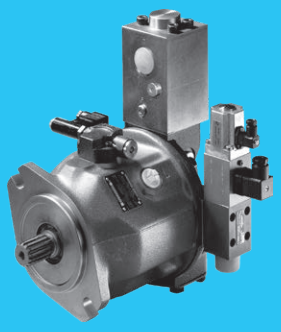
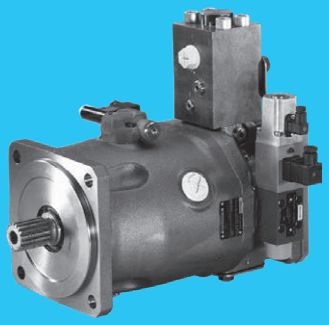
rexroth
A Bosch Company

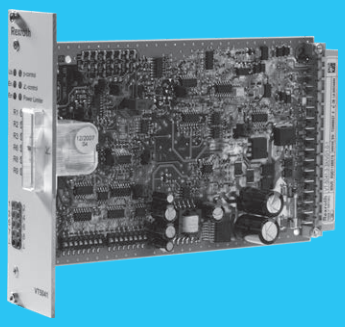
Operating instructions

Pressure and flow control system

Type SYDFE1 series 2X, 3X with external control electronics VT 5041-3X







Valid for the following types:

SYDFE1 series 2X
SYDFE1 series 3X

with external control electronics
VT 5041-3X

RE 30011-B Edition: 10.2022, replaces: 10.2021

The data specified only serve to describe the product. If information on the use of the product is given, it is only to be regarded as application examples and recommendations. Catalog specifications do not constitute assured characteristics. The information given does not release the user from the obligation of own judgment and verification. It must be remembered that our products are subject to a natural process of wear and aging.

The cover shows an example configuration. The product delivered may differ from the image on the cover.

Translation of the original operating instructions. The original operating instructions were prepared in German language.

Content

1 About this documentation

1.1 VALIDITY OF THE DOCUMENTATION

This documentation is valid for the following products:

- SYDFE1 series 2X
- SYDFE1 series 3X

This documentation is intended for engineers, fitters, operators, service technicians and plant operators.

These instructions contain important information on the safe and appropriate installation, transport, commissioning, maintenance, disassembly and simple troubleshooting of the pressure and flow control systems SYDFE1 series 2X and 3X.

▶ Read these instructions completely, especially chapter 2 “Safety instructions“ on page 9, before working with the product.

1.2 REQUIRED AND SUPPLEMENTARY DOCUMENTATION

▶ The product must not be commissioned until you have been provided with the documentation marked with the book symbol 🕮 and you have understood and observed it.

Table 1: Required and supplementary documentation

	Title	Document no.	Document type
🕮	Installation drawing	On request	Contains the outer dimensions, all ports and the hydraulic circuit diagram of your pressure/flow control system SYDFE1
🕮	General operating instructions for axial piston units	RE 90300-B	Operating instructions
🕮	Pressure and flow control system, type SYDFE1, SYDFEE, SYDFED, SYDFEF, component series 2X	RE 30030	Data sheet
🕮	Pressure and flow control system, type SYDFE1, SYDFEE, SYDFED, SYDFEF, component series 3X	RE 30630	Data sheet
	Axial piston variable displacement pump A10VSO series 31, sizes 18 to 100	RE 92711	Data sheet
	Axial piston variable displacement pump A10VSO series 32, sizes 45 to 180	RE 92714	Data sheet
	External control electronics for the SYDFE1 control of the A10VSO axial piston variable pump, type VT 5041-3X/...	RE 30242	Data sheet
	External control electronics (variant) for the SYDFE1 adjustment of the axial piston pump A10VSO	RD 30242-01	Data sheet
	3/3 proportional directional valves, direct operated, with electrical position feedback, as pilot valve for control systems SY(H)DFE, type VT-DFP	RE 29016	Data sheet
	Axial piston units for use with HF fluids	RE 90223	Data sheet
	Hydraulic fluids on a mineral oil basis for axial piston units	RE 90220	Data sheet
	Pump pre-load valve for control system SYDFE, type SYDZ 0001-1X	RE 29255	Data sheet
	Pressure transducer for hydraulic applications, type HM20	RE 30272	Data sheet
	Pressure transducer for hydraulic applications, type HM20	RE 30272-B	Operating instructions

Title	Document no.	Document type
Installation, commissioning and maintenance of hydraulic systems	RE 07900	Data sheet

1.3 PRESENTATION 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, they are explained in the following sections.

1.3.1 Safety instructions

In this documentation, safety instructions precede a sequence of activities whenever there is a risk of personal injury or damage to equipment. The hazard avoidance measures described must be observed.

Safety instructions are structured as follows:

⚠ SIGNAL WORD

Type and source of danger

Consequences in case of non-compliance

- ▶ Hazard avoidance measures
- ▶ <Enumeration>

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

Table 2: Hazard classifications 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 could be damaged.

1.3.2 Symbols

The following symbols indicate notices which are not safety-relevant but increase the comprehensibility of the documentation.

Table 3: Meaning of the 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 instruction: The numbers indicate that the actions must be carried out one after the other.

1.3.3 Designations

The following terms are used in this documentation:

Table 4: Designations

Designation	Meaning
A10VSO	Axial piston variable displacement pump, open circuit
A4VSO	Axial piston variable displacement pump, open circuit
HM20	Pressure transducer
IW9	Swivel angle sensor for the SYDFE1 control system
SYDFE1	Pressure/flow control system for external electronics
SYDFE1-2X	Pressure/flow control system, series 2X, for external electronics and A10 VSO series 31
SYDFE1-3X	Pressure/flow control system, series 3X, for external electronics and A10 VSO series 32
VT-DFP	Pilot valve for SYDFE1
VT 5041-3X	External control electronics for SYDFE1

1.3.4 Abbreviations

The following abbreviations are used in this documentation:

Table 5: Abbreviations

Abbreviation	Meaning
PT	**P**ressure T**ransducer**
EMC	**E**lectro**m**agnetic **c**ompatibility
GND	Ground
NG	**N**enn**g**röße (size)
p	Pressure (symbol)
P	Power
PCV	**P**re**C**ompression **V**olume
p_{Diff}	Control difference between pressure command value and actual pressure value
PE	**P**rotective **E**arth
p_{act}	Actual pressure value
p_{comm}	Pressure command value
RE	**R**exroth document in **E**nglish language

Abbreviation	Meaning
Switch T_D	Switching input for volume adjustment
SWA	Swivel angle
SWA_{act}	Swivel angle feedback value
SWA_{comm}	Swivel angle command value
U_B	Supply voltage
US	Undervoltage
VDE	**V**erband **d**er **E**lektrotechnik, Elektronik und Informationstechnik (Association for electrical, electronic and information technologies)

2 Safety instructions

2.1 ABOUT THIS CHAPTER

The SYDFE1 control system has been manufactured according to the generally accepted rules of current technology. However, there is still a risk of personal injury and damage to property if you do not observe this chapter and the safety instructions in this documentation.

- Read these instructions completely and thoroughly before working with the SYDFE1 control system.
- Keep this documentation in a location where it is accessible to all users at all times.
- Always include the required documentation when you pass the product on to third parties.

2.2 INTENDED USE

The product is electrical/hydraulic equipment.

You may use the product as follows:

- for the electrohydraulic pressure and swivel angle control of an axial piston variable displacement pump

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.

The installation or use of inappropriate products in safety-relevant applications could result in unintended operating states in the application which in turn could cause personal injuries and/or damage to property. Therefore, please only use a product for safety-relevant applications if this use is expressly specified and permitted in the documentation of the product. For example, in explosion-protection areas or in safety-related parts of a control (functional safety).

Bosch Rexroth AG does not assume any liability for damage caused by improper use. The user assumes all risks involved with improper use.

Improper use of the product includes:

- If you do not adhere to the technical data, operating conditions and performance limits specified in the data sheet and given in the order confirmation.
- If you do not observe national EMC regulations during operation for the application at hand. The manufacturer of the system or machine is responsible for complying with the limit values stipulated in national regulations (European countries: EU Directive 2014/30/EU (EMC Directive); USA: See National Electrical Code (NEC), National Electrical Manufacturers Association (NEMA) as well as regional engineering regulations.
- if you use the SYDFE1 control system in a potentially explosive atmosphere.

2.4 QUALIFICATION OF PERSONNEL

The activities described in this documentation require basic knowledge of mechanics, electrics and hydraulics as well as knowledge of the appropriate technical terms. In order to ensure safe use, these activities may only be carried out by an expert in the respective field or an instructed person under the direction and supervision of an expert.

Experts are those who are able to recognize potential hazards and apply 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 undertaken. Qualified personnel must observe the rules relevant to the subject area.

2.5 GENERAL SAFETY INSTRUCTIONS

- Observe the valid regulations on accident prevention and environmental protection.
- Observe the safety regulations and provisions of the country in which the product is used/applied.
- Exclusively use Rexroth products in technically perfect condition.
- Observe all notices 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 released by the manufacturer in order to rule out personnel hazards arising from unsuitable spare parts.
- Comply with 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 can occur in these applications, which can cause personal injury and damage to property. Therefore, use the product only in safety-relevant applications, if this use is expressly specified and permitted in the documentation of the product.
- 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 product is installed, complies with national regulations, safety regulations and standards relevant for the application.

2.6 PRODUCT- AND TECHNOLOGY-RELATED SAFETY INSTRUCTIONS

⚠ WARNING

Control system falling down!

SYDFE1 control systems are heavy. When improperly handled, they can fall down and cause severe injuries and crushing, because the parts can be, for example, sharp-edged, heavy, oily, loose or bulky.

- Transport the SYDFE1 control system using suitable lifting gear at the point provided for this purpose.
- Ensure a stable position during transport to the place of installation.
- Wear personal protective equipment when transporting the control system.
- Comply with the national laws and regulations regarding occupational health and safety for transporting/handling.

Risk of injury caused by systems not shut down!

Working on running systems poses a danger to life and limb. The work steps described in these operating instructions may only be performed on shut down systems. Before beginning work:

- Make sure that the drive motor cannot be switched on.
- Make sure that all power-transmitting components and connections (electrical, pneumatic, hydraulic) are switched off according to the manufacturer's instructions and are secured against being switched on again. If possible, remove the main fuse of the system.
- Ensure that the system is completely hydraulically unloaded and depressurized. Please follow the system manufacturer's instructions.
- Only qualified personnel (see chapter 2.4 "Personnel qualifications" on page 10) are authorized to install the SYDFE1 control system.

Lines under pressure!

Risk of injury.

- Never disconnect, open or cut pressurized lines!
- Before carrying out any installation or other work, depressurize the control system.

High electrical voltage!

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

- Before starting installation work, plugging and unplugging connectors and carrying out any work, switch the control system off. Secure the electrical equipment against restarting.
- Before switching the control system on, check the protective conductor on all electrical devices for proper connection according to the wiring diagram.

⚠ WARNING

High noise emission during operation!

The noise emission of SYDFE1 control systems depends, among others, on speed, operating pressure and the installation situation. Under normal operating conditions, the noise pressure level may rise above 70 dB(A). This can cause hearing damage.

- Always wear hearing protection when you work in the vicinity of a running SYDFE1 control system.

Hot surfaces!

Risk of burning.

The SYDFE1 control system heats up considerably during operation. The pilot valve of the SYDFE1 control system gets so hot during operation that you may burn yourself.

- Let the SYDFE1 control system cool down before touching it.
- Protect yourself by wearing heat-resistant protective clothing, e.g. gloves.

Risk of intoxication and injury!

Contact with hydraulic fluids can be damaging to your health (e.g. eye injuries, skin damage, intoxication upon inhalation and swallowing).

- Always check the lines for wear and damage before each commissioning.
- When doing so, wear protective gloves, safety goggles and suitable working clothes.
- If nevertheless hydraulic fluid comes into contact with the eyes or penetrates the skin, please consult a doctor immediately.
- When handling hydraulic fluids, strictly observe the safety notes of the hydraulic fluid manufacturer.

Risk of fire!

Hydraulic fluid is easily inflammable.

- Keep open fire and sources of ignition away from the SYDFE1 control system.
- Ensure sufficient ventilation.

⚠ CAUTION

Improperly laid lines and cables!

Risk of stumbling!

- Lay cables and lines so that no one can stumble over them.

Uncontrolled system behavior!

The failure of individual components can lead to malfunction of the assembly and therefore to unforeseeable behavior!

- Replace or have defective components replaced immediately.

2.7 PERSONAL PROTECTIVE EQUIPMENT

Personal protective equipment for users of the product consists of:

- Protective gloves and safety shoes for transporting the SYDFE1 control system.
- Hearing protection for working in the direct vicinity of the running system.

All components of personal protective equipment must be intact.

2.8 OBLIGATIONS OF THE MACHINE END-USER

The operation of installations, systems and machines basically requires the implementation of a holistic IT security concept which is state-of-the-art in terms of technology. Accordingly, Bosch Rexroth products and their properties must be considered as components of installations, systems and machines for their holistic IT security concept.

Unless otherwise documented, Bosch Rexroth products are designed for operation in local, physically and logically secured networks with access restrictions for authorized persons, and they are not classified according to IEC 62443-4-2.

3 General notes on damage to property and damage to the product

NOTICE

Inadmissible mechanical load!

Hitting or impulsive forces on the drive shaft or the pilot valve can damage or even destroy the SYDFE1 control system.

- Do not hit on the coupling or drive shaft of the axial piston unit.
- Do not set/place the axial piston unit on the drive shaft or the pilot valve.
- Never use the SYDFE1 control system as a handle or step. Do not place/put any objects on top of it.

Foreign bodies and contaminants in the control system!

Risk of damage, wear and malfunctions due to ingress of dirt and foreign particles.

- During installation, ensure utmost cleanliness in order to prevent foreign particles such as welding beads or metal chips from getting into the hydraulic lines.
- Before commissioning, make sure that all hydraulic connections are tight and that all seals and closing elements of plug-in connections are correctly installed and not damaged.
- Take care that no cleaning agents enter the hydraulic system.
- Do not use cotton waste or linty cloths for cleaning.

Wear!

Wear may lead to malfunctions.

- Carry out the prescribed maintenance work at the time intervals specified in the operating instructions.

Environmentally harmful hydraulic fluid!

Leaking hydraulic fluid leads to environmental pollution.

- Immediately remedy any leakage.
- Dispose of the hydraulic fluid in accordance with the national regulations in your country.

Insufficient pressure!

If the pressure falls below the specified value, damage can occur or the product be destroyed.

- Make sure that the pressure cannot fall under the prescribed minimum value.

Insufficient hydraulic fluid!

If you commission or operate the SYDFE1 control system without or with insufficient hydraulic fluid, the control system is immediately damaged or even destroyed.

- When commissioning or re-commissioning a machine or system, make certain that the housing chamber as well as the suction and working lines of the control system are filled with hydraulic fluid and remain filled during operation.

4 Scope of delivery

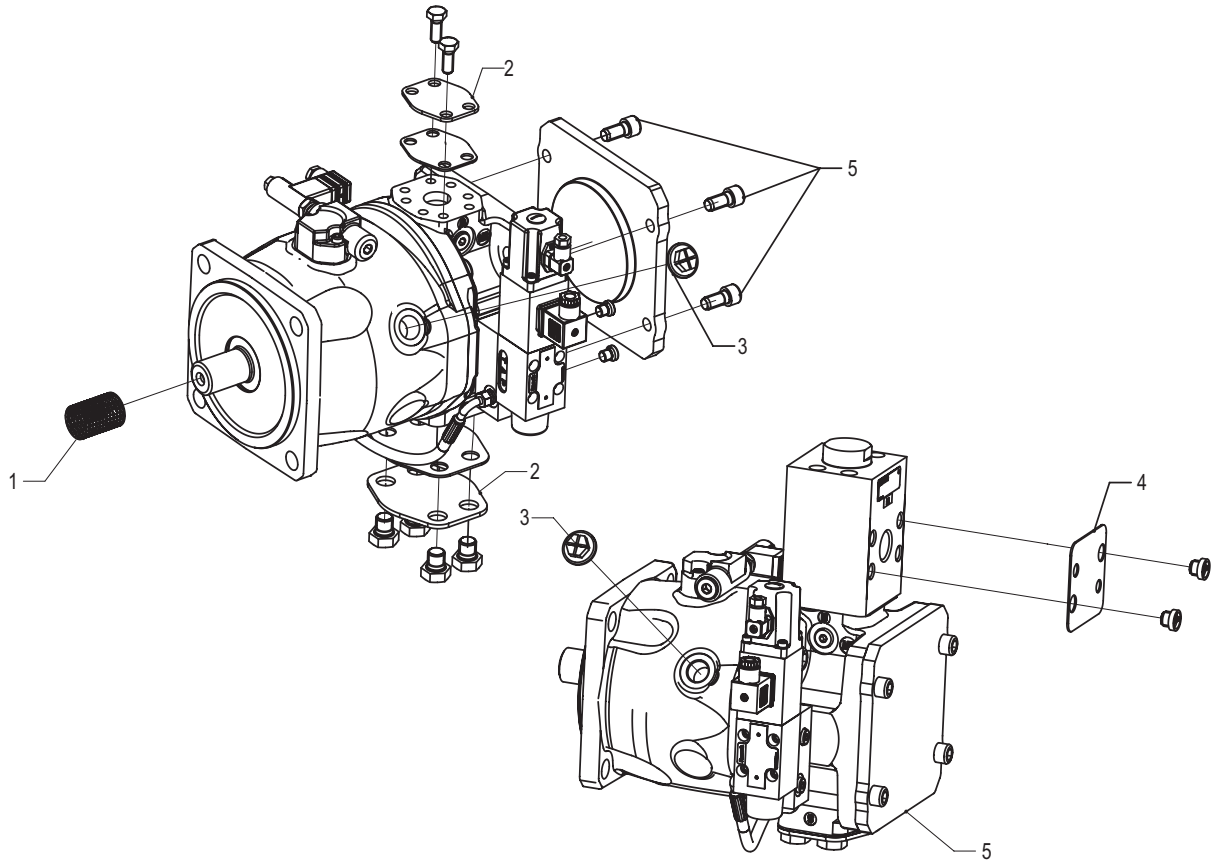


Fig. 1: Control system SYDFE1-3X

The following is included in the scope of delivery:

- 1 control system SYDFE1

When delivered, the following parts are mounted additionally:

1 Transport protection for drive shaft end in the case of keyed shaft
2 Protective cover with mounting screws
3 Plastic plugs/plug screws
4 Protective cover (NG140) or plastic plug on pre-load valve
5 The connection flange is closed operationally safe with a cover (optionally on variant with through-drive)

5 Product description

5.1 PERFORMANCE DESCRIPTION

The SYDFE1 control system is designed and built for the electrohydraulic control of swivel angle, pressure and power (optional) of an axial piston pump. It is intended for stationary applications.

Please refer to the data sheet and order confirmation for the technical data, operating conditions and operating limits of the SYDFE1 control system.

5.2 DEVICE DESCRIPTION

The SYDFE1 control system is based on an axial piston variable displacement pump of swashplate design for hydrostatic drives in the open circuit. The flow is proportional to drive speed and displacement. The flow can be steplessly varied by adjusting the swashplate.

Open circuit

In an open circuit, the hydraulic fluid flows from the tank to the variable displacement pump and is transported from there to the consumer via a directional valve. From the consumer, the hydraulic fluid flows via the directional valve back to the tank.

In the regenerative operating mode (see chapter 5.4.1 “Regenerative operation“ on page 22) the hydraulic fluid can also flow from the consumer through the pump to the tank.

5.2.1 Functional description, section of SYDFE1

In the following description, the numbers in brackets refer to Fig. 2 and Fig. 3 on page 18.

Pressure and swivel angle control of the SYDFE1 control systems is accomplished using an electrically controlled proportional valve (**2**). The proportional valve determines the position of the swashplate (**1**) by means of the actuating piston (**4**). The displaced flow is proportional to the position of the swashplate. The counter-piston (**3**), which is pre-loaded by a spring (**5**), is permanently pressurized to pump pressure.

With a non-rotating pump and depressurized actuating system, the swashplate is held by the spring (**5**) in position +100 %. With a driven pump and a de-energized proportional solenoid (**8**) the system swivels to zero stroke pressure as the valve spool (**9**) is pushed to the initial position by the spring (**10**) and, therefore, pump pressure p is applied to the actuating piston (**4**) via valve port “A”. A balance between the pump pressure on the actuating piston (**4**) and the spring force (**5**) is achieved at a pressure of 8 to 12 bar. This basic position (= zero stroke operation) is obtained when the control electronics is inactive (e.g. when the controller is disabled).

In contrast to this, a pump with external supply swivels to the negative limit stop (regenerative operation).

The proportional valve is controlled by external control electronics VT 5041-3X, which is part of the system. This electronics processes all of the control signals required to operate the SYDFE1 control system.

The external control electronics type VT 5041-3X is designed as plug-in card in Euro-format. As a standard, it is provided with one command value input each for pressure and swivel angle (and optional input for power command value). A pressure transducer senses the actual pressure value. A swivel angle sensor (**7**) on the pump senses the actual swivel angle value. The acquired actual values

are processed in the control electronics and compared with the given command values. A minimum value comparator ensures that automatically only the controller assigned to the desired working point is active. In this process, one system variable (pressure, swivel angle or - optionally - power) is exactly corrected, the other two system variables are below the given command value. The output signal of the minimum value comparator becomes the command value for the valve control loop.

The actual value of the valve spool position is sensed using an inductive position transducer (**6**). The output value of the valve position controller determines via the amplifier output stage the current through the proportional solenoid (**8**). As soon as the working point is reached the control spool (**9**) of the proportional valve is held in the centered position.

When the higher-level controllers demand an increase in the swivel angle (increase in flow), the valve spool (**9**) must be moved away from the central position (connection of the actuating piston (**4**) A → T) until the swivel angle has reached the required value. The movement of the valve spool against the force of the spring (**10**) is achieved by a corresponding increase in the electrical current through the proportional solenoid (**8**).

A reduction of the swivel angle (reduction in flow) is achieved by connecting the actuating piston (**4**) from P → A.

Pre-compression volume PCV

Since the introduction of A10VSO, series 32, a so-called pre-compression volume (**14**) PCV has been available as an optional extra. This variant (feature “32” in the ordering code for the design of the subplate) is an integral part of the subplate and cannot be retrofitted.

The PCV reduces pressure pulsation and can contribute to an improvement in the generation of noise and render secondary measures for pulsation reduction unnecessary. This technology is, however, not employed in the subplate variant without PCV (feature “22” in the ordering code).

Actuating system supply

The actuating system of the pump can be supplied with pilot oil in three different ways:

1. Internal, without pre-load valve (only possible for operating pressures >12...20 bar, see chapter 5.5.1 “Internal/external pilot oil“ on page 25).
2. Internally, with pre-load valve (operating pressure 0...100 %).
3. External supply via a shuttle valve - automatic changeover between internal/ external via a shuttle valve sandwich plate (see “External pilot oil supply“ on page 26).

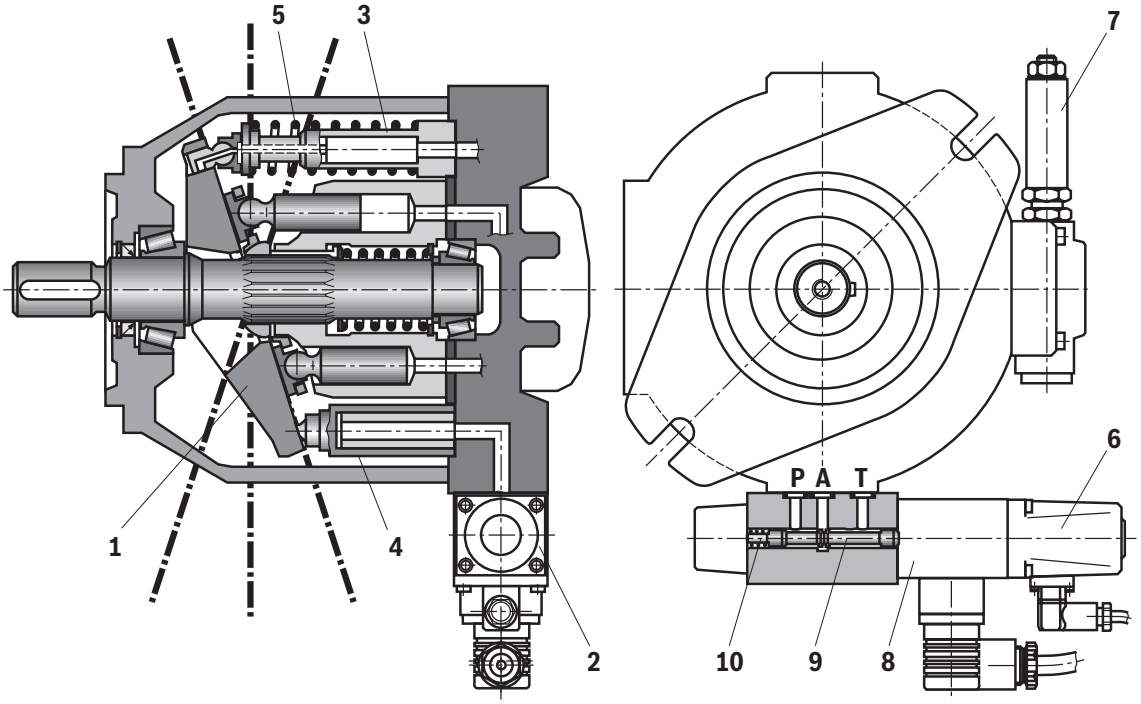


Fig. 2: Type SYDFE1, series 2X

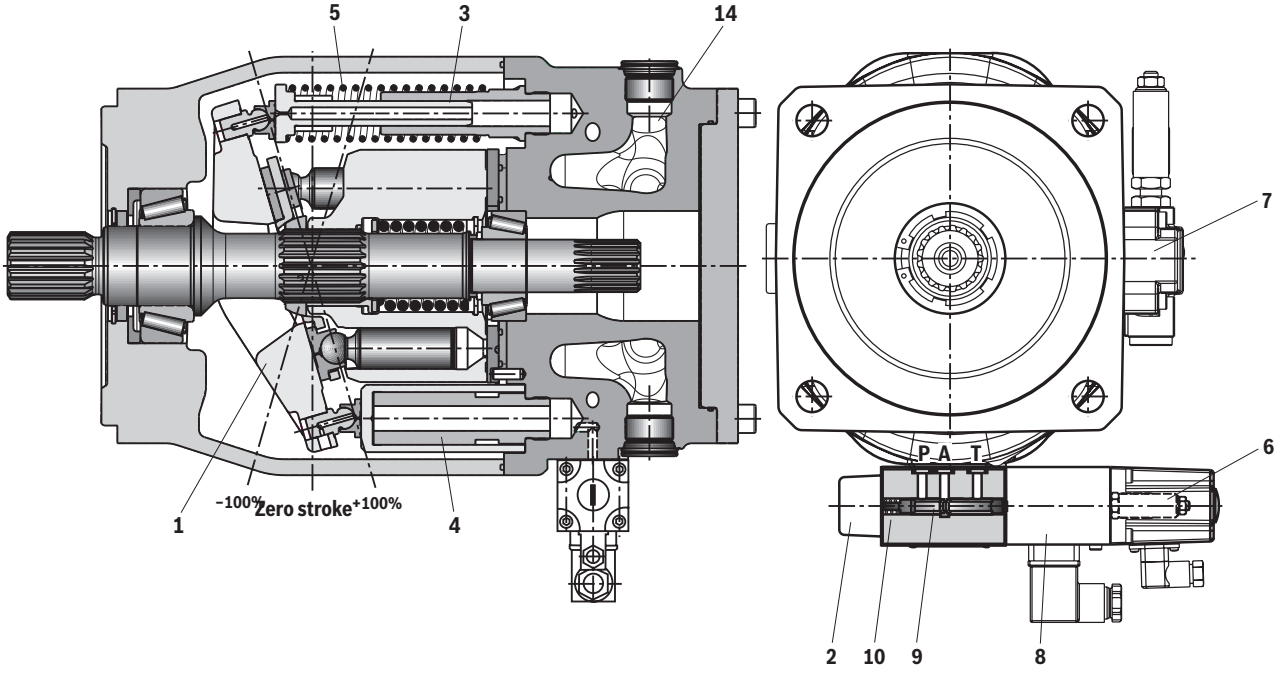


Fig. 3: Type SYDFE1, series 3X

Basic positions of the swivel angle adjustment feature

The sectional drawings overleaf show the mechanical basic position “+100 %“ of the pump (depressurized, drive at rest). This corresponds to the maximum swivel angle of the pump.

Zero stroke pressure: Pressure, which the pump with internal supply generates for its own supply without activation of the pilot valve. The pressure level is usually within the range of 8 to 12 bar. This pressure level can only be achieved when the maximum oil flow, which the pump can deliver, is not exceeded. After the electric drive was started, the pump with **internal supply** automatically swivels in to zero stroke operation

- when the enable of the control electronics is **missing** or
- in the case of an error message of the control electronics (condition: VT 5041-3X: J1 OFF) or
- in the de-energized state of the control electronics

provided that the required pilot pressure can be built up (consumer line is closed).

In contrast to this, the pump with **external supply** swivels in to the **negative limit stop “-100 %“ under the above conditions**!

NOTICE! Cavitation of the pump!

Risk of damage to the pump in the case of systems with external supply.

▶ To prevent damage to the pump, provide a pressure relief/anti-cavitation valve for systems with external supply. If a fault occurs during operation - not during start-up - the motor must be switched off.

5.3 CONTROLLER STRUCTURE AND BASIC OPERATING MODES

The controller structure is illustrated in the figure below.

Controller structure

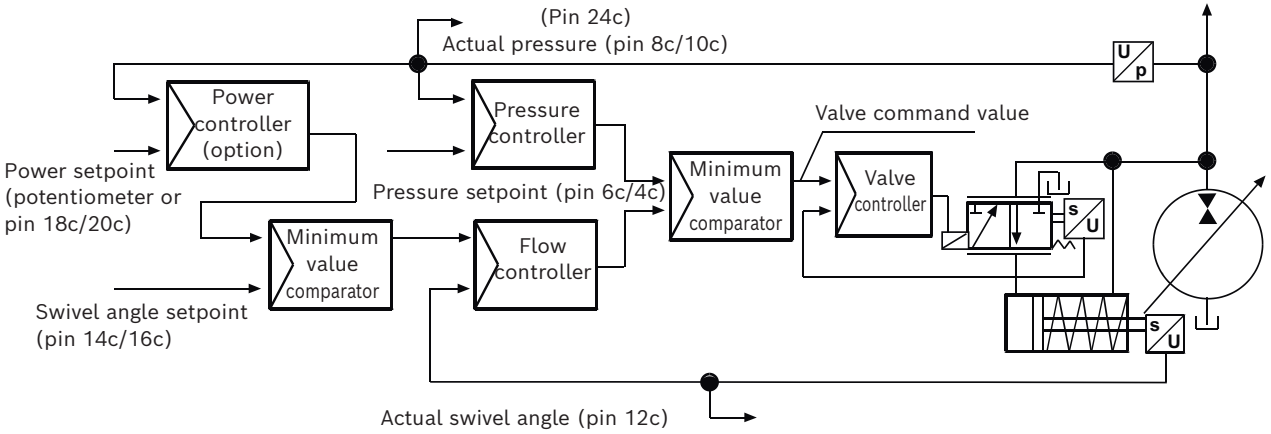


Fig. 4: Controller structure

Basic operating modes

Up to three controllers are continuously active in the possible operating modes:

- Swivel angle controller
- Pressure controller
- Power limitation (optional)

These controllers alternate automatically and jerk-free through evaluation of minimum value comparators.

During steady-state operation, one of the above controllers is active. For the other controllers, the actual value is smaller than the command value.

The following operating modes are available:

5.3.1 Swivel angle control

With version VT 5041-3X/1...
VT 5041-3X/2...

- J4 OFF and
- connect pin 18a to +24 V.

With version VT 5041-3X/3...

If the axis is to run exclusively in this operating mode, an analog signal within the range of +10 V to U_B is assigned to the pressure command value and used to deactivate the pressure controller (0...+10 V ≙ 0...100 % swivel angle).

The pressure transducer signal must be short-circuited or deactivated, because even actual pressure value signals of ≥8.0 V have an influence on or reduce the swivel angle output and hence the valve command value (actuating speed!).

A precondition for this is, however, that the electronics is set for an actual pressure value input “voltage” without raised zero point (e.g. 0 - 10 V, 0 - 20 mA). Otherwise, electronics set for an actual pressure value branch with raised zero point would change to an erroneous state when the pressure transducer signal is missing.

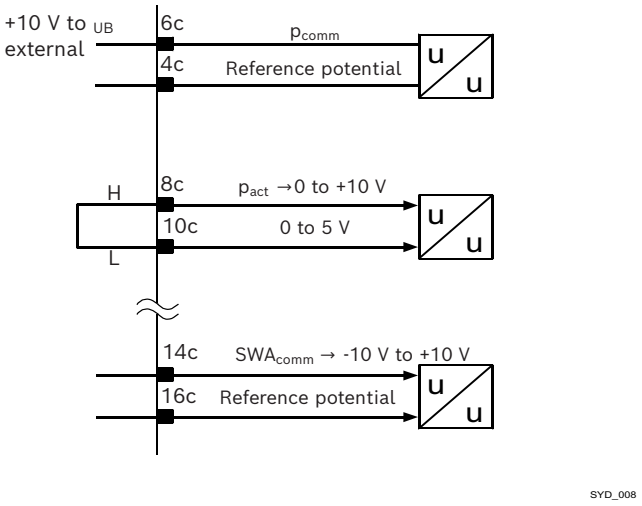


Fig. 5: Circuitry of control electronics VT 5041-3X for closed-loop swivel angle control

5.3.2 Pressure control

⚠ WARNING

Forcefully ejected parts and hydraulic fluid jet!

Risk of severe injury! The electrical pressure control does not assume a pressure relief function.

- Make certain that the maximum operating pressure is not exceeded.
- If a pre-load valve is installed, you can use its pressure relief function. If no pre-load valve is installed, provide a pressure relief valve, the pressure setting of which is 10 % (recommended) higher than the operating pressure, in the pressure line. Operating the system without this valve can lead to malfunction.

If the axis is to operate in this mode, an analog signal within the range from +10.0 V to U_B can be assigned to the swivel angle command value and used to deactivate the swivel angle controller. However, for some applications, it is advantageous to limit the permitted swiveling range of the pump by feedforwarding a suitable swivel angle command value. However, this command value must be sufficiently great in order that the pressure controller can swivel out the pump to the required extent.

5.3.3 Power limitation (optional) with VT 5041-3X/3...

This version allows optimum matching with the performance limits of the drive motor.

Due to the relationship of $P \approx \alpha_{comm} * p_{act}$ the power controller intervenes with a reducing/limiting effect (power hyperbola) via the swivel angle command value branch, if required.

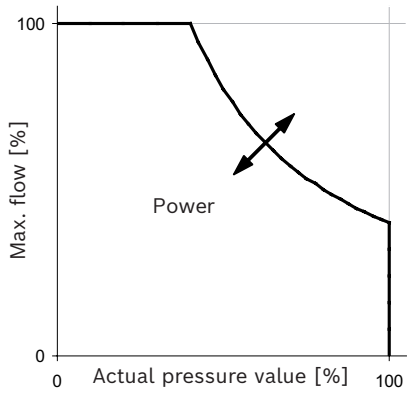


Fig. 6: Power limitation

5.4 SPECIAL OPERATING MODES

This chapter describes certain applications. In these cases, the basic operating modes (see chapter on page 5.3 on page 19) are active.

Starting up at zero pressure

For starting up SYDFE1 systems, no hydraulic circuit needs to be provided for the classical start-up at zero pressure.

When small command values for pressure and swivel angle are provided, starting up under almost no-load conditions is possible.

Circulation operation (by-pass filtration, cooling)

In the case of systems with internal supply and without pre-load valve, hydraulic circulation circuits must be dimensioned so that a minimum pressure of 8...12 bar is obtained, because the pump requires this pressure level to be able to respond to electrical control signals.

Stand-by operation

Operating mode of the pump, in which an operating point is steadily closed-loop-controlled with a corresponding command value over a longer period of time.

Observe the notes on permitted pressures in chapter 5.5.1 ”Internal/external pilot oil“ (page 25).

Zero stroke operation

Operating mode of the pump that refers to the smallest achievable swivel angle and to which the pump usually changes over when no closed-loop control is active.

The withdrawal of the enable signal, missing supply voltage or an error message (exception: J1 set, see page 63) cause the pump to automatically swivel in to zero stroke operation (actuating system with **internal supply**). Whereas in the case of actuating systems with **external supply** the pump swivels to the mechanical positive stop “-100%“ (consumer line closed) irrespective of the command value received.

The feedforward of “0 bar” via the pressure command value branch is not permitted for actuating systems with external supply. In the case of systems with internal supply this is problematic only in the case of a step-change from a high pressure to 0, because undershoots may occur.

5.4.1 Regenerative operation

Regenerative operation is a special operating mode of the SYDFE1 control system, since in this case the SYDFE1 control system is operated as both, generator and motor.

Continuous regenerative operation

We can distinguish between continuous regenerative operation and brief regenerative operation. In the first case, by this we understand coupling of the variable displacement pump with a fixed displacement pump. Here, the two pump displacements are fed together to a common consumer.

This operating mode can be utilized in conjunction with a fixed displacement pump in order to increase the displacement. To achieve “zero” displacement, the closed-loop-controlled pump must “take over” the entire flow from the fixed displacement pump and therefore swivels to the negative swivel angle range (motor operation). It must be noted here that both pump sizes must be matched to each other so that the controlled pump (in regenerative operation) must swivel in to max. –70 %. The fixed displacement pump should be mounted to a through-drive of the SYDFE1 control system.

The following pump variants are available for continuous regenerative operation:

0487: Continuous regenerative operation with external supply

0541: Continuous regenerative operation without external supply (for SYDFE1-3X only)

In the case of pump variants with external supply this operating mode is somewhat complicated in terms of engineering and commissioning, because a pump swiveling in too far (e.g. -75 % instead of -70 %) causes cavitation. We therefore recommend master/slave operation as an alternative with two closed-loop controlled SYDFE1 systems or pump variant 0541 for SYDFE1-3X.

Continuous operation is possible when the given operating limits are adhered to. However, at a total displacement of “zero” (that is, at a negative swivel angle of the SYDFE1 pump) and at high pressures, the noise level increases and efficiency deteriorates.

For pumps with external supply, the use of a pressure relief and anti-cavitation feature as shown in Fig. Fig. 7 on page 23 is indispensable to prevent the pump’s running dry.

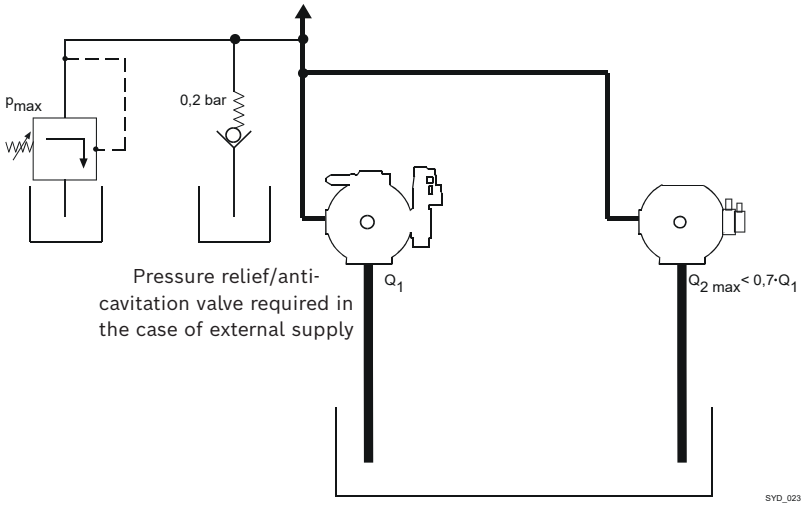


Fig. 7: Circuit diagram for continuous regenerative operation

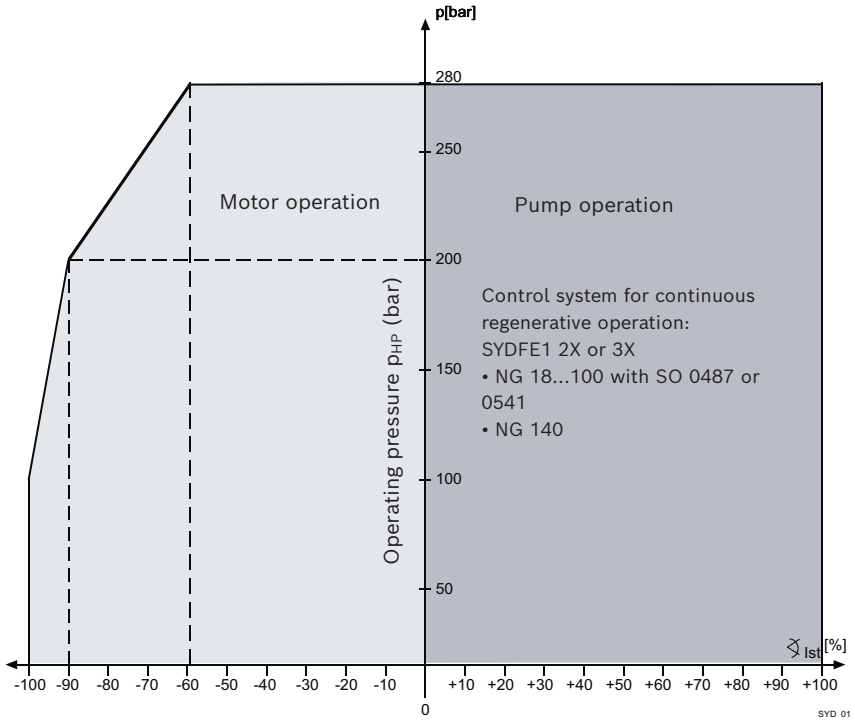


Fig. 8: Operating limits for series SYDFE1-2X and SYDFE1-3X with special rotary group for continuous regenerative operation

Brief regenerative operation

During brief regenerative operation the variable displacement pump changes over to motor operation for a limited period of time, e.g. for lowering a load. If the requirement profile remains within the limits according to Fig. 9, the standard version of the pump can be used (standard rotary group 0000 or 0479).

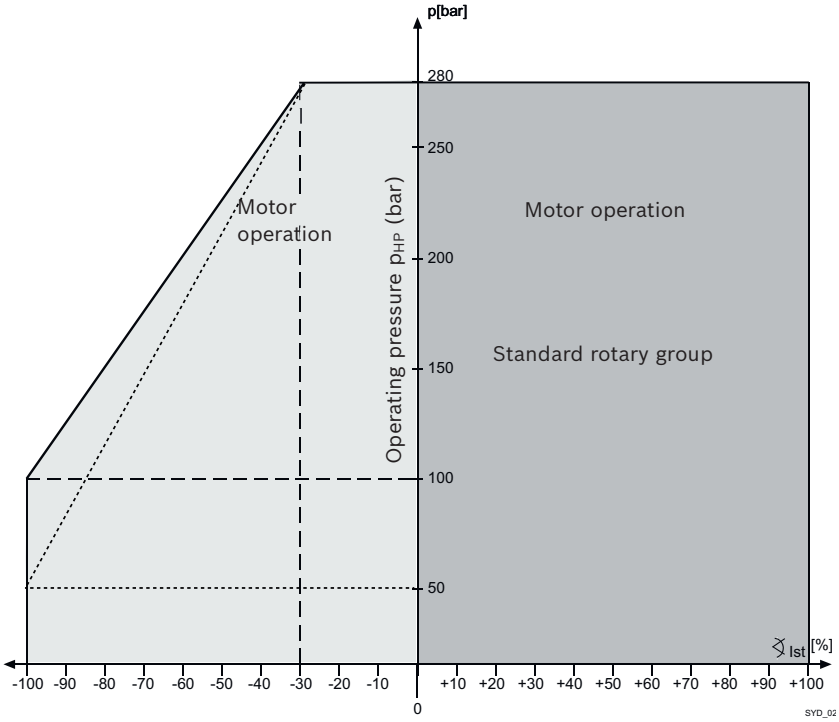


Fig. 9: Operating limits for series SYDFE1-2X and SYDFE1-3X with standard rotary group for brief regenerative operation

For standard applications, the command value for the swivel angle is provided within the voltage range of 0...+10 V; this command value is interpreted by the control electronics so that the swivel angle of the pump is controlled within the swiveling range from 0 % displacement to 100 % displacement.

During regenerative operation, depending on the pump combination, a swivel angle command value of up to -70 % (or -7 V) has to be provided. If the higher-level control is not able to generate the command value range of -7 V to +10 V, the normalization of the command value provision can be re-configured using jumpers J3 and J5.

Table 6: Normalization of swivel angle command value provision

Regenerative operation	Jumper	
	J3	J5
ON	ON	OFF
OFF	OFF	ON

- Standard: J3 open; J5 set
  Swivel angle command value -10...+10 V ≙ -100...+100 % swivel angle
- Regenerative operation: J3: set; J5 open
  Swivel angle command value 0...+10 V ≙ -100 %...+100 % swivel angle or +5 V corresponds to a swivel angle of 0 %.

Example: A swivel angle of -70 % means “zero” displacement of the pump combination. In the “regenerative” mode, this corresponds to a command value provision of +1.5 V for the swivel angle.

To vary the displacement for the pump combination from 0 % to 100 %, swivel angle command values between +1.5 V and +10 V must be provided.

5.5 OPERATING PRESSURE LIMITS

⚠ WARNING

Overpressure!

Risk of severe injury!

▶ Make certain that the maximum operating pressure is not exceeded.

Maximum operating pressure

At a pressure of ≥ 250 bar the following restrictions must be observed for SYDFE1:

- The pressure transducer must be located downstream of a pulsation damper or the high-pressure hose.
- When a standard pilot valve spool is used (version “A”), the pressure controller P-gain (see page 69) may have to be reduced. This has an influence on the accuracy and dynamics of the closed pressure control loop.
- The loop gain can also be reduced by installing a pressure transducer of a higher pressure rating (e.g. 400 bar).

Minimum operating pressure

The minimum operating pressure depends on the pilot oil supply and is explained in more detail in the following chapter.

5.5.1 Internal/external pilot oil

Internal pilot oil supply

If the operating pressures of the application are always > 20 bar, the version with internal pilot oil supply should be selected, because no cavitation due to too small command values can occur with this version.

Operation is also possible at pressures higher than approximately 12 bar, but dynamics is restricted within the range below 20 bar.

This minimum (pilot) pressure level ensures that the pump can respond to the electrical swivel signal at any time. When the consumer line is blocked, the smallest achievable steady-state swivel angle is the zero stroke angle.

For applications, in which lower operating pressures occur or are to be controlled, a pre-load valve (SYDZ for SYDFE1) can be used. For this solution, the minimum pressure is ≥1 bar

Pre-load valve

The advantage of the pre-load valve is that the pilot oil pressure of the pump cannot fall below the value preset on the pre-load valve and that pressures ≤10 bar on the output side can be continuously controlled.

Being equipped with a pre-load valve the pump cannot permanently swivel back over zero, irrespective of electrical actuating signals or any control errors. The smallest achievable swivel angle during steady-state operation therefore is the zero stroke. This is not valid for applications, in which, for example, a suspended load can cause operating pressures ≥12 bar. In such cases the pump can also be used in motor operation (for lowering the load). A check valve integrated in the pre-load valve permits, within certain limits, a reversal of the direction of oil flow.

When using the pump combinations

- NG45 with 45/28/18 or
- NG28 with 28/18 or
- NG18 with 18

in conjunction with the SYDZ pre-load valve on the main pump, there is a mechanical conflict between port “P1” of the pre-load valve and the swivel angle sensor housing of the built-on rear pump. For this reason, we suggest that the main pump of the above combinations be equipped with an SAE flange plate ¾“ (NG28) or 1“ (NG45) having a height of h = 45 mm. The construction height of the pump assembly therefore changes by dimension “h“.

External pilot oil supply

Also here, the minimum pressure is ≥ 1 bar. With external pilot oil supply (0479 for external supply or 0487 for external supply plus regenerative operation for SYDFE1) pressures ≤ 10 bar are only permitted briefly (max. 10 minutes).

An additionally built-on sandwich plate with shuttle valve automatically switches the pilot oil supply between the internal or external pilot oil source, with always the higher pressure level being selected.

A pump for SYDFE1 with external pilot oil supply can be recognized by

- the sandwich plate mounted under the pilot valve and
- the hose routed around the pump case.

With external pilot oil supply, the actuating system of the SYDFE1 pump works independently of the actual high-pressure circuit, thus allowing an adjustment also below an operating pressure of 14 bar within the range of “±100 %“ (change in the direction of displacement!).

In the following situations, the pump swivels to position “-100 %” (motor operation) in an uncontrolled manner:

- when the enable of the control electronics is missing or
- an error message of the control electronics (exception: J1 set, see page 63) or
- in the de-energized state of the control electronics

This can lead to cavitation and damage to the pump.

For this reason, special features are to be provided such as a pressure relief and anti-cavitation valve and actual swivel angle value monitoring.

The pressure relief and anti-cavitation valve diminishes the risk of the pump’s running dry, the effects of which result in a reduction in the service life of the pump.

The actual swivel angle value monitor could, for example, switch off the entire drive or selectively shut off the pilot oil flow.

The following is valid for the actuating pressure:

Pilot oil pressure ≤ minimum operating pressure + 30 bar

Recommendation: Absolute pilot oil pressure ≈ 20 bar

Further notes on the operation with external supply:

- With external supply, the pump does not swivel to zero stroke when the control electronics is de-energized.
- Command values for pressure and flow must always be greater than 1 bar or 5 %, because there is no exact “zero” pressure or “zero” swivel angle due to drift or inaccurate settings. For this reason, selections equal to zero or only slightly greater can lead to cavitation in the worst case.
- In order to ensure sufficient lubrication for the pump system at all times, the actual pressure value must not be less than 10 bar for longer than 10 minutes!

Notes on dimensioning

At a pilot oil pressure of 20 bar the brief pilot oil requirement during swiveling is ca. 17 l/min. In practice, this amount of pilot oil is needed only, if the operating pressure is less than 20 bar during the entire swiveling process and thus the entire pilot oil demand must be supplied by the external source.

In the steady-state, balanced condition, the pilot oil requirement is less than 1 l/min.

Experience has shown that, depending on the operating pressure and swiveling frequency, the actual pilot oil demand is in the order of 5...15 l/min. In the case of external supply, a smaller pump size may be selected if an accumulator is provided.

5.6 AMBIENT CONDITIONS

5.6.1 Oil-immersed applications

The SYDFE1 control system is suitable for oil-immersed applications.

5.6.2 Ambient temperature

The permissible maximum ambient temperature for SYDFE1 control systems is 70 °C at the pump and 50 °C at control electronics VT 5041-3X.

We recommend the installation within a ventilated area with moved ambient air, e.g. in the air flow of an electric motor.

5.7 NOTES ON THE SELECTION OF HYDRAULIC FLUIDS

The SYDFE1 control system is designed for operation with hydraulic fluids in accordance with DIN 51 524 (HL/HLP).

Operating viscosity

We recommend that you select the operating viscosity (at operating temperature) within the following range, which is optimum in terms of efficiency and service life:

- v_{opt} = optimum operating viscosity 16...36 mm²/s

This range is referred to the tank temperature in the open circuit.

Viscosity limits

The following values are valid for limiting operating conditions:

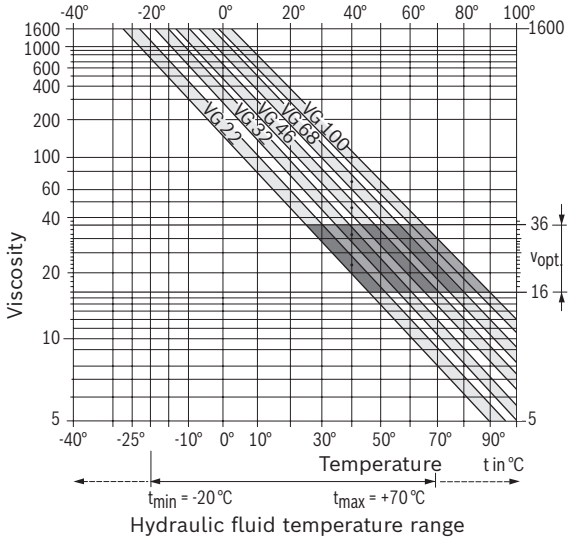
- v_{min} = 10 mm²/s
  Briefly, at max. permissible case drain oil temperature of 90 °C
- v_{max} = 1000 mm²/s
  Briefly, during cold start

Temperature range

The temperature of the hydraulic fluids lies between the following values: (cf. selection diagram)

- t_{min} = -20 °C
- t_{max} = 70 °C

Selection diagram for the hydraulic fluid



Hydraulic fluid temperature range

Notes on the selection
In order to be able to select the correct hydraulic fluid, the operating temperature in the tank (open circuit) in relation to the ambient temperature must be known.

The hydraulic fluid should be selected so that within the operating temperature range, the operating viscosity is within the optimal range (ν_{opt}). This range is shown as gray area in the selection diagram.

We recommend that you select the next higher viscosity class.

Example:

At an ambient temperature of X °C, the resulting temperature in the tank is 60 °C. Within the optimum operating viscosity range (ν_{opt}; gray area) this corresponds to viscosity classes VG 46 and VG 68. You should select: VG 68.

The case drain oil temperature, which is subject to the influence of pressure and pump revving speed, is always higher than the tank temperature. However, the temperature must not exceed 90 °C at any point in the system.
If the conditions described above cannot be complied with due to extreme operating parameters or high ambient temperatures, please consult us.

Filtration of the hydraulic fluid

The finer the filtration of the hydraulic fluid, the better is the achieved cleanliness class, which, in turn, prolongs the service life of the SYDFE1 control system.

To ensure functional reliability of the SYDFE1 control system, the hydraulic fluid must comply at least with cleanliness class 18/16/13 according to ISO 4406 (for particle sizes 4/6/14 µm).

5.8 GENERATION OF NOISE

Compared to, for example, vane pumps, axial piston pumps generate greater changes in flows and thus pressure pulsations for design-inherent reasons. Apart from the propagation of air and structure-borne noise, this can have an influence on fluid-borne noise. In the end, these factors together result in the general perception of “noise”.

Noise often induces vibration on other components, which, in turn, also generate noise. For example, on check valves, which may be installed, the integrated springs must be adapted to the conditions of the systems, if this is a cause of excitations leading to the generation of noise.

The details given for the noise pressure level in the technical documentation refer to measurements taken in an anechoic chamber. Influences of the surroundings such as place of installation, general mechanical concept, piping, etc., are not taken into account.

5.8.1 Generation of noise in the power unit

“Noise“ is composed of various elements. The total result of “noise” is influenced not only by air-borne noise, but also by structure- and fluid-borne noise.

As a result of unfavorable installation and piping conditions, the noise pressure level of the complete system can be 5 to 10 dB(A) higher than the value of the pump alone.

Noise can be reduced by taking, for example, the following measures:

- Low-noise tank
- Damping ring between pump and pump mounting bracket
- flexible pipe conduit
- Anti-vibration rails under the motor
- Installation of the pump at a sufficient distance to the tank wall

5.8.2 Pulsation damper

For some special applications, we recommend the use of a pulsation damper. Due to the reduction of typical pump pressure pulsation, this has a positive effect on the noise level of the hydraulic system as a whole.

Further information can be found in data sheet RE 50142.

5.9 SHAFT VARIANT

The SYDFE1 control system is available with keyed or splined shafts. When compared with the keyed shaft, the splined shaft is not only advantageous with regard to its degrees of freedom during assembly and operation, but also due to its increased torque load carrying capacity and its stability under changing loads.

This increased torque load carrying capacity is useful in particular when pump combinations are to be installed. In the case of multiple pumps, all built-on units are fitted with splined shafts.

In view of the dynamic load carrying capacity and standardization, we recommend the use of standard types with splined shafts. This offers advantages with regard to availability and future spare parts requirements.

When a splined shaft is selected, a clamp coupling must be used for the mechanical connection to the electric motor. Otherwise, frictional corrosion may occur that leads to damage to the pump.

Notes on the transmission of permissible maximum torques can be found in the data sheet.

Keyed shaft

Due to the advantages of the splined shaft, keyed shafts are **not** recommended for new applications. The keyed shaft is no longer used for applications with through-drive.

If a single pump is to be used later as “end pump” in a multiple-pump system, a splined shaft must be selected.

Splined shaft

Splined shaft profiles depend on the size (NG) of the pump. Two different splined shaft profiles are available in conjunction with “SYDFEx“ :

- “S“-profile for NG18, NG100, NG140 and NG180
- “R“-profile for NG28 ... 71

When compared with the “S”-profile, the “R”-profile features further improved properties with regard to the torque carrying capacity of the shaft. This version represents the optimum for a wide variety of applications.

5.10 SPOOL VARIANT OF THE VT-DFPE-X-2X PILOT VALVE

The standard spool according to the ordering code is spool type “A“ (360° spool).

Especially for press applications (280 bar) type “C” (4-groove spool) has proven in practice in conjunction with the SYDFE1 control system.

On older systems, a 2-groove spool “B” was often employed. However, this spool should no longer be used for new applications due its poor dynamics.

5.11 FUNCTIONS OF CONTROL ELECTRONICS VT 5041-3X

5.11.1 Enable

⚠ WARNING

Uncontrolled machine movements!

Risk of severe injury! The enable does not represent a safety function!

▶ All further, safety-relevant interventions must be made by the higher-level control (e.g. switching the drive motor OFF, closing the shut-off valves, ...).

The enable for the control electronics is granted by applying 24 V to switching input 26c. This activates the output stage of the VT 5041-3X, i.e. the pilot valve. The presence of the enable is signaled by LED “En.“ on the front panel.

The following options are provided for connecting enable input 26c:

- Controlling by higher-level control (to be preferred)
- Fixed wire bridge
- Via relay
- Conventional switch

The withdrawal of the enable signal at 26c deactivates the valve output stage of the control electronics and causes the pilot valve to go to a defined position. The same effect is achieved by switching off the voltage supply.

This has the following consequences:

- With an **actuating system with internal supply** the pump swivels to the zero stroke position.
  Zero stroke = minimum pressure generated by a pump with internal supply
- In contrast to this, a pump with **actuating system with external supply** swivels to the mechanical limit stop “-100 %“.

The enable is always required for normal operation. In the event of a fault, such a fault can be cleared by withdrawing and re-applying the enable. Clearing of the fault message is also possible by switching the supply voltage off and then on again.

5.11.2 Switch $_{TD}$

Via switching input “Switch $_{Td}$“ (22c) you can activate a second volume adjustment.

This function is a new feature compared with control electronics VT 5041-2X. For more details on the function, see chapter 8 “Commissioning“ (page 59).

5.11.3 Pressure controller OFF - master/slave operation

(VT 5041-3X/1... and ...2... only)

This function is provided only for versions without power limitation.

The pressure controller can be deactivated via switching input 18a. This means that exclusively the swivel angle control of the control electronics is active. The deactivation of the pressure controller is signaled by L$\measuredangle$-control on the front panel of the control electronics.

In addition, in conjunction with a set jumper (J4) the command value for the swivel angle controller is no longer read in from inputs 14c and 16c, but from inputs 18c and 20c. This function can be utilized for the master/slave operating mode.

When the pressure controller is deactivated, the function of pressure limitation is no longer effective.

5.11.4 Fault message

The switching output “fault message” at input 2c signals a trouble-free state with a 24-V level. When a fault is recognized, this is output as collective fault by a signal level of 0 V at 2c. At the front panel of the control electronics, a fault message is signaled by LED “Err.“.

Also a missing enable will lead to the generation of a fault message.

Causes for fault messages are described in chapter 15 “Troubleshooting“ (page 80).

5.11.5 Signaling of type of control

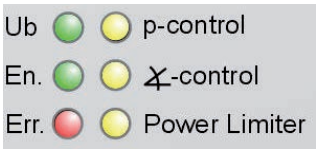


Fig. 10: LED indicator lamps

- An active closed-loop pressure control is signaled by the yellow LED with designation “p-control” on the front panel.
- An active closed-loop swivel angle control is signaled at connection 16a (switching output +24 V). This information is also shown on the front panel of the control electronics (yellow LED with symbol: $\measuredangle$-control).
- An active power limitation is signaled at connection 18a (switching output +24 V). This information is also provided on the front panel of the control electronics (yellow LED with lettering: “Power Limiter“). Available only on version with power limitation!

5.11.6 Actual values

The normalized actual pressure value can be picked up at 24c.

The normalization of 0...+10 V is made using potentiometers R1 and R2 (front panel). The signal is related to test jack 2.

The normalized actual swivel angle value can be picked up at 12c.

The normalization of -10...+10 V is made using potentiometers R8 and R9 (front panel). The signal is related to test jack 4.

5.11.7 Test jacks on the front panel of control electronics VT 5041-3X

The command values for pressure and swivel angle are provided by the higher-level control and can be measured at test jacks 1 and 3.

The actual values for pressure and swivel angle can be measured at test jacks 2 and 4.

The valve command value generated internally by the control electronics as well as the acquired actual valve value of the pilot valve can be measured at test jacks 5 and 6.

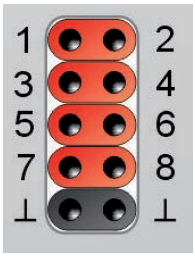
The active swivel angle command value at test jack 7 is the command value that is currently valid for the swivel angle controller. The value can differ from the swivel angle command value at test jack 3 for the following reasons:

- When case drain compensation is active, a compensation value, which is related to pressure, is added to the command value of test jack 3.
- When the master/slave function is active, the command value of the swivel angle is read in at connections 18c(+)/20c(-).
- In the “regenerative” operating mode, the swivel angle command value of 0...+10 V ≙ -100 %...-100 % is internally converted into -10 V...+10 V ≙ -100 %...-100 % (test jack 7).
- The power limiter can limit the swivel angle command value. The limiter’s being active is signaled by LED “Power Limiter“ on the front panel.

On control electronics with power limitation, test jack 8 is used to adjust/measure the power limit value.

Table 7: Test jacks

Assignment of test jacks	
Test jack 1 Pressure command value 0...+10 V	Test jack 2 Actual pressure value 0...+10 V
Test jack 3 Swivel angle command value -10 V...+10 V ≙ -100 %...+100 %	Test jack 4 Actual swivel angle value -10 V...+10 V ≙ -100 %...+100 %
Test jack 5 Valve command value ±10 V	Test jack 6 Actual valve value ±10 V
Test jack 7 Active swivel angle command value ±10 V	Test jack 8[1)] Power limit 0...+10 V
Test jack 9 Reference	Test jack 10 Reference



[1)] Only with version with power limitation

5.11.8 Leakage compensation

As the operating pressure rises, the amount of internal leakage of the SYDFE1 control system increases. For this reason, a certain external swivel angle command value is applied in order to exercise a pressure-dependent influence on the pump’s displacement:

The pump’s displacement decreases at higher pressures.

The standard versions of the various control electronics therefore comprise an automatic case drain compensation feature that constantly adds a certain percentage of the actual pressure value as correction factor to the swivel angle command value. This, however, results in differences between the externally provided swivel angle command value and the actual swivel angle signal when this compensation feature is activated.

In certain applications and with integrated, connected pressure transducer, pressure fluctuations, which may occur during displacement operation (swivel

angle control), can have an unfavorable effect on the swivel angle control when the corrective feature described above is active. In this case, the swivel angle control can be stabilized by reducing or deactivating case drain oil compensation.

Reasons for pressure fluctuations can be the following:

- Process- or material-related
- Hydraulic motors with a small number of pistons
- Lifting cylinders with a low natural frequency
- Overriding closed position or velocity control loop

5.11.9 **Power limitation** (VT 5041-3X/3... only)

In the case of electronics variants with power limitation, a limiting value can be set by means of a potentiometer. Alternatively, a limit value can be provided externally to contacts 18c/20c, if jumper J2 is set in position 2-3.

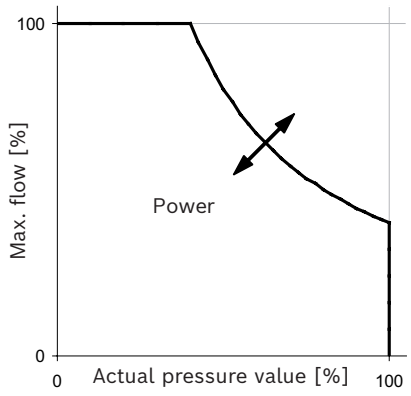


Fig. 11: Power limitation

When the power limiter cuts in, the operating variables (pressure and flow) adjust automatically according to the curve path of the set power hyperbola.

How to adjust the power control is described in chapter 8 “Commissioning” on page 59, the adjustment of the power limitation is described in section 8.1.12 on page 70.

5.12 MASTER/SLAVE OPERATION

Circuitry of SYDFE1 for master/slave operation

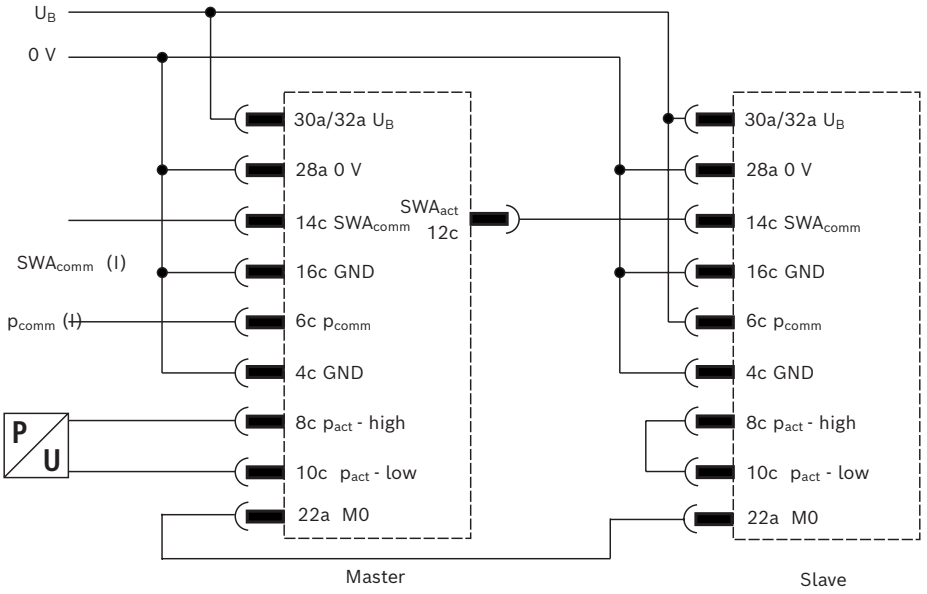


Fig. 12: Circuitry of SYDFE1 for master/slave operation without independent individual operation

Theoretically, an optional number of SYDFE1 control systems can be hydraulically coupled to achieve greater flows, if necessary.

In this case, it is just required to determine a master pump to which the pressure transducer, if provided, has to be connected.

The master controls both, pressure and swivel angle, in accordance with the externally provided command values and passes its actual swivel value (SWA_{act}) on to the slave pumps as swivel angle command value (SWA_{comm}). This ensures smooth and synchronous swiveling of the pumps.

Consequently, the slave pumps operate only under swivel angle control, which is the reason why in this operating mode no pressure transducer signal may be fed to their control electronics.

Circuitry of SYDFE1 with control electronics with power limitation (VT 5041-3X/3-...)

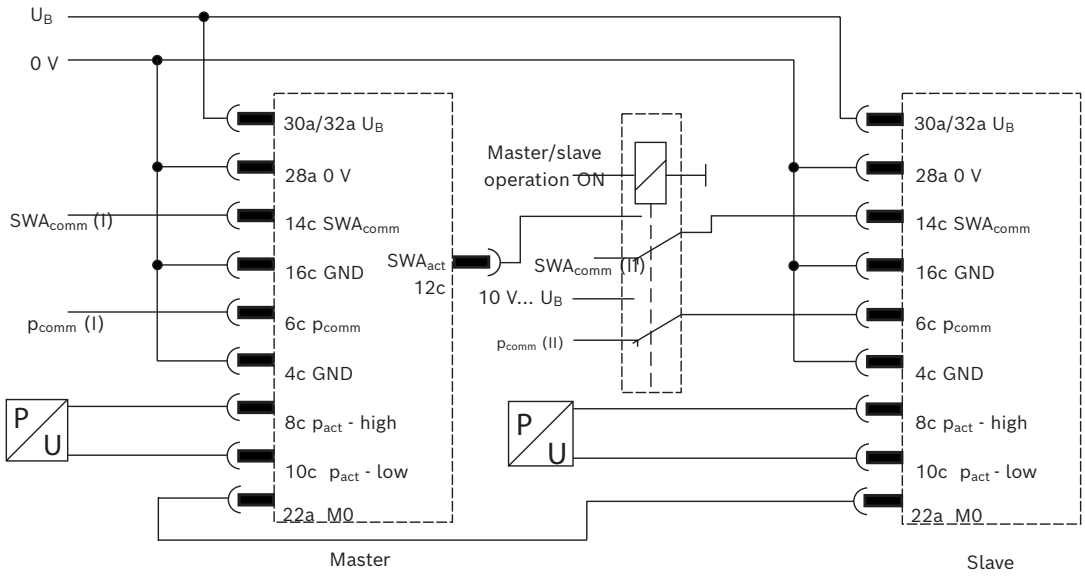


Fig. 13: Circuitry of SYDFE1 for master/slave and independent individual operation

Notes:

- Set the pressure transducer input on the slave axis to 0...10 V.
- The connection for the position transducer of the pump is not drawn here.
- The coupling element (relay, analog switch) can be optionally installed to control both pumps independently of one another. With the proposal shown here, both, swivel angle and pressure control are possible with the slave pump.
- For the master/slave operating mode, the signal p_{comm}(II) must be set to maximum (+10 V).
- If closed-loop pressure control is to be realized also in the master/slave operating mode, only the pressure transducer of the master is evaluated for controlling purposes. If hydraulically separated operation should be possible, too, a separate pressure transducer is required for the slave.

Circuitry of SYDFE1 with control electronics without power limitation (VT 5041-3X/1...)

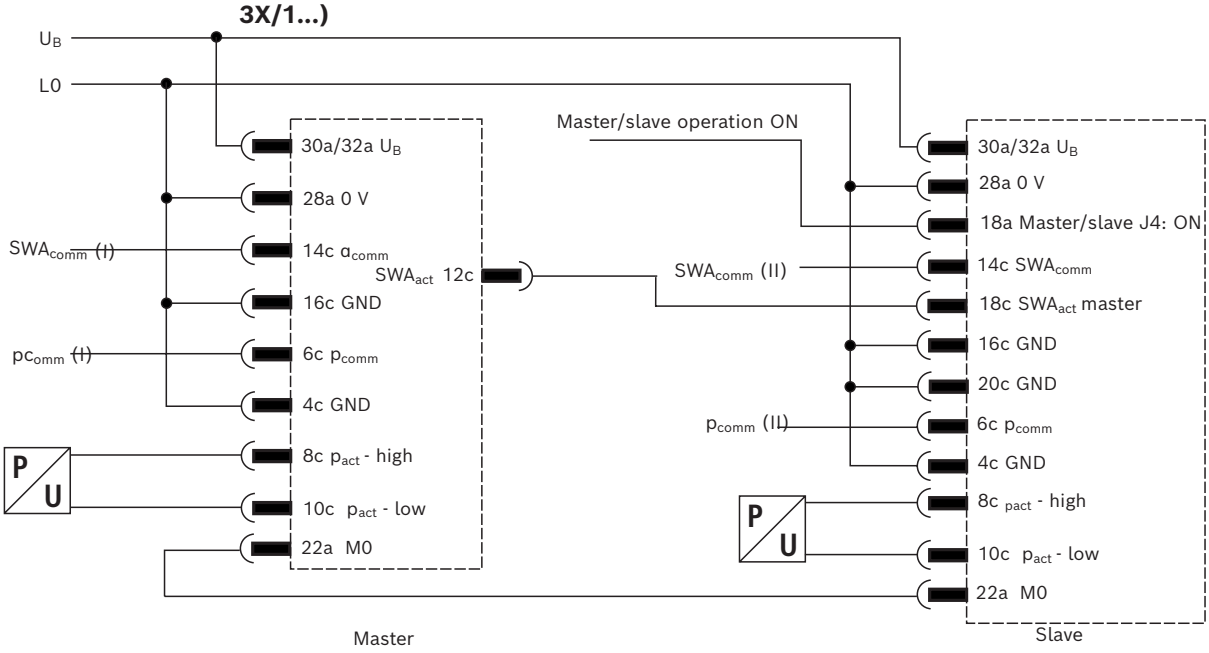


Fig. 14: Circuitry of SYDFE1 for master/slave and independent individual operation

Notes:

- The connection for the position transducer of the pump is not drawn here.
- If closed-loop pressure control is to be realized also in the master/slave operating mode, only the pressure transducer of the master is evaluated for controlling purposes. If hydraulically separated operation should be possible, too, a separate pressure transducer is required for the slave.

Changing over to master/slave operation

0 V reference potentials of the PLC/command value source and GND/0 V of the SYDFE1 electronics must be connected.

Shortly **before** the changeover takes place, switch both pumps to pressure control (low, identical pressure level), while they are hydraulically still uncoupled from each other. Approximately identical actual swivel angle values would be optimal. Set the flow command value to a low value (e.g. 10 %).

When a pre-load valve is used, the pump with the pre-load valve should preferably be the master pump.

Changing over to master/slave operation

Only in conjunction with VT 5041-3X/3-...(Fig. 13)

At low operating pressures, the flow command value, which has been provided by the control, is withdrawn from the slave pump via a changeover contact suitable for small signal voltages (or, alternatively, a wear-free analog switch), and the actual swivel angle value provided by the VT 5041-3X control electronics of the master pump is connected.

The pressure command value of the slave pump is to be set to 100 % (if required, using a second changeover contact or by means of software) in order that closed-loop pressure control of this unit is quasi switched off.

Only in conjunction with VT 5041-3X/1-... and version VT 5041-3X/2...: (Fig. 14)

In the case of control electronics without power limitation: High signal to contact 18a.

For both control electronics:

At the point in time when the master/slave operating mode is activated, the hydraulic short-circuit valve (connection of the previously separated pressure circuits) can be activated as well. The activation of this valve may have to be delayed depending on whether this would improve the system characteristics in the changeover process.

Deactivating master/ slave operation

In the master/slave operating mode it is also useful that the control keeps the two swivel angle command values for the master and the slave pump synchronized in order that striking differences in the signal level are prevented when the swivel angle command value source for the slave pump is switched (from actual swivel angle value of the master pump back to the control output).

The pressure command value of the slave pump should be set to the same level as that of the master pump before the slave pump is changed over to individual operation (jerk-free changeover).

Connection of unused electrical signal inputs

All the analog inputs that are not used, e.g. actual pressure value input in the case of flow control, must be connected to 0 Volt.

In contrast to this, differential amplifier inputs that are not used may also be short-circuited.

5.12.1 Switch-on sequence of electronics/hydraulics

General information

Due to various monitoring routines implemented in the electronic assemblies, fault messages may be generated in the case of an unfavorable order of switching on. These error messages cause uncertainties, although they have no “real” cause of fault.

In principle, it is valid that all SYDFE1 pump systems that are provided exclusively with internal pilot oil supply automatically swivel to the operationally safe zero stroke position in the event of a power failure, missing enable or active fault message (except, “J1” is set, see page 63). However, a precondition for zero stroke is a minimum pressure of 8...12 bar, which the pump has to build up as pilot pressure. This can always be ensured, when no oil can flow away from the pump output (e.g. actuator line hydraulically blocked).

- Observe the special case of suspended loads!

Observe the following activation sequence when **switching on** the analog SYDFE1 electronics:

1. Voltage supply of the electronics on
2. “Enable” signal (VT 5041-3X) when the el. motor starts up and suppression of fault messages. After the star/delta changeover the error message can be evaluated.
3. Open check valve (if provided)

The **switching off sequence** is as follows:

1. Command value provision: α_{comm} = 5 % and p = 10 bar
2. Close check valve (if provided)
3. Suppress error message
4. Switch el. motor off

5.13 IDENTIFICATION OF THE PRODUCT

The SYDFE1 control system can be identified by the nameplate of the pump. The figure below shows an example of a SY2DFEE nameplate

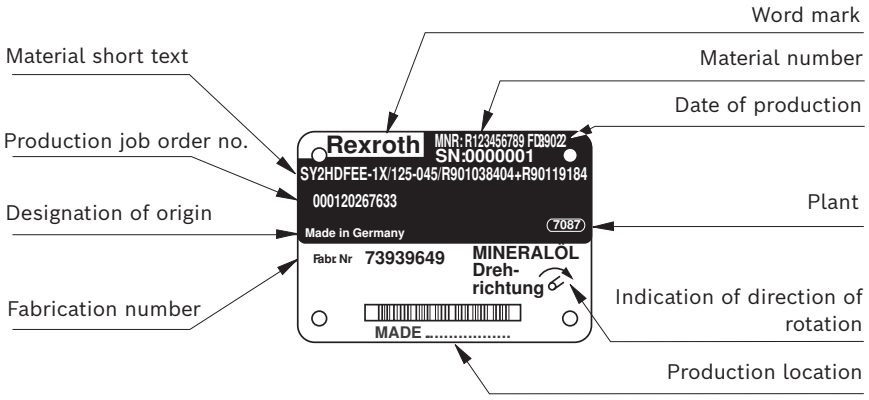


Fig. 15: Nameplate

For queries with regard to the pump combination you must indicate the material number and the fabrication number.

6 Transport and storage

6.1 TRANSPORTING THE SYDFE1 CONTROL SYSTEM

SYDFE1 control systems can be transported using a fork lift truck or lifting gear.

- ▶ Make sure that the load-carrying capacity of your fork lift truck or lifting gear is sufficient.

Dimensions and weights

Table 8: Dimensions and weights

SYDFE1 2X / size			**18**	**28**	**45**	**71**	**100**	**140**
Weight	Pump without through-drive, incl. pilot valve	kg	14	17	23	35	47	62
	In addition, pre-load valve	kg	3.3	3.3	3.3	6.3	6.3	6.3
	In addition, in case of external actuating system supply	kg	2	2	2	2	2	2

SYDFE1 3X / size			**45**	**71**	**100**	**140**	**180**
Weight	Pump without through-drive, incl. pilot valve	kg	32	49	71	75	80
	In addition, pre-load valve	kg	3.4	6.3	6.3	6.3	6.3
	In addition, in case of external actuating system supply	kg	2	2	2	2	2

The dimensions vary depending on optional equipment. The figures applicable to your SYDFE1 control system can be found on the installation drawing or in the data sheet of the relevant control system.

Carrying the SYDFE1 control system

SYDFE1 control systems of a low weight can be transported manually, if required (the weight for brief lifting should not exceed 15 kg for women and 25 kg for men).

CAUTION! Risk of health damage!

Lifting heavy SYDFE1 control systems involves the risk of health damage**!**

- ▶ When carrying the control system, apply suitable techniques for lifting, lowering and relocating or use suitable lifting gear.

6.1.1 Transport using lifting gear

Please observe the following points for transporting:

- Properties of the load (e.g. weight, center of gravity, mounting and attachment points).
- Way of attaching or suspending the load
- Make sure that the load carrying capacity of the lifting gear is sufficient for transporting the SYDFE1 control system without any risks.
- Use textile slings according to DIN EN 1492-2.

For further information on transportation, please contact Bosch Rexroth.

For transporting, the SYDFE1 control system can be connected to a lifting device using a ring screw or a lifting strap.

Transport with ring screw

The drive shaft can be used to transport the SYDFE1 control system as long as only outward axial forces occur. Consequently, you can suspend the SYDFE1 from the drive shaft.

- To do this, screw a ring screw completely into the thread on the drive shaft. The size of the thread is stated in the installation drawing.
- Make sure that the ring screw can bear the total weight of the SYDFE1 control system plus approx. 20 %.

You can lift the SYDFE1 control system without any risk of damage as shown in Fig. 16 using the ring screw screwed into the drive shaft.

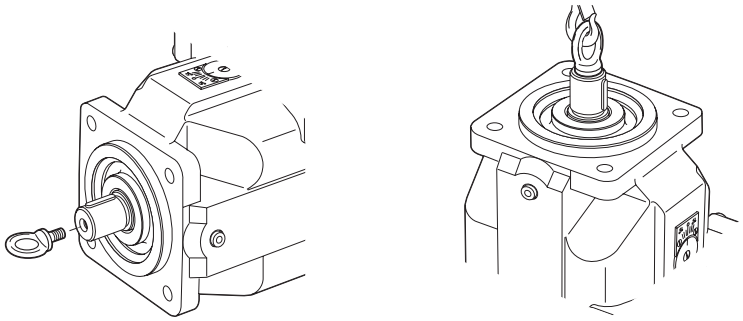


Fig. 16: Fixing the ring screw

Transport with lifting strap

- Place the lifting strap around the SYDFE1 control system in such a way that it neither passes over the attached parts (e.g. valves) nor such that the SYDFE1 control system is hung from attached parts (see Fig. 17).

CAUTION! Risk of injury!

During transport with a lifting device, the control system can fall out of the lifting strap and cause injuries.

- Hold the control system with your hands to prevent it from falling out of the lifting strap.
- Use the widest possible lifting strap.

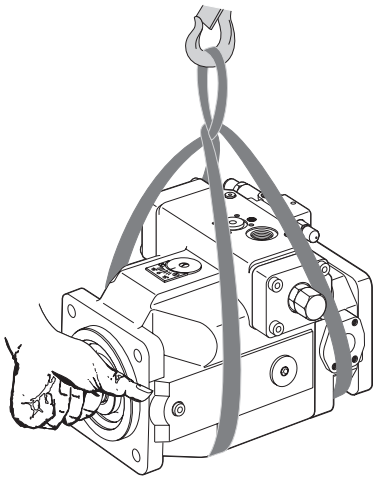


Fig. 17: Transport with lifting strap

Transport damage must be reported to your contact in the sales organization within one week. You can find the addresses of our sales locations on the Internet at:
`http://www.boschrexroth.com`

6.2 STORING THE SYDFE1 CONTROL SYSTEM

Some SYDFE1 control systems are shipped in an anti-corrosion foil (max. storage time 12 months). Without anti-corrosion foil, corrosion protection is limited to transport (a few days). If these control systems are to be stored, then you must provide preservation like for storage after demounting (see below).

Requirement

- Do not store the hydraulic component outdoors but in a well ventilated room.
- The storage rooms must be dry and free from corrosive materials and gasses.
- For the permissible storage temperature, please refer to the relevant data sheet.
- Avoid intense light.
- Do not stack SYDFE1 control systems and store them shock-proof and slip-proof.
- SYDFE1 control systems can be very heavy (see table Table 8 “Dimensions and weights“ on page 39). In this connection observe the admissible load-bearing capacities of your storage system.

▶ Check the SYDFE1 control system monthly for proper storage.

Procedure after expiration of the maximum storage time:

1. Check the entire SYDFE1 control system for damage and corrosion prior to its installation.
2. Check the SYDFE1 control system for proper function and leaks during a test run.
3. Replace the shaft seal ring when the storage time of 24 months is exceeded.

After expiration of the maximum storage time, we recommend that you have the SYDFE1 control system inspected by your responsible Rexroth Service partner.

Should you have questions regarding spare parts, contact your Rexroth Service partner responsible for SYDFE1 control systems, see chapter 10.5“Spare parts“, page 75 for further information.

Following demounting

If a demounted SYDFE1 control system is to be stored, it must be preserved against corrosion for the duration of storage.

The following instructions only refer to SYDFE1 control systems, which are operated with a mineral-oil based hydraulic fluid. Other hydraulic fluids require preservation methods that are specifically tailored to them. In such a case, consult with the Rexroth Service (for address, see chapter 10.5 “Spare parts“, page 75).

Rexroth recommends the following proceeding:

1. Clean the SYDFE1 control system, see also chapter 10.1 “Cleaning and care“, page 73.
2. Drain the SYDFE1 control system completely.
3. For storage times up to 12 months: Wet the SYDFE1 control system internally by filling in about 100 ml of mineral oil.
   For storage times up to 24 months: Fill the SYDFE1 control system with anti-corrosion agent VCI 329 (20 ml).
   Filling via the case drain port.
4. Plug all ports air-tight.
5. Wet non-varnished external metal surfaces of the SYDFE1 control system with a suitable anti-corrosion agent.
6. Pack the SYDFE1 control system air-tight together with a desiccant in an anti-corrosion foil.
7. Protect the SYDFE1 control system against impacts during storage. For further conditions, see “Requirements“ above.

▶ In each case, please observe any applicable provisions and laws regarding the handling of substances hazardous to water or to health.

7 Mounting

Before starting to install the system, have the following documents at hand:

- Hydraulic circuit diagram for the system (made available by the machine manufacturer)
- Data sheet of the SYDFE1 control system (contains the technical data)
- Order confirmation (contains the preset data of the SYDFE1 control system)

7.1 UNPACKING

⚠ CAUTION

Parts falling out!

If the packaging is not opened correctly, parts may fall out and cause injury.

- ▶ Put the packaging on level, bearing ground.
- ▶ Only open the packaging from the top.

SYDFE1 control systems are delivered packed in an anti-corrosion foil made of polyethylene material.

- ▶ Dispose of the packaging in accordance with the national regulations of your country.

7.2 INSTALLATION CONDITIONS

- ▶ Adhere to all limits specified in the data sheet regarding temperature, viscosity, cleanliness of the hydraulic fluid.
- ▶ Make certain that the case of the SYDFE1 control system is filled with hydraulic fluid during commissioning and in operation. This is also to be observed following relatively long standstill periods as the SYDFE1 control system may empty via the hydraulic lines.
- ▶ To achieve favorable noise values, decouple all connecting lines from all components that can vibrate (e.g. tank) using elastic elements.
- ▶ Make certain that the suction line, case drain line, and return line flow into the tank below the minimum fluid level in all operational states.
- ▶ Strictly observe utmost cleanliness. The SYDFE1 control system must be installed without any contamination. Contamination of the hydraulic fluid can significantly affect the service life of the SYDFE1 control system.
- ▶ Do not use cotton waste or linty cloths for cleaning.
- ▶ Use suitable liquid detergents to remove lubricants and other difficult-to-remove dirt. Detergents must not penetrate the hydraulic system.

7.3 INSTALLATION POSITIONS AND PIPING OF SYDFE1 SYSTEMS

7.3.1 General information

The installation orientation and position of the SYDFE1 control system essentially determine the procedures during installation and commissioning (such as for filling the axial piston unit).

Note that you can expect certain installation positions to affect the control behavior or the adjustment feature. Because of gravity, dead weight and case pressure, minor characteristic curve offsets and changes in actuating time may occur.

The installation instructions are tailored to the use of the SYDFE1 control system. Adhering to these instructions is one of the decisive factors for the service life of the units.

The instructions refer to standard types and standard installation situations. Particular installation situations require additional measures to be taken on the unit, which are documented separately.

Generally, care must be taken that during commissioning and re-commissioning of a system or equipment, the entire case of the axial piston unit is filled with hydraulic fluid and remains filled during operation.

NOTICE! Insufficient hydraulic fluid!

Risk of damage or destruction of the rotary group!

- ▶ Each control system type has its optimum filling orientation. Only this orientation allows complete filling of the case, which is the reason why this orientation must be adhered to during commissioning. For re-commissioning, this orientation should be complied with as far as possible.

In the following, we distinguish between the installation position (pump/motor in relation to tank) and the installation orientation (position of the pump/motor shaft end vertical, horizontal, etc.).

Installation position

The following installation positions are possible (see Fig. 18):

- Pos. a): Pump/motor above the tank (above minimum oil level)

NOTICE! Risk of damage due to loss of hydraulic fluid!

With an installation position above the tank, the case interior may drain through the case drain line after longer standstill periods (air enters via the shaft seal ring) or via the service line (gap leakage). The bearings are thus insufficiently lubricated when the pump is restarted.

- ▶ Check the hydraulic fluid level in the pump case at regular intervals; if required, carry out re-commissioning.

- Pos. b): Pump/motor next to or below the tank (below minimum oil level), with the upper edge of the case corresponding to the minimum oil level.
- Pos. c): Pump in the tank (below minimum oil level).

The pipe routing shown in the figures below represents the routing principle.

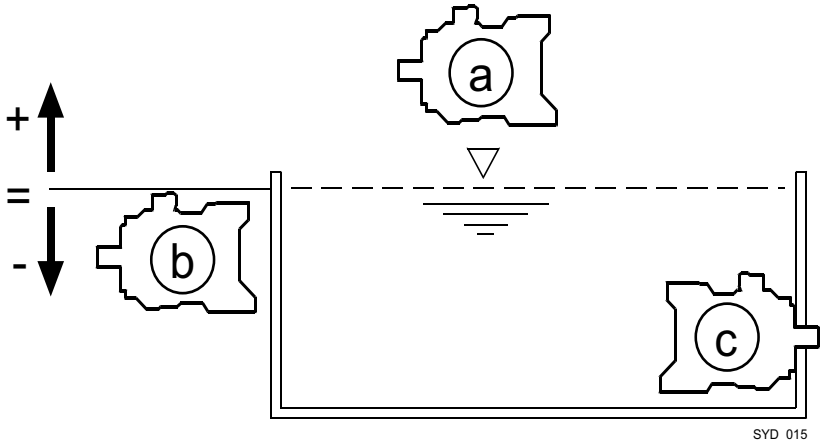


Fig. 18: Installation position

Installation orientation

The following installation orientations are possible:

- Pos.1 horizontal: Shaft end horizontal
- Pos.2 vertical: Shaft end upwards
- Pos.3 vertical: Shaft end downwards (possible only with pump variant 0975)

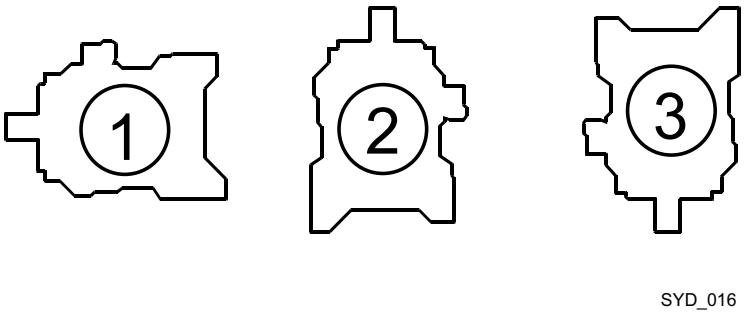


Fig. 19: Installation orientations

7.3.2 Piping

The installation positions and installation orientations shown in Figs. Fig. 18 and Fig. 19 determine the installation of

- suction lines
- case drain lines
- bleed lines

Make sure for all installation positions that always the higher of drain ports “L” or “L1” is piped. Moreover, the distance between the end of installed pipes and the minimum oil level must not be shorter than the specified minimum distance (immersion depth “E”)

To be noticed

When installing suction and case drain lines, take care that the routing is straight and short and has as few bends as possible.

When the system is at rest, the lines drain automatically in the course of time due to the own weight of the hydraulic fluid.

Moreover, the different specific densities of hydraulic fluids must be taken into account, since fluids with a higher density are more difficult to aspire and also flow down more quickly. The limit speeds for hydraulic fluids with high density (≥ mineral oil 0.87 g/ml) are specified in data sheet RE 90223.

For pumps, a minimum suction pressure is prescribed for port “S” irrespective of installation positions and installation orientations:

minimum suction pressure ≥ 0.8 bar abs.

To establish the suction pressure (inlet pressure) p_{abs} in dependence on the displacement or speed, please observe the technical data given in data sheets RE 30030, 30630 and 30035.

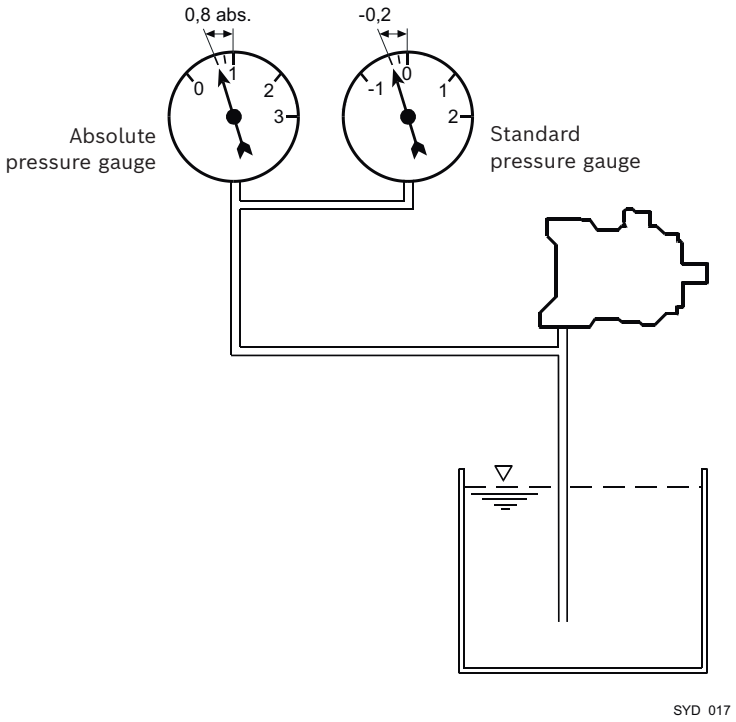


Fig. 20: Minimum suction pressure

Case drain piping

Dynamic swiveling processes result in increased case pressures that are caused by the acceleration phase of the case drain oil column. They occur within milliseconds and must not exceed 6 $bar_{abs.}$. They are influenced by the inductive resistance of the case drain line (Δpi = f (diameter, length)). Here, the flow resistance at the case drain fitting on the pump case plays a subordinate role.

The Δpi value can only be improved by a larger nominal width of the case drain line.

General notes

Generally, the following must be observed:

- Each pump should preferably be piped with a separate case drain line.
- Direct the case drain fluid in the case chamber via the highest case drain port and as shortly as possible (ca. 1 m) directly to the tank. Use a line size, which matches the port.
- When the specified line lengths are exceeded we recommend that the nominal width be increased by one size per additional meter.
- The nominal width of the case drain line determined by the threaded connection on the pump case must not be reduced. Use “light series” pipes only.
- Do not use check valves in case drain lines.
- The case drain line should always enter the tank in the return flow chamber below the oil level. For tank designs without direct separation of the suction

chamber, the drain line should be returned to the tank as far away as possible from the suction port.

- External influences of pressure, e.g. from manifold tank lines, on the pump drain port or the pump case are not permitted.

7.4 INSTALLING THE SYDFE1 CONTROL SYSTEM

⚠ CAUTION

Uncontrolled movements of the control system!

Risk of injury.

- Make sure that the SYDFE1 control system is safely mounted!

NOTICE

Damage caused by missing seals and plugs!

Liquids and foreign particles may penetrate and damage the product.

- Before starting the installation make sure that all seals and plugs of connections are tight.

7.4.1 Preparations

1. Check the scope of delivery for completeness and damage in transit.
2. Compare the material number and designation (ordering code) with the details on the order confirmation.

If the material number for the SYDFE1 control system is not identical with that on the order confirmation, contact Rexroth Service for clarification, see chapter 10.5 “Spare parts” on page 75 for address.

3. Before installing the SYDFE1 control system, completely empty it to prevent mixing with the hydraulic fluid used in the system.
4. Check the direction of rotation of the SYDFE1 control system (shown on the nameplate) and make sure that this corresponds to the actual direction of rotation of the motor.

The direction of rotation as specified on the nameplate shows the direction of rotation of the SYDFE1 control system as viewed on the drive shaft. For information on the direction of rotation of the motor, please refer to the motor manufacturer’s operating instructions.

7.4.2 Dimensions of connections

The data sheet contains the dimensions for all connections to the SYDFE1 control system. Also observe the instructions provided by the manufacturers of the other components when selecting the required tools.

7.4.3 General notes

When installing and demounting the SYDFE1 control system, observe the following general notes and instructions for action:

- Mount the SYDFE1 control system so that the expected forces and torques can be transmitted without any risks.
- The permissible axial and radial loading of the drive shaft, the permissible torsional vibration, the optimum direction of load force, as well as the limit speeds can be found in the data sheet.

7.4.4 Installation with coupling

The SYDFE1 control system is usually flange-mounted to a motor with a coupling. If you plan to install the unit otherwise, please consult us.

How to install the SYDFE1 control system with a coupling is described in detail in the following:

1. Mount the relevant coupling half onto the drive shaft of the SYDFE1 control system according to the instructions of the coupling manufacturer.

   The drive shaft end of the SYDFE1 control system is provided with a threaded bore. Use this threaded bore to mount the coupling element on the drive shaft. Refer to the installation drawing for the dimensions of the threaded bore.

2. Make sure that the installation location is clean and free from dirt and foreign particles.
3. Positively clamp the coupling hub on the drive shaft or ensure permanent lubrication of the drive shaft. This prevents the formation of frictional corrosion and associated wear.
4. Transport the SYDFE1 control system to the place of installation.
5. Mount the coupling to the drive in accordance with the instructions of the coupling manufacturer.

   The SYDFE1 control system must not be tightened down before the coupling has been correctly mounted.

6. Fasten the SYDFE1 control system at the place of installation.
7. If necessary, details on the required tools and tightening torques for the mounting screws are available from the machine or system manufacturer.
   - For bell housing mounting, check the coupling axial play through the bell window according to the manufacturer’s instructions.
   - For flange-mounting, align the support of the SYDFE1 control system with the drive.
8. When using flexible couplings, check that the drive is free of resonance after having completed the installation.

7.4.5 Completing the installation

1. Remove transport screws, if fitted.
2. Remove transport protection.
   The axial piston pump of the SYDFE1 control system was delivered with protective covers and plastic plugs or plug screws. These must be removed before the system can be connected. Use appropriate tools for this.
3. Make certain that the sealing and functional surfaces are not damaged.

CAUTION! Risk of injury caused by ejected plastic plugs!

Operating the SYDFE1 control system with plastic plugs can cause injuries or damage to the SYDFE1 control system.

- Before commissioning, remove all plastic plugs and replace them with suitable, pressure-proof metal plug screws, because plastic plugs are not pressure-proof.

Setscrews, if provided, are protected against unauthorized resetting by means of protective caps. Removing protective caps will void the warranty. If you need to modify the setting, please contact the responsible Rexroth Service (for address, see chapter 10.5 “Spare parts“ on page 75).
For the variant with through-drive, mount the auxiliary pump in accordance with the instructions of the pump manufacturer.

7.5 CONNECTING THE SYDFE1 CONTROL SYSTEM HYDRAULICALLY

⚠ WARNING

Uncontrolled system behavior due to interchanged connections!

Risk of injury! Interchanging the connections will lead to malfunction (e.g. lifting instead of lowering) and therefore represents a related hazard.

- When connecting hydraulic components, observe the specified piping according to the hydraulic circuit diagram of the machine or system manufacturer.

NOTICE

Hydraulic pipes and hoses installed under stress!

Hydraulic lines, which are installed under mechanical stress, generate additional forces during operation, which reduces the service life of the SYDFE1 control system and the machine or system as a whole.

- Install pipes and hoses stress-relieved.

NOTICE

Insufficient suction pressure!

Risk of damage! Generally, a minimum permissible suction pressure at port “S” is prescribed for SYDFE1 control systems in all installation positions. If the pressure at port “S” drops below the specified values, damage may occur which can lead to the destruction of the SYDFE1 control system.

- Make sure that the required suction pressure is achieved.
  This is influenced by:
  – appropriate piping of the suction cross-sections
  – appropriate pipe diameters
  – appropriate position of the tank
  – appropriate viscosity of the hydraulic fluid

The machine or system manufacturer is responsible for dimensioning the lines. The SYDFE1 control system must be connected to the rest of the hydraulic system in accordance with the hydraulic circuit diagram of the machine or system manufacturer.

Connect exclusively hydraulic lines to the service and function ports.

- Always ensure absolute cleanliness.
- Install the SYDFE1 control system in a clean condition.
- Make sure that all ports, hydraulic lines and add-on units (e.g. measuring devices) are clean.
- Make sure that no contaminants can enter the system, also while you are closing the ports.

Observe the following notes when routing suction, pressure and case drain lines.

- See to it that the suction line (pipe or flexible hose) is as short and straight as possible.
- The line cross-section of the suction line is to be dimensioned so that the pressure in the suction port does not fall below the minimum permissible value and the maximum permissible pressure is not exceeded.
- Observe air tightness of the junctions and pressure resistance of the hose, also with respect to the atmospheric pressure.
- In conjunction with the pressure lines, make certain that the pipes, hoses and connecting elements are approved for the operating pressure range.
- Always route case drain lines so that the housing is constantly filled with hydraulic fluid and ensure that no air gets through the shaft seal ring even during extended standstill periods. Under no operating conditions may the pressure inside the case exceed the limit values specified for the SYDFE1 control system in the data sheet. The case drain line in the tank must in any case end up below the minimum fluid level (see chapter 7.3 “Installation positions and piping of SYDFE1 systems“, page 43).

The ports and mounting threads are rated for the operating pressures specified in the data sheet. The machine or system manufacturer must ensure that the connecting elements and lines comply with the specified operating conditions (pressure, flow, hydraulic fluid, temperature) with the necessary safety factors.

The pressure port of the SYDFE1 control system of size 71 is provided with threads for two standard flange connection patterns:

SAE 1“ (dot-dashed line) for pressures above 250 bar and

SAE 1 ¼“ (dotted line) for pressures up to 250 bar.

Because standard flanges according to SAE 1 ¼’’ are permitted up to 250 bar only, the porting pattern to SAE 1” must be used in the case of operating pressures higher than 250 bar.

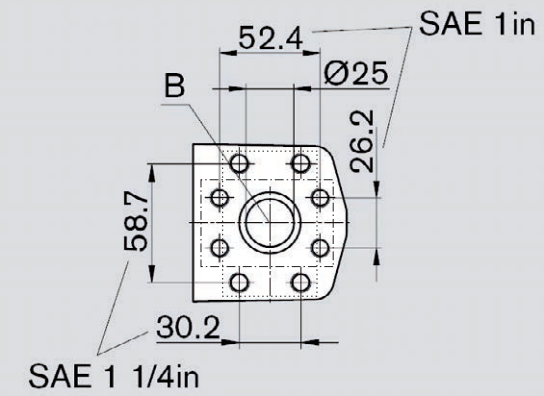


Fig. 21: Flange pattern

Procedure

To connect the SYDFE1 control system to the hydraulic system:

1. Remove the plug screws from the ports that are to be connected according to the hydraulic circuit diagram.
2. Use only clean hydraulic lines.
3. Connect the lines according to the hydraulic circuit diagram.
   Either pipes or hoses must be connected to all ports according to the installation drawing and machine or system circuit diagram or the ports have to be plugged using suitable plug screws.

   The installation drawing contains the dimensions of all connections and ports on the SYDFE1 control system. Also observe the instructions provided by the manufacturers of the other hydraulic components when selecting the required tools.

4. Make sure
   - that the cap nuts are correctly tightened on the fittings and flanges (observe tightening torques!). Mark all checked fittings using e.g. a permanent marker,
   - that the pipes and hose lines and every combination of connecting pieces, couplings or connecting points with hoses or pipes have been inspected by a technically qualified person for their safe working condition.

Tightening torques

The tightening torques for the SYDFE1 control system are listed in the following table:

- Threaded hole in the axial piston unit:
  The maximum permissible tightening torques M_{Gmax} are the maximum values of the threaded holes and must not be exceeded.
- Fittings:
  Observe the manufacturer’s instructions regarding tightening torques for the fittings used.
- Mounting screws:
  For mounting screws according to DIN 13/ISO 68, we recommend checking the tightening torque in each individual case as per VDI 2230.

- Plug screws:
  For the metal plug screws that come with the SYDFE1 control system, the required tightening torques of plug screws M_V apply.

Procedure

SYDFE1 control systems are used in applications with metric as well as with imperial system of units.

Both, the system of units as well as the size of threaded hole and male stud (e.g. plug screw) must match.

Since the systems cannot be distinguished visually, there is a risk of mixing up.

WARNING! Wrong threaded plug!

Risk of serious injury, if a male stud is used that differs from the threaded hole in terms of unit system and size and is pressurized. The male stud may loosen itself or even be ejected from the hole in a projectile-like manner.
Hydraulic fluid can be discharged from this leakage point.

- ▶ Use the drawings (installation drawing/data sheet) to determine the required threaded plug for each fitting.
- ▶ Make certain that there are no mix-ups when assembling valves, mounting screws and plug screws.
- ▶ For all threaded holes, use a male stud from the same system of units and of the correct size.

Table 9: Tightening torques of threaded holes and plug screws

Thread size of ports		**Max. permissible tightening torque of threaded holes M_{Gmax}**	**Required tightening torques for plug screws M_V**	**A/F hexagon socket**
M10x1	DIN 3852	30 Nm	12 Nm	5 mm
M12x1.5	DIN 3852	50 Nm	25 Nm	6 mm
M14x1.5	DIN 3852	80 Nm	35 Nm	6 mm
M16x1.5	DIN 3852	100 Nm	50 Nm	8 mm
M18x1.5	DIN 3852	140 Nm	60 Nm	8 mm
M22x1.5	DIN 3852	210 Nm	80 Nm	10 mm
M26x1.5	DIN 3852	230 Nm	120 Nm	12 mm
M27x2	DIN 3852	330 Nm	135 Nm	12 mm
M33x2	DIN 3852	540 Nm	225 Nm	17 mm
M42x2	DIN 3852	720 Nm	360 Nm	22 mm
5/16-24 UNF-2B	ISO 11926	10 nm	7 Nm	1/8 in
3/8-24 UNF-2B	ISO 11926	20 Nm	7 Nm	5/32 in
7/16-20 UNF-2B	ISO 11926	40 Nm	15 Nm	3/16 in
9/16-18 UNF-2B	ISO 11926	80 Nm	25 Nm	1/4 in
3/4-16 UNF-2B	ISO 11926	160 Nm	62 Nm	5/16 in
7/8-14 UNF-2B	ISO 11926	240 Nm	127 Nm	3/8 in
1 1/16-12 UN-2B	ISO 11926	360 Nm	147 Nm	9/16 in
1 5/16-12 UN-2B	ISO 11926	540 Nm	198 Nm	5/8 in
1 5/8-12 UN-2B	ISO 11926	960 Nm	320 Nm	3/4 in
1 7/8-12 UN-2B	ISO 11926	1200 Nm	390 Nm	3/4 in

For the tightening torques for spare parts, please refer to the data sheet.

7.6 CONNECTING THE SYDFE1 CONTROL SYSTEM ELECTRICALLY

The machine or system manufacturer is responsible for setting up the electrical control.

With electrically controlled SYDFE1 control systems, the electrical control must be connected according to the circuit diagram of the machine or system manufacturer.

The VT 5041-3X control electronics is connected using a 32-pin female multipoint connector and can be installed in a Euro rack or in a card holder from Rexroth (VT3002 according to RE 29928).

CAUTION! Live installation!

Risk of injury when plugging or unplugging connectors under voltage.

- Before carrying out any installation work or plugging or unplugging connectors from the product, disconnect the device from the power supply or the voltage source or de-energize it reliably. Damage to the control system caused by incorrect installation is not covered by the warranty!

1. Disconnect the relevant system part from the power supply.
2. Connect the SYDFE1 control system electrically (24 V).

7.6.1 Cabling of electronic components

Generally, the following is valid:

- Use low-capacitance cables according to the safety regulations of the German VDE or national electrical safety regulations of your country. Whenever possible, establish the cable connections without intermediate terminals!
- Select only cables that have the actually required number of wires (avoid superfluous wires).
- The installation of electromagnetic sources of interference, e.g. unearthed contactors, in the direct vicinity of the pilot valve is not permitted.
- Installing power cables in the vicinity of the control electronics is not permitted.
- No switches or relay contacts may be installed in the electrical connections between the pump/proportional valve and control electronics, because breaking of a connection results in fault messages or malfunctions. Whenever possible, do without intermediate terminal points or reduce their number to a minimum.
- Cables of inductive position transducers, swivel angle sensors and of the pressure transducer must be shielded. Connect the shield only on one side to the control electronics (see Fig. 22). Never connect the shield to the valve, pump or pressure transducer.

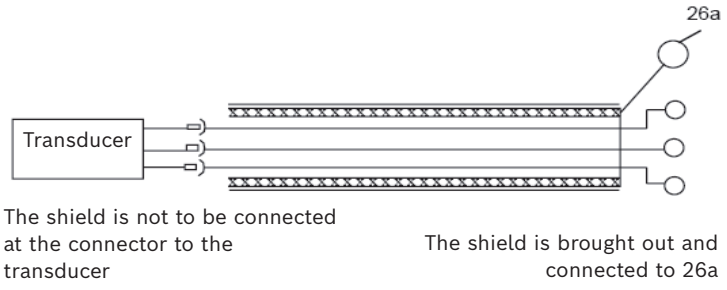


Fig. 22: Connection of the cable shield

Because it is practically almost impossible to connect all shields directly to 26a, the shields of all relevant cables should be brought into contact with a busbar and then the busbar connected to 26a. When selecting this connection variant, see to it that the connected surfaces of the shields are as large as possible.

Install the busbar directly next to the card. The shielded cables have to be routed from the sensor to this busbar without interruption of the shield.

7.6.2 Voltage supply of control electronics VT 5041-3X

Control electronics VT 5041-3X must be supplied with 24 V DC voltage. If this voltage supply cannot be provided by the machine, use a power supply unit VT 19 085 (NE32) according to data sheet RE 29929. In this case, the +24 V of the power supply unit is to be connected to contact 30a of the female connector, and 0 V to contact 28a (recommended cross-section of the supply cable min. 1.5 mm^2).

Recommendation:

The voltage supply for control electronics VT 5041-3X should be protected on the machine side with a 1.6 A/slow-blowing fuse.

7.6.3 Selection, place of installation and mounting orientation of the pressure transducer

Selection of the pressure transducers

To reduce the number of variants, only pressure rating “315 bar” is given in the ordering code of the SYDFE1 control systems. If required, other pressure ratings can be combined (with the correct selection of the relevant electrical interface!). Such pressure transducers for the SYDFE1 control system must, however, be ordered separately.

In terms of signals, the sensors have to be distinguished as follows:

- Sensors with current interface
- Sensors with voltage interface

Here, the usual signal limits are between 0...20 mA or 0...10 V, respectively.

Within these limits, there are further modifications that depend on required options such as monitoring for cable break.

From a technical point of view, the efficiency of the pressure transducer must be adapted to the SYDFE1 system in order that the best possible results can be obtained with regard to accuracy, dynamics and repeatability.

The pressure transducers recommended by us are listed in the RE data sheets of the relevant SYDFE1 system.

- Our pressure transducer model “HM20...C...“ with current interface (4...20 mA) is provided with a 2-conductor connection and allows the fail-safe transmission of signals – even over greater distances. Further pick-offs can be looped in taking into account the relevant input resistances.
- Our pressure transducer model “HM20...H...“ with voltage interface (0.1...10 V) has a 3-conductor connection and an integrated DC/DC converter, which effectively rules out disturbances on the analog signal caused by the voltage supply.

CAUTION! Uncontrolled increase in pressure!

Risk of injury!

▶ The pressure transducer must be wired so that it cannot be short-circuited, because in the event of a missing pressure signal, the control electronics can no longer detect the pressure, which causes an uncontrolled increase in pressure.

Observe the operating instructions of the pressure transducer HM20, RE 30272-B.

Place of installation of the pressure transducer

Favorable places of installation of pressure transducers turned out to be not in the direct vicinity of the pump, but, for example, downstream of the (flexible) pressure hose:

- Always between pump and check valve (if fitted)
- Do not use minimess lines

Mounting orientation of the pressure transducer

We recommend suspended mounting of the pressure transducer so that bleeding problems (and hence control oscillations) can be ruled out right from the start.

If, due to the installation orientation of the pump, a pressure transducer must be installed “vertically” directly in the pump or in the pre-load valve, we recommend another place of installation for the pressure transducer.

Pressure transducer HM20...C...

Pressure transducers of type HM20...C... are provided with a 2-wire current interface and can be connected to control electronics VT 5041-3X as shown below.

The voltage supply for the pressure transducer must be provided in accordance with the data sheet.

For more detailed information about the pressure transducer HM20...C..., see data sheet RE 20272.

Recommended cable type: LiYCY 2 x 0.25 mm²

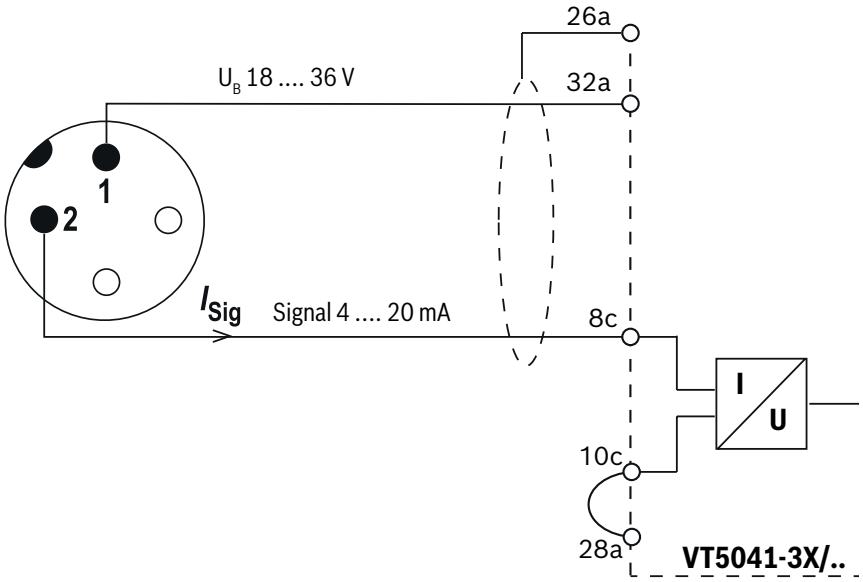


Fig. 23: Connection pattern for pressure transducer HM20...C...

Pressure transducer HM20...H...

Pressure transducers of type HM20...H... are provided with a voltage output of 0.1...+10 V as actual pressure value signal and can be connected to control electronics VT 5041-3X as shown on the figure below.

The voltage supply for the pressure transducer must be provided in accordance with the data sheet.

For more detailed information about the pressure transducer HM20...H..., see data sheet RE 30272.

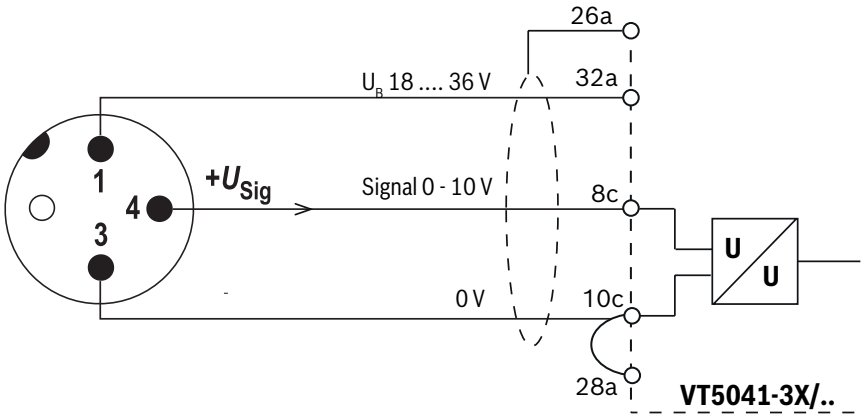


Fig. 24: Connection pattern for pressure transducer HM20...H...

7.6.4 Connecting the valve position transducer

Basically, the pinout of the VT 5041-3X has remained unchanged compared with version VT 5041-2X, i.e. control electronics VT 5041-3X can sense the position transducer signal according to the specification of the VT 5041-2X without requiring a different sensor cable.

Make certain that jumper J8 is set on control electronics VT 5041-3X.

VT5041-2X...

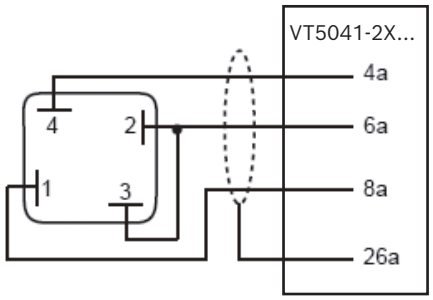


Fig. 25: Connection pattern of the valve position transducer in conjunction with VT5041-2X... (old systems)

The following is valid for all new systems:

In the case of cable lengths up to 50 m the connection can be established using a standard cable. Make certain that jumper J8 is set on control electronics VT 5041-3X.

Recommended cable type: LiYCY 5 x 0.25 mm²

VT5041-3X...

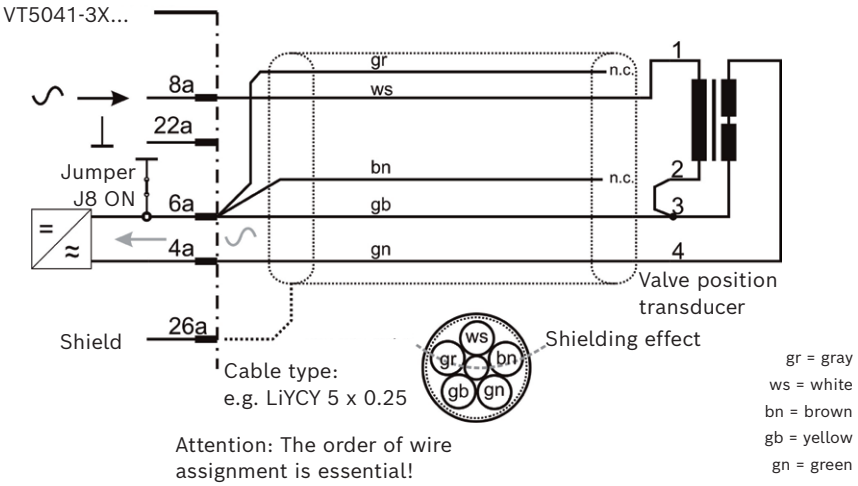


Fig. 26: Cabling for cable lengths up to 50 m

If distances of 50 m or greater must be covered, we recommend that twisted pair cables be installed. In this case, jumper J8 must not be set on control electronics VT 5041-3X.

Recommended cable type: LiYCY(TP) 2 x 2 x 0.25 mm²

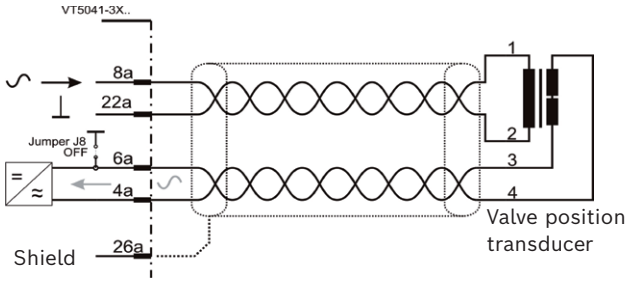


Fig. 27: Cabling in case of cable lengths of more than 50 m or twisted-pair cable

7.6.5 Connecting the swivel angle sensor

Recommended cable type: LiYCY 3 x 0.25 mm²:

If control electronics VT 5041-3X is used in a system as substitute for control electronics VT 5041-2X, it must in any case be checked in advance that there is no connection between pin 12a and 26a. Moreover, connection 12a of control electronics VT 5041-3X must not be connected to a further connection!

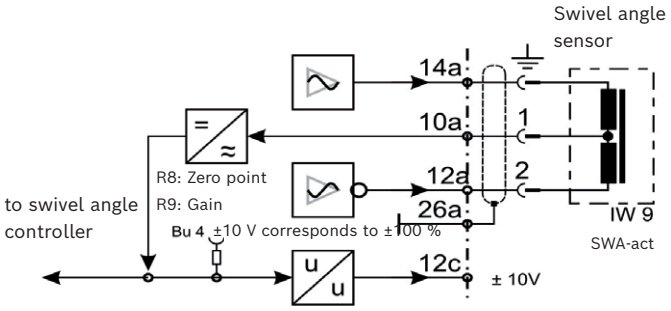


Fig. 28: Connection for swivel angle sensor

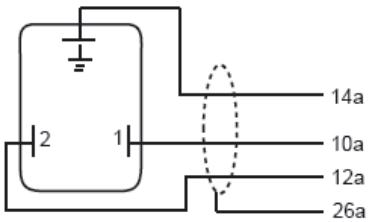


Fig. 29: Connection for clockwise rotating pump

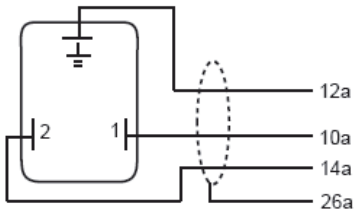


Fig. 30: Connection for counter-clockwise rotating pump

7.6.6 Connecting the solenoid of the proportional valve

▶ Install the solenoid cable separately from other cables, in particular the cables of inductive position transducers. It is recommended that the solenoid cable be shielded.

Recommended cable type: LiYCY 1.5 mm² for up to 50 m length; in the case of longer cable routes, use a greater cable cross-section!

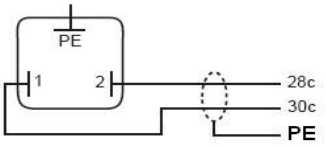


Fig. 31: Connection of the proportional valve solenoid

Attention: Connect shield to PE or ground; **not to 26a**!!

7.6.7 Command values for pressure, swivel angle and power limitation

General notes:

- The command values for pressure and swivel angle are provided as analog variables within the voltage range of 0...+10 V; this corresponds to 0...+100 % of the physical range of values.
- Command values may only be passed on using appropriate contacts that are suitable for currents <1 mA.
- The use of shielded cables is recommended (connect shield of the signal cable to 26a).

Command value for power limitation

- The value for power limitation can either be provided internally by means of potentiometer R3 or externally with a voltage level of 0...10 V.
- If the power limit value is to be provided externally, jumper J2 must always be set in position 2-3 and potentiometer R3 (front side) must be turned to the left-hand positive stop.
- If the external input is not used, connections 20c and 18c must always be connected to 22a (M0).

8 Commissioning

⚠ WARNING

Working in the danger zone of a machine or system!

Risk of severe injury due to unsafe working.

- The machine or system may only be commissioned when safe working is ensured.
- Pay attention to and eliminate potential danger sources before commissioning the machine or system.
- Nobody may stand in the danger zone of the machine or system.
- The emergency stop button for the machine or system must be within the operator's reach.
- Always strictly observe the instructions of the machine or system manufacturer during commissioning.

Uncontrolled system behavior!

Non-connected electrical and hydraulic connections can cause malfunctions and hydraulic fluid jets to be ejected, which can injure you.

- Only commission a completely installed product.

NOTICE

Loss of protection class due to missing seals and plugs!

Liquids and foreign particles may penetrate and damage the product.

- Before commissioning, make sure that all seals and plugs of plug-in connections are tight.

Ingress of dirt!

Damage to the SYDFE1 control system! Contamination of the hydraulic fluid results in wear and malfunction. In particular foreign bodes such as welding beads and metal chips in the hydraulic lines can damage the SYDFE1 control system.

- Observe utmost cleanliness during commissioning.
- When closing measuring ports, make sure that no contamination can enter.

Insufficient hydraulic fluid!

Insufficient amounts of hydraulic fluid can lead to destruction of the product.

- Make certain that the case of the SYDFE1 control system is filled with hydraulic fluid during commissioning and in operation. This must also be observed during longer periods of standstill as the SYDFE1 control system may empty empty via the hydraulic lines.

8.1 INITIAL COMMISSIONING

NOTICE

Air pockets around the bearings!

The device can be destroyed.

- Make certain that with installation orientation “drive shaft up” the pump housing is completely filled with hydraulic fluid during commissioning and in operation.
- Check the hydraulic fluid level in the pump case at regular intervals. If required, carry out recommissioning. For tank-top installation, the case chamber can run dry through the case drain line (ingress of air via the shaft seal ring) or via the working line (gap losses). The bearings are thus insufficiently lubricated when the pump is restarted.
- Ensure that the suction line is always filled with hydraulic fluid during commissioning and operation.

- Let the product acclimate itself for several hours before commissioning, otherwise water may condense in the housing.

When carrying out any work in conjunction with commissioning of the SYDFE1 control system, observe the basic safety instructions and intended use provided in chapter 2 “Safety instructions“ on page 9.

8.1.1 Filling the SYDFE1 control system

NOTICE

Spilled hydraulic fluid!

Discharging or spilling hydraulic fluid while filling the SYDFE1 control system can lead to environmental pollution and contamination of the groundwater.

- When filling and changing the hydraulic fluid, always place a catch pan under the SYDFE1 control system.
- Observe the information in the safety data sheet for the hydraulic fluid and the instructions provided by the system manufacturer.

You will require an approved hydraulic fluid:

The machine or system manufacturer can provide you with precise data of the hydraulic fluid. Details on minimum requirements for mineral-oil-based hydraulic fluids are available in the Rexroth publication RE 90220.

To ensure functional reliability of the SYDFE1 control system, the hydraulic fluid must comply at least with cleanliness class 18/16/13 according to ISO 4406 for particle sizes 4/6/14 µm. For permissible temperatures, see chapter 5.7 “Notes on the selection of hydraulic fluids on page 27.

The SYDFE1 control system should be filled using a filling and filtration unit (10 µm filtration rating). The control system must not be powered when being filled.

1. Fill and air-bleed the SYDFE1 control system via the appropriate ports, see chapter 7.3 “Installation positions and piping of SYDFE1 systems” on page 43. The hydraulic lines of the system must also be filled.
2. Test the direction of rotation of the drive motor. To do this, rotate the motor briefly at the lowest rotational speed (inching). Make sure that the direction of rotation of the SYDFE1 control system corresponds to the indication on the nameplate, see also chapter 5.13 “Product identification”, Fig. 15 “Nameplate“ on page 38.
3. Operate the SYDFE1 control system at low speed (jog mode) until the pump system is completely filled and bled. For checking purposes, drain the hydraulic fluid at the case drain port and wait until fluid flows out without any bubbles.
4. Make certain that all ports are either connected to pipes or plugged according to the general circuit diagram.

8.1.2 Testing the hydraulic fluid supply

The SYDFE 1 control system must always be supplied with sufficient hydraulic fluid. For this reason, the supply of hydraulic fluid must be ensured at the start of the commissioning process.

When you test the hydraulic fluid supply, constantly monitor the noise generation and check the hydraulic fluid level in the tank. If the SYDFE1 control system becomes louder (cavitation) or the case drain fluid flows out with bubbles, this is an indication that the SYDFE1 control system is not sufficiently supplied with hydraulic fluid.

Notes on troubleshooting can be found in chapter 15, “Troubleshooting“ on page 80.

To test the hydraulic fluid supply:

1. Allow the drive motor to run at lowest speed. The SYDFE1 control system must be operated under no-load conditions. Pay attention to leakage and noise.
2. Check the SYDFE1 control system’s case drain line while testing. The case drain fluid should not contain any bubbles.
3. Check the suction pressure at port “**S**” of the SYDFE1 control system pump. For the permissible value, please refer to data sheet RE 92050.
4. Check the case drain pressure at connected port “$\mathbf{K}_1$“ or “$\mathbf{K}_2$“. For the permissible value, refer to data sheets RE 30030 and RE 30630, respectively.

8.1.3 Performing a flushing cycle

To remove foreign particles from the system, perform a flushing run for the entire system.

Flushing is to be carried out with a separate flushing unit. Observe the instructions of the flushing unit manufacturer for the detailed procedure for carrying out flushing.

8.1.4 Configuring switches and jumpers of the VT 5041-3X

Before commissioning you have to configure the switches and jumpers of control electronics VT 5041-3X for the application at hand. A layout that shows the position of setting elements can be found in chapter 17.3 on page 92.

Signal adjustment of the actual pressure value (S2)

The signal range of the connected pressure transducer has to be matched with the signal adjustment of the VT 5041-3X. To this end, switch S2 needs to be configured.

The table below shows the factory setting for a transducer with the level 0...+10 V.

Table 10: Signal adjustment of the actual pressure value

Signal adjustment of actual pressure value		Switch S2							
		.1	.2	.3	.4	.5	.6	.7	.8
V	0 - 10 V	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON
I	0 - 10 V	OFF	OFF	OFF	OFF	ON	OFF	OFF	ON
D	0 - 5 V	OFF	OFF	ON	ON	OFF	OFF	ON	ON
F	0.5 - 0 V	OFF	OFF	ON	ON	ON	OFF	OFF	ON
B	0 - 20 mA	ON	ON	OFF	OFF	OFF	OFF	ON	ON
C	4 - 20 mA	ON	ON	OFF	OFF	ON	ON	OFF	OFF

V = factory setting

Leakage compensation (J6, J7)

Case drain compensation is used for compensating for leakage of the pump and can be set to the following values by means of jumpers J6 and J7 on control electronics VT 5041-3X.

Table 11: Adjustment of case drain compensation

Case drain compensation	Jumper	
	J6	J7
OFF	OFF	OFF
4 %	OFF	ON
6 %	ON	OFF
10 %	ON	ON

Factory setting: Case drain compensation OFF.

The swivel angle is increased in dependence upon the normalized actual pressure value. Example: With a case drain compensation of 10 % and an actual pressure value setting of 315 bar, the swivel angle increases by 8.9 % at 280 bar.

The simultaneous use of power limitation and case drain compensation can lead to vibrations.

At a pressure of 280 bar, pumps of control system SYDFE1 show a leakage rate of about 8 %. On this basis, the following settings are recommended:

Table 12: Settings of actual pressure value normalization

Normalization of actual pressure value	Setting of J6/J7
≤ 200 bar	4 %
ca. 250 bar	6 %
≥ 315 bar	10 %

Monitoring of valve command value (J9)

Control electronics VT 5041-3X includes a monitoring function that evaluates the control error. Usually, the system reduces the control deviation to almost zero within a few 100 msec. In the event of a fault, the correction takes, however, longer in most of the cases.

The monitoring feature continuously checks the valve command value (= control deviation x controller gain; test jack 5) and signals an error as soon as the amount exceeds the value of 4 V for longer than 1 second.

To be still compatible with control electronics of series 2X in terms of function, this monitoring feature can be deactivated by means of a jumper (J9).

Table 13: Activation/deactivation of valve command value monitoring

Valve command value monitoring	Jumper J9
ON	ON
OFF	OFF

Factory setting: Valve command value monitoring deactivated, J9: OFF

Depending on the command and actual values, the monitoring feature may cut in while the drive motor is switched off. This can take place, if the command values for pressure and/or swivel angle are not matched to the current actual values for pressure and swivel angle and the consequence is a valve command value of > 4 V (amount!). The valve command value can be measured at test jack 5 of the control electronics.

Valve shutdown in the event of a fault (J1)

The safety concept of control electronics V T5041-3X is designed so that the detection of a fault is signaled by the fault signal outputs and, at the same time, the activation of the pilot valve is interrupted. This ensures that the pilot valve takes a defined position and the pump with **internal pilot supply** swivels to the zero stroke position.

With control electronics VT 5041-3X, the shutdown of the valve output stage can be prevented by means of a jumper. To this end, jumper J1 must be set.

Table 14: Activation/deactivation of valve shutdown

Valve shutdown in the event of a fault	Jumper J1
Active	OFF
Inactive	ON

Factory setting: Valve shutdown active; J1 not set

Attention:
When the fault-triggered shutdown of the valve output stage is deactivated, the higher-level control must take appropriate measures (disabling of VT 5041-3X, pump motor OFF...) in the case of faults to ensure safety for man and machine.

Function of pressure controller OFF or master/ slave (J4)

This function is available only on the variant without power limitation (VT 5041-3X/1... and VT 5041-3X/2...)!

Pressure controller OFF

On the VT 5041-3X variant “without power limitation”, connection 18a is provided as switching input.

By applying +24 V to this input, the pressure controller of the control electronics can be switched off. In this way, the function of the DFE control is reduced to that of an FE control. To this end, it is not required to connect the pressure command value and the actual pressure value to the control electronics.

This function can also be used by the higher-level control to deliberately deactivate the pressure controller of the VT 5041-3X for certain time intervals within a machine cycle.

Master/slave function

When the switching input is connected to 18a and the pressure controller is deactivated, jumper J4 can be used additionally to re-connect the swivel angle command value input from inputs 14c (+) and 16c (-) to connections 18c (+) and 20c (-).

This reduces the wiring effort for a master/slave circuit (see chapter 5.12 “Master/slave operation“ on page 34. The master/slave function can be deactivated at any time during operation.

Activation/deactivation of pressure controller OFF and master/slave function

Function PLC-in pin 18a	Jumper J4
Pressure control ON/OFF	OFF
Master/slave ON/OFF	ON

Factory setting: J4 not set

Attention:
The function of pressure limitation is no longer effective when the pressure controller is deactivated!

Utilization of the analog input at 18c/20c (J2)

Depending on the variant, the analog input with connections 18c(+) and 20c(-) is used for different purposes.

Version without power limitation (VT 5041-3X/1... or VT 5041-3X/2...)

For the master/slave operating mode, the actual swivel angle value of the master can be read in at this input. When the “slave” operating mode is activated (by means of switching input 18a) the input is automatically connected to the swivel angle controller, and the pressure controller is deactivated. The pump is then operated exclusively under closed-loop swivel angle control.

Version with power limitation (VT 5041-3X/3...)

With the variant of the VT 5041-3X with power limitation, the analog value is taken as power command value. For further notes on power limitation, please read chapter 5.11.9 “Power limitation (VT 5041-3X/3... only)“ on page 33.

Jumper (J8)

If control electronics VT 5041-3X is installed as replacement for VT 5041-2X in an existing system, jumper (J8) must always be set.

For new systems, the jumper must be configured depending on the type of wiring. More details can be found in chapter 7.6.4 “Connecting the valve position transducer“ on page 55.

Gain of pressure controller (J11)

This setting option is provided for reason of compatibility with control electronics VT 5041-2X. If control electronics VT 5041-3X is to be used as substitute for VT 5041-2X, it is possible to select the same gain as with the control electronics of series 2X.

Jumper J11 assumes the same function on both control electronics (series 2X and 3X).

Together with switches S3.7 and S3.8 these jumpers can be used to change the gain of the pressure controller. More details are explained in chapter 8 “Commissioning“ on page 59.

Factory setting: J11 set

Reference for actual position value signal (J16)

The jumper must not be set irrespective of the application at hand and for reason of compatibility with control electronics VT 5041-2X.

Jumper J16 can be used to connect the 0-V reference for the actual pressure value signal to 10c (= reduced wiring effort).

Attention: If 0 V is externally connected to 10c by means of a jumper, J16 must not be set.

8.1.5 Switching on the supply voltage for the control electronics

- Before switching the supply voltage on, thoroughly re-check all cable connections (including any intermediate terminals, if provided).

Measurements at the front-sided test jacks or at the rear male or female multi-point connector may only be taken with instruments having an internal resistance of Ri > 100 kOhm.
The controller card may only be plugged or withdrawn when disconnected from the power supply.

The switch-on sequence of electronics/hydraulics is described in chapter 5.12.1 “Activation sequence of electronics/hydraulics“ on page 37.

For this, the drive motor of the pump must be switched off. For initial commissioning, the following proceeding is recommended:

- Switch on voltage supply

  The green LED “Ub“ signals that the voltage supply is active

- Activate enable

  The green LED “En.“ signals that the enable is applied

  The red LED “Err.“ (fault) must not be ON

If this state is not reached, a fault must have occurred.

Possible faults:

The green LED “Ub“ is OFF

- Check the supply voltage
- Check fuse F1

The red LED “Err.“ (fault) is ON

- The enable contact must be made, i.e. “En.“ is ON
- Measure the actual pressure value at test jack 2 (must be ca. 0 V)

In the case of a negative voltage of less than ca. -1 V or voltages greater than ca. +12 V a fault message is output.

- Check the signal path to the pressure transducer.

The signal range of the pressure transducer must correspond to the configuration of switch S2! (Current, voltage, zero point).

- The swivel angle indicator shows ca. 100 %, and a voltage of ca. 8...10.5 V must be measurable at test jack 4. (The pump, which is at rest, is mechanically fully swiveled out by the spring in the counter-piston).
- If the swivel angle indicator shows “minus 100“ or ca. -10 V is measured at test jack 4, inspect the cabling of the swivel angle transducer.
- When monitoring of the control error was activated (J9 ON), check the valve command value at socket 5. Should the valve command value exceed an amount of 4 V, the command values must be adjusted or J9 set to “OFF” for trial and testing.
- If none of the points above applies, check the connection of the valve position transducer and the solenoid.

- The voltage symmetry of the high-response valve's internal voltage may be outside the limit value. You can check the voltage at connections 24a (+15 V) and 20a (-15 V).

After having detected the fault:

- ▶ Switch off supply voltage
- ▶ Eliminate fault
- ▶ Switch on supply voltage and grant enable

Check connection of command values for pressure and swivel angle

- ▶ Provide command values for (e.g. +1.5 V) and swivel angle (e.g. +2.5 V).
- ▶ At test jack 1, +1.5 V have to be present, at test jack 3, +2.5 V. If not, inspect the cabling of the command value source.

Check the zero point of the pressure transducer

When adjusting the zero point, always see to it that the hydraulic system is depressurized at the place of measurement of the pressure transducer!

- ▶ Check the voltage at test jack 2: 0 V ±50 mV
- ▶ If required, calibrate using potentiometer R1 (at the front)

8.1.6 Switching on the drive motor of the pump

1. Close all directional valves.

2. Before switching the motor on, apply the following command values to control electronics VT 5041-3X:

Pressure command value (p_{comm}) = 1.0 V ≙ 31.5 bar

Flow command value (SWA_{comm}) = 2.0 V ≙ 20 %

These values are valid when you use our standard pressure transducer with a measuring range of 0...315 bar.

In this state, the control electronics VT 5041-3X signals a "fault" (excessive control deviation). When the electronics works properly, the error message disappears when the motor is switched on (control error now equal to zero).

- ▶ Before further commissioning, let the hydraulic oil warm up to operating temperature.
- ▶ For initial commissioning, limit the pressure to max. 50 bar.

8.1.7 Checking and correcting the valve zero point

- ▶ All directional valves must be closed, no oil flow permitted!
- ▶ Provide a swivel angle command value of ≥ 5 V (test jack 3 ≥ +5 V)
- ▶ Set an operating pressure of ca. 100 bar by increasing the pressure command value (read off from the pressure gauge)
- ▶ The correct setting of the valve zero point can be measured between test jacks 1 and 2. At an operating pressure of 100 bar, a voltage value of 0 V ±0.05 V must be measurable at test jacks 1 and 2.
  If the control error is greater (caused by, for example, differing cable lengths), correct the value by adjusting potentiometer R6 at the front panel.
  Adjust R6 so that a voltage of 0 V is measured between test jacks 1 and 2.

8.1.8 Bleeding the pre-load valve

⚠ WARNING

Case interior under high pressure!

Risk of injury! Loosening the screw too far can cause parts and jets of hydraulic fluid to be ejected.

▶ Do not turn the bleed screw out too far (max. 2 turns)!

If a pump unit is operated with a pre-load valve, this valve has to be air-bled for the initial start-up, provided that the pump does not deliver and aspire oil. Bleeding is not required, when the pump displaces oil. Bleed the pump while the system is running at low operating pressure. To this end, loosen the screw (see Figure below) by a maximum of 2 turns and wait until bubble-free oil flows out. Then, re-tighten the screw.

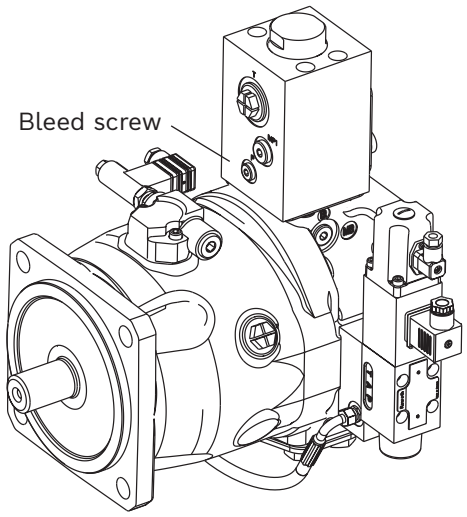


Fig. 32: Bleeding the pre-load valve

8.1.9 Adjusting the operating pressure

The operating pressure is the pressure level that the pump system is to generate as maximum value in the system. The control electronics converts the signal level of the pressure transducer connected to the pump system into the normalized level of 0...10 V and passes this actual pressure value on to the pressure controller. The converted actual pressure value can be measured at test jack 2.

Depending on the signal output of the pressure transducer, the signal adjustment (switch S2) of the control electronics must be preset.

The factory setting of signal adjustment is configured to the signal range of 0...+10 V.

Some examples:

- 4...20 mA is converted into 0...10 V
- 1...10 V is converted into 0...10 V

The pressure controller of the VT 5041-3X compares the level at the command value input (0...10 V; test jack 1) with the converted actual pressure value (0...10 V; test jack 2).

If the measuring range of the pressure transducer does not correspond to the operating pressure, it is not the operating pressure value that is used for

controlling when the maximum pressure value is provided as command value (+10 V), but the final value of the pressure transducer's measuring range.

Two options are provided for adjustment:

- Pressure command value adjustment
- Actual pressure value adjustment

Pressure command value adjustment

With pressure command value adjustment, the pressure command value is normalized to the measuring range of the pressure transducer and fed forward accordingly.

With this method, no adjustments need to be made on control electronics VT 5041-3X.

Example:

Measuring range of standard pressure transducer:	0... 315 bar
Selected operating pressure:	250 bar

The following is valid for the pressure command value provision: 10 V/315 bar = 31.7 mV/bar (= factor)

250 bar x 31.7 mV/bar = 7.94 V

i.e. the pressure command value is normalized to the factor of 31.7 mV/bar; in order to provide the operating pressure as pressure command value, a pressure command value of 7.94 V has to be generated.

General formula:

Factor: 10 V/measuring range of PT (Pressure transducer)

Pressure command value [bar]: Pressure x factor = pressure command value [V]

Actual pressure value adjustment

In the case of actual pressure value adjustment, the actual pressure value is normalized to the operating pressure.

With the factory setting, the control electronics VT 5041-3X.. converts the signal of the pressure transducer internally into the range of 0...+10 V.

To change the signal range (= gain) of the actual pressure value, use potentiometer R2 (front panel) of control electronics VT 5041-3X.

Proceeding while the system is running:

1. Close all directional valves. No oil flow permitted!
2. Provide a swivel angle command value of >+5 V (test jack 3 = +5 V)
3. Set the pressure command value to 5 V (= half operating pressure)
4. Then turn potentiometer R2 until the pressure gauge that measures the pump pressure indicates half the operating pressure.
   - For checking purposes: The provision of a command value of +10 V must result in the full operating pressure (± 3 bar).

8.1.10 Pressure control

Adjustment to the connected oil volume

The oil volume between the consumer and the pump has a decisive influence on the control dynamics of the pressure control loop. Switches S3.1 to S3.3 can be used to adjust the controller to the connected oil volume; whereas when switching input "Switch Td" (22c) is activated, switches S3.4 to S3.6 become active.

With the factory setting, switches S3.1 to 3.6 are in the OFF position

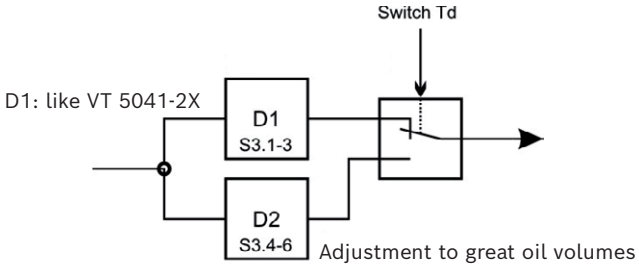


Fig. 33: Adjustment to the connected oil volume

When compared with the predecessor control electronics VT 5041-2X, the function "Switch T_d" with an additional volume adjustment option was newly added.

When substituting control electronics VT 5041-2X with the VT 5041-3X match jumpers J3 to J5 with switches S3.1 to S3.3.

The changeover via switching input "Switch T_d" is also possible while the SYDFE1 control system is running.

Table 15: Volume adjustment

Volume adjustment of pressure controller td = OFF	**Switch S3**		
	.1	**.2**	**.3**
≤ 5.0	OFF	OFF	OFF
7.5	OFF	ON	OFF
10	ON	ON	OFF
15	ON	OFF	ON
20	OFF	ON	ON
25	ON	ON	ON

Pressure controller td = ON	**Switch S3**		
	.4	**.5**	**.6**
12.5	OFF	OFF	OFF
30	OFF	ON	OFF
45	ON	ON	OFF
60	ON	OFF	ON
75	OFF	ON	ON
90	ON	ON	ON

Gain of the pressure controller

Under normal conditions, it is not required to change the P-component of the pressure controller. However, if you hear a rough pump noise within the upper pressure range, you can reduce the gain of the pressure controller.

Table 16: Reduction of P-gain

P-gain of pressure controller	**Switch S3**		
	.7	**.8**	**J11**
8.0	OFF	OFF	OFF
4.8	ON	OFF	OFF
4	OFF	OFF	ON
3	OFF	ON	ON
2.4	ON	OFF	ON
2	ON	ON	ON

With the factory setting, switches S3.7 and 3.8 are in position OFF; jumper 11 is set (ON)

8.1.11 Checking swivel angle sensing

Check swivel angle "zero"

- The directional valve(s) must be closed
- Provide a swivel angle command value of ≥5 V
- Feed forward pressure command value 20 bar
  (Following the example on page 68 (31.7 mV/bar), apply a pressure command value of 0.634 V)

  The resulting pressure must be 20 bar (±3 bar)

- Check, whether a voltage of 0 V ±0.1 V can be measured at test jack 4
- Correct any deviations by means of potentiometer R8 (front panel)

Setting swivel angle "100 %"

The maximum swivel angle of the pump can be adjusted in two different ways.

Adjustment while the system is running:

1. Apply a swivel angle command value >10 V, pressure command value 5 V
2. Direct the full flow via the consumer or flowmeter: e.g. activate hydraulic motor or set pressure relief valve to ca. 20 bar
3. Adjust potentiometer R9 so that a voltage of +10.0 +0.01 V can be measured at test jack 4.

Adjustment while the drive motor is switched off:

1. Switch the hydraulic system off and wait for ca. 5 min until the pump has swiveled out mechanically (wait until pressure reduction is completed). You can also observe the actual swivel angle value (test jack 4) and wait until the actual swivel angle increases to a value below the maximum value and then remains constant.
2. Measure the actual swivel angle value and set it to +10 V +0.01 V (corresponds to maximum stroke) by means of potentiometer R9.
3. In some cases, the pump will not swivel to the limit stop (maximum value). For this reason, briefly switch the motor on, then switch off again, wait until the pump has swiveled out and then measure the actual swivel angle value. If a higher voltage is measured, correct the value. Repeat this procedure several times.

8.1.12 Adjusting the power limitation (with VT-5041-3-3X/... only)

By means of power limitation you can determine the maximum power consumption of the pump in order not to overload the drive motor.

Set constant power limitation by means of potentiometer R3

The calculated power limit can be adjusted by means of potentiometer R3 (front panel) and measured directly at test jack 8 (front panel). The value range of 0...+10 V corresponds to a calculated power of 0...+100 %. The adjustment at the test jacks can also be made while the hydraulics is switched off. Switching output 18a or the LED lamp on the front panel becomes High, when the actual swivel angle value (flow) and the actual pressure value are sufficiently high so that the power limitation responds. When the hydraulics is switched off or shut off, switching output 18a is not active.

Factory setting for R3: 10 V = 100 % (right-hand positive stop)

External input of performance limit

- Check that jumper J2 is set in position 2-3
- Turn potentiometer R3 (front panel) to the left-hand positive stop (factory setting is right-hand positive stop ≙ +100 % power limit)

- By applying a voltage within the range of 0...+10 V to terminals 18c(+) and 20c(-) a power limit of between 0 % and 100 % can be set. The selected value can be checked at test jack 8 (front panel).

Example Calculation of the rated pump power

Motor power P_M = 15 kW

Speed n = 1500 min^{-1}

Displacement V_G = 100 cm^3 (pump size)

Maximum pressure $p_{max.}$ = 315 bar

Efficiency η_{mh} = 1 (theoretical value)

Maximum pressure = pressure [bar], at which the actual pressure value output of the control electronics VT 5041-3X outputs a value of +10 V at test jack 2 (= actual pressure value).

$$P_{100\%} = \frac{V_G\ [cm^3] \cdot n\ [min^{-1}] \cdot p_{max}\ [bar]}{600{,}000 \cdot \eta_{mh}}\ [kW]$$

$P_{100\%}$ = 78.75 kW

Calculation of the ratio

$$(p \cdot \alpha)_{max} = \frac{P_M}{P_{100\%}} \cdot 100\ \% = 19\ \%$$

In this case, the power limit would have to be set to 19 %, i.e. 1.9 V.

8.1.13 Performing a functional test

Once you have tested the hydraulic fluid supply, you must perform a functional test on the machine or system. The functional test should be carried out according to the instructions of the machine or system manufacturer.

Before delivery, the SYDFE1 control system is checked for operability in accordance with the technical data. During commissioning, it must be ensured that the SYDFE1 control system was installed into the machine or system in accordance with the plans and drawings. Use the swivel angle indicator to check whether the SYDFE1 control system correctly swivels in and out during operation.

The position of the swivel angle indicator and the assignment of the swiveling direction to the direction of rotation and control can be found in the associated technical data sheets.

8.1.14 Bleeding during commissioning or after longer standstill periods

Just like during commissioning you have to bleed the SYDFE1 control system also after longer periods of standstill in order that the pump can build up pressure directly after the electric motor starts up. The necessity for this depends, however, also on the installation orientation of the pump.

You can bleed the system manually by “opening” the pressure line at a suitable point (e.g. minimess port, valve, etc.). When an unloading valve to tank is installed (quasi “pressureless start-up”), this procedure can also be automated when the electric motor starts up: The valve merely needs to be activated briefly; a continuous pressureless start-up as described in the following is not required.

If a SYDZ pre-load valve is installed and the pump does not build up pressure or displace hydraulic fluid, this valve must be bled additionally at point “P” as described in section 8.1.8 “Bleeding the pre-load valve“ on page 67.

8.2 RECOMMISSIONING AFTER STANDSTILL

Depending on the installation and ambient conditions, changes may occur in the system which make recommissioning necessary.

Among others, the following criteria may result in the necessity for recommissioning:

- Air in the hydraulic system
- Water in the hydraulic system
- Aged hydraulic fluid
- Contamination

▶ For recommissioning, proceed as described in chapter 8.1 “Initial commissioning” on page 60.

8.3 RUNNING-IN PHASE

NOTICE

Viscosity too low!

Risk of damage! The increased temperature of the hydraulic fluid during the running-in phase can cause the viscosity to drop to impermissible levels.

▶ Monitor the operating temperature during the running-in phase.

▶ Reduce the loading (pressure, speed) of the SYDFE1 control system, if impermissible operating temperatures and/or viscosities occur.

Bearings and sliding surfaces are subject to a running-in phase. Increased friction at the start of the running-in phase results in increased heat generation which decreases with increasing operating hours. The volumetric and mechanical-hydraulic efficiency rises as well by the end of the running-in phase of approx. 10 operating hours.

9 Operation

The SYDFE1 control system is a component which requires no adjustments or changes to be made during operation. For this reason, this chapter of the manual does not contain any information on adjustment options. Only use the product within the performance range provided in the technical data. The machine or system manufacturer is responsible for the correct project planning of the hydraulic system and its control.

10 Maintenance and repair

10.1 CLEANING AND CARE

NOTICE

Solvents and aggressive cleaning agents!

Aggressive cleaning agents may damage the seals of the SYDFE1 control system and make them age faster.

- Never use solvents or aggressive cleaning agents.

Ingress of dirt and liquids!

This will result in the fact that the safe operation of the SYDFE1 control system can no longer be ensured.

- When carrying out any work on the SYDFE1 control system observe strictest cleanliness.
- Do not use high-pressure cleaners.

For cleaning and care of the SYDFE1 control system, observe the following:

- Plug all openings with suitable protective caps/devices.
- Check that all seals and plugs of the plug-in connections are securely seated to ensure that no moisture can enter the SYDFE1 control system during cleaning.
- Use only water and, if necessary, a mild detergent to clean the SYDFE1 control system.
- Remove external coarse dirt and keep sensitive and important parts like solenoids, valves and indicators clean.

10.2 INSPECTION

In order that the SYDFE1 control system will work reliably and for a long time, Rexroth recommends that you inspect the SYDFE1 control system regularly at the following maintenance intervals and document the following operating conditions:

Table 17: Inspection schedule

Work to be carried out		Interval
Hydraulic system	Check level of hydraulic fluid in the tank.	Daily
	Check operating temperature (comparable load state).	Weekly
	Analyze quality of the hydraulic fluid.	Annually or every 2000 h (whichever occurs first)

Work to be carried out		Interval
SYDFE1 control system	Inspect the SYDFE1 control system for leakage. Early detection of hydraulic fluid loss can help identify and rectify faults on the machine or system. For this reason, Rexroth recommends that the SYDFE1 control system and the system as a whole always be kept in a clean condition.	Daily
	Check the SYDFE1 control system for generation of noise.	Daily
	Check mounting elements for proper fit. Inspect all mounting elements while the system is switched off, depressurized and cooled down.	Monthly

10.3 MAINTENANCE

SYDFE1 control systems require little maintenance when properly used.

The service life of the SYDFE1 control system is heavily dependent on the quality of the hydraulic fluid. For this reason, we recommend changing the hydraulic fluid at least once a year or every 2000 operating hours (whichever occurs first) or having it analyzed by the hydraulic fluid supplier or a laboratory to determine its suitability for further use.

The service life of the SYDFE1 control system is limited by the service life of the built-in bearings. The service life can be requested on the basis of the load cycle from the responsible Rexroth Service partner, see chapter 10.5 “Spare parts” below. Based on these details, a maintenance interval is to be determined by the system manufacturer for the replacement of the bearings and included in the maintenance schedule of the hydraulic system.

10.4 REPAIR

Rexroth offers a comprehensive range of services for the repair of Rexroth SYDFE1 control systems.
Repairs of the SYDFE1 control system may only be performed by authorized, skilled and instructed staff.

- Only use genuine spare parts from Rexroth for repairing Rexroth SYDFE1 control systems.

Partially tested and pre-assembled original Rexroth assemblies allow for successful repairs within a minimum of time.

10.5 SPARE PARTS

When ordering spare parts, please state the material number of the relevant spare parts. On some components, the material number is shown on a nameplate or a label.

Please address all questions regarding spare parts to your responsible Rexroth Service partner.

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`

- Please state the following data from the nameplate on your order:
  - Material number
  - Serial number
  - production job order number
  - Date of production

10.5.1 Replacement of components

The replacement of some components of the SYDFE1 control systems is described in the following.

Swivel angle sensor “IW9“ for SYDFE1 systems

Swivel angle sensor IW9 operates as inductor circuit according to the inductive principle and senses the mechanical stroke of the pump without wear. In the case of faults in swivel angle sensing, both, the coil body and the mechanical parts are easy to replace. If the settings of control electronics VT 5041-2X were not changed, matching of the coil body is limited to mechanical clamping/fixing (preferably in zero stroke operation) while controlling the electrical zero point on the control electronics

Table 18: Available spare parts

Material number	Description
R910947340	Complete kit (incl. seal, screws and tapered catch)

Seal kits for the pump

Stating the Mat. no. of the pump you can order seal kits, which are either tailored to certain individual components or offered as complete packages.

Pilot valves VT-DFP-x-2X

The pilot valve is a component, which is sensitive to contamination. When replacing it, take care that no contaminants can enter fluid-carrying parts of the valve and the pump. To replace the pilot valve loosen the 4 screws at the recessed corners of the nameplate on the pilot valve. When replacing the pilot valve, check the valve zero point and correct it, if necessary, see chapter 8.1.7 “Checking and correcting the valve zero point“ on page 66.

Pre-load valve SYDZ0001

To replace the pre-load valve, loosen the mounting screws and remove the pre-load valve.

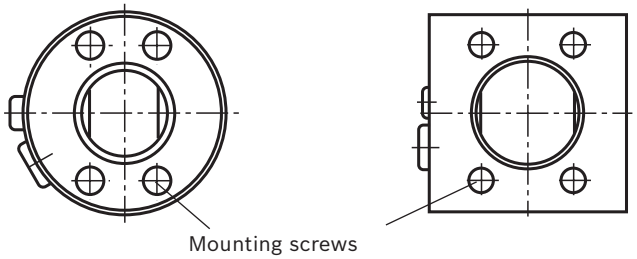


Fig. 34: Mounting bores: left-hand side (round) for NG 18, 28, 25; right-hand side (rectangular) for NG 71, 100, 140

When mounting a new pre-load valve, take care that the seal on the pump side of the pre-load valve is positioned in the recess provided for this purpose. Tighten the mounting screws to the following torque:

Sizes 18, 28 and 45:	45 Nm
Size 71:	55 Nm
Sizes 100, 140 and 180:	100 Nm

After having mounted the pre-load valve, connect the high pressure and case drain oil pipes as described in chapter 7.3 “Installation positions and piping of SYDFE1 systems” on page 43. During re-commissioning, bleed the pre-load valve. Notes on the bleeding procedure can be found in chapter 8.1.8 “Bleeding the pre-load valve“ on page 67.

11 Decommissioning

The SYDFE 1 control system is a component that does not require decommissioning. For this reason, this chapter of the present instructions does not contain any information.

For details about how to demount or replace your SYDFE1 control system, please refer to the following chapter 12 “Demounting and replacement”,

12 Demounting and replacement

12.1 REQUIRED TOOLS

The product can be demounted using standard tools. No special tools are necessary.

12.2 PREPARING DEMOUNTING

1. Decommission the entire system as described in the general instructions for the machine or system.
2. Depressurize the hydraulic system according to the instructions of the machine or system manufacturer.

12.3 DEMOUNTING

Proceed as follows to demount the SYDFE1 control system:

1. Make sure that the hydraulic system is depressurized.
2. Check that the SYDFE1 control system has cooled down sufficiently so that it can be demounted without any risks.

NOTICE! Spilled or discharged hydraulic fluid!

Environmental damage and contamination of the groundwater!

- When filling in and changing the hydraulic fluid, always place a catch pan under the SYDFE1 control system.
- Observe the information in the safety data sheet for the hydraulic fluid and the instructions provided by the system manufacturer.

1. Loosen the lines and collect the escaping hydraulic fluid in the collector provided for this purpose.
2. Demount the SYDFE1 control system. Use suitable lifting gear for this.
3. Drain the SYDFE1 control system completely.
4. Plug all openings.

12.4 PREPARING THE COMPONENTS FOR STORAGE OR FURTHER USE

- Proceed as described in chapter 6.2 “Storing the SYDFE1 control system” on page 41.

13 Disposal

13.1 ENVIRONMENTAL PROTECTION

Careless disposal of the hydraulic components and the hydraulic fluid can lead to pollution of the environment.

- Thus, dispose of the product and the hydraulic fluid in accordance with the national regulations in your country.
- Dispose of hydraulic fluid residues according to the applicable safety data sheets for these hydraulic fluids.
- Observe the following notes for an environmentally friendly disposal of the hydraulic component.

13.2 RETURN TO BOSCH REXROTH AG

The hydraulic products manufactured by us can be returned to us for disposal purposes at no costs. When returned, the products must not contain any inappropriate foreign substances or third-party components. Hydraulic valves have to be drained before being returned. The components have to be sent carriage paid to the following address:

Bosch Rexroth AG

Service Industriehydraulik

Bürgermeister-Dr.-Nebel-Straße 8

97816 Lohr am Main

Germany

13.3 PACKAGING

Upon request, reusable systems can be used for regular deliveries.

The materials for disposable packaging are mostly cardboard, wood, and expanded polystyrene. They can be recycled without any problems. For ecological reasons, disposable packaging should not be used for returning products to Bosch Rexroth.

13.4 MATERIALS USED

Hydraulic components from Bosch Rexroth do not contain any hazardous substances that could be released when used as intended. In the normal case, no negative effects on human beings and on the environment have to be expected.

The components basically consist of:

- Cast iron
- Steel
- Aluminum
- Copper
- Plastics
- Electronics components and assemblies
- Elastomers

13.5 RECYCLING

Due to the high metal share, hydraulic products can mostly be recycled. In order to achieve an ideal metal recovery, disassembly into individual assemblies is required. The metals contained in electrical and electronic assemblies can also be recovered by means of special separation procedures.

14 Extension and modification

The SYDFE1 control system may only be converted or extended in the cases described below using genuine Rexroth SYDFE1 components. Other conversions or extensions, also the readjustment of lead-sealed adjustment potentiometers, render the warranty void. The replacement of a component with a component of identical design is described in chapter 10.5 “Spare parts“ on page 75.

The SYDFE1 control system may be extended by adding an SYDZ pre-load valve. Please ensure that the size of the pre-load valve and the size of the pump are identical.

15 Troubleshooting

The following table may assist you in troubleshooting. The table is not exhaustive.

In practice, problems which are not listed here may also arise.

Generally, the state of the SYDFE1 control system is indicated on the front panel.

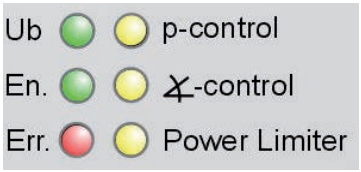


Fig. 35: Indicator lamps on the front panel

Green LED “Ub“

This LED is illuminated when the correct voltage supply is provided for the control electronics VT 5041-3X.

If this LED is not illuminated, check the following:

- Voltage supply available (U = 21...35 V)
- Check fuse F1

The red LED “Err“

This LED signals a collective fault (or missing enable).

The fault signal can also be measured at pin 2c of the female multi-point connector and can be used for signaling this to a higher-level control.

The following is valid here:

0 V	→	fault
24 V	→	no fault

The fault signal refers to a collective fault and is composed of the following individual faults:

- Monitoring of actual pressure value acquisition
- Monitoring of swivel angle sensing
- Monitoring of actual valve value sensing
- Enable not granted
- No supply voltage present or fuse F1 defective
- When monitoring of the control error is activated (jumper J9), excessive control error (valve command value > +4 V or < -4 V) for longer than 1 sec.

Which error is present? The individual faults are signaled on the printed-circuit board of the control electronics (provided that the view to the indicator lamps is not obstructed).

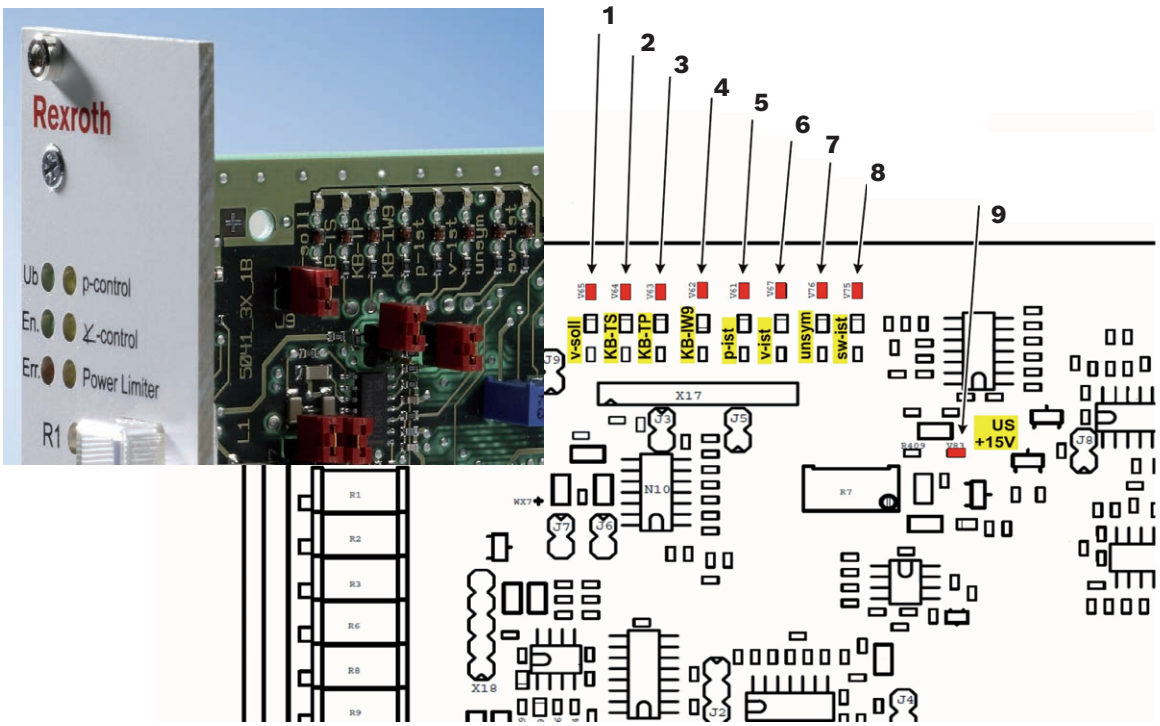


Fig. 36: Fault signals on the printed-circuit board

1 Excessive permanent control error
2 Break of valve position transducer cable (secondary)
3 Break of valve position transducer cable (primary)
4 Break of swivel angle position transducer cable
5 Actual pressure value error
6 Actual valve value error (out of range)
7 Fault of internal voltage supply (unbalance)
8 Actual swivel angle value error (range exceeded)
9 Fault of internal voltage supply (undervoltage)

Neither the individual faults nor the collective fault are saved and they always reflect the **momentary** state.

Example If a loose connection at a plug-in connector of the swivel angle transducer (IW9) results in the temporary detection of a fault, this individual fault will trigger the issue of a fault signal.

Depending on the configuration of jumper J1 the following will happen:

J1 ON, i.e. shutdown of the valve output stage

In this case, the relevant fault results in the shutdown of the valve output stage, that is, the activation of the pilot valve is interrupted.

This causes the position of the valve spool to leave the “permitted” range of the actual valve value and thus results in signaling of the individual fault “v-actual” (fault: actual valve value out of range).

A SYDFE1 system with internal supply will change over to zero stroke operation (ca. 8...12 bar). The command values applied (pressure, swivel angle) will not be

used for controlling. Accordingly, depending on the command value provision, the individual fault message “continuous control error” will be signaled as well.

In this case, consequential faults may, under certain circumstances, also be signaled in addition to the original fault.

J1 OFF, i.e. exclusively signaling of a fault, no shutdown.

In this case, the relevant fault results in brief signaling (loose connection) of the fault, which is indicated by the “error” LED on the front panel of the control electronics as well as well as by PLC output 2c.

15.5.1 Fault analysis

If the LEDs on the control electronics can be viewed without obstruction, it is sufficient to check the individual fault(s) as indicated by the LEDs. If you cannot view the LEDs or if the fault cannot be rectified in this way, check the following points:

Preparations

- ▶ Unplug the motor fuse
- ▶ Switch on the pump electronics

Enable contact closed?

Check the connection between female multi-point connectors 26c and 32a.

Monitoring of actual pressure value acquisition

The actual pressure value, which can be measured at test jack 2, is monitored for the “permitted” range. The “permitted” range is between -0.5 V and +11.5 V.

Possible faults can be an interrupted signal cable, missing voltage supply to the sensor or an incorrectly adapted actual pressure value signal.

Actual pressure value < -0.5V

- ▶ Check cabling and voltage supply to the pressure transducer
- ▶ Correct zero point of the actual pressure value input (R1)

Actual pressure value > +1.5V

- ▶ Check cabling to the pressure transducer
- ▶ Check signal output of the pressure transducer

Monitoring of swivel angle sensing

- Break in swivel angle position transducer cable
  - The monitoring feature recognizes faults in the cabling between the swivel angle sensor of the pump (IW9) and control electronics VT 5041-3X.
- Out of range
  - If the actual swivel angle value (socket 4) is outside the permitted range of ±11 V, a fault signal is generated.
  - When the hydraulics is switched off, the swivel angle of the pump should be +10 V when properly adjusted.
  - Possible faults can be an interrupted signal cable or an incorrectly matched actual swivel angle value.

Moreover, the resistance of cables can be measured while the connector is plugged in on the swivel angle sensor of the pump (IW9).

- ▶ Switch voltage off

▶ Remove control electronics VT 5041-3X from the rack
- – Female multi-point connector 14a to 10a: ca. 36 Ohm
- – Female multi-point connector 12a to 10a: ca. 36 Ohm
- – Female multi-point connector 12a to 14a: ca. 50 Ohm

Note:

This measurement will not provide any information on the correct wiring of counter-clockwise and clockwise rotating pumps (see also chapter 7.6.5 “Connecting the swivel angle sensor“ on page 57).

Monitoring of actual valve value sensing

- Primary and secondary side of the position transducer
  - – The signals to the position transducer (primary side) as well as from the position transducer (secondary side) are checked for plausibility. Should one of the two LEDs be lighted, check whether the position transducer is wired correctly.

	VT 5041-3X	Valve position transducer
Primary side	Connection 8a/22a	Connection 1 and 2
Secondary side	Connection 4a/6a	Connection 3 and 4

- Signal level of position transducer position < -11 V
  - – When the valve is not activated (e.g. no enable given for the valve or the solenoid connector is unplugged), the actual valve value will leave the permitted operating range. This will result in an individual fault.

Moreover, the resistance of the cables can be measured with connectors plugged in on the valves.

▶ Switch voltage off

▶ Remove control electronics VT 5041-3X from the rack
- – Female multi-point connector 28c to 30c: ca. 2-4 Ohm (solenoid)
- – Female multi-point connector 4a to 6a: ca. 103 Ohm (position transducer)
- – Female multi-point connector 8a to 6a: ca. 115 Ohm (position transducer)

Monitoring of the control deviation

This monitoring function is active only when jumper J9 is set (= ON).

The monitoring feature, which was newly added compared with control electronics VT 5041-2X, continuously checks the valve command value (= control difference x controller gain) and signals an error, as soon as the amount exceeds the value of 4 V, which can be measured at test jack 5, for more than one second.

To remain compatible with series 2X control electronics in terms of function, this monitoring feature is deactivated with the factory setting (jumper J9 open).

By setting jumper J9 you can add this fault signal to the collective fault signal.

It must be noted that when this fault signal is deactivated, the LED “v-soll“ on the printed-circuit board continues to signal a control error as fault, but will not evaluate it.

Monitoring of internal voltage supply

The voltages of +15 V and -15 V generated by the own power supply unit of the VT 5041-3X are monitored for the following levels.

- Monitoring of internal voltage +15 V for values less than 10 V (fault is signaled by LED, see Fig. 36, item 9: US +15 V)
- Excessive difference between +15 V and -15 V (= unbalance)

Should one of the two above-mentioned individual faults be present, check, whether too high a load or possibly a short-circuit is present at outputs 20a (-15V) and 24a (+15V).

- Check auxiliary voltages at control electronics VT 5041-3X (reference = 22a)
  - Female multi-point connector 20a = -15 V (-14.1 V...-15.3 V)
  - Female multi-point connector 24a = +15 V (+14.1 V...+15.3 V)

Should the pump generate pressure in an uncontrollable manner without a fault signal being issued by control electronics VT 5041-3X, check the control valve VT-DFP-... for “jamming“.

- Unplug solenoid connector
- Measure actual valve value at socket 6
  With a non-jammed valve, the actual valve value (test jack 6) must now be within the range of +10 V to +15 V. Otherwise, the valve is likely to jam.
- Replace valve

After having rectified the fault

- Switch the voltage off and on (clearing of the fault signal)
- If the fault signal is no longer present, switch the pump off
- Activate the motor fuse
- Switch the pump on

15.1 HOW TO PROCEED FOR TROUBLESHOOTING

- Always work systematically and purposefully, even when under time pressure. Random and imprudent disassembly and changing of settings can, in the worst-case scenario, result in the inability to determine the original cause of error.
- First obtain a general overview of how your product works in conjunction with the entire system.
- Try to find out whether the product has functioned properly in conjunction with the overall system before the fault occurred.
- Try to determine any changes of the overall 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: What were they?
  - Was the product or machine used as intended?
  - How did the fault become apparent?
- Try to get a clear idea of the cause of error. If possible, ask the direct (machine) operator.
- If you cannot rectify the error, contact one of the contact addresses which can be found at:
  `www.boschrexroth.com/addresses`

15.2 FAULT TABLE

Table 19: Malfunction table for SYDFE1 control systems

Malfunction	Possible cause	Remedy
Error message present: Indicator lamp “Err.“ on the front panel of the VT 5041-3X is ON	Enable not granted: Indicator lamp “En.“ is out.	Apply 24 V to contact 26c
	Supply voltage missing or fuse F1 defective: Indicator lamp “Ub“ is out	Apply 24 V to contact 32a, connect 28a to ground (0 V)
	Cable break of the swivel angle sensor cable	Check wiring (see 7.6.5 “Connecting the swivel angle sensor“, page 57)
	Cable break of the valve position sensor cable	Check wiring (see 7.6.4 “Connecting the valve position transducer“, page 55)
	Cable break of the proportional solenoid cable	Check wiring (see 7.6.6 “Connecting the solenoid of the proportional valve“, page 58)
	When monitoring of the control error is activated (jumper J9 set/ON), excessive control error (valve command value > +4 V or < -4 V) for longer than 1 sec.	For further notes, see page 63.
	Defect or short-circuit of auxiliary voltages on the control electronics	Contact Rexroth Service
Humming noise in the pressure control or fluctuations in pressure/flow	Air cushion around the sensor	Bleed control system, pre-load valve (see 8.1.8 on page 67) and pipes completely
	Problem with the cable shield	Connect shield to ground
	Unfavorable place of installation/mounting technique for the pressure transducer	Change place of installation (e.g. suspended mounting, no minimess line, no throttling point between pump and pressure transducer)
	Improperly high gain of the actual pressure value	Reduce weighting of the actual pressure value and pressure command value, see page 68
Screaming noise	Oil level in the tank too low; pump partly aspires air	Top up oil
	Pump aspires air	Change routing of the suction line
	Suction line leaky	Seal suction line
	Pump cavitates when pressure is reduced Diagnostics: Measure, whether overshoots occur in the pressure line at individual pressure levels, e.g. pressure almost 0 bar and, at the same time, negative swivel angle	Optimize controller, reduce command value via a ramp or in steps.
	Fluid in the tank mixed with air; cooling and/or filtration circuit leaky	Seal

Table 19: Malfunction table for SYDFE1 control systems

Malfunction	Possible cause	Remedy
Other unusual noise	Input speed too high	Machine or system manufacturer
	Wrong direction of rotation	Machine or system manufacturer
	Insufficient suction conditions, e.g. air in the suction line, insufficient diameter of the suction line, viscosity of the hydraulic fluid too high, suction height too great, suction pressure too low, foreign body in the suction line	Check, whether shut-off valves are open
		Machine or system manufacturer (e.g. optimize inlet conditions, use suitable hydraulic fluid)
		Air-bleed control system completely, fill suction line with hydraulic fluid
		Remove foreign particles from the suction line
	Improper mounting of the control system	Check mounting of the control system according to the instructions given by the machine or system manufacturer. Observe tightening torques
	Improper mounting of attachment parts, e.g. coupling and hydraulic lines	Mount attachments in accordance with the instructions of the coupling or fitting manufacturer
	Air in the pump or in the pre-load valve	Bleed pump and pre-load valve
	Wear/mechanical damage to the control system	Replace control system, contact Rexroth Service
No or insufficient pressure(< 4 bar)	Faulty mechanical drive (e.g. defective coupling)	Machine or system manufacturer
	Hydraulic fluid not within the optimum viscosity range	Use suitable hydraulic fluid (machine or system manufacturer)
	Drive unit defective (e.g. hydraulic motor or cylinder)	Machine or system manufacturer
	Wear/mechanical damage	Replace control system, contact Rexroth Service
Pressure fixed, ca. 5...12 bar, cannot be changed	Supply voltage not within the permissible range (21.6...33.6) Diagnostics: Is the actual swivel angle value (12c) 0 Volt? If yes, is the supply voltage missing?	Check, whether all connectors are plugged on the pilot valve
		Check voltage at the control electronics
	Command value for pressure, swivel angle or power (optional) is 0 bar or 0 %, respectively	If you use, for example, exclusively closed-loop pressure control, connect the swivel angle command value (14c/16c) to +10 V... U_B
		The potentiometer for the (optional) power limitation must not be at the left-hand limit stop
	Swivel angle sensor defective	Inspect swivel angle sensor, see 8.1.11 page 70
	Spool jams in pilot valve	Contact Rexroth Service

Table 19: Malfunction table for SYDFE1 control systems

Malfunction	Possible cause	Remedy
Pressure too low (< 12 bar)	Weighting of the actual pressure value is incorrectly set Diagnostics: Pressure command value (6c/4c) and actual pressure value normalized (24c) are equal and can be regulated	Adjust pressure command value and/or actual pressure value (see page 68)
		Replace pressure transducer
		Change the place of installation of the pressure transducer (do not install upstream of the pre-load valve; where appropriate, close to the consumer)
	Pressure transducer defective Diagnostics: Measure signal from PT and compare with indication on the pressure gauge	Replace pressure transducer
	Control system does not work in closed-loop pressure control Diagnostics: Pressure command value (6c/4c) is less than actual value normalized (24c).	Increase swivel angle command value
		Increase power limit (see page 70)
		Check that the hydraulic system is leak-free and there is no excessive oil consumption
	Pilot valve defective	Replace pilot valve
Pressure too high	Weighting of the actual pressure value is incorrectly set Diagnostics: Pressure command value (6c/4c) and actual pressure value normalized (24c) are equal and can be regulated	Adjust pressure command value and/or actual pressure value (see page 68)
		Replace pressure transducer
		Replace control electronics VT 5041-3X
	Pressure transducer defective/not connected Diagnostics: Measure signal from PT and compare with indication on the pressure gauge	Connect pressure transducer correctly/ replace
Insufficient flow	Pressure controller active	Increase pressure command value
	Power limitation (optional) active	Increase power command value (optional) (see page 70)
	Actual swivel angle acquisition improperly set	Adjust swivel angle sensor (see page 70)
	Drive speed too low (slip, incorrect frequency, wrong motor)	Machine or system manufacturer
	Damage to the pump (excessive pump leakage)	Replace pump
	Wear/mechanical damage to the control system	Replace control system, contact Rexroth Service
Drive motor shuts down due to overloading	Excessive power consumption of the pump	Reduce power command values (optional (see page 70)
		Reduce swivel angle command value
		Test actual pressure value acquisition (see page 68)
	Overcurrent protection of motor does not work properly	Check setting and function
	Spool jams in pilot valve Diagnostics: Disconnect central plug-in connector X1 or supply voltage from pilot valve and test whether the motor is still overloaded	Replace pilot valve, see page 75
	Actual swivel value acquisition maladjusted or does not work	Check actual swivel angle acquisition (see 8.1.11 on page 70)
	VT 5041-3X defective	Replace control electronics VT 5041-3X

Table 19: Malfunction table for SYDFE1 control systems

Malfunction	Possible cause	Remedy
Hydraulic fluid temperature too high	Inlet temperature at control system too high	Inspect system, e.g. for malfunction of the cooler, insufficient hydraulic fluid in the tank
	Pre-load valve opens Diagnostics: Pipe to the tank heats up	Pressure must be lower than the cracking pressure of the pre-load valve. Keep overshoots and pressure pulsation to a minimum.
	Malfunction of pressure/pilot valves (e.g. high pressure relief valve, pressure cut-off, pressure controller)	Contact Rexroth Service
	Control system worn out	Replace control system, contact Rexroth Service

16 Technical data

The technical data of your SYDFE1 system are contained in the following data sheets:

SYDFE1 series 2X RE 30030

SYDFE1 series 3X RE 30630

The data sheet can be found on the Internet at

www.boschrexroth.com/sydfe

17 Annex

17.1 LIST OF 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`

Support

Email support.automation@boschrexroth.com

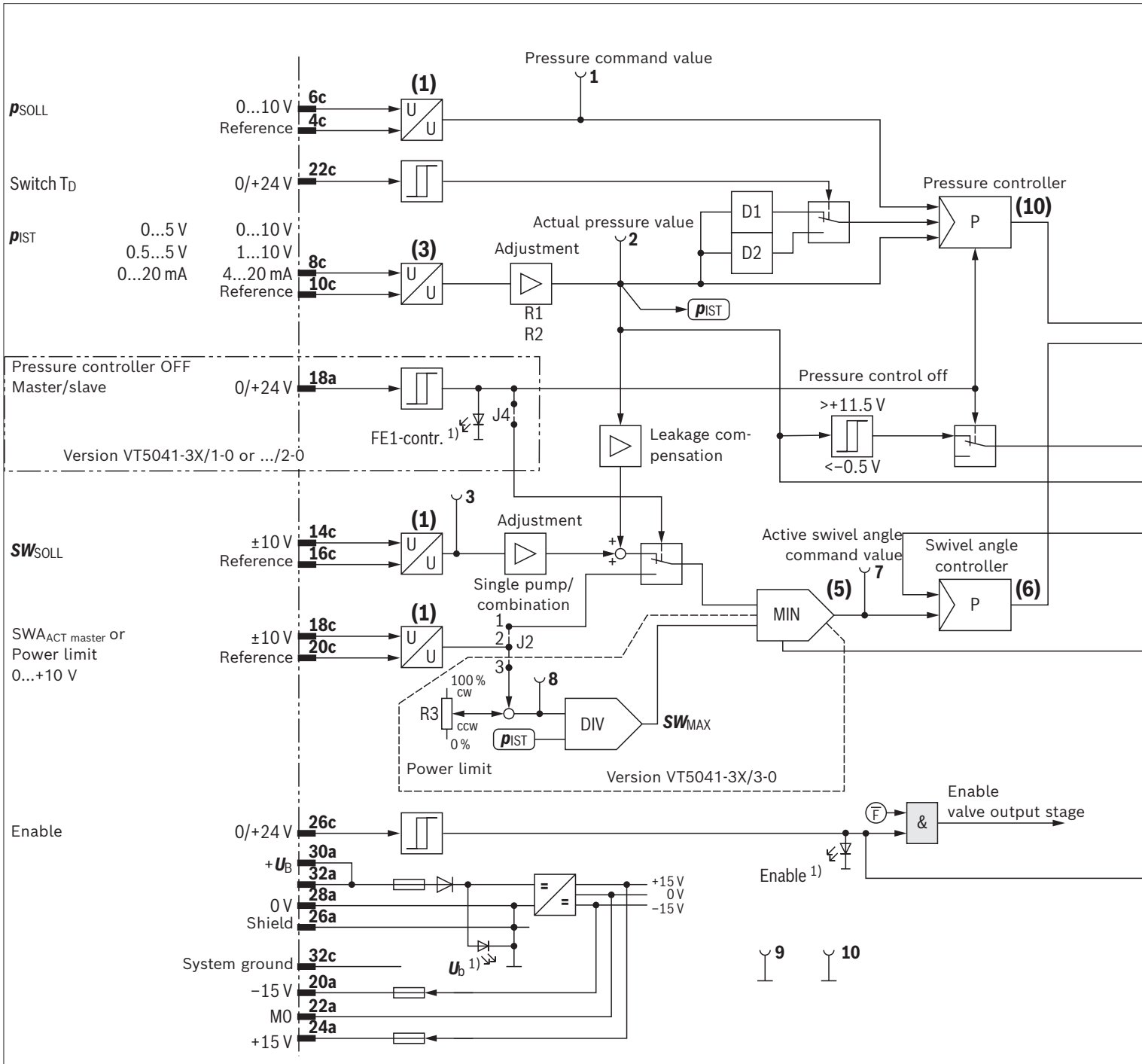
Headquarters

Bosch Rexroth AG
Zum Eisengiesser 1
97816 Lohr am Main
Germany

Phone +49 (0) 9352/18-0
Email my.support@boschrexroth.com

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

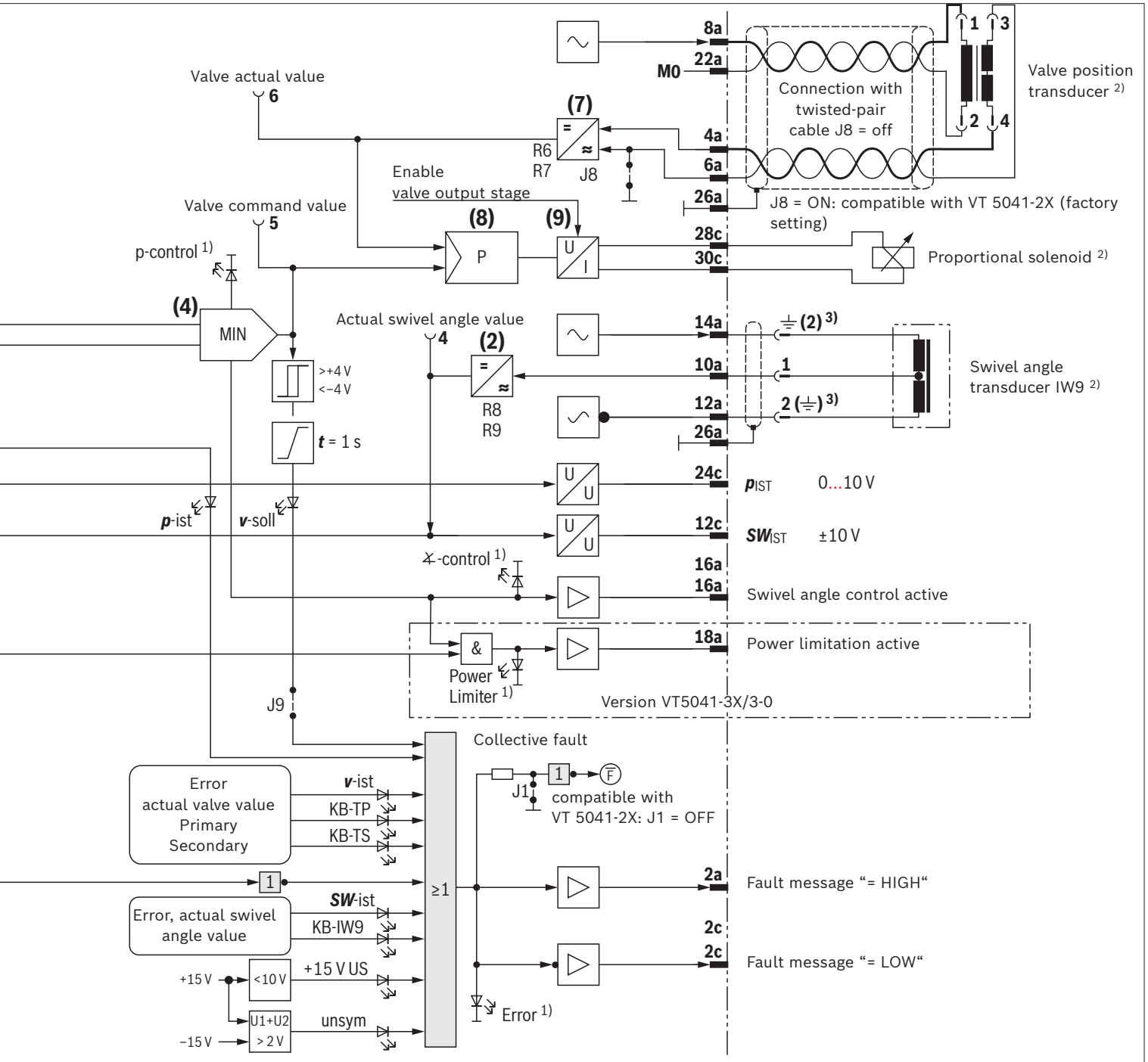
17.2 BLOCK CIRCUIT DIAGRAM OF CONTROL ELECTRONICS VT 5041-3X



Abbreviations used for signals

p_{COMM}	Pressure command value
p_{ACT}	Actual pressure value
Switch T_D	Switching of oil volume
SWA_{COMM}	Swivel angle command value
SWA_{ACT}	Actual swivel angle value
$SWA_{ACT\ master}$	Actual swivel angle value of master
FE1-contr.	Pressure controller deactivated

Function of jumpers and switches on the control electronics, see 17.3 “Display and setting elements of control electronics VT 5041-3X” on pageSeite 92.
Meaning of the test jacks, display and setting elements (potentiometers) on the front panel, see data sheet 40242, page 9.



Diagnostic LEDs on the printed-circuit board

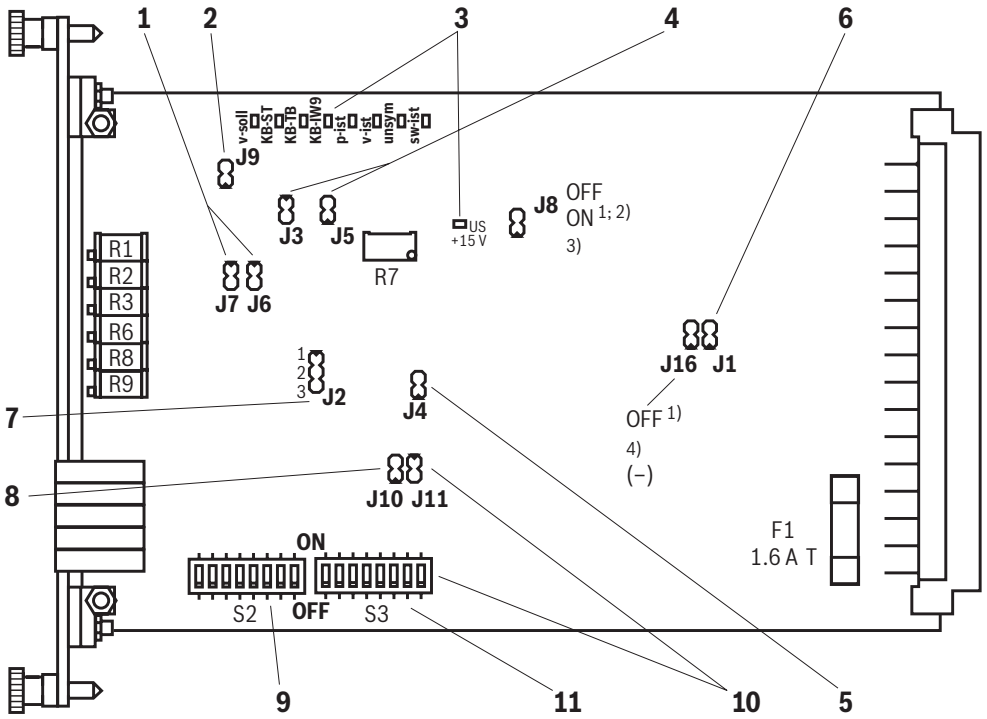
v-com	Excessive permanent control error
v-act	Error, actual valve value out of range
p-act	Actual pressure value error
SWA-act	Error, actual swivel angle value out of range
KB-TP	Break of valve position transducer cable - primary
KB-TS	Break of valve position transducer cable - secondary
KB-IW9	Break in swivel angle position transducer cable
+15 V US	Undervoltage +15 V (internal power supply unit)
unsym	Internal voltage supply unbalanced

1) LED indicator lamps on front panel (for meaning, see page 80)

2) For more details on the connection, see 7.6.4, - 7.6.6 starting on page 55

3) Connection pattern for counter-clockwise rotating systems in ()

17.3 DISPLAY AND SETTING ELEMENTS OF CONTROL ELECTRONICS VT 5041-3X



1	Case drain compensation	Jumper J6	Jumper J7
	Off	OFF	OFF
	4 %	OFF	ON
	6 %	ON	OFF
	10 %	ON	ON

2	Monitoring of valve command value	Jumper J9
	ON	ON
	OFF 2)	OFF

3	Diagnostic LEDs
	For description, see chapter 15, page 80

4	Regenerative operation	Jumper J3	Jumper J5
	ON	ON	OFF
	Off	OFF	ON

5	Function pin 18a 5)	Jumper J4
	Pressure control ON/OFF	OFF
	Master/slave ON/OFF	ON

6	Valve shutdown in the event of a fault	Jumper J1
	Active	OFF 2)
	Inactive	ON

7	Selection for analog input at pin 18c	Jumper J2 bridge
	Actual swivel angle value of master	1-2
	External power limitation	2-3

8	Gain of pressure feedback value	Jumper J10
	Onefold	OFF
	Twofold	ON

9	Signal adjustment of actual pressure value		Switch S2 .1	.2	.3	.4	.5	.6	.7	.8
	V	0 ... 10 V	OFF	OFF	OFF	OFF	OFF	OFF	ON	ON
	I	1 ... 10 V	OFF	OFF	OFF	OFF	ON	OFF	OFF	ON
	D	0 ... 5 V	OFF	OFF	ON	ON	OFF	OFF	ON	ON
	F	0.5 ... 5 V	OFF	OFF	ON	ON	ON	OFF	OFF	ON
	B	0 ... 20 mA	ON	ON	OFF	OFF	OFF	OFF	ON	ON
	C	4...20 mA	ON	ON	OFF	OFF	ON	ON	OFF	OFF

10	P-gain of pressure controller	Switch S3 .7	.8	Jumper J11
	8.0	OFF	OFF	OFF
	4.8	OFF	ON	OFF
	4.0	OFF	OFF	ON
	3.0	OFF	ON	ON
	2.4	ON	OFF	ON
	2.0	ON	ON	ON

11	Volume adjustment, pressure controller								
	Input of switch T_D = OFF	Switch S3 .1	.2	.3	Input of switch T_D = ON	Switch S3 .4	.5	.6
	≤5.0 l	OFF	OFF	OFF	12.5 l	OFF	OFF	OFF
	7.5 l	OFF	ON	OFF	30.0 l	OFF	ON	OFF
	10.0 l	ON	ON	OFF	45 l	ON	ON	OFF
	15.0 l	ON	OFF	ON	60 l	ON	OFF	ON
	20.0 l	OFF	ON	ON	75 l	OFF	ON	ON
	25.0 l	ON	ON	ON	90 l	ON	ON	ON

ON Bridge set
OFF Bridge open
Factory setting

1) Factory setting
2) compatible with VT 5041-2X
3) Reference for position transducer
4) Reference for actual position value
5) Variants “1“ and “2“ only (without power limitation)

18 Alphabetical index

M

N

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Q

R

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T

U

V

W

Z

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