rexroth
A Bosch Company

User manual

CAN-Bus
user manual for On Board Electronic (OBE)

RE 18301-34/2025-01, EN

An example configuration is shown on the title page. The product delivered may therefore differ from that shown.

Contents

1 Introduction

1.1 Document scope

This document describes the requirements for the implementation of CAN bus communication feature on the On Board Electronics (OBE) actuator for EDG.

The reference standards for the CAN bus implementation are SAE-J1939 and IsoBus (ISO-11783).

1.2 Acronyms used

Acronyms	Description
OBE	On Board Electronic
CDV	Compact Directional Valve
PDU	Protocol Data Unit
ECU	Electronic Control Unit

1.3 Standards used

- International Organization for Standardization:
  - ISO 13766-1/2 Earth moving machinery, Electromagnetic compatibility.
  - ISO 14892 Forest and agriculture
  - ISO 13849 Safety of Machinery
  - ISO 11783 Tractors and machinery for agriculture and forestry - Serial control and communications data network (ISOBUS)
- Conformity with ROhs and REACH directives.

2 CAN BUS implementation

2.1 Reference Standard and available CAN-BUS message

Reference Standard: SAE J1939.
The following CAN bus messages are available:

Description	PGN	PGN (hex)	Notes
AUXILIARY VALVE COMMAND, RX	65072 ÷ 65087	FE30h ÷ FE3Fh	
ESTIMATED FLOW, TX	65040 ÷ 65055	FE10h ÷ FE1Fh	
PROPRIETARY A, RX	61312 ÷ 61327	EF80h ÷ EF8Fh	Available only for NodeID change
PROPRIETARY A, TX	61184 + Destination Address (DA)	EF00h + Destination Address (DA)	Available only for NodeID change
DM1, TX	65226	FECAh	
REQUEST PGN GLOBAL, RX	59904	EAFFh	
REQUEST PGN INDIVIDUAL, RX	60032 ÷ 60047	EA80h ÷ EA8Fh	
ADDRESS CLAIM, TX/RX	60928	EE00h	
SW IDENTIFIER, TX	65242	FEDAh	
COMPONENT IDENTIFIER, TX	65242	FEEBh	

2.2 Physical Layer

- Reference: SAE J1939-11.
- Bus Speed: 250 kbit/s.
- Frame Format: CAN 2.0B (29-bit identifiers).
- Termination resistors: not present in the OBE (two 120 Ω resistors must be provided externally).

2.3 Source Address

- The Source Address (SA) is factory set at the value of 80h.
- The Source Address (SA) depends on the Node ID of the unit: SA = 80h + NodeID.
- The NodeID (and therefore the SA) can be modified using the appropriate PARAMETER message.
- Valid NodeID range is from 0 to 15 (max number of OBE modules is 16).
- OBE unit do not support dynamic addressing.

The J1939 address claiming protocol is supported: if a different node on the J1939, bus claims the same source address and has the same NAME field, the OBE module stops communicating on the CAN-BUS to avoid conflicts.

2.4 Destination Address

The Destination Address (ECU address) is factory set at the value of 34 (22hex).

3 Software machine state

The OBE device operates in two distinct modes: **Configuration Mode** and **Run Mode**. These modes define the behavior of the device in terms of how it handles CAN bus messages, configuration changes, and operational control tasks.
Understanding the function and transition between these two modes is essential for proper configuration and operation of the OBE.

3.1 Run Mode

Run Mode is the standard operational mode of the OBE.
In this mode, the device executes its primary functions including:

- processing control commands;
- sending diagnostic information.

Key Features of Run Mode:

- **Control of Hydraulic Functions:** In **Run Mode,** the OBE processes valve commands, such as the Auxiliary Valve Command (AVC) (see 2.1), which directly control the movement and flow of hydraulic systems;
- **Diagnostic Reporting:** The OBE sends operational data and fault reports to the network, including messages like Auxiliary Valve Estimated Flow (AVEF) (see 2.2) and Diagnostic Message 1 (DM1) (see 2.4), which provides fault information.
- **Fixed Node ID:** The device operates with a preset Node ID (ranging from 0 to 15 included), which identifies it on the CAN bus network. **The Node ID is critical for proper communication and must be unique within the network.**

Behavior in Run Mode:
- The device does not accept configuration commands in Run Mode;
- Any changes to the Node ID, require switching to Configuration Mode (see 1.2);
- The OBE stays in Run Mode indefinitely, unless explicitly transitioned to **Configuration Mode** through a specific command.

3.2 Configuration Mode

Configuration Mode is used for modifying the configuration of the OBE.
In this mode, the device temporarily halts its operational tasks and allows the user to update the Node ID.

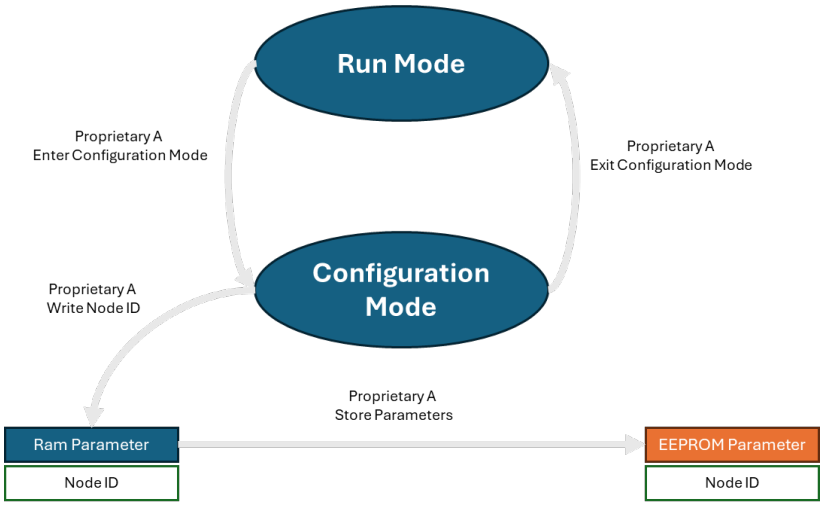
NOTE: OBE NODEID CHANGE IS THE ONLY MODIFICATION ALLOWED BY ENDUSER.

Configuration Mode is accessed through specific commands sent to the device via the Proprietary A (see 2.3) message, which enables modifications that cannot be made in Run Mode.

Key Features of Configuration Mode:

- **Parameter Modification:** Configuration Mode allows the user to change the Node ID, which determines how the OBE interacts with other devices on the CAN bus network;
- **Message Processing:** Only certain messages are accepted while in Configuration Mode, including Write Node ID, Store Parameters, and other configuration-specific commands;
- **No Operational Tasks:** While in Configuration Mode, the OBE does not process control commands or send operational diagnostic data, as it is dedicated solely to updating its internal settings;
- **Temporary State:** Configuration Mode is intended to be a temporary state. Once the required settings have been updated, the device must exit Configuration Mode and return to Run Mode to resume its normal functions.

The following diagram shows the two Modes:



4 Messages description

In this paragraph, a brief description of the main messages is provided.

4.1 Auxiliary Valve Command – AVC (Rx) (RUN MODE)

OBE actuators use the standard AVC (Auxiliary Valve Command) to receive the control set point.

ISO-11783 specification defines AVC message.
Repetition rate: defined by the controlling ECU (typical 100ms, recommended minimum Tx = 10ms, recommended maximum Tx = 250ms (AVC Timeout /2, where AVC timeout is equal to 500ms).

The AVC message standard layout is shown in the following picture:

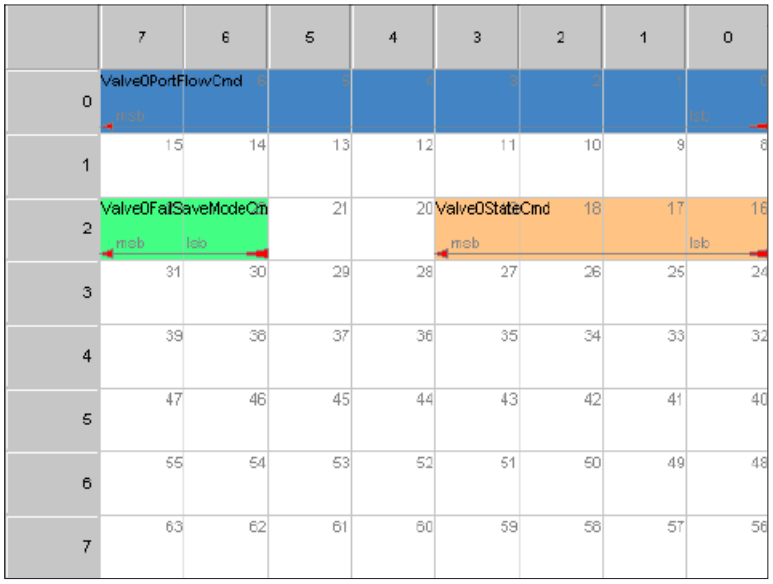


Fig. 1: Auxiliary Valve Command - Structure

Name	Description
Valve0PortFlowCmd	0% to 100%, 0.4%/bit, 0% offset (0→0%, 1→0.4%, 250→100%; >250 not valid)
Valve0StateCmd	0x0 Block (neutral) 0x1 Extend 0x2 Retract 0x3 Float 0xF Reserved
Valve0FailsafeModeCmd (not supported)	0x0 Block (neutral) 0x1 Float 0x2 Error 0x3 Not available

Table 1 Auxiliary Valve Command - Fields description

4.2 Auxiliary Valve Estimated Flow – AVEF (Tx) (RUN MODE)

OBE actuators use the standard Estimated Flow message to send the current estimated flow.

AVEF message is defined in ISO-11783.
Repetition rate: 100ms.

The AVEF message standard layout is shown in the following picture:

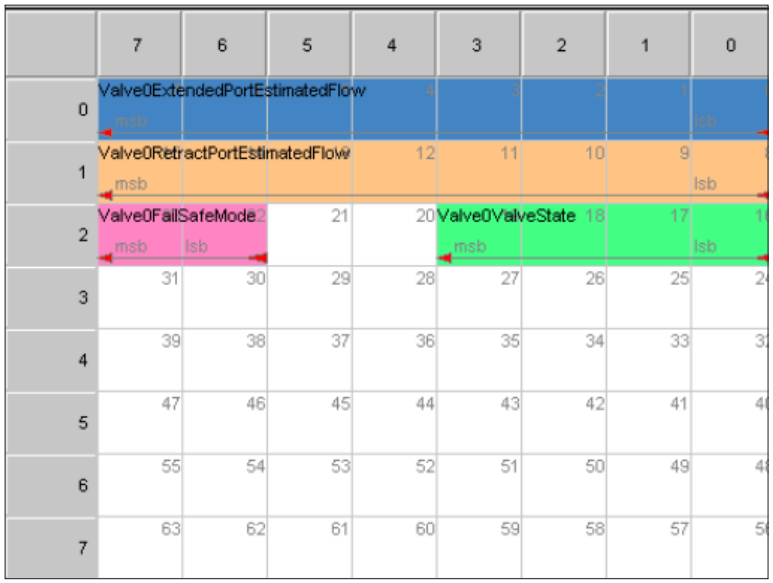


Fig. 2: Auxiliary Valve Estimated Flow - Structure

Name	Description
Valve0ExtendPortEstimatedFlow	-125% to 125%, 1%/bit, -125% offset (25→-100%, 125→0%, 225→100%; >250 not valid)
Valve0RetractPortEstimatedFlow	-125% to 125%, 1%/bit, -125% offset (25→-100%, 125→0%, 225→100%; >250 not valid)
Valve0ValveState	0x0 - Block (neutral) 0x1 - Extend 0x2 - Retract 0x3 - Float 0xF - Don’t care
Valve0FailsafeMode	0x0 - Block (neutral) default value 0x1 - Float 0x2 - Error 0x3 - Not available

Table 2 Auxiliary Valve Estimated Flow - Field description

4.3 Proprietary A (Rx, Tx) (CONFIGURATION MODE)

The Proprietary A message, defined by the SAE-J1939 standard, is used by OBE actuators to send and receive proprietary data on the CAN bus network.
This message enables several key functions, such as writing, and storing configuration parameters, including the modification of the Node ID.

NOTE: OBE NODEID CHANGE IS THE ONLY MODIFICATION ALLOWED BY ENDUSER.

It operates in both transmission (Tx) and reception (Rx) directions, with the message structure varying based on the Command field (data byte 0).

Proprietary A Transmission (Rx):

- **Direction:** Sent from ECU to OBE
- **PGN:** 0xEF00
- **Destination Address:** 0x80 + Node ID
- **Source Address:** Any

PGN	DST	SRC	DATA0	DATA1... DATA7
EF00h	80h + NodeID	Any	Command (Table 3)	PDU

Proprietary A Reception (Tx):

- **Direction:** Sent from OBE to ECU
- **PGN:** 0xEF00
- **Destination Address:** Any
- **Source Address:** 0x80 + Node ID

PGN	DST	SRC	DATA0	DATA1... DATA7
EF00h	Any	80h + NodeID	Command (Table 3)	PDU

Summary of Proprietary A Message:

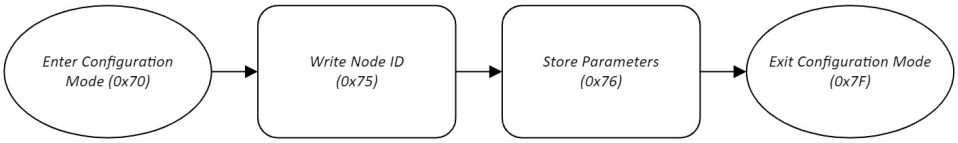
Command		
Name	Value	Description
Enter Configuration Mode	70h	Changes the OBE device state from Run Mode to Configuration Mode.
Exit Configuration Mode	7Fh	Transitions the OBE device back to Run Mode after configuration changes have been made.
Write Node ID	75h	Allows modification of the Node ID on the CAN bus network (enabled only in Configuration Mode)
Store Parameters	76h	Saves the new Node ID and configuration changes to non-volatile memory (enabled only in Configuration Mode)

Table 3 Command coding

4.3.1 Sequence of Commands

The typical command sequence for configuring the OBE might include:

1. Enter Configuration Mode (0x70) to initiate configuration.
2. Write Node ID (0x75) to update the device's Node ID (if needed).
3. Store Parameters (0x76) to permanently save changes in non-volatile memory.
4. Exit Configuration Mode (0x7F) is sent to conclude the configuration session and return the device to normal operation.



4.3.2 ENTER CONFIGURATION MODE command (0x70):

The Enter Configuration Mode command is a critical initial step for modifying the Node ID parameter of the OBE device.
By sending this command, the OBE switches from Run Mode to Configuration Mode.

Importance in Message Sequence: If the target is to change the Node ID, the Enter Configuration Mode command must be the first message sent to the OBE.

This command enables the device to accept configuration changes, ensuring that subsequent commands related to the Node ID parameter is processed correctly.

If any commands to change the Node ID are sent while the device is still in Run Mode, they will be ignored, as the OBE will not accept such changes until it is in Configuration Mode.

Proprietary A Rx Message Structure:

PGN	DST	SRC	DATA0	DATA1... DATA7
EF00h	80h + NodeID	Any	Command	PDU
			70h	FFh

Note: This command requires a response from the OBE, which will be sent via a Proprietary A Tx message

Proprietary A Tx Message Structure:

PGN	DST	SRC	DATA0	DATA1... DATA7
EF00h	80h + NodeID	Any	Command	PDU
			70h	FFh

4.3.3 WRITE Node ID command (0x75):

The Write Node ID command is essential for modifying the Node ID of the OBE device on the CAN bus network.

This command can only be executed while the OBE is in Configuration Mode, which must be entered first using the Enter Configuration Mode (0x70) command.

The Node ID is a 4-bit identifier, which means it can take values between 0 (0x0) and 15 (0xF); it uniquely identifies the OBE on the CAN bus network and changing it will affect how the OBE interacts with other devices, particularly for message transmission and reception during Run Mode.

Modifying the Node ID has a direct impact on the following key messages in Run Mode:
- Auxiliary Valve Command (AVC);
- Auxiliary Valve Estimated Flow (AVEF);
- Diagnostic Message 1 (DM1)

Write Node ID Request Message Structure:

PGN	DST	SRC	DATA0	DATA1	DATA2	DATA3... DATA7
EF00h	80h + NodeID	Any	Command	ParamID	Node ID	PDU
			75h	13h	New Value	FFh

Write Node ID Answer Message Structure:

PGN	DST	SRC	DATA0	DATA1	DATA2	DATA3... DATA7
EF00h	Any	80h + NodeID	Command	ParamID	Node ID	PDU
			75h	13h	New Value	FFh

When the OBE receives the Write Node ID command, it will process the new Node ID and confirm the change by sending an acknowledgment message via Proprietary A Tx.
This acknowledgment will echo the new Node ID, confirming that the modification was successful.
To finalize the change, the Store Parameters (0x76) command should be sent, saving the new Node ID to non-volatile memory so that the change persists across power cycles.

4.3.4 STORE PARAMETER command (0x76):

The Store Parameters command is critical for saving configuration changes made to the OBE, such as the Node ID, to the device's non-volatile memory. This ensures that any updates persist after the device is powered off or restarted.

The Store Parameters command can only be issued while the OBE is in Configuration Mode and is typically used following commands that modify configuration values, such as Write Node ID (0x75).

The primary function of the Store Parameters command is to secure any configuration changes made during the session. Without executing this command, modifications like the new Node ID will be temporary, and the device will revert to the previous settings once it is restarted.

Store Parameters Request Message Structure:

PGN	DST	SRC	DATA0	DATA1... DATA7
EF00h	80h + NodeID	Any	Command	PDU
			76h	FFh

Store Parameters Answer Message Structure:

PGN	DST	SRC	DATA0	DATA1... DATA7
EF00h	Any	80h + NodeID	Command	PDU
			76h	FFh

Upon receiving the Store Parameters (0x76) command, the OBE will store the Node ID into its non-volatile memory.
After storing the parameters, the OBE sends a confirmation response back to the ECU using the Proprietary A Tx message. This acknowledgment confirms that the new parameter is successfully stored.

After the parameters are stored, it is recommended to send the Exit Configuration Mode (0x7F) command to return the OBE to Run Mode.

4.3.5 EXIT CONFIGURATION MODE command (0x7F)

The Exit Configuration Mode command is used to return the OBE (On-Board Electronics) device from Configuration Mode back to its standard Run Mode.

This command effectively concludes the configuration session and transitions the device into operational mode, where it can perform its regular tasks, after sending Exit Configuration Mode, the OBE resumes regular CAN bus communication, such as processing commands for controlling valves or sending diagnostic messages (e.g., Auxiliary Valve Command, Estimated Flow, DM1).
Exit Configuration Mode is typically the last command sent in a configuration session. It should only be issued after executing other configuration commands, such as Write Node ID (0x75) (see 2.4.3) and Store Parameters (0x76) (see 2.4.4), to ensure all changes are finalized and saved.
Once in Run Mode, the OBE will no longer accept configuration commands, therefore, the device must be in Configuration Mode for any changes to be made, and only when all updates are complete should this command be issued.

Exit Configuration Mode Request:

PGN	DST	SRC	DATA0	DATA1... DATA7
EF00h	80h + NodeID	Any	Command	PDU
			7Fh	FFh

Unlike other configuration commands, such as Write Node ID (0x75) or Store Parameters (0x76), the Exit Configuration Mode command (0x7F) does not expect or trigger any acknowledgment or response from the OBE.
The device simply transitions back to Run Mode upon receiving the command.

4.4 Diagnostic Message 1 - DM1 (Tx) (RUN MODE)

The **DM1** (Diagnostic Message 1) is one of the key diagnostic messages used in the SAE J1939 protocol for managing faults.
This message is transmitted by an OBE to signal the presence of active faults detected during system operation.
Repetition rate: 1s.

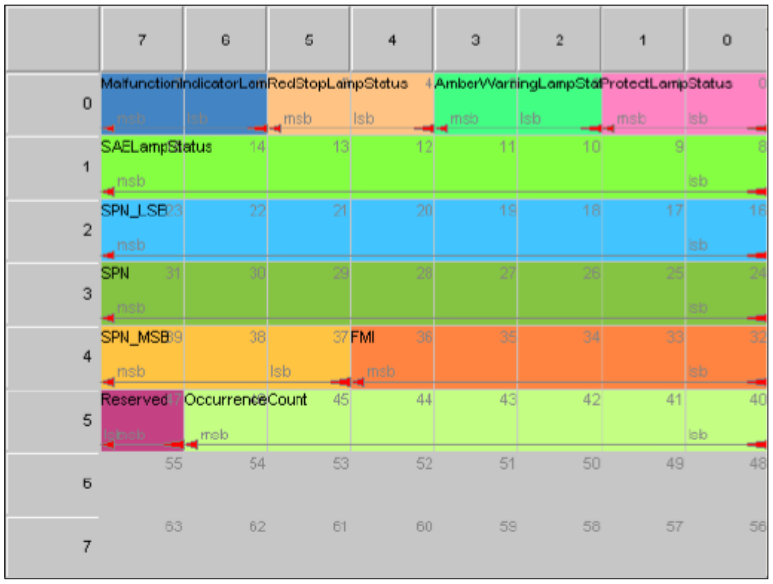


Fig. 3: DM1 - Structure

Name		Description
MalfunctionIndicatorLamp	L1	A lamp used to relay only emissions-related trouble code information
RedStopLampStatus	L2	This lamp is used to relay trouble code information that is of a severe enough condition that it warrants stopping the vehicle: 0x00 – Off 0x01 - On
AmberWarningLampStatus	L3	This lamp is used to relay trouble code information that is reporting a problem with the vehicle system, but the vehicle need not be immediately stopped. 0x00 – Off 0x01 – On
ProtectLampStatus	L4	This lamp is used to relay trouble code information that is reporting a problem with a vehicle system that is most probably not electronic subsystem related. 0x00 – Off 0x01 – On
SAELampStatus	FL	Malfunction (bit 6,7), Red Stop (bit 4,5), Amber warning (bit 2,3) , Protect (bit 0,1)flash lamp status 0x00 – Off 0x01 - Flashing
SPN	SPN	This 19-bit number is used to identify the item for which diagnostics are being reported. SPN_LSB field contains BIT0-7 of SPN Code SPN field contains BIT8-15 of SPN code. SPN_MSB contains BIT16-18 of SPN code
FMI	FMI	The FMI defines the type of failure detected in the subsystem identified by an SPN
Reserved		This bit is set to 1 to be complaint to J1939-73
OccurenceCount		The 7-bit occurrence count field contains the number of times a fault has been independently detected; this feature is not supported by OBE. Data range: 0 to 126 (the value 127 is reserved for indicating not available)

Table 4 DM1 - Fields description

Currently displayed alarms are:

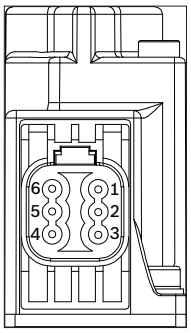
Fault Name	Alarm Description	Action	SPN	FMI	L1	L2	L3	L4	Fl1	Fl2	Fl3	Fl4
CKS	Flash checksum verification failed	A	612	31	0	0	0	1	0	0	0	0
LVDT	Position Transducer fault	A	614	7	0	0	0	1	0	0	0	0
SPOOL_NOT_N	Spool not in neutral at power on	B	614	8	0	0	0	1	0	0	0	0
WAIT_N	Waiting for neutral set point (warning)	C	0	0	0	0	0	0	0	0	0	0
NOT_CAL	Valve has never been calibrated (warning)	D	0	0	0	0	0	0	0	0	0	0
NO_MESSAGE	No Control message received for at least 500ms	A	611	9	0	0	0	1	0	0	0	0
ERR_MESSAGE	Implausible control message for at least 505ms	E	611	2	0	0	0	1	0	0	0	0
VBATT_LOW	under voltage (< 9V)	A	615	17	0	0	0	1	0	0	0	0
VBATT_HIGH	overvoltage (> 30V)	E	615	15	0	0	0	1	0	0	0	0
SPOOL_LOW	Spool deflection too short	F	614	17	0	0	0	1	0	0	0	0
SPOOL_HIGH	Spool deflection excessive	F	614	15	0	0	0	1	0	0	0	0
SPOOL_NOT_F	Spool does not reach float position	F	614	1	0	0	0	1	0	0	0	0
SPOOL_NOT_N	Spool does not reach neutral position	A	614	8	0	0	0	1	0	0	0	0
SPOOL_STUCK	Spool is not neutral position during start-up	A	614	8	0	0	0	1	0	0	0	0
EE_WRONG	Non-consistent EEPROM values	A	612	31	0	0	0	1	0	0	0	0

Action Letter	Description
A	Piloting electro-valves are switched off
B	Wait for neutral spool and command
C	Wait for neutral set point
D	Work with default calibration values
E	Go to failsafe
F	Go to neutral

5 Technical data

Hydraulic		
Maximum supply pressure	Bar	35
Operating pressure	Bar	12÷35
Maximum back pressure	Bar	20
Oil temperature range	°C (°F)	–30....+90 (-22....+194)
Oil viscosity range	cSt	3÷650
Oil filtration		18/15/10 (ISO 4406)
Electronic		
Operating voltage	Vdc	8.5÷30VDC
Mounting position		On machine's chassis (grounded connected)
Ambient temperature range	°C (°F)	–30....+90 (-22....+194)
Input signal		CAN bus SAE J1939
Analog 0÷5V		
Status signal		CAN bus SAE J1939
Analog 0÷5V (spool position)		
Node ID		0 (adjustable)
Environmental protection level		IP69K
Connector type		DT04-6P MALE DEUTSCH
Pin assignment on the connector		See below
CE mark according to machine directive		Conformity according to EMC directives above mentioned

DT04-6P	Protection class: IP 69K with connector properly fitted.



DT04-6P MALE DEUTSCH
Connector-Pin OUT

Pin	D/C0 VER.
1	+V (Power Supply)
2	CAN-L
3	N.C. (Pos. feedback)
4	N.C. (Analog IN)
5	CAN-H
6	-V (Ground Power Supply)

NOTE
If the unit is used out of specification, please consult factory.
This OBE module is NOT a safety device by itself.
Not sold separately.

6 End of life disposal

The valve with OBE must be disposal as industrial product and must applied local disposal for industrial products.

7 Required and supplementary documentation

- Only commission the product if the documentation marked with the book symbol 🕮 is available to you and you have understood and observed it.

Required and supplementary documentation

	Title	Document number	Document type
🕮	CDV catalogue Contains the necessary basic information for installation and dimensions	RE18300-30	Standard usage

Related documents can be found in the manuals listed above and obtained where necessary via:
`www.boschrexroth.com/mobile-hydraulics-catalog`

⚠ WARNING

Not applying to the Operational Conditions can compromise safety.
All uses outside this manual and related document is not allowed.
Depending on CDV variant, age and software there are variations in communication and control. Read this technical information before implementing new CDV with spool sensor in applications.
A CDV with OBE can only perform according to the present descriptions if conditions in this Technical Information are met.
In particularly environmental exposed applications with OBE, protection in the form of a shield is recommended.
Deviation from recommended torque when mounting parts can harm performance and module.
All brands and all types of directional control valves – including proportional valves – can fail and cause serious damage. It is therefore important to analyze all aspects of the application. Because the proportional valves are used in many different operation conditions and applications, the machine builder/ system integrator alone is responsible for making the final selection of the products – and assuring that all performance, safety and warning requirements of the application are met.
When replacing CDV with OBE, the electrical and the hydraulic systems must be turned off and the oil pressure released.
Protect persons and environment against oil spill. Hydraulic oil can cause both environmental damage and personal injuries.
Valve with OBE replacement can introduce contamination and errors to the system. It is important to keep the work area clean and components should be handled with care.
When the OBE is in a value of fault, it’s user responsibility to arrive in a safety condition in the sorter time.

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Subject to change
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