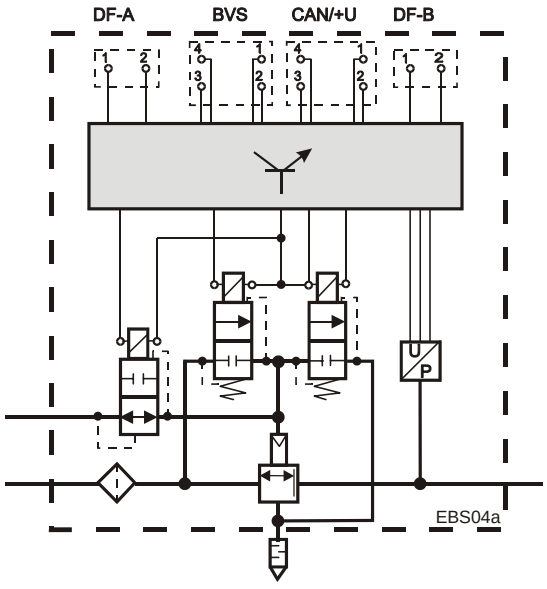
# Electronic Brake System EBS

*Trucknology Generation A (TG-A)*

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**MAN Steyr AG**
**SERVICE AKADEMIE / VNSA**

**This document is intended exclusively for use in training and is not subject to the routine amendment service.**

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## Description of the system

### Electronic Brake System (EBS)

EBS refers to the entire electronic brake system incorporating the following subfunctions:

| | |
|---|---|
| **E P B** | **E**lectro **P**neumatic **B**rake |
| **A B S** | **A**nti-lock **B**rake **S**ystem |
| **A S R** | **A**nti-**S**pin **R**egulator |

**EBS** comprises a purely pneumatic dual-control circuit and an overlaid electro-pneumatic single-control circuit. The structure of the underlaid pneumatic dual-control circuit is essentially the same as that of a conventional brake system.
Electronic brake pressure regulation is backed up by a pneumatic control circuit (back-up circuit) which is automatically activated in the event of electrical failure.
The parking brake is a conventional, mechanically actuated system with pneumatic signal transmission.

### Explanation of subfunctions

**EPB** executes the electronic brake pressure control. Without ABS, this continues until full pressure modulation. Auxiliary functions influence electronic brake pressure control, resulting in variable brake pressure distribution across the brake cylinders.

**ABS** regulates the brake pressure if the wheels start to lock and deactivates the sustained-action brake.

**ASR** regulates the brake pressure on driven axles if the wheels start to spin and/or reduces the engine power.

## Features of EBS for commercial vehicles

- Conventional parking brake system: Mechanically actuated, with pneumatic signal transmission.
- Service brake system: Electronically controlled by the single-circuit vehicle electrical system, with dual-circuit pneumatic back-up circuit.
- 24 Volt vehicle electrical system
- Reservoir pressure up to 12.5 bar
- Brake cylinder pressure up to 10 bar
- Pneumatic dual-line brake system with conventional trailer control module.
- 7-pole electrical plug connection to DIN ISO 7638 between tractor and trailer.
- EBS control unit with CAN data transfer

  General CAN: EBS control unit to other systems in the truck

  Trailer CAN: EBS control unit, tractor/trailer to DIN ISO 7638

  Brake CAN: EBS control unit to pressure control modules in the tractor and trailer
- Single-channel pressure control modules with integral electronic control unit for front axle, mounted near the wheels.
- Dual-channel pressure control module with integral electronic control unit for rear axle, mounted near the wheels.
- Trailer control module for electronic regulation with conventional trailers
- Speed sensors and brake pad wear sensors are connected to the pressure control unit.
- ASR function with brake and engine regulator (via general CAN)
- Additional functional switches (e.g. ASR spin threshold increase)
- Automatic load-dependent brake (ALB) integrated in electro-pneumatic brake system.
- EOL-programmable system configuration and pressure curves based on individual optimisation criteria.
- Coupling force regulation (in conjunction with trailer control module only)
- Brake pad wear regulation, front / rear.
- Brake pad wear indicator
- Diagnosis via diagnostic connector X200 with MAN_Cats II

## Electronic Brake System (EBS)

The EBS (electronic brake system) helps you keep better control of the vehicle in critical situations such as bad weather, slippery roads, downhill gradients, tight curves or obstacles that suddenly appear.

The EBS controls the compressed air in the brake cylinders of the brake system by means of the pressure control module solenoid valves. The EBS control unit co-ordinates the signals from the service brake valve and pressure control modules.

The brake pressure signals – now electrical signals – are transmitted to all the pressure control modules and to the trailer control module via the CAN databus.

The electronically controlled brake pressure build-up and reduction allows fast and simultaneous braking on all axles as well as quick release of the brake. This set-up optimises the braking effect on all wheels whilst the more uniform pad wear results in brake pad lifetimes that are up to 20% longer.

If the entire tractor-trailer unit is fitted with EBS, the coupling force regulation considerably reduces the push and pull forces on the drawbar and the centre pin.

The pneumatic control circuit (back-up circuit) automatically ensures safe braking of the vehicle in the event of electronic brake pressure control failure.

Trailers with EBS are electrically controlled by a separate databus and, at the same time, pneumatically controlled by the trailer control module.

The EBS control unit co-ordinates all the higher-level functions such as brake management with ABS, ASR and the automatic load-dependent brake (ALB).

Components fitted next to each other (sensors, valves, electronic control unit) form a single assembly, the pressure control module.

**Basic electro-pneumatic concept**

The EBS is based on a conventional dual-circuit service brake system. There is a dual-line compressed air connection – with supply line and control line – between the tractor and trailer.

The electronic brake system is applied on the basic brake. The tractor and trailer are electrically connected via the 7-pole socket to ISO 7638. If the electric part of EBS is not active or faulty, the service brakes operate through the safe “pneumatic back-up brake circuit

**Electronic control redundancy (info.)**

The computer core (in the control unit) contains two redundantly arranged microcontrollers (µC).

The control unit performs a self-test after the ignition is switched “ON”. Each pressure control module is then individually controlled by both microcontrollers and energised. Communication via the CAN databus is then initiated. The control unit recognises the installation position of the pressure control modules in the EBS from the switching sequence. This means that the pressure control units can be activated or deactivated as necessary. The chassis earth of the pressure control modules from the power supply is routed into the control unit for monitoring and for warning lamp activation redundancy.

The brake value sensor sends an electrically redundant signal to the EBS control unit. Electric braking is only initiated if both signals indicate that activation is permitted.

The input signals from the brake value sensor and from other components in both microcontrollers are processed in the EBS control unit. The results are then compared. If this comparison proves positive, one of the microcontrollers informs each pressure control module or pair of pressure control modules about the individually applied brake pressure via the CAN databus. One of the microcontrollers records and both of the microcontrollers check the CAN databus status signals.

## Communication between EBS and CAN databus

This is how EBS works with the CAN databus:
Sensors which measure speed and brake pad wear on the wheels are directly connected to the pressure control modules. The electronic control unit integrated in the pressure control module processes and conditions all the information. The pressure control modules communicate with the EBS control unit via the CAN databus.
Higher-level sensor functions such as axle load – which are in the control unit – are used for all brake pressure control circuits as well as for other systems such as ECAS (electronically controlled air suspension). As soon as the service brake valve is actuated, electrical and pneumatic signals are made available. If the valves are de-energised, the pneumatic control signals take effect via the back-up circuit.
In this instance, all the pressure control modules are mechanically safeguarded in a "safety" operating position.

## The system

The dual-circuit pneumatic back-up brake circuit is ready for operation when the ignition switch is in **"off"** position and there is sufficient compressed air. All the solenoid valves in the brake system are de-energised and adopt their basic starting positions by mechanical means (springs).

The EBS control unit starts operating **after the ignition switch is actuated**. Providing no faults are present, EBS is activated when the brake pedal is released. EBS is supplied from the single-circuit vehicle electrical system. All the solenoid valves in the brake system are de-energised when the brake is not actuated.

## Braking with the service brake system

### Electronically controlled braking (EPB)

When the service brake valve is actuated the integrated brake value sensor sends an electrical signal to the EBS control unit. This is generated into a brake pressure setpoint in line with EOL specifications. This setpoint is sent to the trailer plug connection (trailer CAN). and to the pressure control modules via the brake CAN. These PCMs automatically regulate the brake pressure for the series-connected brake cylinders.

The desired pressures sent from the EBS control unit to the pressure control modules are adapted in accordance with the axle load. In order to determine the axle load-dependent desired pressures, a value for the axle load is picked up at the air suspension, e.g. by a pressure sensor, and the measured value is sent to the EBS control unit.

## Braking via back-up circuit

The service brake valve modulates two pneumatic brake pressures in the tractor, irrespective of the brake value sensor electrical signal. These are sent to the pressure control modules in the tractor.

In the case of electronically controlled braking, the pneumatic brake pressure is held as “back-up” at the pressure control modules. The pneumatic pressures from the service brake valve are also present at the trailer control module in the tractor. The trailer control module outputs a pressure to the brake coupling head and reservoir coupling head.

Braking is via the back-up circuit when

- The ignition switch is in “off” position.
- The EBS control unit does not send an electrical setpoint to individual or all pressure control modules.
- The EBS control unit has shut down individual or all pressure control modules following detection of a fault.

**Anti-lock brake system (ABS)**

The speed sensors are connected at the inputs of the pressure control modules. The signals are forwarded to the EBS control unit via the brake CAN. The control unit determines a vehicle reference speed and other variables which are then forwarded to the pressure control modules, again via the brake CAN bus.

**ABS during electro-pneumatic brake system operation (EPB with electrical setpoint)**

Each pressure control module reduces the brake pressure in relation to the specified nominal pressure in its control channel in accordance with a permitted slip value.

**ABS and sustained-action brake**

The sustained-action brake relay output at the control unit and the “ABS active” information in the EBC1 message on CAN J1939 indicate whether ABS regulation is active:

- During service brake operation with ABS
- When spin is increased without the service brakes being actuated

The sustained-action brake can be shut off with these signals during ABS regulation.

## Control processes for commercial vehicle ABS

Four control strategies are available in EBS. These take effect depending on the combination of pressure control module, engine speed sensor and EOL programming.

- Individual control .....(IR)
- Modified individual control.....(IRM)
- Select-low control.....(SL)
- Select-smart control .....(SSM)

## Anti-spin regulator (ASR)

If both the driven wheels spin when the vehicle starts from rest and accelerates, the ECU recognises this from the difference in speed on the driven and non-driven wheels and reduces the engine torque (engine regulator).
In the event of split coefficient road surfaces (μ-split), only the wheel on the low coefficient side usually spins. The spinning wheel is braked by the ASR brake regulator. The drive torque can now take effect on the wheel on the high coefficient side. In this instance, ASR acts as an automatic differential brake.
Switch off the ASR when performing tests on dynamometers/test stands.

**ASR engine regulator**

If the driven wheels are evenly spinning, the engine drive torque is reduced until the average rotating speed of the driven rear axle wheels is slightly higher than that of the non-driven front axle wheels. The EBS control unit outputs the reduction signal required for EDC via T-CAN.
The engine regulator can be activated in all road speed ranges.

**Off-road ASR**

Under certain off-road driving conditions, the spin can be varied by pressing the ASR off-road button. Activation of this special state is indicated to the driver by the INA light on the dashboard (permanently lit or flashing, depending on EOL configuration) and the “ABS off-road switch active” information in the EBC1 message from CAN J1939. The function can be deactivated by pressing the button again or switching the ignition OFF.

**Automatic tyre compensation**

The system includes an automatic tyre compensation feature. Following a wheel change, it may be that the ASR engine regulator is activated before tyre compensation is complete.
This can be cancelled by pressing the ASR off-road button. After a few minutes of driving without braking on a straight road, the adaptation will be complete and ASR off-road can be switched off again.

**ASR brake regulator**

When one wheel starts to spin, the spinning wheel is braked in measured fashion and is checked by pressure and speed sensors. The braking effect reduces the speed of the spinning wheel whilst the speed of the driven wheel increases as a result of the drive torque. The speeds of the driven wheels are thus synchronised.
The brake regulator is not activated at speeds above 40 km/h. However, if it is already active at low road speeds during acceleration, an appropriate control sequence allows it to remain activated until the next gear change, even at speeds above 40 km/h. The EBS control unit does not determine the thermal load on the wheel brakes due to the ASR brake regulator. Possible overload during prolonged ASR regulation should be avoided by starting from rest in an appropriate manner.

If the reservoir pressure is too low in one of the brake circuits, the ASR brake regulator is shut off after one second. This is why the EBS control unit reads in the voltage potential of the red warning light or the reservoir pressure information via CAN J1939 message “Supply Pressure”.

## Interfaces to other systems

Thanks to integration in the CAN databus, **EBS** can be networked with other systems.

| | | |
|---|---|---|
| **A 143** | **ECAS** | Electronically controlled air suspension |
| **A 144** | **Intarder** | Retarder/Intarder control |
| **A 302** | **ZBR II** | Central on-board computer |
| **A 311** | **Ölstandsonde** | Engine oil sensor |
| **A 312** | **KSM** | Customer-specified module |
| **A 330** | **Astronik** | Gearbox control unit |
| **A 402** | **EBS** | Electronic brake system |
| **A 403** | **FFR** | Vehicle management computer |
| **A 407** | **M-TCO** | Tachograph |
| **A 409** | **ECAM** | Electronically controlled air management |
| **A 434** | **Instrument panel** | |
| **A 453** | **EDC** | Electronic diesel control |

**I-CAN** (*Instrument CAN*) – connects the dash board, MTCO and the ZBR.

**T-CAN** (*Drive train CAN*) – connects the ZBR, FFR, ECAS*, ASTRONIK*, EBS, KSM*, the oil level sensing system and the ECAM*.

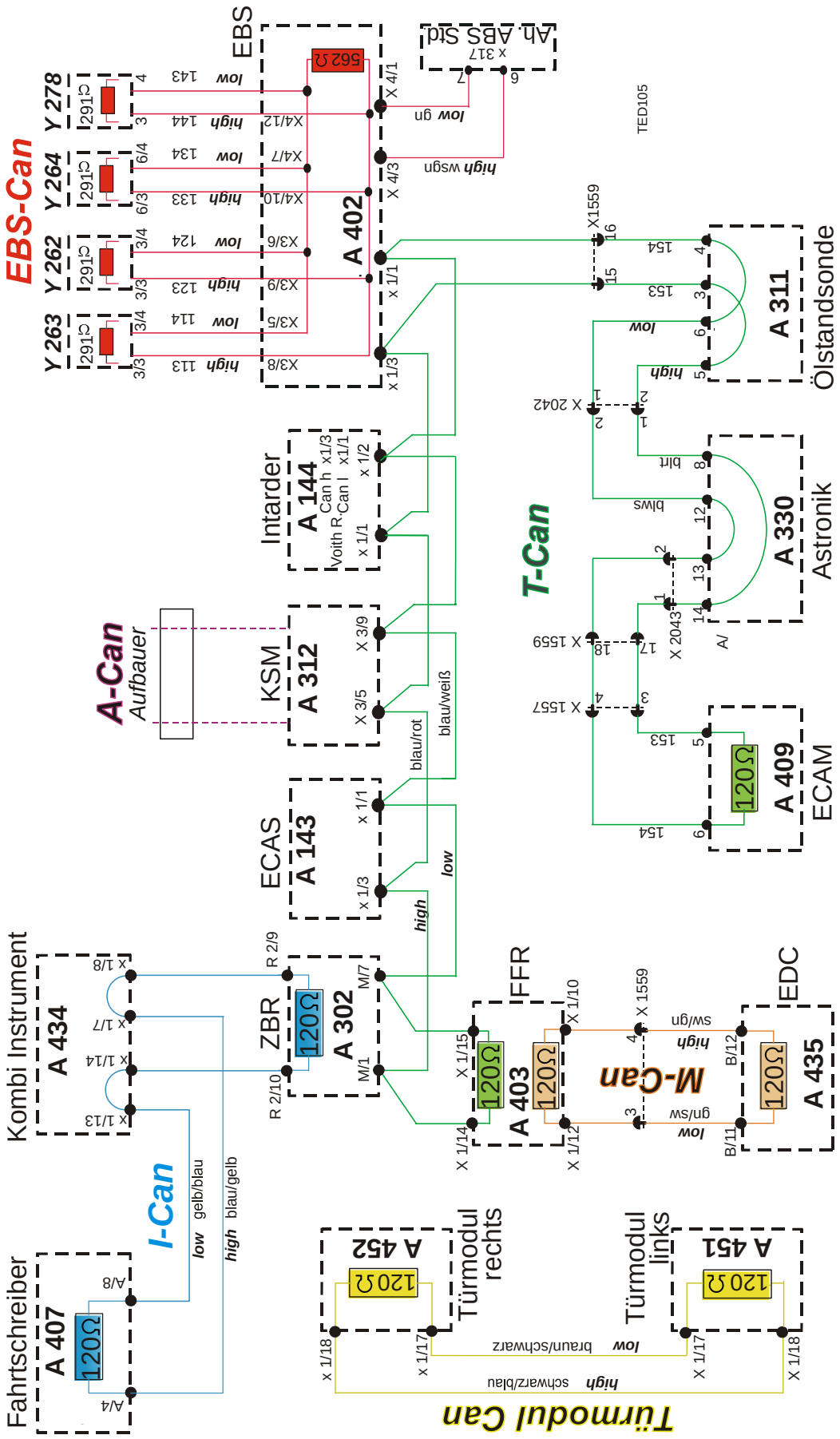
**M-CAN** (*Engine CAN)* – connects den FFR and the EDC control unit.

**Türmodul-CAN** (*Door module CAN*) – connects the two door modules.

**EBS-CAN** in its system to connect its pressure control moduls with the EBS control unit and trailer socket

.

- if equipped


EBS-Can
Y 278
Y 264
Y 262
Y 263
291Ω
EBS
562 Ω
A 402
X 4/1
X 4/3
X 1/1
X 1/3
Ab. ABS Std.
X 317
low gn
high wsgn
low 143
high 144
low 134
high 133
low 124
high 123
low 114
high 113
X4/12
X4/7
X4/10
X3/6
X3/9
X3/5
X3/8
TED105
X1559
16
15
A 311
Ölstandsonde
154
153
low
high
X 2042
blt
bws
A 330
Astronik
X 2043
X 1559
X 1557
A 409
ECAM
120Ω
Intarder
A 144
Can h x1/3
Can l x1/1
Voith R
x 1/2
x 1/1
A-Can
Aufbauer
KSM
A 312
X 3/9
X 3/5
blau/rot
blau/weiß
ECAS
A 143
x 1/1
x 1/3
low
high
T-Can
Kombi Instrument
A 434
x 1/8
x 1/7
x 1/14
x 1/13
ZBR
A 302
R 2/9
R 2/10
M/7
M/1
FFR
A 403
X 1/15
X 1/14
X 1/10
X 1/12
M-Can
X 1559
4
3
high sw/gn
low gn/sw
EDC
A 435
B/12
B/11
Fahrtschreiber
A 407
A/8
A/4
I-Can
low gelb/blau
high blau/gelb
Türmodul rechts
A 452
x 1/18
x 1/17
Türmodul links
A 451
X 1/17
X 1/18
low braun/schwarz
high schwarz/blau
Türmodul Can

## Components

### Electronic control unit

The electronic control unit (A402) centrally co-ordinates the entire EBS.
The control unit is EOL-programmed (end of line). A change of parameters can be done if necessary – using the MAN-cats II diagnostic system.

### Power supply

A filter in the “power supply” module protects against electrical faults at terminal 15 and terminal 30. The voltage supplied is that needed for the pressure control modules (24V) plus 5 Volts for the sensors. The module also supplies a stabilised 5 Volts for internal control unit operation.

### Input circuits

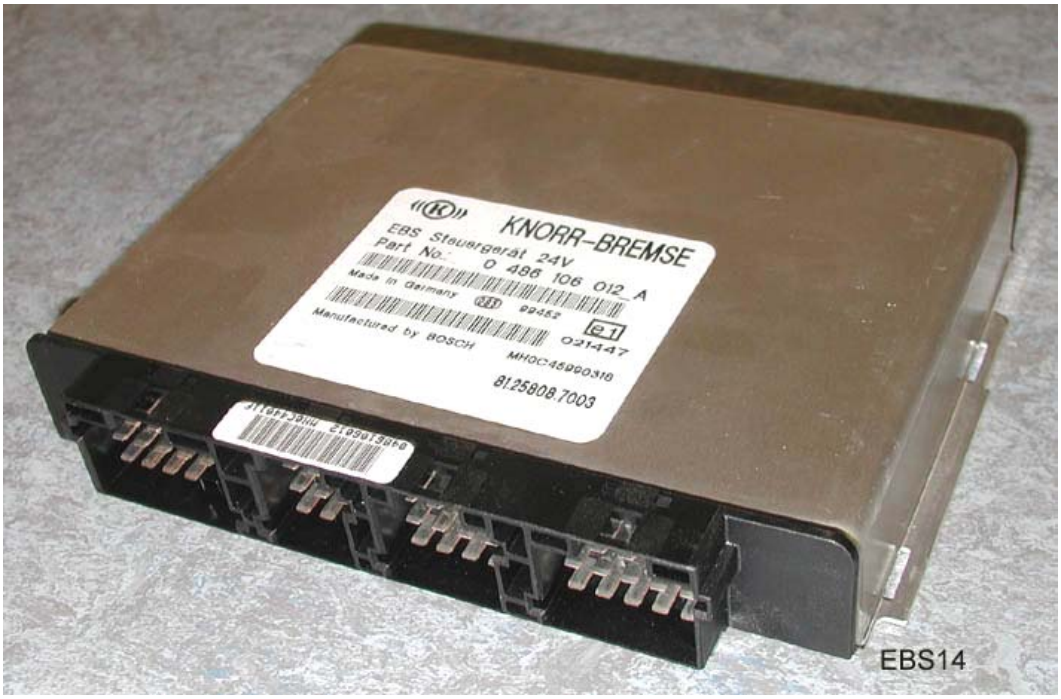
The input circuits are for conditioning the signals for the microcontroller (µC) input. Superimposed unwanted input signals are filtered. Information is transmitted in both directions at the diagnosis interface, i.e. to the control unit and from the control unit, e.g. to the diagnosis unit (MAN-cats).

### Computer

The computer (in the control unit) contains two redundant microcontrollers (µC) with EEPROM and three CAN controllers (general CAN, trailer CAN, brake CAN). The microcontrollers evaluate the signals conditioned by the input circuits and control the output via CAN data bus.

**A** --- Installation port for EBS control unit

## Installation position

**Pressure control module supply**

Pressure control module assignment occurs after the EBS control unit is activated. Each pressure control module is supplied with 24 Volts, successively activated by the microcontrollers (µC) and given a CAN address.

The pressure control modules are shut off in pairs per axle if system faults or errors are detected.

**Output stages**

The output stages activate components such as sustained-action brake shutdown, brake pad wear indicator and the yellow ABS check lamp. The red warning light is activated by a self-conducting output stage.

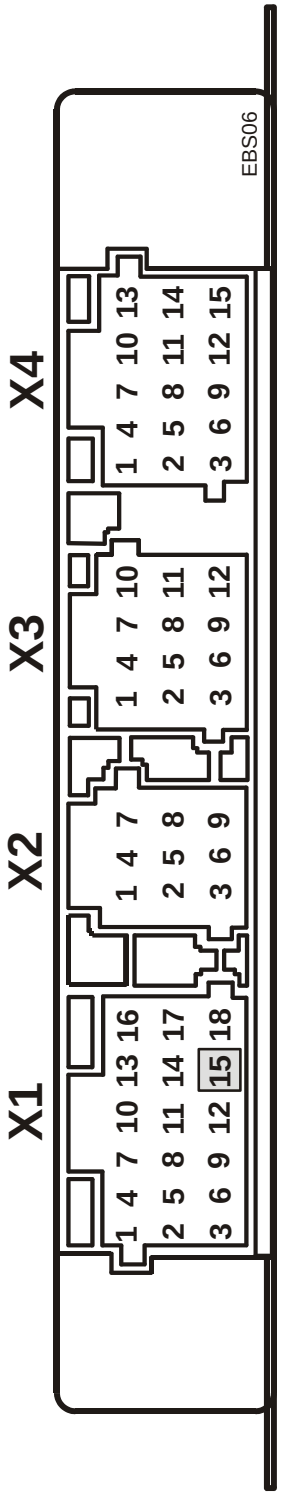
**Connector drop-out detection**

An integral switch in the wiring harness connector (pin **X1/15**) switches on the red warning lamp by closing contacts X1/12 and X1/18 on the wiring harness side as soon as the wiring harness is not connected or drops out due to loose contact.

The switch is opened again as soon as the wiring harness is connected to the control unit.

## Connector pin assignment

As seen looking at the control unit



## Connector X1

| Pin | Line no. | Designation |
|---|---|---|
| 6 | 74512 | Switch, ASR spin threshold increase, control unit, EBS |
| 7 | 73001 | Fuse F162-power supply, control unit, EBS |
| 8 | 73000 | Fuse F161-power supply, pressure control valves |
| 10 | 31000 | Earthing point, cab next to central electrical system |
| 12 | 31000 | Earthing point, cab next to central electrical system |
| 13 | 73201 | Diagnosis, K-line |
| 15 | --- | Detection, interrupt (connector drop-out detection) |
| 18 | --- | Red warning light, self-conducting |

## Connector X2

| Pin | Line no. | Designation |
|---|---|---|
| 2 | 73500 | Power supply, brake value sensor |
| 3 | 73501 | Ground, brake value sensor |
| 4 | 73503 | Pressure setpoint 2 from brake value sensor |
| 7 | 73502 | Pressure setpoint 1 from brake value sensor |

## Connector X3

| Pin | Line no. | Designation |
|---|---|---|
| 2 | CAN 112 | Ground, pressure control module, 1-channel, left |
| 3 | CAN 122 | Ground, pressure control module, 1-channel, right |
| 5 | CAN 114 | CAN_L for pressure control module, 1-channel, left |
| 6 | CAN 124 | CAN_L for pressure control module, 1-channel, right |
| 8 | CAN 113 | CAN_H for pressure control module, 1-channel, left |
| 9 | CAN 123 | CAN_H for pressure control module, 1-channel, right |
| 11 | CAN 111 | Power supply for pressure control module, left |
| 12 | CAN 121 | Power supply for pressure control module, right |

## Connector X4

| Pin | Line no. | Designation |
|---|---|---|
| 1 | Green | CAN_L, trailer socket |
| 3 | White/green | CAN_H, trailer socket |
| 4 | CAN 132 | Ground, pressure control module, 2-channel |
| 6 | CAN 141 | Ground, trailer control module |
| 7 | CAN 134 | CAN_L for pressure control module, 2-channel |
| 9 | CAN 143 | CAN_L for trailer control module |
| 10 | CAN 133 | CAN_H for pressure control module, 2-channel |
| 12 | CAN 144 | CAN_H for trailer control module |
| 13 | CAN 131 | Power supply for pressure control module, 2-channel |
| 15 | CAN 142 | Power supply for trailer control module |

**Service brake valve with integral brake value sensor**

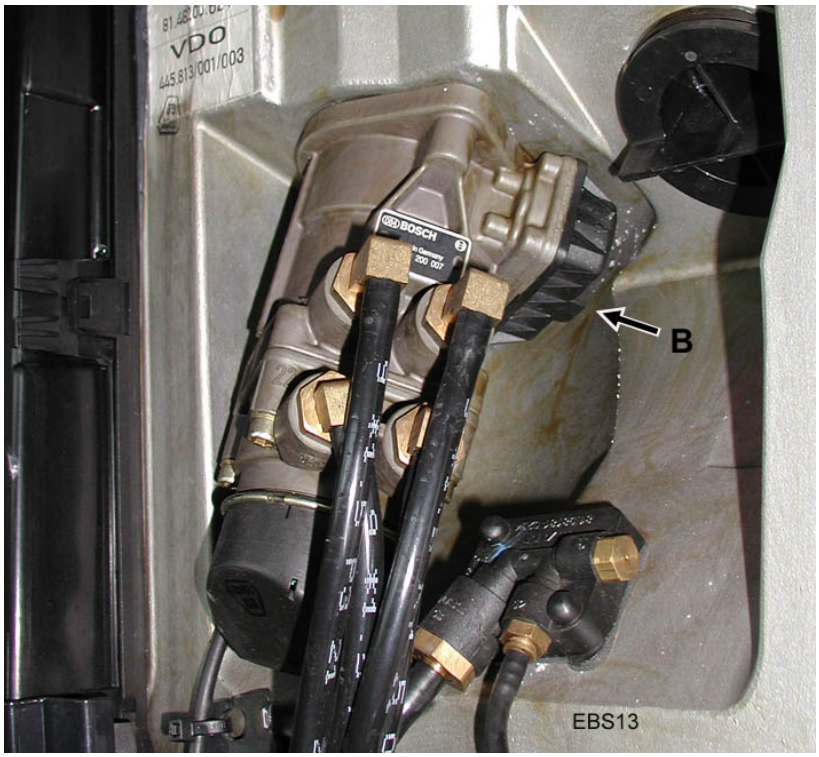
The dual-circuit pneumatic service brake valve (G7.302) has an integral electrical brake value sensor (B337). The brake value sensor is used to generate electrical/pneumatic signals for admitting and removing air in the electronically controlled brake system. A plunger is used for actuation in each case. This plunger actuates the brake value sensor and, by means of the usual springs, a reaction piston and valve assembly which outputs the pneumatic pressure. A single electrical circuit supplies the power for the brake value sensor (constant 5 V from the EBS control unit). Two potentiometer sensors are actuated at the same time.

The brake value sensor (B337) is electrically connected to the EBS control unit. The signals of the two potentiometer pressure setpoint 1 and pressure setpoint 2 run in opposite directions.

The EBS control unit uses pressure setpoint 1 and pressure setpoint 2 to determine setpoints for the trailer and for the pressure control modules in the tractor.

The electrical and pneumatic circuits are harmonised in the vehicle by means of EOL programming.

## Installation position

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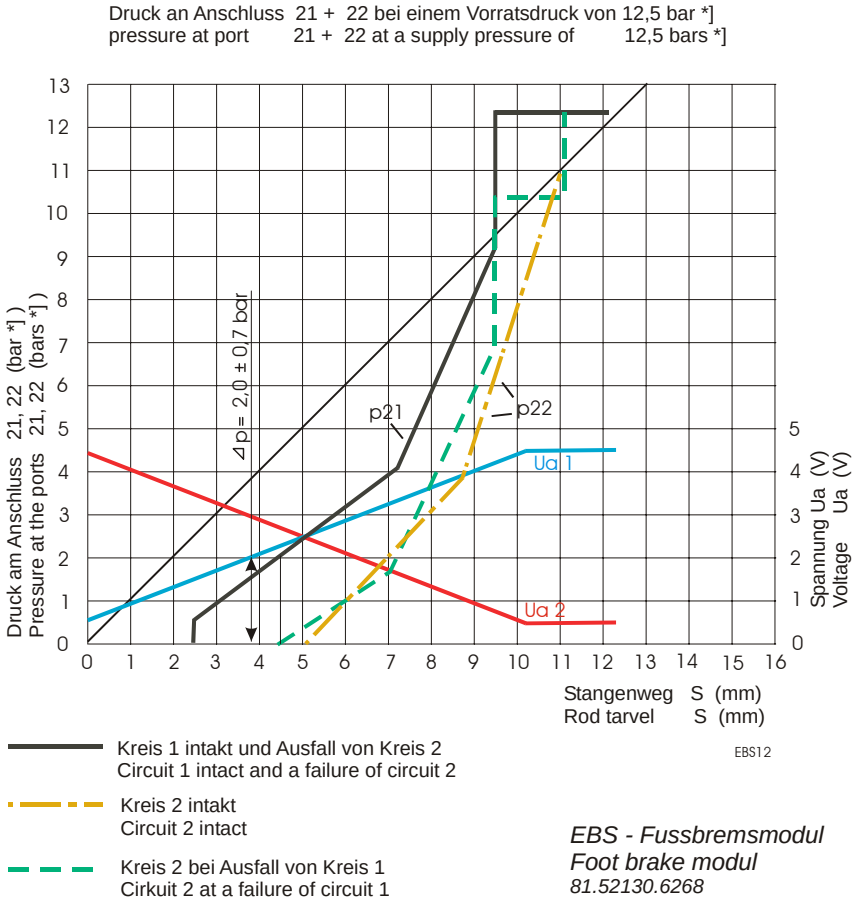



*EBS - Fussbremsmodul*
*Foot brake modul*
*81.52130.6268*

## Functional diagram

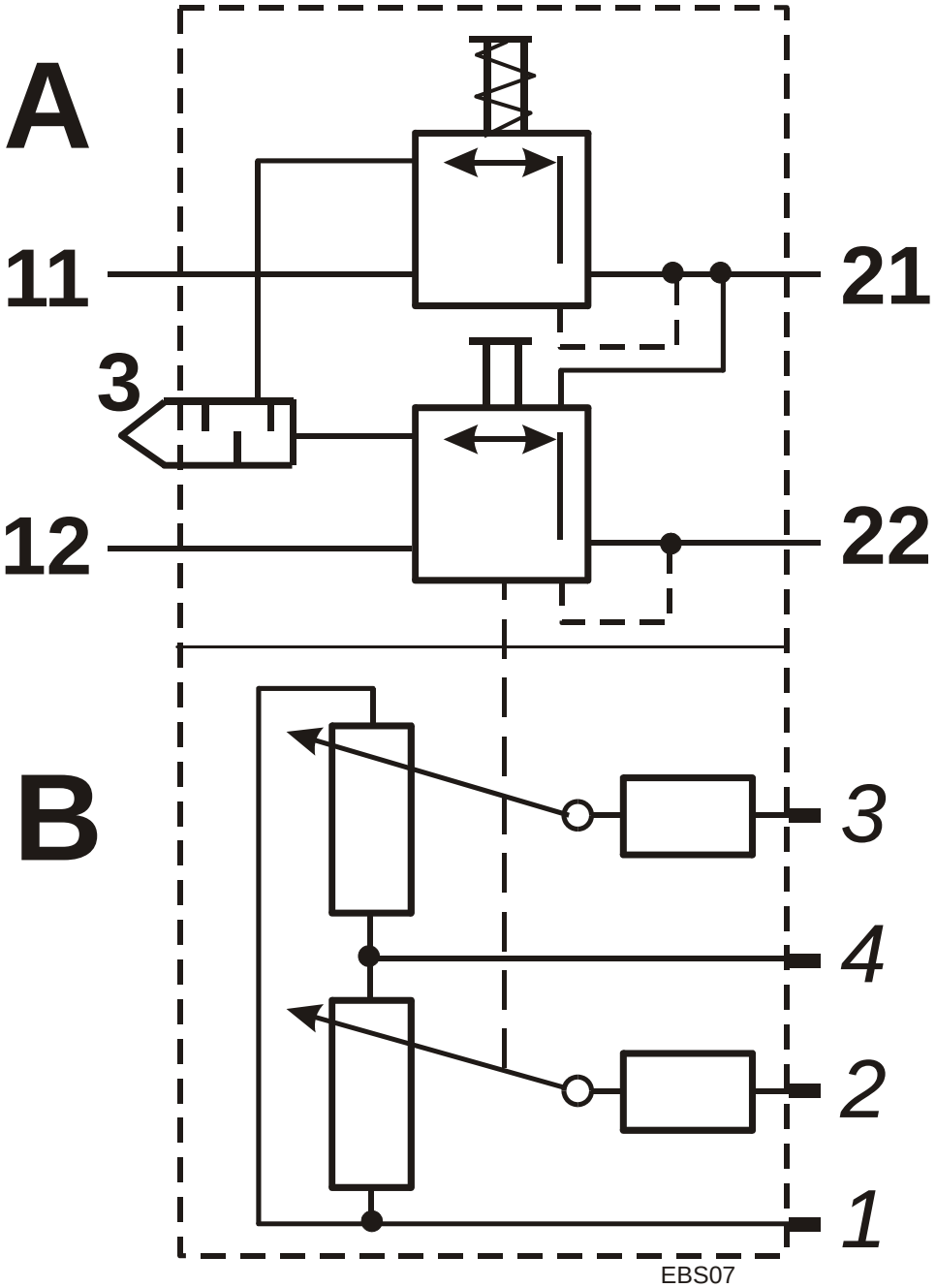
## Legend

**A** **Service brake valve** (pneumatic part)

- **3** Vent
- **11** Energy supply, circuit 1
- **12** Energy supply, circuit 2
- **21** Air outlet to brake circuit 1
- **22** Air outlet to brake circuit 2

**B** **Brake value sensor** (electric part)

- ***1*** Ground
- ***2*** Pressure setpoint 2 (Signal)
- ***3*** Pressure setpoint 1 (Signal)
- ***4*** Power supply (5 Volts)




EBS07

**Pressur control moule**

If no EBS function is active, the pressure sensor measured value is adjusted in line with the current brake cylinder pressure using a time constant (automatic atmospheric pressure setting). Adjustment is limited and may last up to 1 second after the ignition is switched “ON” or the service brake is released. This adjustment time must be taken into account in measurements.

The pressure control module executes control or regulation functions in three different states:

⇒ Normal functioning:

Pressure control module control unit energised and electrical setpoint available or ASR brake regulation required.

When the EBS function is requested, the pressure control module commences brake pressure regulation by closing the back-up circuit solenoid valve (back-up valve) and activating the inlet valve and exhaust valve accordingly.

⇒ Braking with the back-up circuit:

Pressure control module control unit energised but no electrical setpoint or actual value available.

If the electrical setpoint or actual value is defective, the system switches the pressure control module to the back-up circuit (back-up valve is not switched). The pneumatic pressure controls the pressure to the brake cylinders via the relay valve. There is no automatic load-dependent braking or wear regulation. The signals in the pressure control module are processed and communication between the pressure control module and EBS control unit is maintained.

⇒ Pressure control module de-energised:

When the solenoid valves are de-energised, the pneumatic pressure service brake valve controls the pressure to the brake cylinders via the relay valve whilst braking is through the back-up circuit.

## Pressure control module front axle (1-channel)

The pressure control module on the front axle is a 1-channel electro-pneumatic component comprising relay valve, filter, silencer, solenoid valves for back-up circuit (back-up valve), inlet valve and outlet valve, pressure sensor, electronic control unit as well as pneumatic and electrical connections.

At the same time, it is the node for transmitting the signals of the connected sensors, such as

- speed sensor and
- brake pad wear sensor

to the EBS control unit via the “brake” CAN databus.

The pressure control module is fitted on the right and left of the front axle, with the silencer pointing downwards.

The incoming brake value signals give the limit for the brake pressure in the wheel brake cylinder

**Legend:**

**DF-A** ABS sensor, front axle, left (B121)

*Pinning:* ***1*** ➔ *black / white*

***2*** ➔ *brown*

**DF-B** ABS sensor, front axle, right (B120)

*Pinning:* ***1*** ➔ *black / white*

***2*** ➔ *brown*

**CAN/+U** CAN databus and power supply

*Pinning:* ***1*** ➔ *ground*

***2*** ➔ *Power supply*

***3*** ➔ *CAN-high*

***4*** ➔ *CAN-low*

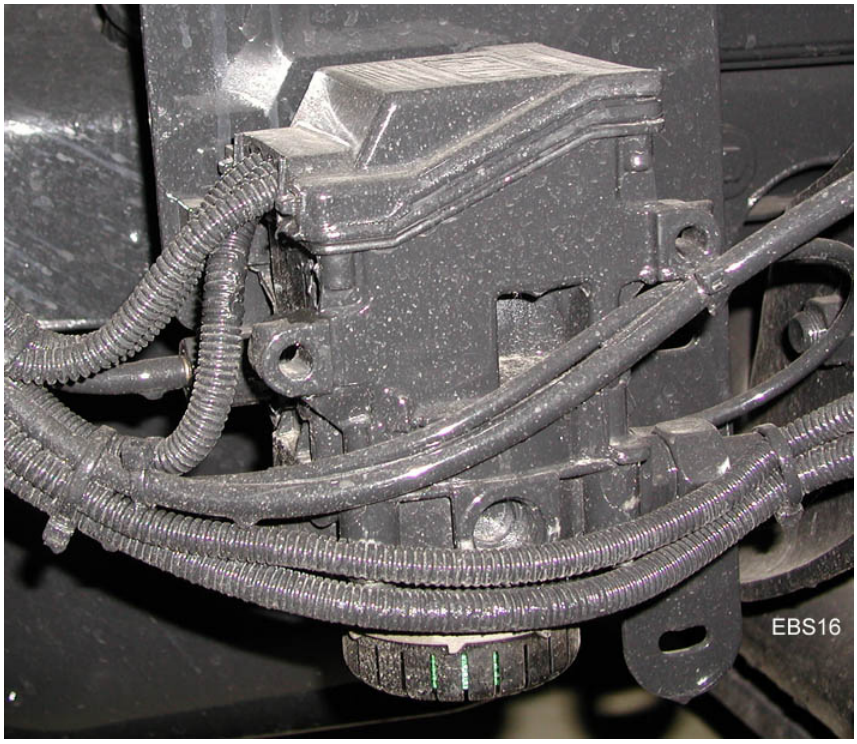
**BVS** Sensor, brake pad, 1st axle, right (B332) or left (B333)

**A** Outlet Valve
**B** Backup valve
**D** Pressure sensor
**E** Inlet valve
**F** Filter
**R** Relay valve
**S** Silencer

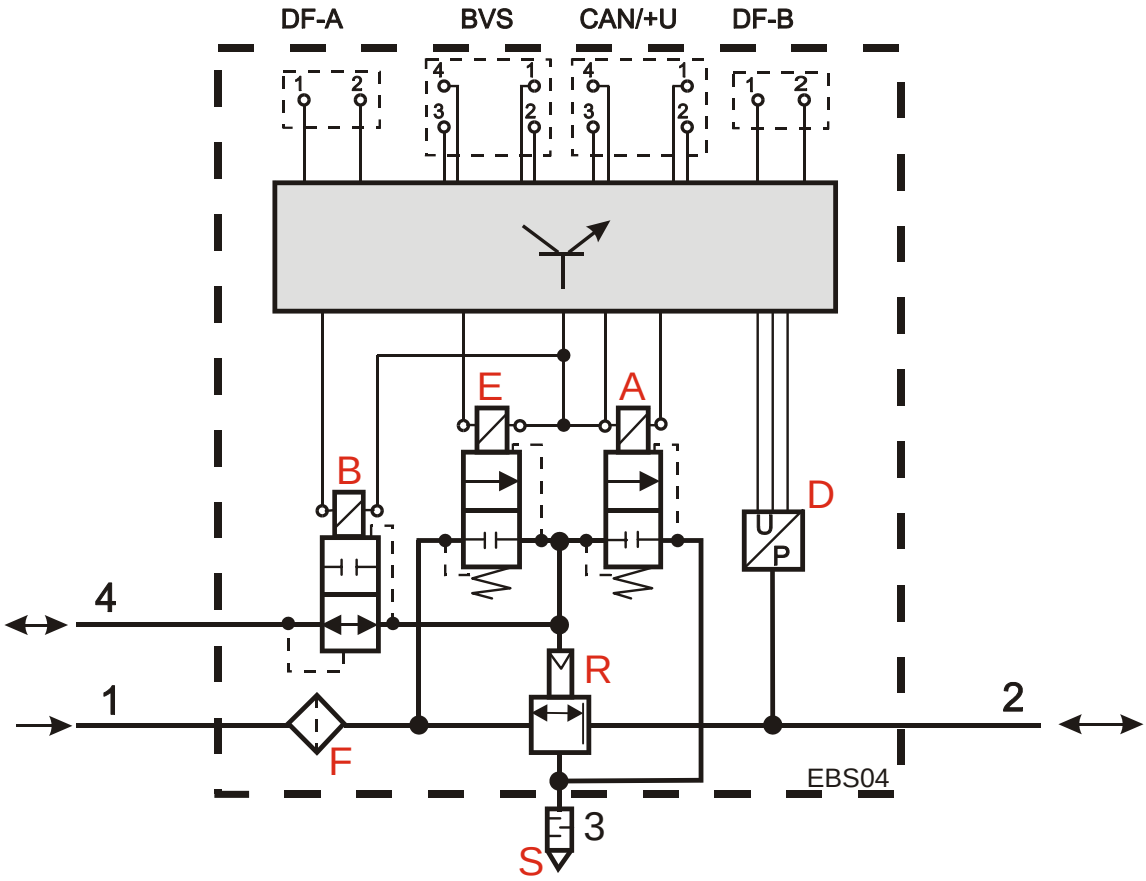
***Pneumatic connections:***

**1** Energy supply (reservoir)
**2** Energy return (brake cylinder)
**3** Vent
**4** Back-up circuit

## Installation position




## Functional diagram



## Pressure control module rear axle (2-channel)

The pressure control module on the rear axle is a 2-channel electro-pneumatic component comprising relay valve, filter, silencer, solenoid valves for back-up circuit (back-up valve), inlet valve and outlet valve, pressure sensor, electronic control unit as well as pneumatic and electrical connections.
At the same time, it is the node for transmitting the signals of the connected sensors, such as

speed sensor,
pad wear sensors and
ALB sensor, rear axle

to the EBS control unit via the “brake” CAN databus.
The 2-channel pressure control module is fitted on the rear axle, with the silencer pointing downwards.

**Legend:**

**DF-A** ABS sensor, front axle, left (B121) *Pinning:* ***1***➔*black / white* ***2***➔*brown*

**DF-B** ABS sensor, front axle, right (B120) *Pinning:* ***1***➔*black / white* ***2***➔*brown*

**CAN/+U** CAN databus and power supply *Pinning:* ***1***➔*ground* ***2***➔*Power supply*
***3***➔*CAN-high* ***4***➔*CAN-low*

**BVS** Sensor, brake pad, rear axle, right (B334) or left (B335)
*Pinning:* ***1***➔*73304 (GND)*
***3***➔*73306 (signal)* ***4***➔*74300 (+5 Volt)*

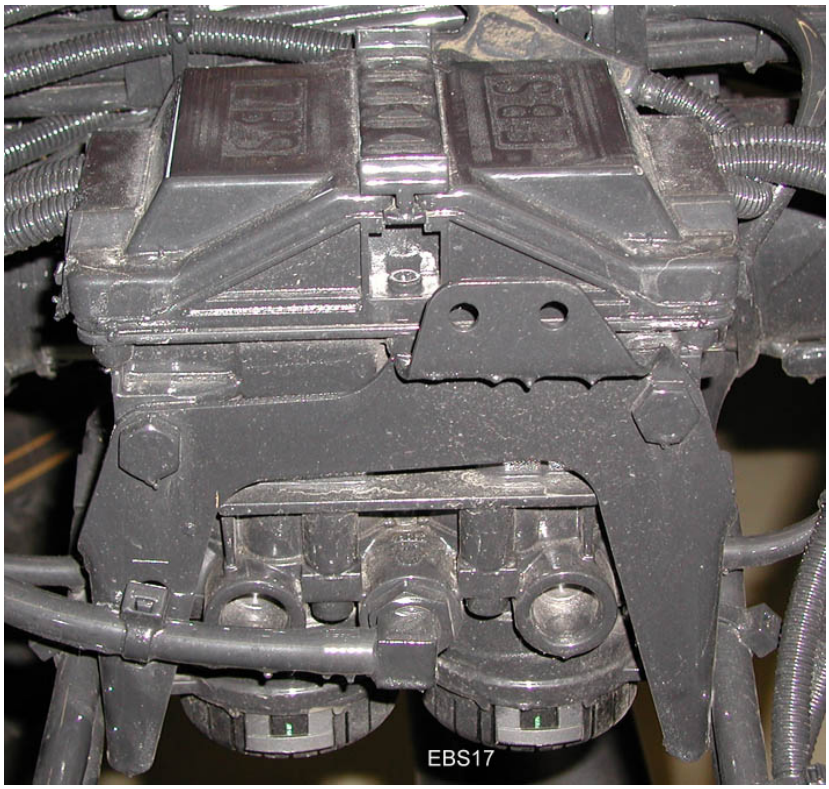
**A** Outlet Valve **B** Backup valve **D** Pressure sensor
**E** Inlet valve **F** Filter **R** Relay valve
**S** Silencer

**ALB ½** ALB sensor (B336) *Pinning:* ***1***➔*73304 (GND)*
***3***➔*73306 (signal)* ***4***➔*74300 (+5 Volt)*

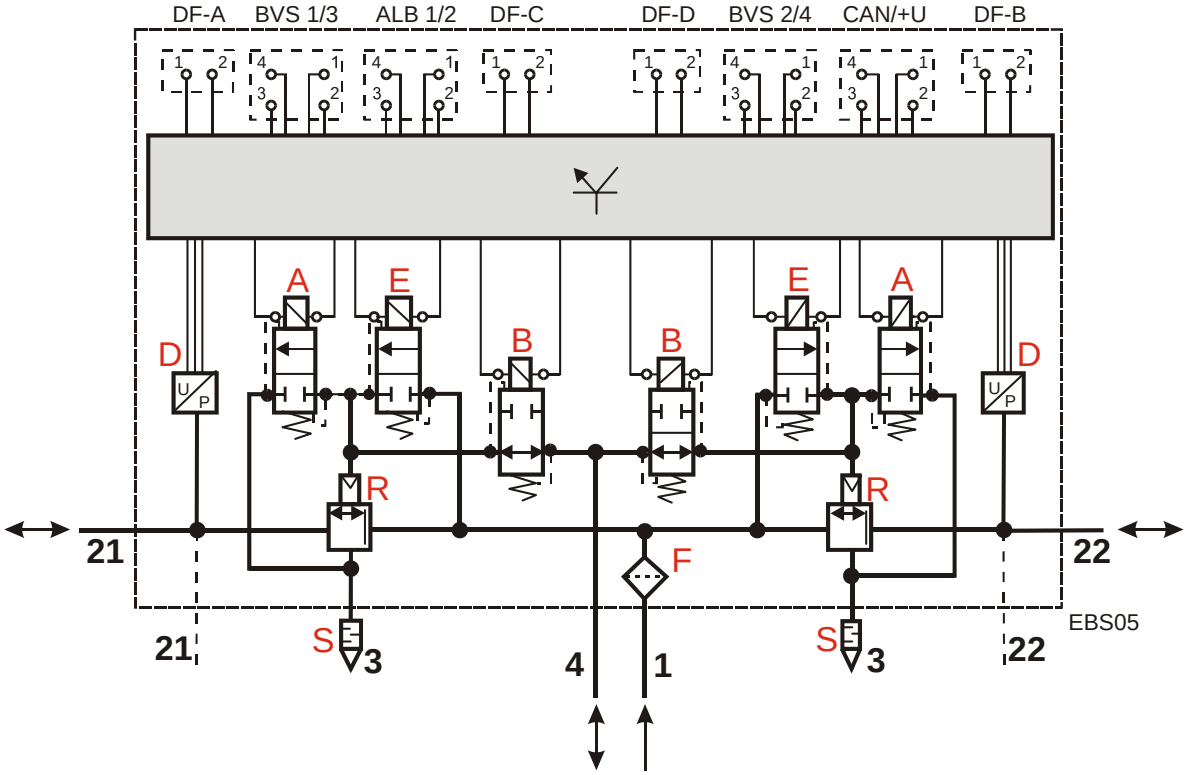
***Pneumatic connections:***

**1** Energy supply (reservoir) **2** Energy return (brake cylinder)
**3** Vent **4** Back-up circuit

## Installation position




## Functional diagram



## Trailer control module (Y 278)

The trailer control module mainly comprises a relay valve with 2 control chambers for the service brake system, one control chamber for the parking brake system, a filter, a throttle valve, electro-magnetic valves (input, output, back-up), a pressure sensor like the one in the 1-channel pressure control module and an integral control unit.
The trailer control module has electrical and pneumatic ports. The electrical ports include the power supply and the link between the “trailer” CAN databus and the EBS control unit.
The pneumatic ports on the input end consist of the energy supply (reservoir 11) and 3 control lines (from the service brake valve with integral brake value sensor to ports 41 and 42 and from the parking brake valve to port 43). Those on the output end consist of the dual-line brake system to the trailer (supply and control line).

The trailer control module is fitted in the rear area of the chassis. The installation position may vary slightly (depending on the chassis).

**Legend:**

**CAN/+U** CAN databus and power supply

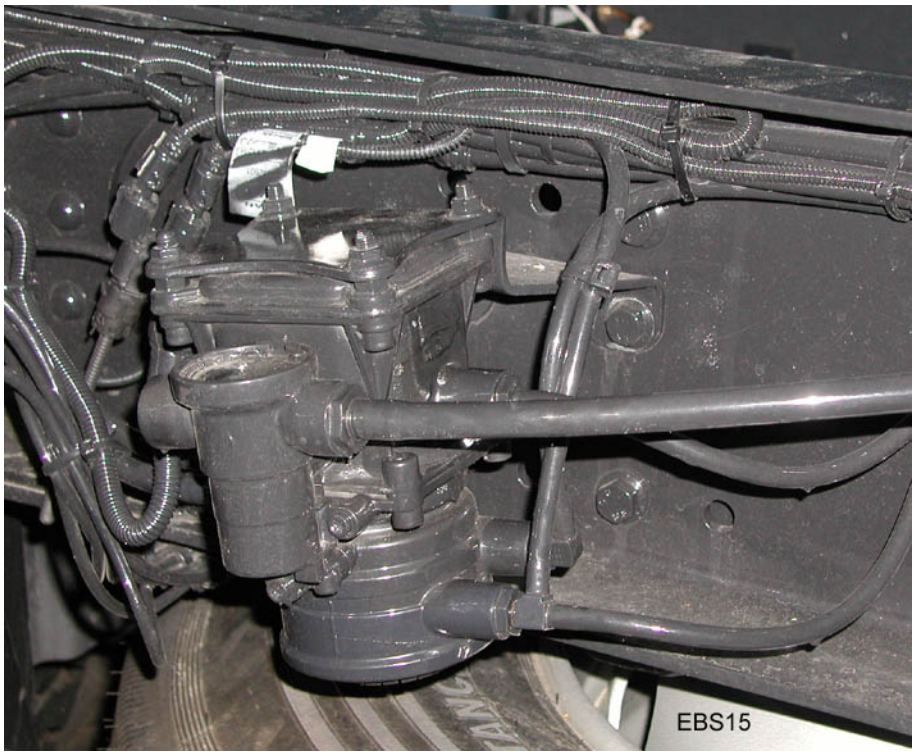
*Pinning:* **1** ground **2** Power supply
**3** CAN-high **4** CAN-low

| | | | | | |
|---|---|---|---|---|---|
| **A** | Outlet Valve | **B** | Backup valve | **D** | Pressure sensor |
| **E** | Inlet valve | **F** | Filter | **R** | Relay valve |
| **S** | Silencer | **2/2 W** | 2/2 Way valve | | |

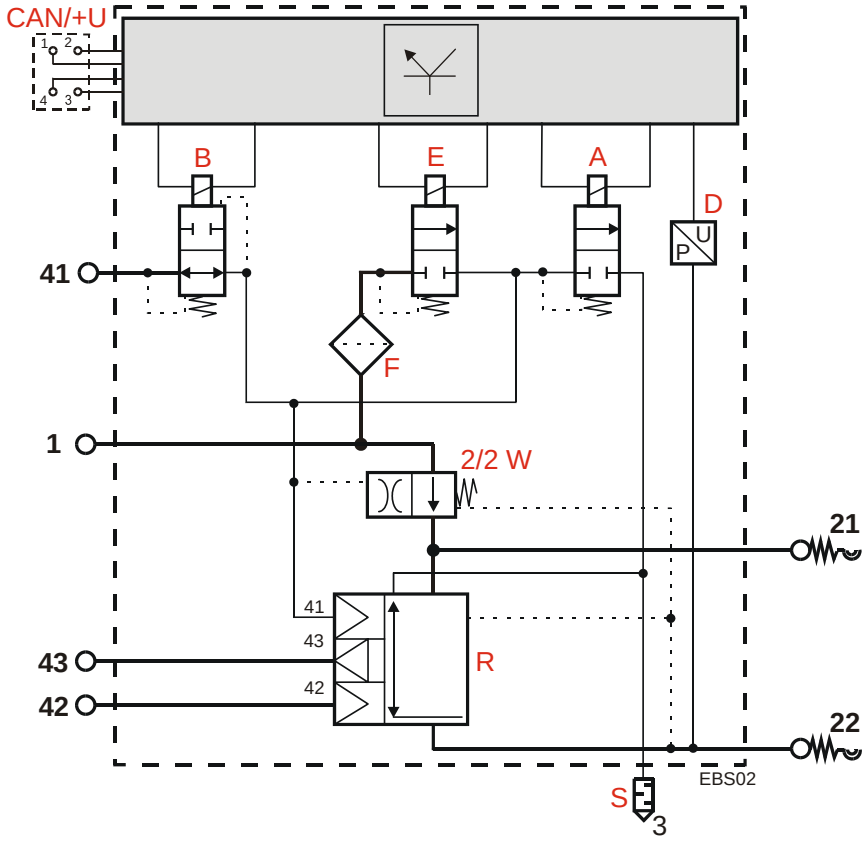
***Pneumatic connections:***

| | | | |
|---|---|---|---|
| **11** | Energy supply (reservoir) | **21** | Reservoir line, trailer |
| **22** | Control line, trailer | **3** | Vent |
| **41** | Service brake circuit, front axle | **42** | Service brake circuit, rear axle |
| **43** | Parking brake circuit | | |

## Instalation position




## Functional diagram



The main functions of the trailer control module are regulating the brake pressure on the trailer control line (port 22) and balancing the brake pressures (coupling force regulation) between the tractor and trailer. The parking brake system (port 43) and the separation function work in the conventional manner.

The EBS control unit pressure setpoint is transmitted to the control unit integrated in the trailer control module via the “trailer” CAN databus.
The trailer control module control unit modifies this setpoint using the coupling force regulation algorithm. Whilst the back-up solenoid valve is closed, the electrical signal sets a pneumatic pressure at output 22 using the electromagnetic input and output valve as well as the pressure sensor. This pressure is then transmitted to the coupling head of the trailer control line.

The pneumatic signal of service brake circuit 41 is blocked by the back-up solenoid valve which is activated for electric braking. If the back-up function is not active, then the back-up solenoid valve is open and the service brake pressure (port 41) forwards brake pressure to the brake coupling head (port 22) via the relay valve control chamber.

The pressure at service brake circuit 42 of the trailer control module serves a separate relay valve control chamber. The response pressure of this relay valve part is approx. 2.5 bar. Assuming an intact trailer control module and a pressure at service brake circuit 42 of the trailer control module amounting to approx. 8 bar, the pressure that is electrically controlled with back-up solenoid valve, input and output valve at port 22 can be reduced to about 4 bar. If the electrically controlled pressure is reduced further, the pressure at service brake circuit 42 of the trailer control module determines the brake pressure at port 22.

If the electronic brake system and service brake circuit 41 fail, the pneumatic curve for service brake circuit 42 automatically changes the characteristic. The response pressure remains at approx. 2.5 bar almost irrespective of the reservoir pressure. However, in this case, assuming 8 bar brake pressure at service brake circuit 42, there is also approx. 8 bar at trailer control line 22.
Parking brake circuit 43 is pressurised when the parking brake is released. This means that the service brake cylinders in the trailer are not actuated. Activating the parking brake reduces the pressure at the parking brake circuit. This leads to a pressure increase in trailer control line 22 and to actuation of the trailer service brake.

If the trailer control line (port 22) becomes separated, the pressure supply of the trailer reservoir line (port 21) is restricted by an automatically closing throttle during braking so as to ensure that the supply pressure falls below 1.5 bar within 2 seconds, thus braking the trailer.

**ALB sensor, for truck with air-suspended rear axle**

A pressure sensor that measures the bellows pressure is used to determine the load in vehicles that have air suspension on the rear axle. and supplied with 5 V.

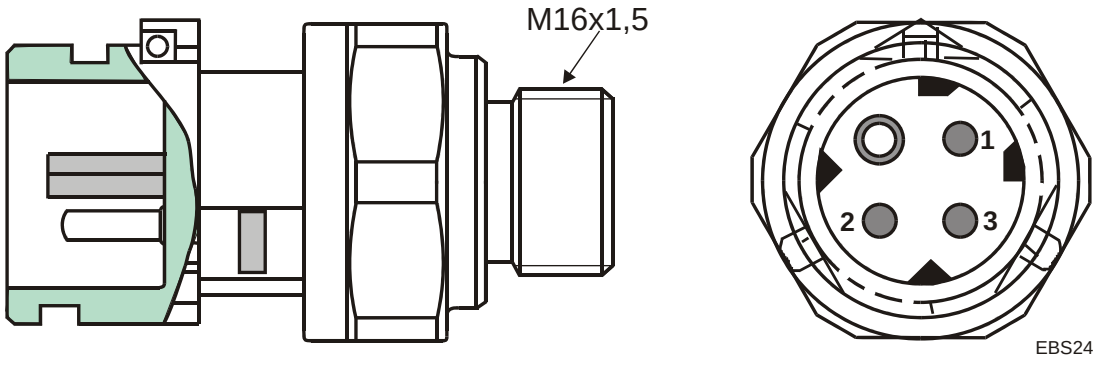
It contains a pressure-sensitive measuring element (analogue/digital converter).and a booster circuit. It convert physical variables (e.g. pressure) into a voltage.

This information is analysed together with the specific vehicle parameters to calculate the current load status.

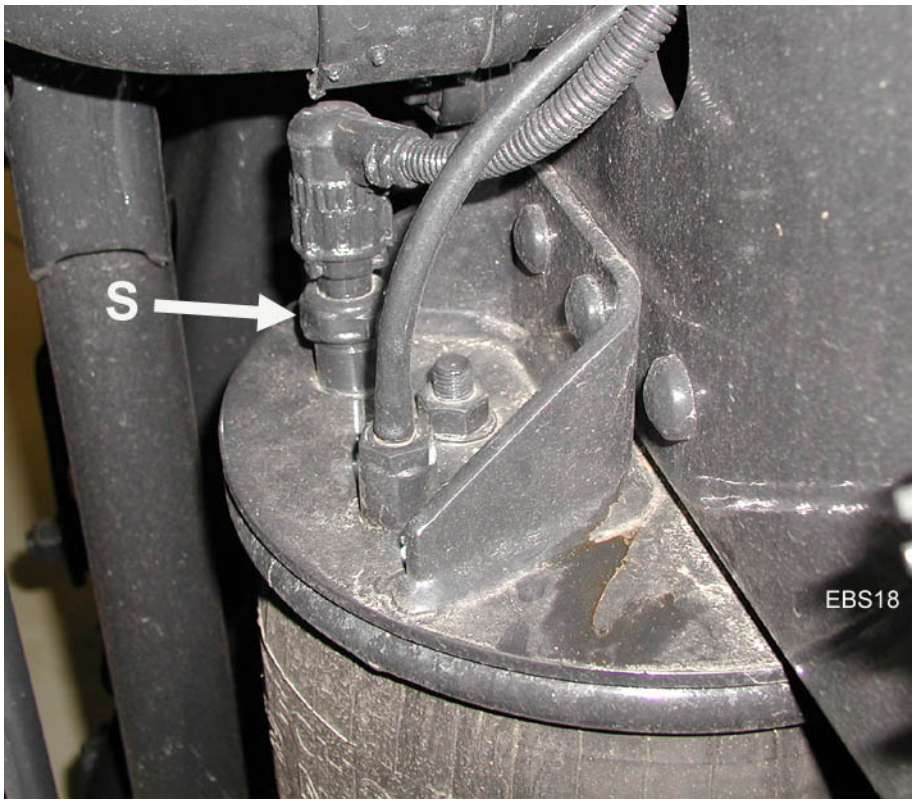
These signal values are assigned brake pressure curves which the EBS control unit uses to control the brake pressures, depending on load.

**Connector pin assignment** (B336)

| Pin | Line no. | Designation |
|---|---|---|
| 1 | 74300 | Vc (Power supply 5 Volts) |
| 2 | 73304 | Ground |
| 3 | 73306 | Sensor |

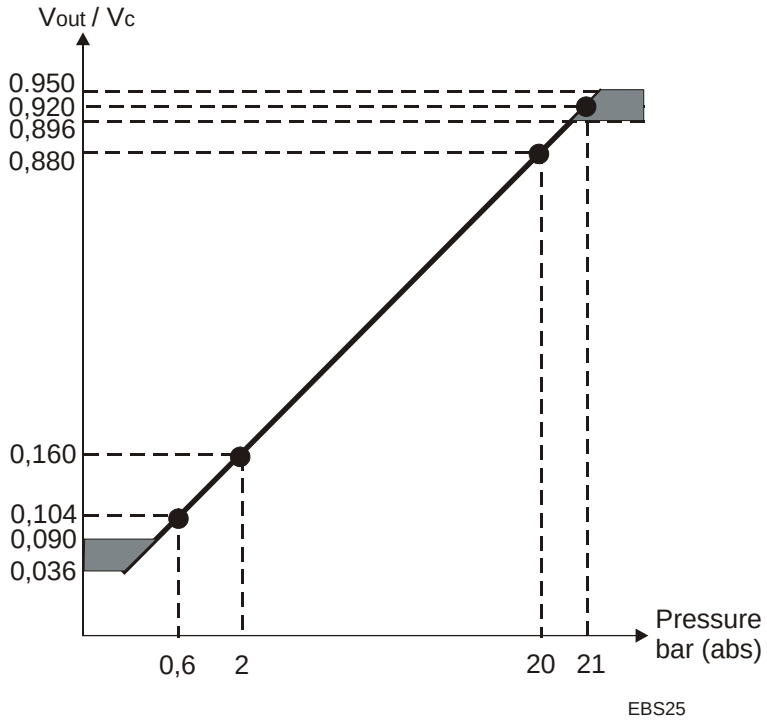


## Mounting position




## Diagram

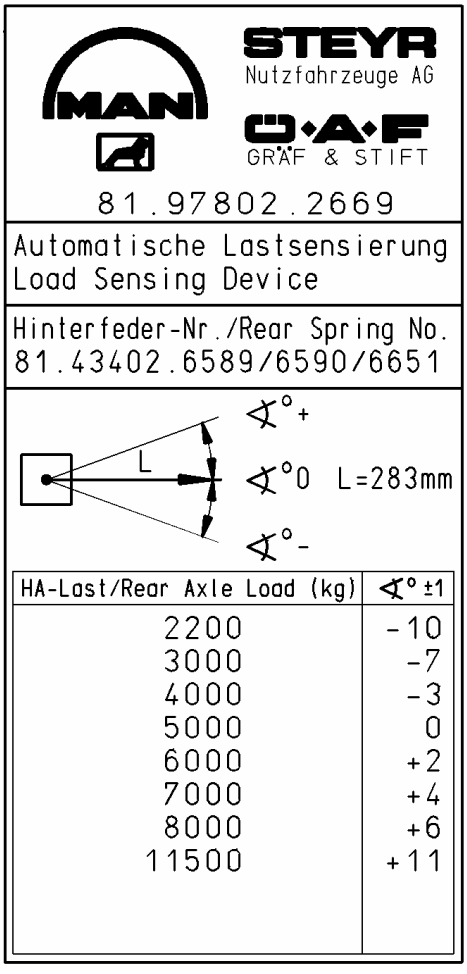
$V_{out} / V_c = 0{,}08 + 0{,}04 \times P$;  P in bar (abs)

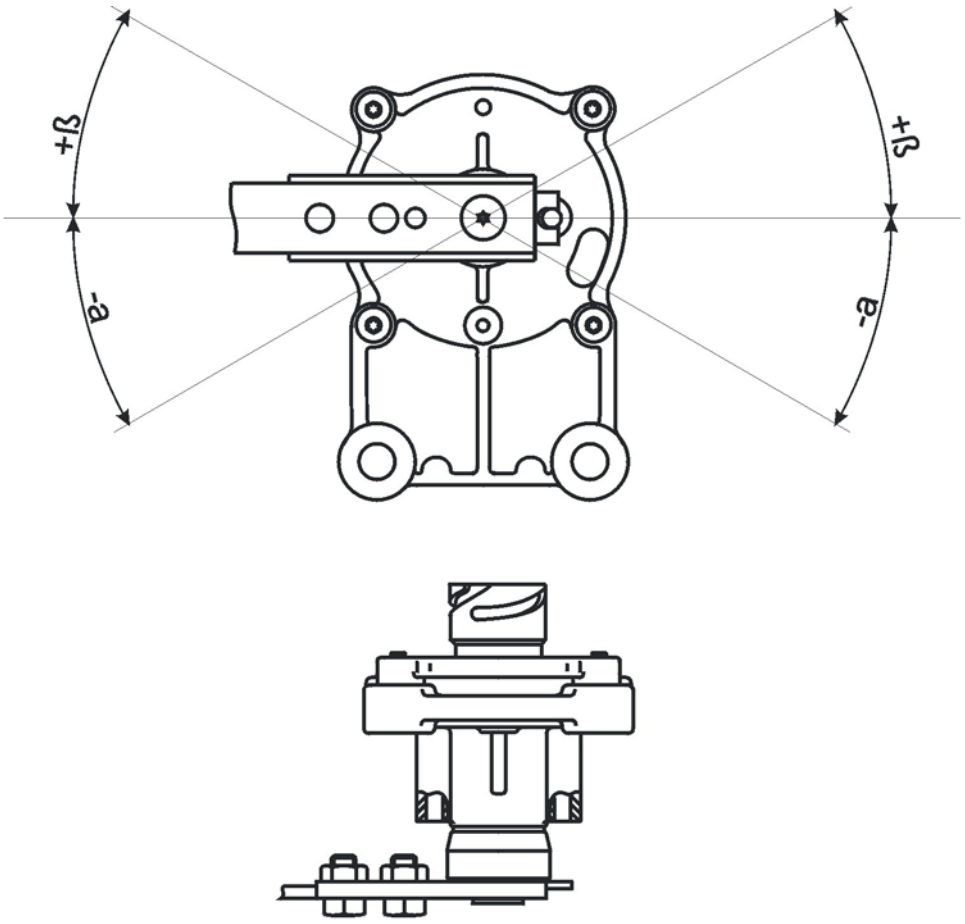


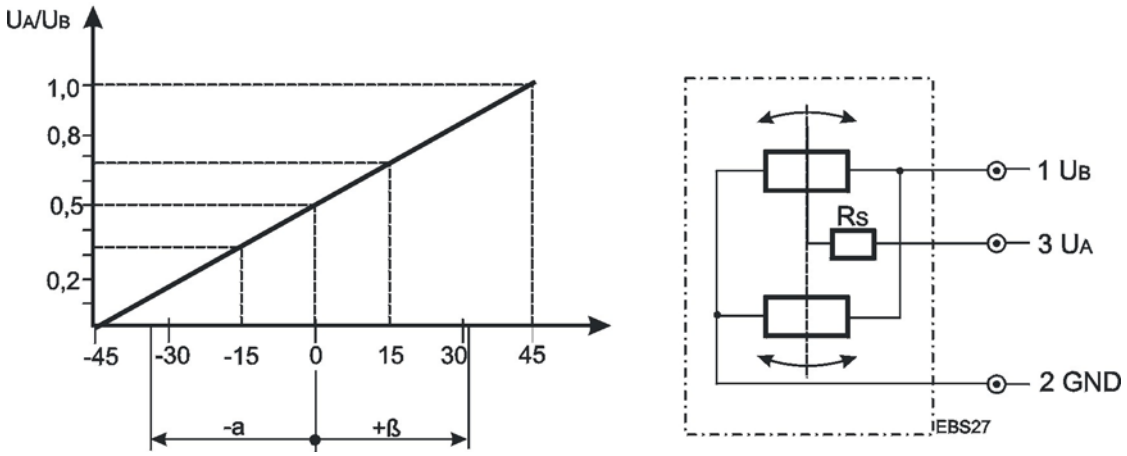
**ALB sensor, for truck with flat-suspended rear axle**

**Technical data:**

| | |
|---|---|
| supply voltage | $U_B = 5\ V_{DC} \pm 5\%$ |
| resistor | $R = 5\ K_Q \pm 20\%$ |
| collector protection resistor | $R_S = 2.5\ K_Q \pm 20\%$ |
| linearity error | < 2% |
| istallation position | Betätigungsachse horizontal |
| permissible axial force<br>radial force | $F_A$ < 10 N<br>$F_R$ < 10 N |
| temperature range | - 40° ... 85° C |




+ß
-a
+ß
-a


UA/UB
1,0
0,8
0,5
0,2
-45
-30
-15
0
15
30
45
-a
+ß
RS
1 UB
3 UA
2 GND
EBS27

**Brake pad wear sensor**

The brake pad wear sensors are electrically connected to the pressure control module. Data is transferred via the “brake” CAN databus.
The permanently measuring brake pad wear sensor is an integral part of the wheel brake.

**Functions**

The brake pad wear sensors used for disc brakes are pencil-style sensors.
The brake pad wear sensor is only energised after braking. The brake pad wear sensor then sends a wear or adjustment-dependent voltage to the pressure control module and from there to the EBS control unit via the “brake” CAN databus for evaluation.

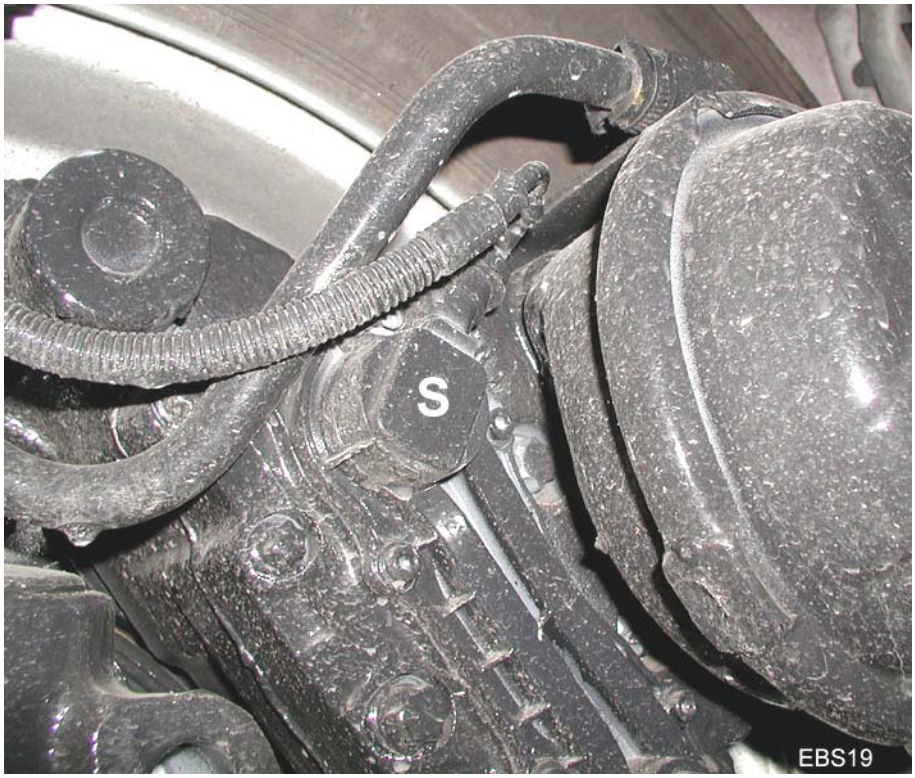
**The EBS control unit can not distinguish between pad wear and disc wear.**

If the brake pad thickness falls below the minimum allowed, the EBS control unit activates the brake system check and the “Brake pad wear” error message appears on the display.

**Brake pad wear regulation**

The brake pad wear regulator calculates corrective brake pressure values for each axle based on a requirement to keep the sum of brake pressures constant in order to ensure harmonisation of brake pad wear and an increase in brake pad lifetime. Regulation is done axle by axle.

**S** Sensor


S
EBS19


EBS09

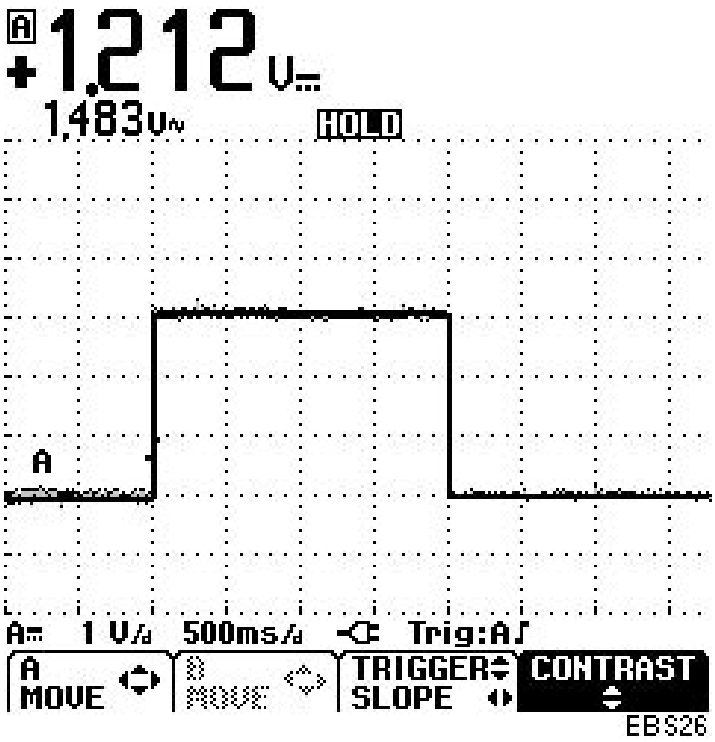
**Pinning of wear sensor:**

Pin 1 ➔ Ground

Pin 3 ➔ Signal

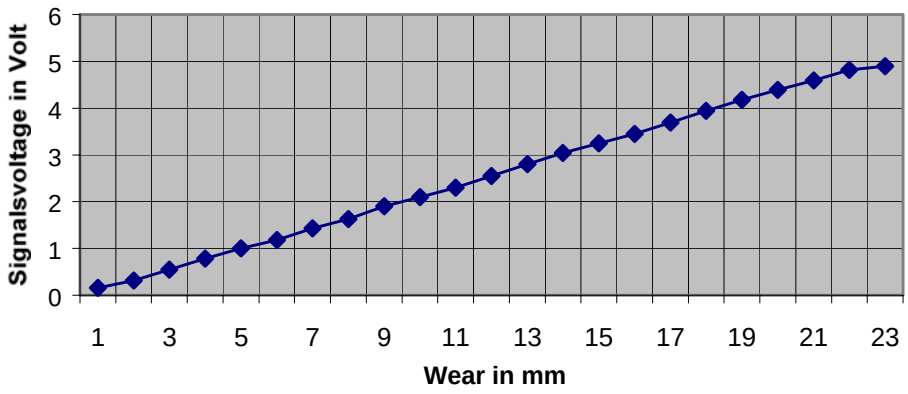
Pin 4 ➔ Power supply (5 Volts)

**Scopemeter picture of sensor signal**

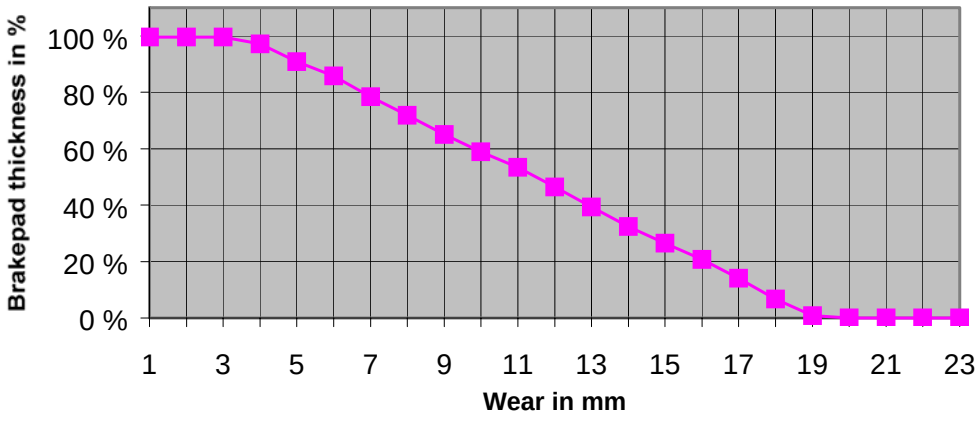



The sensor signal is sent to the control unit every time after releasing the brake

*Displaied Voltage in MAN Cats*




*Displaied wear in %*

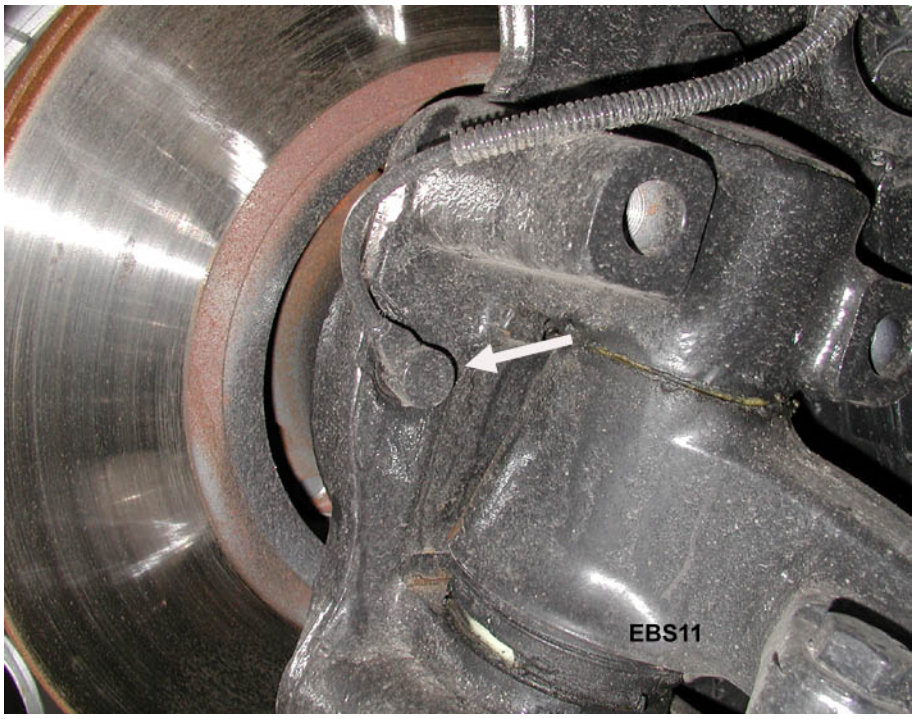


**Speed sensor**

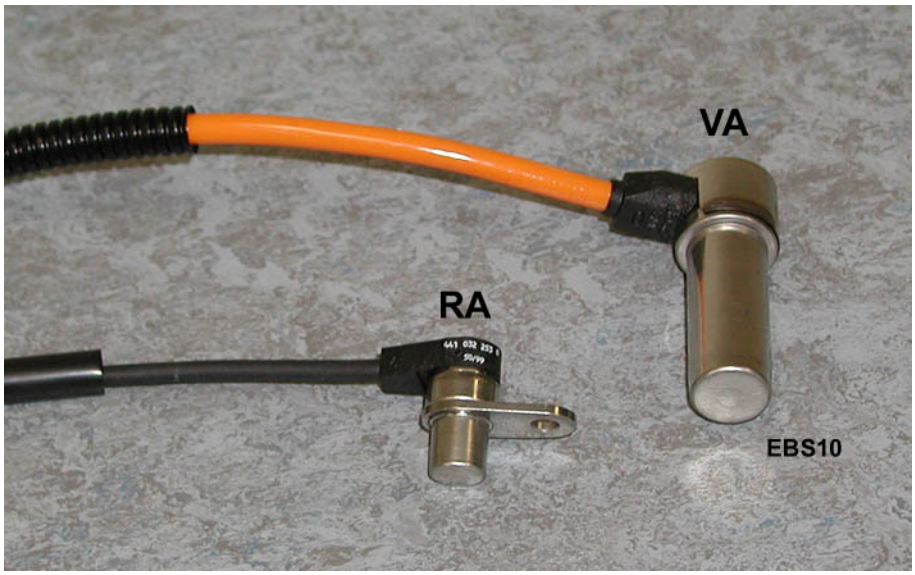
The speed sensor consists of a coil and a permanent magnet that are firmly bedded in a high-grade steel jacket to protect against vibrations.
The speed sensor is electrically connected to the pressure control module.
In this case, one speed sensor is connected to each of the 1-channel pressure control modules (on the right and left of the front axle) and two speed sensors are connected to the 2-channel pressure control module (on the rear axle).
The speed sensor system consists of a rotor and an inductive speed sensor. The rotor is mounted in accordance with the usual ABS specifications on the wheel hub.
When the wheel rotates, an alternating voltage is created in the speed sensor, the frequency of which is proportional to the wheel speed.
The speed sensor signals are recorded in the pressure control modules, converted to a CAN bus signal and transferred to the EBS ECU.

The assignment of speed sensors to wheels when connection to the pressure control module takes place can be EOL-programmed.

**Installation position** (on right of front axle)




**Sensor**



**Monitoring**

The speed sensor is monitored by the pressure control module.

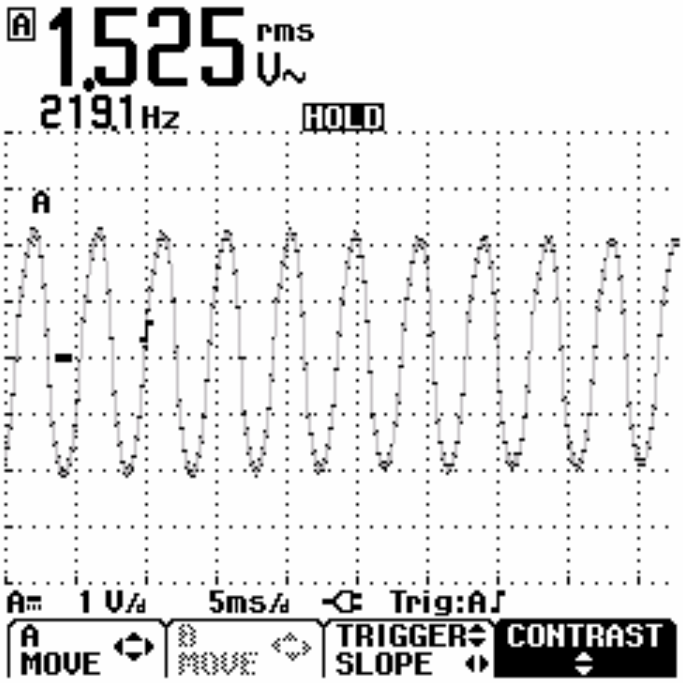
The time that elapses before the software detects a short-circuit between speed sensor connections depends on the vehicle speed.

**Vehicle speed calculation**

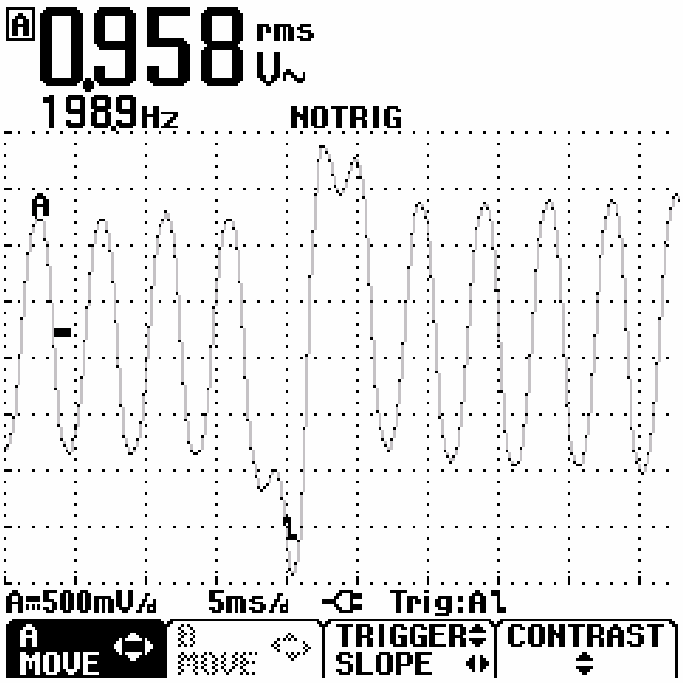
The speed sensor signals are pre-processed in the pressure control module to ensure that a vehicle speed signal promptly arrives at the EBS control unit via the “brake” CAN databus. The vehicle speed is determined from the data received from all the sensed wheels and the sent pressure control module status signals, taking into account different tyre diameters and the slip criteria. This information is then sent to the “brake” CAN databus.

## Speed sensor signal

correct




faulty



## Compatibility of different brake systems - tractor/trailer

Alongside tractor/trailer combinations with EBS, combinations of EBS tractors with conventional trailers and with trailers to ISO 11992 and ISO 7638 (7-pole) are also possible.
The effect on the trailer depends on the pneumatic and electrical supply as well as the control lines running between the tractor and trailer.

The following components are required to operate **EBS** and to ensure that tractors and trailers are interchangeable:

- Dual-line compressed air brake system with compressed air reservoir and control line.
- Plug-and-socket device for ABS **but with full pin assignment**, including pin 6 and 7 (7-pole connection cable).

**If EBS is integrated in the trailer but only a 5-pole ABS connection cable is used between the tractor and trailer, functioning in the trailer is the same as trailor without EBS.**

**Trailer socket X317**

| | | |
|---|---|---|
| X317 pin 1 | ⇒ Terminal 30 + | from central electric A100 |
| X317 pin 2 | ⇒ Terminal 15 + | from ZBR |
| X317 pin 3 | ⇒ Terminal 31 - | Ground |
| X317 pin 4 | ⇒ Terminal 31 - | Ground |
| X317 pin 5 | ⇒ Check lamp ABS | to ZBR |
| X317 pin 6 and 7 | ⇒ Trailer CAN bus | from EBS control unit |


EBS22

DIAGRAMS

**EBS survey**

**Key**

Modification status: 06.99

| | |
|---|---|
| A100 | Central electrical system |
| A402 | Control unit, EBS |
| B119 | ABS sensor, front axle, left |
| B120 | ABS sensor, front axle, right |
| B121 | ABS sensor, rear axle, left |
| B122 | ABS sensor, rear axle, right |
| B332 | Sensor, brake pad, 1st axle, right |
| B333 | Sensor, brake pad, 1st axle, left |
| B334 | Sensor, brake pad, 2nd axle, right |
| B335 | Sensor, brake pad, 2nd axle, left |
| B336 | ALB sensor, rear axle |
| B337 | Brake value sensor, EBS |
| F161 | Fuse, EBS/ABS power supply, pressure control valve |
| F162 | Fuse, EBS/ABS, control |
| S256 | Button, ASR spin threshold increase |
| X1640 | Crimp connector, line 31000 |
| X1641 | Crimp connector, line 58000 |
| X1644 | Earthing point, cab next to central electrical system |
| X1910 | Crimp connector K-KWP2 (SA) |
| X200 | Plug connection, 37-pole, diagnosis (MAN-cats) |
| X317 | Trailer socket, ABS |
| Y262 | Pressure control module, front axle, right |
| Y263 | Pressure control module, front axle, left |
| Y264 | Pressure control module, rear axle |
| Y278 | Trailer control module **Connector drop-out detection** |

Short-circuit spring insulated by control unit cell **X1/15** when inserted.

Pin **X1/12** and pin **X1/18** short-circuit if not inserted.

CAN, drive train

Ground, white

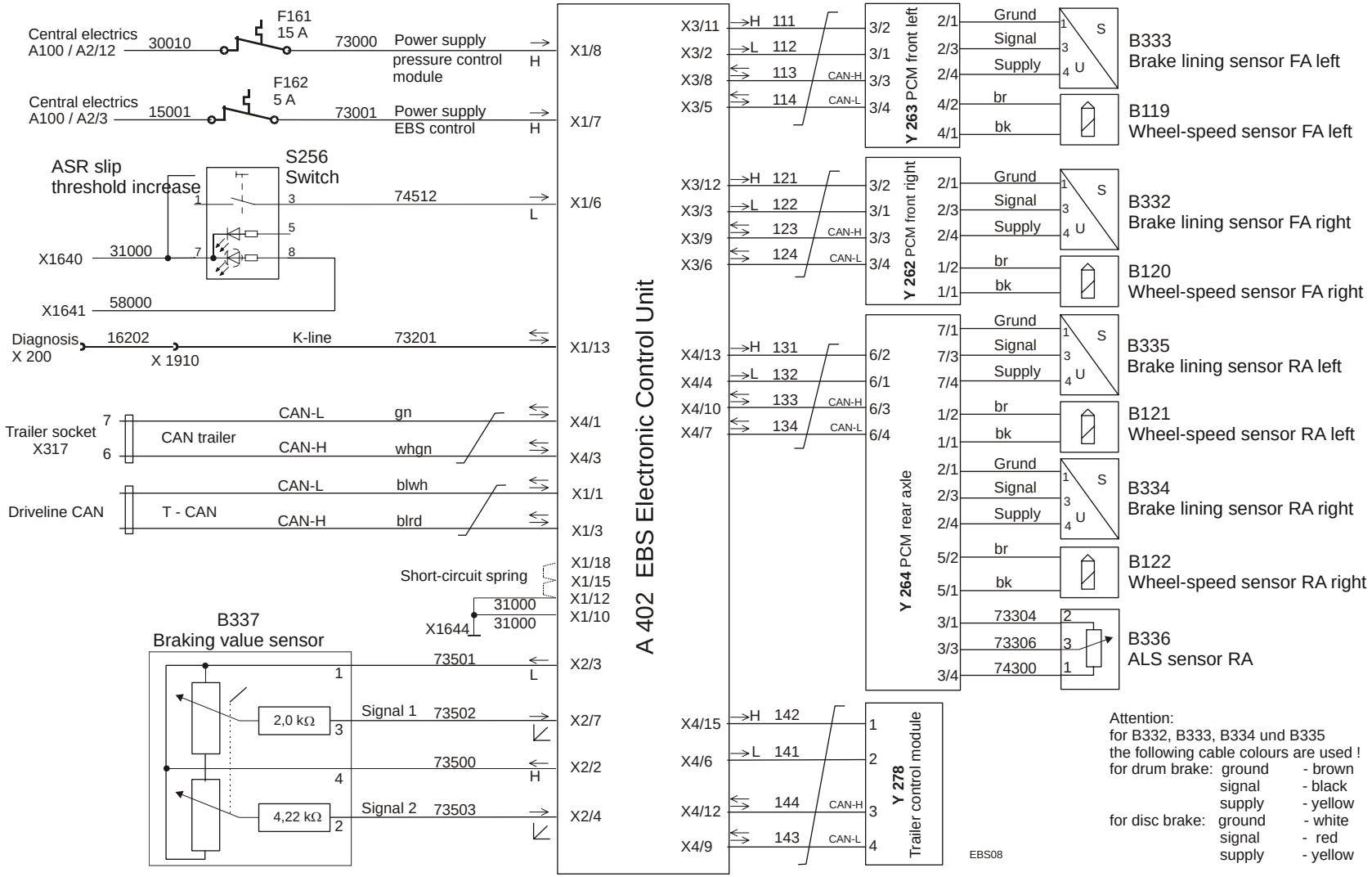
Signal, red

Supply, yellow

Brown

Black-white

## EBS survey


Central electrics A100 / A2/12
30010
F161 15 A
73000
Power supply pressure control module
H
X1/8
Central electrics A100 / A2/3
15001
F162 5 A
73001
Power supply EBS control
H
X1/7
ASR slip threshold increase
S256 Switch
74512
L
X1/6
X1640
31000
X1641
58000
Diagnosis X 200
16202
X 1910
K-line
73201
X1/13
Trailer socket X317
CAN trailer
CAN-L
gn
X4/1
CAN-H
whgn
X4/3
Driveline CAN
T - CAN
CAN-L
blwh
X1/1
CAN-H
blrd
X1/3
Short-circuit spring
X1/18
X1/15
X1/12
X1/10
31000
31000
X1644
B337
Braking value sensor
73501
L
X2/3
2,0 kΩ
Signal 1
73502
X2/7
73500
H
X2/2
4,22 kΩ
Signal 2
73503
X2/4
A 402 EBS Electronic Control Unit
X3/11
X3/2
X3/8
X3/5
H 111
L 112
113
114
CAN-H
CAN-L
Y 263 PCM front left
3/2
3/1
3/3
3/4
2/1
2/3
2/4
4/2
4/1
Grund
Signal
Supply
br
bk
B333
Brake lining sensor FA left
B119
Wheel-speed sensor FA left
X3/12
X3/3
X3/9
X3/6
H 121
L 122
123
124
Y 262 PCM front right
B332
Brake lining sensor FA right
B120
Wheel-speed sensor FA right
X4/13
X4/4
X4/10
X4/7
H 131
L 132
133
134
6/2
6/1
6/3
6/4
7/1
7/3
7/4
1/2
1/1
B335
Brake lining sensor RA left
B121
Wheel-speed sensor RA left
Y 264 PCM rear axle
2/1
2/3
2/4
5/2
5/1
B334
Brake lining sensor RA right
B122
Wheel-speed sensor RA right
3/1
3/3
3/4
73304
73306
74300
B336
ALS sensor RA
X4/15
X4/6
X4/12
X4/9
H 142
L 141
144
143
Y 278
Trailer control module
EBS08
Attention:
for B332, B333, B334 und B335
the following cable colours are used !
for drum brake: ground - brown
signal - black
supply - yellow
for disc brake: ground - white
signal - red
supply - yellow

## Wiring diagrams

**Key**

Diagram no. **81.99192.2987** Sheet **1** of 3

Modification status: 3.2001

**EBS 4x2 diagram**

**A = Pressure control module, front axle, left**

**B = Pressure control module, front axle, right**

**C = Pressure control module, rear axle**

**A**402 (399) Control unit, EBS

**B**119 (245) ABS sensor, front axle, left

B120 (246) ABS sensor, front axle, right

B121 (247) ABS sensor, rear axle, left

B122 (248) ABS sensor, rear axle, right

B332 (243) Sensor, brake pad, 1st axle, right

B333 (253) Sensor, brake pad, 1st axle, left

B334 (254) Sensor, brake pad, 2nd axle, right

B335 (255) Sensor, brake pad, 2nd axle, left

B336 (256) ALB sensor, rear axle

B337 (244) Brake value sensor, EBS

**X**317 (202) Trailer socket, ABS

X1548 Plug connection, frame IV

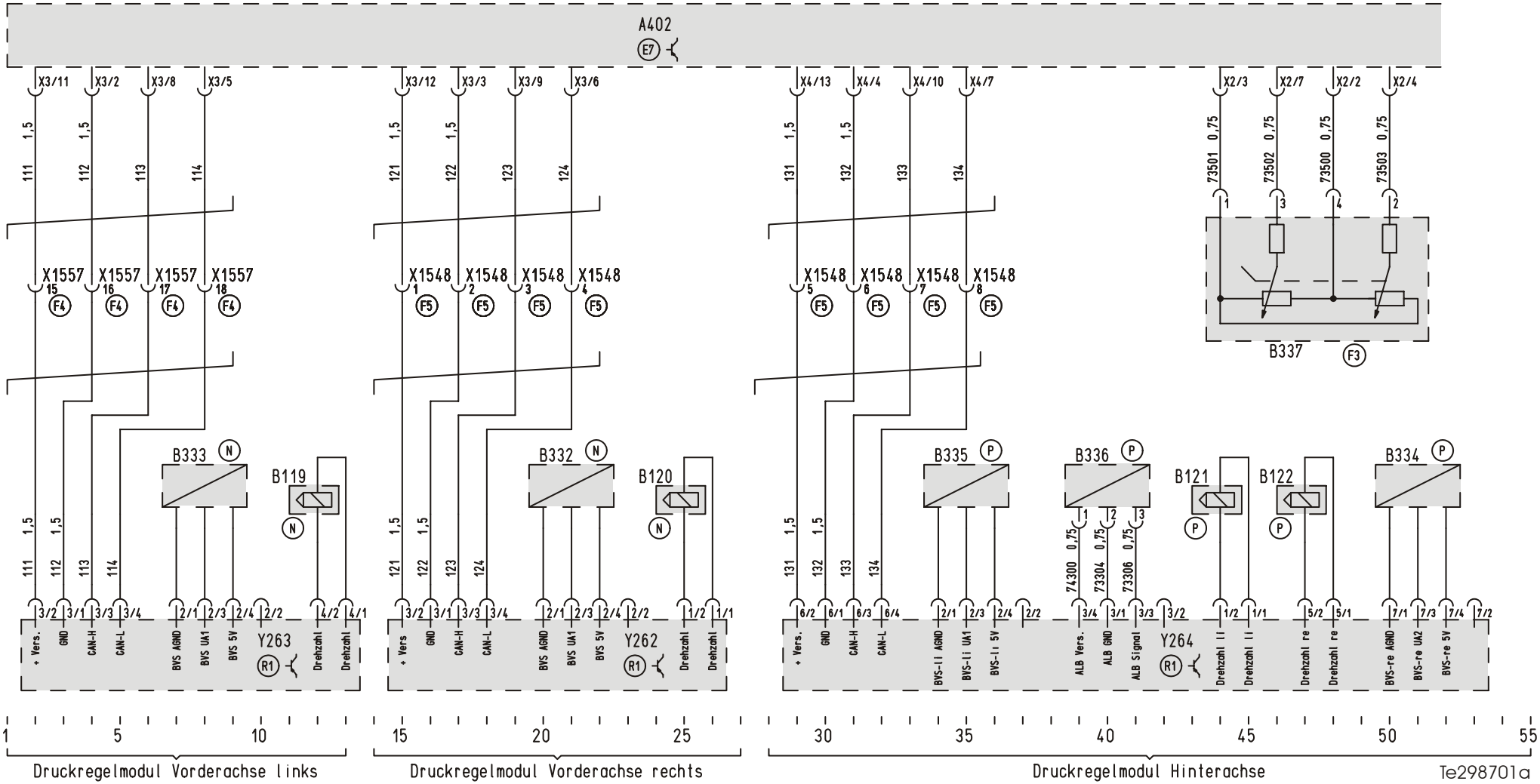
X1557 Plug connection, frame, left

**Y**262 (170) Pressure control module, front axle, right

Y263 (170) Pressure control module, front axle, left

Y264 (171) Pressure control module, rear axle

# Wiring diagam EBS *81.99192.2987 sheet **1** of 3*



**Wiring diagrams**

**Key**

Diagram no. **81.99192.2987** Sheet **2** of 3

Modification status: 3.2001

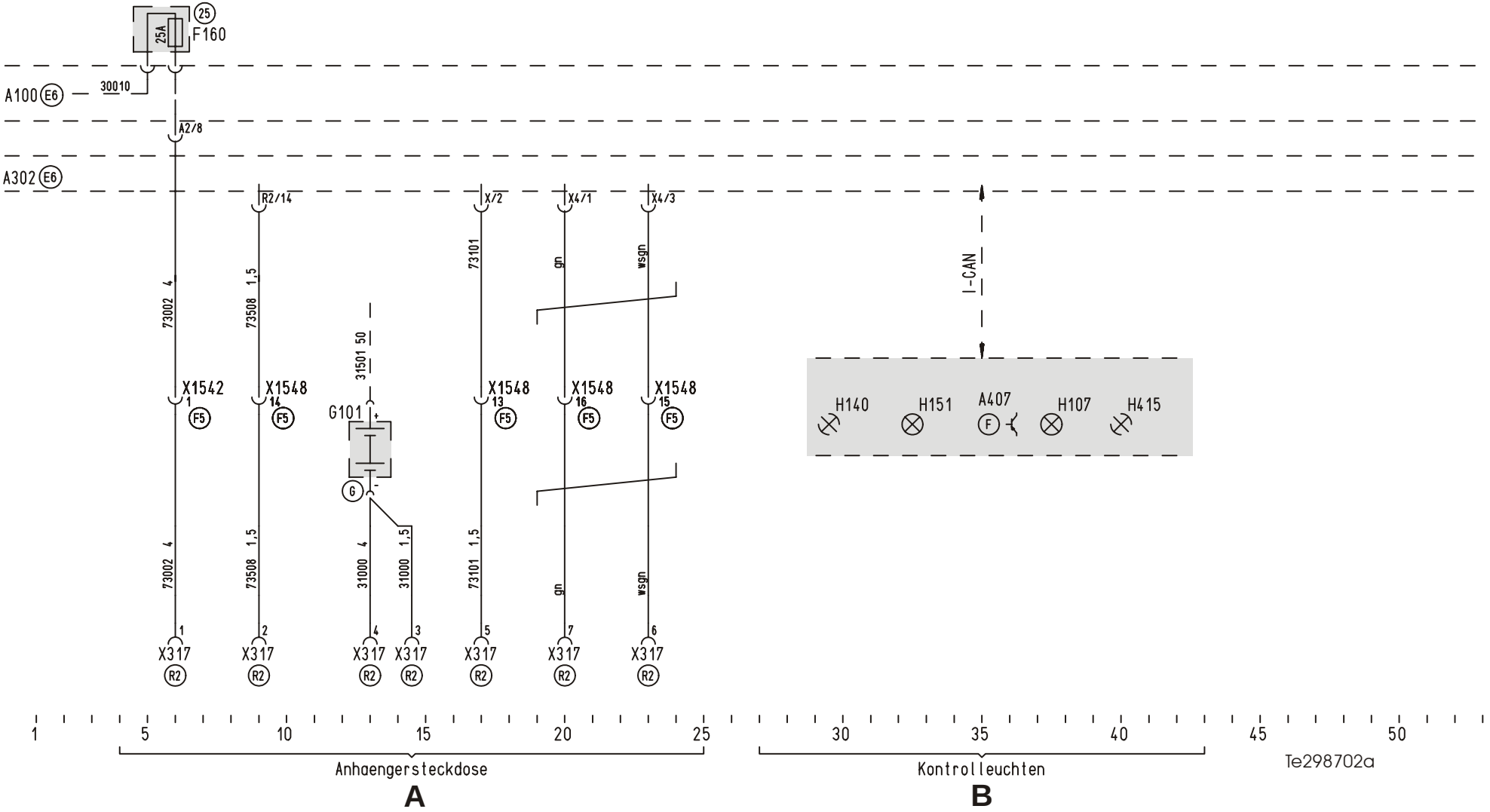
**EBS 4x2 diagram**

**A = Trailer**

**B = Check lamps**

| | | |
|---|---|---|
| **A**100 | (255) | Central electrical system |
| A302 | (352) | Central computer 2 |
| A407 | (342) | Instrumentation |
| **F**160 | (105) | Fuse, EBS/ABS, power supply, trailer |
| **G**101 | (113) | Battery 2 |
| **H**107 | | ABS, tractor/trailer |
| H140 | | Check lamp, ASR info. |
| H151 | | Check lamp, ABS info., trailer |
| H415 | | Diving stability |
| **X**317 | (202) | Trailer socket, ABS |
| X1542 | | Plug connection, frame II |
| X1548 | | Plug connection, frame IV |

# Wiring diagam EBS *81.99192.2987 sheet **2** of 3*



**EBS 4x2 diagram**

**Key**

Diagram no. **81.99192.2352** Sheet **3** of 3

Modification status: 6.99

**A = Power supply**

**B = Trailer control module**

**C = Anti-spin regulator - spin thresholds**

**D = Diagnosis**

**A**100 (255) Central electrical system

A302 (352) Central computer 2

A402 (399) Control unit, EBS

**F**161 (103) Fuse, EBS/ABS power supply, pressure control valve

F162 (111) Fuse, EBS/ABS, control

**S**256 (455) Button, ASR spin threshold increase

**X**1548 Plug connection, frame IV

X1616 Plug connection, trailer control module

X1640 Crimp connector, line 31000

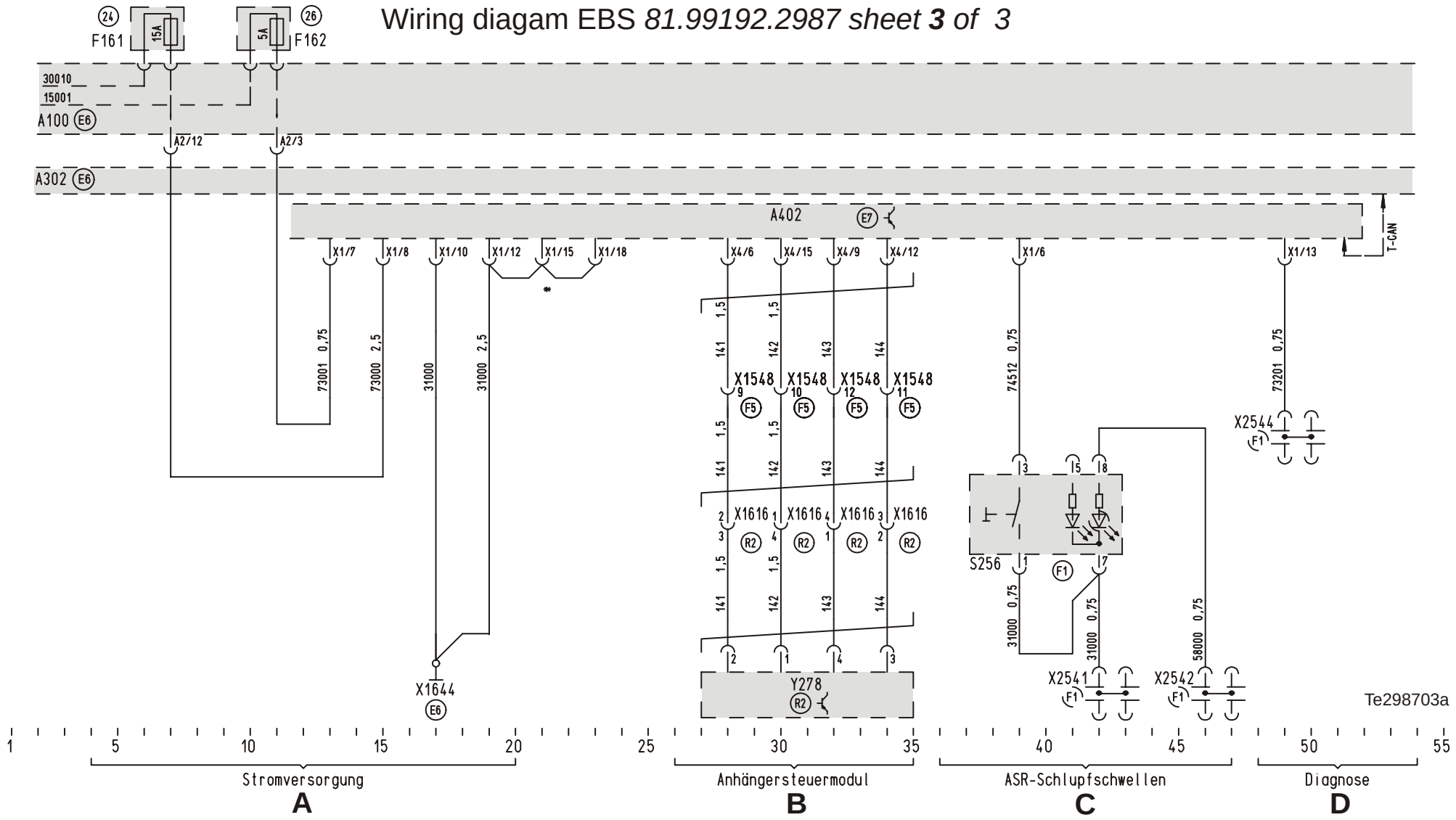
X1641 Crimp connector, line 58000

X1644 Earthing point, cab next to central electrical system

X1910 Crimp connector K-KWP2 (SA)

**Y**278 (175) Trailer control module

# Wiring diagam EBS *81.99192.2987 sheet **3** of 3*



## Pneumatic diagrams

### Equipment list for brake and compressed air systems

| | |
|---|---|
| G1.1 | Compressor 1 cylinder |
| G1.2 | Compressor 2 cylinder |
| G10.300 | Diaphragm cylinder, right |
| G10.301 | Diaphragm cylinder, left |
| G11.300 | Combination cylinder, right |
| G11.301 | Combination cylinder, left |
| G14.300 | Relay valve |
| G17.301 | Trailer control module |
| G19.3 | Coupling head, reservoir (red) with closing element |
| G19.4 | Coupling head, brake (yellow) with closing element |
| G19.30 | Dummy coupling, 2-line |
| G23.1 | Non-return valve |
| G25.300 | ECAM, 12.5 bar |
| G29.3 | Serpentine hose unions |
| G5.121 | Safety valve, 17+2 bar |
| G50.300 | Compressed air tank, 40 l, 12.5 bar |
| G50.40 | Compressed air reservoir 4 l, 12.5 bar |
| G51.3 | Drain valve with pin, without ring |
| G53.3 | Charge valve |
| G54.X | Test connections |
| G55.300 | Pressure sensor (switch), NC contact, 5.8-0.4 bar |
| G56.2 | Compressed air cylinder for exhaust flap |
| G57.2 | Pressure gauge |
| G57.300 | Pressure sensor |
| G61.200 | Solenoid valve, air-admitting |
| G67.304 | Pressure control module (1-channel) |
| G67.305 | Pressure control module (2-channel) |
| G7.302 | Service brake valve |
| G8.205 | Parking brake valve with test valve |

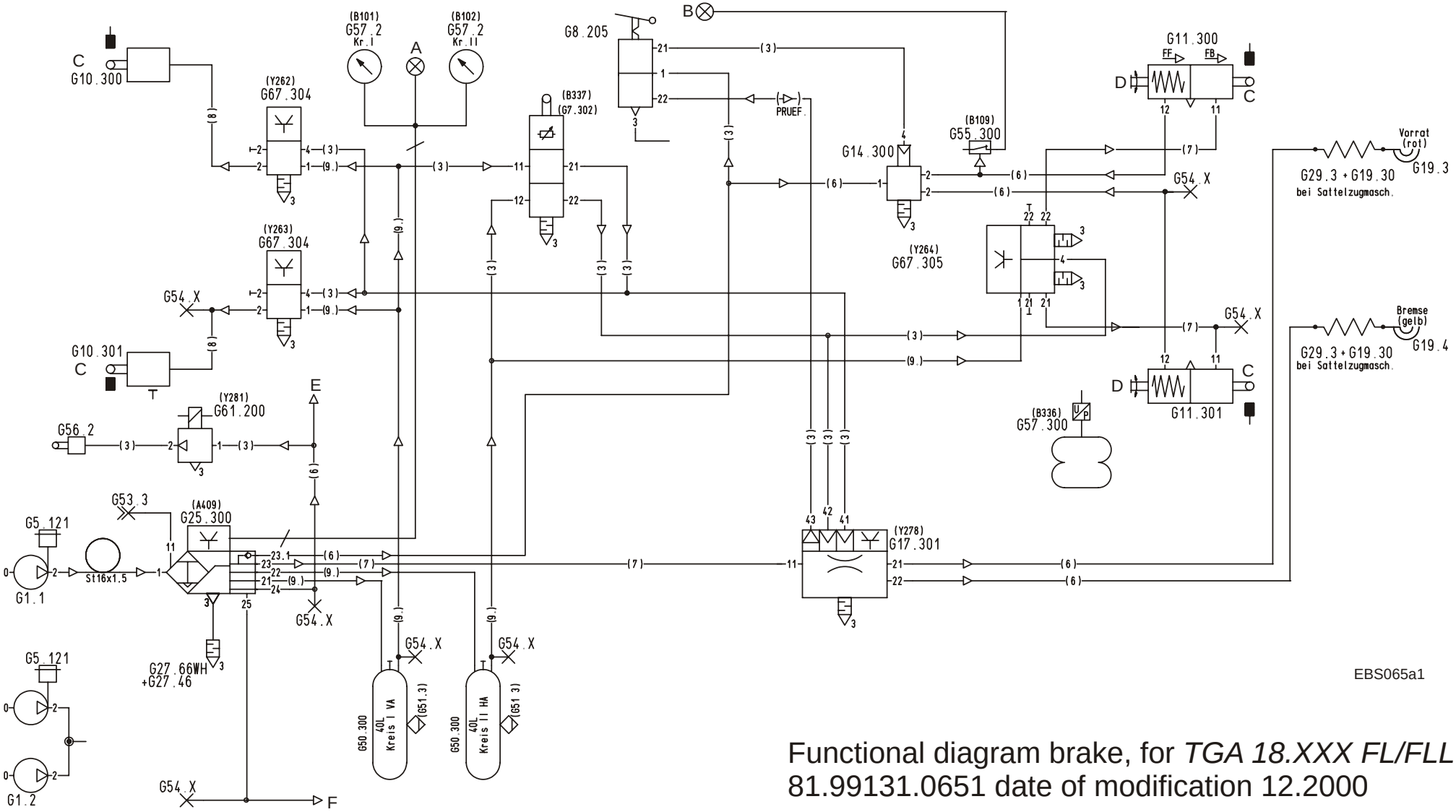
### Electrical designation

| | |
|---|---|
| (A409) | Control unit, ECAM |
| (B101) | Pressure circuit 1 |
| (B102) | Pressure circuit 2 |
| (B109) | Pulse generator |
| (B336) | ALB sensor, rear axle |
| (B337) | Operating value sensor |
| (Y262) | Pressure control module with control unit (front axle, right) |
| (Y263) | Pressure control module with control unit (front axle, left) |
| (Y264) | Pressure control module with control unit (rear axle) |
| (Y278) | Trailer control module with control unit |
| (Y281) | Solenoid valve |

**Additions**

| | |
|---|---|
| **A** | Check lamp, reservoir, brake circuit 1 and 2 |
| **B** | Check lamp, parking brake system |
| **C** | Automatic adjustment |
| **D** | Mechanical emergency release device |
| **E** | Line to auxiliary consumer |
| **F** | Line to air suspension |

| | | |
|---|---|---|
| (1) | PA 6x1 | = St 6x1 |
| (2) | PA 9x1 | = St 8x1 |
| (3) | PA 9x1,5 | = St 12x1 |
| (6) | PA 12x1,5/14x2,5 | = St 2x1 |
| (7) | PA 14x2-PHLY | = St 12x1 |
| (9.) | PA 14x2,5 ww PA 12x1,5-PHLY | |
| (8) | PA 16x2 | = St 16x1,5 |




Functional diagram brake, for *TGA 18.XXX FL/FLL*
81.99131.0651 date of modification 12.2000

## Equipment list for brake and compressed air systems

| | |
|---|---|
| G1.1 | Compressor 1 cylinder |
| G1.2 | Compressor 2 cylinder |
| G10.300 | Diaphragm cylinder, right |
| G10.301 | Diaphragm cylinder, left |
| G11.300 | Combination cylinder, right |
| G11.301 | Combination cylinder, left |
| G11.309 | Combination cylinder, left |
| G11.310 | Combination cylinder, right |
| G14.300 | Relay valve |
| G14.66 | Relay valve with adjustable lead (adjusted to 0,4 bar) |
| G21.11 | Double check valve (opening at low pressure) |
| G25.300 | ECAM, 12.5 bar |
| G27.63 | Silencer |
| G5.121 | Safety valve, 17+2 bar |
| G50.300 | Compressed air tank, 40 l, 12.5 bar |
| G50.301 | Compressed air tank, 30 l, 12.5 bar |
| G51.3 | Drain valve with pin, without ring |
| G53.3 | Charge valve |
| G54.X | Test connections |
| G55.300 | Pressure sensor (switch), NC contact, 5.8-0.4 bar |
| G56.2 | Compressed air cylinder for exhaust flap |
| G57.2 | Pressure gauge |
| G57.300 | Pressure sensor |
| G61.200 | Solenoid valve, air-admitting |
| G67.304 | Pressure control module (1-channel) |
| G67.305 | Pressure control module (2-channel) |
| G7.302 | Service brake valve |
| G8.205 | Parking brake valve with test valve |

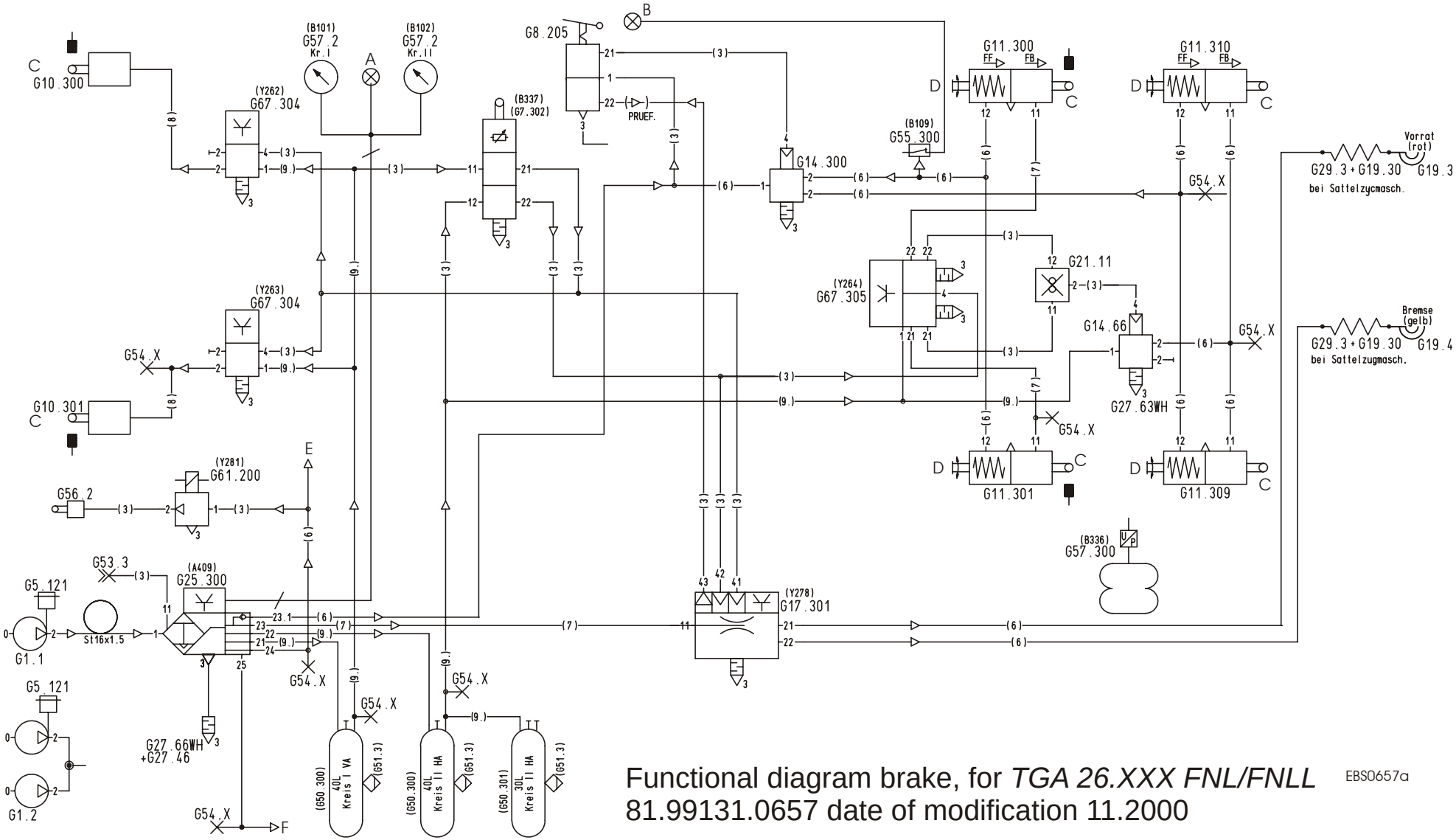
## Electrical designation

| | |
|---|---|
| (A409) | Control unit, ECAM |
| (B101) | Pressure circuit 1 |
| (B102) | Pressure circuit 2 |
| (B109) | Pulse generator |
| (B336) | ALB sensor, rear axle |
| (B337) | Operating value sensor |
| (Y262) | Pressure control module with control unit (front axle, right) |
| (Y263) | Pressure control module with control unit (front axle, left) |
| (Y264) | Pressure control module with control unit (rear axle) |
| (Y281) | Solenoid valve |

**Additions**

| | |
|---|---|
| **A** | Check lamp, reservoir, brake circuit 1 and 2 |
| **B** | Check lamp, parking brake system |
| **C** | Automatic adjustment |
| **D** | Mechanical emergency release device |
| **E** | Line to auxiliary consumer |
| **F** | Line to air suspension |

| | | |
|---|---|---|
| (4) | PA 6x1 | = St 6x1 |
| (5) | PA 9x1 | = St 8x1 |
| (6) | PA 9x1,5 | = St 12x1 |
| (6) | PA 12x1,5/14x2,5 | = St 2x1 |
| (7) | PA 14x2-PHLY | = St 12x1 |
| (9.) | PA 14x2,5 ww PA 12x1,5-PHLY | |
| (8) | PA 16x2 | = St 16x1,5 |




Functional diagram brake, for *TGA 26.XXX FNL/FNLL*
81.99131.0657 date of modification 11.2000

EBS0657a

# On-board diagnosis

## Malfunction display and emergency functions

Malfunctions and faults in the EBS system are indicated by a warning light and on the instrument panel display.

A new attempt is made to start EBS when the ignition is switched “ON” again. If the fault is still present and is detected, the light and the emergency function are activated but the error is not stored again.

A fault is detected when a certain time passes by after the error occurs.

The fault present is then classified as a “continuous” error.

Certain EBS functions are switched off, depending on the type and the severity of the error.

**These errors and the resultant operating state (back-up level) are listed in the following table.**

## Function levels of EBS

The range of available functions changes when a fault is detected in the system. Subfunctions of the main function are shut off or switched to the pneumatic back-up circuit (back-up levels).

| Function level / Function | 1 | 1a | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Control unit | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ♦ | --- |
| Pressure control module | ● | ● | ● | ● | ● | ● | ● | ● | ♦ | ♦ | ♦ | --- | --- |
| EPB | ● | ● | ● | ● | ● | ● | ● | ● | ♦ | --- | --- | --- | --- |
| Back-up circuit | + | + | + | + | + | + | + | + | ♦ | ● | ● | ● | ● |
| ALB | ● | ● | ● | ● | ● | --- | ● | ● | ♦ | --- | --- | --- | --- |
| ABS | ● | ● | ● | ● | ● | ● | ♦ | --- | ♦ | --- | --- | --- | --- |
| ASR-MR | ● | --- | ● | ● | ● | ● | --- | --- | --- | --- | --- | --- | --- |
| ASR-MR | ● | ● | ● | ● | ● | ● | --- | --- | --- | --- | --- | --- | --- |
| DBR | ● | ● | ● | ● | --- | ● | --- | --- | --- | --- | --- | --- | --- |
| Engine speed sensor | ● | ● | ● | ● | ● | ● | ♦ | --- | ♦ | ● | ● | --- | --- |
| BVS | ● | ● | ● | --- | ● | ● | ● | ● | ♦ | ● | ● | --- | --- |
| BVA | ● | ● | ● | ● | --- | ● | ● | ● | ● | ● | ● | --- | --- |
| Brake value sensor | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | --- | ● | --- |
| Trailer CAN | ♦ | ● | --- | ● | ● | ● | ● | ● | ● | ● | ♦ | --- | --- |
| Brake CAN | ● | ● | ● | ● | ● | ● | ● | ● | ♦ | ● | ● | --- | --- |
| General CAN | ● | --- | ● | ● | ● | ● | ● | ● | ● | ● | ● | --- | --- |

● = Functioning

♦ = Partially functioning (some components failed or one component only partially unctioning)

--- = Not functioning

\+ = Ready

## Description of function levels

| Level | Description |
|---|---|
| **1** | EBS functions without restrictions in the tractor and trailer. If the yellow warning light comes on in this level, this means that there is only 1-wire communication via trailer CAN or that EOL adjustment is not performed (error code 3011). |
| **1a** | EBS functions without restriction except for ASR engine control and/or general CAN communication and the associated functions. |
| **2** | The trailer EBS functions are maintained via the 5-pole trailer plug connection and the sensed pneumatic activation pressure for the trailer. |
| **3** | The brake pad wear monitor has failed. All other EBS functions are available. |
| **4** | EBS functions function without restriction. The EBS control unit continues attempting to activate the sustained-action brake and/or brake pad wear sensor. |
| **5** | EBS operates using the EOL-programmed value “L = ALB-Fehl” (ALB error) for brake pressure distribution when braking with service brake (EPB) and using the ALB value L = 0 in the case of ABS for IRM (modified individual control) on the front axle. |
| **6** | The brake pressure in the affected control channel is regulated based on the electrical setpoint (EPB). With ABS, the wheel with the defective speed sensor is treated as if it were running unblocked on the high coefficient side of the road. The brake pressure is set based on the IRM (modified individual control) conditions that apply to the axle/pressure control channel. The ASR functions (brake and engine control) are switched off. The sustained-action brake output is not activated. |
| **7** | The brake pressure at the affected control channel is controlled based on the electrical setpoint (EPB). The vehicle has no ABS. The ASR functions (brake and engine control) are switched off. The sustained-action brake output is not activated. |
| **8** | The affected pressure control module is de-energised. Braking occurs on the affected axle via the pneumatic back-up circuit, even if the pressure control module is still intact. There is no ALB or ABS control. The ASR functions (brake and engine control) are switched off. |
| **9** | EBS control unit and pressure control module are energised, all sensor signals are processed. Communication between the pressure control module and the EBS control unit is maintained. Solenoid valves remain in the starting position. They are not electrically activated. Braking is via the pneumatic back-up circuit (without ALB, ABS, ASR). |
| **10** | The EBS control unit and pressure control module are energised. The signals in the pressure control module are processed and communication between the pressure control module and the EBS control unit is maintained. The EBS control unit always sends setpoint "zero" to the pressure control module. Braking is via the pneumatic back-up circuit. There is no ALB or ASR control (brake and engine controller). |
| **11** | All pressure control modules are de-energised. The EBS control unit is energised. Braking is via the pneumatic back-up circuit. The system has no ALB, no ABS and no ASR (brake and engine controller). |
| **12** | The EBS is energised. Braking is via the pneumatic back-up circuit. The system has no ALB, no ABS and no ASR (brake and engine controller). |

## SPN list - error codes

The following is a list of the error codes that appear on the instrument panel display or the MAN-cats screen when an error occurs (**SPN - S**uspect **P**arameter **N**umber - error location)

The following check lamps are relevant in the case of the errors listed below:

**H 140** = ASR info. check lamp

**H 151** = Trailer ABS info. check lamp (yellow)

**H 107** = Tractor/trailer ABS (red)

## Error messages from the control unit

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3000 | No error | | | |
| 3001 | Control unit defective; unknown µC interrupt, µC self-test, RAM or ROM test | | | X |
| 3002 | Control unit defective; timeout data exchange µC active - µC passive | | | X |
| 3003 | Control unit defective; redundancy error, µC input signal | | | X |
| 3004 | Control unit defective; testsum data exchange µC active - µC passive | | | X |
| 3005 | Control unit defective; EEPROM error: Checksum not correct | | | X |
| 3006 | No valid error definition | | | |
| 3007 | No valid error definition | | | |
| 3008 | Control unit defective; test transmission from µC to trailer CAN IC | | | X |
| 3009 | Control unit defective; redundancy error, µC output signal | | | X |
| 3010 | Control unit defective;wheel diameter compensating value incorrect | | | X |
| 3011 | Control unit defective; error in service brake valve curve | | X | |

### Control unit error messages

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3012 | Control unit defective; incompatibility in data record version number | | | |
| 3013 | Control unit defective; curve in EEPROM not plausible | | | |
| 3014 | No valid error definition | | | |
| 3015 | No valid error definition | | | |
| 3016 | No valid error definition | | | |
| 3017 | No valid error definition | | | |
| 3018 | No valid error definition | | | |
| 3019 | No valid error definition | | | |

### Analogue signal error messages

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3020 | Defective supply voltage (5 V) for analogue sensors | | | X |
| 3021 | Defective service brake valve-potentiometer signal | | | X |
| 3022 | Defective axle load, sensor 1 | | X | |
| 3023 | Defective axle load, sensor 2 | | X | |
| 3024 | Brake pad wear: Incorrect tendency between the axles | | | |
| 3025 | Brake pad wear: Incorrect tendency between the wheels on axle 1 | | | |
| 3026 | Brake pad wear: Incorrect tendency between the wheels on axle 2 | | | |
| 3027 | Brake pad wear: Incorrect tendency between the wheels on axle 3 | | | |
| 3028 | Brake pad wear: Incorrect tendency between the wheels on axle 4 | | | |
| 3029 | No valid error definition | | | |

### Error messages, check-back signals

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H107 |
| 3030 | Defective brake pad wear and sustained-action break wear relay output stage check-back signal | | X | |
| 3031 | Defective sustained-action brake wear relay output check-back signal | | X | |
| 3032 | Defective brake pad wear output stage check-back signal | | X | |
| 3033 | Invalid check-back signal for the yellow warning light | | | |
| 3034 | Invalid check-back signal for the red warning light | | | |
| 3035 | No valid error definition | | | |
| 3036 | Short-circuit at one of the module output stages | | | |

**Error messages, check-back signals**

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H107 |
| 3037 | No valid error definition | | | |
| 3038 | No valid error definition | | | |
| 3039 | No valid error definition | | | |
| 3040 | No valid error definition | | | |

**Error messages, engine interface**

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3041 | Engine interface, DKV input permanently low, > 400 ms | X | | |
| 3042 | Engine interface, DKV input permanently high, > 400 ms | X | | |
| 3043 | Engine interface, DKV input frequency > 220 Hz | X | | |
| 3044 | Engine interface, DKV input frequency < 120 Hz | X | | |
| 3045 | Engine interface, DKV input, mark-to-space ratio < 5% | X | | |
| 3046 | Engine interface, DKV input, mark-to-space ratio > 95% | X | | |
| 3047 | DKV input permanently low or high 80 ..... 400 ms | X | | |
| 3048 | No valid error definition | | | |

**Error messages, CAN databus**

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3049 | Drive train CAN databus, receive time exceeded | | | |
| 3050 | Drive train CAN databus, Bus-Off | | X | |
| 3051 | Drive train CAN databus, receive time exceeded for message EEC1 from EDC | | X | |
| 3052 | No valid error definition | | | |
| 3053 | No valid error definition | | | |
| 3054 | No valid error definition | | | |
| 3055 | No valid error definition | | | |
| 3056 | Drive train CAN databus, receive time exceeded for message ERC1_D from retarder | | X | |
| 3057 | Drive train CAN databus, receive time exceeded for message ERC1_E from retarder | | X | |
| 3058 | Drive train CAN databus, receive time exceeded for message ERC1_EX from vehicle management computer | | X | |
| 3059 | Drive train CAN databus, receive time exceeded for message “High Resolution Vehicle Distance” from tachograph | | X | |
| 3060 | Drive train CAN databus, receive time exceeded for message “Supply Pressure” from ECAM | | | X |

## Error messages, CAN databus

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3061 | Drive train CAN databus, receive time exceeded for message EEC3 from EDC | | X | |
| 3062 | Drive train CAN databus, receive time exceeded for message “CruiseControl/VehicleSpeed” from EDC via FFR | | X | |
| 3063 | Drive train CAN databus, receive time exceeded for message “Vehicle weight measurement” from ECAS | | X | |
| 3064 | Drive train CAN databus, vehicle weight values for message “Vehicle Weight” from ECAS out of range | | X | |
| 3065 | Drive train CAN databus, receive time exceeded for message TSC1_ACC from ACC | | | |
| 3066 | No valid error definition | | | |
| 3067 | Drive train CAN databus, receive time exceeded for message TCO1 from tachograph | | | |
| 3068 | Drive train CAN databus, values for message “TCO1-Vehicle Speed” from tachograph not plausible | | | |
| 3069 | No valid error definition | | | |
| 3070 | No valid error definition | | | |
| 3071 | No valid error definition | | | |
| 3072 | No valid error definition | | | |
| 3073 | No valid error definition | | | |
| 3074 | No valid error definition | | | |
| 3075 | No valid error definition | | | |
| 3076 | No valid error definition | | | |
| 3077 | No valid error definition | | | |
| 3078 | No valid error definition | | | |
| 3079 | No valid error definition | | | |
| 3080 | No valid error definition | | | |
| 3081 | No valid error definition | | | |
| 3082 | No valid error definition | | | |
| 3083 | No valid error definition | | | |
| 3084 | No valid error definition | | | |
| 3085 | No valid error definition | | | |
| 3086 | No valid error definition | | | |
| 3087 | No valid error definition | | | |
| 3088 | No valid error definition | | | |
| 3089 | No valid error definition | | | |
| 3090 | No valid error definition | | | |
| 3091 | No valid error definition | | | |
| 3092 | No valid error definition | | | |

**Error messages, CAN databus**

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3093 | No valid error definition | | | |
| 3094 | No valid error definition | | | |
| 3095 | No valid error definition | | | |
| 3096 | No valid error definition | | | |
| 3097 | No valid error definition | | | |
| 3098 | No valid error definition | | | |
| 3099 | No valid error definition | | | |

**Error messages, PCM (1-channel)** on the left of the front axle

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3100 | PCM; front axle, left; no error | | | |
| 3101 | PCM; front axle, left; interrupt, short-circuit, wheel sensor, left | | X | |
| 3102 | PCM; front axle, left; wheel sensor, left: Excessive delay | | X | |
| 3103 | PCM; front axle, left; wheel sensor, left: Starting error | | X | |
| 3104 | PCM; front axle, left; wheel sensor, left: Excessive air gap | | X | |
| 3105 | PCM; front axle, left; infinite regulation, wheel sensor, left | | X | |
| 3106 | PCM; front axle, left; long instability, wheel sensor, left | | X | |
| 3107 | PCM; front axle, left; pulse ring error, wheel sensor, left | | X | |
| 3108 | PCM; front axle, left; error on lifting axle, wheel sensor, left | | X | |
| 3109 | PCM; front axle, left; no valid error definition | | | |
| 3110 | PCM; front axle, left; no valid error definition | | | |
| 3111 | PCM; front axle, left; interrupt, short-circuit, wheel sensor, right | | X | |
| 3112 | PCM; front axle, left; wheel sensor, right: Excessive delay | | X | |
| 3113 | PCM; front axle, left; wheel sensor, right: Starting error | | X | |
| 3114 | PCM; front axle, left; wheel sensor, right: Excessive air gap | | X | |
| 3115 | PCM; front axle, left; infinite regulation, wheel sensor, right | | X | |
| 3116 | PCM; front axle, left; long instability, wheel sensor, right | | X | |
| 3117 | PCM; front axle, left; pulse ring error, wheel sensor, right | | X | |
| 3118 | PCM; front axle, left; error on lifting axle, wheel sensor, right | | X | |
| 3119 | PCM; front axle, left; no valid error definition | | | |
| 3120 | PCM; front axle, left; error, power supply, pad wear sensor | | | |
| 3121 | PCM; front axle, left; pad wear sensor, left out of permitted value range | | | |
| 3122 | PCM; front axle, left; pad wear sensor, right out of permitted value range | | | |

**Error messages, PCM (1-channel)** on the left of the front axle

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3123 | PCM; front axle, left; pressure sensor out of permitted value range | | X | |
| 3124 | PCM; front axle, left; time for scan "current pressure" too long | | X | |
| 3125 | PCM; front axle, left; poor ventilation | | X | |
| 3126 | PCM; front axle, left; excessive pressure during the pulse test | | | X |
| 3127 | PCM; front axle, left; residual pressure after braking operation | | | |
| 3128 | PCM; front axle, left; error, pressure sensor without braking | | | |
| 3129 | PCM; front axle, left; no valid error definition | | | |
| 3130 | PCM; front axle, left; wheel sensor IC defective | | X | |
| 3131 | PCM; front axle, left; defective back-up valve check-back signal | | X | |
| 3132 | PCM; front axle, left; defective intake valve check-back signal | | X | |
| 3133 | PCM; front axle, left; defective intake and back-up valve check-back signal | | X | |
| 3134 | PCM; front axle, left; defective exhaust valve check-back signal | | X | |
| 3135 | PCM; front axle, left; defective exhaust and back-up valve check-back signal | | X | |
| 3136 | PCM; front axle, left; defective exhaust and intake valve check-back signal | | X | |
| 3137 | PCM; front axle, left; defective exhaust and intake and back-up valve check-back signal | | X | |
| 3138 | PCM; front axle, left; no valid error definition | | | |
| 3139 | PCM; front axle, left; no valid error definition | | | |
| 3140 | PCM; front axle, left; no CAN receive from module | | X | |
| 3141 | PCM; front axle, left; software incompatibility between control unit and pressure control module | | | X |
| 3142 | PCM; front axle, left; 12/24 Volt incompatibility between control unit and pressure control module | | | X |
| 3143 | PCM; front axle, left; high sequence protection, intake valve active, pressure < 4 bar | | X | |
| 3144 | PCM; front axle, left; arithmetic test not successful | | X | |
| 3145 | PCM; front axle, left; wheel balance error, wheel sensor, left | | X | |
| 3146 | PCM; front axle, left; wheel balance error, wheel sensor, right | | X | |
| 3147 | PCM; front axle, left; error at power supply, axle load sensor | | X | |
| 3148 | PCM; front axle, left; pressure difference on pressure control module pair, front axle | | X | |
| 3149 | PCM; front axle, left; no valid error definition | | | |

**Error messages, PCM (1-channel)** on the right of the front axle

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3150 | PCM; front axle, right; no error | | | |
| 3151 | PCM; front axle, right; interrupt, short-circuit, wheel sensor, left | | X | |
| 3152 | PCM; front axle, right; wheel sensor, left: Excessive delay | | X | |
| 3153 | PCM; front axle, right; wheel sensor, left: Starting error | | X | |
| 3154 | PCM; front axle, right; wheel sensor, left: Excessive air gap | | X | |
| 3155 | PCM; front axle, right; infinite regulation, wheel sensor, left | | X | |
| 3156 | PCM; front axle, right; long instability, wheel sensor, left | | X | |
| 3157 | PCM; front axle, right; pulse ring error, wheel sensor, left | | X | |
| 3158 | PCM; front axle, right; error on lifting axle, wheel sensor, left | | X | |
| 3159 | PCM; front axle, right; no valid error definition | | | |
| 3160 | PCM; front axle, right; no valid error definition | | | |
| 3161 | PCM; front axle, right; interrupt, short-circuit, wheel sensor, right | | X | |
| 3162 | PCM; front axle, right; wheel sensor, right: Excessive delay | | X | |
| 3163 | PCM; front axle, right; wheel sensor, right: Starting error | | X | |
| 3164 | PCM; front axle, right; wheel sensor, right: Excessive air gap | | X | |
| 3165 | PCM; front axle, right; infinite regulation, wheel sensor, right | | X | |
| 3166 | PCM; front axle, right; long instability, wheel sensor, right | | X | |
| 3167 | PCM; front axle, right; pulse ring error, wheel sensor, right | | X | |
| 3168 | PCM; front axle, right; error on lifting axle, wheel sensor, right | | X | |
| 3169 | PCM; front axle, right; no valid error definition | | | |
| 3170 | PCM; front axle, right; error, power supply, pad wear sensor | | | |
| 3171 | PCM; front axle, right; pad wear sensor, left out of permitted value range | | | |
| 3172 | PCM; front axle, right; pad wear sensor, right out of permitted value range | | | |
| 3173 | PCM; front axle, right; pressure sensor out of permitted value range | | X | |
| 3174 | PCM; front axle, right; time for scan “current pressure” too long | | X | |
| 3175 | PCM; front axle, right; poor ventilation | | X | |
| 3176 | PCM; front axle, right; excessive pressure during the pulse test | | | X |
| 3177 | PCM; front axle, right; residual pressure after braking operation | | | |
| 3178 | PCM; front axle, right; error, pressure sensor without braking | | | |
| 3179 | PCM; front axle, right; no valid error definition | | | |
| 3180 | PCM; front axle, right; wheel sensor IC defective | | X | |
| 3181 | PCM; front axle, right; defective back-up valve check-back signal | | X | |
| 3182 | PCM; front axle, right; defective intake valve check-back signal | | X | |

**Error messages, PCM (1-channel)** on the right of the front axle

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3183 | PCM; front axle, right; defective intake and back-up valve check-back signal | | X | |
| 3184 | PCM; front axle, right; defective exhaust valve check-back signal | | X | |
| 3185 | PCM; front axle, right; defective exhaust and back-up valve check-back signal | | | |
| 3186 | PCM; front axle, right; defective exhaust and intake valve check-back signal | | X | |
| 3187 | PCM; front axle, right; defective exhaust and intake and back-up valve check-back signal | | X | |
| 3188 | PCM; front axle, right; no valid error definition | | | |
| 3189 | PCM; front axle, right; no valid error definition | | | |
| 3190 | PCM; front axle, right; no CAN receive from module | | X | |
| 3191 | PCM; front axle, right; software incompatibility between control unit and PCM | | | X |
| 3192 | PCM; front axle, right; 12/24 Volt incompatibility between control unit and PCM | | | X |
| 3193 | PCM; front axle, right; high sequence protection, intake valve active, pressure < 4 bar | | X | |
| 3194 | PCM; front axle, right; arithmetic test not successful | | X | |
| 3195 | PCM; front axle, right; wheel balance error, wheel sensor, left | | X | |
| 3196 | PCM; front axle, right; wheel balance error, wheel sensor, right | | X | |
| 3197 | PCM; front axle, right; error at power supply, axle load sensor | | X | |
| 3198 | PCM; front axle, right; pressure difference on pressure control module pair, front axle | | X | |
| 3199 | PCM; front axle, right; no valid error definition | | | |

**Error messages, PCM (2-channel)** on the 1st rear axle (left-hand side)

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3200 | PCM; rear axle, left; no error | | | |
| 3201 | PCM; rear axle, left; interrupt, short-circuit, wheel sensor, left | | X | |
| 3202 | PCM; rear axle, left; wheel sensor, left: Excessive delay | | X | |
| 3203 | PCM; rear axle, left; wheel sensor, left: Starting error | | X | |
| 3204 | PCM; rear axle, left; wheel sensor, left: Excessive air gap | | X | |
| 3205 | PCM; rear axle, left; infinite regulation, wheel sensor, left | | X | |
| 3206 | PCM; rear axle, left; long instability, wheel sensor, left | | X | |
| 3207 | PCM; rear axle, left; pulse ring error, wheel sensor, left | | X | |

**Error messages, PCM (2-channel)** on the 1st rear axle (left-hand side)

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3208 | PCM; rear axle, left; error on lifting axle, wheel sensor, left | | X | |
| 3209 | PCM; rear axle, left; no valid error definition | | | |
| 3210 | PCM; rear axle, left; no valid error definition | | | |
| 3211 | PCM; rear axle, left; interrupt, short-circuit, wheel sensor, right | | X | |
| 3212 | PCM; rear axle, left; wheel sensor, right: Excessive delay | | X | |
| 3213 | PCM; rear axle, left; wheel sensor, right: Starting error | | X | |
| 3214 | PCM; rear axle, left; wheel sensor, right: Excessive air gap | | X | |
| 3215 | PCM; rear axle, left; infinite regulation, wheel sensor, right | | X | |
| 3216 | PCM; rear axle, left; long instability, wheel sensor, right | | X | |
| 3217 | PCM; rear axle, left; pulse ring error, wheel sensor, right | | X | |
| 3218 | PCM; rear axle, left; error on lifting axle, wheel sensor, right | | X | |
| 3219 | PCM; rear axle, left; no valid error definition | | | |
| 3220 | PCM; rear axle, left; error, power supply, pad wear sensor | | | |
| 3221 | PCM; rear axle, left; pad wear sensor, left out of permitted value range | | | |
| 3222 | PCM; rear axle, left; pad wear sensor, right out of permitted value range | | | |
| 3223 | PCM; rear axle, left; pressure sensor out of permitted value range | | X | |
| 3224 | PCM; rear axle, left; time for scan “current pressure” too long | | X | |
| 3225 | PCM; rear axle, left; poor ventilation | | X | |
| 3226 | PCM; rear axle, left; excessive pressure during the pulse test | | | X |
| 3227 | PCM; rear axle, left; residual pressure after braking operation | | | |
| 3228 | PCM; rear axle, left; error, pressure sensor without braking | | | |
| 3229 | PCM; rear axle, left; no valid error definition | | | |
| 3230 | PCM; rear axle, left; wheel sensor IC defective | | X | |
| 3231 | PCM; rear axle, left; defective back-up valve check-back signal | | X | |
| 3232 | PCM; rear axle, left; defective intake valve check-back signal | | X | |
| 3233 | PCM; rear axle, left; defective intake and back-up valve check-back signal | | X | |
| 3234 | PCM; rear axle, left; defective exhaust valve check-back signal | | X | |
| 3235 | PCM; rear axle, left; defective exhaust and back-up valve check-back signal | | X | |
| 3236 | PCM; rear axle, left; defective exhaust and intake valve check-back signal | | X | |
| 3237 | PCM; rear axle, left; defective exhaust and intake and back-up valve check-back signal | | X | |

**Error messages, PCM (2-channel)** on the 1st rear axle (left-hand side)

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3238 | PCM; rear axle, left; no valid error definition | | | |
| 3239 | PCM; rear axle, left; no valid error definition | | | |
| 3240 | PCM; rear axle, left; no CAN receive from module | | X | |
| 3241 | PCM; rear axle, left; software incompatibility between control unit and PCM | | | X |
| 3242 | PCM; rear axle, left; 12/24 Volt incompatibility between control unit and pressure control module | | | X |
| 3243 | PCM; rear axle, left; high sequence protection, intake valve active, pressure < 4 bar | | X | |
| 3244 | PCM; rear axle, left; arithmetic test not successful | | X | |
| 3245 | PCM; rear axle, left; wheel balance error, wheel sensor, left | | X | |
| 3246 | PCM; rear axle, left; wheel balance error, wheel sensor, right | | X | |
| 3247 | PCM; rear axle, left; error at power supply, axle load sensor | | X | |
| 3248 | PCM; rear axle, left; pressure difference on pressure control module pair, rear axle | | X | |
| 3249 | PCM; rear axle, left; no valid error definition | | | |

**Error messages, PCM (2-channel)** on the 1st rear axle (right-hand side)

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3250 | PCM; rear axle, right; no error | | | |
| 3251 | PCM; rear axle, right; interrupt, short-circuit, wheel sensor, left | | X | |
| 3252 | PCM; rear axle, right; wheel sensor, left: Excessive delay | | X | |
| 3253 | PCM; rear axle, right; wheel sensor, left: Starting error | | X | |
| 3254 | PCM; rear axle, right; wheel sensor, left: Excessive air gap | | X | |
| 3255 | PCM; rear axle, right; infinite regulation, wheel sensor, left | | X | |
| 3256 | PCM; rear axle, right; long instability, wheel sensor, left | | X | |
| 3257 | PCM; rear axle, right; pulse ring error, wheel sensor, left | | X | |
| 3258 | PCM; rear axle, right; error on lifting axle, wheel sensor, left | | X | |
| 3259 | PCM; rear axle, right; no valid error definition | | | |
| 3260 | PCM; rear axle, right; no valid error definition | | | |
| 3261 | PCM; rear axle, right; interrupt, short-circuit, wheel sensor, right | | X | |
| 3262 | PCM; rear axle, right; wheel sensor, right: Excessive delay | | X | |
| 3263 | PCM; rear axle, right; wheel sensor, right: Starting error | | X | |
| 3264 | PCM; rear axle, right; wheel sensor, right: Excessive air gap | | X | |
| 3265 | PCM; rear axle, right; infinite regulation, wheel sensor, right | | X | |

**Error messages, PCM (2-channel)** on the 1st rear axle (right-hand side)

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3266 | PCM; rear axle, right; long instability, wheel sensor, right | | X | |
| 3267 | PCM; rear axle, right; pulse ring error, wheel sensor, right | | X | |
| 3268 | PCM; rear axle, right; error on lifting axle, wheel sensor, right | | X | |
| 3269 | PCM; rear axle, right; no valid error definition | | | |
| 3270 | PCM; rear axle, right; error, power supply, pad wear sensor | | | |
| 3271 | PCM; rear axle, right; pad wear sensor, left out of permitted value range | | | |
| 3272 | PCM; rear axle, right; pad wear sensor, right out of permitted value range | | | |
| 3273 | PCM; rear axle, right; pressure sensor out of permitted value range | | X | |
| 3274 | PCM; rear axle, right; time for scan “current pressure” too long | | X | |
| 3275 | PCM; rear axle, right; poor ventilation | | X | |
| 3276 | PCM; rear axle, right; excessive pressure during the pulse test | | | X |
| 3277 | PCM; rear axle, right; residual pressure after braking operation | | | |
| 3278 | PCM; rear axle, right; error, pressure sensor | | | |
| 3279 | PCM; rear axle, right; no valid error definition | | | |
| 3280 | PCM; rear axle, right; wheel sensor IC defective | | X | |
| 3281 | PCM; rear axle, right; defective back-up valve check-back signal | | X | |
| 3282 | PCM; rear axle, right; defective intake valve check-back signal | | X | |
| 3283 | PCM; rear axle, right; defective intake and back-up valve check-back signal | | X | |
| 3284 | PCM; rear axle, right; defective exhaust valve check-back signal | | X | |
| 3285 | PCM; rear axle, right; defective exhaust and back-up valve check-back signal | | X | |
| 3286 | PCM; rear axle, right; defective exhaust and intake valve check-back signal | | X | |
| 3287 | PCM; rear axle, right; defective exhaust and intake and back-up valve check-back signal | | X | |
| 3288 | PCM; rear axle, right; no valid error definition | | | |
| 3289 | PCM; rear axle, right; no valid error definition | | | |
| 3290 | PCM; rear axle, right; no CAN receive from module | | X | |
| 3291 | PCM; rear axle, right; software incompatibility between control unit and pressure control module | | | X |
| 3292 | PCM; rear axle, right; 12/24 Volt incompatibility between control unit and pressure control module | | | X |
| 3293 | PCM; rear axle, right; high sequence protection, intake valve active, pressure < 4 bar | | X | |
| 3294 | PCM; rear axle, right; arithmetic test not successful | | X | |
| 3295 | PCM; rear axle, right; wheel balance error, wheel sensor, left | | X | |

**Error messages, PCM (2-channel)** on the 1st rear axle (right-hand side)

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3296 | PCM; rear axle, right; wheel balance error, wheel sensor, right | | X | |
| 3297 | PCM; rear axle, right; error at power supply, axle load sensor | | X | |
| 3298 | PCM; rear axle, right; pressure difference on pressure control module pair, rear axle | | X | |
| 3299 | PCM; rear axle, right; no valid error definition | | | |

**Error messages, PCM (2-channel)** on the 2nd rear axle (left-hand side)

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3300 | PCM; rear axle, left; no error | | | |
| 3301 | PCM; rear axle, left; interrupt, short-circuit, wheel sensor, left | | X | |
| 3302 | PCM; rear axle, left; wheel sensor, left: Excessive delay | | X | |
| 3303 | PCM; rear axle, left; wheel sensor, left: Starting error | | X | |
| 3304 | PCM; rear axle, left; wheel sensor, left: Excessive air gap | | X | |
| 3305 | PCM; rear axle, left; infinite regulation, wheel sensor, left | | X | |
| 3306 | PCM; rear axle, left; long instability, wheel sensor, left | | X | |
| 3307 | PCM; rear axle, left; pulse ring error, wheel sensor, left | | X | |
| 3308 | PCM; rear axle, left; error on lifting axle, wheel sensor, left | | X | |
| 3309 | PCM; rear axle, left; no valid error definition | | | |
| 3310 | PCM; rear axle, left; no valid error definition | | | |
| 3311 | PCM; rear axle, left; interrupt, short-circuit, wheel sensor, right | | X | |
| 3312 | PCM; rear axle, left; wheel sensor, right: Excessive delay | | X | |
| 3313 | PCM; rear axle, left; wheel sensor, right: Starting error | | X | |
| 3314 | PCM; rear axle, left; wheel sensor, right: Excessive air gap | | X | |
| 3315 | PCM; rear axle, left; infinite regulation, wheel sensor, right | | X | |
| 3316 | PCM; rear axle, left; long instability, wheel sensor, right | | X | |
| 3317 | PCM; rear axle, left; pulse ring error, wheel sensor, right | | X | |
| 3318 | PCM; rear axle, left; error on lifting axle, wheel sensor, right | | X | |
| 3319 | PCM; rear axle, left; no valid error definition | | | |
| 3320 | PCM; rear axle, left; error, power supply, pad wear sensor | | | |
| 3321 | PCM; rear axle, left; pad wear sensor, left out of permitted value range | | | |
| 3322 | PCM; rear axle, left; pad wear sensor, right out of permitted value range | | | |
| 3323 | PCM; rear axle, left; pressure sensor out of permitted value range | | X | |

**Error messages, PCM (2-channel)** on the 2nd rear axle (left-hand side)

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3324 | PCM; rear axle, left; time for scan “current pressure” too long | | X | |
| 3325 | PCM; rear axle, left; poor ventilation | | X | |
| 3326 | PCM; rear axle, left; excessive pressure during the pulse test | | | X |
| 3327 | PCM; rear axle, left; residual pressure after braking operation | | | |
| 3328 | PCM; rear axle, left; error, pressure sensor without braking | | | |
| 3329 | PCM; rear axle, left; no valid error definition | | | |
| 3330 | PCM; rear axle, left; wheel sensor IC defective | | X | |
| 3331 | PCM; rear axle, left; defective back-up valve check-back signal | | X | |
| 3332 | PCM; rear axle, left; defective intake valve check-back signal | | X | |
| 3333 | PCM; rear axle, left; defective intake and back-up valve check-back signal | | X | |
| 3334 | PCM; rear axle, left; defective exhaust valve check-back signal | | X | |
| 3335 | PCM; rear axle, left; defective exhaust and back-up valve check-back signal | | X | |
| 3336 | PCM; rear axle, left; defective exhaust and intake valve check-back signal | | X | |
| 3337 | PCM; rear axle, left; defective exhaust and intake and back-up valve check-back signal | | X | |
| 3338 | PCM; rear axle, left; no valid error definition | | | |
| 3339 | PCM; rear axle, left; no valid error definition | | | |
| 3340 | PCM; rear axle, left; no CAN receive from module | | X | |
| 3341 | PCM; rear axle, left; software incompatibility between control unit and pressure control module | | | X |
| 3342 | PCM; rear axle, left; 12/24 Volt incompatibility between control unit and pressure control module | | | X |
| 3343 | PCM; rear axle, left; high sequence protection, intake valve active, pressure < 4 bar | | X | |
| 3344 | PCM; rear axle, left; arithmetic test not successful | | X | |
| 3345 | PCM; rear axle, left; wheel balance error, wheel sensor, left | | X | |
| 3346 | PCM; rear axle, left; wheel balance error, wheel sensor, right | | X | |
| 3347 | PCM; rear axle, left; error at power supply, axle load sensor | | X | |
| 3348 | PCM; rear axle, left; pressure difference on pressure control module pair, rear axle | | X | |
| 3349 | PCM; rear axle, left; no valid error definition | | | |

**Error messages, PCM (2-channel)** on the 2nd rear axle (right-hand side)

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3350 | PCM; rear axle, right; no error | | | |
| 3351 | PCM; rear axle, right; interrupt, short-circuit, wheel sensor, left | | X | |
| 3352 | PCM; rear axle, right; wheel sensor, left: Excessive delay | | X | |
| 3353 | PCM; rear axle, right; wheel sensor, left: Starting error | | X | |
| 3354 | PCM; rear axle, right; wheel sensor, left: Excessive air gap | | X | |
| 3355 | PCM; rear axle, right; infinite regulation, wheel sensor, left | | X | |
| 3356 | PCM; rear axle, right; long instability, wheel sensor, left | | X | |
| 3357 | PCM; rear axle, right; pulse ring error, wheel sensor, left | | X | |
| 3358 | PCM; rear axle, right; error on lifting axle, wheel sensor, left | | X | |
| 3359 | PCM; rear axle, right; no valid error definition | | | |
| 3360 | PCM; rear axle, right; no valid error definition | | | |
| 3361 | PCM; rear axle, right; interrupt, short-circuit, wheel sensor, right | | X | |
| 3362 | PCM; rear axle, right; wheel sensor, right: Excessive delay | | X | |
| 3363 | PCM; rear axle, right; wheel sensor, right: Starting error | | X | |
| 3364 | PCM; rear axle, right; wheel sensor, right: Excessive air gap | | X | |
| 3365 | PCM; rear axle, right; infinite regulation, wheel sensor, right | | X | |
| 3366 | PCM; rear axle, right; long instability, wheel sensor, right | | X | |
| 3367 | PCM; rear axle, right; pulse ring error, wheel sensor, right | | X | |
| 3368 | PCM; rear axle, right; error on lifting axle, wheel sensor, right | | X | |
| 3369 | PCM; rear axle, right; no valid error definition | | | |
| 3370 | PCM; rear axle, right; error, power supply, pad wear sensor | | | |
| 3371 | PCM; rear axle, right; pad wear sensor, left out of permitted value range | | | |
| 3372 | PCM; rear axle, right; pad wear sensor, right out of permitted value range | | | |
| 3373 | PCM; rear axle, right; pressure sensor out of permitted value range | | X | |
| 3374 | PCM; rear axle, right; time for scan “current pressure” too long | | X | |
| 3375 | PCM; rear axle, right; poor ventilation | | X | |
| 3376 | PCM; rear axle, right; excessive pressure during the pulse test | | | X |
| 3377 | PCM; rear axle, right; residual pressure after braking operation | | | |
| 3378 | PCM; rear axle, right; error, pressure sensor without braking | | | |
| 3379 | PCM; rear axle, right; no valid error definition | | | |
| 3380 | PCM; rear axle, right; wheel sensor IC defective | | X | |
| 3381 | PCM; rear axle, right; defective back-up valve check-back signal | | X | |

**Error messages, PCM (2-channel)** on the 2nd rear axle (right-hand side)

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3382 | PCM; rear axle, right; defective intake valve check-back signal | | X | |
| 3383 | PCM; rear axle, right; defective intake and back-up valve check-back signal | | X | |
| 3384 | PCM; rear axle, right; defective exhaust valve check-back signal | | X | |
| 3385 | PCM; rear axle, right; defective exhaust and back-up valve check-back signal | | X | |
| 3386 | PCM; rear axle, right; defective exhaust and intake valve check-back signal | | X | |
| 3387 | PCM; rear axle, right; defective exhaust and intake and back-up valve check-back signal | | X | |
| 3388 | PCM; rear axle, right; no valid error definition | | | |
| 3389 | PCM; rear axle, right; no valid error definition | | | |
| 3390 | PCM; rear axle, right; no CAN receive from module | | X | |
| 3391 | PCM; rear axle, right; software incompatibility between control unit and pressure control module | | | X |
| 3392 | PCM; rear axle, right; 12/24 Volt incompatibility between control unit and pressure control module | | | X |
| 3393 | PCM; rear axle, right; high sequence protection, intake valve active, pressure < 4 bar | | X | |
| 3394 | PCM; rear axle, right; arithmetic test not successful | | X | |
| 3395 | PCM; rear axle, right; wheel balance error, wheel sensor, left | | X | |
| 3396 | PCM; rear axle, right; wheel balance error, wheel sensor, right | | X | |
| 3397 | PCM; rear axle, right; error at power supply, axle load sensor | | X | |
| 3398 | PCM; rear axle, right; pressure difference on pressure control module pair, front axle | | X | |
| 3399 | PCM; rear axle, right; no valid error definition | | | |

**Error messages, trailer control module (TCM)**

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3400 | Trailer control module, no error | | | |
| 3401 | Trailer control module electronic control unit, unknown µC interrupt,<br>µC self-test, RAM or ROM test | | X | |
| 3402 | Trailer control module, no valid error definition | | | |
| 3403 | Trailer control module electronic control unit, EEPROM, too many write access operations | | | |
| 3404 | Trailer control module electronic control unit, EEPROM, checksum error or EOL data invalid | | X | |
| 3405 | Trailer control module electronic control unit, EEPROM, to many data repairs | | X | |

## Error messages, trailer control module (TCM)

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3406 | Trailer control module electronic control unit, EEPROM, monitoring time exceeded during data writing | | X | |
| 3407 | Trailer control module, no valid error definition | | | |
| 3408 | Trailer control module electronic control unit, EEPROM, error in dynamic parameters | | X | |
| 3409 | Trailer control module electronic control unit, EEPROM, dynamic parameters out of the permitted value range | | X | |
| 3410 | Trailer control module, no valid error definition | | | |
| 3411 | Trailer control module, no valid error definition | | | |
| 3412 | Trailer control module, no valid error definition | | | |
| 3413 | Trailer control module, no valid error definition | | | |
| 3414 | Trailer control module, no valid error definition | | | |
| 3415 | Trailer control module, no valid error definition | | | |
| 3416 | Trailer control module, error in coupling force regulation | | X | |
| 3417 | Trailer control module, no valid error definition | | X | |
| 3418 | Trailer control module, no valid error definition | | X | |
| 3419 | Trailer control module, error in weight estimation | | X | |
| 3420 | Trailer control module, no valid error definition | | | |
| 3421 | Trailer control module, no valid error definition | | | |
| 3422 | Trailer control module, pressure sensor out of the permitted value range | | X | |
| 3423 | Trailer control module, implausible pressure sensor value when no braking | | X | |
| 3424 | Trailer control module, no valid error definition | | X | |
| 3425 | Trailer control module, pressure build-up too slow and error at parking brake switch | | X | |
| 3426 | Trailer control module, residual pressure after pressure build-up greater than threshold value at parking brake switch | | | |
| 3427 | Trailer control module, residual pressure after braking operation | | | |
| 3428 | Trailer control module, no valid error definition | | | |
| 3429 | Trailer control module, no valid error definition | | | |
| 3430 | Trailer control module, no valid error definition | | | |
| 3431 | Trailer control module, defective back-up valve check-back signal | | X | |
| 3432 | Trailer control module, defective intake valve check-back signal | | X | |
| 3433 | Trailer control module, no valid error definition | | X | |
| 3434 | Trailer control module, defective exhaust valve check-back signal | | X | |
| 3435 | Trailer control module, no valid error definition | | X | |
| 3436 | Trailer control module, defective exhaust valve and intake valve check-back signal | | X | |

**Error messages, trailer control module (TCM)**

| SPN | SPN plain text | Check lamps | | |
|---|---|---|---|---|
| | | H 140 | H 151 | H 107 |
| 3437 | Trailer control module, no valid error definition | | X | |
| 3438 | Trailer control module, no valid error definition | | | |
| 3439 | Trailer control module, no valid error definition | | | |
| 3440 | Trailer control module, no CAN receive from trailer control module | | X | |
| 3441 | Trailer control module, software incompatibility between control unit and trailer control module | | | X |
| 3442 | Trailer control module, 12/24 V incompatibility between control unit and trailer control module | | X | |
| 3443 | Trailer control module; high sequence protection, intake valve active, pressure < 4 bar | | X | |
| 3444 | Trailer control module, arithmetic test not successful | | X | |
| 3445 | Trailer control module, impermissible pressure at coupling head | | | |
| 3446 | Trailer control module, no valid error definition | | | |
| 3447 | Trailer control module, no valid error definition | | | |
| 3448 | Trailer control module, pressure difference between pressure control modules and trailer control module | | | |
| 3449 | Trailer control module, no valid error definition | | | |

**Error messages, ESP**

| SPN | SPN plain text |
|---|---|
| 3450 | ESP, no valid error definition |
| 3451 | ESP, internal control unit error |
| 3452 | ESP, no valid error definition |
| 3453 | ESP, checkback, voltage implausible |
| 3454 | ESP, no valid error definition |
| 3455 | ESP configuration not valid |
| 3456 | ESP, EEPROM, checksum invalid |
| 3457 | ESP, EEPROM, parameter defective |
| 3458 | ESP, EEPROM, parameter out-of-range |
| 3459 | ESP, EEPROM, not programmable |
| 3460 | ESP, no valid error definition |
| 3461 | ESP EOL data in the EBS ECU not compatible with ESP software version |
| 3462 | ESP, no valid error definition |
| 3463 | ESP, no valid error definition |
| 3464 | ESP, no valid error definition |
| 3465 | ESP, no valid error definition |
| 3466 | ESP, no valid error definition |
| 3467 | ESP, lateral acceleration sensor out of permitted range |
| 3468 | ESP, no valid error definition |
| 3469 | ESP, lateral acceleration sensor, long-time alignment |
| 3470 | ESP, lateral acceleration sensor, standstill alignment |
| 3471 | ESP, lateral acceleration sensor, plausibility monitoring valid for model |
| 3472 | ESP, lateral acceleration sensor, plausibility monitoring not valid for model |
| 3473 | ESP, steering angle sensor not calibrated |
| 3474 | ESP, steering angle sensor, CAN timeout |
| 3475 | ESP, steering angle sensor out of permitted range |
| 3476 | ESP, steering angle sensor, defective CAN message content |
| 3477 | ESP, steering angle sensor, gradient error |
| 3478 | ESP, steering angle sensor, long-time alignment |
| 3479 | ESP, steering angle sensor, constant signal |

| SPN | SPN plain text |
|---|---|
| 3480 | ESP, steering angle sensor incorrectly mounted, incorrect steering angle sign |
| 3481 | ESP, steering angle sensor, plausibility monitoring between steering angle and rotational speed |
| 3482 | ESP, no valid error definition |
| 3483 | ESP, rotational speed sensor, CAN timeout |
| 3484 | ESP, rotational speed sensor signal out of permitted range |
| 3485 | ESP, rotational speed sensor, defective CAN message content |
| 3486 | ESP, rotational speed sensor, static BITE error |
| 3487 | ESP, rotational speed sensor, dynamic BITE error |
| 3488 | ESP, steering angle sensor, gradient error |
| 3489 | ESP, no valid error definition |
| 3490 | ESP, rotational speed sensor, fast alignment |
| 3491 | ESP, rotational speed sensor, standstill alignment |
| 3492 | ESP, rotational speed sensor, normal alignment |
| 3493 | ESP, rotational speed sensor, sensitivity error |
| 3494 | ESP, rotational speed sensor, plausibility monitoring valid for model |
| 3495 | ESP, rotational speed sensor, plausibility monitoring not valid for model |
| 3496 | ESP, rotational speed sensor incorrectly mounted, incorrect steering angle sign |
| 3497 | ESP, rotational speed sensor, plausibility monitoring between rotational speed and steering angle |
| 3498 | ESP, no valid error definition |
| 3499 | ESP, no valid error definition |
| 3500 | ESP, no CAN communication with ESP |
| 3501 | ESP, software incompatible |
| 3502 | ESP, 12/24V incompatible with EBS |
| 3503 | ESP, no valid error definition |
| 3504 | ESP, ALU test failed |
| 3505 | ESP, output stage defective |
| 3506 | ESP, intervention not plausible |
| 3507 | OBD, no valid error definition |
| 3508 | OBD, no valid error definition |
| 3509 | OBD, no valid error definition |

| SPN | SPN plain text |
|---|---|
| 3510 | OBD, no valid error definition |
| 3511 | OBD, no valid error definition |
| 3512 | OBD, request, red warning lamp for diagnosis |
| 3513 | OBD, request, yellow warning lamp for diagnosis |
| 3514 | OBD, no valid error definition |
| 3515 | OBD, brake wear sensor signal |
| 3516 | OBD, trailer EBS has no errors |
| 3517 | OBD, voltage too high or too low |
| 3518 | OBD, trailer interface in single line mode |
| 3519 | OBD, wheel speed sensor, error during the last switch-on cycle |
| 3520 | OBD, limit gap speed, warning level, repeated every second |
| 3521 | OBD, frequent-stop brake active |
| 3522 | OBD, chassis dynamometer mode active |
| 3523 | OBD, no valid error definition |
| 3524 | OBD, no valid error definition |
| 3525 | OBD, external wheel alignment (speedo signal/speed sensor) |
| 3526 | OBD, alignment, lateral acceleration sensor not completed |
| 3527 | OBD, steering angle sensor, fast alignment not completed |
| 3528 | OBD, ESP control unit overvoltage or undervoltage |
| 3529 | OBD, ESP is passive |

## EBS 2.3 with ESP

**Use**

Currently, the EBS 2.3 is used only in semi-trailer tractors. It is largely identical with the EBS 2.2 unit but has the ESP as an additional function. The ESP has its own electronic control unit and is connected via the CAN BUS for the brake with the EBS control unit. A steering-wheel-angle and a yaw-rate/transverse-acceleration sensor is connected to the EBS control unit.

**Function**

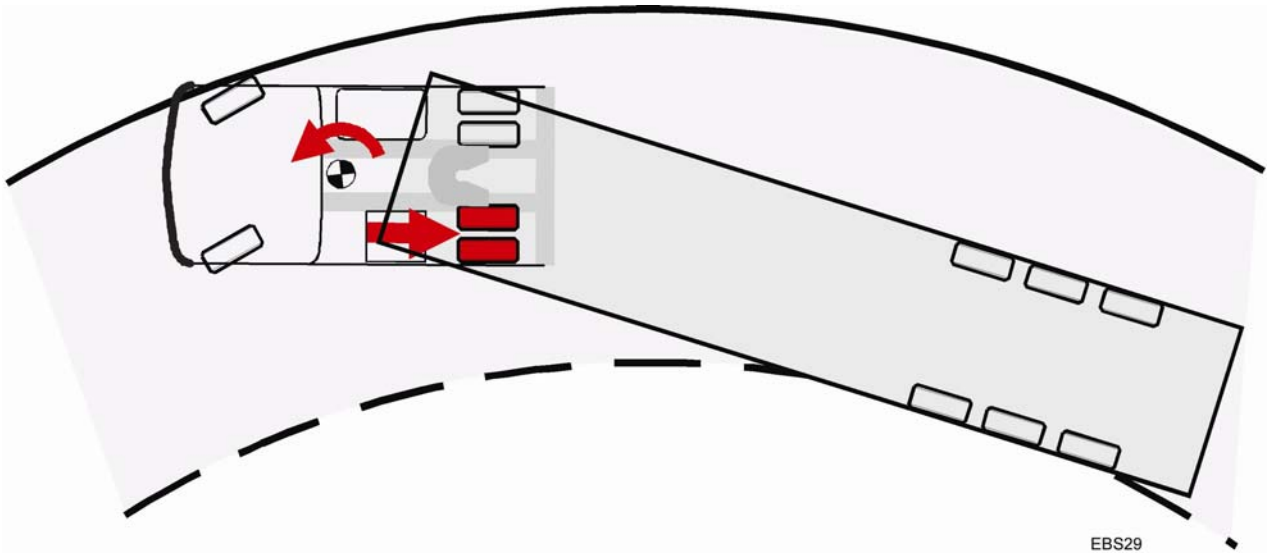
The ESP stabilises the vehicle within the limits of physics and counteracts the effects of "oversteering" and "understeering".

In addition, the ESP reduces the risk of the vehicle turning over.

**Understeering**

(Pushing via the front wheels):

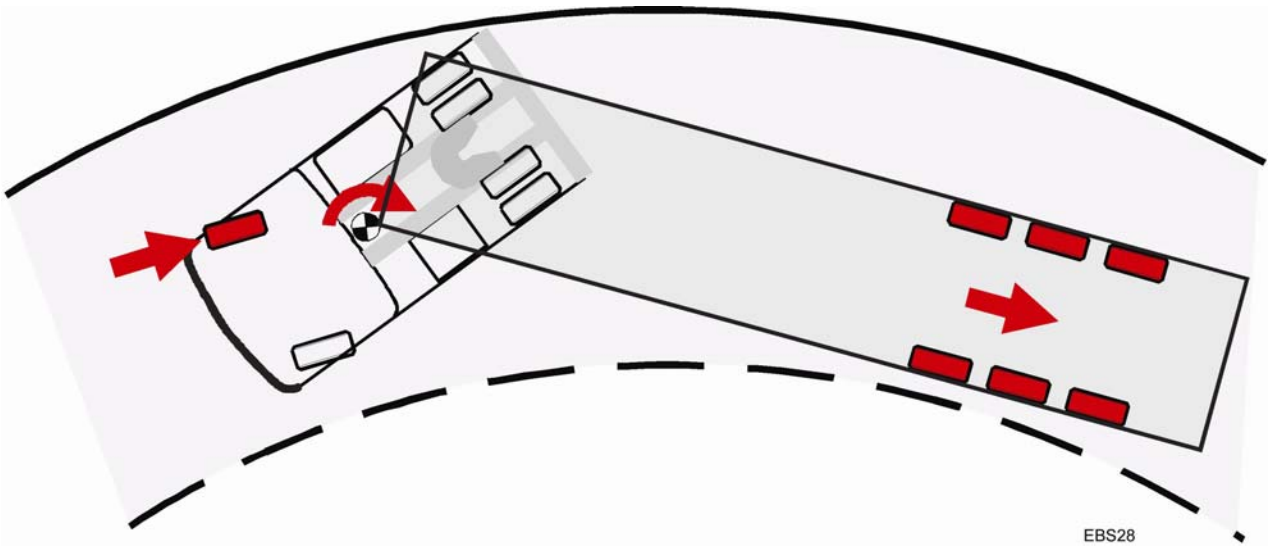
Deceleration of the inside rear wheel




**Oversteering**

(Jackknifing)

Deceleration of the outside front wheel and of the trailer



## ESP electronic control unit

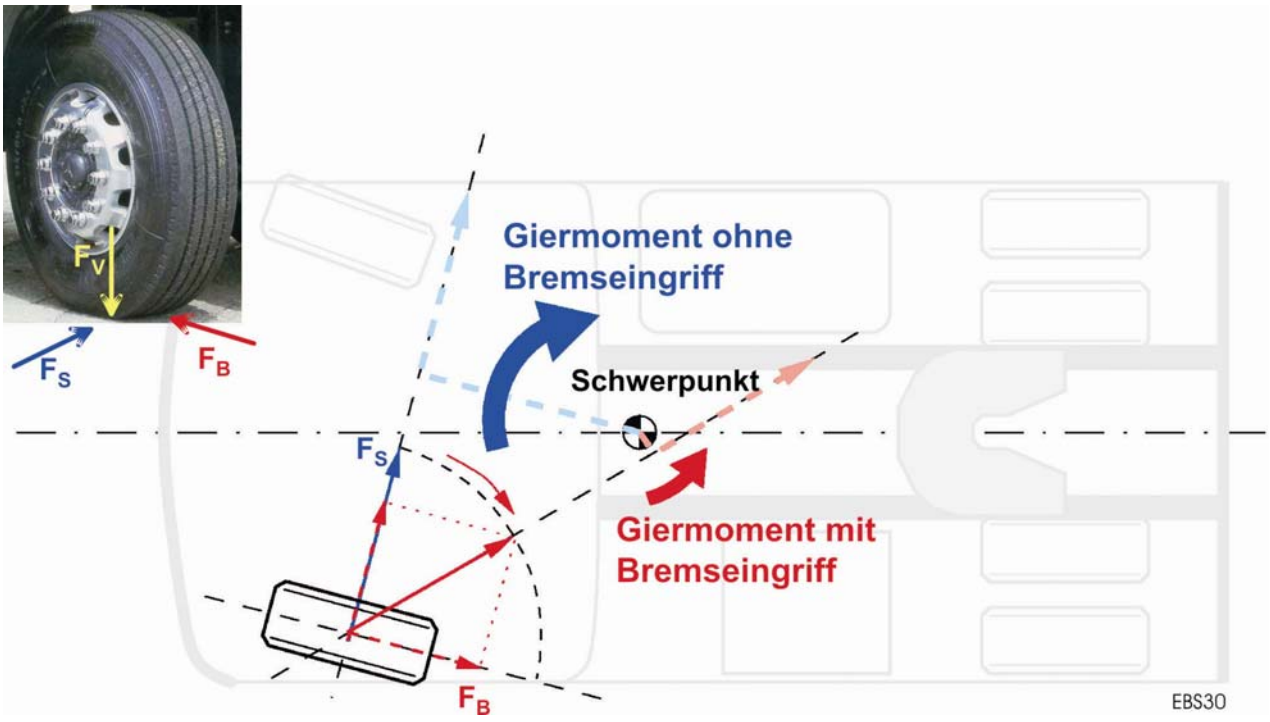
### Use

The ESP-ECU is used in conjunction with the EBS-ECU as a regulating unit for the ESP in semi-trailer tractors. The ECU offers the following functions:

- ESP function
- Monitoring
- Diagnosis

### Structure of the ECU

The ECU housing contains a PC board with a strip of plugs soldered into place. The PC board integrates the entire electronic circuit with all components.




Giermoment ohne/mit Bremseingriff = Yawing moment without/with brake intervention;
Schwerpunkt = Centre of gravity

**Maintenance**

The ECU unit is maintenance-free.

**Technical data:**

| | |
|---|---|
| Nominal voltage: | 24 volt direct voltage |
| Power consumption: | 1 ampere |
| Operating temperature: | -40° to +85°C |

**Important:**

- Turn off driving switch and disconnect the power supply before disconnecting the plug from and reconnecting it to the ECU.
- Unplug battery plug before carrying out electric or protective gas arc welding work as well as before quick charging.
- While externally supplied starting aid is being given, the permissible on-board voltage must not be exceeded; otherwise the plug on the ECU is to be disconnected too.
- If during painting work the temperature at the ECU exceeds +80°C, the ECU unit must be removed.
- Operation without battery is not permissible.
- The data from the vehicle manufacturers must be heeded.

**Diagnosis**

The fault memory is read out via the diagnostic interface on the EBS-ECU. Faults in the ESP are reported via the CAN-BUS to the EBS-ECU. A fault in the ESP is indicated on the display or via a warning lamp in the instrument panel.

## Steering-wheel angle sensor

### Use

The steering-wheel angle sensor is used with the ESP for recording the steering angle of the wheels.

### Structure

The steering-wheel angle sensor is integrated in a housing and has its own electronics.

### Function

The steering-wheel angle sensor is installed in the steering column and driven by the steering column. The measuring range is 1560°, which is equivalent to approx. 4.3 turns of the steering wheel.

The steering-wheel angle sensor is connected to the ESP-ECU which supplies the sensor with a voltage of 12 volt. It has its own integrated electronics which converts the measured values into CAN signals and sends them on to the ECU.

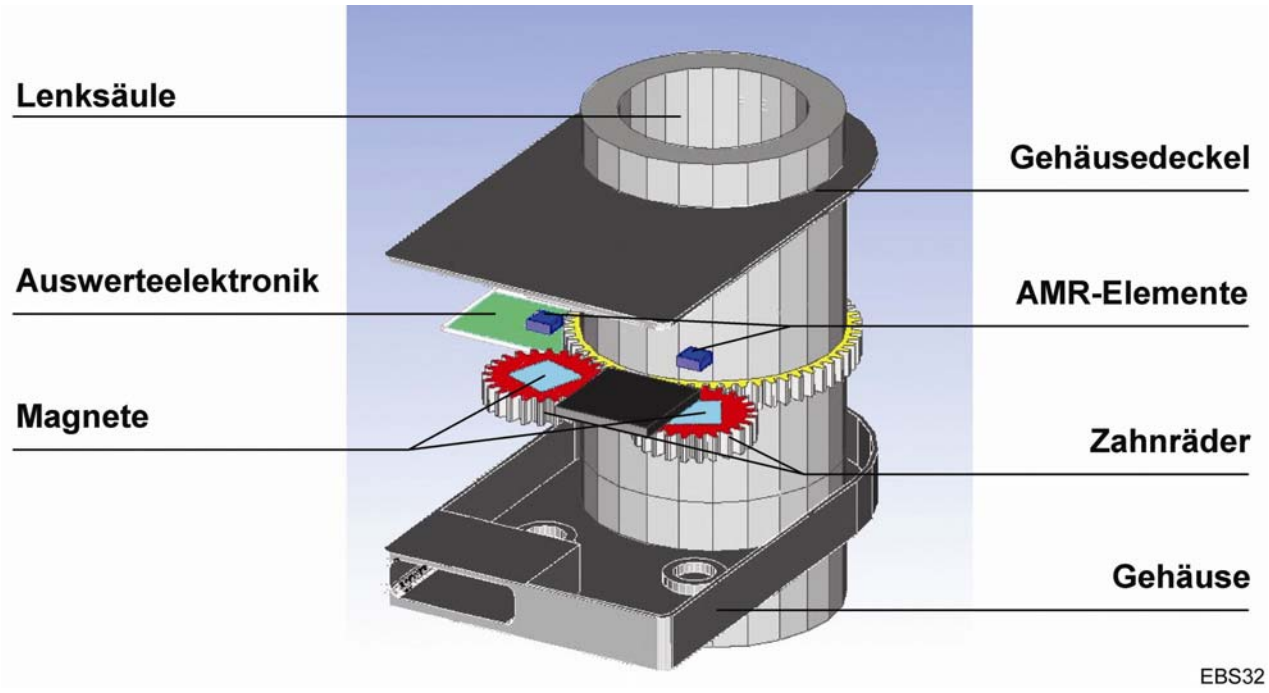
If a sensor fails, the ESP will be switched off. A fault message is released via the EBS. The functioning of the EBS is not impaired by this.

### Maintenance

The steering-wheel angle sensor is maintenance-free.

The following jobs necessitate readjusting the steering-wheel angle sensor:

- Exchange of the sensor
- Adjustment work concerning wheel toe, wheel camber, the steering linkage, steering shaft, steering column and steering gear
- After an accident in which the steering was damaged


Lenksäule = Steering column, Auswerteelektronic = Evaluation electronics, Magnete = Solenoids, Gehäusedeckel = Housing cover, AMR-Elemente = AMR elements, Zahnräder = Gears, Gehäuse = Housing

# Yaw-rate and transverse-acceleration sensor

**Sensor**

This sensor records the yaw rate via the vehicle's vertical axis and transverse acceleration.

**Function**

The yaw-rate sensor incorporates two micromechanical oscillating masses. The yaw rate is recorded with the aid of these oscillating masses. For measuring the transverse acceleration a micromechanical acceleration sensor is used. Both sensors are contained in a housing. An integrated electronic system processes the signals and sends them via the CAN BUS to the ESP-ECU. The yaw-rate and transverse-acceleration sensor is supplied with a voltage of 12 volt by the ESP-ECU. The housing is located outside the cab and fitted to the frame.

If a sensor fails the ESP will be switched off. A fault message is sent via the EBS. The functioning of the EBS is not impaired by this.

The sensor is attached to the vehicle frame and supplied with a voltage of 12 volt.

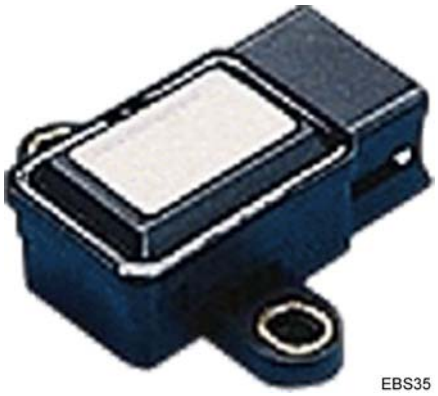
The values measured by the sensor are evaluated by the ESP-ECU and passed on to the EBS-ECU via the CAN BUS for the brake.

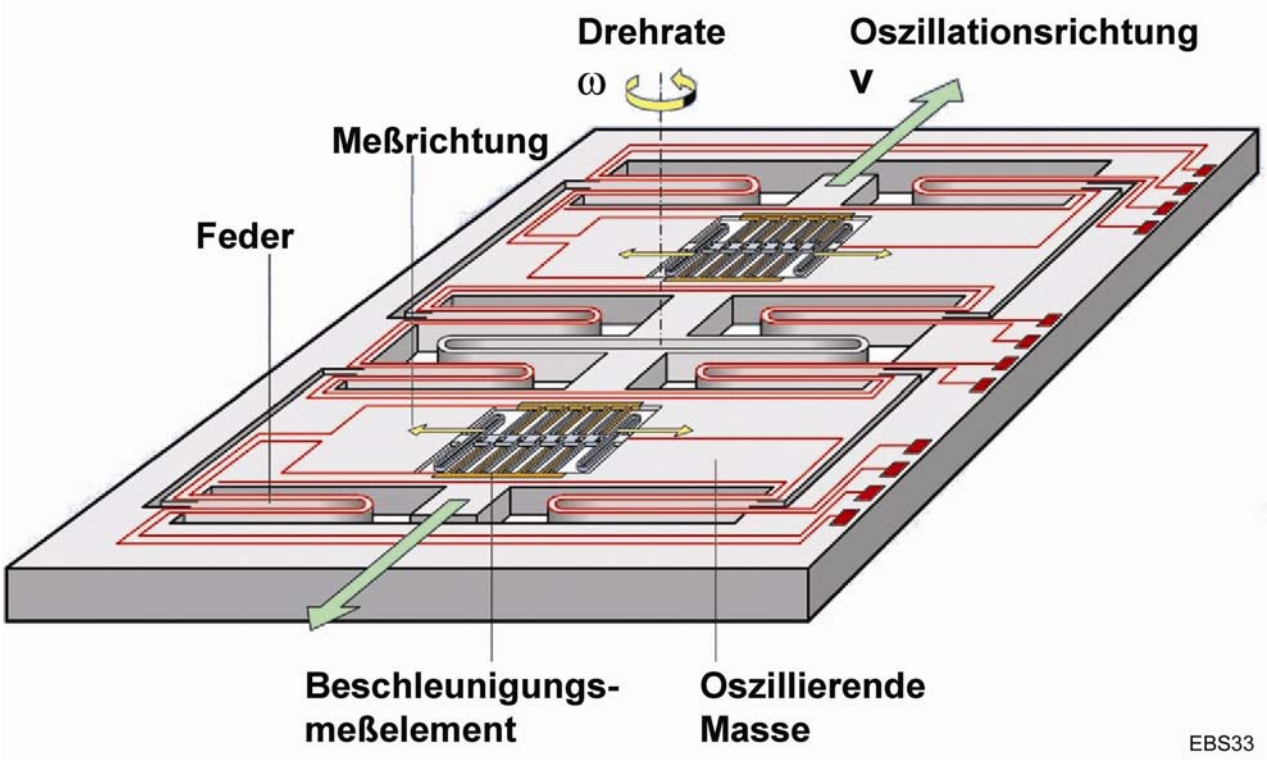
**Maintenance**

The yaw-rate and transverse-acceleration sensor is maintenance-free.

The following jobs necessitate readjustment work:

- Exchange of the sensor
- Removal and installation of the sensor
- After an accident in which the frame or the sensor holder may have been damaged or deformed.




Feder = Spring, Meßrichtung = Measuring direction, Drehrate = Yaw rate, Oszillationsrichtung = Oscillating direction, Beschleunigungsmeßelement = Acceleration measuring element, Oszillierende Masse = Oscillating mass