Trailer EBS - System Description

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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 an Electronically controlled Braking System (EBS) for trailers, Trailer EBS for short, is one step towards meeting these stringent requirements.

1.1 Benefits of EBS on Trailers

- ❑ 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.
- ❑ 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 (in Germany: under No. 33).

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).

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 2- to 6-wheel semitrailers and central axle trailers with air suspension systems.
- **4S/2M,** 4 speed sensors and one trailer modulator for 4- and 6-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 4- to 8-wheel semitrailers and 4- and 6-wheel central axle trailers with air suspension systems.
- **4S/3M,** 4 speed sensors, one trailer modulator and one EBS relay valve for 4 to 10-wheel towbar trailers and 4- to 8-wheel semitrailers or 4- and 6-wheel central axle trailers with air suspension systems.

2S/1M, 4S/4M and **6S/3M** ABS configurations are **not** being 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 utilization of the adhesion coefficient to be roughly identical. If not all wheels are sensor-controlled, the axle(s) which tend(s) to lock first should have to have sensors fitted.

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 O3 and O4 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 Design and Operation

2.1 System Design

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).

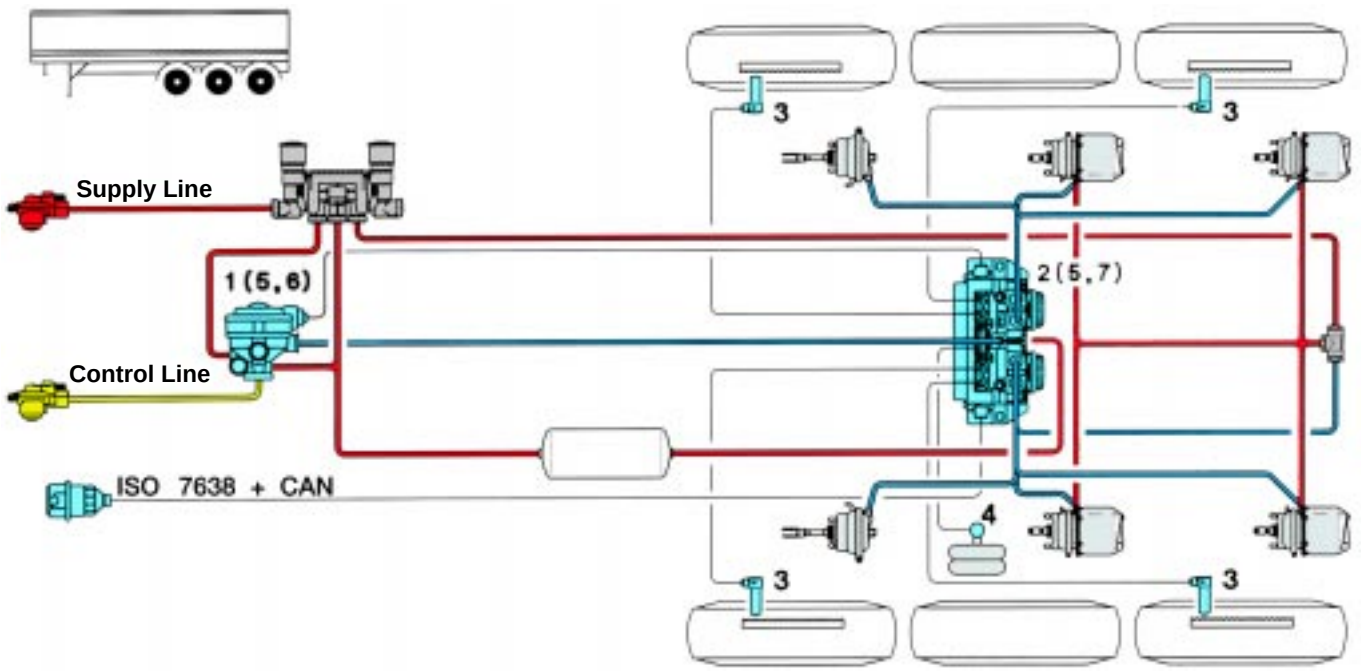


Fig. 2-1: Braking system 4S/2M for semitrailers

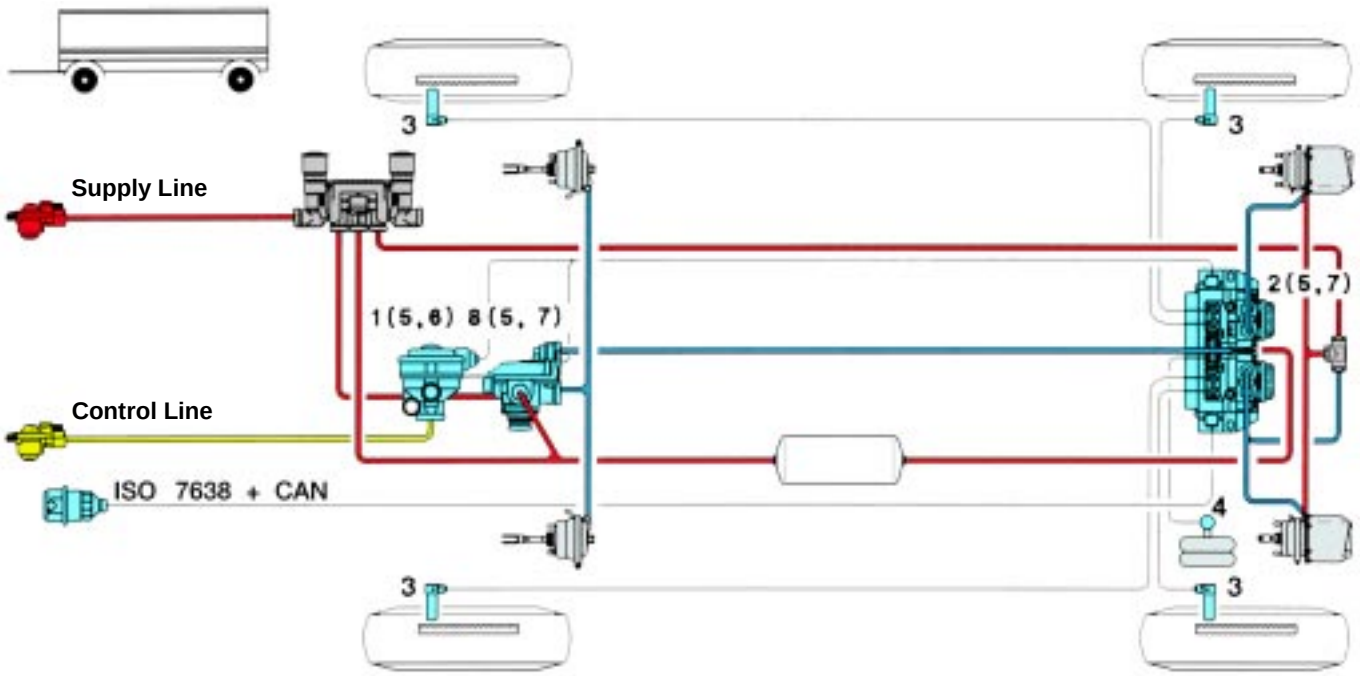


Fig. 2-2: Braking system 4S/3M for towbar trailers

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 EBS Relay Emergency Valve 971 002 ... 0

As trailers which have had EBS fitted are also used in combination with towing vehicles which have a conventional braking system, the standard functions of the relay emergency valve, such as the breakaway function and the check valve, continue to be required. The adjustable advance does not apply since this is achieved electronically. The EBS relay emergency valve actuates the trailer's braking system pneumatically in the event of a redundancy.

The EBS relay emergency valve has an integrated index pressure sensor. It provides the index value (braking force as desired by the driver) when a trailer with EBS is being towed by a towing vehicle with a conventional system. In addition, an index pressure switch (brake switch) has been integrated which monitors the index pressure sensor and also detects any rupture of the supply line. The electrical evaluation and monitoring processes are accomplished by the trailer modulator.

In order to achieve the best possible time response behaviour, the EBS relay emergency valve should be fitted as close to the hose couplings as possible.

EBS relay emergency valve 971 002 ... 0

2.2.2 EBS Trailer Modulator 480 102 ... 0

The trailer modulator (TM) is used to control and monitor the electro-pneumatic braking system.

It is mounted on the vehicle frame between the air reservoir or EBS relay emergency valve and the brake cylinder close to the axles on the vehicle's frame (e.g. on a 6-wheel semitrailer: on the cross member above the second axle). It controls the pressure in the brake cylinders on both sides of one, two or three axles.

The TM has two pneumatically independent pressure control channels with a breather valve, a redundancy valve, a pressure sensor and shared control electronics. If a trailer interface is available, the index retardation of the vehicle is computed from the CAN index value. Otherwise the index retardation is derived from the pressure signal received from the EBS relay emergency valve.

The TM has a connection for one axle load sensor. The braking force is modified as a ratio of the vehicle's load. In addition, the wheel speeds are picked up by up to four speed sensors, and evaluated. If a tendency to lock is detected, the braking pressure for the brake cylinders is controlled by the ABS control circuit.

The TM has an electrical connection for an ABS or EBS relay valve. This connection can be used to separately control the brake cylinder pressures on one axle.

The supply pressure is picked up by an integated pressure sensor. If the supply pressure falls below 4.5 bar, the driver is alerted by the warning or indicator lamps.

A bidirectional data interface to ISO 14230 (KWP 2000) is provided for TM diagnosis.

If an extended ISO-7638 plug-in facility is available, the TM communicates with the motor vehicle via the electrical trailer interface to ISO 11992.

Position for Installation:
Vent facing downwards, max. deviation from vertical position ± 15°. An air speed of at least 2 m/sec must be ensured. For this reason, the trailer modulator may not be fitted in an enclosed area on the vehicle. When installing the modulator it is vital that it is placed far enough away from any components which give off heat to prevent it being exposed to circulating hot air.

2.2.3 EBS Relay Valve 480 207 ... 0

Within the electro-pneumatic braking system, the EBS relay valve is used as an actuator for the delivery of control pressures on the front axle of towbar trailers or a 3rd axle on semitrailers.

This valve consists of a relay valve with two solenoid valves (inlet and outlet valves), a redundancy valve and a pressure sensor. It is electrically actuated and monitored by the trailer modulator.

2.2.4 ABS Relay Valve 472 195 0.. 0

The ABS relay valve known from conventional braking systems, together with a double check valve, is used as an actuator for outputting the braking pressures on one steering axle of semitrailers. Electrical actuation and the monitoring process are accomplished by the trailer modulator.

2.2.5 Lifting Axle Valve 463 084 010 0

The ABS relay valve known from conventional braking systems, together with a double check valve, is used as an actuator for outputting the braking pressures on one steering axle of semitrailers. Electrical actuation and the monitoring process are accomplished by the trailer modulator.

2.2.6 ECAS 446 055 066 0

Electronically Controlled Air Suspension system.

Electrical actuation and the monitoring process are accomplished by the trailer modulator.

The design and operation of ECAS are described in more detail in brochure 815 003 197 3.

2.2.7 Axle Load Sensor 441 040 007 0 to 441 040 010 0

The axle load sensor (pressure sensor) detects the bellows pressure of the air suspension system. The braking forces are adjusted to the load carried as a ratio of the bellows pressure. Electrical actuation and the monitoring process are accomplished by the trailer modulator.

The axle load sensor must pick up the bellows pressure on a non-liftable axle; on towbar trailers, the axle load sensor must always pick up the bellows pressure on the axle controlled by the trailer modulator.

If an air suspension system with one levelling valve is used, the axle load sensor can be conntected to any of the air suspension bellows.

If an air suspension system with two levelling valves is used (levelling control for both sides of the vehicle), the axle load sensor must receive the higher bellows pressure via a two-way valve.

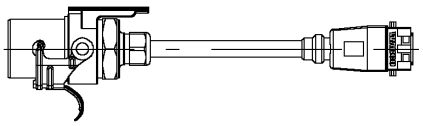
2.2.8 ABS-Sensors 441 032 578 0/ 441 032 579 0

Trailer EBS includes two optional sensor types, the only difference between them being the cable length.
When replacing sensors, it is advisable to use sensor set 441 032 921 2 or 441 032 922 2. The speed sensors used have to comply with WABCO's specification, or have to have been approved by WABCO.

2.3 Cable Overview

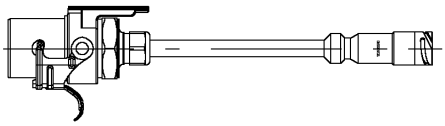
For Trailer EBS, pre-fabricated cables must be used; they have sprayed-on plugs. The various cable types are available in different lengths.

Supply Cable for Towbar Trailer (2 x 4², 5 x 1,5²)



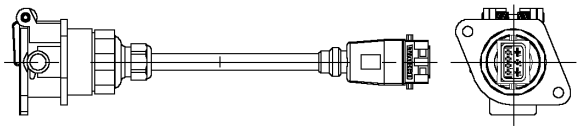
Part Number	Length L (mm)
449 272 090 0	9 000
449 272 100 0	10 000
449 272 120 0	12 000
449 272 . . . 0	..

Supply Cable for Towbar Trailer
with bayonet disconnector (2 x 4², 5 x 1,5²)



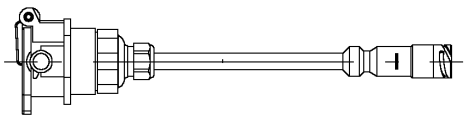
Part Number	Length L (mm)
449 233 100 0	10 000
449 233 140 0	14 000
449 233 . . . 0	..

Supply Cable for Semitrailer (2 x 4², 5 x 1,5²)



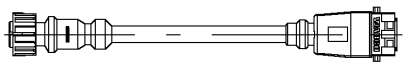
Part Number	Length L (mm)
449 172 090 0	9 000
449 172 120 0	12 000
449 172 130 0	13 000
449 172 150 0	15 000

Supply Cable for Semitrailer with
bayonet disconnector (2 x 4², 5 x 1,5²)



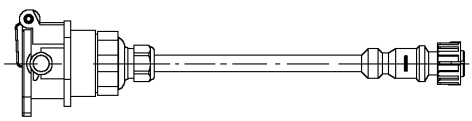
Part Number	Length L (mm)
449 133 120 0	12 000
449 133 150 0	15 000
449 133 . . . 0	..

Supply Cable for Towbar Trailer/Semitrailer with
bayonet fellow (2 x 4², 5 x 1,5²)



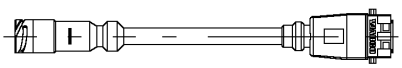
Part Number	Length L (mm)
449 333 003 0	300
449 333 . . . 0	..

Supply Cable for Semitrailer with bayonet fellow (2 x 4², 5 x 1,5²)



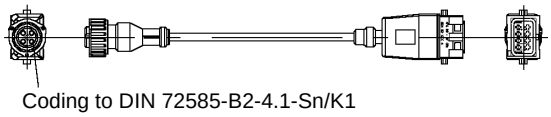
Part Number	Length L (mm)
449 135 005 0	500
449 135 . . . 0	..

Supply Cable for Semitrailer with bayonet
disconnector (2 x 4², 5 x 1,5²)



Part Number	Length L (mm)
449 335 140 0	14 000
449 335 . . . 0	..

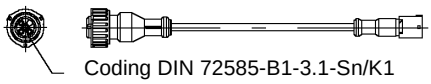
REV Line „B2“ (4 x 0,5²) / cable for relay emergency valve



Part Number	Length L (mm)
449 472 030 0 *)	3 000
449 472 035 0 *)	3 500
449 472 050 0 *)	5 000
449 472 080 0 *)	8 000
449 472 130 0 *)	13 000
449 472 145 0 *)	14 500

*) only fits relay emergency valve 971 002 802 2

Axle load sensor (3 x 0,5^2)



Part Number	Length L (mm)
449 752 020 0	2 000
449 752 030 0	3 000
449 752 080 0	8 000

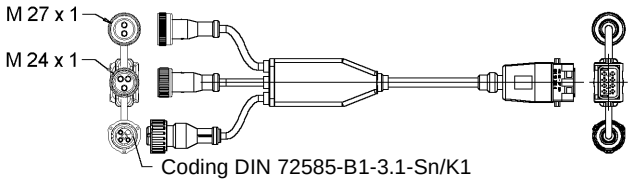
Sensor extension cable

Part Number	Length L (mm)
449 712 030 0	3 000
449 712 . . . 0	. . .

ABS Relay Valve (3 x 1,5^2) with DIN Bayonet

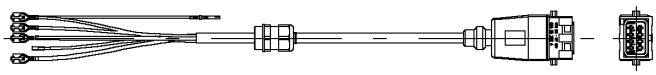
Part Number	Length L (mm)
449 426 020 0	2 000
449 426 030 0	3 000
449 426 080 0	8 000

EBS Relay Valve (3 x 0,5^2, 5 x 1^2)



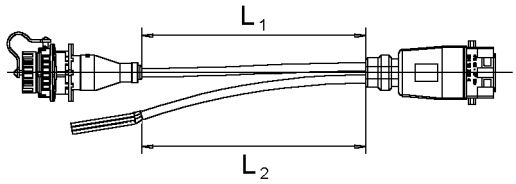
Part Number	Length L (mm)
449 372 060 0	6 000
449 372 080 0	8 000
449 372 130 0	13 000

ECAS (2 x 2,5², 3 x 0,5²)



Part Number	Length L (mm)
449 382 060 0	6 000

Diagnosis and ISS or ILS (3 x 0,75²)

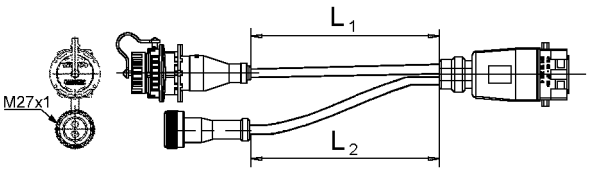


Part Number	Length L1/L2 (mm)
449 614 148 0	3 000 / 3 000
449 614 153 0	6 000 / 3 000
449 614 295 0	8 000 / 8 000

Diagnosis (3 x 0,5²)

Part Number	Length L (mm)
449 672 030 0	3 000
449 672 040 0	4 000
449 672 060 0	6 000

Diagnosis (3 x 0,5²) and M27x1 (2 x 1,5²)
for lifting axle valve 463 084 010 0



Part Number	Length L1/L2 (mm)
449 624 . . . 0	..... / .....
449 624 113 0	6000 / 2000
449 624 . . . 0	..... / .....

2.4 List of Components

Name	Part Number	Comments
Modulator	480 102 000 0	for semitrailers or towbar trailers max. (4S/3M)
Modulator	480 102 001 0	for semitrailers max. (4S/2M)
EBS relay valve	480 207 001 0	
EBS relay emergency valve	971 002 80 . 0	
ABS relay valve	472 195 020 0	
Axle load sensor	441 040 007 0	
Double check valve	434 208 02 . 0	
Supply cable	449 172 000 0	for semitrailers, available in different lengths
Supply cable	449 272 000 0	for towbar trailers, available in different lengths
Diagnostic cable	449 672 000 0	available in different lengths
diagnostic cable and switching output ports	449 614 000 0	available in different lengths
cable for relay emergency valve	449 472 000 0	available in different lengths
cable for axle load sensor	449 752 000 0	available in different lengths
ABS sensor extension cable	449 712 000 0	available in different lengths
Cable for EBS relay valve	449 372 000 0	available in different lengths
Cable for ABS relay valve	449 426 000 0	available in different lengths

2.4.1 Other Components

Other components which are part of the electro-pneumatic braking system:

- ❑ brake cylinders
- ❑ air reservoirs
- ❑ pipes

These are essentially similar to those of a conventional compressed air braking system.

3. System Description

3.1 Electro-Pneumatic Function

EBS for Trailers is switched on electrically via Pin 2 of the ISO 7638 plug-in connection (Cl. 15). Immediately after it has been switched on, a system check (inaudible) is performed.

Please note: During the process of the system being activated, the ABS may not be fully operable as a dynamic check of the ABS sensors requires the vehicle to be moving.

The system is operable no more than 150 milliseconds after it has been switched on. When it is switched off, it will continue to run for a further 5 seconds only if an ECAS system has been installed.

For electro-pneumatic actuation, the integrated redundancy valves are energized when the brakes are first actuated, so that the pneumatic control pressure of the relay emergency valve is eliminated and the supply pressure is present at the inlet valves of the modulators. This allows the pressure to be adjusted up to the supply pressure.

The index values for Trailer EBS are primarily provided via the electrical trailer interface to ISO 11992 (CAN). If this interface is not available, the index values are provided by the pressure sensor integrated in the relay emergency valve.

The pressure output is effected via pressure control circuits with pulsed relay valves. For the purpose of adjusting the braking forces to different loads, the axle loads of vehicles with air suspension systems are picked up by sensors detecting the pressure in the bellows.

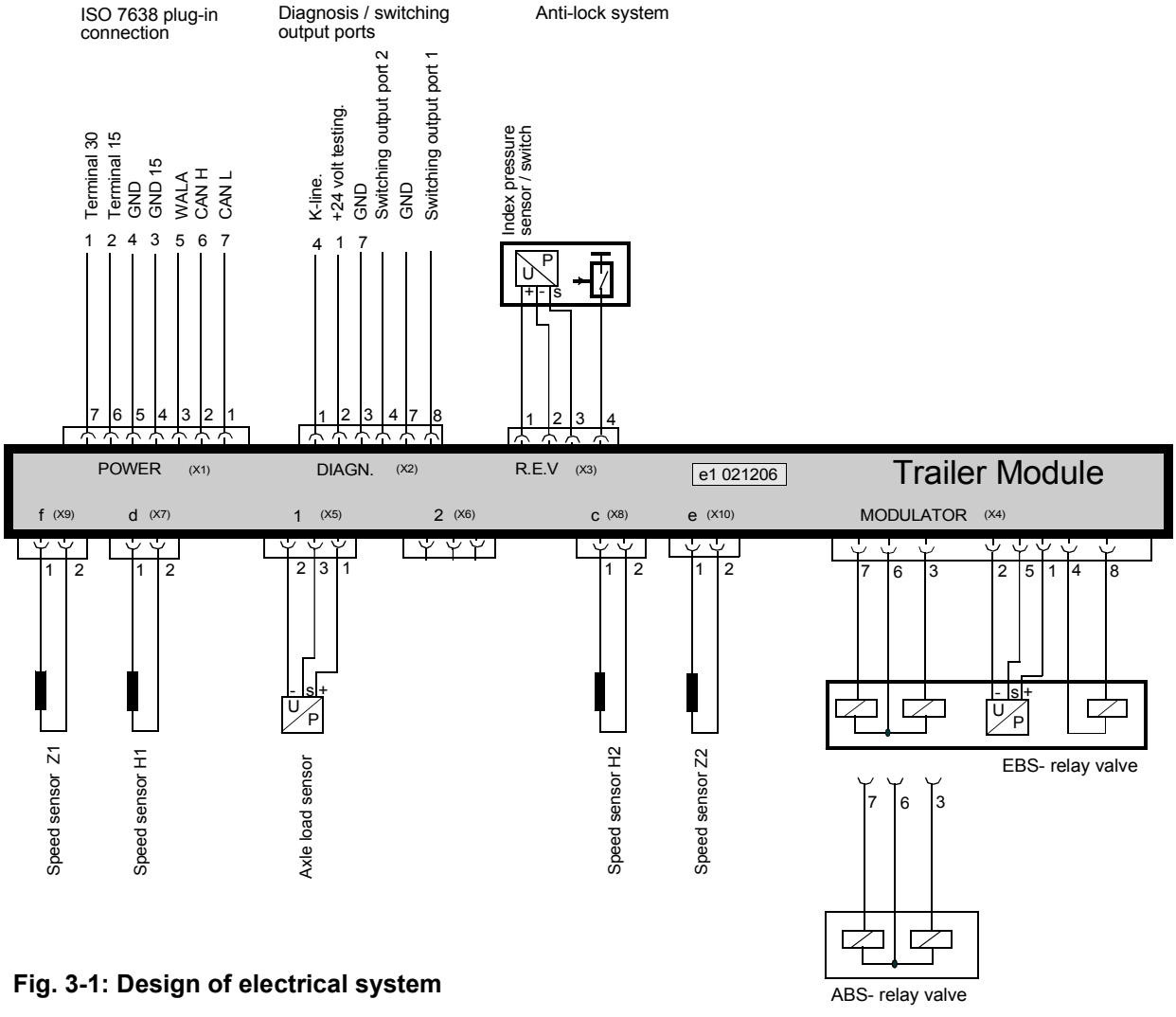


Fig. 3-1: Design of electrical system

3.2 Pneumatic Redundancy

In the event of a fault in the system which requires parts of the system to be switched off, the pneumatic control pressure is switched to the open inlet valves and the closed outlet valves of the modulators so that the purely pneumatic operating pressure is available, albeit without taking the axle loads (load-sensing) into account. The ABS function is maintained for as long as possible. Via Pin 5 of the ISO 7638 plug-in connection, the driver is informed of the condition of the system by means of a warning lamp (in keeping with legal provisions).

3.3 Electrical / Electronic System Design

Fig. 3-1 shows the design of the electrical system, including the electrical wiring.

The trailer modulator is supplied from the plug-in facility to ISO 7638 (Terminals 15 and 30).

The electrical data link between the motor vehicle and the trailer modulator is achieved via the trailer interface to ISO 11992 (PIN 6+7 ISO 7638). The data received are processed by the trailer modulator according to their relative importance and function.

For the purpose of determining the index value when a trailer is being towed by a motor vehicle that has no EBS, a pressure sensor and a switch have been integrated in the relay emergency valve. The sensor receives its power supply from the trailer modulator. The index value is an analog signal. When the pressure in the control line rises, the switch discontinues the offset calculation of the pressure sensors required for the control process. In addition, it is possible to check the index value for plausibility. When the pressure rises in the control line, the switch switches the electronic inlet port to earth.

The pneumatic redundancy is achieved with the 3/2-way solenoid valves integrated in the trailer modulator. At the beginning of any braking cycle, the trailer modulator bypasses the solenoid valves and thus the redundant actuation.

The pressure for the front axle of a towbar trailer, or for the 3rd axle of a semitrailer, is controlled by means of an electro-pneumatic EBS relay valve. A pressure sensor and a 3/2-way solenoid valve are integrated in the valve assembly. The pressure sensor receives its power supply from the trailer modulator.

The pressure for the 3rd axle (trailering - steering axle) of a semitrailer can also be controlled by means of an ABS relay valve.

The power supply for all active sensors is provided through joint short-circuit stable output ports on the trailer modulator.

For detecting the axle load, a pressure sensor is used, its readings being evaluated by the trailer modulator. The sensor receives ist power supply from the trailer modulator.

A sensor for the supply pressure and two sensors for picking up actual pressures are integrated in the trailer modulator.

For other trailer systems, two switching output ports are provided which can have their parameters set by means of diagnostic equipment.

Any system errors are detected and stored by the trailer modulator (error memory). A visual indication of the condition of the trailer system is effected via PIN 5 of the ISO 7638 plug-in connection (warning lamp) and in parallel via the electrical trailer interface to ISO 11992. It is up to the driver to make sure that the warning lamp is in good working order.

3.3.1 Warning Signal Sequences

1st Option
When vehicle is stationary:

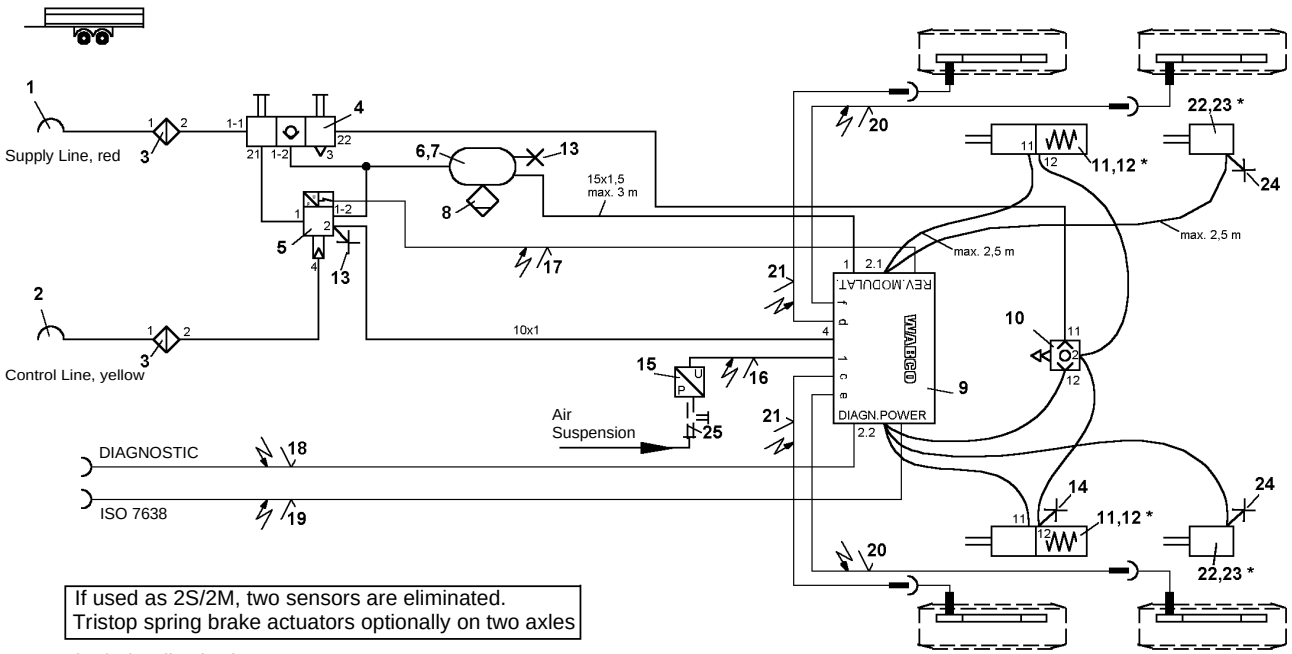
- Warning lamp comes on after ‘ignition on’.
- If no prevailing error is detected, the warning lamp goes off after approx. 2 seconds.
- If a prevailing error is detected, e. g. a defective sensor, the warning lamp stays on.
- If an error or defect was detected when the vehicle was last moved but this error no longer prevails, the warning lamp goes off when the vehicle speed v exceeds 7 k.p.h.

When vehicle is being moved at v > 7 k.p.h:

- Warning lamp comes on and stays on if a prevailing error has been detected.

2nd Option
- Warning lamp comes on after ‘ignition on’.
- If no prevailing error is detected, the warning lamp goes off after approx. 2 seconds and comes on again after a further 2 seconds. It then goes off at v > 7 k.p.h.
- If a prevailing error is detected, e. g. a sensor having been detached, the warning lamp stays on.

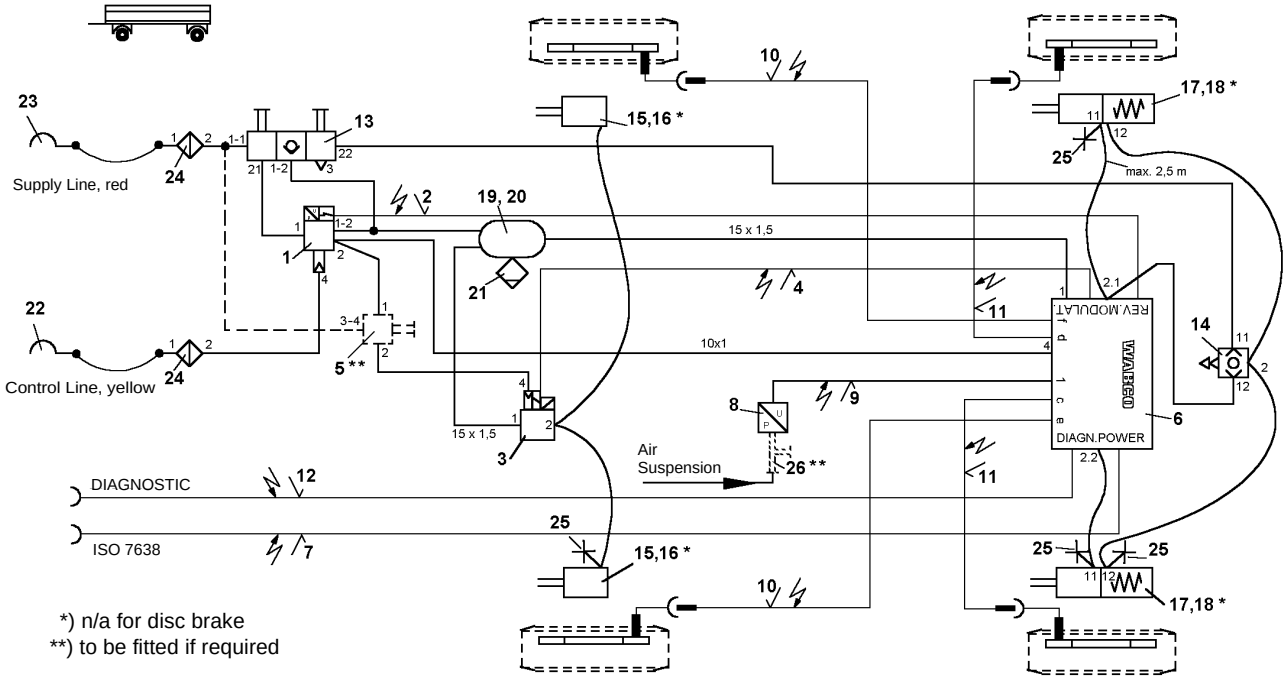
2-Axles Central Axle Trailer 4S/2M and 2S/2M



No.	Pcs.	Description	Part Number
1	1	Hose Coupling, supply	952 200 021 0
2	1	Hose Coupling, control	952 200 022 0
3	2	Line Filter	432 500 02 . 0
4	1	Double Release Valve with Check Valve	963 001 051 0
5	1	EBS-Relay Emergency Valve	971 002 80 . 0
6	1	Air reservoir	950 0
7	2	Mounting clamp	451 999 . . . 2
8	1	Drain Valve	934 300 001 0
9	1	EBS Trailer Modulator	480 102 0 . . 0
10	1	Two-way Quick Release Valve	973 500 051 0
11	2	Tristop Spring Brake Actuator	925 0
12	2	Mounting pack *	423 903 532 2

No.	Pcs.	Description	Part Number
13	2	Test connection	463 703 115 0
14	1	Test connection	463 703 036 0
15	1	Axle Load Sensor	441 040 007 0
16	1	Axle Load Sensor cable	449 752 0 . . 0
17	1	Relay Emergency Valve cable	449 47. 000 0
18	1	Diagnostic cable	449 672 . . . 0
19	1	Supply cable	449 172 . . . 0
20	2	Extension RA, for Sensor	449 712 . . . 0
21	2	Extension FA, for Sensor	449 712 . . . 0
22	2	Brake Chamber	423 0
23	2	Mounting pack *	423 2
24	2	Test connection	463 703 114 0
25	1	Test Valve (alternatively)	463 710 998 0

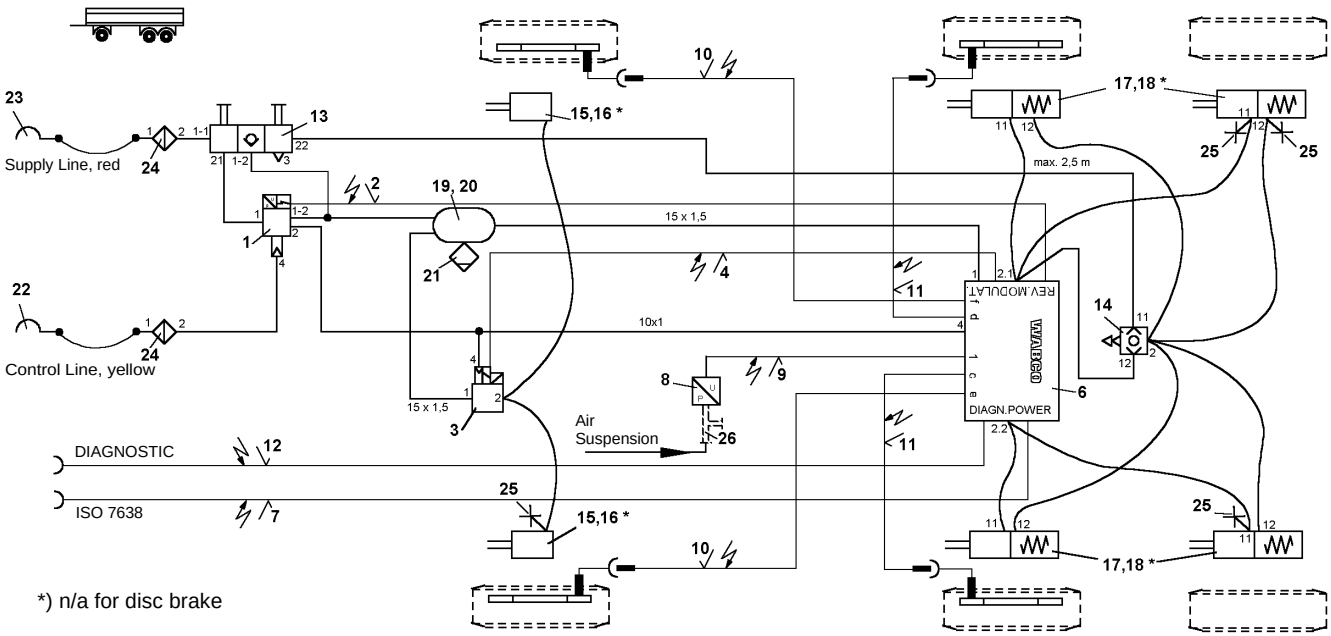
2-Axles Towbar Trailer 4S/3M



No.	Pcs.	Description	Part Number
1	1	EBS-Relay Emergency Valve	971 002 80 . 0
2	1	Relay Emergency Valve cable	449 47. 000 0
3	1	EBS Relay Valve	480 207 0 . . 0
4	1	EBS Relay Valve cable	449 372 0 . . 0
5	1	Trailer Quick Release Valve **	463 034 005 0
6	1	EBS Trailer Modulator	480 102 0 . . 0
7	1	Supply cable	449 272 . . . 0
8	1	Axle Load Sensor	441 040 007 0
9	1	Axle Load Sensor cable	449 752 0 . . 0
10	2	Extension VA, for Sensor	449 712 . . . 0
11	2	Extension RA, for Sensor	449 712 . . . 0
12	1	Diagnostic cable	449 672 . . . 0
13		Double Release Valve with Check Valve	963 001 051 0

No.	Pcs.	Description	Part Number
14	1	Two-way Quick Release Valve	973 500 051 0
15	2	Brake Chamber	423 0
16	2	Mounting pack *	423 2
17	2	Tristop Spring Brake Actuator	925 0
18	2	Mounting pack *	423 903 532 2
19	1	Air reservoir	950 0
20	2	Mounting clamp	451 999 . . . 2
21	1	Drain Valve	934 300 001 0
22	1	Hose Coupling, supply	952 200 021 0
23	1	Hose Coupling, control	952 200 022 0
24	2	Line Filter	432 500 02 . 0
25	3	Test connection	463 703 036 0
26	1	Test Valve (alternatively)	463 710 998 0

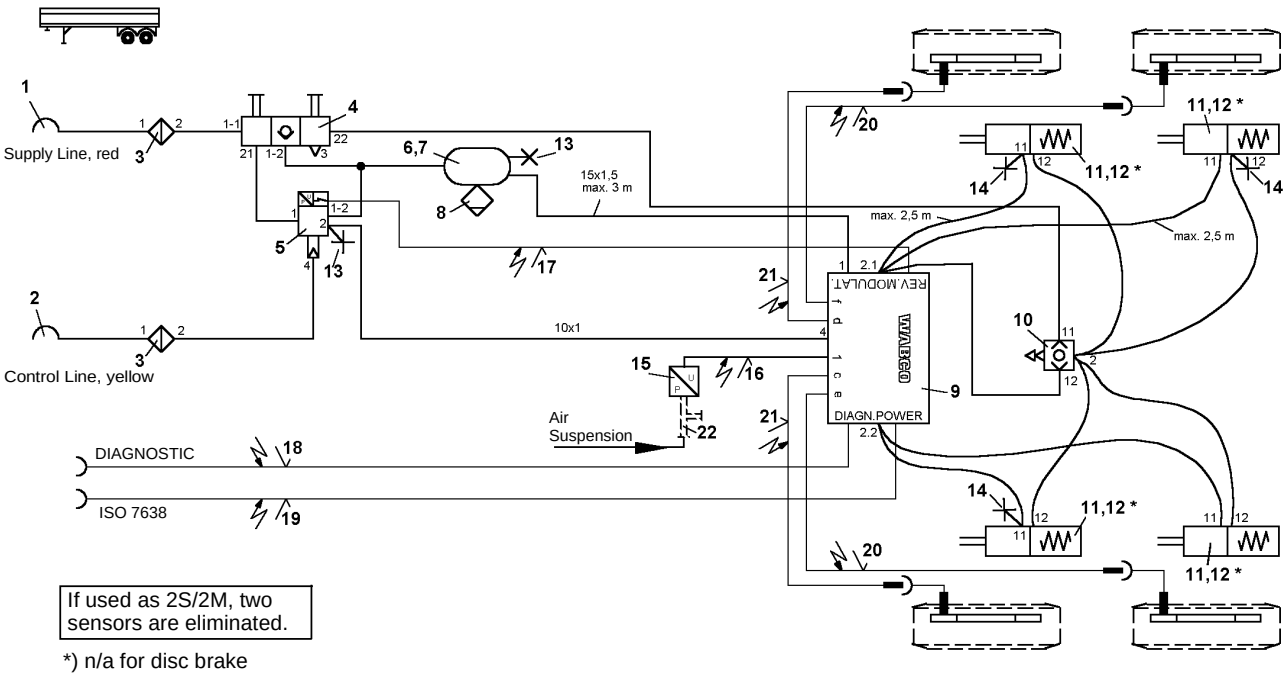
3-Axles Towbar Trailer 4S/3M



No.	Pcs.	Description	Part Number
1	1	EBS-Relay Emergency Valve	971 002 80 . 0
2	1	Relay Emergency Valve cable	449 47. 000 0
3	1	EBS Relay Valve	480 207 0 . . 0
4	1	EBS Relay Valve cable	449 372 0 . . 0
5			
6	1	EBS Trailer Modulator	480 102 0 . . 0
7	1	Supply cable	449 272 . . . 0
8	1	Axle Load Sensor	441 040 007 0
9	1	Axle Load Sensor cable	449 752 0 . . 0
10	2	Extension VA, for Sensor	449 712 . . . 0
11	2	Extension RA, for Sensor	449 712 . . . 0
12	1	Diagnostic cable	449 672 . . . 0
13		Double Release Valve with Check Valve	963 001 051 0

No.	Pcs.	Description	Part Number
14	1	Two-way Quick Release Valve	973 500 051 0
15	2	Brake Chamber	423 0
16	2	Mounting pack *	423 2
17	4	Tristop Spring Brake Actuator	925 0
18	4	Mounting pack *	423 903 532 2
19	1	Air reservoir	950 0
20	2	Mounting clamp	451 999 . . . 2
21	1	Drain Valve	934 300 001 0
22	1	Hose Coupling, supply	952 200 021 0
23	1	Hose Coupling, control	952 200 022 0
24	2	Line Filter	432 500 02 . 0
25	4	Test connection	463 703 036 0
26	1	Test Valve (alternatively)	463 710 998 0

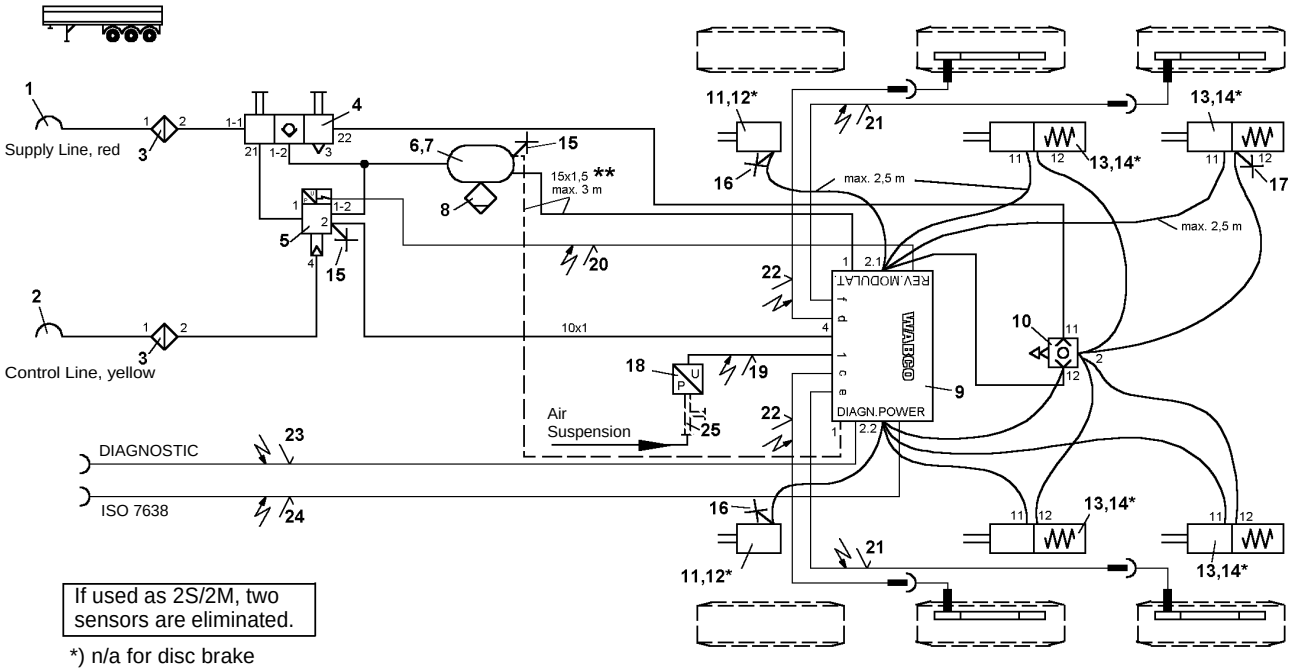
2-Axles Semitrailer 4S/2M and 2S/2M



No.	Pcs.	Description	Part Number
1	1	Hose Coupling, supply	952 200 021 0
2	1	Hose Coupling, control	952 200 022 0
3	2	Line Filter	432 500 02 . 0
4	1	Double Release Valve with Check Valve	963 001 051 0
5	1	EBS-Relay Emergency Valve	971 002 80 . 0
6	1	Air reservoir	950 0
7	2	Mounting clamp	451 999 . . . 2
8	1	Drain Valve	934 300 001 0
9	1	EBS Trailer Modulator	480 102 0 . . 0
10	1	Two-way Quick Release Valve	973 500 051 0
11	4	Tristop Spring Brake Actuator	925 0

No.	Pcs.	Description	Part Number
12	4	Mounting pack *	423 903 532 2
13	2	Test connection	463 703 115 0
14	3	Test connection	463 703 036 0
15	1	Axle Load Sensor	441 040 007 0
16	1	Axle Load Sensor cable	449 752 0 . . 0
17	1	Relay Emergency Valve cable	449 47. 000 0
18	1	Diagnostic cable	449 672 . . . 0
19	1	Supply cable	449 172 . . . 0
20	2	Extension RA, for Sensor	449 712 . . . 0
21	2	Extension VA, for Sensor	449 712 . . . 0
22	1	Test Valve (alternatively)	463 710 998 0

3-Axles Semitrailer 4S/2M and 2S/2M



*) n/a for disc brake

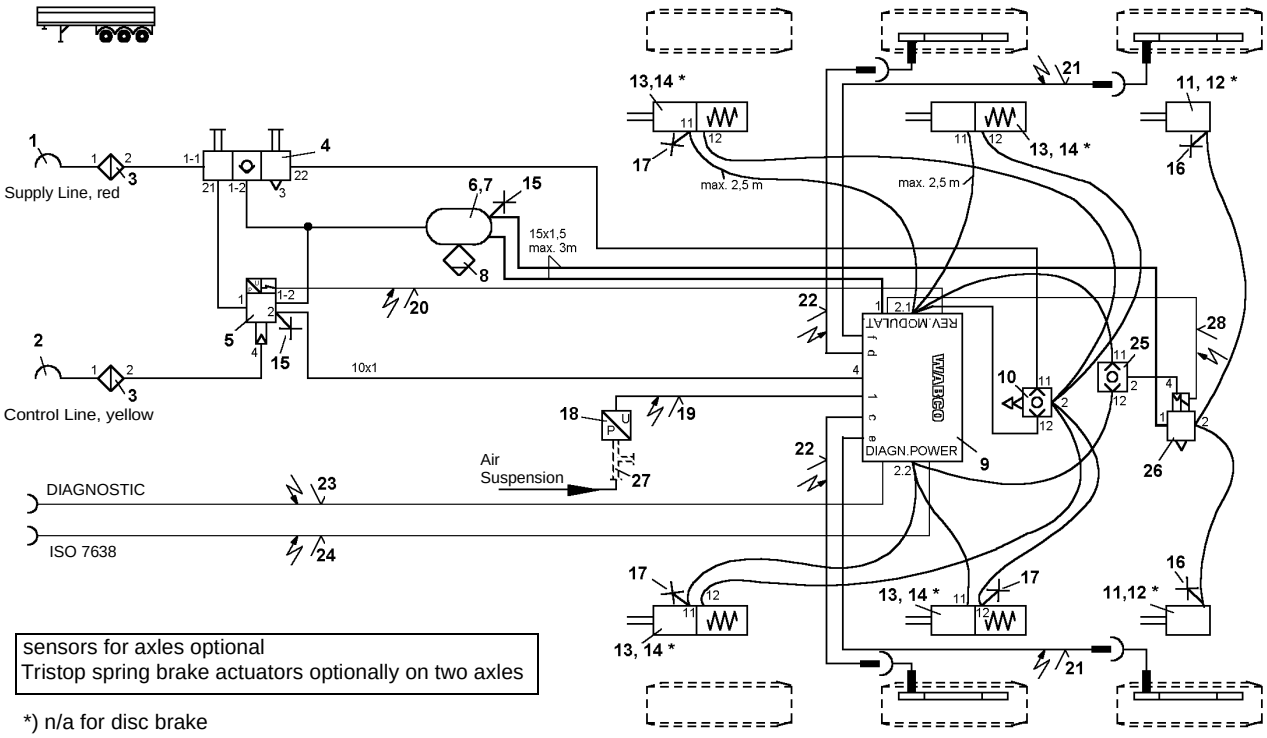
**) For cylinders ≥18" supply line 18 x 2 or 2 x 15 x 1.5

No.	Pcs.	Description	Part Number
1	1	Hose Coupling, supply	952 200 021 0
2	1	Hose Coupling, control	952 200 022 0
3	2	Line Filter	432 500 02 . 0
4	1	Double Release Valve with Check Valve	963 001 051 0
5	1	EBS-Relay Emergency Valve	971 002 80 . 0
6	1	Air reservoir	950 0
7	2	Mounting clamp	451 999 . . . 2
8	1	Drain Valve	934 300 001 0
9	1	EBS Trailer Modulator	480 102 0 . . 0
10	1	Two-way Quick Release Valve	973 500 051 0
11	2	Brake Chamber	423 0
12	2	Mounting pack *	423 2

No.	Pcs.	Description	Part Number
13	4	Tristop Spring Brake Actuator	925 0
14	4	Mounting pack *	423 903 532 2
15	2	Test connection	463 703 115 0
16	2	Test connection	463 703 114 0
17	1	Test connection	463 703 036 0
18	1	Axle Load Sensor	441 040 007 0
19	1	Axle Load Sensor cable	449 752 0 . . 0
20	1	Relay Emergency Valve cable	449 47. 000 0
21	2	Extension RA, for Sensor	449 712 . . . 0
22	2	Extension MA, for Sensor	449 712 . . . 0
23	1	Diagnostic cable	449 672 . . . 0
24	1	Supply cable	449 172 . . . 0
25	1	Test Valve (alternatively)	463 710 998 0

Braking Diagram 841 700 892 0

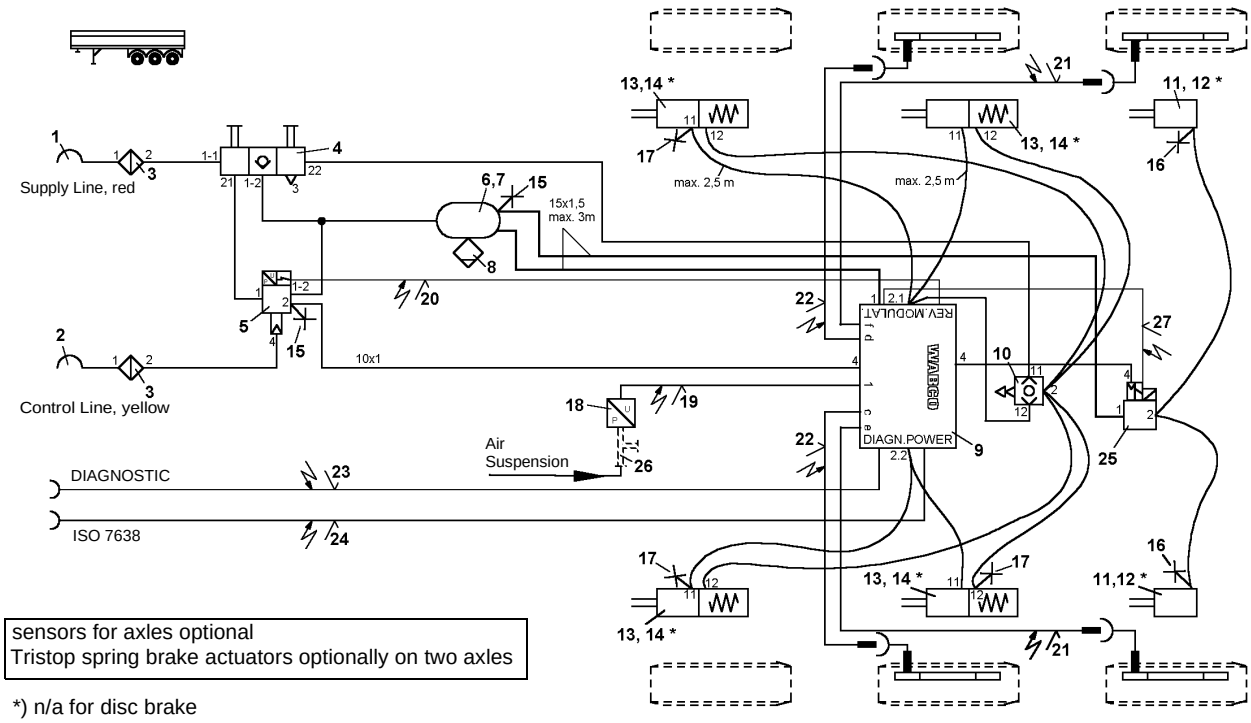
3-Axles Semitrailer 4S/2M + 1M



No.	Pcs.	Description	Part Number
1	1	Hose Coupling, supply	952 200 021 0
2	1	Hose Coupling, control	952 200 022 0
3	2	Line Filter	432 500 02 . 0
4	1	Double Release Valve with Check Valve	963 001 051 0
5	1	EBS-Relay Emergency Valve	971 002 80 . 0
6	1	Air reservoir	950 0
7	2	Mounting clamp	451 999 . . . 2
8	1	Drain Valve	934 300 001 0
9	1	EBS Trailer Modulator	480 102 0 . . 0
10	1	Two-way Quick Release Valve	973 500 051 0
11	2	Brake Chamber	423 0
12	2	Mounting pack *	423 2
13	4	Tristop Spring Brake Actuator	925 0

No.	Pcs.	Description	Part Number
14	4	Mounting pack *	423 903 532 2
15	2	Test connection	463 703 115 0
16	2	Test connection	463 703 114 0
17	3	Test connection	463 703 036 0
18	1	Axle Load Sensor	441 040 007 0
19	1	Axle Load Sensor cable	449 752 0 . . 0
20	1	Relay Emergency Valve cable	449 47. 000 0
21	2	Extension RA, for Sensor	449 712 . . . 0
22	2	Extension MA, for Sensor	449 712 . . . 0
23	1	Diagnostic cable	449 672 . . . 0
24	1	Supply cable	449 172 . . . 0
25	1	Two-way Valve	434 208 0 . . 0
26	1	ABS Relay Valve	472 195 020 0
27	1	Test Valve (alternatively)	463 710 998 0
28	1	Solenoid cable	449 426 0 . . 0

3-Axles Semitrailer 4S/3M



*) n/a for disc brake

No.	Pcs.	Description	Part Number
1	1	Hose Coupling, supply	952 200 021 0
2	1	Hose Coupling, control	952 200 022 0
3	2	Line Filter	432 500 02 . 0
4	1	Double Release Valve with Check Valve	963 001 051 0
5	1	EBS-Relay Emergency Valve	971 002 80 . 0
6	1	Air reservoir	950 0
7	2	Mounting clamp	451 999 . . . 2
8	1	Drain Valve	934 300 001 0
9	1	EBS Trailer Modulator	480 102 0 . . 0
10	1	Two-way Quick Release Valve	973 500 051 0
11	2	Brake Chamber	423 0
12	2	Mounting pack *	423 2
13	4	Tristop Spring Brake Actuator	925 0

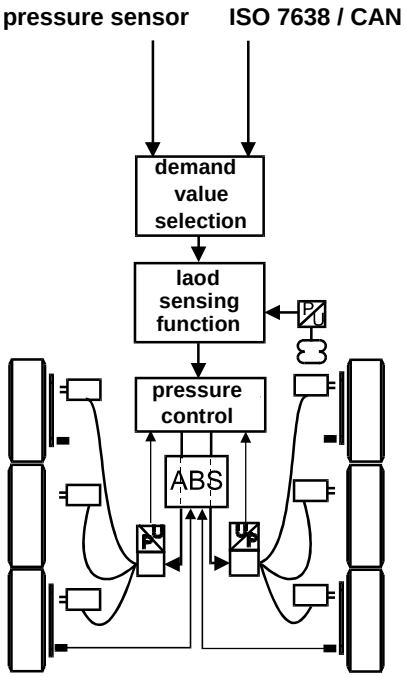
No.	Pcs.	Description	Part Number
14	4	Mounting pack *	423 903 532 2
15	2	Test connection	463 703 115 0
16	2	Test connection	463 703 114 0
17	3	Test connection	463 703 036 0
18	1	Axle Load Sensor	441 040 007 0
19	1	Axle Load Sensor cable	449 752 0 . . 0
20	1	Relay Emergency Valve cable	449 47. 000 0
21	2	Extension RA, for Sensor	449 712 . . . 0
22	2	Extension MA, for Sensor	449 712 . . . 0
23	1	Diagnostic cable	449 672 . . . 0
24	1	Supply cable	449 172 . . . 0
25	1	EBS Relay Valve	480 207 001 0
26	1	Test Valve (alternatively)	463 710 998 0
27	1	EBS Relay Valve cable	449 372 0 . . 0

5. Functional Description

The operation of Trailer EBS can be described by way of various partial functions.

5.1 Selection of Index Value

The term ‘index value’ is used for the braking force applied by the driver. For operation with an EBS towing vehicle with a 7-pole (ABS) plug-in connection to ISO 7638, the trailer modulator receives the index value from the EBS motor vehicle via the trailer interface (CAN). If no index value is available from the trailer interface, e. g. when the trailer is being towed by a motor vehicle with a conventional braking system with a 5-pole (ABS) plug-in connection to ISO 7638, or if the connection of the trailer interface (CAN) of a tractor-trailer combination with EBS is broken, an index value is generated by measuring the control pressure in the relay emergency valve. The index value from CAN always takes priority.



5.2 Automatic Load-Sensitive Braking (ALB)

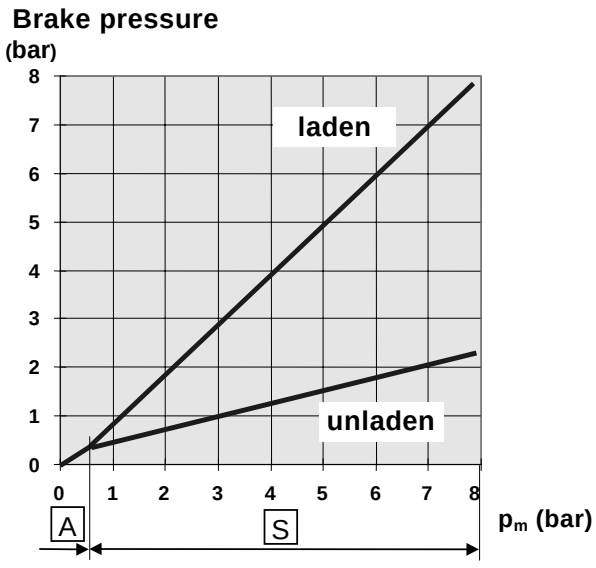
Trailer EBS includes load-sensitive braking control; there are some differences between semitrailers or central-axle trailers and towbar trailers.

The actual load on the trailer is detected by sensors on the air suspension bellows.

Semitrailers have a static load-sensing valve with a ray characteristic, like conventional valves. The transmission function of control pressure (p_{cyl}) via hose coupling pressure (p_m) is divided into two separate areas:

- A contact area
- S stability area

In this example, the brake cylinder pressure rises from 0 to 0.4 bar in the contact area of p_m = 0 bar to p_m = 0.7 bar.
At p_m = 0.7 bar, the response pressure of the wheel brake has been reached, so that the vehicle can now begin to build up braking forces. This point, i. e. the response pressure of the whole of the trailer’s braking system, can have its parameter set within the scope of the EC braking bands



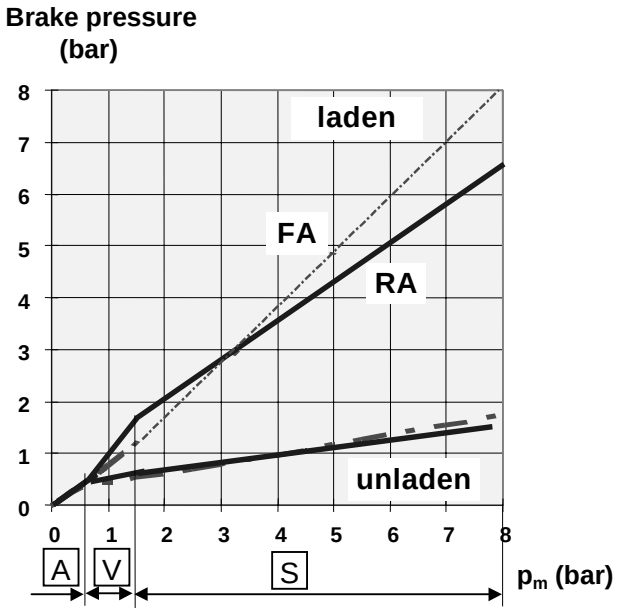
LSV-function in semitrailer

In its subsequent course, the control pressure on a laden vehicle follows the straight line running through the computed value at p_m = 6.5 bar. On an unladen vehicle, the response pressure output also occurs at p_m = 0.7 bar, after this the control pressure is reduced depending on the load carried.

For a towbar trailer, the brake force distribution achieved on the basis of software replaces the two load-sensing valve, the adapter valve on the front axle and the pressure limiting valve on the rear axle which are being used in conventional systems.

Here, the transmission functions is divided into three areas:

- A contact area
- V wear area
- S stability area



Distribution of brake forces on a towbar trailers

At the end of the contact area, output will occur again of the response pressures which can vary from axle to axle.

Within the partial braking range, the pressure output is adjusted to optimize wear. On a towbar trailer, e. g. with 24-type cylinders on the front axle and 20-type cylinders on the rear axle, the pressure on the front axle is reduced slightly, depending on the configuration, and increased slightly on the rear axle. This ensures a more accurate distribution of the load on all wheel brakes than with the adapter valve used in conventional systems.

Within the stability range, the output of pressures depends on the axle load in keeping with an even utilization of adhesion.

The load on the rear axle is picked up from the pressure in the air suspension bellows. The load on the front axle is not detected by an axle load sensor but is derived from the difference in slip of the wheels which have speed sensors fitted.
The parameters are computed by means of WABCO's brake computing programme. The parameters are stored in the trailer modulator with the corresponding brake computing number.

5.3 Pressure Control

The pressure control circuits convert the index pressures provided by the load-sensing function into cylinder pressures.

The control unit compares the actual pressures received from the output port of the relay valves with the index values. In the event of a deviation, this is levelled by actuation of the solenoids for reducing or reducing the pressure.

5.4 Anti-Lock Function (ABS)

From the speed behaviour of the wheels, the control logic determines whether one or several wheels show a 'locking tendency' and decides whether the respective braking pressure must be lowered, held or increased.

In a **2S/2M** configuration, one ABS sensor and one pressure control channel of the trailer modulator each are combined for one control channel. Any other wheels on one side are indirectly controlled. The braking forces are subject to the principle of Individual Control **(IR)**. For this purpose, each side of the vehicle receives the control pressure achievable for the prevailing road condition and the braking characteristic. If, on a vehicle with several axles that has this configuration, wheels which have had no sensors fitted are controlled indirectly, this is called 'Indirect Individual Control' **(INIR)**.

A **4S/2M** configuration has two ABS sensors on each side of the vehicle. In this type of system, control is again achieved for each side. The control pressure is the same for all wheels on one side of the vehicle. The two wheels on that side which have had sensors fitted are controlled on the basis of modified side control **(MSR)**. This means that the wheel on one side of the vehicle which locks first determines the ABS control process. However, the two modulators are controlled individually. As far as the two sides of the vehicle are concerned, they are subject to individual control. Whenever wheels which have not had any sensors fitted are indirectly controlled in this configuration on vehicles with several axles, this is known as 'indirect side control' **(INSR)**.

A **4S/3M** configuration is preferred for towbar trailers or semitrailers with one trailing steering axle. Two sensors and one EBS relay valve are placed on the steering axle. This achieves control by axle because the control pressure is the same on all the wheels of this axle. The first wheel on this axle to show a tendency to lock will dictate the ABS control process. This axle is controlled according to the principle of modified axle control **(MAR)**. Another axle has one ABS sensor and one pressure control channel of the trailer modulator fitted for lateral control. These wheels are subject to individual control **(IR)**.

For semitrailers with a trailing steering axle, a **4S/2M+1M** configuration may be more economical than a 4S/3M system. There are two sensors and one ABS relay valve on the steering axle. The steering axle is then controlled according to the **MAR** principle, one other axle being subject to **IR**.

In addition to the brake cylinders of the wheels with sensors, all these configurations allow brake cylinders of other axles to be connected to the existing modulators. These indirectly controlled wheels, however, do not supply any information to the trailer modulator when they show a tendency to lock. This means that there is no guarantee that they might not lock.

Examples for different system configurations are contained in Annex 8 C, 'Arrangement of Sensors'.

5.5 Stationary Function

When the vehicle is stationary (v < 1.8 k.p.h.) **and** the pneumatic actuating pressure is higher than 3.5 bar, the electro-pneumatic pressure output is changed to pneumatic pressure output. This is done to prevent unnecessary power consumption when the vehicle is parked, i.e. the handbrake is on, and the driving switch has been actuated. This function is deactivated when the vehicle is moved.

5.6 Emergency Braking Function

In order to provide the greatest possible brake force at all times, an emergency braking function is included. Whenever the driver's brake application requires more than 90% of the available supply pressure, i.e. in a panic braking situation, the control pressures are increased to the level of the available supply pressure. This function is also effective in the event of a bellows of the air suspension system bursting.

5.7 Testing Mode

In order to be able to check the electrical control pressure allocation while the vehicle is stationary, the electronic braking system has to be set to the testing mode. This switches off the stationary and the emergency braking functions. To activate the testing mode, the ignition has to be switched on while the pilot line is pressureless (neither the service braking system nor the parking braking systems have been actuated).

Automatic load-sensitive braking can then be checked in this mode as a ratio of the hose coupling pressure and the current axle load or the current bellows pressure.

On towbar trailers, the pressure output is achieved on the steering axle according to the bellows pressure on the main axle.

By pulling out the plug of the axle load sensors, a 'laden' vehicle can be simulated although the vehicle may in fact be empty.

Please note: In this case, the warning lamp will be activated! After testing, the axle load sensor has to be re-connected and the prevailing error deleted from the electronic control unit by breaking the power supply (reset function).

As soon as the vehicle moves at a speed of more than 10 k.p.h., the stationary and emergency braking functions are released once again.

5.8 Prevention of Automatic Braking After Line Rupture

In keeping with the provisions of ECE No 13/09 (Supplement 2), Subsection 5.2.2.12.1, it is permissible, for operation with a towing vehicle that has an electrical trailer interface to ISO 11992, to suppress automatic braking by the relay emergency valve until the supply pressure has fallen to below 4.5 bar. The driver is warned that this is happening. This function is not effective while the vehicle is stationary.

5.9 Monitoring the Supply Pressure

EBS monitors the supply pressure for the trailer.

If the supply pressure falls to below 4.5 bar, the driver is alerted by the warning lamps. While the braking system is being filled, the warning lamps do not go off until the supply pressure on the trailer has risen to above 4.5 bar.

5.10 Mileage Recorder

Trailer EBS has an integrated mileage recorder which records the mileage covered. Two individual functions can be used:

The **total mileage recorder** records the total mileage which the vehicle has covered since the system was installed. This value is recorded at regular intervals and can be read out at any time using different diagnostic equipment.

In addition, there is a so-called **daily mileage recorder**. This can be deleted at any time. This can be used, for instance, to determine the mileage covered between maintenance intervals, or within a certain period of time. The daily mileage recorder can be read out by using the diagnostic equipment.

Special calibration of the mileage recorder is not required. A calibration factor is computed from the rolling circumferences and the number of pole wheel teeth from the EBS parameters.

The mileage recorder requires operating voltage. If there is no power supply for the Trailer EBS, the mileage recorder does not work.

5.11 Service Signal

This function can be activated by means of diagnostic equipment. On new vehicles, this function is inactive. In addition, a mileage (in kilometres) can be freely selected. When the vehicle has covered this distance, the warning lamp is activated when the ignition is next switched on and while the vehicle is still stationary. The warning lamp will then flash eight times. From then on, it will flash every time the ignition is switched on to remind the driver that the vehicle is due for a service.

When the vehicle has been serviced, the service signal can be reset. The next service interval will then commence, and the signal is generated once again when the preset distance has been covered.

5.12 Lifting Axle Control ILS

If the vehicle has lifting axles, Trailer EBS can automatically control them depending on the current axle load (Integrated Load Switch). For this purpose, connect one lifting axle control valve 463 084 010 0 to electrical switching output port 1 and/or to electrical switching output port 2.

All lifting axles are lifted or lowered only while the vehicle is stationary. They are lowered automatically when the voltage supply is switched off.

The parameters are set using the diagnostic equipment.

Annex 8 D ‘Lifting Axle Control’ shows examples for vehicles with three 9-tonne axles and diagrams for lifting axle control.

The lifting axle may only have ABS sensors e and f fitted. ABS sensors c and d may not be fitted to the lifting axle!

5.13 Integrated Speed Switch (ISS

The electrical switching output port 1 of the trailer modulator can work in dependency of the vehicle speed (integrated speed switch). Whenever the speed of a vehicle falls below or rises above a speed threshold for which a parameter has been set, the switching condition of this output port will change. This permits relay or solenoid valves, for example, to be switched on or off depending on the speed of the vehicle.

One typical application for the use of ISS is, for example, to control steering axles which are to be locked at certain speeds.

The parameter for the speed threshold at which the switching condition of the output port changes is freely selectable within a range of between 4 and 120 k.p.h.

The parameter is set by using diagnostic equipment. Below the speed threshold for which the parameter has been set, the switching output port is switched off. In this condition, the output voltage is 0. When the threshold is reached, the output port is switched on. When the speed then falls below this threshold once again, there is a hysteresis of 2 k.p.h. before the output port is switched off again.

By means of setting the parameter for the speed threshold accordingly it is possible to determine whether the switching output port is to be switched on (+ 24 volts) or off (0 volts).

For non-permanent solenoid valves, the level of the switching output can be reversed for a period of 10 seconds when the speed threshold parameter is exceeded.

In the event of a defect it must be ensured that the equipment controlled by the switching output port is made safe. For example, if the power supply fails, a steering axle should be locked as this would represent a safe condition. The vehicle manufacturer must design the facilities to be controlled in such a way that this is ensured.

5.14 Voltage Output for Vehicle Air Suspension Systems

The trailer modulator has an electrical switching output port 2 for the power supply of air suspension systems in vehicles (ECAS). The current load is limited to 2 amps. When certain system errors occur or/and if the power supply is insufficient, this output port is deactivated!

5.14.1 Speed Signal C3

Trailer EBS does not provide a C3 speed signal in the form of a pulse-width modulated rectangular signal. Systems which require a continuous speed signal (e. g. ECAS) receive speed information via the diagnostic line (K line).

6. Diagnosis

The term ‘diagnosis’ is used for the following individual tasks:

- ❑ setting of parameters by the vehicle manufacturer or when a modulator has been replaced
- ❑ setting of parameters by customer, e. g. in the workshop
- ❑ EOL (end-of-line) checks on the vehicle, functional testing
- ❑ error storage, error output
- ❑ periodic checks
- ❑ access to the data stored during operation.

For homologation, every trailer needs a braking computation which, for WABCO systems, is usually done by WABCO.
The computed parameters are set by the vehicle manufacturer.

After initial installation and after replacing a modulator, or whenever parameters have been set at a later date, the EBS system has to be commissioned. If this step within diagnosis is neglected, the warning lamp will not go off. Braking processes are governed by the EBS parameters which have been set.

The commissioning process or setting the parameters requires either PIN release or diagnosis. The fingerprint is stored in the electronic control unit whenever parameters are changed.

For diagnosis, a data interface to ISO 14230 (KWP 2000) is provided on the trailer modulator. This is used to connect diagnostic equipment such as the Diagnostic Controller, diagnosis by means of a desk-top computer, etc.

For diagnostic equipment that has no power supply of ist own, a voltage supply is provided. Diagnosis cannot be achieved via the electrical trailer interface to ISO 11992, nor is it possible to do diagnosis via flash-code.

The diagnosis comprises the following functions:

- commissioning
- error search
- actuation
- measuring values
- parameters
- extras: mileage recorder, service interval
- printing: error memory, commissioning log and EBS system sticker (with PC diagnosis only).

6.1 Diagnosis Using A Desk-Top Computer (PC)

At present the diagnostic programme is available on two 3.5" floppy discs but can also be loaded from the Internet, i. e. web shop (http://www.wabco.de).
The operating instructions are provided with the PC programme.

System Requirements:

- notebook / laptop or desktop computer
- Pentium processor recommended
- 16 MB main memory, colour display 800 x 600
- approx. 10 MB available harddisc memory, 3 ½" floppy disc drive
- COM interface (9-pole connector) for WABCO’s diagnostic interface
- Windows 95/ 98 / Windows NT

Software Part Numbers:

446 301 540 0 (German)

446 301 541 0 (French)

446 301 542 0 (English)

446 301 543 0 (Italian)

In addition, a diagnostic interface and a diagnosis cable are required for the connection between the ECU and the computer:

446 301 021 0	Diagnostic interface set (consisting of diagnostic interface + connecting cable for the computer)
446 300 329 2	Trailer diagnosis cable

6.2 Diagnosis Using the Diagnostic Controller

The Diagnostic Controller is a computer which can exchange data with electronic control units (ECUs). In order to be able to communicate with an ECU, it requires a programme card on which the diagnostic programme is stored.

Part Numbers:

446 300 331 0 Diagnostic Controller Set

consisting of:
Diagnostic Controller 446 300 320 0
Carrier Bag 446 300 022 2

446 300 ... 0 Programme Card Trailer EBS (English)

Accessories:

446 300 328 0 keyboard for Diagnostic Controller

884 604 301 2 multimeter cable black

884 604 302 2 multimeter cable red

6.3 Warning Lamp Concept EBS to ECE 13/09

Warning Lamps on the Motor Vehicle

yellow trailer warning lamp = actuation through pin 5 ISO 7638

red warning lamp = actuation through pin 6/7 ISO 7638 (CAN) and through towing vehicle EBS

yellow motor vehicle warning lamp = actuation through towing vehicle EBS

6.4 Error Management

Any errors which have occurred during operation are stored in the trailer modulator.
They are displayed in the motor vehicle according to their significance ratings and the visual warning facilities installed.

The significance of errors is divided into three categories:

0 : slight defect: Have this seen to the next time the vehicle is in the workshop.

1 : intermediate defect: Have this seen to as soon as possible.

2 : serious defect: Have this seen to immediately

Significance Rating 0:
Any defects with a significance rating of 0 (e. g. chattering brakes and intermittent errors in CAN communication, slight undervoltage) are displayed via the warning lamp (PIN 5 ISO 7638). When the defect no longer prevails, the warning lamp goes off without the ignition having to be switched off and on again. The source of the defect should be located when the vehicle is next taken to the workshop.

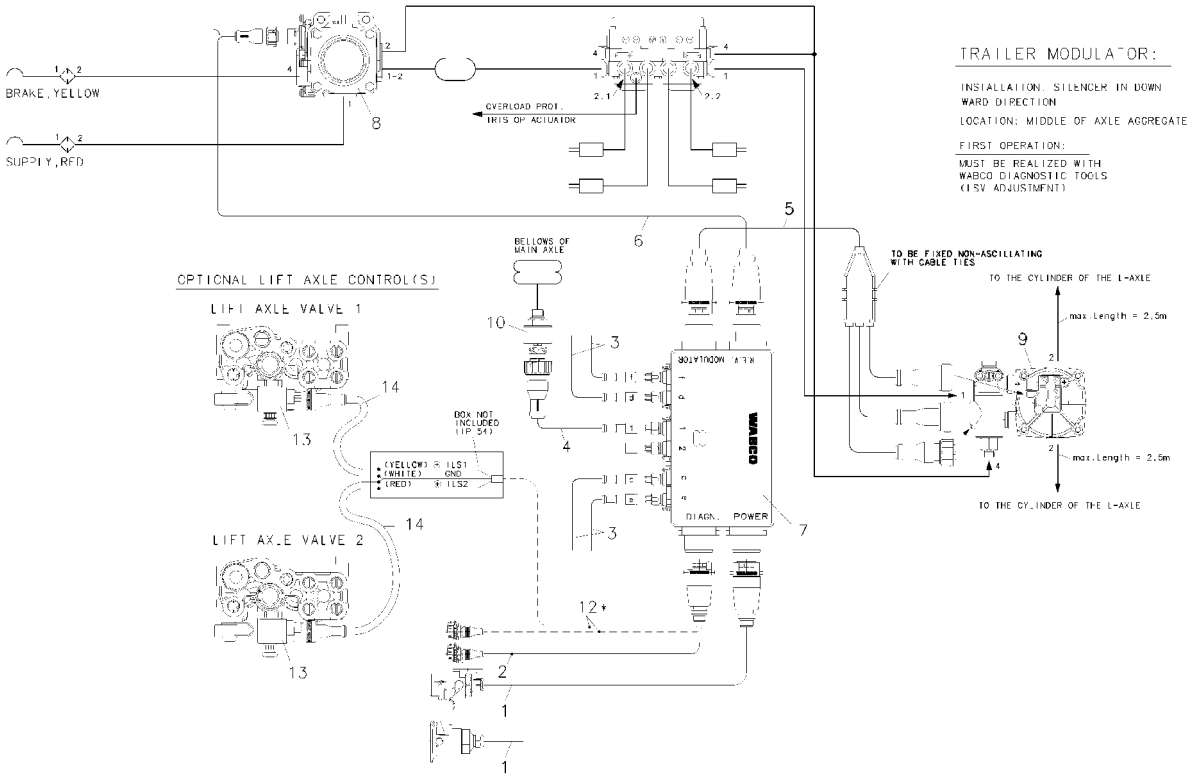
Significance Rating 1:
These defects result in individual functions (e. g. ALB, ABS) being switched off. Full braking performance is, however, maintained. This is indicated via the warning lamp (PIN 5 ISO 7638).

Significance Rating 2:
According to the legislation pertaining to EBS, any defects which result or can result in the required braking performance not being achieved (underbraking) are displayed via the warning lamps. With a conventional towing vehicle, it is not possible to tell a significance rating of 2 apart from a significance rating of 1 as there is only one warning lamp available.

	yellow motor vehicle	red motor vehicle + trailer	yellow trailer
no defect	○	○	○
intermediate/slight defect on towing vehicle	●	○	○
serious defect on towing vehicle	●	●	○
intermediate/slight defect on trailer	○	○	●
serious defect on trailer	○	●	●

6.5 Installation Model

Installation diagram 841 801 620 0 shows the wiring and piping for a 4S/3M system. One installation model is described below.



Trailer Modulator (7)

Supply Port:
The assignments of the supply port (cover marking: POWER) are in keeping with ISO 7638-1999 (7-pole). It has to be connected at all times.

EBS Relay Emergency Valve:
The relay emergency valve is connected to this port (cover marking: R.E.V.). It has to be connected at all times.

Modulator Port:
The modulator port (cover marking: MODULATOR) is used only for 3M or 2M+1M systems. If a 2M system is used, this port is supplied with its cover in place.

ABS Sensor Ports:
If a 4S system is used, all connectors (cover markings: c, d, e, f) must have been assigned. If a 2S system is used, only connectors c and d are assigned. The other connectors are supplied with their covers in place.

Please note:
The yellow connectors (YE1, YE2) known from VCS and the rule that 'the sensors on the right-hand side when facing the engine are connected to the yellow connectors' no longer apply. For Trailer EBS, connectors **d and f** are always assigned to the sensors which are braked via **ports 2.1**.

Bellows Pressure Sensor:
It is always the air suspension bellows of the main axle which has a sensor fitted. Connector 1 has a cable for this bellows pressure sensor assigned to it (cover marking: 1). Connector 2 is to be used for subsequent wear sensors, i.e. this is supplied with a cover at the present time.

Diagnostic Port:
This port (cover marking: DIAGN) is primarily used for connecting diagnostic equipment. On vehicles which have lifting and/or steering axles, these are also used to connect actuator valves. If an electronically controlled air suspension system is in place, this is where the ECAS control unit is connected. Diagnostic equipment is then plugged into the ECAS diagnostic socket.

Pneumatic Ports and Piping

Designation	Thread	Application
Trailer Modulator		
1	2 x M22 x 1.5	air reservoir
2.1	3 x M22 x 1.5	brake cylinder
2.1	1 x M16 x 1.5	overload valve parking brake
2.2	3 x M22 x 1.5	brake cylinder
4	2 x M16 x 1.5	relay emergency valve
EBS Relay Valve		
1	1 x M22 x 1.5	air reservoir
2	2 x M22 x 1.5	brake cylinder
3	1 x M16 x 1.5	relay emergency valve
ABS Relay Valve		
1	1 x M22 x 1.5	air reservoir
2	2 x M22 x 1.5	brake cylinder
4	1 x M16 x 1.5	2-way valve
Relay Emergency Valve		
1	1 x M22 x 1.5	supply hose coupling, red
1-2	1 x M22 x 1.5	air reservoir
2	1 x M22 x 1.5	trailer modulator
4	1 x M22 x 1.5	control hose coupling, yellow

brake cylinder TM	min:	1 x type 16 per valve
	max:	3 x type 30 per valve
brake cylinder relay valve	min:	2 x type 16
	max:	2 x type 30
supply line	length:	max. 3 m
	diameter:	min. 15 x 1.5 mm
operating line	length:	max. 2.5 m
	The lines on both sides of the vehicle must be identical.	
pilot line	The dimensions of the pilot line must be such that the response and pressure build-up times as defined in EG 98/12 are complied with.	
	recommendation:	max. length 10 m
	diameter:	10 x 1 mm or 9 x 1 mm

7. Retrofit

Of course Trailer EBS can also be retrofitted, regardless of whether the trailer has disc brakes or drum brakes. However, it must have an air suspension system.
The following aspects might make retrofitting an EBS advisable:

- Best possible balance for the tractor- trailer combination if both the motor vehicle and the trailer have EBS.
- By means of accurately operating pressure control circuits, the deviations in the characteristics for the air valves which have occurred in the past can be virtually eliminated, i. e. any problem vehicles (difficulties in balancing the tractor-trailer combination) can thus be got under control.
- The predominance or the settings for the load-sensing valve can only be modified by authorized workshop staff.
- If braking equipment or ABS units are defective, a conversion to the new EBS technology could well be worthwhile.

Please note: When subsequently fitting EBS on trailers which use ECAS, the ECAS control unit with the part number 446 055 066 0 must be used!

7.1 Retrofitting Example

The example below describes the conversion of an air braking system with VCS to Trailer EBS. The vehicle in this example is a 4-wheel semitrailer with a box body and Vario Compact ABS (VCS) 2S/2M.

Removal of Braking Equipment and VCS

First the relay emergency valve, the load-sensing valve, the ABS electronic control unit and the ABS relay valves have to be removed. The 5-pole ABS supply cable must be taken out. If VCS has been fitted, the ABS sensor extension cables can be used for Trailer EBS (provided they are the right lengths). Brake lines and hoses must be shortened or replaced as required.

Fig. 1 shows the components which have been removed.

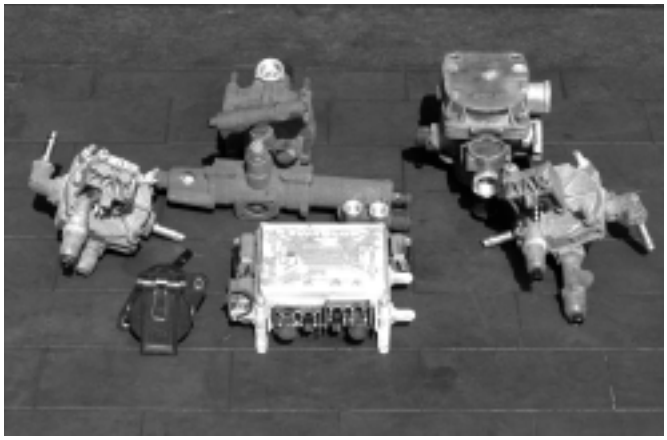


Fig. 1: Components after removal

Fitting EBS

Fig. 2 shows the components required, and the diagnostic tools for EBS.

Fig. 2: Required components

Now the EBS relay emergency valve, the EBS trailer modulator, the axle load sensor and its wiring and piping are fitted as shown in brake diagram 841 700 890 0. The EBS relay emergency valve can be installed in the same location as the relay emergency which has been removed (Figs. 3 and 4). The position of the pneumatic ports is important here. In order to achieve the best possible time response behaviour, however, it should be placed as close as possible to the front wall or the hose couplings.

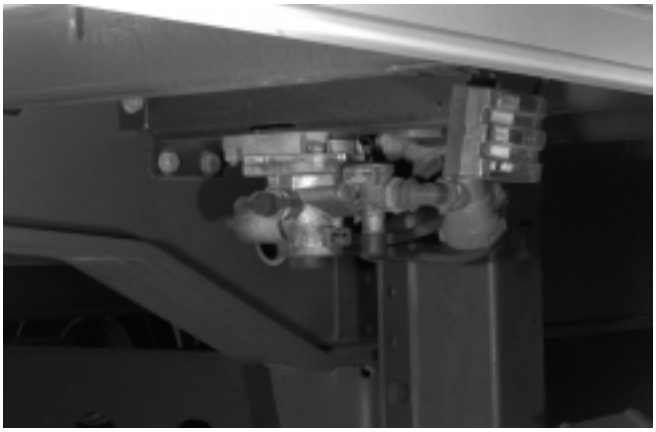


Fig. 3: Conventional relay emergency valve

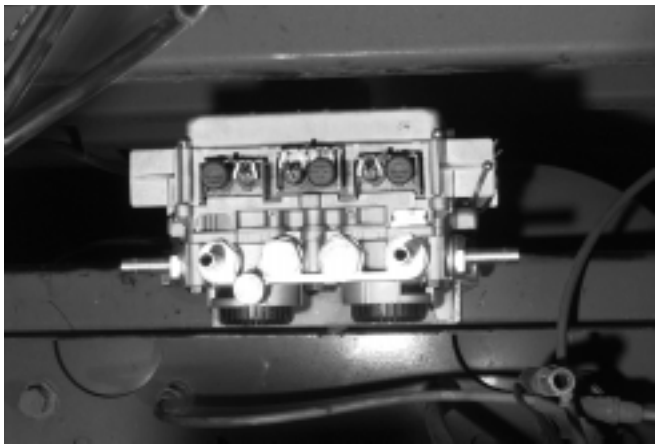


Fig. 5: EBS trailer modulator

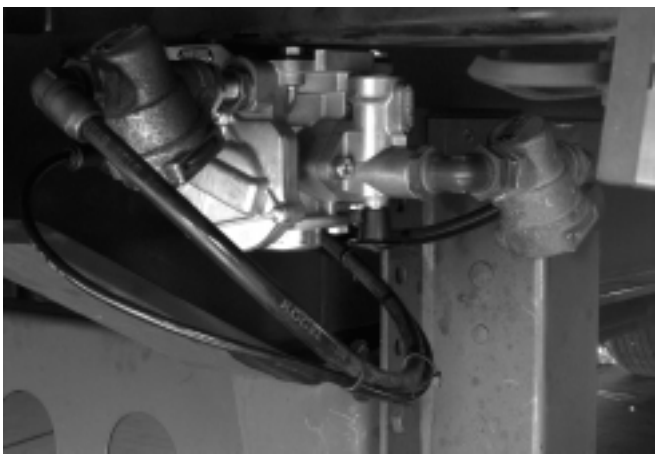


Fig. 4: EBS relay emergency valve

Fig. 6: EBS trailer modulator after installation

The trailer modulator is fitted above the axle with the sensors (Figs. 5 and 6). The bracket (flat steel, at least 6 mm thick) has to have two 10 mm holes for the modulator, 135 mm apart (see outline drawing for the modulator in Annex ‘D’).

The axle load sensor is installed in the air line leading to the air suspension bellows of the main axle in the vicinity of the bellows. Fig. 7 shows a T-shaped screw-in union on the air suspension bellows selected for this purpose. A relief tube as used in ECAS is not required.

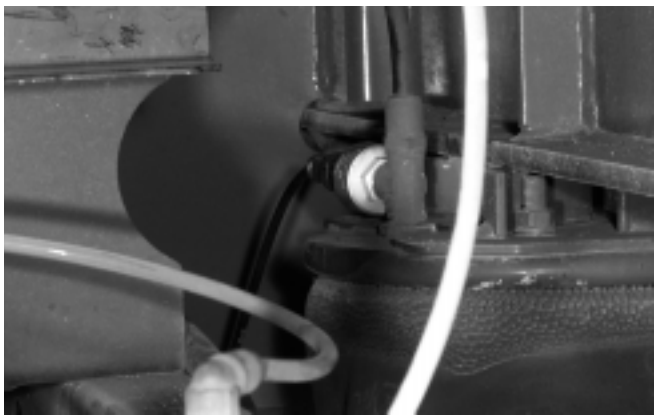


Fig. 7: Axle load sensor

When the wiring and the air lines have been connected, the installation process has been completed. The system is now commissioned by means of the PC diagnostic programme or the Diagnostic Controller with the programme card, as described in the chapter on ‘Diagnosis’. This is followed by printing the EBS system sticker (Fig. 8) by means of the PC programme, using a laser printer, and sticking it into the place where the ALB sticker was located previously.

The sticker shown in Fig. 9 tells the driver that this vehicle may only be operated with the power supply via the ISO 7638 plug-in connection.

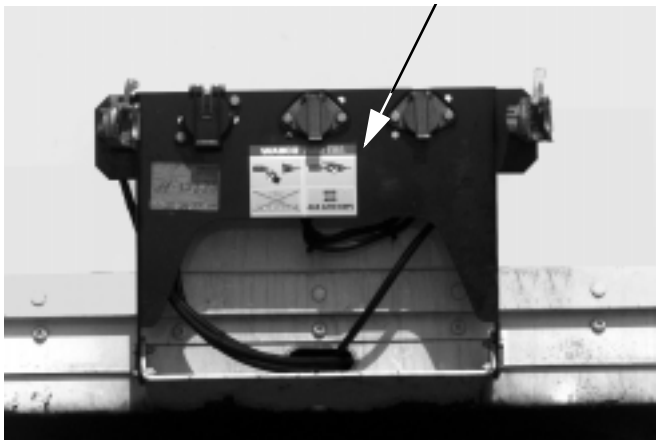
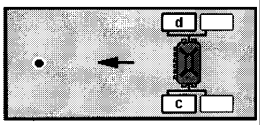


Fig. 9

After the installation, the trailer must be taken in for official inspection and for having the system registered in the vehicle's documents. For inspection, the 'Technical Report for Trailer EBS' is available on request, Publication No. 815 000 275 3.

WABCO **TRAILER EBS**

HERSTELLER MANUFACTURER CONSTRUCTEUR	MUSTER			ELEKTR: SCHALTER 1 ELECTR: SWITCH 1 COMMUTATEUR ELECTR.1	---
TYP TYPE TYPE	XXX			ISS GESCHW: ISS SPEED COMMUTATEUR VITESSE	2
FAHRGESTELLNUMMER CHASSIS NUMBER NUMERO DE CHASSIS	0815			ISS:PIN INVERTIERT ISS. PIN INVERT COMMUTATEUR INVERSÉ	---
BREMSBERECHNUNGS-NR. BRAKE CALCULATION NO. CALCUL DE FREINAGE NO.	WDE 1234			10 s PULS 10 s PULSE IMPULSION 10s	---
POLRADZÄHNEZAHL c,d POLE WHEEL TEETH c,d DENTS ROUE DENTÉE c,d	100	ABS-System	2S/2M	Now printing TER 2 ELECTR: SWITCH 2 COMMUTATEUR ELECTR.2	---
POLRADZÄHNEZAHL e,f POLE WHEEL TEETH e,f DENTS ROUE DENTÉE e,f	100	LIFTACHSEN LIFTAXLE ESS. RELEV.		WARNLAMPE WARNING LAMP VOYANT DE SÉCURITÉ	2s



GGVS/ADR TPN 2064/98

	STEUERDRUCK PM (BAR) CONTROL PRESSURE (BAR) PRESSION DE SERVICE PM (BAR)		6.5	STEUERDRUCK PM (BAR) CONTROL PRESSURE (BAR) PRESSION DE SERVICE PM (BAR)		0.6	1.6	6.5
	ACHSLAST LEER AXLE LOAD UNLADEN CHARGE ESSIEU A VIDE (KG)	BALGDRUCK LEER SUSP. PRESS. UNLADEN PRESS. SUSP. A VIDE (BAR)	BREMSDRUCK LEER BRAKE PRESS. UNLADEN PRESS. DE FREIN. A VIDE (BAR)	ACHSLAST BELADEN AXLE LOAD LADEN CHARGE ESSIEU EN CHARGE (KG)	BALGDRUCK BELADEN SUSP. PRESS. LADEN PRESS. SUSP. EN CHARGE (BAR)	BREMSDRUCK BELADEN BRAKE PRESS. LADEN PRESS. DE FREIN. A CHARGE (BAR)		
1. ACHSE 1st. AXLE ESSIEU 1	1300	0.8	1.5	9000	4.5	0.6	1.6	6.5
2. ACHSE 2nd. AXLE ESSIEU 2	1300	0.8	1.5	9000	4.5	0.6	1.6	6.5
3. ACHSE 3rd. AXLE ESSIEU 3								

Fig. 8: EBS system sticker

Annex

Annex A - ‘Abbreviations Used’

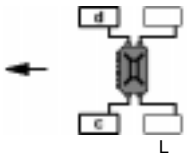
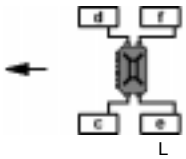
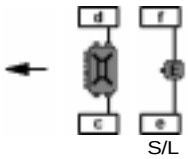
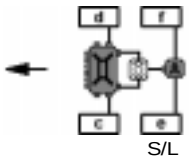
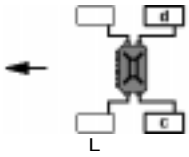
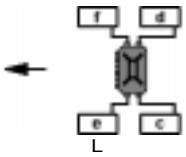
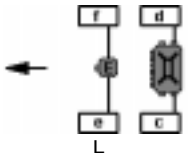
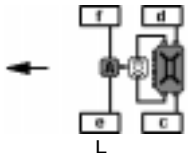
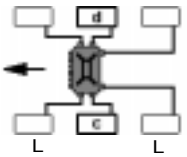
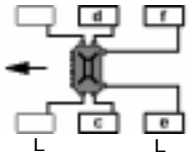
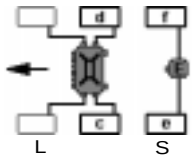
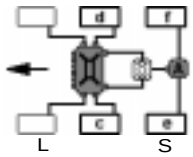
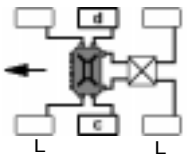
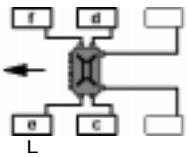
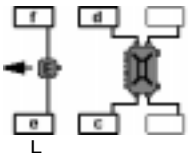
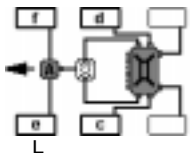
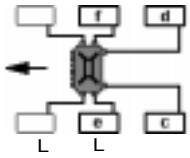
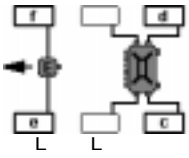
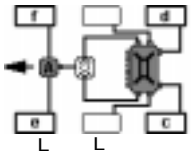
ABS	Anti-lock Braking System
ALB	Automatic Load-sensitive Braking
CAN	Controller Area Network
EBS	Electronic Braking System
ECAS	Electronically Controlled Air Suspension system
ECU	Electronic Control Unit
ILS	Integrated Lifting axle control
ISS	Integrated Speed Switch
KWP	Key Word Protocol
REV	Relay Emergency Valve
TM	Trailer Modulator
WALA	Warning Lamp
VCS	Vario Compact System (ABS for trailers)

Required reservoir sizes for standard trailers

Vehicle type	Number of axles	Brake chamber equipment (Diaphragm brake chambers)			Required reservoir size for standard trailers
		Number per type			
Semitrailer		2 x	2 x	2 x	(liter)
Centre-axle trailer	1	12			20
		16			30
		20			30
		24			40
		30			40
	2	12	12		40
		16	16		40
		20	20		60
		24	24		60
		30	30		80
	3	12	12	12	60
		16	16	16	80
		20	20	20	80
		24	24	24	80
		24	24	30	100
		30	30	30	100
Towbar Trailer	2	16	24		60
		20	24		60
		20	30		60
		24	30		80
	3	16	16	24	80
		20	20	24	80
		20	20	30	80
		24	24	30	100
		30	30	36	100

For brake cylinder/reservoir size combinations not listed the requisite reservoir size is to be determined in a similar way to the above stipulations.

SEMITRAILER
AXLE BOGIE WITH AIR SUSPENSION AND
TRAILING-STEERING AXLE AND/OR LIFTAXLE

	VEHICLE TYPE	2S / 1M	2S / 2M	4S / 2M	4S / 3M	4S / 2M + 1M
2 AXLES	 S/L		 L	 L	 S/L	 S/L
	 L		 L	 L	 L	 L
3 AXLES	 L S/L		 L L	 L L	 L S	 L S
	 L S/L		 L L	 L	 L	 L
	 L L			 L L	 L L	 L L

Legend:

Mounting instructions for axle bogie types:

S = With trailing-steering axle (adhesion-steered) / (automatically steered trailing axle are to be handled like single axles)

L = With Liftaxle

◄— = Driving direction

S/L = Trailing-steering axle or liftaxle optional

= Trailer Modulator

= Two Way Valve (SHR)

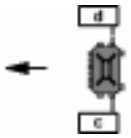
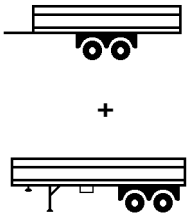
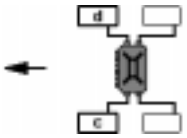
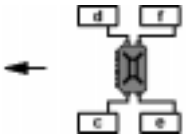
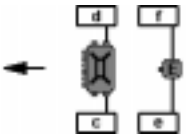
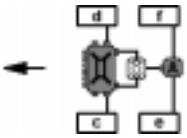
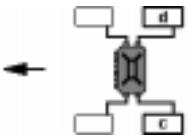
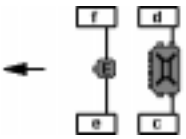
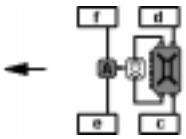
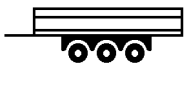
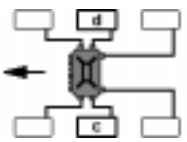
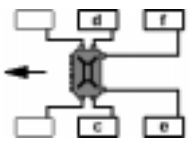
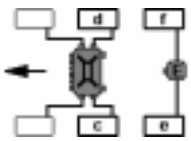
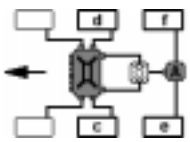
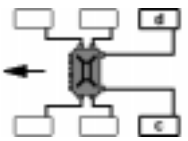
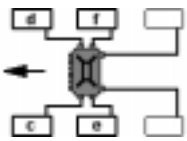
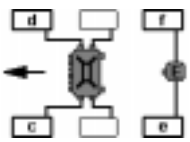
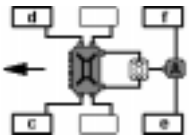
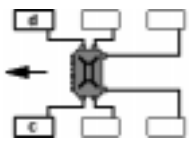
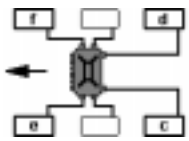
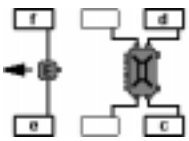
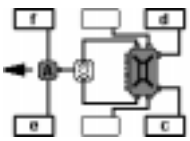
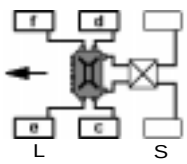
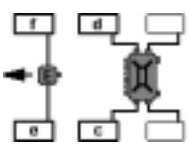
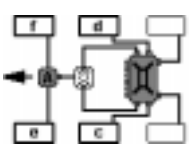
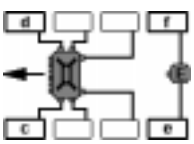
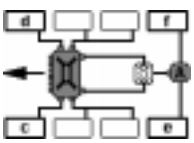
= Double Check Valve(SLR)

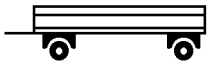
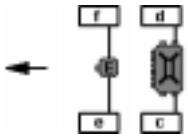
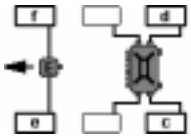
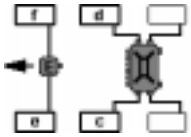
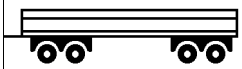
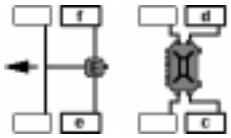
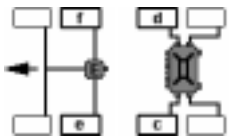
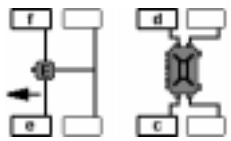
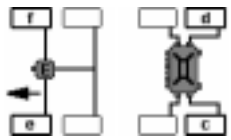
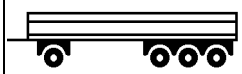
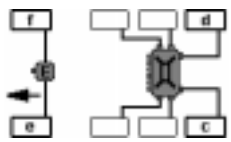
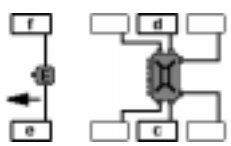
= EBS-Relay Valve (Mod. Steering axle)

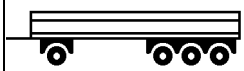
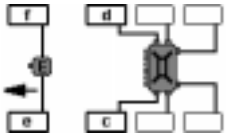
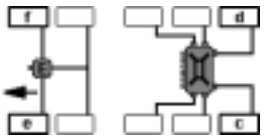
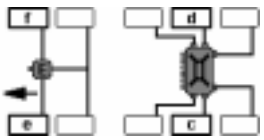
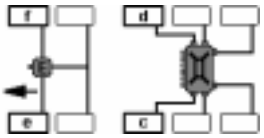
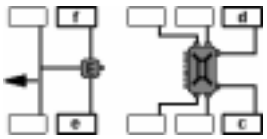
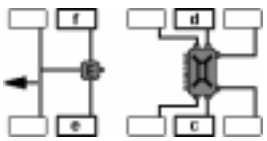
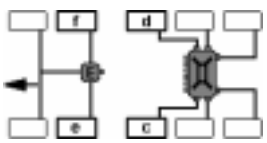
= ABS-Relay Valve

Arrangement of control channels:
(ACC. to WABCO Wiring Diagram 841 801 620 to 841 801 622 0)

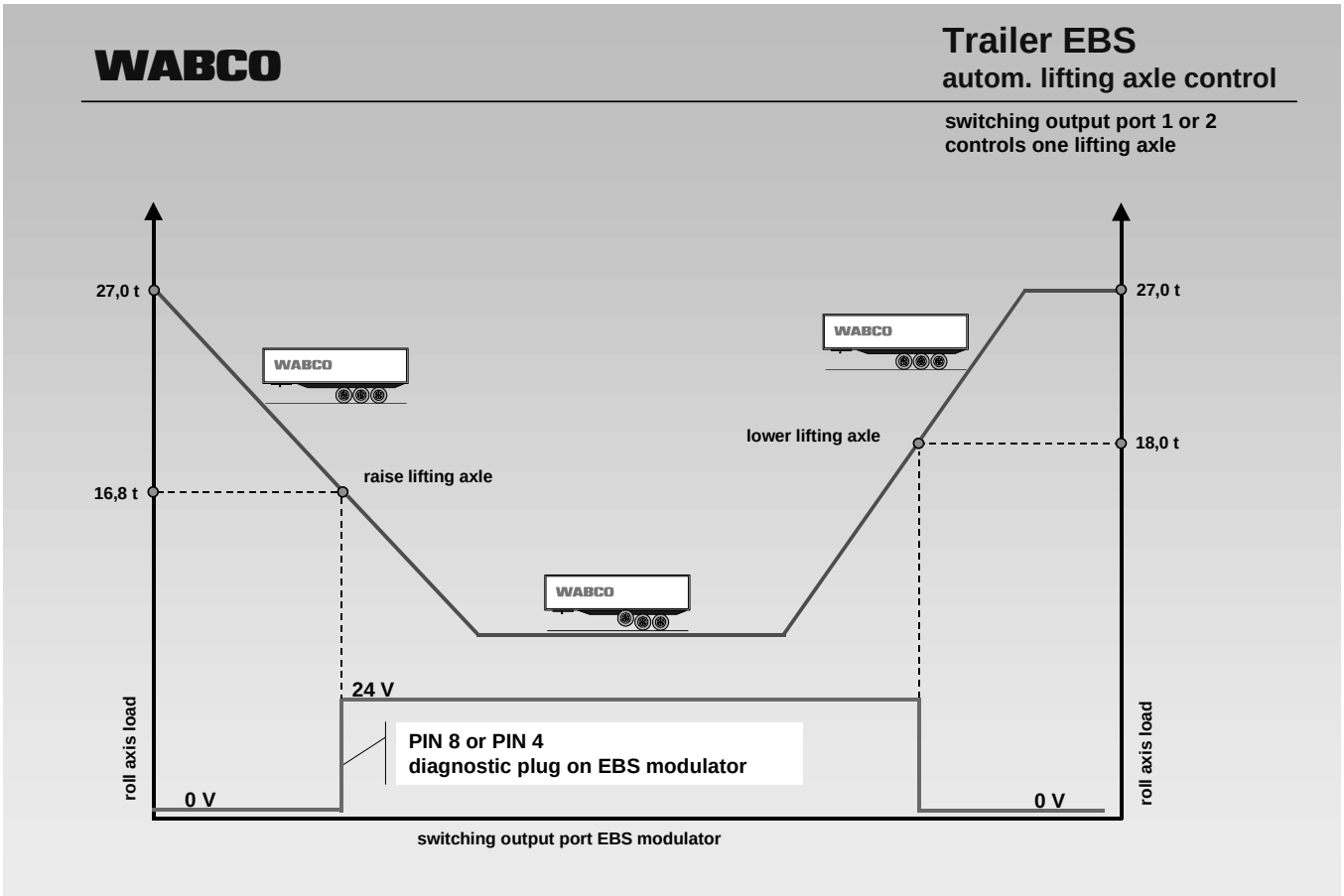
(M) MODULATOR	(S1) SENSOR RIGHT	(S2) SENSOR LEFT	SENSED (DIRECTLY CONTROLLED) / NOT SENSED (INDIRECTLY CONTROLLED)	
			SYSTEM AXLE	CONTROL LOGIC:
H	d	c	MAIN AXLE (NOT LIFTABLE)	IR / MSR
A/E	f	e	STEERING AXLE (LIFTABLE)	MAR
Z	f	e	ADDITION. AXLE (LIFTABLE)	MSR

	VEHICLE TYPE		2S / 2M	4S / 2M	4S / 3M	4S / 2M + 1M
CENTRE AXLE TRAILER + SEMITRAILER						
						
						
						
						
						
						
						

	VEHICLE TYPE	2S / 2M	4S / 2M	4S / 3M	4S / 2M + 1M
DRAWBAR TRAILER					
					
					
					
					
					
					
					
					

	VEHICLE TYPE	2S / 2M	4S / 2M	4S / 3M	4S / 2M + 1M
DRAWBAR TRAILER					
					
					
					
					
					
					

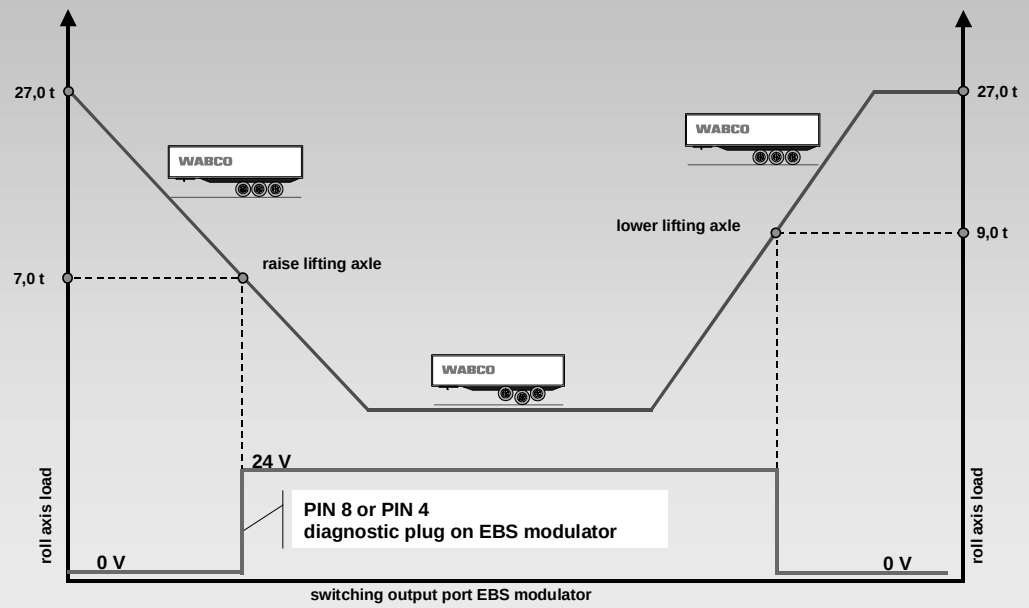
Example for vehicle with 3 x 9 tonne axle load



WABCO

Trailer EBS
autom. lifting axle control

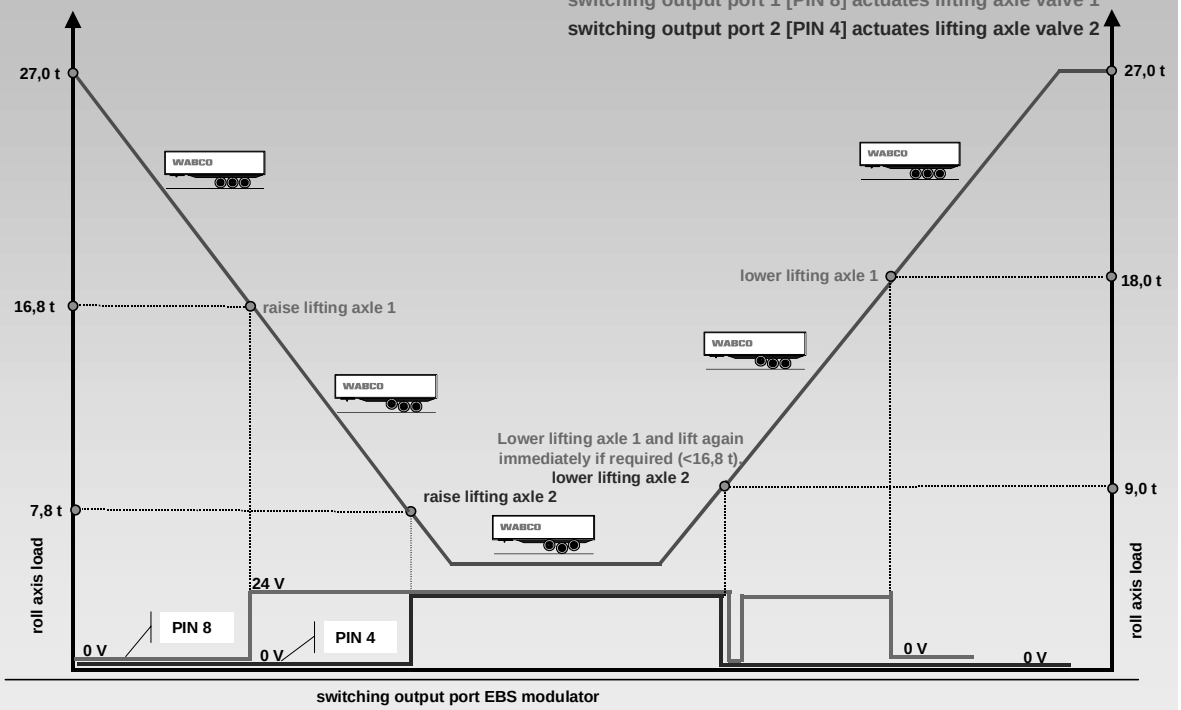
switching output port 1 or 2
cntrols two lifting axles

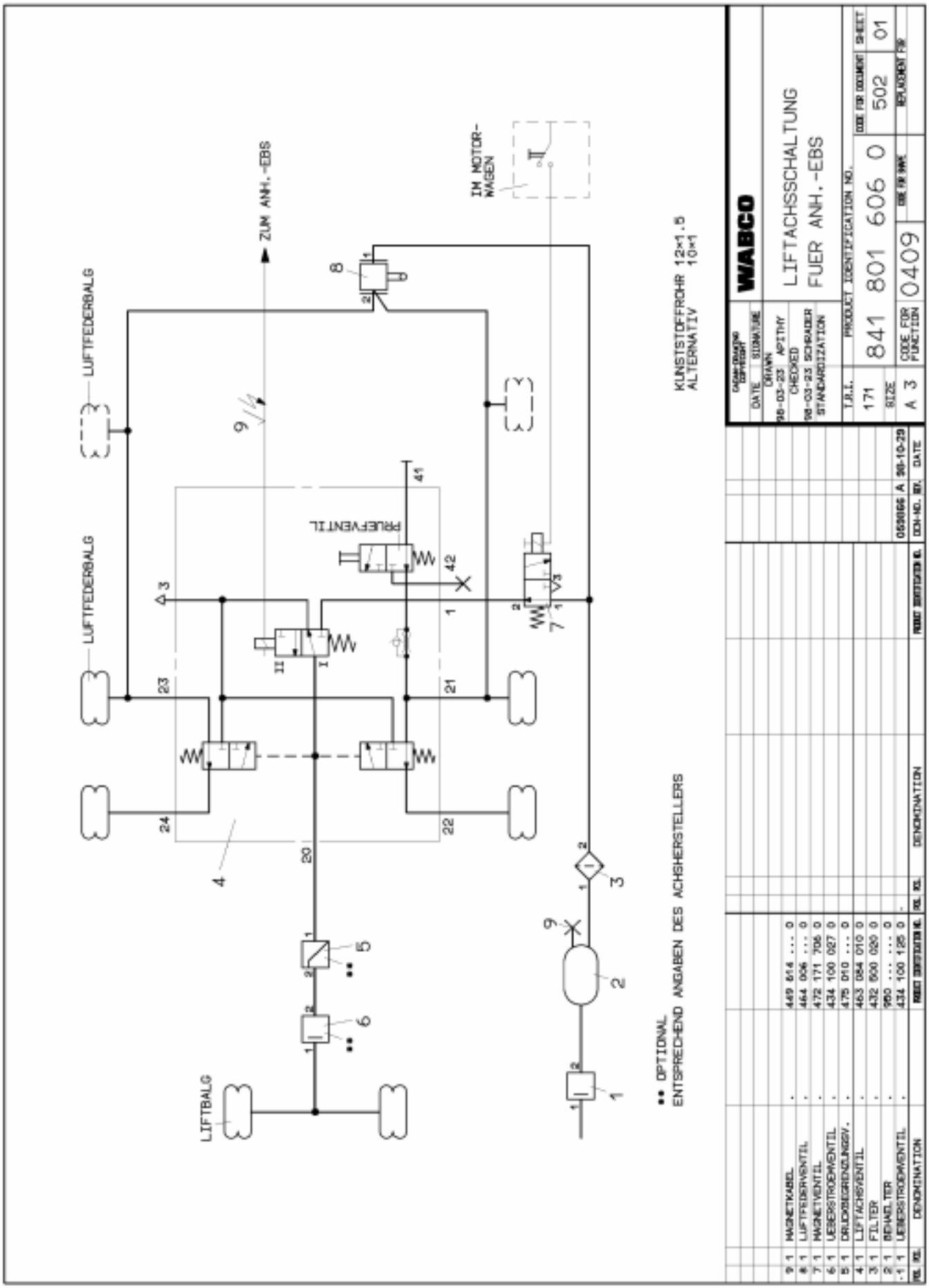


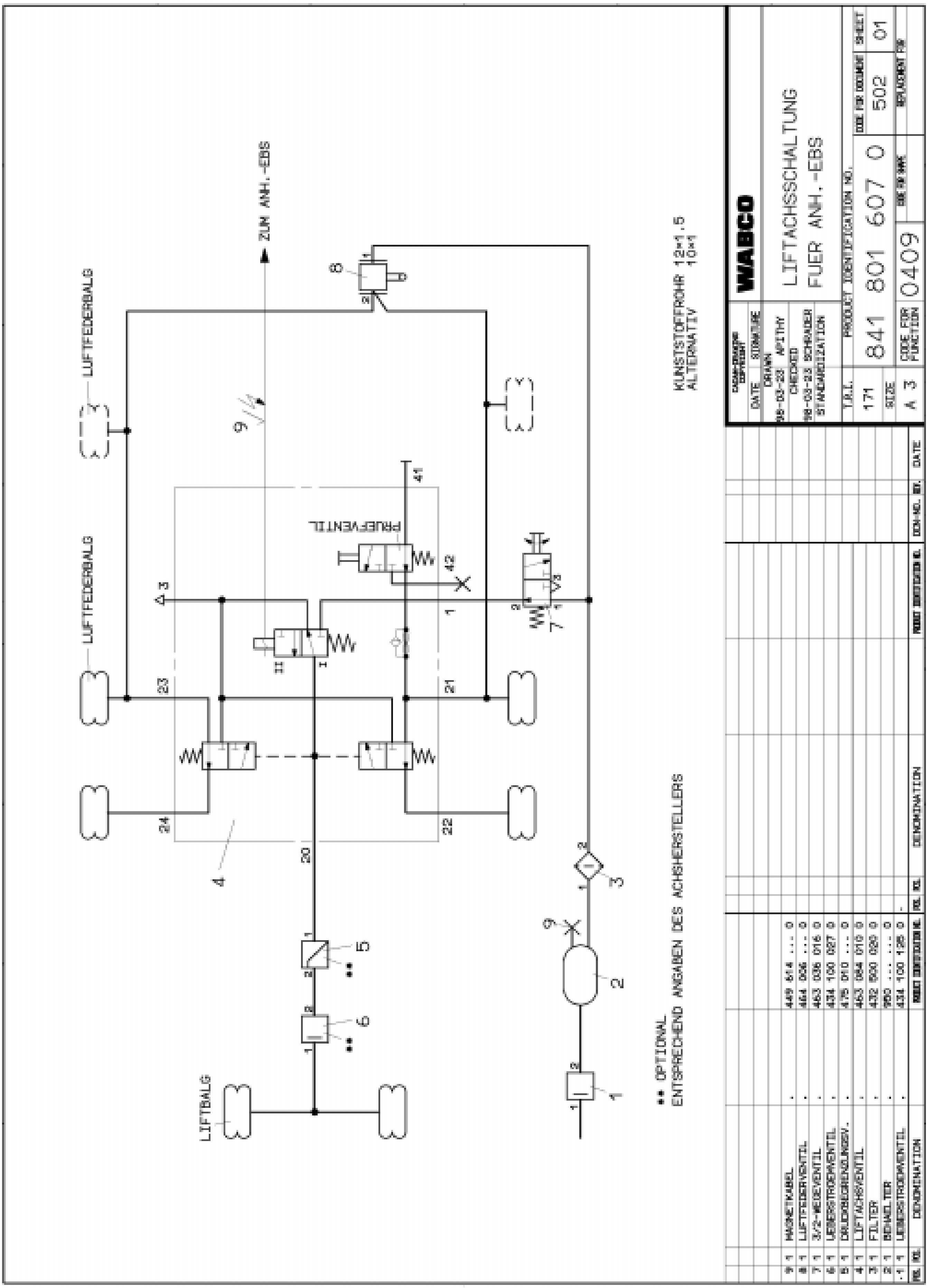
WABCO

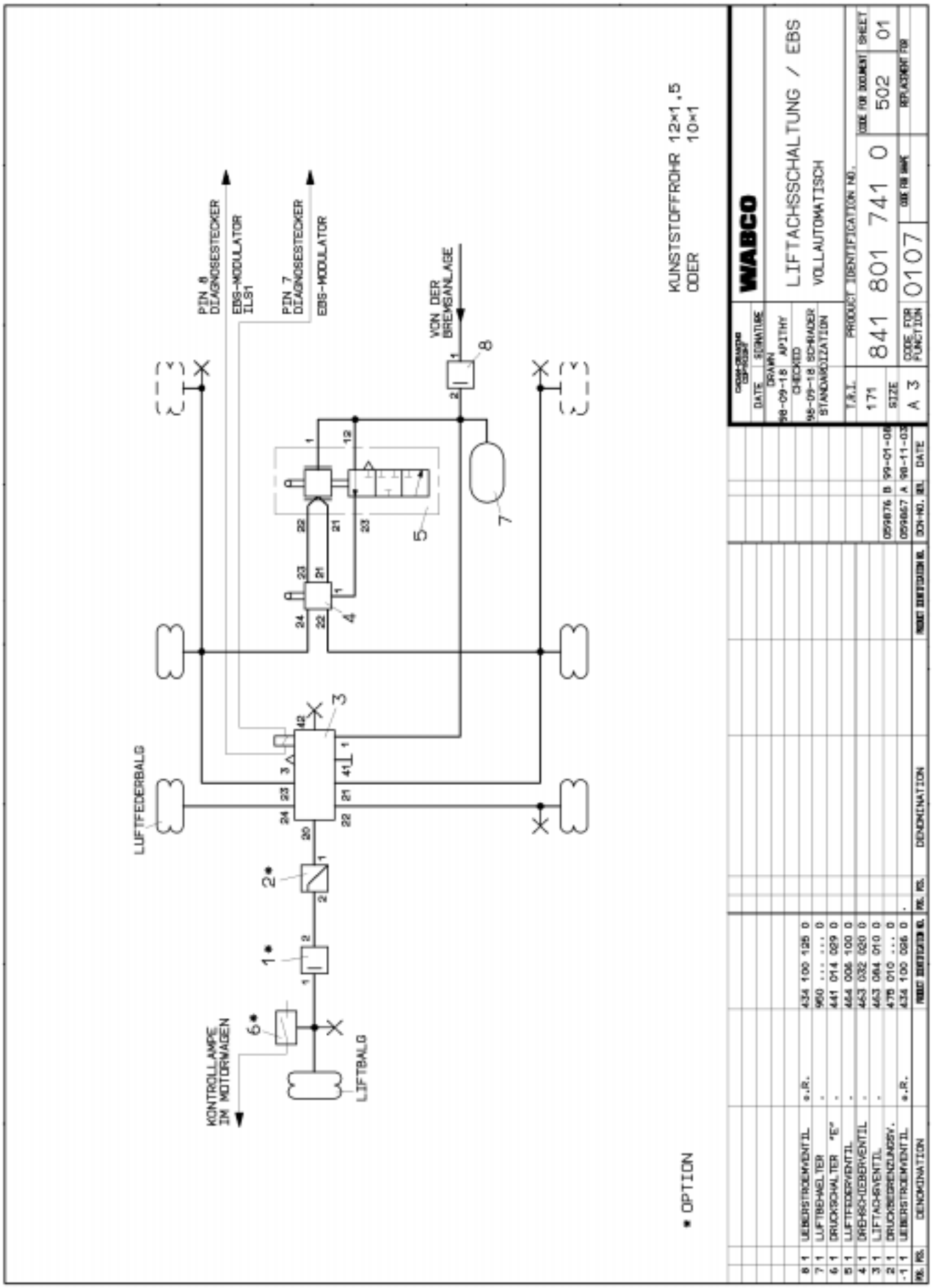
Trailer EBS
autom. lifting axle control

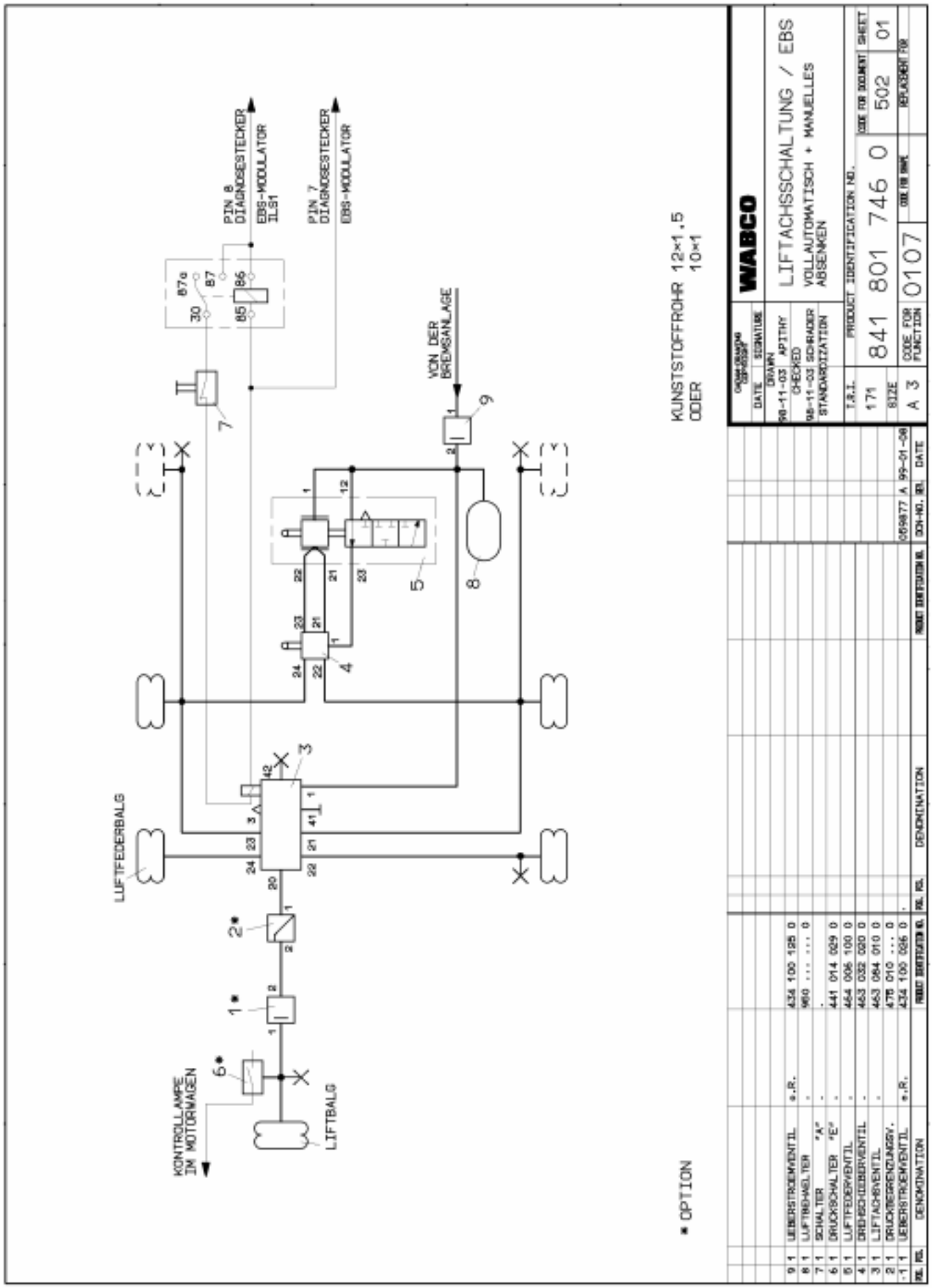
switching output port 1 [PIN 8] actuates lifting axle valve 1
switching output port 2 [PIN 4] actuates lifting axle valve 2




ZUM ANH.-EBS
IM MOTOR-WAGEN
LUFTFEDERBALG
LUFTFEDERBALG
LIFTBALG
PRUEFVENTIL
KUNSTSTOFFROHR 12x1.5
ALTERNATIV 10x1
** OPTIONAL
ENTSPRECHEND ANGABEN DES ACHSHERSTELLERS
WABCO
LIFTACHSSCHALTUNG
FUER ANH.-EBS
841 801 606 0
502 01
0409
A 3


LUFTFEDERBALG
LUFTFEDERBALG
LIFTBALG
ZUM ANH.-EBS
PRUEFVENTIL
KUNSTSTOFFROHR 12x1,5
ALTERNATIV 10x1
** OPTIONAL
ENTSPRECHEND ANGABEN DES ACHSHERSTELLERS
9 1 MAGNETKABEL 449 614 ... 0
8 1 LUFTFEDERVENTIL 464 006 ... 0
7 1 3/2-WEGEVENTIL 463 036 016 0
6 1 UEBERSTROEMVENTIL 434 100 027 0
5 1 DRUCKBEGRENZUNGSV. 475 010 ... 0
4 1 LIFTACHSVENTIL 463 084 010 0
3 1 FILTER 432 500 020 0
2 1 BEHAELTER 950 0
1 1 UEBERSTROEMVENTIL 434 100 126 0
WABCO
LIFTACHSSCHALTUNG
FUER ANH.-EBS
841 801 607 0
502
01
0409
A 3

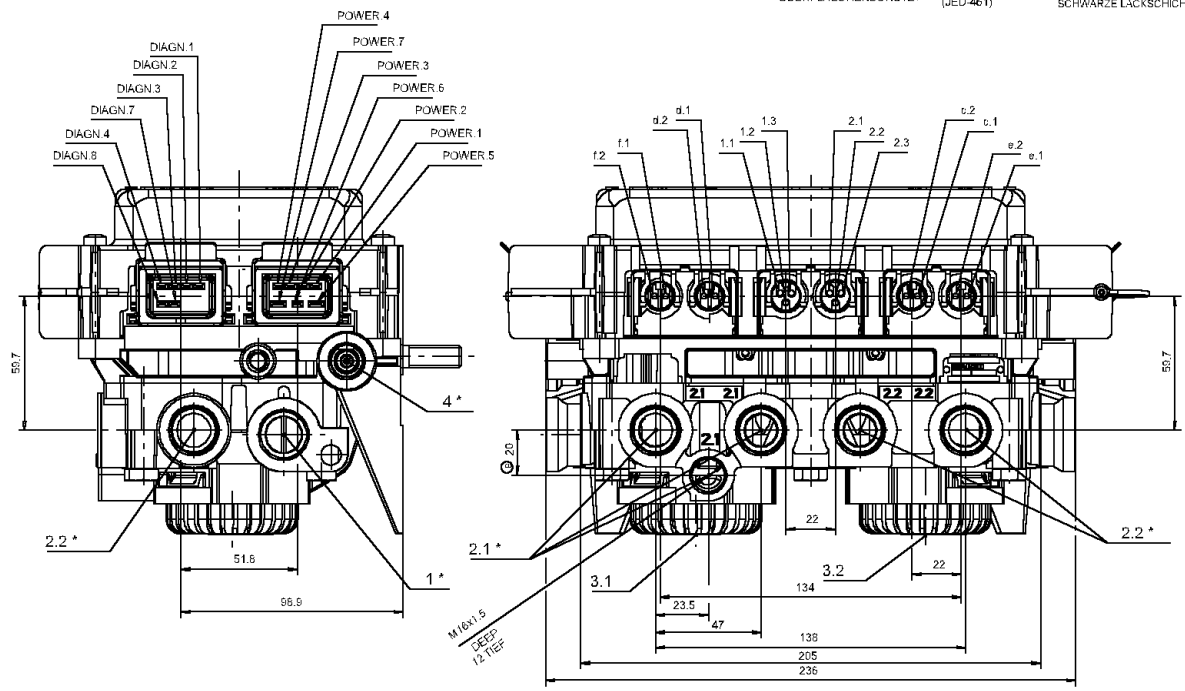

KUNSTSTOFFROHR 12×1,5
ODER 10×1
PIN 8
DIAGNOSESTECKER
EBS-MODULATOR
ILS1
PIN 7
DIAGNOSESTECKER
EBS-MODULATOR
VON DER
BREMSANLAGE
LUFTFEDERBALG
KONTROLLAMPE
IM MOTORWAGEN
LIFTBALG
* OPTION
WABCO
LIFTACHSSCHALTUNG / EBS
VOLLAUTOMATISCH
841 801 741 0
502 01
0107
A 3

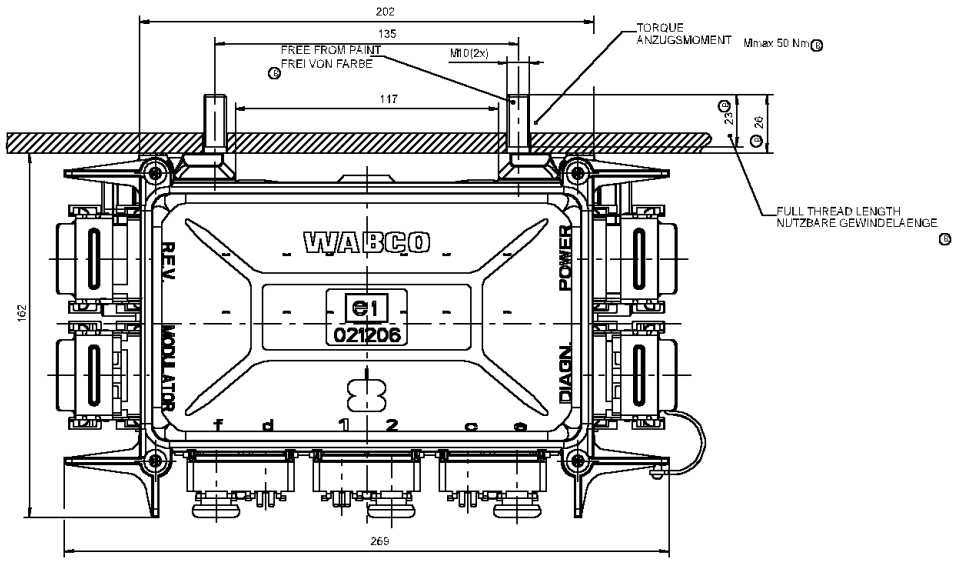

PIN 8
DIAGNOSESTECKER
EBS-MODULATOR
ILS1
PIN 7
DIAGNOSESTECKER
EBS-MODULATOR
VON DER
BREMSANLAGE
KUNSTSTOFFROHR 12×1,5
ODER 10×1
LUFTFEDERBALG
KONTROLLAMPE
IM MOTORWAGEN
LIFTBALG
* OPTION
WABCO
LIFTACHSSCHALTUNG / EBS
VOLLAUTOMATISCH + MANUELLES
ABSENKEN
841 801 746 0
502 01
A 3
0107

FURTHER TECHNICAL DATA SEE PRODUCT SPECIFICATION, DOCUMENT NO.:
WEITERE TECHNISCHE DATEN SIEHE PRODUKT-SPEZIFIKATION, DOKUMENT- NR.: 480 102 000 0

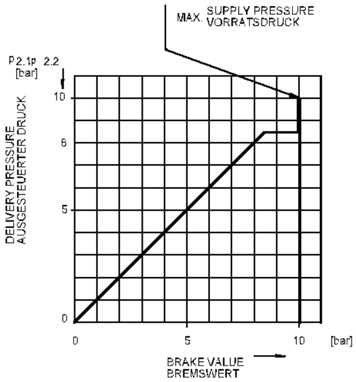
1.1	WORKING MEDIUM ARBEITSMEDIUM	AIR (WATER, OIL AND ALCOHOL CONTAINING) LUFT (WASSER, OEL- UND ALKOHOLHALTIG)		
1.2	WORKING ENVIRONMENT UMGEBUNGSMEDIUM	AIR (CONTAINING WATER, SALT, DUST AND OIL) LUFT (WASSER-, SALZ-, STAUB- UND OELHALTIG)		
2.1	THERMAL RANGE OF APPLICATION UNDER NORMAL AMBIANT CONDITIONS THERMISCHER ANWENDUNGSBEREICH UNTER NORMALEN UMGEBUNGSBEDINGUNGEN	-40° ... +65°C	SEE PRODUCT SPECIFICATION SIEHE PRODUKTSPEZIFIKATION	
2.2	SHORT TERM RESISTANCE TO HEAT KURZZEITIGE WAERMEBESTAENDIGKEIT	MAX. 110°C AT 1 h	WITHOUT FUNCTION OHNE FUNKTION	
3.1	WORKING PRESSURE (SUPPLY) BETRIEBSDRUCK (VORRAT)	p_e = 8,5 bar		
3.2	MAX. PERMISSIBLE WORKING PRESSURE (SUPPLY) MAX. ZULAESSIGER BETRIEBSDRUCK (VORRAT)	p_e = 10 bar	TEMPORARILY KURZZEITIG	

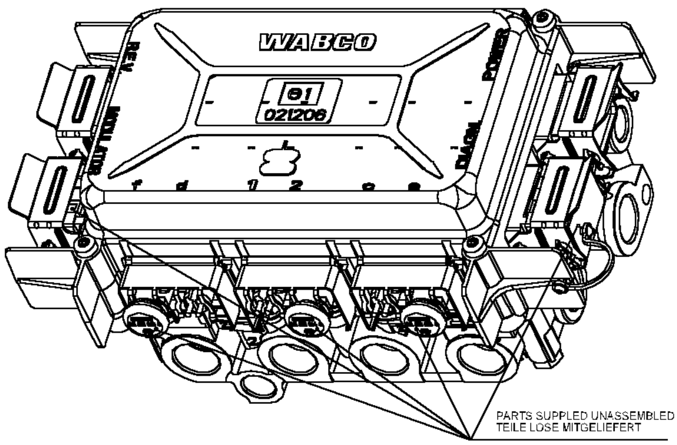
4	MIN. FLOW, PASSAGE /NOMINAL DIAMETER MIN. DURCHFLUSSOEFFNUNG /NENNWEITE		
	PORT 1-2.2 ANSCHLUSS 1-2.2 : 78,5 mm 2/ NW10	PORT 3.1,3.2 ANSCHLUSS 3.1,3.2 : 54 mm2/ NW 14	PORT 4 ANSCHLUSS 4: 1,8 mm 2/ NW 1.5
5	VOLTAGE TERMINAL SPANNUNG ANSCHLUSS	POWER 5 / POWER 7: 24±6V	
6	TYPE OF PROTECTION ACC. TO IEC 529 SCHUTZART NACH IEC 529	COMPLETE DEVICE WITH MOUNTED PLUG KOMPLETTES GERAET MIT MONTIERTEM STECKER	IP 66
		AS SOON AS ICE 529 IS ADAPTED SOBALD ICE 529 ANGEPASST WIRD	IP 69 K
7	INSTALLATION LIMITATIONS EINBAUBESCHRAENKUNGEN	MAX. DEVIATION OF THE DEVICE FROM THE VERTICAL MAX. ABWEICHUNG DES GERAETES VON DER SENKRECHTEN	±
8	INSTALLATION INSTRUCTION INSTALLATIONSHINWEIS	PARAMETER SETTING REQUIRED DURING INITIAL INSTALLATION PARAMETRIERUNG BEI ERSTINSTALLATION ERFORDERLICH	
9	SURFACE PROTECTION : 652 004 610 4 OBERFLAECHENSCHUTZ : (JED-461)	BLACK PAINT COAT SCHWARZE LACKSCHICHT	



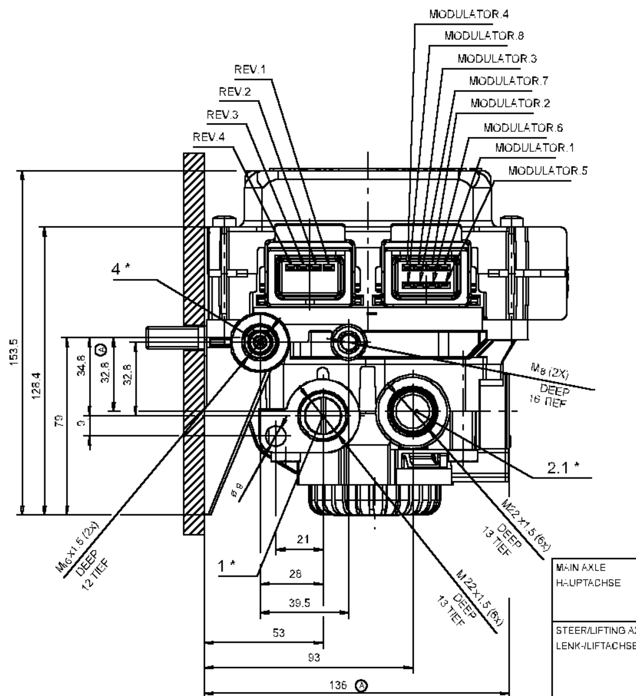


TORQUE
* ANZUGSMOMENT : Mmax = 53 Nm
LENGTH OF ENGAGEMENT:
EINSCHRAUBLAENGE : max. 12mm



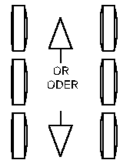


THREADES PIPE CONNECTION, EXHAUST AND ELECTRICAL CONTROL WITHOUT SURFACE PROTECTION
GEWINDEANSCHLUESSE, ENTLUEFTUNG UND ELEKTRISCHE STEUERANSCHLUESSE OHNE OBERFLAECHENSCHUTZ



	PORT	ANSCHLUSS	FUNCTION FUNKTION
	1	1	SUPPLY, ENERGIEZUFLUSS VOM VORRAT
	2.1 2.1 2.1 2.1	2.2 2.2 2.2	DELIVERY ENERGIEABFLUSS
	3.1	3.2	EXHAUST, ANSCHLUSS ATMOSPHAERE
	4	4	BACK UP PORT, REDUNDANZANSCHLUSS,
		POWER	X1: POWER SUPPLY, VERSORGUNG
		POWER.1	CAN-L (ISO 11992)
		POWER.2	CAN-H (ISO 11992)
		POWER.3	WARNING LAMP, WARNLAMPE
		POWER.4	GND ELECTRONIC, GND ELEKTRONIK
		POWER.5	GND ELECTROVALVE. GND ELEKTROVENTIL
		POWER.6	PLUS ELEKTRONIC, PLUS ELEKTRONIK
		POWER.7	PLUS ELECTROVALVE, PLUS ELEKTROVENTIL
		DIAGN	
		DIAGN.1	K-LINE (ISO14230)
		DIAGN.2	PLUS DIAGNOSTIC DEVICE. PLUS DIAGNOSEGERAET
		DIAGN.3	GND SUB-SYSTEM, GND UNTERSYSTEM
		DIAGN.4	PLUS SUB-SYSTEM, PLUS UNTERSYSTEM
		DIAGN.7	GND ISS / ILS
		DIAGN.8	ISS / ILS
	R.E.V.		X3: RELAY EMERGENCY VALVE, ANHAENGERBREMSVENTIL
	REV.1		PLUS DESIRED-PRESSURE SENSOR, PLUS SOLLDRUCKSENSOR
	REV.2		GND DESIRED-PRESSURE SENSOR, GND SOLLDRUCKSENSOR
	REV.3		DESIRED-PRESSURE SENSOR VALUE. SOLLDRUCKSENSORWERT
	REV.4		DESIRED-PRESSUR SWITCH, SOLLDRUCKSCHALTER
	MODULATOR		X4: MODULATOR, MODULATOR
	MODULATOR.1		PLUS BRAKE PRESSURE SENSOR, PLUS BREMSDRUCKSENSOR
	MODULATOR.2		GND BRAKE PRESSURE SENSOR, GND BREMSDRUCKSENSOR
	MODULATOR.3		AV (DISCHARGE VALVE, AUSLASSVENTIL
	MODULATOR.4		PLUS BACK UP VALVE. PLUS REDUNDANZVENTIL
	MODULATOR.5		BRAKE PRESSURE VALUE, BREMSDRUCKWERT
	MODULATOR.6		GND EV-AV
	MODULATOR.7		EV (INLET VALVE, EINLASSVENTIL
	MODULATOR.8		GND BACK UP VALVE, GND REDUNDANZVENTIL
MAIN AXLE HAUPTACHSE	d	c	X7, X8: WHEEL SPEED SENSOR, RADDREHZAHLSENSOR
	d.1	c.1	SENSOR IG
	d.2	c.2	SENSOR IGM,MM
STEER/LIFTING AXLE LENK-/LIFTACHSE	f	e	X9, X10: WHEEL SPEED SENSOR. RADDREHZAHLSENSOR
	f.1	e.1	SENSOR IG
	f.2	e.2	SENSOR IGM
REAR AXLE HINTERACHSE	1		X5:AXLE LOAD PRESSURE SENSOR, ACHSLASTDRUCKSENSOR,
	1.1		PLUS AXLE LOAD PRESSURE SENSOR, PLUS ACHSLASTDRUCKSENSOR
	1.2		GND AXLE LOAD PRESSURE SENSOR, GND ACHSLASTDRUCKSENSOR
	1.3		AXLE LOAD PRESSURE SENSOR VALUE, REAR AXLE, ACHSLASTDRUCKSENSORWERT HINTERACHSE
FRONT AXLE VORDERACHSE		2	X6:AXLE LOAD PRESSURE SENSOR, ACHSLASTDRUCKSENSOR
		2.1	PLUS AXLE LOAD PRESSURE SENSOR, PLUS ACHSLASTDRUCKSENSOR
		2.2	GND AXLE LOAD PRESSURE SENSOR, GND ACHSLASTDRUCKSENSOR
		2.3	AXLE LOAD PRESSURE SENSOR VALUE, FRONT AXLE, ACHSLASTDRUCKSENSORWERT VORDERACHSE

DRIVING DIRECTION
FAHRTRICHTUNG



GENERAL SPECIFICATION JED-334.0
FURTHER TECHNICAL DATA:
DOC. CODE: SHEET TO
GENERAL TOLERANCES
RANGE OF NOMINAL DIMENSIONS (± mm)

CLASS 1)	≤ 50	> 50 ≤ 150	> 150 ≤ 400	> 400	
FINE	0.5	1.0	1.5	2.0	±3°
MEDIUM	1.0	2.0	3.0	4.0	
COARSE	2.0	3.5	5.0	6.5	

TAPPED HOLES ACC. ISO 7020 / JED-152
1) TOLERANCE CLASS APPLIED CROSSMARKED

DCN-NO.	REV.	DATE
065208	6xB	09-05-15
065209	2xA	09-03-19

PROENGINEER DRAWING
COPYRIGHT

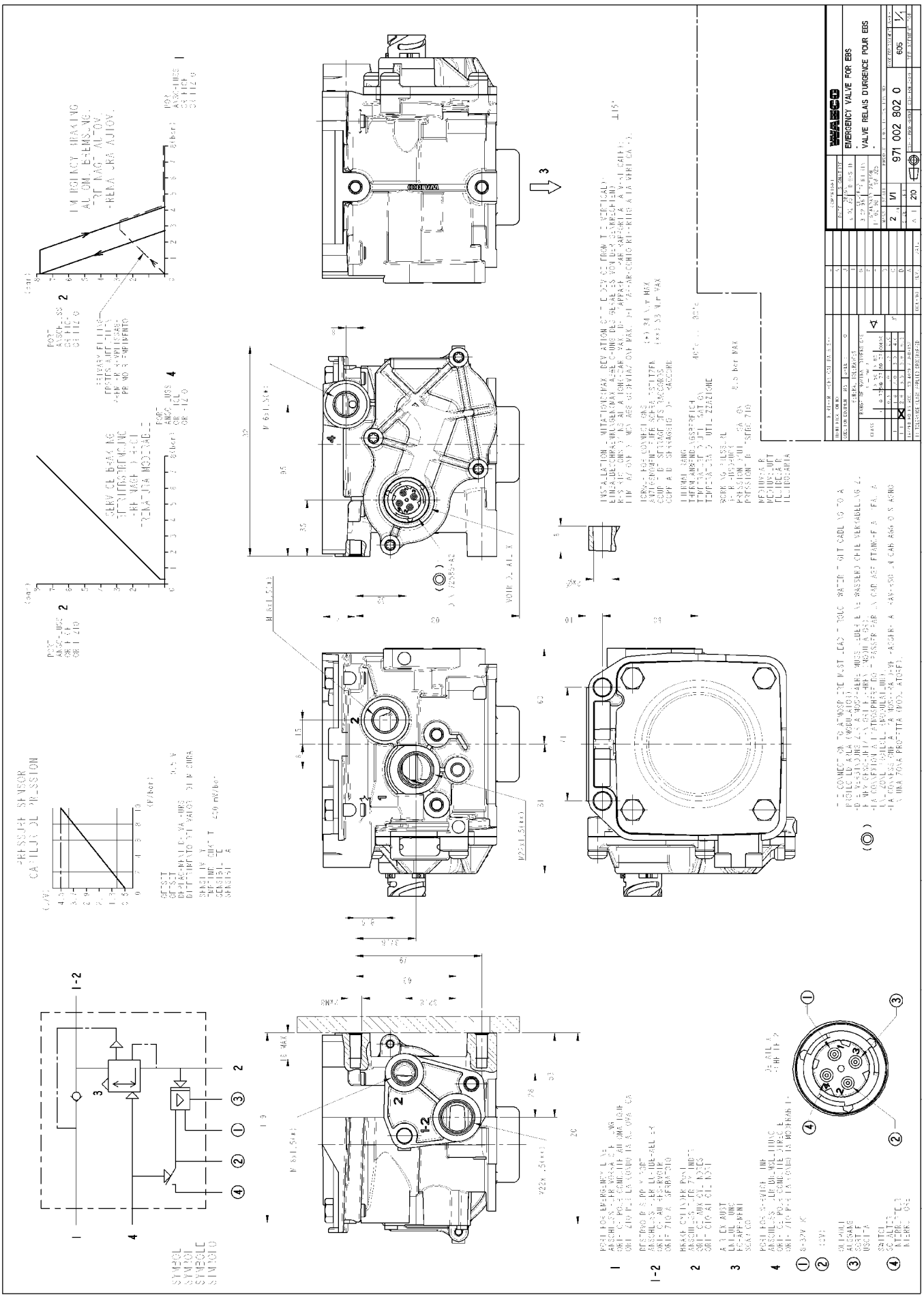
DATE	SIGNATURE
DRAWN	
97 09 29	GIESEKE
CHECKED	
97 09 29	FRANK/BISSE
EXPERT CODE	
T 6.5	

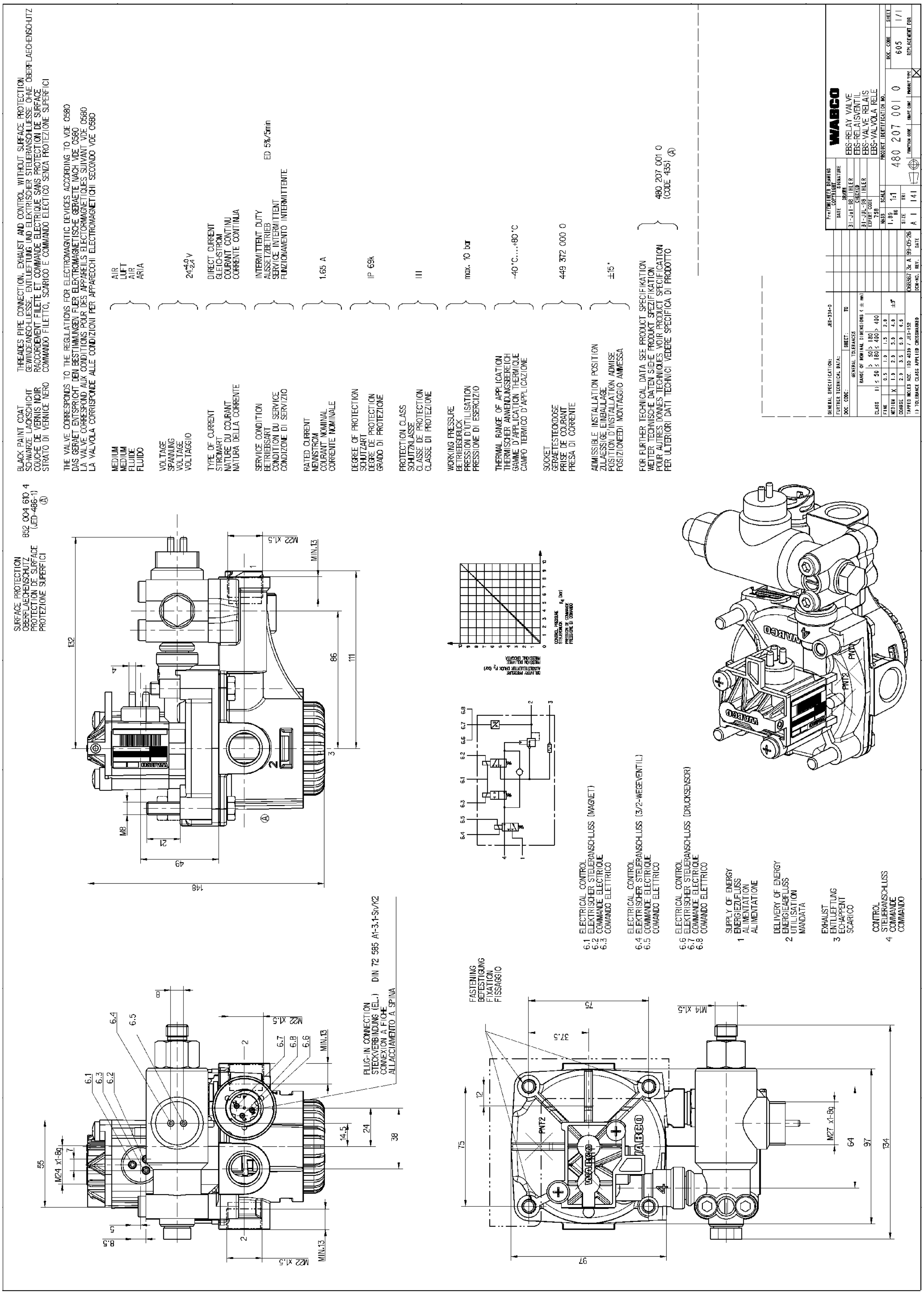
WABCO

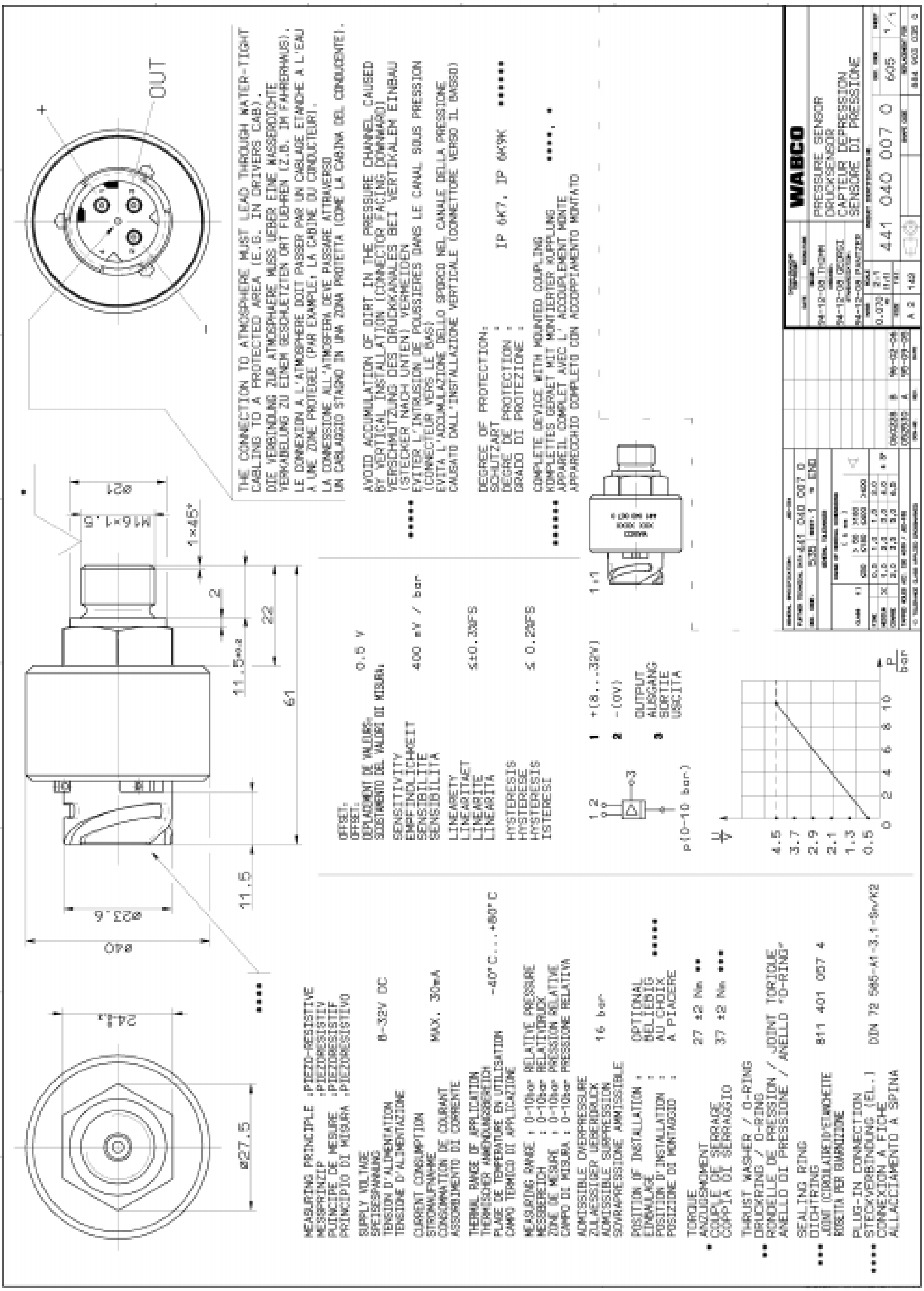
EBS TRAILER MODULATOR
EBS-ANHAENGERMODULATOR

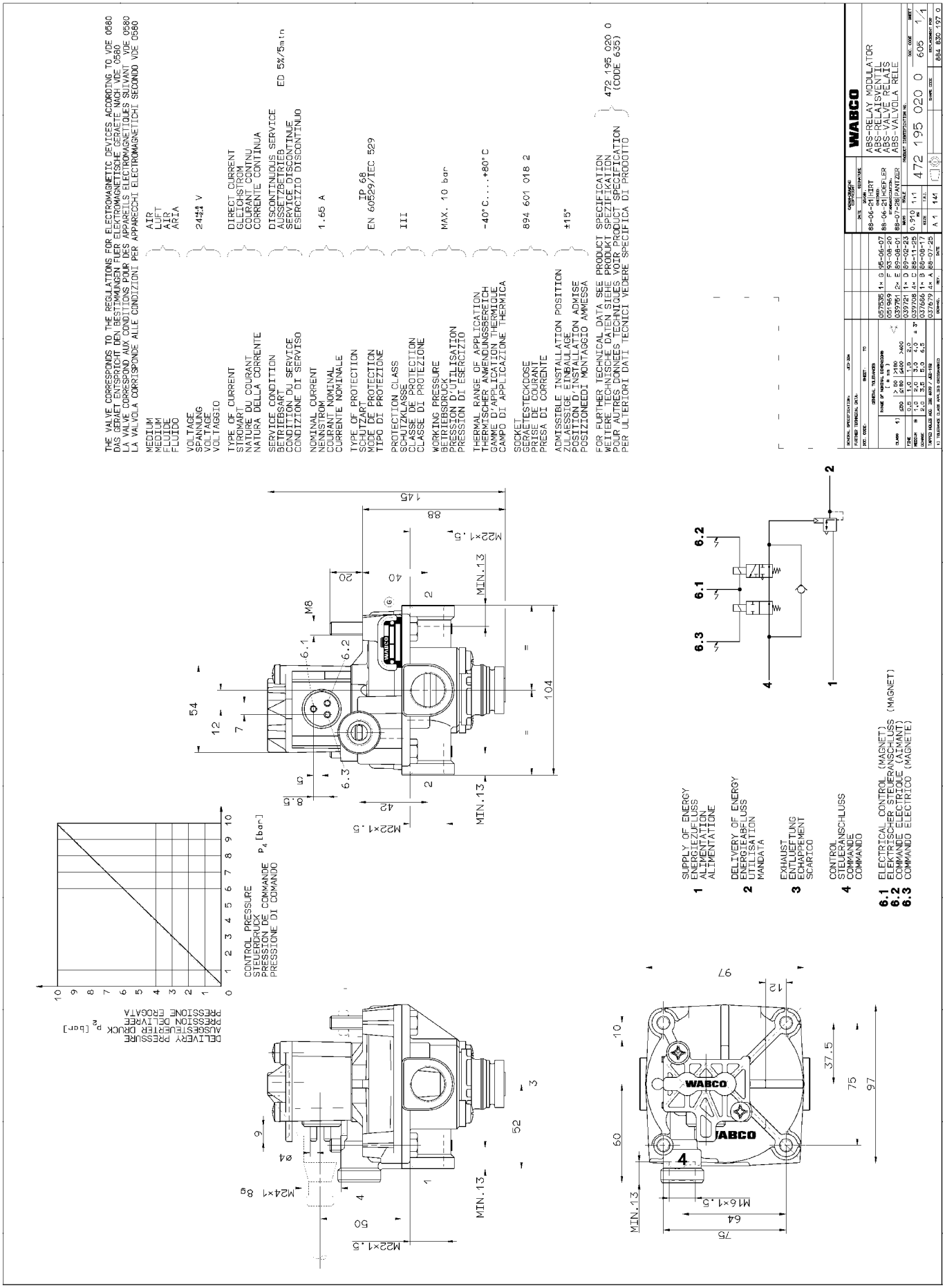
MASS	SCALE	PRODUCT IDENTIFICATION NO	DOC. CODE	SHEET
3.9 KG	1:1	480 102 000 0	605	1/ 1
SIZE	TP			
A 0	14'			

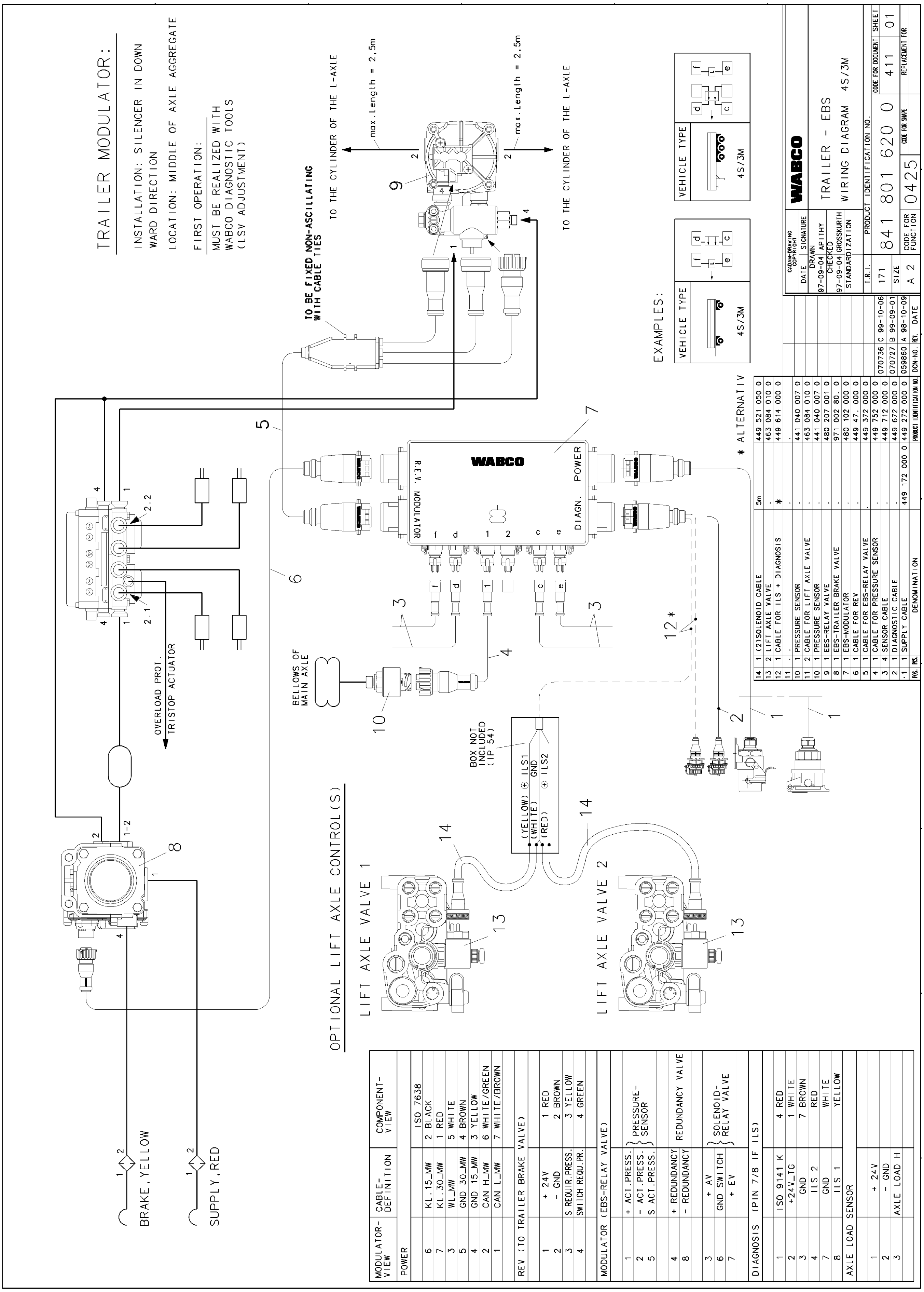
Annex E ‘Emergency Valve 971 002 802 0’

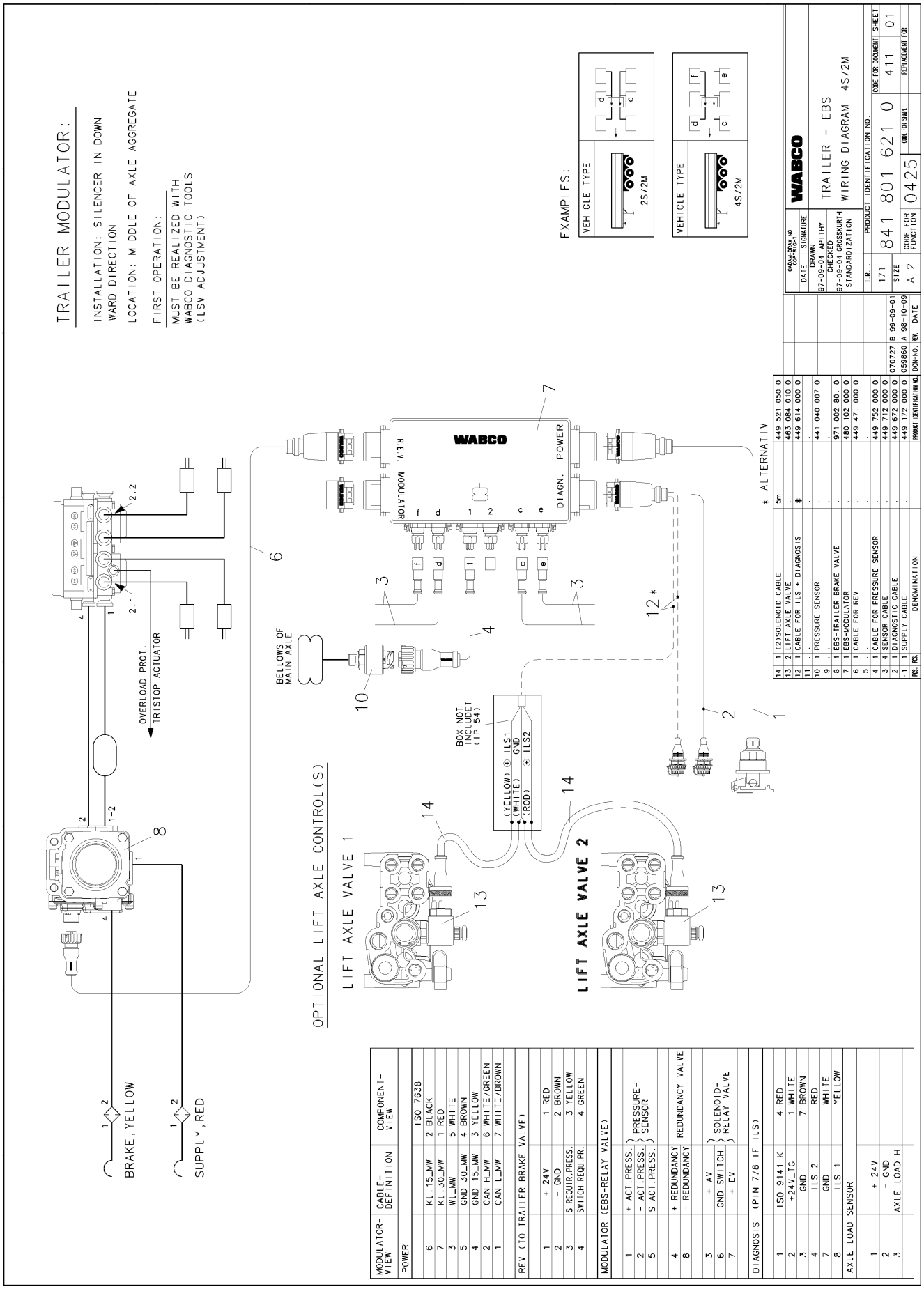



SURFACE PROTECTION
OBERFLAECHENSCHUTZ
PROTECTION DE SURFACE
PROTEZIONE SUPERFICI
852 004 610 4
(JED-486-1)
BLACK PAINT COAT
SCHWARZE LACKSCHICHT
COUCHE DE VERNIS NOIR
STRATO DI VERNICE NERO
THREADES PIPE CONNECTION, EXHAUST AND CONTROL WITHOUT SURFACE PROTECTION
GEWINDEANSCHLUESSE, ENTLUEFTUNG UND ELEKTRISCHER STEUERANSCHLUESSE OHNE OBERFLAECHENSCHUTZ
RACCORDEMENT FILETE ET COMMANDE ELECTRIQUE SANS PROTECTION DE SURFACE
COMMANDO FILETTO, SCARICO E COMMANDO ELECTICO SENZA PROTEZIONE SUPERFICI
THE VALVE CORRESPONDS TO THE REGULATIONS FOR ELECTROMAGNTIC DEVICES ACCORDING TO VDE 0580
DAS GERAET ENTSPRICHT DEN BESTIMMUNGEN FUER ELEKTROMAGNETISCHE GERAETE NACH VDE 0580
LA VALVE CORRESPOND AUX CONDITIONS POUR DES APPAREILS ELECTORMAGNETIQUES SUIVANT VDE 0580
LA VALVOLA CORRISPONDE ALLE CONDIZIONI PER APPARECCHI ELECTROMAGNETICHI SECONDO VDE 0580
MEDIUM / MEDIUM / FLUIDE / FLUIDO — AIR / LUFT / AIR / ARIA
VOLTAGE / SPANNUNG / VOLTAGE / VOLTAGGIO — 24+4.0-2.4 V
TYPE OF CURRENT / STROMART / NATURE DU COURANT / NATURA DELLA CORRENTE — DIRECT CURRENT / GLEICHSTROM / COURANT CONTINU / CORRENTE CONTINUA
SERVICE CONDITION / BETRIEBSART / CONDITION DU SERVICE / CONDIZONE DI SERVIZIO — INTERMITTENT DUTY / AUSSETZBETRIEB / SERVICE INTERMITTENT / FUNZIONAMENTO INTERMITTENTE — ED 5%/5min
RATED CURRENT / NENNSTROM / COURANT NOMINAL / CORRENTE NOMINALE — 1.65 A
DEGREE OF PROTECTION / SCHUTZART / DEGRE DE PROTECTION / GRADO DI PROTEZIONE — IP 69k
PROTECTION CLASS / SCHUTZKLASSE / CLASSE DE PROTECTION / CLASSE DI PROTEZIONE — III
WORKING PRESSURE / BETRIEBSDRUCK / PRESSION D'UTILISATION / PRESSIONE DI ESERCIZIO — max. 10 bar
THERMAL RANGE OF APPLICATION / THERMISCHER ANWENDUNGSBEREICH / GAMME D'APPLICATION THERMIQUE / CAMPO TERMICO D'APPLICAZIONE — -40°C....+80°C
SOCKET / GERAETESTECKDOSE / PRISE DE COURANT / PRESA DI CORRENTE — 449 372 000 0
ADMISSIBLE INSTALLATION POSITION / ZULAESSIGE EINBAULAGE / POSITION D'INSTALLATION ADMISE / POSIZIONEEDI MONTAGGIO AMMESSA — ±15°
FOR FURTHER TECHNICAL DATA SEE PRODUCT SPECIFIKATION
WEITER TECHNISCHE DATEN SIEHE PRODUKT SPEZIFIKATION
POUR AUTRES DONNES TECHNIQUES VOIR PRODUCT SPECIFICATION
PER ULTERIORI DATI TECHNICI VEDERE SPECIFICA DI PRODOTTO
480 207 001 0 (CODE 435)
PLUG-IN CONNECTION
STECKVERBINDUNG (EL.) DIN 72 585 A1-3.1-Sn/K2
CONNEXION A FICHE
ALLACCIAMENTO A SPINA
FASTENING
BEFESTIGUNG
FIXATION
FISSAGGIO
6.1 6.2 6.3 ELECTRICAL CONTROL / ELEKTRISCHER STEUERANSCHLUSS (MAGNET) / COMMANDE ELECTRIQUE / COMANDO ELETTRICO
6.4 6.5 ELECTRICAL CONTROL / ELEKTRISCHER STEUERANSCHLUSS (3/2-WEGEVENTIL) / COMMANDE ELECTRIQUE / COMANDO ELETTRICO
6.6 6.7 6.8 ELECTRICAL CONTROL / ELEKTRISCHER STEUERANSCHLUSS (DRUCKSENSOR) / COMMANDE ELECTRIQUE / COMANDO ELETTRICO
1 SUPPLY OF ENERGY / ENERGIEZUFLUSS / ALIMENTATION / ALIMENTATIONE
2 DELIVERY OF ENERGY / ENERGIEABFLUSS / UTILISATION / MANDATA
3 EXHAUST / ENTLUEFTUNG / ECHAPPENT / SCARICO
4 CONTROL / STEUERANSCHLUSS / COMMANDE / COMMANDO
CONTROL PRESSURE / STEUERDRUCK / PRESSION DE COMMANDE / PRESSIONE DI COMANDO
DELIVERY PRESSURE / AUSGESTEUERTER DRUCK / PRESSION DELIVREE / PRESSIONE DI MANDATA
M24 x1-8g
M22 x1.5
MIN.13
M8
M14 x1.5
M27 x1-8g
WABCO
EBS-RELAY VALVE
EBS-RELAISVENTIL
EBS-VALVE RELAIS
EBS-VALVOLA RELE
480 207 001 0
31-Jul-98 IHLER
A 1 141
1:1


OUT
ø27.5
24±1,1
ø40
ø23.6
11.5
M16×1.5
ø21
1×45°
2
11.5±0.2
22
61
THE CONNECTION TO ATMOSPHERE MUST LEAD THROUGH WATER-TIGHT CABLING TO A PROTECTED AREA (E.G. IN DRIVERS CAB).
DIE VERBINDUNG ZUR ATMOSPHAERE MUSS UEBER EINE WASSERDICHTE VERKABELUNG ZU EINEM GESCHUETZTEN ORT FUEHREN (Z.B. IM FAHRERHAUS).
LE CONNEXION A L'ATMOSPHERE DOIT PASSER PAR UN CABLAGE ETANCHE A L'EAU A UNE ZONE PROTEGEE (PAR EXAMPLE, LA CABINE DU CONDUCTEUR).
LA CONNESSIONE ALL'ATMOSFERA DEVE PASSARE ATTRAVERSO UN CABLAGGIO STAGNO IN UNA ZONA PROTETTA (COME LA CABINA DEL CONDUCENTE).
MEASURING PRINCIPLE : PIEZO-RESISTIVE
MESSPRINZIP : PIEZORESISTIV
PRINCIPE DE MESURE : PIEZORESISTIF
PRINCIPIO DI MISURA : PIEZORESISTIVO
SUPPLY VOLTAGE / SPEISESPANNUNG / TENSION D'ALIMENTATION / TENSIONE D'ALIMENTAZIONE 8-32V DC
CURRENT CONSUMPTION / STROMAUFNAHME / CONSOMMATION DE COURANT / ASSORBIMENTO DI CORRENTE MAX. 30mA
THERMAL RANGE OF APPLICATION / THERMISCHER ANWENDUNGSBEREICH / PLAGE DE TEMPERATURE EN UTILISATION / CAMPO TERMICO DI APPLICAZIONE -40°C...+80°C
MEASURING RANGE : 0-10bar RELATIVE PRESSURE
MESSBEREICH : 0-10bar RELATIVDRUCK
ZONE DE MESURE : 0-10bar PRESSION RELATIVE
CAMPO DI MISURA : 0-10bar PRESSIONE RELATIVA
ADMISSIBLE OVERPRESSURE / ZULAESSIGER UEBERDRUCK / ADMISSIBLE SURPRESSION / SOVRAPRESSIONE AMMISSIBLE 16 bar
POSITION OF INSTALLATION / EINBAULAGE / POSITION D'INSTALLATION / POSIZIONE DI MONTAGGIO : OPTIONAL / BELIEBIG / AU CHOIX / A PIACERE *****
* TORQUE / ANZUGSMOMENT / COUPLE DE SERRAGE / COPPIA DI SERRAGGIO 27 ±2 Nm ** 37 ±2 Nm ***
** THRUST WASHER / O-RING / DRUCKRING / O-RING / RONDELLE DE PRESSION / JOINT TORIQUE / ANELLO DI PRESSIONE / ANELLO "O-RING"
*** SEALING RING / DICHTRING / JOINT (CIRCULAIRE)D'ETANCHEITE / ROSETTA PER GUARNIZIONE 811 401 057 4
**** PLUG-IN CONNECTION / STECKVERBINDUNG (EL.) / CONNEXION A FICHE / ALLACCIAMENTO A SPINA DIN 72 585-A1-3.1-Sn/K2
OFFSET / OFFSET / DEPLACEMENT DE VALEURS / SCOSTAMENTO DEL VALORI DI MISURA 0.5 V
SENSITIVITY / EMPFINDLICHKEIT / SENSIBILITE / SENSIBILITA 400 mV / bar
LINEARETY / LINEARITAET / LINEARITE / LINEARITA ≤±0.3%FS
HYSTERESIS / HYSTERESE / HYSTERESIS / ISTERESI ≤ 0.2%FS
***** AVOID ACCUMULATION OF DIRT IN THE PRESSURE CHANNEL CAUSED BY VERTICAL INSTALLATION (CONNECTOR FACING DOWNWARD)
VERSCHMUTZUNG DES DRUCKKANALES BEI VERTIKALEM EINBAU (STECKER NACH UNTEN) VERMEIDEN
EVITER L'INTRUSION DE POUSSIERES DANS LE CANAL SOUS PRESSION (CONNECTEUR VERS LE BAS)
EVITA L'ACCUMULAZIONE DELLO SPORCO NEL CANALE DELLA PRESSIONE CAUSATO DALL'INSTALLAZIONE VERTICALE (CONNETTORE VERSO IL BASSO)
DEGREE OF PROTECTION / SCHUTZART / DEGRE DE PROTECTION / GRADO DI PROTEZIONE : IP 6K7, IP 6K9K ******
****** COMPLETE DEVICE WITH MOUNTED COUPLING / KOMPLETTES GERAET MIT MONTIERTER KUPPLUNG / APPAREIL COMPLET AVEC L' ACCOUPLEMENT MONTE / APPARECCHIO COMPLETO CON ACCOPPIAMENTO MONTATO ****, *
1 +(8...32V)
2 -(0V)
3 OUTPUT / AUSGANG / SORTIE / USCITA
p(0-10 bar)
1:1
U/V
4.5
3.7
2.9
2.1
1.3
0.5
0 2 4 6 8 10
p/bar
WABCO
PRESSURE SENSOR
DRUCKSENSOR
CAPTEUR DEPRESSION
SENSORE DI PRESSIONE
441 040 007 0
605
1/1
884 903 035 0
94-12-08 THOMM
94-12-08 GEORGI
94-12-08 PANTZER
2:1
A 2
142
535
END


THE VALVE CORRESPONDS TO THE REGULATIONS FOR ELECTROMAGNETIC DEVICES ACCORDING TO VDE 0580
DAS VENTIL ENTSPRICHT DEN BESTIMMUNGEN FÜR ELEKTROMAGNETISCHE GERÄTE NACH VDE 0580
LA VALVE CORRESPOND AUX CONDITIONS POUR DES APPAREILS ELECTROMAGNETIQUES SELON VDE 0580
LA VALVOLA CORRISPONDE ALLE CONDIZIONI PER APPARECCHI ELECTROMAGNETICHI SECONDO VDE 0580
MEDIUM / MEDIUM / FLUIDE / FLUIDO: AIR / LUFT / AIR / ARIA
VOLTAGE / SPANNUNG / VOLTAGE / VOLTAGGIO: 24±3 V
TYPE OF CURRENT / STROMART / NATURE DU COURANT / NATURA DELLA CORRENTE: DIRECT CURRENT / GLEICHSTROM / COURANT CONTNU / CORRENTE CONTINUA
SERVICE CONDITION / BETRIEBSART / CONDITION DU SERVICE / CONDIZIONE DI SERVISO: DISCONTINUOUS SERVICE / AUSSETZBETRIEB / SERVICE DISCONTINUE / ESERCIZIO DISCONTINUO ED 5%/5min
NOMINAL CURRENT / NENNSTROM / COURANT NOMINAL / CORRENTE NOMINALE: 1.65 A
TYPE OF PROTECTION / SCHUTZART / MODE DE PROTECTION / TIPO DI PROTEZIONE: IP 68 EN 60529/IEC 529
PROTECTION CLASS / SCHUTZKLASSE / CLASSE DE PROTECTION / CLASSE DI PROTEZIONE: III
WORKING PRESSURE / BETRIEBSDRUCK / PRESSION D'UTILISATION / PRESSIONE DI ESERCIZIO: MAX. 10 bar
THERMAL RANGE OF APPLICATION / TEMPERATURBEREICH / GAMME D'APPLICATION THERMIQUE / CAMPO DI APPLICAZIONE TERMICA: -40°C....+80°C
SOCKET / GERÄTESTECKDOSE / PRISE DE COURANT / PRESA DI CORRENTE: 894 601 018 2
ADMISSIBLE INSTALLATION POSITION / ZULAESSIGE EINBAULAGE / POSITION D'INSTALLATION ADMISE / POSIZIONEDI MONTAGGIO AMMESSA: ±15°
FOR FURTHER TECHNICAL DATA SEE PRODUCT SPECIFICATION / WEITERE TECHNISCHE DATEN SIEHE PRODUKT SPEZIFIKATION / POUR AUTRES DONNEES TECHNIQUES VOIR PRODUCT SPECIFICATION / PER ULTERIORI DATI TECNICI VEDERE SPECIFICA DI PRODOTTO: 472 195 020 0 (CODE 635)
WABCO
ABS-RELAY MODULATOR
ABS-RELAISVENTIL
ABS-VALVE RELAIS
ABS-VALVOLA RELE
472 195 020 0
884 830 197 0
SUPPLY OF ENERGY / ENERGIEZUFLUSS / ALIMENTATION / ALIMENTATIONE
DELIVERY OF ENERGY / ENERGIEABFLUSS / UTILISATION / MANDATA
EXHAUST / ENTLUFTUNG / ECHAPPEMENT / SCARICO
CONTROL / STEUERANSCHLUSS / COMMANDE / COMMANDO
6.1 ELECTRICAL CONTROL (MAGNET) / ELEKTRISCHER STEUERANSCHLUSS (MAGNET) / COMMANDE ELECTRIQUE (AIMANT) / COMMANDO ELECTRICO (MAGNETE)
CONTROL PRESSURE / STEUERDRUCK / PRESSION DE COMMANDE / PRESSIONE DI COMANDO
DELIVERY PRESSURE / AUSGESTEUERTER DRUCK / PRESSION DELIVRÉE / PRESSIONE EROGATA


TRAILER MODULATOR:
INSTALLATION: SILENCER IN DOWN WARD DIRECTION
LOCATION: MIDDLE OF AXLE AGGREGATE
FIRST OPERATION:
MUST BE REALIZED WITH WABCO DIAGNOSTIC TOOLS (LSV ADJUSTMENT)
TO THE CYLINDER OF THE L-AXLE
max.Length = 2,5m
TO BE FIXED NON-ASCILLATING WITH CABLE TIES
EXAMPLES:
VEHICLE TYPE
4S/3M
WABCO
R.E.V. MODULATOR
POWER
DIAGN.
OVERLOAD PROT.
TRISTOP ACTUATOR
BELLOWS OF MAIN AXLE
BOX NOT INCLUDED (IP 54)
(YELLOW) ILS1
(WHITE) GND
(RED) ILS2
OPTIONAL LIFT AXLE CONTROL(S)
LIFT AXLE VALVE 1
LIFT AXLE VALVE 2
BRAKE, YELLOW
SUPPLY, RED
* ALTERNATIV
TRAILER - EBS
WIRING DIAGRAM 4S/3M
PRODUCT IDENTIFICATION NO.
841 801 620 0
CODE FOR DOCUMENT 411
SHEET 01
CODE FOR FUNCTION 0425
SIZE A 2
97-09-04 APITHY
97-09-04 GROSSKURTH

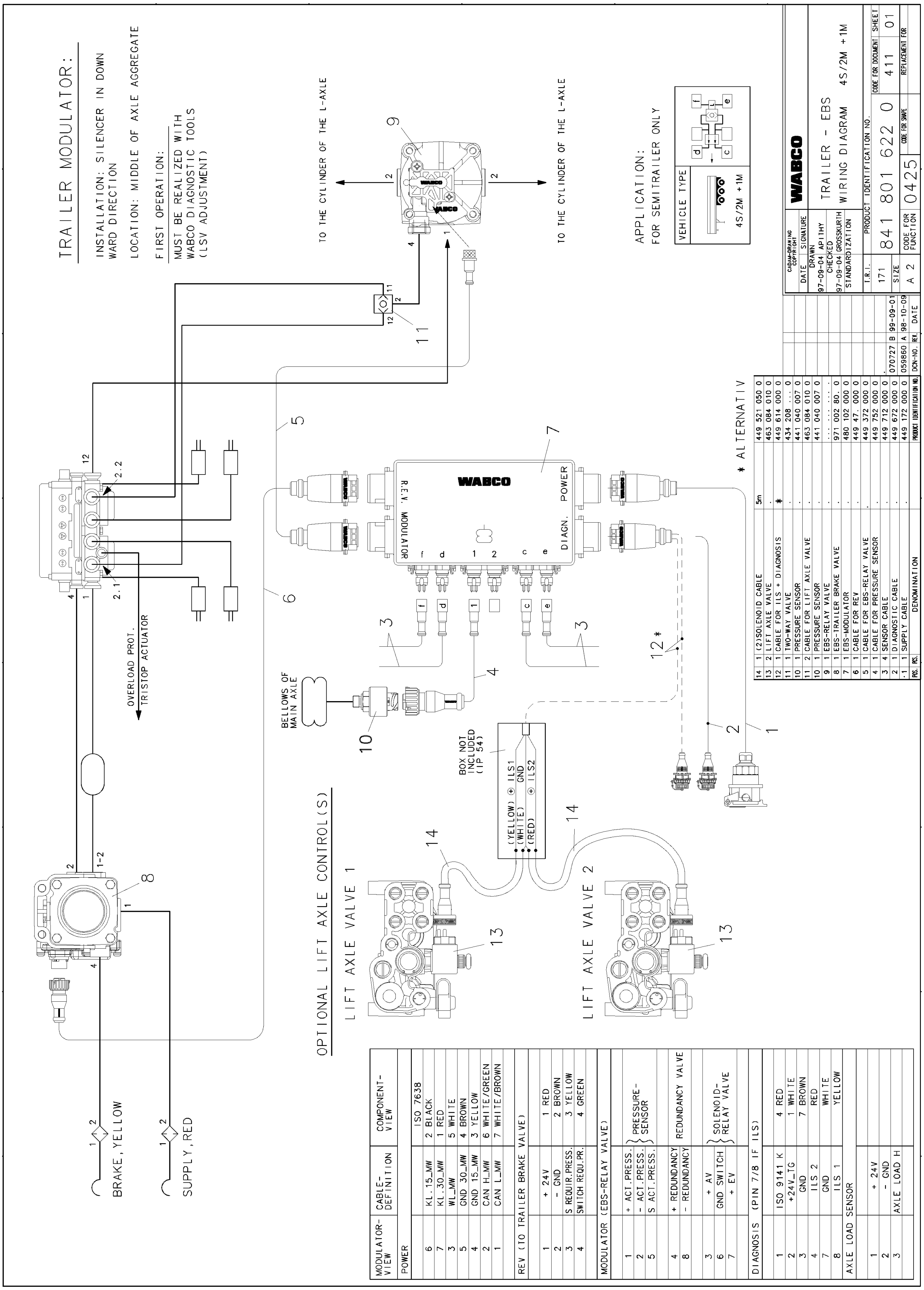


MODULATOR-VIEW	CABLE-DEFINITION	COMPONENT-VIEW
POWER		ISO 7638
6	KL.15_MW	2 BLACK
7	KL.30_MW	1 RED
3	WL_MW	5 WHITE
5	GND 30_MW	4 BROWN
4	GND 15_MW	3 YELLOW
2	CAN H_MW	6 WHITE/GREEN
1	CAN L_MW	7 WHITE/BROWN
REV (TO TRAILER BRAKE VALVE)		
1	+ 24V	1 RED
2	- GND	2 BROWN
3	S REQUIR.PRESS.	3 YELLOW
4	SWITCH REQU.PR.	4 GREEN
MODULATOR (EBS-RELAY VALVE)		
1	+ ACT.PRESS.	PRESSURE-SENSOR
2	- ACT.PRESS.	
5	S ACT.PRESS.	
4	+ REDUNDANCY	REDUNDANCY VALVE
8	- REDUNDANCY	
3	+ 4V	SOLENOID-RELAY VALVE
6	GND SWITCH	
7	+ EV	
DIAGNOSIS (PIN 7/8 IF ILS)		
1	ISO 9141 K	4 RED
2	+24V_TG	1 WHITE
3	GND	7 BROWN
4	ILS 2	RED
7	GND	WHITE
8	ILS 1	YELLOW
AXLE LOAD SENSOR		
1	+ 24V	
2	- GND	
3	AXLE LOAD H	

POS. NO.	DENOMINATION	PRODUCT IDENTIFICATION NO.	DON-NO.	REV.	DATE
14	1 (2)SOLENOID CABLE	5m	449 521 050 0		
13	2 LIFT AXLE VALVE	-	463 084 010 0		
12	1 CABLE FOR ILS + DIAGNOSIS	*	449 614 000 0		
11	-	-	-		
10	1 PRESSURE SENSOR	-	441 040 007 0		
9	-	-	-		
8	1 EBS-TRAILER BRAKE VALVE	-	971 002 80. 0		
7	1 EBS-MODULATOR	-	480 102 000 0		
6	1 CABLE FOR REV	-	449 47. 000 0		
5	-	-	-		
4	1 CABLE FOR PRESSURE SENSOR	-	449 752 000 0		
3	4 SENSOR CABLE	-	449 712 000 0		
2	1 DIAGNOSTIC CABLE	-	449 672 000 0	070727	B 99-09-01
1	1 SUPPLY CABLE	-	449 172 000 0	059860	A 98-10-09

COPYRIGHT	DATE	SIGNATURE
DRAWN	97-09-04	APITHY
CHECKED	97-09-04	GROSSKURTH
STANDARDIZATION		

T.R.I.	PRODUCT IDENTIFICATION NO.	CODE FOR DOCUMENT	SHEET
171	841 801 621 0	411	01
SIZE	CODE FOR FUNCTION	CODE FOR SHAPE	REPLACEMENT FOR
A 2	0425		


TRAILER MODULATOR:
INSTALLATION: SILENCER IN DOWN WARD DIRECTION
LOCATION: MIDDLE OF AXLE AGGREGATE
FIRST OPERATION:
MUST BE REALIZED WITH WABCO DIAGNOSTIC TOOLS (LSV ADJUSTMENT)
TO THE CYLINDER OF THE L-AXLE
TO THE CYLINDER OF THE L-AXLE
APPLICATION:
FOR SEMITRAILER ONLY
VEHICLE TYPE
4S/2M +1M
WABCO
TRAILER - EBS
WIRING DIAGRAM 4S/2M +1M
841 801 622 0
PRODUCT IDENTIFICATION NO.
97-09-04 APITHY
97-09-04 GROSSKURTH
070727 B 99-09-01
059860 A 98-10-09
R.E.V. MODULATOR
POWER
DIAGN.
* ALTERNATIV
OVERLOAD PROT.
TRISTOP ACTUATOR
BELLOWS OF MAIN AXLE
BOX NOT INCLUDED (IP 54)
(YELLOW) ⊕ ILS1
(WHITE) GND
(RED) ⊕ ILS2
OPTIONAL LIFT AXLE CONTROL(S)
LIFT AXLE VALVE 1
LIFT AXLE VALVE 2
BRAKE, YELLOW
SUPPLY, RED
14 1 (2)SOLENOID CABLE 449 521 050 0
13 2 LIFT AXLE VALVE 463 084 010 0
12 1 CABLE FOR ILS + DIAGNOSIS 449 614 000 0
11 1 TWO-WAY VALVE 434 208 ... 0
11 1 PRESSURE SENSOR 441 040 007 0
10 2 CABLE FOR LIFT AXLE VALVE 463 084 010 0
10 1 PRESSURE SENSOR 441 040 007 0
9 1 EBS-RELAY VALVE
8 1 EBS-TRAILER BRAKE VALVE 971 002 80. 0
7 1 EBS-MODULATOR 480 102 000 0
6 1 CABLE FOR REV 449 47. 000 0
5 1 CABLE FOR EBS-RELAY VALVE 449 372 000 0
4 1 CABLE FOR PRESSURE SENSOR 449 752 000 0
3 4 SENSOR CABLE 449 712 000 0
2 1 DIAGNOSTIC CABLE 449 672 000 0
1 1 SUPPLY CABLE 449 172 000 0
POS. PCS. DENOMINATION
MODULATOR-VIEW
CABLE-DEFINITION
COMPONENT-VIEW
POWER
ISO 7638
6 KL.15_MW 2 BLACK
7 KL.30_MW 1 RED
3 WL_MW 5 WHITE
5 GND 30_MW 4 BROWN
4 GND 15_MW 3 YELLOW
2 CAN H_MW 6 WHITE/GREEN
1 CAN L_MW 7 WHITE/BROWN
REV (TO TRAILER BRAKE VALVE)
1 + 24V 1 RED
2 - GND 2 BROWN
3 S REQUIR.PRESS. 3 YELLOW
4 SWITCH REQU.PR. 4 GREEN
MODULATOR (EBS-RELAY VALVE)
1 + ACT.PRESS.
2 - ACT.PRESS.
5 S ACT.PRESS.
PRESSURE-SENSOR
4 + REDUNDANCY
8 - REDUNDANCY
REDUNDANCY VALVE
3 + AV
6 GND SWITCH
7 + EV
SOLENOID-RELAY VALVE
DIAGNOSIS (PIN 7/8 IF ILS)
1 ISO 9141 K 4 RED
2 +24V_TG 1 WHITE
3 GND 7 BROWN
4 ILS 2 RED
7 GND WHITE
8 ILS 1 YELLOW
AXLE LOAD SENSOR
1 + 24V
2 - GND
3 AXLE LOAD H