

# Application software eOC BODAS pump control library



- ▶ Electronic control for open circuit pumps
- ▶ Software library solution for various control units
- ▶ Optimized with an appropriate pump control valve and pump sensor configuration
- ▶ Product variant 100 V2.0.0

## Features

- ▶ Library with data interface for pump pressure, displacement, flow and torque control
- ▶ Adjustable and variable dynamics
- ▶ Improved machine performance and productivity
- ▶ Less fuel consumption and optimized battery usage
- ▶ Reduced pump variance and service effort
- ▶ Integrated component calibration
- ▶ Easy application with commissioning guideline for parameter optimization

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## 1 Introduction

The portfolio of open circuit axial piston pumps from Bosch Rexroth provides a high variance of hydro-mechanical control functions with mechanical interfaces for machine optimization.

With the new electronic control concept eOC BODAS pump control all these functions and interfaces are now transferred into software.

The software library solution is a software for various control units that allows to electronically control the pressure, displacement, flow and torque of an axial piston pump thus enabling customizable control modes and adjustable pump dynamics during operation.

For integration of this function on various control units, a library is provided. The interfaces to this library are data structures that can be used to control the pump behavior, to get status information and to parametrize the functions. An integration guide provides the interface specification and all other necessary information for integration. Please get in touch with your Bosch Rexroth sales representative for this document.

All available control functions and possibilities for customization are described in this data sheet. The implementation of additional customer specific functions can be done using the available data interfaces. In order to get support on this, please get in touch with your Bosch Rexroth sales representative.

The eOC BODAS pump control library is prepared to be applied to any kind of electronic control unit. Hardware requirements are specified and need to be satisfied by the control unit.

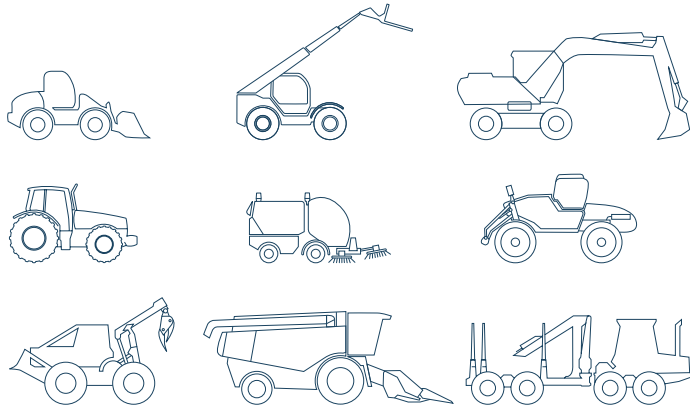
The library can also be integrated on a Rexroth RC controller series 40. Moreover, an integrated ready to use eOC library function is available on an RC5-6/40 (see data sheet 95345).

The provided eOC function can be applied in any kind of mobile working machine that requires an open circuit axial piston pump. Still, the maximum operating conditions of the installed axial piston pump must be respected.

For detailed technical information, please refer to the corresponding pump data sheet.

## 2 Typical applications and benefits

The eOC BODAS pump control library is suitable for a wide range of mobile working machines requiring an open circuit axial piston pump – from construction, agricultural and forestry machines to municipal vehicles.



Each machine has different requirements towards the hydraulic system and its components. With eOC BODAS pump control library function, the following major advantages can be achieved.

### **Adjustable and variable features**

The required features can be selected and optimized via the library data interface. The provided library contains the complete available feature set.

### **Improved machine performance and productivity**

Mobile machines are highly productive and optimized for their intended load cycles. At the same time, the installed engine power is limited. With the new eOC BODAS pump control library software it is now possible to establish a direct communication between engine and axial piston pump to adapt the hydraulic power continuously and dynamically to the available engine torque. Further, the pump software is able to compensate disturbances (e.g. temperature, speed) in machine load cycles, which allows highly dynamic operating functions with a high level of precision to increase the overall productivity of the machine.

### **Less fuel consumption & optimized battery usage**

The control principle of an axial piston pump and how it interacts with the hydraulic system are two of the major aspects that affect the energy efficiency of a mobile machine. eOC BODAS pump control library target is to optimize both. On the one hand, the consolidation of multiple controller axes for pressure, flow and torque into one results in a reduced fluid consumption of the pump control valve itself. On the other hand, the possibility to dynamically adjust control parameters, for instance in standby condition or during eco mode, allows to minimize the energy consumption of the overall hydraulic system.

### **Reduced pump variance and service effort**

As all the different pump control types and mechanical settings of Rexroth axial piston pumps can be transferred into software, the number of pump configurations required for an OEM can be significantly reduced. This directly affects the effort of managing spare parts and aftermarket components and at the same time simplifies engineering work.

In the event of a malfunction or feature update the eOC BODAS pump control library software can be maintained via status information out of the library. A commissioning guide supports the machine function optimization.

### 3 System description

The eOC BODAS pump control requires an electro-hydraulic control valve on the pump (“EC4” or “EB4”), described in the eOC pump data sheets e.g. 92705 (A10VO/32), a Hall-sensor for the pump swivel angle, see data sheet 95153 (SWS/20), and 95161 (PAL2/10) and a pressure sensor on the pump outlet, see Rexroth data sheet 95156 (PR4 SENT).

In order to realize an electronic load sensing function, an additional pressure sensor for the load pressure has to be installed at the load sensing port of the main control valve. To realize an accurate pump flow control function, the engine speed has to be available on the CAN bus (typically J1939 EEC1).

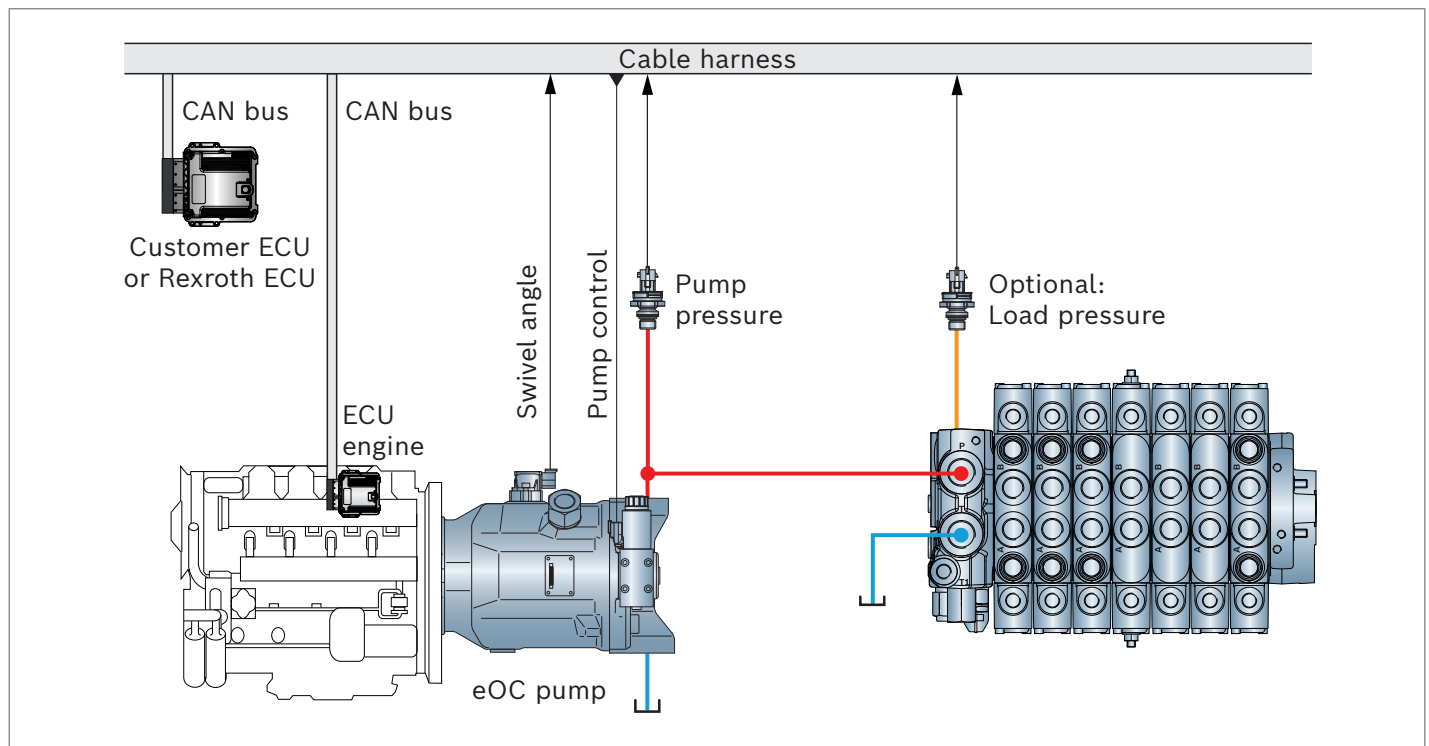
The eOC BODAS pump control library software itself runs on various control units and processes the pressure, swivel angle and speed information to calculate the control current that drives the pump control valve. Without control current, the pump swashplate will stay at minimum displacement for the “EC4” valve variant and at maximum displacement for the “EB4” valve variant.

The command values for pressure, angle, flow and torque control have to be provided to the software via the data interface.

The library interface description can be found in the integration guide.

#### 3.1 System overview

##### ▼ Typical configuration for electrohydraulic pump control eOC BODAS pump control



### 3.2 Pumps prepared for eOC control

The eOC BODAS pump control can be applied to various types of Rexroth variable displacement pumps in swashplate design.

#### Prepared for series production:

- ▶ A10VO series 31 (92701)
- ▶ A10VO series 32 (92705)
- ▶ A10VO series 52/53 (92703)
- ▶ A11V(L)O series 1x (92500)
- ▶ A20V(L)O series 1x (93100)

#### In preparation, available on request:

- ▶ A15V(L)O series 12 (92512)
- ▶ A28VO series 1x (93105)
- ▶ A8VO series 63/72 (93013)
- ▶ A10VOH series 60 (92704)

All pumps require an electro-proportional control valve (type “EC4”, “EB4” or equivalent, see pump data sheet) to realize the intended control function and a swivel angle sensor to feedback the actual swashplate displacement. For detailed information about the eOC supported pump sizes, please consult the project guidelines and your Bosch Rexroth sales representative.

Please refer to the individual data sheets for detailed information about available configurations and operating limits.

#### ▼ Variable displacement pump A10VO series 32, prepared for eOC BODAS pump control



### 3.3 Control unit specification

In order to run the eOC BODAS control library on the target control unit, some hardware specific requirements need to be fulfilled. This applies to the accuracy of the inputs, the overall latency from input to output, the ability to control the output for the control valve with 1000 Hz PWM signal, the required memory and also sufficient runtime performance.

A complete table of hardware requirements is provided in the integration guide.

To be able to assess the required runtime of the library, a runtime equivalent source code is available on demand with similar runtime behavior.

BODAS controller RC5-6/40 meets these requirements and the eOC BODAS pump control can be supplied already installed on Rexroth ECU (see data sheet 95345).

### 3.4 Sensor specification

The eOC BODAS control library function requires sensor information via the data interface. Selection of sensors is in customer responsibility. Bosch Rexroth recommends to use the Bosch Rexroth pressure sensor PR4 (see data sheet 95156) with the digital SENT interface due to accuracy reasons. Any other sensor can be used respecting the accuracy demands in the integration guide.

The swivel angle sensor is part of the Bosch Rexroth pump. See data sheet of pumps and sensor data sheet SWS/20 (95153), SWS/03 (95150) or PAL2 (95161).

This sensor information has to be processed adequately in the target control unit and transferred to the eOC BODAS control library via the data interface.

## 4 Functional description

The eOC BODAS pump control library provides and extends the three main control principles of a swashplate axial piston pump with a much higher flexibility as its mechanical controlled predecessors.

- ▶ Pressure and delta pressure control
- ▶ Displacement and flow control
- ▶ Torque control

In addition to the main control functions the software further allows to customize the dynamics of each control principle to adapt the pump behavior to the hydraulic system and machine dynamics.

- ▶ Pressure change rate
- ▶ Displacement and flow change rate
- ▶ Torque change rate

Enhanced valuable software functions can be activated as add-ons in accordance with the chosen software configuration.

Further, e.g. machine specific functions can be added on demand.

- ▶ Self-calibration cycle
- ▶ Cold start program
- ▶ Pump protection
- ▶ Virtual minimum displacement
- ▶ Virtual pressure cut-off
- ▶ Limp home modes

Further, e.g., machine specific functions can be added on demand.

A data interface to the eOC BODAS pump control library allows parametrization and activation of functions. It is specified in the integration guide.

### 4.1 Pump control functions and dynamics

#### Pressure and delta pressure control

The pressure control function allows to control the pump pressure to a desired value.

The delta-pressure control function allows electronic load sensing control by maintaining a constant pressure difference between load pressure and pump pressure (additional pressure sensor for load sensing required).

The command values for maximum pressure and delta pressure can be set via data interface.

#### Displacement and flow control

The displacement control function allows to control the displacement of an axial piston pump to a desired value.

The flow control function allows precise control of the actual flow produced by the axial piston pump. It takes into account both the current pump speed and its efficiency (ratio and engine speed needs to be communicated via J1939 EEC1 message).

The command values can be set via data interface.

#### Torque control

The torque control function allows to control the input torque of the pump that is required from the engine (pump efficiency map is considered in the algorithm). As soon as the input shaft torque exceeds the defined set-point, the controller will reduce the pump displacement accordingly.

The command values for maximum input shaft torque can be set via data interface.

#### Variable pump dynamics

The pump dynamics can be adjusted by limiting the derivatives of each control mode, e.g. maximum pressure change rate, maximum flow change rate and maximum torque change rate via data interface.

#### Pump protection

The pump protection module prevents unfavorable operating conditions of the pump. It limits the maximum allowed pressure level according to data sheet information (e.g. default value 350 bar with A10VO) and limits the maximum allowed swiveling speed of the swashplate regardless of the main control functions.

**Important:** The maximum working pressure (e.g. 280 bar with A10VO) still has to be ensured via pressure control command in the data interface.

#### Fail-safe behavior

The following failures have to be recognized in the target control unit outside the eOC BODAS pump control library:

- ▶ Sensor failure
- ▶ Solenoid failure
- ▶ Internal control unit failure
- ▶ Communication failure
- ▶ Start condition failure

Depending on the failure type, substitute values are used, a limp home mode becomes active, or the control is switched off and the pump acts according to its hydro-mechanical fallback behavior.

### Limp home modes

In case of sensor failures, the eOC BODAS pump control system offers limp home modes. In detail, if the pump pressure sensor is malfunctioning, the pump can still be controlled in angle control mode. Similarly, if the angle sensor is broken, the eOC BODAS pump control system will switch to a pressure control mode with limited dynamics

### Multiple instances of pump control in one control unit

The eOC BODAS pump control library can be integrated more than once. Thus, multiple axial piston pumps can be controlled independently. Runtime constraints have to be considered depending on the control unit.

## 4.2 Add-Ons available

### Self-calibration cycle

With the self-calibration add-on the angle sensor information for maximum and minimum displacement is automatically recalibrated and stored at engine start. The feature allows to skip a manual calibration end of line and to compensate potential sensor drifts during the lifetime of the axial piston pump.

The calibration is skipped below 15 °C (parameter). In these cases the latest values from the persistent memory are used. The interface to the persistent memory of the control unit is shown in the integration guide (chapter "Example integration with pseudo-code").

Impact on pump behavior:

- ▶ Pump is forced to maximum displacement during speeding up the pump for around 100 ms.  
Background information: Due to spring forces it is set closed to maximum displacement anyway.
- ▶ Pump is controlled to minimum displacement by a defined pressure level after start up phase for around 150 ms. During calibration no pump flow is allowed (e.g. flushing valve) in order to reach the correct  $V_{g\ Zero}$  position.

**Additional hint:** If mechanic  $V_{g\ min}$  position is set, this position needs to be set as parameter in order to correctly extrapolate towards  $V_{g\ Zero}$ .

### Cold start program

A specific cold start procedure is not part of the eOC BODAS pump control library. It can be realized in the integration part of the library by limiting the command values (displacement, torque or pressure).

### Virtual minimum displacement/flow

With the virtual minimum displacement add-on the pump swashplate will be virtually stopped at a predefined minimum displacement. The feature supports several use cases, such as flushing of the main control valve, increased dynamics at start of movements, and standby management. This can be also configured for a virtual minimum flow, incorporating the pump speed.

In contrast to a mechanical stop, the maximum pressure setting will override the minimum displacement setting. See Chapter 4.3.

### Virtual pressure cut-off

The virtual pressure cut-off add-on serves to restrict the pump pressure to a predetermined maximum value. This feature facilitates fast pressure limitation, ensuring that the pump pressure remains within the desired range.

The pressure cut-off setting assumes the highest control priority within the control chain. For further details, please refer to Chapter 4.4.

## 4.3 Add-ons available on demand

### Hybrid operating mode

With the hybrid operating add-on the eOC BODAS pump control library software will be able to control the pump in the positive and additionally in the negative quadrant. Meaning, the pump will operate as a motor by swiveling the swashplate across zero into the negative quadrant. The motor operating mode may be used for hybrid systems with recuperation function or advanced system concepts. The feature can only be activated, if the pump hardware is prepared for a two-quadrant functionality. Please get in touch with your Bosch Rexroth sales representative to discuss about such solutions.

### Advanced pump protection

Please get in touch with your Bosch Rexroth sales representative to discuss about such solutions.



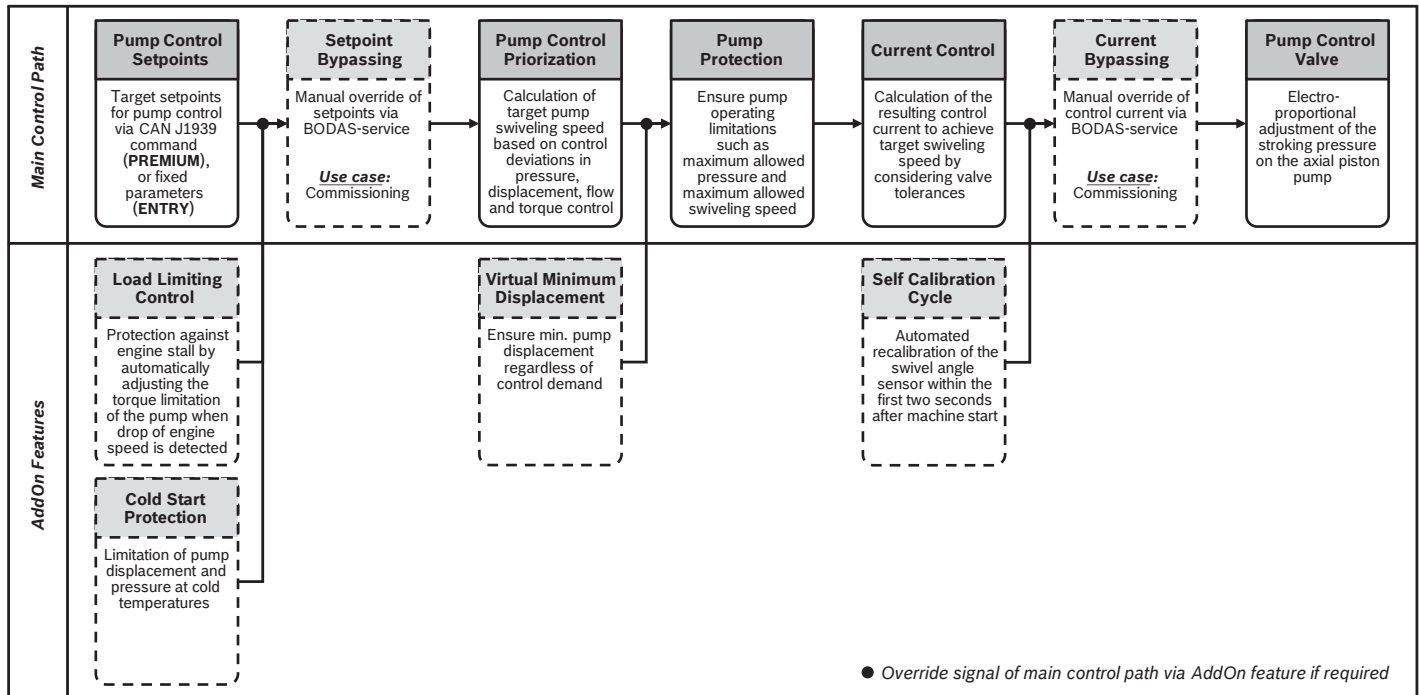
#### 4.4 Control priorities

Since several control paths / functions can be active at the same time an abstracted signal flow diagram shows the priority of the different control functions.

If activated, the virtual minimum displacement function has higher priority compared to the main control setpoints, but lower priority compared to the pressure limitation function within the pump protection module.

For commissioning purpose all measurements, setpoints, but also the control current to the solenoid can be bypassed via data interface.

If activated, the self-calibration cycle will always have the highest priority within the first few seconds (typically < 2s) after machine start.



#### 4.5 Data interfaces and functionality

##### System inputs

The following information is required to the control unit input to allow the full scope of eOC pump control functions.

##### Mandatory:

- ▶ Pump swivel angle
- ▶ Pump pressure

##### Optional:

- ▶ Load pressure
- ▶ Engine speed



## 5 Functional safety considerations

eOC BODAS pump control library transfers hydro-mechanical pump control functions into software. Therefore, no safety functions are foreseen or implemented. This assumption has to be confirmed by the system design in combination with safety requirements derived from a hazard analysis and risk assessment.

Safety functions for safety relevant movements must still be realized within the hydraulic circuit, independently of the pump behavior.

For further questions concerning safety, or if the pump control function shall be part of a safety function, please contact your Bosch Rexroth sales representative.

## 6 Project engineering and ordering information

### 6.1 Ordering code

01	02	03
ASlib	-	eOC 100

Type		
01	Application software	ASlib
Function		
02	The functional scope is specified. It covers a superset of all functions described in this data sheet.	eOC
Release		
03	Variant number of the software	100

**Note**

The eOC BODAS pump control library will be delivered via the myRexroth platform or in another mutually agreed way.

### 6.2 eOC prototype starter kits and reference

In order to generate a functional reference at the machine, it is highly recommended to apply the ASRun product (data sheet 95345) of the eOC pump control function in the target machine and design the wiring harness in a way that the SRC-eOC control unit and the target control unit for series can be easily exchanged. With this approach, the root cause analysis of integration issues is facilitated. The concept is described in detail in the integration guide.

### 6.3 Project engineering

For integration support or training, please get in touch with your Bosch Rexroth sales representative.

### 6.4 Project specific parameters

In the target application it is required to calibrate and optimize software parameters for the eOC BODAS pump control library function. Some parameters are related to the used target pump some of them depend on the required control mode, some of them are related to the project specific communication and some of them need to be optimized to reach the desired (dynamic) machine behavior.

The process to find these parameters is described in a **Calibration Guide** which can be requested from the responsible sales representative.

Bosch Rexroth offers support to calibrate the eOC BODAS pump control library software in the target application on demand.

## 6.5 Documents and tools container

To assist in handling the product properly, a documents and tools container contains provide useful files and documentation:

- ▶ Test specification example file for approval test
- ▶ Integration guide
- ▶ Calibration guide

The complete list of container contents are summarized in Chapter 7.

The documents and tools container is provided upon request via [Info.Bodas@boschrexroth.de](mailto:Info.Bodas@boschrexroth.de)  
Please use the following subject for your e-mail request:  
“Container request: ASlib-eOC100”

Please also provide the following information:

- ▶ Company name
- ▶ Contact person
- ▶ E-mail address

## Relevant part numbers for adjacent electronic components that can be used for equipping a reference machine

All electronic components must be ordered separately. Please find below list of required part numbers.

Components	Part number	Plant	Data sheet
Lab starter kit eOC (for prototypes)	R917014438	Homburg	95345
Machine starter kit (for prototypes)	R917015295	Homburg	95484
SRC-eOC + ASrun-eOC100 <sup>1)</sup>	R917014452	Homburg	95207
PR4 SENT	see data sheet for detailed configuration	Homburg	95156
Connector kit RC5-6/40 (only connector)	R917010843	Homburg	95207
Connector kit RC5-6/40 incl. wiring 1.5 m	R917013283		
Connector kit PR4	R917009890	Homburg	95156
Connector kit SWS20 angle sensor	R902603524	Homburg	95153 / 95150
Connector kit EC4/EB4	R902601804	Homburg	pump data sheet
Connector kit PAL angle sensor			

<sup>1)</sup> Included in Starter Kit

## 7 Valid standards and additional documentation

### ▼ Valid standards

Additional documents explaining normative and project-specific regulations are listed in the following tables.

Document	
Standard DIN ISO 13849-1:2006-11	Safety of machinery – Safety-related parts of control systems
Standard DIN ISO 13849-2:2012-10	Part 1: General principles for design Part 2: Validation
SAE J2716 January 2010	Single Edge Nibble Transmission (SENT) protocol

### ▼ Additional relevant documents in container of chapter 6.5

Document	
Projecting Guideline	Projecting information regarding pump types, sizes, hardware configuration and application hints
Calibration guide	Step by step support information to optimize the software parameters for the eOC BODAS pump control functions
Integration guide	Instruction how to integrate the library function into the control unit

### ▼ Compatible Rexroth products

Document	Data sheet	Comments
Axial piston variable pump A10VO series 31	92701	with eOC pump valve (EC4) and swivel angle sensor configuration
Axial piston variable pump A10VO series 32	92705	with eOC pump valve (EC4) and swivel angle sensor configuration
Axial piston variable pump A10VO series 60	92706	with eOC pump valve (EC4) and swivel angle sensor configuration
Axial piston variable pump A10VO series 52/53	92703	with eOC pump valve (EC4) and swivel angle sensor configuration
Axial piston variable pump A11V(L)O series 1x	92500	with eOC pump valve (EC4) and swivel angle sensor configuration
Axial piston variable pump A15V(L)O series 12	92512	with eOC pump valve (EC4) and swivel angle sensor configuration
Axial piston variable pump A20V(L)O series 1x	93100	with eOC pump valve (EC4) and swivel angle sensor configuration
BODAS pressure sensor PR4	95156	PR4 420 XX B SE/10   PR4 280 XX B SE/10
Hall-effect swivel angle sensor SWS series 20	95153	Sensor to be specified for A10VO and A11VO pumps
Hall-effect swivel angle sensor SWS20 series 06	95150	Sensor to be specified for A15VO pumps
BODAS Hall-effect angular or linear position sensor PAL	95161	New platform sensor, successive availability for various pump types and sizes
Rexroth control unit SRC-eOC series 40	95207	RC5-6/40 Note: The control unit SRC-eOC series 40 is technically identical with a reduced number of available in- and outputs. Therefore, this document is applicable as valid hardware data sheet.
BODAS-service 4.x	95087	BODAS service tool
BODAS-service connection cable	95087	Wiring harness to establish CAN communication to BODAS-service
BODAS measuring adapter MA6	95090	For checking of wiring harness
CAN-USB interface	95087	Device to establish the CAN communication between RC and PC
Diagnostics socket	95087	

## 8 Abbreviations

Abbreviation	Meaning
BODAS	Bosch Rexroth digital application solutions
CAN	Controller area network
DIN	Deutsches Institut für Normung (German Institute for Standardization)
ECU	Electronic control unit
eOC	Electronic open circuit
GCC	GNU Compiler Collection
ISO	International organization for standardization
OEM	Original equipment manufacturer
PC	Personal computer
PKCS	Public-Key Cryptography Standards
PWM	Pulse-width modulation
RC	Rexroth control unit
RSA	Rivest–Shamir–Adleman
SAE	Society of automotive engineers
SENT	Single edge nibble transmission
SRC	Special Rexroth control unit

## 9 Security information

### General terms of Product security

Security relates to enforcing policies to prevent changes in systems by unauthorized personal.

### Security elements

The eOC BODAS pump control library is executed on a control unit that is not part of the Bosch Rexroth supply. Since there are no external reachable interfaces to the library, there are no security elements relevant. Ensuring security measures is not in responsibility of Bosch Rexroth.

## 10 Safety instructions

- ▶ THE SOFTWARE represents a safety element out of context (SEooC). The machine manufacturer must verify whether it is the right product for the specific 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 THE SOFTWARE in a specific application.
- ▶ The machine manufacturer bears responsibility for applying the valid safety standards at the machine level.
- ▶ The machine manufacturer is responsible for fulfilling all safety requirements at the hydraulic circuit and machine level.
- ▶ The machine manufacturer is responsible for validating the machine-specific configuration of THE SOFTWARE.
- ▶ Configurations of THE SOFTWARE used for serial production must be validated.
- ▶ The proposed circuits 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.
- ▶ 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 dangers of this type.
- ▶ The application software must be installed and removed only by Bosch Rexroth or an authorized partner to pre-serve 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 great damage to property.
- ▶ System developments, installations and commissioning of electronic systems for controlling hydraulic circuits 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 when using the product.

#### **Intended use**

- ▶ The eOC BODAS control unit library is designed for use in mobile working machines provided no limitations/restrictions are made to certain application areas in this data sheet.
- ▶ Use outside of the specified and released boundary conditions may result in hazard to persons and/or cause damage to components which could result in sequential damage to the mobile working machine.

#### **Improper use**

- ▶ Damage resulting from improper use and/or from unauthorized interference in the component not described in this data sheet render all warranty and liability claims void with respect to the manufacturer.

#### **More detailed information**

- ▶ Observe the operating instructions for the product.
- ▶ The safety measures are to be observed.
- ▶ In addition, the application-specific documents (integration guide, calibration guide) are to be observed.
- ▶ Pay regular visits to our home page for the latest product information and information about updates.
- ▶ Copying, translation and distribution of Bosch Rexroth software is prohibited under copyright law.

## **11 Scope of license**

Additionally to the general terms and conditions attached in the Bosch Rexroth quoting process, the following conditions apply:

1. The eOC BODAS pump control library is technically predicted and therefore foreseen in conjunction with the Bosch Rexroth hydraulic open loop pump A10, A11, A15.  
The use in combination with other products is technically unpredicted and therefore not foreseen from Rexroth side.
2. Since the eOC BODAS pump control library allows a huge variety of features that are license relevant, the license cost has to be agreed upon upfront via Bosch Rexroth offer and ordering process. Usage without order is not permitted.
3. The way of delivery is to be defined between Bosch Rexroth and the customer. Successful transfer has to be documented on both sides.
4. It is customer's responsibility to test integration and/or configuration as defined in the integration guide.
5. The machine function validation for any series release is in responsibility of the customer since the machine behavior is influenced by the software and hardware of the target control unit as well as by other machine components like the main control valve, the hydraulic architecture and the machine kinematics. The parameter values provided by Bosch Rexroth are always starting point for calibration and never shall be used for series without further calibration and or validation.
6. Developing of functions for cycle / test recognition in relation to or based on the eOC BODAS pump control library is not permitted.

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