Introduction

The growing competitive pressure in the transportation trade is the reason that the requirements on the brake system also increase steadily. The introduction of the Electronically controlled Braking System EBS is the logical step to meet this and other requirements.

Benefits of EBS

– EBS enhances vehicle and road safety by means of reducing the stopping distance, achieving improved braking stability and montitoring the braking system.

– EBS spares the brake pads and offers wheel brakes the possibility of a durably optimal coordination of the braking powers between the single one as well as between towing machine and trailer.

– The full diagnosis and surveillance functions of the EBS as well as the display of brake lining wear offer an effective fleet logistics.

– In addition, EBS considerably improves both economic efficiency and driving comfort.

For this reason EBS will be included in new vehicle series. The pioneer was the new vehicle series ACTROS from Daimler-Benz which has an electronically controlled air braking system fitted as standard equipment. This system by name of “Telligent® Braking System” from Daimler-Benz (formerly EPB), is a joint development by Daimler-Benz and WABCO.

Please note

The term “Telligent® Braking System” comprises the whole of the braking system, not only its controlling system which we call EPB.

The ACTROS “Telligent® Braking System” contains some specific Daimler-Benz features for which WABCO, in applications for vehicles from other manufacturers (in the meantime e. g. EVO-Bus and IVECO), has substituted its own solutions. These includes the following functions:

– Special control functions in the area of brake force distribution (differential, drive-slip control DSR), lining wear control and trailer control

– Lining wear regulation and control of the trailer

– Redundancy Valve, Rear axle redundancy

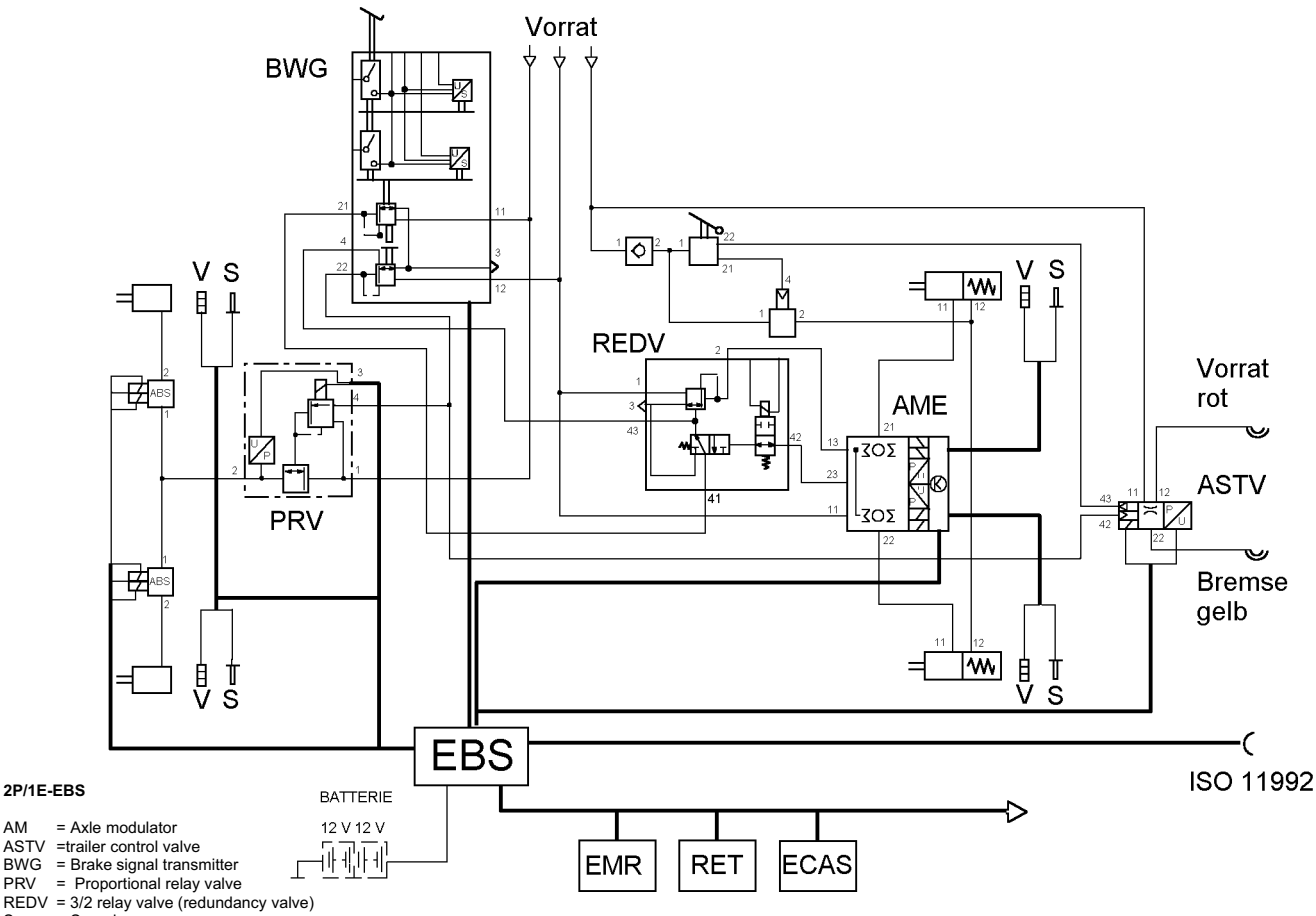
– testing and diagnostic methods typical for ACTROS.

WABCO EBS construction kit

The design and structure of WABCO EBS allow high flexibility for vehicle manufacturers during system construction. In terms of range

- subsystem or full system
- Way of redundancy
- Trailer control strategy
- electrical interfaces
- etc.

the most complex demands can, therefore, be met. For meeting the essential requirements of the vehicle owner, WABCO recommends an EBS which comprises individual pressure control on front and rear axles and trailer control, and which provides for pneumatic redundancies in all braking circuits.

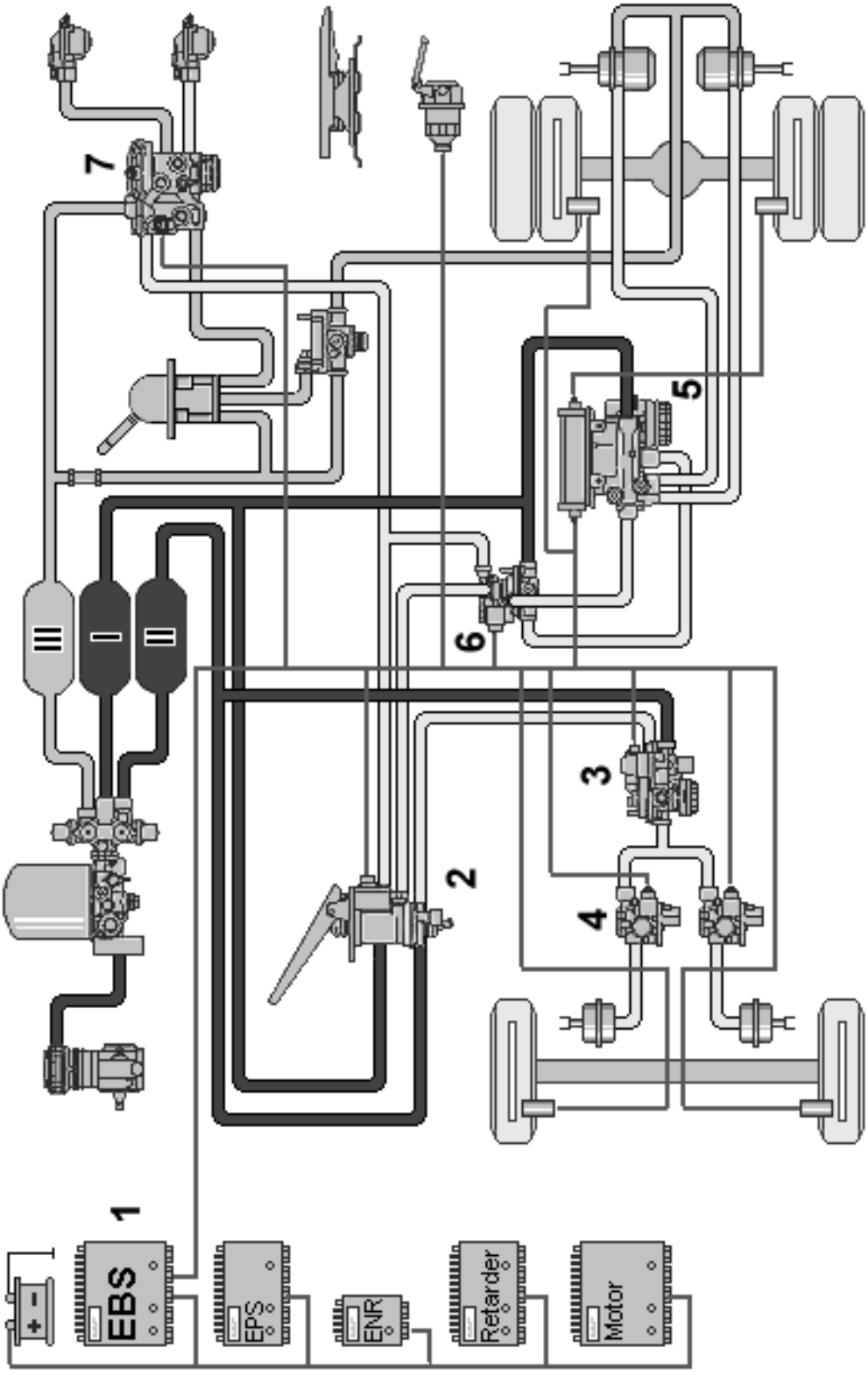


The EBS described here consists of a dual-circuit, purely pneumatic unit and a superimposed single-circuit, electro-pneumatic unit. This configuration is described as 2P/1E system.

The single circuit electro-pneumatic part of the system consists of one central electronic control unit (central module), the axle modulator with integrated electronics for the rear axle, a brake signal transmitter with parely pneumatical integrated stroke sensors and brake switches, an electro-pneumatic control valve and two ABS valves for the front axle, plus an electro-pneumatic trailer control valve.

In terms of structure, the dual-circuit pneumatic unit basically corresponds to that of a conventional braking system. This unit serves as redundancy and only becomes active in case of electro-pneumatic circuit failure.

EBS Brake System for Track 4 x 2



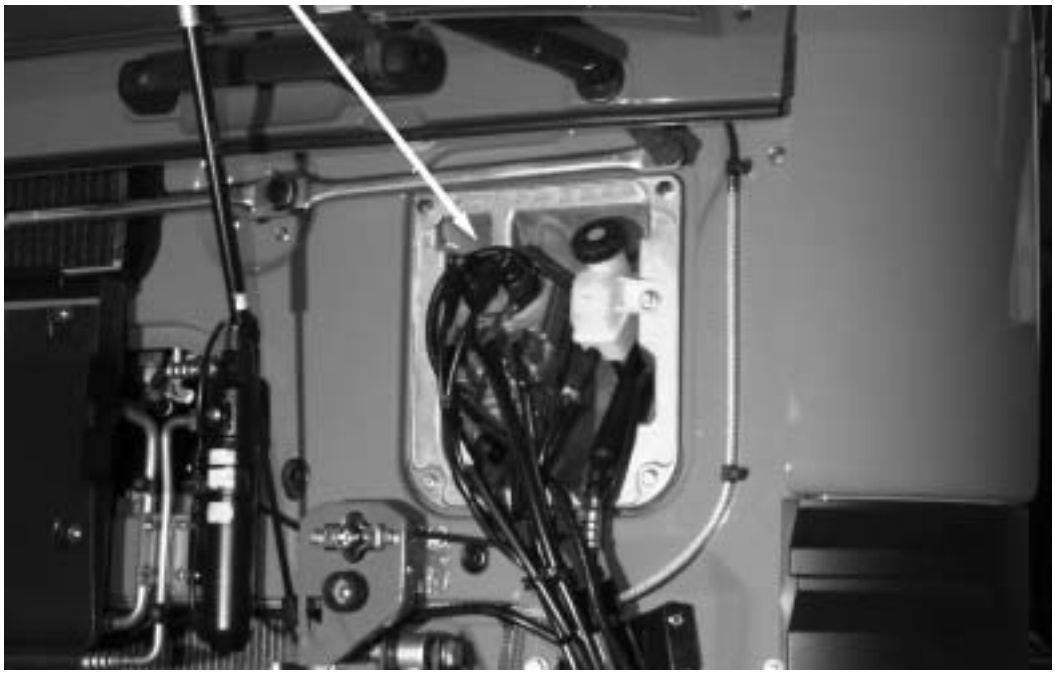
Legend

1. Central Module
2. Brake Signal Transmitter
3. Proportional relay valve
4. ABS solenoid valve
5. Rear Axle Modulator
6. 3/2 relay valve (redundancy valve)
7. trailer control valve

Brake signal transmitter 480 001

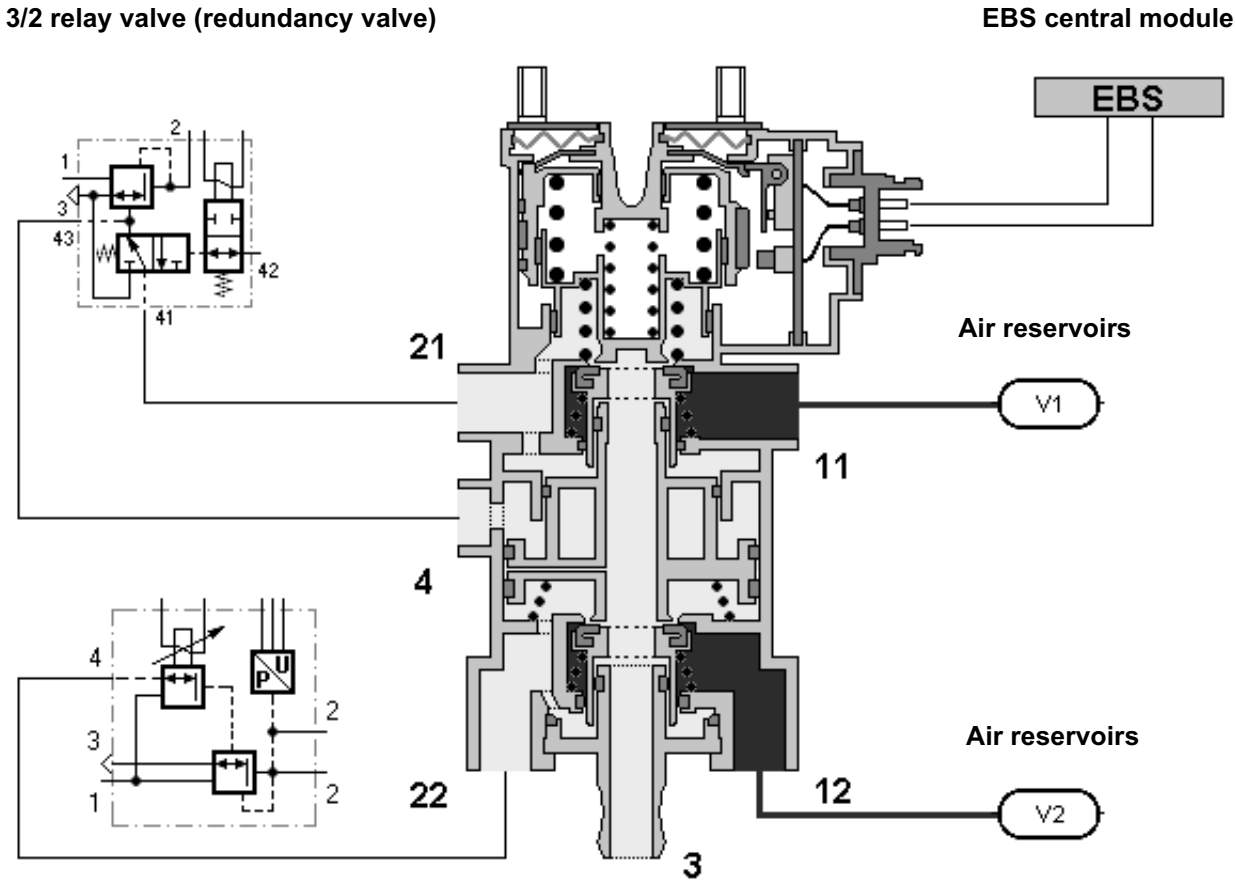
The brake signal transmitter is used to produce electrical and pneumatic signals, and to increase and decrease the air pressure of the electronically controlled braking system. The device has a dual-circuit pneumatic and a dual-circuit electrical structure. Actuation start is recorded electronically by a double switch. The operating tappet's route is controlled and transmitted as pulse-width modulated electrical signal. Further pneumatic redundancy pressure is delivered in circuits 1 and 2. The pressure in the second circuit is retained slightly in the process. Via an additional pilot connection 4 it is possible (at a customer's specific request) to adjust the pneumatic characteristic of the 2nd circuit. In case of (electrical or pneumatic) failure of a circuit, the other circuits remain functional.

Position (MB Actros): driver's cab - front
place of installtion: the same as before the foot brake valve



Brake signal transmitter 480 001

Mode of function

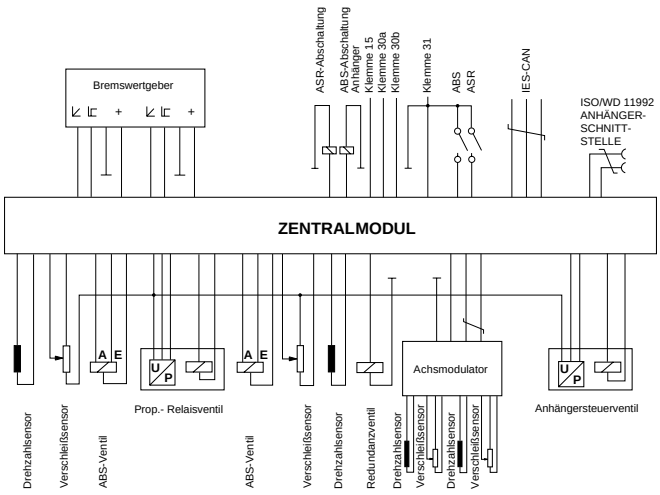


Central module

446 130

The central module is used to control and monitor the electronically controlled braking system. It determines the vehicle's nominal delay from the signals received by the brake signal transmitter. Together with the wheel speeds measured by the wheel speed sensors, the intended retardation is the input signal for EBS control which uses these readings to establish the index pressure values for the front and rear axles and the trailer control valve. The front axle's nominal pressure value is then compared with the measured actual value, and any existing deviations corrected with the help of the proportional relay valve. Output of the trailer control pressure is achieved in a similar manner. Moreover, the wheel velocity is evaluated so that in case of locking, an ABS control can be carried out by modulating the braking pressure in the brake cylinders. The central module exchanges data, via the EBS system bus, with the axle modulator (or axle modulators in 6S/6M systems). Electrical braking systems for trailers are actuated via a data interface to ISO 11992. The central module communicates with other systems of the towing vehicle (engine control, retarder, etc.) via a vehicle data bus.

Central module 446 130 . . . 0



Place of installation (MB Actros):
Footwell - front-seat passenger side

Proportional relay valve 480 202

The proportional relay valve is used in the electronically controlled braking system to modulate the braking pressure on the front axle.

It comprises the proportional solenoid valve, relay valve and pressure sensor. Electrical drive and monitoring takes place via the central module of the hybrid system (electro-pneumatically / pneumatically).

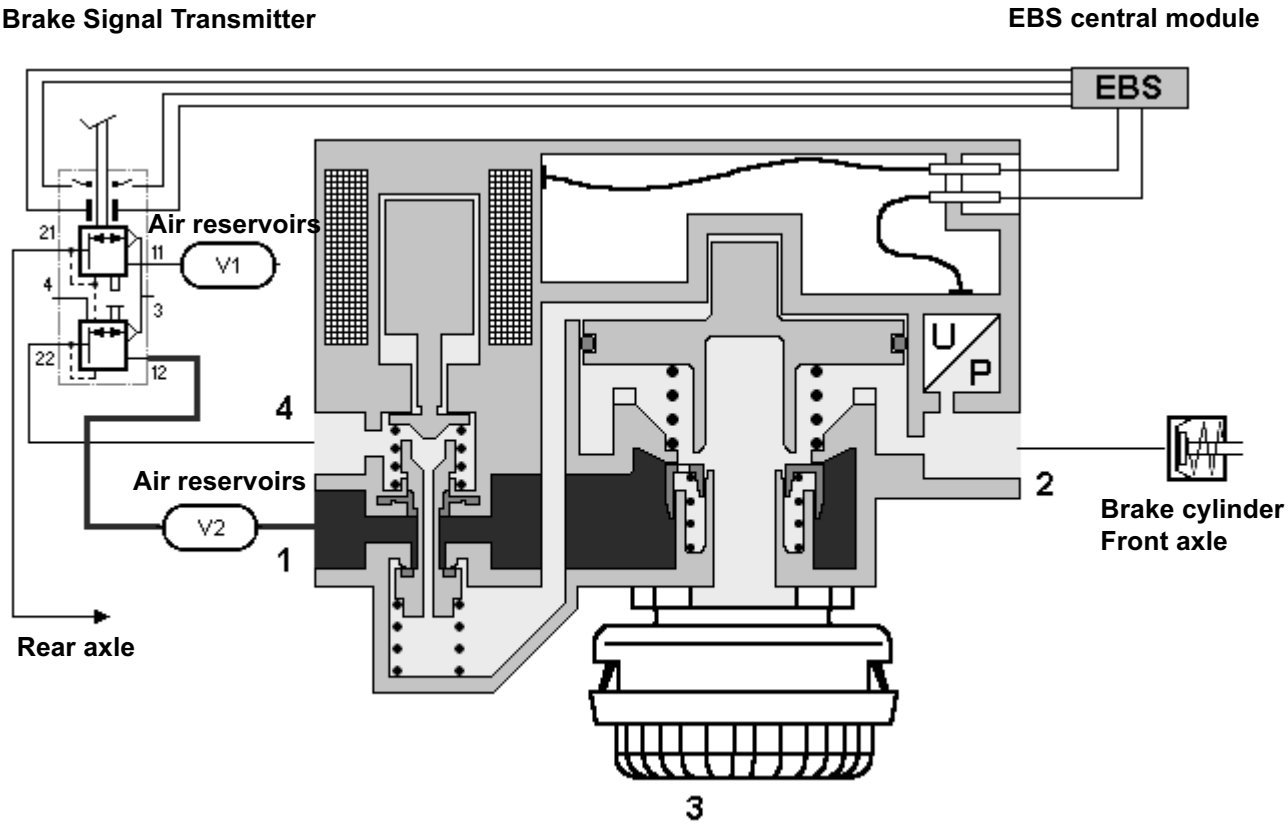
The control current impressed by the electronic unit is transformed via the proportional solenoid valve into a control pressure for the relay valve. The proportional relay valve's output pressure is proportional to this pressure. The pneumatic drive on the relay valve takes place via the brake signal transmitter's redundant (back-up) pressure.

Proportional relay valve 480 202 . .. 0

Place of installation (MB Actros): front bumper area - left

Proportional relay valve 480 202

Mode of function



Backup valve

480 205 ...

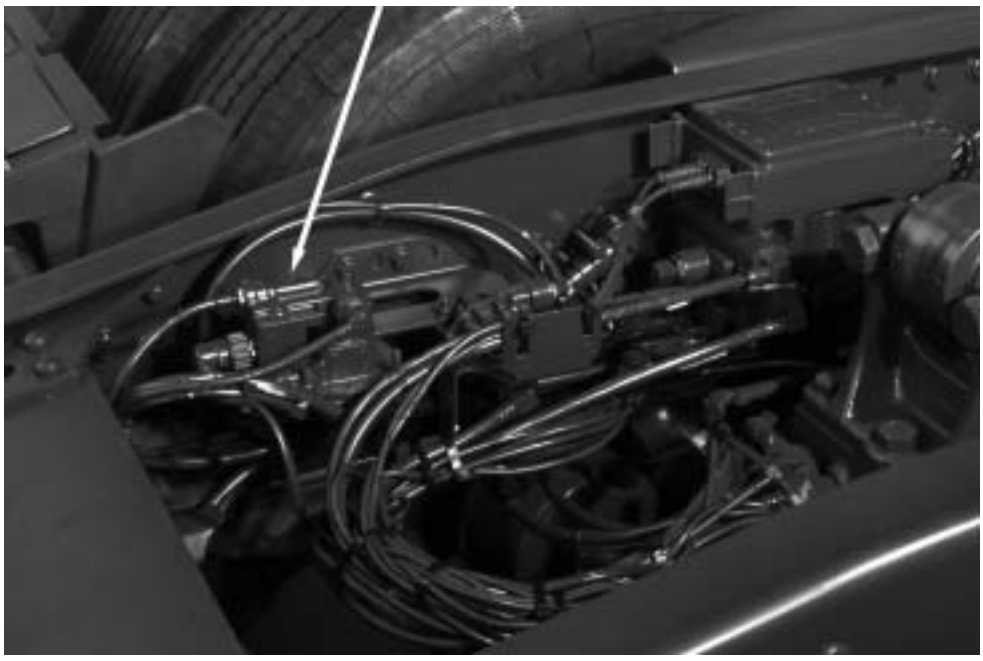
The 3/2 relay valve is used to supply air to and remove air quickly from the brake cylinder on the rear axle in case of redundancy, and comprises several valve units which must fulfil the following functions, among others:

- 3/2 solenoid valve function for restraining redundancy in intact electro-pneumatic braking circuit
- Relay valve function, to improve the time behaviour of redundancy,
- Pressure retention, to synchronise the beginning of pressure level control on the front and rear axle, in case of redundancy
- pressure reduction to avoid overbraking of the rear axle to the largest possible extent in the case of a backup (reduction approx. 2:1).

The redundancy valve which is installed in the Actros consists in addition to that of a 2/2 way valve which is energized in any case of ABS. This prevents a involuntary drive through of the rear axle redundancy pressure during ABS control.

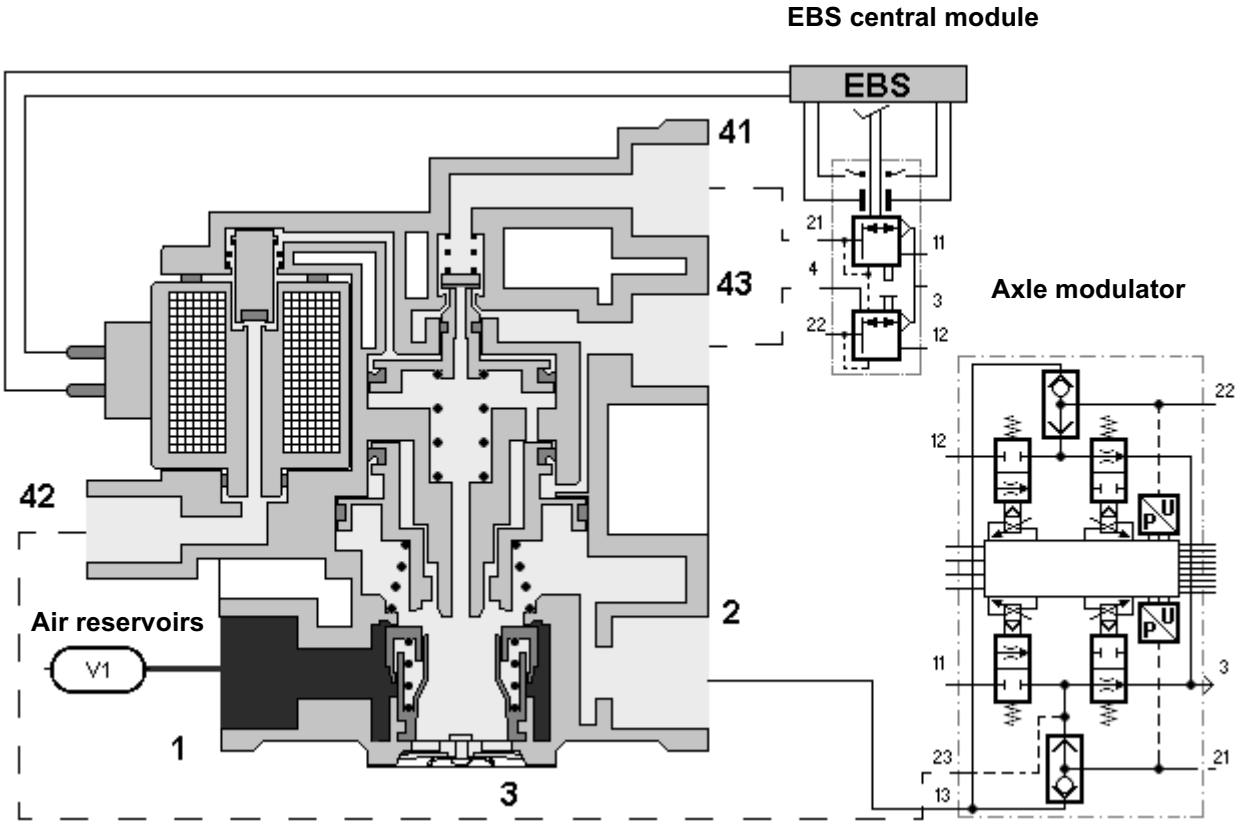
Backup valve 480 205 . . .0

Place of installation (MB Actros): frame inside - rear axle area



Backup valve 480 205 ...

Mode of function



Axle modulator 480 103

The axle modulator controls the brake cylinder pressure on the two sides of a single or dual axle.

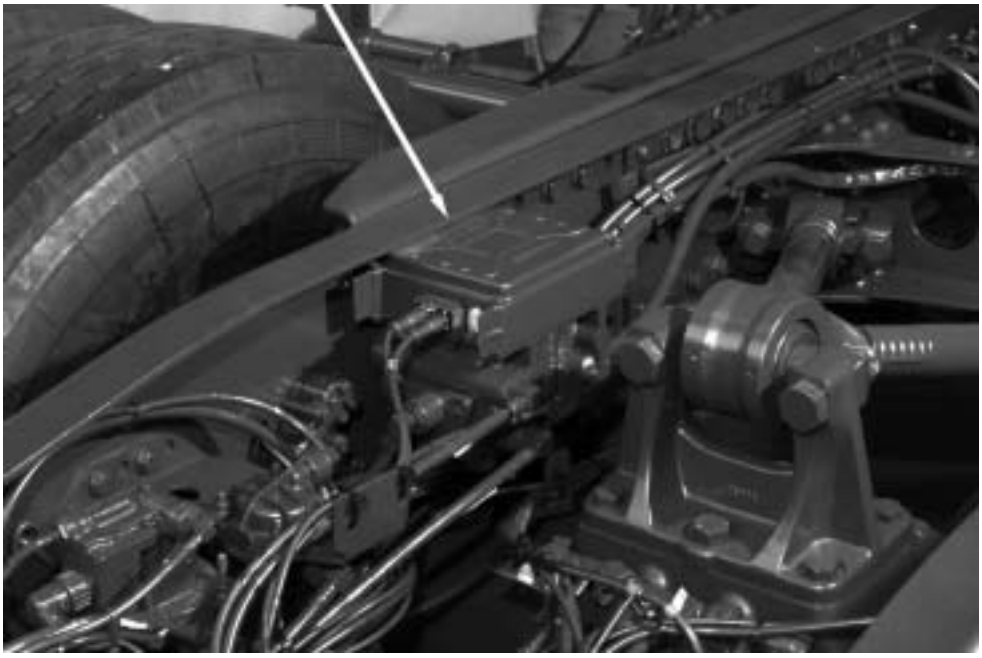
It contains two independent pneumatic pressure control channels (Channels A and B), each containing one inlet and one exhaust valve, plus one pressure sensor, sharing one electronic control unit. Desired pressure definition and external surveillance take place via the central module.

Moreover, wheel rotation speed is measured and evaluated via two speed sensors. The index pressures and external monitoring functions are provided by the central module. In addition, two speed sensors monitor and evaluate the wheel speeds.

The axle modulator has an additional connection for a redundant pneumatic braking circuit. A two-way check valve on each side drives the higher pressure (electro-pneumatic or redundant) through to the brake cylinder.

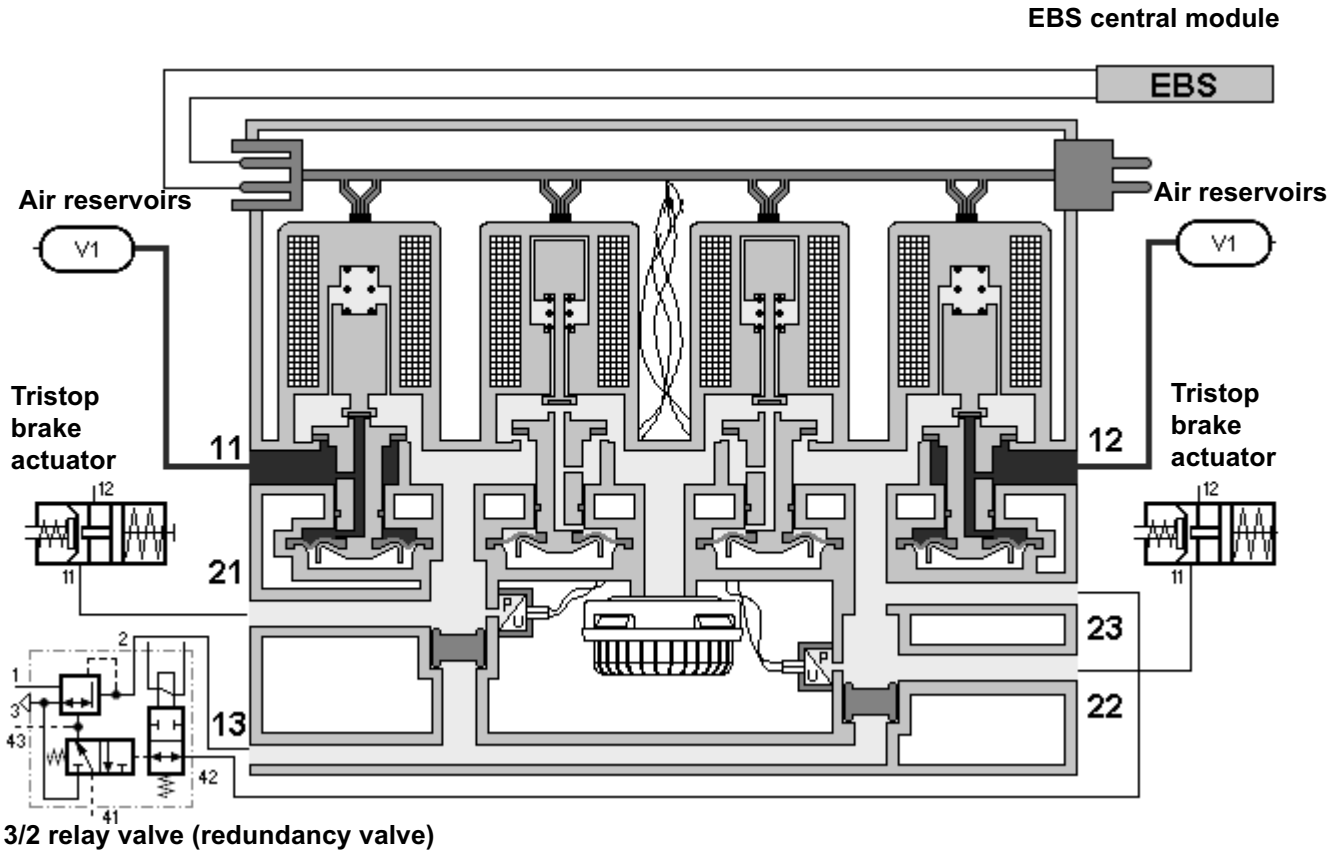
Axle modulator 480 103 . . .0

Place of installation (MB Actros): frame inside - rear axle area



Axle modulator 480 103

Mode of function



3/2 relay valve (redundancy valve)

Trailer Control Valve

480 204

The trailer control valve is used in the electronically controlled braking system to modulate actuator to modulate the coupling head pressures.

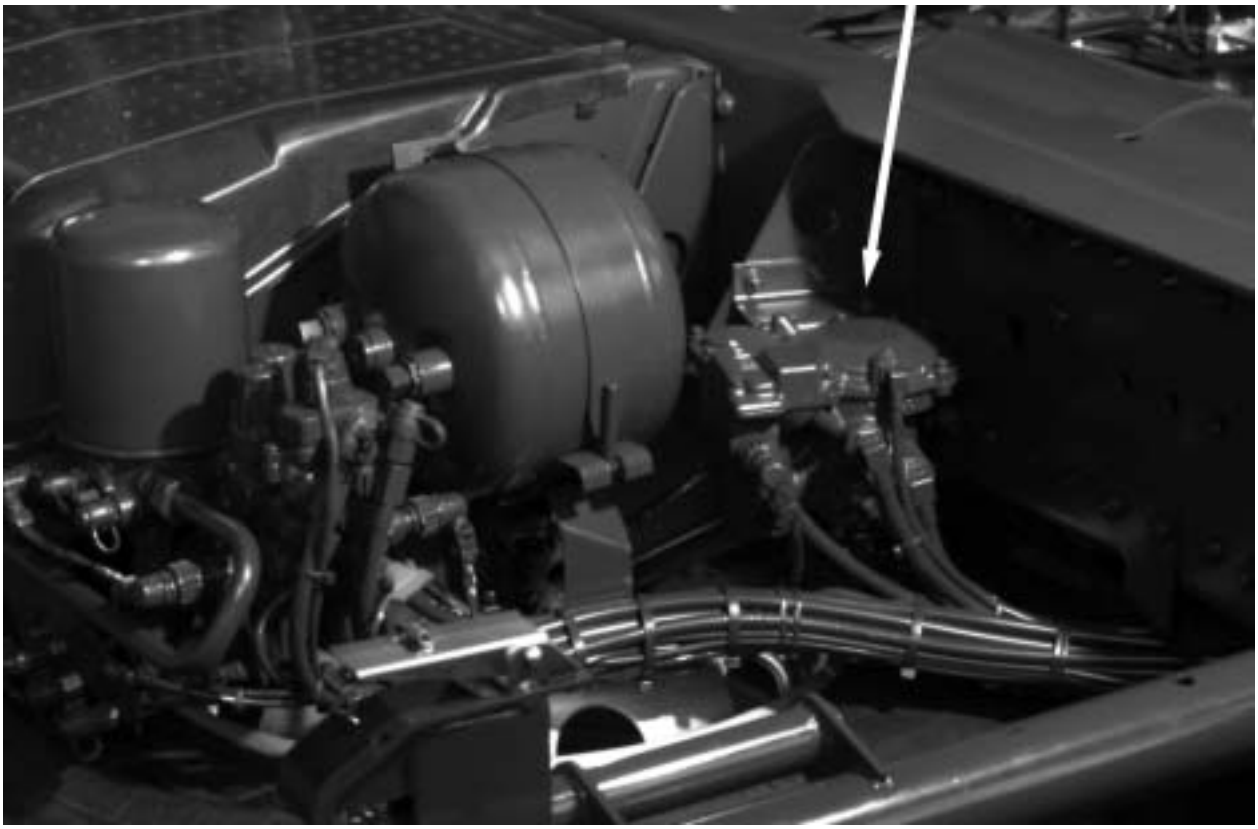
The trailer control valve consists of a proportional solenoid valve, a relay valve, a breakaway emergency valve and a pressure sensor. Electrical actuation and monitoring are effected by the central module.

The control current impressed by the electronic unit is transformed via the proportional solenoid valve into a control pressure for the relay valve. The output pressure of the trailer control valve is proportional to that pressure.

The pneumatic actuation of the relay valve is effected by means of the backup pressure from the brake signal transmitter and the output pressure from the hand brake valve.

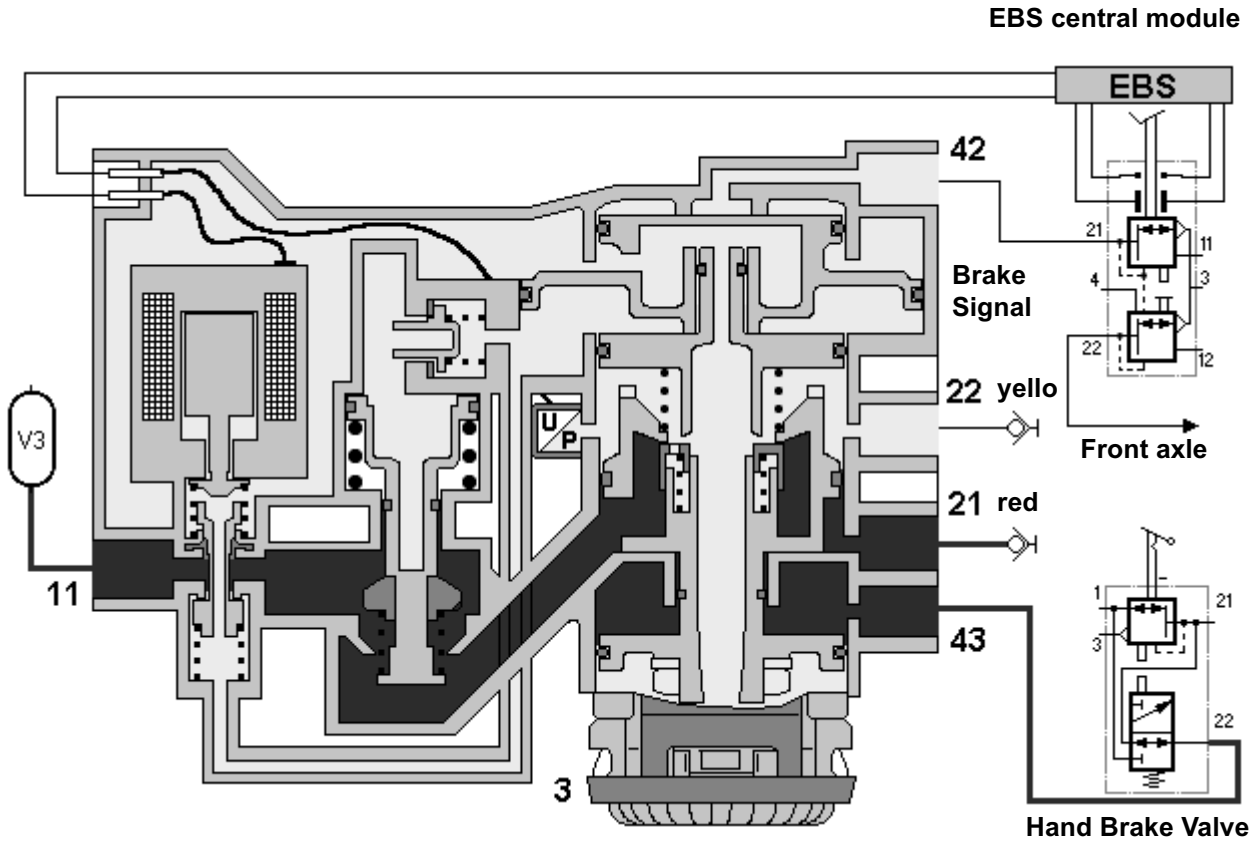
Brake signal transmitter 480 204 ...0

Place of installation (MB Actros): Nearby the air reservoirs



Trailer Control Valve 480 204

Mode of function



Other components:

Further components of the electronically controled brake system are:

- ABS solenoid valves
- wheel speed sensors
- wear sensors
- ASR-solenoid valves at 6x2 and 6x2/4 vehicles which the additional axle pneumatically uncouples at ASR regulation of the driving axle.

Order numbers

EBS central module:

446 130 000 (all vehicles up tp 07/97)446130 005 0 (4x2 semitrailer-tractors since 08/97)
446130 005 0 (4x2 semitrailer-tractors since 08/97)

Brake signal transmitter:
480 001 000 0

Proportional relay valve:
480 202 005 0 (8x4 vehicles)
480 202 004 0 (all other vehicles since 08/97)

Redundancy valve:
480 205 001 0

Axle modulator:
480 103 002 (4x2 vehicles up tp 07/97)
480 103 001 (6x2, 6x4, 6x2/4 and 8x4 vehicles up to 07/97)
480 103 004 0 (4x2 vehicles since 08/97)

480 103 005 (6x2, 6x4, 6x2/4 and 8x4 vehicles since 08/97)

Trailer control valve:
480 204 001 0

ABS solenoid valve:
472 195 008 0

Function of the electro-pneumatic unit

The electro-pneumatic unit of the towing vehicle and its signal path work via

brake signal transmitter
- two distance sensors determine the nominal value which is transmitted as pulse-width modulated signal; two integrated switches are used for nominal value confirmation

EBS central module
- for determining the desired pressure for each axle and system control

Proportional relay valve
- for pressure control on the front axle

ABS solenoid valves
- for quick ABS pressure control cycles on the left and right wheel brakes of the front axle

3/2 relay valve (redundancy valve)
- for restraining the rear axle redundancy pressure

Axle modulator
- with integrated control unit for regulating brake pressures on each side of the rear axle(s).

EBS can be activated electrically via the driving switch (cl. 15) or by actuating the brake signal transmitter via the integrated brake switches.

The measured brake pedal distance is interpreted as the desired delay and converted by the central module into desired pressure standards for the rear and front axle, using various criteria.

The nominal value standard for the axle modulators is transmitted by a sytem bus via the central module. The axle modulators regulate and record the braking pressures of the rear axles' left and right wheel brake. The braking pressure of the front axle is regulated by the central module via the proportional relay valve with integrated pressure sensor.

The wheel rotation speeds are recorded via the sensors known to the ABS system and serve, among others, as input quality for the pressure control algorithms, for the ABS function and for the ASR function.

Before carrying out a wear control operation, the brake lining wear sensors analyse the brake lining wear on each wheel brake. The sensor signals on the front axle are recorded by the central module whereas those on the rear axle are recorded by the axle modulator.

Signal processing and errors monitoring for the rear axles is made by axle modulator, so that the sensor values can be subsequently transmitted to the central module via the data bus.

Function of pneumatic redundancy

Front and rear axle circuits work with different redundancy methods. The front axle circuit works according to the additional redundancy principle, the rear axle circuit is equipped with a redundancy unit which can be activated with the help of a solenoid valve.

Additional redundancy on the front axle

The front axle circuit which functions pneumatically and serves as redundancy works via

brake signal transmitter
- with 2 pneumatic circuits (front and rear axle)

Proportional relay valve
- relay valve with combined pre-control via pneumatic front axle circuit and the proportional solenoid valve

on the front axle brake cylinder.

Electro-pneumatic pressure is delivered via the proportional valve when the brake signal transmitter is activated. Depending on the control force, pressure is supplied to the proportional valve by the brake signal transmitter in a delayed, pneumatically redundant manner.

This is added to the pressure delivered already electro-pneumatically. The pressure delivered by the proportional valve is adjusted to the set desired pressure by varying the electro-pneumatic pressure.

In case of electro-pneumatic unit failure the pneumatic redundant pressure is passed.

Due to the need to restrain the front axle redundant brake pressure vis-à-vis the electro-pneumatic pressure output (for instance, measures to optimise wear, or integration of endurance brake), the “electrical” nominal value predominates the pneumatic front axle pressure output on the brake signal transmitter (2nd pneumatic circuit of the brake signal transmitter).

Rear axle redundancy

The pneumatic redundancy of the rear axle works via

brake signal transmitter
- with 2 pneumatic circuits (front and rear axle)

3/2 relay valve (redundancy valve)
- with a 2/2-way solenoid valve, a 3/2-way valve and a relay valve.

Shuttle valves
- integrated in the rear axle's axle modulator

on the brake cylinder of the rear axle.

During hitch-free EBS operation, i.e. an electronic pressure control is possible on the rear axle, the 3/2 solenoid valve in the 3/2 relay valve is set to “switch off redundancy”, due to the electronically controlled pressure at the left rear wheel.

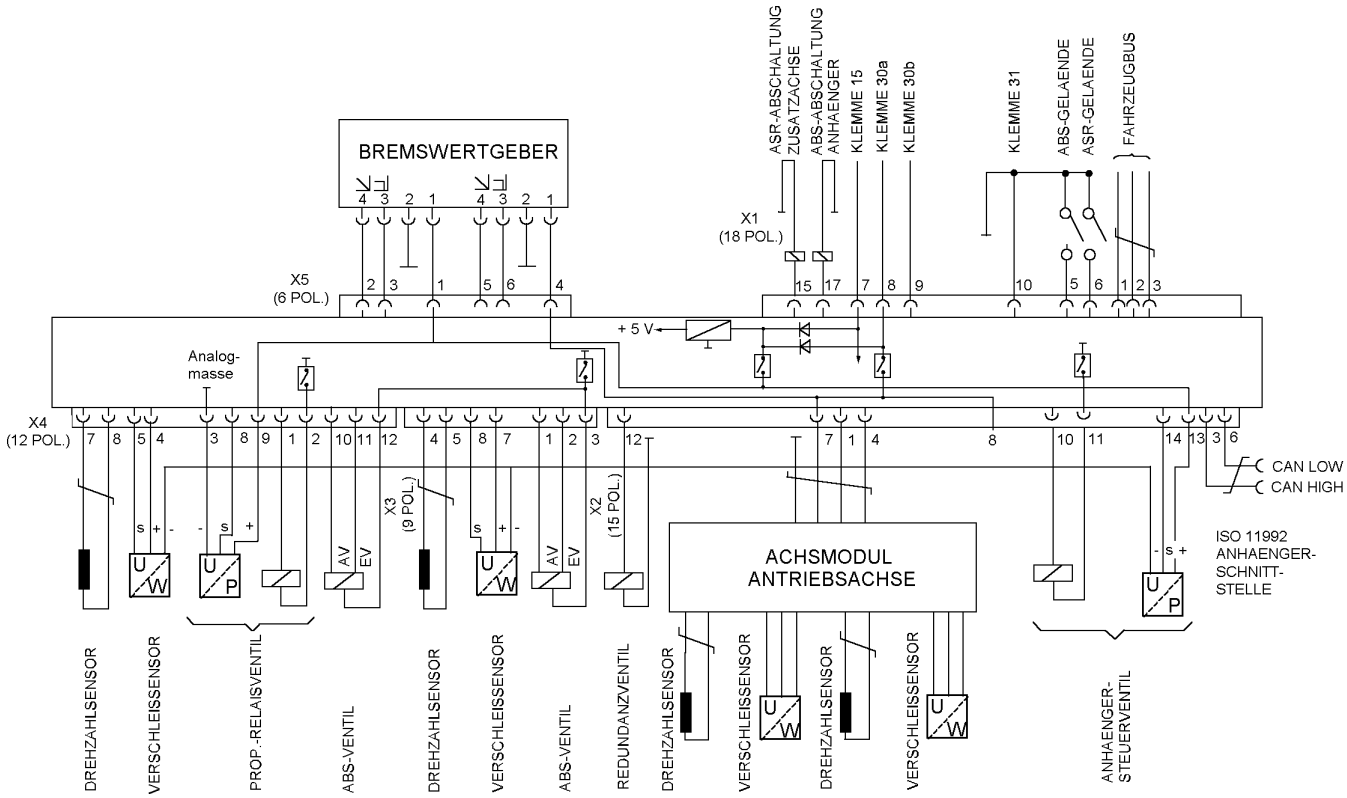
Operation of Trailer Control

The trailer control is made via a dual-circuit electropneumatic trailer control valve (here one circuit electropneumatic or pneumatic). This valve is controled by the central module. A proportional valve and a pressure sensor offer the possibiliy of an electropneumatically pressure control of the trailer control pressure.

The part of the trailer control valve which operates only pneumatically is designed like a conventional trailer control valve (activation of port 42 via circuit 1, demolition safeguarding, pressure control via parking braking system).

The pneumatic control connection is supplied with power via the redundancy port of the brake signal transmitter on the rear axle if a ratio falls below $p_{el}/p_{42} \approx 0.5$. Above this ratio the electropneumatically actuated pressure affects on its own.

Electrical / electronic structure



Picture 3 shows the electrical system structure

Power is supplied to the electronic braking system via not protected supplies in dual circuits.

Clip 30a:
Voltage supply for the proportional relay valve, the trailer control valve and the ABS valves.

Clip 30b:
Voltage supply for a sensor in the brake signal transmitter, the axle modulator and the redundancy valve.

The central module and the other brake signal transmitter circuit are supplied by both clips.

The central module has a data bus interface for communication with other vehicle systems (engine, gear system, retarder).

The axle modulator(s), the ABS valve, the proportional relay valve of the front axle and the trailer control valve can be switched off individually via the short circuit-proof electronic switch in the central module.

The grounds for the external pressure and wear sensors are returned to the central module or axle modulator. Direct connection to the vehicle mass is not allowed. The masses of the sensors of the central module are led to a sensor mass central point next to the central module ($l \leq 1$ m). Another central point

($l \leq 1$ m) serves as a connection point for the performance mass (redundancy valve, brake signal transmitter, axle modulator). The ground lines of the ABS valves are returned into the central module where can be splitted with the help on an electronical switch in any case of failure.

Connection between the central module and the axle modulator(s) is established via an individual CAN system bus (brake bus).

For the activation of and the data exchange with electrical brake systems in trailers the central module has an electrical data interface according to ISO 11992.

The power supply of the trailer system is not made via the central module.

Data contents according to ISO 11992 part 2 are processed by the central module depending on their significance and function. For communication purposes the manufacturer vehicle-bus product brief has to be exchanged with other bus participants.

The brake signal transmitter is separated electrically and has a dual circuit. The actuation process is recognised via two switches. The switches have the following functions:

- Sensing the beginning of the braking process
- Activating the EBS (if the driving switch is in the “off” position)
- the offset values of the nominal value sensors are calibrated and monitored without being activated

The inactivated distance sensors transmit the electrical brake nominal value as pulse-width modulated signals to the central module. Both signals of the redundant electrical transmitter are evaluated equally.

The braking pressures on the front axle and on the coupling head “brake” are regulated with electrically controlled proportional valves. The actual-pressure sensors are integrated into the valve subassemblies. The actual values are transmitted as analogue signals.

Axle load sensing is not required. Depending on the load the changing difference slip is determined with the help of the wheel speed sensors. The valves are evaluated and actuated by the central module.

The central module can indicate the system status via a yellow EBS Info lamp and via a red warning lamp. Another yellow info lamp indicates the ASR function. The functions and colours of the lamps can differ between the different vehicle manufacturers. Mercedes-Benz is using an indicating instrument in the instrument panel which reports about the system status.

Potentiometers must be provided (or possibly alternative limit switches for drum brakes) for sensing brake lining wear, and which are read in for the front axle by the central module. The activities of each rear axle wear sensor is recorded by the axle modulator; the results are transmitted via the system bus brake to the central module. The sensors are supplied individually and per axle with short circuit-proof 5V.

Control functions

Delay control
Delay control is used to adapt the braking pressure level to the driver’s desired braking rate (def. As z in %).
When the same amount of pressure is applied on the pedal, the vehicle is often braked in the same manner, irrespective of the amount of load it is carrying.

If the coefficient of friction on a wheel brake changes (for instance when the vehicle is moving downhill), the delay control unit ends every adaptation process when a predefined, fixed maximum is attained, to enable the driver to also to feel the deterioration.

Adapting to the braking system hysteresis is also part of delay control. Each time the brake is released, the releasing process is chosen in such a way that an immediate braking force modification is adjusted. This function results in quick release of the brakes, i.e. car feeling.

Braking force distribution
The distribution of braking forces on the front and rear axles depends, among others, on the comparison made in the program range “Delay control” between the actual and nominal value of vehicle delay. The controlled magnitudes are the wheel speeds which are monitored over the speed sensors. The evaluation of the wheel speed sensors yields the subtly differentiated slip between front and rear axle, the difference slip control. At an optimal braking power distribution no difference slip arises in the ideal case between the axles of the towing vehicle. The pressure on the front and rear axles is set in such a way that the difference slip is approx. 0.

Brake lining wear control
At an uncritical braking is into dependence of the wear signals on hand, i.e. the braking pressure distribution adapted to a recorded wear difference. The pressure on the wheel brakes with more lining wear is reduced slightly, whereas the pressure on the wheel brakes with less lining wear is increased adequately (up to 0.5 bar), so that there is no change in the overall braking rate required by the driver.

Trailer Control
The trailer control A string strength sensor is renounced for reasons of cost. At first the braking ratio in the towing vehicle lies in the middle of the EC braking band. At a simultaneous band middle situation of the trailer no string strength will arise. The trailer differs the band middle situation of off, this recognizes the towing vehicle electronic due to the program part delay regulation and controls the trailer pressure correspondingly after.

A discrimination threshold of the trailer brakes which can be may be is compensated by a corresponding inshot. The inshot of pressure in the control line (yellow) of the trailer starts at the beginning of the braking with approx. 2 bar. Most of the problems known today are solved with this approach.

WABCO has collaborated in the design of the standardization of the electrical vehicle trailer interface in charge (ISO 11992).

The EBS contains the following renowned functions:

Anti-lock braking system (ABS)
The control logic determines from the wheel rotation speed whether one or more wheels can be blocked and decides whether to decrease, maintain, or increase the braking pressure on it. The rear axle wheels are controlled in their optimum area in a similar manner (individual control ⇨IR).

By 3 and 4 axle vehicles with 4S/4M system a side wise con-control of the non-sensored wheels.

On roads with extremely different adhesion levels between the right and left sides, vehicles are uncontrollable or difficult to control using the different braking forces in ABS (yawning moment development).

As a result, the braking pressure on the front axle brakes is not adjusted independent of each other, so that the driver can have a steering reaction (modified individual control ⇨ MIR).

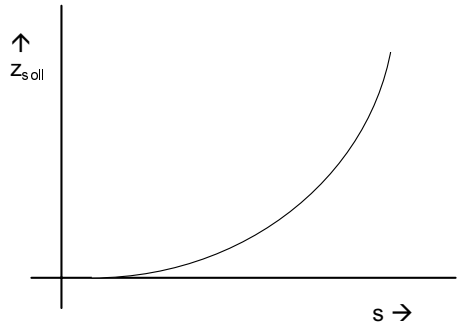
If the driving wheels are locked when the endurance brake is applied on low adhesion levels, possibly resulting in vehicle instability, the ABS endurance brake is deactivated via the vehicle's CAN bus to maintain vehicle stability.

Traction control system (TCS)
Just like in the ABS function, while the vehicle is in motion, the electronic control system determines whether the wheels are in the stable area of the μ slip curve.

In case of wheel-spin, the engine output and/or driving axle wheel braking is adjusted by the axle modulator via the CAN bus and engine control system. An activated traction control system is displayed on the functions display.

Backup functions

Generating brake nominal value
The brake pedal distance measured by the sensors in the brake signal transmitter is transmitted to the central module where it is "processed". The distance is converted into a nominal delay, based on the characteristic curve described in the chart.



Determining brake nominal value

Pressure control front axle, rear axle and electro-pneumatic trailer control
The nominal pressure derived from the brake nominal value using the higher control algorithms is controlled in the front and rear axle's pressure control circuits. In order to improve the pressure control properties, the solenoid current in the solenoid valves are controlled.

Wheel speed sensing and wheel adjustment
Wheel speed sensing corresponds to the sensing function known to ABS. Automatic wheel adjustment makes up for the nominal wheel sizes and thus the rolling circumferences between the axles. If unacceptable wheel combinations are used, this is recognised as an error.

If the wheel sizes change, the system requires a change of parameters.

1. Introduction

The growing market for the transport trade has also resulted in more stringent requirements regarding conventional braking systems for motor vehicles and their trailers. Today, modern commercial vehicles are expected to work safely, effectively and comfortably, and to be economically compatible. The introduction of the Electronically Controlled Braking System (EBS) for trailers, trailer EBS 1998, was the one step to meet the stringent requirements. Since the introduction of the Trailer-EBS up to the end of the year 2002 130.000 vehicles all over the world have been equipped with WABCO Trailer-EBS.

1.1 Benefits of Trailer EBS

- ❑ Best possible balance of the braking forces of the towing vehicle and its trailer.
- ❑ Shorter response times and simultaneous response of wheel brakes in the whole of the tractor- trailer combination.
- ❑ The ‘braking wire’ and electronic pressure control can improve the time response and thus help shorten the stopping distance and enhance the stability of the tractor-trailer combination.
- ❑ Introduction of electronic load-sensing control, thereby eliminating pneumatic valves and adjustment work.
- ❑ Permanent checking of the brake lining wear and indication of the achieving of wear limit (from march 2000)
- ❑ Improved driving and braking stability because of Roll Stability Support (RSS) (from december 2001).
- ❑ Reduction in the number of individual components and their connecting elements (e. g. by eliminating the load-sensing valve, pressure ratio valves and pressure limiting valves on towbar trailers).
- ❑ Easier installation of the braking system by the vehicle manufacturer and thus cost reductions.
- ❑ Enhanced reliability by means of end-of-production testing with automatic storage of test findings.
- ❑ Extended diagnostic capabilities for the whole of the braking system.

1.2 Functional Requirements

Electronically controlled braking system have load-dependent braking pressure control and include automatic anti-lock braking.

Trailers equipped with such braking systems may only be towed by motor vehicles with an extended ISO 7638-1996 plug-in connection (7-pin; 24 volts; towing vehicles with CAN data line) or with an ISO 7638-1985 plug-in connection (5-pin, 24 volts; towing vehicles with no CAN data line).

This must be documented by a corresponding entry in the vehicle's documents.

EBS for trailers meets the requirements of Annex X of Guideline 71/32/EWG as amended by 91/422/EG and Annex 13 of the provisions of ECE No 13, Amendment Series 09, Supplement 2, and Sections 20 and 21 of the German motor vehicle construction and use regulation (Technical Report EB 115.0 dated 11/11/97). The innocuousness of the use of wear sensors and the GGVS suitability were checked by the MOT (expert's statement MOT ATC -- for TB2002 for 64.00 with regard to the judgement according to § Abs. 2 of the StVZO for the presentation at vehicle controls for MOT Hessen). Trailer-EBS with RSS was released by the RW-TÜV (Technical Report no 134.0 or Technical Report no EB.134.0E)

WABCO's Trailer EBS meets the requirements of Appendix B, Annex B.2, ”Standardised Provisions for the Construction of Vehicles for Carrying Hazardous Loads Including Any Necessary Type Approval“ of the Directive on Domestic and International Carriage of Hazardous Goods on the Road (Regulations on Hazardous Goods) of 27.07.1985 as amended on 18.07.1995.

1.3 Configuration

The following ABS configurations are being supported:

- **2S/2M,**2 speed sensors and one trailer modulator for 1- to 3-wheel semitrailers and central axle trailers with air suspension systems.
- **4S/2M,**4 speed sensors and one trailer modulator for 2- to 3-wheel semitrailers and central axle trailers with air suspension systems.
- **4S/2M+1M,**4 speed sensors, one trailer modulator

and one ABS relay valve for 2- to 4-wheel semitrailers and 2- and 3-wheel central axle trailers with air suspension systems.

- **4S/3M,**4 speed sensors, one trailer modulator and one EBS relay valve for 2- to 5-axle drawbar trailers and 2- and 4-axle semitrailer or 2- to 3- axle central axle trailers with air suspension systems.

2S/1M, 4S/4M and **6S/3M**ABS configuration are **not** be supported.

Annex '8 C' (Sensor Allocations) shows possible configurations of sensors and modulators for the different types of trailers.

Axles or wheels which have had no sensors fitted can be indirectoy controlled by directly controlled axles or wheels.

Multi-axle assemblies require the utilisation of the adhesion to be roughly identical. If not all wheels are sensored the axle(s) that lock(s) in general at first has to be equipped with a sensor.

Multi-axle assemblies with **static** axle load allocation only should be equipped in such a way (brake cylinders, length of brake levers, etc.) that the wheels of all axles reach the locking limit as simultaneously as possible and that a directly controlled wheel does not indirectly control

- more than two wheels, or
- in the case of central axle trailers: not more than one wheel
- or one axle.

1.4 Scope of Application

Vehicles

Trailers with one or several axles of vehicle categories O_3 and O_4 as per EC Framework Guideline 70/156/EWG, Annex II with air suspension systems, disc or drum brakes.

Braking Systems

Power braking systems with a pneumatic transmission system as per the provisions of the motor vehicle construction and use regulation or EC Guideline 98/12/EG or ECE Directive No. 13.

Wheels and Tyres

Single and twin tyres.

2. System structure and function

2.1 System structure

Trailer EBS consists of an EBS relay emergency valve (1) with an integrated index pressure sensor (5) and brake switch (6), a trailer modulator (2) with an integrated electronic control unit, integrated pressure sensors (5), integrated redundancy valves (7) and an axle load sensor (4) plus the wiring for the components.

This configuration (Fig. 2-1) is described as a 2S/2M or 4S/2M system, depending on the number of speed sensors (3) used.

Extending this configuration by an ABS relay valve for controlling the pressure of a third axle on semitrailers (e.g. steering axle) produces a system known as 4S/2M + 1M.

Extending this configuration by an EBS relay valve (8) for controlling the pressure of the front axle on towbar trailers or a third axle of semitrailers produces a system known as 4S/3M (Fig. 2-2).

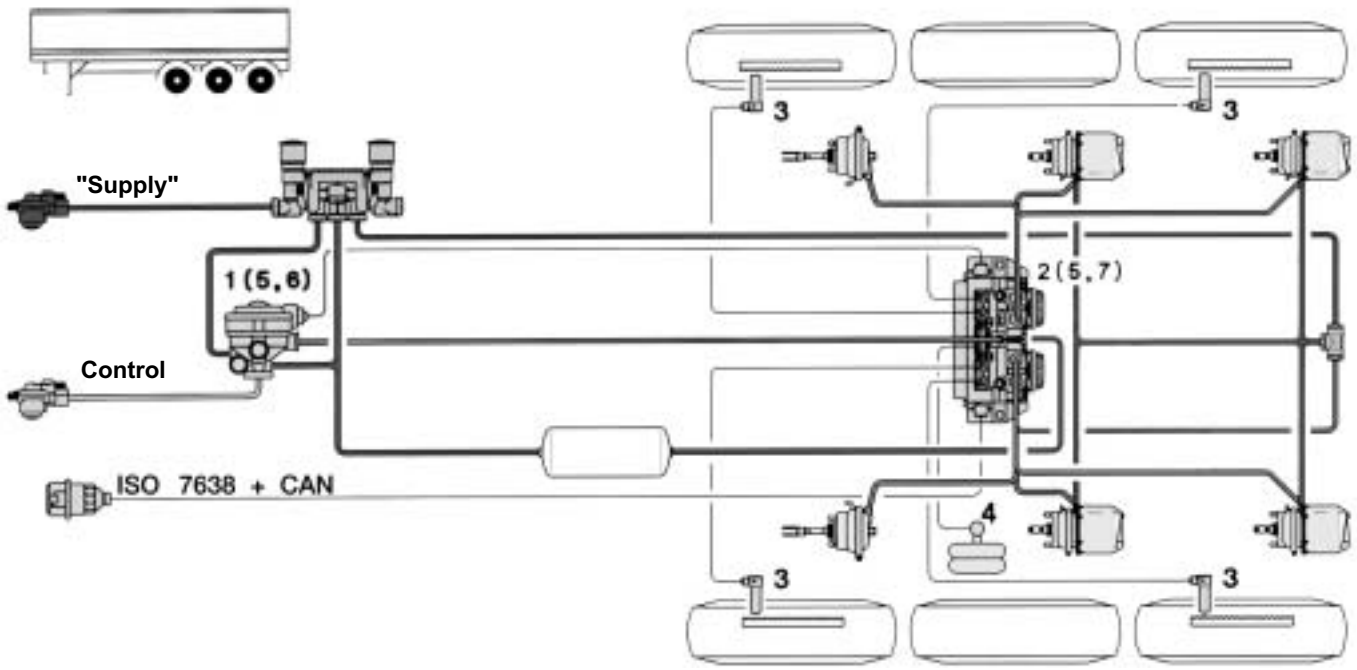


Fig. 2-1 shows: Braking system 4S/2M for semitrailers

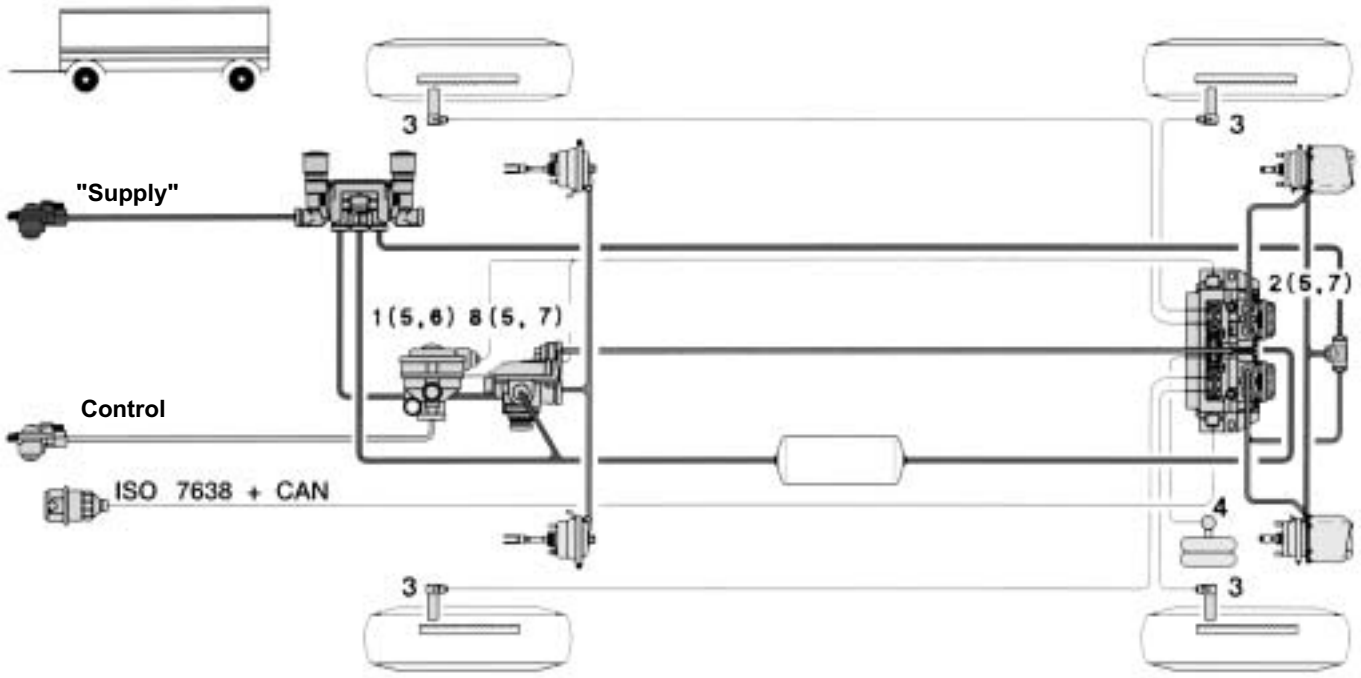


Fig. 2-2 shows: Braking diagram 4S/3M for drawbar trailer

2.1.1 Scope of System

The system described in this document does not comprise all the components of a trailer braking system. The following are not covered by this document, or only indirectly:

a) the wheel brakes including the braking cylinders

b) the vehicle's sustained-action brakes.

2.2 Description of components

The essential features of the system's components are described below.

2.2.1 Trailer emergency valve

The trailer EBS is a system working independently and works independently of the braking system of the towing vehicle. The trailer braking systems must be observed required by law. Therefore the following has to be considered:

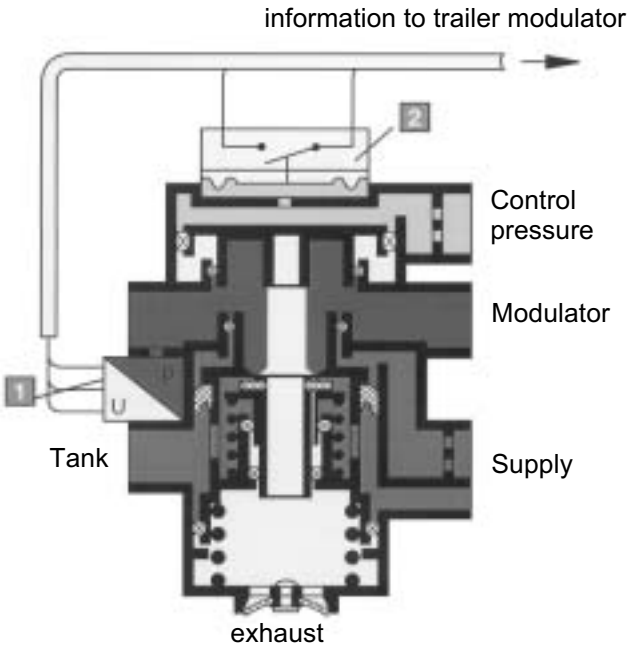
- automatic braking of the trailer when the trailer supply line breaks away or is unhitched.
- automatic braking of the trailer up to approx. 3.5 bar when filling of the trailer's compressed air system and solving of the brake at transgression of the pressure value
- Pressure retention when the trailer is unhitched
- Activation of the trailer braking system in case of redundancy
- To meet this requirements a conventional or an EBS trailer emergency valve is used.

2.2.1.1 EBS trailer emergency valve 971 002 801 0

The EBS trailer emergency valve can be used for all Trailer-EBS systems of the C-generation. A setpoint pressure sensor is integrated in the EBS trailer emergency valve. He serves for the set point

specification (braking wish of the driver) for an EBS-drive behind conventional towing vehicles. Furthermore a nominal pressure switch (brake switch) is integrated. His registration is the supervision of the nominal pressure sensor and the recognition of the braking away of the supply line Electrical control and monitoring is performed by the trailer modulator.

To achieve an optimal time response, the EBS trailer emergency valve should be installed nearby the coupling heads.



Operation of the EBS trailer control valve

The exchange of the trailer emergency valve is not always absolutely required in the service case.

f the failures “EBS trailer emergency valve / switch (246/05)”, “EBS trailer emergency valve (77/11)” + “failure of the Set point extraction (76/12)”, “EBS trailer emergency valve / switch (246/04)” and “EBS trailer emergency valve / switch / residual pressure (246/14)” appear the installation of the repair kit 971 002 920 2 is a low cost alternative.

2.2.1.2 Trailer emergency valve 971 002 301 0 and ...310 0 .

This one with a trailer modulator as of production date CW 49/02 on the type signpost (i.e. trailer EBS C3 generation) is equipped, the installation of the conventional trailer emergency valve 971 002 301 0 is possible for trailer. In this case an additional pressure sensor 441 040 013 0 or ...015 0 to “gain reference value” for the trailer modulator has to be installed on port 2 of the trailer emergency valve. This combination can already be ordered pre-installed under the WABCO part number 400 600 010 0.

If this possibilty is chosen for exchanging the EBS trailer emergency valve 971 002 802 0 in addition the wire of the pressure sensor has to be changed because of different plug coding - wire 449 473 000 0 is used.

The function of the conventional trailer emergency valve with pressure senor is identical to that of the EBS trailer emergency valve during the braking sequence. The main difference of the conventional trailer emergency valve with pressure sensor compared with the EBS trailer emergency valve is that in the conventional trailer emergency brake with pressure sensor no nominal value switch is included that indicates the trailer modulator by closing and opening the end of a braking sequence. With the introduction of the Trailer EBS C3-generation or the trailer emergency valve with pressure sensor the trailer modulator is informed about the start of braking by exceeding a certain pressure threshold and about the end of braking when the pressure falls below a certain pressure threshold.

2.2.2 EBS trailer modulator 480 102 0.. 0

The trailer modulator is used for controlling and monitoring the electropneumatic brake system.

The trailer modulator is installed in the electropneumatic braking system between reservoir tank or EBS trailer emergency valve and brake cylinder nearby the axles on the frame (e g on a 3-axle trailer above the second axle). It controls the brake cylinder pressure on both sides of one, two or three axles.

The trailer modulator has two pneumatically independent pressure control channels, each with an air admitting (2) and an air exhausting valve (3), a redundant valve (6), a pressure sensor (5) and a shared control ECU. The vehicle's nominal delay is determined of the CAN setpoint - if if a trailer interface is available. In other cases the nominal delay is based on the received pressure signal of the EBS trailer emergency system.

A connection for a axle load sensor can be found on the trailer modulator. The brake force is modified depending on the vehicle load (load-dependent brake force control). In addition, the wheel speeds are recorded by up to four speed sensors and evaluated. If the wheels start to lock, the brake pressure specified for the brake cylinders is reduced by the ABS control circuit.

The trailer modulator has an electrical connection for an ABS or EBS relay valve. The brake cylinder pressures on an axle can be controlled separately using this connection.

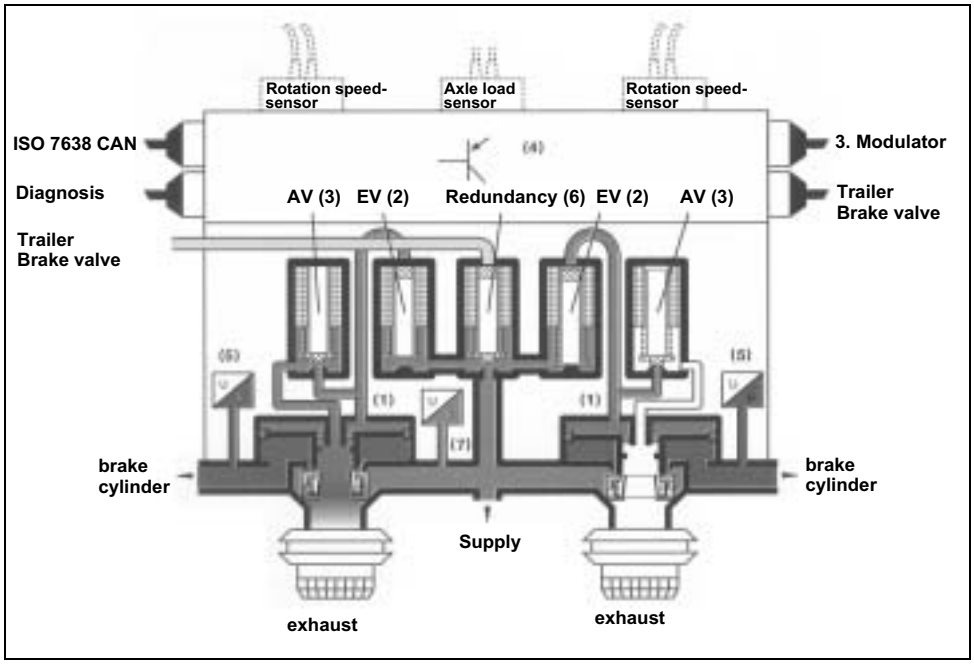
The reservoir pressure is detected by an integrated pressure sensor. If the reservoir pressure drops below 4.5 bar, the driver is warned by the red and yellow warning lights.

A bidirectional data interface according to ISO 14230 (KWP 2000) is provided for diagnosis of the trailer modulator.

If an expanded ISO -7638 plug device (7-pole interface with CAN-HIGH and CAN-LOW data bus) is used, the trailer modulator communicates with the tractive unit via the electrical trailer interface according to ISO 11992.

Installation position (see fig. 2-8):

Exahust downwards, generally max. 15° tended from the vertical (limiting by required RSS function: max. 3° of the Vehicle longitudinal (=$\Delta\beta$) and altitudinal axle (=$\Delta\upsilon$) tended as well max. 2000 mm in front or behind the the



Operation of the EBS trailer modulator

middle of the axle support (=ΔX) and max. 300 mm in travelling direction next to the middle of the axle (=ΔY))

An installation in closed room (e. g. a box) is not permitted. At the installation the compliance with a

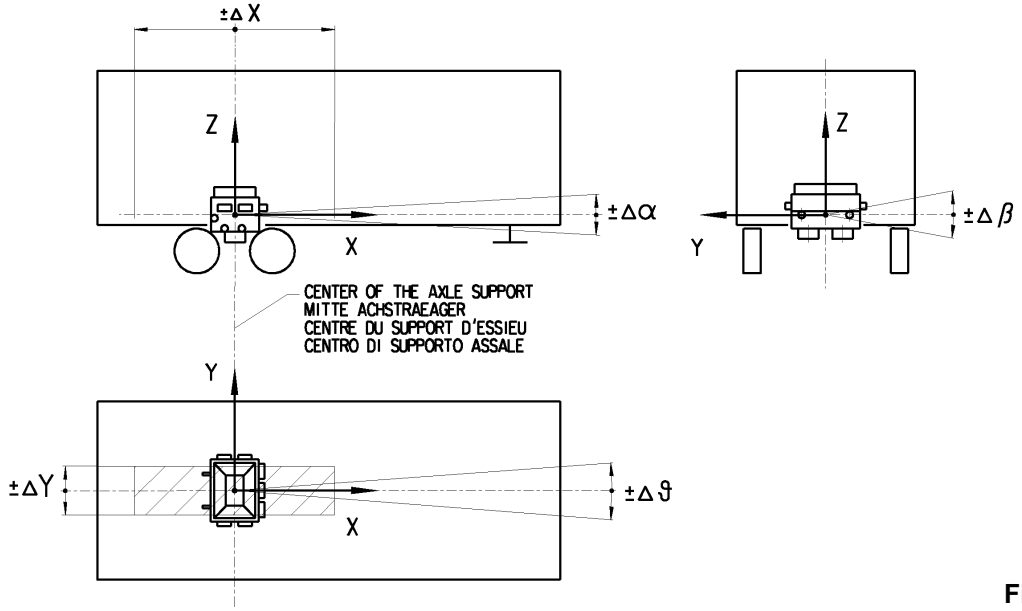


Fig. 2-8

sufficient distance to strongly warmth radiating components must be paid attention to to avoid a re-flow with hot air.

At present 5 different variations of the trailer modulator exist. They are listed in the following tables. In this table for each variant typical features are indicated.

Table: Functionality / service for Trailer EBS / trailer modulator 480 102 ...

WABCO no. 480 102 ...	**... 000 0**		**... 001 0**		**... 002 0**		**... 004 0**	**... 005 0**
TEBS generation	EBS-C2 up to week 48/ 01	EBS-C3 from week 49/ 01	EBS-C2 up to week 48/ 01	EBS-C3 from week 49/ 01	EBS-C2 up to week 48/ 01	EBS-C3 from week 49/ 01	EBS-C3 from week 49/ 01	EBS-C3 from week 49/ 01
ABS configuration	4S/3M	4S/3M	4S/3M	4S/3M	4S/3M	4S/3M	4S/3M	4S/3M
Battery charge			**X**	**X**			**X**	
only with TCE usable					**X**	**X**		**X**
RSS							**X**	**X**
Wear input	**X**	**X**	**X**	**X**			**X**	
Switching output 1	**X**	**X**	**X**	**X**			**X**	
Switching output 2	**X**	**X**	**X**	**X**			**X**	
ILS	**X**	**X**	**X**	**X**			**X**	

2.2.3 EBS relay valve 480 207 ... 0

The EBS relay valve is used in the electropneumatic brake system as an actuator for modulating the brake pressures in the front axle of drawbar trailers or a 3rd axle in semitrailers.

The EBS relay valve consists of a relay valve and two solenoid valves (air admitting/air exhausting valve), a redundant valve and a pressure sensor. Electrical control and monitoring is performed by the trailer modulator.

2.2.4 ABS relay valve 472 195 0.. 0

The ABS relay valve familiar from conventional brake systems and a double non-return valve are used in the electropneumatic brake system as an actuator for modulating the brake pressures on a steering axle of semitrailers. Electrical control and monitoring is performed by the trailer modulator.

2.2.5 Lifting axle valve 463 084 010 0

The lifting axle valve familiar from conventional brake systems can be used for controlling up to two lifting axles automatically with the trailer EBS depending on the current axle load. Electrical control and monitoring is performed by the trailer modulator.

2.2.6 ECAS 446 055 066 0

An electronic air suspension system ECAS can be connected in series with the trailer EBS. Electrical control and monitoring is performed by the trailer modulator. If ECAS is installed, a battery can be connected to the **trailer modulator** (variant 480 102 001 0 or ...004 0) by means of which ECAS can be operated without the trailer being hitched to a tractive unit.

In case of replacing the usage of the **trailer modulator** 480 102 014 0 is also possible.

Refer to publication 815 000 186 3 for more information about ECAS.

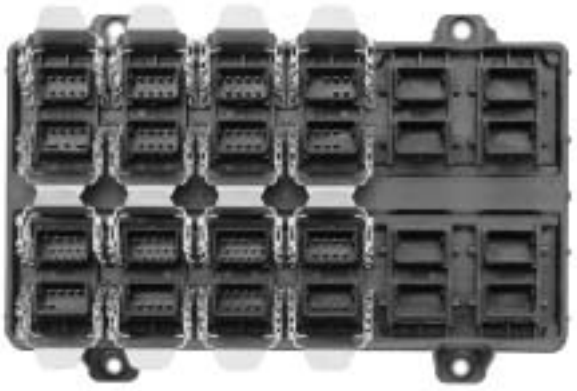
2.2.7 ELM 474 100 001 0

An electronic air suspension module ELM can be connected in series with the trailer EBS. Electrical control and monitoring is performed by the trailer modulator. If ECAS is installed, a battery can be connected to the **trailer modulator** (variant 480 102 001 0 or ...004 0).

In case of replacing the usage of the **trailer modulator** 480 102 014 0 (Trailer EBS D-generation) is also possible.

Refer to publication 815 000 348 3 for more information about ELM.

2.2.8 TCE 446 122 000 0



The Trailer EBS can be expanded by a Trailer Central Electronic unit (TCE). The electrical supply and monitoring of the Trailer EBS is made by the TCE. Only a **trailer modulator** 480 102 002 0 without RSS option) or 480 102 005 0 (with RSS option) is allowed to be used if a TCE is fitted, use of different modulators leads to a fault message from the TCE. In case of replacing the usage of the **trailer modulator** 480 102 015 0 (Trailer EBS D-generation) is also possible. During startup, the Trailer EBS is taken into service first, followed by the TCE.

Refer to publication 815 000 329 3 for more information about TCE.

2.2.9 Axle load sensor 441 040 ...0

With the axle load sensor (pressure sensor) the bellows pressure of the air suspension system is measured. Depending on the bellows pressure a brake force control not depending on the load is carried out. Electrical control and monitoring is performed by the trailer modulator.

The axle load sensor has to measure the bellows pressure of one liftable axles; by drawbar trailers the axle load sensor always has to monitor the bellows pressure of the axle which is controled by the trailer modulator.

Air suspension systems with a levelling valve can be connected with the axle load sensor on each air suspension bellow

By air suspension systems with two levelling valves (side wise control of the level) the axle load sensor has to has more bellows pressure which he he gets by a two-way valve.

For service purposes the pressure sensor 441 040 007 0 be replaced by the pressure sensor 441 040 013 0 oder ...015 0.

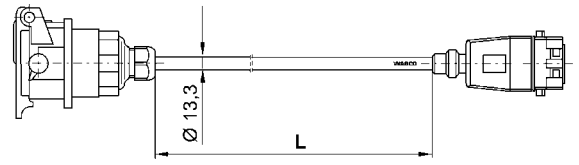
2.2.10 ABS sensor 441 032 ... 0

In the Trailer EBS mainly ABS sensors of the S_{plus} type (variant 441 032 808 0 or ...809 0) are installed. Within a vehicle a installation mixture that means type S and S_{plus} ABS sensors is possible. The mentioned variants for the ABS sensor types only differ in the length of the cable Whenever a sensor is replaced, we recommend to use the sensor set 441 032 921 2 or 441 032 922 2. The used speed sensors have to correspond to the WABCO specification or have to be authorised by WABCO.

2.3 Cable overview

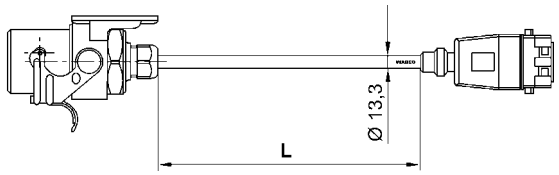
Power supply cable

for semitrailer (24V)



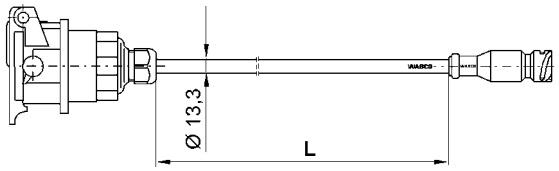
Part number	L in m	cable end type	
449 172 090 0	9	EBS electronic “Power”	Socket ISO 7638
449 172 120 0	12		
449 172 130 0	13		
449 172 150 0	15		

for drawbar (24V)



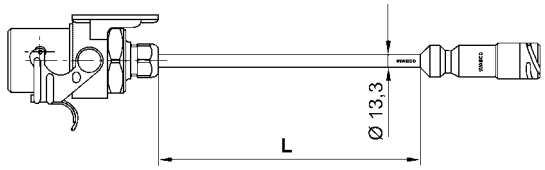
Part number	L in m	cable end type	
449 272 090 0	9	EBS electronic “Power”	Plug ISO 7638
449 272 100 0	10		
449 272 120 0	12		

for semitrailer (combined with 449 333 ... 0) 24V



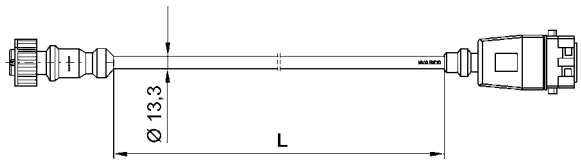
Part number	L in m	cable end type	
449 133 120 0	12	Socket ISO 7638	coupling 7-pin mating part for 449 333 ... 0
449 133 150 0	15		

for drawbar trailers (combined with 449 333 ... 0) 24V



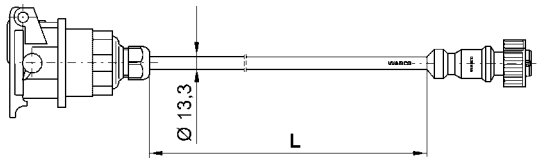
Part number	L in m	cable end type	
449 233 100 0	10	Plug ISO 7638	coupling 7-pin mating part for 449 333 ... 0
449 233 140 0	14		
449 233 180 0	18		

449 333 (combinated with 449 133 ... 0 or 449 233 ... 0)



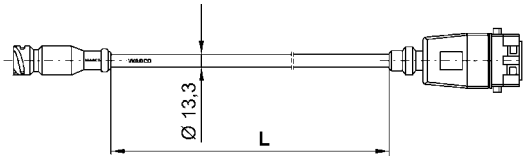
Part number	L in m	cable end type	
449 333 003 0	0.3	EBS electronic “Power”	Couplings Socket 7-pin mating part for 449 133 ... 0 449 233 ... 0
449 333 025 0	2.5		

for semitrailer (combined with 449 335 ... 0) 24V



Part number	L in m	cable end type	
449 135 005 0	0.5	Socket ISO 7638	coupling 7-pin mating part for 449 335 ... 0

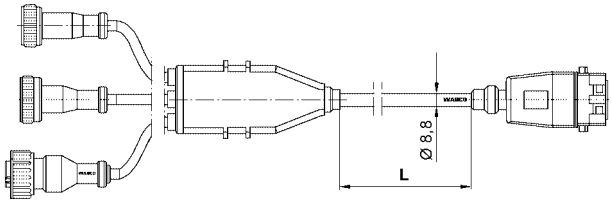
499 335 (combinated with 449 135 ... 0)



Part number	L in m	cable end type	
449 335 110 0	11	EBS electronic “Power”	coupling 7-pin mating part for 449 135 ... 0
449 335 140 0	14		

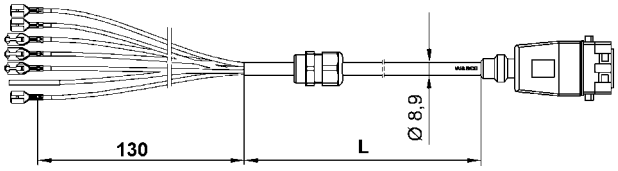
Solenoid cable

Relay valve (drawbar trailer) (3rd modulator)



Part number	L in m	cable end type	
449 372 030 0	3	EBS electronic "Modulator"	Sockets Kostal 1x M 24x1 1x M 27x1 1x DIN 72585 B1-3.1-Sn/K1
449 372 060 0	6		
449 372 080 0	8		
449 372 120 0	12		
449 372 130 0	13		

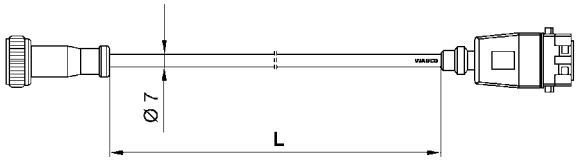
EBS-ECAS



Part number	L in m	cable end type	
449 382 010 0	1	EBS electronic "Diagnosis"	PG 11 7-pin 3 x 1.5 mm² 4 x 0.5 mm² 6 with cable shell
449 382 015 0	1.5		
449 382 060 0	6		
449 382 080 0	8		
449 382 090 0	9		

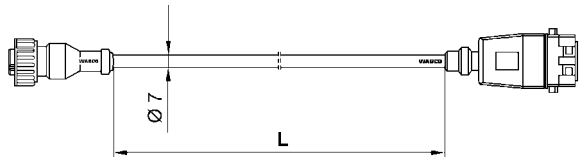
for ABS relay valve (3rd modulator)

not used for new design



Part number	L in m	cable end type	
449 426 020 0	2	EBS electronic "Modulator"	Socket Kostal M 24x1
449 426 030 0	3		
449 426 040 0	4		
449 426 080 0	8		

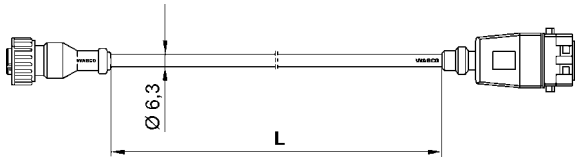
for ABS relay valve (3rd modulator)



Part number	L in m	cable end type	
449 427 020 0	2	EBS electronic "Modulator"	Socket Bayonet DIN 72585 B1-3.1-Sn/K1
449 427 030 0	3		

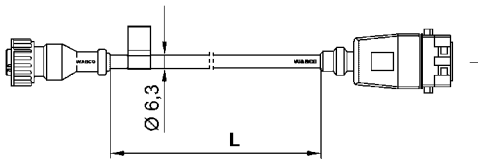
Trailer emergency valve

for relay emergency valve 971 002 802 0 only



Part number	L in m	cable end type	
449 472 030 0	3	EBS electronic “REV”	Socket Bayonet DIN 72585 B2-4.1-Sn/K1
449 472 035 0	3.5		
449 472 050 0	5		
449 472 080 0	8		
449 472 120 0	12		
449 472 130 0	13		
449 472 145 0	14.5		

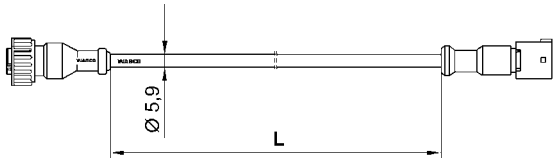
Connection to external brake pressure sensor and trailer emergency valve 971 002 301 0



Part number	L in m	cable end type	
449 473 010 0	1	EBS electronic “REV”	Socket Bayonet DIN 72585 B1-4.1-Sn/K1
449 473 030 0	3		
449 473 050 0	5		
449 473 080 0	8		
449 473 120 0	12		
449 473 130 0	13		
449 473 145 0	14.5		

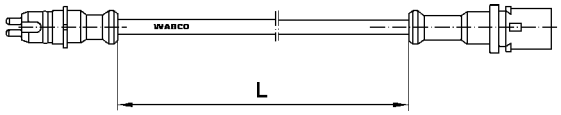
sensor cable

for pressure sensor (extern. axle sensor)



Part number	L in m	cable end type	
449 752 010 0	1	EBS electronic	Socket Bayonet DIN 72585 B1-3.1-Sn/K1
449 752 020 0	2		
449 752 030 0	3		
449 752 050 0	5		
449 752 060 0	6		
449 752 080 0	8		
449 752 100 0	10		
449 752 120 0	12		

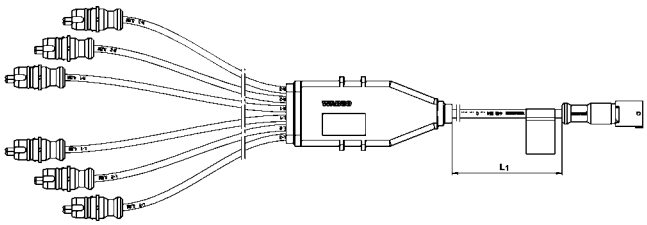
Extension cable



Part number	L in m	cable end type	
449 712 008 0	0.8	Plug	Socket
449 712 018 0	1.8		
449 712 023 0	2.3		
449 712 030 0	3		
449 712 035 0	3.5		
449 712 038 0	3.8		
449 712 040 0	4		
449 712 051 0	5.1		
449 712 060 0	6		
449 712 064 0	6.4		
449 712 070 0	7		
449 712 080 0	8		
449 712 090 0	9		
449 712 100 0	10		
449 712 120 0	12		
449 712 130 0	13		
449 712 150 0	15		
449 712 200 0	20		

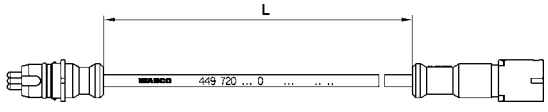
EBS - Wear indicator

Cable from EBS modulator to brake calliper



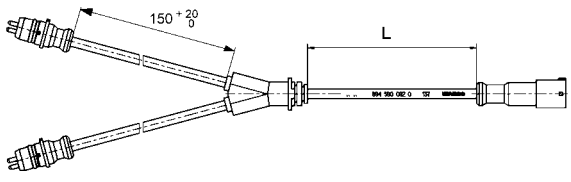
Part number	L in m	cable end type	
449 834 013 0	1.3	Coupling socket	coupling plug

Extension cable



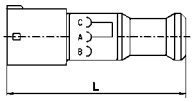
449 720 010 0	1	Coupling socket	coupling plug
449 720 050 0	5		

Cable Y-distributor



894 590 082 0	1	Coupling socket	coupling plug

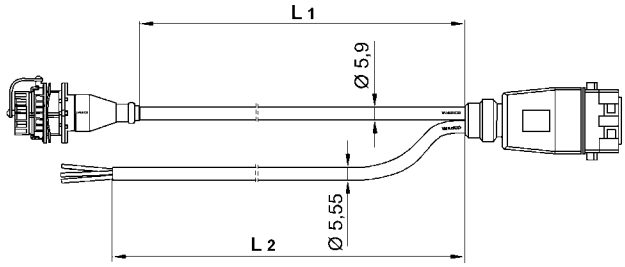
Plug (required to close up cable-ends)



Part number	L in m		
441 902 312 2	0.56		

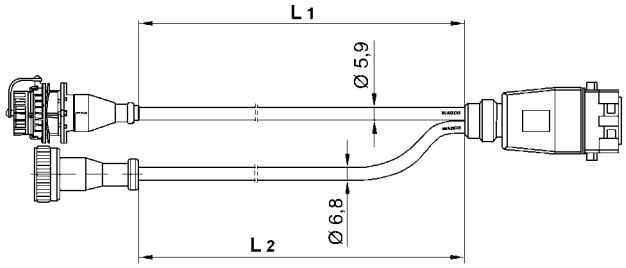
Diagnostic cable

for Diagnosis and ISS or ILS



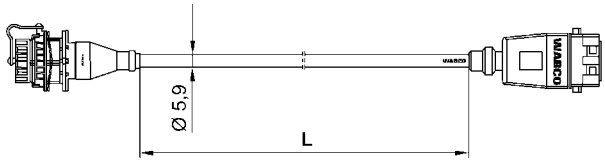
Part number	L1 in m	l 2 in m	cable end type		
449 614 148 0	3	3	EBS electronic "Diagnosis"	Socket Diagnosis	3-pin 3 x 0.75 mm²
449 614 153 0	6	3			
449 614 253 0	6	6			
449 614 295 0	8	8			

for diag. und lift axle cont. valve



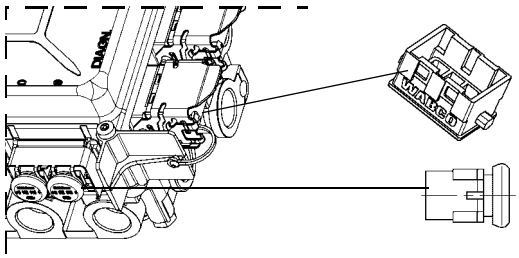
Part number	L1 in m	l 2 in m	cable end type		
449 624 113 0	6	2	EBS electronic "Diagnosis"	Socket Diagnosis	Socket M 27x1

for diagnostic



Part number	L in m	cable end type	
449 672 030 0	3	EBS electronic "Diagnosis"	Socket Diagnosis
449 672 040 0	4		
449 672 050 0	5		
449 672 060 0	6		
449 672 080 0	8		

EBS modulator



Order number	Anschlussabdeckung
894 110 139 2	mit Dichtring für plug body
441 032 043 4	for sensor

For the Trailer EBS prefabricated cables have to be used. These stand out due to moulded plugs. The different types of cables are available in various lengths.

The following components are used in addition to the listed cables:

2.4 Components

Description	Order number	Remarks
Trailer modulator	480 102 000 0	for vehicle configuration up to 4S/3M; do not use with TCE; no battery loading up function, no RSS
Trailer modulator	480 102 001 0	for vehicle configuration up to 4S/3M; do not use with TCE; no battery loading up function, no RSS
Trailer modulator	480 102 002 0	for vehicle configuration up to 4S/3M; only use with TCE, no RSS
Trailer modulator	480 102 004 0	for vehicle configuration up to 4S/3M; do not use with TCE; no battery loading up function, no RSS
Trailer modulator	480 102 005 0	for vehicle configuration up to 4S/3M; only use with TCE, RSS
EBS relay valve	480 207 001 0	
EBS trailer emergency valve	971 002 802 0	
Trailer emergency valve module	400 600 010 0	Combination of trailer emergency valve 971 002 301 0 and Pressure Sensor 441 040 015 0
ABS relay valve	472 195 020 0	
Axle load sensor	441 040 007 0	Older standard version; replaced by 441 040 013 0
Axle load sensor	441 040 008 0	Version with O-ring
Axle load sensor	441 040 010 0	Scania version
Axle load sensor	441 040 013 0	New standard version; replacement for 441 040 007 0
Axle load sensor	441 040 015 0	Version with O-ring and Raufoss screw connection
Two-way valve	434 208 02. 0	Overload protection of TRISTOP cylinders
Quick release valve	973 500 051 0	Overload protection of TRISTOP cylinders with quick release function
Trailer release valve	463 034 005 0	Releasing the front axle in drawbar trailers
Double release valve	963 001 051 0	Releasing the brake system and applying/releasing of the TRISTOP cylinder

Other components of the electropneumatic brake system are

- ❑ Brake cylinder
- ❑ Reservoir tank
- ❑ Piping

These broadly correspond to the components of a conventiona pneumatical braking system.

3. System description

3.1 Electropneumatic function

The trailer EBS is electrically connected via pin 2 of the ISO 7638 plug connection (terminal 15). A system check (silent) is performed as soon as the trailer EBS is switched on.

Note: The ABS function may be only available in a restricted form when the trailer EBS is switched on, since a dynamic check of the ABS sensors is not performed until the start of the journey.

The system is ready for operation within 150 ms after being switched on. If the system is switched off only in installed ECAS systems a stand-by time of 5 s takes place.

The integrated redundant valves are energised for electropneumatic actuation at the start of braking. This means the pneumatic control pressure is diverted away and the reservoir pressure is applied to the intake valves of the modulators. This means pressure control is possible up to the level of the reservoir pressure.

The setpoint for the trailer EBS is predominantly specified via the electrical trailer interface according to ISO 11992 (CAN). Is the interface not available the nominal value standard is made by the pressure sensor which is integrated in the trailer emergency valve.

The pressure is modulated by pressure control loops with pulsed relay valves. In order to adapt the brake forces to various loading conditions, the axle loads on vehicles with air suspension are measured by registering the bellows pressures.

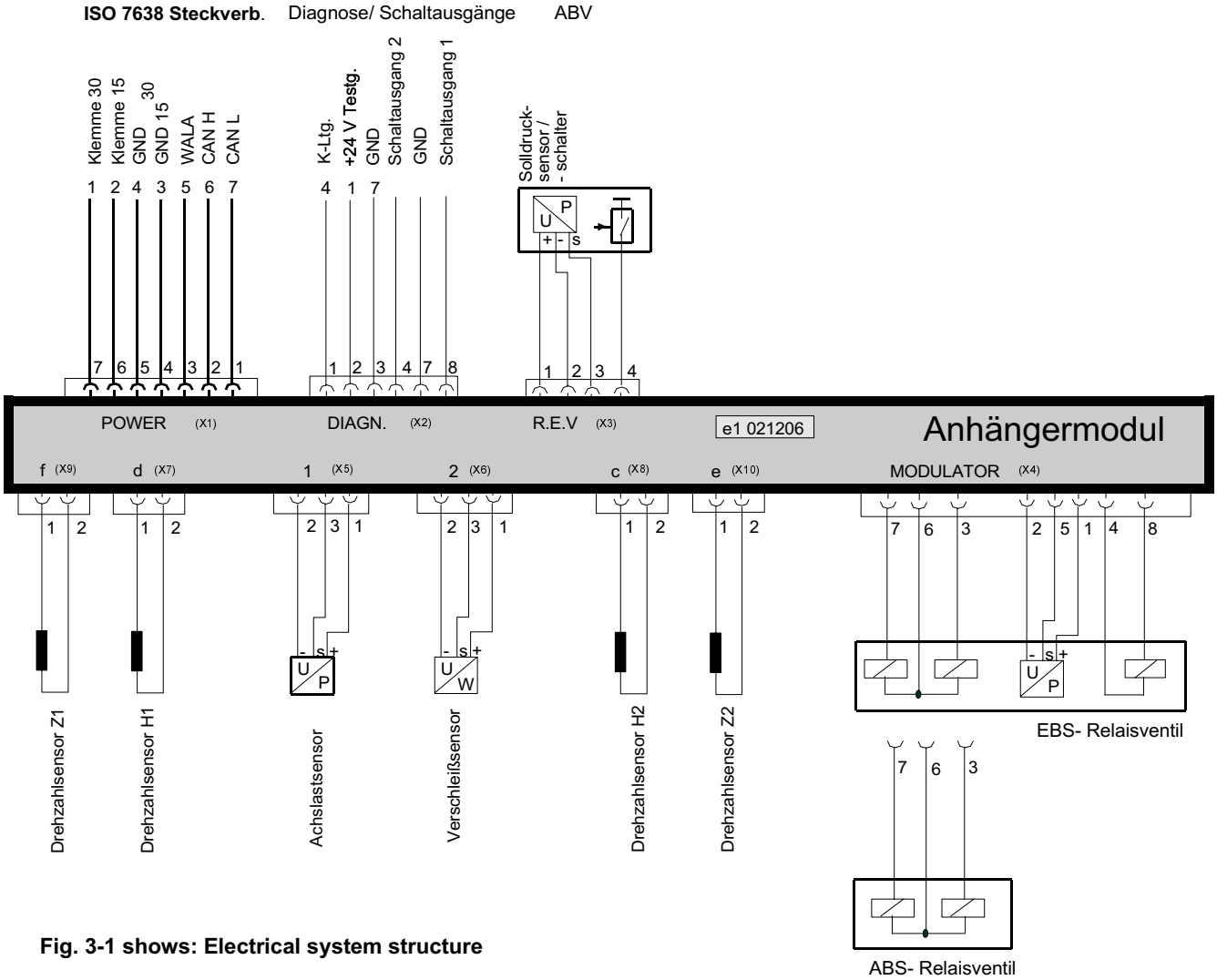


Fig. 3-1 shows: Electrical system structure

3.2 Pneumatic redundancy

In the event of system faults which require part of the overall system to be switched off, the pneumatic control pressure is switched through to the opened intake valves and the closed outlet valves of the modulators. This means the braking pressure can be applied purely pneumatically, however without consideration for the axle loads (LSV). The ABS function is maintained for as long as possible. The status of the system is indicated to the driver by a warning light connected to pin 5 of the ISO 7638 plug connection (the warning light display is based on the applicable statutory regulations).

3.3 Electrical/electronical system structure

Figure 3-1 shows the electrical structure including the electrical connection lines.

During normal operation, the trailer modulator is powered by fused supply cables via the ISO 7638 interface (plug X1, tl. 15 and tl. 30).

The electrical data connection between the towing vehicle and the trailer modulator is implemented via the trailer interface according to ISO 11992 (PIN 6+7 ISO 7638). The data content is processed by the trailer modulator in accordance with its significance and function.

A pressure sensor for measuring the control pressure in the trailer modulator is integrated in the trailer modulator in order to ascertain the nominal value behind a towing vehicle without EBS. The sensor is supplied with voltage from the trailer modulator. Der Sollwert ist als analoges Signal ausgeführt. The switch is stopping - in case of an increase of pressure in the control line - the offset determined for the control of the pressure sensors. Furthermore it is possible to monitor the nominal value for plausibility. The switch switches the electronic entrance at a rise in pressure in the control line against mass.

Pneumatic redundancy is implemented by means of 3/2-way solenoid valves integrated in the trailer modulator. At the beginning of every braking cycle, the trailer modulator switches off the solenoid valves and with that the redundant activation.

The pressure in the front axle of a drawbar trailer or the 3rd axle of a semitrailer is preferably controlled using an electropneumatic EBS relay valve. An actual pressure sensor and a 3/2-way solenoid valve are integrated in the valve module. The actual pressure sensor is supplied with voltage from the trailer modulator.

The pressure in the 3rd axle of a semitrailer (trailing/ steering axle) can also be controlled using an ABS relay valve.

Electrical power is supplied from the trailer modulator to all active sensors jointly via short circuit-proof outputs.

For the sensing of the axle load a pressure sensor is required which will be evaluated by the trailer modulator. The sensor is supplied with voltage from the trailer modulator.

A reservoir pressure sensor and two actual pressure sensors are integrated in the trailer modulator.

For the brake lining wear sensor a height sensor is required which is evaluated by the trailer modulator. The sensor is supplied with +5V from the trailer modulator. The wear value is operated as an analog signal.

Two switching outputs are provided for additional systems in the trailer. Their mode of function can be set in the parameters using a diagnostic tool.

System failures are monitored by the trailer modulator and stored (failure memory). An optical warning about the situation of the trailer system is made via PIN 5 of the ISO 7638 plug device (warning lamp) and at the same time via the electrical trailer interface according to ISO 11992. The correct function of the warning lamp has to be overviewed by the driver.

Error recognition and display

The electronic braking system EBS has a considerably further-reaching own supervision than today's ABS systems. Detected errors of the towing vehicle are stored and either signaled to the driver over the warning lamps or the display in the indicating instrument.

EBS failures of the trailer are indicated by the trailer ABS warning lamp. The warning devices have to be checked for a correct function at the safety test (SP).

Pneumatic redundancy functions which are to the electropneumatic circuits, guarantee the function of the Service Braking System (SBS) even in cases of failures in the electrical part.

Trailer control

The drive of a carried trailer with a conventional braking system is carried out via an electropneumatic trailer control valve and the conventional two line connection of the EBS towing vehicle with trailers with EBS in addition about the electrical plug connection (ABS ISO enlarged at two of pin 7638 supply).

Trailers with EBS braking system can be used either behind towing vehicles with conventional braking system and 5-pole ISO 7638 ABS socket or behind towing vehicles with EBS and 7-pole ABS socket.

Air obtaining and wheel brake

The structure of the air production system and of the parking brake system is mainly like the structure of common pressure braking systems. The checking is made the same way as of conventional braked vehicles.

The effectiveness testing of the wheel brake in EBS vehicles is because of built-in test routins also possible in the role test bench as by any other air braking system

Extrapolation

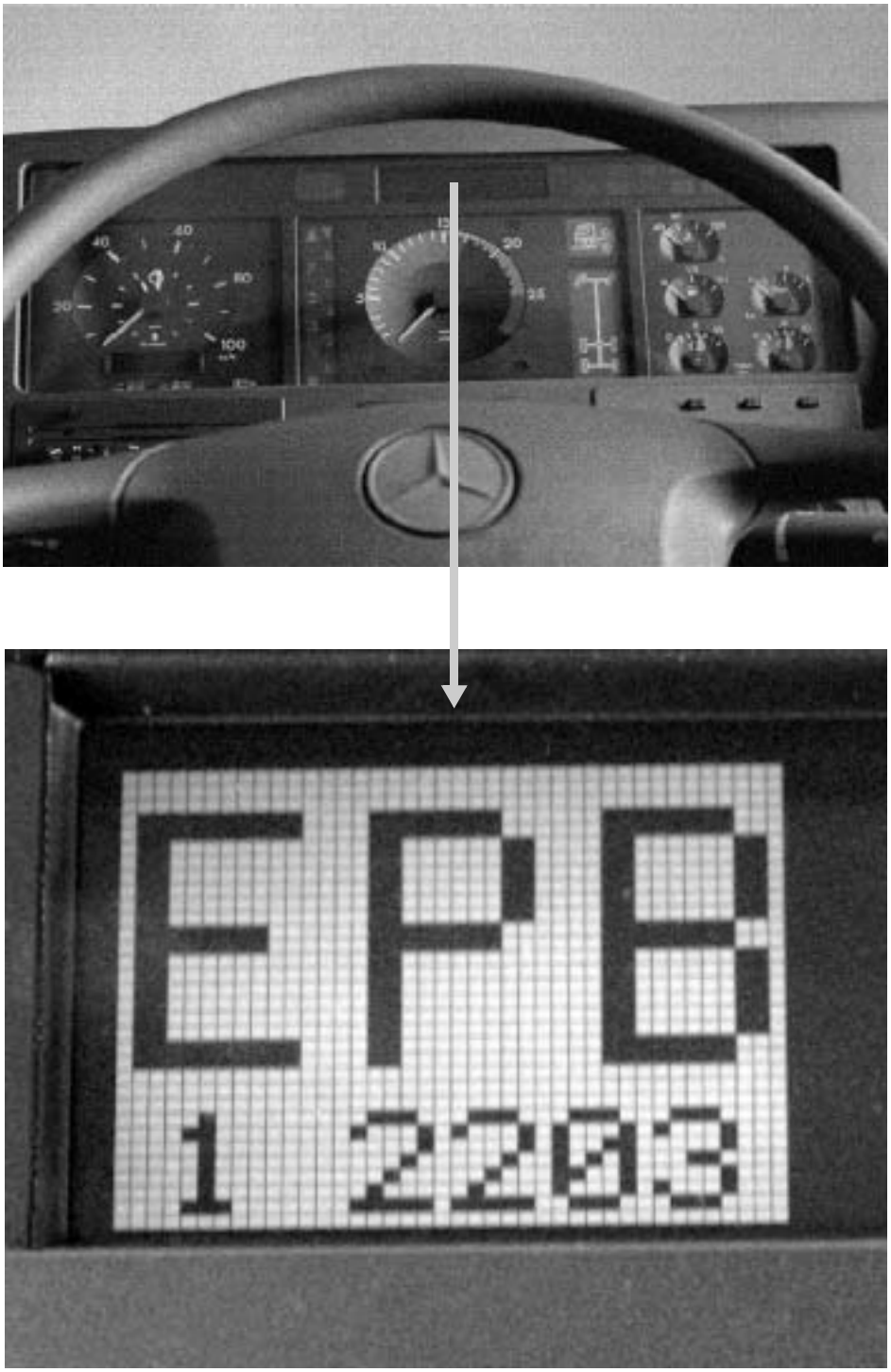
The extrapolation is the same procedure as for conventional braked vehicles. At the calculated pressure the information of the vehicle manufacturer as to be noted (e. g. for MB “ACTROS”: calculated pressure 8.5 bar.) For trailers the pressure is 6.5 bar.

Please note

The checking of the electrical ISO-7638 supply socket is made with the already mentioned testing appliance known from the ABS.

An example for the display of a defect in the EBS system

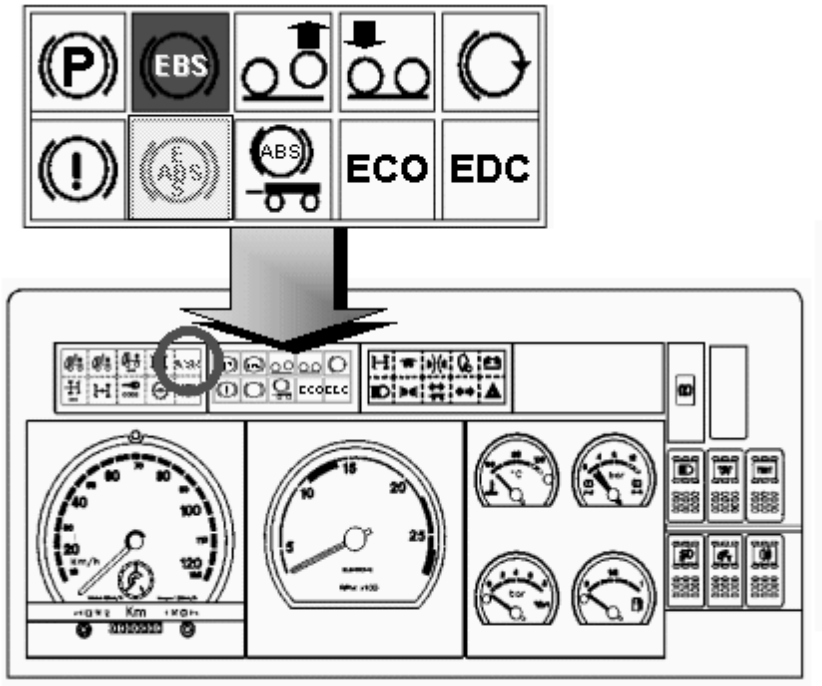
The following illustrations show the display in a MB “ACTROS”. The abbreviation EPB is the name used by Daimler Chrysler for EBS. In vehicles since '99 instead of “EPB” the name “BS” is used for braking systems.



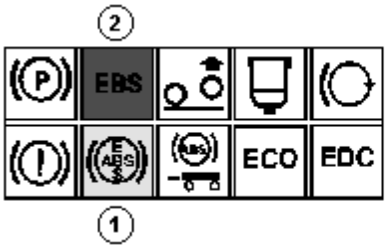
As an alternative the fault display be obtained via the warning lamps.

Example

IVECO EuroTech or EuroStar (Cursor 10):



In this case it means:



① Yellow indicator light

shows “minor” faults, the braking perfomance is not impaired but control functions are blocked (e. g. ABS)

② red indicator light

shows severe faults, the brakingperformance is impaired, redundancy operation EBS is switch off partly or wholly.