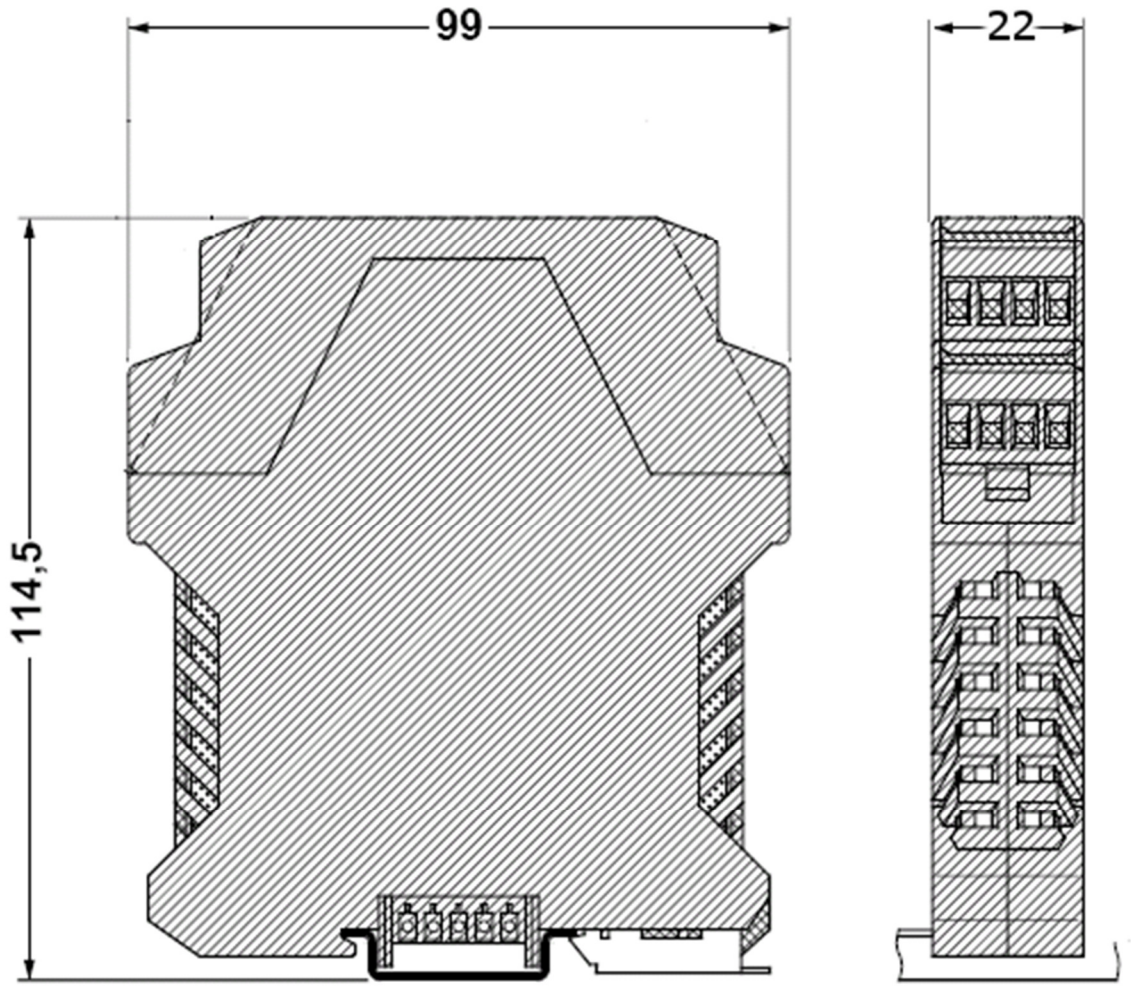
Order designation

MC-KP...	Single channel LVDT/RVDT-amplifier in plastic housing for DIN-top hat rail mounting (IP20)			
	...-12E-...	Supply voltage: 10 ... 18 VDC		
	...-24E-...	Supply voltage: 18 ... 30 VDC		
		...-010-...	Analogue output: 0 ... 10 V	
		...-B10-...	Analogue output: ± 10 V	
		...-420-...	Analogue output: 0 ... 10 V and 4 ... 20 mA	
			...-no declaration	Oscillator frequency 4,8 kHz / 2,2 V
			...-10K	Oscillator frequency 10 kHz / 2,2 V

Component diagram



Housing dimensions



Subject to modifications.

All information describe our products in general form.