

# ■ **Test and Adjustment Instructions**

Compressed Air Processing System  
Air Processing Unit (APU)

■ 1st issue

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**WABCO**

**Vehicle Control Systems**  
An American Standard Company

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## 2 Safety

### 2.1 Safety

Each person engaged in test and adjustment work must have read and understood this instruction and in particular the safety chapter.

Explanation of the symbols used in this instruction:



**Warning - Danger for people!**



**Caution - Damage to the module!**



Note

Here you will find information or notes.

Before carrying out the test and adjustment work ensure that all the safety conditions have been fulfilled.

Comply with the relevant accident prevention regulations and other generally accepted safety and occupational medicine regulations.

### 2.2 Qualifications required

Test and adjustment work may only be carried out by authorized and technically qualified personnel.

The skilled personnel must carry out the relevant technical work safely and successfully and correctly assess and remove any residual risks that occur.

### 3 Description and Overview

#### 3.1 Functional description

The version of the air pressure unit (APU) equipped with the maximum possible features consists of the following modules:

- Air dryer with cartridge heater and integrated pressure regulator
- Multi-circuit protection valve with 2-stage pressure limitation
- Pressure sensors for the service brake circuit pressures

The air processing unit (APU) fulfills the following tasks with respect to the vehicle's compressed air system:

- Overload protection for the compressed air system
- Drying the compressed air supplied by the compressor
- Monitoring and controlling the system pressure within the fixed pressure values (readings)
- Adjusting the necessary pressures for the respective load circuits
- Securing the pressure of the individual load circuits relative to each other and the atmospheric pressure
- Measuring the service brake circuit pressures for readout on the display and for controlling the brake-pressure indicator lights

#### 3.2 Overview of the APU variations

The air processing unit (APU) is available in several variations with different features.

The following table gives an overview of these variations.

ID No. APU <b>932 500 ... 0</b>	<b>001</b>	<b>002</b>	<b>003</b>	<b>004</b>	<b>005</b>	<b>006</b>	<b>007</b>	<b>013</b>	<b>014</b>	<b>015</b>	<b>017</b>	
replaced by APU <b>932 500 ... 0</b>					<b>015</b>	<b>013</b>	<b>014</b>					
ID No. Air dryer <b>932 400 ... 0</b>	<b>001</b>	<b>002</b>	<b>003</b>	<b>003</b>	<b>002</b>	<b>001</b>	<b>002</b>	<b>005</b>	<b>006</b>	<b>006</b>	<b>010</b>	
Replacement cartridge	432 410 222 7											
Rep set Air dryer	932 400 000 2											
Rep set Pressure regulator	432 410 001 2											
ID No. LT heater	no heater	894 260 049 2	no heater	no heater	894 260 049 2	no heater	894 260 049 2	no heater	894 260 049 2	894 260 049 2	894 260 049 2	
Rep set heater	-	432 410 932 2	-	-	432 410 932 2	-	432 410 932 2	-	432 410 932 2	432 410 932 2	432 410 932 2	
PSV	Opening pressure of the LT safety valve: 14.5 +2.5 bar											
PCUT-OFF	12.5 bar		10 bar		12.5 bar							10 bar
dPDR	1.5 bar		0.7 bar		1.5 bar							0.7 bar
Remarks on the LT			GD snap connection	Unit damper 432 407 012 0				Power reduction	Power reduction	Power reduction	Power reduction	
ID No. MKS <b>934 705 ... 0</b>	<b>001</b>	<b>001</b>	<b>002</b>	<b>002</b>	<b>003</b>	<b>005</b>	<b>005</b>	<b>005</b>	<b>005</b>	<b>003</b>	<b>007</b>	
Bleed back	No											
Limiting pressure circuit 1	10 bar		-		10 bar							-
Limiting pressure circuit 2	8.5 bar											
POPEN	Opening pressure circuits 1+2: 9.0 bar / Circuits 3+4: 7.5 bar											
PCLOSING	Closing pressure circuits 1+2: > 7.0 bar / Circuits 3+4: > 4.5 bar											
ID No. Pressure sensor	<b>934 705 501 1</b>	-	-	-	<b>441 034 002 1</b>	<b>441 034 504 1</b>	<b>441 034 504 1</b>	<b>441 034 504 1</b>	<b>441 034 002 1</b>	<b>441 034 002 1</b>		
Pressure sensor supply voltage	5 V		-		8 - 32 V		5 V		8 - 32 V			

## 3.3 Configuration

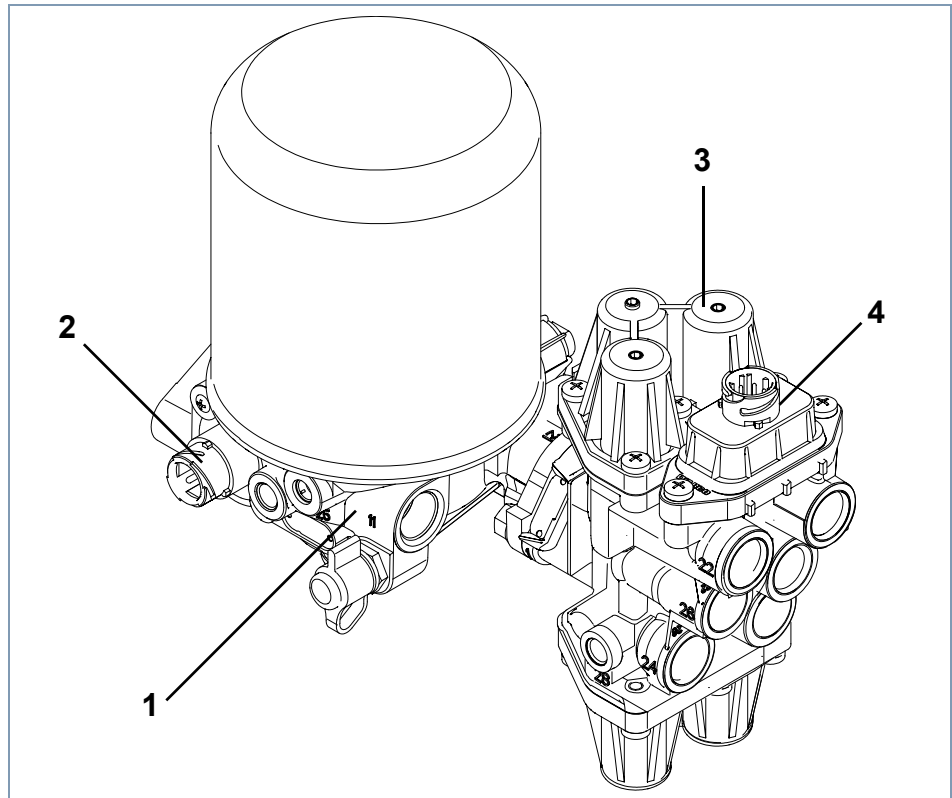


Fig 1: Configuration

**1 Air dryer**

- with cartridge heater and integrated pressure regulator
- ID No. 932 400 ... 0

**2 heater**

- to protect the air dryer against icing
- ID No. 894 260 049 2

**3 Multi-circuit protection valve**

- with 1 or 2 stage pressure limitation
- ID No. 934,705 ... 0

**4 Pressure sensors**

- for the service brake circuit pressures
- ID No., 5V new: 441 043 50 . 1
- ID No., 5V old: 934 705 501 1
- ID No., 24V: 441 043 00 . 1

3.4 Pneumatics diagram (connection assignments)

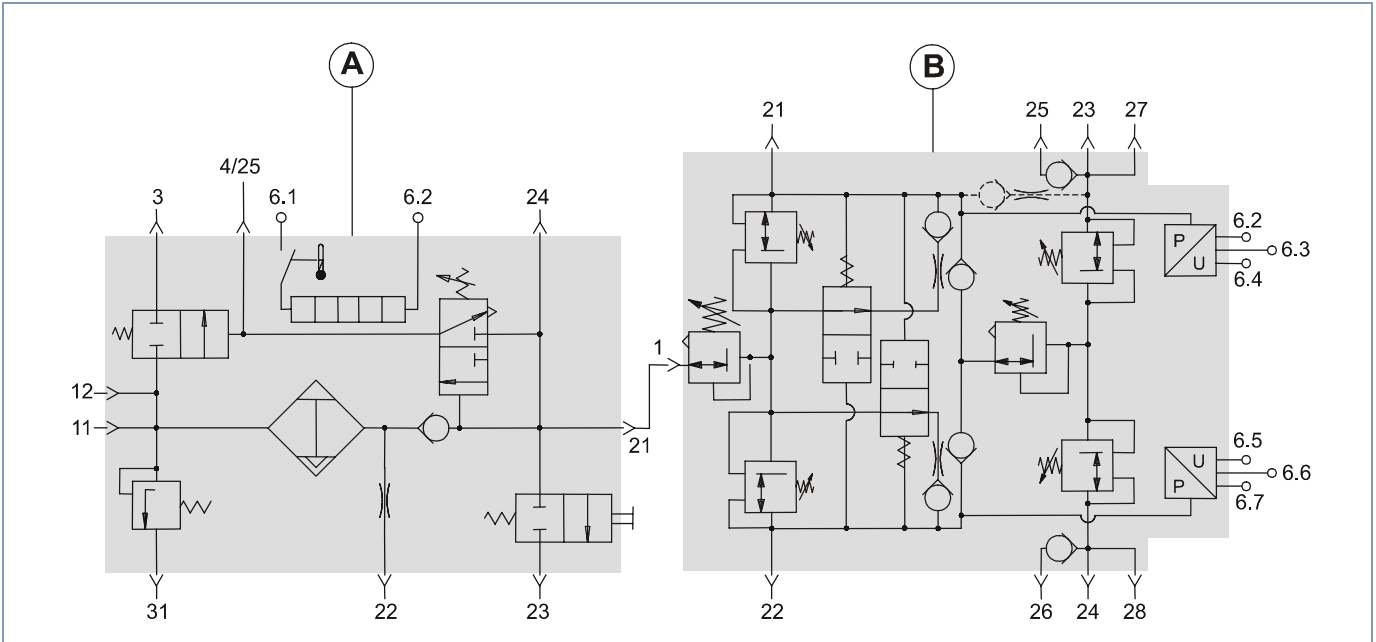


Fig 2: Pneumatics diagram

**A Air dryer**

**Inputs**

- 11 Compressor
- 12 External filling

**Outputs**

- 3 Venting - compressor idling
- 4/25 "Power Reduction"
- 21 Multi-circuit protection valve
- 22 Regeneration air reservoir
- 23 Tire inflating connection
- 24 Air suspension reservoir
- 31 Venting - safety valve

**Electrical connections**

- 6.X Heater

**B Multi-circuit protection valve**

**Inputs**

- 1 Air dryer

**Outputs**

- 21 Service brake
- 22 Service brake
- 23 Trailer brake system
- 24 Accessory loads
- 25 Parking brake system
- 26 Clutch / Transmission control
- 27 Pressure switch
- 28 Pressure switch

**Electrical connections**

- 6.X Pressure sensor



### 3.5 "APU interchangeability" table

The following table provides an overview of which modification and adjustment work enables the specified condition of a required APU to be achieved when servicing an existing APU.

**IMPORTANT! When carrying out the work described here it is possible that the resulting condition of the APU no longer matches the condition given on the rating plate. In this case, in order to prevent errors during the next service, we suggest either defacing the WABCO order number on the rating plate of the modified module and the whole APU after the modification or adjustment work has been carried out, or removing the rating plate concerned.**

The modification and adjustment work often consists of a combination of various individual activities such as the following:

- a) Install heater 894 260 049 2 in the air dryer; MA of the fixing screws = 3Nm (Note: air dryer rating plate and APU rating plate invalid.)
- b) Air dryer heater 894 260 049 2 not to be connected; if necessary protect electrical connection against water penetration
- c) Pressure sensor of multi-circuit protection valve not to be connected; if necessary protect electrical connection against water penetration
- d) Adjust pressure regulator cut-off pressure from 12bar to 10bar; adjust pressure regulator control range from 1.5 bar to 0.7 bar (Note: air dryer rating plate and APU rating plate invalid.)
- e) Remove pressure sensor 934 705 501 1, replace by installing pressure sensor 441 043 002 1 (Note: multi-circuit protection valve rating plate and APU rating plate invalid.)
- f) Remove pressure sensor 934 705 501 1, replace by installing pressure sensor 441 043 504 1 (Note: multi-

circuit protection valve rating plate and APU rating plate invalid.)

g) Remove pressure sensor 441 043 504 1, replace by installing pressure sensor 441 043 002 1 (Note: multi-circuit protection valve rating plate and APU rating plate invalid.)

h) Remove pressure sensor 441 043 504 1, replace by installing pressure sensor 934 705 501 1 (Note: multi-circuit protection valve rating plate and APU rating plate invalid.)

i) Remove pressure sensor 441 043 002 1, replace by installing pressure sensor 934 705 501 1 (Note: multi-circuit protection valve rating plate and APU rating plate invalid.)

j) Remove pressure sensor 441 043 002 1, replace by installing pressure sensor 441 043 504 1 (Note: multi-circuit protection valve rating plate and APU rating plate invalid.)

k) Remove silencer 432 407 012 0 (Note: air dryer rating plate and APU rating plate invalid.)

l) Close port 4/25 at the air dryer

m) Snap silencer 432 407 012 0 onto the air dryer's vent

n) Remove silencer 432 407 012 0

o) Important! Bleed back function (i.e. if circuit 1 fails, it results in return flow from connection 23/26 - check whether it can be used!

"Modification not possible" (= KUM...), as certain circumstances in the components prevent modification:

- |       |  |
|-------|--|
| KUM 1 | Bleed back function does not exist                                       |
| KUM 2 | Power reduction function does not exist                                  |
| KUM 3 | it is not possible to connect the silencer to the air dryer vent         |
| KUM 4 | only one pressure stage available in the multi-circuit protection valve. |

ID No. APU 932 500 ... 0	001	002	003	004	005	006	007	013	014	015	017
ID No. Air dryer 932 400 ... 0	001	002	003	003	002	001	002	005	006	006	010
ID No. Multi-circuit protection valve 934 705 ... 0	001	001	002	002	003	005	005	005	005	003	007
Modification from APU ...											
932 500 001 0	-	a	c; d	KUM 3	KUM 1	KUM 1	KUM 1	KUM 1; 2	KUM 1; 2	KUM 1; 2	KUM 1; 2
932 500 002 0	b	-	d	KUM 3	KUM 1	KUM 1	KUM 1	KUM 1; 2	KUM 1; 2	KUM 1; 2	KUM 1; 2
932 500 003 0	KUM 4	KUM 4	-	m	KUM 1; 4	KUM 1; 4	KUM 1; 4	KUM 1; 2; 4	KUM 1; 2; 4	KUM 1; 2; 4	KUM 1; 2; 4
932 500 004 0	KUM 4	KUM 4	n	-	KUM 1; 4	KUM 1; 4	KUM 1; 4	KUM 1; 2; 4	KUM 1; 2; 4	KUM 1; 2; 4	KUM 1; 2; 4
932 500 005 0	b; i; o	i; o	b; c; d; o	KUM 3	-	b; j	j	KUM 2	KUM 2	KUM 2	KUM 2
932 500 006 0	h; o	a; d; o	c; d; o	KUM 3	a; g	-	a	KUM 2	KUM 2	KUM 2	KUM 2
932 500 007 0	b; h; o	h; o	b; c; d; o	KUM 3	g	b	-	KUM 2	KUM 2	KUM 2	KUM 2
932 500 013 0	h; i; o	a; h; i; o	c; d; i; o	KUM 3	a; g; i	i	a; i	-	a	a; g	a; d; g
932 500 014 0	b; h; i; o	h; i; o	b; c; d; i; o	KUM 3	g; i	b; i	i	b	-	g	d; g
932 500 015 0	b; i; i; o	i; i; o	b; c; d; i; o	KUM 3	i	b; j; i	j; i	b; j	j	-	d
932 500 017 0	KUM 4	KUM 4	b; c	KUM 3	KUM 4	KUM 4	KUM 4	KUM 4	KUM 4	KUM 4	-

Important! APU variations 932 500 005 0, 006 0; 007 0; 013 0; 014 0; 015 0 and ...017 0 have a so-called "bleed back" function, which means that if circuit 1 fails, connections 23 and 27 of the multi-circuit protection valve may become unpressurized.

## 4 Preparatory Work

### 4.1 Tools required

- Offset screwdriver DIN 911 Size 3
- Allen key Size 3
- Combination spanner SW 13
- Universal strap spanner Ø 160 mm
- Soft aluminum jaws for the vice
- Torque spanner

### 4.2 Resources required

- 4 nozzle Ø 0.4 mm
- 1 nozzle Ø 1.1 mm
- Connection cable, ID No. 894 600 454 2 (only for version with heater)
- Ampere meter (measuring range  $\geq 5$  A)
- Voltmeter (measuring range  $\geq 24$  V)
- Sealing device, ID No. 899 709 113 2 (up to 20 bar)
- Screw plugs with seal
  - 2 M 12 x 1.5
  - 1 M 16 x 1.5
  - 8 M 22 x 1.5

 Note

This test and adjustment instruction describes the functional check of the air processing unit (APU) on the WABCO test bench, ID No. 435 197 000 0.

- The most extensively equipped version is assumed.

### 4.3 Preparing for the test

#### General

- To check the air processing unit, disconnect the multi-circuit protection valve and the air dryer by undoing the two hexagonal nuts SW 13.

#### Air dryer

- Connection 24: Close pressure-tight with screw plug M 22 x 1.5.

#### Multi-circuit protection valve

- Connection 1: Insert nozzle Ø1.1 mm.
- Connections 25 and 26: Close pressure-tight with one screw plug M 22 x 1.5 each.
- Connections 27 and 28: Close pressure-tight with one screw plug M 12 x 1.5 each.

#### Preparation at the test bench

- In the overhead vent inserts 3, 4, 6 and 7 of the test bench: Insert nozzles Ø 0.4 mm.

## 5 Air Dryer Test

### 5.1 Test port assignment

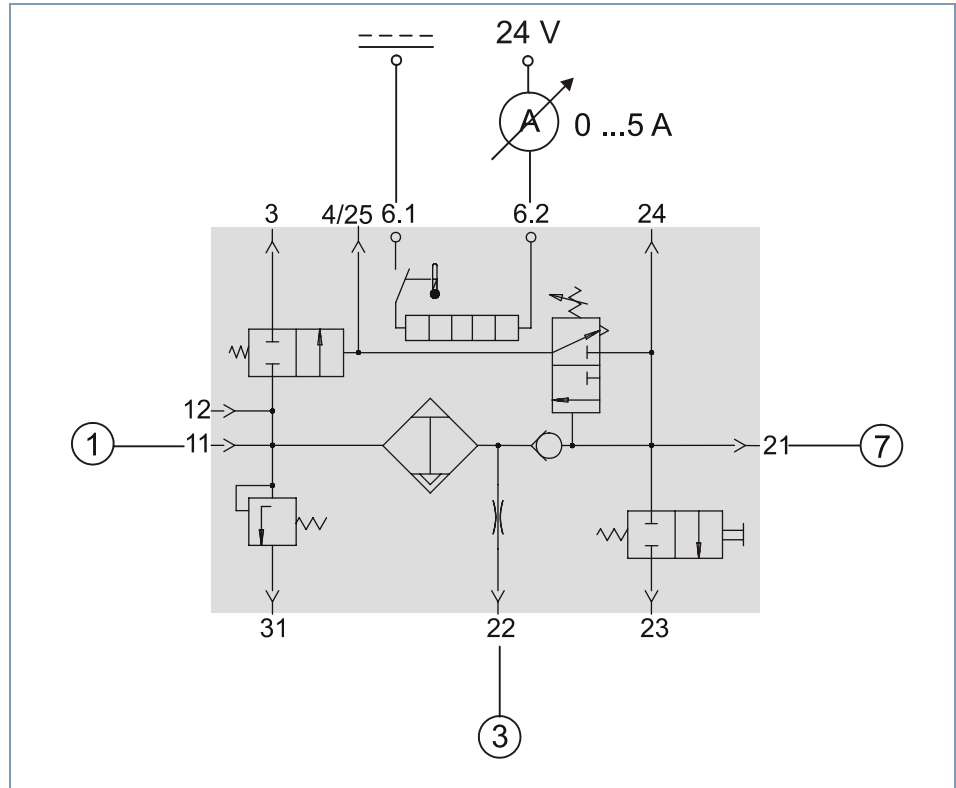


Fig 3: Test port assignment

### 5.2 Basic setting at the test bench

Test pressure required:

- max 20 bar

Set the stopcocks at the test bench to the following basic setting:

- 1 = Stopcock open
- 0 = Stopcock closed

A	B	C	D	E	F	L	V	2	3	4	6	7	11	12	21	22
1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0

### 5.3 Preparing for the air dryer test

- Clamp the air dryer in the vice.
- Connection 11: Connect according to the test port assignment.
- Connections 21 and 22: Initially remain open.

### 5.4 Testing the safety valve

The safety valve ensures that the pressure in the air dryer section cannot arbitrarily rise if the pressure regulator fails. Excessive pressure can cause the air dryer cartridge to explode.

1. Port 22: Close with screw plug M 16 x 1.5.
2. Unscrew the air dryer cartridge from the housing and insert the sealing device (up to 20 bar) (ID No. 899 709 113 2).
3. Screw the air dryer cartridge back onto the housing (17 Nm).
4. Port 11: Use the fine control valve FH12 to pressurize until the safety valve responds, however up to 17 bar maximum.
  - The safety valve must vent intermittently between 14.5 - 17 bar and the pressure at manometer 1 must drop to 14.0 - 14.3 bar.

► Note

If the safety valve test result is negative, adjust in accordance with the following chapter "Adjusting the safety valve". Then repeat the test.

5. Port 31: Check the safety valve for leaks by soaping it down.

► Note

Leaks of 8 cm<sup>3</sup>/min, which corresponds to one cherry-sized soap bubble per minute, are permissible.

6. Remove the sealing device again and screw the air dryer cartridge back onto the housing (17 Nm).
7. Port 22: Remove screw plug M 16 x 1.
8. Remove any test connections.


### 5.5 Adjusting the safety valve

If the safety valve test results are negative, adjust the safety valve as described in the following. Then repeat the test.

1. Port 11: Use the fine control valve FH12 to reduce the pressure to 12.0 bar.
2. Port 31:
  - Remove the toothed ring of the quick-release valve (nip off if necessary),
  - remove the rubber disc,
  - screw in the adjusting ring of the quick-release valve up to the limit stop (this sets the safety valve seat).
3. Port 11: Use the fine control valve FH12 to increase the pressure to 16 bar.
4. Port 31: Unscrew the adjusting ring of the quick-release valve until the safety valve seat starts to leak.
5. Port 11: Use the fine control valve FH12 to reduce the pressure to 12.0 bar.
6. Port 31: Re-insert the rubber disc and toothed ring (ID No. 895 222 500 4).
7. Test the safety valve in accordance with the previous chapter "Testing the safety valve".

## 5.6 Testing the pressure regulator

The pressure regulator's cut-off function limits the operating pressure of the whole compressed air system and protects the following units against overload.

 **Note**

As this test is very loud, it is advisable to attach a WABCO silencer (ID No. 432 407 015 0 ) to connection 3.

 **Caution - Damage to the air processing unit**

Using the wrong silencer or hoses connected to port 3 can cause increased dynamic pressures in the venting area.

Only use original WABCO silencers and remove hoses.

1. Ports 21 and 22: Connect according to the test port assignment.
2. Port 11: Use the fine control valve FH12 to pressurize until the pressure regulator responds.
  - The pressure regulator must switch when the cut-off point is reached and intermittently vent through port 3, the pressure reading can be read off at manometer 7.
  - At the time of venting there is a simultaneous pressure drop, this can be read off at manometer 1.

ID No.	932 500 003 0 932 500 004 0 932 500 017 0	932 500 001 0 / ... 002 0 and 932 500 005 0 to 932 500 015 0
Cut-off point	10.0 -10.2 bar	12.5 -12.7 bar
Pressure drop (Value for INFO only!)	9.8 -10.2 bar	11.7 -12.3 bar

 **Note**

If the pressure regulator test result is negative, adjust in accordance with the following chapter "Adjusting the cut-off pressure". Then repeat the test.



3. The pressure reading ( $p_{AB}$ ) measured at the time of venting is required for testing and adjusting the control range.
4. Open tap 7 to simulate an air consumption which terminates the venting of the pressure regulator.
5. Check the control range.

### 5.7 Adjusting the cut-off pressure

If the pressure regulator test results are negative, adjust the cut-off pressure as described in the following. The cut-off pressure is adjusted at the adjusting screw of the pressure regulator unit. Then repeat the test.

#### Note

When adjusting the cut-off pressure, use an open-end spanner SW 13 to hold tight the guide piece of the adjusting screw, otherwise the factory control range setting can shift.

1. Adjusting screw: Use a size 3 Allen key to adjust the cut-off pressure:
  - Screw in the adjusting screw = increase cut-off pressure
  - Unscrew the adjusting screw = lower cut-off pressure

ID No.	932 500 003 0 932 500 004 0 932 500 017 0	932 500 001 0 / ... 002 0 and 932 500 005 0 to 932 500 015 0
Set value for the cut-off pressure $p_{CO}$	10.0 -10.2 bar	12.5 -12.7 bar

2. Tap 7: Turn 5 x. The simulated consumption releases the tension in the cut-off spring caused by the adjustment.
3. Test the pressure regulator in accordance with the previous chapter "Testing the pressure regulator".

### 5.8 Testing the control range

The control range  $[\Delta p]$  is the tolerance range of the pressure regulator. The operating pressure in the compressed air system is regulated within this tolerance, starting from the cut-off pressure  $[p_{co}]$  of the pressure regulator.

1. Port 21: Vent tap 7 up to the cut-in pressure  $[p_{ci}]$ , the air discharge at vent 3 ends abruptly.
2. Use the following formula to calculate the control range  $[\Delta p]$ :
  - Control range  $[\Delta p] = \text{cut-off pressure } [p_{co}] - \text{cut-in pressure } [p_{ci}]$

ID No.	932 500 003 0 932 500 004 0 932 500 017 0	932 500 001 0 / ... 002 0 and 932 500 005 0 to 932 500 015 0
Control range $[\Delta p]$	0.7 -1.3 bar	1.2 -1.8 bar

3. If the control range value  $[\Delta p]$  differs, correct it at the eccentric screw of the pressure regulator.
4. After correcting the value, re-check the cut-off pressure and control range.

### 5.9 Testing the return nozzle and the non-return valve

The return nozzle and the non-return valve are located in port 21. The non-return valve prevents a pressure drop in the compressed-air system during dynamic processes in the air dryer (especially during regeneration).

1. Port 11: Use the fine control valve FH12 to pressurize the pressure regulator up to the cut-off pressure.
2. Tap 12: close
3. Check the following pressures:
  - Manometer 3: The pressure must drop uniformly.
  - Manometer 7: The pressure must remain constant.
4. Tap 12: Reopen.

## 5.10 Testing for leaks

The following steps are used to successively prove that the air dryer and the non-return valve are airtight to secure the pressure in the brake circuits and the pressure regulator.

1. Fine control valve FH12: Lower the pressure at port 11 to approx 9 bar.
2. Fine control valve FH12: Slowly increase the pressure to the test pressure (approx 0.3 bar below the cut-off pressure).

ID No.	932 500 003 0 932 500 004 0 932 500 017 0	932 500 001 0 / ... 002 0 and 932 500 005 0 to 932 500 015 0
Test pressure	approx 9.8 bar	11.8 -12.0 bar

► Note

If the pressure regulator must not have switched already, otherwise the procedure must be repeated.

3. Tap 12: close
  - The unit must be airtight after 10s, the pressure at manometers 3 and 7 is no longer allowed to change.
4. Tap 12: open
5. Fine control valve FH12: Increase the pressure up to the cut-off pressure.
6. Tap 12: close
7. Vent 3: Check for leaks by soaping down.

► Note

Leaks of 8 cm<sup>3</sup>/min, which corresponds to one cherry-sized soap bubble per minute, are permissible.

### 5.11 Testing the heater

The heater protects the air dryer against icing. It is controlled by a bimetal. The heating duration depends on the media temperature:

- Cut-in temperature: approx + 7 °C
  - Cut-off temperature: approx +30 °C
1. Make the following connections in accordance with the test port assignment:
    - Connect the connection cable (ID No. 894 600 454 2) to the heater and the power supply unit (24 V) of the magnetic test device.
    - Connect the ampere meter – in series.
  2. Magnetic test device: Switch on 24 VDC:
    - The ampere meter initially displays a current input of 3.9 - 4.2 A.
    - The heater must automatically switch off after a short time.
    - The ampere meter then displays a current input of 0 A.

### 5.12 End of test

1. Open tap 7 to simulate air consumption, all ports become unpressurized.
2. Remove the test ports from the air dryer.
3. If no further tests are to be carried out, connect the air dryer to the multi-circuit protection valve (20<sup>+4</sup> Nm) and carry out a final check of the air pressurizing unit.

## 6 Multi-Circuit Protection Valve Test

### 6.1 Test port assignment

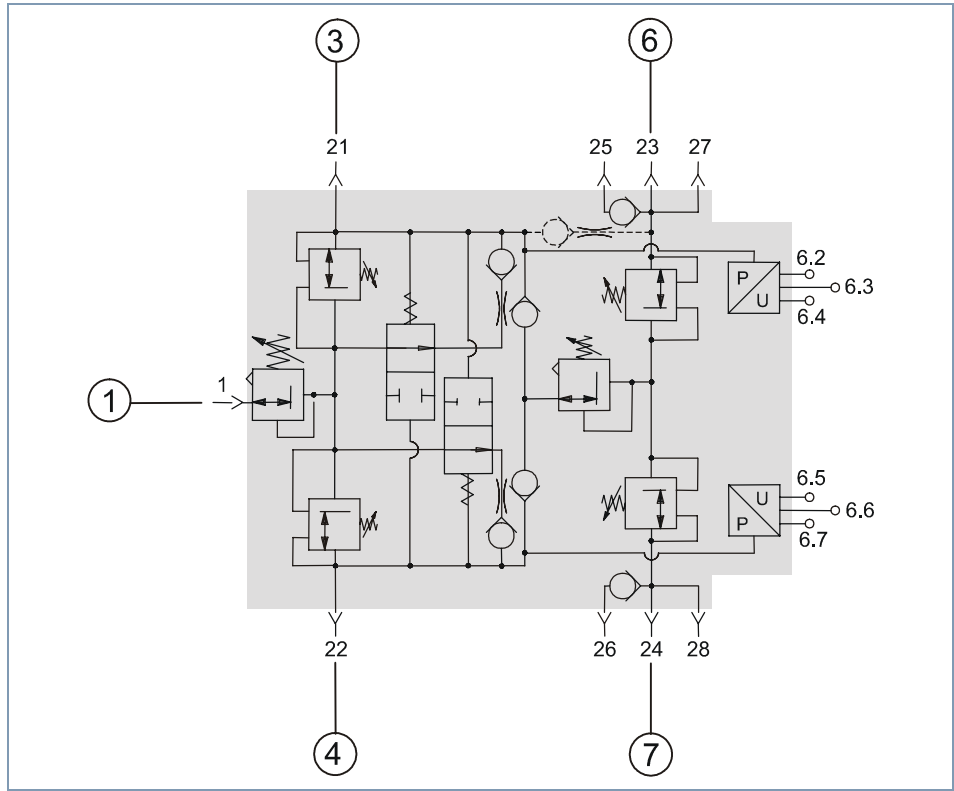


Fig 4: Test port assignment

### 6.2 Basic setting at the test bench

Test pressure required:

- max 13 bar

Set the stopcocks at the test bench to the following basic setting:

- 1 = Stopcock open
- 0 = Stopcock closed

A	B	C	D	E	F	L	V	2	3	4	6	7	11	12	21	22
1	0	0	1	0	0	0	0	0	0	0	0	0	0	1	0	0

### 6.3 Preparing for the multi-circuit protection valve test

- Clamp the multi-circuit connection valve in the vice.
  - Ports 1, 21, 22, 23 and 24 : Connect according to the test port assignment.
1. Fine control valve FH12: Adjust the pressure at port 1.

ID No.	932 500 003 0 932 500 004 0 932 500 017 0	932 500 001 0 / ... 002 0 and 932 500 005 0 to 932 500 015 0
Pressure at port 1	10 bar	12.5 bar

2. Tap 12: Turn at least 3 x.
  - At the end, tap 12 is closed.

### 6.4 Testing the pressure limitation

The pressure limitation protects the service-brake circuit, trailer brake circuit and the accessory loads circuit against overload. The pressure limitation takes place in one or two stages depending on the APU variation.

- Single stage pressure limitation restricts the pressures of the service brake circuits and of the accessory load circuits (2nd pressure stage only).
- Two stage pressure limitation restricts the pressures of the service brake circuits (1st pressure stage) and of the accessory load circuits (2nd pressure stage).

ID No.	932 500 003 0 932 500 004 0 932 500 017 0	932 500 001 0 / ... 002 0 and 932 500 005 0 to 932 500 015 0
Pressure limitation	single stage	two stage

1. Fine control valve FH12: Adjust the pressure at port 1.
2. Tap 12: open
3. Tap 6: Turn 1 x.
  - The simulated consumption should cause the pressure at manometer 6 to drop below 2 bar.

► Note

If the pressure does not sufficiently drop, remove nozzle Ø 0.4 mm from vent 6 of the test bench.

Re-insert the nozzle Ø 0.4 mm after the test!

4. Check the pressures for the pressure limitation:

- Service brake circuit
  - Manometer 3 ( $p_{21}$ )
  - Manometer 4 ( $p_{22}$ )
- Trailer brake circuit
  - Manometer 6 ( $p_{23}$ )
- Accessory load circuit
  - Manometer 7 ( $p_{24}$ )

ID No.	932 500 003 0 932 500 004 0 932 500 017 0	932 500 001 0 / ... 002 0 and 932 500 005 0 to 932 500 015 0
Manometer 3	--	10.7 -11.0 bar
Manometer 4	--	10.7 -11.0 bar
Manometer 6	8.6 -8.9 bar	8.6 -8.9 bar
Manometer 7	8.6 -8.9 bar	8.6 -8.9 bar

► Note

If the pressure limitation test result is negative, adjust in accordance with the following chapter "Adjusting the limiting pressures". Then repeat the test.

### 6.5 Adjusting the limiting pressures

If the test results are negative, use a size 3 Allen key to adjust the pressure limitation in accordance with the following description.

- At the adjusting screw (1): Adjust the limiting pressures for both brake circuits (1st pressure stage).
- At the adjusting screw (2): Adjust the limiting pressures for the trailer brake circuit and the accessory load circuits (2nd pressure stage).

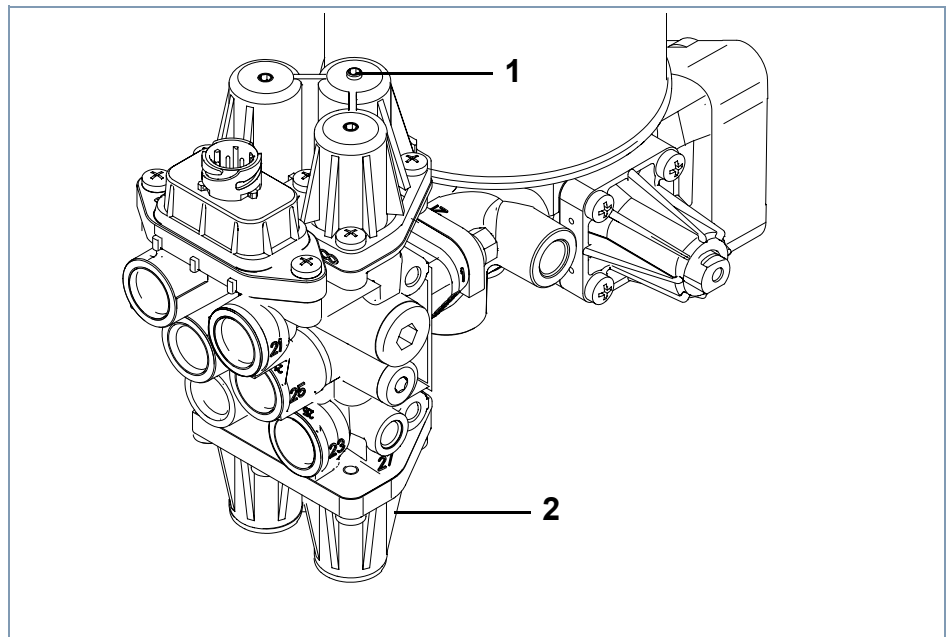


Fig 5: Limiting pressure adjusting screw

1. Adjusting the limiting pressure:
  - Increase the limiting pressure
    - Screw in the adjusting screw (1 or 2)
  - Reduce the limiting pressure
    - Unscrew the adjusting screw (1 or 2)
2. Test the pressure limitation.



### 6.6 Testing the minimum pressures in the circuits

The minimum pressures are the values below which the pressures must not fall during normal system operation without a circuit failure (this is called a constant pressure system).

1. Fine control valve FH12: Adjust the pressure at port 1.
2. Tap 12: open
3. Tap 6: turn
  - The simulated consumption should cause the minimum pressures to set-in in the circuits.
4. Check the minimum pressures:
  - Service brake circuit (not for variations 973 500 003 0 / ... 004 0 / ... 017 0)
    - Manometer 3 ( $p_{21}$ )
    - Manometer 4 ( $p_{22}$ )
  - Trailer brake circuit
    - Manometer 6 ( $p_{23}$ )
  - Accessory load circuit
    - Manometer 7 ( $p_{24}$ )

Manometer	Pressure
Manometer 3	10 bar
Manometer 4	10 bar
Manometer 6	$\geq 8$ bar
Manometer 7	$\geq 8$ bar

5. Tap 6: close

## 6.7 Testing the opening pressures

The opening pressures are the pressures required to open the circuit (assured pressure).

 Note

To check the opening pressures, remove the nozzles Ø 0.4 mm from the overhead vent inserts 3, 4, 6 and 7 of the test bench.

Re-insert the nozzles Ø 0.4 mm after the test!

1. Fine control valve FH12: Adjust the pressure at port 1.
2. Tap 12: open
3. Taps 3, 4, 6, 7: Open one after the other
  - Manometers 3, 4, 6, 7: Read off the pressure when the tap is open and check:

ID No.	932 500 003 0 932 500 004 0 932 500 017 0	932 500 001 0 / ... 002 0 and 932 500 005 0 to 932 500 015 0
Manometer 3	9.0 -9.3 bar	9.0 -9.3 bar
Manometer 4	9.0 -9.3 bar	9.0 -9.3 bar
Manometer 6	7.2 -7.5 bar	7.2 -7.5 bar
Manometer 7	7.2 -7.5 bar	7.2 -7.5 bar

4. Taps 3, 4, 6, 7: close
  - After closing the respective tap the limiting pressures tested as described in the chapter "Testing the pressure limitation" should set in again.

 Note

If the opening pressure test results are negative, adjust in accordance with the following chapter "Adjusting the opening pressures". Then repeat the test.

### 6.8 Adjusting the opening pressures

If the test results are negative, use a size 3 Allen key to adjust the opening pressures in accordance with the following description.

- At the adjusting screw (1): Adjust the opening pressure for the service brake circuit at port 22.
- At the adjusting screw (2): Adjust the opening pressure for the service brake circuit at port 21.
- At the adjusting screw (3): Adjust the opening pressure for the trailer brake circuit at port 23.
- At the adjusting screw (4): Adjust the opening pressure for the accessory load circuit at port 24.

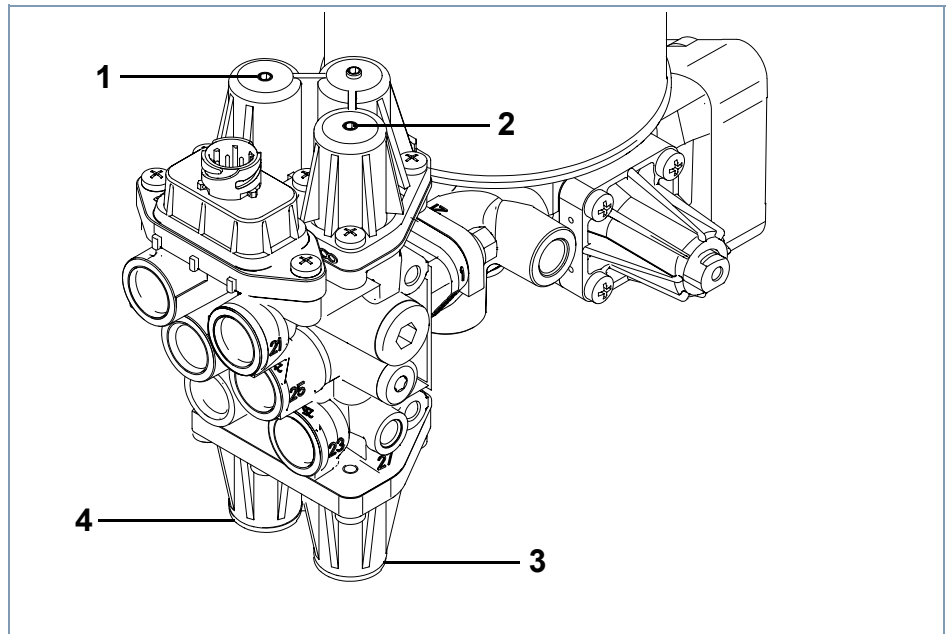


Fig 6: Opening pressure adjusting screws

1. Adjusting the opening pressures:
  - Increase the opening pressure
    - Screw in the adjusting screw (1, 2, 3, 4)
  - Lower the opening pressure
    - Unscrew the adjusting screw (1, 2, 3, 4)
2. Test the opening pressures.

### 6.9 Testing the static closing pressures

If the pressure falls below the static closing pressures the system recognizes a circuit failure in the circuit in which the pressure fell below the required value.

1. Fine control valve FH12: Adjust the pressure at port 1.
2. Tap 12: open
3. Tap 12: re-close
4. Taps 3, 4, 6, 7: Open one after the other and then close again
  - Manometers 3, 4, 6, 7: Read off the static closing pressure when the tap is open and check:

Manometer	Pressure
Manometer 3	$\geq 6.0$ bar
Manometer 4	$\geq 6.0$ bar
Manometer 6	$\geq 4.5$ bar
Manometer 7	$\geq 4.5$ bar

5. Tap 12: open
  - After opening tap 12 the limiting pressures tested as described in the chapter "Testing the pressure limitation" should set in again.

### 6.10 Testing for leaks

The following steps are used to prove that the multi-circuit protection valve is airtight.

1. Fine control valve FH12: Adjust the pressure at port 1.
2. Tap 12: open
  - After opening tap 12 the limiting pressures tested as described in the chapter "Testing the pressure limitation" should set in.
3. Check for leaks by soaping down.

 **Note**

Leaks of 8 cm<sup>3</sup>/min, which corresponds to one cherry-sized soap bubble per minute, are permissible.

### 6.11 Testing the bleed back function

► Note

The bleed back function has not been integrated in all variations of the air pressure unit:

- from May 1998
- Multi-circuit protection valve ID No. 934 705 003 0, 934 705 005 0, 934 705 007 0,

The bleed back function causes the spring-type actuator of the rear axle circuit to activate, i.e. the TRISTOP® cylinders move into the braking position.

The bleed back function test essentially corresponds to "Testing the non-return valves".

1. Fine control valve FH12: Adjust the pressure at port 1.
2. Tap 12: open
3. Tap 12: re-close
4. Port 21: Vent tap 3 (rear axle brake circuit):
  - The pressure at port 22 must not drop below 6.0 bar.
  - At ports 23, 24: the pressure must not drop below 4.5 bar.

► Note

To extend the test, proceed as described in the next chapter "Further tests on the multi-circuit protection valve".

## 6.12 Further tests on the multi-circuit protection valve

The further tests for the multi-circuit protection valve checks the additional functions of the device. These tests are relatively complicated and time-consuming and extend beyond the normal scope of testing.

### 6.12.1 Testing the overfill value

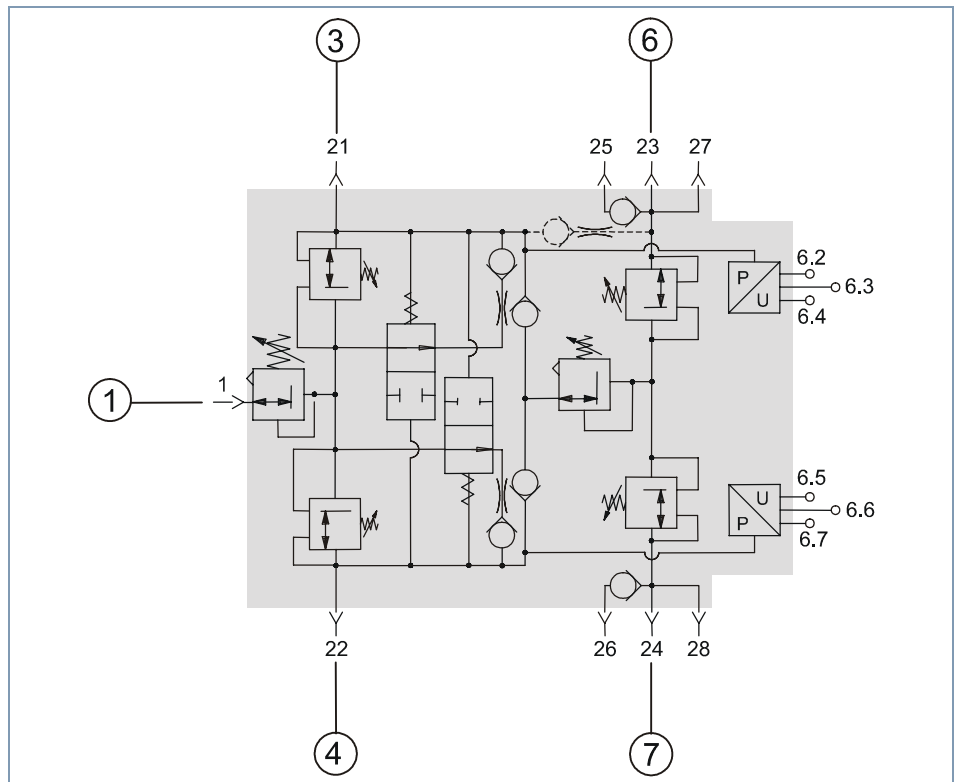


Fig 7: Test port assignment

Test pressure required:

- max 13 bar

Set the stopcocks at the test bench to the following basic setting:

- 1 = Stopcock open
- 0 = Stopcock closed

A	B	C	D	E	F	L	V	2	3	4	6	7	11	12	21	22
1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

The overfill value denotes the maximum pressures occurring in the brake circuits (1st pressure stage) and in the accessory load circuits (2nd pressure stage); overflows result if they are exceeded.

1. Ports 1, 22 and 23: Connect according to the test port assignment.
2. Ports 21 and 24: Insert a  $\varnothing$  0.35 - 0.4 mm nozzle.
3. Fine control valve FH12: Adjust the pressure at port 1.

ID No.	932 500 003 0 932 500 004 0 932 500 017 0	932 500 001 0 / ... 002 0 and 932 500 005 0 to 932 500 015 0
Pressure at port 1	10.0 bar	12.5 bar

4. Tap 12: open (for the versions 932 500 003 / ...004 0 / ... 017 0 continue with step 6)
  - Manometers 1, 3: The overfill value for the braking circuits - i.e. the value at which the pressures rise together must be  $\leq$  11.8 bar.
5. Tap 12: close
6. Tap 22: open
7. Manometers 2, 4: The overfill value for the trailer/accessory load circuits - i.e. the value at which the pressures rise together must be  $\leq$  9.8 bar.
8. Tap 22: close

## 6.12.2 Testing the non-return valves

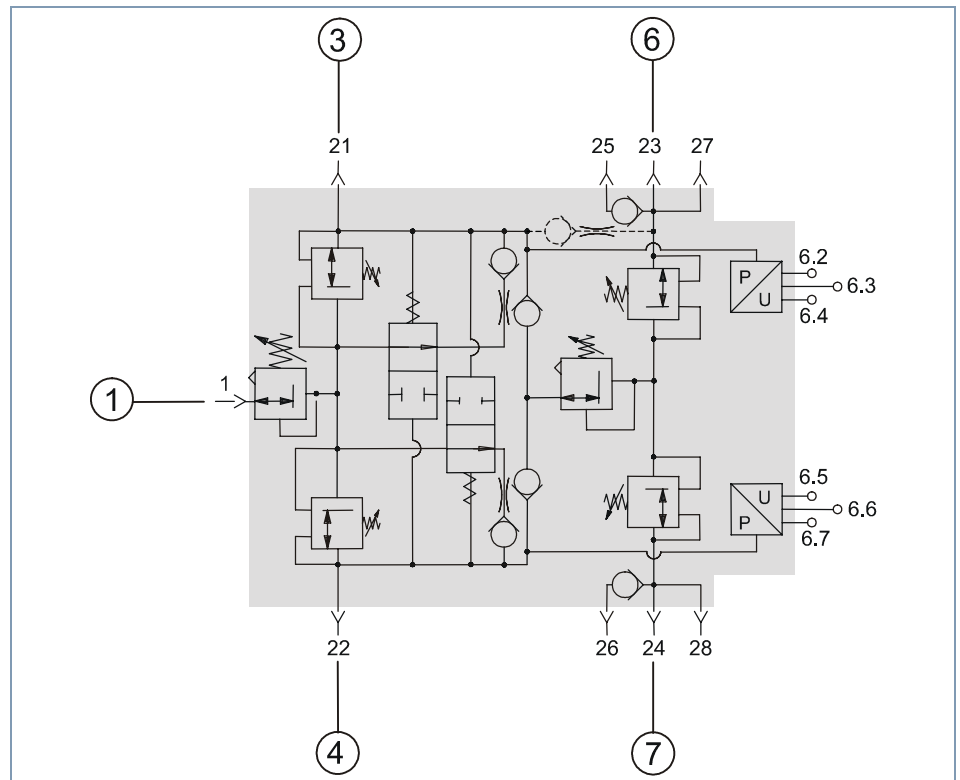


Fig 8: Test port assignment

Test pressure required:

- max 13 bar

Set the stopcocks at the test bench to the following basic setting:

- 1 = Stopcock open
- 0 = Stopcock closed

A	B	C	D	E	F	L	V	2	3	4	6	7	11	12	21	22
1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0



There are non-return valves in the ports 25 and 26. A flow resistant develops at the non-return valves, which must not exceed a certain pressure value.

1. Ports 25 and 26: Unscrew screw plug M 22 x 1.5.
2. Port 22: Screw in screw plug M 22 x 1.5.
3. Remaining ports: Connect according to the test port assignment.

 Note

To check the non-return valves, remove the nozzles  $\varnothing 0.4$  mm from the overhead vent inserts 3, 4, 6 and 7 of the test bench.

Re-insert the nozzles  $\varnothing 0.4$  mm after the test!

4. Fine control valve FH12: Adjust the pressure at port 1.

ID No.	932 500 003 0 932 500 004 0 932 500 017 0	932 500 001 0 / ... 002 0 and 932 500 005 0 to 932 500 015 0
Pressure at port 1	10.0 bar	12.5 bar

5. Tap 12: open
6. Tap 6: open
  - Manometer 3: When the tap is open the pressure must be  $\leq 0.5$  bar (check non-return valve in port 25).
7. Tap 6: close
8. Tap 7: open
  - Manometer 4: When the tap is open the pressure must be  $\leq 0.5$  bar (check non-return valve in port 26).
9. Calculate the pressure difference ( $\Delta p$ ) between the pressures at manometer 2 and 4. This pressure difference  $\Delta p$  provides information about the function of the double non-return valve in the device.
  - The pressure difference ( $\Delta p$ ) must be 0.7 - 1.1 bar.
10. Tap 7: close

## 6.13 End of test

1. Simulate consumption to depressurize all ports.
2. Remove the test ports from the multi-circuit protection valve.
3. If no further tests are to be carried out, connect the multi-circuit protection valve to the air dryer ( $20^{+4}$  Nm) and carry out a final check of the air processing unit.

## 7 Pressure Sensor Test

### 7.1 Test port assignment

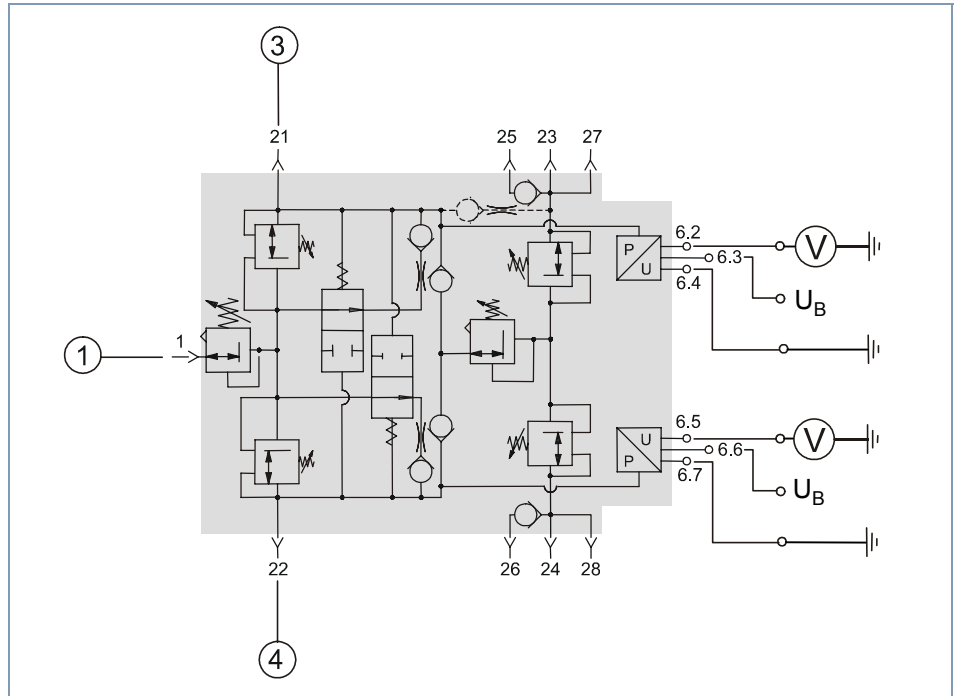


Fig 9: Test port assignment

### 7.2 Basic setting at the test bench

Test pressure required:

- max 12 bar

Electrical connection data:

- $U_B = 5\text{ V}$ 
  - for variations 932 500 001 0, ... 002 0, ... 003 0, ... 004 0, ... 006 0, ... 007 0, ... 013 and 932 500 014 0
- $U_B = 24\text{ V}$ 
  - for variations 932,500,005 0, ... 015 0 and 932 500 017 0
- $R_L: 1\text{ K}\Omega$

Set the stopcocks at the test bench to the following basic setting:

- 1 = Stopcock open
- 0 = Stopcock closed

A	B	C	D	E	F	L	V	2	3	4	6	7	11	12	21	22
1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

## 7.3 Preparing for the pressure sensor test

In several types of vehicles it is possible to show the brake circuit pressures on a display. The pressure sensors supply the required information to the central computing unit of these vehicles. The pressure sensors are therefore irrelevant for the function of the air processing unit.

The pressure-proportional voltage in the unpressurized condition and in operating condition are checked.

1. Connect the electrical test setup in accordance with the test port assignment.

Pin No.	Pin assignment
6.2	Signal output 1st braking circuit
6.3	U <sub>B</sub> 1st braking circuit (5 V or 24 V)
6.4	GND 1st braking circuit
6.5	Signal output 2nd braking circuit
6.6	U <sub>B</sub> 2nd braking circuit (5 V or 24 V)
6.7	GND 2nd braking circuit

2. Ports 1, 21 and 22: Connect according to the test port assignment.
3. Fine control valve FH12: Adjust the pressure at port 1.

ID No.	932 500 003 0 932 500 004 0 932 500 017 0	932 500 001 0 / ... 002 0 and 932 500 005 0 to 932 500 015 0
Pressure at port 1	10.0 bar	12.5 bar

## 7.4 Testing in unpressurized condition

1. Tap 12: is still closed
2. Ports 21 and 22: No pressure has been applied yet.
3. The voltmeter displays around 1 V at PINs 2 and 5.

### 7.5 Testing in operating condition

1. Tap 12: open
  - Manometers 4 and 5: The pressures determined in the chapter "Testing the pressure limitation" are displayed.
2. The voltmeter displays the analog voltage signal for the measured pressure at port 21 (22) according to the formula.

$$U_B = \frac{p}{4} + x$$

$p$  = applied pressure [in bar]

$U_S$  = voltage to be output [in volts]

$x$  = voltage in unpressurized condition

#### Example

Pressure at port 21: 11 bar

Voltage in unpressurized condition: 1 V

Voltage signal =  $11 : 4 + 1 = 3.75$  V

### 7.6 End of test

1. Simulate consumption to depressurize all ports.
2. Remove the test ports from the multi-circuit protection valve.
3. If no further tests are to be carried out, connect the multi-circuit protection valve to the air dryer (20<sup>+4</sup> Nm) and carry out a final check of the air processing unit.

8 Final Check

8.1 Test port assignment

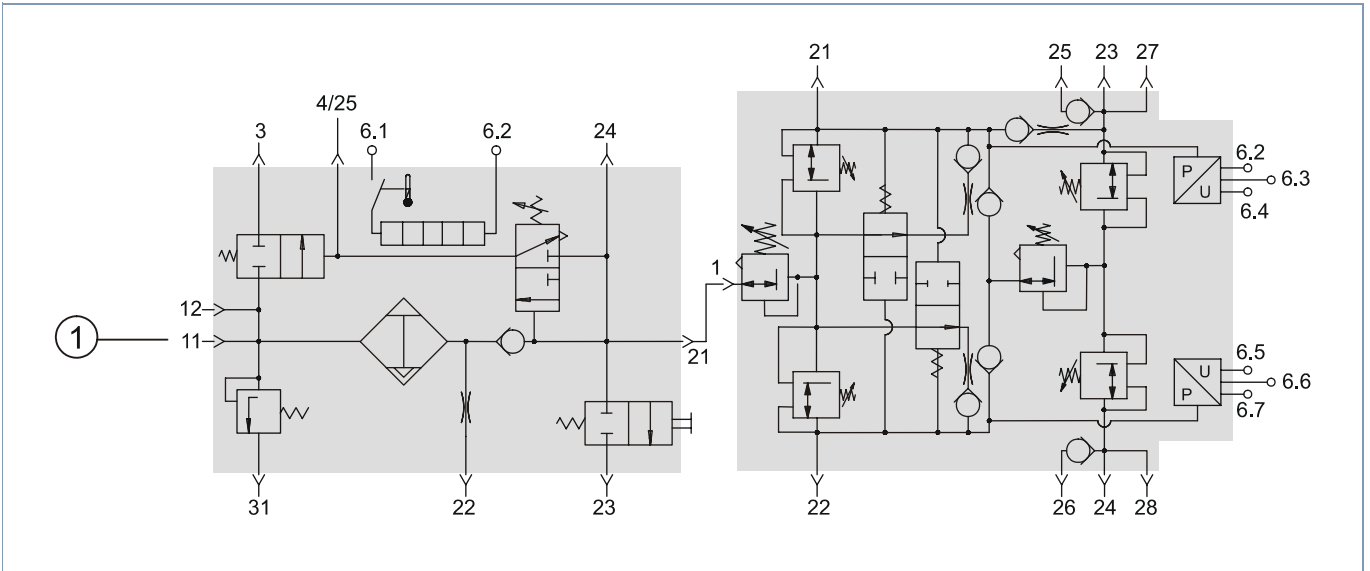


Fig 10: Test port assignment

8.2 Basic setting at the test bench

Test pressure required:

- max 13 bar

Set the stopcocks at the test bench to the following basic setting:

- 1 = Stopcock open
- 0 = Stopcock closed

A	B	C	D	E	F	L	V	2	3	4	6	7	11	12	21	22
1	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0

### 8.3 Testing for leaks

The tests described and performed here have ensured adequate functionality of the air processing unit. The whole system must then be checked for leaks.

1. Use screw plugs to close the ports 22 and 24 at the air dryer and ports 21, 22, 23, 24, 25, 26, 27 and 28 at the multi-circuit protection valve.
2. Connect port 11 of the air dryer with port 1 of the test bend and apply a test pressure of 10 bar.
3. Check for leaks by soaping down.

 Note

Leaks of 8 cm<sup>3</sup>/min, which corresponds to one cherry-sized soap bubble per minute, are permissible.

Moisture must not get into the area of the sensor socket if the sensor connector is not plugged in!

4. Depressurize the air processing unit.
5. Dismantle and remove the air processing unit from the test bench.