rexroth
A Bosch Company

VT-MRMA1-1

Analog amplifier module

Operating instructions
RE 30214-B/03.2019

Replaces: 03.2017
English

The data specified only serve to describe the product. No statements concerning a certain condition or suitability for a certain application can be derived from our information. The information given does not release the user from the obligation of own assessments and verification. It must be remembered that our products are subject to a natural process of wear and aging.

An example configuration is shown on the title page. The delivered product may, therefore, differ from the product which is pictured.

The original operating instructions were created in the German language.

Content

1 About this documentation

1.1 Validity of the documentation

This documentation is valid for the following analog amplifier module:
• VT-MRMA1-1-1X/V0/0

This documentation is intended for fitters, operators, service technicians and plant operators.
This documentation contains important information on the safe and appropriate installation, transport, commissioning, maintenance, operation, removal and simple troubleshooting of the product.

- Read this documentation thoroughly, especially chapter 2 “Safety instructions“ and chapter 3 “General notes on damage to material and the product“, before working with the analog amplifier module.

1.2 Required and supplementary documentation

- Only commission the product, when you have the documents marked with the book symbol 🕮 at hand and have understood and observed them.

Table 1: Required and supplementary documentation

	Title	Document number	Type of document
🕮	Analog amplifier module VT-MRMA1-1	30214	Data sheet
🕮	Pressure transducer for hydraulic applications, type HM20-2X	30272	Data sheet
🕮	Proportional pressure reducing valve with DC motor actuation	29173	Data sheet
🕮	Power supply unit type VT-NE30-2X	29929	Data sheet

1.3 Representation of information

In order that this documentation allows you to work directly and safely with your product, standardized safety notes, symbols, terms and abbreviations are used. For a better understanding, these are explained in the following sections.

1.3.1 Safety instructions

This documentation contains safety notes in Chapter 2.6 “Product-specific safety instructions“ and Chapter 3 “General notes on damage to material and the product“ as well as before a sequence of activities or instructions for action, which involve the risk of personal injury or damage to equipment. The measures described for averting the hazard have to be observed.

Safety notes are structured as follows:

⚠ SIGNAL WORD

Type and source of hazard!
Consequences in the case of non-observance
- Measures to avert the hazard
- <Enumeration>

- **Warning symbol:** draws attention to a hazard
- **Signal word:** identifies the degree of hazard
- **Type and source of hazard:** identifies the type or source of the hazard
- **Consequences:** describes the consequences in the case of non-observance
- **Precautions** states, how the hazard can be avoided

Table 2: Hazard classes according to ANSI Z535.6-2011

Warning sign, signal word	Meaning
⚠ DANGER	Indicates a hazardous situation which, if not avoided, will certainly result in death or serious injury.
⚠ WARNING	Indicates a hazardous situation which, if not avoided, could result in death or serious injury.
⚠ CAUTION	Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.
NOTICE	Damage to property: The product or the environment can be damaged.

1.3.2 Symbols

The following symbols refer to notes, which are not relevant to safety, but increase the legibility of the documentation.

Table 3: Meaning of symbols

Symbol	Meaning
	If this information is disregarded, the product cannot be used or operated in an optimum manner.
▶	Individual, independent action
1. 2. 3.	Numbered instructions for action: The numbers indicate that the activities are to be carried out consecutively.

1.3.3 Terms used

The following terms are used in this documentation:

Table 4: Terms used

Term	Meaning
VT-MRMA1	Analog amplifier module
UB	Operating voltage
HM20	Pressure transducer

1.3.4 Abbreviations used

The following abbreviations are used in this documentation:

Table 5: Abbreviations used

Abbreviation	Meaning
EMC	ElectroMagnetic Compatibility
PE	Protective Earth
PELV	Protective Extra Low Voltage

2 Safety instructions

2.1 About this chapter

The analog amplifier module has been manufactured according to good engineering practice. There is, however, still a risk of personal injury or damage to equipment if you do not observe this chapter and the safety instructions contained in this documentation.

- Read these instructions completely and thoroughly before working with the product.
- Keep this documentation in a location where it is accessible to all users at all times.
- Always pass the product together with the required documentation to third parties.

2.2 Intended use

The analog amplifier module is an electrical component.
You may use the product as follows:
- For controlling a DC motor-actuated proportional pressure reducing valve with electrical position feedback, type (Z)DRS, size 6, component series 1X

The product is intended exclusively for professional use and not for private usage. Operation according to the intended use also implies that you have read and understood this documentation completely, especially chapter 2 “Safety instructions“.

2.3 Improper use

Any use other than described in the section “Intended use” is considered as improper and is therefore not permitted.
For damage resulting from improper use, Bosch Rexroth AG will not bear liability. The risks arising from improper use lie exclusively with the user.
Improper use includes, but is not limited to the following, foreseeable misuse:
- operating the analog amplifier module outside the specified performance limits and operating conditions, especially the prescribed ambient conditions;

2.4 Personnel qualifications

The activities described in this documentation require basic knowledge of electrics and hydraulics as well as knowledge of the associated technical terms. To ensure safe usage, these activities may therefore only be carried out by qualified personnel or under the direction and supervision of qualified personnel.
Qualified personnel are those who can recognize possible hazards and institute the appropriate safety measures due to their professional training, knowledge and experience, as well as their understanding of the relevant conditions pertaining to the work to be done. Qualified personnel have to observe relevant specialist rules and have the required expertise.
With regard to hydraulic products, specialist knowledge means, for example:
- The ability to read and entirely understand hydraulic circuit diagrams,

- the complete understanding in particular of interrelationships with regard to safety equipment and
- knowledge of the function and structure of hydraulic components.

Bosch Rexroth offers qualifying training courses in specific fields. You can find an overview of training contents on the Internet at:
http://www.boschrexroth.com

2.5 General safety instructions

- Observe valid regulations for accident prevention and environmental protection.
- Observe the safety regulations and rules of the country where the product is used/operated.
- Use Rexroth products only in technically perfect condition.
- Observe all notes given on the product.
- Persons who install, commission, operate, demount or maintain Rexroth products must not consume any alcohol, drugs or pharmaceuticals that may affect their ability to respond.
- Only use accessory and spare parts approved by the manufacturer in order to rule out personnel hazards arising from unsuitable spare parts.
- Adhere to the technical data and ambient conditions specified in the product documentation.
- If unsuitable products are installed or used in safety-relevant applications, unintended operational states may occur in the application that can cause personal injury and/or damage to property. Therefore, use the product only in safety-relevant applications such as in explosion protection areas or in safety-related parts of a control (functional safety), if this use is expressly specified and permitted in the documentation.
- You may commission the product only when it has been established that the final product (for example, a machine or system), in which the Rexroth products is installed, complies with national regulations, safety regulations and standards relevant for the application.
- Observe safety-relevant information and information on risks in the operating instructions of the manufacturer of the connected hydraulic system before commissioning the analog amplifier module with a hydraulic system.
- Technical data, the connection and installation conditions can be found in the product documentation and have to be strictly observed.
- Observe general installation and safety regulations for working on electrical systems.
- Generally, you may not modify or convert the product.

2.6 Product-specific safety instructions

If for certain work to be carried out safety features on the product are temporarily not used for functional reasons, you have to ensure the same safety and protection level in a different way in accordance with valid regulations.

⚠ WARNING

Hazardous movements!

Risk of injury due to incorrect activation of the proportional pressure reducing valve via the analog amplifier module and resulting unforeseeable machine movements.

- Operate the amplifier only together with the valves specified in the type code.
- Observe safety in accordance with EN 13849 or IEC 62061.
- If persons have to enter the hazard zone while the control is active, provide superordinate monitoring functions or measurers for personal safety. The plant manufacturer/user has to rate and dimension these measures on the basis of a risk and failure analysis according to the specific situation on site. The safety regulations valid for the system have to be taken into account for this.
- The electronics emits interference to other electronics within the permitted limit values. This can cause malfunction in the control process. Only use electronics below the EMC limit values or provide appropriate shielding.
- The electronics of the analog amplifier module VT-MRMA1 responds to electromagnetic interference from non-shielded, improperly installed or wrongly connected signal cables. If the limit values given in the data sheet are exceeded, malfunction or uncontrolled movements are possible. Adhere to the limit values given in the data sheet, use only electronics below the EMC limit values or provide proper shielding.
- Electrostatic processes, an inadequate grounding concept or missing equipotential bonding can lead to damage to the electronics and hence cause malfunction or uncontrolled movements of the machine. Ensure proper grounding and provide equipotential bonding.
- Using the product outside the specified IP protection class can result in short-circuit and malfunction and hence in uncontrolled machine movements. Therefore, use the product only within the IP protection class and in environments as specified in the data sheet.
- Provide safety functions for personal safety separately. The analog amplifier module VT-MRMA1 itself does not include safety functions for personal safety and is no safety-related component.

High electric voltage through incorrect connection!

Danger to life, risk of injury due to electric shock.

- When carrying out any work, disconnect the relevant machine section from the power supply and protect it against being switched on again.
- Only connect devices, electrical components and lines which feature protective extra low voltage (PELV) to connections or terminals having voltages from 0 to 50 Volt.
- Only connect voltages and power circuits that feature safe isolation from dangerous voltages. Safe electrical isolation can be achieved with, for example, isolating transformers, safe opto-couplers or mains-free battery operation.

⚠ WARNING

Lightning!
Risk of uncontrolled machine movements.
- An inadequate grounding concept or missing equipotential bonding can lead to damage to the electronics. Provide for equipotential bonding of the device.

Failures and defects in the control current circuits or the energy supply!
Risk of uncontrolled machine movements.
- Observe safety in accordance with EN 13849 or IEC 62061.

⚠ CAUTION

Hot surfaces!
Risk of burning.
- System parts can heat up during operation. Let system parts cool down before touching it or wear protective gloves.

3 General notes on damage to material and the product

The warranty is valid exclusively for the configuration delivered.
- Warranty claims will be rejected in the case of improper installation, commissioning and operation as well as in the case of use not in accordance with the intended purpose and/or improper handling.

NOTICE

High voltage!
Risk of damage to the analog amplifier module.
- Wire the analog amplifier module only when disconnected from the power supply.

Overloading!
Risk of overloading and damage to the supply cable in the case of insufficient dimensioning and/or operation with several electrical devices.
- Provide current limitation by overload protection.
- Select an appropriate rating of power supply unit and cables.

Short-circuit!
Risk of overloading and damage of the supply cable in the case of defects of the electrical device.
- Provide current limitation by overload protection.

Impermissible temperature range!
Risk of overheating. The device can be thermally destroyed.
- Adhere to the specification in the data sheet.

4 Scope of delivery

The scope of delivery includes:
• Analog amplifier module

Accessories such as cables and mains adaptor and cable sets are not included in the scope of delivery, but have to be ordered separately. See also chapter 7.3 “Recommended accessories“on page 26.

5 About this product

5.1 Performance description

The analog amplifier module VT-MRMA1-1 is used for controlling a DC motor-actuated pressure reducing valve with self-locking feature. It is designed as module.

Features

- Module housing for toolless quick “snap-in” installation
- Plug-in screw connectors that can be withdrawn individually
- Configurable pressure command value input with cable break detection feature (0 to 10 V, can be switched over to 4 to 20 mA)
- Separately adjustable ramp times for pressure command value input
- Actual valve position value with cable break detection feature and electronic limit stops
- Position controller
- Characteristic curve correction for valve position command value
- Output stage with ”clocked control voltage” for the valve actuator
- 24 V inputs/outputs for operational states (enable, ready for operation, position command value reached)
- Configurable actual pressure value input 0.5 to 5 V (can be switched over to 4 to 20 mA) with cable break detection feature
- Integrated pressure switch function with adjustable switching thresholds
- Two 24 V outputs for pressure switches
- Test jack can be switched over
- Reverse polarity protection for power supply (short-circuit-proof power supply unit)
- Power supply unit with DC/DC converter
- LED indicator lamps

5.1.1 Block circuit diagram of the controller structure of the analog amplifier module:

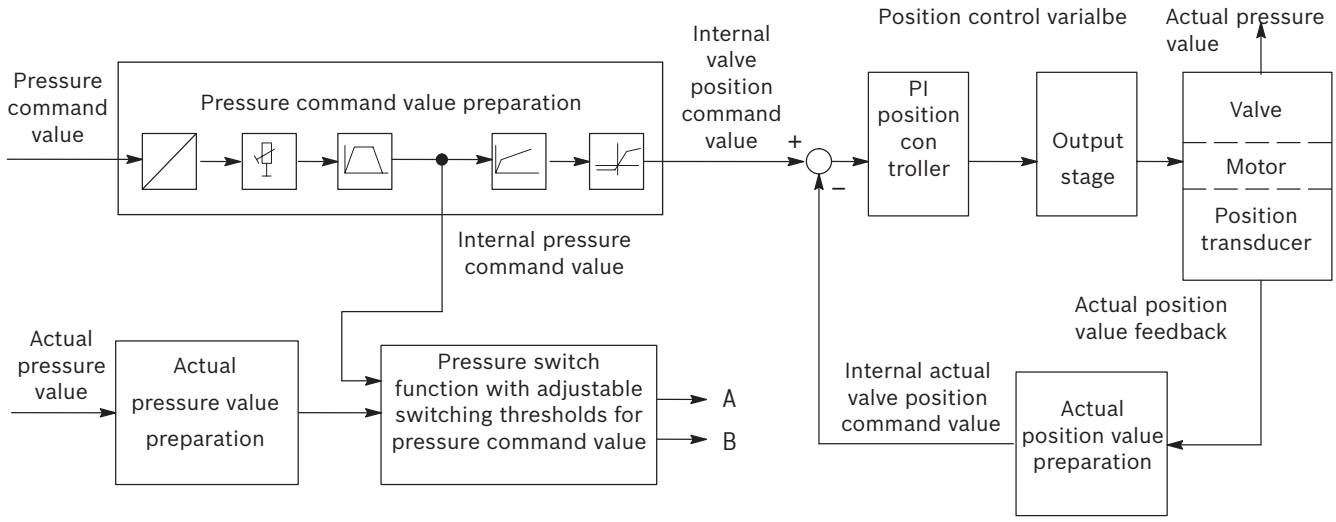


Fig. 1: Block circuit diagram of the controller structure of the analog amplifier module

From the external pressure command value, the pressure command value processor generates both, the internal pressure command value and – according to the valve characteristics – the internal valve position command value. The PI position controller acquires the system deviation on the basis of the valve position command value and the actual valve position value and generates from this the position control output for the DC motor in the pressure reducing valve. An absolute position transducer integrated in the valve provides the actual valve position. The integrated pressure switch function compares the processed actual pressure value with the processed pressure command value. Pressure values above or below limit values can be diagnosed via outputs A or B of the pressure switch.

5.2 Product description

5.2.1 Components that can be connected

The following components are to be connected to the analog amplifier module (for data sheets, see chapter 1.2 “Required and supplementary documentation“ on page 5):

- ZDRS 6VP-1X: Proportional pressure reducing valve with electromotive adjustment element (and optional pressure transducer). The valve is self-locking.
- HM20-2X: Pressure transducer at ZDRS 6VP-1X
- VT-NE30-2X: Power supply unit
- Machine control: command value provision, I/O for control and status of the amplifier module

Fig. 2: Proportional pressure reducing valve of type (Z)DRS, size 6, series 1X

1 Position transducer
2 Actuator
3 Main stage
4 Connection of pressure transducer
5 Pressure transducer

5.2.2 Function

The function of the analog amplifier module is described in data sheet 30214.

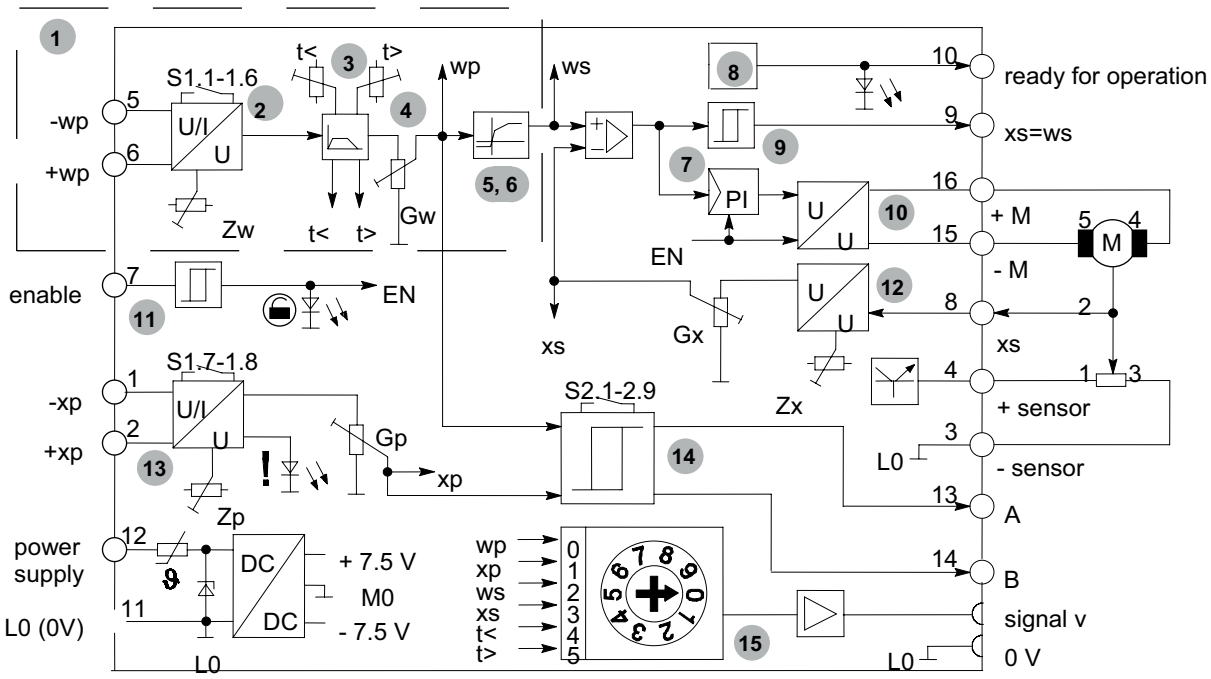


Fig. 3: Block circuit diagram of the amplifier module

1 Pressure command value preparation
2 Pressure command value feedforward
3 Ramp generator
4 Pressure command value attenuator
5 Linearization of valve characteristic curve
6 Amplitude limiter
7 Valve position controller
8 Fault detection
9 "Position command value reached" recognition
10 Output stage
11 Enable function
12 Actual valve position value acquisition
13 Actual pressure value preparation
14 Pressure switch function
15 Measuring point changeover switch

5.2.3 Functions within the amplifier module

Command value preparation (1)

Pressure command value preparation takes places at various levels:

- Analog pressure command value provision with adjustable zero point correction (current or voltage interface)
- Ramp generator for pressure increase or pressure reduction of the pressure command value
- Pressure command value attenuator
- Linearization for compensating for the non-linear valve characteristic curve through generation of the relevant valve position command value
- Amplitude limitation of the valve position command value

The result of command value preparation is the internal pressure command value and the internal valve position command value.

Pressure command value feedforward (2)

Table 6: Pressure command value feedforward

Purpose	Effect	Setting
The pressure command value feedforward generates the internal pressure command value signal from an external pressure command value signal taking account of zero point compensation (zero point potentiometer).	Pressure increase/reduction as the pressure command value becomes higher/lower.	Configure input with DIL switch **S1** to “0 to 10 V differential input” or “4 to 20 mA current input“. Zero point potentiometer $\mathbf{Z_W}$: 30 %

When using the differential input (pressure command value) always activate or deactivate both inputs simultaneously.
Make sure that the ground of the pressure command value ($-w_P$, terminal 5) has the same potential as the ground (L0, terminal 11) of the power supply unit (if required, use an equipotential bonding strip to suppress disturbance more effectively).
For carrying out zero point compensation using zero point potentiometer ZW, potentiometer G_W must not be turned to the left-hand limit stop (= 0 %).

If the current input is not connected or in the event of a command value cable break, the resulting internal pressure command value signal is < 0 %. In any case, the valve comes to a standstill at its current position. When the enable is not set, the valve cannot be adjusted, positioning control is inactive, but the positioning signal (”command value reached”) and the pressure switch are active. The pressure command value has therefore also to be applied when the enable signal is missing.

Ramp generator (3)

Table 7: Ramp generator

Purpose	Effect	Setting
Limits the increase in the pressure command value input signal.	A given step-change signal is turned into a ramp-shaped output signal.	Separate potentiometers **t<** and **t>** for the ramp times of pressure increase or pressure reduction. The ramp time refers to a signal change of 100 %.

The ramp time is not extended or reduced by the downstream ”pressure command value attenuator”.

The current ramp time can be established according to the following formula from the voltage of the measuring signals (switch position 4 or 5) at test jack v (front):

$$t = \frac{1\ V}{U_t} \bullet 1\ [sec]$$

The following table shows the value measured at the test jack and the associated current ramp time:

Table 8: Ramp times

Value at test jack position 4, 5	U_t in Volt	10	5	3	2	1	0.5	0.01	0.05	0.03	0.02	0.01
Current ramp time (±20 %)	t in sec	0.1	0.2	0.33	0.5	1	2	10	20	33.3	50	100

Pressure command value attenuator (4)

Table 9: Pressure command value attenuator

Purpose	Effect	Setting
Limits the maximum actual pressure value	The internal pressure command value is influenced.	With potentiometer **G_W**: 0 % to 130 %

Example: Application with pressure stage having a nominal value of 100 bar
A voltage applied by the machine control corresponds to 10 V (= 100 %) at input **wp**. A max. pressure of 80 bar (= 80 %) is to be possible. Potentiometer **Gw** is used to adjust the internal pressure command value to a voltage of 8 V (= 80 %) (voltage at test jack **v** with switch position **0**). With an applied pressure command value of 10 V, this corresponds to an actual pressure value of 80 bar.

Linearization of valve characteristic curve (5)

Table 10: Linearization

Purpose	Effect	Setting
Compensation of a non-linear valve characteristic curve	Generates the valve position command value from the pressure command value	None

Amplitude limiter (6)

Table 11: Linearization

Purpose	Effect	Setting
Internal limitation of the valve position command value (irrespective of the pressure command value applied).	Safety limitation of the valve stroke to +110 % and -5 %	None

5.2.4 Controller and functions closely related to the controller

The description refers to functions that are directly or indirectly related to the position controller in functional terms.

Valve position controller (7)

Table 12: Valve position controller

Purpose	Effect	Setting
Generation of output variable for clocked output stage from the system deviation of position.	Matching of the actual valve position value with the internally applied valve position command value.	None

Output stage (10)

Table 13: Output stage

Purpose	Effect	Setting
Generates the clocked control voltage for the DC motor, which acts as actuator in the pressure reducing valve.	The DC motor adjusts the pilot pressure by way of the position of the spring plate. From this pilot pressure, the main stage of the pressure reducing valve generates the reduced “actual pressure value” by shifting the valve spool.	None

The output stage output is short-circuit-proof. Moreover, the output stage is de-energized when no enable is present or a fault has been detected.

Enable function "external enable“ (11)

Table 14: Enable function

Purpose	Effect	Setting
Activation of the position controller and the output stage.	Enables the valve adjustment or pressure adjustment.	Enable signal by machine control. Indication of enable: Yellow LED on front panel

Enable input (terminal 7): When a voltage of less than +6 V is applied, the output stage is blocked independently of the current position command value and actual position value. The valve remains in the self-locked position. When a voltage greater than +8.5 V is applied, positioning control and the output stage are activated. An enable cable break corresponds to a 0 V signal.
When the enable is not set, adjusting the valve is impossible, positioning control is inactive, but the positioning signal (”position command value reached”) and the pressure switch are active. The pressure command value therefore also has to be applied when the enable signal is missing.

- Make sure that the enable signal is only given when a new actuating process of the valve is going to take place. When the new working pressure has been reached, the enable has to be reset (see also application example in chapter 8.4, on page 41)!

5.2.5 Actual value preparation

Actual value preparation refers to the closed-loop-controlled actual valve position value, the resulting actual pressure value and the pressure switch function.

Actual valve position value acquisition (12)

Table 15: Actual valve value acquisition

Purpose	Effect	Setting
Processing of the actual valve position value of the position transducer.	Generates the internal actual position value signal for the position controller.	With zero point potentiometer **Zx** and sensitivity potentiometer **Gx**. **Zx**: 15 % **Gx**: 90 % to 120 %

The position transducer integrated in the valve is supplied from a voltage output (terminals 3 and 4). A cable break of a position transducer port is detected (ready output) and the output stage is switched off.

Actual pressure value input (13)

Table 16: Actual pressure value input

Purpose	Effect	Setting
Generates the internal actual pressure value signal from the external actual pressure value signal of the pressure transducer.	Provision of the internal actual pressure value signal for the pressure switch function.	Configuration of the input with DIL switch S1 to “0.5 to 5 V differential input” or “4 to 20 mA current input“. Zero point potentiometer **ZP**: ± 5 % Sensitivity potentiometer **GP**: 90 % to 120 %

When the actual pressure value input is configured as ”4 to 20 mA” input and operated in series connection with a further, separate, external current input (PLC, etc.), the module electronics provides an offset current at terminal 1. This has to be taken into account when the external current input is calibrated!

- Monitoring of the actual pressure value input (depending on the characteristics of the pressure transducer electronics):
- Cable break of the actual pressure value cables connected to the input (terminals 1 and 2)
- Exchange of the actual pressure value cables
- Cable break of the positive supply cable of the pressure transducer
- Cable break of the negative supply cable (ground) of the pressure transducer
- Detection of undervoltage at terminal 2 (+xp < 0.35 V)

If one of the faults above is detected, **both pressure signals A and B drop to 0 V and the red LED ”!”** on the front panel of the amplifier module **lights up**.

In the event of a cable break of the actual pressure value cable, the further operation of the closed-loop valve position control is not affected.

Pressure switch function (14)

Table 17: Pressure switch function

Purpose	Effect	Setting
Uses switching thresholds **A** and **B** to monitor, whether the actual pressure value signal is within a window around the pressure command value.	Actual pressure value permitted only within the valid range within the switching thresholds. In the event of a cable break or a value that exceeds or falls below the switching thresholds, the closed-loop position control function is maintained. Action required from higher-level control.	DIL switch S2 for the individual configuration of the lower (A) and upper (B) switching threshold. The actual pressure value has to be within this range.

Table 18: Operational states of pressure switch signals A and B:

Actual pressure value	Pressure switch signal A (terminal 13)	Pressure switch signal B (terminal 14)
No switching threshold exceeded	24 V (HIGH)	24 V (HIGH)
Value fallen below lower switching threshold (insufficient pressure)	**0 V (LOW)**	24 V (HIGH)

Actual pressure value	Pressure switch signal A (terminal 13)	Pressure switch signal B (terminal 14)
Upper switching threshold exceeded (excessive pressure)	24 V (HIGH)	**0 V (LOW)**
Cable break of actual pressure value cables or pressure transducer supply cables	**0 V (LOW)**	**0 V (LOW)**

Setting the pressure switch thresholds:
The upper and lower switching thresholds each are composed of a **relative** and an **absolute** amount. The relative switching threshold is defined in % and refers to the currently set pressure command value. The absolute switching threshold is defined in % and refers to the nominal value (= maximum pressure) of the selected pressure level (see figure below):

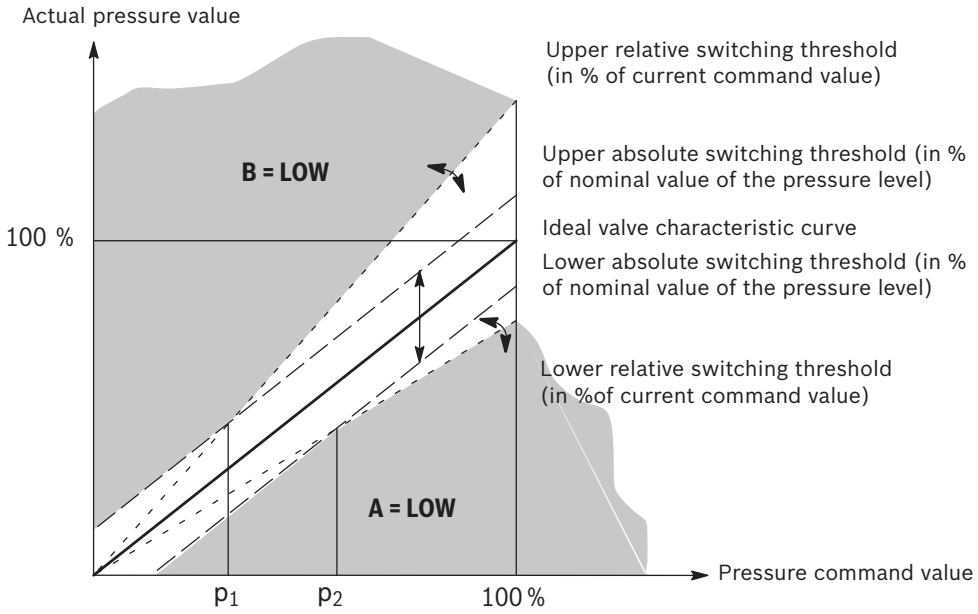


Fig. 4: Pressure switch thresholds

Overlapping (p1, p2) of the relative and the corresponding absolute switching thresholds results in an envelope curve in the form of a ”funnel” (see figure above). As long as the actual pressure value remains within the ”funnel limits” at a given pressure command value, both pressure switch signals A and B are HIGH. If the pressure exceeds or falls below one of the two limits (actual pressure value is in the gray area), the corresponding pressure switch signals falls to LOW.

5.2.6 Monitoring functions

The monitoring functions of the amplifier module are to detect faults in the system and in the supply lines and to initiate appropriate measures in the event of a fault.

Fault detection (8)

Table 19: Fault detection

Purpose	Effect in the event of a fault	Setting
Fault detection for certain signal cables and internal processes.	Output stage is deactivated. “Ready-for-operation” output is switched to 0 V and the green LED on the front panel goes out.	None

The fault detection function monitors:
- Cable break of the pressure command value cables
- Exchanged pressure command value cables
- Cable break of the position transducer connecting cables
- Short-circuit of the position transducer supply cable with L0

When a new pressure adjustment process is being initiated, the following faults are detected via the protective motor circuit (see “Protective motor circuit“ below):
- Exchanged motor cables (positive feedback)
- Jamming of the valve actuator
- Cable break of motor cables

When no fault is present, the green LED for readiness for operation lights up on the front panel and the ”ready-for-operation” output is connected to the 24 V operating voltage.
After the fault was rectified, the electronics can be re-activated by resetting and then setting the ”enable” again.

Protective motor circuit

The protective motor circuit is an integral part of the fault detection feature (see page 20).

Table 20: Protective motor circuit

Purpose	Effect	Setting
Ensures proper operation of the valve actuator by monitoring the time required for adjusting the position.	When the max. permissible adjustment time (max. 4 sec) is exceeded, the output stage is deactivated, the green LED on the front panel of the module goes out, and the ”ready-for-operation” output is reset to 0 V.	None

Example of faults, in the case of which the protective motor circuit responds:
- Jamming of the valve actuator
- Positive feedback as a result of exchanged motor cables
- Motor cable break

The protective motor circuit detects these faults only when a new pressure adjustment process is being initiated.

Electronic limit stop

Table 21: Electronic limit stop

Purpose	Effect in the event of a fault	Setting
Protects the actuator drive against collision with mechanical limit stops.	Deactivation of the output stage when the electronic limit stop is exceeded (traversing in the opposite direction is possible)	None

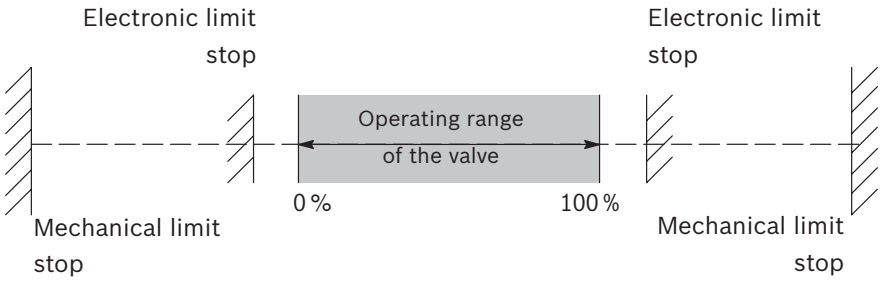


Fig. 5: Electronic limit stops

Electronic limit stops are only effective when the position transducer and motor are correctly wired (e.g. a positive feedback of the motor results in the fact that the valve ignores the electronic limit stops and moves to the mechanical limit stop. In this case, the protective motor circuit cuts in and ensures that the output stage is switched off before, see also “Protective motor circuit“ above).

Recognition of "position command value reached" (9)

Table 22: Recognition of position command value reached

Purpose	Effect in the event of a fault	Setting
Monitoring of the system deviation of the valve position controller.	“Position command value reached” (terminal 9) = 24 V (High) as long as the following is valid:. $\|wS - xS\| < 5\ \%$ Otherwise, terminal 9 is connected to 0 V (LOW).	None
Information about the state of closed-loop position control		
Synchronization with the higher-level sequence program.		

When the ramp is set, the signal for ”position command value reached” is LOW for the duration of the ramp.

Internalposition controller and output stage enable

Table 23: Position controller and output stage enable

Purpose	Effect in the event of a fault	Setting
Activation/deactivation of the position controller and the output stage in dependence on disturbances and enable.	Allows pressure adjustments.	None

Preconditions for the internal controller and output stage enable:

- The ”external enable” is set (see also “Enable function “external enable“ (11)“ on page 17

- The electronics is ”ready for operation” and the fault detection feature has not detected a fault (see “fault detection” and “protective motor circuit” above).

5.2.7 Measuring point changeover switch (15)

Table 24: Measuring point changeover switch

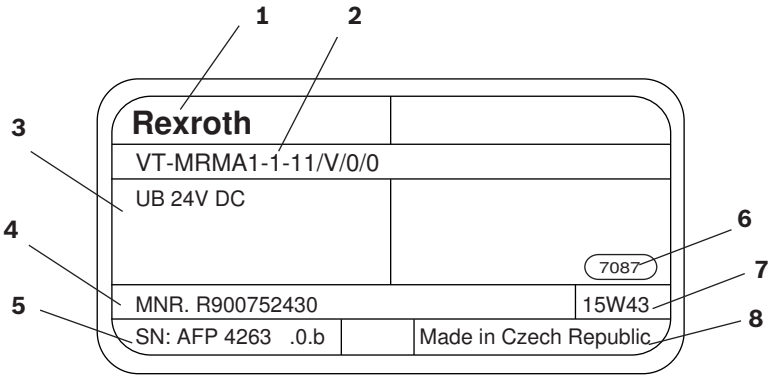
Purpose	Effect in the event of a fault	Setting
Access to various, internal measuring points.	Various measuring points can be measured at test jack v (see below)	Selection of measuring points by means of measuring point selector switch  on the front panel

Measuring points (see also chapter 8.1.3, „Measuring signal and measuring point selector switch“ on page 38):

- Pressure command value w_P
- Actual pressure value x_P
- Valve position command value w_S
- Actual valve position value w_S
- Ramp time “up” t <
- Ramp time “down” t >

5.3 Identification of the product

At the side of the VT-MRMA1 there is a label showing the most important data.



1 Word mark
2 Material short text
3 Operating voltage
4 Material number
5 Serial number
6 Date of production
7 Plant
8 Country of origin

6 Transport and storage

There are no special instructions for transporting this product. Observe, however, the notes in Chapter 2. “General safety instructions” and comply with the ambient conditions for storage and transport which are detailed in the technical data of data sheet 30214.

6.1 Storing the VT-MRMA1

Proceed as follows in order to prepare the analog amplifier module for storage and further use:

- Only use the original packaging for storage.
- Observe the permissible storage temperature range (see data sheet 30214)
- Protect the VT-MRMA1 from dust and humidity.

7 Installation

⚠ WARNING

Pressurized parts or component parts hurling around!
Risk of injury due to parts flying around and due to ejecting oil jet, if hydraulic parts or hydraulic lines were improperly or incompletely mounted before pressure was switched on.

- Depressurize the relevant system part prior to mounting the device.
- Use sufficiently dimensioned connection threads with sealing points.
- Have the mounting work carried out by a specialist according to these instructions and test the system before commissioning by applying the relevant overpressure according to ISO 4413.

⚠ CAUTION

Fault currents and short-circuits!
Impairment of safety and malfunction.

- Keep the surroundings free from electrically conductive contamination (acids, bases, corrosive agents, salts, metal vapors, etc.) and do not expose the device to these substances. Generally rule out any deposits according to protection class IP 20.

Cables lying around!
Risk of stumbling!

- Lay the cables and lines so that they cannot be damaged and no one can stumble over them.

NOTICE

Major differences in potentials!
Risk of destruction of the VT-MRMA1 by plugging or unplugging connectors under voltage.

- Switch off power supply to the relevant system part before installing the unit or plugging or unplugging connectors. Damage to the control system caused by incorrect installation is not covered by the warranty!
- Observe the protection class, the voltage supply and the environmental conditions according to data sheet 30214.

Emitted interference!
Risk of affecting other devices.

- Use shielded signal cables and power supply unit VT-NE30-2X (or comparable unit) for the VT-MRMA1 in order to fulfill EMC requirements.

Overheating!
The device might be destroyed.

- Ensure sufficient air circulation by providing space to the right, to the left, top and bottom. See Fig. 6.

NOTICE
Condensate! Damage to the electronics and impairment of function due to ingress of water. ▶ Let the analog amplifier module acclimate itself before installing it and switching it on.

7.1 Installation conditions

The amplifier module VT-MRMA1 is intended for vertical mounting on DIN rails in control cabinets. The dimensions are given in data sheet 30214.
Ensure sufficient clearance to the right and to the left of at least 25 mm. By providing a minimum clearance of 50 mm up and down, ensure sufficient air circulation to the venting slots in the housing.
All cables (e.g. for command values, pressure transducer feedback values, enable signals) have to be rated so (cable thickness, length) that the operating data and operating ranges (input voltage range, power consumption) are adhered to taking account of technical data (input resistance, power consumption).

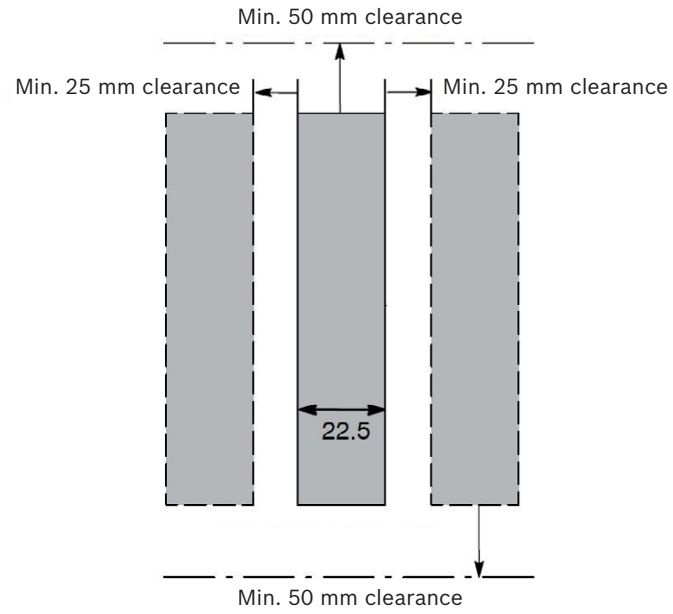


Fig. 6: Required clearance

7.2 Required tools

For installing the product, no special tools are required.

7.3 Recommended accessories

We recommend the use of the following accessories for connecting the amplifier module VT-MRMA1. These accessories are not included in the scope of delivery, but can be ordered separately from Bosch Rexroth:

Table 25: Accessories

Component	Material number
Compact power supply unit VT-NE30-2X	R901082348

7.4 Installing the VT-MRMA1

- For mounting, observe the notes on applicable standards and operating conditions in the data sheet.
- Open and wire the amplifier module only when it is disconnected from the power supply.
- Do not lay solenoid or signal cables near power cables!
- Generally, route all electrical connection cables via strain reliefs.
- Use shielded cables (suitable for EMC) for signal and valve cables.
- Use relays with gold-plated contacts for switching command values (small voltages, small currents).
- Do not use any silicone-containing sealants, adhesives or insulating agents.
- See to it that the installation position provides ease of maintenance, i.e. unhindered access to connection lines. Ensure free access to the connection side. The cable ends should be sufficiently long in order that the amplifier can also be removed from the DIN rail when connected.
- Before installing the device, note the details given on the nameplate. If nameplates are no longer visible or legible after installation you will have the data at hand at any time.
- When several modules are installed, see to it that there is sufficient space to remove the analog amplifier modules again.

The installation position of the analog amplifier module is vertical. The amplifier module can be installed without tools on a mounting rail TH35-7.5 to EN 60715 (DIN rail). Latches with spring are provided for fixation of the module housing.
By snapping the housing of the VT-MRMA1 on a conductive mounting rail, the ground connection is established. This constitutes the HF grounding of the analog amplifier modules VT-MRMA1.

- Let the amplifier module snap in on the mounting rail. The latch (with spring pressure) prevents loosening of the module housing from the mounting rail.
- To loosen the module, push the latch downwards.

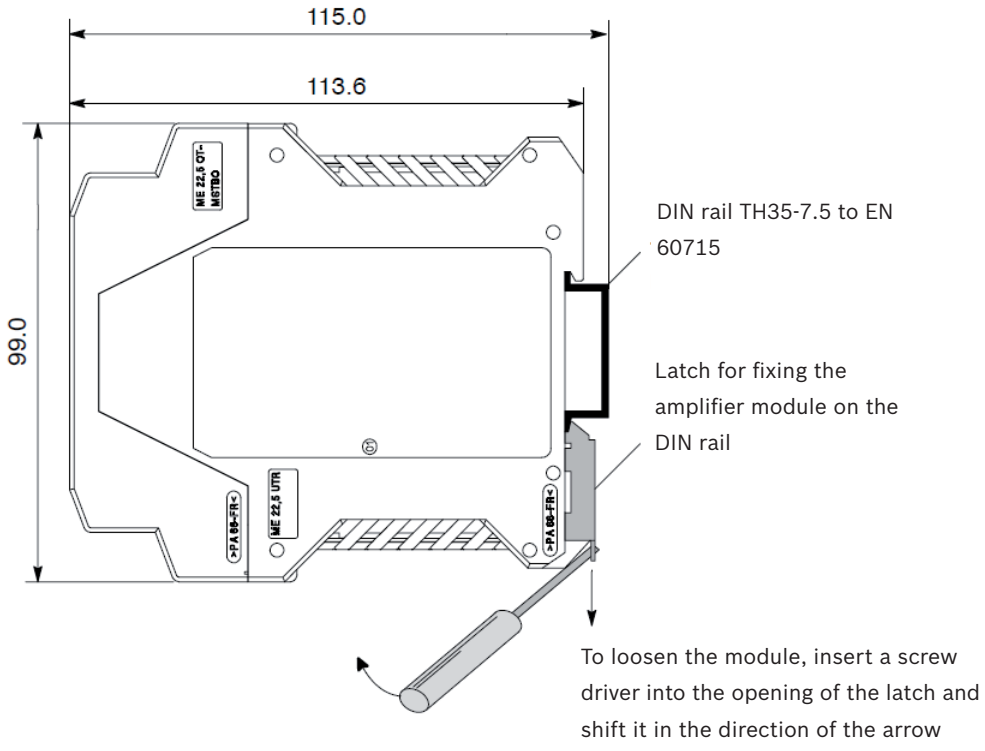


Fig. 7: Installing the analog amplifier module

7.5 System-specific circuitry of the amplifier module

All cables (e.g. for command values, pressure transducer feedback values, enable signals) have to be rated so (cable thickness, length) that the operating data and operating ranges (input voltage range, power consumption) are adhered to taking account of technical data (input resistance, power consumption).

Preconditions

All device connections (4 plug-in screw connectors (see chapter 7.6.6 on page 31), 4-pole, wire cross-section: 0.2 mm^2 to 2.5 mm^2) are located on the front panel of the amplifier module. Wires may be rigid or flexible.
The circuitry of the amplifier module refers to the connection of the

- power supply unit (see chapter 7.6.2 on page 29)
- valve (see chapter 7.6.3 on page 29)
- pressure transducer (see chapter 7.6.4 on page 30)
- higher-level control (see chapter 7.6.5 on page 31)

7.6 Overview of connections

The binding documents for the electrical connection are always the wiring diagrams and working instructions of the machine manufacturer!
Any compulsory components such as emergency stop circuits, master switches, etc. have to be provided and planned by the system engineer in accordance with recognized state of the art and in view of best possible safety.
The analog amplifier module VT-MRMA1 is equipped with 8 inputs and 8 outputs to 16 terminals as well as 1 test jack.

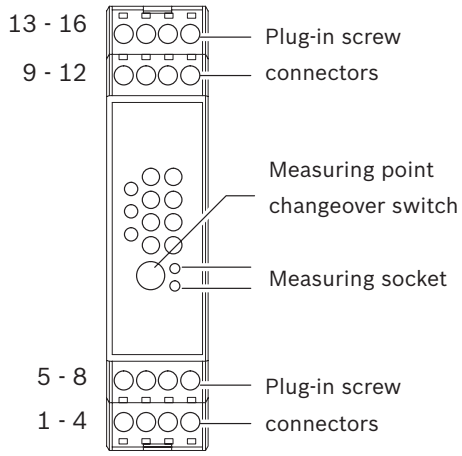


Fig. 8: Front view

7.6.1 Terminal assignment

Terminal	Designation of terminal	Type	Remark	Supply from/to
1	- x_P	Input	Reference potential of actual pressure value (Ground potential of the pressure transducer)	Pressure transducer
2	+ x_P	Input	Actual pressure value (Input signal for pressure transducer)	Pressure transducer
3	- sensor	Output	Negative connection for position transducer (position transducer ground)	Position transducer in the valve
4	+ sensor	Output	Positive connection for position transducer (supply voltage)	Position transducer in the valve
5	-w_P	Input	Reference potential of the pressure command value	Command value input
6	+w_P	Input	Pressure command value	Command value input
7	Enable	24 V input	Activation of position controller and output stage	Control
8	x_S	Input	Actual position value of the valve (Output signal of the position transducer)	Position transducer in the valve
9	Position command value reached	24 V output (High active)	High, when valve position command value and actual valve position value are identical **and** ramp completed	Control
10	Ready for operation	24 V output (High active)	Monitoring of position transducer and pressure command value cables (every individual wire), jamming of the actuator drive and positive feedback due to incorrect motor wiring	Control
11	Ground or L0 (0V)	Input	Reference potential of operating voltage +UB	Power supply unit
12	+U_B	Input	Operating voltage	Power supply unit
13	A	24 V output	Pressure switch signal (monitors values for falling below the pressure command value window)	Control
14		24 V output	Pressure switch signal (monitors values for exceeding the pressure command value window)	Control
15	-M	Output	- motor	Motor in the valve
	+M	Output	+ motor	Motor in the valve

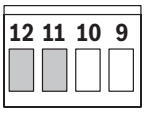
7.6.2 Connection of the power supply unit

Whenever possible, system circuits should be engineered so that the analog amplifier module and all connected components are always switched on simultaneously.

From the operating voltage applied, the analog VT-MRMA1-1 amplifier module generates the internally/externally required system voltages for
- logic
- output stage
- signal processing
- position transducer supply

A suitable power supply unit for the analog amplifier module is VTNE30-2X (see data sheet 29929).

Table 26: Terminal assignment to the power supply unit

Terminal	Pin	Assignment	Explanation
	11	Ground or L0 (0V)	Reference potential of operating voltage $+U_B$
	12	$+U_B$	Operating voltage

7.6.3 Connection of the pressure reducing valve

5 terminal connections on the amplifier module are reserved for the connection to the pressure reducing valve. The terminal connections are assigned to the following components of the pressure reducing valve:
- DC motor (2 supply connections)
- Position transducer (2 supply connections, 1 connection for the actual position value)

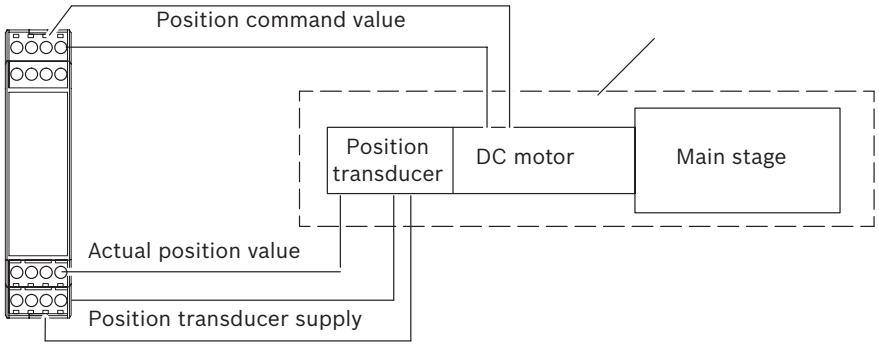
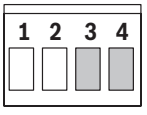
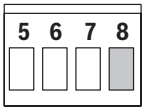
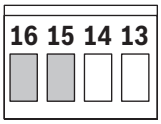


Fig. 9: Terminal connections of the amplifier module (viewed to the front)

Table 27: Terminal assignment to the pressure reducing valve

Terminal	Pin	Assignment	Explanation
	3	- sensor	Position transducer ground
	4	+ sensor	Position transducer supply

Terminal	Pin	Assignment	Explanation
	8	X_S	Actual position value of the valve (Output signal of the position transducer)
	15	-M	- motor
	16	+M	+ motor

Key data:

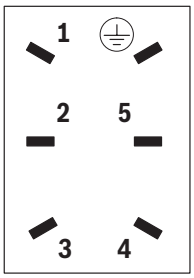
Due to the confined space in the mating connector on the valve, only one cable thickness can be used for connecting the valve:

Cable length: max. 50 m (for greater lengths, please consult Rexroth!)

Type: e.g. LiYCY 0.5 mm^2

Number of wires: 5

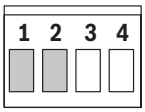
Table 28: Pinout of the connection between valve (ZDRS 6 VP-1X) <->

Connector Mat. no. R900021448	Valve connection	Designation	Amplifier module
	1	+ sensor	Terminal 4
	2	Actual position value	Terminal 8
	3	- sensor	Terminal 3
	4	+ motor	Terminal 16
	5	- motor	Terminal 15
	PE	n.c.	

7.6.4 Connection of actual pressure value cables (pressure transducer)

A pressure transducer (e.g. HM20-2X) is used for acquiring the actual pressure value. It is mounted directly to the pressure reducing valve:

Table 29: Terminal assignment of actual pressure value input

Terminal	Pin	Assignment	Explanation
	1	$-X_P$	Reference potential of the actual pressure value (ground potential of pressure transducer)
	2	$+X_P$	Actual pressure value (pressure transducer output)

When using the differential input (actual pressure value) always activate or deactivate both inputs simultaneously.

The supply of the pressure transducer is ensured by an external power supply unit (see figure below), whose ground has the same potential as terminal 11 of the amplifier module.

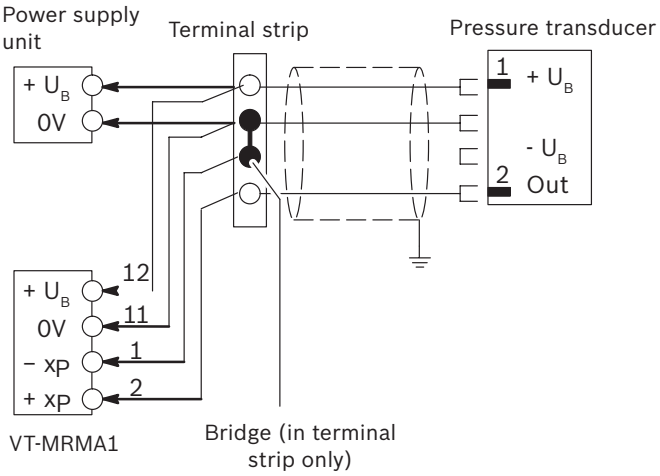
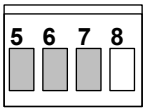
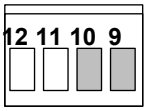
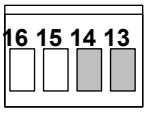


Fig. 10: Pinout: Pressure transducer – amplifier module – power supply unit

7.6.5 Connection of the control

For connecting the amplifier module to the higher-level control, a total of 3 inputs and 4 outputs are available for the provision of pressure command values, enable and auxiliary process variables.

Table 30: Terminal assignment to the control

Terminal	Pin	Assignment	Explanation
	5	-wP	Reference potential of the pressure command value
	6	+wP	Pressure command value
	7	Enable	Activation of position controller and output stage
	9	Position command value reached	High, when valve position command value and actual valve position value are identical
	10	Ready for operation	Monitoring of position transducer and pressure command value cables (every individual wire), jamming of the actuator drive and positive feedback due to incorrect motor wiring, cable break of a motor cable
	13	A	Monitoring of actual pressure value for falling below the threshold
	14	B	Monitoring of actual pressure value for exceeding the threshold

7.6.6 Plug-in screw connectors

The amplifier module offers the possibility of routing the connection cables to a total of 4 plug-in screw connectors. These can be removed from the module housing with the help of a screwdriver (blade width approx. 2.5 mm) even when the module is installed (see figure below).

You can replace the amplifier module without having to re-connect the cables to new plugs, for example in the case of servicing.

Each of the 4 plug-in screw connectors comprises 4 terminal connections.

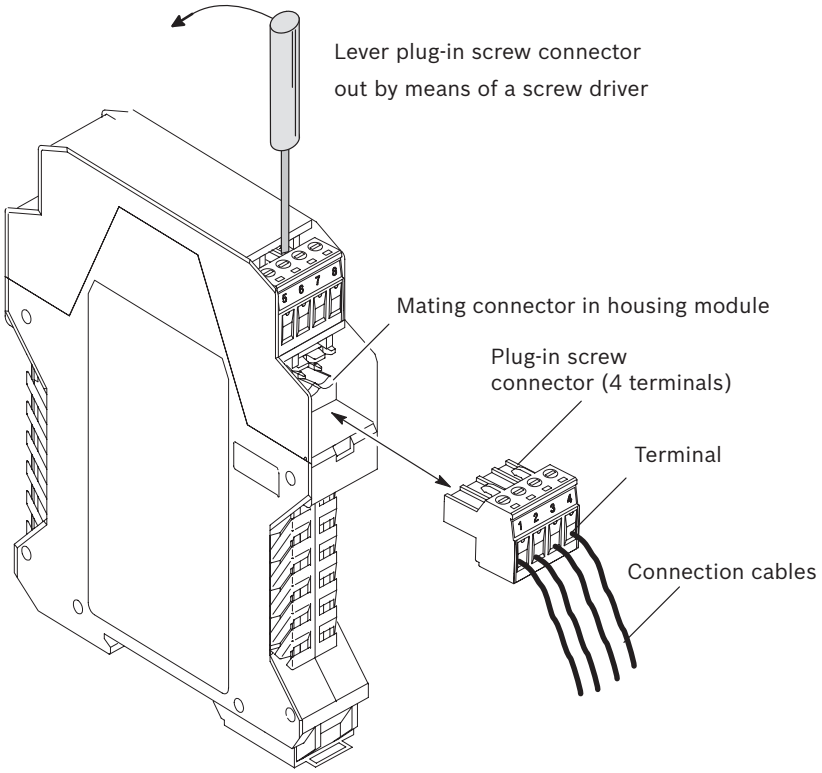


Fig. 11: Plug-in screw connectors

8 Commissioning

NOTICE

Uncontrolled plugging and unplugging of connectors!
The device might be destroyed.
- Before plugging or unplugging connectors into or from the device, disconnect the device from the power supply or de-energize it reliably!
  Damage to the device caused by incorrect installation is not covered by the warranty!
- Observe the protection class, the voltage supply and the environmental conditions according to data sheet 30214.

Various adjustment, measuring and display elements are available for commissioning the amplifier module (see below).
Commissioning of the amplifier comprises several steps that should be followed in the recommended order (see chapter 6.3).
An application example of pressure adjustment can be found in chapter 6.6.

8.1 Adjustment, measuring and indicator elements

The following setting elements are available:
- 2 DIL switches — see chapter 8.1.1
- 8 potentiometers — see chapter 8.1.2
- 1 measuring point selector switch and
- 2 test jack outputs — see chapter 8.1.3
- 3 LEDs (front panel) — see chapter 8.1.4

8.1.1 DIL switches

The amplifier module is provided with 2 DIL switches (**S1** and **S2**), which are located on the printed-circuit board within the module housing.
The DIL switches are used for configuring the **pressure command value** and the **actual pressure value** as “voltage input” or as “current input” as well as the **pressure switch thresholds** A and B.

To gain access to the DIL switches, pull module housing 1 (= front) from module housing 2.
Procedure:
1. Press the two fixing clamps slightly into the module housing using a screwdriver (blade width approx. 2.5 mm).
2. Loosen module housing 1 (front) from module housing 2 (see figure below).

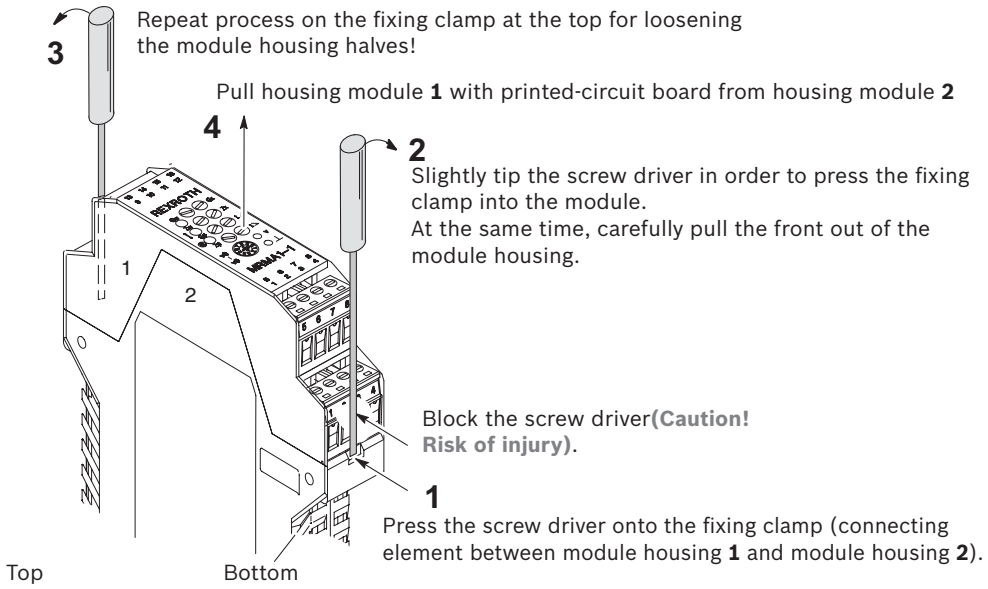
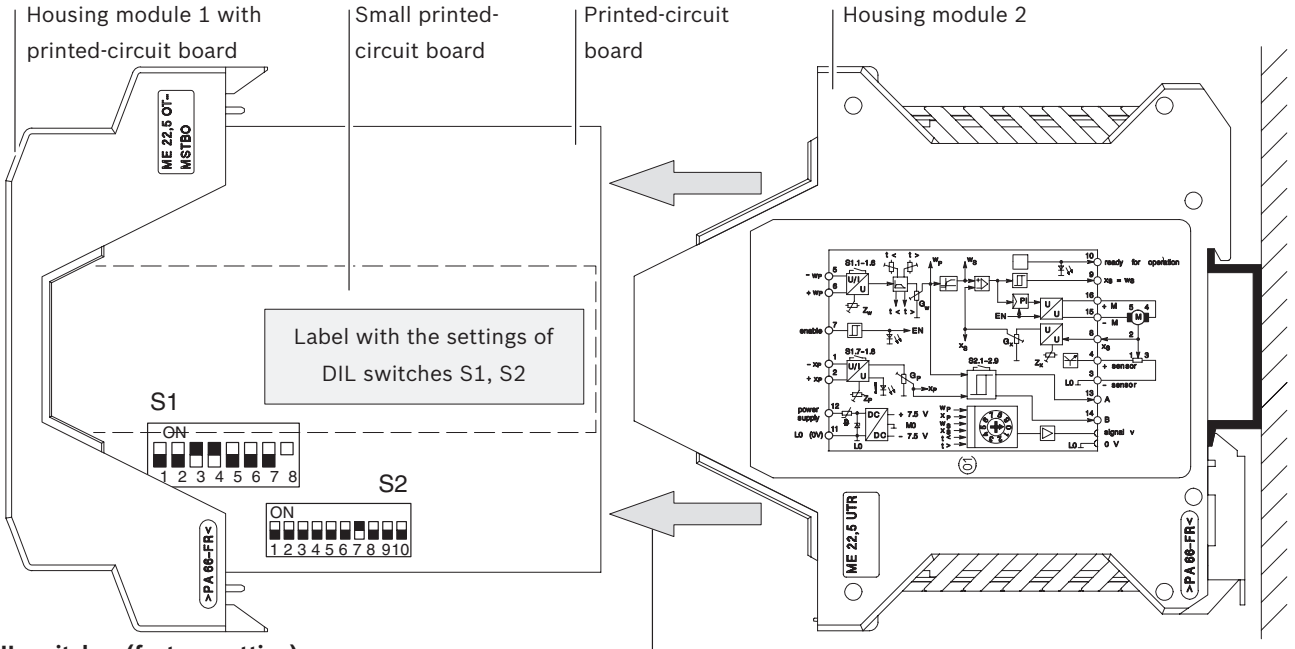


Fig. 12: Access to the DIL switches

- DIL switch settings may only be changed when the module is disconnected from the power supply!

Set the DIL switches by means of a tool with a suitable tip. The setting options of the DIL switches are shown on a label on the printed-circuit board).

- Before installing and commissioning the module, make sure that the DIL switches on the printed-circuit board are set correctly.



DIL switches (factory setting)

S1: Configuration of analog inputs

S2: Configuration of pressure switch thresholds

For setting the DIL switches

Pull housing module 1 with printed-circuit board from housing module 2

Fig. 13: Setting the DIL switches

Setting of the DIL switches S1

The inputs of the pressure command value and the actual pressure value can optionally be configured as voltage or current input with the help of DIL switches:

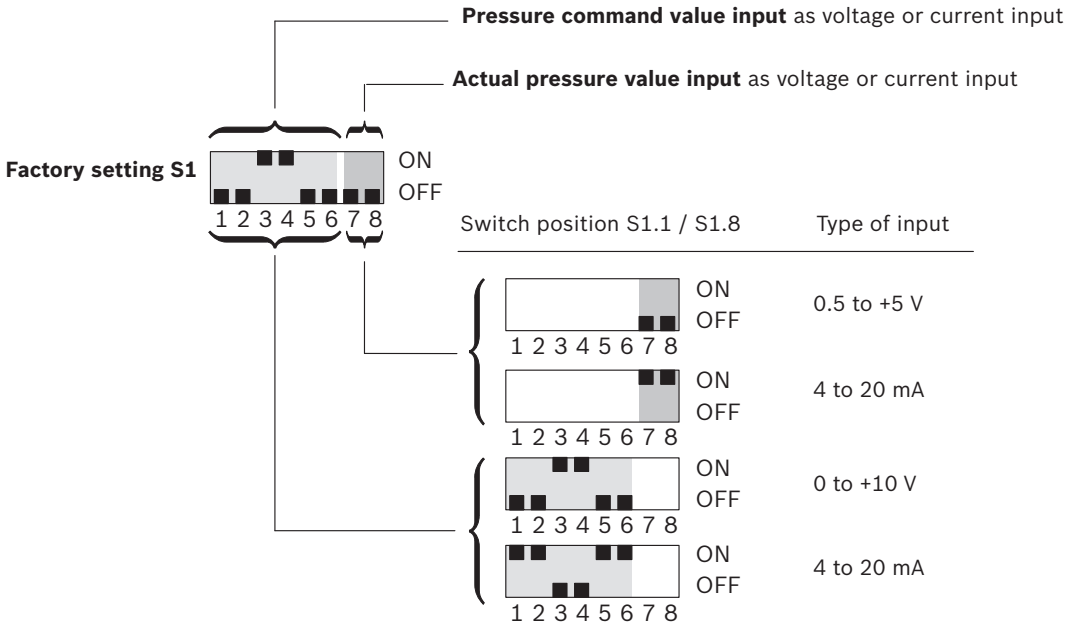


Fig. 14: Setting of DIL switch S1

Setting of DIL switch S2

S2 is used for setting the switching thresholds for the actual pressure value:

- **Relative switching thresholds:**
  They are defined in % and refer to the current pressure command value. The upper and lower switching thresholds can be adjusted separately (see table below).
- **Absolute switching thresholds:**
  They are defined in % and refer to the nominal value (= maximum pressure) of the selected pressure level. The setting always refers to both (upper and lower) absolute switching thresholds.

S2.10 has no function!

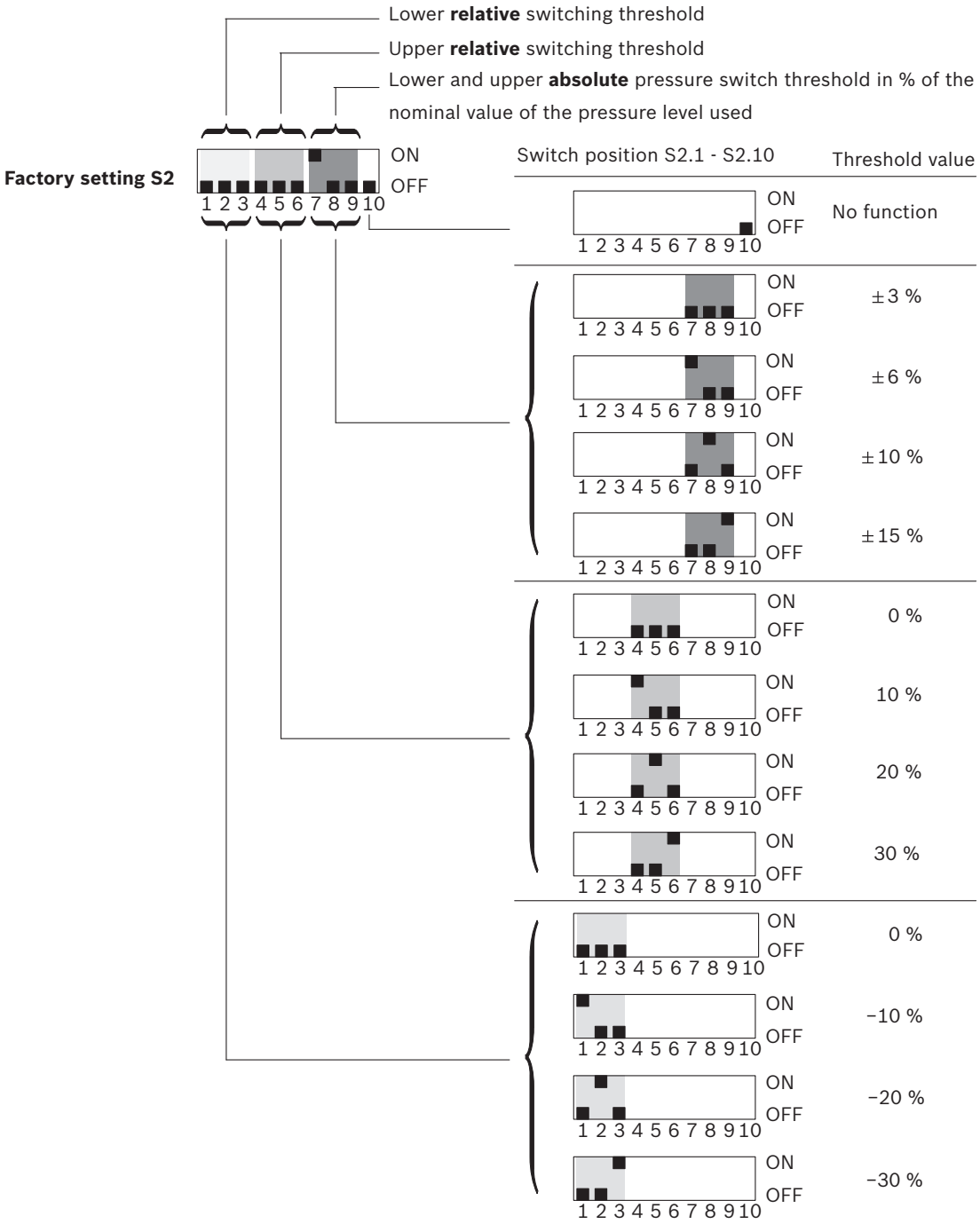


Fig. 15: Setting of DIL switch S2

Example Pressure level of a nominal value of 100 bar at a pressure command value of 50 bar while switches S2.1 and S2.5 are ”ON” means:

- Lower relative threshold: 50 bar * 90 % / 100 % = 45 bar
- Upper relative threshold: 50 bar * 120 % / 100 % = 60 bar
- Lower absolute threshold: 50 bar −3% * 100 bar / 100 % = 47 bar
- Upper absolute threshold: 50 bar +3% * 100 bar / 100 % = 53 bar

The effective pressure switch thresholds result from the lowest and highest threshold of all absolute and relative thresholds established (see also „Pressure switch function (14)“ on page 18). In the present example, this results in the following:

- Lower pressure switch threshold A: 45 bar
- Upper pressure switch threshold B: 60 bar

8.1.2 Potentiometers

A total of 8 potentiometers are arranged on the front panel of the amplifier module.

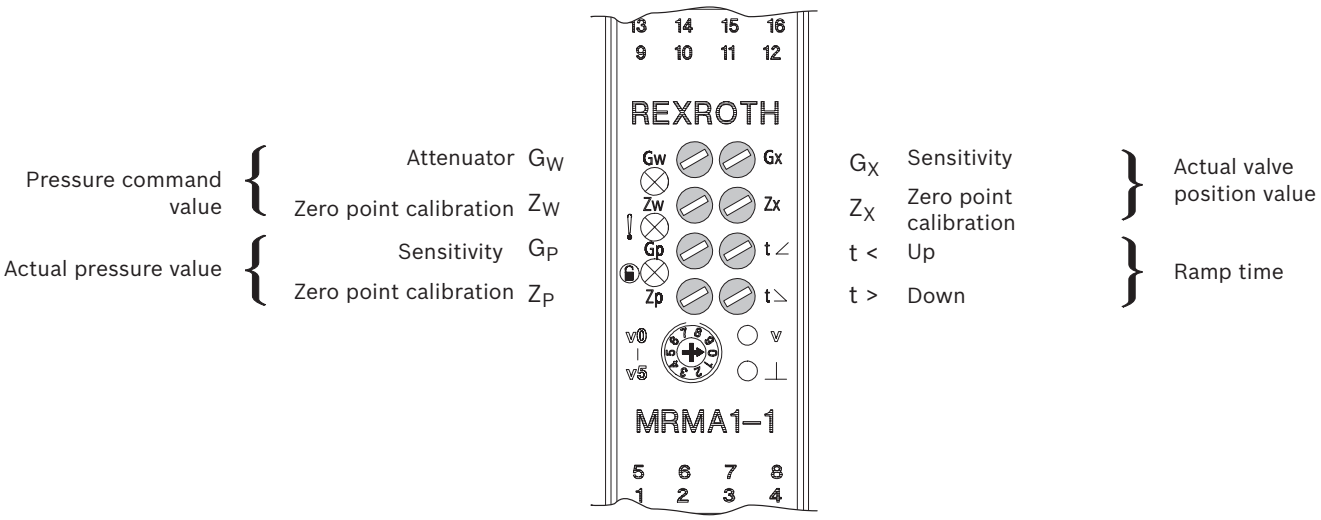


Fig. 16: Arrangement of the potentiometers

The following adjustment ranges are valid for these potentiometers:

Table 31: Adjustment ranges of the potentiometers

Designation of potentiometer	Relevant signal	Meaning	Adjustment range
Gw	Pressure command value	Amplitude attenuator	0 to 130 % *
Zw		Zero point calibration	±30 %
GP	Actual pressure value	Sensitivity of actual pressure value	90 to 120 % *
ZP		Zero point calibration	±5 %
GX	Actual valve position value	Actual valve position value sensitivity	90 to 120 % *
ZX		Zero point calibration	±15 %
t < and t >	Pressure command value	Ramp times (up and down)	0.1 to 100 sec

* With correctly set zero point

Use a screwdriver with a blade width of approx. 2.5 mm for adjusting the potentiometer.

8.1.3 Measuring signal and measuring point selector switch

Test jack v is provided for checking various command and actual values and ramp times (for changing the measuring point switch over, use a screwdriver with a blade width of approx. 2.5 mm).

Measurements on the amplifier module may only be taken using measuring instruments with an internal resistance of (Ri) > 100 kΩ!

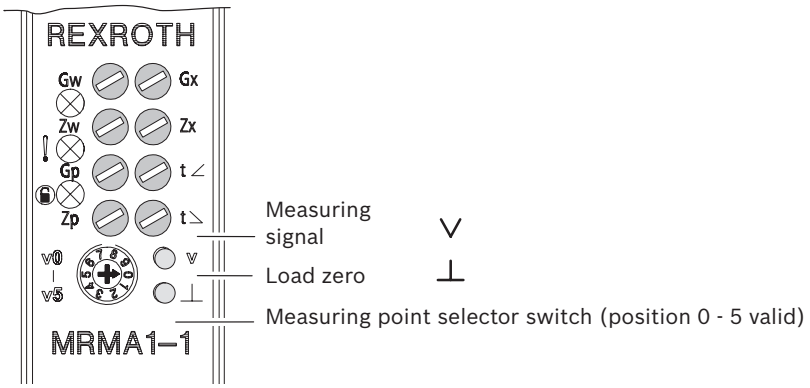


Fig. 17: Measuring point selector switch

Technical data

Test jack: 0 to +10 V ±2 %
I_{max} = 2 mA

Measuring point selector switch

Depending on the selected measuring point selector switch position (see table below), a certain measured signal can be output at test jack v:

Table 32: Measuring signals

Switch position	Measuring point		Measuring signal at test jack v
0	Pressure command value	wP	0 % = 0 V 100 % = 10 V
1	Actual pressure value	xP	0 % = 0 V 100 % = 10 V
2	Valve position command value	wS	0 % = 0 V 100 % = 10 V
3	Actual valve position value	xs	0 % = 0 V 100 % = 10 V
4	Ramp times “up”	t <	10 mV to 10 V
5	Ramp time “down”	t >	10 mV to 10 V
	Fixed potentials for orientation		
6	No function		0 V
7	No function		< -10 V
8	No function		< -10 V
9	No function		< -10 V

8.1.4 LEDs

A total of 3 LEDs on the front panel of the amplifier module provide information about the states of the amplifier module:

- Readiness for operation (green)
- Cable breaks of the pressure transducer cables (red)
- Enable for position controller and output stage (yellow)

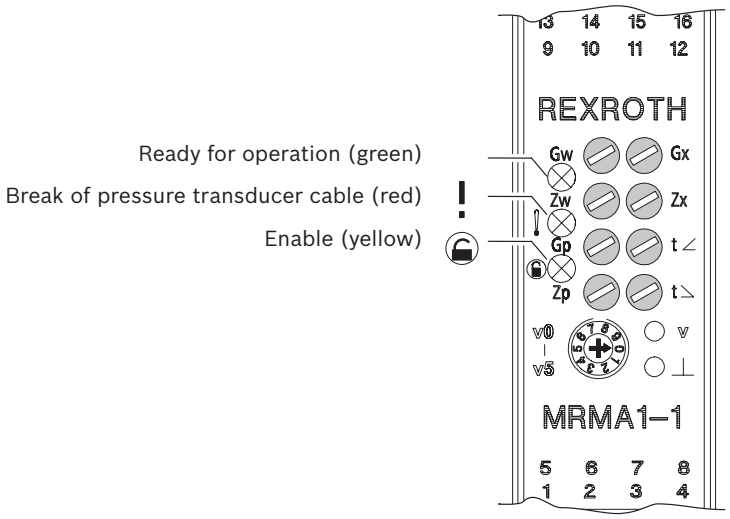


Fig. 18: LEDs on the front panel

8.2 Commissioning instructions

Before you can start with the adjustment work the system-specific connections have to be made.

The following table just shows an overview of measures to be taken when the amplifier module is to be commissioned initially. A detailed description can be found in chapter 8.3, “Fine tuning of the complete system“ on page 40.

Table 33: Steps before initial commissioning

Step	Signal	Measure
1		Set DIL switch (inside the amplifier module) while the amplifier is disconnected from the power supply (see chapter 8.1.1, page 33).
2		Connect amplifier module
3	Pressure command value	Adjust pressure command value zero point (→Zw)
4		Set ramp times. Internal: by means of amplifier module (see “ramp generator (3)” on page 15) External: via machine control
5		Set maximum value of pressure command value (→Zw)

The following additional step is required only in the case of insufficient accuracy:

Step	Signal	Measure
6	Actual pressure value of the complete system	Fine tuning of the complete system according to chapter 6.5.

Condition as supplied

When the electronics leaves the factory, it is characterized by the following features:

- Minimum ramp times
- Sensitivity of GW is set to 100 %
- The linearity of the complete system (module electronics and valves) is subject to series production tolerances

- The factory settings of DIL switch S1 (current or voltage input for the pressure command value) and DIL switch S2 (switching thresholds for the actual pressure value) are as follows (see also chapter 8.1.1 on page 33):

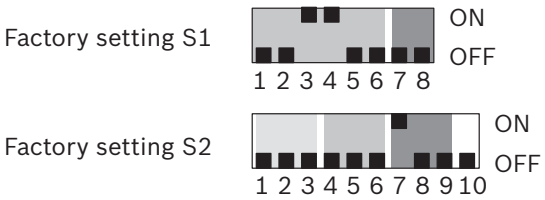


Fig. 19: Factory setting of S1/S2

8.3 Fine tuning of the complete system

Preconditions:

The system-specific connections must have been made!

The hydraulic oil must have reached its (regulated) operating temperature.

1. Set the DIL switches on the printed-circuit board of the amplifier module according to your individual requirements (see chapter 8.1.1 on page 33).
2. Switch the amplifier module on.
3. Switch the hydraulic system on.
4. Adjust the system by taking the following measures:

Table 34: Setting steps

No.	Signal	Adjustment element		Setting
1	Pressure command value zero point		= 0	1. The external pressure command value feedforward to 0 %. 2. Set measuring point selector switch to 0 When adjusting Zw, potentiometer Gw must not be turned to the left-hand limit stop (= 0 %)! 3. Use zero point potentiometer Zw to set the measuring signal at test jack v to 0 V ±5 mV (= 0 %).
			Zw	
			v	
2	Maximum value of pressure command value		= 0	1. Calibrate the zero point before calibrating the maximum value. 2. Select an external pressure command value of 100 %. 3. Set measuring point selector switch to 0. 4. Use zero potentiometer Gw to set the measuring signal at test jack v to 10 V ±5 mV (= 0 %).
			Gw	
			v	
3	Ramp times		= 4	1. Select the potentiometer to be adjusted by means of the measuring point selector switch (position 4 for ramp Up t< and position 5 for ramp Down t>)
			= 5	
			t<	2. Adjust the ramp times according to the formula or the table “ramp time setting” (see “Ramp generator (3)“ on page 15) at test jack v.
			t>	
			v	

Table 34: Setting steps

No.	Signal	Adjustment element		Setting
4	20 % actual pressure value			The pressure command value must have been calibrated according to the above procedure! 1. Connect the electrical system of the valve. 2. Measure the position transducer supply voltage on the module side between terminal 4 and 3: +10.0 V ±300 mV 3. Set the external pressure command value feedforward to 20 %.
		⊖	Zx	4. Apply an external enable signal. For adjusting Zw, potentiometer Gw must not be turned to the left-hand limit stop (= 0 %)! 5. Use ZX to set the actual pressure value (= voltage between terminal 2 and 1) to 20 % of the nominal pressure value:
				Pressure transducer / Output signal (20 %) / Voltage terminal 2 and 1) "0.5 - 5 V" output / +1.40 V / +1.40 V "4 - 20 mA" output / +7.2 mA / +0.72 V (R_{load} = 100 Ω)
		⊗	= 1 Zp	6. Set measuring point selector switch to 1. When adjusting Zp, potentiometer Gp must not be turned to the left-hand limit stop (= 0 %)!
		⊖	v	7. Use zero potentiometer ZP to calibrate the measuring signal at test jack v: +2.00 V ±5 mV.
5	Maximum value of pressure command value			Before adjusting the maximum value of the actual pressure value, the adjustment of the 20 % actual pressure value must have been completed! 1. Set the external pressure command value feedforward to 100 %. 2. Apply an external enable signal.
		⊖	Gx	3. Use GX to set the actual pressure value signal (= voltage between terminal 2 and 1) to 100 % of the nominal pressure value:
				Pressure transducer / Output signal (100 %) / Voltage terminal 2 and 1) "0.5 - 5 V" output / +5.00 V / +5.00 V "4 - 20 mA" output / +20 mA / +2.00 V (R_{load} = 100 Ω)
		⊗	= 1 GP	6. Set the measuring point selector switch to 1. 7. Use potentiometer GP to calibrate the measuring signal at test jack v: +10.00 V ±5 mV.
		⊖		
6	Actual pressure value			1. Check the two working points (step 4 and 5) 2. If required, repeat steps 4 and 5
7	Maximum value of pressure command value (individual)			1. Set the external pressure command value feedforward according to your individual requirements. Example: Reduce external pressure command value from 100 % to 80 % 2. Set the external pressure command value feedforward to 100 %.
		⊕	= 0 Gw	3. Turn the measuring point selector switch to 0. 4. Use potentiometer GW to adjust the measuring signal at test jack v according to your individual requirements.
		⊖	v	Settings according to the example: 8 V ±5 mV (= 80 %)

8.4 Application example

Target

The clamping pressure is to be adjusted while the workpiece is clamped.

Preconditions

- The current pressure command value is applied
- Pressure switch signals A and B are available (24 V at terminals 13 and 14)
- Signal "ready" is present (24 V at terminal 10)
- Signal "position command value reached" is present (24 V at terminal 9)
- Signal "enable" is not set (0 V at terminal 7)

Notes on the sequence program

The following explanations with regard to signals apply to the sequence program. They are used for synchronizing the amplifier module with the higher-level control:

- Enable input (24 V input):

– When a voltage greater than +8.5 V is applied, positioning control and the output stage are activated.
– Blocking of positioning control and the output stage when a voltage of less than +6 V is applied.
The valve remains in the self-locked position.

Make sure that the enable signal is only given when a new actuating process of the valve is going to take place. When the new working pressure has been reached, the enable has to be reset again!

Permanently active monitoring functions

- "Ready" signal (24 V output):
The "ready" output is connected against the 24 V operating voltage, when the fault detector has not established a fault (see "Fault detection (8)" on page 20).
- "Position command value reached" signal (24 V output):
This signal is used for monitoring the valve position controller. The output is connected against the 24 V operating voltage when the actual valve position value corresponds to the valve position command value resulting from the pressure command value.

When the ramp is active, the signal for "position command value reached" is connected to 0 V for the duration of the ramp.

- Pressure switch signals A and B:
Pressure switch signals A and B monitors the actual pressure value for being within the selected limits.

For the system, this results in the following signal and adjustment sequence:

Table 35: Signal and adjustment sequence

Measure	Signal and adjustment sequence	Terminal	Status
Query of state signals	Output "ready for operation"	10	High *
	Output "position command value reached"	9	High
	Outputs of pressure switch signals A and B	13, 14	High
Functional test of pressure switch signals (increased safety)	Apply new pressure command value for checking purposes (it should be significantly greater (smaller) than the current pressure command value)	6	
	"Position command value reached" becomes inactive	9	Low *
	One of the two pressure switch signals A or B becomes inactive (delay depends on set ramp time)	13, 14	Low
Provide desired pressure command value from the control	Apply new pressure command value	6	
Enable internal controller and output stage	Set enable	7	High
	Actuating process on the valve starts: The position adjustment signal "position command value reached" becomes inactive for the duration of the actuating process	9	Low
	Actuating process completed:		
	Positioning signal "position command value reached" is re-activated	9	High
	Pressure switch signal A (pressure is present within the agreed tolerance range)	13	High
	Pressure switch signal B (pressure is present within the agreed tolerance range)	14	High

Measure	Signal and adjustment sequence	Terminal	Status
Block internal controller and output stage	Remove enable	7	Low
The pressure command value has to continue to be present for diagnostics of “position command value reached” and pressure switch.			

* High = 24 V, low = 0 V

9 Operation

During normal operation, no interventions are required on the part of the operator. Should a fault occur during operation, e.g. a power failure, the electronics can simply be switched on again without further measures and it is then ready for operation again.

10 Maintenance and repair

10.1 Cleaning and care

NOTICE

Malfunction!

Loss of function and short-circuit due to the ingress of contaminants and humidity!

- When working on the analog amplifier module VT-MRMA1, observe strictest cleanliness.
- Only use a dry and dust-free cloth for cleaning.

10.2 Maintenance

In view of a long service life and operability you should include the following activities in your maintenance schedule for the analog amplifier module:

- Check all terminal connections for proper fit and damage at least once a year. Check cables for breaks or pinching.
- Have defective or damaged parts immediately replaced.

10.3 Repair

The VT-MRMA1-1 amplifier module can only be replaced as a complete unit. Unauthorized modifications on the amplifier module are not permitted for safety reasons! Repair work may only be carried out by Bosch Rexroth AG. For repair purposes send the device to the service address given in chapter 16.

11 Demounting and replacement

11.1 Preparing demounting

NOTICE
Improper demounting! The device can be destroyed! ▶ Decommission the entire system as described in the general instructions for the system. ▶ Disconnect the device and all connected components from the power supply.

11.2 Demounting

Remove the analog amplifier from the DIN rail as described in chapter “Installation”, Fig. 7 on page 27.
The plug-in screw connectors are to be removed as shown on Fig. 11, page 32.

11.3 Preparing the components for storage or further use

Proceed as follows in order to prepare the VT-MRMA1-1 for storage and further use:

- ▶ Only use the original packaging for storage.
- ▶ Observe the permissible storage temperature range specified in data sheet 30214.
- ▶ Protect the analog amplifier module from dust and humidity.

12 Disposal

12.1 Environmental protection

Careless disposal of the VT-MRMA1-1 and the packaging material could lead to pollution of the environment.

- ▶ Therefore, dispose of the analog amplifier module and the packaging material in accordance with the currently applicable regulations in your country and recycle the material as far as possible.

13 Extension and conversion

The analog amplifier module VT-MRMA1-1 may be neither extended nor converted. If you convert the amplifier module, the warranty becomes void.

14 Troubleshooting

14.1 How to proceed for troubleshooting

- Always act systematically and focused, even under pressure of time. Random and imprudent disassembly and changing of settings might result in the inability to ascertain the original cause of fault.
- First obtain a general overview of how your product works in conjunction with the entire system.
- Try to determine whether the product worked properly in conjunction with the entire system before the troubles occurred.
- Try to determine any changes of the entire system in which the product is integrated:
  - Were there any changes to the product's operating conditions or operating range?
  - Were there any changes (e.g. retrofit) or repairs carried out on the complete system (machine/system, electrics, control) or on the product?
    If yes: Which?
  - Was the product or machine used as intended?
  - How becomes the malfunction apparent?
  - Try to get a clear idea of the error cause. If possible, ask the direct (machine) operator.

14.2 Erroneous states and error diagnostics

Various monitoring functions are active in the amplifier module.
When no error is present

- the green "ready" LED is ON
- 24 V operating voltage is applied to the "ready" output (terminal 10)

In the event of a fault, the fault detection feature provides information on the possible causes of the fault:

Fault detection for	Fault	Effect	Remedy
Pressure command value cables (2 cables)	Cable break (at 0...10 V input)	Output stage switches off	Replace cable
		"Ready for operation" and, if applicable, "Position command value reached" become inactive (0 V)	
	Cable break or short-circuit (at 4...20 mA input)	The green "ready" LED is OFF	Replace cable Check pressure command value connections
		Pressure switch signals A or B becomes inactive	

Fault detection for	Fault	Effect	Remedy
Actual pressure value cables (2 cables)	Cable break or short-circuit (at 0.5...5 V input or 4...20 mA input) Exchange of the actual pressure value cables Cable break of the ground cable of the pressure transducer Cable break of supply cable of the recommended pressure transducer	Pressure switch signals A and B become inactive (0 V) Position control function is maintained Red LED "cable break / pressure“ is on	Replace cable Check actual pressure value connections
	Voltage at terminal 2 less than +0.35 V		Check function and connection of pressure transducer HM20-2X (see chapter 7.6.4 on page 30) If necessary, replace pressure transducer
Position encoder cables (3 cables)	Cable break	Output stage switches off The green “ready” LED is OFF "Ready for operation“ and "Position command value reached“ become inactive (0 V)	Replace cable
	Short-circuit of the position transducer supply cable with L0		Check position transducer connections
Function of the valve actuator Attention! Faults in the valve actuator are not recognized by the internal fault detector before the pressure command value is "re-adjusted"!	Jamming of the valve actuator	Output stage is switched off (after about 4 sec.) "Ready for operation“ and, if applicable, "Position command value reached“ become inactive (0 V) The green “ready” LED is OFF	Check motor connections Reset enable and set again
	Exchange valve motor cables (positive feedback)		
	Cable break of a motor cable		Check motor connections Connect valve
	Short-circuit between the motor cables	PTC thermistor fuse limited to current consumption	Eliminate short-circuit
Enable cable	Cable break	Output stage is switched off	Replace cable

15 Technical data

The technical data can be found in data sheet 30214.

16 Annex

16.1 Addresses

Contact for service and spare parts

Bosch Rexroth AG
Service Industriehydraulik
Bürgermeister-Dr.-Nebel-Strasse 8
97816 Lohr am Main
Germany

Phone +49 (0) 9352/40 50 60
E-mail service@boschrexroth.de

Outside Germany you will find service subsidiaries in your vicinity on the Internet at www.boschrexroth.com

Headquarters:

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97816 Lohr am Main
Germany

Phone +49 (0) 9352/40 30 20
E-mail my.support@boschrexroth.de

The addresses of our sales and service network and sales organizations can be found at www.boschrexroth.com/addresses

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