

■ Trailer EBS C / D System Description

■ 2nd Edition

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1 Safety instructions

This publication describes the system structure, functions and components of the Trailer EBS generation C and D.

Read this document carefully. All instructions, notes, and safety instructions must be adhered to in order to avoid personal injury and/or material loss.

WABCO will only guarantee the safety, reliability and performance of its products and systems if all information provided in this document is observed.

- Only trained and qualified technicians are permitted to perform work on the vehicle.
- Always follow specifications and instructions of vehicle manufacturer.
- Always comply with the company's regulations for the prevention of accidents and national regulations.
- Wear any necessary protective clothing.
- Your workspace must be dry as well as sufficiently illuminated and ventilated.

Risk of injury!

Pedal actions can cause serious injuries if persons are near the vehicle.

Ensure that pedal action is prevented by means of the following measures:

- Switch the gearbox to "neutral" and actuate the hand brake.
- Use brake wedges to secure the vehicle against rolling away.
- Attach a clearly marked note on the steering wheel saying that work is being performed on the vehicle and that the pedal must not be applied.
- Do not wear a tie, bulky clothing, open hair, bracelets or watches, etc. when working on the vehicle, especially if the engine is running. Keep your hands and hair away from moving parts.

Fire hazard!

- Only use lamps with a ground connection.
- Keep flammable materials (cloth, paper, etc.) away from the exhaust system.
- Do not smoke at your workplace.
- Check the electrical lines to make sure they are properly insulated and fastened.

2 System

The system Trailer EBS is an electronically controlled braking system with load-related braking pressure control and anti-lock braking system.

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)
- Motor vehicles with 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 title (in Germany under item 33).

2.1 Scope of application

Vehicles

Trailer vehicles with one or more than one axle in classes O₃ and O₄ according to the framework directive 70/156/EEC, Annex II with air suspension, disc or drum brakes.

Trailer EBS D (with LSV valve): additional mechanical suspension.

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 71/320/EG or ECE Directive No. 13.

Wheels and Tyres

Single and twin tyres. For each axle whose rotational speed is sensed, identical tyre dimensions and identical numbers of pole wheel teeth must be used.

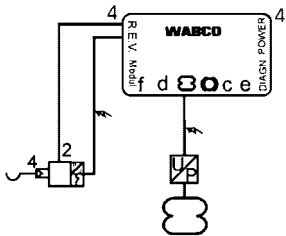
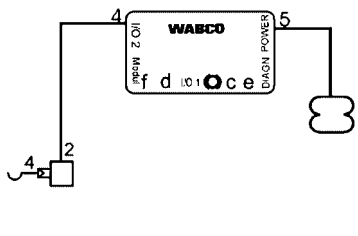
2.2 System structure

2.2.1 History of the System

Version	Dual release valve	Relay Emergency Valve	Demand pressure sensor	Trailer EBS Modulator	Axle load sensor
Trailer EBS C2 – 11/2001		with integrated demand pressure sensor 			
Trailer EBS C3 11/2001 – 09/2003		conventional 		+ RSS 	
Trailer EBS D 10/2003 –		conventional 		+ RSS 	
Trailer EBS D+ 10/2003 –	Park-release emergency valve (PREV) 			+ RSS 	

Integrated demand pressure sensor with TEBS D

Whilst with Trailer EBS C the demand pressure of the brake system and the air bellows pressure were determined by external pressure sensors, Trailer EBS D modulator has integrated pressure sensors.

	Trailer EBS C	Trailer EBS D
Control pressure	external pressure sensor for REV at 1st port 4	integrated pressure sensor at port 4
Bellows pressure	external pressure sensor for air bellow at 2nd port 4	integrated pressure sensor air bellow at port 5
Diagram		

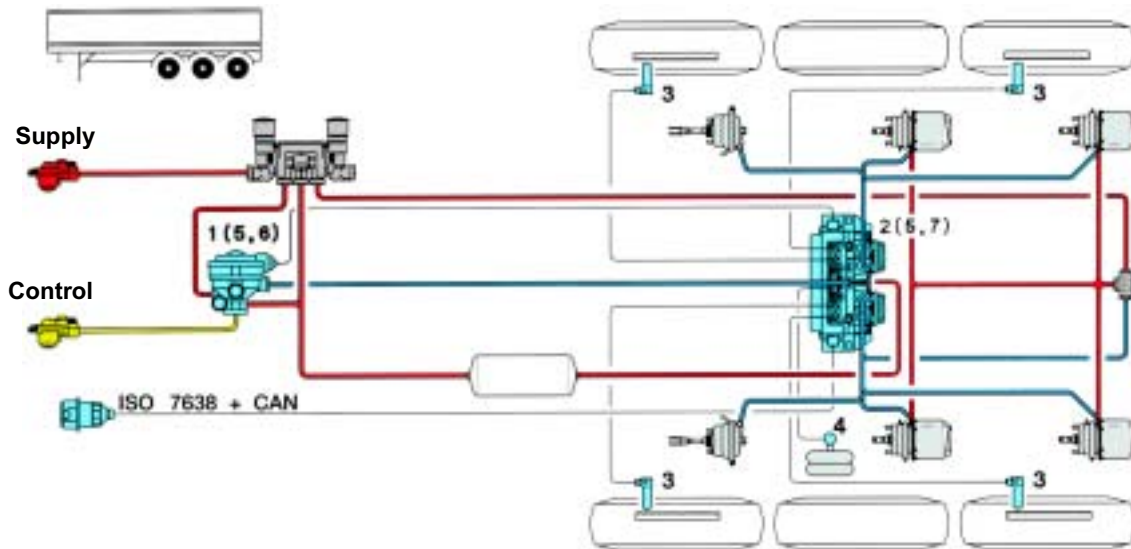
For your information: Trailer EBS E

A new Trailer EBS called generation E was introduced mid of 2007. The extended functionality includes complete control of the air suspension in a central axle trailer or semitrailer with lifting axle control. It can be operated using an ECAS remote con-

trol unit, an ECAS control box or the SmartBoard. Piping and wiring efforts of the trailer brake and air suspension system are reduced significantly.

Please find information and publication about Trailer EBS E in our product catalogue INFORM under www.wabco-auto.com in the Internet.

2.3 Trailer EBS C

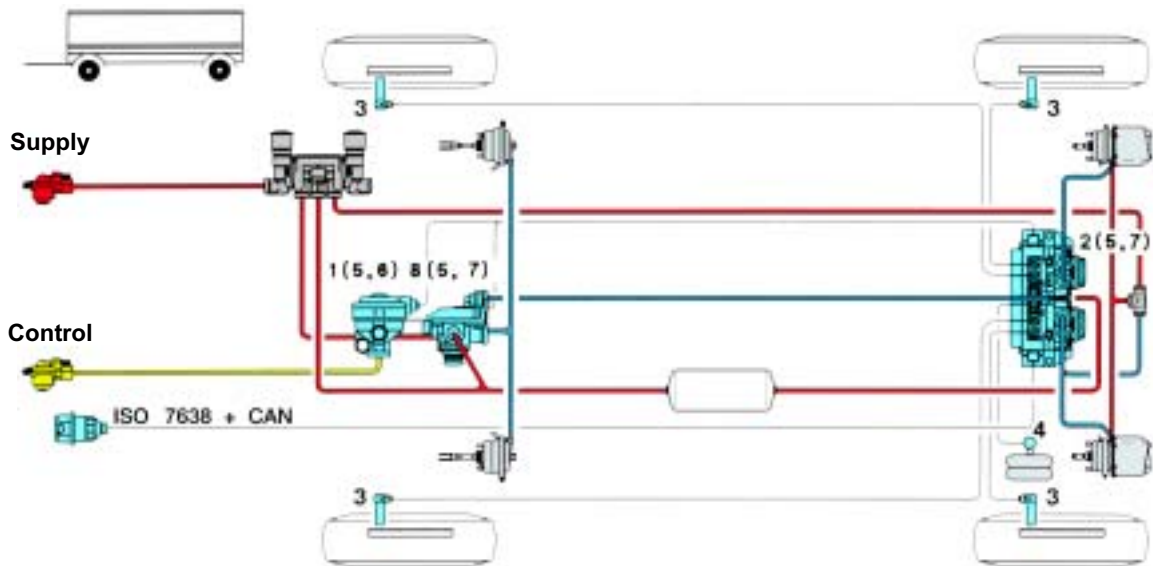


Brake diagram T EBS C, 4S/2M for semitrailer

Trailer EBS C consists of an dual release valve, a relay emergency valve (1) with an integrated demand 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 is described as a 2S/2M or 4S/2M system, depending on the number of speed sensors (3) used.

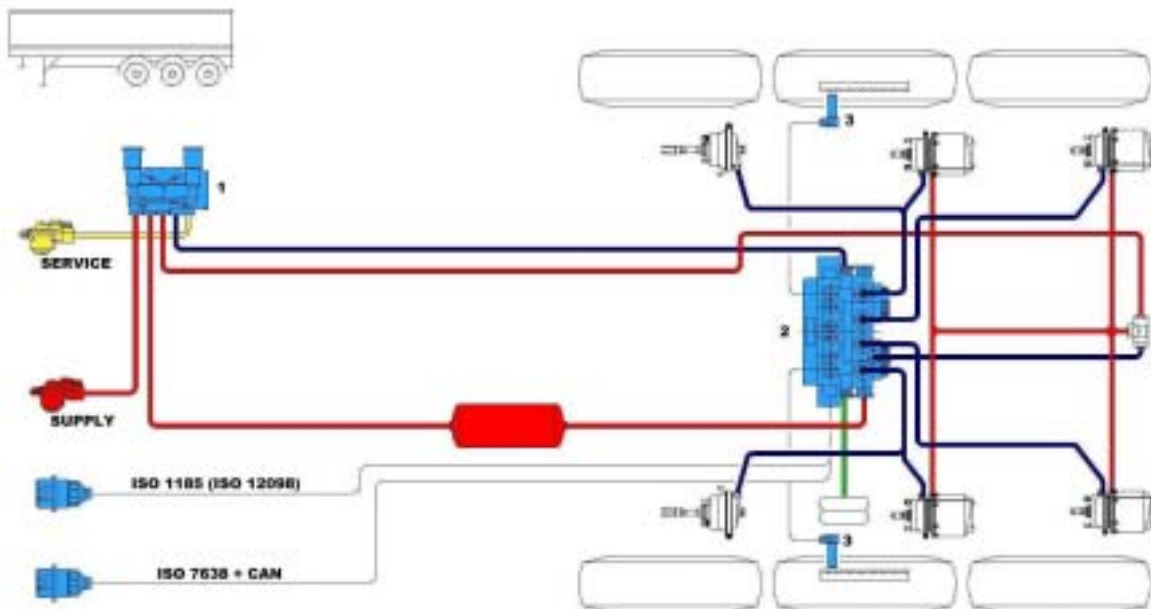
The addition of an EBS relay valve (8) to the 4S/2M configuration for controlling the front axle pressure in drawbar trailers or a 3rd axle in semitrailers is referred to as a 4S/3M system.



Brake diagram T EBS C, 4S/2M for drawbar trailer

2.4 Trailer EBS D

The trailer EBS D generation consists of a Park Release Emergency Valve PREV (1), the EBS trailer modulator (2) - an electropneumatic control unit with an integrated electronic control unit, integrated pressure sensors and integrated redundant valves – as well as the cabling and piping of the components.



Brake diagram T EBS D+ with PREV, 2S/2M for semitrailer

Depending on the number of speed sensors (S) and control circuits (M), this configuration is referred to as a 2S/2M or 4S/2M system.

The 4S/2M configuration, with the addition of an ABS relay valve for ABS control of a 3rd axle in semitrailers, is referred to as a 4S/2M+1M system.

The addition of an EBS relay valve to the 4S/2M configuration for controlling the front axle pressure in drawbar trailers or a 3rd axle in semitrailers is referred to as a 4S/3M system.

2.5 Configuration

Trailer EBS supports the following ABS configurations:

- **2S/2M**, 2 speed sensors and one trailer modulator for 1- to 3-wheel semitrailers and central axle trailers with air suspension systems.
- **2S/2M + SLV**, Extension to the configuration by a Select Low valve for controlling a steering axle on a semitrailer.
- **4S/2M**, 4 speed sensors and one trailer modulator for 2- to 3-wheel semitrailers and central axle trailers with air suspension systems.
- **4S/2M+1M**, 4 speed sensors, one trailer modulator and one ABS relay valve for 2- to 4-wheel semitrailers and 2- and 3-wheel central axle trailers with air suspension systems.
- **4S/3M**, 4 speed sensors, one trailer modulator and one EBS relay valve for 2- to 5-axle drawbar trailers and 2- and 4-axle semitrailer or 2- to 3- axle central axle trailers with air suspension systems.

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

Axes or wheels which have had no sensors fitted can be indirectly controlled by directly controlled axles or wheels.

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

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

2.5.1 Installation recommendation for semitrailers, central axle trailers and drawbar trailers

Lifting axles

2S/2M System: Lift axles are not to be sensed.







All other systems: Lift axles can be sensed with ABS sensors of axles e, f.

Steering axles

Constrained steering axles can be treated like rigid axles. WABCO prescribes EBS configurations 4S/3M, 4S/2M+1M or 2S/2M+SLV for vehicles with self-steering axles.

If 2S/2M or 4S/2M EBS-systems are to be used in vehicles with self-steering axles, tests during the type test must establish that there are no abnormal axle vibrations

or course deviations. It is not possible to investigate all axles on the market to check how they respond when ABS is triggered.

Notation	Explanation
	Driving direction
	Trailer modulator
	Two-Way Valve (SHV)
	Double cut-off valve (SLV)
	EBS Relay Valve
	ABS relay valve
*	These types of vehicle are not listed in the "Type approval report for ABS brake systems in trailers" no. 123.4 and require separate acceptance.
**	up from Trailer EBS generation D

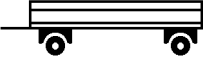
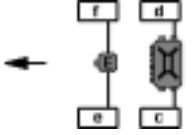
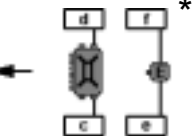
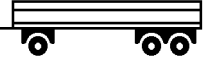
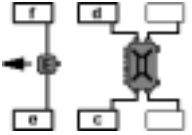
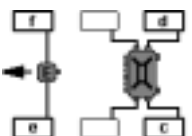
Assignment of control channels (according to schemes 841 801 620 up to 841 801 622 0)

Modulator	Sensors	<input type="checkbox"/> sensed (directly controlled) <input type="checkbox"/> not sensed (indirectly controlled)	
		System axle	Control electronics
M	c, d	Main axle (not lifting)	IR/MSR
A/E	e, f	Steering axle (lifting)	MAR
Z	e, f	Additional axle (lifting)	MSR


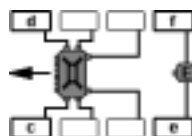
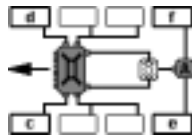
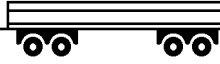
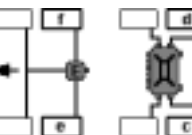
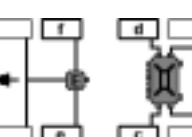
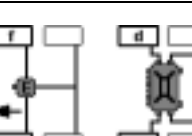
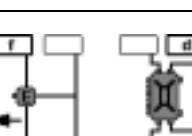
Central axle trailers and semitrailers

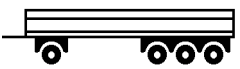
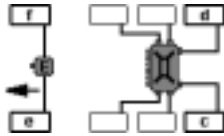
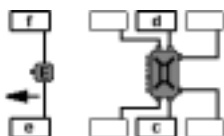
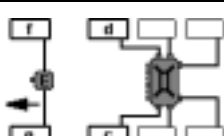
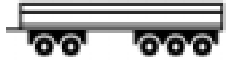
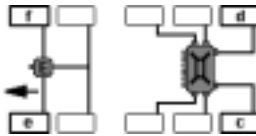


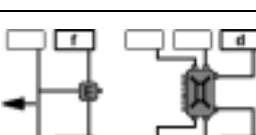
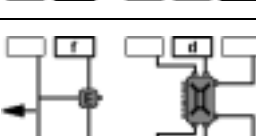
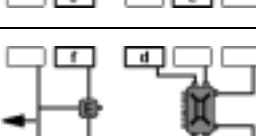
Vehicle type	2S/1M	2S/2M	4S/2M	4S/3M	4S/2M + 1M
 + 					
		 2S/2M + SLV			
 + 					
		 2S/2M + SLV			
		 2S/2M + SLV			

Drawbar trailer

Vehicle type	2S/2M	4S/2M	4S/3M	4S/2M + 1M
				
				
				
				

Semi trailer and drawbar trailer
(separate acceptance required)

Vehicle type	2S/2M	4S/2M	4S/3M	4S/2M + 1M
				
				
				
				
				

Vehicle type	2S/2M	4S/2M	4S/3M	4S/2M + 1M
<p>*</p> 				
				
				
<p>*</p> 				
				
				
				
				
				

3 Components

3.1 Trailer EBS Modulator 480 102 0 . . 0



The trailer modulator is used for controlling and monitoring the electropneumatic brake system. It controls the brake cylinder pressure on both sides of one, two or three axles.

The trailer modulator is installed in the electropneumatic braking system between reservoir tank or EBS trailer emergency valve (with T-EBS C) or Park release emergency valve (with T-EBS D) and brake cylinder nearby the axles on the frame (e. g. on a 3-axle trailer above the second axle).

The trailer modulator has two pneumatically independent pressure control channels, each with an air admitting and an air exhausting valve, a redundant valve, a pressure sensor and a shared control ECU as well as an electrical connection for an ABS or EBS relay valve. The brake cylinder pressures on an axle can be controlled separately using this connection.

The wheel speeds are recorded and evaluated by up to four speed sensors. If the wheels start to lock, the brake pressure specified for the brake cylinders is reduced by the ABS control circuit.

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

If an expanded ISO 7638 plug device is used, the trailer modulator communicates with the tractive unit via the electrical trailer interface according to ISO 11992 (1998-04-01). A bidirectional data interface according to ISO 14230 (KWP 2000) is provided for diagnosis of the trailer modulator.

3.1.1 Modulator Trailer EBS C

If a CAN interface is available, the vehicle's nominal delay is determined of the CAN braking signal of the towing vehicle. In other cases the nominal delay is based on the received pressure signal of the EBS trailer emergency valve.

A connection for a axle load sensor can be found on the trailer modulator. The brake force is adapted depending on the vehicle load (load-dependent brake force control).

Variants of the modulator Trailer EBS C

(up to week 48/2001: T-EBS C2, from week 49/2001: T-EBS C3)

WABCO no.	480 102 000 0	480 102 001 0	480 102 002 0	480 102 004 0	480 102 005 0
ABS configuration	max. 4S/3M	max. 4S/3M	max. 4S/3M	max. 4S/3M	max. 4S/3M
Battery charge		X		X	
to be used with TCE			X		X
RSS				X	X
Connection wear indicator	X	X		X	
Switching output 1 / 2	X	X		X	

3.1.2 Modulator Trailer EBS D

With Trailer EBS D, the setpoint deceleration of the vehicle is calculated with an integrated pressure sensor by measuring the pneumatic control pressure of the tractive unit and – if a trailer interface is available – the CAN setpoint. In vehicles with critical timing characteristics, it is possible to connect an additional separate brake pressure sensor as an option in order to improve the timing response.

The trailer modulator has an integrated axle load sensor. In addition, a separate axle load sensor can be connected, for example so that a pressure sensor with a larger measuring range can be used with hydraulic suspension systems. The brake force is modified depending on the vehicle load (load-dependent brake force control).

A second CAN interface (ISO 11992 or ISO 11898) can be used for connecting a telematic system or a second trailer modulator.

Variants of the modulator Trailer EBS D

480 102 010 0 - standard 4S/2M

Fits to semi trailers without TCE.

480 102 014 0 - Premium 4S/3M

Fits to drawbar or semi trailers without TCE.

The version has an electrical connection for an external EBS or ABS relay valve. The brake cylinder pressures on an axle can be controlled separately when an EBS relay valve is connected. When an ABS relay valve is connected, the specified brake pressure can be controlled separately for an axle by the ABS control loop if a wheel is starting to lock.

The RSS (roll stability support) function can be activated. When the RSS function is activated, the trailer is braked automatically if the risk of overturning is detected.

When operating with ECAS/ELM, a battery can be connected for operating the trailer independently without the tractive unit. The current for charging the battery is restricted by the EBS electronic control unit in order to prevent any overload of the connected cables. The battery is charged from the tractive unit's electrical system when the power intake is higher than 24 V and no EBS/ABS brake operation is performed.

480 102 015 0 - TCE + 4S/2M

Fits to drawbar or semi trailers **only** in combination with TCE (no separate installation).

Function	480 102 010 0 Standard	480 102 014 0 Premium	480 102 015 0 with TCE
ABS system	max. 4S/2M	max. 4S/3M	max. 4S/3M
CAN bus 24 V (ISO 7638)	X	X	
CAN bus 5 V			X
Brake light supply	X	X	
Switching output 1 / 2	X	X	
Traction help	X	X	
Wear sensing	X	X	
2nd CAN bus (IVTM etc.)		X	
Battery charge for ECAS		X	
RSS		X	X
Connection external Brake pressure sensor		X	X
Connection external Axle load sensor	X	X	X

3.2 Park-release emergency valve (PREV) 971 002 900 0



In the trailer EBS D generation, the typical functions of the trailer emergency valve such as the line break function or pressure retention must be assured when the trailer is unhitched. The park-release emergency valve should preferably be used for this purpose. However, these functions can also be ensured by a conventional or an EBS trailer emergency valve.

The park-release emergency valve provides the functions of emergency braking in case of a pneumatic supply line break and the double release valve function.

The black actuation button (release button of the service brake system) enables the brake system to be released manually following automatic braking when the vehicle is parked up without any compressed air supply. However, there must be sufficient reservoir pressure in the tank to permit this.

The red actuation button (actuation of the parking brake system) enables the parking brake to be applied or released by venting the spring-type brake actuators.

When the trailer is unhitched (supply line evacuated), it is braked automatically by the service brakes and, at the same time, the non-return valve integrated in the park-release emergency valve is bypassed in the spring-type brake actuator circuit. If the reservoir pressure in the parked trailer drops, the spring-type brake actuators automatically take over providing the braking effort and prevent the vehicle from rolling away.

All control functions are active in case of a supply line break.

3.3 Trailer emergency valve 971 002 301 0



Trailer EBS C

The conventional trailer emergency valve is used up from Trailer EBS C3 generation in combination with an external demand pressure sensor.

Trailer EBS D

Trailer EBS D generation operates with a conventional trailer emergency valve without external demand pressure sensor because it is integrated in the modulator.

It is important to use a trailer emergency valve without predominance.

3.4 EBS relay valve 480 207 001 0



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

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

3.5 ABS Relay Valve 472 195 03. 0



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

3.6 Lifting axle valve 463 084 010 0 (dual circuit)



An electrical lifting axle valve can be used to control up to two lifting axles automatically via the trailer EBS relative to the current axle load. Electrical control and monitoring is performed by the trailer modulator.

3.7 Lifting axle valve 463 084 031 0 (single circuit)



Using a single circuit lifting axle valve, a lifting axle can be automatically controlled by the trailer EBS D depending on the current axle load. Electrical control and monitoring is performed by the trailer modulator.

A traction help with residual pressure holding is possible after unscrewing the vent. To do this, a line is routed from the vent to the 3/2-way solenoid valve for residual pressure holding.

To do this, cable 449 764 ... 0 must be connected to the IN/OUT1 connection of the Trailer EBS D modulator. The lifting axle valve vent (connection 3) is shut off by a 2-way valve, vented accordingly by the EBS D modulator and the maximum possible bellows pressure is retained. The traction help can be activated by a button (see chapter 4.16 „Integrated Lifting axle control ILS (Integrated Load Switch)“, page 34).

Lifting axle valve 463 084 031 0 replaces the previous version 463 084 030 0.

3.8 Double cut-off valve 434 500 003 0 (Select Low valve)



The double cut-off valve is used in vehicles with 2S/2M + Select Low control in order to provide axle-by-axle braking (e.g. steering axle). The input pressures are the pressures output by the trailer modulator for each side. The lower pressure is then directed to the axle to be braked.

3.9 ECAS 446 055 066 0



An electronic air suspension system ECAS can be connected in series with the trailer EBS. Electrical control and monitoring is performed by the trailer modulator. If ECAS is installed, a battery can be connected to the trailer modulator (480 102 014 only) by means of which ECAS can be operated without the trailer being hitched to a tractive unit.

Please find information and publication about ECAS in our product catalogue INFORM under www.wabco-auto.com in the Internet.

3.10 ELM 474 100 001 0



An electronic air suspension module ELM can be connected in series with the trailer EBS. Electrical control and monitoring is performed by the trailer modulator.

Please find information and publication about ELM in our product catalogue INFORM under www.wabco-auto.com in the Internet.

3.11 TCE 446 122 001 0



The trailer EBS can be expanded by a trailer central electronic unit (TCE). Electrical power supply, sensor data transmission (except for speed sensors and any external brake pressure sensor fitted) and monitoring of the trailer EBS is performed by the TCE.

Please find information and publication about TCE in our product catalogue INFORM under www.wabco-auto.com in the Internet.

! If TCE is fitted, the following modulators can be used only

▪ **Trailer EBS C: 480 102 002 0, 480 102 005 0**

Trailer EBS D: 480 102 015 0

Usage of different modulators will cause an error message by TCE. During startup, the trailer EBS is taken into service first, followed by the TCE.

3.12 Pressure sensor 441 044 101 0 / 102 0



The pressure sensors 441 044 101 0 / 102 0 replace the previous versions 441 040 013 0 / 015 0

Trailer EBS C

Trailer EBS C is using an axle load sensor (pressure sensor) to measure the bellows pressure of the air suspension system. Depending on the bellows pressure a brake force control not depending on the load is carried out. Electrical control and monitoring is performed by the trailer modulator.

The axle load sensor has to measure the bellows pressure of one axle which is not lifted. At drawbar trailers, the axle load sensor must observe the bellows pressure of the axle which is controlled by the modulator (and not the axle with the 3rd modulator).

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

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

Trailer EBS D

An external brake pressure sensor for improving timing characteristics can be connected to the Trailer EBS D IN/OUT2 port (all versions except for 480 102 010 0). This pressure sensor measures the control pressure in the brake line and transmits the measured value to the trailer modulator.

Additionally, an external axle load sensor can be connected at IN/OUT1.

The pressure sensor may also be used during servicing if an internal demand pressure sensor fails.

When the external pressure sensor is connected, the relevant internal one is not active.

3.13 ABS sensor 441 032 808 0 / ... 809 0



Type S_{plus} sensors are used as ABS sensors. ABS sensors 441 032 808 0 (cable length 400 mm) or ... 809 0 (cable length 1,000 mm) are used.

Sensor sets 441 032 921 2 (cable length 400 mm) or ... 922 2 (cable length 1,000 mm) are recommended as replacement solution.

3.14 SmartBoard 446 192 110 0



The SmartBoard is a display and control panel for trailer vehicles and combines the following functions:

- Display of distance driven (operates without power supply from the towing vehicle)
- Brake lining wear indicator (in connection with WABCO BVA)
- Current axle load indicator
- Tyre pressure indicator (in connection with WABCO IVTM)
- Display of diagnostics and system messages

The SmartBoard functions in combination with every Trailer EBS D system with a Premium ECU 480 102 014 0 of week of manufacture 51/03 or later according to the type plate or 2003 CW51 according to the Diagnostic Software.

Assembly

The SmartBoard is simply screwed onto the exterior of the frame and connected to the Trailer EBS D modulator via cable. The distance between the Trailer EBS D ECU and the desired point of installation determines the cable length:

- Cable 449 377 030 0: 3 m

- Cable 449 377 080 0: 8 m

The CAN 2 communication of the Trailer EBS D modulator is activated via diagnostics. The SmartBoard does not require any parameter settings.

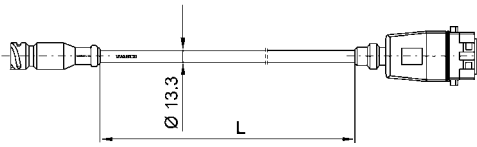
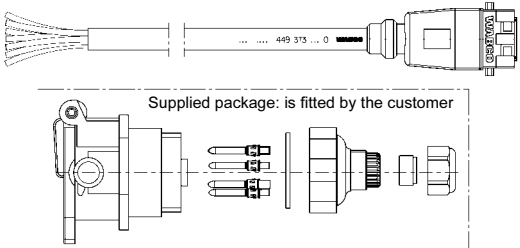
You will find further information, such as connecting the SmartBoard to an ABS sensor for independent odometer reading, in the SmartBoard system description 815 010 136 3. Operating instructions for the driver are available under 815 010 138 3. Both publications can be obtained from the product catalogue INFORM at www.wabco-auto.com.

3.15 Cable overview

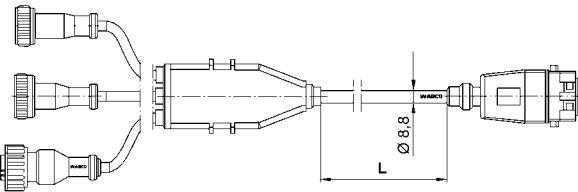
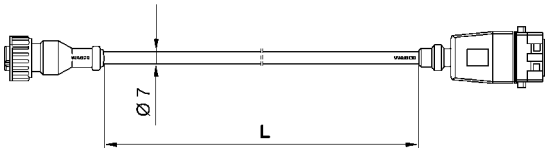
Prefabricated cables should be used for the trailer EBS, since these have moulded-on plugs and are therefore optimally protected against external influences.

3.15.1 Power supply cable

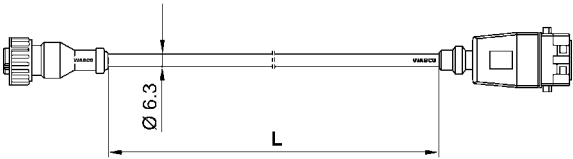
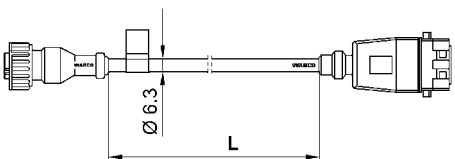
Cable	WABCO no.	L in m	cable end type	
	for semi trailers, 24 V, 7-pin			
	449 172 090 0	9	T EBS „Power“	Socket ISO 7638
	449 172 120 0	12		
	449 172 130 0	13		
	449 172 150 0	15		
	for drawbar trailers, 24 V, 7-pin			
	449 272 090 0	9	T EBS „Power“	Connector ISO 7638
	449 272 100 0	10		
	449 272 120 0	12		
	for semi trailer (combined with 449 333 ... 0) (24V)			
	449 133 120 0	12	Socket ISO 7638	Coupling 7-wire, mating component for 449 333 ... 0
	449 133 150 0	15		
	for semi trailers (combined with 449 333 ... 0) (24V)			
	449 233 100 0	10	Connector ISO 7638	Coupling 7-wire, mating component for 449 333 ... 0
	449 233 140 0	14		
	449 233 180 0	18		
	449 333 (combined with 449 133 ... 0 or 449 233 ... 0)			
	449 333 003 0	0,3	T EBS „Power“	Coupling 7-wire, mating component for 449 133 ... 0 449 233 ... 0
	449 333 025 0	2,5		
	for semi trailer (combined with 449 335 ... 0) (24V)			
	449 135 005 0	0,5	Socket ISO 7638	Coupling 7-wire, mating component for 449 335 ... 0

Cable	WABCO no.	L in m	cable end type	
	499 335 (combined with 449 135 ... 0)			
	449 335 110 0	11	T EBS „Power“	Coupling 7-wire, mating component for 449 135 ... 0
449 335 140 0	14			
	open ends with EBS plug (24 V) 7-pin			
	449 373 090 0	9	T EBS „Power“	7-pin open ends
449 373 120 0	12			

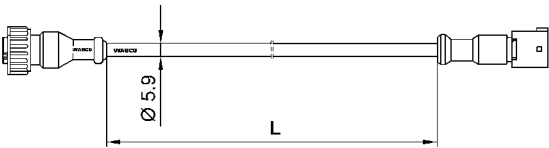
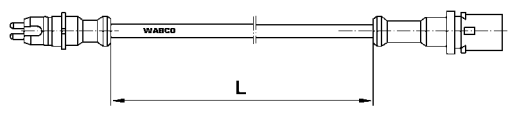
3.15.2 Solenoid cable

Cable	WABCO no.	L in m	cable end type	
	Relay valve (drawbar trailer, 3rd modulator)			
	449 372 030 0	3	T EBS „Modulator“	Socket Kostal 1× M24×1 1× M27×1 1× DIN 72585 B1-3.1-Sn/K1
	449 372 060 0	6		
	449 372 080 0	8		
	449 372 120 0	12		
449 372 130 0	13			
	ABS relay valve (3rd modulator)			
	449 427 020 0	2	T EBS „Modulator“	Socket bajonet DIN 72585 B1-3.1-Sn/K1
449 427 030 0	3			

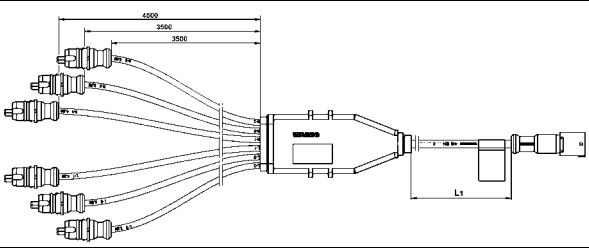
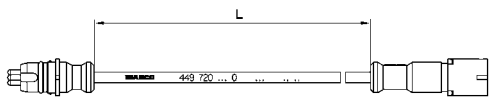
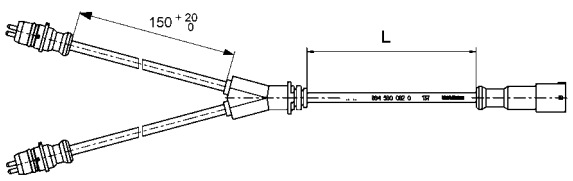
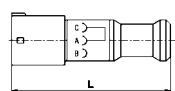
3.15.3 Relay Emergency Valve

Cable	WABCO no.	L in m	cable end type	
	Relay Emergency Valve 971 002 802 0			
	449 472 030 0	3	T EBS „IN/OUT2“	Socket bajonet DIN 72585 B2-4.1-Sn/K1
	449 472 035 0	3,5		
	449 472 050 0	5		
	449 472 080 0	8		
	449 472 120 0	12		
	449 472 130 0	13		
449 472 145 0	14,5			
	Ext. pressure sensor and Relay Emergency Valve 971 002 301 0			
	449 473 010 0	1	T EBS „IN/OUT2“	Socket bajonet DIN 72585 B1-4.1-Sn/K1
	449 473 030 0	3		
	449 473 050 0	5		
	449 473 080 0	8		
	449 473 120 0	12		
	449 473 130 0	13		
449 473 145 0	14,5			

3.15.4 Sensor cable

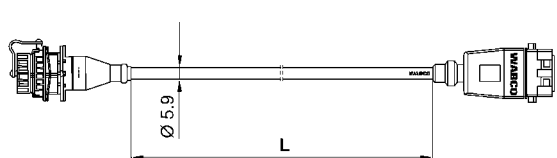
Cable	WABCO no.	L in m	cable end type	
	Pressure sensor			
	449 752 010 0	1	T EBS „ABS sensor“	Socket bajonet DIN 72585 B1- 3.1-Sn/K1
	449 752 020 0	2		
	449 752 030 0	3		
	449 752 080 0	8		
449 752 100 0	10			
	Extension cable for ABS sensor (straight)			
	449 712 008 0	0,8	Coupling socket	coupling plug
	449 712 018 0	1,8		
	449 712 030 0	3		
	449 712 040 0	4		
	449 712 060 0	6		
	449 712 080 0	8		
	449 712 100 0	10		
	449 712 120 0	12		
	449 712 150 0	15		
449 712 200 0	20			

3.15.5 EBS - Wear indicator

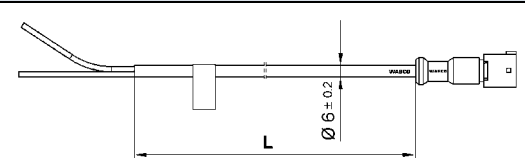
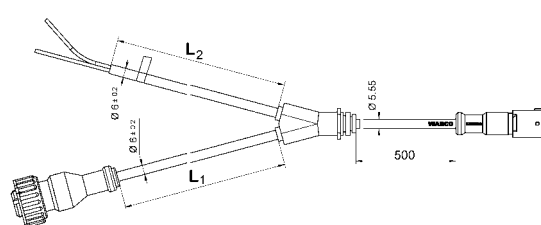
Cable	WABCO no.	L in m	cable end type	
	Cable from EBS modulator to brake caliper			
	449 834 013 0	1,3	Coupling socket	coupling plug
	Extension cable			
	449 720 010 0	1	Coupling socket	coupling plug
449 720 050 0	5			
	Cable Y-distributor			
	894 590 082 0	1	Coupling socket	coupling plug
	Plug (electrical jumper)			
	441 902 312 2	0,56		

3.15.6 Diagnostic cable

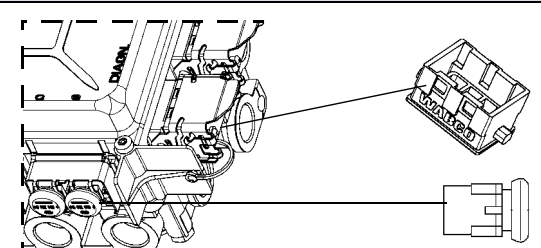
Cable	WABCO no.	L in m	cable end type	
	Diagnosis and ISS or ILS			
	449 614 148 0	3 / 3	T EBS „Diagnosis“	Diagnostic socket; 3-pin, 3× 0,75 mm ²
	449 614 153 0	6 / 3		
	449 614 253 0	6 / 6		
449 614 295 0	8 / 8			
	Diagnosis and ILS			
	449 624 113 0	6 / 2	T EBS „Diagnosis“	Socket Diagnosis; socket M 27×1
	Diagnosis and ILS1/ILS2 stop light supply			
	449 684 153 0	6 / 3	T EBS „Diagnosis“	Socket Diagnosis, 4-pin, 2× 0.5 mm ² , 2× 2.5 mm ²
	449 684 313 0	6 / 10		
449 684 333 0	6 / 12			
	Diagnosis and ECAS			
	449 382 010 0	1	T EBS „Diagnosis“	PG 11, 7-pin 3× 1.5 mm ² 4× 0.5 mm ² 6 with cable shells
	449 382 015 0	1,5		
	449 382 060 0	6		
	449 382 080 0	8		
449 382 090 0	9			
	Diagnosis and single-circuit lifting axle valve			
	449 664 050 0	4 / 1	T EBS „Diagnosis“	Socket Diagnosis; socket bajonet DIN 72585 B1-3.1- Sn/K1
	449 664 190 0	4 / 4		
449 664 253 0	6 / 6			
	Diagnosis and ELM			
	449 344 246 0	6 / 2	T EBS „Diagnosis“	Socket Diagnosis; elbow bajonet DIN 15170 B1-3.1- Sn/K1
449 344 253 0	6 / 6			

Cable	WABCO no.	L in m	cable end type		
	Diagnostics			T EBS „Diagnosis“	Socket Diagnosis
	449 672 030 0	3			
	449 672 040 0	4			
	449 672 050 0	5			
	449 672 060 0	6			
	449 672 080 0	8			

3.15.7 Cable for traction help button

Cable	WABCO no.	L in m	cable end type		
	Traction help switch type TH			Coupling socket T EBS „IN/OUT1“	2-pin, 2× 0,75 mm ²
	449 762 020 0	2			
	449 762 150 0	15			
	Traction help switch type TH and solenoid valve			Coupling socket T EBS „IN/OUT1“	2-pin, 2× 0.75 mm ² Socket bajonet DIN 72585 B1-2.1-Sn/K1
	449 764 348 0	3 / 15			

3.15.8 Sealing plug for Trailer EBS modulator

sealing plugs	WABCO no.	Comment
	894 110 139 2	with sealing for socket X1...X4
	441 032 043 4	for sensor socket X5...X10

3.16 Other components

Description	Order number	Comment
Solenoid valve	472 0	Pressure holding function in traction help
Two-way valve	434 208 02 . 0	Overload protection of TRISTOP cylinders
Quick-release valve	973 500 051 0	Overload protection of TRISTOP cylinders with quick release function
Trailer release valve	463 034 005 0	Releasing the front axle in drawbar trailers
Double release valve	963 001 051 0	Releasing the brake system and applying/releasing of the TRISTOP cylinder
Brake cylinders		These components broadly correspond to the components of a conventional braking system.
Reservoir		
Piping		

4 Functional description

This chapter describes the functions of individual subsystems, components, and their interaction.

4.1 Electro-pneumatic function

The trailer EBS is electrically connected via pin 2 of the ISO 7638 plug connection (terminal 15).

The brake system can be powered via an optional stop light supply in case of failure of the electrical power supply via the ISO 7638 plug connection. A system check is performed as soon as the trailer EBS is switched on. 2 seconds after switch-on, the solenoids in the trailer modulator are switched through one after the other; this procedure can be heard as the solenoids are clicking. The system is ready for operation within 150 ms after being switched on.

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

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

For pressure control, a setpoint is specified for the trailer modulator and this value is used as the target for the control loop, depending on the load. The supporting bellows pressure supplied to the trailer modulator via a pneumatic line is measured in order to adapt the brake forces to the various loading conditions.

The setpoint for the trailer EBS is predominantly specified via the electrical trailer interface according to ISO 11992 (1998-04-01). If this interface is unavailable, the setpoint is specified by the pressure sensor integrated in the trailer modulator or, in vehicles with critical timing characteristics, by an external brake pressure sensor in the control line.

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

When an ECAS system is connected, the system continues to operate for 5 seconds after the trailer EBS is switched off.

4.1.1 Pneumatic redundancy

In the event of system faults which require part of the overall system to be switched off, the pneumatic control pressure is switched through to the opened intake valves and the closed outlet valves of the modulators. This means the braking pressure can be applied purely pneumatically, however without consideration for the axle loads (LSV). The ABS function is maintained for as long as possible.

The status of the system is indicated to the driver by a warning light connected to pin 5 of the ISO 7638 plug connection (the warning light display is based on the applicable statutory regulations).

4.2 Electrical / electronic system structure

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

As a safety function, there is provision for electrical power supply via stop light so that certain control functions can be maintained even if the electrical power supply via the ISO 7638 interface fails.

The electrical data connection between the tractive unit and the trailer modulator is implemented via the trailer interface according to ISO 11992 (plug X1, pins 6 and 7). The data content is processed by the trailer modulator in accordance with its significance and function.

A pressure sensor for measuring the control pressure in the trailer modulator is integrated in the Trailer EBS D modulator in order to ascertain the setpoint behind a tractive unit without EBS. In long pneumatic control lines, the speed of response can be improved by using an external brake pressure sensor (if an EBS trailer emergency valve is used, this is integrated in the device). The setpoint is monitored for plausibility.

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

The pressure in the front axle of a drawbar trailer or the 3rd axle of a semitrailer is preferably controlled using an electropneumatic EBS relay valve. A brake pressure sensor and a 3/2-way solenoid valve are integrated in the valve module. The brake pressure sensor is supplied with voltage from the trailer modulator (plug X4). The actual value is output as an analog signal.

The pressure in the 3rd axle of a semitrailer (trailing/steering axle) can also be controlled using an ABS relay valve. In this case, only the pressure in the blocking range of the axle is controlled; in other respects a braking pressure is set which is pneumatically specified via port 4 of the ABS relay valve.

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

A reservoir pressure sensor and two brake pressure sensors are integrated in the Trailer EBS D modulator. They are supplied with voltage from the trailer modulator. Their actual values are output as analog signals.

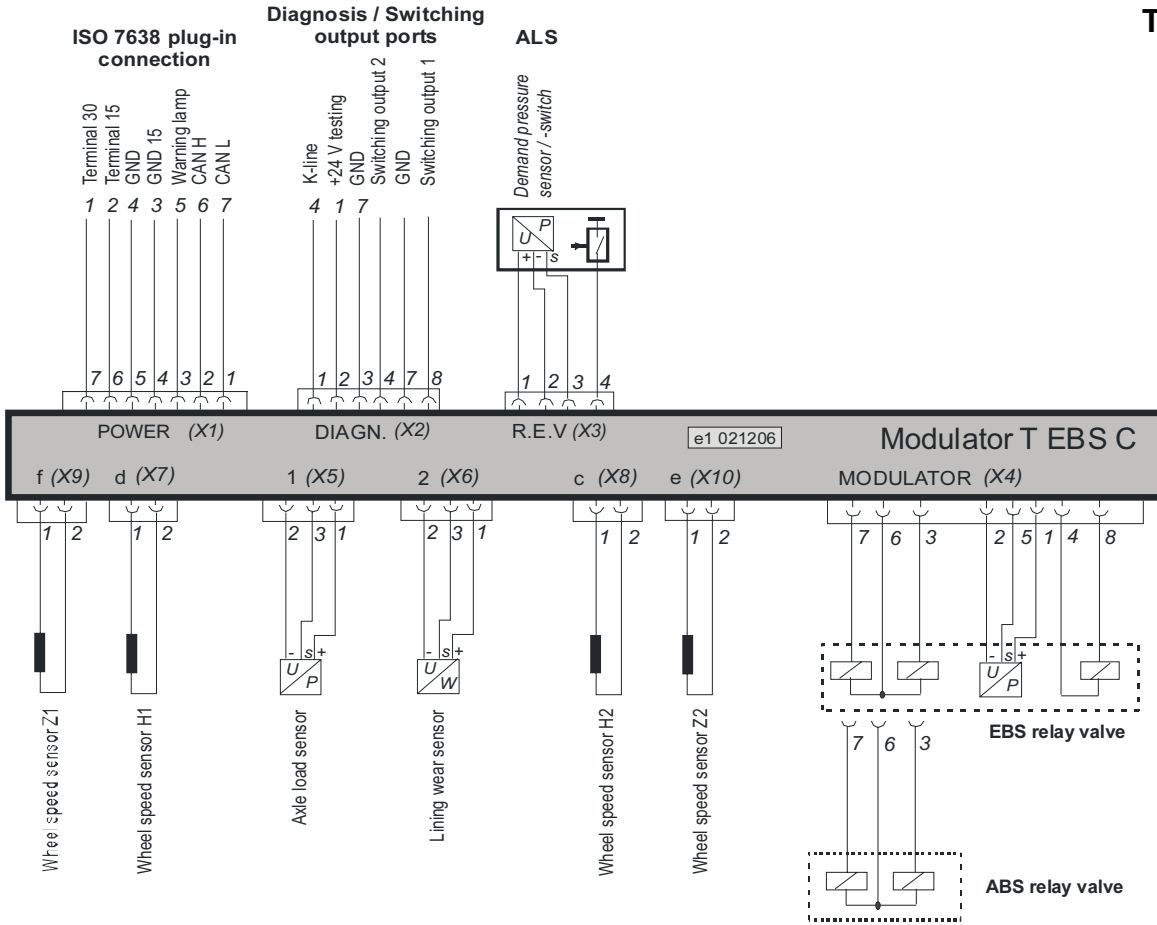
A pressure sensor is integrated in the Trailer EBS D modulator in order to register the air suspension pressure. In this case, a pneumatic line is routed from the trailer modulator to the supporting bellows. In addition, a separate axle load sensor can be connected (to plug X5), for example so that a pressure sensor with a larger measuring range can be used with hydraulic suspension systems. Optionally, plug X5 can also be set as a switching input in the parameters, in which case it serves to activate a traction help in trailers with lifting axle(s).

Limit value indicators are provided for registering the brake pad wear on the wheel brakes. Their signals are evaluated by the trailer modulator and transmitted to the tractive unit via the ISO 11992 interface.

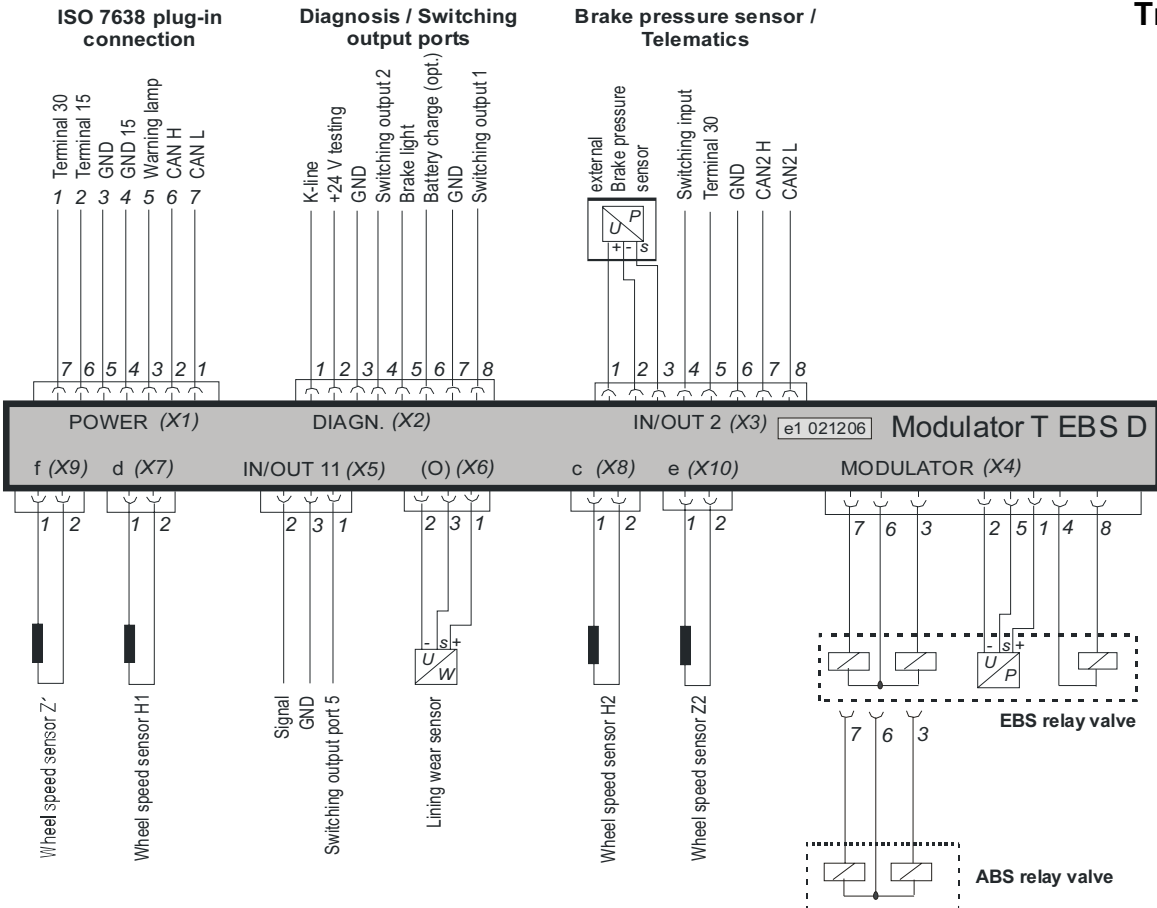
2 switching outputs are provided for additional systems in the trailer. Their mode of function can be set in the parameters using a diagnostic tool.

System faults are picked up by the trailer modulator and stored in the diagnostic memory in accordance with a specified fault table.

Trailer EBS C



Trailer EBS D



4.3 Warning signal sequences

The driver is warned about the status of the trailer EBS by a warning light which is controlled via pin 5 of the ISO 7638 interface. In parallel to this, a warning signal is output via the trailer interface according to ISO 11992.

The following applies in general: The yellow (pin 5 ISO 7638) and the red (ISO 11992) warning lights are switched on if the reservoir pressure in the trailer drops below 4.5 bar. The warning lights go out again if the pressure goes back above 4.5 bar.

It is possible to set 2 different warning signal sequences in the parameters.

1st possibility

When the vehicle is at a standstill: The warning device lights up after "Ignition on".

If no current fault is detected, the warning lamp goes out after approx. 2 seconds.

If a current fault was detected, such as a sensor error, the warning device remains on.

If an ABS sensor fault was saved during the last drive but this fault is no longer present, the warning device goes out after $v > 7$ km/h.

During normal driving $v > 7$ km/h: The warning device lights up or remains lit if a current fault was detected.

2nd possibility

The warning device lights up after "Ignition on".

If no current fault was detected, the warning device goes out after approx. 2 seconds and lights up again after another 2 seconds.

The warning device goes out at $v \geq 7$ km/h.

If a current fault was detected, e.g. sensor broken off, the warning device remains on.

4.4 Setpoint selection and pressure control

The braking request issued by the driver is referred to as the setpoint.

If the trailer is towed by an EBS towing vehicle with a 7-pin (ABS) plug connection according to ISO 7638, the Trailer EBS gets the nominal value from the EBS vehicle via the trailer interface (CAN). The setpoint via the CAN always takes precedence in the control loop.

If no setpoint is available via the trailer interface, e.g.:

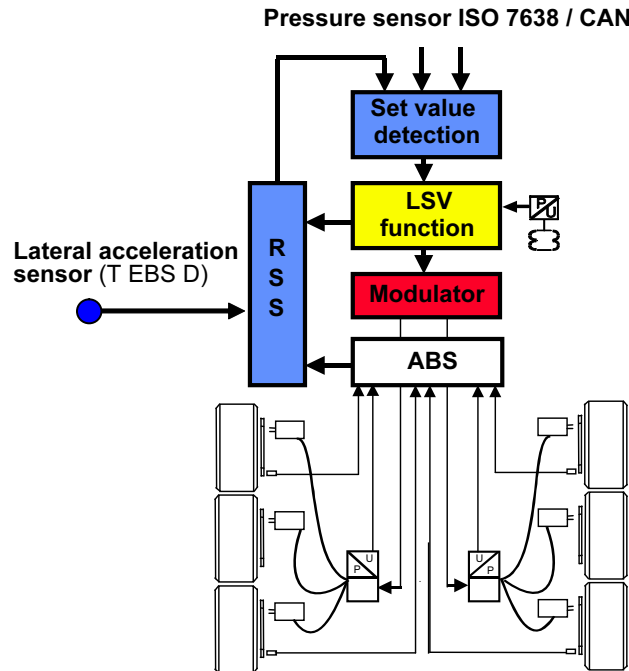
- if a trailer is towed by a conventionally braked tractive unit with a 5-pin (ABS) plug connection according to ISO 7638, or

- if the trailer interface (CAN) is interrupted in an EBS tractor/trailer combination,

then a setpoint is generated by measuring the control pressure. This measurement is performed:

- in the trailer modulator
- with an optional external setpoint pressure sensor. In the C version, the setpoint pressure was monitored to check for unintentional braking by means of the switch integrated in the trailer emergency valve. This has been replaced in Trailer EBS D by a plausibility check of the sensor value. When the control pressure of 0.3 bar is exceeded, the redundant valve integrated in the trailer modulator is switched over to the reservoir pressure and EBS braking starts. During braking, the redundant valve is briefly switched back to the control pressure and checked using the integrated actual pressure sensors to establish whether pneumatic pressure is

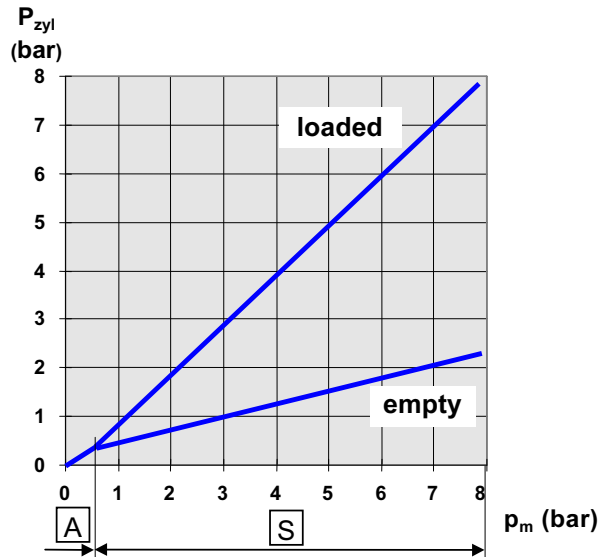
present there. If there is no pneumatic pressure present, EBS braking is cancelled and the system is switched over to redundant braking.



4.5 Load sensing brake control (LSV)

The trailer EBS includes load-dependent brake force control. This system differs between semitrailers or central axle trailers and drawbar trailers.

The current loading condition is ascertained by sensors which measure the pressure in the air bellows.



A static control table is implemented in semitrailers, as in conventional LSV controllers. The transition function from brake pressure (p_{cyl}) to coupling head pressure (p_m) is divided into two areas:

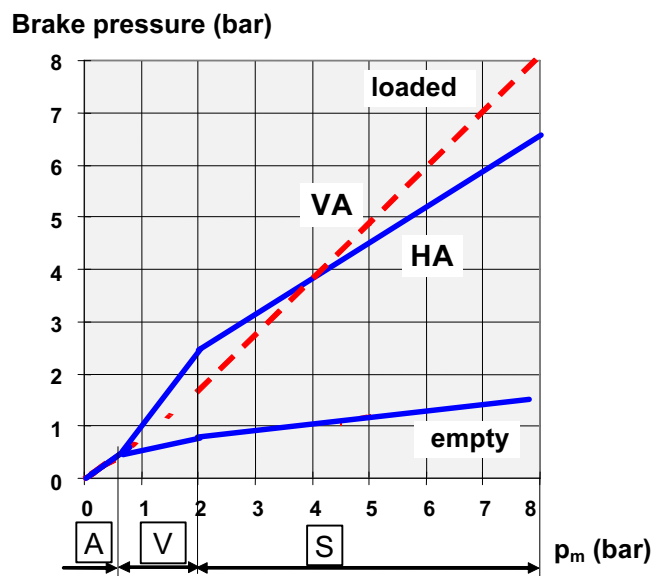
- **A** Application range
- **S** Stability range

In the example, the brake cylinder pressure increases from 0 to 0.4 bar in the application range from $p_m = 0$ bar to $p_m = 0.7$ bar.

At $p_m = 0.7$ bar, the response pressure in the wheel brake is reached and therefore the vehicle can start to build up braking force from that point on. This point, being the response pressure of the entire trailer brake, can be set in the parameters within EC braking bands.

As the sequence continues, the brake pressure follows a straight-line characteristic when the vehicle is laden. This line takes it through the calculated value at $p_m = 6.5$ bar. If the vehicle is empty, the response pressure is also output at $p_m = 0.7$ bar, after which the brake pressure is reduced according to the load.

In a drawbar trailer, brake force distribution implemented as software has replaced the two LSV controllers, the adapter valve on the front axle and the pressure limiting valve on the rear axle.



Brake force distribution in the drawbar trailer

The transition function is divided into three areas here:

- **A** Application range
- **V** Wear range
- **S** Stability range

The response pressures of the brakes are once again output at the end of the application range. These pressures may also differ from one axle to another.

The pressures are output in order to optimise wear in the partial braking range (wear range). In a drawbar trailer with type 24 cylinders on the front axle and type 20 cylinders on the rear axle, for example, the pressure at the front axle is slightly reduced and that at the rear axle is slightly increased in accordance with the configuration. This ensures that the load is distributed evenly between all wheel brakes and is more exact than the function of the adapter valve used nowadays.

In the stability range, the pressures are output in such a way as to ensure the same adhesion utilisation as a function of the axle load.

The rear axle load is measured on the basis of the air bellows pressure. The front axle load is calculated without using an axle load sensor, on the basis of the slip differential between the wheels which are equipped with speed sensors.

The parameters are calculated using the WABCO brake calculation program. The parameters are stored in the trailer modulator with the corresponding brake calculation number.

4.6 Pressure control

The pressure control circuits take the setpoint pressures specified by the LSV function and convert them into pressures for the wheel brake cylinders. The control unit takes the actual pressures measured at the output of the relay valves integrated in the trailer modulator and compares them with the setpoint pressure specification. If there is a discrepancy, this is compensated for by actuating the inlet or exhaust solenoids.

4.7 Anti-lock braking system (ABS)

The control logic determines from the wheel rotation speed whether one or more wheels can be locked and decides whether to decrease, maintain, or increase the braking pressure on it.

2S/2M

In a 2S/2M configuration, an ABS sensor and the pressure control channel of the Trailer EBS are grouped together to make one control channel. Any other wheels on one side are indirectly included in the control function. The brake forces are controlled according to the principle referred to as individual control (IC). In this case, each side of the vehicle gets the brake pressure which is possible based on the road conditions and the brake characteristic.

2S/2M + SLV

The 2S/2M +SLV (Select Low valve) is a modification of the 2S/2M system for semi-trailers with a trailing steering axle. In this case, the lower pressure in the two pressure control channels is supplied to the steering axle via the Select Low valve, which means the axle remains stable even if the wheels on either side are on parts of the carriageway with different coefficients of friction (according to ABS category Cat. A).

4S/2M

In a 4S/2M configuration, two ABS sensors are arranged on each side of the vehicle. Here too, control is separate for each side. The brake pressure is the same for all wheels on each side. The two wheels on this side with sensors are controlled according to the modified side control (MSC) principle. In this case, the first wheel to lock on one side of the vehicle is the determining factor for ABS control. In contrast, the two modulators are individually controlled. The principle of individual control is used as far as both sides of the vehicle are concerned.

4S/3M

A 4S/3M configuration is to be preferred for full trailer or semi-trailer with a follower steering axle. In this case, the rear (in drawbar trailers) or main axle(s) (in semitrailers) are individually controlled (IC) in accordance with the 2S/2M configuration described above. However, two sensors and an EBS relay valve are arranged on the steering (in drawbar trailers) or trailing axle (in semitrailers). In this case, control is axle-by-axle. The wheel on this axle which first starts to lock is the dominant one for ABS control. Control on this axle is according to the principle of modified axle control (MAC).

4S/2M + 1M

A 4S/2M+1M configuration can be used as a lower cost alternative to a 4S/3M system in semitrailers with a trailing steering axle. There are two sensors on the trailing steering axle, whilst a Select Low valve as well as an ABS relay valve are used instead of the EBS relay valve used in the 4S/3M system. In this case, the leading axle(s) are controlled according to the IC principle and the trailing steering axle according to the MAC principle.

In all configurations, it is possible to connect additional wheel brake cylinders for other axles to the existing modulators in addition to the wheel brake cylinders of the ABS wheels. These wheels are indirectly controlled, however, and do not supply any information to the trailer modulator if these start to lock. Consequently no lock efficiency of these wheels can be ensured.

4.8 Roll Stability Support (RSS)

RSS for semitrailers was introduced with Trailer EBS C3.

A vehicle can overturn if the transverse acceleration critical for overturning is less than the adherence utilisation between the tyres and the road surface. Further definitions: The transverse acceleration critical for overturning is the limit value of the force which is allowed to act on a vehicle transversally to its driving direction before the vehicle tips over. The adherence utilisation between the tyres and the road surface is the limit value of the force which is allowed to act on a vehicle transversally to its driving direction before the vehicle slips off the carriageway. Trailers often have a relatively high centre of gravity, and so they are particularly prone to overturning when cornering at a sufficiently rapid speed. Drivers generally notice in time when the tractive unit is starting to tip, whereas they often recognise the same symptoms in the trailer too late in order to take corrective action (e.g. braking). The RSS function detects when there is a risk of the trailer overturning and applies the brakes automatically. This means the risk of overturning is reduced.

The RSS function uses the known input parameters of the trailer EBS: Wheel speeds, load information and setpoint deceleration as well as an (in Trailer EBS D) additional transverse acceleration sensor integrated in the EBS modulator.

RSS detects when there is a risk of overturning due to the significant reduction in load on the wheels on the inside of the bend. Test pressure activations are performed for restricted periods at low pressure if the calculated transverse acceleration critical for overturning is exceeded in the trailer. The duration and magnitude of the pressure depend on the actual transverse acceleration sequence. The risk of overturning is detected on the basis of the wheel reaction of wheels braked during a test.

When a risk of overturning is detected, the trailer wheels on the outside of the bend are braked at high pressure so as to prevent the trailer from overturning. The brake pressure for the wheels on the inside of the curve is largely unchanged.

-
- ! Braking operations actuated by RSS do not cause the stop light to come on, since the stop light is only allowed to be controlled from the tractive unit whereas braking conducted as part of RSS control are only performed by the trailer.
-

RSS control is started in the unbraked or partially braked driving condition. No RSS control is triggered if the driver brakes sufficiently strongly (deceleration above the level of RSS deceleration). If the towing vehicle specifies a pneumatic or electrical brake setpoint to the trailer whilst RSS control is in effect, then RSS control is cancelled as soon as the setpoint from the towing vehicle exceeds the setpoint from RSS control. The brake pressure in the trailer is then modulated in accordance with the towing vehicle demand until the end of the braking operation.

However, RSS control is not able to go beyond the laws of physics. The tractor/trailer combination can still tip over even with RSS activated providing the transverse force acting on the trailer does not diminish sufficiently quickly or continues to increase in spite of automatic brake intervention and the associated deceleration.

During driving, the system compensates for up to 9 % difference in tyre circumferences as well as a modulator slant of up to 3 degrees about the longitudinal axis of the vehicle, in addition to the offset tolerance of the transverse acceleration sensor.

The RSS function may be deactivated or respond with a delay up to the compensation level. The warning light may go out even before RSS is working optimally.

Whenever trailers without any pressure in their supporting bellows are moved, RSS may be unable to detect the risk of overturning because there is no load information available.

RSS is permanently switched off and the warning light is activated whenever faults are detected which mean that correct RSS function is no longer guaranteed.

Trailer EBS C

RSS calculates the risk of overturning using the rotational speed differentials of sensed wheels of two axles. This is the reason why RSS is realized with configurations 4S/2M, 4S/2M + 1M or 4S/3M only.

Trailer EBS D

The Premium variant is equipped with a lateral acceleration sensor. With this, vehicles with 2S2M and any lifting axles can be fitted. RSS supports 2S/2M, 2S/2M + SLV, 4S/2M and 4S/3M. The vehicles can also be equipped with steering axles. The RSS function has been developed further and adapts the individual transverse acceleration thresholds after only a few test braking operations.

4.9 Standstill function

When the vehicle is at a standstill ($v < 1.8$ km/h) **and** the pneumatic control pressure is greater than 3.5 bar, the system changes over from electropneumatic to pneumatic pressure modulation after 5 seconds. This function is used to avoid unnecessary current consumption if the vehicle is parked up with the parking brake applied and the ignition switched on. This function is deactivated at the start of a drive.

4.10 Emergency braking function

An emergency braking function is available so that the maximum possible braking effort can always be applied. If the driver's braking requirement corresponds to more than 90 % of the available reservoir pressure, in other words full-on braking is called for, the brake pressures are increased up to the level of the available reservoir pressure. This function is also in effect even if a bellows in the air suspension system should burst.

4.11 Test mode

The electronic brake system must be set to test mode in order to allow the brake pressure distribution to be checked at a standstill. For test mode to be activated, the ignition must be switched on when the control line is vented (service brake system and parking brake system not applied). This switches off the standstill function and the emergency braking function.

In this mode, load sensing valve can be checked depending on the coupling head pressure and the current axle load or the current bellows pressure.

In drawbar trailers, the pressure is output at the steering axle in accordance with the bellows pressure of the rear axle which is controlled by the trailer modulator.

Trailer EBS C

It is possible to simulate the status "laden" for an unladen vehicle by unplugging the axle load sensor which in return will generate full brake pressure.

-
- ! In this case, the warning lamp is activated! After the test has been completed, the axle load sensor must be re-connected and the actual error in the ECU is to be deleted by interruption of power supply (reset).
-

The standstill function and the emergency braking function are re-enabled as soon as the speed of the vehicle exceeds 10 km/h.

Trailer EBS D

The "laden" status can be simulated in an unladen vehicle as follows:

- By venting the supporting bellows
- =>bellows pressure < 0.15 bar
- by disconnecting the pneumatic line from the modulator to the supporting bellows
- by the diagnostic software

-
- ! The supporting bellows must be re-inflated at the end of the simulation, or the pneumatic connection between the modulator and the supporting bellows must be re-established.
- The standstill function and the emergency braking function are re-enabled as soon as the speed of the vehicle exceeds 2.5 km/h. In drawbar trailers, the brake pressure is distributed according to slip criteria at speeds above 10 km/h.
-

If the lifting axle(s) in vehicles with one or more lifting axle is/are to be lowered in order to check the braking forces of the unladen vehicle, this can be achieved by setting the air suspension pressure between 0.15 and 0.25 bar. This can be done by:

- Venting the supporting bellows (lowering using the rotary slide valve, ECAS or ELM)
- Connecting a pressure simulation to connection 5 of the modulator (e.g. with test valve)
- by PC diagnosis

The brake pressures of the laden vehicle are output if the air suspension pressure is reduced below 0.15 bar.

4.12 Supply pressure monitoring

The reservoir pressure in the trailer is monitored by the EBS. If the reservoir pressure drops below 4.5 bar, the driver is warned by the red and yellow warning lights switching on. When the brake system is being charged, the warning lights do not go out until the reservoir pressure rises above 4.5 bar.

A fault is stored if the reservoir pressure drops below 4.5 bar during driving.

4.13 Preventing automatic brake action at line tear-off

-
- ! This function is available only for the Trailer EBS C-Generation in combination with trailer emergency valve with integrated pressure switch and pressure sensor.
-

According to ECE-Regulation no. 13/09 (Addition 2) par. 5.2.2.12.1 it is permitted that automatic braking is avoided as long as the power supply drops below 4.5 bar. The driver is warned. This function is not considered during vehicle's standstill.

4.14 Odometer

The trailer EBS is equipped with an integrated mileage counter which measures the distance (in km) covered during operation. Two individual functions are possible:

Total mileage counter

The total mileage counter records the entire distance covered (in km) since initial installation of the system. This value is stored regularly and can be read out using various diagnostic units.

Trip mileage counter

The trip mileage counter can be zeroed at any time. In this way, for example, it is possible to determine what distance has been covered between two service intervals or within a certain period of time. The trip counter can be read out and deleted using the diagnostic devices.

No special calibration of the mileage counter is required. A calibration factor is calculated on the basis of the tyre tread circumferences and the number of teeth of the pole wheel from the EBS parameters.

The mileage counter requires operating voltage. The mileage counter only works when there is electrical power to the trailer EBS, and is therefore not secure against tampering.

4.15 Service signal

A service signal can be activated with the help of diagnostic units. If this function is active, a warning light is triggered and flashes 8 times when the ignition is next switched on and the vehicle is stationary after having covered a freely selectable mileage value (in km). This value can be set in the parameters using the diagnostic function. The flashing procedure repeats every time the ignition is switched on, and is intended to remind the driver that service work is due to be performed, for example.

The service signal can be reset. Following this, the service interval set in the parameters starts to count down as described.

This function is switched off in the supplied system.

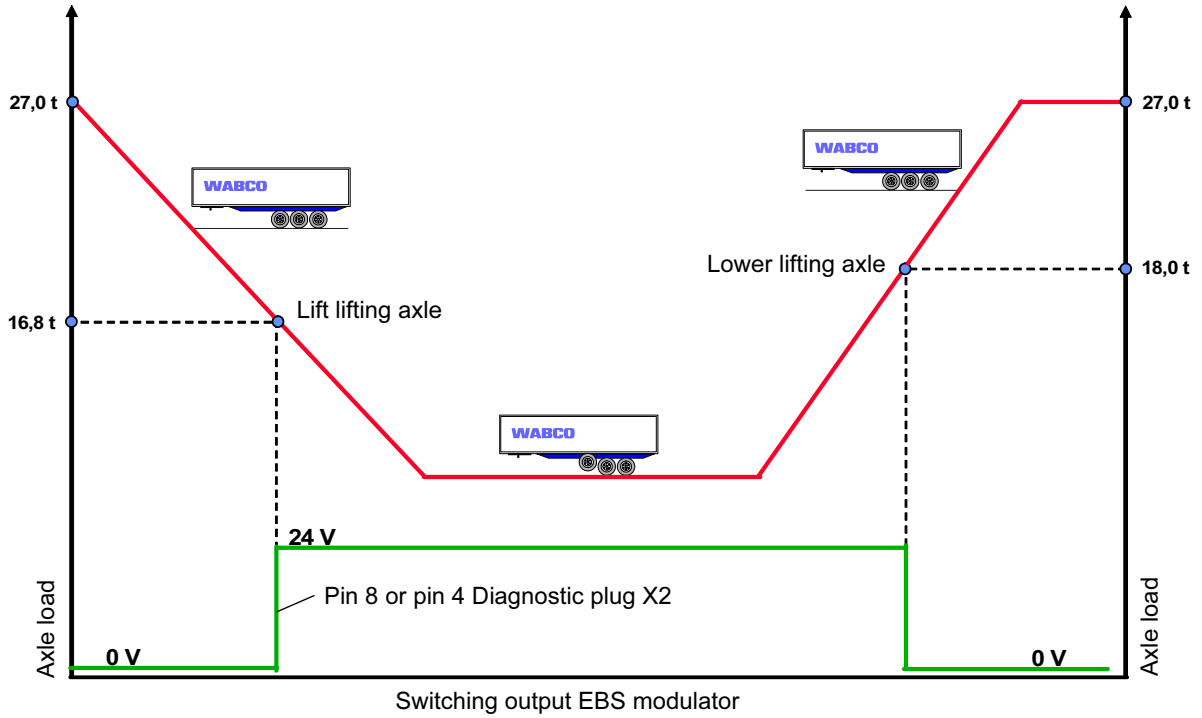
4.16 Integrated Lifting axle control ILS (Integrated Load Switch)

The trailer EBS can control the lifting axle(s) automatically depending on the current axle load if the vehicle is equipped with one or more lifting axles. For this purpose, one or one each of lift axle control valve 463 084 ... 0 must be connected to electrical switching output 1 and/or electrical switching output 2 of the trailer modulator.

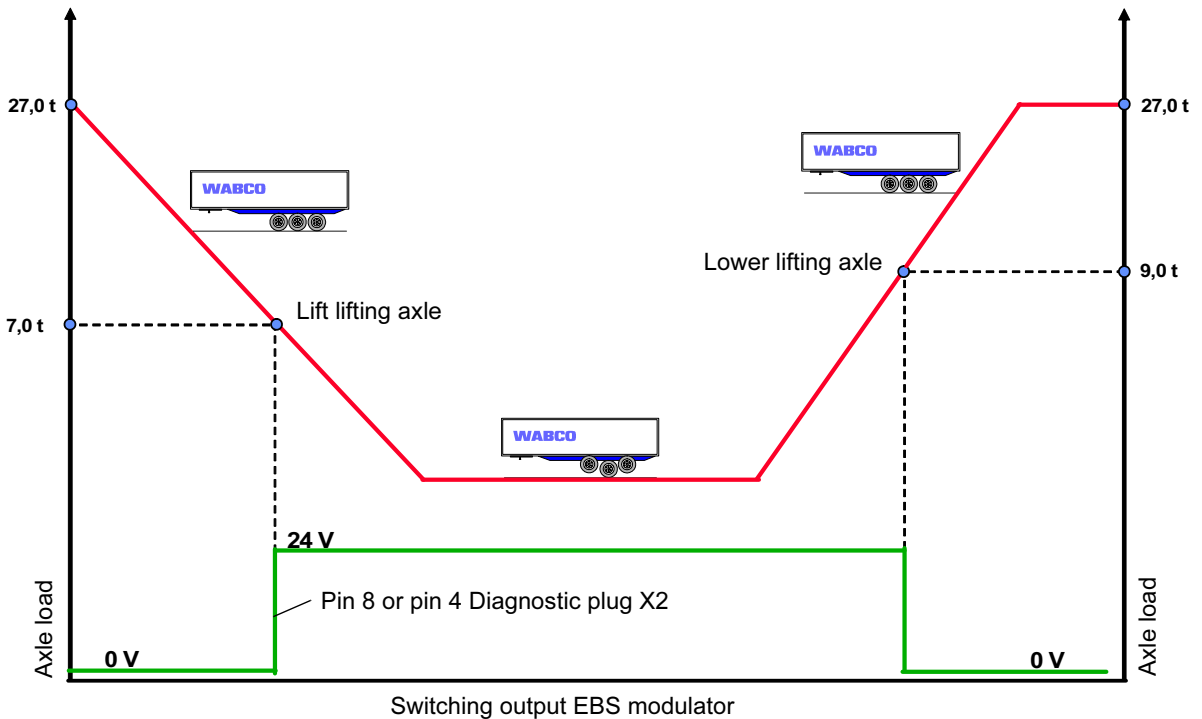
! The lifting axle is only allowed to be fitted with ABS sensors e and f. ABS sensors c and d are not allowed to be used on the lifting axle!

4.16.1 Lifting axle control for trailer with 3 times 9t axle load

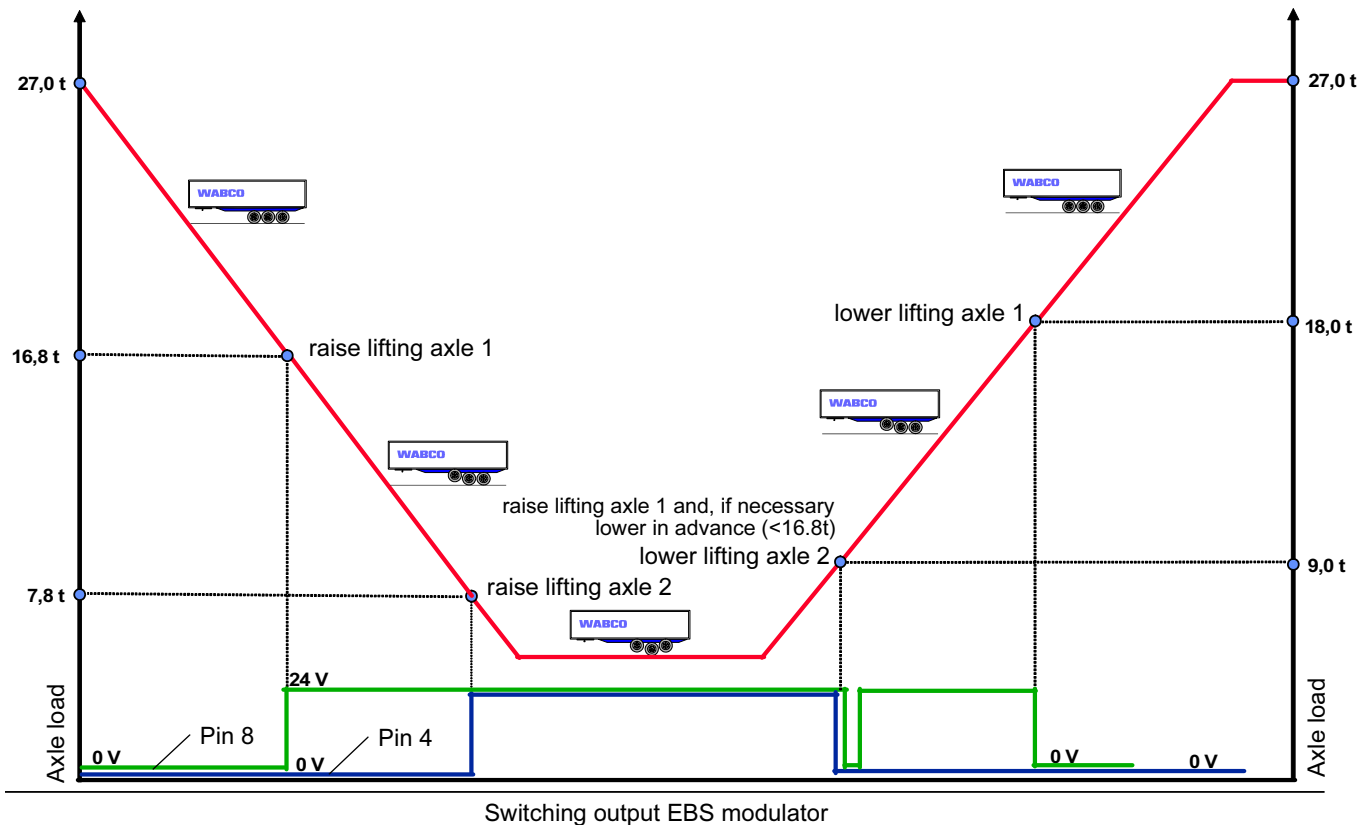
Switching output 1 or 2 controls one lifting axle



Switching output 1 or 2 controls two lifting axles



Switching output 1 (pin 8) switches lifting axle valve 1, Switching output 2 (pin 4) switches lifting axle valve 2



Trailer EBS C

All lifting axles are raised or lowered during standstill only. They will be lowered automatically in case of switched-off power supply. It is fixed by parameter at which bellows pressure the lifting axle is lowered.

Trailer EBS D

With the automatic lifting axle function, the lifting axles can optionally be lifted during driving; constrained steering is possible via CAN or using a button. Lifting axle(s) can be lifted in a speed range from 0 to 30 km/h; fixed by parameters.

The bellows pressure for lowering lifting axle(s) is fixed next to the brake parameters additionally with parameter "percentage axle load when laden".

When the lifting axle is being controlled, the lifting axle valve is activated six times briefly in order to warn the operator prior to lowering or lifting.

The position of the lifting axles is transmitted to the tractive unit via the tractive unit/trailer interface according to ISO 11992 (1998-04-01) where the position is displayed.

If a fault is detected on the axle load sensor, the lifting axle is lowered between 5 and 30 km/h and, at speeds below 5 km/h, it is not switched.

The electronic control unit detects a slip fault during driving (with lifted axle) if lifting axles (e.g. in a 4S/4M system) are equipped with ABS sensors e and f and the lifting axles were not selected on the first parameter settings screen during commissioning.

4.17 Integrated Speed Switch ISS

The electrical switching output 1 of the trailer modulator can work as a function of the vehicle speed. The switching condition of this output changes if the vehicle drives

faster than or slower than a speed threshold set in the parameters. This means relay or solenoid valves, for example, can be switched on or off according to the speed.

A typical application concerns the control of steering axles which should be blocked depending on the speed.

The speed threshold at which the switching condition of the output changes can be set in the parameters anywhere between 4 and 120 km/h. The switching output is switched off below the speed threshold set in the parameters. The output is switched on when the threshold is reached. Once the speed drops back below the threshold, there is still a 2 km/h hysteresis before the output is switched off again.

It is possible to set in the parameters whether the switching output is switched on (+24 V) or off (0 V) below the speed threshold set in the parameters.

In the case of solenoid valves which are not high-endurance, the level of the switching output can be changed over for a duration of 10 s when the speed drops below the threshold set in the parameters.

In the event of a fault, it has to be ensured that the equipment controlled by the switching output is set to a safe condition. For example, a steering axle should be blocked if there is an electrical power supply failure since that represents the safe condition. The vehicle manufacturer must design the equipment to be controlled so that this is guaranteed.

4.18 Voltage output for vehicle level control systems

The trailer modulator has an electrical switching output 2 for supplying electrical power to vehicle level control systems (ELM, ECAS). The current load is limited to max. 2 A. This output is deactivated by certain system faults and/or if the voltage supply is inadequate.

The trailer EBS does not provide a C3 speed signal in the form of a pulse width modulated rectangular signal. Systems which need a continuous speed signal (e.g. ECAS) get their speed information via a diagnostic line (K data line).

Battery charge

The trailer modulator provides an output for a battery which is required for ECAS or ELM operation without the tractive unit. If the ignition of the tractive unit is not switched on, the voltage from terminal 30 is connected through to the connected battery. The EBS electronic control unit takes over monitoring via this connection when the ignition is switched on (e.g. the EBS electronic control unit is operating).

The output is only switched on under certain conditions. A connected battery is only charged if the supply voltage measured by the trailer modulator is greater than 24 volts and no braking is taking place. The charging process is switched off if the supply voltage falls below 23 volts. The charge current is limited to 3.5 A.

4.19 Wear Indicator

The brake wear monitoring was introduced with Trailer EBS C2.

It is possible to connect up to six wear indicators to the ECU in order to monitor the wear status of the disc brakes. The wear indicators (a wire integrated in the brake pad) measure the wear on both pads in a brake. All indicators are connected in series and connected to the wear input.

The driver is warned using the ABS warning light shortly before the wear limit is reached.

Warning step 1

- The ABS warning light flashes 4 times (1 cycle) after ignition is switched on if one of the wear indicator was stripped in braked mode (> 3 brake actions).

Warning step 2

- the ABS warning light flashes 4 times 4 cycles (16 times) after ignition is switched on if one of the wear indicators is worn through.

The warning is interrupted when the vehicle's speed exceeds 7 km/h. In case of system faults the ABS warning light is activated continuously! At the same time, the corresponding information is transmitted via the motor vehicle/trailer interface and can be shown on the display there.

The system automatically detects new wear indicators when brake linings are replaced. All warning levels are deactivated after a time of 2 minutes (switch on the ignition for at least 2 minutes). The warning light extinguishes not earlier than the next ignition ON.

TCE

The wear information is ascertained from the TCE in systems with TCE. The trailer modulator is responsible for warning the driver and activating the ABS warning light. This is necessary because only an ECU can activate the ABS warning light when service information has built up.

Trailer EBS D

The last five brake pad changes (mileage in km and operating hour when the second warning level and the pad change occurred) are stored in the ECU and can be read out using PC diagnosis. If a SmartBoard is installed, the warning will also be displayed on the SmartBoard.

The WABCO wear indicator is authorised by ADR/GGVS (hazchem road haulage legislation in Germany).

4.20 Additional functions of Trailer EBS D**4.20.1 Traction Help**

An integrated traction help function for semitrailers can be activated using a button or via the CAN bus of the tractive unit/trailer interface (7-pin according to ISO 11992).

If a button is connected to the power supply (+24 V) or earth on the IN/OUT1 (plug X5) and the parameters are set accordingly, a traction help can be implemented on semitrailer vehicles with a lifting first axle in accordance with EC Directive 98/12. The value for the axle load when traction help is active is not allowed to exceed the maximum permitted axle load by more than a 30 % overload and must be defined by the vehicle manufacturer. The axle is lowered again when the vehicle reaches 30 km/h. Two versions can be selected:

**Design
Traction Help (TH)**

One lifting axle valve: The lifting axle can be lifted as a traction help providing the permitted bellows pressure set in the parameters is not exceeded after lifting. If the permitted pressure is exceeded when traction help is active, traction help is cancelled and the lifting axle is lowered.

**Design
Traction Help Plus (TH+)**

One lifting axle valve and a solenoid valve: The load is transferred off the lifting axle as a traction help, up to the level of the permitted bellows pressure set in the parameters. Then the supporting bellows of the lifting axle is shut off using the solenoid valve.

The traction help (or constrained lifting) is activated if the button is pressed for between 0.1 and 5 seconds. Pressing > 5 s causes constrained lowering of the lifting axle. If the constrained lowering function alone is required, the value for the permitted bellows pressure must be set to 0 bar.

The lifting axle (or traction help) can also be activated by the tractive unit via the tractive unit/trailer interface according to ISO 11992 (1998-04-01).

A decoupling diode must be installed in the line to the IN/OUT1 plug if there is a warning light installed in the tractive unit in parallel with the switch. Otherwise, the ECU cannot evaluate the button.

4.20.2 Operating hours meter

The expired operating time is stored in the non-volatile memory and can be read out via the diagnostic port.

The operating hours counter only works when there is electrical power to the Trailer EBS D, and is therefore not secure against tampering.

4.20.3 Safety circuit (emergency supply via stop light)

ABS and LSV remain functional when the stop light supply is connected and there is a malfunction in the ISO 7638 plug connection (7-pin trailer socket). The vehicle remains stable when braking.

4.20.4 2nd CAN bus

For connecting the WABCO tyre pressure monitoring system (IVTM) or a telematics system for position tracking and reading out operating data.

4.20.5 Telematics

Data from the trailer are transmitted via a radio interface in order to implement telematics services. These data can be provided by various control units or trailer systems. The data interface to the telematics control unit is implemented using a CAN bus system.

Such a bus system cannot be connected to the tractive unit/trailer interface according to ISO 11992-2 (1998) because this is configured as a peer-to-peer connection and is exclusively intended for data exchange with electronic brake and chassis systems. For this reason, a second CAN interface (telematics port) according to ISO 11898 (5 V, multi-point, 250 kbaud) is provided in the trailer EBS.

4.20.6 Tyre pressure monitoring system IVTM

An IVTM electronic control unit can be connected to the "IN/OUT2" modulator connection. This means it is possible to pass the CAN data from the IVTM ECU on to the trailer interface, and therefore through to a CAN system in the tractive unit.

4.20.7 Park-release emergency valve (PREV)

PREV combines the functions of a double release valve with those of a conventional trailer emergency valve. Emergency braking, ABS and RSS remain functional if the supply line via the service brake system (BBA) is pulled off.

The trailer is always automatically braked when unhitched. Even if there is a total air loss in the tank when the vehicle is parked up, the trailer will still always be prevented from rolling away because the spring-type brake actuators automatically engage in this circumstance.

5 Diagnostics

Diagnosis of Trailer EBS combines

- Setting the system parameters
- EOL (end-of-line) check on the system after parameter settings on the vehicle manufacturer's premises, functional test
- Fault display, fault storage
- Periodic tests (main/safety test SP)
- Access to data gathered during operation

5.1 Setting the system parameters

Every trailer requires a brake calculation for homologation. For WABCO brake systems, this is generally performed by WABCO. The trailer EBS can be adapted to various vehicle and system configurations by means of parameter settings.

! The parameters calculated for a trailer vehicle are stored into the ECU at the vehicle manufacturer's premises. When replacing a Trailer EBS modulator, the original parameter set must be copied to the new device.

5.2 Startup of a trailer

EBS must be started up following initial installation or after a modulator is changed. If this diagnostic step is not performed, the warning light (yellow trailer warning light) controlled via pin 5 of the ISO 7638 plug connection does not go out. Braking takes place in accordance with the entered EBS parameters providing the vehicle configuration matches the parameter settings.

Startup and/or parameter settings can only be enabled after entering a PIN (personal identification number) in the diagnostic program. With storage of parameters, the serial number of the diagnostic program with user identification is stored in the ECU.

5.3 Troubleshooting

Any faults detected in the system are stored in the trailer modulator. A fault entry includes the following information, amongst other items:

- Fault location (corresponds to the component)
- Fault type (e.g. short circuit or discontinuity)
- Validity information
- Fault significance

5.3.1 Fault significances

Fault significance is divided into three categories:

- **Level 0:** Have the malfunction rectified on the next occasion the trailer is in the workshop
- **Level 1:** Have the malfunction rectified as soon as possible
- **Level 2:** Have the malfunction rectified immediately

A yellow and a red warning light signal are available for displaying faults in the trailer EBS.

The red warning light signal is generated by the trailer modulator and transmitted to the tractive unit via the tractive unit/trailer interface according to ISO 11992. It activates the red EBS warning light in the tractive unit. The red warning light signal displays faults which lead to an impairment of braking performance.

The yellow warning light signal is generated via pin 5 of the 7-pin ISO 7638 connection. It controls the trailer ABS display (i.e. yellow or red trailer ABS warning light of tractive unit display) in the tractive unit. The yellow warning light signal displays faults which do not lead to an impairment of braking performance.

Level 0

Level 0 faults are displayed using the yellow (or red) trailer ABS warning light or on the tractive unit display, but only for as long as the malfunction exists. This display goes out before the ignition is switched off when the malfunction ceases, and the switch-off responses are withdrawn. Faults of this type do not necessarily indicate faulty cabling, and should not therefore prompt an unscheduled visit to the workshop (e.g. brake chatter or temporary malfunctions in CAN communication).

Level 1

Level 1 faults in which the full braking effort is retained lead to a partial or total shut-down of EBS/ABS. The display is (only) on the yellow (or red) trailer EBS warning light or tractive unit display. The fault display and the switch-off measures continue in effect until the ignition is next switched off, irrespective of the actual duration of the malfunction.

Level 2

In accordance with EBS regulations, faults which lead or could lead to the specified braking effort not being achieved (under-braking) are indicated by the red EBS warning light and the yellow (or red) trailer ABS warning light or the tractive unit display. Level 2 is assigned to these faults. As with level 1 faults, the fault display and the switch-off measures continue in effect until the ignition is next switched off, irrespective of the actual duration of the malfunction. (Exception: Inadequate reservoir pressure, slight undervoltage.)

It is not possible to differentiate between level 2 and level 1 in a conventional tractive unit, since there is only one warning light.

5.4 System diagnosis Trailer EBS

WABCO offers the PC diagnosis for Trailer EBS D. For the diagnosis, you need either

- a PC or a laptop,
- a Diagnostic Interface,
- a connection cable to the vehicle
- the Diagnostic Software "TEBS D"

Trailer EBS C generations could still be fully diagnosed using the WABCO diagnostic controller 446 300 320 0. This is no longer possible now that the trailer EBS D generation has been introduced.

5.4.1 Hardware



PC / laptop

WABCO can offer you a laptop that is resistant to impact and dirt, and is therefore suitable for workshop use. You can order the "Toughbook" from WABCO with ready installed Diagnostic Software.

The Diagnostic Software will also run on all standard PCs with an operating system Microsoft Windows 2000 or higher.

There are no special hardware requirements. The PC should, however, have a free USB port or a free serial port (COM interface 9-pin).




Diagnostic Interface Set

For establishing diagnosis with the control unit, WABCO Diagnostic Interface Set, Part No. 446 301 030 0 (USB) is required. The set comprises the interface and a USB connecting cable to the PC or Laptop.







Older diagnostic interfaces with serial port (446 301 021 0) or USB (446 301 022 0) can continue to be used.

Connecting cable for diagnosis

Trailer EBS C: Diagnosis via ISO 14230 (KWP 2000).

Diagnostic Interface	Diagnostic cable	Diagnostic cable
446 301 021 0 (serial) / 446 301 022 0 (USB) / 446 301 030 0 (USB)	446 300 329 2	with socket 449 672 030 0
		 <p>if no externally installed diagnostic socket is available</p>

Trailer EBS D: Up from mid of 2003, diagnosis is enabled according ISO 11992 (1998-04-01) and up from 2004 via CAN (ISO 7638). For diagnosis, an ISO 7638 disconnecting adapter is installed between the helix cables from the towing vehicle and ISO 7638 socket.

Diagnostic Interface	Diagnostic cable	Connection adapter
446 301 021 0 (serial)	CAN Converter 446 300 470 0	446 300 360 0
		
446 301 022/030 0 (USB)	446 300 361 0	446 300 360 0
		

5.4.2 Diagnostic Software

There are 3 options to purchase Diagnostic Software "TEBS D" for Trailer EBS C and D:

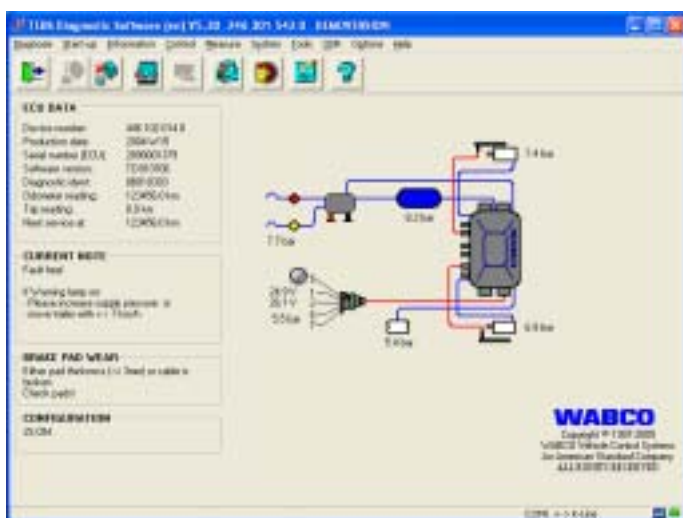
- Offline as a USB-Stick version
- Online as a Single Download
- Part of a WABCO System Diagnostics Subscription

For the diagnosis of multiple WABCO systems, WABCO offers you four different Diagnostic Software Subscriptions via the internet. These contain numerous diagnostic programs at a very low price.

Click the link "WABCO Diagnostics" in the "Quick Access Links" box on the Internet at our homepage www.wabco-auto.com and afterwards on "WABCO System Diagnostics". You will find further information there and can order and download diagnostic software in your desired language.

The Diagnostic Software may be used by any user for the purpose of diagnosis. If parameters are to be changed however, an authorization (PIN) is required. This PIN is obtained by completing corresponding training at the WABCO Academy. More information on WABCO Academy training courses, visit www.wabco-auto.com.

5.4.3 Diagnostic Software "TEBS D"



Switch ignition on before starting the Diagnostic Software. The program opens with the start screen showing the recognized system configuration actual data of the trailer modulator:

- applied trailer reservoir pressure
- brake pressure at the yellow coupling head
- controlled brake actuator pressure
- measured bellow pressure
- actual voltage at pin 1 and 2 of the ISO 7638 connection
- status of pin 5 of the ISO 7638 connection (warning lamp)
- the incoming CAN setpoint (if an EBS tractive unit is hitched up)

Furthermore, important ECU data, the last current malfunction present, the status of the brake pad wear sensors and the detected vehicle configuration are displayed.

There is a menu bar at the top, whilst frequently used and important commands can be selected using buttons in the toolbar below the menu bar. Below you find the description of the individual menus.

Diagnostics

The diagnostic connection to the ECU can be started and broken off here. The "ECU RESTART" command performs a software reset of the modulator and corresponds to switching on and off with the ignition, except that the diagnostic connection is retained.

This menu item also contains the print mode which can be used for printing out the startup and diagnostic memory log.

System start-up

During startup, it is possible to select which steps should be performed as part of the trailer EBS startup.

required steps:

- Parameter
- EBS pressure test
- Redundancy test
- ABS sensor assignment
- Test of warning lamp control

optional steps:

- Checking the CAN lines (a check is only necessary if the power cable plug had to be disconnected in order to install the cable)

Only a completely successful startup causes the yellow or red trailer ABS warning light (or the corresponding warning on the tractive unit display) to go out.

Messages

The content of the diagnostic memory is displayed, in which case current faults are indicated with a red icon and non-current faults with a blue icon. There is an extensive information file as part of this menu which can be used for performing straightforward troubleshooting.

Actuation

Certain control functions can be performed by PC to check the system.

Pressure specification: It is possible to specify the (brake) control pressure, speed and bellows pressure, and to check the EBS responses on the displayed diagram. The specification values are simulation values used in the computer. They are not suitable for checking the responses of the following systems (e.g. ECAS or ELM).

Tests which are part of the startup procedure, can be performed here separately:

- EBS pressure test
- Redundancy test
- Warning lamp test

Measurement values

Certain measure and test functions can be performed by PC to check the system:

ABS sensors: it is possible to check the assignment of the ABS sensors. To do this, the wheels with sensors must be rotated, then the sensor signals are evaluated and the corresponding wheels are braked.

CAN line test: The assignment of CAN lines is checked. To do this, the voltages on the various lines are measured. In the PC program, select "Help" - "Contents" and choose the "CAN line test" item in the "Commands" - "Measurement values menu" section to find a description of how a CAN adapter can be made for this test (see chapter 7.2 „CAN line test“, page 59).

Voltage supply test: The input voltage on the ECU is measured under load. To do this, the voltage is measured at pins 15 and 30 with no load and at 2 different load levels.

Time response: The time response of the trailer modulator is measured. A trailer reservoir pressure of 7.0...7.5 bar is required for this measurement.

! This measurement does not replace the reaction time measurement of the trailer which is a requirement of ECE-R13, because the pneumatic components in the vicinity of the trailer modulator are not considered.

Axle load: The measured axle load on the axles with bellows pressure sensors is output. It is arrived at by interpolation, taking the existing bellows pressure and the parameters for unladen and laden conditions. The axle load is not output for drawbar trailers.

Brake pad wear: The status ascertained for the brake pad wear indicators (sensors with abraded wire) or the total remaining pad thickness (analog sensors) is output.

Brake change documentation: When parameters have been set for brake pad wear indicators, it is possible to read off here when the last 5 brake pad changes took place.

Pole wheel test: A pole wheel test is performed to detect the number of teeth of the pole wheel and any tumble. The ABS sensor signals are evaluated for this purpose. For the pole wheel teeth number test, the specified number of wheel rotations must be exactly adhered to and the measurement must be stopped manually because the periods of the polewheel pulses are counted. For the tumble test, it is necessary to comply with the specified measuring time at least; after the measuring time has elapsed, the measurement is stopped automatically and the pole wheel status is evaluated and output.

Driving test: In this menu item, it is possible to measure pneumatic and CAN set-point/actual pressure values as well as the vehicle speed and braking during driving. To do this, the cable between the trailer diagnostic socket and the Diagnostic Interface must be extended. The maximum permitted length of this measuring cable is 20 m.

Calibrate RSS modulator installation position: The RSS system calibrates itself automatically during the first 10 stops after it has been installed. This procedure can also be performed manually using this menu item. To do this, the vehicle must be parked on a flat, level surface and the calibration procedure started.

System

Parameter setting takes place over 4 screens and is used to adapt the ECU to the vehicle in accordance with the existing vehicle configuration and the existing brake calculation.

Page 1

- Vehicle type
- Number of axles
- ABS configuration
- Assignment of the axles to the ABS sensors and lifting axles

Page 2

- Assignment of electrical switching outputs 1 and 2
- Pad wear sensing
- RSS (roll stability support) status
- Definition of the warning light function
- Tyre / pole wheel parameters
- Service interval setting

Page 3

- Additional lifting axle parameters (speed at which the lifting axle is lifted; percentage axle load at which the lifting axle is lowered)
- Assignment of the IN/OUT ports 1 and 2 (definition of traction help parameters; CAN2 assignment; external brake pressure sensor)

Page 4

- Enter the brake pressure control values as a function of the axle loads in accordance with the brake calculation.

The most important item in this menu is the ECU parameter setting function; in addition to the test device identification (the fingerprint for the individual areas of the ECU is stored in this program item) and the possibility of storing the EEPROM contents of the ECU on a PC (the stored EEPROM contents can be used by WABCO specialists to evaluate what is happening in special problematical cases).

It is possible to print out an EBS system plate. To do this, it is necessary to use a laser printer and a blank foil (WABCO no. 899 200 922 4).

In the menu item "Enter brake data" brake-specific data can be typed in. The data is stored when parameters are set for the ECU. The background is as follows: If a vehicle is to undergo acceptance according to ECE R 13, the data for the brake system must be carried in the vehicle. Electronic storage is allowed (§ 5.1.4.5.1.).

Tools

- Service interval (i.e. activation of the warning light function to signal a service is due)
- Reset mileage counter
- Mileage counter status

Options

The main item here concerns the possibility of entering of PIN's. Any PIN may be used to start the diagnostic software. If parameters are to be changed however, the combination of user ID and PIN is required, you obtained by completing corresponding training at the WABCO Academy.

The serial number of the Diagnostic Software is displayed above the PIN input fields. This serial number consists of the software identification and the user ID.

In the "Settings" item, it is possible to make various PC-relevant settings (port, program display on the monitor and file storage, i.e. the folder from which the parameter records are loaded or into which parameter records are stored) and you can store printer settings for creating a system plate.

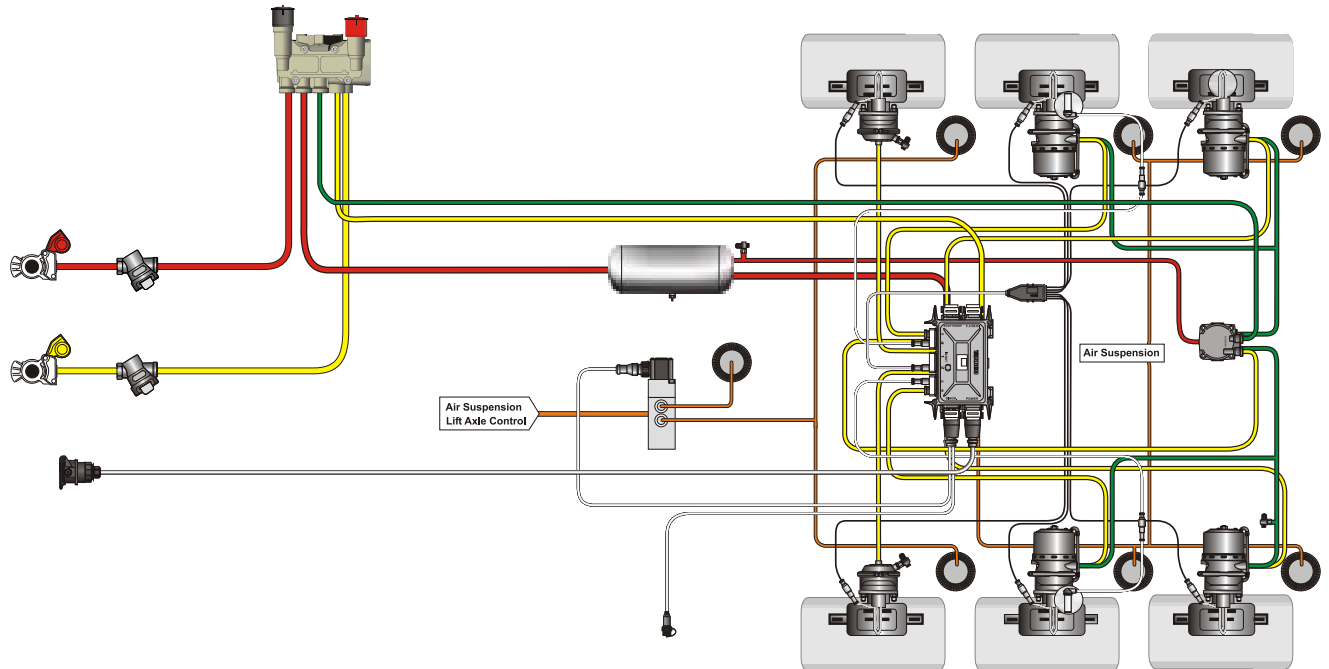
Furthermore, it is possible to set the sequence of ABS sensor assignment during startup (side-by-side, e.g. by lifting one side of the vehicle at a time during startup, or axle-by-axle, e.g. for startup on a roller dynamometer) and the reservoir pressure for the LSV test (for a successful LSV test, this must be approx. 0.5 bar higher than the brake pressure set in the parameters when the vehicle is laden).

Help

The help section provides extensive help options for handling the program, for example possible faults and rectification procedures are described in the repair help.

6 Modulator exchange and Installation

The diagram shows a sample installation Trailer EBS D for a 3-axle semitrailer with one lifting axle.



6.1 Modulator exchange Trailer EBS C

For replacement purposes, a trailer modulator of the trailer EBS C generation, i.e. one built before November 2002, must be replaced by a trailer modulator of the trailer EBS D generation. With the exchange of the modulator you may benefit from all functions of Trailer EBS D, like Roll Stability Support (RSS), wear monitoring system (BVA) and Integrated traction help.

Replacement table Trailer EBS modulators

Trailer EBS C	Type	Replacement Trailer EBS D
480 102 000 0	EBS/BVA	480 102 014 0
480 102 002 0	EBS/TCE	480 102 015 0
480 102 001 0	EBS/BVA, battery	480 102 014 0
480 102 004 0	EBS/RSS/BVA	480 102 014 0
480 102 005 0	EBS/TCE/RSS	480 102 015 0

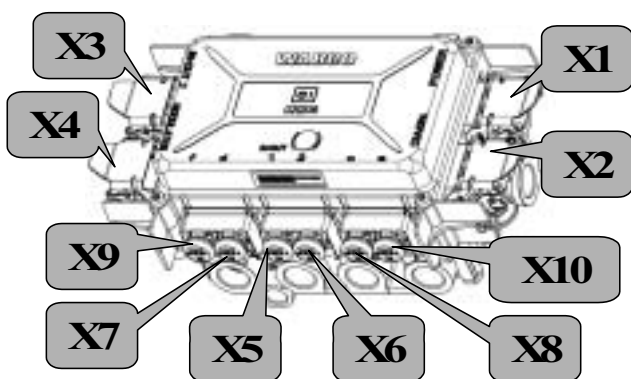
- Observe the instructions of the vehicle manufacturer.
- Parameter settings must be transferred to the new device. You need the actual version of Diagnostic Software TEBS and the PIN for parameter setting.
- Connect the pneumatic control line from the trailer emergency valve to port 4 only, port 5 must be closed.
- Connect the cable of the trailer emergency valve to IN/OUT2 and the cable of the external axle load sensor to IN/OUT1.
- Set parameter according to the silver system plate at the vehicle.

- Via software, set the assignments:
 - Connector IN/OUT1 = "external axle load sensor"
 - Connector IN/OUT2 = "external brake pressure sensor"
- Perform the system startup.

For an overview of functions of the various generations of Trailer EBS C and D see chapter 7.1 „Functions / service for Trailer EBS / trailer modulator 480 102 ... 0“, page 58.

When replacing Trailer EBS with a modulator of the E generation you exchange all components beside ABS sensors.

6.2 Electrical connections of the Trailer EBS Modulator



X1 Supply

The supply connection (cap marked POWER) is assigned according to ISO 7638-1996 (7-pin). It must always be connected.

X2 Diagnosis

This connection (cap marked DIAGN) is primarily used for connecting diagnostic units. In vehicles with lifting and/or steering axles, the activation valves are also connected here. The ECAS control unit is connected here with electronic air suspension. The diagnostic units are then connected to the ECAS diagnostic plug.

If an ELM is fitted in the trailer, it is powered via this connection in parallel to the diagnostic connection.

X3 IN/OUT2

With **Trailer EBS C** you connect a EBS trailer emergency valve to this port (cap marked R.E.V.). It must always be connected.

Using an EBS trailer emergency valve with **Trailer EBS D**, it is connected to this port (cap marked IN/OUT2).

If an external brake pressure sensor is required, it is connected here.

Furthermore, the telematics system which can be used as an option or a tyre pressure monitoring system (IVTM) is connected here.

X4 Modulator

The modulator connection (cap marked MODULATOR) is only needed for 3M or 2M+1M systems. In 2M systems, this slot remains covered by the cap which is fitted at the factory.

X5 "Axle load sensor" (T EBS C), IN/OUT1 (T EBS D)

With **Trailer EBS C** you connect an axle load sensor to this port (cap marked 1). The bellows of the main axle must always be sensed.

With **Trailer EBS D**; a switch for traction help or, when replacing a modulator C generation, the external axle load sensor for measuring the bellows pressure is connected. This connection is fitted with a cap at the factory.

X6 "Brake lining"

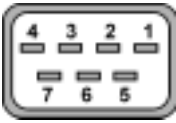
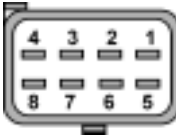
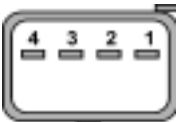

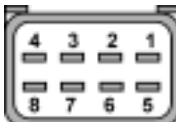
The brake pad wear indicators are connected to this connection (Cap marked 2). If it is not used, it must be fitted with a cap like the other unused connections for the ABS sensors.




X7...X10 ABS sensors

In 4S systems, all slots (caps marked c, d, e, f) must be occupied. Only slots c and d are occupied in 2S systems. The other slots are closed off by caps at the factory.

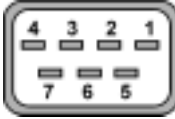
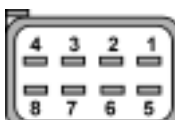
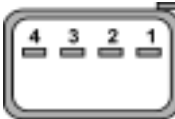

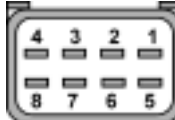

! The yellow slots familiar from VCS (YE1, YE2) and the rule of thumb "The sensors on the right in the direction of travel are connected to yellow slots" no longer apply in the trailer EBS.
 In a 4S/2M trailer EBS system, slots d and f must always have those sensors assigned to them which are braked via connections 2.1.



6.2.1 Pinning Trailer EBS C / D

Connector		Pin	Trailer EBS C 480 102 000 0 / ...001 0 / ...004 0	Trailer EBS D Standard 480 102 010 0	Trailer EBS D Premium 480 102 014 0
X1 Power is connected to the electrical power supply cable using the 7-pin ISO 7638 interface		1	CAN low (ISO 11992) 24 V		
		2	CAN high (ISO 11992) 24 V		
		3	warning lamp		
		4	GND electronic		
		5	GND electrovalve		
		6	Plus electronic		
		7	Plus electrovalve		
X2 Diagnostics is connected to the diagnostic socket and/or other in-series loads (e.g. lifting axle valve, ELM, ECAS, etc.).		1	K-line (ISO 14230)		
		2	Plus diagnostic tool	Plus switching output 4	
		3	GND Subsystem	Plus electrovalve	
		4	Plus subsystem switching output 2		
		5	24 N input		
		6	Battery charging out	Battery charging out	
		7	GND switching outputs	GND electrovalve	
		8	Plus switching output 1		
X3 IN/OUT2 can be connected to various loads. Coded.	T EBS C 	1	Plus demand pressure sensor		Plus switching output 3
	T EBS D 	2	GND demand pressure sensor		GND electrovalve
		3	Value demand pressure sensor		Analog input 0...5 V
		4	Demand pressure switch		Switching input
		5	Plus electrovalve		
	6	GND electrovalve			
	7			CAN2 high	
	8			CAN2 low	
X4 Modulator is connected to a 3rd modulator (EBS or ABS relay valve) if required. Coded.		1	Plus brake pressure sensor		Plus switching output 3
		2	GND brake pressure sensor		GND electrovalve
		3	AV (outlet valve)		AV (outlet valve)
		4	Plus redundancy valve		Plus redundancy valve
		5	Value brake pressure		Value brake pressure
		6	GND EV-AV		GND EV-AV
		7	EV (inlet valve)		EV (inlet valve)
		8	GND redundancy valve		GND redundancy valve

Connector		Pin	Trailer EBS C 480 102 000 0 / ...001 0 / ...004 0	Trailer EBS D Standard 480 102 010 0	Trailer EBS D Premium 480 102 014 0
X5 IN/OUT1		1	Plus axle load sensor	Plus switching output 5	
		2	GND axle load sensor	GND electrovalve	
		3	Axle load sensor value for axle c, d	Multifunction input	
X6 Wear sensor		1	Plus wear sensor		
		2	GND wear sensor		
		3	Value wear sensor		
X7...X10 ABS-Sensor		1	ABS sensor high (X7 d, X8 c, X9 f, X10 e)		
		2	ABS sensor low (X7 d, X8 c, X9 f, X10 e)		

6.2.2 Pinning Trailer EBS C / D with TCE

Connector		Pin	Trailer EBS C with TCE 480 102 002 0 / ...005 0	Trailer EBS D with TCE 480 102 015 0	
X1 Power		1	CAN low (ISO 11898)	CAN low (ISO 11992) 5 V	
		2	CAN high (ISO 11898)	CAN high (ISO 11992) 5V	
		3 / 4			
		5	GND electrovalve		
		6			
		7	Plus electrovalve		
X2 Diagnostics		1	K-line (ISO 14230)		
		2	Plus diagnostic tool	Plus switching output 4	
		3	GND Subsystem	Plus electrovalve	
		4...6			
		7		GND electrovalve	
X3 IN/OUT2	T EBS C 	1	Plus demand pressure sensor	Plus switching output 3	
	T EBS D 	2	GND demand pressure sensor	GND electrovalve	
		3	Value demand pressure sensor	Aanalog input (0...5 V)	
		4	Demand pressure switch	Switching input	
		5		Plus electrovalve	
		6...8			
	X4 Modulator is connected to a 3rd modulator (EBS or ABS relay valve) if required. Coded.		1	Plus brake pressure sensor	Plus switching output 3
			2	GND brake pressure sensor	GND electrovalve
3			AV (outlet valve)		
4			Plus redundancy valve		
5			Value brake pressure		
6			GND EV-AV		
7			EV (inlet valve)		
8			GND redundancy valve		
X5 IN/OUT1		1	Plus axle load sensor	Plus switching output 5	
		2	GND axle load sensor	GND electrovalve	
		3	Axle load sensor value for axle c, d	Multifunction input	

Connector		Pin	Trailer EBS C with TCE 480 102 002 0 / ...005 0	Trailer EBS D with TCE 480 102 015 0
X6 Wear sensor		1		
		2		
		3		
X7...X10 ABS-Sensor		1	ABS sensor high (X7 d, X8 c, X9 f, X10 e)	
		2	ABS sensor low (X7 d, X8 c, X9 f, X10 e)	

6.3 Pneumatic ports

Application	Connection	Thread	Comment
Trailer EBS Modulator			
Reservoir	1	2× M 22×1,5	
Brake cylinders	2-1,	3× M 22×1.5	
Overload valve Tristop® cylinder	2-1	1× M 16×1.5	
Brake cylinders	2-2	3× M 22×1.5	
Trailer emergency valve port 2	4	1× M 16×1.5	
Bellow air suspension	5	1× M 16×1.5	T EBS D only
ABS relay valve			
Reservoir	1	1× M 22×1.5	
Brake cylinders	2	2× M 22×1,5	
Two-way valve	4	2× M 16×1.5	
EBS Relay Valve			
Reservoir	1	1× M 22×1.5	
Brake cylinders	2	2× M 22×1,5	
Trailer emergency valve	4	1× M 14×1.5	1× M 12×1.5
Trailer emergency valve			
Coupling head supply (red)	1	M 22x1.5	
Reservoir	1-2	M 22×1.5	
Trailer EBS Modulator	2	M 22×1.5	
Coupling head brake (yellow)	4	M 22×1.5	
Park-release emergency valve			
up from T EBS D+			
Coupling head supply (red)	1-1	M 16×1.5	
Reservoir	1-2	M 16×1.5	
Trailer EBS Modulator	2-1	M 16×1.5	
Spring-type brake actuator	2-2	M 16×1.5	
Coupling head brake (yellow)	4	M 16×1.5	

6.4 Pneumatic lines and screw fittings

Name	min. Diameter	max. length	Comment
Supply line to the modulator	2× 15×1,5 or 18×2	3 m	
Reservoir line to EBS (ABS) relay valve	12×1,5	3 m	
Brake line to sensed wheels wheels without sensors	9 mm 9 mm	3 m* 5 m	*6 m for T EBS D 4S/3M Vario

The supply lines must be selected so that the timing characteristics demanded by statutory regulations are fulfilled.

Make sure that no angled screw fittings are used for connecting the supply lines to tanks and the modulator, since such fittings can significantly impair the timing characteristics.

Brake cylinders and sensors on a particular side of the trailer must exclusively be connected to the side of the modulator which is facing them.

6.5 System start-up

Every trailer requires a brake calculation for homologation. For WABCO brake systems, this is generally performed by WABCO. The calculated parameters are entered when the system is first installed.

EBS must be started up following initial installation or after a modulator is changed. The warning light does not go out if this diagnostic step is not performed. Braking takes place according to the entered EBS parameters.

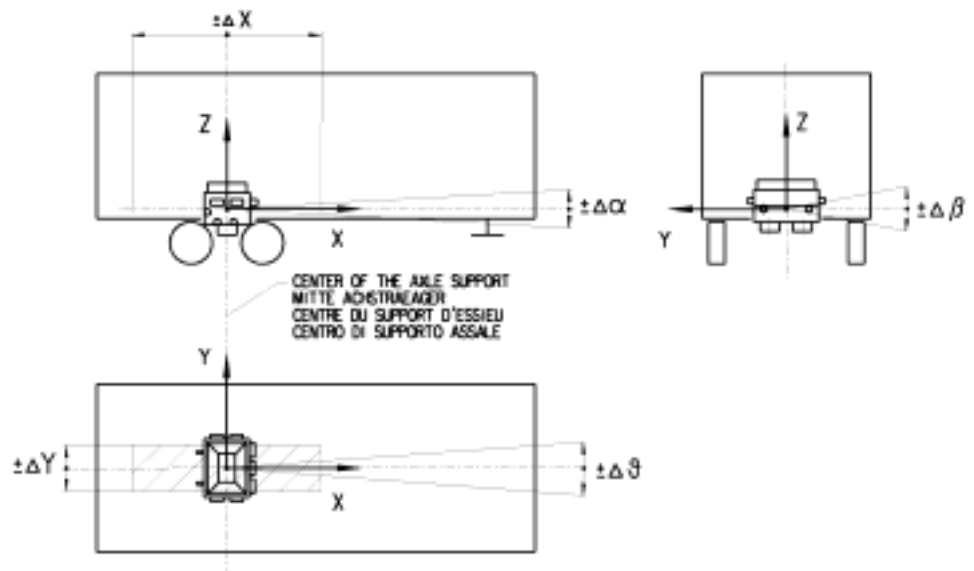
Startup and/or parameter settings can only be performed after the diagnostic function has been enabled using a PIN. The fingerprint is stored whenever changes are made to the parameters.

6.6 RSS installation regulation

Required end-of-line parameter setting

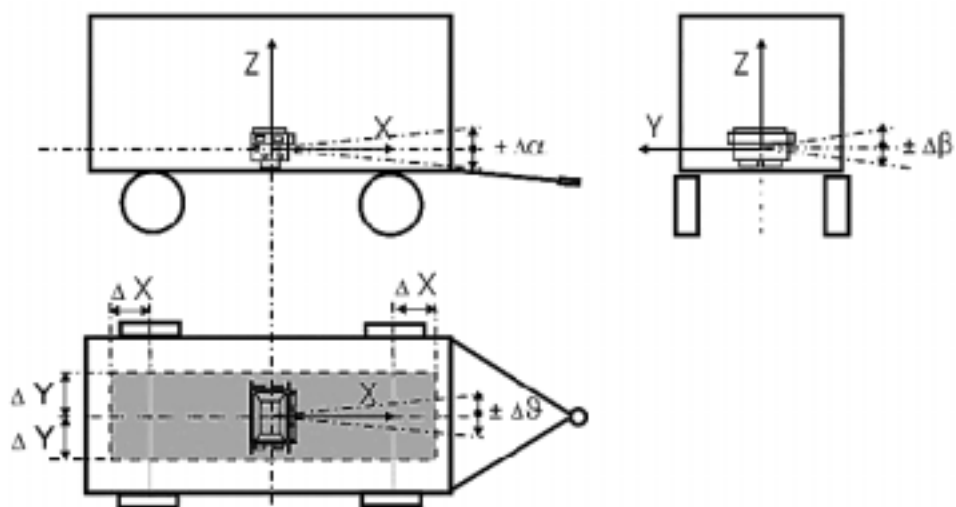
To provide for a range of tyres, it is permitted to fit tyres up to 8 % smaller than the parameter settings. However, the setting for the number of teeth of the pole wheel must correspond to the installed pole wheel. Refer to the WABCO brake calculation for the values for the permitted tyre circumference range and the LSV data. It is not permitted to install tyres which are larger than described by the parameter settings.

6.6.1 Semitrailer



RSS function	ΔX [mm]	ΔY [mm]	$\Delta \alpha$	$\Delta \beta$	$\Delta \theta$
deactivated			$\pm 15^\circ$		
active	± 2000	± 300	$\pm 15^\circ$	$\pm 3^\circ$	$\pm 3^\circ$

6.6.2 Draw-bar trailer



RSS function	ΔX [mm]	ΔY [mm]	$\Delta \alpha$	$\Delta \beta$	$\Delta \theta$
deactivated				$\pm 15^\circ$	
activated (T EBS D up from cw 51/2004 only)	± 600	± 300	$\pm 15^\circ$	$\pm 3^\circ$	$\pm 3^\circ$

6.6.3 Application range of the RSS function

Trailers in classes O₃ and O₄ according to the framework directive 70/156/EEC or according to Annex 7 of the "Consolidated Resolution on the Construction of Vehicles (R.E.3)". Semitrailers and central axle trailers with the system configurations 2S/2M, 2S/2M+SLV, 4S/2M and 4S/3M and drawbar trailers with the system configuration 4S/3M.

In vehicles with an adhesion-steered steering axle, RSS is only permitted in conjunction with a 2S/2M+SLV system (steering axle control via a Select Low valve) or a 4S/3M EBS/ABS system (steering axle with MAC).

Vehicle type	Semitrailer			Central axle trailer			Drawbar trailer		
	1	2	3...6	1	2	3	2	3	
Axles	1	2	3...6	1	2	3	2	3	
2S/2M	!	✓	✓	!	✓	✓	–	–	
4S/2M	–	✓	✓	–	✓	✓	–	–	
2S/2M+SLV	–	✓	✓	–	✓	✓	–	–	
4S/2M+1M	–	✗	✗	–	✗	✗	–	–	
4S/3M	–	✓	✓	–	✓	✓	✓	✓	
Lifting axle control and RSS									
Lifting axle control by trailer EBS								✓	
Pneumatic lifting axle valve e.g. 463 084 020 0 or 463 084 000 0								✓	
Pneumatic forced lowering of lifting axle controlled by Trailer EBS, e.g. 463 036 016 0 (pneumatic rotary switch)								✗	
Key:	✓	permitted without restrictions							
	!	not recommended, because braking only one axle by RSS is not enough							
	✗	not authorised							
	–	Variant does not exist							

6.6.4 Minimum sizes for the reservoir tank in standard trailers

Vehicle type	Type brake cylinder (inch) (2 / axle)			Minimum sizes for the air reservoir in litres
	Axle 1	Axle 2	Axle 3	
Semi / central axle trailer	12			20
	16			30
	20			30
	24			40
	30			40
	12	12		40
	16	16		40
	20	20		60
	24	24		60
	30	30		80
	12	12	12	60
	16	16	16	80
	20	20	20	80
	24	24	24	80
	24	24	30	100
	30	30	30	100
Draw bar trailer	16	24		60
	20	24		60
	20	30		60
	24	30		80
	16	16	24	80
	20	20	24	80
	20	20	30	80
	24	24	30	100
	30	30	36	100

For brake cylinder/tank size combinations not listed here please contact your WABCO partner.

6.7 Installation regulation quick release valve 973 500 051 0



When fitting the quick release valve 973 500 051 0 manufactured between production week **11/2006** and **42/2007** to the Trailer EBS modulator and the PREV; please note that ports 11 and 12 are connected as follows:

Quick Release Valve CW 11/2006...42/2007	connected to component
Port 11	to Trailer EBS modulator port 21 (M 16×1.5)
Port 12	to Park-release emergency valve (PREV) port 22

The reason for this is an additional spring which fixes the piston into a secure position. Mixing up the ports might cause venting air at the exhaust of both LSV or EBS modulator. This would be no fault at these devices.

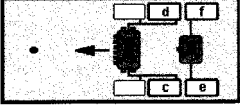
The installation position of the quick release valve shown is ± 5° max deviation.

This prioritised connection no longer exists in the device since week of manufacture 43/2007. This means that ports 11 and 12 are equivalent and can be interchanged.

6.8 EBS system plate

After the trailer EBS system has been installed, the PC diagnostic program can be used for making an EBS system plate displaying the setup data. This EBS system plate must be affixed in a clearly visible place on the vehicle (e.g. in the area where the LSV plate is located in conventional brake systems).

The blank foil for this type plate can be obtained from WABCO, order number 899 200 922 4. The data must be printed out using a laser printer.

WABCO				TRAILER EBS							
HERSTELLER MANUFACTURER CONSTRUCTEUR		WABCO		ELEKTR. SCHALTER 1 ELECTR. SWITCH 1 COMMUTATEUR ELECTRIQUE 1		ILS1					
TYPE TYPE		Muster		ISS GESCHW. ISS SPEED COMMUTATEUR VITESSE		2					
FAHRGESTELLENUMMER CHASSIS NUMBER NUMERO DE CHASSIS		WABCO Muster		ISS PIN INVERTERT ISS PIN INVERT COMMUTATEUR INVERSE		---					
BREMSRECHNUNGS NR. BRAKE CALCULATION NO. CALCUL DE FREINAGE NO.		WDE 0815		10 s PULS 10 s PULSE IMPULSION 10s		---		BREMSPROFNUMMER BRAKE TEST NUMBER NUMERO D'ESSAI DE FREIN			
POLRADZAHNENH. c/d POLE WHEEL TEETH c/d DENTS ROUE D'ENTEE c/d		100	ABS-System	4S/3M	ELEKTR. SCHALTER 2 ELECTR. SWITCH 2 COMMUTATEUR ELECTRIQUE 2		---				
POLRADZAHNENH. *f POLE WHEEL TEETH *f DENTS ROUE D'ENTEE *f		100	POS. LIFTACHSEN POS. LIFT AXLE PREP. ESS. RELEV.		WARNLAMP WARNING LAMP VOYANT DE SECURITE		2s		GGVS/ADR	TPN 1805/99	
EXT. BREMSRÜCKSENS. EXT. BRAKE PRESS. SENS. EXT. CAPT. PRES. DE FREIN		---	#01	TH+	LIFTACHSENRELEV.V LIFT AXLE SPEED V VITESSE ESS. RELEVABLE		10		ANFAHRLIFTE GEOSCHW. TRACTION HELP V VITESSE AIDE DEMARRAGE		
C/N2		---	RSS RSS RSS	RSS-D	LIFTACHSEN SENKEN % LOWER LIFT AXLE % BAISSER ESSISU RELEV. %		90		ANFAHRLIFTE DRUCK TRACTION HELP PRESS. PRES. AIDE DEMARRAGE		
		STELERDRUCK PM (BAR) CONTROL PRESSURE (BAR) PRESSION DE SERVICE PM (BAR)		6.5		STELERDRUCK PM (BAR) CONTROL PRESSURE (BAR) PRESSION DE SERVICE PM (BAR)		0.7		2.0	6.5
ACHSE AXLE ESSIEU	ACHSLAST LEER AXLE LOAD UNLOADED CHARGE ESSISU A VIDE (KG)	BALDRUCK LEER SUSP. PRESS. UNLOADED PRESS. SUSP. A VIDE (BAR)	BREMSDRUCK LEER BRAKE PRESS. UNLOADED PRESS. DE FREIN A VIDE (BAR)	ACHSLAST BELADEN AXLE LOAD LOADED CHARGE ESSISU EN CHARGE (KG)		BALDRUCK BELADEN SUSP. PRESS. LOADED PRESS. SUSP. EN CHARGE (BAR)		BREMSDRUCK BELADEN BRAKE PRESS. LOADED PRESS. DE FREIN A CHARGE (BAR)			
1	1800	0.5	1.8	8000	3.7	0.4	1.5	5.6			
2	1800	0.5	1.8	8000	3.7	0.4	1.5	5.6			
3	1800	0.5	6.5	8000	3.7	0.7	2.0	6.5			

6.9 Certificates

A lot of certificates are available covering the initial installation of a trailer EBS system of the D generation, replacing a trailer modulator of the TEBS D generation with an existing TEBS C generation system and retrofitting brake pad wear sensors. These significantly facilitate vehicle registration.

Please find this expertise in our product catalogue INFORM in the internet under www.wabco-auto.com

Subject	Certificate number
ABS	EB_123.5 (German), EB_123.5e (English) with Information Document ID_TEBS123.5
EBS (with ECE R13, Annex 18)	EB_124.1E and KBA_EB_124.1E with Information Document ID_EB_124_1
RSS	EB_134.2 (German), EB_134.2E (English)
Replacement of D version for C version by RWTÜV	27_123.4 (German)
Replacement of D version for C version by RDW	RDW_D_C
ADR/GGVS certificates	
ADR/GGVS certificates for EBS having lining monitoring	TÜV ATC-TB2002-64.00

6.10 Trailer EBS test instruction - a tool for experts

Test	Regulation	What must be tested?	How is the test done?	Simulation
Response time	98/12/EC Annex III ECE R13, Annex 6	Threshold time < 0.44 s There are no requirements for the trailer vehicle in regard of time response behaviour.	With CTU: Initial conditions: <ul style="list-style-type: none"> Set LSV to laden If necessary, set the brake narrow. 	A
Power consumption by ABS - equivalent actuations	98/12/EC Annex XIV	After the number of equivalent actuations (n_e) from the ABS certificate (§ 2.5), there must still be pressure in the cylinder for a 22.5 % braking at the last brake actuation. TEBS-D: Disc brake $n_e = 11$ Drum brake $n_e = 10$ VCS 1: Disc brake $n_e = 16$ Drum brake $n_e = 16$	<ul style="list-style-type: none"> Fill the trailer reservoir to 8 bar Shut off the supply At the yellow coupling head with 6.5 bar, brake with the number n_e In the last actuation, hold the pressure and measure the cylinder pressure Compare with the required pressure: pH at $z = 22.5\%$ from the brake calculation page 1	A
Power consumption by spring-type brake actuator	98/12/EG Annex V, § 2.4 ECE R13, Annex 8, §2.4	Check if it is possible to release the parking brake of the unhitched trailer at least three times.	<ul style="list-style-type: none"> Support axle(s) with spring brakes on blocks Charge the trailer to 6.5 bar reservoir pressure (7.5 bar for ECE acceptance) Unhitch the trailer autom. Release automatic braking (black button) Exhaust and admit air into the parking brake system (spring brake) three times by pressing the red button It must still be possible to turn the wheels with spring-type brake actuators. 	
Start of braking of spring-type brake actuators	98/12/EG Annex V, §2.5 ECE R13, Annex 8, §2.5	This checks that the start of braking of spring-type brake actuators is not greater than the reservoir pressure after 4 complete actuations.	<ul style="list-style-type: none"> Ignition off Support axle(s) with spring brakes on blocks Shut off the supply Charge the trailer to 6.5 bar reservoir pressure (7.0 bar for ECE acceptance) Exhaust and admit air into the parking brake system (spring-type brake actuator) by pressing the red button until a wheel with a spring-type brake actuator can no longer be turned Measure the reservoir pressure Charge the trailer back up to 6.5 bar reservoir pressure (7.0 bar for ECE acceptance) Actuate fully four times via the yellow coupling head Measure the reservoir pressure The reservoir pressure at the start of braking of the spring-type brake actuators must be less than the reservoir pressure after four complete actuations.	

Test	Regulation	What must be tested?	How is the test done?	Simulation
Measure the brake forces on all axles of an unladen vehicle on the roller dynamometer		The controlled braking forces of all axles of an unladen vehicle are to be measured.	The lifting axle is lifted and must be lowered for the test.	B
LSV characteristic when the vehicle is stationary		The characteristic output by EBS for the unladen or laden vehicle is to be checked using a pressure gauge.	<ul style="list-style-type: none"> • Connect a fine pressure control valve and pressure gauge to the yellow coupling head • Connect a pressure gauge to the brake cylinder test connection • Supply the trailer with electrical power • Slowly increase the pressure using the fine control valve and record the pressure gauge values. 	C

Simulation	How to simulate?	C generation	D generation	Note
A	Laden vehicle	<ul style="list-style-type: none"> • Disconnect the axle load sensor plug • Connect a test valve to connection 5 and simulate laden bellows pressure • Set the unladen braking pressure to 6.5 bar in the parameters (new startup required at the end of the measurements) 	Set bellows pressure < 0.15 bar as follows <ul style="list-style-type: none"> • Use rotary valve (ECAS...) to lower onto blocks • Connect a test valve to connection 5 and simulate laden bellows pressure • Set the unladen braking pressure to 6.5 bar in the parameters (new startup required at the end of the measurements) 	Reconnect the axle load sensor plug
B	Lowering the lifted lifting axle(s) of the unladen vehicle.	Set an air suspension pressure between 0.15 and 0.25 bar by <ul style="list-style-type: none"> • Exhausting the supporting bellows using the rotary slide valve • Connecting a pressure simulation to the modulator's port for bellow pressure • by PC diagnosis. 	Set an air suspension pressure between 0.15 and 0.25 bar by <ul style="list-style-type: none"> • Exhausting the supporting bellows using the rotary slide valve • Connecting a pressure simulation to connection 5 of the modulator • by PC diagnosis. 	
C	Test mode for checking the LSV characteristic. The emergency braking function and standstill function are switched off in test mode.	Switch on the ignition / electrical power supply with the vehicle stationary and no pressure at the yellow coupling head.	Switch on the ignition / electrical power supply with the vehicle stationary and no pressure at the yellow coupling head.	Test mode is switched off when the vehicle is moved at faster than 2.5 km/h.

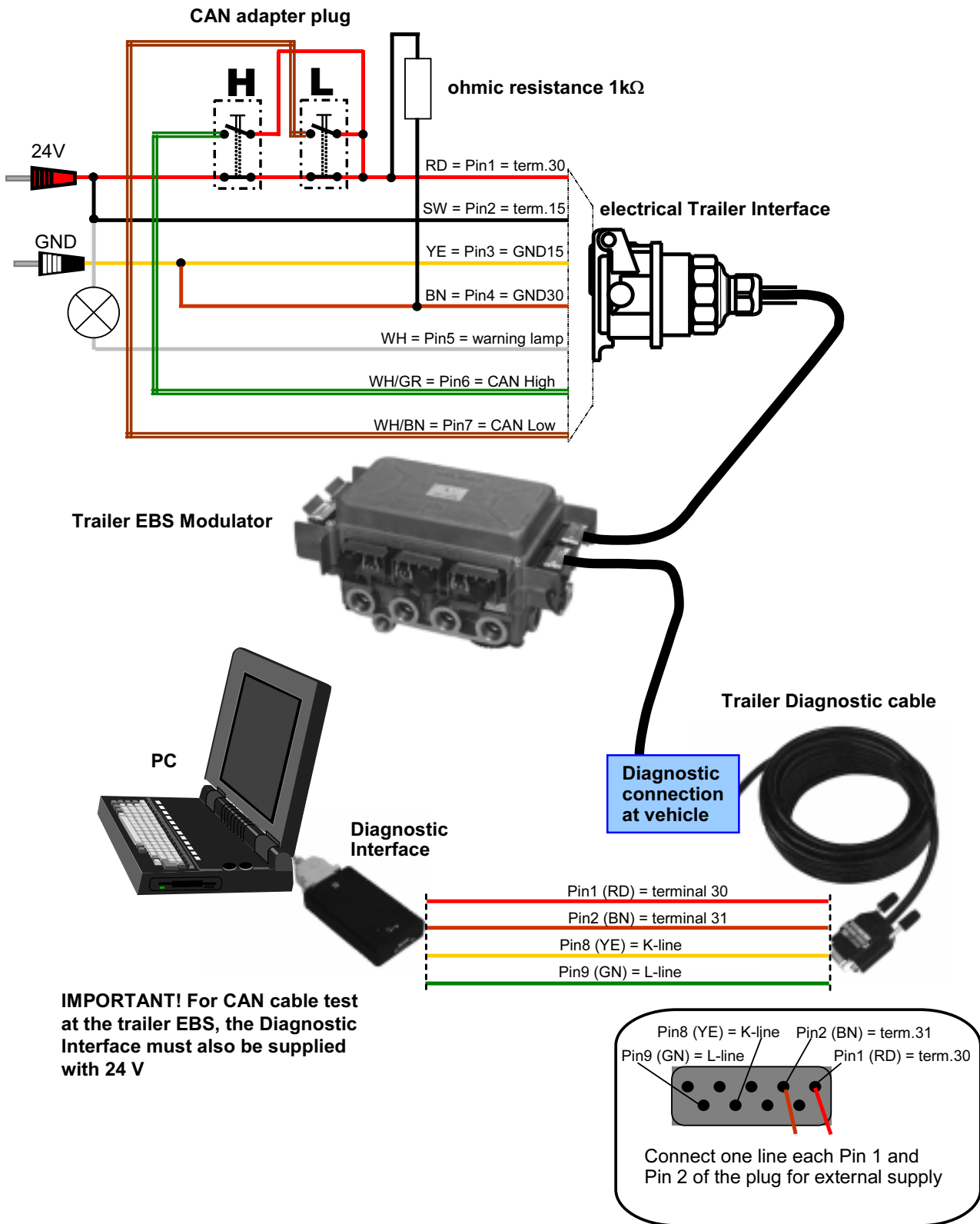
7 Appendix

7.1 Functions / service for Trailer EBS / trailer modulator 480 102 ... 0

WABCO no. 480 102 ...	... 000 0		... 001 0		... 002 0		... 004 0	... 005 0	... 010 0	... 014 0	... 015 0
	EBS-C2 to week 48/01	EBS-C3 from week 49/01	EBS-C2 to week 48/01	EBS-C3 from week 49/01	EBS-C2 to week 48/01	EBS-C3 from week 49/01	EBS-C3 from week 49/01	EBS-C3 from week 49/01	EBS-D from week 44/02	EBS-D from week 44/02	EBS-D from week 44/02
ABS configuratio n	4S/3M	4S/3M	4S/3M	4S/3M	4S/3M	4S/3M	4S/3M	4S/3M	4S/2M	4S/3M	4S/3M
Battery charge			X	X			X			X	
TCE					X	X		X			X
RSS							X	X		X	X
Wear input	X	X	X	X					X	X	
Switching output 1	X	X	X	X					X	X	
Switching output 2	X	X	X	X					X	X	
ILS	X	X	X	X					X	X	
Axle load sensor	...007 0 ...013 0 ...015 0	...007 0 ...013 0 ...015 0	...007 0 ...013 0 ...015 0	...007 0 ...013 0 ...015 0	...007 0 ...013 0 ...015 0	...007 0 ...013 0 ...015 0	...007 0 ...013 0 ...015 0	...007 0 ...013 0 ...015 0	441 044 101 0 / 102 0 *	441 044 101 0 / 102 0 *	441 044 101 0 / 102 0 *
Ext. Brake pressure sensor		...007 0 ...013 0 ...015 0		...007 0 ...013 0 ...015 0		...007 0 ...013 0 ...015 0		...007 0 ...013 0 ...015 0		441 044 101 0 / 102 0 *	441 044 101 0 / 102 0 *
Trailer emergency valve	...802 0	...802 0 ...301 0	...802 0	...802 0 ...301 0	...802 0	...802 0 ...301 0	...802 0 ...301 0	...802 0 ...301 0	...301 0 (...PREV up from III/03)	...301 0 (...PREV up from III/03)	...301 0 (...PREV up from III/03)
971 002 ...											
Can be replaced by AHM 480 102 ...	... 014 0 (...010 0 only for 4S/2M)	... 014 0 (...010 0 only for 4S/2M)	... 014 0	... 014 0	... 015 0	... 015 0	... 014 0	... 015 0	... 015 0	... 014 0	... 015 0

* with Trailer EBS D, pressure sensors for axle load and brake pressure are integrated in the modulator. The pressure sensor may also be used during servicing if an internal demand pressure sensor fails.

7.2 CAN line test

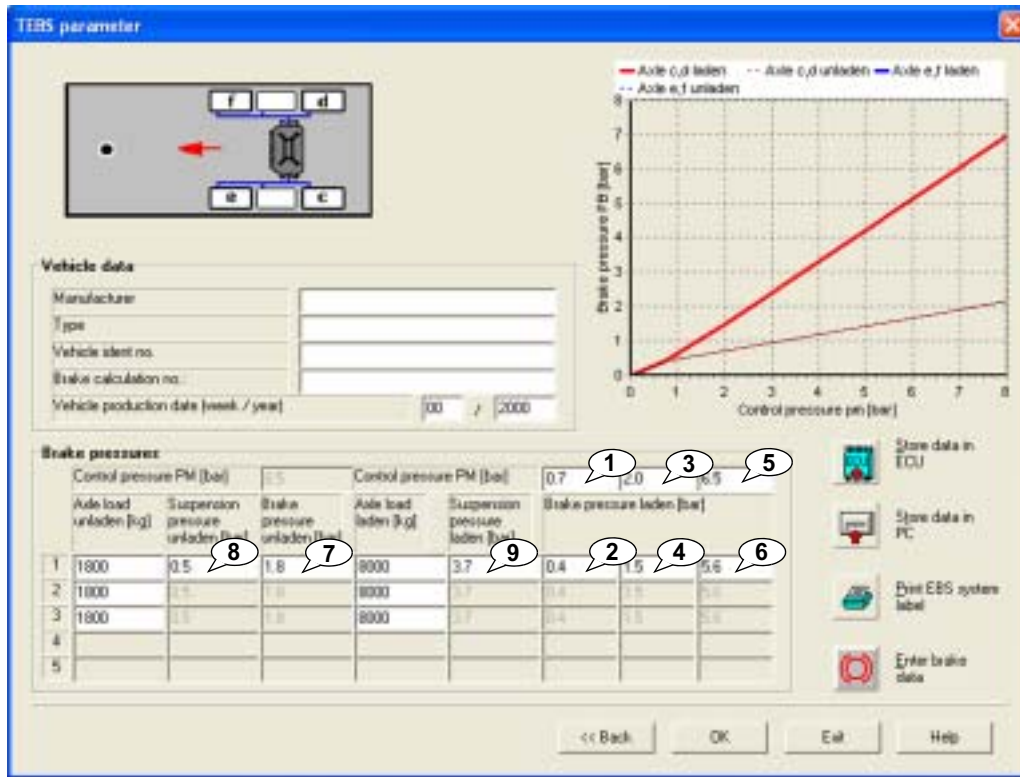


7.3 Parameter settings for lifting axle control on a semitrailer

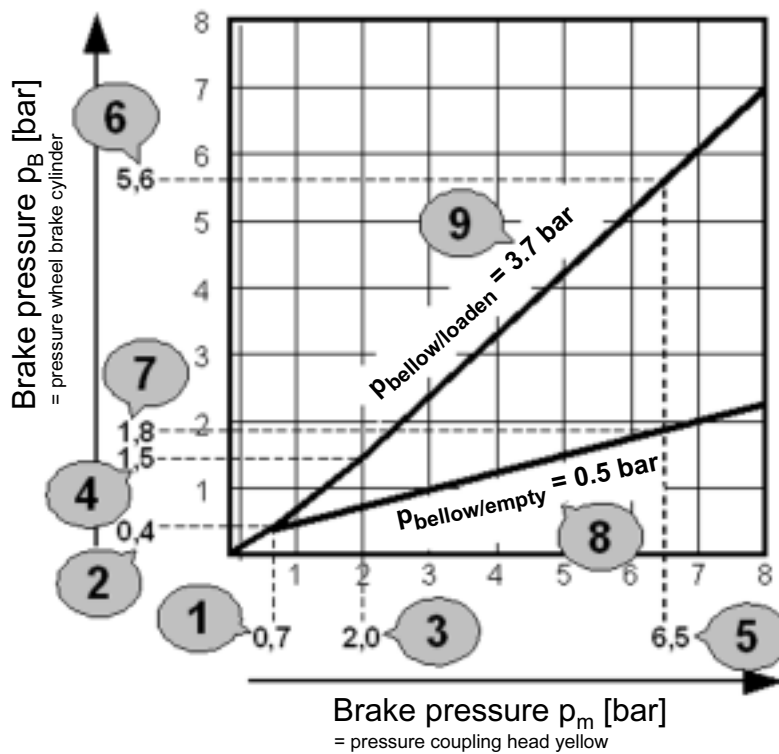
	Desired lifting axle function	PC diagnosis "EBS parameters"							
		Page 1	Page 2		Page 3				
		Lifting axles	ILS1	ILS2	IN/OUT1	Speed "Lifting axle raise" (km/h)	Percentage axle load lifting axle lower (%)	Traction help pressure restriction (bar)	stop of traction help (km/h)
Lift axle control									
1	One lifting axle; raise while standstill	X	X			0	max. 100		
2	One lifting axle; raise while ride	X	X			20	max. 100		
3	Two parallel lifting axles; raise while standstill	X	X			0	max. 100		
4	Two parallel lifting axles; raise while ride	X	X			20	max. 100		
5	Two separate lifting axles; raise while standstill	X	X	X		0	max. 100		
6	Two separate lifting axles; raise while ride	X	X	X		20	max. 100		
Traction help									
7	One lifting axle	X	X		TH	0...30	max. 100	1.3× bellow pressure, loaden	30
8	One lifting axle with residual pressure holding (additional solenoid valve)	X	X		TH(+)	0...30	max. 100	1.3× bellow pressure, loaden	30
9	Two separate lifting axles (ILS1 at LA 1)	X	X	X	TH	0...30	max. 100	1.3× bellow pressure, loaden	30
Special cases									
10	Only constrained lowering / no traction help	X	X		TH	0...30	max. 100	0	0
11	Only Traction Help / no lifting axle function	X	X		TH or TH(+)	0	10	1.3× bellow pressure, loaden	30

7.4 Parameters load sensing

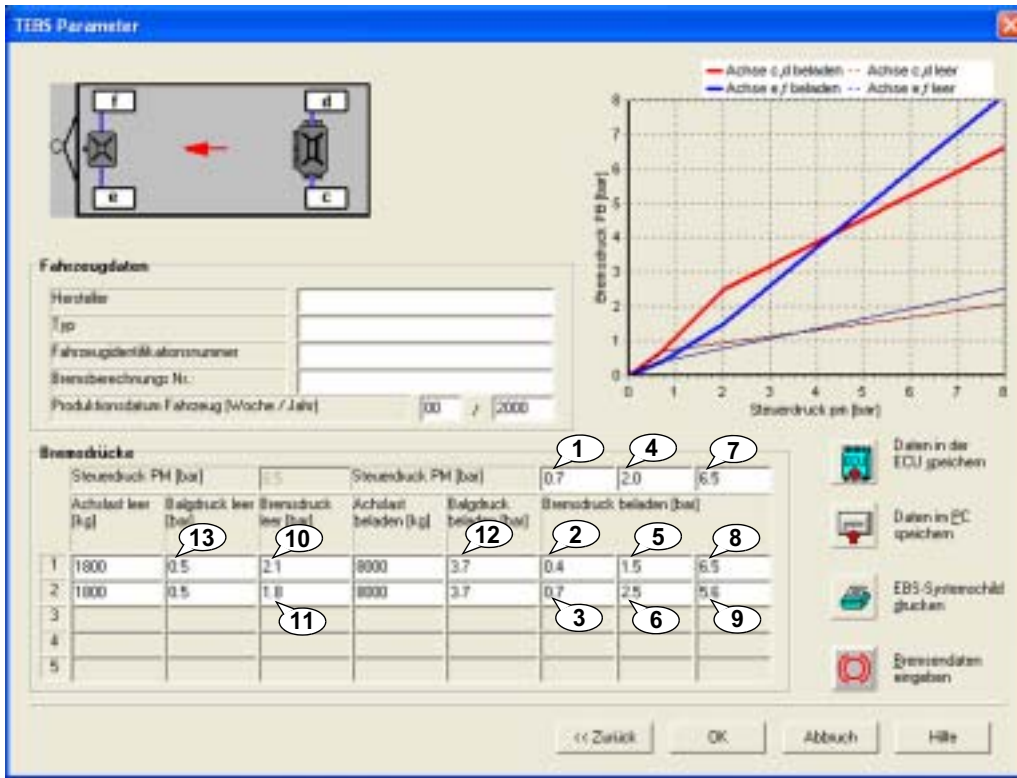
Relationship axle load/bellows pressure/brake pressure semi trailer



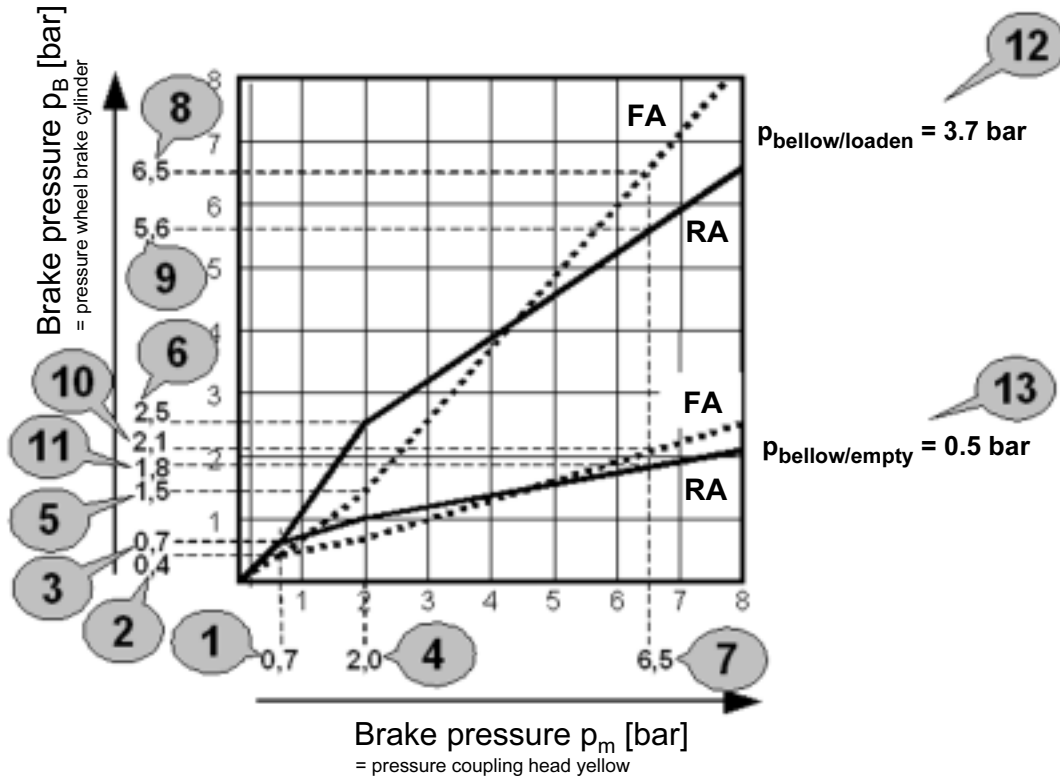
LSV function in the semi trailer



Relationship axle load/bellows pressure/brake pressure draw bar trailer

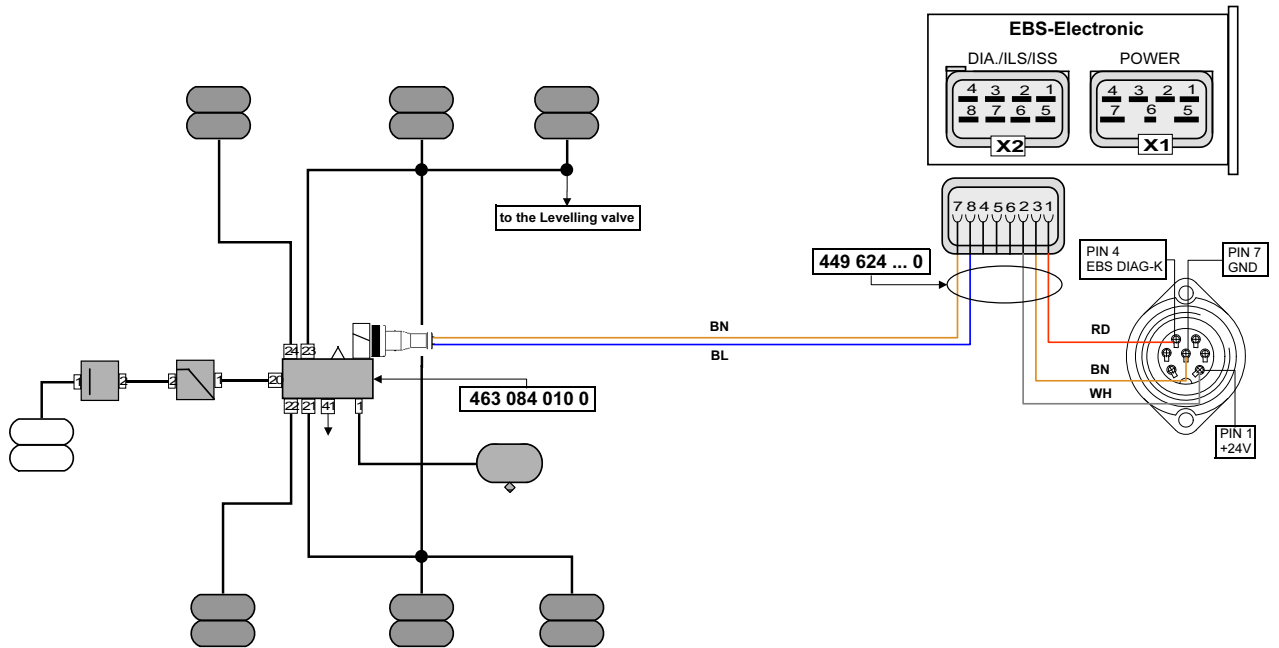


Brake force distribution in the drawbar trailer

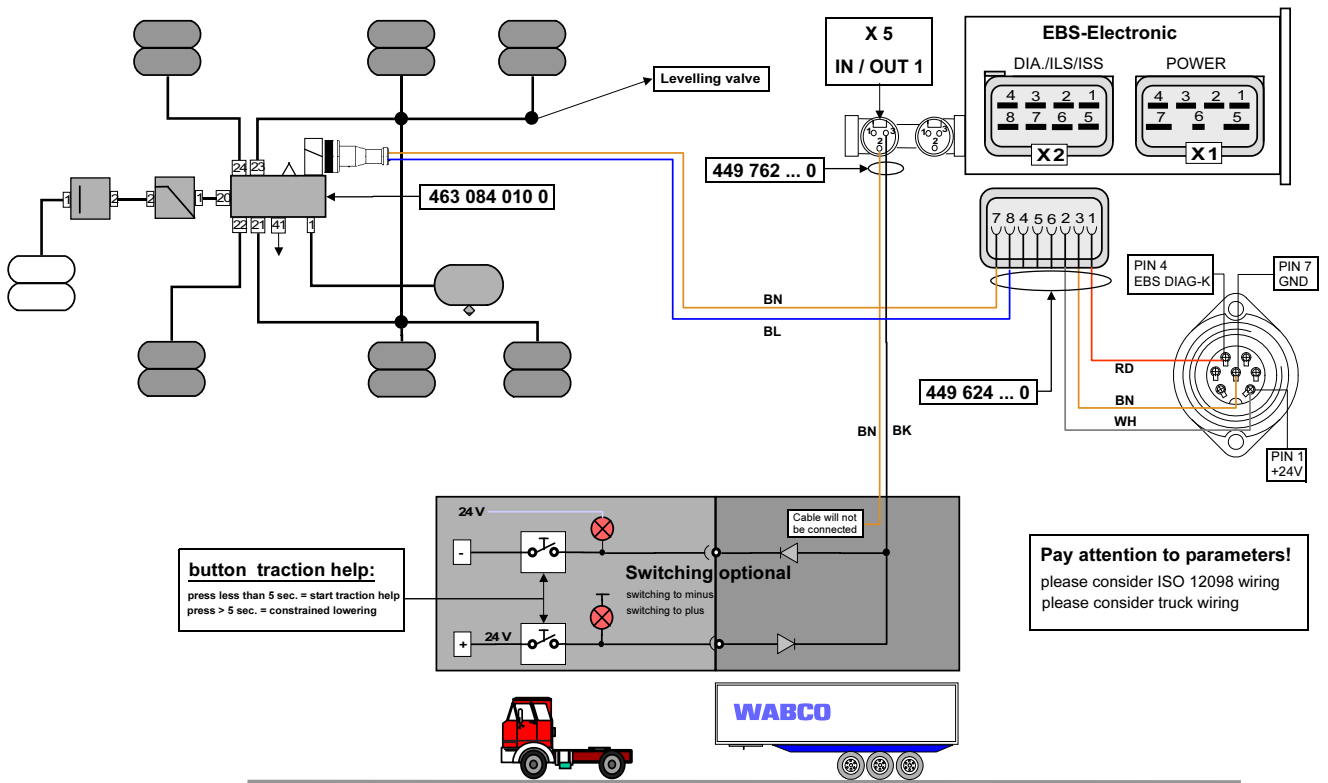


7.5 Lifting Axle Circuit

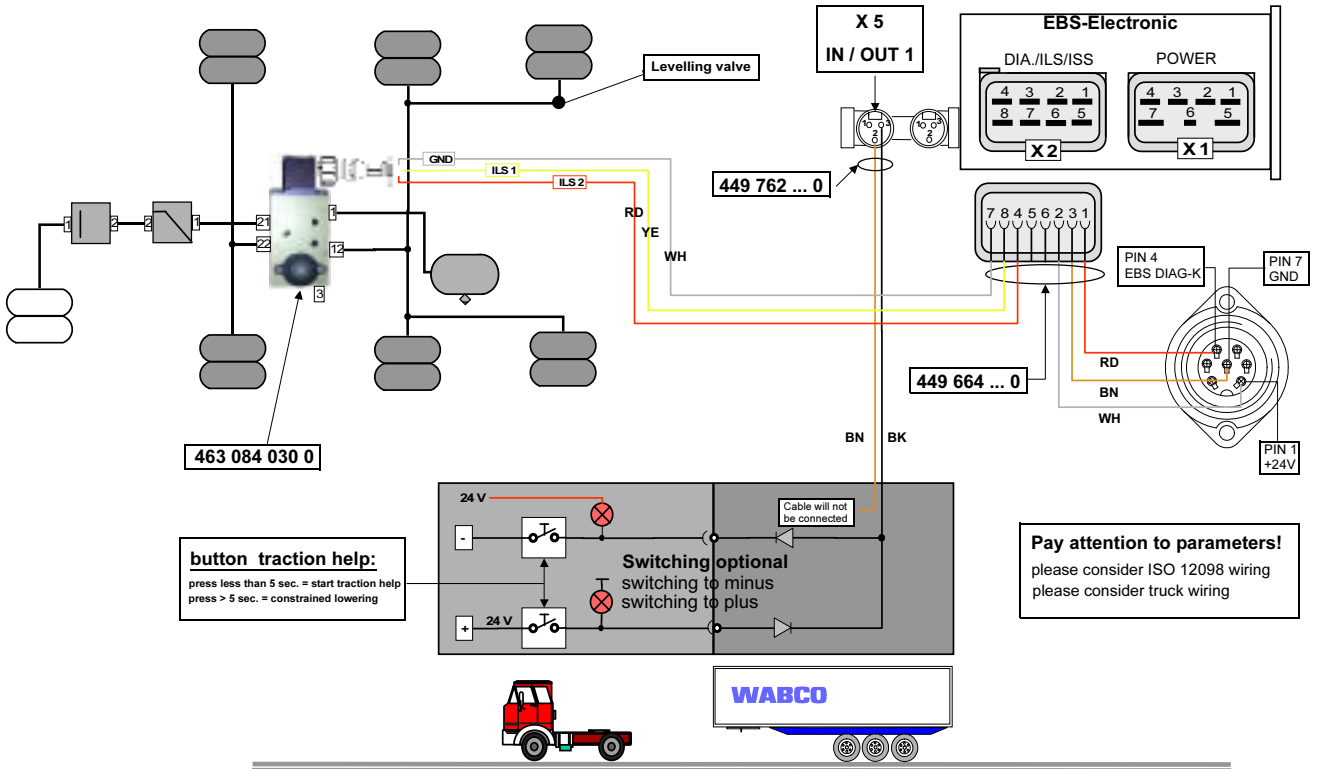
Lifting axle dual circuit



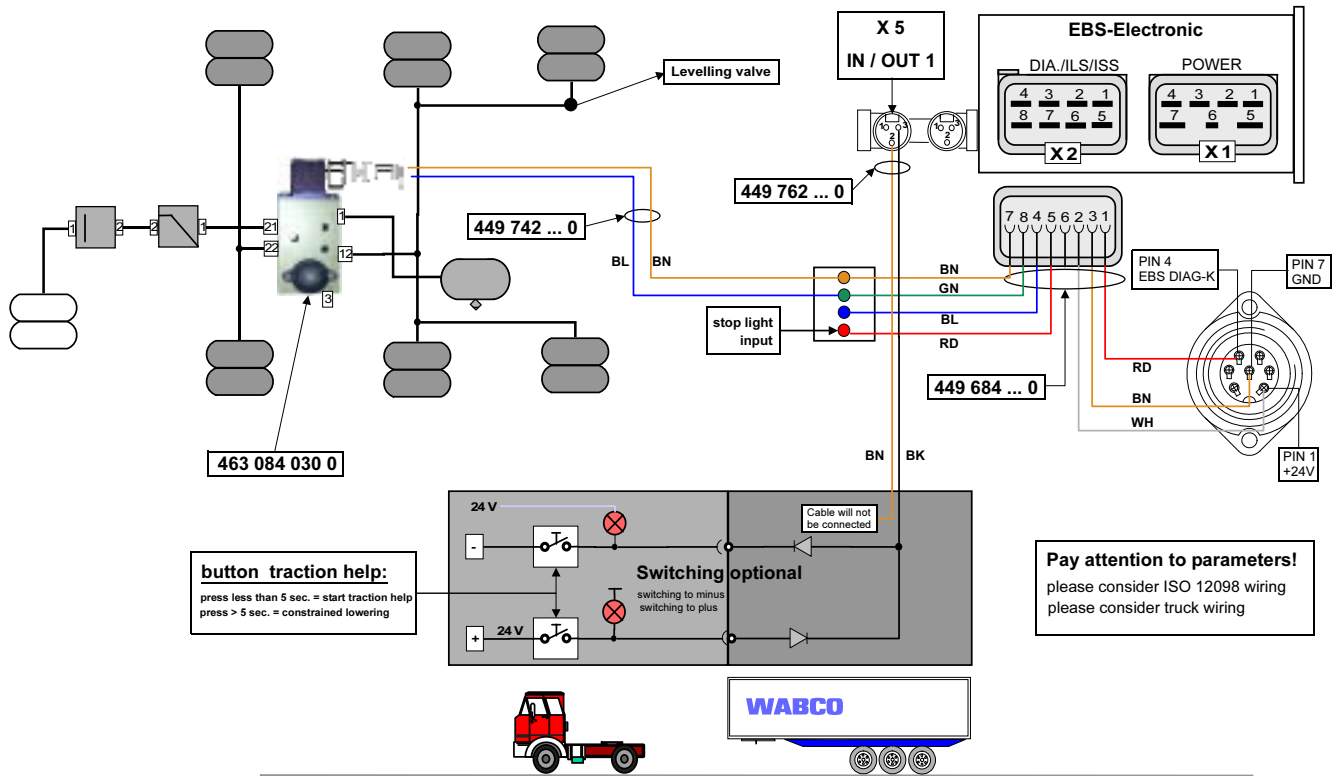
Lifting axle dual circuit Traction help



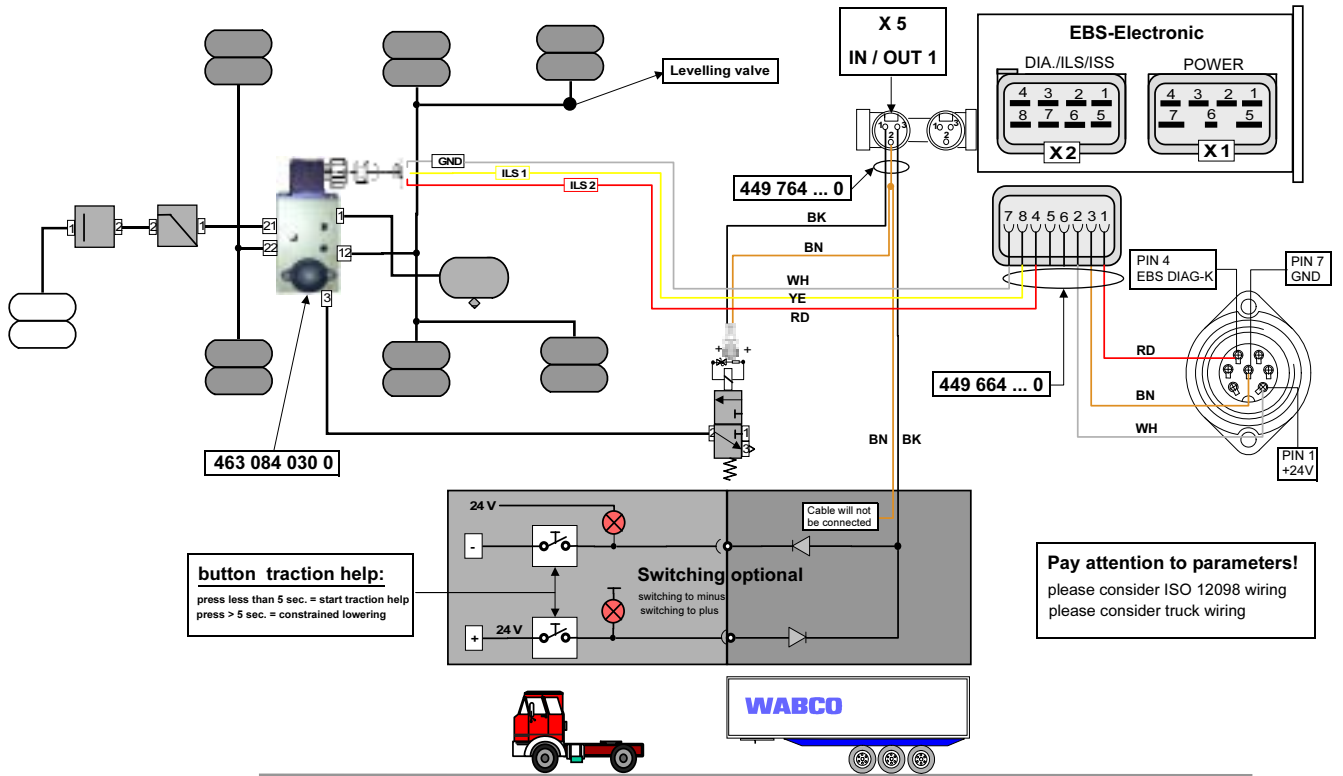
Lifting axle single circuit
Traction help



Lifting axle single circuit
Traction help, stop light input

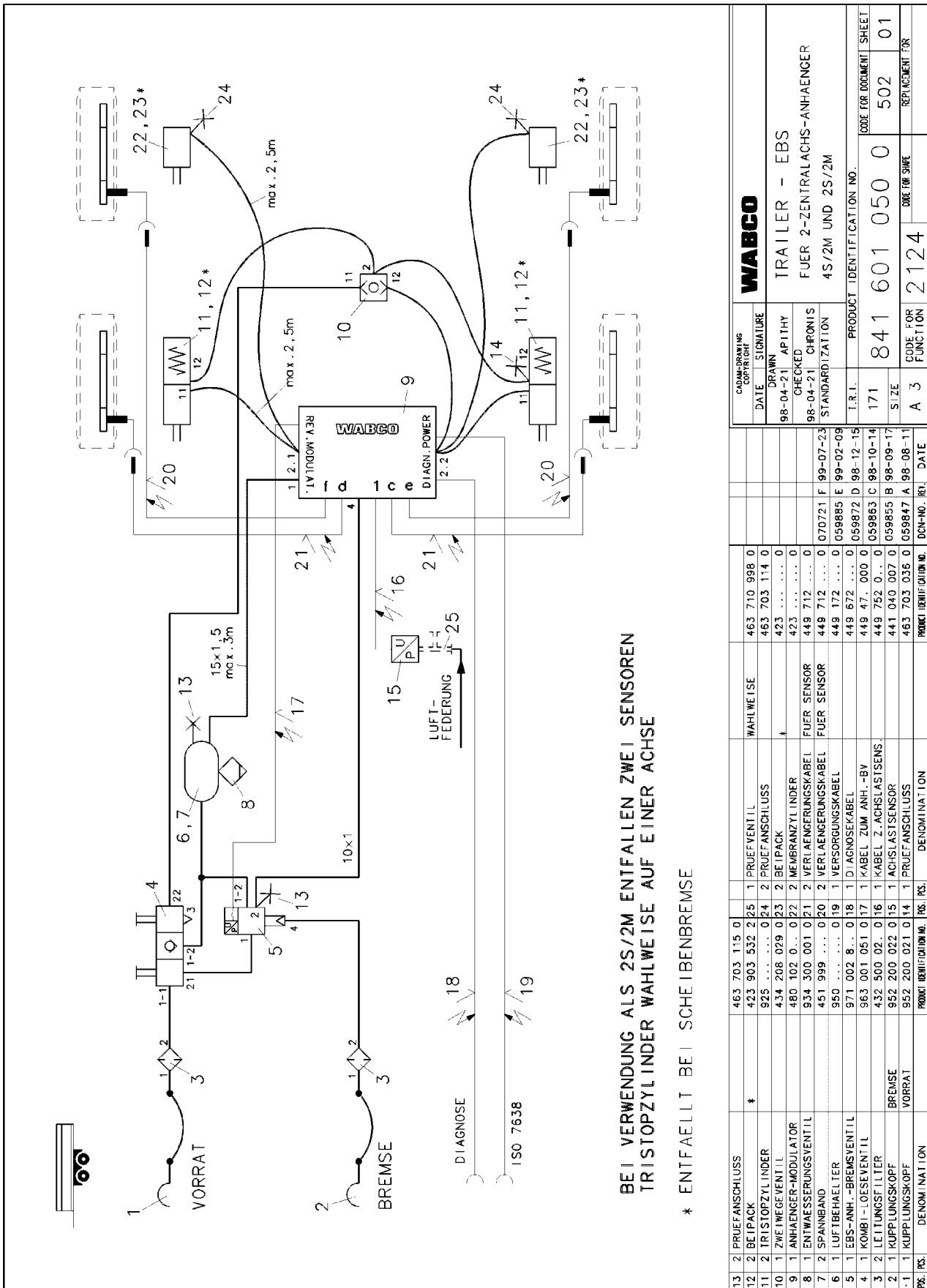


**Lifting axle single circuit
Traction help with residual pressure holding**



7.6 Braking system diagram Trailer EBS C

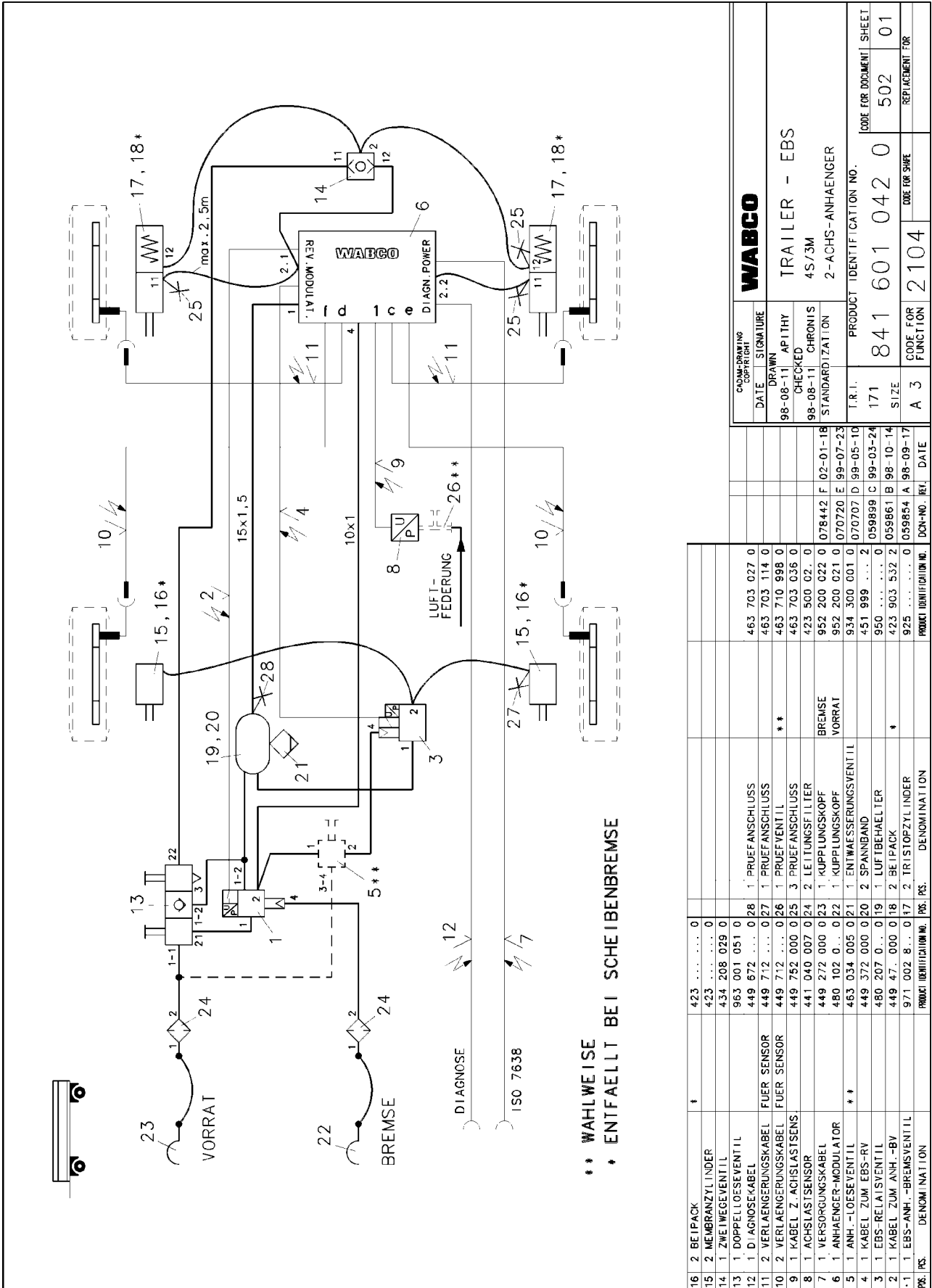
Trailer EBS C: Central axle trailer 2-axle 4S/2M and 2S/2M



CAD-DRAWING COPYRIGHT		WABCO	
DATE	SIGNATURE	TRAILER - EBS	
98-04-21	AP I THY	FUER 2-ZENTRALACHS-ANHAENGER	
98-04-21	CHRONIS	4S/2M UND 2S/2M	
STANDARDIZATION		PRODUCT IDENTIFICATION NO.	
T.R.T.		CODE FOR DOCUMENT SHEET	
171		841 601 050 0	
SIZE		CODE FOR	
A 3		FUNCTION	
		DATE FOR SHIP	
		2124	
		REPLACEMENT FOR	
		01	

FIG. POS.	DENOMINATION	FIG. POS.	DENOMINATION	FIG. POS.	DENOMINATION	FIG. POS.	DENOMINATION
13	2 PRUEFANSCHLUSS	463 703 115 0					
12	2 BEIPACK	423 903 532 225	1 PRUEFVENTIL	463 710 998 0			
11	2 TRISTOPZYLINDER	925 024	2 PRUEFANSCHLUSS	463 703 114 0			
10	1 ZWEIWEGEVENTIL	434 208 029 023	2 BEIPACK	423 0			
9	1 ANHAENGER-MODULATOR	480 102 0 ... 022	2 MEMBRANZYLINDER	423 0			
8	1 ENTWASSERUNGSVENTIL	934 300 001 021	2 VERLAEGERUNGSKABEL	449 712 ... 0			
7	2 SPANNBAND	451 999 ... 020	2 VERLAEGERUNGSKABEL	449 712 ... 0	070721 F	99-07-23	
6	1 LUFTBEHAELTER	950 019	1 VERSORGUNGSKABEL	449 172 ... 0	059885 E	99-02-09	
5	1 EBS-ANH.-BREMSVENTIL	971 002 8 ... 018	1 DIAGNOSEKABEL	449 672 ... 0	059872 D	98-12-15	
4	1 KOMBI-LOESEVENTIL	963 001 051 017	1 KABEL ZUM ANH.-BV	449 47 ... 000 0	059863 C	98-10-14	
3	2 LEITUNGSLITER	432 500 02 ... 016	1 KABEL Z. ACHSLASTSENS.	449 752 0 ... 0	059855 B	98-09-17	
2	1 KUPPLUNGSKOPF	952 200 022 015	1 ACHSLASTSENSOR	441 040 007 0	059847 A	98-08-11	
1	1 KUPPLUNGSKOPF	952 200 021 014	1 PRUEFANSCHLUSS	463 703 036 0	059847 A	98-08-11	

Trailer EBS C: 2-axle drawbar trailer 4S/3M



** WAHLWEISE
* ENTFALLT BEI SCHEIBENBREMSE

PG. NO.	DENOMINATION	PG. NO.	DENOMINATION	PG. NO.	DENOMINATION	PG. NO.	DENOMINATION
16	2 BEIPACK	423	..... 0				
15	2 MEMBRANZYLLINDER	423	..... 0				
14	1 ZWEIFACHVENTIL	434	208 029 0				
13	1 DOPPELLOESEVENTIL	963	001 051 0				
12	1 DIAGNOSEKABEL	449	672 026	1	PRUEFANSCHLUSS	463	703 027 0
11	2 VERLAENGERUNGSKABEL	449	712 027	1	PRUEFANSCHLUSS	463	703 114 0
10	2 VERLAENGERUNGSKABEL	449	752 000 026	3	PRUEFANSCHLUSS	463	703 036 0
9	1 KABEL Z. ACHSLASTSENS.	441	040 007 024	2	LEITUNGSKOPF	423	500 02. 0
8	1 ACHSLASTSENSOR	449	272 000 023	1	KUPPLUNGSKOPF	952	200 022 0
7	1 VERSORNGUNGSKABEL	480	102 0... 022	1	KUPPLUNGSKOPF	952	200 021 0
6	1 ANHAENGER-MODULATOR	463	034 005 021	1	ENTWAESSERUNGSVENTIL	934	300 001 0
5	1 ANH.-LOESEVENTIL	449	372 000 020	2	SPANNBAND	451	999 ... 2
4	1 KABEL ZUM EBS-RV	480	207 0... 019	1	LUFTEHAELTER	950	..... 0
3	1 EBS-RELAISVENTIL	449	47. 000 018	2	BEIPACK	423	903 532 2
2	1 KABEL ZUM ANH.-BV	971	002 8... 017	2	TRISTOPZYLLINDER	925	..... 0
-1	1 EBS-ANH.-BREMSVENTIL						

DATE	SIGNATURE	PRODUCT IDENTIFICATION NO.	DATE
98-08-11	API THY	841 601 042 0	99-07-23
CHECKED	CHRONIS		059899 C
STANDARDIZATION			070707 D
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			059899 C
			98-10-14
			059861 B
			98-09-17
			059854 A

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STANDARDIZATION			070707 D
			99-05-10
			059899 C
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			059854 A

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CHECKED	CHRONIS		059899 C
STANDARDIZATION			070707 D
			99-05-10
			059899 C
			98-10-14
			059861 B
			98-09-17
			059854 A

DATE	SIGNATURE	PRODUCT IDENTIFICATION NO.	DATE
98-08-11	API THY	841 601 042 0	99-07-23
CHECKED	CHRONIS		059899 C
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			99-05-10
			059899 C
			98-10-14
			059861 B
			98-09-17
			059854 A

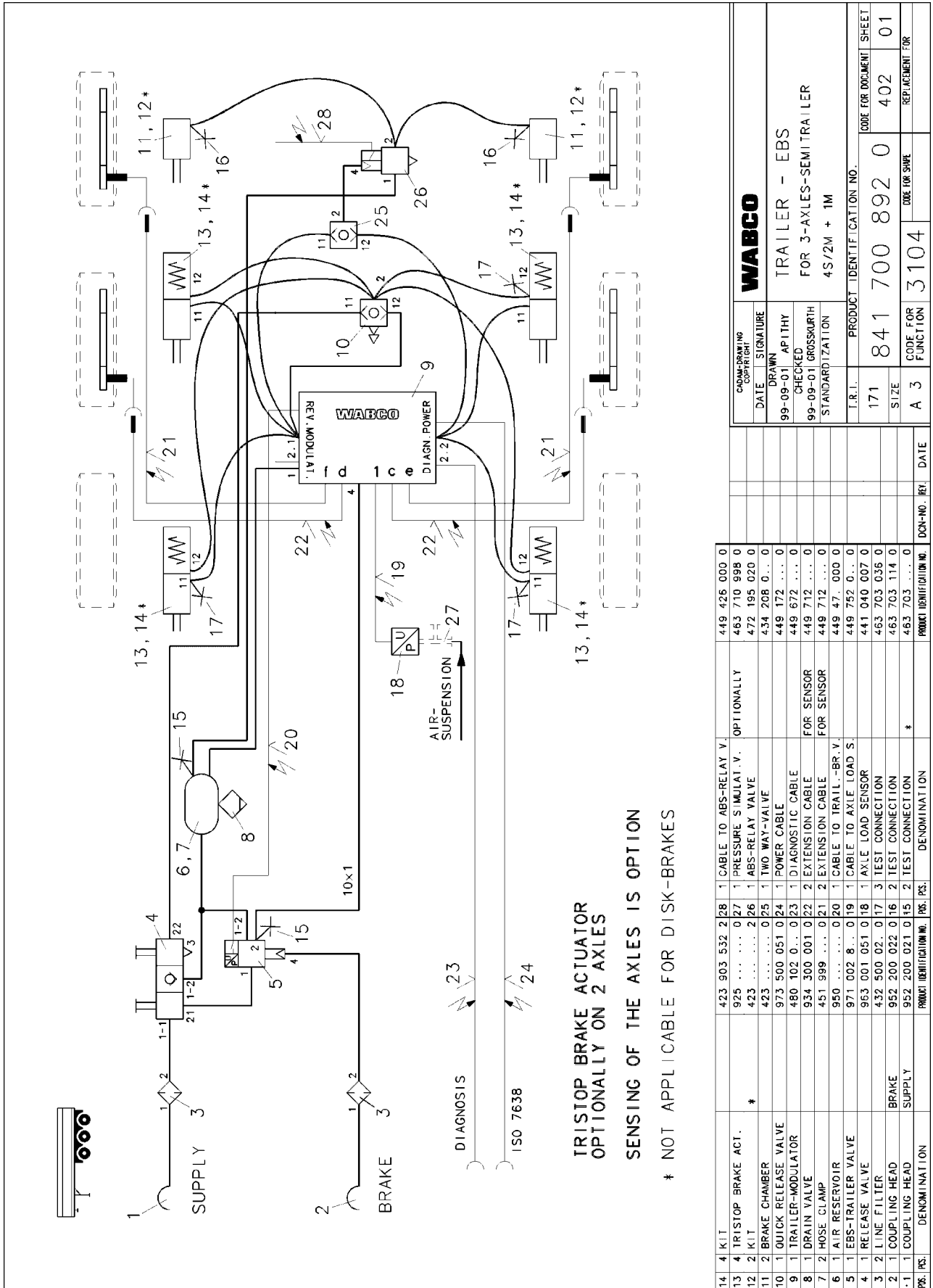
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98-08-11	API THY	841 601 042 0	99-07-23
CHECKED	CHRONIS		059899 C
STANDARDIZATION			070707 D
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98-08-11	API THY	841 601 042 0	99-07-23
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STANDARDIZATION			070707 D
			99-05-10
			059899 C
			98-10-14
			059861 B
			98-09-17
			059854 A

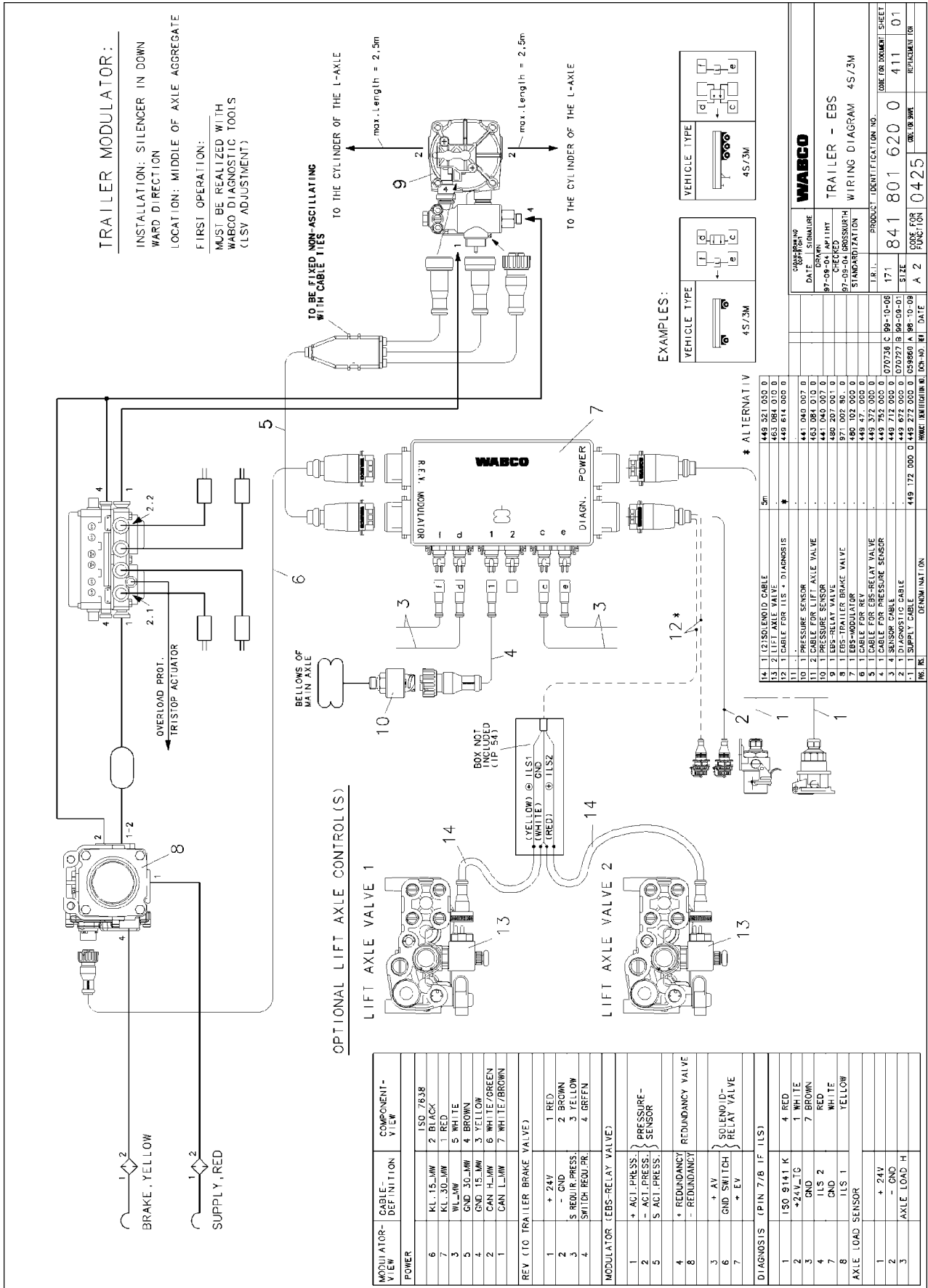
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98-08-11	API THY	841 601 042 0	99-07-23
CHECKED	CHRONIS		059899 C
STANDARDIZATION			070707 D
			99-05-10
			059899 C
			98-10-14
			059861 B
			98-09-17
			059854 A

DATE	SIGNATURE	PRODUCT IDENTIFICATION NO.	DATE
98-08-11	API THY	841 601 042 0	99-07-2

Trailer EBS C: Semi trailer 3-axle 4S/2M + 1M

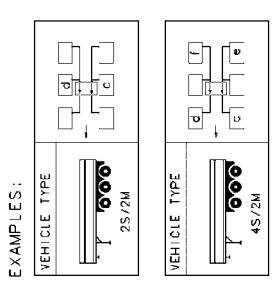
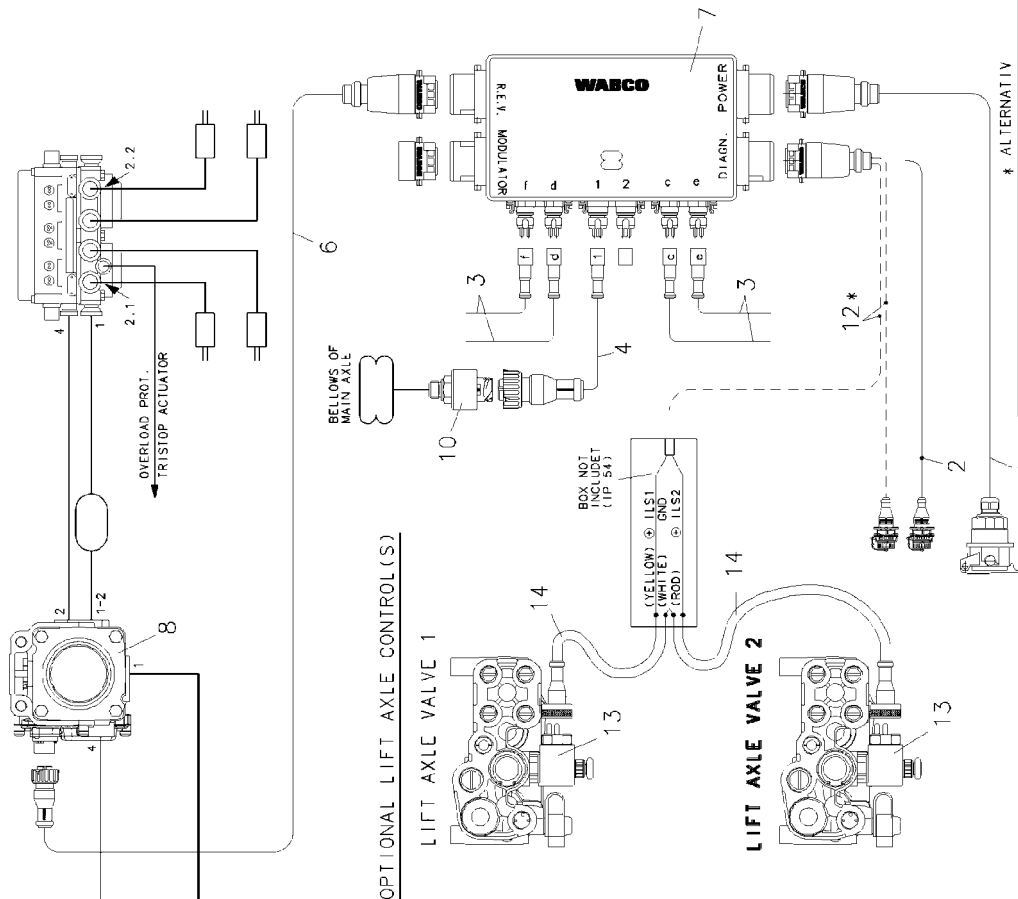


Trailer EBS C: Installation diagram 4S/3M



Trailer EBS C: Installation diagram 4S/2M

TRAILER MODULATOR:
 INSTALLATION: SILLENCER IN DOWN
 WARD DIRECTION
 LOCATION: MIDDLE OF AXLE AGGREGATE
 FIRST OPERATION:
 MUST BE REALIZED WITH
 WABCO DIAGNOSTIC TOOLS
 (LSV ADJUSTMENT)



WABCO
TRAILER - EBS
WIRING DIAGRAM 4S/2M
PRODUCT IDENTIFICATION NO.
171
841 801 621 0
411 01
0425

NO.	DESCRIPTION	QTY	UNIT	DATE
14	1 (2) SOLENOID CABLE	5m		
13	2 LIFT AXLE VALVE			
12	1 CABLE FOR ILS + DIAGNOSIS			
10	1 PRESSURE SENSOR			
9	1 PRESSURE SENSOR			
8	1 EBS-TRAILER BRAKE VALVE			
7	1 EBS-MODULATOR			
6	1 CABLE FOR REV			
5	1 CABLE FOR PRESSURE SENSOR			
4	1 SENSOR CABLE			
3	1 DIAGNOSTIC CABLE			
2	1 SUPPLY CABLE			
1	1 SUPPLY CABLE			

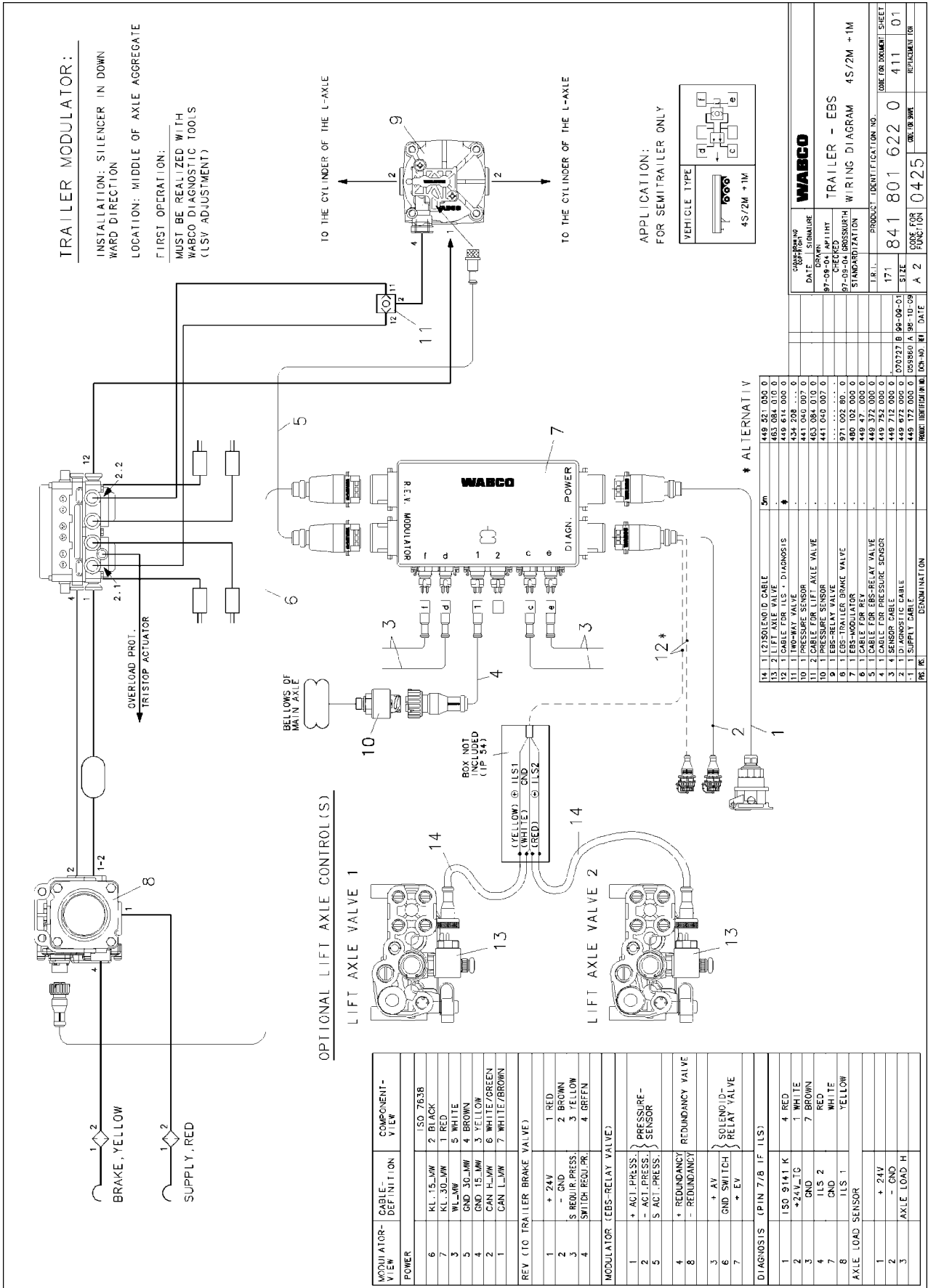
MODULATOR - CABLE - DEF INITION	COMPONENT - VIEW
KL. 15_LW	ISO 7638
KL. 30_MW	2 BLACK
WL. 10_LW	RED
WL. 10_MW	5 WHITE
GN. 15_LW	4 BROWN
GN. 15_MW	3 BROWN
CAN. P_LW	6 WHITE/GREEN
CAN. L_MW	7 WHITE/BROWN

REV (TO TRAILER BRAKE VALVE)	COMPONENT - VIEW
1	+ 24V
2	- GND
3	S. REQUIR. PRESS.
4	SWITCH. REQUIR. PR.

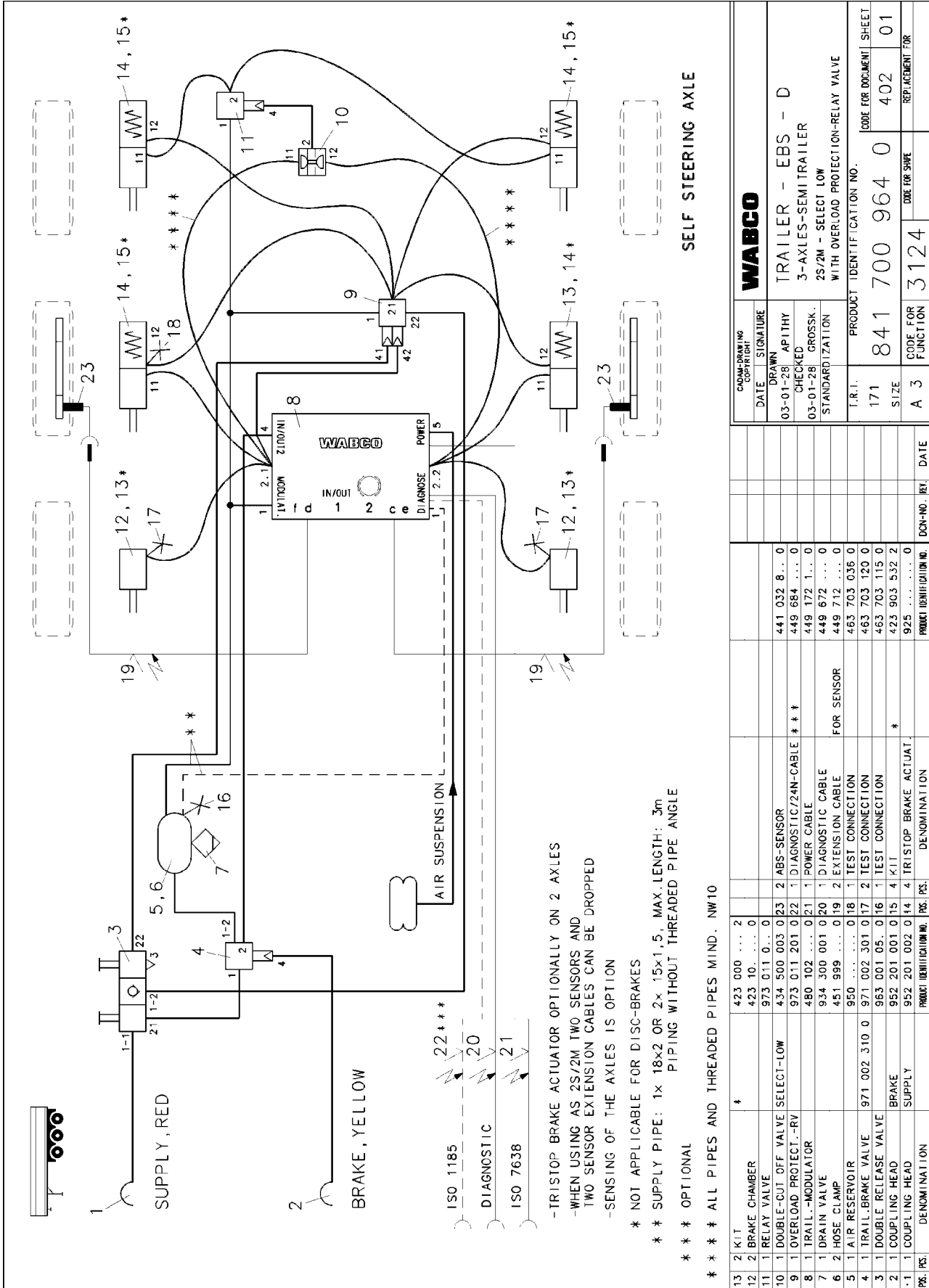
MODULATOR (EBS-RELAY VALVE)	COMPONENT - VIEW
+ ACT. PRESS.	PRESSURE - SENSOR
- ACT. PRESS.	
+ REDUNDANCY	REDUNDANCY VALVE
- REDUNDANCY	
+ AV	SOLENOID - RELAY VALVE
GN. SWITCH	

DIAGNOSIS (PIN 7/8 IF ILS)	COMPONENT - VIEW
ISO 9141 K	4 RED
+24V_TG	1 WHITE
GND	7 BROWN
ILS 2	RED
CND	WHITE
ILS 1	YELLOW

Trailer EBS C: Installation diagram 4S/2M +1M



Trailer EBS D: 3 axle semitrailer 2S/2M "Select Low" for adhesion-steered trailing axle with trailer emergency valve, double release valve and and 2-way valve



Trailer EBS D: 3 axle semitrailer 4S/3M with trailer emergency valve, double release valve and 2-way valve

