Rexroth
Bosch Group

DRC Travel Drive Control Application Software

RE 95 320/06.06
replaces: 02.04

Technical data sheet

Electronic travel drive control for
travel management of hydraulic drives

Contents

Features

The electronic travel drive control is an application-specific, adaptable software package for travel management of hydraulic drives. With its integrated reversing functions and hydrostatic braking, it allows soft start-up, acceleration and reversing operations.

Variants DRCD and DRCE also include functions for speed limiting, diesel-engine overheating protection (via CAN), diesel-engine overspeed protection, automotive travel, load limiting control, CAN-bus interface (SAE-J 1939) and three parameterizable travel modes which can be selected by the driver.

The integrated, adjustable inch function enables infinite limiting of the pump control.

Variants A, B and C:

– Travel drives with simple pump control in combination with fixed displacement motors

Variants D and E:

– Complex travel drives with pump and motor control

The DRC travel drive control is designed for operation with Rexroth pumps A4VG and A10VG with electric control (proportional solenoid).

The software can be parameterized by the user.

Diagnostics and parameterization are possible with the BODEM PC software.

The control offers diagnostic capabilities via the CAN bus.

Ordering code

AS/	DRC		1x

Type

Application software	AS/

Software

Travel drive control	DRC

Variant A

Control of an EP variable pump via joystick	A

Variant B

Control of an EP variable pump via acceleration pedal with direction switch	B

Variant C

Control of an EP variable pump via external voltage with direction switch	C

Variant D

Control of a DE/EV variable pump and an EP variable motor (load-dependent travel behavior)	D

Variant E

Control of an EP variable pump and an EP variable motor (load-independent travel behavior)	E

Version

The version number indicates the development state of the software.	1x

Ordering information

The AS/DRC application software may only be operated with controllers RC2-2/20 (DRCA to DRCC) or RC4-4 (DRCD and DRCE) and other additional components (see pages 11 and 20). When placing an order, the hardware and software ordering codes are to be linked by a "+".

Examples:
RC2-2/20+AS/DRCA10
RC4-4/20+AS/DRCD10

Variant overview

The fundamental differences between the various variants are summarized in the following tables:

Variants	A	B	C
	See page 4		
Installed on controller	RC2-2		
Control of variable pump	Electro-proportional EP (with feedback)		
Possible variable pumps	A4VG…EP, A10VG…EP		
Possible fixed / variable motors	Fixed displacement motor, e.g. A2FM		
Pilot control devices	Joystick	Acceleration pedal and direction switches	External control voltage (e.g. from PLC) and direction switches
Automotive travel	No		
Load limiting control	No		
Number of variants of the acceleration behavior which are parameterizable and which can be selected by the driver	3		
Additional functions	No		
CAN-bus interface (SAE-J 1939)	No		
Field of application	Pavers, rollers		Industrial applications

Variants	D	I
	See page 11	
Installed on controller	RC4-4	
Control of variable pump	Electric, direct-controlled DE or EV (without feedback)	Electro-proportional EP (with feedback)
Possible variable pumps	A4VG…DE/EV, A10VG.DE	A4VG…EP, A10VG…EP
Possible fixed / variable motors	Up to 2 variable motors A6VM…EP; fixed displacement motor, e.g. A2FM	
Pilot control devices	Acceleration pedal or CAN Inch pedal Travel direction switch Poti for speed limiting Selector switch for travel modes	
Automotive travel	Yes	
Load limiting control	Yes	
Number of travel modes which can be parameterized and selected by the driver	3	
Additional functions	Speed limiting Overheating protection (via CAN) Diesel overspeed protection	
CAN-bus interface (SAE-J 1939)	Yes	
Field of application	Wheeled vehicles with **load-dependent** travel behavior (wheel loaders, fork lift trucks, telehandlers, special vehicles)	Wheeled vehicles with **load-independent** travel behavior (special vehicles)

Variants DRCA, DRCB and DRCC

The electronic drive control is designed to actuate a variable pump in a closed hydraulic circuit.

Control is based on the following hydraulic concept:

- An A4VG or A10VG variable pump with electro-proportional EP control combined with one or more A2FM, A2FE, A4FM or A10FM fixed displacement motors.

The following diesel engine configuration can be used:

- Diesel engine with or without CAN-bus interface
  The travel drive control receives the actual speed value via a speed sensor.

Functional description

The software is used for the realization of easily reversible hydraulic drives. Figure 1 shows a typical configuration for the travel drive control.

Setpoint specification

The desired vehicle speed and travel direction are specified via the setpoint specification. This can be performed in three different ways:

- **Variant A:** Joystick

  If the drive is controlled via a joystick, the setpoint and travel direction are specified via this lever. The potentiometer of the joystick is monitored for wire break and short circuit.

- **Variant B**: Acceleration pedal

  If the drive is controlled via an acceleration pedal, two direction switches (for forwards/backwards travel) must also be connected. The setpoint is specified via the pedal, the travel direction via the direction switches. The potentiometer connected to the acceleration pedal is monitored for wire break and short circuit.

- **Variant C**: External control voltage

  If the drive is controlled via an external voltage, for example via a PLC, two direction switches (for forwards/backwards travel direction) can also be connected. The setpoint is specified via the external control voltage, the travel direction via a control signal or the direction switches.

  Where setpoint specification occurs via an external control voltage, no monitoring is carried out by the travel drive control. Undefined states at the inputs can cause the drive to start unintentionally.

  Safety monitoring must be guaranteed by the connected signal source (e.g. PLC).

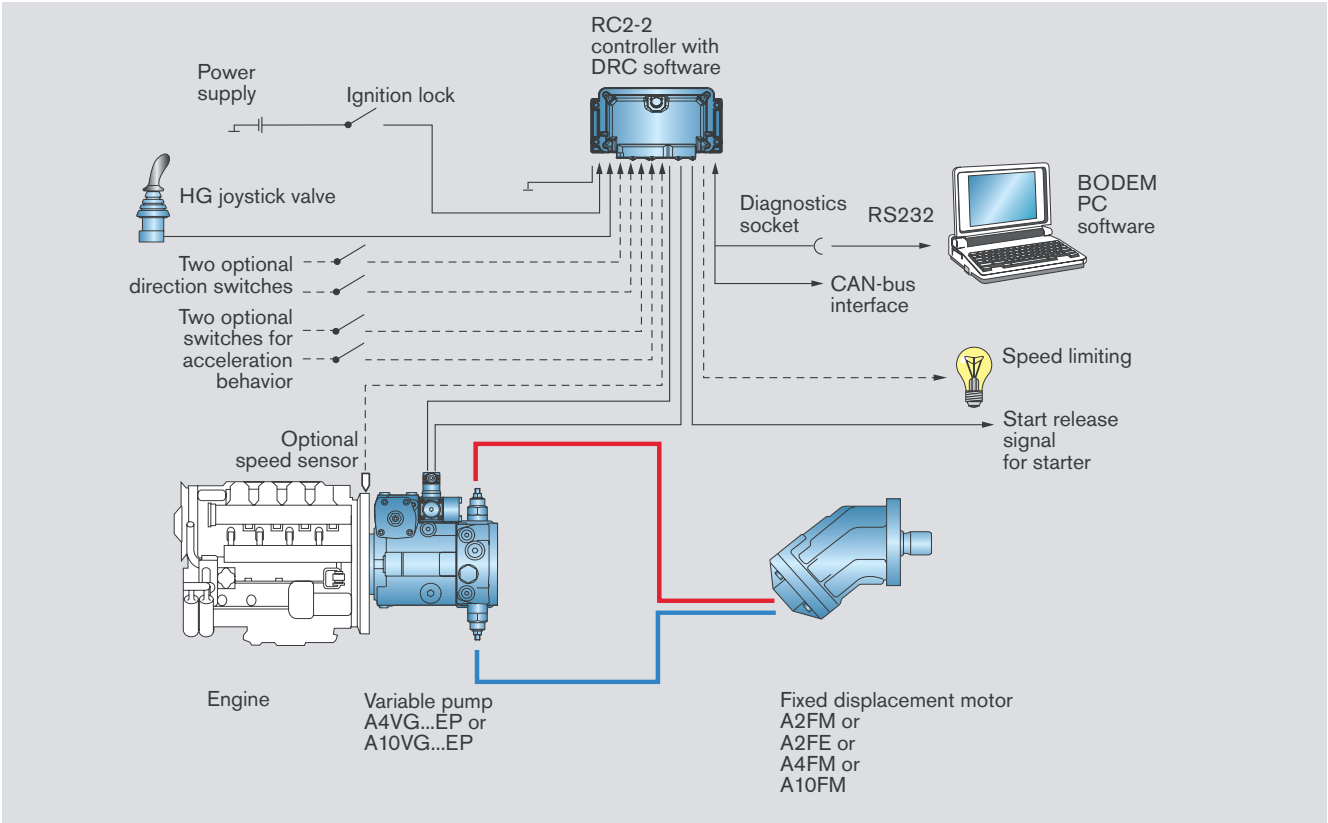


Figure 1: Typical configuration for the DRC travel drive control, variants A-C (DRCA to DRCC)

Inch function

A second potentiometer can be connected for infinitely variable setpoint limitation.

For **variants A and B**, the inching potentiometer is monitored for wire break and short circuit.

For **variant C**, the values at the input for the inching potentiometer are specified by an external control voltage. In this case safety must be guaranteed by the connected signal source.

Travel behavior

Travel behavior is controlled by three variables.

- The setpoint is specified via the joystick, the acceleration pedal or the external control voltage (depending on the variant).
- The control of the PWM output for the specified setpoint is defined in the travel behavior characteristic.
- The acceleration behavior selected by the position of the time ramp switch determines how quickly the control at the PWM output changes.

Figure 2 shows the method of operation of the travel drive control. The following is a description of travel behavior for variant A. The principles are the same for variants B and C:

- The joystick is in the neutral position when it is positioned within a user-definable range around the zero position (dead band).

If the joystick is in the neutral position, the PWM outputs for the forwards and backwards directions that control the proportional solenoids of the pump are switched off.

- If the joystick is moved to a position outside the dead band, the current at the relevant PWM output (for forwards or backwards travel) increases according to the position of the joystick and the set characteristic. The corresponding proportional solenoid is actuated. In addition, the acceleration behavior can be selected via the time ramp switch. Three different travel modes can be parameterized ("soft", "medium", "hard").

Start release

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

For start release, a digital switched output is used. Its signal must be integrated into the start control of the diesel engine. The output is switched on if the joystick is in the neutral position.

After the controller is switched on (ignition switch turned on), the joystick must be in the neutral position in order for the start release to be issued and the drive started

Speed monitoring

With speed monitoring, stalling of the diesel engine can be prevented. This requires an additional speed sensor. With this sensor, a speed threshold can be set. This threshold must be exceeded before the drive can be started.

Special function

The special function can be used for different purposes and in different modes:

- In "error lamp" mode, a signaling device such as an error lamp can be connected in order to display various error warnings through different flashing frequencies.
- In "backwards travel" mode, the special function is connected as soon as backwards travel is selected. This can be used for a warning signal or reversing light, for example.
- In "operating threshold" mode, a special function is connected when an operating threshold is reached. This could be a vibration drive on a roller, for example. The threshold can be set separately for forwards and backwards travel.

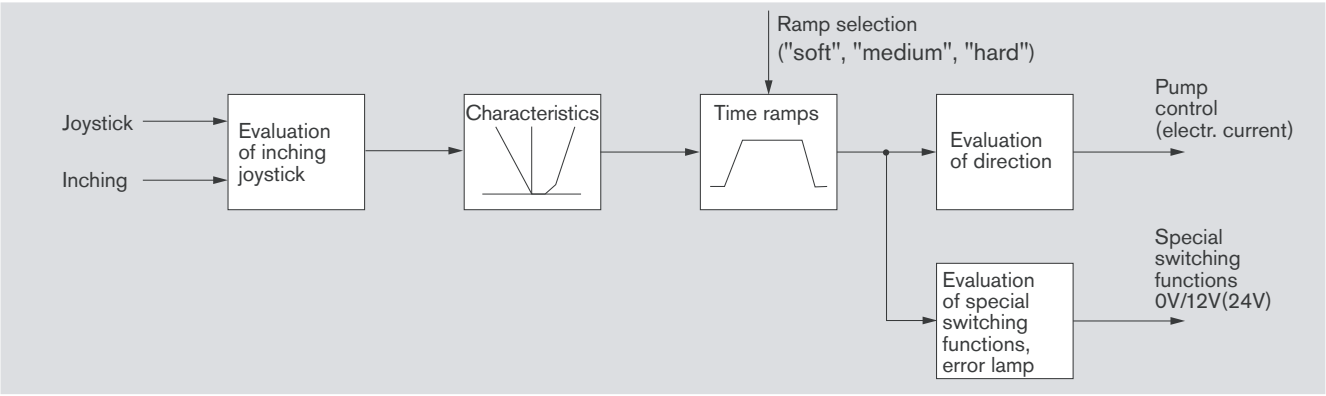


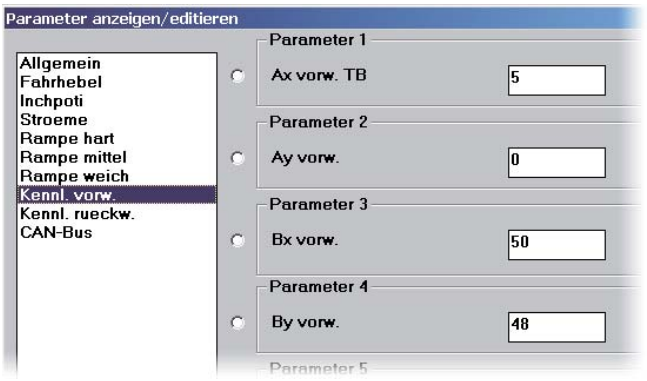
Figure 2: Method of operation of the DRC travel drive control, variants A-C (DRCA to DRCC)

Important features

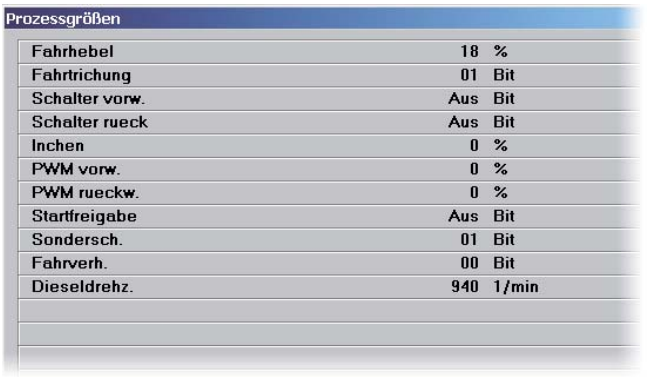
- Three different possibilities for setpoint specification are available through the variants
- Integrated inch function
- Three different acceleration and delay behaviors can be selected externally
- Integrated backwards travel warning possible
- Integrated safety functions for start release and speed monitoring
- Joystick, acceleration pedal and inching potentiometer are monitored for wire break and short circuit.
- The inputs and outputs of the controller are monitored (for cable break, short circuit).
- Divers errors can be displayed by means of a flashing code on one of the connected error lamps.
- All errors can be output via the CAN-bus interface.
- Important error events are stored in the controller and can also be read later in plain text form using BODEM.

Parameterization and diagnostics

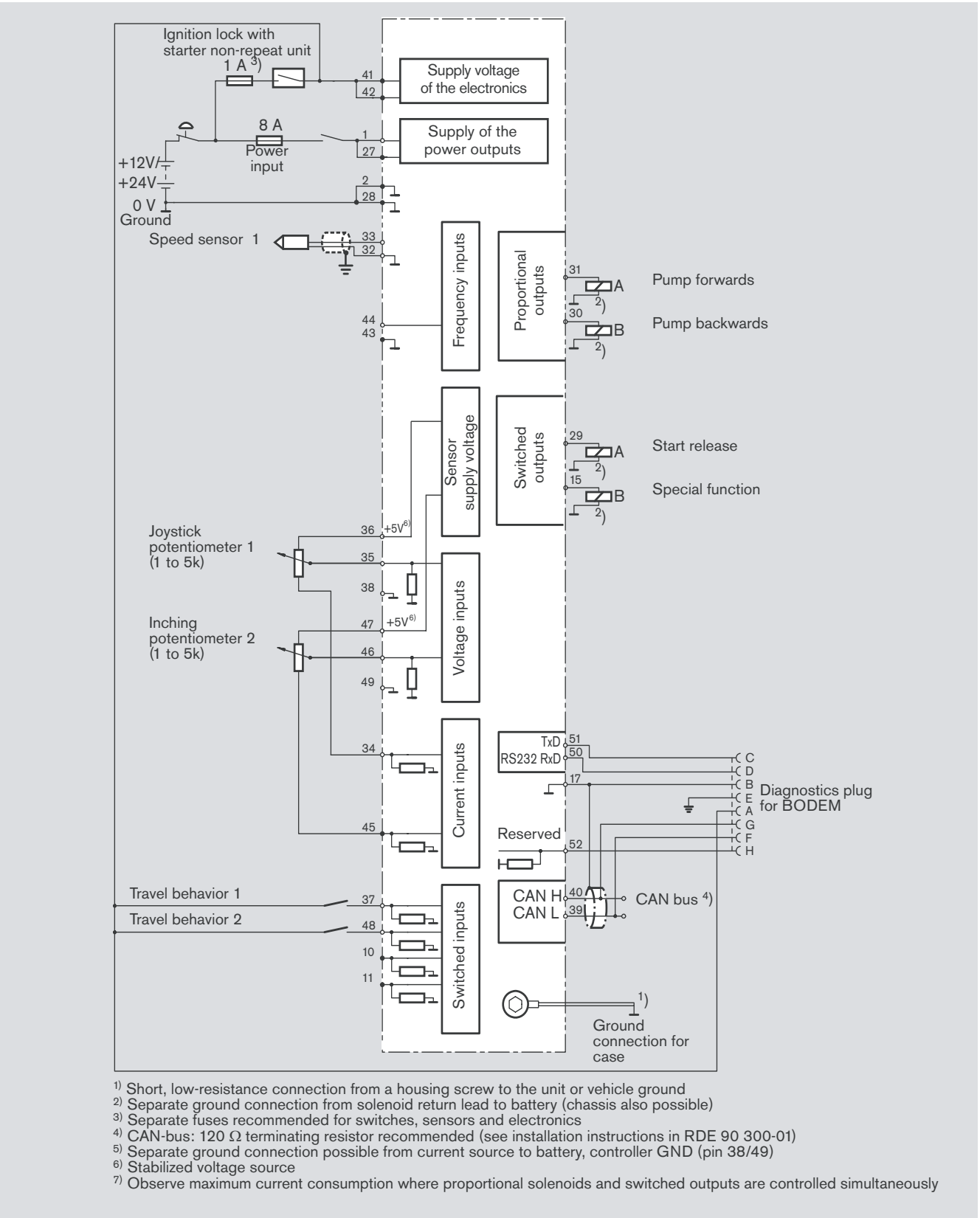
The parameters which need to be set in order to commission the DRC travel drive control can be easily changed using the BODEM PC software.



You can configure BODEM to display the most important process data and the error messages for diagnostics and troubleshooting purposes.



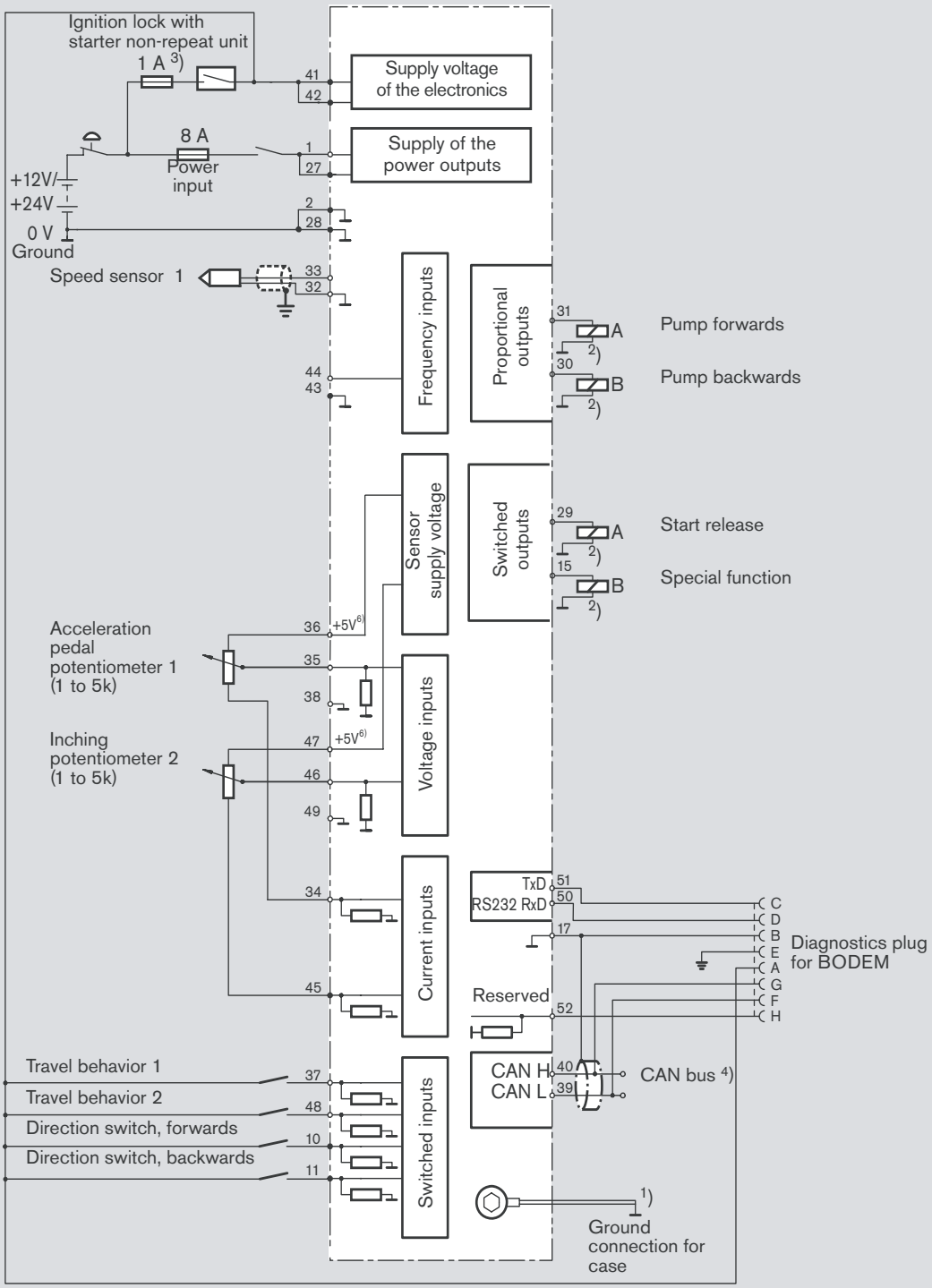
DRCA connection diagram



1) Short, low-resistance connection from a housing screw to the unit or vehicle ground
2) Separate ground connection from solenoid return lead to battery (chassis also possible)
3) Separate fuses recommended for switches, sensors and electronics
4) CAN-bus: 120 Ω terminating resistor recommended (see installation instructions in RDE 90 300-01)
5) Separate ground connection possible from current source to battery, controller GND (pin 38/49)
6) Stabilized voltage source
7) Observe maximum current consumption where proportional solenoids and switched outputs are controlled simultaneously

Figure 3: Inputs and outputs on controller for DRC, variant A (DRCA)

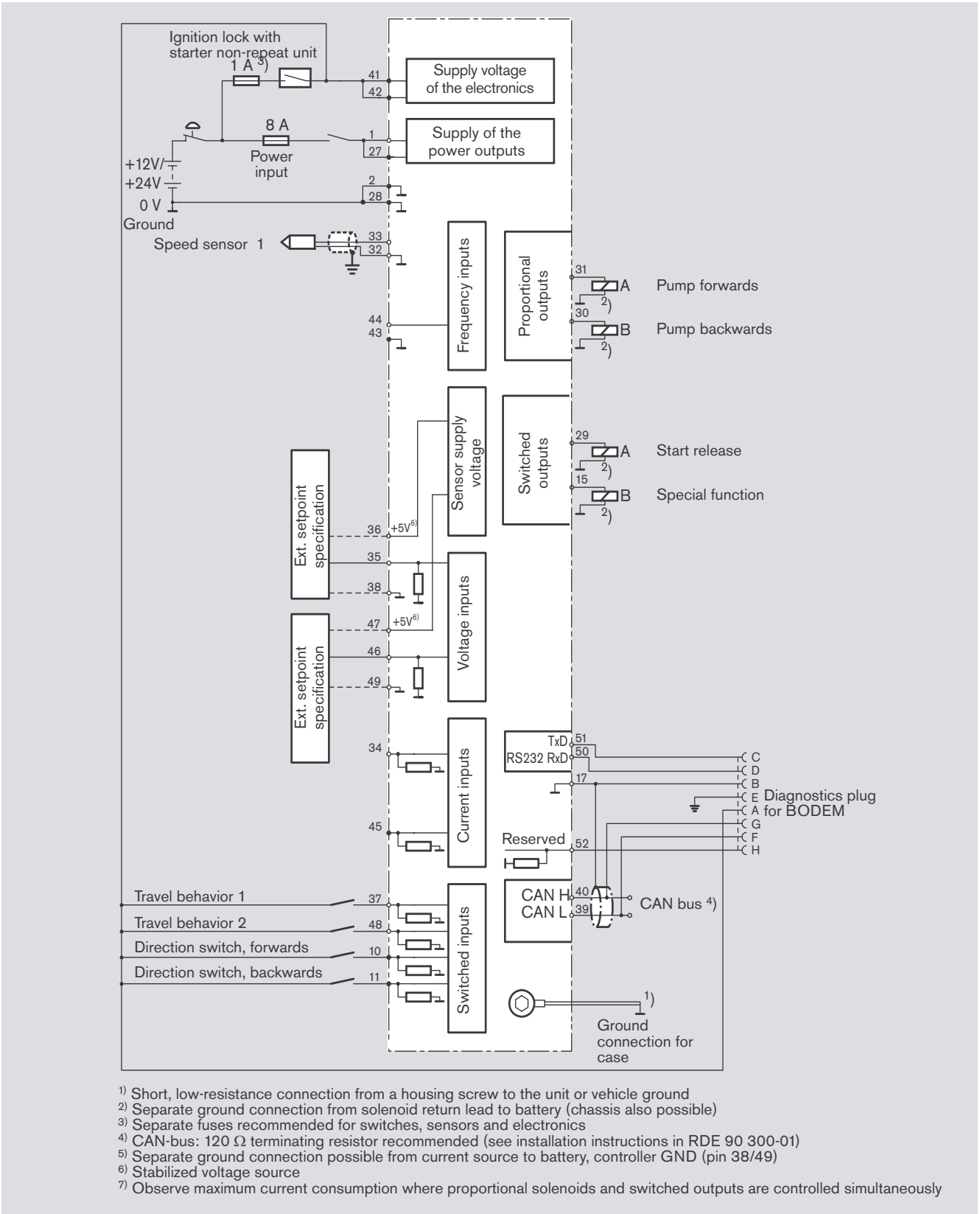
DRCB connection diagram



1) Short, low-resistance connection from a housing screw to the unit or vehicle ground
2) Separate ground connection from solenoid return lead to battery (chassis also possible)
3) Separate fuses recommended for switches, sensors and electronics
4) CAN-bus: 120 Ω terminating resistor recommended (see installation instructions in RDE 90 300-01)
5) Separate ground connection possible from current source to battery, controller GND (pin 38/49)
6) Stabilized voltage source
7) Observe maximum current consumption where proportional solenoids and switched outputs are controlled simultaneously

Figure 4: Inputs and outputs on controller for DRC, variant B (DRCB)

DRCC connection diagram



1) Short, low-resistance connection from a housing screw to the unit or vehicle ground
2) Separate ground connection from solenoid return lead to battery (chassis also possible)
3) Separate fuses recommended for switches, sensors and electronics
4) CAN-bus: 120 Ω terminating resistor recommended (see installation instructions in RDE 90 300-01)
5) Separate ground connection possible from current source to battery, controller GND (pin 38/49)
6) Stabilized voltage source
7) Observe maximum current consumption where proportional solenoids and switched outputs are controlled simultaneously

Figure 5: Inputs and outputs on controller for DRC, variant C (DRCC)

Required components

The following electronic components are required:

- RC2-2/20 controller with 52-pin mating connector (RE 95200)
- Software AS/DRCA, AS/DRCB or AS/DRCC
- HG104 joystick (RE 95041)
- Optional: IDR speed sensor (RE 95130) with mating connector
- Optional: acceleration and inch pedals
- Optional: time-ramp switch for the acceleration behavior
- Optional: direction switch

The following hydraulic components are required:

- Variable pump with electro-proportional control
  A4VG…EP (RE 92003) or
  A10VG…EP (RE 92750)
- Fixed displacement motor
  A2FM (RE 91001) or
  A2FE (RE 91008) or
  A4FM (RE 91120) or
  A10FM (RE 91172)

The following items are required for commissioning and service:

- Diagnostics socket (RE 95085)
- BODEM PC software with BODEM connecting cable (RE 95085)

Variants DRCD and DRCE

Hydraulic system

The electronic travel drive control is designed to actuate a variable pump in a closed hydraulic circuit with electric, direct-controlled DE / EV control (DRCD) or electric, proportional EP control (DRCE) and a variable motor with electric, proportional EP control.

The following Rexroth hydraulic pumps are supported:

DRCD:

- A4VG.DE, A4VG.EV (see catalog RE 92003)
- A10VG.DE (see catalog RE 92750)

DRCE:

- A4VG.EP (see catalog RE 92003)
- A10VG.EP (see catalog RE 92750)

In combination with the variable pump, multiple fixed or up to two variable motors can be used.

The following Rexroth fixed displacement motors are supported:

- A2FM (see catalog RE 91001)
- A2FE (see catalog RE 91008)
- A4FM (see catalog RE 91120)
- A10FM (see catalog RE 91172)

The following Rexroth variable motor is supported:

- A6VM.EP (see catalog RE 91 604)

The electronic travel drive control can be used with a diesel engine with or without a CAN bus interface.

Interfaces

Comprehensive information on interfaces and technical data for the RC4-4 controller can be found in the catalog entitled "Controller RC" (RE 95 200). The most important interfaces for the DRCD and DRCE electronic travel drive control are:

- Analog input signals (from potentiometers or angle sensors)

  Analog voltages in the range from 0 - 5 V are received as input signals by the DRCD and DRCE.

- Digital input signals (from switches)

  DRCD and DRCE receive digital input signals from the travel direction switch, from the switch for determining the travel mode, from the seat switch and, if applicable, from the switch contacts on the acceleration and inch pedals.

  The "teach function" input can be used to activate calibration of the potentiometers and the plotting of the teach curve without BODEM.

- Frequency inputs (from the speed sensor)

  The DRCD and DRCE can receive frequency signals from speed sensors for the purpose of monitoring the speed of the diesel engine and of the hydraulic motor.

- Proportional outputs (PWM currents)

  The DRCD and DRCE supply regulated pulse-width modulated currents for direct control of proportional solenoids. The dither frequency optimizes these outputs for accuracy and minimum hysteresis for the electrical control of pumps and hydraulic motors.

- Switched outputs

  The DRCD and DRCE supply digital output signals for direct control of on/off solenoids. These outputs control the directional valve of the pump for travel direction pre-selection.

  The DRCD and DRCE supply a digital output signal for connecting an error lamp.

- CAN-bus interface

  The CAN-bus interface CAN1 is available for transmitting the speed and the temperature of the diesel engine. In addition, the position of the acceleration pedal can be determined by the diesel engine. Diagnostic messages can be transmitted on CAN2 by the RC controller.

- Diagnostics interface

  To communicate with the parameterization and diagnostic tools, the tool in question must be connected to the controller via a special diagnostics socket.
  This diagnostics socket needs to be part of the cable harness. This enables the connection of a laptop with the BODEM PC software (RE 95 085).
  BODEM can be used for communicating with a variety of controllers available in the Rexroth line.

Functional description

Automotive travel

The hydrostatic drive with travel drive control facilitates comfortable driving, such as that experienced in an automobile. The variable pump is controlled by the deflection of the acceleration pedal. The variable motor follows after the pump is fully swiveled out.

DRCD

The travel behavior of the DRCD drive control is load dependent, as with all cars or trucks. With increasing load, the vehicle slows or becomes sluggish. Examples here include beginning to climb after traveling on a flat stretch or the difference between a loaded and an empty vehicle. The load dependence has the advantage that the driver has a better feel for the driving status and conditions.

DRCE

The travel behavior of the DRCE drive control is load independent if sufficient drive power is present. It is therefore particularly well suited for applications in which it is important that fixed speeds be maintained.

Inch function

A potentiometer can be used to infinitely limit the pump and, therefore, the flow from the pump. Thus, the vehicle speed can be decoupled from the diesel engine speed.

As a result, the vehicle can be driven slowly while at the same time maintaining maximum diesel speed to provide maximum flow for the working hydraulics.

The inch function can be activated or deactivated via parameters.

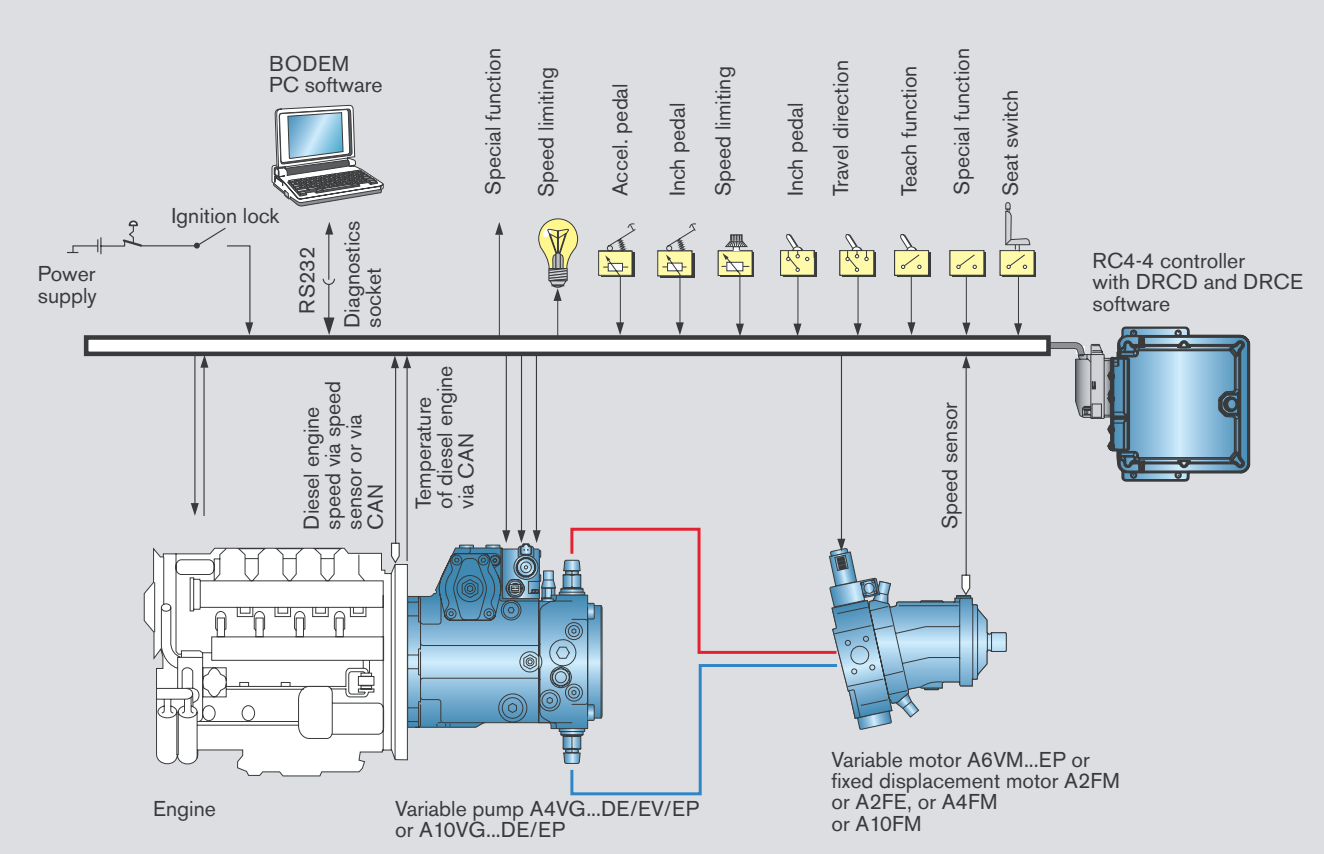


Figure 6: Typical configuration for the DRC travel drive control, variants D-E (DRCD and DRCE)

Travel behavior

Travel behavior is controlled by the following variables.

- The travel mode ("soft", "medium", "hard") is defined with one switch and two digital inputs. This determines, among other properties, how quickly the control of the proportional outputs is changed.
- The setpoint value for the pump and motor is specified by the acceleration pedal and the teach curve. The direction is specified by the direction switch.
- The control of the variable pump for the specified diesel-engine-speed setpoint value is defined in the travel behavior characteristic.

  A separate characteristic with the corresponding ramps can be parameterized for each travel mode ("soft", "medium", "hard").
- The output speed at the hydraulic motor and the acceleration pedal define the behavior of the variable motors.

If the acceleration pedal is pressed:

- If a **fixed displacement motor** is connected (only the variable pump is controlled), the current value of the pump control increases.

  The current value increases with increasing deflection of the acceleration pedal. The pump swivels out further and the vehicle speed increases.

  The fixed displacement motor reaches its maximum speed at maximum pump flow.
- If a **variable motor** is connected (both variable pump as well as variable motors are controlled):

  With increasing deflection of the acceleration pedal, the swivel angle of the pump is initially increased. If the pump is completely swiveled out, the swivel angle of the variable motor is also reduced and, as a result, so too is the displacement. The variable motor is guided by the measured output speed (hydraulic-motor speed-guided behavior). The output speed continues to increase.

  With the acceleration pedal fully pushed down, the pump control is at a maximum and the motor is swiveled back to a minimum displacement $V_{g\,min}$ determined by the hydraulic travel drive control. The variable motor has reached the maximum output speed.

The travel behavior is defined via two switched inputs. The selected travel mode determines:

- The characteristic for the travel behavior
- The characteristic for the pre-position
- The reaction behavior during reversing

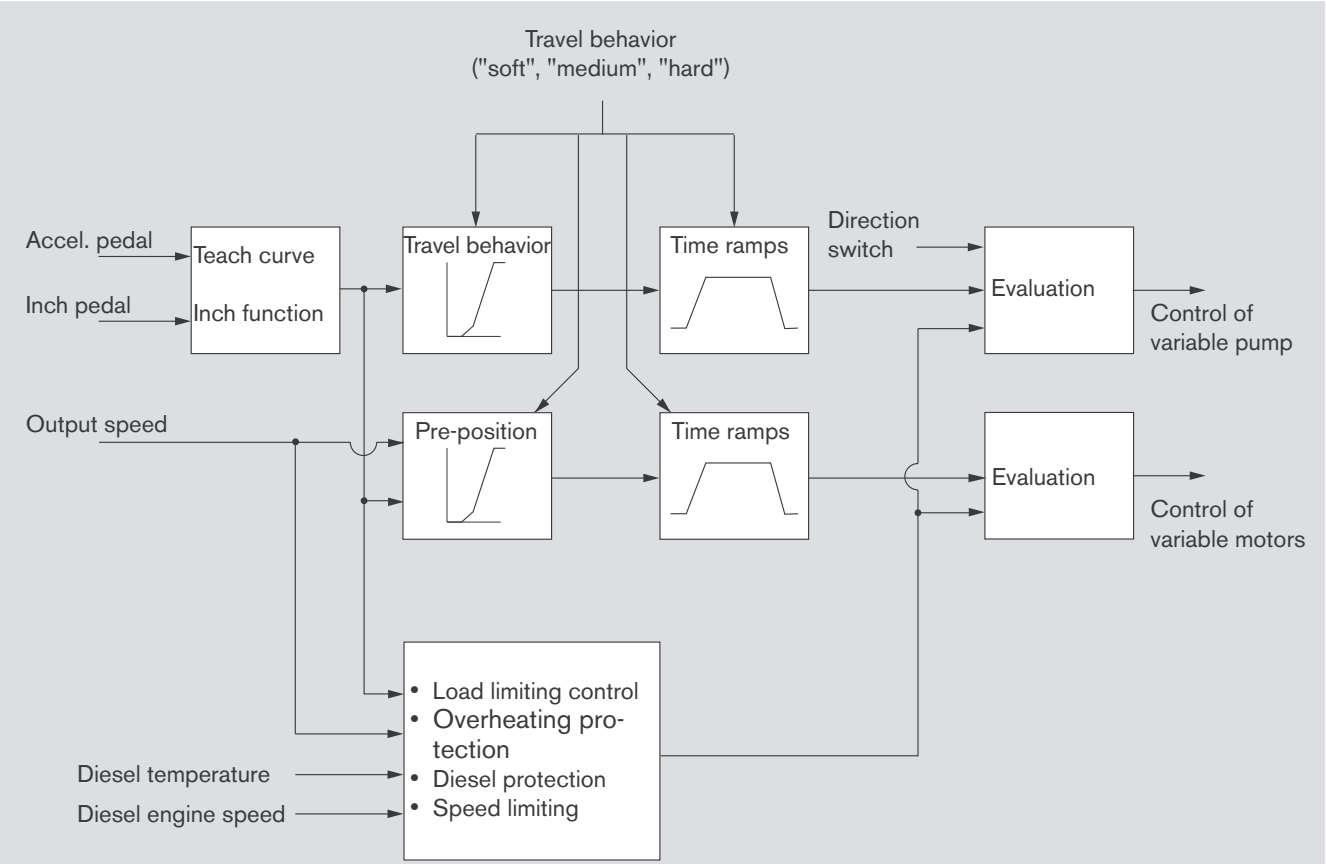


Figure 7: Method of operation of the DRC travel drive control, variants D-E (DRCD and DRCE)

Reversing operation

Travel direction change (reversing) is performed via the direction switch. The vehicle is decelerated and then reaccelerated in the opposite direction. The reaction behavior can be specified in parameters.

Load limiting control

The integrated load limiting control reduces the accepted hydraulic power in the event of overloading of the diesel engine. It can be activated or deactivated via parameters.

The most important feature of the travel drive control is the measurement of the set and actual speeds of the diesel engine.

- The set speed of the diesel engine is measured via the acceleration pedal position (via analog input or via CAN bus).
- The actual speed is measured via a speed sensor (via frequency input or CAN bus).

Through the comparison of the set and actual speeds, it is possible to detect an overload of the diesel engine. In the event of a potential overload, the electronics reduce the power input of the hydraulic pump and of the variable motor:

- The load limiting control calculates the current speed drop of the diesel engine from the set and actual speed values.
- The current speed drop is compared to the parameterizable limit values. Different limit values can be parameterized for different set speeds.
- As long as the accepted hydraulic power does not exceed the installed diesel power, the speed drop will not exceed the parameterized limit values. The load limiting control does not engage.
- If the speed drop of the diesel engine exceeds the limit values, the load limiting control engages:
  - The pump power is reduced (the swivel angle is reduced).
  - If a variable motor is used, the motor power is also reduced (the swivel angle is increased).

The controller calculates the available pump power or motor power. The control behavior can be set on the basis of the factors of the individual controller elements. You can set the P, I and D factors separately for the closed loop control of the pump power and the motor power.

The software contains default values for the parameters of the closed loop control. To achieve optimal behavior, these parameters must be individually tuned to the respective machine.

Overheating protection

Requirement for this function is a diesel engine with a CAN-bus interface and an available temperature signal. The temperature of the diesel engine is transmitted via the CAN bus. It is compared to a parameterizable limit value. As soon as the limit value is exceeded, overheating protection engages:

- The pump power is reduced. If a variable motor is used, the motor power is reduced as well.
- The accepted hydraulic power is limited until the diesel temperature is 5 °C below the parameterized maximum temperature.

Overheating protection can be activated or deactivated via parameters.

Diesel protection

When traveling downhill, the machine supports itself on the diesel engine ("engine brake"). To protect the diesel engine from overspeeding, the hydraulic transmission ratio is increased. The requirement for this function is the use of variable motors.

- The diesel engine speed is compared to a parameterizable limit value.
- As soon as the diesel engine speed exceeds the limit value, diesel protection engages:
  - The motor power of the variable motor is increased.
  - Diesel protection can be activated or deactivated via parameters.

Speed limiting

In order to adhere to country-specific regulations, the maximum speed of the vehicle is defined. It is stored in a parameter during commissioning. The requirement for this function is a connected speed sensor on the hydraulic motor.

In addition, a potentiometer can be used to limit the vehicle speed during operation. For example, to simplify driving and working with attachments such as brushes.

The speed sensor on the hydraulic motor delivers the actual value and the set maximum speed serves as the setpoint value for a PI controller. Speed limiting can be activated or deactivated via parameters.

Seat switch

A seat-switch input can be parameterized as a safety function. Travel is possible only when the seat switch is closed.

Special function

The special function directly outputs the digital signal from the "special function" input to the "special function" output.

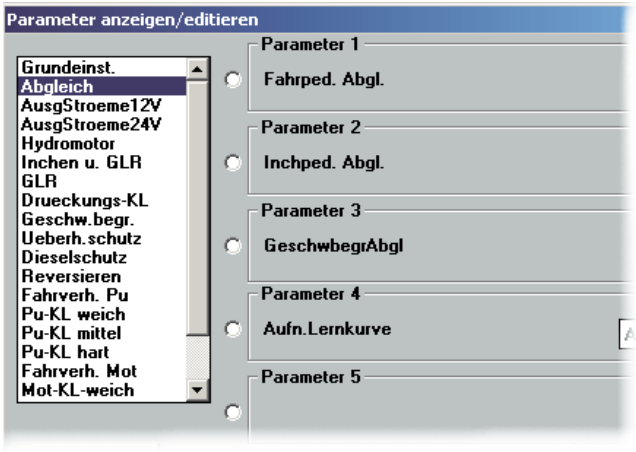
Note that when in the open state, the switch must be connected to ground; when in the closed state, it must be connected to battery voltage.

Important features

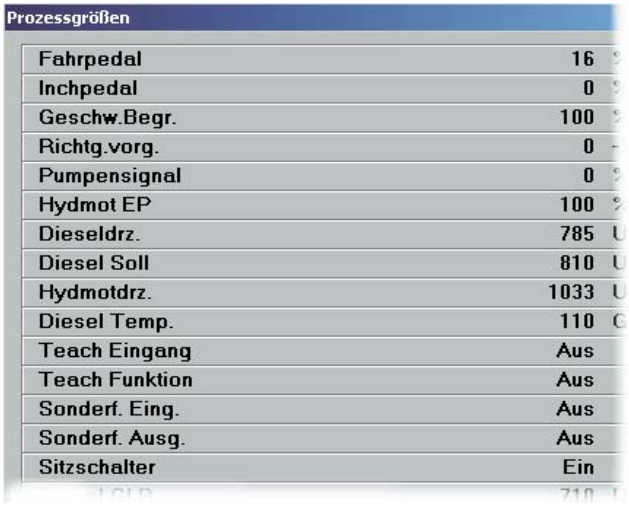
- Automotive travel
- Selectable travel modes
- Integrated load limiting control
- Reversing operation
- Integrated inch function
- Three different acceleration and delay behaviors can be selected externally
- Parameterizable speed limiting
- Integrated overheating protection of the diesel engine
- Integrated safety functions for start release
- Analog inputs and proportional outputs are monitored for wire break and short circuit.
- Divers errors can be displayed by means of a flashing code on one of the connected error lamps.
- All errors can be output via the CAN-bus interface.
- Important error events are stored in the controller and can also be read later in plain text form using BODEM.

Parameterization and diagnostics

The parameters which need to be set in order to commission the DRC travel drive control can be easily changed using the BODEM PC software.

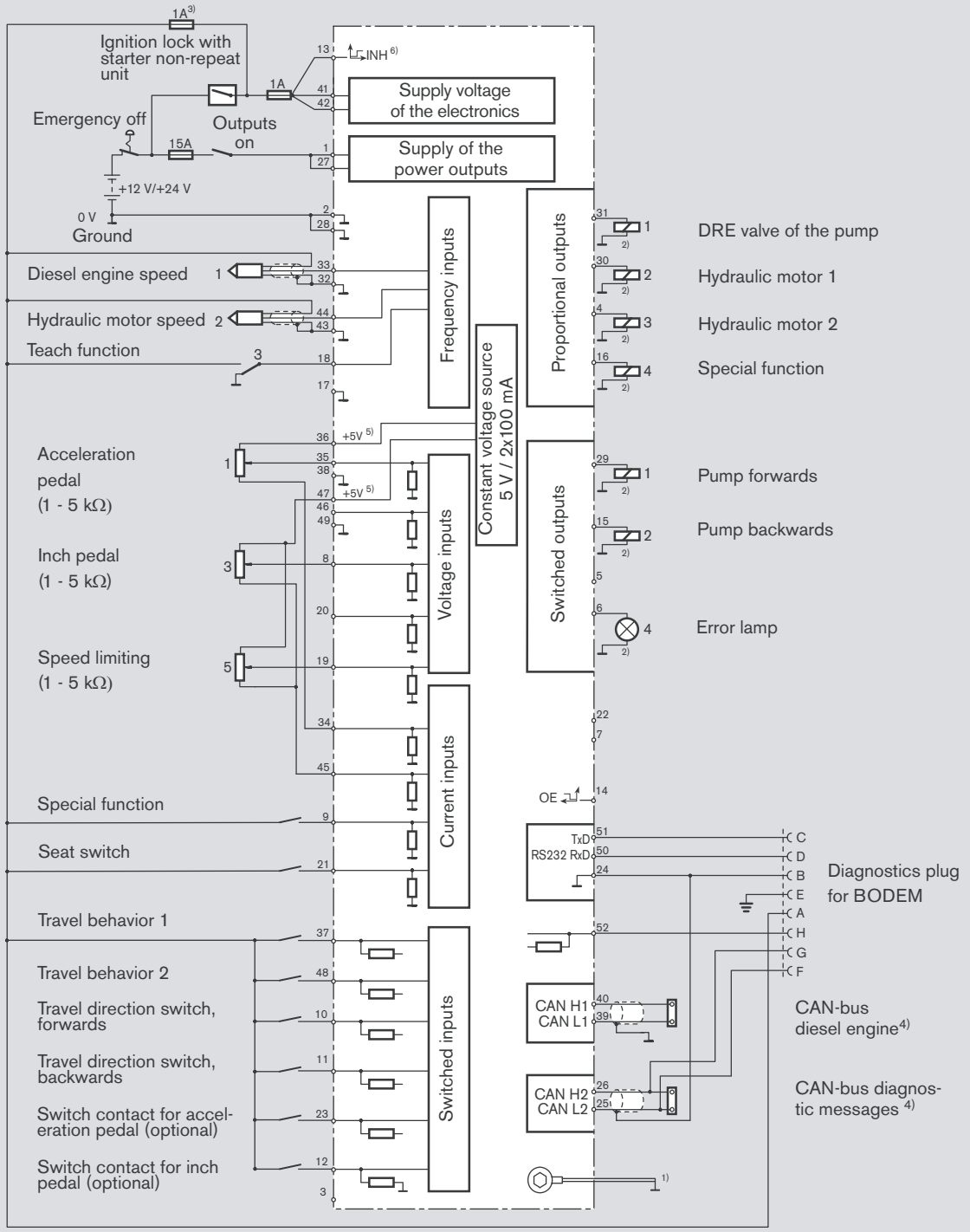


You can configure BODEM to display the most important process data and the error messages for diagnostics and troubleshooting purposes.



DRCD connection diagram

Control via potentiometers

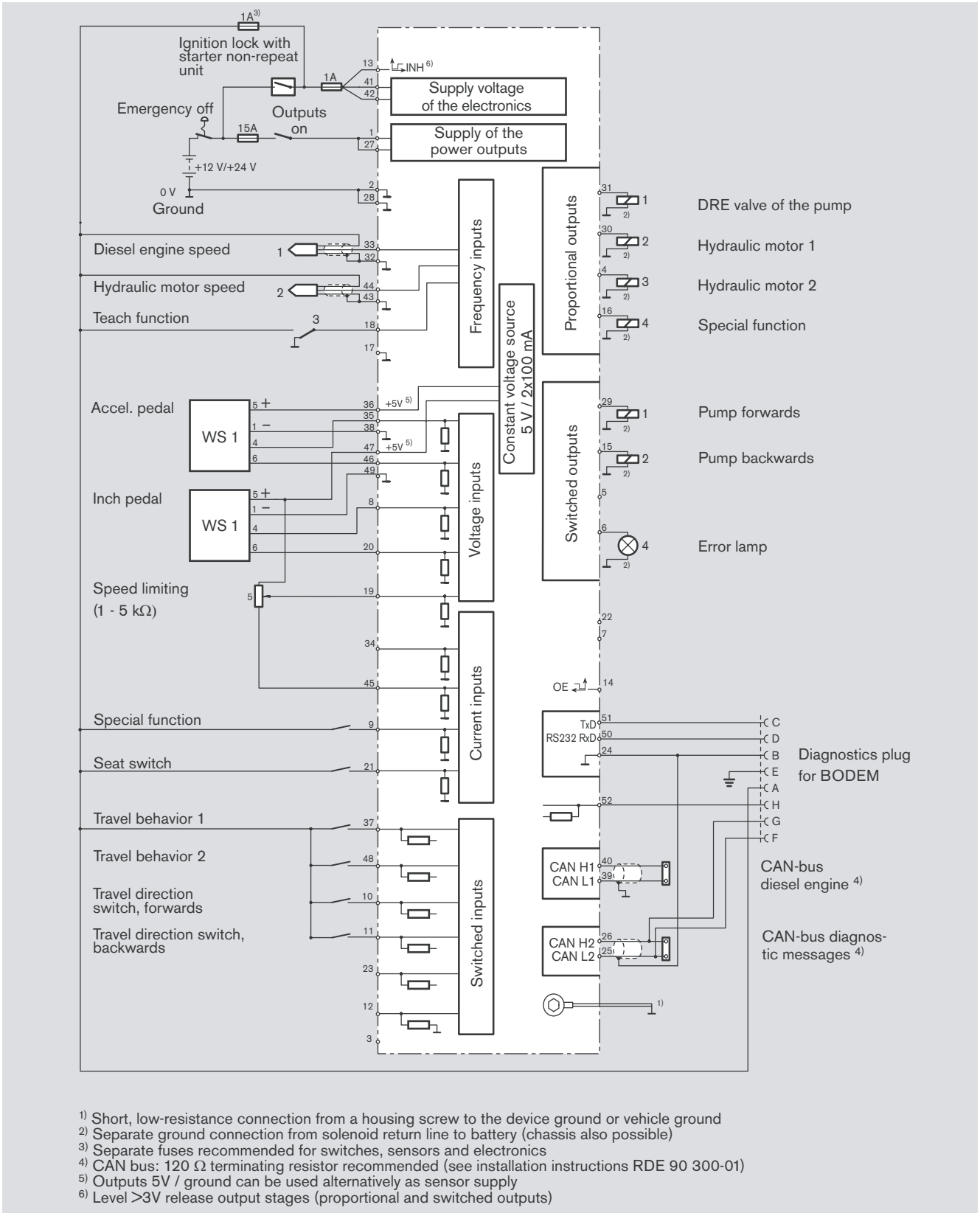


1) Short, low-resistance connection from a housing screw to the device ground or vehicle ground
2) Separate ground connection from solenoid return line to battery (chassis also possible)
3) Separate fuses recommended for switches, sensors and electronics
4) CAN bus: 120 Ω terminating resistor recommended (see installation instructions RDE 90 300-01)
5) Outputs 5V / ground can be used alternatively as sensor supply
6) Level >3V release output stages (proportional and switched outputs)

Figure 8: Inputs and outputs on the controller for DRCD, control via potentiometers

DRCD connection diagram

Control via angle sensors

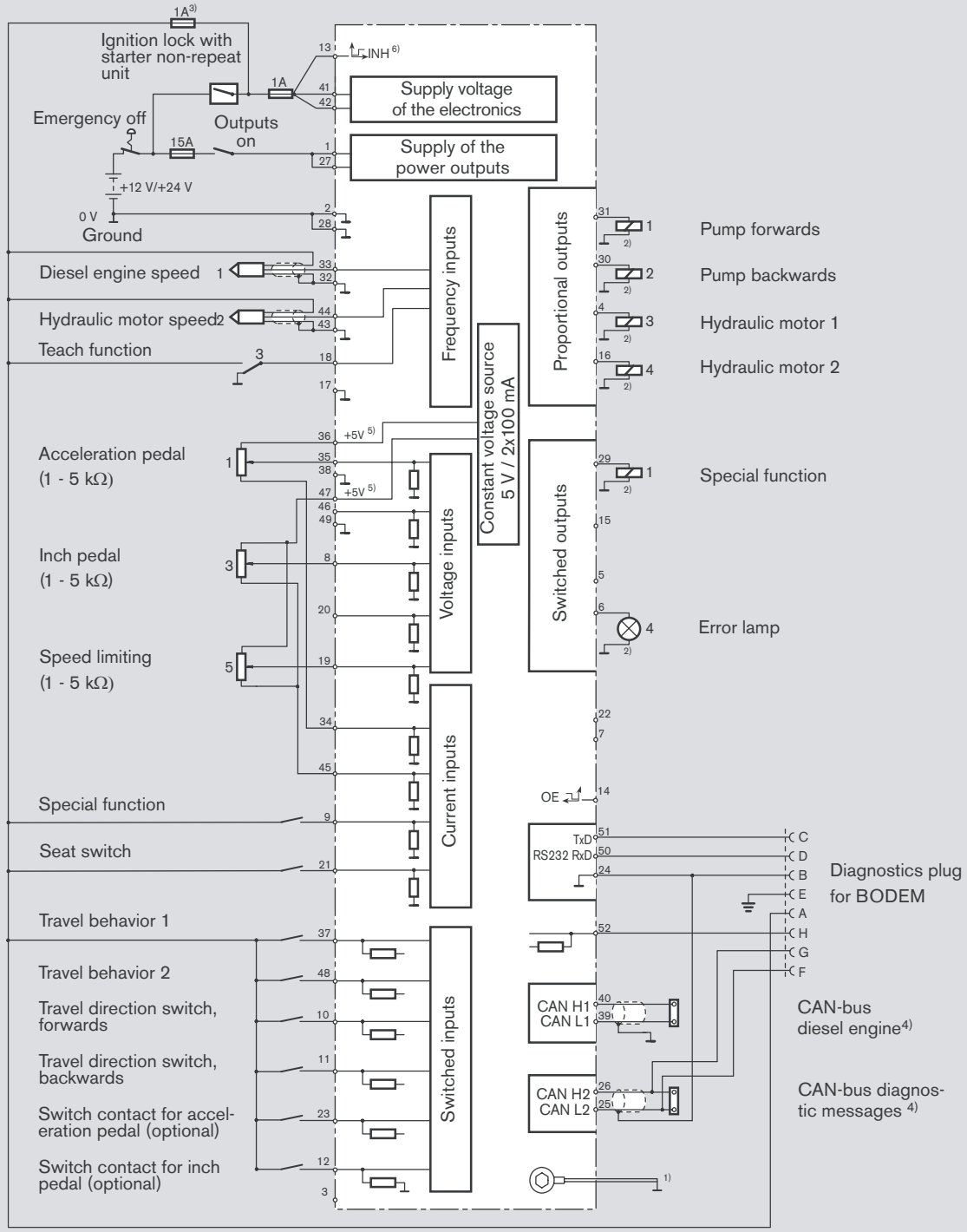


1) Short, low-resistance connection from a housing screw to the device ground or vehicle ground
2) Separate ground connection from solenoid return line to battery (chassis also possible)
3) Separate fuses recommended for switches, sensors and electronics
4) CAN bus: 120 Ω terminating resistor recommended (see installation instructions RDE 90 300-01)
5) Outputs 5V / ground can be used alternatively as sensor supply
6) Level >3V release output stages (proportional and switched outputs)

Figure 9: Inputs and outputs on the controller for DRCD, control via angle sensors

DRCE connection diagram

Control via potentiometers

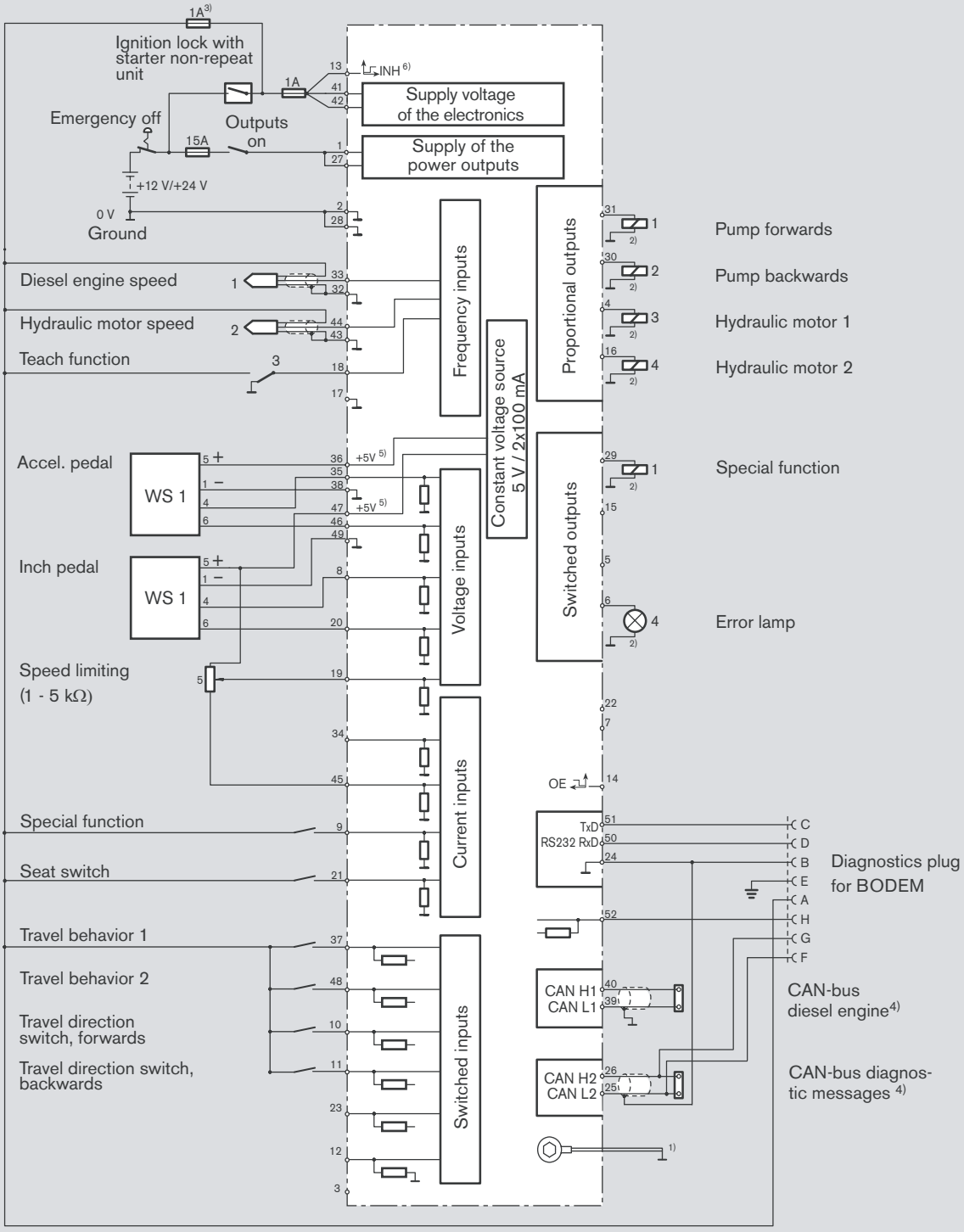


1) Short, low-resistance connection from a housing screw to the device ground or vehicle ground
2) Separate ground connection from solenoid return line to battery (chassis also possible)
3) Separate fuses recommended for switches, sensors and electronics
4) CAN bus: 120 Ω terminating resistor recommended (see installation instructions RDE 90 300-01)
5) Outputs 5V / ground can be used alternatively as sensor supply
6) Level >3V release output stages (proportional and switched outputs)

Figure 10: Inputs and outputs on the controller for DRCE, control via potentiometers

DRCE connection diagram

Control via angle sensors



1) Short, low-resistance connection from a housing screw to the device ground or vehicle ground
2) Separate ground connection from solenoid return line to battery (chassis also possible)
3) Separate fuses recommended for switches, sensors and electronics
4) CAN bus: 120 Ω terminating resistor recommended (see installation instructions RDE 90 300-01)
5) Outputs 5V / ground can be used alternatively as sensor supply
6) Level >3V release output stages (proportional and switched outputs)

Figure 11: Inputs and outputs on the controller for DRCE, control via angle sensors

Required components

The following electronic components are required:

- RC4-4 controller with 52-pin mating connector (RE 95200) and installed AS/DRCD or DRCE software
- Travel direction switch
- Selector switch for travel modes
- Speed sensor for recording the vehicle speed (can be integrated in the hydraulic motor)
- Acceleration pedal with angle sensor and mating connector (alternately via CAN)
- Inch pedal with angle sensor and mating connector
- Optional: error lamp
- Multi-circuit switch as input for teach function

The following hydraulic components are required:

- Variable pump with electro-proportional control

DRCD:
A4VG…DE or EV (RE 92003) or
A10VG…DE (RE 92750)

DRCE:
A4VG…EP (RE 92003) or
A10VG…EP (RE 92750)

- Fixed displacement motor
  A2FM (RE 91001) or
  A2FE (RE 91008) or
  A4FM (RE 91120) or
  A10FM (RD 91172)

The following items are required for commissioning and service:

- Diagnostics socket (RE 95085)
- BODEM PC software with BODEM connecting cable (RE 95085)

Safety instructions

- The suggested circuits do not imply any technical liability for the system on the part of Rexroth.
- To switch off the system in emergencies, the power supply to the electronics must be disconnected by an emergency off switch. The emergency off switch must be installed in an easily accessible position for the operator. Safe braking must be ensured when the emergency off function is activated.
- The vehicle must be equipped with sufficiently dimensioned, separate mechanical service brake and parking brake.
- Lines to the electronics must not be routed close to other power conducting lines in the machine or vehicle.
- Radio equipment and mobile telephones must not be used inside the driver's cab without a suitable outside antenna and nowhere near the control electronics. A sufficiently large distance to radio systems must be maintained.
- All connectors must be unplugged from the electronics during electrical welding operations.
- The electronics may only be tested with the proportional solenoids connected.
- The proportional solenoids must not be connected to spark suppression diodes.
  On/off solenoids at the outputs of the RC electronics do not need to be connected to spark suppression diodes.
  Other inductive consumers that are in the system but not connected to the RC must be connected to spark suppression diodes.
- In order to preserve the warranty, any installation or replacement of the RC software (flash EPROM) must be performed by Rexroth staff.
- Cables/wires must be sealed individually to prevent water from entering the unit.
- Dangerous malfunctions may result if the control electronics are opened or modified or the wiring repaired without authorization.
- A risk analysis according to IEC 61508 is to be performed for the travel drive. For classifications greater than "SIL a", please consult Rexroth.
- Please observe operating instructions RE 95320-B (DRCA, DRCB, DRCC), RE 95321-B (DRCD) and RE 95322-B (DRCE).

Bosch Rexroth AG
Hydraulics
Product Unit Mobile Electronics
Elchingen Plant
Glockeraustraße 4
89275 Elchingen, Germany
Telephone +49 (0) 73 08 82-0
Fax +49 (0) 73 08 72-74
info.brm-me@boschrexroth.de
www.boschrexroth.com/mobile-electronics