

Application software BODAS-work EHC40



Features

- ▶ Force control, position control and mixed control
- ▶ Active vibration damping for transport
- ▶ External push-buttons for manual lifting/lowering
- ▶ Automatic hitch control (AHC)
- ▶ Anti-slip control (ASC)
- ▶ Hitch lowering support (HLS)
- ▶ Scalable and modular software concept for efficient customer-specific extensions
- ▶ Easily configurable to various system configurations by means of parameter adjustments
- ▶ Flexible interfaces – discrete or CAN J1939
- ▶ Diagnostics, parameter settings and guided commissioning via BODAS-service
- ▶ Inputs/Outputs monitored for wire breakage, short circuits, range feasibility and consistency.
- ▶ Integrated safety functions in accordance with EN ISO 25119
- ▶ BODAS-work EHC40 is part of BODAS Bosch Rexroth design and application system for mobile electronics

- ▶ Electrohydraulic control of rear and front hitch for small, medium and large tractors
- ▶ Designed for use with hydraulic hitch control valves
 - EHR5-EM2, EHR12-EM2, EHR24-EM2
 - EHR11-EHS4, EHR11-EHS4-HLS2, EHR24-EHS4, EHR24-EHS4-HLS2
- ▶ Software solution on Rexroth controller RC/40

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1 Introduction

The BODAS-work EHC40 is a standard software solution embedded in Rexroth Controllers RC/40 for the control of hydraulic hitch control valves.

Decades of experience stand behind the Electrohydraulic Hitch Control (EHC) from Rexroth. The BODAS-work EHC40 is an updated advancement for rear and front tractor operations with a series of various functions that can be added for even better results in tillage and for greater operating comfort.

Farmers can achieve sustainable yield increases with automated soil cultivation. By controlling the exact amount of force, the exact positioning or a mixture of both, BODAS-work EHC40 is able to perform precise lifting and lowering of the hitch and thus makes precise plowing possible.

The automatic hitch control feature ensures more even soil cultivation in different soil conditions by automatically and dynamically regulating the ratio between position and tractive force. Only the required working depth has to be set. A manual override is still available.

BODAS-work EHC40 anti-slip control feature also reduces slippage and significantly prevents the drive wheels from losing traction. This lowers fuel consumption, tire wear and at the same time protects the soil.

Furthermore, when it comes to transporting items with the plow raised or with other attachments, the system implements a damping function when driving on poorly constructed roads, thus avoiding unsafe driving conditions. Simple to integrate, simple to use: The hitch lowering support provides pressure to the hitch to lower it actively and thereby significantly faster. The advantages are realized especially when the hitch has no load and when ambient temperatures are low. The defined pressure also means attachments can be unhitched more easily – especially useful when catch hooks become jammed.

Tractor manufacturers can fully integrate the electrohydraulic hitch control into their tractors' overall operating concept.

BODAS-work EHC40 can be configured and adapted to the specific machine requirements by setting parameters with BODAS-service. Ready-to-use safety functions developed in accordance with the standard EN ISO 25119 are part of the software. Documents and tools enable a systematic integration of BODAS-work EHC40 within the machine environment from project planning to the start of production and beyond. The modular design of the software allows efficient customer-specific extensions. For more information about customer-specific extension, please consult your Bosch Rexroth contact.

2 Typical applications

BODAS-work EHC40 is designed to control hitch valves for tractor or agricultural telehandler.

Note

BODAS-work EHC40 helps to realize functionality and safety at the machine level. The machine manufacturer must thoroughly check whether the functionality of BODAS-work EHC40 can fulfil the requirements of the specific machine. If additional features are required, BODAS-work EHC40 can be extended. Please consult your Bosch Rexroth contact for an individual solution.

The BODAS-work EHC40 configuration is always based on an engine with a standard CAN J1939 interface and a Rexroth hitch control valve (EHR) with electromagnetically proportional actuation (EM2) or electrohydraulic actuation with on-board electronics (EHS4).

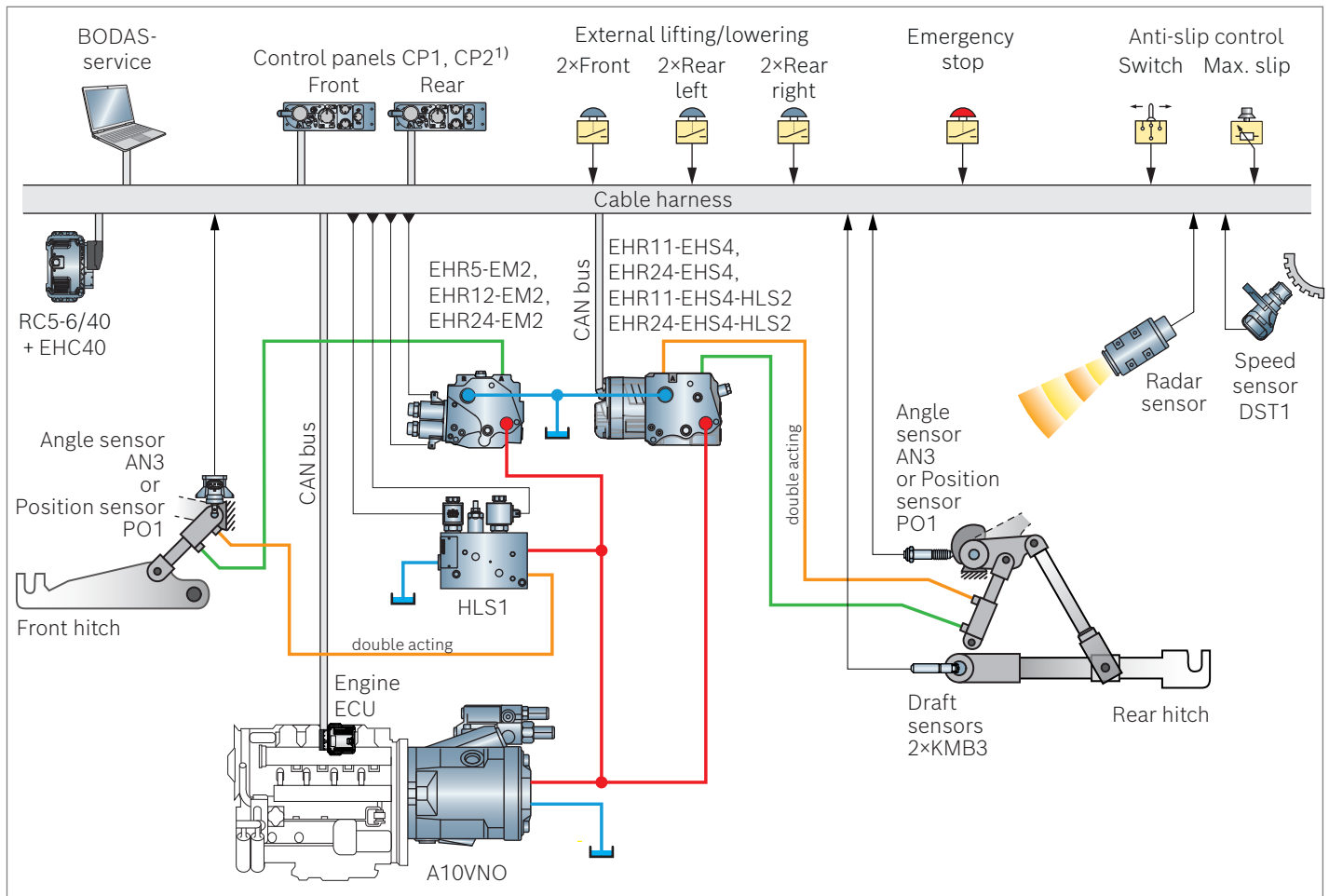
3 EHR system functional description

A core function of tractors is the efficient and soil-preserving transmission of machine forces during field use. The attachments required for field use are connected to the tractor's hitch and can be lifted or lowered using the hitch control. This hitch control plays an important role and is a standard feature on today's tractors. It gives farmers numerous useful functions for efficiently and conveniently managing their tasks.

Bosch Rexroth is the leading supplier, manufacturer and developer of EHR systems, which include tested and sophisticated components such as control units, control valves, control panels and sensors. These individual elements combine to form a rugged, user-friendly and extremely reliable working unit, even after years of use.

3.1 System overview

▼ Example system overview for BODAS-work EHC40



¹⁾ The latest CP2 version (release 2022) is required.

BODAS-work EHC40 required and optional components	
Engine	Mechanically or electronically controlled (communication via CAN J1939)
Hitch control valves	EHR5-EM2, EHR12-EM2, EHR24-EM2, EHR11-EHS4, EHR11-EHS4-HLS2, EHR24-EHS4 and EHR24-EHS4-HLS2
Hitch lowering support	Separate valve module (HLS1) or as integrated valve function (HLS2) for double-acting hitch function
Sensors	Hitch position: BODAS position sensor PO1 or BODAS angle sensor AN3 Draft: BODAS draft sensor KMB3 or DP1. 1× for upper link control (lower precision) or 2× for lower link control Wheel speed: BODAS speed sensor DST1 or CAN J1939 (CCVS / UCSS) Vehicle speed: radar sensor with frequency input or CAN J1939 (VDS)
Rexroth control panels	BODAS control panel CP1 or CP2 ¹⁾
Safety Standards	EN ISO 25119
Operator interface	Analog or CAN SAE J1939
BODAS controller	RC5-6/40

The latest version of BODAS-service can be connected for diagnostics and commissioning.

See data sheet 95087 for a detailed description of BODAS-service functions.

3.2 Hitch control valves

EHR Hitch control valves

The hitch control is available in different sizes and variants.

▼ Flange design

Control valve	Actuation type	Maximum flow rate
EHR5-EM2	Electromagnetically proportional	60 l/min

▼ Sandwich plate design for combination with directional valves SB

Control valve	Actuation type	Maximum flow rate
EHR12-EM2	Electromagnetically proportional	60 l/min
EHR24-EM2		100 l/min
EHR11-EHS4	Electrohydraulic with on-board electronics (EHS4)	80 l/min (sa)
EHR11-EHS4-HLS2		80 l/min (da)
EHR24-EHS4		140 l/min (sa)
EHR24-EHS4-HLS2		140 l/min (da)

The pump pressure and proportional opening cross-section of the lift spool lift the attachment as gently or as rapidly as desired.

With the single-acting hitch control (sa), the weight of the attachment lowers the hitch, proportional lowering is controlled by the lowering valve.

With the double-acting hitch control (da), lowering can also be actively supported by pump pressure.

For a detailed description of the hitch control valves, see data sheet 66126.

Hitch Lowering Support (HLS)

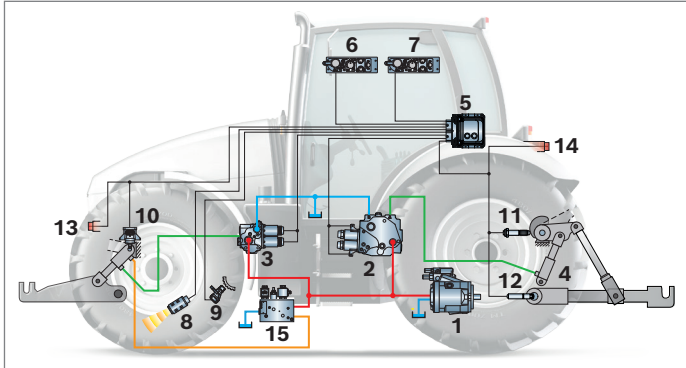
The hitch lowering support can be provided either with a separate valve module (HLS1) or a double-acting hitch control valve (EHRxx-EHS4-HLS2).

For a detailed description of the HLS variants, see data sheet 66126.

¹⁾ The latest CP2 version (release 2022) is required.

4 Functional description

System components



- | | |
|-----------------------------|----------------------------------|
| 1 Hydraulic pump | 9 Speed sensor |
| 2 Rear hitch control valve | 10 Angle sensor |
| 3 Front hitch control valve | 11 Position sensor |
| 4 Hitch cylinder | 12 Draft sensor |
| 5 Electronic control unit | 13 Front control push-button |
| 6 Front control panel | 14 Rear control push-button |
| 7 Rear control panel | 15 Hitch lowering support (HLS1) |
| 8 Radar speed sensor | |

Rear hitch control (RHC)

The hydraulic pump (1) pumps oil to the control valve (2), which controls the hitch cylinders (4). These cylinders act on the lower links, which are used to lift, hold or lower attachments.

The setpoint value is entered on the control panel (7), then the actual values are measured by the sensors (11) and (12), and transmitted to the electronic control unit (5). The offset resulting from the comparison of the setpoint to the actual values is processed by the control unit (5) and then transmitted to the control valve (2). The lifting and lowering valve is adjusted by two proportional solenoids.

The following operating modes are available:

Front hitch control (FHC)

The setpoint values for front control are preset on the control panel (6). The actual hitch position value is measured by the sensor (10) and transmitted to the electronic control unit (5). Based on the offset resulting from the comparison of the setpoints to the actual values in the control unit, the flow rate of the control valve (3) is proportionally adjusted. Front control can be used to implement the position functions.

Position control (included in RHC and FHC)

The control variable in this mode is the position of the hitch. The position sensor (11), which is operated by a cam disk on the hitch, supplies the actual value.

Tractive force control (included in RHC)

The control variable in this mode is the force on the lower or on the upper links. When constant, tractor power utilization is optimal, such as when plowing on hilly ground or working with inhomogeneous soil. The actual value is measured by the draft sensors (12). Tractive force is controlled by changing the working depth of the attachment (e.g. plow).

Mix control (included in RHC)

In this mode, the offsets between position and tractive force are combined into an adjustable ratio on the control panel and processed as a control variable. Mix control reduces changes in working depth caused by different types of ground resistance, such as those encountered when just using traction force control.

Oscillation damping (included in RHC and FHC)

To reduce front axle load fluctuations when transporting heavy attachments and thereby improve steerability, the sensors (11) and (12) are used to measure the control variable. The electronic control unit (5) analyzes this variable and sends the appropriate electronic signals to the control valve (2).

Manual rear control outside of the cabin (included in RHC and FHC)

The rear hitch can be lifted and lowered with two push-buttons (14) on the rear of the tractor.

Startup interlock and motion limit (included in RHC and FHC)

Aside from its control and signal processing functions, the electronic control unit has various monitoring features. A startup interlock prevents the hitch from moving during startup. The interlock is released by switching the lifting switch from stop to transport. Initial movement is at reduced speed after release. Start-up interlock will be reactivated if an external push-button is pressed. The maximum lifting height is also monitored. A potentiometer can be used to preselect a limit. Monitoring of the position sensor cable for interruption or short circuit shuts off the electronic control unit in case of a fault, which prevents the hitch from moving.

Renumbering (REN)

Any hitch control valve can be easily replaced, even in the field, thanks to the renumbering feature. Just mount the new hitch control valve instead of the defective one and start the engine. The new hitch control valve will be recognized and assigned with the proper CAN id number without having to use BODAS-service. If several valves must be replaced, the process must be repeated for each individual valve.

Automatic hitch control (AHC)

To perfectly adjust to varying soil conditions, the ratio between position and tractive force is regulated automatically and dynamically.

To achieve an optimal result only the required working depth has to be set. A manual override is still available.

Hitch lowering support (HLS)

A separate valve module (HLS1 (15)) or an integrated valve function (HLS2) can be used for replicating a double acting hitch function.

The HLS is activated by the EHR control system and controls the active lowering of the hitch at a defined pressure of maximum 30 bar¹⁾. This allows a rapid lowering of (uncoupled) hitch at low temperature.

Anti-slip control (ASC)

Anti-slip control offers the following benefits:

- ▶ Less time and fuel consumption
- ▶ Less tire wear
- ▶ Soil preserved
- ▶ Less work for the driver
- ▶ No getting stuck

In this mode, actual travel speed (radar sensor (8) or via CAN) and wheel speed (speed sensor (9) or via CAN) are measured.

¹⁾ This feature can not be used to achieve a high pressure double acting performance.

5 Electrical interfaces

5.1 General information

Note

The detailed hardware characteristics of the Rexroth controller are described in data sheet 95207. Please refer to this data sheet and read it carefully before using BODAS-work EHC40.

Mandatory functions

The following inputs are mandatory for front and rear hitch control:

- ▶ Hitch setpoint
- ▶ Maximum position setpoint
- ▶ Lowering speed setpoint
- ▶ Mode setpoint: transport, stop, working (standard inclusive floating) and fast lowering
- ▶ Actual hitch angle or position
- ▶ At least one set of external manual controls for lifting/lowering
- ▶ Pilot pressure request by use of EHRxx-EHS4 valves

Optional functions

Additional optional functions and the relationship to the associated interfaces are described in the table below.

Optional functions		Inputs						Outputs	
		Enabling anti-slip control switch	Maximum slip potentiometer	Vehicle speed from radar sensor	Vehicle speed from or GPS	Wheel speed from speed sensor	Wheel speed from vehicle ECU	Safe-out channel 1	Safe-out channel 2
AHC Automatic Hitch Control ¹⁾									
HLS Hitch Lowering Support	Separate valve module (HLS1) ²⁾							●	●
	Integrated valve function (HLS2) ¹⁾								
ASC Anti-slip control	Enabling anti-slip control	●							
	Maximum slip		●						
	Vehicle speed			●	●				
	Wheel speed					●	●		

● = Mandatory for functionality ● = Optional, one option only

¹⁾ No additional input or output required for this function

²⁾ HLS1 is available only as ASlib. In case of integration in the ASopen software, the use of the safe-out channels must be shared between the different actuators (in particular with EM2 actuations)

The following inputs are mandatory for rear hitch control only:

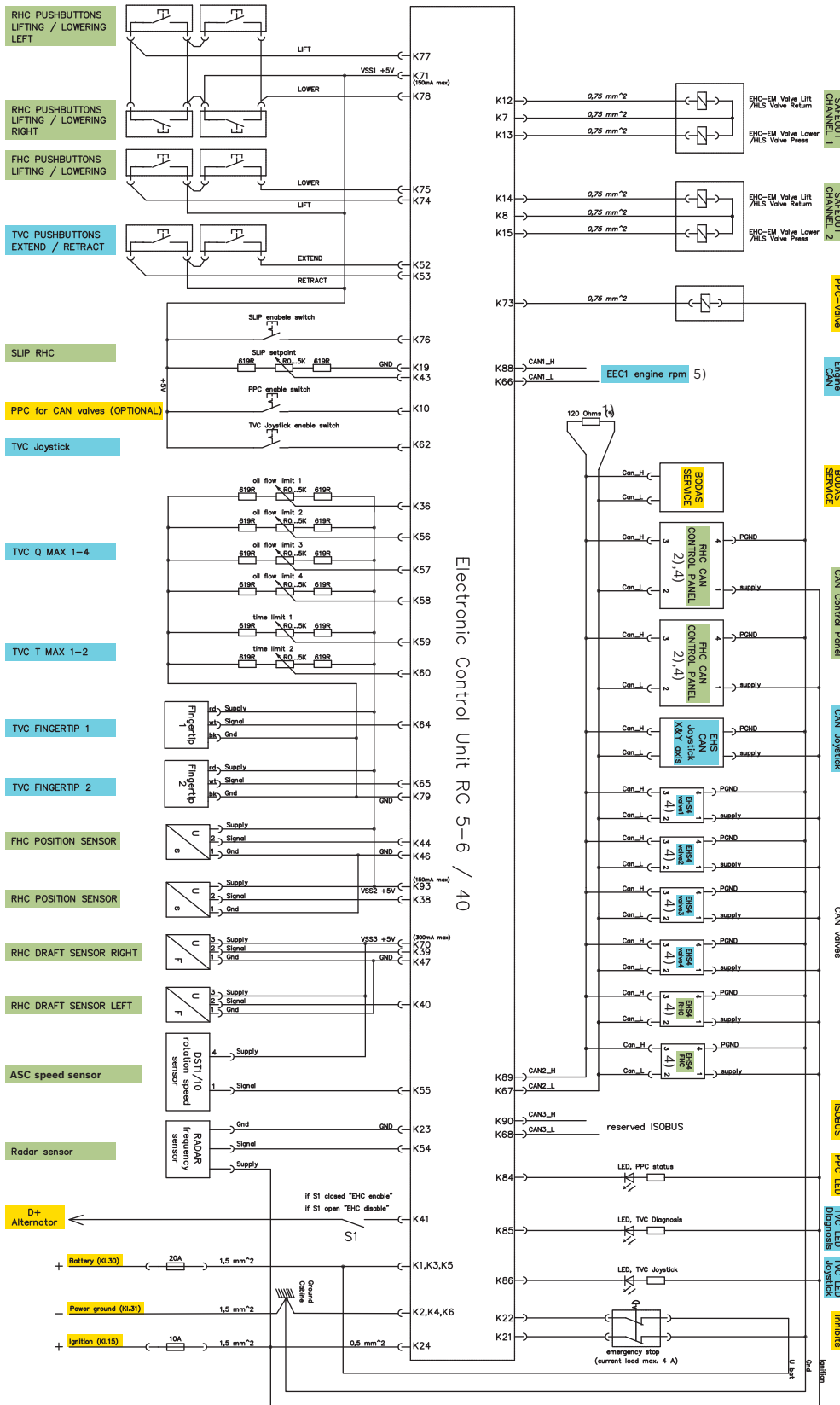
- ▶ Mix factor for position, draft, or mixed control
- ▶ Oscillation damping request
- ▶ Actual draft

Using these inputs, the basic, mandatory EHC40 functionality is provided. This includes:

- ▶ Transport mode with active oscillation dampening
- ▶ Stop mode
- ▶ Working mode with position control
- ▶ Working mode with draft and mixed control (for rear hitch control)
- ▶ Fast lowering mode
- ▶ Manual mode
- ▶ Emergency stop mode

5.2 Wiring diagrams

▼ RC5-6/40 for ASrun 1



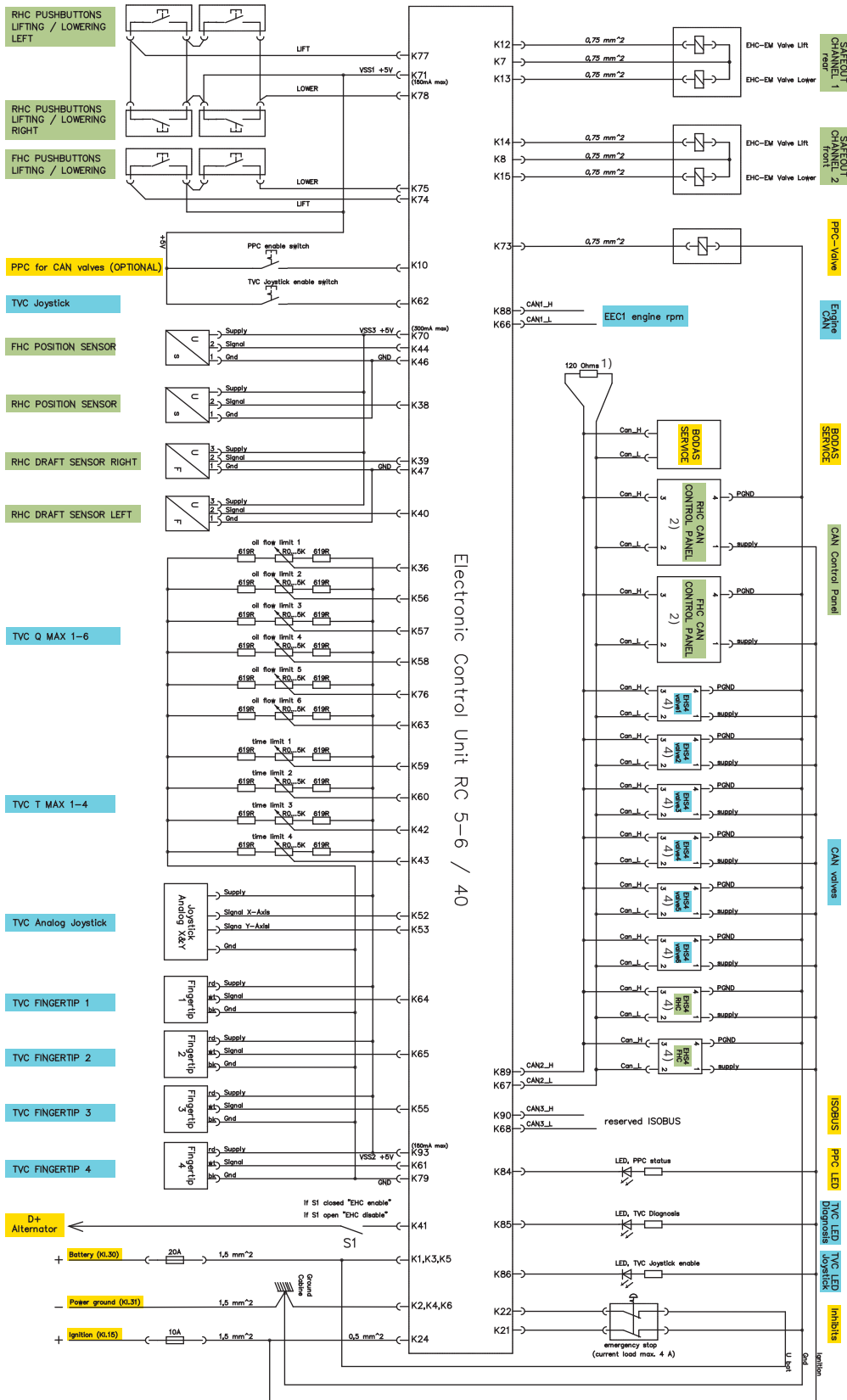
EHC40

TVC40³⁾

Common

- 1) Only if not mounted on this bus
- 2) Rexroth CP2 R983077790 has internal 120 Ω resistor
- 3) TVC40 see data sheet 95335
- 4) CAN channel can be shifted to CAN1
- 5) CAN channel can be shifted to CAN2

▼ **RC5-6/40 for ASrun 2**



EHC40

TVC40³⁾

Common

- 1) Only if not mounted on this bus
- 2) Rexroth CP2 R983077790 has internal 120 Ω resistor
- 3) TVC40 see data sheet 95335
- 4) CAN channel can be shifted to CAN1

▼ **Pinout for ASrun 1 and ASrun 2**

PIN	Description	ASrun 1	ASrun 2
01	Battery KL. 30	Battery power supply	
02	Power ground KL. 31	Battery power ground	
03	Battery KL. 30	Battery power supply	
04	Power ground KL. 31	Battery power ground	
05	Battery KL. 30	Battery power supply	
06	Power ground KL. 31	Battery power ground	
07	Highside power output	Safout 1 common high-side for EHR-EM or HLS hydraulic valve	
08	Highside power output	Safout 2 common high-side for EHR-EM or HLS hydraulic valve	
09	Highside power output	Free	
10	Analog inputs	Pressure cut-off switch/button (PPC)	
12	Lowside power output, switching output	Safout 1 low-side 1 for EHR-EM valve lift or HLS valve return	
13	Lowside power output, switching output	Safout 1 low-side 2 for EHR-EM valve lower or HLS valve press	
14	Lowside power output, switching output	Safout 2 low-side 1 for EHR-EM valve lift or HLS valve return	
15	Lowside power output, switching output	Safout 2 low-side 2 for EHR-EM valve lower or HLS valve press	
16	Lowside power output, switching output	Free	
18	Ground	Free	
19	Ground	GND for slip setpoint	Free
20	Sensor supply 4	Free	
21	Inhibit input 2	GND	
22	Inhibit input 1	UBAT	
23	Ground	Sensor GND for Radar sensor	
24	Ignition switch KL. 15	Ignition, power supply for radar sensor, auxiliary valves, control panels	
25	Analog output / PWM	Free	
29	Highside power output	Free	
36	Multi-functional inputs 2 + resistance inputs	CU1 / q_{\max} potentiometer 1	
37	Digital, analog, frequency and power inputs	Free	
38	Multi-functional inputs 1	RHC position sensor	
39	Multi-functional inputs 1	RHC draft sensor right	
40	Multi-functional inputs 1	RHC draft sensor left	
41	Multi-functional inputs 1	D+ Alternator	
42	Multi-functional inputs 1	Free	CU5 / t_{\max} potentiometer 3
43	Multi-functional inputs 1	Slip setpoint	CU6 / t_{\max} potentiometer 4
44	Multi-functional inputs 2	FHC position sensor	
45	Multi-functional inputs 2	Free	
46	Ground	Sensor GND for RHC&FHC position sensors	
47	Ground	Sensor GND for RHC draft sensors	
51	Lowside power output, PWM	Free	
52	Multi-functional inputs 1 + resistance inputs	TVC extend button	CU1 / AnJystk X
53	Multi-functional inputs 1 + resistance inputs	TVC retract button	CU2 / AnJystk Y
54	Multi-functional frequency and power inputs	Radar sensor	Free
55	Multi-functional frequency and power inputs	DST1	CU5 / Fingertip 3
56	Multi-functional inputs 2 + resistance inputs	CU2 / q_{\max} potentiometer 2	
57	Multi-functional inputs 2 + resistance inputs	CU3 / q_{\max} potentiometer 3	
58	Multi-functional inputs 2 + resistance inputs	CU4 / q_{\max} potentiometer 4	
59	Multi-functional inputs 1 + resistance inputs	CU3 / t_{\max} potentiometer 1	
60	Multi-functional inputs 1 + resistance inputs	CU4 / t_{\max} potentiometer 2	

PIN	Description	ASrun 1	ASrun 2
61	Digital, analog, frequency and power inputs	Free	CU6 / Fingertip 4
62	Multi-functional input 2 or Analog output	Joystick enable switch	
63	Multi-functional inputs 2	Free	CU6 / q_{\max} potentiometer 6
64	Multi-functional inputs 2	CU3 / Fingertip 1	
65	Multi-functional inputs 2	CU4 / Fingertip 2	
66	CAN_1 Low	See chapter 5.3 CAN signals	
67	CAN_2 Low	See chapter 5.3 CAN signals	
68	CAN_3 Low	See chapter 5.3 CAN signals	
70	Sensor supply 3	ASC speed sensor & RHC draft sensors	EHC position & draft sensors
71	Sensor supply 1	EHC buttons & potentiometers	
72	Sensor supply 1	Free	
73	Highside power output	Pressure cut-off valve high-side (PPC)	
74	Analog inputs	FHC lift button	
75	Analog inputs	FHC lower button	
76	Analog inputs	ASC switch	CU5 / q_{\max} potentiometer 5
77	Analog inputs	RHC lift button	
78	Analog inputs	RHC lower button	
79	Ground	Sensor GND for TVC fingertips & buttons & potentiometers	Sensor GND for TVC fingertips & potentiometers
80	Low-side digital outputs, low performance, PWM	Free	
81	Low-side digital outputs, low performance, PWM	Free	
82	Low-side digital outputs, low performance, PWM	Free	
83	Low-side digital outputs, low performance, PWM	Free	
84	Low-side digital outputs, low performance	Pressure cut-off LED (PPC)	
85	Low-side digital outputs, low performance	LED TVC diagnosis	
86	Low-side digital outputs, low performance	LED TVC Joystick	
87	Low-side digital outputs, low performance	Free	
88	CAN_1 High	See chapter 5.3 CAN signals	
89	CAN_2 High	See chapter 5.3 CAN signals	
90	CAN_3 High	See chapter 5.3 CAN signals	
92	LIN	Free	
93	Sensor supply 2	Sensor supply for TVC fingertips & buttons & potentiometers	
94	Sensor supply 2	Free	

5.3 CAN signals

▼ Up to two CAN channels are supported with configurable usages:

		Vehicle ECU	Valves	Control Panel	Diagnostic (UDS/J1939)
All in one	CAN1				
	CAN2	•	•	•	•
Vehicle CAN / Hitch CAN	CAN1	•			
	CAN2		•	•	•
Public CAN / Private CAN	CAN1		•		
	CAN2	•		•	•

CAN3 (ISOBUS) is currently not used in ASrun configurations.
Input and output signals for the driver and machine interface are sent with a baud rate of 250 kBaud.
For details, see the CAN database, which is part of the BODAS-drive documents and tools container.

Vehicle ECU	Communication with the diesel engine ECU (EEC)
Valves	Communication with CAN EHS4 actuations
Control panel	Communication with the Bosch Rexroth control panel CP1 / CP2 ¹⁾
Diagnostic (UDS/J1939)	Communication with the Bosch Rexroth diagnostic tool BODAS-service with UDS protocol and in addition J1939/DM1...DM3 ²⁾ . By using BODAS-service it is possible to adjust parameters, view process values, view active error messages, view and delete saved error messages and to flash the EHC software on controller.

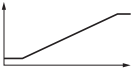
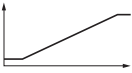
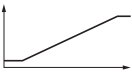
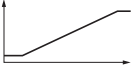
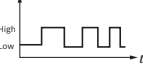
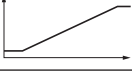
▼ CAN channels

<div><div>CAN</div><div>SAE J1939</div></div> <div>Standard</div>	Signal is contained in a standard J1939 message.
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1) The latest CP2 version (release 2022) is required.
2) Only for application software error messages. Some base software error messages may be not supported.

5.4 Inputs

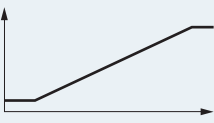
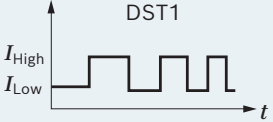
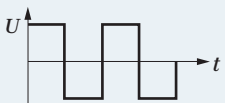
Range inputs

	Supported electrical interfaces	Maximum signal voltage range ¹⁾	Open input voltage ²⁾	Remarks	Supported CAN messages	Remarks
Engine speed	–	–	–	–	CAN SAE J1939	Standard EEC1
Alternator voltage (D+)	Analog	0 to 20 V	0 V	Alternative to engine speed used for enabling	–	–
RHC						
Setpoint	–	–	–	–	CAN SAE J1939	Standard CP1 for RHC
Position higher limit						
Mixture factor						
Lowering speed higher limit						
Position sensor		0.5 V to 4.5 V	0 V	Signal range adjustable via BODAS-service	–	–
Left force sensor		0.75 V to 4.25 V	0 V	Signal range adjustable via BODAS-service	–	–
Right force sensor		0.75 V to 4.25 V	0 V	Signal range adjustable via BODAS-service	–	–
ASC						
Slip higher limit potentiometer		0.5 V to 4.5 V	0 V	Signal range adjustable via BODAS-service	–	–
Vehicle speed sensor		0 to U_{Bat}	0 V	–	–	–
Wheel speed sensor		Signal channel of controller	–	–	CAN SAE J1939	Standard CCVS / UCSS
FHC						
Setpoint	–	–	–	–	CAN SAE J1939	Standard CP1 for FHC
Position higher limit						
Lowering speed higher limit						
Position sensor		0.5 V to 4.5 V	0 V	Signal range adjustable via BODAS-service	–	–


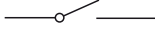
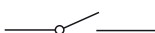



1) Passive sensors such as potentiometers must be connected to a 5 V sensor supply (VSS_1-3). Active sensors must be supplied as specified by sensor data sheet (VSS_1-3 or VSS_4).

2) Voltage measured in case of unconnected signal pin. Voltage results from internal circuitry of RC.


▼ **Supported electrical interfaces**

	This interface expects one analog voltage signal in the range from V_{\min} to V_{\max} . The details of the signal characteristics including start and end point as well as the allowed tolerances can be configured via parameters.
	DST1 Sensor: This interface expects one frequency signal with coded error and direction information.
	Frequency Input: This interface expects one frequency signal.

Switch inputs

	Supported electrical interfaces	Closed switch voltage ³⁾	Open input voltage ⁴⁾	Remarks	Supported CAN messages	Remarks
PPC switch / button		5 V	85% U_{Bat}	Switch may be normally open or closed. Button must be normally open.		
EHS4 status	–	–	–	–	CAN SAE J1939	Standard EHS4 DM1
EHS4 Address Claim	–	–	–	–	CAN SAE J1939	Standard EHS4 Address Claim
RHC						
Lift button		5 V	85% U_{Bat}	Button must be normally open.	–	–
Lower button		5 V	85% U_{Bat}	Button must be normally open.	–	–
Main mode request	–	–	–	–	CAN SAE J1939	Standard CP1 for RHC
Damping request				–		
ASC						
Slip control switch		5 V	85% U_{Bat}	Switch may be normally open or closed.	–	–
FHC						
Lift button		5 V	85% U_{Bat}	Button must be normally open.	–	–
Lower button		5 V	85% U_{Bat}	Button must be normally open.	–	–
Main mode request	–	–	–	–	CAN SAE J1939	Standard CP1 for FHC

▼ **Supported electrical interfaces**

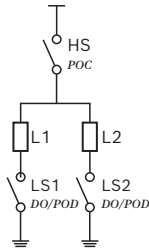
	This interface expects an on/off signal coming from a push button or switch with normally open contact.
--	---

³⁾ External potential connected to RC by a closed switch.

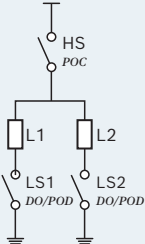
⁴⁾ Potential measured at RC pin at open switch. Voltage results from internal circuitry of RC.

5.5 Outputs

Range outputs

	Supported electrical interfaces	Default output logic ¹⁾	Invertible ²⁾	Remarks	Supported CAN messages	Remarks
EHC valve		Valve is off	No	2 safout channels are available to be configured for EHC valves, but could be also used for HLS valves.	CAN SAE J1939	Standard EHS4 Command



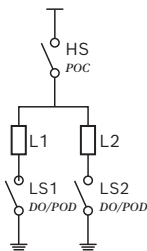
▼ Supported electrical interfaces

	<p>PHDLS mode (Proportional High – Digital Low Switchable)</p> <ul style="list-style-type: none">– Only one LS can be ON at a time (e.g. direction change).– If the other digital LS is switched ON, a switchover takes place.– With a set point of zero current the channel is switched OFF i.e common output and LS's are switched OFF, means regardless of which LS was switched ON.
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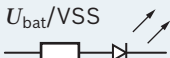
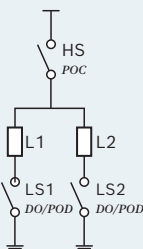
1) For output that is shut off (no current), expected default machine behavior for a deactivated output (no current driven by high-side output).

2) Indicates whether output logic can be inverted by parameter.

Switch outputs

	Supported electrical interfaces	Default output logic ³⁾	Invertible ⁴⁾	Remarks	Supported CAN messages	Remarks
PPC valve		Valve is off.	No	–	–	–
PPC lamp		Lamp is off.	No	Lamp off: PPC valve is off. Lamp on: PPC valve is on. Flash fault codes: PPC switch / button and / or valve have error.	–	–
HLS valve		Valve is off.	No	2 safout channels are available to be configured for EHR valves, but could be also used for HLS1 valve modules.	–	–
RHC						
Status lamp	–	–	–	–	CAN SAE J1939	Standard CP1 for RHC Status lamp displays lock/unlock state and flashes fault codes.
Lift lamp						
Lower lamp						
Damping lamp						
FHC						
Status lamp	–	–	–	–	CAN SAE J1939	Standard CP1 for FHC Status lamp displays lock/unlock state and flashes fault codes.
Lift lamp						
Lower lamp						

▼ Supported electrical interfaces

	This high-side output expects a solenoid connected GND. The digital output current is generated by the high-side output via switching ON/OFF.
	This low-side switching output expects a low power load (e.g. lamp or LED) powered by a sensor supply pin (VSS) or battery voltage.
	DHDLM operating mode (Digital High - Digital Low Multiple) – Parallel operation of up to four LS is possible. – Maximum allowed current is limited by the HS

³⁾ For output in on-state, expected default machine behavior for an activated output (output connected to supply potential).

⁴⁾ Indicates whether output logic can be inverted by parameter.

6 Functional safety in accordance with ISO 25119

6.1 Approach

BODAS EHC is set up as a category 2 system in sense of ISO 25119.

6.2 Valve control system

The machine manufacturer can use the BODAS controller RC/40 + BODAS-work EHC40 within the machine safety concept to realize safety functions for the electronical control of the hydraulic system.

The described characteristics within this data sheet refer to the BODAS-work EHC40 software.

Ready-to-use safety functions developed according to the standard ISO 25119 are part of the software. If the performance level of BODAS-work EHC40 is sufficient to reach the required system performance level, BODAS-work EHC40 can be used based on the customer-specific risk assessment. In any case, the requirements of the relevant safety standard must be fulfilled at the machine level.

6.3 Concept

BODAS-work EHC40 utilizes an inherent safety concept. This means that all noted safety functions are realized not by a dedicated monitoring software, but by a safe implementation of the safety relevant software program parts. The BODAS-work EHC40 software has been completely developed according to SRL 1. The software comes with four pre-defined safety functions:

- ▶ Safe standstill
- ▶ Safe direction
- ▶ Safe speed
- ▶ Safe limiting of damping range

For additional safety functions, contact your Bosch Rexroth sales partner.

This inherent approach is combined with a safe diagnosis system within the BODAS-work EHC40 software, fulfilling the requirements of category 2: Detection of and appropriate reaction to hardware faults.

As BODAS-work EHC40 represents a safety element out of context (SEooC), the machine manufacturer must verify whether it is the right product for the specific application. In any case, the machine manufacturer is responsible to fulfill the overall safety requirements at the machine level.

The following approach shows how the machine manufacturer can reach the required performance level for a specific application applying BODAS-work EHC40.

1. Risk assessment

- ▶ Performance of risk assessment
- ▶ Functional safety concept

2. Safety concept and category selection:

Category 2 is pre-defined for BODAS-work EHC40

Mapping of requirements from functional safety concept to technical safety concept of BODAS-work EHC40

- ▶ If the safety requirements of the application cannot be fulfilled with the existing safety functions of BODAS-work EHC40, the product must not be used. In this case, consult your Bosch Rexroth contact regarding a customized solution. Otherwise go on with the next step.
- ▶ Developing a safety concept for the complete machine
 - Applying BODAS-work EHC40 inherent safety approach
 - Approve of the overall agricultural performance level A calculation. An example is provided with the technical ASrun documentation.

3. Integration and parameterization of BODAS-work EHC40 in the machine

- ▶ Integrate BODAS-work EHC40 in the machine environment interfacing the wiring harness and devices which are selected according to the safety requirements.
- ▶ Set parameters with BODAS-service according to the application-specific requirements.

4. Validation

- ▶ Creation of an appropriate application-specific approval test specification. The BODAS-work EHC40 approval test specification is part of the documents and tools container and can be used as a starting point. An application-specific adaptation is required in any case.
- ▶ Performance of approval tests specific to application and project as well as documentation of the results.

7 Project engineering and ordering information

7.1 Ordering code

01	02	03	04	05
	-	TRC	1	7

Type

01	Application software ready to run on RC controller	ASrun
	Application software open for modifications	ASopen

Application

02	Tractors or agricultural applications	TRC
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Controller

03	RC5-6/40	1
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Core software

04	EHC40 / TVC40	7
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Variant

05	Variant 1	1
	Variant 2	2

Note

The BODAS-work EHC40 ASrun shall be flashed on a BODAS controller RC5-6/40 ordered separately.

▼ **Software features**

			ASrun- TRC171 ASopen- TRC171	ASrun- TRC172 ASopen- TRC172
Rear hitch	RHC Rear Hitch Control	Position control	●	●
		Draft control	●	●
		Mixed control	●	●
		Active oscillation dampening	●	●
		Floating	●	●
		CAN control panel CP1 or CP2 ¹⁾	●	●
		External push-buttons for lifting/lowering	2x2	2x2
		Valve actuation	EM2	●
			CAN EHS4	●
	AHC Automatic Hitch Control		●	●
	HLS Hitch Lowering Support	Variant	separate valve module (HLS1)	–
			integrated valve function (HLS2)	●
	ASC Anti Slip Control	Enabling switch	●	–
		Maximum slip potentiometer	●	–
		Vehicle speed	from radar sensor	●
			from GPS via CAN	●
		Wheel speed	from speed sensor	●
			from vehicle ECU via CAN	●
Front hitch	FHC Front Hitch Control	Position control	●	●
		Floating	●	●
		CAN control panel	●	●
		External push-buttons	2	2
		Valve actuation	EM2	●
			CAN EHS4	●
	HLS Hitch Lowering Support	Variant	separate valve module (HLS1)	–
			integrated valve function (HLS2)	●
Common rear/ front hitch	REN Renumbering		●	●
	Mode selection	Ignition input	●	●
		Emergency stop	●	●
		System enabling switch pilot oil cut-off	●	●

● = Available – = Not available

¹⁾ The latest CP2 version (release 2022) is required to show EHC40 error messages on CP2 display.

7.2 Pricing request

The price depends only on the requested configuration regardless of the software deliverable (ASrun, ASopen, ASlib).

Please provide your request to your Bosch Rexroth contact.

Features	Requested configuration
FHC Front Hitch Control / RHC Rear Hitch Control	●
AHC Automatic Hitch Control	o
HLS Hitch Lowering Support	o
ASC Anti Slip Control	o

● = Mandatory o = Optional

7.3 Project engineering

The way from machine prototyping to serial production

- ▶ The outputs of the BODAS-work EHC controller are deactivated in the initial delivery status.
- ▶ Each ASrun software needs to be parameterized. Access to the parameters is password-protected. The password is part of the documents and tools container.
- ▶ The machine manufacturer must ensure that BODAS-work EHC40 is compatible with the machine with regard to machine-specific requirements.

Important:

- ▶ The details in chapter 6, “Functional safety”, must be taken into account.
- ▶ Customer specific parameters must be transferred into the BODAS-work EHC40 platform software for serial production. Either by transferring parameters using BODAS-service, or by creating a customer-specific software. Please consult your Bosch Rexroth contact.

Documents and tools container

To assist in handling the product properly, the documents and tools container contains the following files and documents:

- ▶ Software documentation (application guideline, detailed functional description, parameter description, etc.)
- ▶ User password to access the parameters via BODAS-service
- ▶ Test specification example file for approval test
- ▶ Measurement, calibration and testing-tool support

The operating instructions as well as the valid standards and separate documentation (chapter 8) must be considered before start-up of the software.

The documents and tools container is provided upon request via Info.Bodas@boschrexroth.de
Please use the following subject for your e-mail request: “Container request: ordering code” (see chapter 7.1)

Please also provide the following information:

- ▶ Company name
- ▶ Contact person
- ▶ E-mail address
- ▶ Purchase order number

Required tools

- ▶ BODAS-service. For the latest version, see www.boschrexroth.com/p-BODAS-service

Recommended tools

- ▶ Vector CANalyzer Pro including virtual testbox and plant model.





8 Valid standards and separate documentation

Documents	
2001/95/EC	Directive 2001/95/EC of the European Parliament and of the Council of 3 December 2001 on general product safety
Regulation (EU) 2016/679	General Data Protection Regulation
167 EUV 2013	EU regulation: Approval and market surveillance of agricultural and forestry vehicles
Regulation (EU) No 1322/2014	EU regulation: COMMISSION DELEGATED REGULATION (EU) No 1322/2014 in addition to 167 EUV 2013
ISO 12100:2010	Safety of machinery – General principles for design – Risk assessment and risk reduction
ISO 25119-2:2018 ISO 25119-3:2018	Tractors and machinery for agriculture and forestry – Safety-related parts of control systems
08511	Rexroth brochure “10 Steps to Performance Level”

▼ Compatible Rexroth products

Component	Relevant type code / Information	Document no.	
Control panel CP1		95255	
Control panel CP2		95256	
Hitch control valves EHR	EHR5, EHR24-EM2, EHR24-EHS4	66126	
Speed sensor DST	DST1/10	95131	
Draft sensor KMB	KMB/30	95170	
Draft sensor DP1	DP1/10	95171	
Angle sensor AN3	AN3/10	95144	
Position sensor PO1	PO1/20	95160	
BODAS Controller RC5-6 Series 40	RC5-6/40	95207	
BODAS-service		95087	

▼ Videos

Title	Link	
Electrohydraulic Hitch Control – EHC [en]	https://www.youtube.com/watch?v=XOu0720yt-Y	
EHR Expansion Stage: HLS Hitch Lowering Support [de]	https://www.youtube.com/watch?v=dHzJJdB2j5E	
EHR Expansion Stage: AHC Automatic Hitch Control [en]	https://www.youtube.com/watch?v=mZBGVBSYQY4	
History of the EHR [en]	https://www.youtube.com/watch?v=irlp1l-CwPg	

9 Abbreviations

Abbreviation	Meaning
AgPL	Agriculture Performance Level
AHC	Automatic hitch control
AN3	Angle sensor
ASC	Anti-slip control
ASlibrary	Collection of SW components with well-defined tasks
ASopen	Application Software, open for source code modifications
ASrun	Application Software, not open for source code modifications. Parametrization required.
ASW	Application Software
BODAS	Bosch Rexroth Design & Application System
BR	Bosch Rexroth AG
BSW	Base Software
CAN	Control Area Network
CCP	CAN Calibration Protocol
CP	Control panel
da	Double-acting
DC	Diagnostic Coverage
DET	Detent
DP1	Draft sensor
ECU	Electronic Control Unit
EEC	Electronic Engine Controller
EHC	Electrohydraulic Hitch Control Software
EHR	Electrohydraulic Hitch Control Valve
FHC	Front Hitch Control
FuSa	Functional Safety

Abbreviation	Meaning
HLS	Hitch Lowering Support
HMI	Human machine interface
HW	Hardware
ISO	International Organization for Standardization
KMB	Draft sensor
MASAR	Machine Application Software Architecture @Rexroth
PPC	Pilot cut-off for EHS4 actuations (Power pressure control)
PRG	Progressive curves
RAC	Rate control
RC	Rexroth Controller
REN	Renumbering
RHC	Rear Hitch Control
sa	Single-acting
SAE	SAE Society of Automotive Engineers
SCA	Scaling
SCM	Scenario manager
SEooC	safety element out of context
SF	Safety Function
SFP	Social oil-flow and priority
SRL	Safety Requirement Level
SW	Software
TVC	Tractor Valve Control
U _{Bat}	Battery voltage
XCP	Universal Measurement and Calibration Protocol

10 General information

Legal information, software license agreement, free and open source software

The “General Terms and Conditions of Deliveries and Services by Bosch Rexroth AG” as well as the “Supplementary Terms of Delivery (License Terms) for the Sale of Software of Bosch Rexroth AG” and the “FOSS Quotation and Sales Conditions of Bosch Rexroth AG” shall apply.

Link:

<https://www.boschrexroth.com/en/dc/legal-notice/>



This product contains Free and Open Source Software. Further details and license information are given within the software documentation.

11 Safety instructions

- ▶ BODAS-work EHC40 represents a safety element out of context. The machine manufacturer must verify whether it is the right product for the specific intended application.
- ▶ The machine manufacturer must perform a risk assessment.
- ▶ The required safety functions and performance levels must be fulfilled with the product in order to use BODAS-work EHC40 in a specific application.
- ▶ The machine manufacturer is responsible for applying the valid safety standards at the machine level.
- ▶ The machine manufacturer is responsible for fulfilling all safety requirements at the drivetrain and machine level.
- ▶ The machine manufacturer is responsible for validating the machine-specific configuration of BODAS-work EHC40.
- ▶ Configurations of BODAS-work EHC40 used for serial production must be validated.
- ▶ The proposed circuit layouts do not imply any technical liability for the system on the part of Bosch Rexroth.
- ▶ Incorrect connections could cause unexpected signals at the outputs of the RC controller.
- ▶ Incorrect programming or parameter settings may create potential hazards while the machine is in operation.
- ▶ It is the responsibility of the machine manufacturer to identify hazards of this type in a hazard analysis and to bring them to the attention of the end user. Bosch Rexroth assumes no liability for hazards of this type.
- ▶ The application software must be installed and removed only by Bosch Rexroth or an authorized partner to preserve the warranty.
- ▶ It must be ensured that the vehicle is equipped with adequately dimensioned service and parking brakes.
- ▶ Make sure that the software configuration does not lead to safety-critical malfunctions of the complete system in the event of failure or malfunction. This type of system behavior may put life in danger and/or cause substantial damage to property.
- ▶ System engineering, installation and commissioning of electronic systems for controlling hydraulic drives must only be carried out by trained and experienced specialists who are sufficiently familiar with both the components used and the complete system.
- ▶ The machine may pose unforeseen hazards while commissioning and maintenance are carried out. Before commissioning the system, you must therefore ensure that the vehicle and the hydraulic system are in a safe condition.
- ▶ Make sure that nobody is in the machine's danger zone.

- ▶ No defective or incorrectly functioning components may be used. If the components should fail or demonstrate faulty operation, repairs must be performed immediately.
- ▶ The technical specifications and safety instructions of all involved components must be considered.
- ▶ The machine manufacturer must follow the valid standards and separate documentation (see chapter 8) when using the product.

Product security

- ▶ Security relates to enforcing policies to prevent changes in systems by unauthorized personnel.
- ▶ The BODAS-service protocol provides security mechanism to prevent malicious manipulation of configuration or runtime behavior.
- ▶ Critical BODAS-service protocols/services require authentication.
- ▶ Manipulation or spoofing of CAN messages cannot be detected.
- ▶ Usage of this product shall hence be limited to private CAN networks without public accessibility. It is the responsibility of the machine manufacturers to implement CAN segregation accordingly.

Intended use

- ▶ The control unit is designed for use in mobile working machines provided no limitations / restrictions are made to certain application areas in this data sheet.
- ▶ Operation of the control unit must generally take place within the operating ranges specified and approved in the RC data sheet, particularly with regard to voltage, current, temperature, vibration, shock and other described environmental influences.
- ▶ Use outside of the specified and approved boundary conditions may result in hazard to persons and/or cause damage to components which could result in consequential damage to the mobile working machine.

Improper use

- ▶ Any use of the control unit other than as described under "Intended use" is considered to be improper.
- ▶ Use in explosive areas is not permissible.
- ▶ Damage resulting from improper use and/or from unauthorized interference in the component not described in this data sheet shall render all warranty and liability claims void with respect to the manufacturer.

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