RINGSPANN®
Power Transmission

Installation and Operating Instruction for Hydraulic Brake Control System BCS600

E09.755e

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IMPORTANT

Please read these instructions carefully before installing and operating the product. Your particular attention is drawn to the notes on safety.

These installation and operating instructions are valid on condition that the product meets the selection criteria for its proper use. Selection and design of the product is not the subject of these installation and operating instructions.

Disregarding or misinterpreting these installation and operating instructions invalidates any product liability or guarantee by RINGSPANN; the same applies if the product is taken apart or changed.

These installation and operating instructions should be kept in a safe place and should accompany the product if it is passed on to others -either on its own or as part of a machine- to make it accessible to the user.

SAFETY NOTICE

- Installation and operation of this product should only be carried out by skilled personnel.
- Repairs may only be carried out by the manufacturer or accredited RINGSPANN agents.
- If a malfunction is indicated, the product or the machine into which it is installed, should be stopped immediately and either RINGSPANN or an accredited RINGSPANN agent should be informed.
- Switch off the power supply before commencing work on electrical components.
- Rotating machine elements must be protected by the purchaser to prevent accidental contact.
- Supplies abroad are subject to the safety laws prevailing in those countries.

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1. Introduction

The present document acquaints the system operator with the

- use,
- safety measures,
- setup,
- functionality,
- operation
- and maintenance

of the Hydraulic Brake Control System. Before commissioning, these operating instructions must be read carefully. Furthermore, before first use, the actual operating personnel will be instructed by employees or agents of the manufacturer and acquainted with the special features. Moreover, all rules and regulations for the prevention of accidents that apply at the site of operation must be complied with.

Fig. 1

2. Notes

Particularly important items in this document are marked with symbols that are explained below. Irrespective of the highlighted notes the entire contents of the operating instructions as well as the content of those documents referred to, must be taken into account for safe and competent handling.

This symbol marks text items containing notes that refer to a direct danger to the life or health of persons.

This symbol marks text items containing notes that refer to the competent handling of the test stand. Non-compliance with these notes may cause damage to the system.

3. Identification

The hydraulic brake control system is clearly marked by a Part number. The Part Number is stated on the name plate located on the side of terminal box.

This documentation is part of the Hydraulic **B**rake **C**ontrol **S**ystem BCS-600.

4. Use within specifications

The system defined in Section 3 is provided exclusively for the following uses:

- Hydraulic control of a hydraulically active brake system
- Hydraulic control of a hydraulically released, spring-operated brake system.

Here, a brake system may consist of up to 4 brake calipers. All brake calipers are to be operated on one drive train or output train.

5. Liability

The hydraulic brake control system has been built in accordance with the current state of the art and the generally recognized technical safety rules. Nevertheless, operation and use of the hydraulic brake control system may cause hazards to life and limb of the user or any third parties and/or have detrimental effects on the brake control system or other property. In order to prevent such hazards the following instructions must be complied with.

The product is to be operated only:

- within the intended specifications, described in Section 4,
- in a technically safe and perfect condition and

- by trained specialist personnel

Any faults that may have a detrimental effect on safety must be removed immediately.

In the event of personal injury and damage to property all warranty and liability claims shall be excluded if they can be traced back to one or several of the following causes:

- use not within specifications,
- incorrect assembly, commissioning, operation and maintenance of the machine,
- operation with defective protection or safety devices and facilities,
- non-compliance with instructions and notes in these operating instructions and in the documents herein referred to,
- transport damage,
- unauthorized modifications to hardware or software,
- insufficient maintenance and monitoring of wear parts,
- in events of disaster by impact of foreign objects and acts of God.

6. EC Declaration of Conformity

The design of the machine:

Hydraulic brake control system BCS-600
Serial Number : 4456-600XXX-XXXXXX

has been developed and manufactured in accordance with the specified EC directives, under the responsibility of:

RINGSPANN GmbH
Schaberweg 30-38
61348 Bad Homburg

We hereby declare that the above named product complies with all relevant provisions of the Machinery Directive 2006/42/EC.
The following EC directives have been applied:

2006/42/EC Machinery

2006/95/EC Low voltage electrical equipment

2004/108/EC Electromagnetic compatibility

97/23/EC Pressure equipment

The following harmonized standards have been applied:

DIN EN 294 Safety of machinery; safety distances to prevent danger zones from being reached by the upper limbs

DIN EN 349 Safety of machinery; minimum gaps to avoid crushing of parts of the human body

DIN EN 376 Calibration of force measurement devices

DIN EN 954-1 Safety of machinery; safety-related parts of control systems

DIN EN 982+983 Safety of machinery; technical safety requirements on technical fluid systems and their components; Hydraulics

DIN EN 1037 Safety of machinery; avoiding unexpected start-up

EN ISO 12100-1 Safety of machinery; basic terms (formerly 292-1)

EN ISO 12100-2 Safety of Machinery; Technical principles (formerly 292-2)

DIN EN 50274 Low voltage switchgear combinations

DIN EN 60204-1 Electrical equipment of machines (VDE 0113 T1)

DIN EN 60439 Low voltage switchgear combinations

DIN EN 61000-6-1 Electromagnetic compatibility

DIN EN 61558-2-17 Switch mode power supplies

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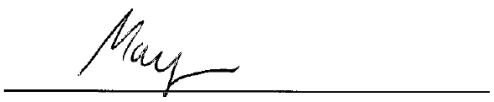


Bad Homburg, 30.05.2014

7. General description

Fig. 2

The brake control system does not include its own brake. It is only possible to connect and then control external brakes.
The system consists of two essential components. The top switch cabinet contains the electric control system with different configuration levels.

Operation Button Service Key ENABLE Button (option)

STOP button (option) Touch panel (option) DISABLE Button (option)

Fig. 4

The lower switch cabinet contains the hydraulics, required for the operation of the brake system. Optionally, additional hydraulic accumulators can be connected externally.

Fig. 5

7.1 Hydraulic circuit diagrams

These are standard designs. To find the exact parts we need to know the part number stated on the name plate at the side of the terminal box. You may also look in the appendix for a special hydraulic circuit plan.

7.1.1 Hydraulic circuit diagram for passive brakes (spring applied)

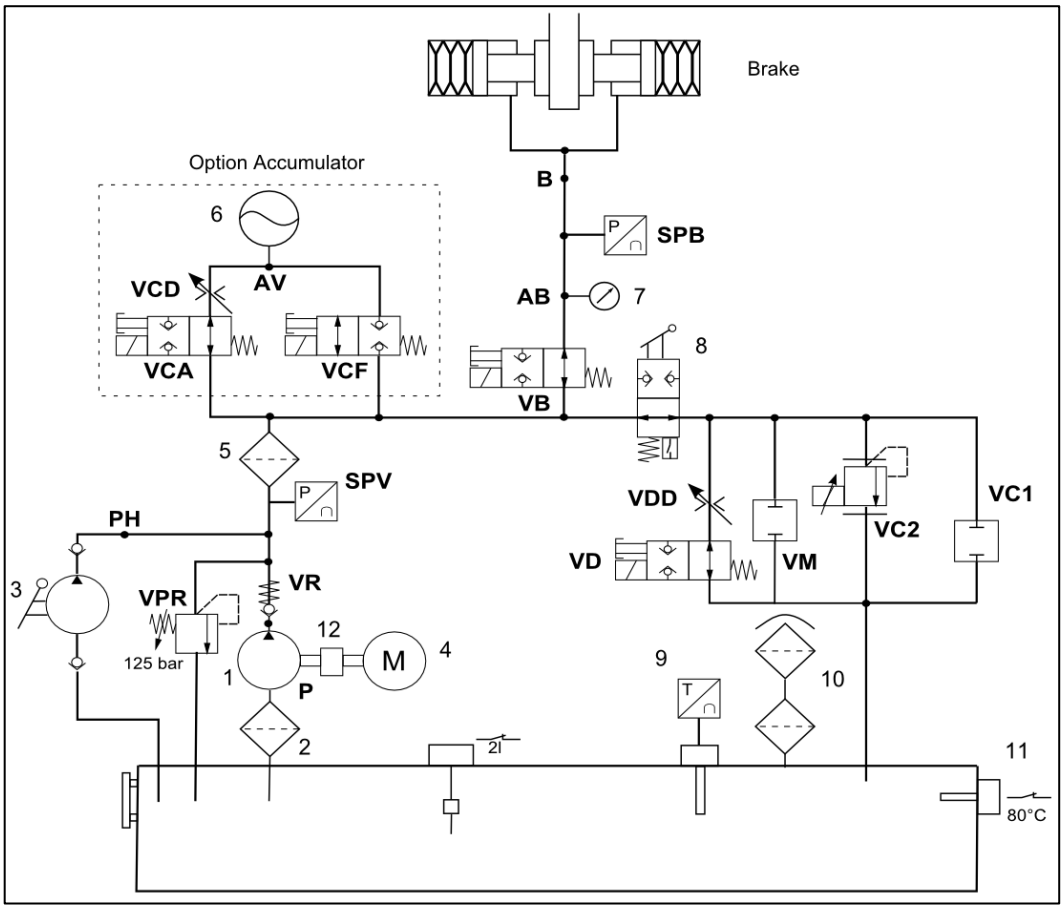


Fig. 6

1. Hydraulic pump, part no.: 3515-001001-000000
2. Intake filter, part no.: 3515-001057-000000
3. Manual Pump, part no.: 3515-001051-000000
4. Motor, part no.: 3515-001014-000000 for 230VAC, others see type code
5. High pressure filter, part no.: 3515-001005-000000
6. Accumulator, part no.: see type code and pre-charge pressure (option)
7. Pressure gauge, part no.: 3515-001010-000000
8. Ball valve, part no.: 3515-001018-000000
9. Level and temperature sensor, part no.: 3515-001016-000000
10. Filling and filter, part no.: 3515-001045-000000
11. Temperature switch off
12. Coupling, part no.: 2785-025607-000000

VPR: Pressure Limiting valve, part no.: 3515-001008-000000

VR: Non-return valve, part no.: 3515-001009-000000

VCA: plug, part no.: 5017-020002-000000 (if no accumulator)

VCD: plug, part no.: 5017-020002-000000 (if no accumulator)

AV: plug, part no.: 5017-013303-000000 (if no accumulator)

VCF: plug, part no.: 5017-020002-000000 (if no accumulator)

SPV: Pressure sensor, part no.: 3515-001015-000000

SPB: Pressure sensor, part no.: 3515-001015-000000 (if pressure sensor is mounted to the brake, then plug 5017-013303-000000 is used)

VB: Switching valve and coil, part no.: 3515-001002-000000, 3515-001003-000000

VM: Dummy valve, part no.: 3515-001037-000000

VD: Switching valve and coil, part no.: 3515-001022-000000, 3515-001003-000000

VC1: Prop. Pressure limiting valve

VC2: Prop. Pressure limiting valve

Option Accumulator, plugs are replaced with:

VCA: Switching valve and coil, part no.: 3515-001002-000000, 3515-001003-000000

VCD: Choke, part no.: 3515-001021-000000

AV: pipe and accumulator, part no.: 3515-001031-000000, accumulator see type code and pre-charge pressure

VCF: Switching valve and coil, part no.: 3515-001022-000000, 3515-001003-000000

7.1.2 Hydraulic circuit diagram for active brakes (hydraulic applied)

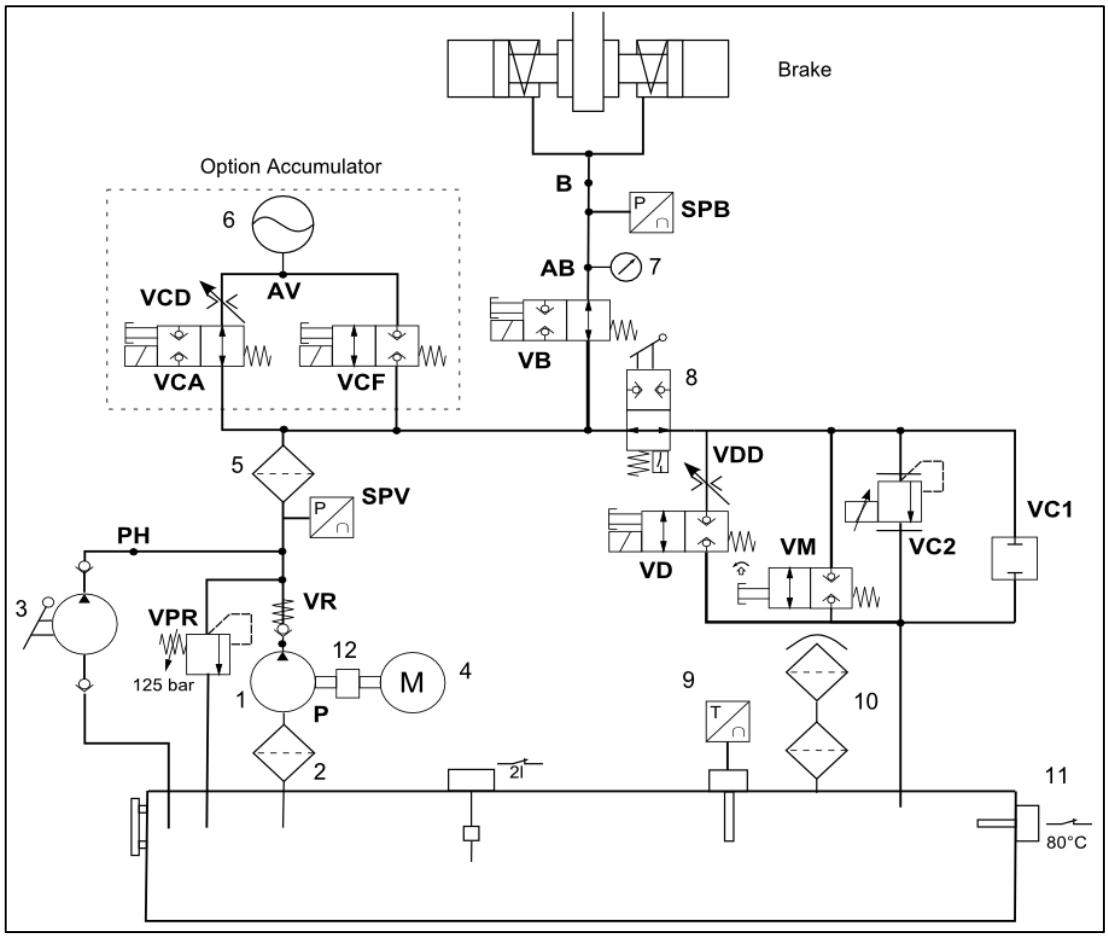


Fig.6

1. Hydraulic pump, part no.: 3515-001001-000000
2. Intake filter, part no.: 3515-001057-000000
3. Manual Pump, part no.: 3515-001051-000000
4. Motor, part no.: 3515-001014-000000 for 230VAC, others see type code
5. High pressure filter, part no.: 3515-001005-000000
6. Accumulator, part no.: see type code and pre-charge pressure (option)
7. Pressure gauge, part no.: 3515-001010-000000
8. Ball valve, part no.: 3515-001018-000000
9. Level and temperature sensor, part no.: 3515-001016-000000
10. Filling and filter, part no.: 3515-001045-000000
11. Temperature switch off, part no.: 3515-001011-000000
12. Coupling, part no.: 2785-025607-000000

VPR: Pressure Limiting valve, part no.: 3515-001008-000000

VR: Non-return valve, part no.: 3515-001009-000000

VCA: plug, part no.: 5017-020002-000000 (if no accumulator)

VCD: plug, part no.: 5017-020002-000000 (if no accumulator)

AV: plug, part no.: 5017-013303-000000 (if no accumulator)

VCF: plug, part no.: 5017-020002-000000 (if no accumulator)

SPV: Pressure sensor, part no.: 3515-001015-000000

SPB: Pressure sensor, part no.: 3515-001015-000000 (if pressure sensor is mounted to the brake, then plug 5017-013303-000000 is used)

VB: Switching valve and coil, part no.: 3515-001002-000000, 3515-001003-000000

VM: Manual valve, part no.: 3515-001033-000000

VD: Dummy valve, part no.: 3515-001037-000000

VC1: Prop. Pressure limiting valve

VC2: Prop. Pressure limiting valve

Option Accumulator, plugs are replaced with:

VCA: Switching valve and coil, part no.: 3515-001002-000000, 3515-001003-000000

VCD: Choke, part no.: 3515-001021-000000,

AV: pipe and accumulator, part no.: 3515-001031-000000, accumulator see type code and pre-charge pressure

VCF: Switching valve and coil, part no.: 3515-001022-000000, 3515-001003-000000

8. Workplace

The control system is not designed as a permanent workplace for an operator. If a continuous manual on-site operation is intended, the system operator must set up a workplace which has been appropriately fitted out. This is not at the discretion of the manufacturer.
In connection with the operation, commissioning and maintenance an easy and nonhazardous accessibility of the system must be ensured.

9. Instruction and training of operating personnel

Before commissioning, the installation, operation, service and repair personnel must be instructed in the operation and setup of the plant.

10. Setup, fitting and connection

10.1 Setup and fitting

The system must be set up such that it is protected against the weather. It must be protected against rain or direct sun radiation. Spray water must also be absolutely avoided.
The system must be aligned vertically. Here, the electrical switch cabinet is located at the top, and the switch cabinet with the hydraulics supply is located at the bottom. Both switch cabinets are permanently interconnected. The system must be fitted to the wall by means of its rear wall (see typical switch cabinet mounting points in Fig. 8).

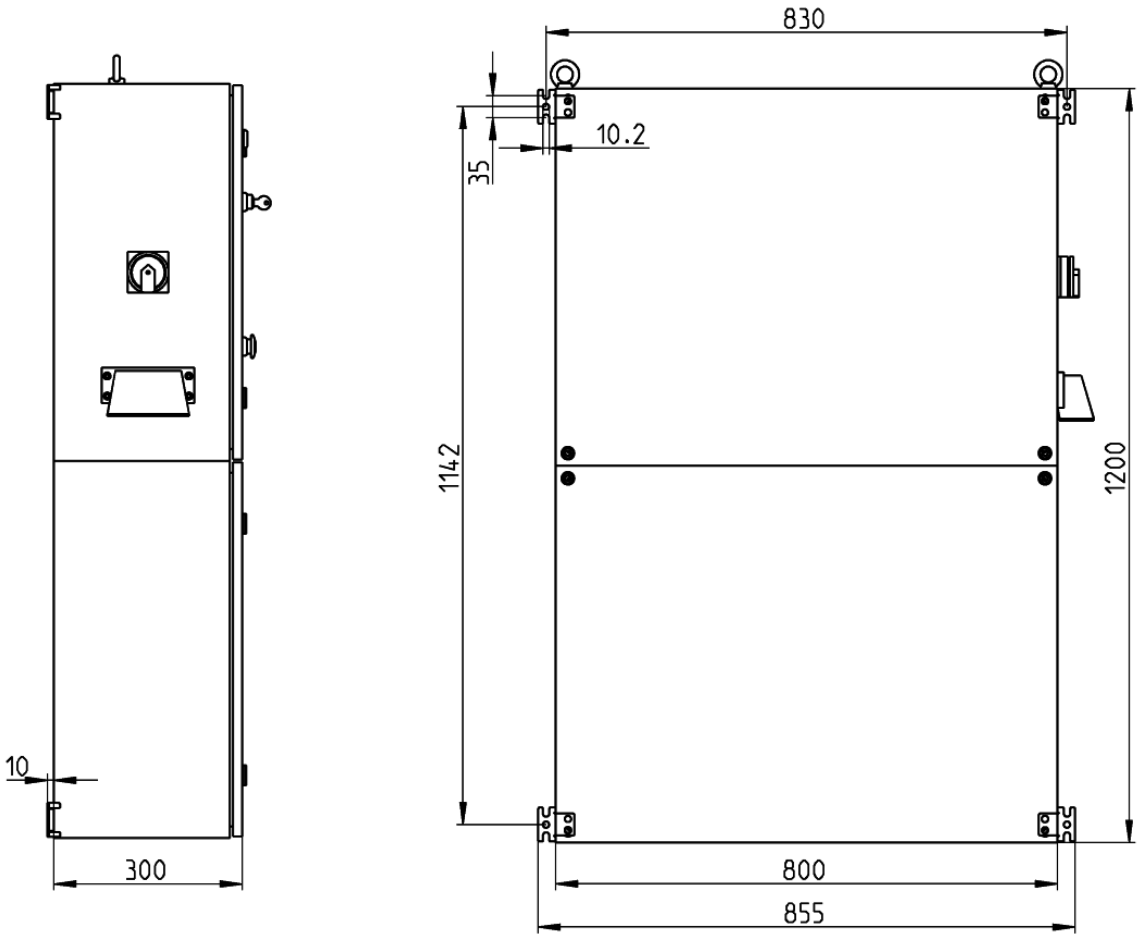


Fig. 8

10.2 Electrical connection

The electrical connection and all work on the electrical switch cabinet are to be carried out by trained specialist personnel only.

10.2.1 Power connection

The system can handle different voltage ranges and frequency ranges.

At the request of the customer, the manufacturer of the system adapts the system to the respective operating point.

The following operating points are supported:

- 110 V / 1-phase / 60 Hz
- 230 V / 1-phase / 50 Hz
- 230 V / 1-phase / 60 Hz
- 400 V / 3-phase / 50 Hz
- 400 V / 3-phase / 60 Hz

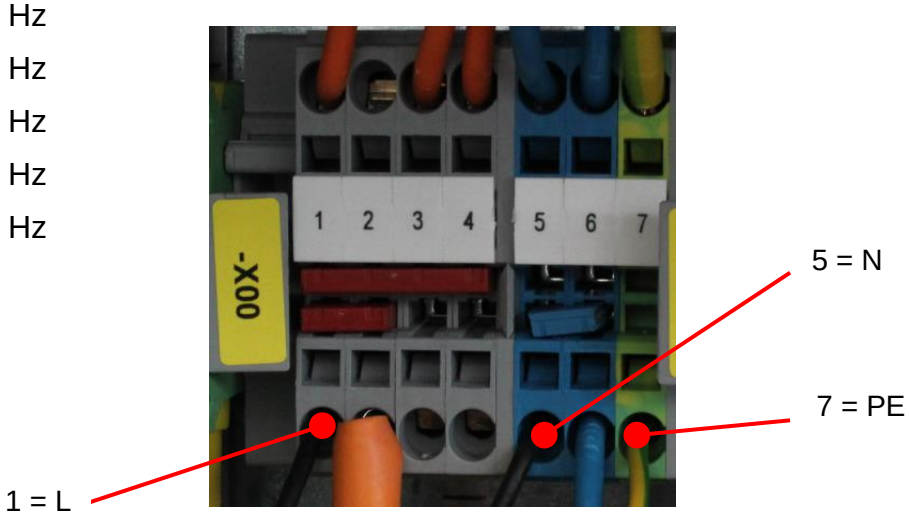


Fig. 9

Exceptional case is the 110VAC supply voltage. In this special case RINGSPANN has to use a 110VAC-motor for the hydraulic pump.
The supply voltage is connected to the terminal section X00. You can see the 230VAC connection in the Fig. 9 (see also page 1 of the Appendix).

10.2.2 Signal Exchange

Beside the fieldbus communication hard wired contacts are used:

- **External release** (High level signifies release)
- **System Ready** (High level corresponds to the state: brake control system is ready for braking)
- **System Fault** (High level corresponds to the state: no system-critical faults)

These contacts you can find in terminal section X50 in the electric switch cabinet.

External release:

The system requires an external release. This is implemented as a 24 V potential-free contact.
The external release signal is connected in terminal section X50 on terminal block 5.1 and 5.2. See also page 2 in the Appendix.

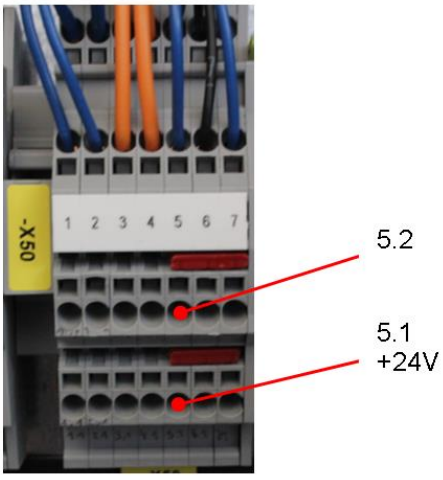


Fig. 10

System ready:

For selecting the state “System Ready” a voltage signal is connected in terminal section X50 on 3.2 by the customer. This voltage signal can be used from the customer in terminal section X50 on 3.1 for his external logical control. See also page 2 in the Appendix.

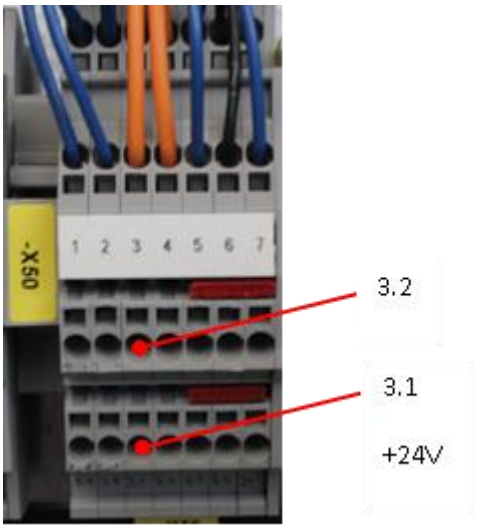


Fig. 11

System fault:

For selecting the state “System Fault” a voltage signal is connected in terminal section X50 on 4.2 by the customer. This voltage signal can be used from the customer in terminal section X50 on 4.1 for his external logical control. See also page 2 in the Appendix.

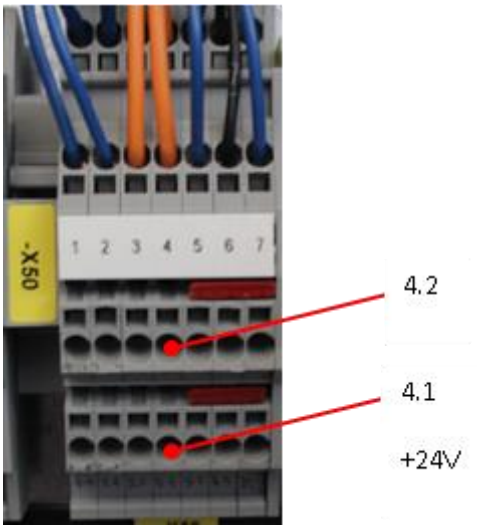


Fig. 12

Option: Local release

As an option the release can be implemented locally by a self-releasing contactor. This is provided by the manufacturer.
In this case nothing further needs to be done during commissioning.

Fig. 13

10.2.3 Option: Uninterruptible power supply

The system can be equipped with an uninterruptible power supply (UPS). The commissioning engineer does not need to take any measures. However, with the system switched off, a residual voltage in the 24 V circuit is to be expected.

The UPS is generally intended for one controlled braking action if there is an electric power failure. Therefore it provides electric power for at least 3 minutes. The UPS is not designed to keep the system running. If you need longer battery time please consult RINGSPANN.

10.2.4 Option: External control system

For integration into a superordinate control system the optional interface is to be considered.
The following field buses are supported:

- EtherCAT,
- Profibus,
- CANOpen

EtherCAT:
The customer has to connect the external control with the bridge terminal (EL6692, 8K7.2) via Ethernet cable (patch cable). Socket RJ45 (X1, Input).

Profibus:

The customer has to connect the external control with the slave terminal (EL6731-0010, 8K7.2). Interface: D-sub socket, 9-pin, galvanically decoupled

CANopen:
The customer has to connect the external control with the slave terminal (EL6751-0010, 8K7.2). Interface: D-sub connector, 9-pin according to CANopen specification, galvanically decoupled.

10.2.5 Rotary encoder

A rotary encoder must be connected by all means. This can be executed as INI or as an incremental encoder. In accordance with the target speed of the system, a sensor with a corresponding resolution is to be selected.
Sensors with 5 or 24 V impulse signal with A and B channel are supported.
For connection details see page 3 in the Appendix.

10.2.6 Option: Second rotary encoder

The system can be equipped with a second speed signal. The connection will then be effected in analogy to section 10.2.5, details on page 3 in the Appendix. The second speed signal can be used to watch a drive system, or it is possible to check wether the first speed signal is still working.

10.2.7 Option: Opening contacts of brakes

For position feedback of the brake calipers, INIs can be integrated. For each brake caliper up to 2 INIs are supported. As the system knows the number of brake calipers and their required number, all INIs are to be connected.

A high level of the signal corresponds to the open state of the brake. For connection details see page 4 in the Appendix.

10.2.8 Option: Force and torque sensor

Optionally, a force or torque sensor can be integrated into the system. The following connection data shall be observed:

- DMS supply: 10 V
- DMS version: Full bridge
- connection option: 4 conductors + 2x sense wire

For connection details see page 5 in the Appendix.

10.2.9 Option: Wear detection on the brakes

There are two different systems:

- INI contact,
- earthing contact

Only one contact will be supported. In the case of several brake callipers to be monitored the signals shall be connected in series by the system operator. For connection details see page 4 in the Appendix.

10.2.10 Option Integration into the external safety circuit

The optional integration into an external safety circuit is effected via two potential free contacts.

If no external safety circuit is integrated, the contacts must be bridged by the manufacturer.

The integration of the external safety circuit is done via terminal section X50, 1.1 and 1.2. For connection details see page 2 in the Appendix.

10.2.11 Sealing of the cable entry point

On completion of the cabling, the cable entry point must be sealed. Cable entry point sleeves by Icotec are suitable for this purpose.

10.3 Hydraulic connection

The unit is supplied in an empty state. The equipment corresponds to the ordered options. In terms of valve technology, the system is pre-equipped. The customer does not need to carry out any valve technology measures.

10.3.1 Connection of the brake

Work to be undertaken comprises: the oil filling, connection of the external brake system (pressure line). Only one brake system can be connected to the unit at any one time. If necessary, a connection to the tank is also possible.
Here, a brake system can comprise several brake calipers. The hydraulic connection P to the hydraulic cabinet is done at a bulkhead fitting XSV NW 08 HL (DIN 2353, ISO 8434-1), External thread M16x1,5. If necessary, a pipe to the tank can be connected over T at a a bulkhead fitting XSV NW 10 HL (DIN 2353, ISO 8434-1), External thread M18x1,5.

Fig. 14

10.3.2 Basic setting of the pressure limiting valve

The pressure limiting valve (VPR) is supposed to have been preset already by the manufacturer. This must be checked during the course of commissioning by the commissioning engineer.

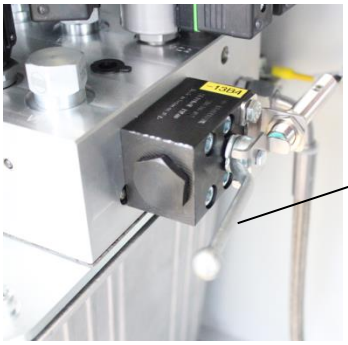
Fig. 15

10.3.3 Filling and venting

The unit will be supplied in a clean state and can be filled directly. Filling can be observed via the sight glass directly on site. The unit should be filled up to the top edge of the sight glass. To fill the tank we need about 18l hydraulic oil (with the brakes and pipes 20l should be available when commissioning). Alloyed mineral oil, Group HLP46 as defined in DIN 51525, or API class SC, SD or SE may be used as pressure fluid (see also chapter 11.1.2).

sight glass

oil filler



ballcock

Fig. 16

Subsequently, the system can be vented.

Venting with a brake control system for spring applied brakes (fail save condition = no pressure):

Close the ballcock while turning the lever in upwards position. Create an artificial leak point close to the brake caliper (undoing hydraulic screw connections). Through this leak point air can escape. Using the manual pump, the pressure or volume flow required for venting is built up. If the pressure pipe to the brake and the brake itself is totally vented, close the artificial leak point and the ballcock. Upon further actuation of the manual pump, the hydraulic block is vented. If necessary, the oil in the unit must be replenished (up to the top edge of the sight glass).
The pressure course can be traced on the integrated pressure gauge. For this purpose, the control system is not required. To vent the system totally, you have to build up and release pressure with the hand pump and the ballcock 2-3 times.

Venting with a brake control system for hydraulic applied brakes (fail save condition = pressure):

Create an artificial leak point close to the brake caliper (undoing hydraulic screw connections). Through this leak point air can escape.

Using the manual pump, the pressure or volume flow required for venting is built up. If the pressure pipe to the brake and the brake itself is totally vented, close the artificial leak point.
Upon further actuation of the manual pump, the hydraulic block is vented. If necessary, the oil in the unit must be replenished (up to the top edge of the sight glass).
The pressure course can be traced on the integrated pressure gauge. For this purpose, the control system is not required. To vent the system totally, you have to build up and release pressure with the hand pump and the ballcock 2-3 times.

11 Commissioning / decommissioning

11.1 Commissioning

On completion of the installation work and hydraulic commissioning work, it is recommended to use a check list in order to exclude any faults. After the electric and hydraulic connection of a brake system to the brake control system (as described in detail in Chapter 10) commissioning can now take place.Observe the instructions in the following chapters in the sequence stated.

11.1.1 Inspection of the equipment

The sub-systems

- Electrical and hydraulic connections
- Fuses, motor contactors
- Units

have to be inspected in advance and checked for any damage or leakages.

11.1.2 Hydraulic medium

The hydraulic media to be used exclusively are HLP-46 or media mixable with the same.

11.1.3 Setting the pressure limiting valve

The pressure limiting valve is to be set to a safe pressure for the brake. The critical brake pressure is contained in the documentation of the brake calipers. The pressure limiting valve (VPR) is normally preset by the manufacturer. You can see it, when the setting of the valve is marked with a colored sealing wax. If there is no colored sealing wax on the pressure limiting valve, the pressure to be set at the pressure limiting valve (VPR) should be set within the critical range of the brake caliper.For this purpose, the simplest procedure is as follows:

- The entire system is connected and closed
- The ball cock must be closed (ballcock in upwards position)
- Use the manual pump to pressurize the system

• The pressure build-up should be followed on the pressure gauge. In order to set the correct pressure, screw the pressure limiting valve in step by step, so that the pressure is increased until the required critical pressure has been reached. The pressure thus set (note the characteristic of the pressure limiting valve) should be 10% above the operating pressure of the brake, in order to prevent an early opening of the pressure limiting valve.

• After the pressure limiting valve has been set, open the ball cock.

• Secure the pressure limiting valve by sealing wax.

11.1.4 Plant power supply

The plant is switched on by operating the main switch. The operating state is signaled by the illumination behavior of the pushbutton “Operation". The definition is contained in the section 17.4.

Fig.17

When switched on, the system will not automatically start but go to a fault condition.

11.1.5 Configuration of the brake system

The system is always supplied complete with a pre-configured brake configuration.
Here, no special measures by the commissioning engineer are required. Further service activities are described in Section 17.14.

11.1.6 First activation of the system

The first activation of the system can be effected in service mode; here an external control as release instance would not be required. After setting the service key switch to position 1, you can use the pushbutton “Operation" to acknowledge the fault condition into which the system will always have gone upon switching it on. The system will then set itself to the primary mode described in the configuration. Usually, this will be "Brake open".

Fig.18

11.2 Decommissioning and re-commissioning

Before the system is decommissioned the service engineer must have made sure that the system or the brakes may be deactivated. Depending on the function of the brakes this may cause braking or an opening of the brakes. This must be clarified in advance. When the system has been switched off, the brake system goes to its hydraulic fail-safe state. This is defined by the brake type built in.

The system can be switched off directly by means of the main switch.

A long term deactivation of the system can also be effected by means of the main switch.

In case of the integrated UPS (Option), it should be noted that even though the system has been switched off, it is possible for a limited period of time (set value approximately 3 minutes) that a residual voltage may remain at 24V components.

Re-commissioning after a short-term switch off is non-critical. Ambient conditions (temperature) are to be taken into account. In the case of a longer break in a climatically very cold environment it must be noted that the interior spaces of the switch cabinets (electrical and hydraulic) must be preheated! The re-commissioning engineer must guarantee that there is no condensation forming on the electrical side and that the oil temperature is above 0°C.

Only after the switch cabinets have been pre-heated and condensation prevented, the main switch can be operated.

12 Protective measures / protective equipment

The following protective measures shall be carried out by the system operator:

- Protection against any direct weather impact (sun radiation, rain)
- Protection against any mechanical damage
- Protection against any unauthorized access

In spite of the above-mentioned protective measures the following residual risks remain:

- Scalding on the unit
- Leaking hot hydraulic oil

These residual risks must be counter-acted by means of appropriate instructions and preventive maintenance.

13 Stability during operation / transport / assembly

During transportation the system must be secured sufficiently against tilting over and dropping. Installation shall be carried out by means of corresponding auxiliary lifting devices.
The system must be mounted completely by means of the attachment options provided for this purpose.

A non-attached system must not be operated.

14 Safety notes on Transport / Storage

Transport and storage is only permissible with an empty tank! All hydraulic connections must have been closed externally. The electrical connections must be disconnected in the switch cabinet by specialist personnel. Any GSM aerials possibly connected externally must be removed before transportation and any corresponding apertures must be closed.

During transportation and storage the system must be secured sufficiently against tilting over and dropping. Horizontal transportation or storage is permissible. The system cannot be stacked.

15 Accidents / Faults

An appropriate fail-safe strategy shall be defined by the brake manufacturer. If a fault occurs, appropriate system equipment will cause a transition to a safe state. In order to avoid system faults, preventative maintenance measures must be carried out, Chapter 19.

16 Residual risks

Notes on residual risks are found in Chapter 12.

17 Operation

The system can be operated in different ways:

- Operation without external control system
- Operation without external control system but with local release
- Operation with local monitor
- Operation with external supervisory console

- Operation with external control system
- Service/Manual operation
- Configuration

Before describing the various individual scenarios the basic operating states and procedures are explained.

17.1 Operating states

The operating states define the basic operation of the control system in combination with the system connected. They represent the target for the system.

There are 3 so-called target states that the control system is to achieve:

Primary operating state: This is the default state of the actively operated system. An example of the primary state for conveyor systems is “brake open".

Secondary operating state: The control system will change over to this state if an external request is received. An example of the secondary state for conveyor systems is “brake closed". An external request may be a user stop or a request via the external control interface.

Fail safe operating state: The control system will change over to this state if an internal fault, a monitoring process (e.g. speed) is triggered. An example of the fail-safe state for conveyor systems is “brake closed".

The primary state can only be set by means of a user interaction.

Furthermore, there are so-called initial states. They define the transition to a target state. Example: the system changes over from the primary target state “brake open" to the fail-safe state “brake closed", initiated by a speed ramp.

The following target states are defined:

Brake open: The brake is fully open and is held in this position. By default, the unit is switched off. The brake pressure is monitored and corrected, if necessary.

Brake closed: The brake is fully closed and is held in this position. By default, the unit is switched off. The brake pressure is monitored and corrected, if necessary.

Constant speed: The brake is fully open and is held in this position. By default, the unit is switched off. The brake pressure is monitored and corrected, if necessary. A defined speed is monitored. If the speed exceeds the defined speed minus a tolerance, the control system will become ready to work and will switch on the unit. If the speed exceeds the defined speed, the brake will reduce the speed down to the defined speed. If the control system must brake for longer than the defined period of time, there will be a transition to the fail safe target state. This function can be used for catching temporary load peaks on conveyor systems.

Pressure control: Using the external control interface, nominal brake pressures are defined. If this condition is active for longer than the defined period of time, there will be a transition to the fail safe target state.

Speed control: Using the external control interface, nominal speeds are defined. If this condition is active for longer than the defined period of time, there will be a transition to the fail safe target state.

Torque control: Using the external control interface, nominal braking torques is defined. If

this condition is active for longer than the defined period of time, there will be a transition to the fail safe target state. This condition is meaningful only in combination with a torque measurement.

The following initial states are defined:

Nothing: No initial state is defined. There will be a direct changeover to the new target state. There is no controlled braking or monitored acceleration.

Speed ramp up: Limiting controlled speed ramp up to a defined initial speed. For instance in the case of conveyor systems in order to accompany them to an optimum speed range produced by an external drive. The definition of the ramp is effected by means of a target speed and the specification of a ramp time. Furthermore, the ramp can be initiated optionally by means of a pressure ramp. Here, a brake pressure is set by means of a target pressure and a ramp time. Subsequent to the pressure ramp, there follows the speed ramp.

Speed ramp down: Controlled speed ramp down to a defined final speed (usually 0 rpm). The specification of the ramp can be effected by means of the following parameters:

- Target speed, ramp time
- Target speed, acceleration
- Target speed, revolutions

The current speed is used as a start value for the calculation of the ramp. In order to provide for a jolt-free stop a second speed ramp can be defined. This is defined by the parameters:

- start speed
- end speed (usually 0 rpm)
- ramp time.

As a rule, this ramp should be flatter than the main ramp. If a speed lower than the start speed is detected, the second ramp will be executed.

17.2 Brake system monitoring

In addition to the conscious initiations of changes in operating state by a user request or the external control system, the control system is able to carry out braking independently. These are triggered by signal- or self-monitoring. There will be an automatic change over to the fail safe state, prepared by an initiating state if necessary.

The following monitoring can be activated within the configuration file:

Monitoring the rotational direction: The rotational direction is monitored. A positive speed signal is considered to be a valid rotational direction. A tolerance for a negative rotational direction can be defined. If this tolerance is exceeded, this monitoring process will be executed. Parameters:

- Tolerance: Defines a permitted negative rotational direction.

For this function a rotary encoder complete with rotational direction detection is required.

Speed limitation: The speed is monitored independent of rotational direction. The reaction is effected in two steps. Initially, a warning will be issued from a certain specific warning speed onwards. A superordinate control system can respond to this. In a second stage, from a certain specific fault speed onwards, there will be a changeover to the fail-safe target state. Parameters:

- Warning speed
- Fault speed

External safety circuit: The system is integrated in a two-channel external safety circuit, e.g. emergency stop. If this drops, there will be a changeover to the fail-safe target state.

Fast stop: If a fast stop pushbutton has been installed, its operation will cause a changeover to the fail-safe target state.

Speed difference: If a second speed sensor has been installed and if a speed difference is detected which is larger than the tolerance specified, there will be a changeover to the fail-safe target state. Parameters:

- Tolerance, speed difference

Position in stop state: In the target state Brake closed the position of the brake is monitored. If the deviation of the position is greater than the tolerance to be set, then a fault message will be issued to the external control system. Parameters:

- Tolerance, position deviation

Monitoring of spring force: This monitoring process can only be used for passive spring-operated brakes. Here, the opening pressure of the brakes is monitored in order to be able to detect a weakened or defective spring. INIs for detecting the state of the brakes (open / closed) must be built into the system. Parameters:

- Opening pressure warning
- Opening pressure fault

A warning will be issued if the first INI signals the state “Brake open" and the brake pressure is less than the defined warning pressure. If the brake pressure is below the fault pressure, there will be a changeover to the fail-safe target state.

17.3 Time monitoring, brake operation

As it is not possible on the basis of a brake operation and the overall system constellation to draw conclusions as to the brake performance rendered and thus to the heating-up of the brake, the target or initiating states, where the unit is active, are limited to a time range of 60s maximum. This is to prevent an overheating of the brake.

Depending on the state, this timeout can be limited further by a configuration parameter.

17.4 System states

The so-called system states describe the current state of the system. The system state may correspond to the desired operating state. However, it may deviate due to faults or other system parameters.

The following system states are defined:

Start-up: Starting the system. The control system waits for the initialisation of the hardware. The unit is deactivated. No user action required. Operation
LED status: System not ready

Wait: The system waits for the external or optional local release. The unit is deactivated. In the case of a local release, this must be given by the operator.
Operation LED status: System not ready

Prepare: The external or optional local release was granted. If a hydraulic accumulator (AV) has been installed, this will be pre-filled. The unit is active. No user action required. Operation
LED status: System not ready

Ready: Intermediate state. The unit is active. No user action required. Operation
LED status: System not ready

Active: Intermediate state. The unit is active. No user action required. Operation
LED status: System not ready

Ramp up: Initial state. The unit is active. No user action required. Operation
LED status: System operates / triggered

Ramp down: Initial state. The unit is active. No user action required. Operation
LED status: System operates / triggered

External specification: Target state. Setpoint specification for pressure, speed or torque by an external control system. The unit is active. No user action required. Operation LED status: System operates / triggered

Brake clean: Intermediate state. The unit is active. No user action required. This state is used for cleaning the brake discs or brake pads. Here, the brake will be lightly applied for a short period of time. After cleaning, the control system will return to the previous target state. This state is initiated when the control system is in the target state

- “Brake open"
- “Constant speed" (if the unit is not active)

and when the brake cleaning is active.

The state is defined by:

- Brake pressure: Pressure to which the system regulates by means of a pressure ramp. Here, a brake pressure should be set which causes the brakes to apply a slight clamping force.
- Interval: In this interval, the system attempts to clean the brake.
- Minimum speed: If the speed underruns this value, cleaning will not be started or will be cancelled, respectively.
- Duration: After the defined period of time, cleaning is terminated. Maximally 60 s are possible.

The unit is active. No user action required. Operation LED status: System operates / triggered.

Brake closed: This system state corresponds to the target state “Brake closed".

The unit is deactivated. No user action required. If this state is the primary target state, then the operation LED indicates the status : System in primary state. Otherwise, the operation LED status is: System operates / triggered.

Brake open: This system state corresponds to the target state “Brake open". The unit is deactivated. No user action required. LED status: System in primary state.

Constant speed: This system state corresponds to the target state “Constant speed". No user action required. If the unit is inactive, then the operation LED status is: System in primary state. Otherwise, the operation LED status is: System operates / triggered.

Critical error: A system fault has been identified which causes the system to be incapable of carrying out any function in a controlled manner. The system is in a hydraulic fail-safe state. The unit is deactivated. A fault removal is required. Operation LED status: System fault.

Manual operation: In this state valve tests and pressure control settings can be carried out.

Before it enters into this state, the system operator must safeguard the system, i.e. ensure a safe operation even without the brake being ready to operate. The unit can be active. User action required. Operation LED status: System not ready.

Jolt-free stop: In the initial state, the jolt-free stop is activated. Thus, a second speed ramp follows. The unit is active. No user action required. Operation LED status: System operates / triggered

17.5 Indication of the system states

The system state is indicated by means of the graphical user interface 17.16 or via the LED of the operation button 12.

The state is indicated by flashing (basic frequency 0.5 Hz). Here, the meaning is as follows:

System off: 0 per cent on, 100 per cent off

System not ready: 50 per cent on, 50 per cent off

System operates / triggered: 80 per cent on, 20 per cent off, explanation: The unit operates or is in its secondary state or fail-safe state.

System in primary state: 100 per cent on, 0 per cent off

System fault: 20 per cent on, 80 per cent off

17.6 Fault messages

In principle, 3 message categories are differentiated

Information**:**

These messages serve for information purposes only. The brake control system does not carry out any reaction as a result of such messages. A reaction is not required either for the operator or an external control system.

Warning:
These messages indicate an operationally non-critical fault of the brake control system or that a monitoring process of the brake has been triggered. The brake control system does not carry out any reaction as a result of such messages. For the operator or an external control system, these messages should trigger a non-time-critical action.

Fault:
These messages indicate an operationally critical fault. Such faults may comprise monitoring of the brake state as well as internal faults of the brake control system. If a monitoring device triggers the fault, there will be a changeover to the fail-safe target state. If the fault is detected within the brake control system, this may cause an uncontrolled braking depending on the actual fault (e.g. valve or fieldbus failure). This depends on the hydraulic fail-safe behaviour of the brake control system.

Information:

VPN is active / Remote service (VPN) is active

User triggers fast stop / User triggers fast stop

External Safety circuit released / External Safety circuit is released (External Brake Command)

Service mode active / service mode is active

Nominal system load reached / nominal system load is reached

Speed difference detected / speed difference is detected

Speed limit reached / speed limit is reached

Speed reversion detected / speed reversion is detected

Passive force brake warning / spring force diminishes

Timeout speed constant / timeout speed constant is reached

USV loading / USV is loading

Warning:
Warning valve pressure control (VC1) / warning valve pressure control (VC1)

Warning valve pressure control (VC2) / warning valve pressure control (VC2)

Level switch warning / check oil level

Diffision by zero / Check configuration

Max brake load reached / max brake load reached

Max brake pressure reached / max brake pressure reached

Emergency supply / emergency supply

Oil temperature is high / oil temperature is high

Position movement failure / position movement failure

Passive force brake failure / spring force diminishes

External mode failure / external mode failure

Speed warning / speed getting critical

Speed constant brake active / the brake is active during speed constant

Speed sensor 1 failure / speed sensor 1 failure

Speed sensor 2 failure / speed sensor 2 failure

Fault:
USV alarm / check USV

USV Battery usage / check USV and electric power supply

Fuse cabinet heating / check Fuse and cabinet heating

Fuse hydraulic pump / check fuse motor

Fuse 24V power supply / check Fuse 24V and connected devices

Check oil level, oil temperature / check Oil level/temperature, refill oil and check system against leakage

Oil temperature sensor defect / check sensor and sensor wiring

Force sensor overrange detected / check sensor

Force sensor error detected / check sensor and sensor wiring

Brake max wear level reached / check brake pads and if necessary replace brake pads

Error 2/2 valve pressure control / check cable to valve VCA

Error 2/2 valve brake / check cable to valve VB

Error 2/2 valve fast fill / check cable to valve VCF

Error valve pressure control 1 / check cable to valve VC1

Error valve pressure control 2 / check cable to valve VC2

EtherCAT failure / check fieldbus

System configuration failure / system configuration failure

EtherCAT bus incomplete / check fieldbus

Brake mode failure / brake mode failure

Oil temperature is too high / oil temperature is too high

Pressure is too high / oil pressure is too high

Oil supply failure / oil supply failure

Accufill failure / accufill failure

Brake open failure, brake open failure

Error 2/2 valve drop / check cable to valve VD

External interface lost / external interface lost

Max active brake time reached / max active brake time reached

17.7 Integration into a network of the system operator

The integration into a system operator network requires the configuration of the network interface of the control computer. This is carried out by means of Linux configuration commands.

The computer can always be reached under the IP address 192.168.2.2.

For configuration, a log-in as administrator by means of SSH (Putty) is required:

- User: root
- Password: Must be obtained from the manufacturer

Using the configuration tool yast, the new interface configuration must be carried out.

The subnet 192.168.0.X is pre-allocated for remote maintenance purposes. If a colliding configuration should be required, please contact the manufacturer.

17.8 Integration into an external control system

The brake control system can be integrated into a superordinate control system by means of a fieldbus.

The following fieldbuses are available for selection:

- EtherCAT
- Profibus
- CANOpen

The brake control system will in each case function as a fieldbus slave. An interface definition (e.g. GSD file) must be supplied to the system operator by the manufacturer.

In general the interface for the superordinate control system is independent of the fieldbus used.

17.8.1 Interface: Actual brake values to external control system

In the following, the values are described which are provided by the brake control system to the external control system.

Designation	Type	Scaling	Range	Description
System Ready	uint8	-	0,1	0-System is not ready, 1-System is ready
Messages Information	uint32	-	-	Bit mask of the messages of type Information, see Chap. 17.8.6
Messages/Warning	uint32	-	-	Bit mask of the messages of type Warning, see Chap. 17.8.6
Message faults	uint32	-	-	Bit mask of the messages of type Fault, see Chap. 17.8.6
Primary state	uint8	-	-	Actual value of the primary state, see Chap. 17.8.3
Secondary state	uint8	-	-	Actual value of the secondary target state, see Chap. 17.8.3
Active state	uint8	-	-	Actual value of the current system state, see Chap. 17.8.3
Wear brake	uint8	-	0,1	0-Wear points not reached, 1-Wear point reached
Position brake	uint16	-	-	Bit mask of the brake position monitoring, see Chap. 17.8.5
Speed brake	uint16	0.1 rpm	-	Actual speed of the brake.
Torque brake	uint32	1 Nm	-	Actual torque of the brake
Pressure brake	uint16	0.1 bar	-	Actual value of hydraulic brake pressure
Pressure supply	uint16	0.1 bar	-	Actual hydraulic supply pressure

17.8.2 Interface: Nominal values for the external control system to the brake control system

In the following, the values are described which are provided by the brake control system to the external control system.

Designation	Type	Scaling	Range	Description
External control	uint8	-	0,1	0-no control for brake control system, 1-Control of brake control system
Messages / Acknowledgement	uint8	-	0,1	0-inactive, 1-Acknowledge error messages, Change from fail-safe target state into the primary mode
primary	uint8	-	-	nominal value of external primary target state, see Chap. 17.8.4
secondary	uint8	-	-	external secondary target state, see Chap. 17.8.4
speed	uint16	0.1 rpm	-	speed, brake control system
Torque	uint32	1 Nm	Torque	
Brake pressure	uint16	0.1 bar	Brake pressure	

17.8.3 Target states, external interface

The following target operating states (explanations in 17.4) are defined in external operation:

State	Nummer
Not a valid state	0
Speed ramp down	1
Speed ramp up	2
Speed limitation (Trigger)	3
Speed reversion detected (Trigger)	4
Jolt-free stop	5
Jolt-free acceleration	6
External speed specification	7
External Torque specification	8
External pressure specification	9
Brake closed	10
Brake open	11
User stop triggered (Trigger)	12
Constant speed	13
Brake clean	14
External safety curcuit triggered (Trigger)	15
Speed difference (Trigger)	16
Position in stop state (Trigger)	17
Monitoring of spring force (Trigger)	18
Pressure Ramp to start braking	19

The target states are realized through system states. States marked with “Trigger” introduce a change from primary state into secondary state.

17.8.4 Specification of state

By means of an external interface the following state specifications can be made.

State	number
Specification Speed	7
Specification Torque	8
Specification Pressure	9
Brake closed	10
Brake open	11
Constant speed	12

Other values are ignored by the control system.

17.8.5 Position monitoring

The position monitoring is provided via a value of type uint16. Here, it is possible to monitor maximally 8 closed brakes with 2 cylinders each.

$$n_{Brakes} \times n_{cylinde} = value$$

Example for 1 brake with 2 cylinders:

$$1 \times 2 = 2$$

1	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0
0															15

17.8.6 Bit mask of error messages

Information

ID	Message	Bitposition
0	VPN active	0
8	User triggers fast stop	1
9	External Safety circuit released	2
10	Service mode active	3
26	Nominal system load reached	4
27	Max Brake load reached	5
42	Passive force brake warning	6
45	UPS loading	7

Warnings

ID	Message	Bitpos
1	USV alarm, Check usv	0
2	USV Battery usage, Check supply	1
3	Fuse cabinet heating, Check fuses	2
4	Fuse Hydraulic pump, Check fuses	3
7	Brake max wearlevel reached, Check brake	4
11	Oil temperature sensor defect	5
12	Force sensor overange detected	6
13	Force sensor error detected	7
14	Error 2/2 valve pressure control	8
15	Error 2/2 valve brake	9
16	Error 2/2 valve fast fill	10
17	Warning valve pressure control 1	11
19	Error valve pressure control 1	12
23	Levelswich Warning, Check Oillevel	13
25	Diffision by zero, check config	14
28	Max Brake pressure reached	15
32	Speed difference detected	16
33	Speed limit reached	17
34	Speed reversion detected	18
36	Oil temperature is high	19
38	Accufill failure	20
40	Error 2/2 valve drop	21
41	Position movement failure	22
48	External Mode failure	23
50	Speed warning	24
51	Speed constant Brake active	25
52	Speed sensor 1 failure	26
53	Speed sensor 2 failure	27

Errors

ID	State	Nummer
5	Fuse 24V power supply, Check fuses	0
6	Check oil level, oil temperature	1
18	Error valve (VC1)	2
20	Error valve (VC2)	3
21	EtherCAT failure, Check Fieldbus	4
22	System configuration failure	5
24	EtherCAT bus incomplete, Check Fieldbus	6
29	Brake mode failure	7
30	Oil temperature is too high	8
31	Pressure is too high	9
35	Emergency supply	10
37	Oil supply failure	11
39	Brake open failure	12
43	Passive Force brake error	13
44	Timeout speed constant	14

46	Ballvalve switch position	15
47	External Interface lost	16
49	Max active Braketime reached	17

17.9 Operating without any external control system

17.9.1 Boundary conditions

- The system is not connected to an external control system by means of a fieldbus
- The system does not have an operating panel
- The system has an external voltage supply
- The system has an external release contact
- The external signal contacts are connected

17.9.2 Switching on

Switching on is effected as described in Section 11.1.4. By default, the system enters a fault condition. This is indicated by the operation LED 17.5 **State System error**. Via the external signal contacts, the following signals are issued:

- Ready: Low signal (not ready)
- Error: Low signal (error is present)

The errors must be acknowledged. This is affected by operating the operation button. Following acknowledgement of the error messages the operation LED should indicate the state **System not ready**. If the system remains in the state **System error**, an internal error exists. In such a case the service department must be contacted. If there is no error, the control system waits inactively for external release.

17.9.3 External release

If an external release is granted by means of a high level, the system will check whether any possibly installed accumulators need to be filled. The operation LED continues to show the state **System not ready**. When the pre-filling has been completed, the system changes over to the primary target state and a corresponding initial state. Via the external signal contacts, the following signals are issued:

- Ready: Low signal (not ready)
- Error: High signal (no error)

17.9.4 Operation

In operation no action by the operator is required. The operation LED continues to show the state **System in primary state**. Via the external signal contacts, the following signals are issued:

- Ready: High signal (ready)
- Error: High signal (no error)

17.9.5 Change of state

If due to a monitoring process 17.2 a change of state (if necessary, a brake operation) is initiated, the system will remain in the corresponding target state. The operation LED continues to show the state **System operates / triggered**. Via the external signal contacts, the following signals are issued:

- Ready: High signal (ready)
- Error: High signal (no error)

17.9.6 Return jump to the primary target state

In order to be able to access the primary target state (as a rule, “Brake open"), the operator must press the button “Operation". The operation LED continues to show the state **System operates / triggered**. Via the external signal contacts, the following signals are issued:

- Ready: High signal (ready)
- Error: High signal (no error)

When the target state has been reached, the behaviour is as described in Chap. 17.9.4.

17.9.7 Errors

If an error occurs during operation which renders the system incapable of functioning, the system will enter into the hydraulic fail-safe state (as a rule, the system effects a non-controlled braking) and remain in this state. The operation LED continues to show the state System error. Via the external signal contacts, the following signals are issued:

- Ready: Low signal (not ready)
- Error: Low signal (error is present)

The acknowledgement of the error is effected analogous to Chap. 17.9.2.

17.10 Operation without external control system but with local release

The operation is effected analogous to Chap. 17.9. The exception here is the granting of the release.

17.10.1 Boundary conditions

- The system is not connected to an external control system by means of a fieldbus
- The system does not have an operating panel
- The system has an external voltage supply
- The system does not have an external release contact
- A local release unit is installed

17.10.2 Releasing the system

If a local release has been installed, the operator will be able to locally release by means of the **Enable** button (see Fig. 13). The release is held by a self-holding contact. The state of the release (On/Off) is indicated by the LED of the **Enable** button. The local release can be withdrawn by operating the button **Disable**. After the system has been switched off by means of the main switch or after a power failure, release is withdrawn.

17.11 Operation with a local monitor

The operation is effected analogous to Chap. 17.9. The local monitor provides further options for operation and display. More detailed information on the operation of the interface is to be found in Chap. 17.16.

17.11.1 Boundary conditions

- The system is not connected to an external control system by means of a fieldbus
- The system is provided with an operating panel
- The system has an external voltage supply
- The system has an external release contact

17.11.2 System start

Following the start of the system, a graphical user interface is provided on the local monitor (see Fig. 19). In addition to what is described in Section 17.9.2 the existing errors can be acknowledged via the error dialogue. More detailed information on the operation of the interface is to be found in Chap. 17.16.

17.11.3 Return jump to the primary target state

In addition to what is described in Section 17.9.6 the return jump to the primary target state can be effected with the button “Operation Button" (see Fig. 17).
More detailed information on the operation of the interface is to be found in Chap. 17.16.

17.12 Operation with an external supervisory console

The operation is effected analogous to 17.9 and 17.11. The local monitor provides further options for operation and display. More detailed information on the operation of the interface is to be found in Chap. 17.16.

17.12.1 Boundary conditions

- The system is not connected to an external control system by means of a fieldbus
- The system is integrated into the system operator network
- The system has an external voltage supply
- The control system is running and can be reached via the network

17.12.2 Starting the graphical interface

The graphical interface must be started on the supervisory console computer. The configuration file is to be loaded into the interface (see Fig. 21).

The IP address of the control system is stored in the configuration file.
Connect yourself to the system. More detailed information on the operation of the interface is to be found in Chap. 17.16.

17.12.3 Notes

In contrast to the operation complete with local monitor 17.11 it is not possible to re-start or stop the control system. More detailed information on the operation of the interface is to be found in Chap. 17.16.

17.13 Operation with an external control system

The operation is effected analogous to Chap. 17.9. Note the information on interfaces provided in Chap. 4.4.2.

17.13.1 Boundary conditions

- The system is connected to an external control system by means of a fieldbus
- The system has an external voltage supply
- The system has an external release contact

17.13.2 Switching on the external interface

If the signal **External control** (Section 17.8.3) has been set to **0**, then the external interface will not have any effect on the brake control system. In this case the control settings are taken from the configuration file.
If the signal **External Control** is set to **1**, the specifications of the external interface will be taken into account.

17.13.3 Switchover of the primary target state

If the external interface is active and if the value of the primary target state is changed, the system will follow into the respective target state. The respective changeover in state is initiated by the specification from the configuration file (ramp up, ramp down).

If one of the target states

- Specification Speed
- Specification Torque
- Specification Pressure

- Constant Speed

is selected, the operating time of the unit will be monitored. After maximally 60s there will be an automatic changeover to the fail-safe target state.

17.13.4 Target state: External specification

In the target state **External specification** (Specification of state: Specification Speed, Specification Torque, Specification Pressure) the nominal values

- Nominal value Speed
- Nominal value Torque
- Nominal value Brake pressure

The external specification is dampened by means of a PT1 filter.

17.13.5 Acknowledgement of error messages

If the signal **Acknowledge messages** is set to **1**, the error messages of the system will be reset, and, if no further errors exist, the system will enter into its primary fail-safe state.

17.14 Service operation, manual operation

Service operation can be accessed only via the key switch **Service Key**.

If this switch is operated, then the following is to be noted:

- The system grants itself automatically the external release
- The general function is not influenced directly by the activation of the service mode.
- The external signal \Ready" and the signal **System ready** of the external interface are set to **0**.
- In service mode it is not possible to effect control via the external interface.

The following functions are released in service mode:

- Changing and saving operating parameters
- Changing and saving display parameters
- Re-start / stop of the control computer
- Manual pressure specification
- Manual operation of the system

In service mode / manual mode the system may be caused to interfere with the operation of the brake system. This may cause damage to components.

17.14.1 Changing display parameters

Relevant information on this is to be found in the description of the graphical user interface in Chap. 17.16.2.

17.14.2 Changing operating parameters

Relevant information on this is to be found in the description of the graphical user interface in Chap. 17.16.

Changes to parameters have a direct and immediate effect on the brake control system.

17.14.3 Saving changes

How to save changes is explained in the description of the graphical user interface in Fig. 26.

17.14.4 How to shut down / re-start the system

How to shut down and re-start the system is explained in the description of the graphical user interface in Fig. 20.

A system shutdown may cause an uncontrolled braking, depending on the hydraulic fail-safe state of the system (see Fig. 20).

17.14.5 Manual operation

The manual operation is explained in the description of the graphical user interface in Chap. 17.16.4.

Manual operation may cause uncontrolled braking. Operation in manual operating mode may be carried out only if the overall system is in a safe state even without any active brake.

Start / end of the manual operating mode: Manual operation can be started only if the brake status is closed.
When manual operation is exited, the system enters normal operating mode.

Pressure specification: Information on pressure specification is to be found in the description of the graphical user interface in Fig. 35.

Signal generator: Information on the signal generator is to be found in the description of the graphical user interface in Fig.35.

17.14.6 Notes on setting the controller

The setting of the parameters for the controller must be effected by the commissioning engineer. In the case of incorrect settings for the controller unintended major fluctuations in the braking effect of the braking system may occur. This may cause damage to the system.

The setting of the controllers must be carried out by trained specialist personnel.
For setting the controller parameters, the complete system must first be secured by measures taken by the system operator so that personal injury and damage to the system can be excluded.

Pressure controller: The pressure controller depends on the valve selection. Appropriate initial values of the controller are:

P-share: 2 bar/bar

I-share: 2 bar/bar/s

The pressure controller should be tested in manual operating mode by means of the signal generator, using lead jumps. The stable controller behaviour is essential for the operation of the system.

Rotational speed control: The speed controller depends on the brake selection of the braking route and the load states of the route.

Proceed as follows:

1. Check the pressure controller in manual operating mode
2. Zero the controller values
3. Iterate the P-share in 0.05 bar/rpm steps with subsequent testing by deceleration
4. If no vibratory behaviour is detected, the P-share can be increased even further.
5. If a vibrating controller behaviour occurs, the controller value must be slightly reduced.
6. If, in later operation, there are major fluctuations in rotating inertia, the controller value will have to be reduced even further. In such cases the following holds: A stable controller is to be preferred to a high-performing but – in phases - unstable controller.
7. Iteration of the I-share. Generally the same way of proceeding as for the P-share. The I-share should be smaller than the P-share by a factor of 3-10.

17.15 Configuration

The configuration of the system is based on a configuration file. This is provided for by the manufacturer of the braking system.

The configuration file is loaded when the control system is started. If changes not involving the service interface are made to the file, the changes will only become effective after a re-start of the system.

The configuration file may be viewed within the graphical user interface (see Fig. 23).

17.15.1 Configurator

The configuration file is prepared by means of a configuration program. The manufacturer loaded the configuration file on the system before delivery.

17.15.2 Loading the configuration

A configuration prepared externally can be loaded into the system.

For this purpose, the commissioning engineer may use a laptop to connect himself to a password-protected Windows release.

The name of the Windows release is: **CONFIG**. It is accessible under *//IP-address/CONFIG.*
The access data are:

- User: service
- Password: Must be obtained from the manufacturer

The configuration file is stored under the name **configuration.yaml**.

If no such file exists or if it is defective, the system cannot be operated. The software will report a corresponding error.

17.16 The graphical user interface (GUI)

17.16.1 Start screen

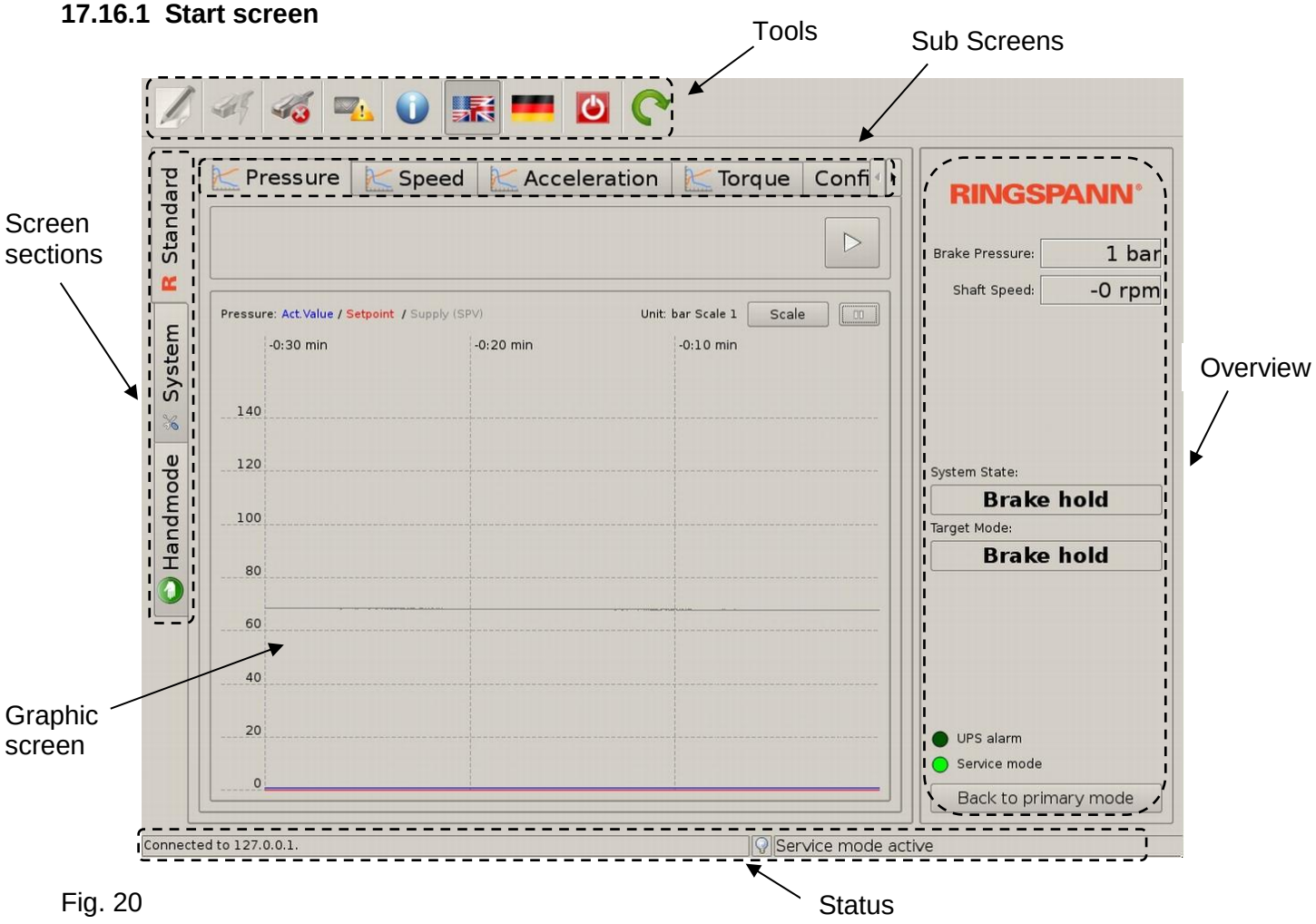


Fig. 20

The graphical user interface is subdivided into several different areas. The top edge lists tools in the form of buttons. These will be explained in more detail below. When tools are shown in grey, they cannot be selected because the preconditions for their use have not been met.
On the left-hand side, there are the screen sections, i.e. the grouping of various display areas. The screen sections are permanently visible.
Each section comprises various different sub-screens, which show specific displays. The presentation is effected in the Graphic Screen area.
On the right-hand side there is the Overview area. This is an overview with the most important displays that can also be seen permanently.
At the bottom edge of the screen there is the Status, in which the status messages are shown.

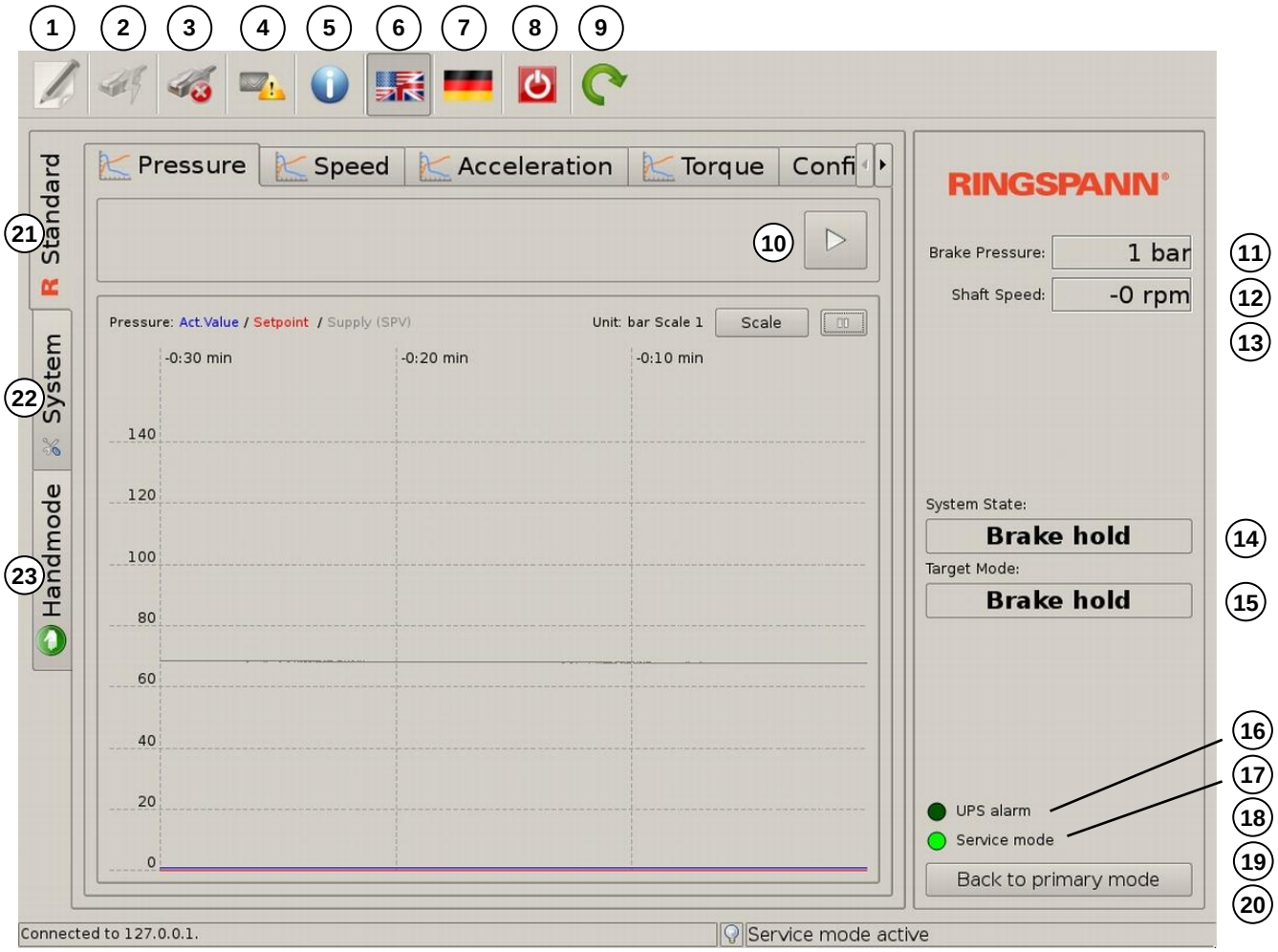


Fig. 21

1. Load configuration: Using this tool, a local configuration may be loaded.
2. Connect: This tool makes the connection.
3. Disconnect: Using this tool an existing connection can be broken.
4. Messages: This can be used to open the message display window.
5. Info: Here, the manufacturer's details and software information are stored.
6. English: Here, the language of the graphical user interface is switched over to English.
7. German: Here, German can be selected as the display language.
8. Shutdown: This tool is used to completely shut down the system.
9. Reboot: This tool is used to shut down the system completely and re-start the same.
10. Scrolling: Use these arrows to scroll forwards and backwards within the subscreens.
11. Display of the current brake pressure.
12. Display of the current speed of the speed sensor.
13. Display of the current brake torque. If no real force or torque sensor has been built in, the torque is determined by reverse calculation on the basis of the brake pressure.

14. Display of the current brake status. This is determined on the basis of the brake opening contacts.
15. Display of the target mode. This indicates the target state. Please note in this regard the detailed information on the operating states provided in the operating instructions Chap. 17!
16. UPS Alarm: LED indication for the UPS. This indicates whenever the UPS has a problem, e.g. when a battery problem has been detected. The LED will then be bright green.
17. Service active: If the service switch has been operated, this LED indicator will turn bright green.
18. Wear Level: The LED indicator will turn bright red if a brake wear point has been detected.
19. Bus Interface: A bright red LED indicates whether the external bus interface is connected and active. This does not mean whether the external control makes the set value specification.
20. This button has the same function as the operation button. It causes a return jump from the secondary into the primary operating state.
21. Screen Section Standard: Here, you change into the screen section “Standard".
22. Screen Section System: Here, you change into the screen section “System".
23. Screen Section Handmode: Here, you change into the screen section “Handmode".

17.16.2 Standard

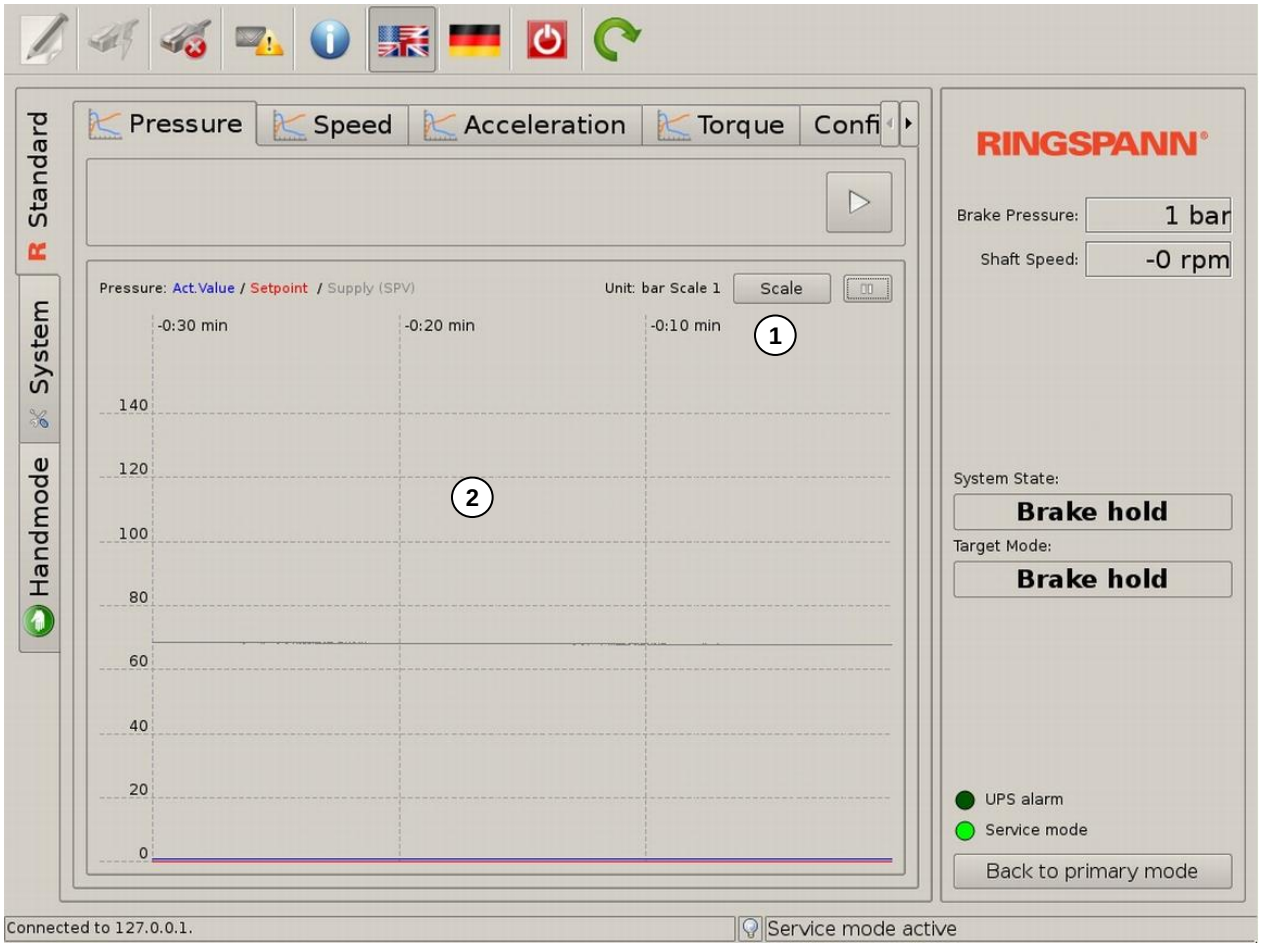


Fig. 22

1. Scale: Using this button, a dialogue opens in order to scale the graphical display. This is only possible in service mode. If changes are effected here, the change must be saved in order to secure the same permanently.
2. Graphic Screen: This is the graphical representation zone for the corresponding graphics. Here, e.g., for the current (actual) brake pressure and the nominal value (blue and red).

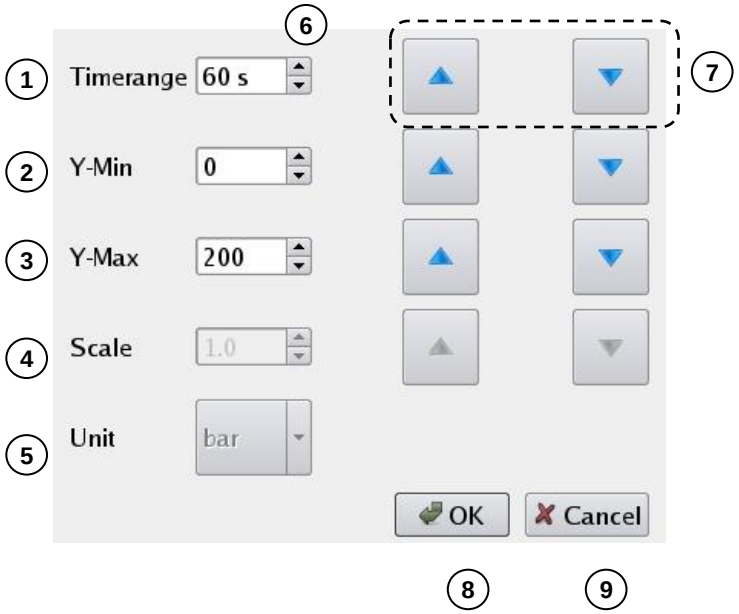


Fig. 21

1. Here, the time range can be reset.
2. Definition of the minimum display value of the Y axis.
3. Definition of the maximum display value of the Y axis.
4. Scaling amount for the display.
5. Selection of the unit (setting of rpm or m/s).
6. Using these arrows, the value can be changed.
7. Using these arrows, the value can also be changed.
8. Pressing the button will save the setting and close this window. The changes only have an effect on the graph.
9. This button is used to cancel this dialogue. Preset values are not saved. The window is closed.

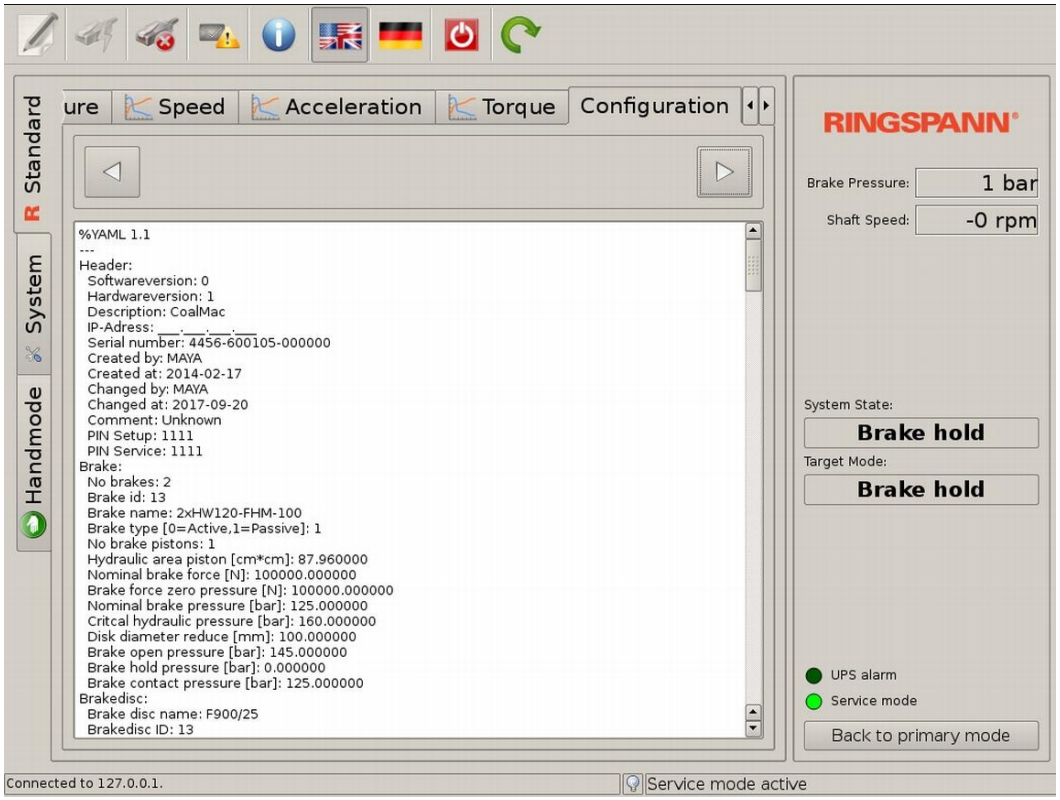


Fig. 24

The Configuration window shows the currently loaded configuration. This display will not be modified in the event of any changes in the GUI. It is the configuration loaded at system start.

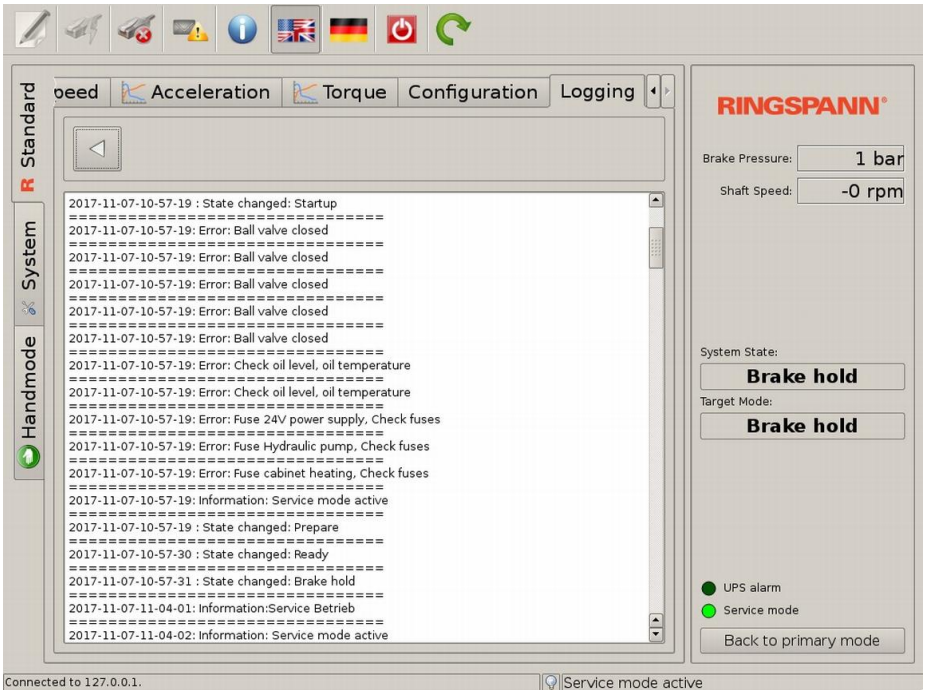


Fig. 25

The Logging window shows all log messages complete with time stamp. Changes of state and any messages received are shown. This is a display function only. In this window, editing is not possible. When working with the system, the most recent 500 log messages are saved.

17.16.3 System

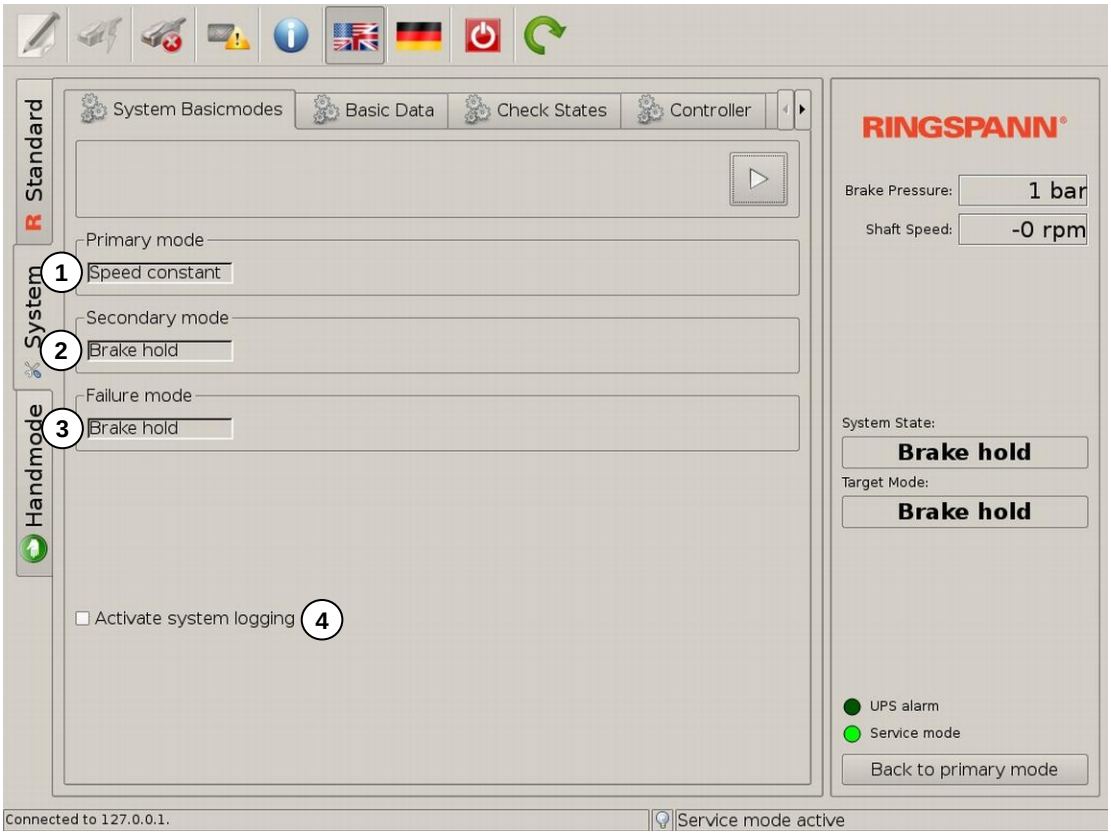


Fig. 26

1. The primary state indicates the state which the brake normally has. (As a rule, this is something to do with "Brake open" or "Speed constant"). Please note in this regard the detailed information on the operating states provided in the operating instructions Chap. 17!
2. This indicates the secondary operating state which the system is to enter in a controlled fashion, if a user request (as a rule, "Braking") was carried out.
3. This indicates which state the system is to enter if the system has detected internal errors (e.g. excess speeds or out of tolerance deviations or any faults on the system itself that do not completely prevent the regulation of the system but should cause a braking in order to enter into a safe state).
4. This allows the optional internal logging to be activated. This logging is based on the DLS data logging system. It should be switched on for analyses. This marking will be reset following a reboot.

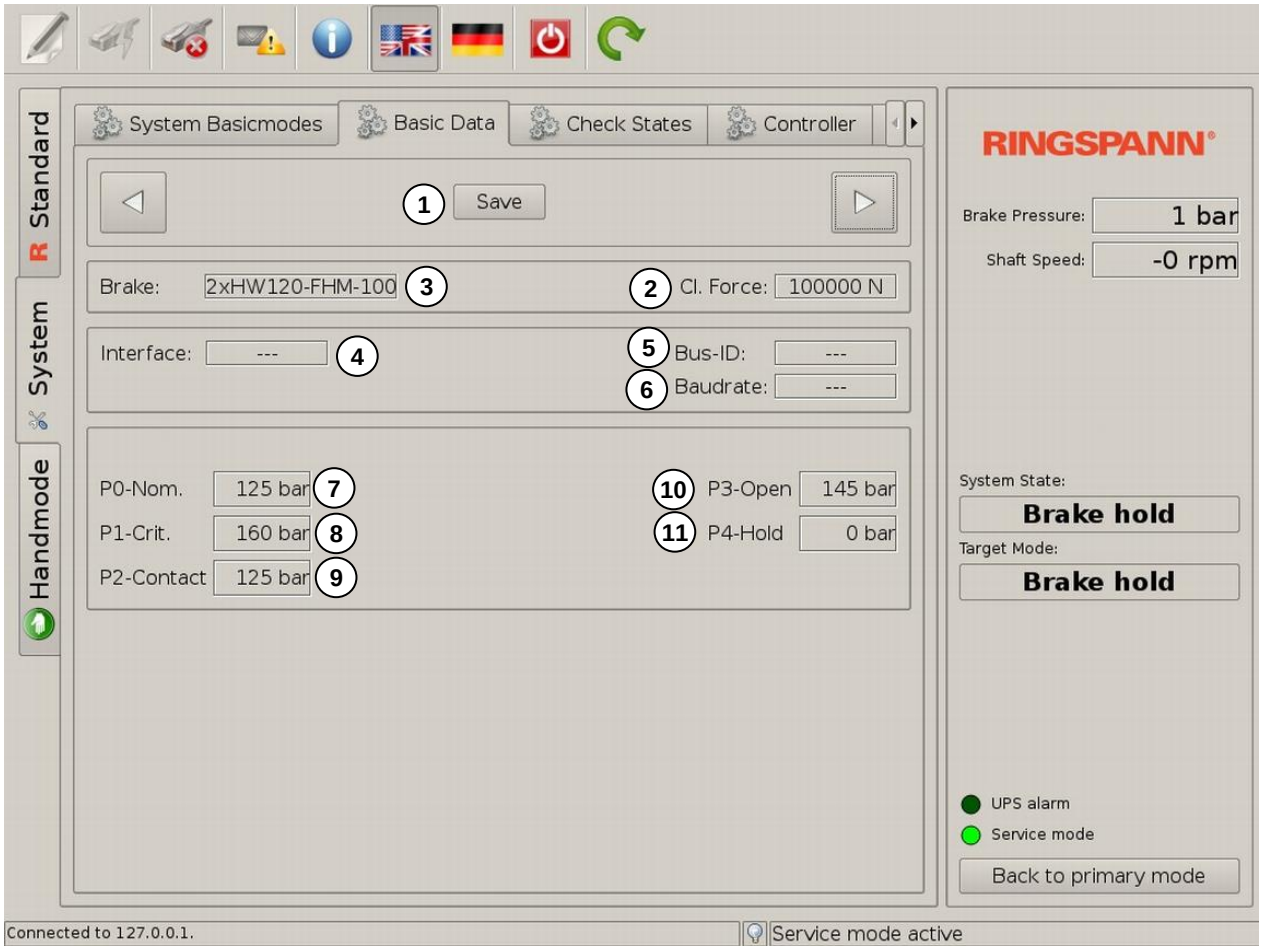


Fig. 27

Display of the basic configuration of the system, the parameters of which cannot be changed in the GUI.

1. Button for saving the configuration. A dialogue is opened in which an alternative configuration file can be selected. As a rule, the default proposition "configuration.yaml" should be accepted.
2. This indicates the nominal clamping force of the brake.
3. This indicates the basic type of the brake.
4. This indicates which external interface is active.
5. The items 5 and 6 indicate interface-specific information. If necessary, these values are to be ignored (e.g. for EtherCAT the values do not have any significance).
6. See item 5.
7. Maximum pressure differential during pressure control (Items 7-11 specify the operating pressures. Please note in this regard the detailed description in the operating instructions Chap. 17! They can be edited here in service mode. Thus, it will be possible in service mode to carry out modifications or adaptations of the brake behavior).
8. Maximum allowable Pressure of the brake.
9. Hydraulic pressure when brake pad touching the brake disc.
10. Hydraulic pressure when the brake is totally open.
11. Hydraulic pressure when the brake is totally closed.

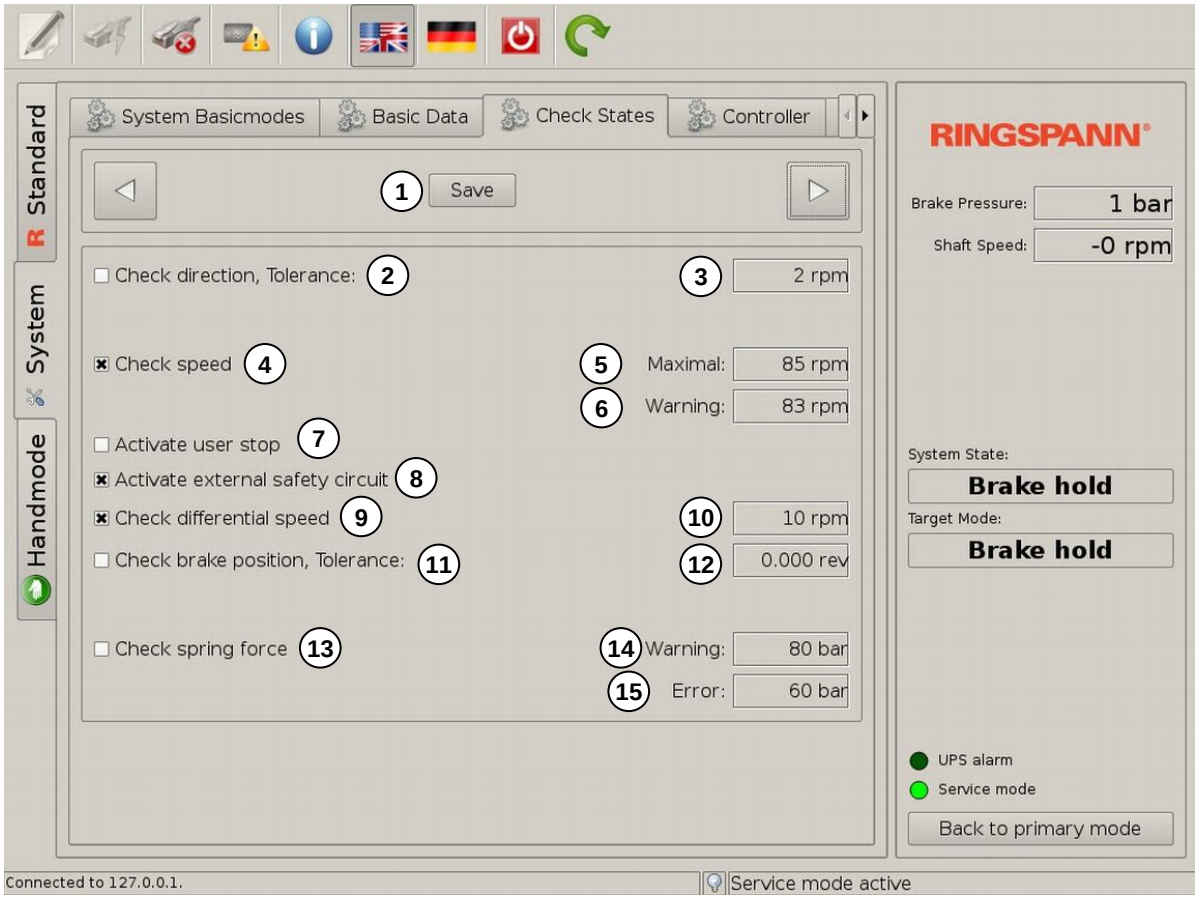


Fig. 28

In this screen, the individual monitoring processes will be activated. These monitoring processes have already been described in detail, complete with their parameters, in the preceding text of the operating instructions (Chap. 17).

1. Save button.
2. Direction monitoring (Boundary condition is a directionally suitable speed sensor).
3. Tolerance specification in rpm (based on speed).
4. This activates speed monitoring.
5. Maximum value for speed monitoring where a braking is initiated.
6. Warning level of speed monitoring (without any reaction).
7. This activates the user stop. This user stop can be built into the front side of the switch cabinet. A braking is carried out by pressing the activated user stop.
8. The state of external safety contacts is monitored. If these drop, a braking will be carried out.
9. Where a second sensor has been installed, a differential rotation speed can be monitored. If a difference occurs, a braking will be carried out.
10. Here, the tolerance limit of the differential rotation speed can be defined.
11. In the stopped state the brake can be position-monitored and issue a message to the superordinate system.
12. Here, the tolerance for item 11 can be entered in the unit “Speed".

13. In the case of passive brakes, the opening pressure can be monitored here, to check the springs. There are two levels at items 14 and 15 to check the springs.
14. Definition for the warning, if the pressure drops below the value defined here.
15. Definition for fault pressure. If the pressure drops even below the pressure defined here, a direct braking will be carried out.

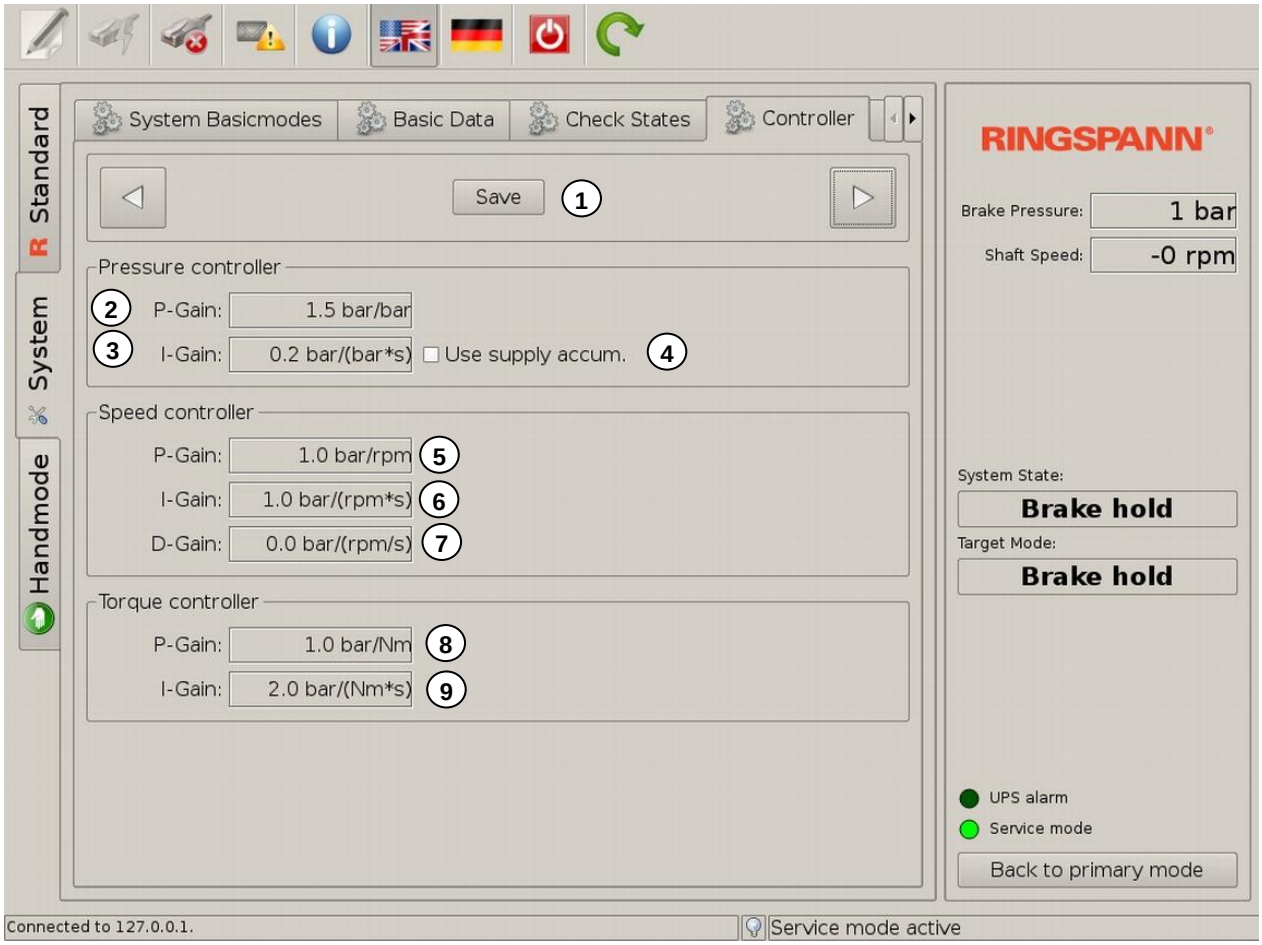


Fig. 33

Here, the different controller parameters (all PI controllers) are listed.

1. Save button.
2. P-Gain specification for pressure controller.
3. I-Gain specification for pressure controller.
4. For active brakes an accumulator can be connected in here as an additional pressure source.
5. P-Gain specification for speed controller.
6. I-Gain specification for speed controller.
7. D-Gain specification for speed controller.
8. P-Gain specification for torque controller.
9. I-Gain specification for torque controller.

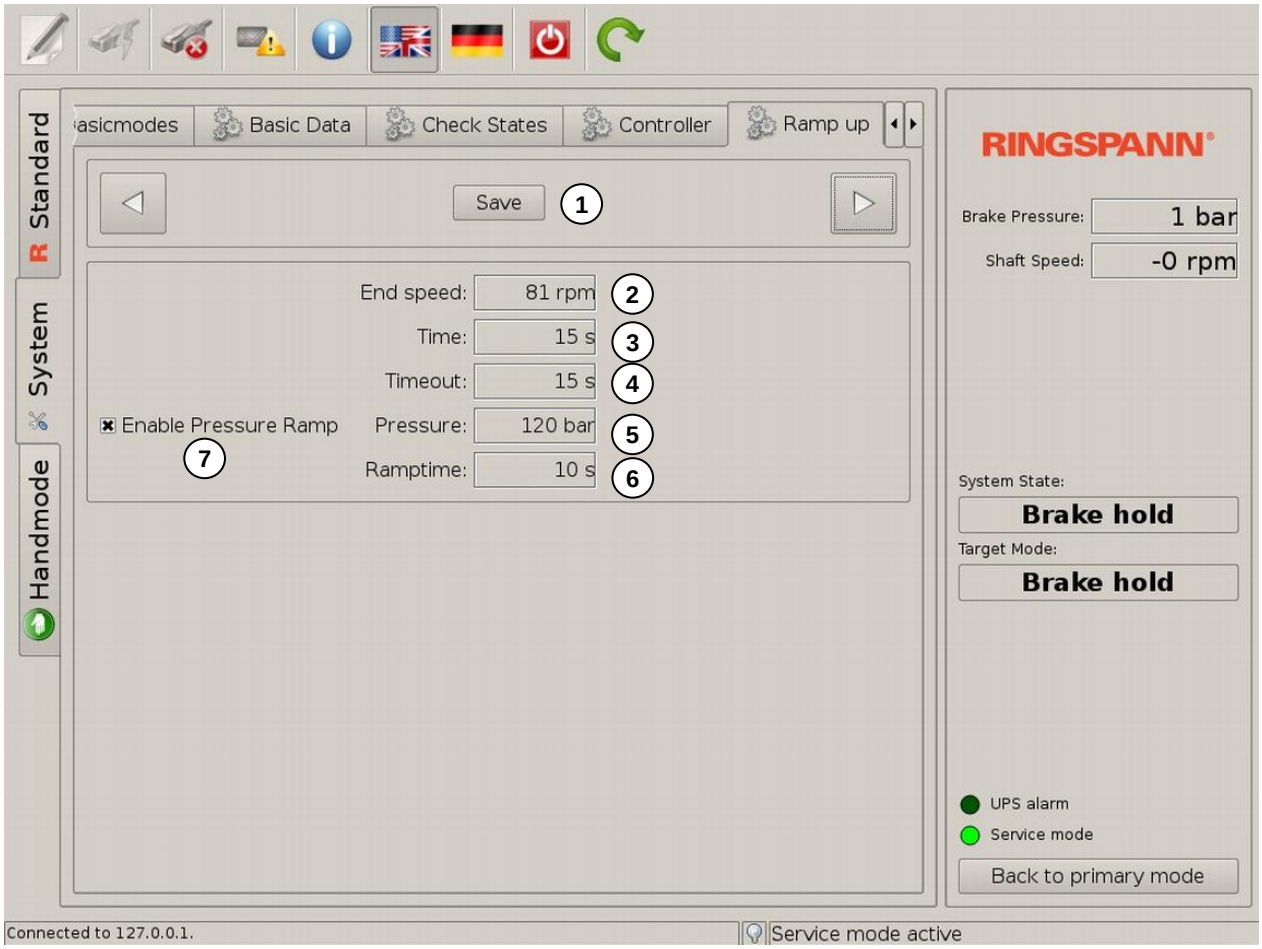


Fig. 30

Ramp up is to be considered as being analogue to ramp down. However, only a time-based ramp is possible here.

1. Save button.
2. Specification of the end speed.
3. Specification of the parameter Time.
4. If the system detects no speed within this time, the system switch to brake hold.
5. Possibility for initiating the speed ramp via a small pressure ramp.
6. Pressure details for the pressure ramp.
7. Time for the pressure ramp.

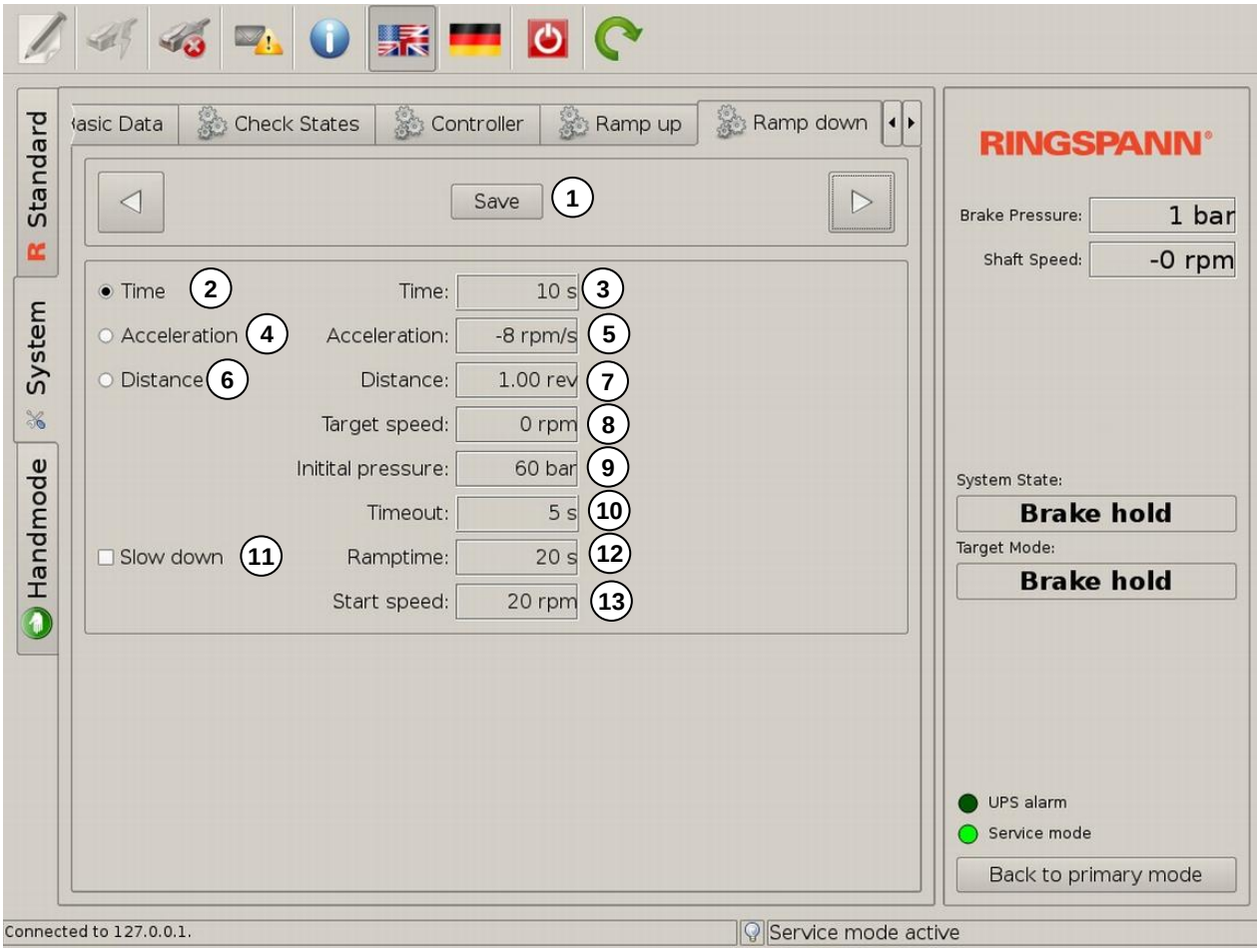


Fig. 29

Here, a speed ramp can be defined by means of which a braking can be carried out. The specification can be effected in different ways here. Using the selectors 2, 4 and 6 the ramp can be based on time, acceleration or distance.

1. Save button.
2. Selection of a time-based ramp.
3. Specification of the parameter Time for the time-based ramp.
4. Selection of an acceleration-based ramp.
5. Specification of the negative acceleration for the ramp.
6. Selection of the distance-based ramp.
7. Specification of the number of revolutions for the distance-based ramp.
8. Here, a target speed can be specified. As a rule, 0 rpm is to be selected here.
   It is also possible to specify a different target speed.
9. Starting pressure for the ramp down
10. Time after the system switch to brake hold when the set value of the speed reaches zero
11. Selection of a soft stop. If the slow down is activated, a further speed ramp will be added to the actual ramp proper from a pre-defined speed onwards. This provides for a fast ramp to be enabled to have a soft run-out at the end and thus to feature a soft stop.
12. Definition of the time for the ramp to enable a soft stop.
13. Definition of the start speed for the soft stop.

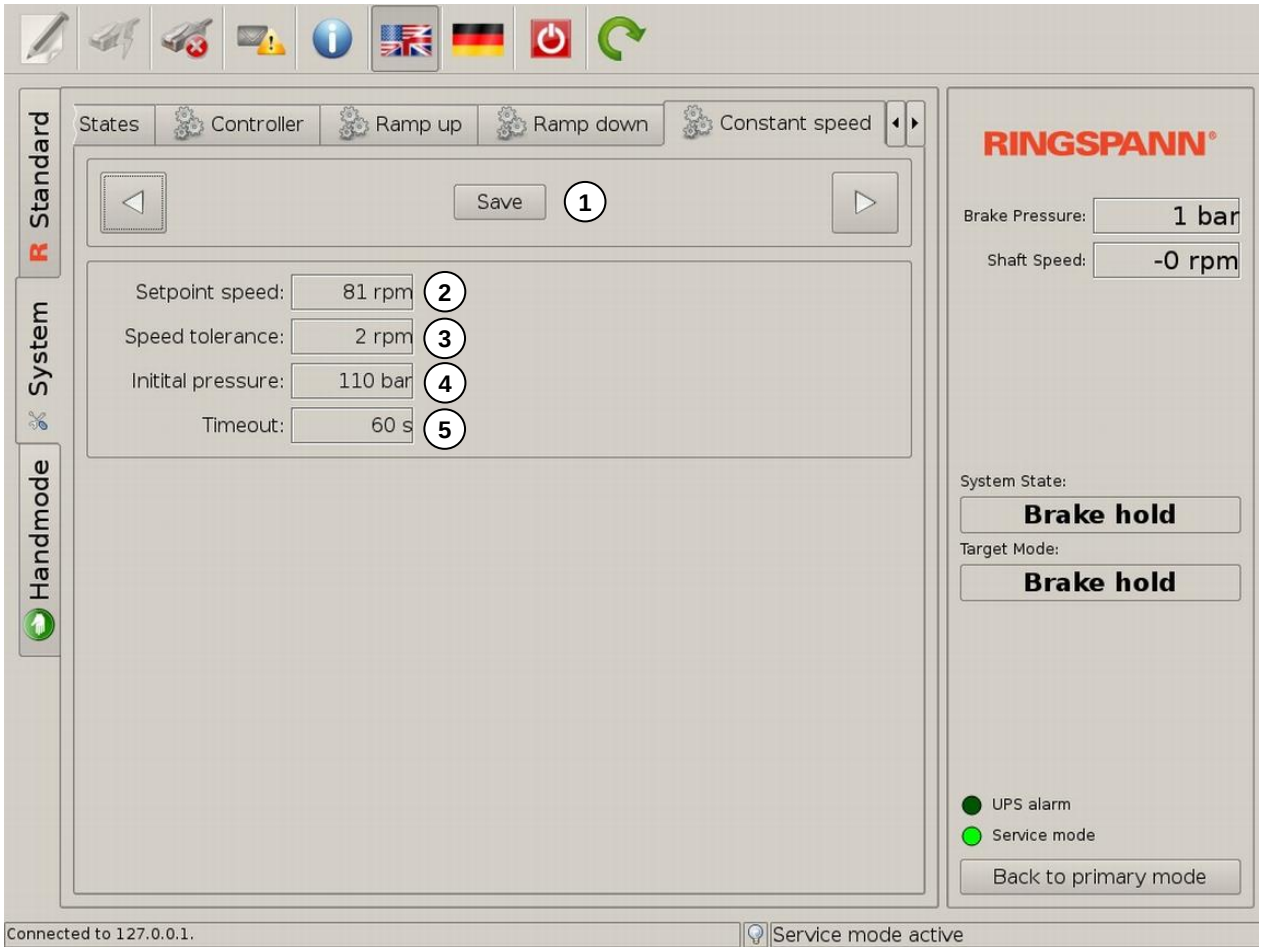


Fig. 31

The primary target state "Constant Speed" is parameterized here.

1. Save button.
2. Specification of the nominal speed at which the brake intervenes and controls.
3. This tolerance specifies from which point onwards the system starts to regulate speed. Example: 81rpm as nominal speed, 2 rpm as tolerance: If the speed rises above 83 rpm, the unit switches on and the brake starts its regulating / control operation. It regulates down to 81 rpm.
4. Starting pressure for the constant speed braking
5. Specification of the time value Timeout, for as long as this regulation is done maximally. If a braking occurs, the timeout factor will apply. This prevents any overheating of the brake, in this case 60s. After 60s braking in constant speed mode the system switch to secondary mode.

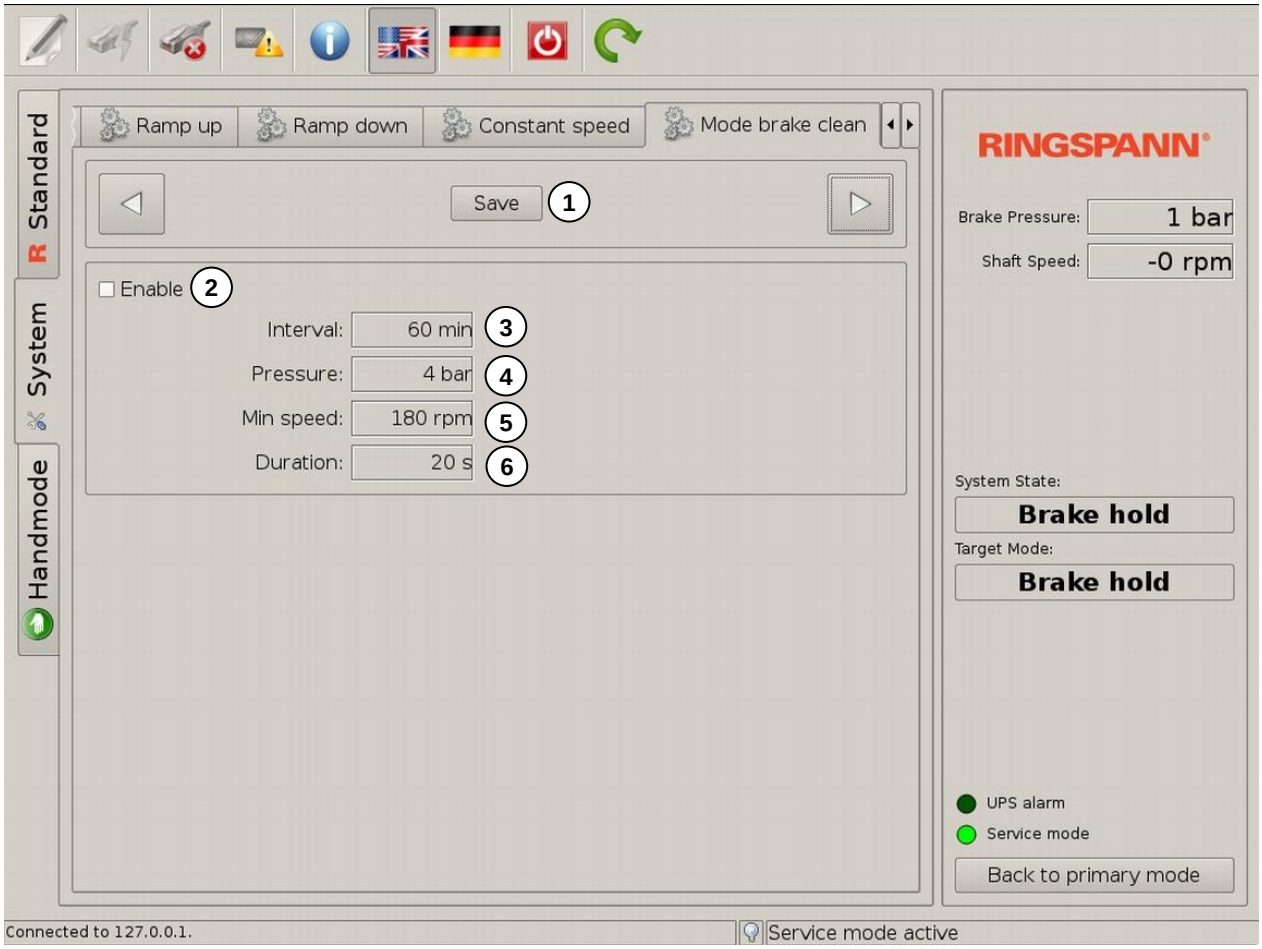


Fig. 32

Within the interval specified at item 3, a light braking at the specified pressure (item 4) is carried out. If the speed drops below the value specified at item 5, cleaning is terminated. The value specified at item 6 indicates the maximum time for cleaning.
On completion of this interval cleaning will be terminated automatically. Thereafter the system returns to its original state.

1. Save button.
2. With this marking, the cleaning mode is activated.
3. Specification of the interval within which the cleaning is to take place.
4. Specification of the pressure.
5. The minimum speed is entered here. Below this value, cleaning is terminated.
6. Specification of cleaning time.

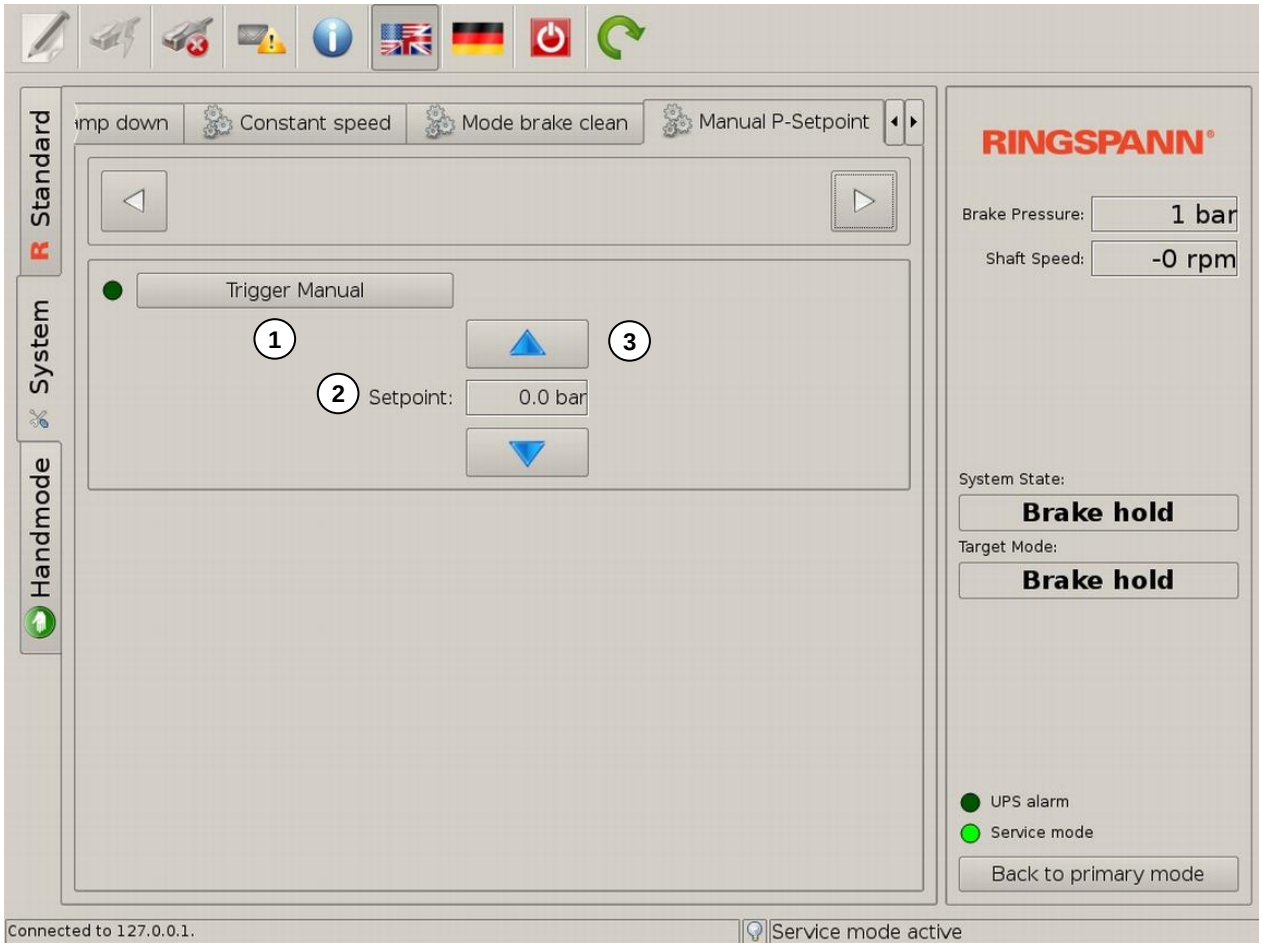


Fig. 34

Has been designed for service operation only. If the trigger has been activated, it is possible here, in service mode, to specify the pressure directly. Take care of overheating of the brake pads, because there is no timeout.

1. Activation of the manual trigger.
2. Setting option for the pressure (from 0 bar to P nominal / P0 of the brake).
3. Arrows for increasing and decreasing the value.

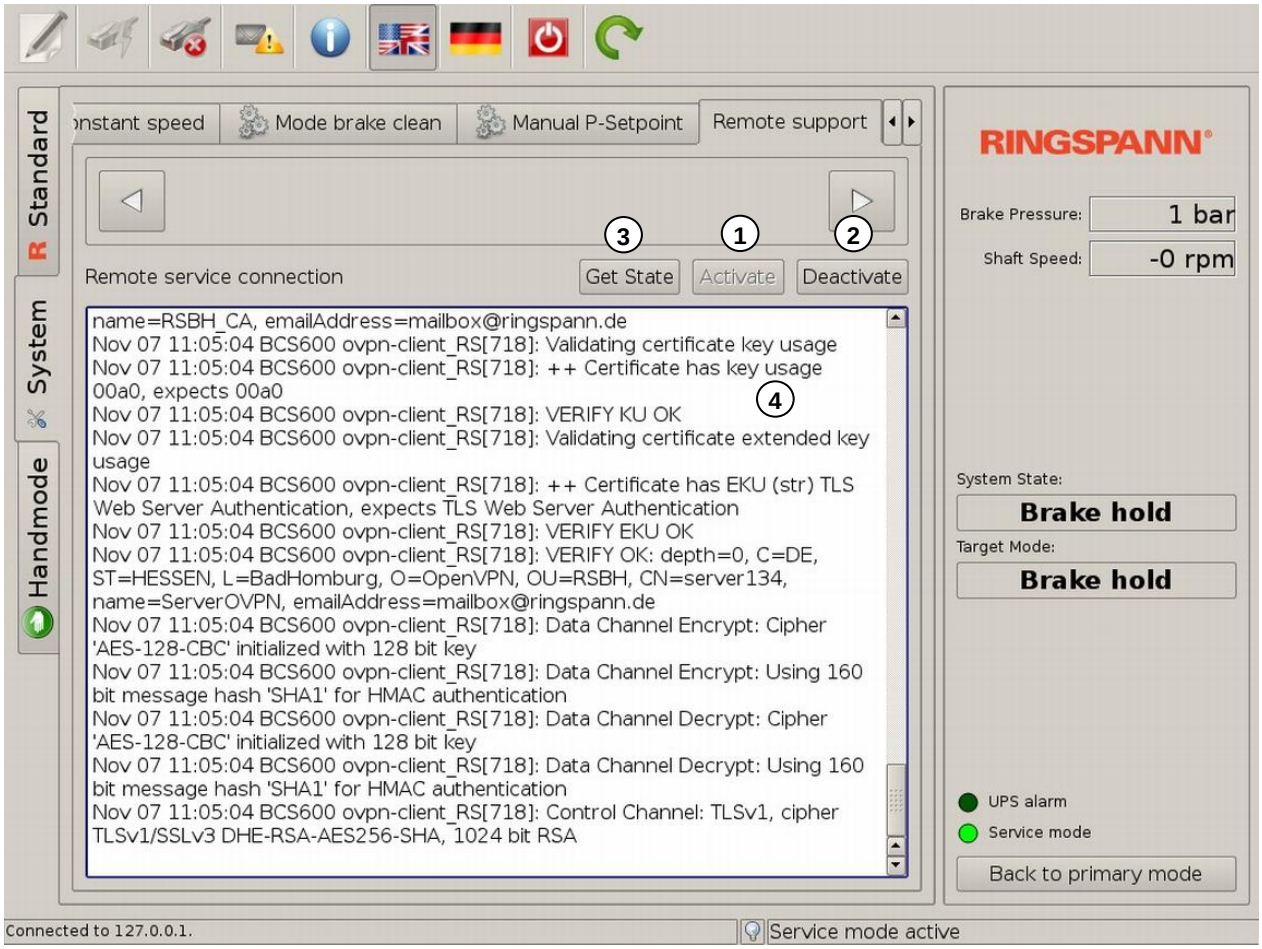


Fig. 35

For remote maintenance of the BCS600. The BCS600 will connect automatically for each restart of the system with RINGSPANN Remote Service. An existing internet connection or a mobile connectivity (option) is necessary.

1. Activation of the connection.
2. Deactivation of the connection.
3. Status request of the connection.
4. Status of the connection is shown here.

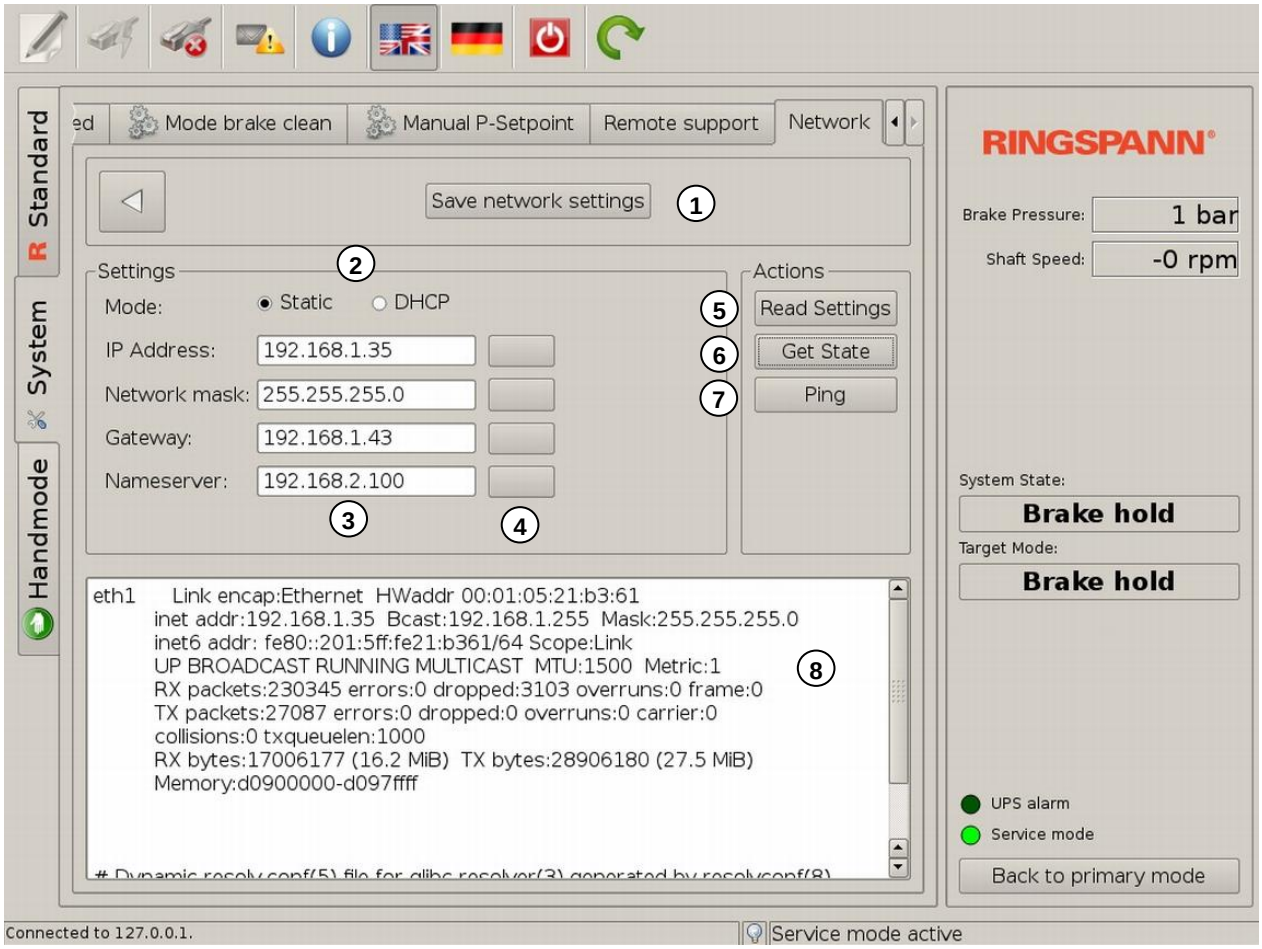


Fig. 35.1

1. Button to save any changes in network settings.
2. Setting mode, static IP-address should always be preferred.
3. Input fields for the network connection.
4. Button for numeric keypad.
5. Button to read changes.
6. Read actual configuration of the network adapter.
7. Test the connection.

17.16.4 Handmode

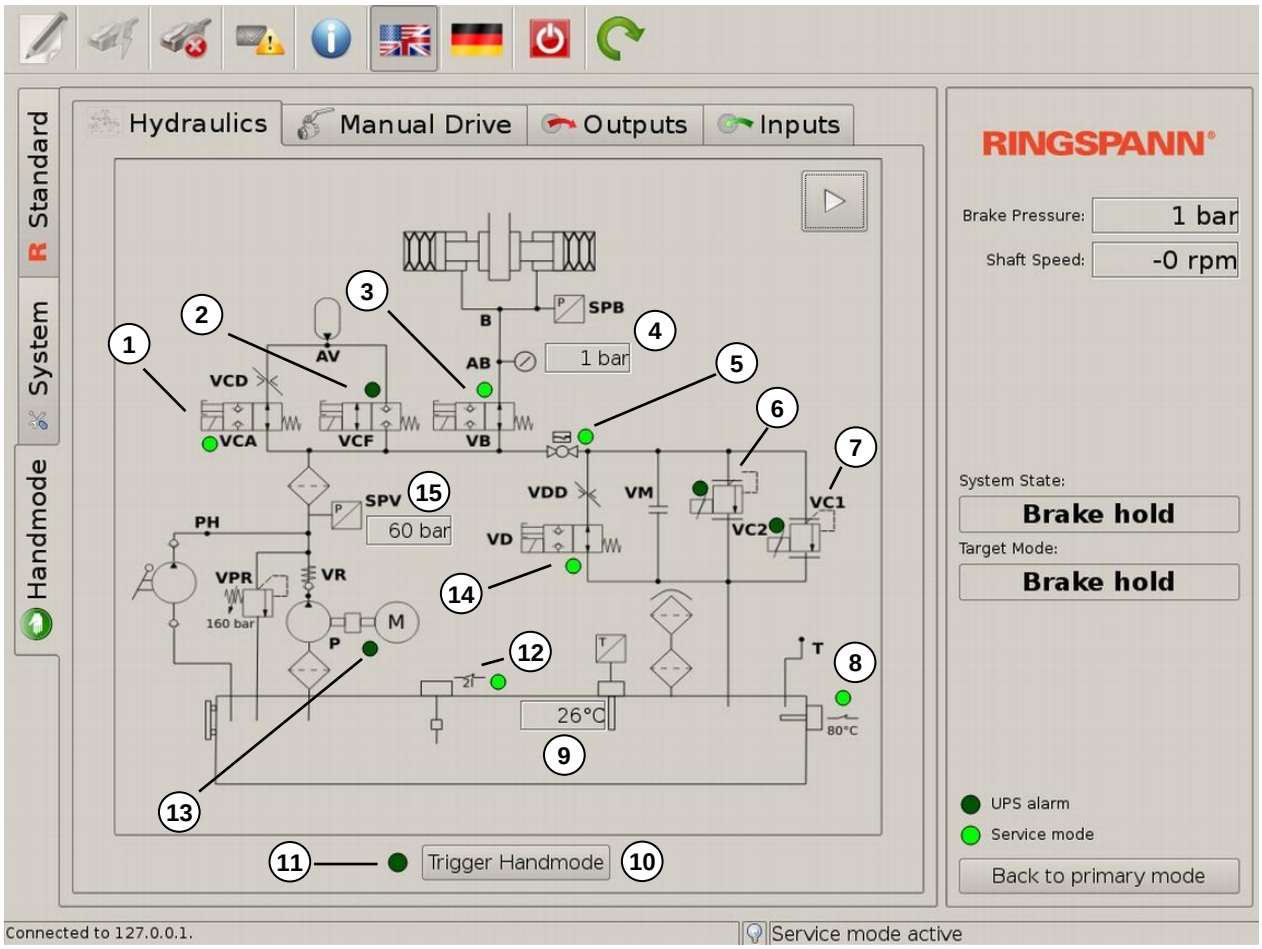


Fig. 36

If an LED illuminates brightly, the component is active electrically, i.e. electrically switched. The LEDs do NOT indicate the valve state (open/closed)!

When you are in service mode and the brake state is “closed", i.e. the system is at a standstill, there is the option to activate manual mode by means of button 10. Attention: In certain circumstances the system may then open the brake. Therefore, it must be ensured before pressing the button, that the connected brake system is in a safe state as a result of different safety measures. As can be seen in Fig.37, it is then possible to switch all valves individually.

1. Switching valve VCA, if an accumulator has been installed.
2. Switching valve VCF, if an accumulator has been installed.
3. Switching valve VB (decoupling of brake).
4. Indication of the pressure SPB (brake pressure).
5. Indication of the state of the ball cock monitoring, as a rule ON.

6. Indication, whether the valve VC2 has been activated and is allowed to execute its control function.
7. Indication, whether the valve VC1 has been activated and is allowed to execute its control function.
8. Indication of temperature monitoring (hard contact).
9. Indication of the tank temperature.
10. Button for manual mode.
11. LED indication for manual mode.
12. Level monitoring state (warning level). The error level is not indicated as it is hard-wired in the safety circuit.
13. Indication of the pump activity.
14. Quick relief valve VD.
15. Indication of the pressure SPV (supply pressure).

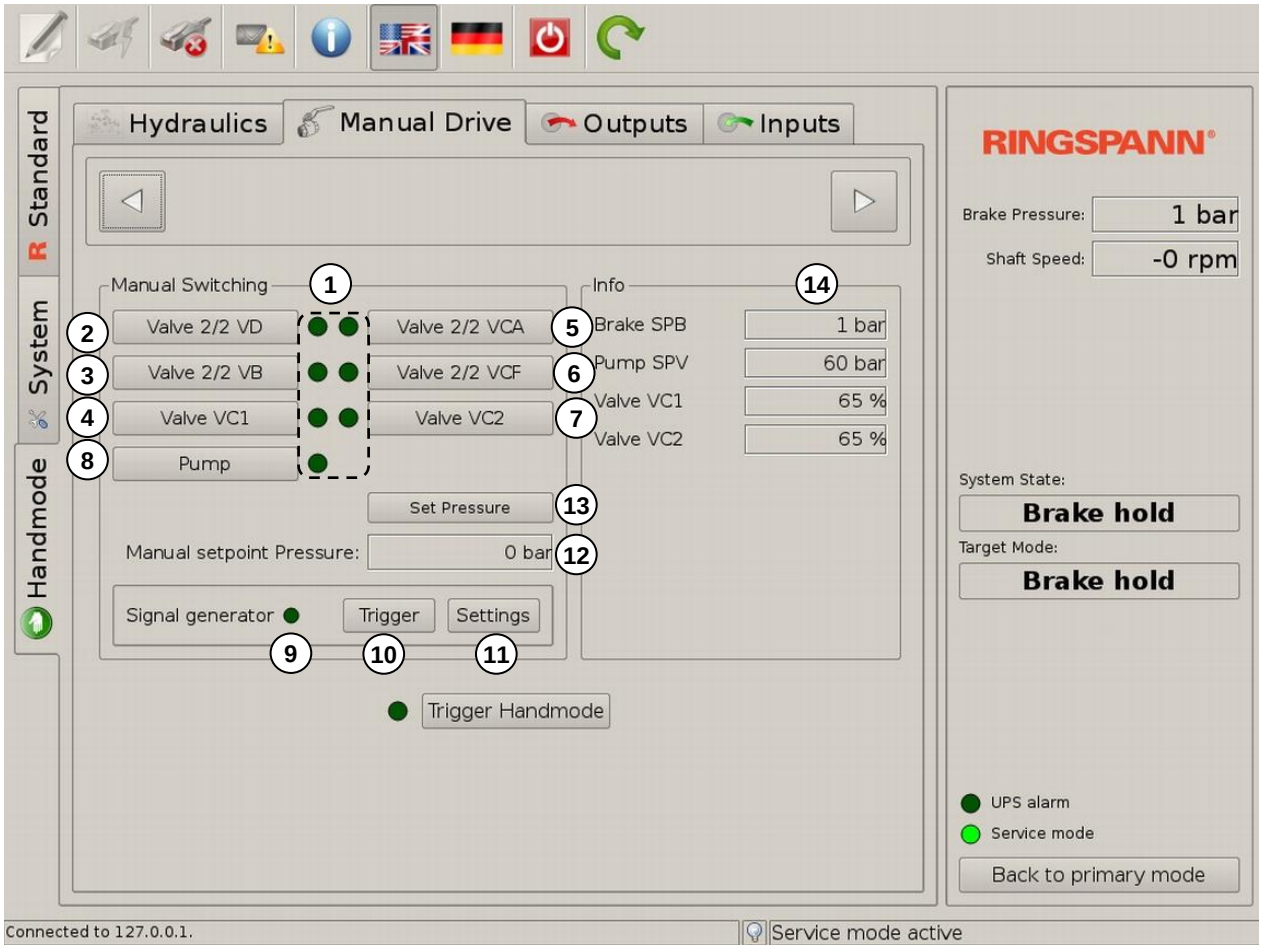


Fig. 37

1. LED indications for components 2-8.
2. On-off valve VD can be activated.
3. On-off valve VB can be activated.
4. Regulating valve VC1 can be activated.

5. On-off valve VCA can be activated.
6. On-off valve VCF can be activated.
7. Regulating valve VC2 can be activated.
8. Pump can be switched on.
9. Indication of LED to the signal generator.
10. As an alternative to a static pressure, it is possible here to specify nominal pressures via a signal generator. This button activates the signal generator which should first be parameterized by means of button 11.
11. Parameterization of the signal generator.
12. Here, a nominal pressure can be specified. This is only accepted into the system after button 13 has been operated.
13. Acknowledgement of the pressure at item 12.
14. Information like brake pressure, pump pressure and proportional valve

Attention: There is no time monitoring and no brake monitoring, that means, there is a possibility of brake damage or hydraulic overheating, both causing a fault condition.

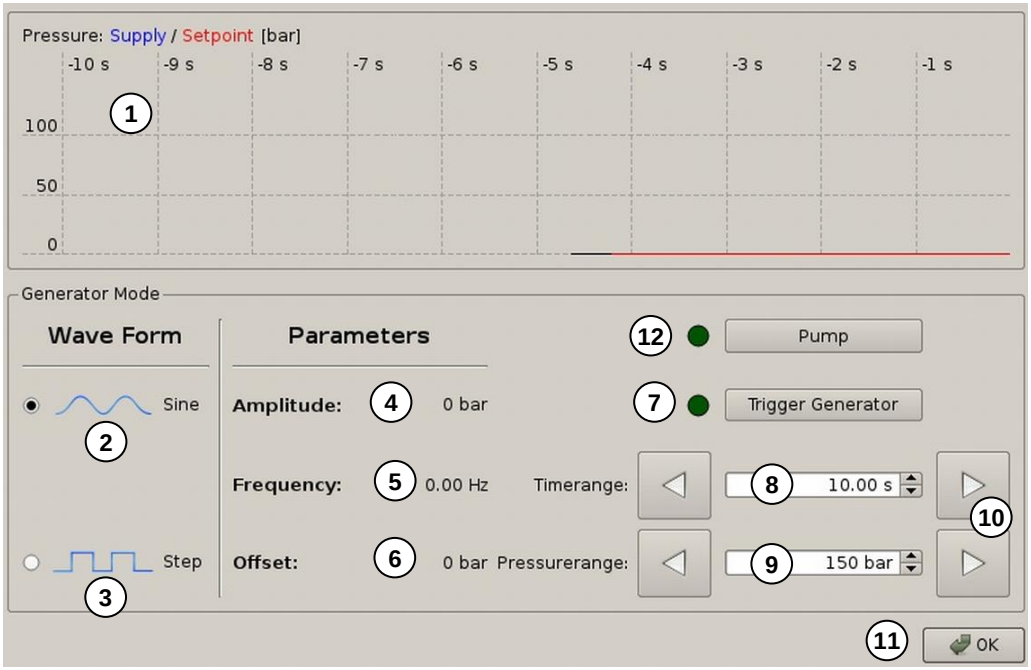


Fig. 38

1. Nominal and actual pressure curves are shown in a graph.
2. Selection of the signal curve for the sinus signal.
3. Selection of the signal curve for the step response (meaningful for controller setting).
4. Amplitude can be set.
5. Frequency can be set.
6. Offset can be set.
7. Activation of a signal generator is possible.
8. The value "time range" can be optimized here for the graphical display.
9. The value "pressure range" can be optimized here for the graphical display.
10. Using the small arrows next to the value or the large arrows to the left and right of the setting value, the value can be set higher or lower.
11. Using this button, the settings are saved and the window is closed.
12. Using this button, the pump can be switched.

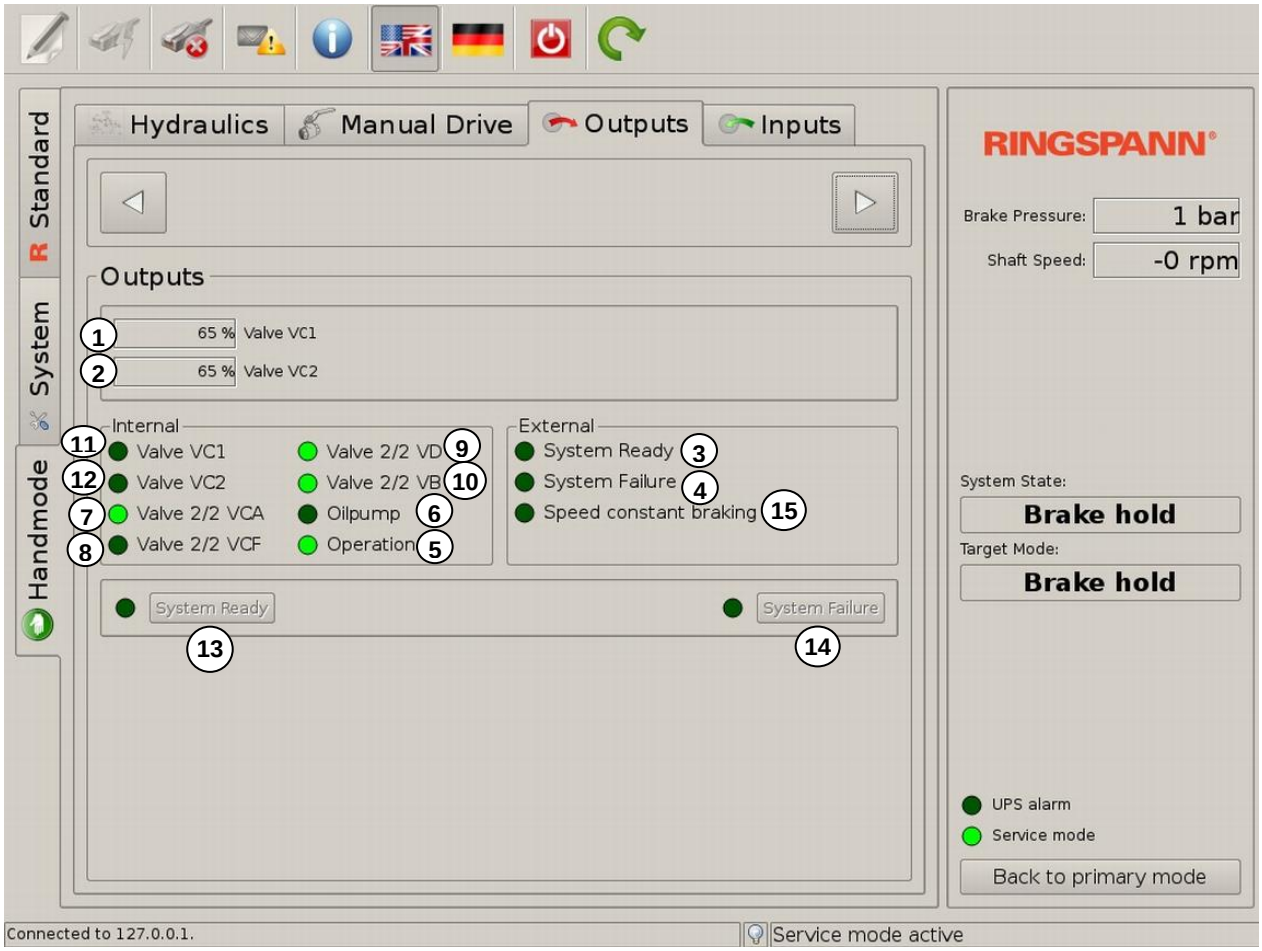


Fig. 39

Here, the current output values of the internal fieldbus and external signals are shown. Note also in this regard the detailed information provided in the electrical circuit diagram (in the annex of the technical documentation).

1. Percentage specification for driving the control valve VC1. The percentage specification refers to the maximum current of the output unit, as a rule 2A.
2. Percentage specification for driving the control valve VC2. The percentage specification refers to the maximum current of the output unit, as a rule 2A.
3. LED is shining, when brake is ready
4. LED is shining, when no problem exists with the brake
5. LED is shining, when brake system is in primary state
6. LED is shining, when pump is working
7. LED is shining, when current is applied to valve VCA
8. LED is shining, when current is applied to valve VCF
9. LED is shining, when current is applied to valve VD
10. LED is shining, when current is applied to valve VB
11. LED is shining, when current is applied to valve VC1
12. LED is shining, when current is applied to valve VC2

13. In manual mode, the control signals - which are hard-wired to an external control system - can be specified manually. Here "External Ready".
14. In manual mode, the control signals - which are hard-wired to an external control system - can be specified manually. Here "External Failure".
15. LED is shining, when pump is on during speed constant braking.

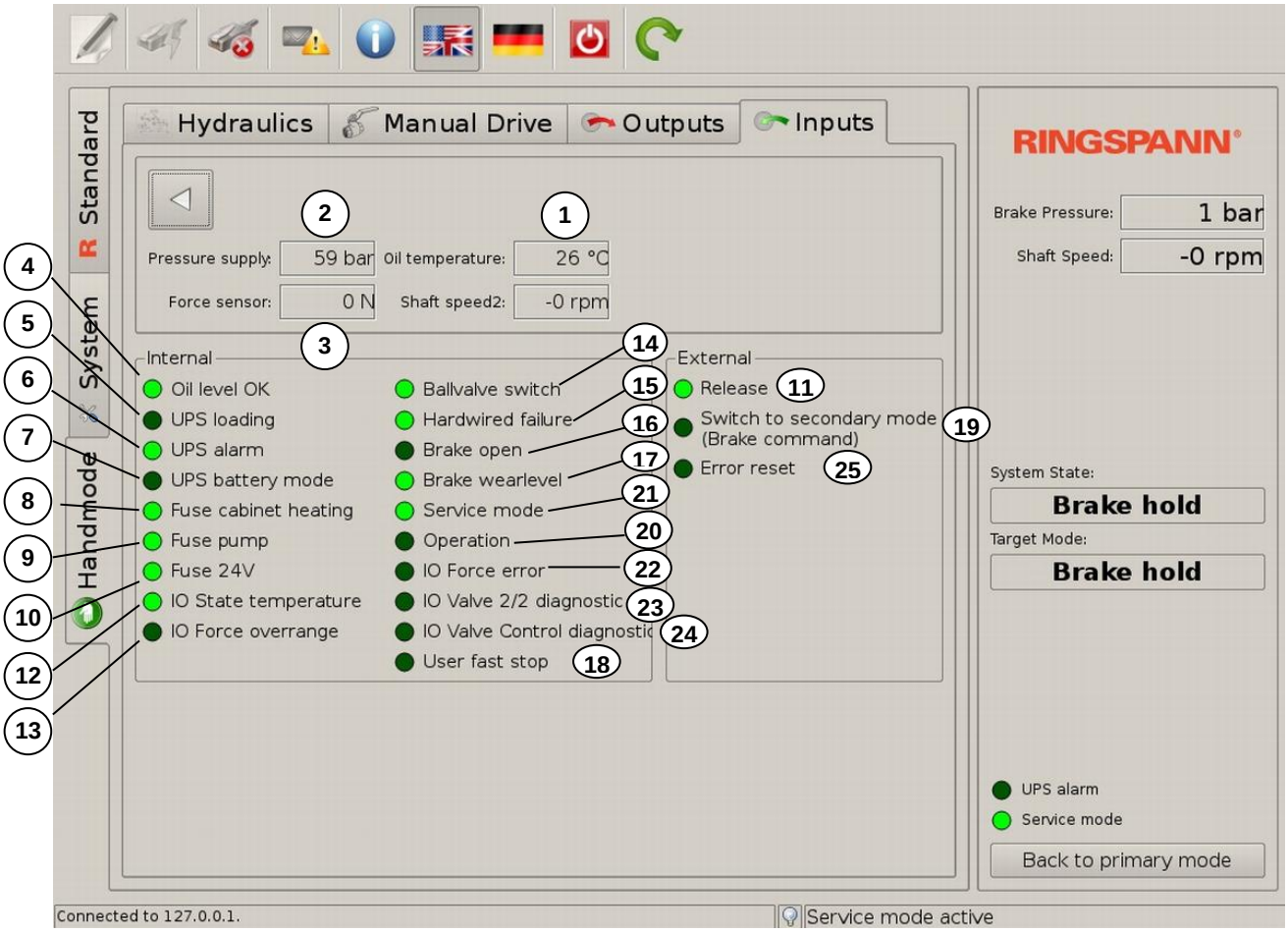


Fig. 40

Here you can find the most important input values.

1. Oil temperature
2. Pressure supply
3. Force sensor value
4. LED is shining, when oil level is o.k.
5. LED is shining, when UPS is loading
6. LED is dark, when UPS is on alarm status

7. LED is shining, when UPS is on battery operation
8. LED is dark, when fuse of the cabinet heating is triggered
9. LED is dark, when fuse of the oil pump (motor) is triggered
10. LED is dark, when fuse of the 24VDC supply voltage is triggered
11. LED is shining, when external release issued
12. LED is shining, when temperature is o.k.
13. LED is shining, when force sensor is overloaded
14. LED is shining, when ballvalve is in open (lever horizontal) position
15. LED is shining, when hard wire is o.k.
16. LED is shining, when brake is open
17. LED is shining, when wear level of brake pad is reached
18. LED is shining, when user fast stop is tripped
19. LED is shining, when external safety circuit (brake command) is tripped
20. LED is shining, when system in primary mode
21. LED is shining, when system is in sevice mode
22. LED is shining, when force sensor is in failure mode
23. LED is dark, when on/off valve is o.k.
24. LED is dark, when control valve is o.k.
25. LED is shining, when error reset is on.

18 Possible application faults

Incorrect brake design: A reasonable design of the system must be effected on the part of the system operator.

Incorrect configuration: In the case of a (syntactically) incorrect configuration file, the system enters into a fault state. The system remains inactive.

Unplanned braking: At the conception stage it must defined on the part of the system integrated or deactivated, 17.6.

19 Maintenance

In order to assure a safe and correct functioning of the brake control system, regular maintenance must be carried out.

Some work must be carried out outside the annual maintenance cycle. This also includes the monthly leakage test (Chap. 19.3). During the annual maintenance, the steps shown in Chapter 19.4 must be carried out.

The following table contains a maintenance overview.

Interval	Note
Routine	at the start of every shift or upon operator change, 19.2
Monthly	19.3
Annually	19.4

19.1 Observe before each maintenance activity!

Before any maintenance work can be carried out on the control system, this must be switched off and externally switched into a current-free condition. This is done by disconnecting the mains plug (if present) or by switching off the corresponding fuse. The liquids in the system have a high temperature of up to 80 ◦C. Therefore there is a risk of scalding.

Furthermore, the system controlled by this control system must be set to a safe state not depending on the functioning of the brake.

19.2 Routine maintenance

The following measures must be taken by the operator before the system is switched on:

- Visual inspection of the system for its proper condition
- Visual inspection of the system for any damage or hazards
- Visual inspection for leaks within the hydraulic system
- Checking of the oil level (approx. in the center of the inspection glass on the work reservoir)
- Visual inspection for contamination or foreign matter

If necessary, suitable remedial measures are to be taken.

19.3 Monthly maintenance

A visual inspection for leakage is to be carried out at least once a month. If necessary, seals must be replaced.
Furthermore the following items shall be carried out in connection with the monthly maintenance interval:

- Visual inspection for any leakage

- Checking the UPS possibly built into the system
- Availability and condition of the documentation
- Function test of the computer and the operating elements
- Check, poss. re-tighten or replace the seals and screw connections
- Check the setting of the pressure limiting valve

19.4 Annual maintenance

1. Dirt check in the reservoir and filter change (flow pipe and intake filter)
2. Check and possibly replace the hydraulic medium
3. Check the display ranges of the pressure sensors by means of the pressure gauge or an external measuring instrument
4. Thermographic examination of the switch cabinet
5. Check the lighting of the switch cabinet
6. Check hoses for wear and replace, if necessary
7. Check the seat valves in manual mode for leak tightness
8. Check, possibly re-set, the pre-filling pressure of the integrated accumulators by manual operation or external devices
9. Replace all integrated hydraulic hoses after a maximum period of 7 years
10. Check electrical cables for porosity and replace, if necessary
11. Check the functionality of the manual pump
12. Check all safety devices
    - Pressure limiting valve setting and functionality
    - Reservoir level switch
    - Temperature shutdown
13. Check the remote maintenance link
14. Select and view messages and diagnosis data by remote access
15. Check the filling levels of the file systems by remote access
16. Backup of the system data by remote access
17. Retrieve the hardware state of the CF card by remote access

20 Spare parts

The following spare parts are defined;

- Intake filter, hydraulic diagram number 2, part no.: 3515-001004-000000
- Flow pipe filter, hydraulic diagram number 6, part no.: 3515-001005-000000
- Sealing kit for switching valves, bore T-13A, part no.: 3515-001043-000000
- Sealing kit for switching valves, bore T-8A, part no.: 3515-001044-000000

21 Disposal

The Hydraulic brake control system may be returned for proper disposal to the manufacturer in Bad Homburg:

RINGSPANN GmbH
Schaberweg 30-38
61348 Bad Homburg
Telephone: +49 6172 / 275 -0
Fax: +49 6172 / 275 -275
www.ringspann.com

22 Airborne noise emission

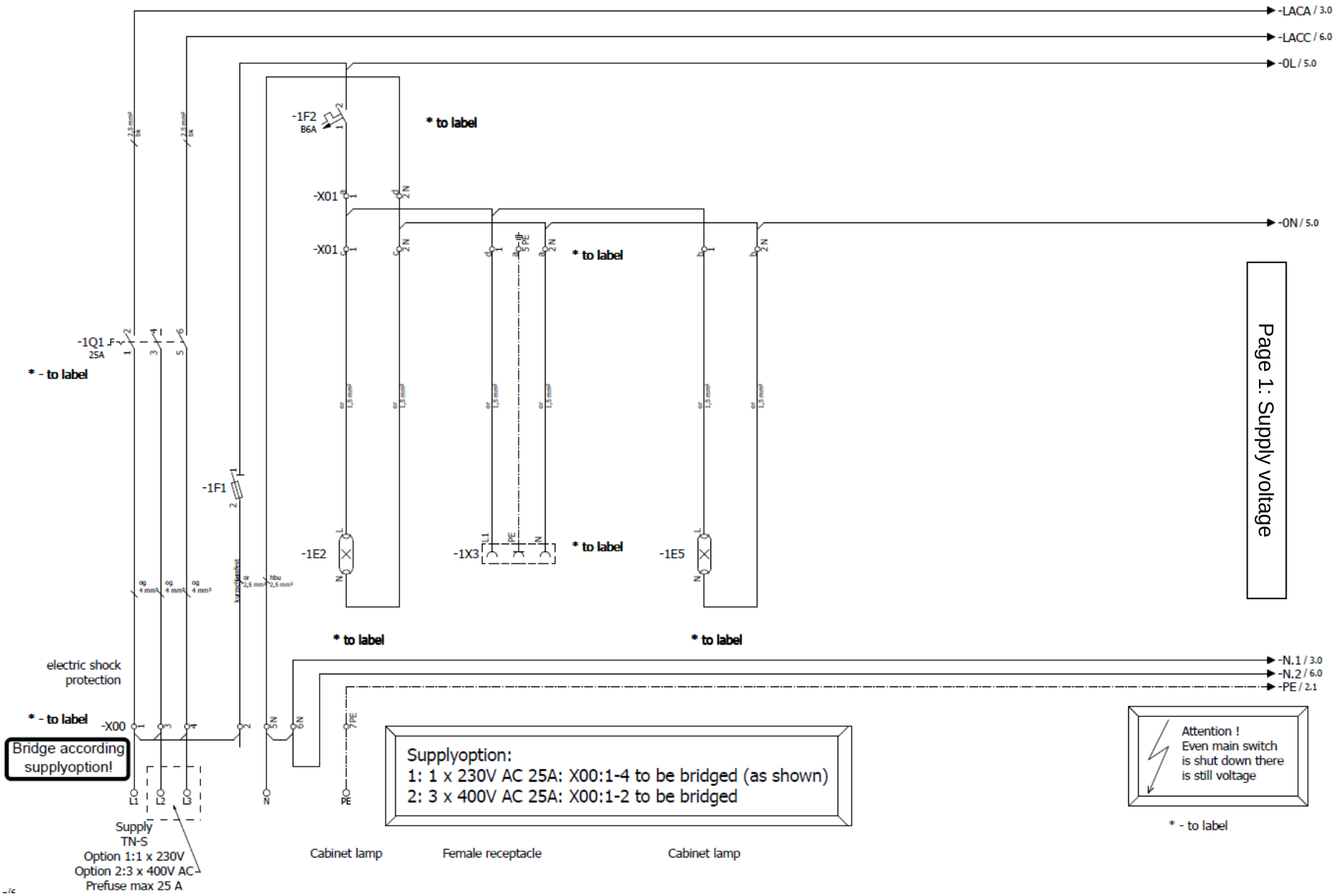
The emission noise pressure level for a workplace directly next to the hydraulic brake control system is less than 70 dB(A).

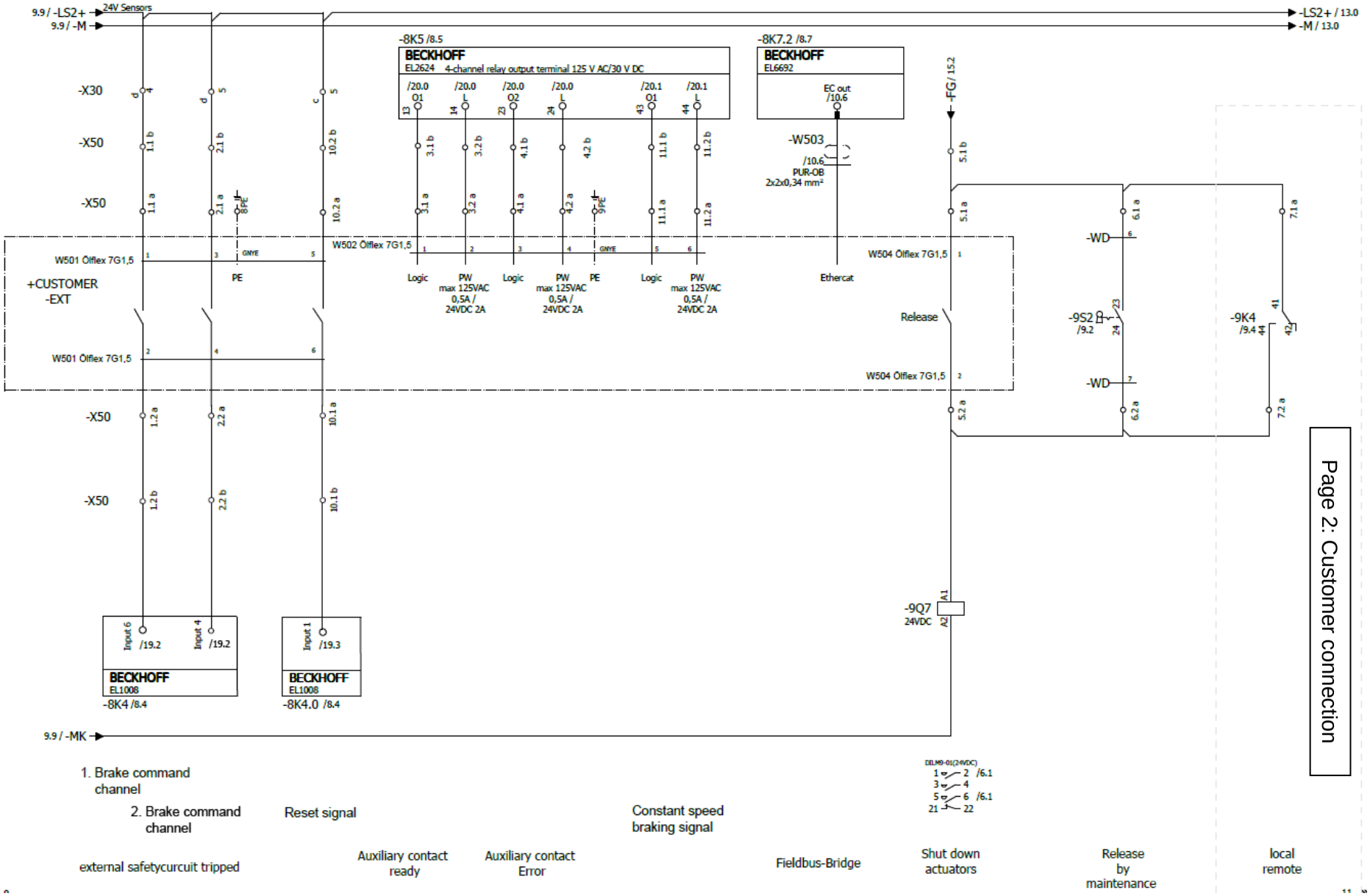
23 Non-ionising radiation

Not applicable.

24 Appendix E-Plan

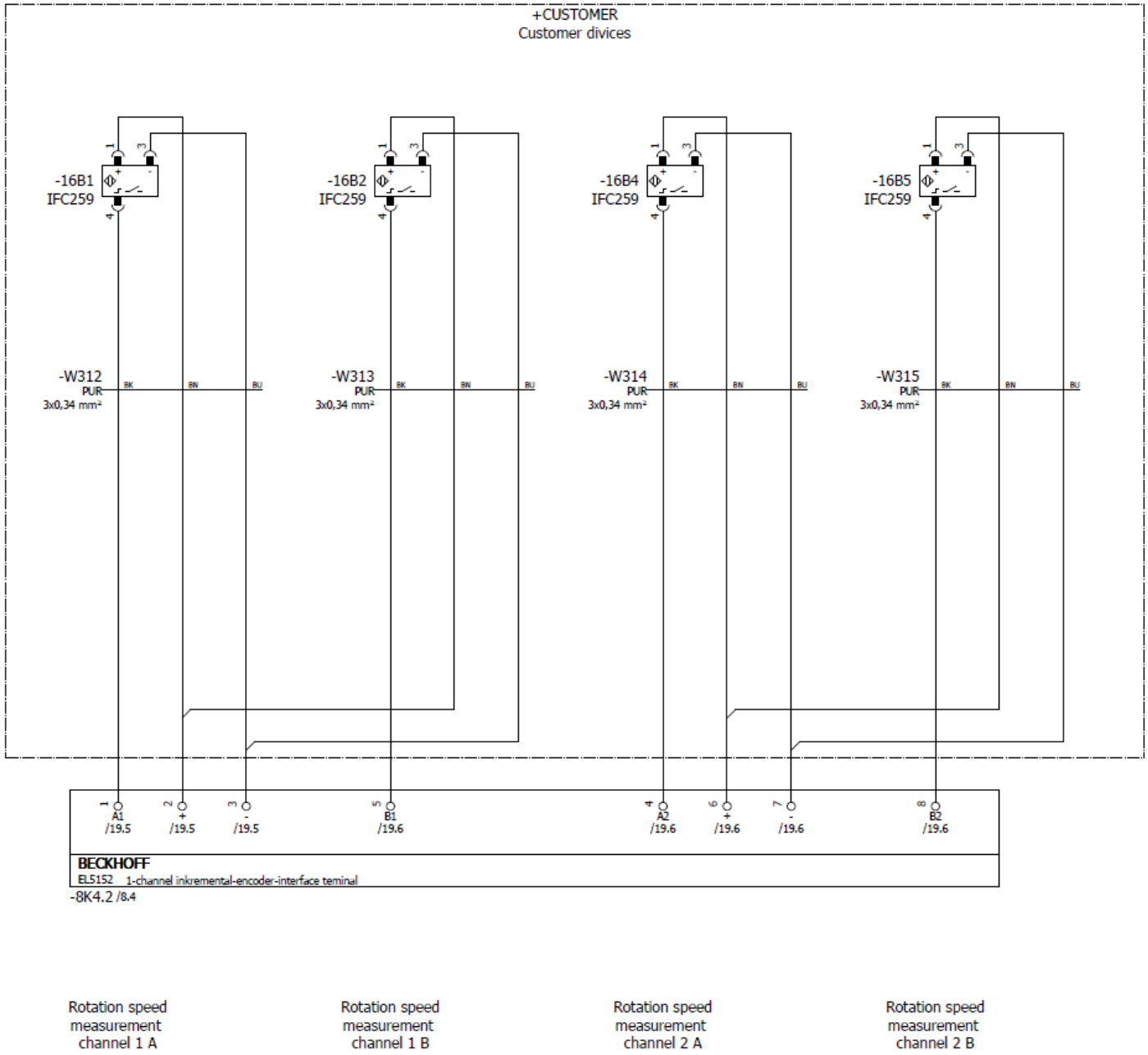
Page 1: Supply voltage
Page 2: Customer connection
Page 3: Connection speed sensor
Page 4: Connection brake condition (open/closed)
Page 5: Connection force sensor

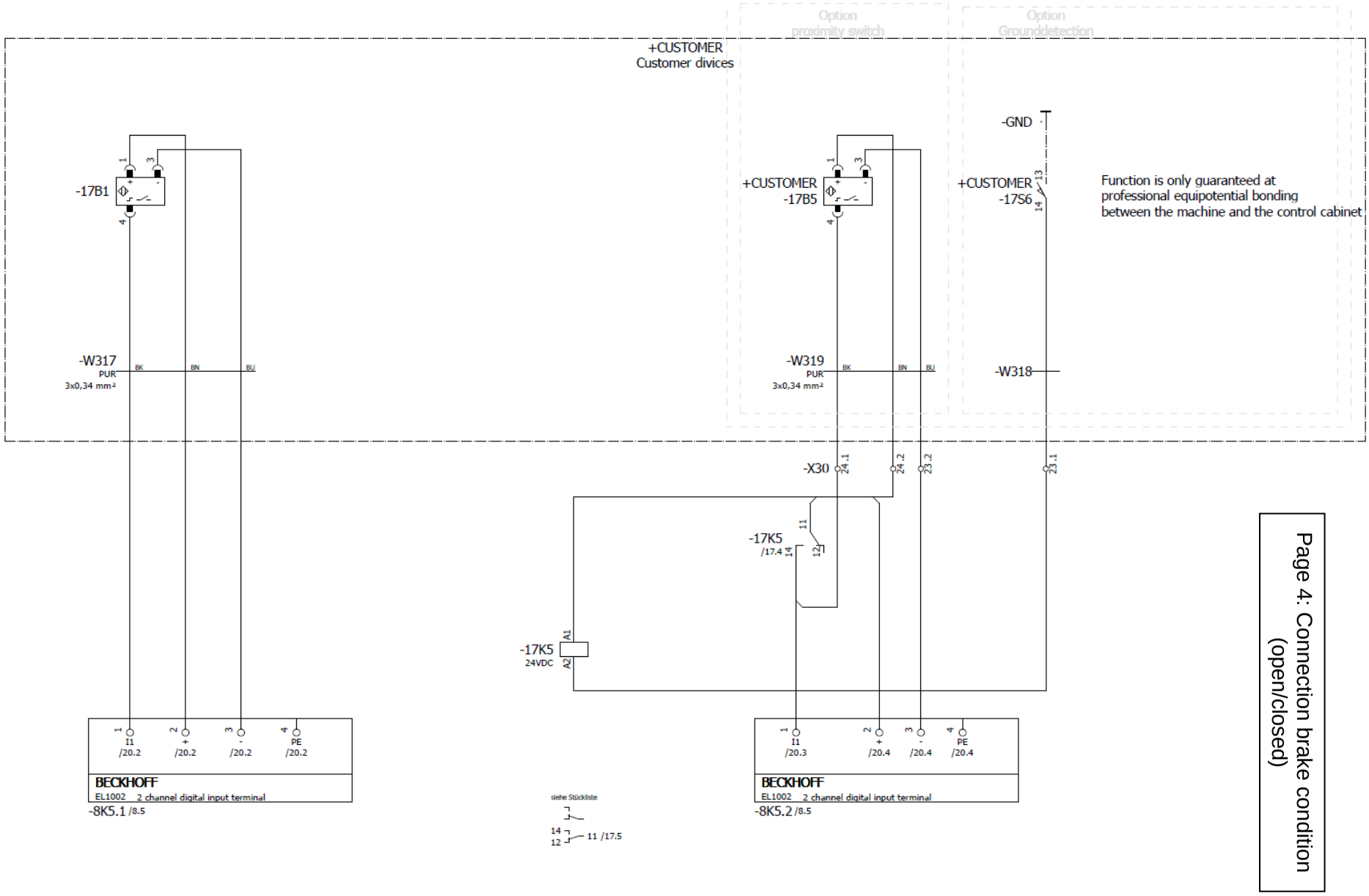

-LACA / 3.0
-LACC / 6.0
-0L / 5.0
-0N / 5.0
-N.1 / 3.0
-N.2 / 6.0
-PE / 2.1
-1F2
B6A
* to label
-X01
-1Q1
25A
* - to label
-1F1
-1E2
-1X3
-1E5
Page 1: Supply voltage
electric shock protection
-X00
Bridge according supplyoption!
Supply
TN-S
Option 1:1 x 230V
Option 2:3 x 400V AC
Prefuse max 25 A
Cabinet lamp
Female receptacle
Cabinet lamp
Supplyoption:
1: 1 x 230V AC 25A: X00:1-4 to be bridged (as shown)
2: 3 x 400V AC 25A: X00:1-2 to be bridged
Attention !
Even main switch is shut down there is still voltage
* - to label

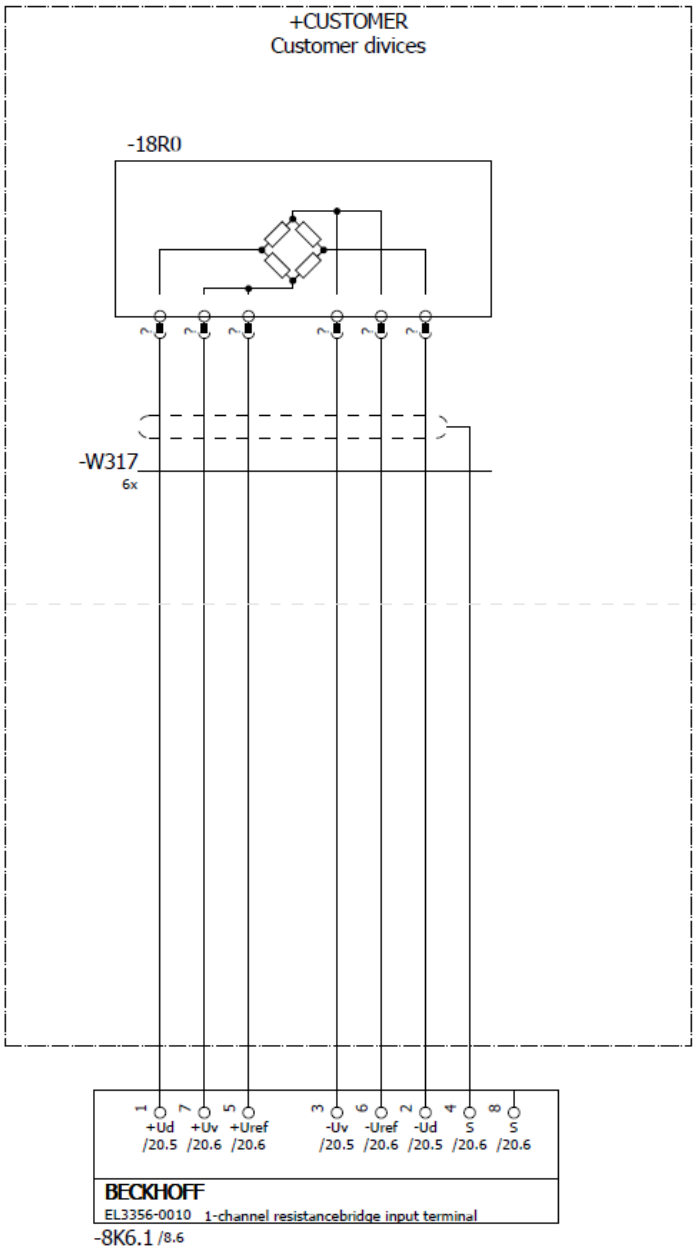


Page 2: Customer connection

Page 3: Connection speed sensor




Option
proximity switch
Option
Grounddetection
+CUSTOMER
Customer divices
-17B1
-W317
PUR
3x0,34 mm²
BK
BN
BU
+CUSTOMER
-17B5
-W319
PUR
3x0,34 mm²
-GND
+CUSTOMER
-17S6
-W318
Function is only guaranteed at
professional equipotential bonding
between the machine and the control cabinet
-X30
-17K5
/17.4
-17K5
24VDC
I1
/20.2
+
/20.2
-
/20.2
PE
/20.2
BECKHOFF
EL1002 2 channel digital input terminal
-8K5.1 /8.5
I1
/20.3
+
/20.4
-
/20.4
PE
/20.4
BECKHOFF
EL1002 2 channel digital input terminal
-8K5.2 /8.5
siehe Stückliste
14
12
11 /17.5
Brake is closed
Brake wear limit
Brake wear limit
Page 4: Connection brake condition
(open/closed)



Optional measuring point!
Implementation and connection are examples!

Load cell