CTU

CONFORMITY TEST UNIT

Operating Instructions

WABCO

Edition 4
Version 1 (03.2023)
815 010 190 3 (en)

This publication is not subject to an updating service.
You will find the current version at:
http://www.wabco.info/i/142

Table of contents

Table of contents

1 Information about this document

1.1 Validity

This document applies to the following WABCO part numbers:

- 446 310 000 0
- 446 310 010 0
- 446 310 011 0
- 446 310 013 0

and all associated components, see chapter "6 Description of components", page 19.

1.2 Symbols used

i	Important information, notes and/or tips

Descriptive text

▸ For individual action steps

1. Action step 1
2. Action step 2
   ↳ Consequence of an action

- Listing

2 List of abbreviations

Abbreviation	Meaning
CAN	(Controller Area Network); network for vehicle control systems
COM	(Component Object Model); technology from Microsoft for inter-process communication
CTU	(Conformity Test Unit); measuring device for conformity tests
EBS	Electronic Braking System
ECU	Electronic Control Unit
LSV	Load-Sensing Valve
RGE	(Running Gear Equipment); wheel suspension system
UNECE	United Nations Economic Commission for Europe

3 Basic safety instructions

3.1 Proper use

The ZF/WABCO product is intended exclusively for the purpose specified in the contract and agreed upon delivery. Any other use or use beyond this is considered improper. Proper use also includes observing this documentation and the applicable documents in order to avoid malfunctions and damage during operation. The ZF/WABCO product is designed and manufactured according to state-of-the-art technology and is safe to operate when used as intended. However, hazards may arise from this ZF/WABCO product if it is used improperly or not for its intended use by unauthorised, untrained or uninstructed personnel.

3.2 Obvious misuse

Other uses than described under 3.1 are not permitted.

3.3 Qualification and knowledge of the specialist staff

The activities described in this documentation require basic knowledge of automotive engineering and knowledge of the associated technical terms. To ensure safe use, these activities may therefore only be carried out by an appropriate specialist or a person instructed by a specialist (fitter).

A specialist is someone who, on the basis of his technical training, knowledge and experience as well as his knowledge of the relevant regulations, can assess the work assigned to him, recognise possible dangers and take suitable safety measures. A specialist must comply with the relevant specialist rules.

A fitter is someone who, on the basis of his knowledge and experience as well as his knowledge of the relevant regulations, can assess the work assigned to him, recognise possible dangers and take suitable safety measures. A fitter must comply with the relevant specialist rules.

3.3.1 Structure of the warning notes

Warnings are structured as follows:

- Signal word and pictogram
- Correct naming of the hazard
- Description of the consequences if the hazard is ignored
- Description of the measure(s) to prevent the hazard

3.3.2 Explanation of the warning notes

⚠ WARNING

Indicates a hazard that may result in death or serious injury if not avoided.

⚠ CAUTION

Indicates a hazard that may result in slight or moderately serious injury if not avoided.

NOTICE

Indicates a hazard that may result in material damage if not avoided.

3.4 General safety instructions

- Follow all safety information, instructions and notices in this document to avoid personal injury and material damage.
- Follow regional and national regulations on accident prevention.
- Make sure your workplace is dry as well as adequately lit and ventilated.
- Secure the vehicle against rolling by using chocks.
- Only use spare parts approved by ZF/WABCO or the vehicle manufacturer.

3.5 Personal protective equipment

- Wear personal protective equipment to prevent injury:
  - Safety boots
  - Safety goggles
  - Protective gloves

4 Introduction

This Conformity Test Unit (CTU) can be used to carry out the following tests.

The CTU is used for testing the requirements as described in the UNECE Regulation 13. Requirements up to and including supplement 8 for amendment series 11 of the UNECE R13 have been integrated.

The CTU replaces the time measurement unit and can be used for the following measurements:

- Check for sufficient capacity of the supply reservoirs, both on the towing vehicle and on the trailer
- Measurement of the threshold times on conventional and electronically controlled pneumatic braking systems on towing vehicles as well as trailers
- Compatibility of towing vehicle and trailer ports, pneumatic as well as electronic
- Test of the CAN data line and CAN data transmission
- Test of the CAN data

The last update of the CTU concerns an improved test of the towing vehicle reservoir capacity and a new capacity test for trailers.

> i UNECE R13
>
> For further information, direct your web browser to:
> http://www.UNECE.org/trans/main/wp29/wp29regs1-20.html

Tests on the towing vehicle

- Testing the pressure increase behaviour on the least favourably positioned wheel brake cylinder on a vehicle with no trailer control system (UNECE R13, Annex 6, point 2)
- Testing of pressure increase behaviour on the least favourably positioned wheel brake cylinder, and testing of pressure increase behaviour at the yellow coupling head for vehicles with pneumatic trailer control system (UNECE R13, Annex 6, point 2)
- Testing of pressure increase behaviour on the least favourably positioned wheel brake cylinder, and testing of pressure increase behaviour at the yellow coupling head, as well as testing of signal behaviour at the ISO 7638 7-pin socket for vehicles with pneumatic and electronic trailer control system (UNECE R13, Annex 6, point 2)
- Testing of pressure drop behaviour at the red coupling head in the event of a failure of the pneumatic control signal (disconnection behaviour) for vehicles with pneumatic trailer control system (UNECE R13, Annex 6, point 2.7)
- Testing of the data transfer at the ISO 7638 electronic trailer port (UNECE R13, Annex 16)
- Electrical simulation of the trailer – Testing of reactions induced by means of CAN messages at the ISO 7638 electronic trailer port (UNECE R13, Annex 17, point 3)
- Testing of supply pressure reservoir volume (UNECE R13, Annex 7, point A.1.2)

Tests on the trailer

- Test of the response and pressure rise characteristics at the least favourably positioned wheel brake cylinder when a pneumatic control signal is input (UNECE R13, Annex 6, point 3)
- Test of the response and pressure rise characteristics at the least favourably positioned wheel brake cylinder when a pneumatic and electronic control signal is input (UNECE R13, Annex 6, point 3)

- Testing of the data transfer at the ISO 7638 electronic towing vehicle port (UNECE R13, Annex 16)
- Electrical simulation of the towing vehicle – Testing of reactions induced by means of CAN messages at the ISO 7638 electronic towing vehicle port (UNECE R13, Annex 17, point 4)
- Testing of supply pressure reservoir volume (UNECE R13, Annex 7, point A.1.3)
- Testing of supply pressure reservoir volume (UNECE R13, Annex 8, point A.2.5)
- Testing of supply pressure reservoir volume (UNECE R13, Annex 20, point 7.3)
- Tests on the "Towing vehicle – trailer" data port

The exchange of digital information at the electrical connection between the towing and towed vehicle is covered in ISO 11992. The provisions therein have been partially transferred to UNECE R13 and must be verified. It must in particular be possible to perform the following tests:

- Search and display the messages arriving at the 7-pin socket
- Display the data content and repetition times of the incoming EBS messages
- Display of data bus utilisation

Testing of other special functions

Other special functions are primarily used for CTU self-verification. Calibration and control functions are combined. Specifically, they are:

- Calibration of the CTU hardware (UNECE R13, Annex 6, point 3)
- Calibration of the simulator internal pressure sensors (UNECE R13, Annex 6, point 3)
- Pneumatic verification of the simulator (UNECE R13, Annex 6, point 3)

4.1 General operating instructions

Compliance with the following operational guidelines is required so as to ensure the trouble-free operation of the CTU.

Calibration

Certain basic principles must be observed with regard to the calibration of the measurement recorders (e.g. pressure sensors). The measurement recorders are subject to the relevant applicable national calibration requirements.

The pressure sensors must be verified in a calibration laboratory. In the event that the pressure sensors do not comply with the set calibration limits, they must be replaced.

Testing the time measurement equipment

A note on the "Directive governing the use, characteristics and testing of time measurement devices for the determination of communication and reaction times for certain operating brakes of motor vehicles and trailers" to §41 of the Road Traffic Licensing Regulation:
In paragraph 1, sub-section 1.3, this directive refers to the need for routine testing and describes this further in paragraph 7 "Routine testing". The statements therein can be summarised as follows:

- Routine tests shall be carried out at intervals of no more than 2 years.
- The inspecting body shall issue a certificate of the routine test.
- The routine test shall compare a device to be tested with a normal device, who limit errors shall be defined in terms of paragraph 5.6 of the directive.

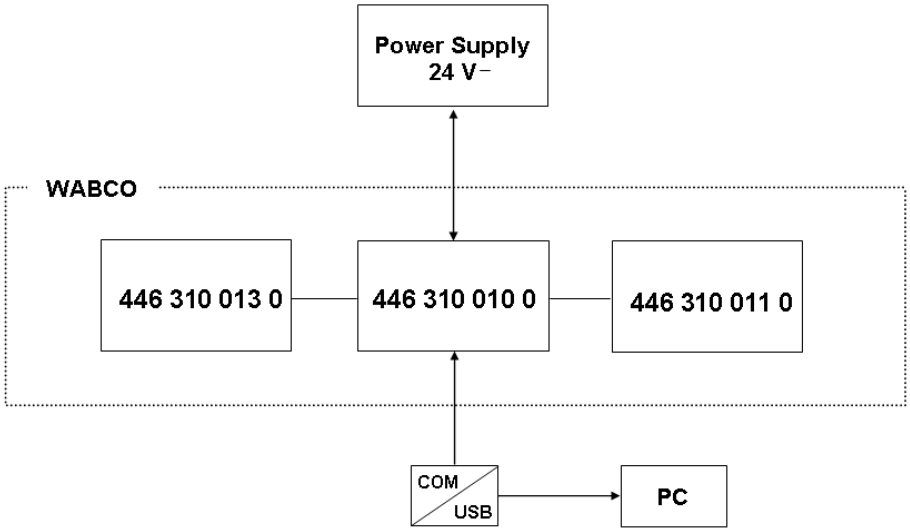
5 CTU concept

In order to be properly equipped for the various possible uses of the CTU, the CTU is offered in three modules:

- Basic package 446 310 010 0
- "Towing vehicle" expansion package 446 310 013 0
- "Trailer" expansion package 446 310 011 0

This categorisation was decided upon in order to be able to meet the different requirements of technical services, towing vehicle manufacturers, trailer vehicle manufacturers and workshops.

Overview of package



Using the USB RS232 adapter

The connection between the CTU ECU and the computer is normally established by means of a serial data connection. The computer's 9-pin COM port is used for this.

Besides the COM port, the computer's USB port can also be used as an alternative. A USB RS232 adapter is used for this purpose. This adapter is also connected between the computer and the CTU ECU.

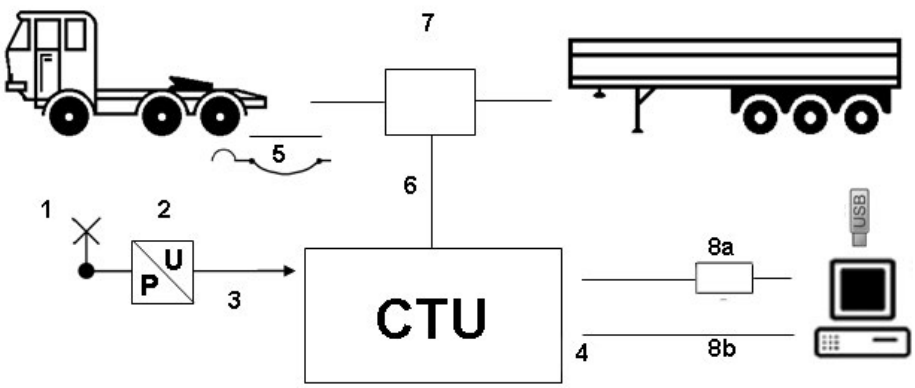
5.1 Basic package 446 310 010 0

The basic package can be used to carry out tests on the ISO 7638 port.

The basic package enables the electronic verification of the towing vehicle/trailer ISO 7638 port (EBS socket) as well as a towing vehicle/trailer simulation. The basic package is accommodated in an accessories case and includes the basic electronic equipment for the performance and evaluation of investigations. The basic package also includes components which are required in both the towing vehicle and the trailer (pressure sensor for the least favourably positioned wheel brake cylinder including a pressure sensor cable as well as connector element for the wheel brake cylinder and hose to the red coupling head).

CTU concept

Basic package



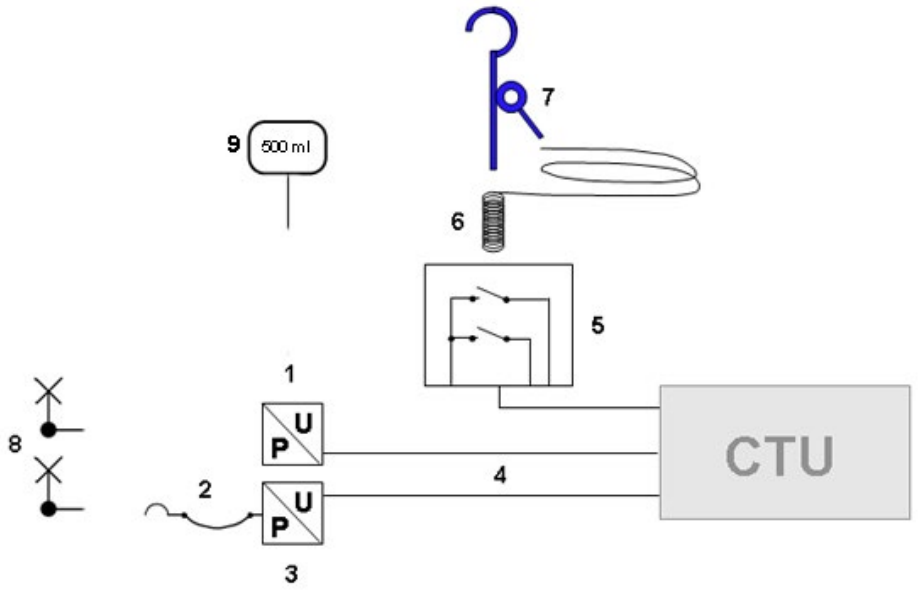
Item	Designation
1	"Test connection to pressure sensor adapter" hose
2	Pressure sensor adapter
3	"CTU to pressure sensor adapter" cable
4	CTU
5	"Red coupling head" hose
6	"ISO 7638 adapter to ECU" cable
7	Insertion adapter
8a/8b	Alternatively: **8a** USB RS232 adapter (+ USB stick)/ **8b** data transmission cable CTU to PC

5.2 Towing vehicle expansion package 446 310 013 0

Together with the basic package, this expansion package is particularly suitable for towing vehicle manufacturers who use the CTU for system verifications and optimisation, for example.
The "Towing vehicle" expansion package comprises components for performing pressure flow time records and measurements on the towing vehicle.
The components of the "Towing vehicle" expansion package are included in the accessories case if ordered.
The "Towing vehicle" expansion package consists of the following components:

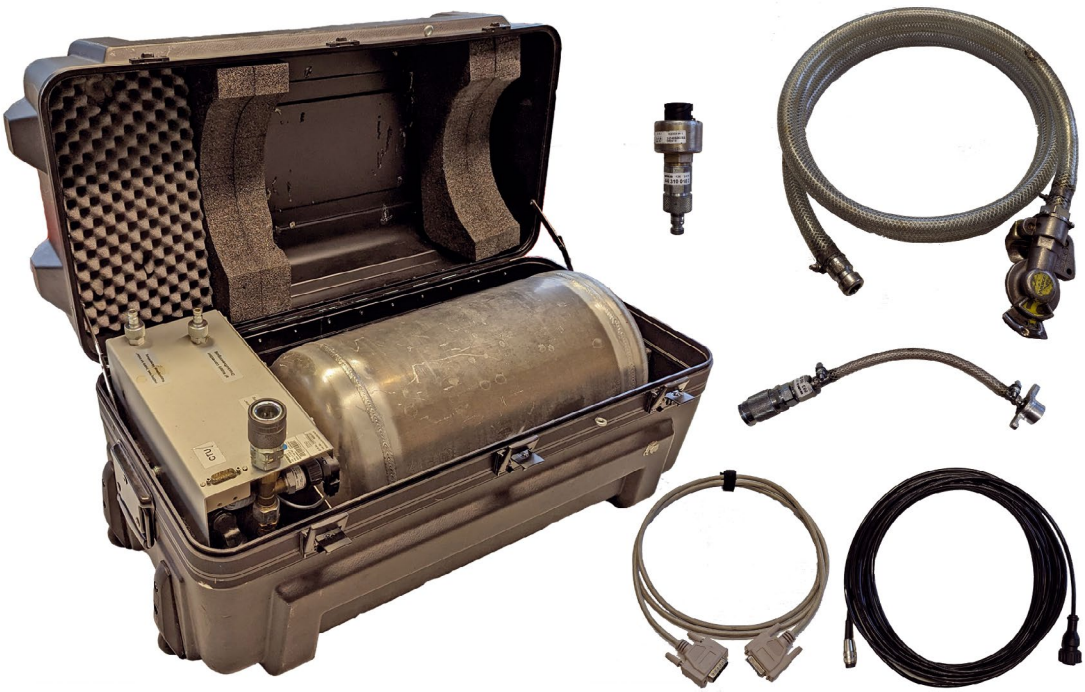
CTU concept

"Towing vehicle" expansion package



Item	Designation
1	Pressure sensor adapter + "Red coupling head" pressure sensor (2x)
2	"Yellow coupling head" hose (together with yellow trailer connection coupling head)
3	Pressure sensor adapter + "Yellow coupling head" pressure sensor
4	"CTU to pressure sensor adapter" cables (2x)
5	Treadle (double contactor)
6	Cable pull for treadle
7	Actuator for treadle
8	"Test connection to pressure sensor adapter" hose (2x)
9	500 ml test volume

5.3 Trailer expansion package 446 310 011 0



Together with the basic package, the "Trailer" expansion package is particularly suitable for trailer manufacturers who also use the CTU for system verifications and optimisation, for example.

The "Trailer" extension package includes:

- simulator for simulating the towing vehicle behaviour (in accordance with UNECE R13 annex to Annex 6)
- ensuring the pneumatic supply of the trailer vehicle
- generating sudden brake applications
- various cables
- components for trailer verification in accordance with UNECE R13
- provision of the compressed air supply to the reservoir from an in-house unit (or from a towing vehicle)

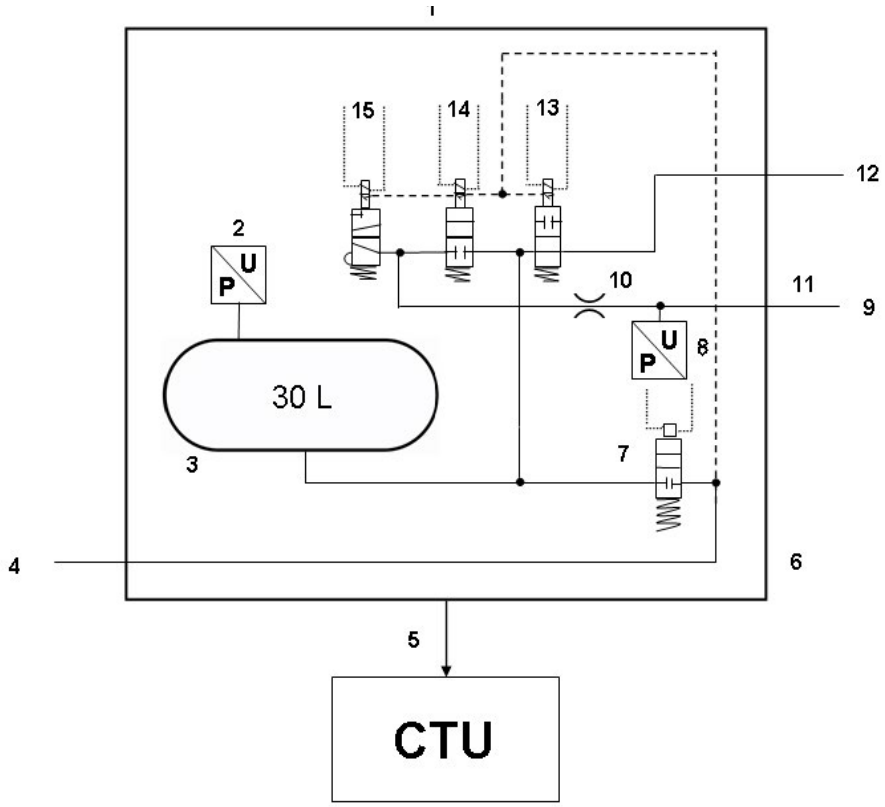
The measurement recorder components required for connecting to the wheel brake cylinder are provided in the basic package. The components of the "Trailer" expansion package are accommodated in the accessories case in which the simulator is located.

CTU concept

The "Trailer" expansion package consists of the following components:

CTU concept

"Trailer" expansion package



Item	Designation
1	Simulator
2	Pressure sensor
3	Reservoir 30 litres
4	Supply > 6.5 bar
5	"Simulator to CTU" cable
6	Simulator
7	Solenoid valve
8	Pressure sensor
9	Trailer control pressure
10	Diaphragm 4 mm
11	Coupling head, yellow "control line trailer" – brake line
12	Coupling head, red "supply line trailer" – supply line
13, 14, 15	Solenoid valves
16	Connection with connecting hose
Not illustrated	Pressure sensor with adapter for test port

6 Description of components

Figure/part number	Component/description	Basic package	Expansion packages	
			Towing vehicle 446 310 013 0	Trailer 446 310 011 0
446 310 019 0  	Case • component list for basic package and "Towing vehicle" expansion package	1	1	
446 310 000 0 	CTU • central control unit for the measurements	1		
446 310 022 0	USB stick • with measuring software	1		
446 310 016 2	ISO 7638 adapter set • consisting of: ISO 7638 insertion adapter K1a 446 310 017 2, cable K1b 446 310 018 2 • plug adapter for ISO 7638 port including data transmission cable and CTU power supply connector	1		
446 310 021 2 	"PC to CTU" data transfer cable	1		
446 310 014 4	USB RS232 adapter • adapter for establishing a data connection via the computer's USB port	1		

Description of components

Figure/part number	Component/description	Basic package	Expansion packages	
			Towing vehicle 446 310 013 0	Trailer 446 310 011 0
435 201 790 2 435 201 410 2 	Actuator (435 201 790 2) • consisting of: hook with clamping device		1	
	Cable pull (435 201 410 2) • consisting of: steel cable with tension spring		1	
446 310 015 2 	Treadle • triggering the measurement process in the towing vehicle		1	
446 310 300 2 	"Pressure sensor to CTU" connector cable	1	2	1
894 600 001 0 	Pressure sensor • pressure measurement unit	1	2	1
893 600 021 0 	Hose • with yellow coupling head to connect the towing vehicle and pressure measurement point		1	
893 600 022 0 	Hose • with red coupling head to connect the towing vehicle and pressure measurement point	1		
893 600 024 0 	Connector element • to connect the wheel brake cylinder and pressure measurement point	1	2	1

Description of components

Figure/part number	Component/description	Basic package	Expansion packages	
			Towing vehicle 446 310 013 0	Trailer 446 310 011 0
446 310 023 0 	Simulator case • component list for the "Trailer" expansion package			1
446 310 025 2 	Simulator • triggering the measurement process on the trailer and pneumatic towing vehicle simulation			1
446 310 024 2 	"Simulator to CTU" data transmission cable			1
893 600 023 0 	Hose • with yellow coupling head for connection to trailer			1
446 310 016 4 	500 ml test volume • for towing vehicle pressure container test		1	

Correct measurements can only be achieved if the hoses supplied by ZF/WABCO are used. The use of non-certified hoses and cables can lead to incorrect measurements.

Case 446 310 019 0

The case can accommodate the components of the basic package 446 310 010 0 and the "Towing vehicle" expansion package 446 310 013 0.

If only basic package 446 310 010 0 is ordered, the relevant spaces for the components of the "Towing vehicle" expansion package remain empty.

CTU 446 310 000 0

The CTU is the central control unit for the measurements.

USB RS232 adapter 446 310 014 4

The USB RS232 adapter can be used for PCs without a COM port.

Description of components

Insertion adapter 446 310 017 2

The ISO 7638 insertion adapter is connected to the ISO 7638 connector/socket, depending on the design of the vehicle. This adapter provides access to the ISO 7638 port on the vehicle. The connections for the ISO 7638 plug connection are diverted to the laterally-mounted connector and connected to the CTU.

Together with the connected "ISO adapter power supply line" cable, the ISO 7638 insertion adapter constitutes the ISO 7638 adapter set 446 310 016 2.

Power supply cable ISO adapter 446 310 018 2

The ISO adapter power supply line cable is connected to the laterally mounted connector and connects the ISO 7638 adapter with the CTU to enable data transfer. The cable also has an outlet with a coaxial socket – the CTU can thus be provided with power if needed, see chapter "7.5 Power supply", page 31.

"PC to CTU" data transmission cable 446 310 021 2

The "PC to CTU" cable is connected to the CTU's "RS232" socket and connects the CTU with the PC.

Treadle 446 310 015 2

The cable from the treadle (double contactor) is connected to the CTU's "Treadle" connector and connects the CTU with the double contactor on the treadle. The double contactor triggers the START and STOP signals for time measurement and disconnection testing on the towing vehicle.

Actuator 435 201 790 2

The actuator consists of a hook with clamping device. Together with cable pull 435 201 410 2 (steel cable with tension spring), this forms part of the "Towing vehicle" expansion package. On the one side the actuator and cable pull can be fitted to the double contactor and on the other side to the steering wheel in order to determine the actuation start and end points of the brake pedal.

"Pressure sensor to CTU" data transmission cable 446 310 300 2

The "Pressure sensor to CTU" cables are connected to connectors "Pressure sensor 1" to "Pressure sensor 3" and connect the CTU with the relevant pressure sensors.

Pressure sensor 894 600 001 0

The pressure sensors 894 600 001 0 measure the pressure at the measurement points and are connected to the connector element 893 600 024 0 and/or the ends of the hoses 893 600 021 0 (to the yellow coupling head) and 893 600 022 0 (to the red coupling head). Each pressure sensor is connected to the CTU by means of a cable 446 310 300 2.

Hose 893 600 021 0

The hose has a dual function when used for towing vehicle or trailer measurements.

Measurements on the towing vehicle: The hose is connected to the yellow coupling head of the towing vehicle. The yellow coupling head is of the same design as the one used on the trailer. There is a coupling at the other end of the hose to which the pressure sensor used for measuring the braking pressure to the trailer control system is connected. The hose has a volume of 385 ± 5 cm^3 and thus corresponds to the trailer's dead volume, as required by UNECE R13.

Measurements on the trailer: The hose is connected to the simulator's "Air supply connection/ Druckluftversorgung" connector. The simulator can now be supplied with compressed air via the coupling head.

Description of components

Hose 893 600 022 0

The hose has a dual function when used for towing vehicle or trailer measurements.

Measurements on the towing vehicle: The hose is connected to the red coupling head.
There is a coupling at the other end of the hose to which the pressure sensor used for measuring the supply pressure to the trailer control system is connected.

Measurements on the trailer: The hose provides the connection from the simulator's supply pressure connector to the trailer's red coupling head.

Connecting element 893 600 024 0

The connecting element is connected to the test connector of the least favourably positioned wheel brake cylinder. There is a coupling tip at the other end of the hose to which the pressure sensor used for measuring the braking pressure in the wheel brake cylinder is connected.

The connector piece can also be used to connect a pressure sensor adapter with a supply pressure reservoir.

Case with simulator 446 310 023 0

The simulator 446 310 025 2 forms a major part of the case as this ensures pneumatic supply and control functions during measurements on trailer vehicles.

Further components of the case are the components of the "Trailer" expansion package 446 310 011 0.

> i The simulator container (30 litres) must be drained before each use.

Simulator connector plate 446 310 025 2

The CTU data and power supply connector 446 310 000 0 can be seen on the upper left-hand side. On the one hand, this port enables the data exchange for controlling the simulator, on the other, it ensures the power supply to the solenoid valves inside the simulator. The cable 446 310 024 2 from the CTU connector "Simulator" is connected here.

On the lower left, the "Coupling head, control line trailer/Kupplungskopf, Bremsleitung" connector is connected to hose 893 600 023 0, which leads to the trailer's yellow coupling head.
This connection passes the braking pressure to the trailer's yellow coupling head.

On the upper right, the "Coupling head, supply line trailer/Kupplungskopf, Vorratsleitung" connector is connected to hose 893 600 022 0, which leads to the trailer's red coupling head.
This connection passes the supply pressure to the trailer's red coupling head.

On the lower right can be seen the "Air supply connection/Druckluftversorgung" connector, which supplies the simulator with compressed air. This can be achieved by means of an in-house system or by means of a towing vehicle. For the latter case, hose 893 600 021 0 is available, which can be connected here coming, for example, from the red coupling head of the towing vehicle.

Description of components

"Simulator to CTU" data transmission cable 446 310 024 2

This cable connects the CTU (simulator connector) to the simulator.

Hose 893 600 023 0

The hose is connected to the trailer's yellow coupling head. The yellow coupling head is of the same design as the one used on the towing vehicle. At the other end of the hose there is a coupling tip to which the "Coupling head, control line trailer/Kupplungskopf, Bremsleitung" simulator input is connected; this is provided for the trailer control system.

USB RS232 adapter 446 310 014 4

If the PC has no COM port, a connection can also be established using the computer's USB port. A USB RS232 adapter is used for this purpose.

500 ml test volume

The 500 ml test volume simulates the pneumatic control line of a connected trailer when measuring the volume of the towing pressure reservoir. The reservoir with the test volume is connected to the towing vehicle via a yellow coupling head during the measurement.

7 Start-up

The following tasks must be completed before performing the measurement:

Connect the CTU to the PC, see chapter "7.1 Connection to the computer", page 25.

1. Start the PC.
2. Supply the CTU with power, see chapter "7.5 Power supply", page 31.
3. Install and start the measurement program, see chapter "8 Measurement program", page 36.
4. Follow the measurement program instructions.

The measurement program supports the establishment of the measurement structure. Should any cabling/tubing/calibration be required during the measurement process, the user is provided with appropriate action instructions.

7.1 Connection to the computer

Connection via COM port

– Check whether your PC has a COM port.
– Connect the data cable between the CTU and the PC's COM port.
– If your PC does not have a COM port, proceed as described in the "Connection via USB port" section below.

Connection via USB port

– Connect the data cable to the COM port of the USB RS232 adapter.
– Connect the USB RS232 adapter to a free USB port on your computer.

Driver installation

– Insert the disk for the USB RS232 adapter into your PC's DVD drive.
– Follow the instructions for the USB RS232 adapter in the enclosed user's manual.

  ↳ Once the installation is successfully completed, the port simulated by the adapter is shown in the operating system's device manager.

7.2 Connecting the basic package

The cabling of the basic package essentially provides the basic electrical structure for all of the tests.

The CTU must be wired together with the power supply, the PC, the measurement recorder and the actuators.

The corresponding connection names are marked on the CTU.

Meaning of the connection designations

- **24 V:** Connection for the power supply, see chapter "7.5 Power supply", page 31 – possible are: Power supply line with cable "ISO 7638 adapter – ECU" 446 310 018 2)
- **RS232:** Connects the data line to the PC RS232 port (cable 446 310 021 2) and/or to the USB RS232 adapter

- **ISO 7638:** Connects the data line from the ISO 7638 adapter (cable 446 310 018 2)
- **Simulator:** Connects the data line to the simulator (only required for measurements on a trailer – cable 446 310 021 2 is part of the trailer expansion package)
- **Pressure sensors:** Connects the cable for the external pressure sensors (only required for measurements on a towing vehicle or trailer – cables 446 310 300 2 are part of the the basic and towing vehicle expansion packages)
- **Treadle:** Connects the cable to the treadle (only required for measurements on a towing vehicle – cable 446 310 015 2 is part of the towing vehicle expansion package)

> i When assembling the basic package, the CTU's "24 V", "RS232" and "ISO 7638" connectors must be wired up.

Plugging in the plug connection

– Plug the ISO 7638 adapter on the ISO 7638 5- or 7-pin plug connection of the vehicle to be tested (towing vehicle or trailer).

– Lock the ISO 7638 adapter onto the ISO 7638 5- or 7-pin plug connection of the vehicle to be tested. The other side of the ISO 7638 adapter can remain free, as long as this is not required for the power supply.

– Insert the bayonet connector of the cable "ISO 7638 adapter – ECU" 446 310 018 2 into the side-mounted socket of the ISO 7638 adapter.

The basic package cabling is complete if no further "Towing vehicle" or "Trailer" expansion package is to be connected.

Preparations for measurement

– Switch on the CTU power supply.

– Start the measurement program on the PC.

– You can now perform the measurements which are possible with this set-up.

7.3 Connecting the towing vehicle expansion package

When performing time measurements on a towing vehicle (except for disconnection tests), the components of the "Towing vehicle" expansion package must be inserted into the measurement set-up. The description given here is applicable to a fully equipped vehicle. In particular instances it may not be possible to carry out the stated steps (e.g. trailer measurement point cabling for solo vehicles) – these may then be regarded as irrelevant and are omitted.

Installation of actuator and cable pull

– Suspend the spring from the double contactor stop pins.

– Insert the end of the steel cable into the other end of the spring.

– Secure the other end of the steel cable to the end of the hook.

– Secure the hook to the steering wheel.

Setting the double contactor

– Set the spring force so that the first contactor is triggered at the start of pedal actuation, and the second contactor is triggered at the end of pedal actuation.

Assembling the treadle

– Ensure that the basic package components are wired up.
– Secure the treadle to the brake pedal.

Standing pedals

With standing pedals this should easily be possible with the included lashing strap.

Suspended pedals

When suspended brake pedals are used, the design of the pedal can lead to problems.
Spacers – not included in the scope of supply – under the pedal can help here.

> **i** When using spacers, it must be ensured that the brake pedal can be depressed such that the full braking pressure is applied.

– Fix the treadle to the steering wheel using the cable pull (with spring) and the hook-shaped actuator (with clamping tappet for the cable pull end).

• Both switches must be open when not actuated.

– Check the settings of the internal treadle switch as follows:

• After the start of actuation, switch 1 must close.
• When fully actuated, switch 2 must be closed – this is achieved by tightening the cable pull, which is clamped to the actuator by means of the tappet.
• When released, first switch 2 and then switch 1 must open.

Connecting the pressure sensor adapter

⚠ WARNING

Risk of injury due to uncontrolled movement of the trailer

Coupling and uncoupling in the wrong order may cause uncontrolled movements of the trailer.

▸ Always keep to the correct order.

– Connect the hose "Test connection – pressure sensor adapter" 893 600 024 0 from the basic package to the test connector of the least favourably positioned wheel brake cylinder.
– Set the wheel brakes of the vehicle under test as tightly as possible.
However, they must not make contact, i.e. it must still be possible to turn the wheels easily when the brakes are not actuated.
– Connect the hose "Yellow coupling head" 893 600 021 0 to the "Towing vehicle" expansion package using the towing vehicle's yellow coupling head.
– Connect the hose "Red coupling head" 893 600 022 0 from the basic package using the towing vehicle's red coupling head.

Vehicle with braking force control

– Set the braking force control such that the "Fully laden" operating condition is simulated.

Braking force distribution is implemented mechanically or pneumatically, for example, by an LSV or electronically by a pressure transducer via the software or the braking system. When wiring up the "Towing vehicle" expansion package, the CTU's RS232 and "ISO 7638" connections as well as its "Pressure sensor 1", "Pressure sensor 2" and "Pressure sensor 3" connections must also be wired up.

– To do this, connect the cables to the "CTU pressure sensor adapter" from the basic package and the "Towing vehicle" expansion package.

In order to prevent incorrect measurements, use the following configuration:

- At the test port of the wheel brake cylinder positioned least favourably: pressure sensor from CTU connection "Pressure sensor 1"
- At the yellow coupling head of the towing vehicle: pressure sensor from CTU connection "Pressure sensor 2"
- At the red coupling head of the towing vehicle: pressure sensor from CTU connection "Pressure sensor 3"

Cabling and measurement

– Connect the cables from the basic package and the "Towing vehicle" expansion package to the pressure sensor adapters.

– Connect the pressure sensor adapters with the prepared adapter connectors.

– Switch on the CTU power supply.

– Start the measurement program on the PC.

↳ You can now perform the measurements which are possible with this set-up.

7.3.1 Performing the disconnection test (not required for solo vehicles)

When performing a disconnection test on a towing vehicle, a modification to the set-up described above is required. The set-up process for the disconnection test on the towing vehicle time measurement set-up is described below.

Establishing the set-up for the disconnection test

– Disconnect hose 893 600 021 0, which is connected to the yellow coupling head.

– Modify a coupling head so that it becomes possible to simulate a hose disconnection.

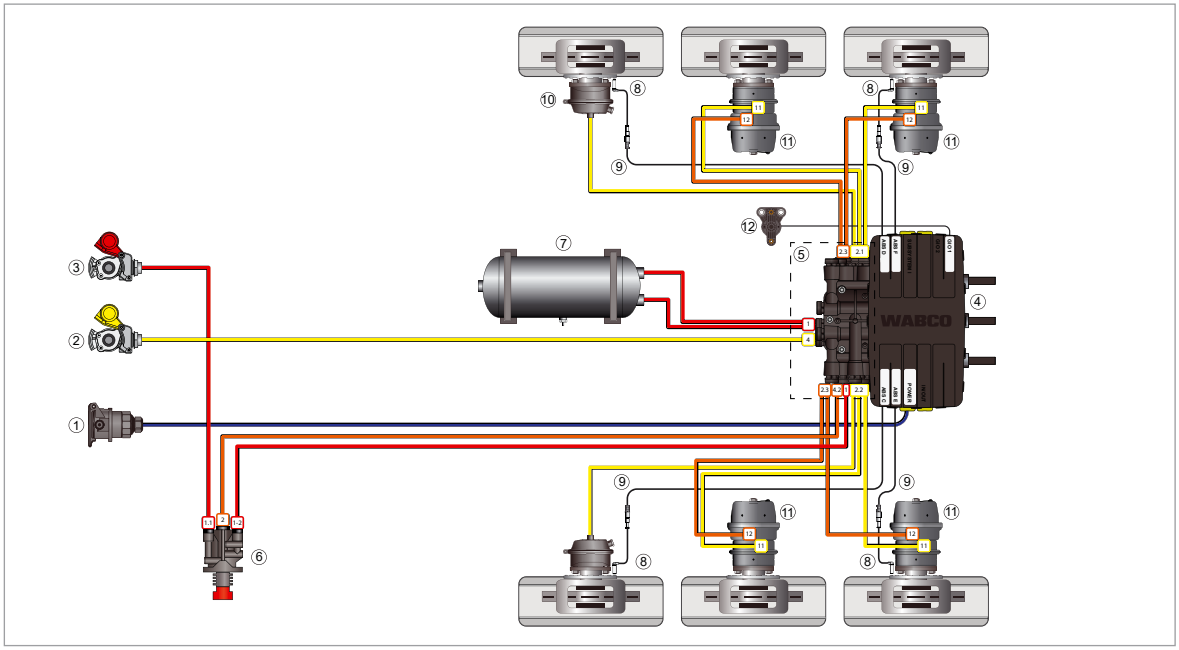
The figure provides an example of how a hose disconnection adapter might appear.

The hose disconnection adapter is not included in the scope of supply of the measurement device.

A pipe section is fitted to a coupling head 452 200 022 0 or 952 200 022 0, through which the air can escape. The pipe diameter on the exhaust side should be at least 8 mm.

7.3.2 Connecting the trailer expansion package

i Before performing time measurements on a trailer, the components of the "Trailer" expansion package must be inserted into the measurement set-up. For this purpose, the components of the basic package must be connected as described above.



Item	Designation
1	Power supply via ISO 7638 connector
2	Control line
3	Supply line
4	iEBS modulator
5	Pneumatic distribution module (PDM)
6	Park release valve (PRV)
7	Reservoir for braking system
8	ABS wheel speed sensor
9	Extension cable wheel speed sensor
10	Service brake cylinder
11	Tristop™ cylinder
The lines represent the power and compressed air lines to the components.	

Key					
	Supply		Control/service brake		Electrical signals
	Parking brake		Air suspension lines		Power supply (ISO 7638) + CAN lines (ISO 11992)

Start-up

Securing pneumatic supply to the trailer in order to fulfil the connection conditions

– Connect the hose (e.g. hose "Yellow coupling head" 893 600 021 0 from the "Towing vehicle" expansion package) to the "Air supply connection/Druckluftversorgung" connection, which is located on the simulator connection plate.

  ↳ This will secure the air supply connection to the simulator.

The supply is implemented through the pressure system on site, a towing vehicle – red coupling head or similar.

– Connect the hose "Simulator – yellow coupling head" 893 600 023 0 to the "Trailer" expansion package using the trailer's yellow coupling head.
– Then also connect the hose "Simulator – yellow coupling head" 893 600 023 0 using the "Coupling head, control line trailer/Kupplungskopf, Bremsleitung" connector to the simulator's connector plate.
– Connect the hose "Red coupling head" 893 600 022 0 from the basic package using the trailer's red coupling head.
– Then also connect the hose "Red coupling head" 893 600 022 0 using the "Coupling head, supply line trailer/Kupplungskopf, Vorratsleitung" connector to the simulator's connector plate.
– Connect the hose "Test connection – pressure sensor adapter" 893 600 024 0 from the basic package using the pressure sensor adapter connector to the test connector of the least favourably positioned wheel brake cylinder.

> **i** Generally speaking, the wheel brakes of the vehicle under test must be tightened as much as possible for the measurement. However, they must not make contact, i.e. it must still be possible to turn the wheels easily when the brakes are not actuated.

Vehicle with braking force control

Braking force control can be achieved either mechanically or pneumatically by means of an LSV.

If a braking force control system is fitted: Position the vehicle such that its "Fully laden" operating condition is simulated. The braking system software achieves braking force control electronically by means of a pressure transducer.

1. Connect the cable 446 310 300 2 to the CTU "Pressure sensor" connector.
2. Connect the cable 446 310 024 2 with the CTU "Simulator" connector.
3. Connect the "CTU pressure sensor adapter" with the cable the pressure sensor adapter 894 600 001 0.
4. Connect the cable with the pressure sensor adapter and the prepared adapter connector on the wheel brake cylinder.
5. Switch on the CTU power supply.
6. Boot the PC where the measurement program is installed.

   ↳ You can now perform the measurements which are possible with this set-up.

7.4 Pressure sensor adjustment

At various points in the measurement program the user is provided with the option to adjust the pressure sensors – at certain points a pressure sensor adjustment is essential to continue with the program sequence. Pressure sensor adjustment is always identical. A reference to the explanation given here is made at the corresponding points in the program description.

A pressure sensor adjustment consists of adjusting the pressure sensors to atmospheric pressure. Within the program, it is assumed that an increase in pressure sensor readings above the pressure range of 0 ... 12 bar to be measured will proceed on a continuous, linear basis.

The measurement program differentiates between 5 pressure sensors:

- **Pressure sensor 1:** external sensor to which CTU output "Pressure sensor 1" is assigned
- **Pressure sensor 2:** external sensor to which CTU output "Pressure sensor 2" is assigned
- **Pressure sensor 3:** external sensor to which CTU output "Pressure sensor 3" is assigned
- **Pressure sensor 4:** internal sensor mounted on the control pressure output of the simulator downstream of the diaphragm (diameter 4.0 to 4.3 mm) which measures the braking pressure on the yellow trailer coupling head when performing trailer measurements
- **Pressure sensor 5:** internal sensor which is mounted on the container (30 litres) in the simulator and measures the trailer supply pressure in the simulator tank when performing trailer measurements
- Pressure sensors 1 to 3 are similar. These are numbered according to their connections to the CTU.

External pressure sensors are sensors which are connected to the CTU. As there is a risk of confusing the sensors following each measurement set-up or alteration, the external pressure sensors must be calibrated every time the measurement program is loaded.

Internal pressure sensors are sensors which are fixed in position in the simulator. Since there is no risk of confusion here, the internal pressure sensors must be calibrated daily – before measurement.

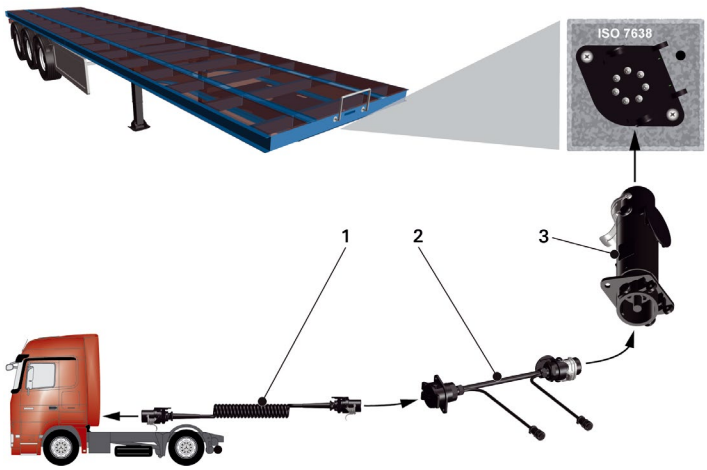
7.5 Power supply

The CTU must be supplied with power during the measurement. The power supply required will depend on the desired use of the CTU as well as the vehicle to be tested. The power supply can be provided by the towing vehicle or by an external power source, such as the WABCO Power Case.

7.5.1 Power supply from the towing vehicle by means of an ISO 7638 port

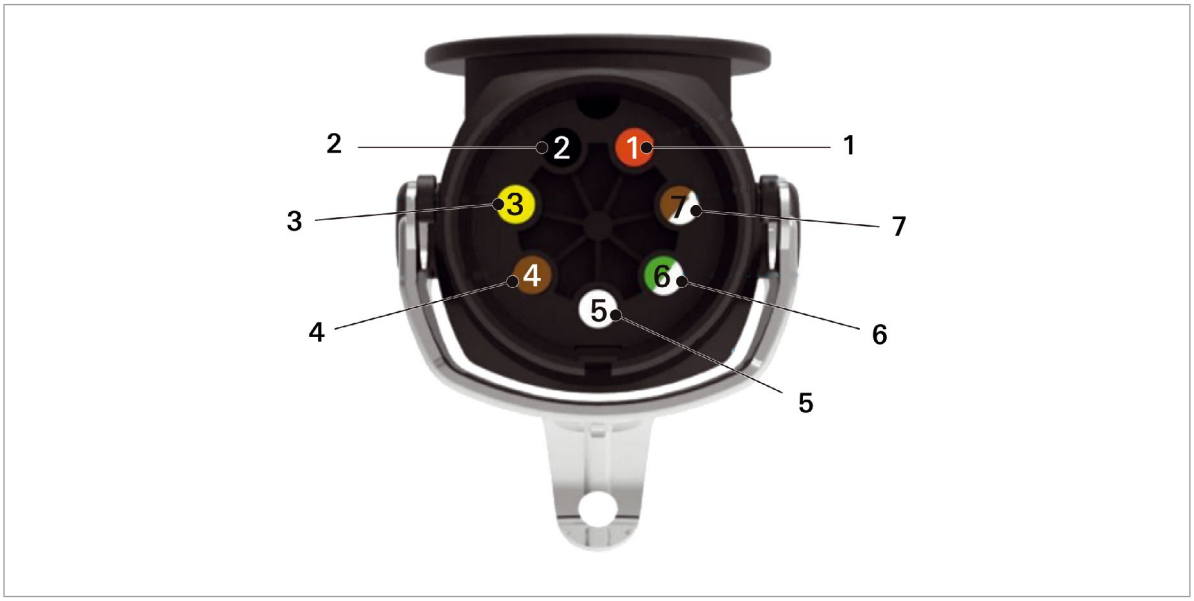
In towing vehicles fitted with an ISO 7638 port, the supply voltage for the CTU control electronics can be drawn off in exactly the same way as in trailers fitted with an ISO 7638 port and which are supplied with power from a towing vehicle or battery vehicle. This enables testing of a wide range of conventionally braked vehicles as well as EBS-braked towing vehicles. Restrictions are applicable for the verification of EBS-braked trailers, as the undervoltage test in accordance with UNECE R13, Annex 17, point 4.2.2.2.1.2. and verification of the warning lamp switching sequence are no longer possible in this case.

CTU power supply I



Number	Part number	Designation
1	446 008 XXX 0	Coiled cable
2	446 300 360 0	Diagnostic adapter ISO 7638 socket
3	446 310 017 2	Adapter CTU ISO 7638

In the special case "Power supply to the trailer via the ISO 7638 7-pin socket from the towing vehicle, which sends CAN data over this 7-pin socket" problems may occur on the data lines (pins 6 and 7 of the 7-pin socket). If in doubt, it must be ensured that no data can be sent from the towing vehicle side to the trailer.



Item	Designation
1	Terminal 30 (continuous supply 24 V)
2	Terminal 15 (ignition on/off 24 V)
3	Ground terminal 15
4	Ground terminal 30
5	Warning lamp
6	24 V CAN High (yellow)
7	24 V CAN Low (green)

7.5.2 Supply via external power supply through the WABCO Power Case

The WABCO Power Case is intended for exclusive use on 24 V and 12 V vehicles and trailer systems. The unit is to be used for the following function:

Connections

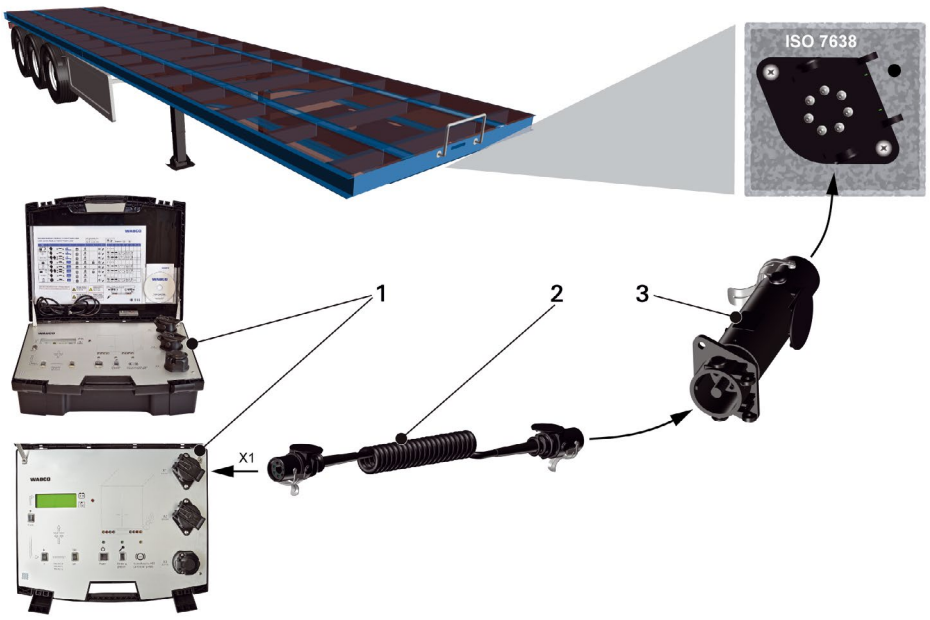
7-pin ISO 7638 connection (24 V system)

13-pin ISO 11446 connection (12 V system)

Measurement of the voltages at the individual pins of the corresponding connections:

ISO 7638	Pin 1 and 2
ISO 12098	Pin 1, 2, 3, 5, 6, 7, 8, 10, 11 and 12
ISO 11446	Pin 1, 2, 4, 5, 6, 7, 8 and 9
ISO 12098	Only use the connection with 24 V voltage.
ISO 11446	Only use the connection with 12 V voltage.

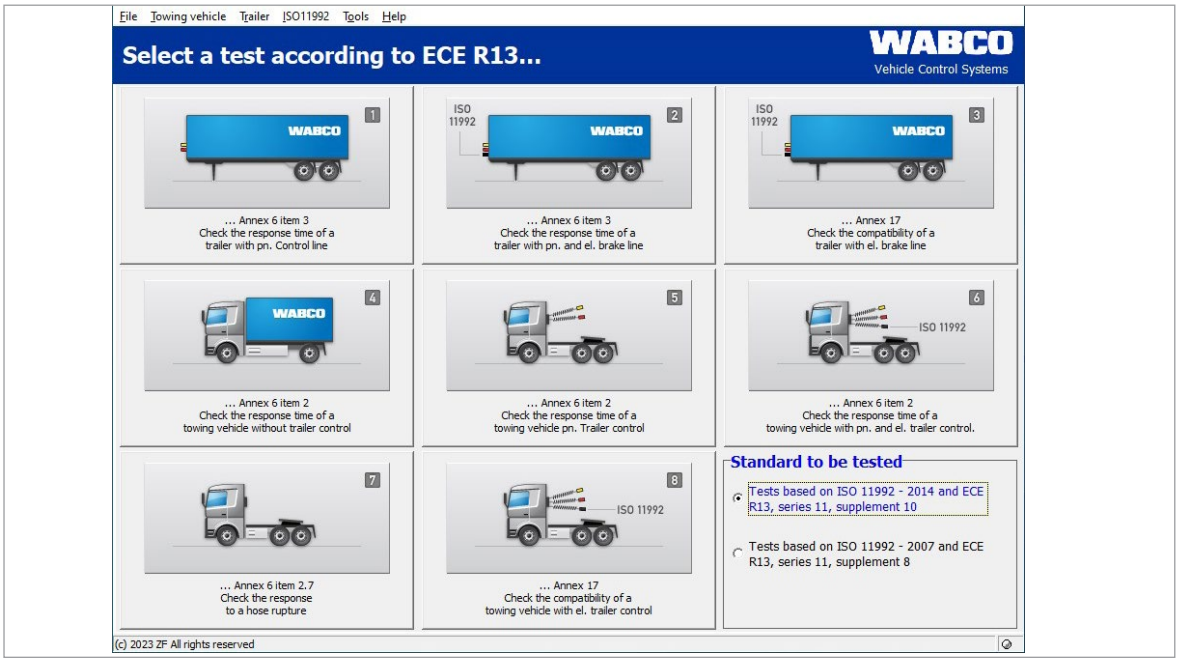
CTU power supply II



Number	Part number	Designation
1	300 100 001 0	WABCO Power Case
2	446 008 XXX 0	Coiled cable
3	446 310 017 2	Adapter CTU ISO 7638

Technical data 300 100 001 0	
Operating voltage	24 V DC/12 V DC
Weight	12 kg
Fuse internal	30 A short-circuit protection
Battery	Voltage 2 x 12 V Charging time 8-24 hours
Capacitance	7 Ah corresponds to a normal usage time of approx. 6-8 hours.
Charging mode	Mains voltage 230 V
Current consumption	0.8 A

8 Measurement program



The test is performed with the help of the PC. Once the preparations listed in the "Start-up" chapter have been completed, the measurement program can be started, see chapter "7 Start-up", page 25.

8.1 Start screen – program modules

The measurement program is modular in layout. The desired test is started by clicking the menu on the start screen.

Before starting the measurements, choose from the different testing standards in the tile at the bottom right:

1. Testing based on ISO 11992 – 2014 and UNECE R13, series 11, supplement 10

or

2. Testing based on ISO 11992 – 2014 and UNECE R13, series 11, supplement 8

All subsequent measurements are carried out and documented in accordance with the standard specifications.

At the bottom right of the welcome screen the status of the warning lamp is (pin 5, ISO 7638) is indicated.

It is also possible to select program modules from the command bar. The command bar offers a somewhat wider selection of clickable program modules as compared to the buttons.
The description below follows the numbering of the program modules.

Following a measurement, a measurement log can be printed out. It is also possible to save the data and print out the log at a later date.

8.1.1 Module 1: Time measurement for trailers with pneumatic brake line

This test measures and evaluates the response time of a trailer with pneumatic braking system and pneumatic control.

This test is not described separately as this is also included in the time measurement for trailer vehicles with pneumatic and electrical brake lines, and is described in the next item. Only the electrical control system is missing here.

8.1.2 Module 2: Time measurement for trailers with pneumatic and electrical brake line

This test measures and evaluates the response time of a trailer with pneumatic braking system and electrical and pneumatic control. This also includes a test for a trailer with pneumatic braking system and pneumatic control systems.

– Make sure that the pressure in the trailer reservoir does not exceed a maximum of 6.5 bar. Higher pressures will not be recognised by the measurement system. This may lead to improved response times and thus to non-compliant results.

Once the completion of start-up has been confirmed, calibration will be required.

Following the end of the test, the pressure curve at the pressure sensors and the control signal curve for the electronic actuation are shown in the diagrams on the monitor.

The measurement results are displayed immediately following the end of the measurement.

8.1.3 Module 3: Testing the compatibility of a trailer with electrical brake line

This test of the CAN connection is only required for trailers that transmit CAN data in accordance with ISO 11992 to the ISO 7638 port (7-pin trailer socket). This includes a review of the messages in accordance with the requirements of UNECE R13, Annex 17. This is therefore an electronic test that can already be performed with the basic package. In order to provide brake cylinder control the trailer must be supplied with compressed air however.

i
- The towing vehicle simulator from the "Trailer" expansion package is required for the trailer test in accordance with Annex 17.
- This test is only required if no appropriate certificate is available from the brake system supplier (EBS certificate). A detailed understanding of the statutory provisions is required for the performance of this test.

Before starting measurement, the preparation tasks for a trailer with electrical control lines must have been completed. Program queries are triggered at the start of the test and these must be confirmed by pressing the NEXT button.

After the required data has been entered, the system is ready to start measurement and the test can then be performed.

– Follow the measurement program instructions.

8.1.4 Module 4: Time measurement for towing vehicles without trailer control

This test is also included in the time measurement for towing vehicles with pneumatic and electrical trailer control, see chapter "8.1.6 Module 6: Time measurement for towing vehicle with pneumatic and electrical brake line", page 38. The trailer port test is completely omitted.

In the displayed results, the diagrams and tables for verifying the trailer pneumatic and electrical ports are left empty.

8.1.5 Module 5: Time measurement for towing vehicles with pneumatic trailer control

This test measures and evaluates the response time of a towing vehicle with pneumatic trailer control. This is not described separately, as the test is included in the time measurement for towing vehicles with pneumatic and electrical trailer control, see chapter "8.1.6 Module 6: Time measurement for towing vehicle with pneumatic and electrical brake line", page 38. The trailer port test is omitted.

In the displayed results, the diagrams and tables for verifying the trailer pneumatic port are left empty.

8.1.6 Module 6: Time measurement for towing vehicle with pneumatic and electrical brake line

This test measures and evaluates the response time of a towing vehicle with pneumatic and electrical trailer control. This test is the most comprehensive time measurement and includes both of the tests described above.

When performing the measurement on the towing vehicle, it can be useful to involve a second person, as support tasks such as actuating the brake pedals, supplementing the service brake circuit pressures up to the pressure regulator starting pressure are required during the measurement.

– Follow the measurement program instructions.

8.1.7 Module 7: Testing response to hose disconnection

This test measures and evaluates the response time of a towing vehicle with pneumatic trailer control in the event of the disconnection of the control line (yellow coupling head). This test is not required for solo vehicles.

The measurement set-up is similar to the program operation for towing vehicles with pneumatic trailer control. A major difference is that the pneumatic control line to the trailer is not connected and as a result the yellow coupling head on the towing vehicle is in the open position.

– Follow the measurement program instructions.

8.1.8 Module 8: Compatibility of a towing vehicle with electrical trailer control

Testing of the CAN connection is only required for towing vehicles that transmit CAN data in accordance with ISO 11992 to the ISO 7638 port (7-pin trailer socket). This is therefore a purely electronic test which can already be performed with the basic package. In order to provide brake cylinder control the towing vehicle must be supplied with compressed air.

– Follow the measurement program instructions.

8.2 Further program modules

In contrast to the previously described program modules 1-8, the program modules described in the text below have no button on the measurement program interface and can only be activated using the command bar.

8.2.1 Menu item: ISO 11992

The section below describes the possible tests on the basis of ISO 11992-2:2003, ISO 11992-2:2003/Amd.1:2007 and ISO 11992-2:2014 on the ISO 7638 port. These are purely display functions for testing the communication between the towing vehicle and the trailer vehicle.

The power supply can – where required – be preferentially taken from the port.

8.2.2 Display messages

This test allows the display of the CAN messages (more about the CAN messages, see chapter "9.1 CAN messages", page 45) arriving at the ISO 7638 trailer port. It is therefore possible to monitor the CAN port of a towing vehicle or a trailer. If the ISO 7638 adapter is used between the 7-pin socket and the 7-pin connector, the message exchange via the port can also be observed.

The "Receive all CAN messages" option can be switched on or off to display the CAN messages sent to the port.

If this option is selected, all CAN messages which are received or can be received over the port are displayed. Recognised CAN identifiers (meaning that these identifiers are stored in a matrix in the CTU program and can thus be "recognised") are displayed together with their message names.

If this option is switched off, a check is performed whether the CAN messages that should be received according to the specified matrix are actually received at the port.

8.2.3 Display data contents

The "Display data contents" test alternatively allows the display of the data content for recognised "EBS" and "RGE" (Running Gear Equipment) type CAN messages which arrive at the ISO 7638 trailer port. It is therefore possible to monitor the CAN port of a towing vehicle or a trailer. If the ISO 7638 adapter is used between the 7-pin socket and the 7-pin connector, data passing through the port can also be observed. The data displayed updates automatically after the corresponding computer cycle times have elapsed.

8.2.4 Response time test of the messages

This test displays the repetition times for recognised "EBS" and "RGE" type CAN messages which arrive at the ISO 7638 trailer port. It is possible to monitor the CAN port of a towing vehicle or a trailer. If the ISO 7638 adapter is used between the 7-pin socket and the 7-pin connector, data passing through the port can also be observed. The displayed cycle times are determined and displayed again each time after pressing the refresh button on the program interface.

The determined repetition times of the recognised "EBS" and "RGE" (Running Gear Equipment) type CAN messages are measured and compared with the ISO 11992 requirements.

The program is embedded with a display and evaluation of the repetition times for the sent, recognised "EBS" and "RGE" type CAN messages in accordance with ISO 11992 requirements.

8.2.5 Bus loading

The "Bus load" test shows the load on the CAN data bus at the ISO 7638 trailer port. It is possible to monitor the CAN port of a towing vehicle or a trailer.

8.2.6 Menu item: Tools

The "Tools" area defines the processes which are required for the verification of the measurement equipment hardware and for setting up the PC. Hardware verification is partly required by UNECE R13 (cf. Annex 6, point 3.3.3) and must therefore be possible at all times.

The following individual menu items can be selected:

- Testing the CTU hardware calibration: This allows the verification and performance of the calibration functions for all internal and external pressure sensors, testing the treadle (double contactor) contacts as well as the warning lamp, the pre-setting of CAN line status (e.g. short-circuit, transmission of EBS message, etc.), the control of the simulator solenoid valves and the pre-setting of the simulator reservoir pressure.

> i The external pressure sensors must be calibrated before each measurement and/or after setting up the measurement test prior to recording the measurement values.
> A daily calibration is necessary for internal pressure sensors – prior to measurement.

- Pressure sensor adjustment: This item forms part of the CTU hardware calibration and is only used to calibrate the pressure sensors.
- Pneumatic testing of the simulator: In this section, the simulator can be tested in accordance with the requirements of UNECE R13, Annex 6, point 3.3.3.

8.2.7 Testing the CTU hardware

This segment of the program allows the verification and performance of zero point adjustments for all internal and external pressure sensors, testing the treadle (double contactor) contacts as well as the separate brake pedal actuation time measurement, the status of the yellow warning lamp (pin 5 of the ISO 7638 plug connection), the pre-setting of CAN line status (e.g. short-circuits, transmission of EBS trailer messages), the control of the simulator solenoid valves and the pre-setting of the simulator reservoir pressure.

These test functions are used to test the measurement structure hardware and can be performed without a vehicle. Only pressure control for the compressed air reservoir must be provided during these simulator function verifications.

8.2.8 Adjust the simulator pressure sensors

This enables the calibration (= zero point adjustment) of the internal pressure sensors to be performed. This calibration is identical to the calibration of the internal pressure sensors, see chapter "8.2.7 Testing the CTU hardware", page 40.

This test function is used to test the measurement structure hardware and can be performed without a vehicle. Only pressure control for the compressed air reservoir must be provided during this calibration.

In the example given here the program recognises a connected simulator. A non-connected simulator will be recognised and transmitted as information.

In order to perform the zero point adjustment for the simulator's internal pressure sensors, the simulator must be connected electrically and pneumatically to the CTU. The zero point adjustment is started by pressing the "Simulator zero adjustment" button. The simulator will be vented during the automatically performed zero adjustment. It must therefore be ensured that "Pressure sensor 4" and "Pressure sensor 5" are at atmospheric pressure. The zero point adjustment will then be performed.

Pressing the OK button will then return you to the measurement program start screen.

8.2.9 Pneumatic testing of the simulator

The WABCO simulators comply with the statutory requirements in terms of the flow behaviour of control pressure for pneumatic trailer braking. The definition of flow behaviour provides an accurately defined pressure build-up, and multiple actuations with final interpolation and evaluation calculation in pneumatic trailer investigations can be omitted – in contrast to pneumatic towing vehicle examinations.

The legislator defines in UNECE R13, Annex 6, point 3.3.3 how the simulator should be designed. In this section, the simulator can be tested in accordance with the requirements of UNECE R13, Annex 6, point 3.3.3.

The following tasks are required for simulator testing:

- Establishing the electrical connection between the simulator and CTU
- Connection of a test volume of 385 cm³ to the control pressure output
- Establishing the pressure supply for the simulator

8.2.10 Settings

The "Settings" area allows various PC-specific settings to be applied:

- The PC's serial port to which the CTU is connected.
- The directories in which measurement data is saved.
- User data and the measurement program's serial number.
- Language selection for the program.

8.2.11 Menu item: Trailer

This test according to ISO 11992 is only possible for trailers that transmit CAN data in accordance with ISO 11992 to the ISO 7638 port (7-pin towing vehicle socket).

This displays messages, determines the repetition times for the transmitted EBS and RGE messages and tests the towing vehicle port for non-specified messages. This is therefore a purely electronic test which can already be performed with the basic package.

Before starting measurement, the preparation tasks for a trailer with electrical control lines must have been completed. (The towing vehicle's ISO 7638 7-pin trailer socket can be connected to the ISO 7638 adapter – if the CTU electronic system must be supplied with power from the towing vehicle.)

> i If the measurement system is connected to a towing vehicle with EBS, duplicate messages occur on the CAN bus (CTU and towing vehicle).
> Using a 5-pin coiled cable, for example, can correct this.

In the measurement program this test is not listed directly on the main program page but on the command bar under the menu item "Trailer". In order to ensure the required preparatory tasks have been completed, program queries are triggered at the start of the test, and these must be acknowledged by pressing the NEXT button. The measurements are performed and the values displayed in accordance with a procedure which is defined in the program.

8.2.12 Capacity test of the supply reservoirs

This is a capacity test of the supply reservoirs according to UNECE R13.

Trailer:

- Capacity test of the supply reservoirs (ECE R13, Annex 7, point A.1.3)
- Capacity test of the supply reservoirs (ECE R13, Annex 20, point 7.3)
- Capacity test of the supply reservoirs (ECE R13, Annex 8, point A.2.5)

Towing vehicle:

- Capacity test of the supply reservoirs (ECE R13, Annex 7, point A.1.2)
  - In the menu shown, indicate whether the trailer vehicle has an electric control line.
  - Click "Next" and follow the instructions in the measurement program.

8.2.13 Additional capacity test of the supply reservoirs for vehicles with ABS

As an alternative to the capacity test according to UNECE R13, Annex 13, point 6.1, the test according to UNECE R13, Annex 20, point 7.3 is carried out.

8.2.14 Additional capacity test of the supply reservoirs

As an alternative to previous capacity tests, a further test is carried out in accordance with UNECE R13, Annex 8, point A.2.5.

Additional threshold tests are carried out by entering further specifications of the installed brake cylinders.

- Click "Next" and follow the instructions in the measurement program.

8.2.15 Testing in accordance with ISO 11992

This is the display of the CAN messages according to UNECE R13, Annex 17, point 4.1.4.

- Click on "Next" to show the repetition times and to display the non-authorised messages.

At the end of the program segment you can print the log or save it to be printed later.

- Click "OK" to return to the start menu.

8.2.16 Towing vehicle simulation

The towing vehicle simulation is a process by which CAN messages for a towing vehicle are fed using the PC via the ISO 7638 insertion adapter to the trailer. In this way, it is possible to evaluate the trailer responses.

It is also possible to control the pneumatic control and supply systems using the simulator.

In the measurement program this test is not listed directly on the main program page but on the command bar under the menu item "Trailer".

8.2.17 Menu item: Towing vehicle

This menu item allows additional towing vehicle tests to be performed. The measurement program explains these tests in the main dialogue box.

Before starting measurement, the preparation tasks for a towing vehicle with electrical trailer brake control must have been completed.

Measurement program

In the measurement program, this test is not listed directly on the main program page, but rather on the command bar, under the menu item "Towing vehicle". In order to ensure the required preparatory tasks have been completed, program queries are triggered at the start of the test, and these must be acknowledged by pressing the NEXT button. The measurements are performed and the values displayed in accordance with a procedure which is defined in the program.

8.2.18 Capacity test of the supply reservoirs

This is a capacity test of the supply reservoirs according to UNECE R13.

Trailer:

- Capacity test of the supply reservoirs (ECE R13, Annex 7, point A.1.3)
- Capacity test of the supply reservoirs (ECE R13, Annex 20, point 7.3)
- Capacity test of the supply reservoirs (ECE R13, Annex 8, point A.2.5)

Towing vehicle:

- Capacity test of the supply reservoirs (ECE R13, Annex 7, point A.1.2)

– Enter the following data in the displayed menu:

- Supply pressure for front and rear axles in accordance with manufacturer's specifications.
- The minimum pressure set by the manufacturer which must be present in order to obtain the prescribed minimum auxiliary brake output.
- Whether the vehicle is fitted with a pneumatic control line.
- The pressure with full actuation at the yellow coupling head if the supply reservoir has a nominal pressure according to the manufacturer's specifications.

– Click "Next" and follow the instructions in the program.

You can find a visual representation here: see chapter "9.2 Start-up schemes", page 46.

8.2.19 Testing in accordance with ISO 11992

This is the display of the CAN messages according to UNECE R13, Annex 17, point 3.1.3.

– Click on "Next" to show the repetition times and the inadmissible messages.

At the end of the program segment you can print the log or save it to be printed later.

– Click "OK" to return to the start menu.

8.2.20 Trailer simulation

This is a purely electronic test which – like the towing vehicle test according to ISO 11992 – can already be carried out with the basic package.

Trailer simulation is a process in which CAN messages from a trailer are fed into the towing vehicle with the PC via the ISO 7638 insertion adapter. In this way, it is possible to evaluate the towing vehicle response.

In the measurement program, this test is not listed directly on the main program page, but rather on the command bar, under the menu item "Towing vehicle".

8.2.21 Menu item: Help

The "User's manual" item allows you to open the user's manual. If the user's manual is not available in your language, use the program link to the WABCO homepage, with references for the brochures.

9 Annex

9.1 CAN messages

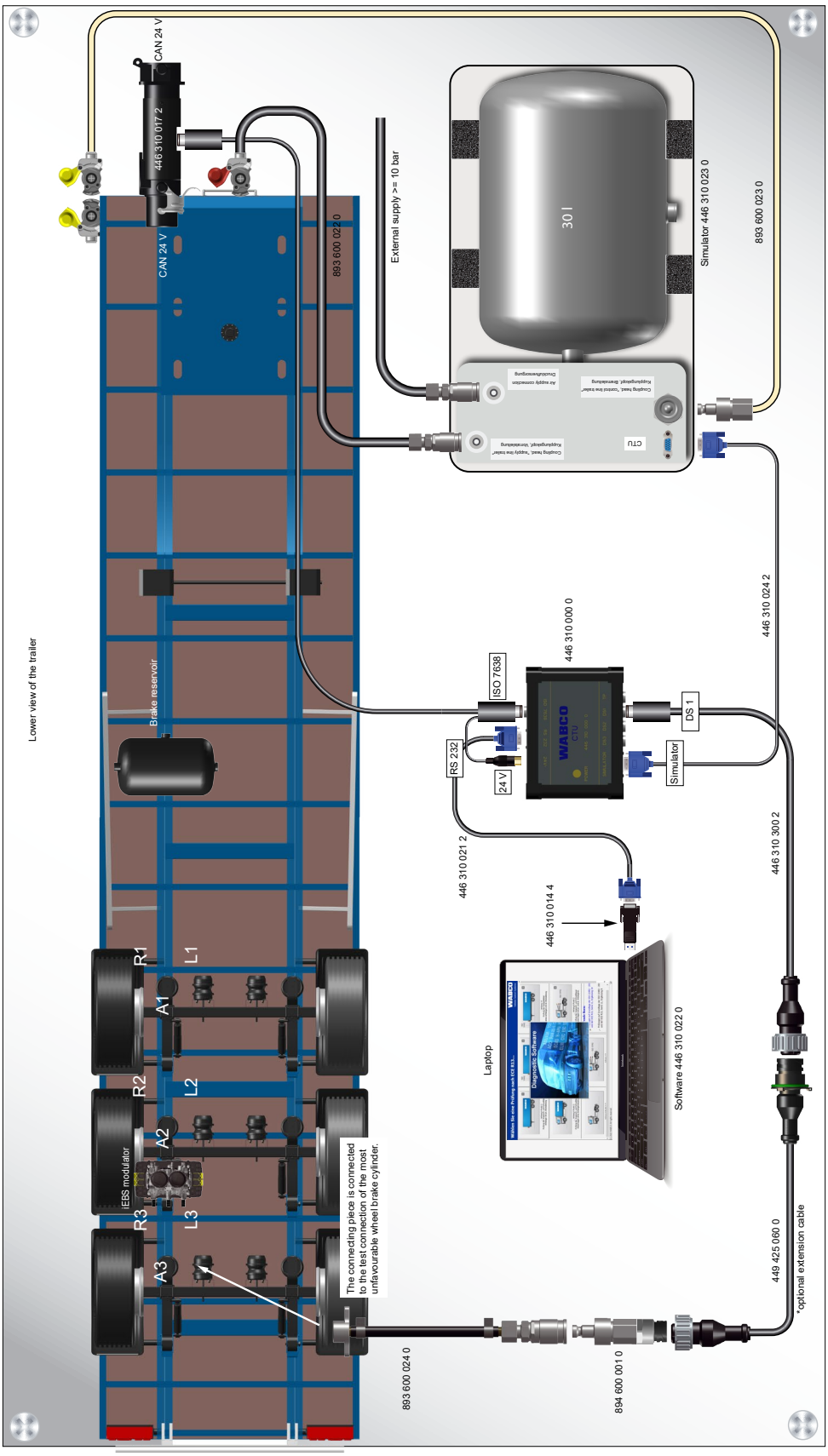
In order to test the CAN messages it may be necessary to know the identifier display of the permissible messages.

The table provides a summary of the specified towing vehicle and trailer messages permitted for the ISO 7638 trailer port. In addition, the permissible values for the repetition times of the messages according to ISO 11992 are given.

Message	Repetition time (ms)	Identifier Hex	Identifier Dec
EBS11	10	0C02C820	201508896
EBS12	100	18FEC920	419350816
EBS21	10	0C0320C8	201531592
EBS22	100	18FEC4C8	419349704
EBS23	100	18FEC6C8	419350216
EBS24	1000	18FD9AC8	419273416
EBS25	50	18F020C8	418390216
EBS25 (2014)	100	18F020C8	418390216
EBS26	10	0CF01FC8	217063368
RGE11 (GFM12)	100	18E4C820	417646624
RGE12 (2014)	100	188AC820	411748384
RGE22	100	18FE5CC8	419323080
REGE23	1000	18FE5EC8	419323592
RGE24 (2014)	1000	188920C8	411640008
TD11	1000	18FEE620	419358240
GFM11	100	18E2C820	417515552
GFM12 (RGE11)	100	18E4C820	417646624
GFM21	100	18E120C8	417407176
GFM22 (RGE21)	100	18E520C8	417669320
GFM23	100	18FEC6C8	419350216
GFM24	100	18FEC8C8	419350728

Annex

9.2 Start-up schemes



9.3 Information on the test bench mode of different generations of trailer braking systems

9.3.1 TEBS E

Test mode

Application

Integrated function in the TEBS E modulator

Purpose

Checking the LSV characteristic curve in a stationary vehicle

Function

The automatic load-dependent braking force control can be checked in this test mode depending on the coupling head pressure and the current axle load or the current bellows pressure.

The standstill function and the emergency brake function are deactivated for test purposes.

Simulation start

– Switch on the ignition with the control line vented (service brake system and parking brake system of the towing vehicle unactuated) to switch the electronic braking system into test mode.

↳ The standstill function and the emergency braking function are switched on as soon as the vehicle is moving.

As soon as the vehicle exceeds 10 km/h, the test mode ends.

Vehicle laden simulation

The "Laden" status can be simulated when the vehicle is unladen by venting the support bellows (< 0.15 bar) or lowering the vehicle onto buffers. The full braking pressures are applied in accordance with the safety function "Vehicle on buffer".

Mechanical suspension:

– Unhook the linkage for the height sensor and turn the lever to the position that corresponds with the spring-deflected vehicle.

Simulation by diagnosis

With the TEBS E diagnostic software you can simulate this safety function via the Control menu.

Annex

9.3.2 iEBS

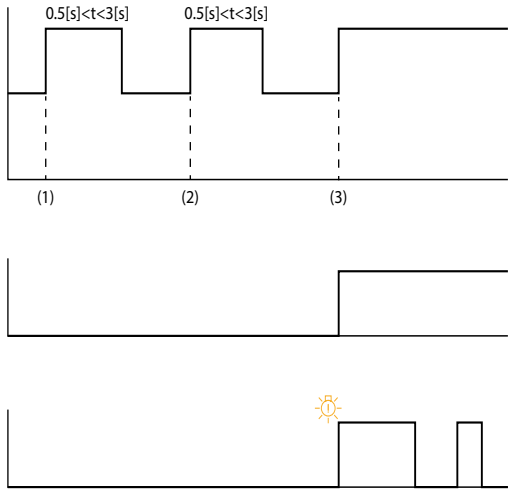
Test mode

The test mode deactivates the standstill function and the emergency brake function for the purpose of the test. This is used to check the characteristic curve for the load-dependent braking force control when the vehicle is stationary, e.g. on the brake roller test stand.

In this test mode, the automatic load-dependent braking force control can be checked as a function of the clutch pressure (pm) in relation to the current axle load or the current bellows pressure.

Simulation laden trailer: The "Laden" status can be simulated with an unladen trailer by venting the spring bellows (< 0.15 bar) or by setting the trailer down on buffers. The full braking pressure is transmitted in analogue form to the safety function "Vehicle on buffer".

Mechanical suspension: Unhook the linkage for the height sensor and turn the lever to the position that corresponds to the spring compression when the trailer is laden.

<table>
<tr><th colspan="3">Starting test mode with the towing vehicle</th></tr>
<tr><td>Switch the ignition on and off three times at intervals between 0.5 and 3 seconds to activate the test mode.</td><td>Ignition
ON
OFF</td><td rowspan="3"> 
</td></tr>
<tr><td>The warning lamp flashes long and short alternately to indicate that the test mode is active. The sequence for activating the test mode can be configured via the system diagnosis.</td><td>Test mode active</td></tr>
<tr><td></td><td>Trailer warning light</td></tr>
<tr><th colspan="3">Activating the test mode using the diagnosis</th></tr>
<tr><td colspan="3">The test mode can be activated with the WABCO Diagnostic Software.</td></tr>
</table>

9.4 EC declaration of conformity

This product complies with the standards or normative documents.

Designation of the device:	Measuring device
Device type:	CTU 3 HW version 3
Item number:	446 310 000 0

The latest declaration of conformity can also be found at:

http://www.wabco.info/i/2177

10 Maintenance and care instructions

The CTU is maintenance-free.

11 WABCO contact

You can find your local WABCO contact via the following page:
http://www.wabco.info/i/1489

You can find information on WABCO products here: www.wabco-customercentre.com

Please contact your WABCO partner for further information.

ZF Friedrichshafen AG

ZF is a global technology company and supplies systems for passenger cars, commercial vehicles and industrial technology, enabling the next generation of mobility. ZF allows vehicles to see, think and act. In the four technology domains Vehicle Motion Control, Integrated Safety, Automated Driving, and Electric Mobility, ZF offers comprehensive solutions for established vehicle manufacturers and newly emerging transport and mobility service providers. ZF electrifies different kinds of vehicles. With its products, the company contributes to reducing emissions and protecting the climate.

ZF, which acquired WABCO Holdings Inc. on May 29, 2020, now has 162,000 employees worldwide with approximately 260 locations in 41 countries. In 2019, the two then-independent companies achieved sales of €36.5 billion (ZF) and $3.4 billion (WABCO).

With the integration of WABCO, the leading global supplier of braking control systems and other advanced technologies that improve the safety, efficiency and connectivity of commercial vehicles ZF will create a new level of capability to pioneer the next generation of solutions and services for original equipment manufacturers and fleets globally. WABCO, with almost 12,000 people in 40 locations worldwide, will now operate under the ZF brand as its new Commercial Vehicle Control Systems division.

Mobilizing Commercial Vehicle Intelligence

WABCO