Rexroth
Bosch Group

Application Software Open and Closed Loop Speed Control SPC

RE 95300/12.07
Replaces: 04.04

Technical data sheet

Electronic open and
closed loop speed control for hydraulic drives

Contents

Features

Hydraulic drives are often operated on diesel engines whose speed in operation cannot be kept constant due to different driving profiles.

The electronic open and closed loop speed control is an easily configurable software application for the open and closed loop control of hydraulic drives. It is used to keep the output speed constant independently of diesel engine and pump speeds.

Three variants are available:

- **Variant A** for open loop speed control (SPCA)
- **Variant C** for closed loop speed control (SPCC)
- **Variant D** for closed loop speed control in concrete mixer vehicles (SPCD)

The open and closed loop speed control is designed for use with Rexroth hydraulic pumps.

The user can easily configure the open and closed loop speed control for various combinations of pumps, combustion engines, sensors and equipment.

The open and closed loop speed control is suitable for diesel engines with or without a CAN bus interface (SAE J1939 protocol for SPCA).

Diagnostics and parameter settings are performed with the BODAS service PC software.

Ordering Code

AS/	SPC		
01	02	03	04

Type

01	Application software	**AS/**

Software

02	Open and closed loop speed control	**SPC**

Variants

03	Open loop speed control with speed pick-up in the diesel engine	**A**
	Closed loop speed control with speed pick-up in the hydraulic motor	**C**
	Closed loop speed control for concrete mixer vehicles	**D**

Version

04	Variants C and D	**10**
	Variant A	**20**

Ordering information

The AS/SPC application software may only be operated with the controller RC2-2/21 (variant A) or RC2-2/20 (variants C and D) and other additional components. When ordering, link the hardware and software type codes with a "+":

Example: RC2-2/21+AS/SPCA20

Note

Variant C is described on page 7.
Variant D is described on page 11.

Variant SPCA

The electronic open loop speed control (Speed Control, SPCA) is an easily configurable software application for controlling hydraulic drives. These drives usually consist of a hydraulic pump and one or more hydraulic motors. The open loop speed control serves to keep the output speed constant, independent of the speeds of the diesel engine and the pump.

The SPCA electronic speed control is designed to control a variable pump in an open or closed hydraulic circuit.

The following hydraulic concept is used in an open hydraulic circuit:

- A variable pump A11VO, A7VO or KVA with electroproportional control EP together with one or more fixed motors A2FM, A2FE, A4FM, A10FM or MCR

In a closed hydraulic circuit, the following hydraulic concept is used:

- A variable pump A4VG or A10VG with electroproportional control EP together with one or more fixed motors A2FM, A2FE, A4FM, A10FM or MCR

Two different designs of diesel engine can be used:

- In the case of diesel engines without a CAN bus interface, the actual speed of the diesel engine is sent to the speed control by a speed sensor on the starter gear ring.
- In diesel engines with a CAN bus interface, the speed control receives the actual speed of the diesel engine via the CAN bus.

Functional Description

In order to keep the output speed of hydraulic drives constant and independent of the diesel engine speed and the pump speed, the swivel angle of the hydraulic variable pump is adjusted by electroproportional control.

Open circuit speed control

A joystick supplies the target output speed. An external speed sensor or the CAN bus acquires the actual speed of the diesel engine. If the actual speed of the diesel engine exceeds a set minimum speed (start of control), open loop speed control begins. If the diesel engine speed increases further, the electric control current (PWM signal) to the pump is reduced. This reduction is inversely proportional to the increase of the diesel engine speed. Thus, in spite of increasing diesel engine speed, the pump flow and, as a result, the hydraulic motor speed, remain constant. The SPCA open loop speed control thus keeps the output speed at the value specified by the target output speed independent of the diesel engine speed.

When the open loop speed control is not active, the pump control uses adjustable time ramps to achieve linear adjustment according to the desired setpoint. The time ramps are set for the joystick deflection (without the intervention of the open loop speed control).

SPCA open loop speed control can be used for variable pumps in both open and closed hydraulic circuits.

When a pump is used in an open circuit, only one direction of rotation can be used for the drive (either forwards or backwards).

The open loop speed control can be switched on or off with a switch in the vehicle.

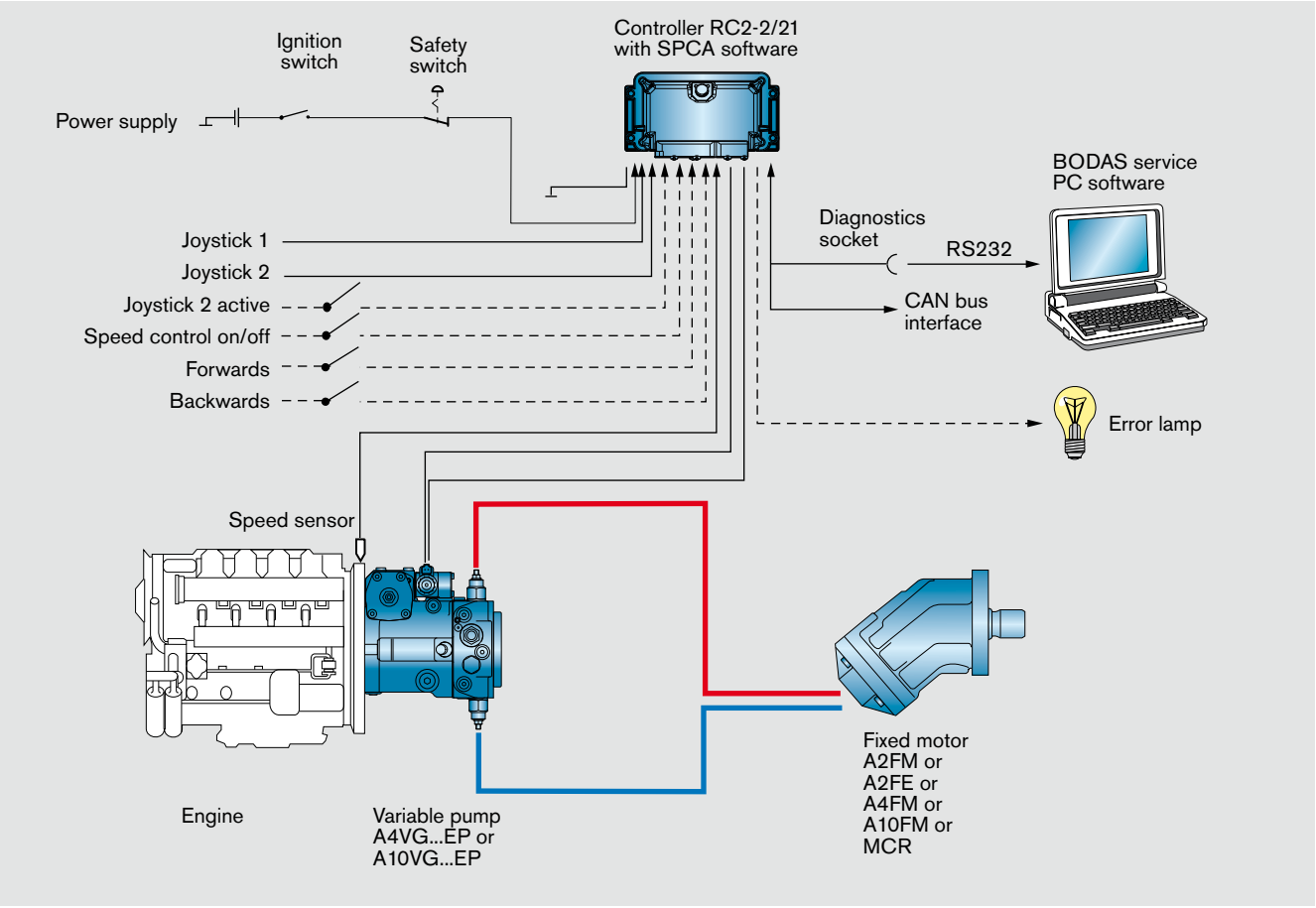


Figure 1: Typical configuration for the SPCA, closed hydraulic circuit, diesel engine without CAN bus interface

Setpoint specification

The output speed or the volume flow is specified by a joystick. The joystick can be a drive lever or a simple potentiometer.

It is also possible to use two joysticks in the vehicle. The second joystick can also be a lever or a simple potentiometer. A switch can then be used to switch between the two joysticks, for example if there is one potentiometer in the driver's compartment and another at the rear of the vehicle. Switching is only possible when the drive is at a downtime.

Two direction switches in the vehicle set the direction of drive rotation (forwards or backwards).

Working behavior

The working behavior of the drive is controlled by three parameters:

- The output speed setpoint value is specified by the joystick.
- The direction switch determines whether the drive runs forwards or backwards.
- The acceleration behavior selected using the time ramp settings determines how quickly the control is changed at the PWM output to the pump. The time ramps can be set separately for the joystick deflection (without open loop speed control intervention) and with open loop speed control intervention.

The joystick is in the neutral position if it is positioned within a range about the zero position. This range is called the dead band. A fixed value has been set for the dead band in the software and cannot be altered.

When the joystick is in the neutral position, the PWM outputs for controlling the proportional solenoids of the pump are switched off (there are two PWM outputs in the closed circuit and one in the open circuit).

When the joystick is moved to a position outside the dead band, the current at the respective PWM output (forwards or backwards direction of rotation) increases depending on the position of the joystick, the direction switch and the set time ramp. The corresponding proportional solenoid of the pump is controlled.

Safety functions

Various options are available for monitoring working behavior:

- Start condition

  The start condition is used to prevent the drive from starting unintentionally.

  After switching on the controller (ignition on), the joystick that has been switched to active must be in the neutral position and the direction switches must be off so that the drive can be started.

  To acknowledge errors, the joystick that has been switched to active must be moved to the neutral position and the direction switches must be turned off.

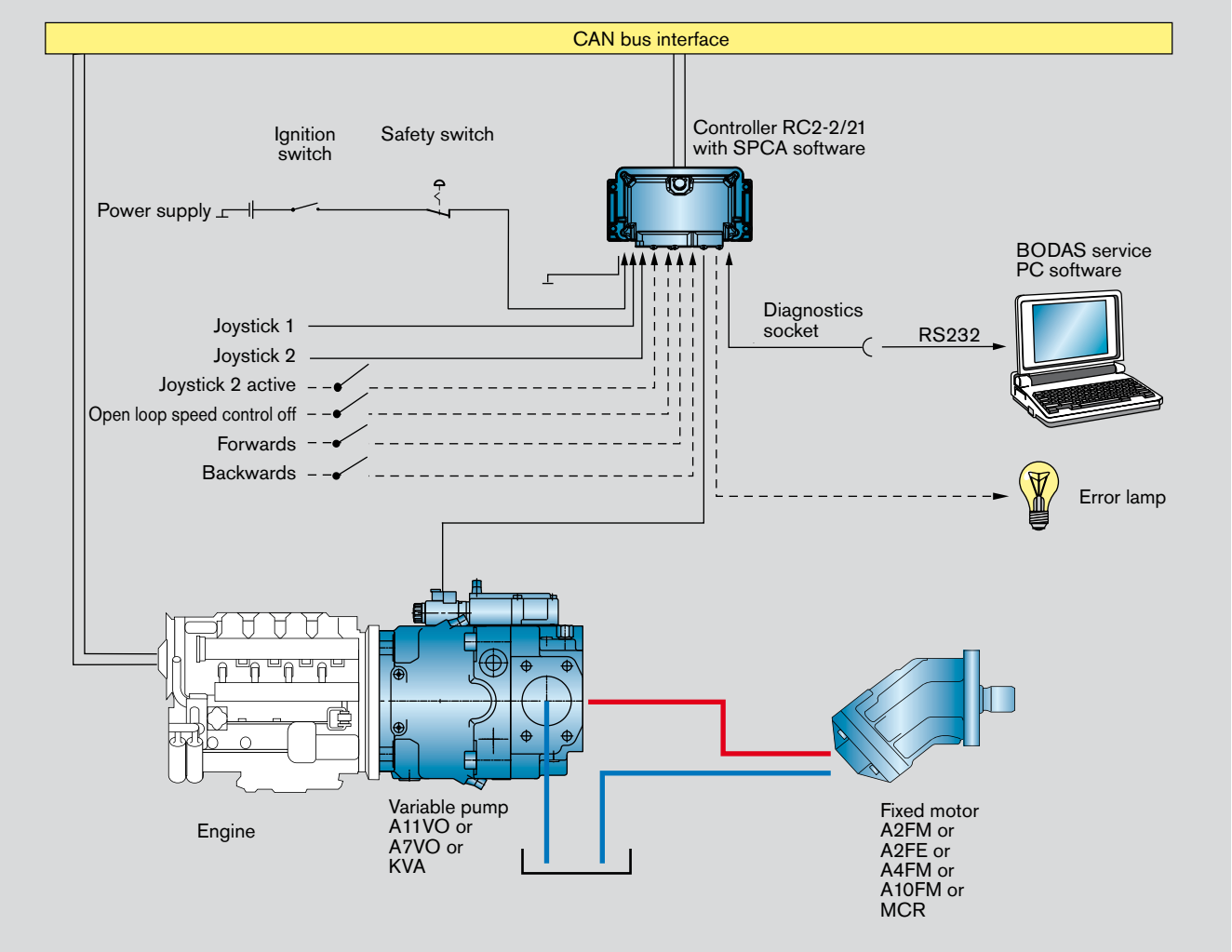


Figure 2: Typical configuration for the SPCA, open hydraulic circuit, diesel engine with CAN bus interface

- Monitoring the diesel engine speed

  At diesel engine speeds below the idle speed, the drive is switched to a fixed low output speed.

- Monitoring the inputs and outputs

  The lines for setpoint inputs and outputs and the proportional solenoid outputs are monitored for wire breaks and short circuits.

  In case of an error or if the safety switch is actuated, the drive is turned off immediately.

  An error lamp also lights up if there is an error.

Important features

- It is possible to switch between two joysticks for the setpoint specification.
- The acceleration and deceleration times can be set separately for the joystick deflection (without the intervention of the open loop speed control) and open loop speed control intervention.
- A switch in the vehicle can be used to switch the open loop speed control on or off.
- The actual value of the diesel engine speed is acquired by a speed sensor or via the CAN bus.
- The behavior of the drive is monitored by safety functions such as the start condition and the diesel engine speed monitor.
- The inputs and outputs of the controller (e.g. joystick) are monitored for cable breaks and short circuit. In case of an error or if the safety switch is actuated, the drive is turned off immediately.
- Errors can be displayed via the connected error lamp.
- All errors that occur can be output with protocol SAE J1939 via the CAN bus interface.
- All errors that occur are stored in the controller and can also be read out later in plain text using the BODAS service diagnostic tool.

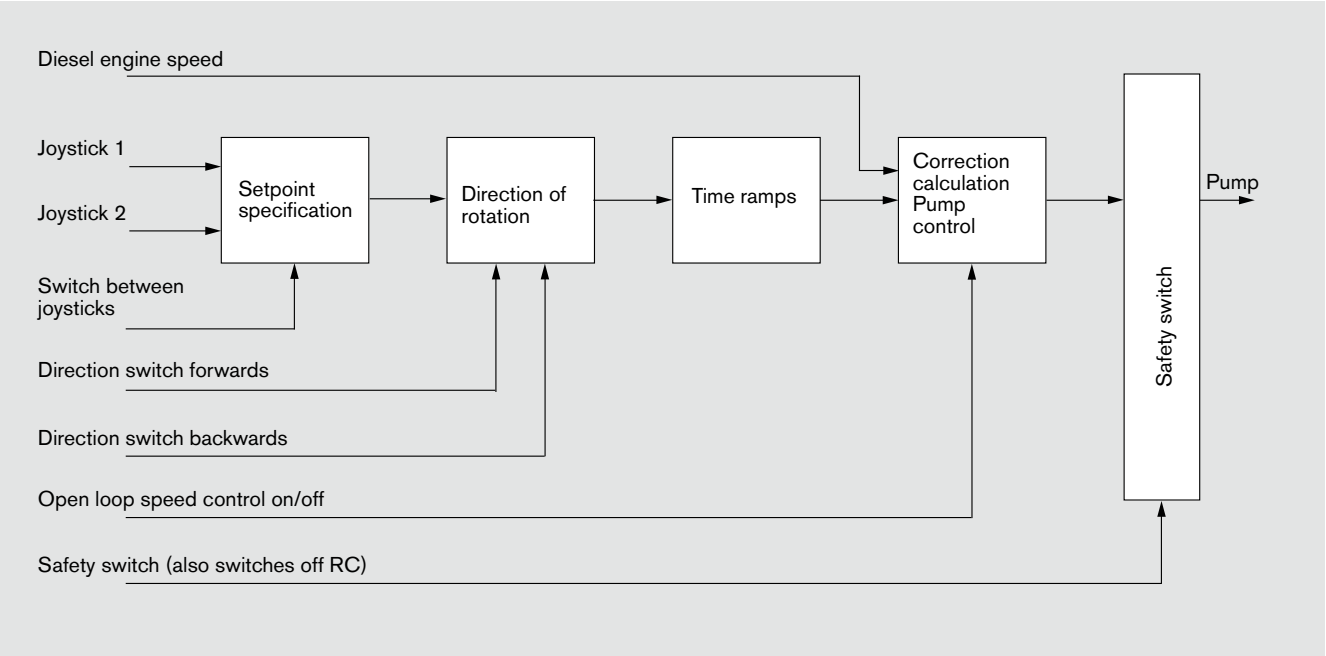


Figure 3: How the SPCA open loop speed control works

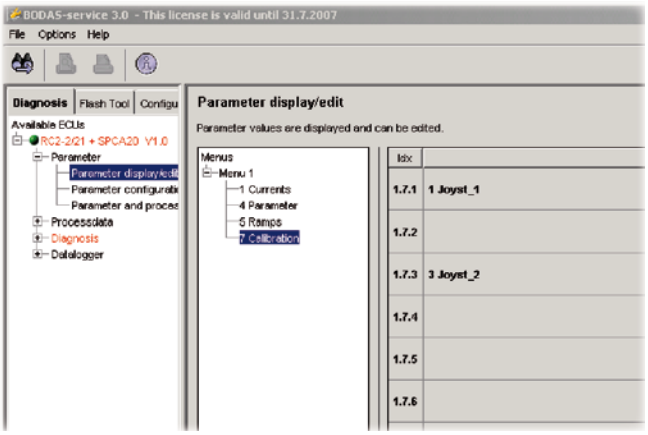
Important parameters

- Diesel engine data (actual speed via sensor or CAN bus, number of teeth on the starter gear ring)
- Drive lever or potentiometer for the set speed of the drive
- Configuration (acceleration behavior)
- Minimum and maximum solenoid current for pump forwards and backwards
- Use of the CAN bus (yes/no)

Parameter Settings and Diagnostics

The parameters to be set for commissioning the SPCA open loop speed control are easy to adjust with the BODAS service PC software.

For diagnostics and troubleshooting, you can use BODAS service to display the most important process variables and error messages.



Required Components

The following electronic components are required:

- RC2-2/21 controller with mating connector (RE 95201)
- Software: AS/SPCA, Version 20
- Drive lever HG104GF/11
- Safety switch

The following additional electronic components can be used:

- IDR speed sensor (RE 95130) with mating connector for diesel engines without a CAN bus interface.
- Potentiometer for setpoint specification (alternative to the drive lever)
- Switch for toggling between joysticks
- Switch for turning speed control on and off
- Direction switches
- Error lamp for indicating error states

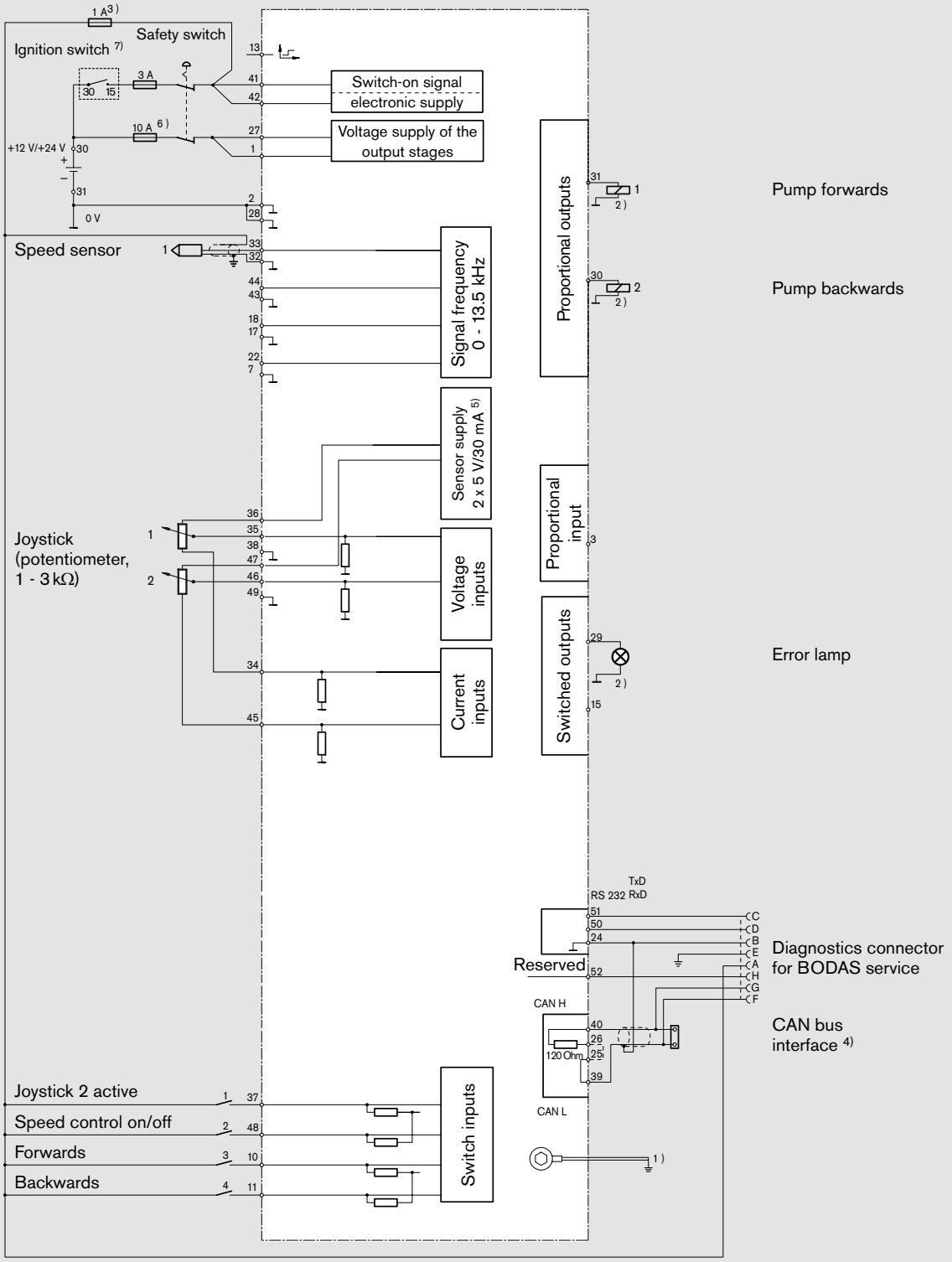
The following hydraulic components are required:

- Variable pump with corresponding control device
  A4VG…EP (RE 92003) or
  A10VG…EP (RE 92750) or
  A11VO…EP (RE 92500) or
  A7VO…EP (RE 92202) or
  KVA…EP (RE 92250)
- Fixed motors
  A2FM (RE 91001) or
  A2FE (RE 91008) or
  A4FM (RE 91120) or
  A10FM (RE 91172) or
  MCR (RE 15205 … 15209)

The following are items required for commissioning and service:

- BODAS service PC software (RE 95086)
- BODAS service connection cable (RE 95086)
- Diagnostics socket (RE 95086)

SPCA Connection Diagram



1) Short, low-resistance connection from a case screw to the vehicle ground
2) Separate ground connection to battery (chassis possible)
3) Separate fuses recommended for switches and sensors and electronics
4) CAN bus: 120 Ω termination resistor recommended (see installation instructions RDE 90 300-01)
5) 5V / ground outputs may also be used alternatively as sensor supply
6) Observe maximum current consumption where proportional solenoids and switched outputs are controlled simultaneously
7) The terminals are labeled according to DIN 72 552. This does not apply for the controller.

Figure 4: Inputs and outputs on the controller for SPCA

Variant SPCC

The electronic closed loop speed control (Speed Control, SPCC) is an easily configurable software application for the closed loop control of hydraulic drives. Here, the hydraulic drive consists of a pump and one or more hydraulic motors. The closed loop speed control serves to keep the drive speed constant, independent of the speeds of the diesel engine and the pump.

The SPCC electronic closed loop speed control is designed to control a variable pump in a closed hydraulic circuit.

The following hydraulic concept is used:

- A variable pump A4VG or A10VG with electroproportional control EP together with one or more fixed motors A2FM, A2FE, A4FM, A10FM or MCR

The following diesel engine design is used:

- Diesel engine with or without CAN bus interface

  The SPCC closed loop speed control does not use the CAN bus. Neither the set speed nor the actual speed of the diesel engine is necessary for closed loop speed control. The closed loop control is dependent on the set speed and actual speed of the hydraulic motor.

Functional Description

In order to keep the output speed of hydraulic drives constant and independent of the diesel engine speed and the pump speed, the swivel angle of the hydraulic variable pump is adjusted by electroproportional control.

Closed loop speed control

A switch in the vehicle can be used to switch the closed loop speed control on or off.

When the closed loop speed control is switched on, the following applies: The set speed of the drive is specified by the drive potentiometer. The actual speed of the drive is measured by a speed sensor in the hydraulic motor. When the actual speed changes, the pump control and, thus, the swivel angle of the pump are regulated in such a way that the flow stays constant. As a result, the output speed of a hydraulic motor connected to the pump is held constant.

When the closed loop speed control is switched off, the pump control adjusts itself in a linear fashion using the set time ramps to reach the desired setpoint.

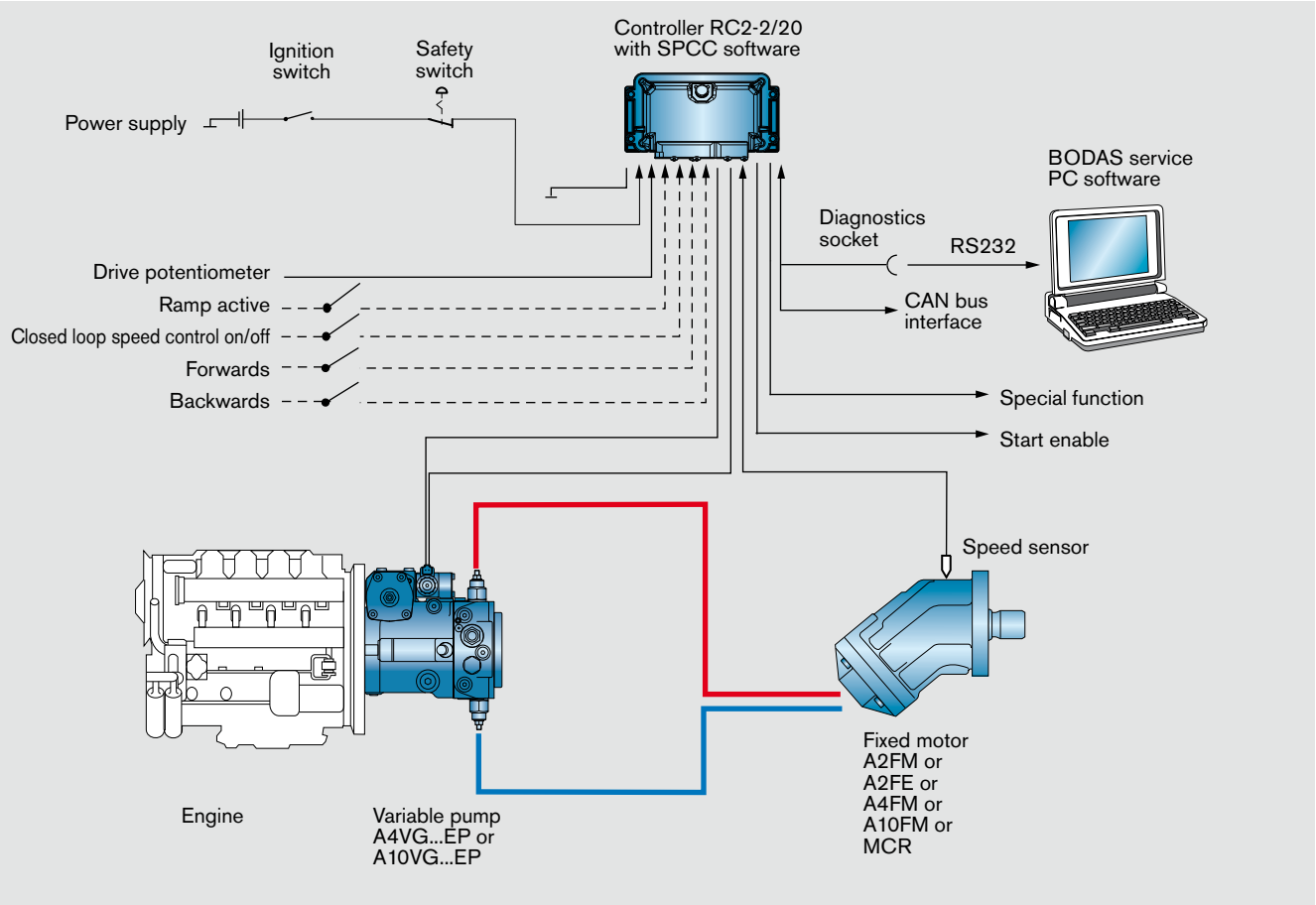


Figure 5: Typical configuration for the SPCC closed loop speed control

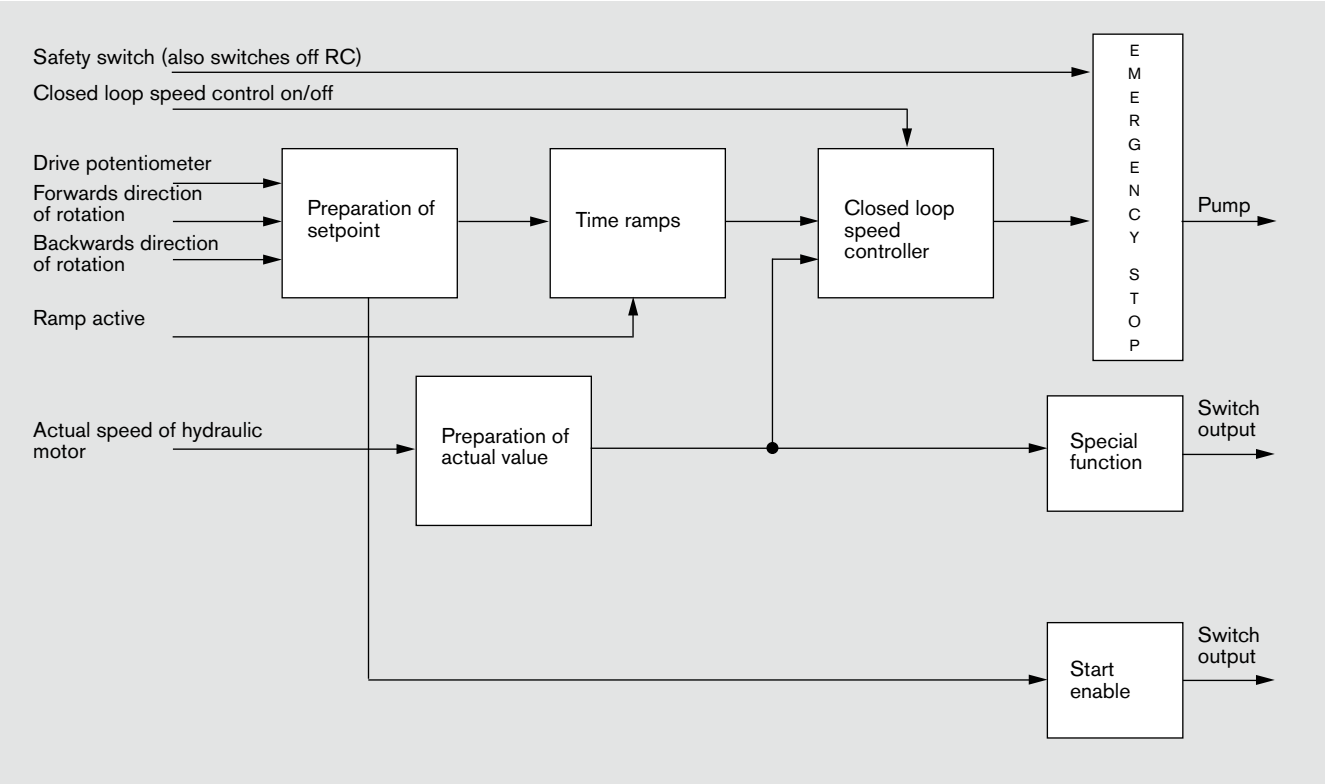


Figure 6: How the SPCC closed loop speed control works

Setpoint specification

The drive potentiometer sets the output speed. This can be a potentiometer on the drive lever or an external potentiometer.

Two direction switches in the vehicle set the direction of drive rotation (forwards or backwards).

Working behavior

The working behavior of the drive is controlled by three parameters:

- The drive potentiometer supplies the setpoint for the output speed.
- The direction switch determines the direction of rotation (forwards or backwards).
- The acceleration behavior selected by the time ramp settings determines how fast the control changes at the PWM output. The time ramps can be adjusted separately for acceleration and deceleration and for forwards and backwards rotation. The time ramps can be switched on and off using a switch in the vehicle.

The drive potentiometer is in the neutral position if it is positioned within an adjustable range around the zero position. This range is called the dead band.

When the drive potentiometer is in the neutral position, the PWM outputs for controlling the proportional solenoids of the pump are switched off.

When it is moved to a position outside of the dead band, the current at the respective PWM output (for forwards or backwards rotation) increases depending on the position of the potentiometer, the direction switch and the set time ramp. The corresponding proportional solenoids of the pump are activated.

Special function

Closed loop speed control enables the control of a special function. This can be any other function, for example another drive. When the speed of the hydraulic motor exceeds a selected switching level, the special function switches on.

Safety functions

Various options are available for monitoring the working behavior:

- Start enable

  Start enable is used to prevent the drive from starting unintentionally.

  After switching on the controller (ignition on), the starting condition must be satisfied in order for the switching signal for start enable to activate. Only then can the drive be started. This means that the start enable signal must be incorporated in the start control of the diesel engine.

  The starting condition is satisfied when

  – the drive potentiometer is in the neutral position,

  – the direction switches are off and

  – the hydraulic motor is at a downtime.

To acknowledge errors, the drive potentiometer must be moved to the neutral position and the direction switches must be turned off.

- Monitoring the inputs and outputs

  The lines for setpoint inputs and outputs and the proportional solenoid outputs are monitored for wire breaks and short circuits.

  In case of an error or if the safety switch is actuated, the drive is turned off immediately.

Important features

- The acceleration and deceleration times can be set separately for both directions of drive rotation. They can be switched on and off with a switch in the vehicle.
- A switch in the vehicle can be used to switch the closed loop speed control on or off.
- A sensor in the hydraulic motor (integrated or external) measures the actual speed of the drive.
- Accurate closed loop speed control is possible even at low speeds.
- Safety functions such as the start enable monitor the operating behavior of the drive.
- The inputs and outputs of the controller (e.g. drive potentiometer) are monitored (for cable breakage and short circuit). In case of an error or if the safety switch is actuated, the drive is turned off immediately.
- All errors that occur are stored in the controller and can also be read out later in plain text using the BODAS service diagnostic tools.

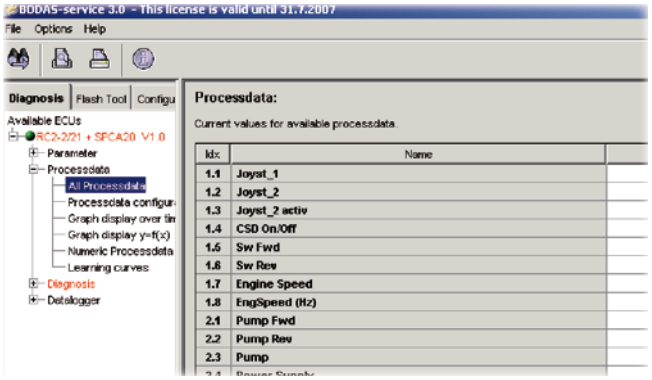
Important parameters

- Hydraulic motor data (actual speed, sensor HDD2)
- Drive potentiometer for set speed
- Configuration (acceleration and deceleration times, dead band, speed regulator, special function)
- Minimum and maximum solenoid current for pump forwards and backwards

Parameter Settings and Diagnostics

The parameters to be set for commissioning the SPCC closed loop speed control are easy to adjust with the BODAS service PC software.

For diagnostics and troubleshooting, you can use BODAS service to display the most important process variables and error messages.



Required Components

The following electronic components are required:

- RC2-2/20 controller with mating connector (RE 95200)
- Software: AS/SPCC, Version 10
- Drive lever HG104GF/11 (RE 95041)
- HDD2 speed sensor with mating connectors (RE 95135), preferably integrated in the hydraulic motor
- Safety switch (emergency stop)

The following additional electronic components can be used:

- Potentiometer for setpoint specification (alternative to the drive lever)
- Switch for turning the time ramps on and off
- Switch for turning the closed loop speed control on and off
- Direction switches

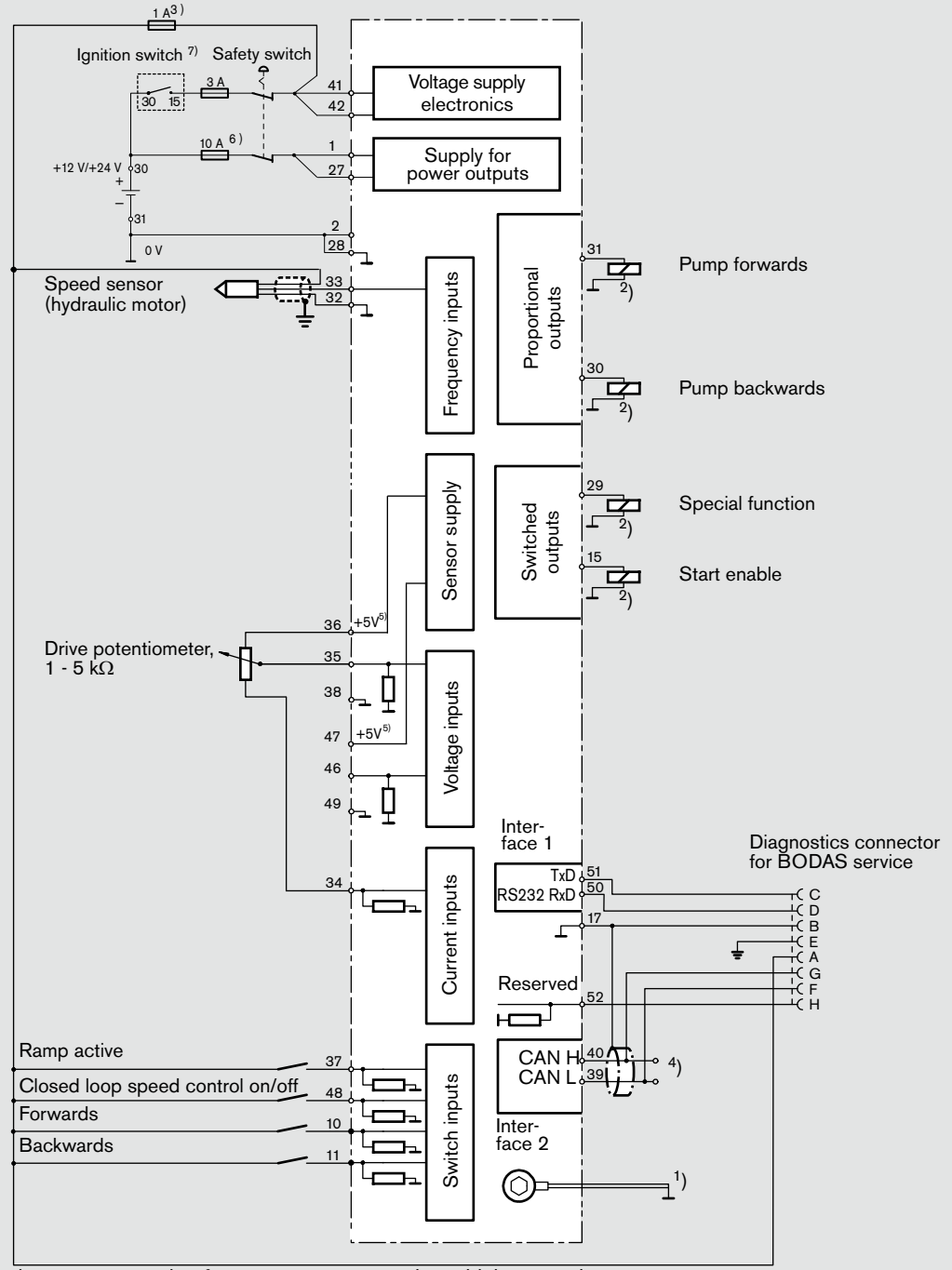
The following hydraulic components are required:

- Variable pump with corresponding control device
  A4VG…EP (RE 92003) or
  A10VG…EP (RE 92750)
- Fixed motors
  A2FM (RE 91001) or
  A2FE (RE 91008) or
  A4FM (RE 91120) or
  A10FM (RE 91172) or
  MCR (RE 15205 … 15209)

The following are required for commissioning and service:

- BODAS service PC software (RE 95086)
- BODAS service connection cable
- Diagnostics socket

SPCC Connection Diagram



1) Short, low-resistance connection from a case screw to the vehicle ground
2) Separate ground connection to battery (chassis possible)
3) Separate fuses recommended for switches and sensors and electronics
4) CAN bus: 120 Ω termination resistor recommended (see installation instructions RDE 90 300-01)
5) 5V / ground outputs may also be used alternatively as sensor supply
6) Observe maximum current consumption where proportional solenoids and switched outputs are controlled simultaneously
7) The terminals are labeled according to DIN 72 552. This does not apply for the controller.

Figure 7: Inputs and outputs on the controller for SPCC

Variant SPCD

The electronic closed loop speed control (Speed Control, SPCD) is an easily configurable software application for the closed loop control of hydraulic drives in concrete mixer vehicles. The hydraulic drive here consists of a pump and a hydraulic motor. It is used to turn the drum of the concrete mixer vehicle. The SPCD closed loop speed control is used to keep the hydraulic drive speed constant, independent of the speeds of the diesel engine and the pump.

The SPCD electronic closed loop speed control is designed to control a variable pump in a closed hydraulic circuit.

The following hydraulic concept is used:

- An A4VTG, A4VG or A10VG variable pump with electroproportional control EP together with an A2FM, A2FE, A4FM, A10FM or MCR fixed motor

The following diesel engine design is used:

- Diesel engine with or without CAN bus interface

  The closed loop speed control does not use the CAN bus. Neither the set speed nor the actual speed of the diesel engine is necessary for closed loop speed control. The closed loop control is dependent on the set speed and actual speed of the hydraulic motor.

Functional Description

In order to keep the output speed of hydraulic drives constant and independent of the diesel engine speed and the pump speed, the swivel angle of the hydraulic variable pump is adjusted by electroproportional control.

Closed loop speed control

The set speed of the drum is set by means of two pushbuttons (right/left) in the vehicle. The actual speed of the drum is measured by a speed sensor in the hydraulic motor. When the actual speed changes, the pump control and, thus, the swivel angle of the pump are regulated in such a way that the flow stays constant. As a result, the output speed of a hydraulic motor connected to the pump is held constant at the set speed value. This keeps the drum rotating at a constant speed independent of the diesel engine speed and pump speed.

This is achieved by regulating the swivel angle of the hydraulic variable pump in the closed circuit by electroproportional control. The pump control varies according to the time ramp that has been set for the working behavior.

The closed loop speed control can be switched on or off during commissioning.

If closed loop speed control has been switched off during commissioning, the pump is controlled in proportion to the setpoint specification and the speed of the diesel engine. All swivel angles are then possible in the range 0 to 100%.

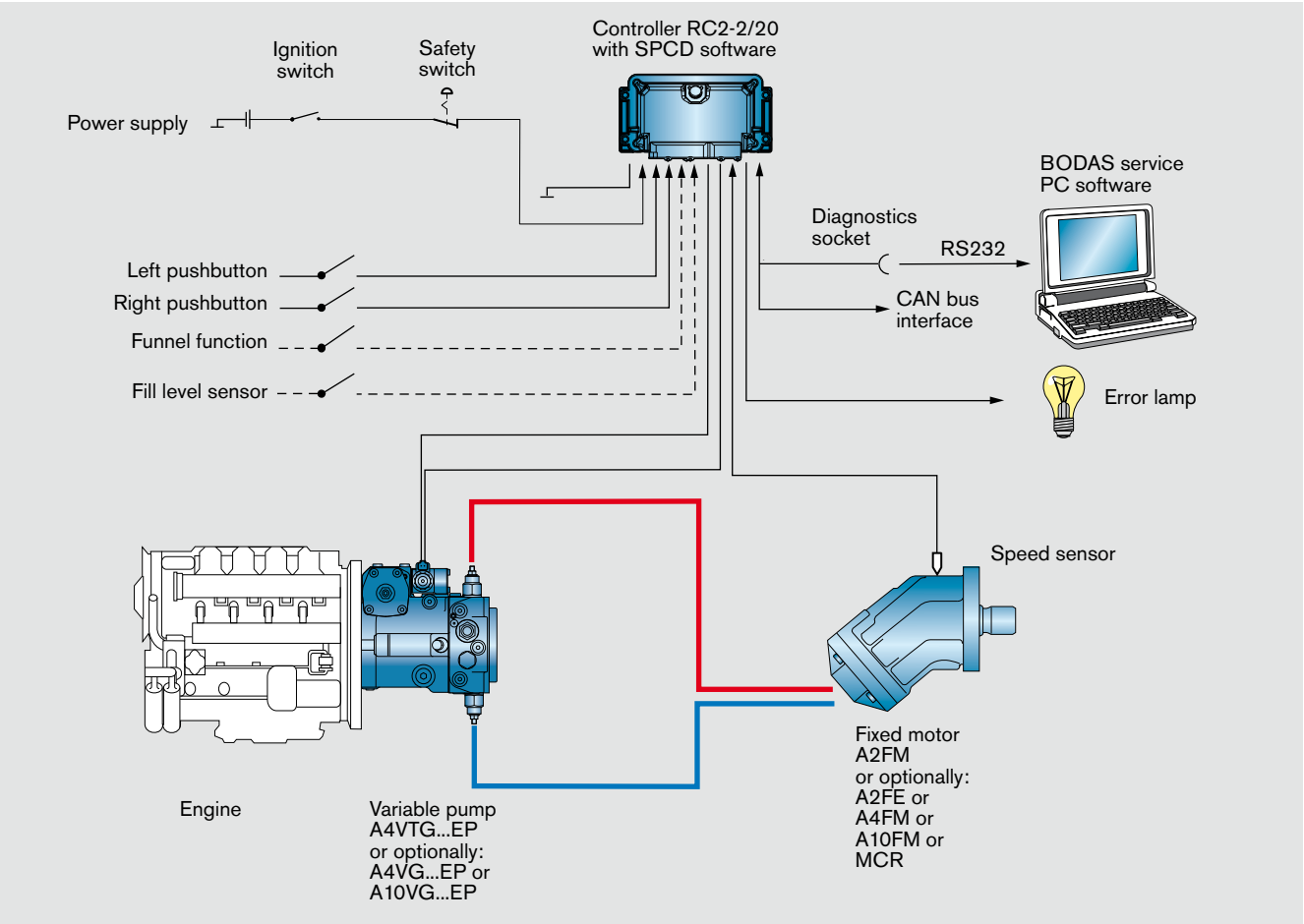


Figure 8: Typical configuration for the SPCD closed loop speed control

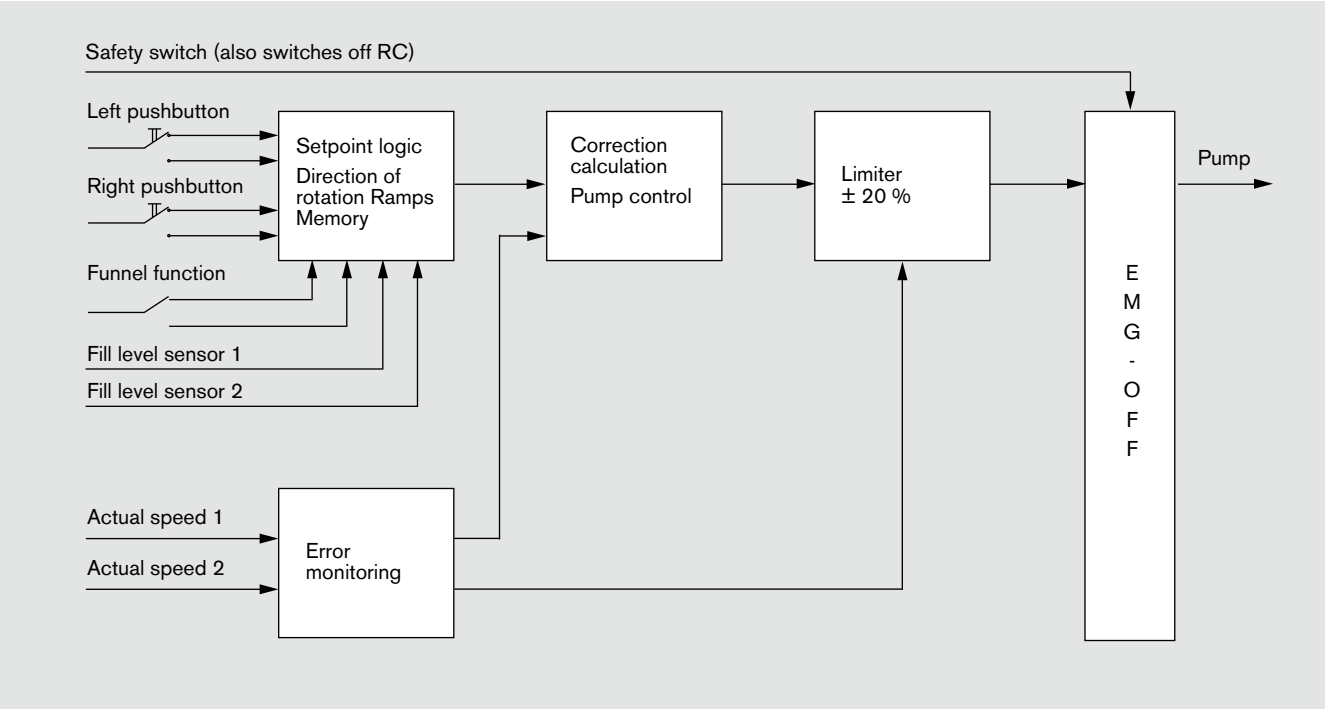


Figure 9: How the SPCD closed loop speed control works

Setpoint specification

Two pushbuttons in the vehicle (left and right) are used to select the output speed or flow.

They also set the direction of the drive (clockwise/counter-clockwise) and therefore the direction in which the drum rotates.

Working behavior

The working behavior of the drum when mixing and delivering the concrete is controlled by two variables:

- The pushbuttons (right/left) set the setpoint for the output speed and direction in which the drum rotates.
- The acceleration and deceleration behavior selected by the time ramps determine how quickly the control changes at the PWM output.

If the drum is at a downtime and one of the buttons (e.g. right) is pressed, the drive starts to move in the appropriate direction (clockwise) and the drum rotates clockwise and mixes the concrete.

Pressing the same button (right) again increases the output speed in this direction according to the selected time ramp.

Pressing the other button (the left button in this example) reduces the output speed in the selected direction of rotation (clockwise in this example) according to the selected time ramp.

The time ramps for increasing and reducing the output speed for concrete mixing are set at the same time.

If the output speed is reduced so much that the mixing drum is at a downtime and the button that was pressed to reduce the speed (the left button in this example) is pressed once more, the drum stays still for a period of time (that can be set) and then starts to move in the corresponding opposite direction (counterclockwise). In doing so, the time ramps that were set together are again used.

Stop function

If both pushbuttons are pressed together, the drum is braked over an adjustable time ramp until it comes to a downtime (stop function).

The time ramp used for the stop function is set separately from the time ramp for the working behavior.

Additional functions

The SPCD closed loop speed control has two additional functions:

- Memory function

  The memory function is turned on or off during commissioning.

  If the memory function is on and the stop function is used to bring the drum to a downtime, the most recent speed and direction of rotation (that were used immediately before the stop function was activated) are stored.

When the button used to select the direction of rotation is pressed once more, the drum starts to move again. The drive uses the stored speed and direction of rotation. This takes place with an adjustable time ramp. The time ramp for the memory function is set at the same time as the time ramp for the stop function.

If the other button is pressed, the stored speed and direction of rotation are erased. This also happens if both buttons are pressed together. The drum drive must then be started as described under "working behavior".

- Funnel function

  The funnel function is used to control delivery from the mixer, for example into the funnel of a concrete pump. A switch in the vehicle is used to switch it on and off. The function must be activated during commissioning.

  When the funnel function is switched on and the "left" button is pressed, the function starts up and the drum starts moving counter-clockwise. Only counter-clockwise rotation is used for delivery. The speed is preset and stored with the button. The concrete then flows from the drum on the vehicle into the funnel.

  A sensor monitors the fill level in the funnel. When the funnel is full, the fill level sensor opens (i.e. the input voltage at the controller is 0 V) and the drum is stopped according to the preset time ramp.

  While the fill level sensor is open, only the clockwise direction of rotation can be used. This is used to maintain the mixing function while the funnel function is stopped. The speed can then be increased using the right button and reduced with the left one. The speed of clockwise rotation is not stored at this time.

  When the funnel is empty, the fill level sensor closes (the input voltage at the controller is 24 V) and the following applies:

  – If the drum is at a downtime, it time ramps up again, moving counter-clockwise, in order to continue discharging. The drive uses the stored speed.

  – If the drum is moving clockwise, it must be stopped before delivery can continue in the counter-clockwise direction.

  The stop ramp for the funnel function is set separately from the time ramps for mixing operation.

  While the funnel function is active, the error lamp remains on all the time. It acts as a status lamp in this case.

Safety functions

Various options are available for monitoring working behavior:

- Start condition

  The start condition is used to prevent the drive from starting unintentionally.

  After switching on the controller (ignition on), the starting condition must be satisfied in order for the drive to be started. The starting condition is met if no buttons are pressed.

- Monitoring the actual speed

  The actual speed of the drum is measured in the hydraulic motor. The speed sensor is monitored for wire breaks and short circuit

  In case of an error, the maximum swivel angle for each adjustment is limited to ±20 % and closed loop speed control is switched off.

- Monitoring the inputs and outputs

  The lines for setpoint inputs and outputs and the proportional solenoid outputs are monitored for wire breaks and short circuits.

  In case of an error or if the safety switch is actuated, the drive is turned off immediately.

  An error lamp also flashes if there is an error.

Important features

- Two buttons (right/left) are used for the setpoint specification.
- The setpoints for speed and direction of rotation can be stored using the memory function.
- The funnel function can control delivery from the mixer drum into the funnel of a concrete pump.
- A sensor in the hydraulic motor (integrated or external) measures the actual speed of the drive.
- Accurate closed loop speed control is possible even at low speeds.
- The working behavior of the drive is monitored by safety functions such as the starting condition and the actual speed monitor.
- The inputs and outputs of the controller (e.g. pushbuttons) are monitored (for cable breaks and short circuit). In case of an error or if the safety switch is actuated, the drive is turned off immediately.
- All errors that occur are stored in the controller and can also be read out later in plain text using the BODAS service diagnostic tools.

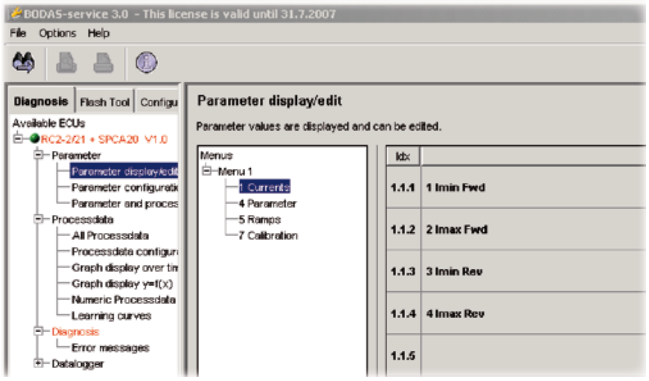
Important parameters

- Hydraulic motor data (actual speed, gearbox ratio)
- Configuration (acceleration and deceleration times, dead band, speed regulator, memory function, funnel function)
- Minimum and maximum solenoid current for pump in both directions

Parameter Settings and Diagnostics

The parameters to be set for commissioning the SPCD closed loop speed control are easy to adjust with the BODAS service PC software.

For diagnostics and troubleshooting, you can use BODAS service to display the most important process variables and error messages.



Required Components

The following electronic components are required:

- RC2-2/20 controller with mating connector (RE 95200)
- Software: AS/SPCD, Version 10
- Pushbuttons (single-pole changeover switches) for setpoint specification
- HDD2 speed sensor with mating connectors (RE 95135), preferably integrated in the hydraulic motor
- Safety switch (emergency stop)

The following additional electronic components can be used:

- Switch for switching over to funnel function
- Fill level sensor (switch on funnel)

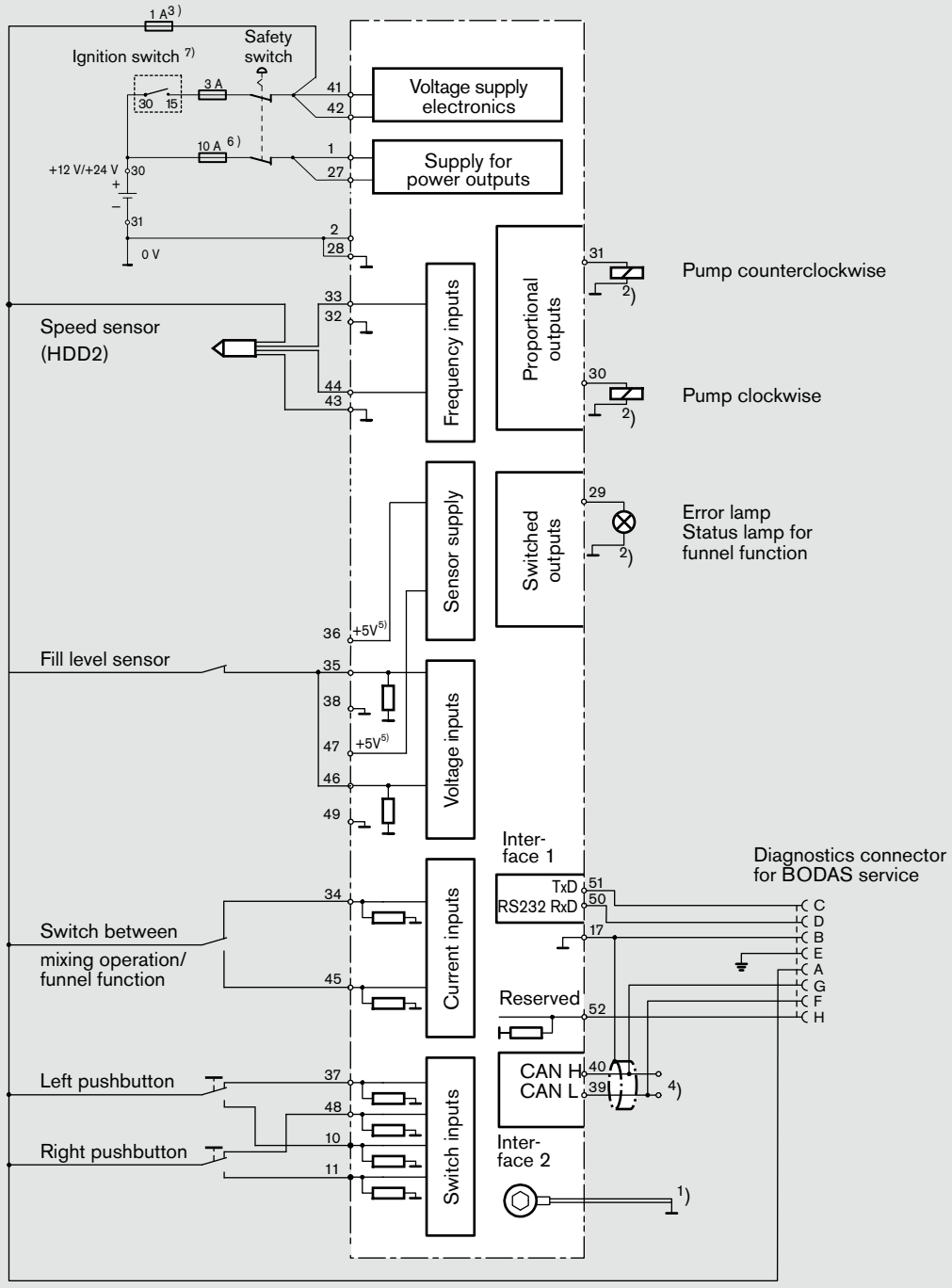
The following hydraulic components are required:

- Variable pump with appropriate control device
  A4VTG…EP (RE 92012)
  or optionally:
  A4VG…EP (RE 92003) or
  A10VG…EP (RE 92750)
- Fixed motor
  A2FM (RE 91001)
  or optionally:
  A2FE (RE 91008) or
  A4FM (RE 91120) or
  A10FM (RD 91172) or
  MCR (RE 15205 … 15209)

The following are required for commissioning and service:

- BODAS service PC software (RE 95086)
- BODAS service connection cable
- Diagnostics socket

SPCD Connection Diagram



1) Short, low-resistance connection from a case screw to the vehicle ground
2) Separate ground connection to battery (chassis possible)
3) Separate fuses recommended for switches and sensors and electronics
4) CAN bus: 120 Ω termination resistor recommended (see installation instructions RDE 90 300-01)
5) 5V / ground outputs may also be used alternatively as sensor supply
6) Observe maximum current consumption where proportional solenoids and switched outputs are controlled simultaneously
7) The terminals are labeled according to DIN 72 552. This does not apply for the controller.

Figure 10: Inputs and outputs on the controller for SPCD

Safety Instructions

- Observe the respective operating instructions: RE 95300-B for **SPCA**, RE 95302-B for **SPCC** and RE 95303-B for **SPCD**.
- Observe the safety instructions in the data sheet for BODAS controllers RC (RE 95200, RE 95201)

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