

■ **ATC-CAN**

Automatic Temperature Control
with CAN in MAN city bus
with **WABCO ATC**
446 195 004 0

■ System description

■ 2nd Edition

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General Information

This publication describes the heating, ventilation and air conditioning (ATC) in a MAN city bus. The publication is meant for trained commercial vehicle workshop personnel with knowledge of automotive electronics.

Before you perform any work on the vehicle (repair, maintenance, diagnostics, parameter definition), you must ensure the following:

- Only trained and qualified personnel may perform repairs on the vehicle.
- Always follow the specifications and instructions of the vehicle manufacturer.
- Always comply with the Company and national accident prevention guidelines and Health and Safety regulations.

- Wear suitable protective clothing as the situation requires.
- The workplace has to be dry, as well as sufficiently lit and ventilated.

Used abbreviations

ATC	Automatic Temperature Control
HLK	Heater and climate control
ATR-E	Automatic Temperature Regulation Economic
VDV	Association of German Transport Undertakings
CAN	Controller Area Network

1 Introduction

Heating, ventilation and air conditioning control (HLK) now belong to the standard equipment on city buses and touring coaches.

ATC provides maximum comfort for the drive and the passengers.

Different control elements and designs are used to adapt the ATC to the respective vehicle-specific requirements by the vehicle manufacturer. The ability of parameter definition allows the ATC to be adapted to different customer requirements.

1.1 History of ATC systems

1981 PDV for BR 200 Kässbohrer



1991 ATR for BR 300 Kässbohrer



1992 ATC for Futura BOVA/Berkhof



1993 ATR-E for BR 300 Kässbohrer

1996 ATC for F 2000 MAN



1996 ATC for city bus MAN



1997 ATC CAN for city bus CITARO



1999 ATC CAN for touring coach TRAVEGO



2000 ATC CAN for city bus MAN



2004 Neoplan Centroliner and MAN Lion City



1.2 Physical Principles

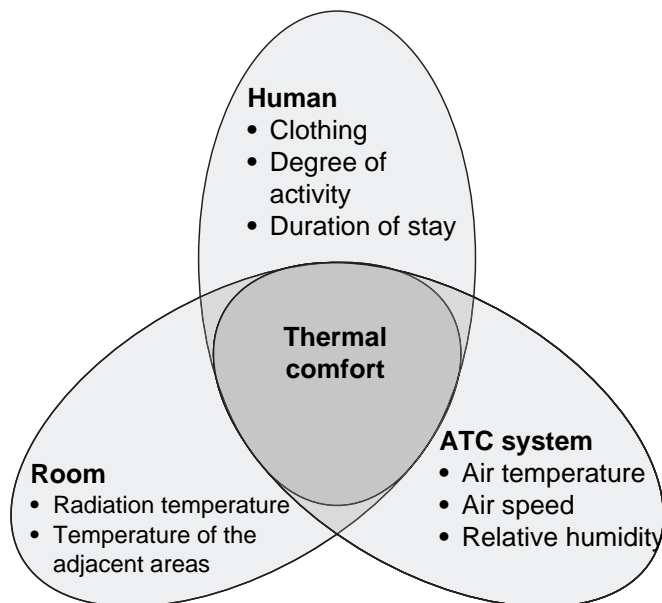
The electronic temperature controller should regulate the temperature in the interior of an Bus. The principle is to mix warm and cold air to achieve a comfortable climate for those inside.

Two major requirements are the heating and ventilation systems on Buses:

- Providing a comfortable climate
- Clearing the windows of frost and humidity

Comfort is also influenced by other alternating factors:

- **Individual machine status:**
 - Activity or idle
 - Clothing etc.
- **Heating-ventilation-air conditioning system, also known as HLK (German) or ATC :**
 - Air temperature
 - Air speed etc.
- **Constructive passenger space arrangement:**
 - Radiation temperature
 - Temperature of the adjacent areas



Other influential variables on the comfort are the duration of the stay, the density of people in the area (on full buses for example) and more. These factors must be adapted to one another during the time that people are in the passenger space so that comfort is guaranteed. HLK or ATC systems can be used to influence the area temperature, the air speed and the exchange of air in the area.

Because of the many influential variables on the comfort, it is not easy to create one climate to satisfy a number of people. This creates the desire for individual control capabilities with adjustable flaps, fans or jets within the immediate grasp of the occupants.

The influential factors that are indicated here \are by no means exhausted and show the complexity that the driver is confronted with in Buses to achieve a comfortable climate for themselves and for the passengers.

Utilising these electronics, it is possible to free the driver from the manual air-conditioning control so that he can concentrate on the actual job at hand. The temperature control is done by the electronics according to the specified control characteristic.

Investigations concerning comfort or the subjective well-being of people shows that

- temperature stratification in the passenger space ("warm feet - cool head") should not exceed 40 °C
- a dependency between inside and outside temperatures are desired.

1.3 Air conditioning requirements

All of the requirements for an ideal acclimatised city bus are listed in regulation 236 of the VDV (Association of German Transport Undertakings), which is the basis for regulating the city bus ATC.

- **Room temperature**
 - Passenger space between + 18 °C and + 22 °C
 - Driver's area between +18 °C and + 25 °C
 - Approximately 3 °C below the outside temperature in cooling mode
- **Flow speeds**
 - Avoid draughts
 - Guarantee sufficient air circulation
- **Humidity**
 - Clear windows
 - In cooling mode, drying is unregulated
- **Air quality**
 - Minimum fresh air rate 15 m³/h
 - Air exchange through forced ventilation
 - Air purity 70 % for particles > 1µm
- **Noise emissions**
 - Average value approx. 68 dB (A)

2 System Description

2.1 Advantages of ATC

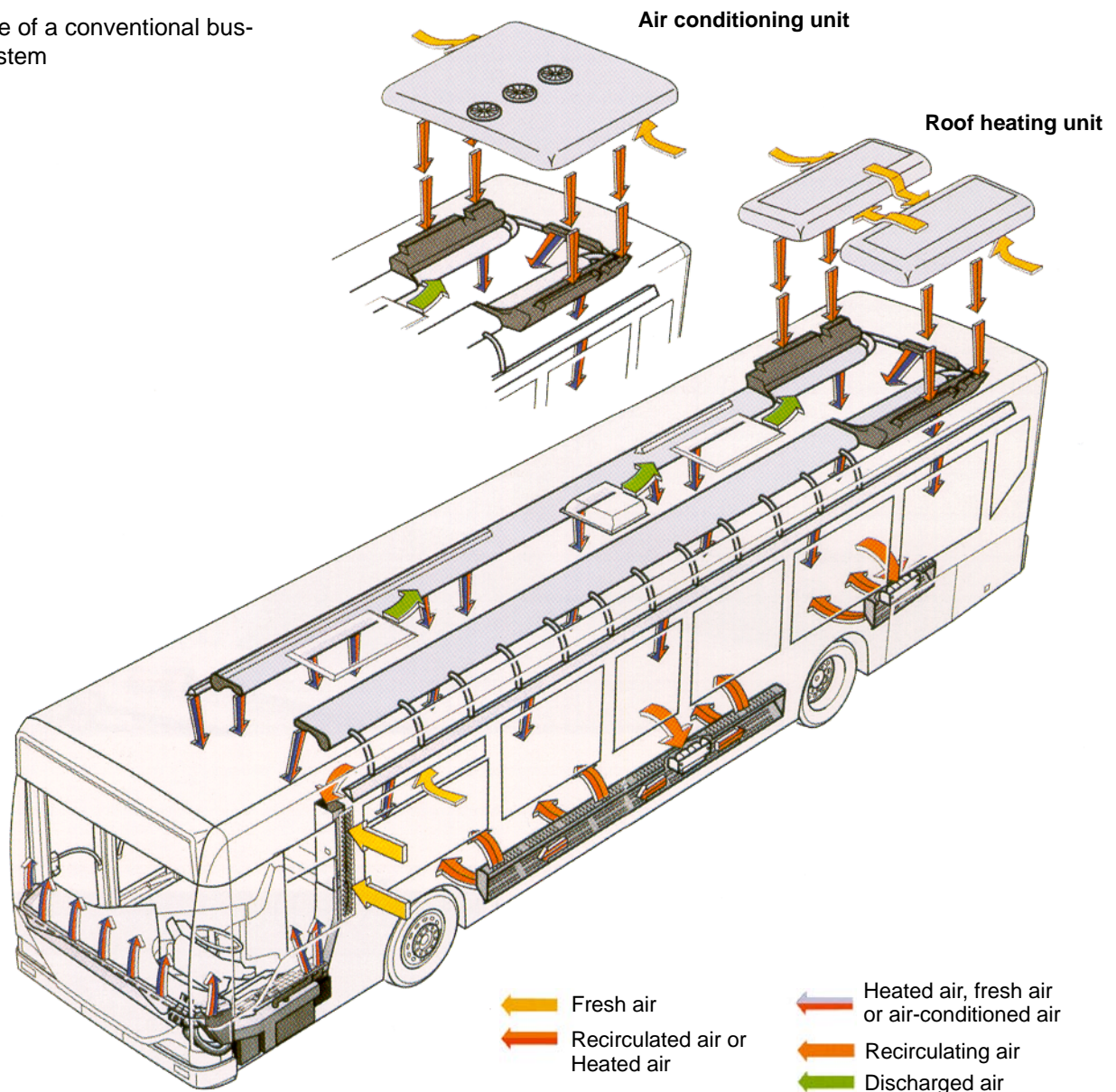
- Automatic control for heating, ventilation and air conditioning (HLK) so that the driver does not have to perform extensive adjustment activities
- Manual control capabilities in the flaps, temperature and fan control for the driver's area
- Completely automatic air conditioning for the driver's space (can be switched on or off on the control panel)
- Extensive adjustment capabilities for passenger compartment control in touring buses
- Setting and regulation of the work space of the driver according to personal desires

- Quick diagnosis of the ATC via diagnostics programs; Errors can be read and localised

2.2 Features of ATC

- Master-Slave system, which corresponds with the vehicle via a CAN interface: direct reading of the vehicle data (such as e. g. coolant temperature)
- Connection of the sub-stations via an internal HLK-CAN Bus
- Control panel with integrated display for vehicles without a central display
- Set value setting via control panel

Example of a conventional bus-HKL system



- Temperature control precision of approx. 1°C
- Connection of auxiliary and independent heating is possible
- Control of the fan speeds and optimised door closing through signals from the door movements
- Extensive onboard diagnostics in the control panel with display
- Functions that are integrated in the control panels such as smog mode, defrost function and reheat operation

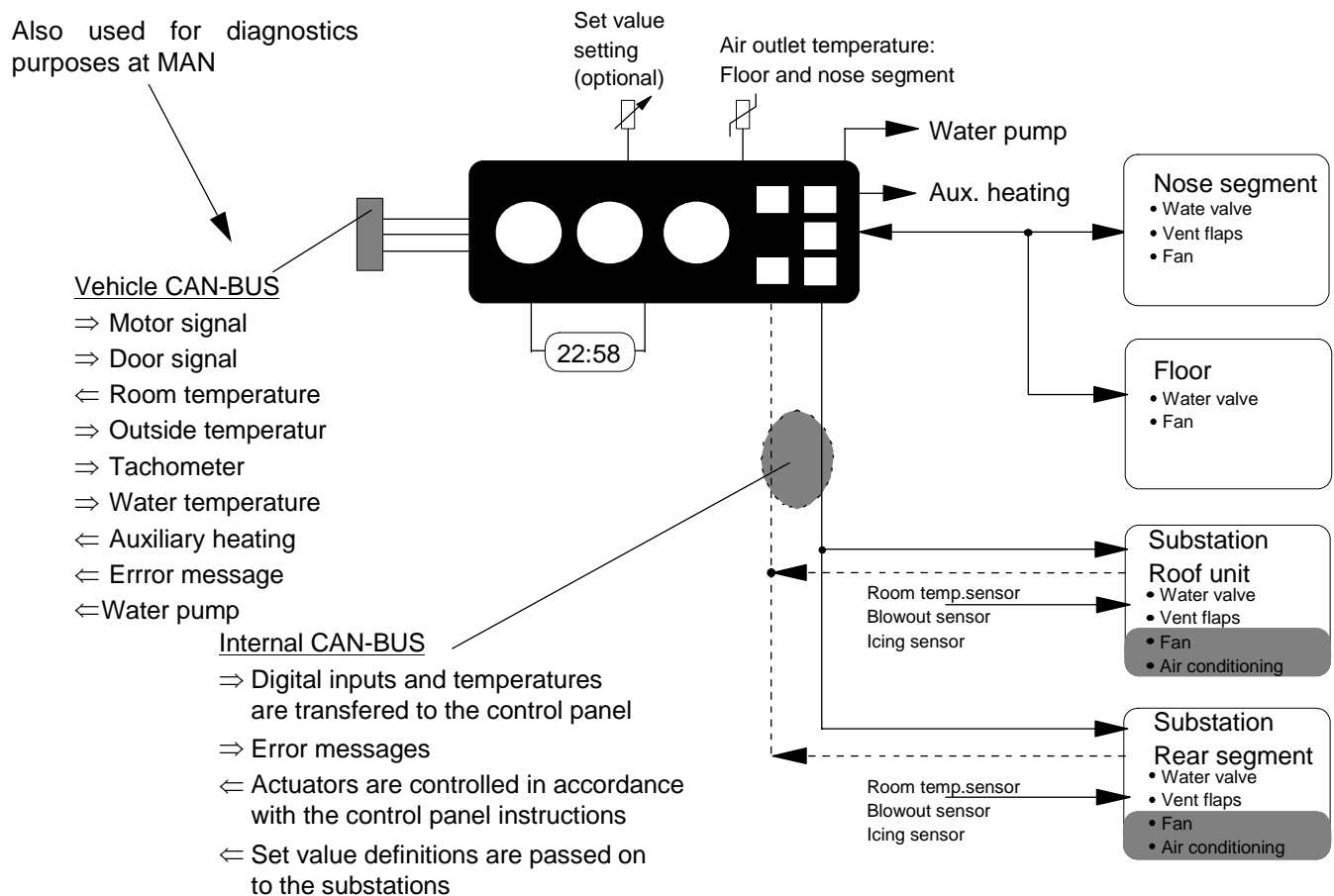
2.3 Function

The electronics handle the room temperature control in the passenger compartment, which cannot be influenced by the driver. The air conditioning of the passenger compartment is done fully automatically, only when transferring the buses can the passenger compartment

control be switched off in a simple form (switch) by the driver.

The electronics of the control panel regulates the entire front box as well as the floor area of the vehicle. Only these electronics are required in the simplest variation. If the bus is equipped with a roof mount system or if an articulating bus is used, additional substations are used there. The control panel is connected with the substation via an internal CAN Bus. The substations can be implemented universally. All characteristics and parameters are defined centrally for this system. A data exchange is done via the internal CAN Bus, also called the System Bus, with the substations.

The control panel allows the driver to have direct access to all of the HLK settings that are relevant to him directly from his workplace. In this case, the flaps, set values for the front box blow out temperature and the fan speed capabilities can be adapted to the driver's desires.



3 Components

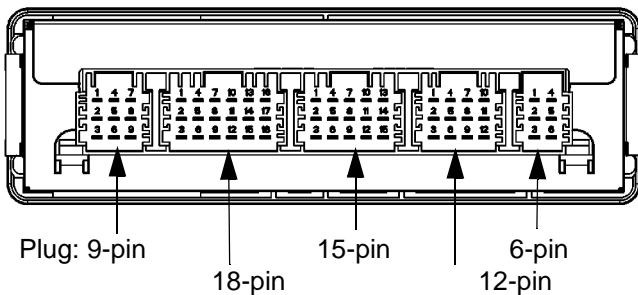
3.1 The control panel 446 195 004 0



Supply voltage: Terminal 30 =>24V
 Standby current: 0.005 A
 Maximum current consumption: 4 A

The control panel has reverse polarity protection.

Plug side of the control panel



Plug connector pin assignment

9-pin plug connector

Pin	Meaning
1	Terminal 30 (steady positive voltage)
2	Terminal 15 (ignition on) Wakeup
3	Terminal 31 (vehicle ground)
4	Terminal 58 (lighting)
5	Engine signal input (D+61)
6	Diagnosis (currently not supported)
7	CAN - interface (vehicle bus) H
8	CAN - interface (vehicle bus) GND
9	CAN - interface (vehicle bus) L

18-pin plug connector

Pin	Meaning
1	Water valve front box DC motor (+)
2	Water valve front box DC motor (-)
3	not used
4	not used
5	Front windscreen flap (+)
6	Activation UV's
7	PWM - Front box blower output
8	Front windscreen flap (-)
9	Auxiliary heating return information

Pin	Meaning
10	Reference voltage for feedback potentiometer
11	Water valve front DC motor potentiometer feedback
12	Ground for feedback potentiometer
13	Input potentiometer feedback front windscreen flap
14	Input potentiometer fan adjustment (Reserve)
15	Input sensor fan monitor (old: RESERVE 2)
16	Outside temperature sensor
17	Air blowout temperature sensor for driver's area
18	Ground for temperature sensors

15-pin plug connector

Pin	Meaning
1	Fresh air/recirculating air flap (+)
2	Passenger compartment fan level 1 (output for relay)
3	Reserve AD input for ext. set value potentiometer
4	Fresh air/recirculating air flap (-)
5	Passenger compartment fan level 2 (output for relay)
6	Output for error lamp
7	10 kOhm pull resistor for PWM output X18.7
8	Input for auxiliary heating operation via time switch Wakeup
9	Input for door signal
10	(not supported)
11	Input for energy-saving mode Wakeup
12	Input for remote actuation with remote supply for heating
13	Passenger temperature sensor
14	Air blowout temperature sensor Floor
15	Ground for temperature sensors

12-pin plug connector

Pin	Meaning
1	Water valve Floor DC motor (+)
2	Water valve Floor DC motor (-)
3	Vref. for pot. feedback Water valve Floor
4	Ground for feedback potentiometer
5	Air conditioning output (3A)
6	Auxiliary heating output
7	Auxiliary heating Energy saving level
8	Water pump output
9	Water valve Floor DC motor potentiometer feedback
10	CAN - interface (heating bus) H
11	CAN - interface (heating bus) GND
12	CAN - interface (heating bus) L

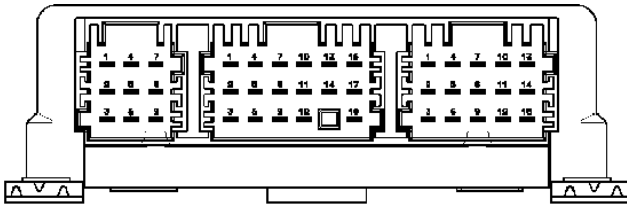
3.2 The submodule 446 196 000 0



The substation(s) is/are component(s) of the Bus ATC system. The substation(s) are connected with the control panel with a special interface. This interface makes it possible to exchange operational data, such as e. g. sensor values, set values and naturally diagnostic messages.

The submodule has a steady power supply via terminal 30. The activation is via the connection on terminal 15, which is separate from the control panel. This guarantees that the control panel e. g. can handle follow-up control.

Plug connector side of the submodule:



Overview of the PIN assignments of the plug connector

9-pin plug connector

Pin	Meaning
1	Terminal 30 (steady positive voltage)
2	Terminal 15 (ignition on) Wakeup
3	Terminal 31 (vehicle ground)
4	Input for coding 1
5	Input for coding 2
6	120 Ohm termination resistor
7	CAN - interface (heating bus) H
8	CAN - interface (heating bus) GND
9	CAN - interface (heating bus) L

15-pin plug connector

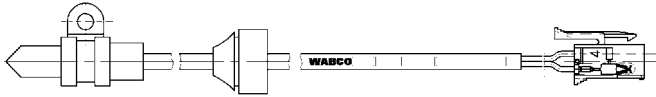
Pin	Meaning
1	Output for roof flap right (+)
2	Output for roof flap left (+)
3	PWM - Front box evaporator fan
4	Output for roof flap right (-)
5	Output for roof flap left (-)
6	Output for condenser fan
7	10 kOhm pull resistor for PWM output X15.3
8	Reference voltage for roof flap potentiometer
9	Input sensor fan monitor
10	Input potentiometer feedback Roof flap right
11	Input potentiometer feedback Roof flap left
12	Blowout sensor Roof duct rear
13	Icing sensor (evaporator temperature)
14	Room temperature sensor
15	Ground for temperature sensors and feedback potentiometer

18-pin plug connector

Pin	Meaning
1	Water valve Roof DC motor (+)
2	Water valve Roof DC motor (-)
3	Water valve Roof Reference voltage for potentiometer feedback message
4	Output for skylights
5	Water valve Floor DC motor (+)
6	Water valve Floor DC motor (-)
7	Output for roof fan Level 1
8	Output for roof fan Level 2
9	Compressor coupling output (3A)
10	Output for passenger fan rear Level 1 (relay)
11	Output for passenger fan rear Level 2 (relay)
12	Input Water valve Roof Potentiometer feedback message
13	Input Water valve Floor Potentiometer feedback message
14	Input for low pressure switch
15	not used
16	Input for high pressure switch
17	Blowout sensor Floor rear
18	Ground connection for temperature sensors and feedback potentiometer

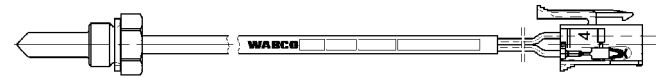
3.3 Sensors

3.3.1 Outside air temperature sensor 446 097 000 0



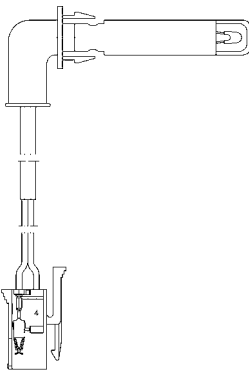
Type: NTC resistor at 25 °C: 100 kOhm ± 3%

3.3.2 Water temperature sensor 446 097 001 0

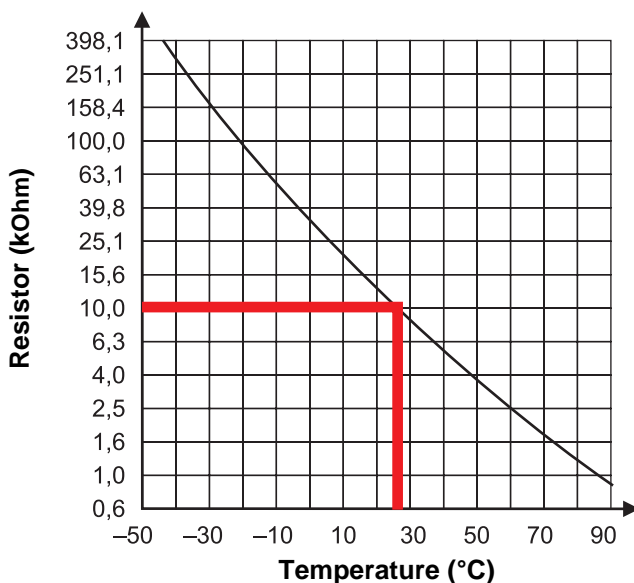


Type: NTC resistor at 25 °C: 10 kOhm ± 3%

3.3.3 Air outlet temperature sensor 446 092 003 0

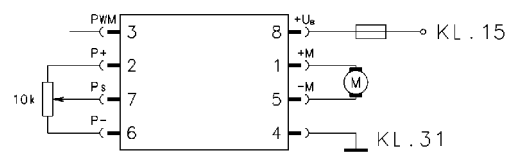
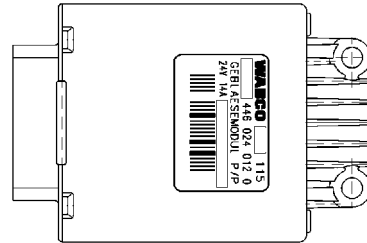


Type: NTC resistor at 25 °C: 10 kOhm ± 3%



Characteristic curve for air outlet temperature sensor

3.4 Blower module with control via potentiometer or PWM signal 446 024 012 0



Voltage: 24 V
Output: permitted steady current 14 A
Required fuse: max. 15 A

3.5 The data interface of the system CAN Bus HLK

The 9-pin plug connector of the submodule is assigned as follows:

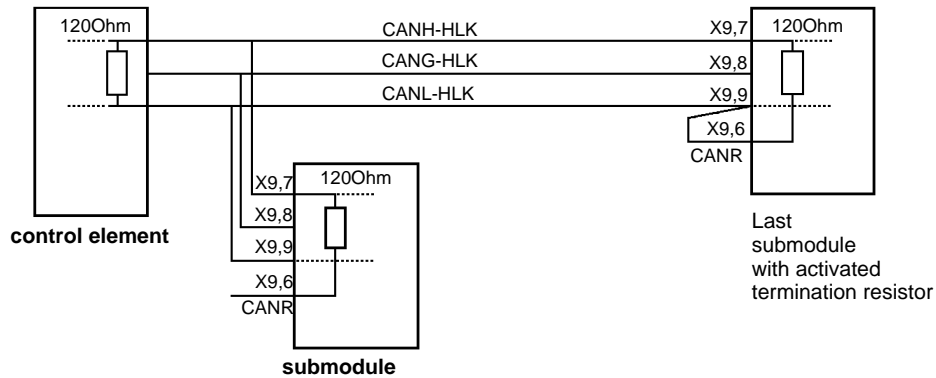
- PIN 7 => CAN H
- PIN 8 => CAN Ground
- PIN 9 => CAN L
- PIN 6 => CAN R (termination resistor)

Termination resistors are required for the CAN databus. Each submodule already has this termination resistor integrated from the factory:

The resistor can be "called up" between CAN H and CAN L, by activating the 120 Ohm resistor by bridging PIN 6 with PIN 9 of the 9-pin plug connector. A 120 Ohm termination resistor is integrated in the control panel at the beginning of the CAN system bus line.

This bridge is only to be set up at the end of the CAN line in the last submodule of course.

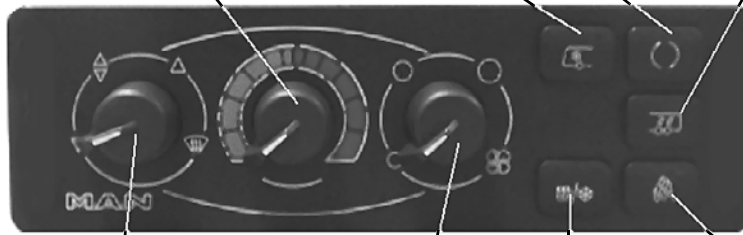
The resistance measured between CAN H and CAN L should be 60 Ohm with the supply voltage switched off.



The electronic connection for the submodule is done using three plug-in connectors with tinned contacts.

4 Operation

Set value of the front-box temperature Driver's area climate Smog Passenger compartment heating



Front windscreen-/Footwell flap

Fan speed

Reheat

Auxiliary heating

The control panel consists of 3 rotary potentiometers and 5 pushbuttons. In order to relieve the driver of the switching responsibilities from the driver's area, he can only switch off the full-automatic functionality here. All other functions on the control panel serve for individual setting for the driver's workplace.

- ⇩ Down arrow: **Footwell flap**
All of the air is sent to the footwell.
- ⇩/⇧ Down/up arrow: **Centre position**
The air flow is distributed between the footwell and the front windscreen.
- ⇧ Up arrow: **Front windscreen flap**
All air is directed onto the front windscreen.
- ⇒ Windscreen symbol: **Defrost**
Water valve completely open; flap on front windshield; Maximum fan speed.

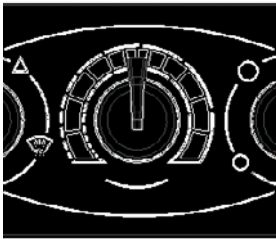
Implementation is via characteristic curves, which also allow intermediate settings.

4.1 Front windscreen-/Footwell flap



The front windscreen or footwell flap is controlled according to the symbols.

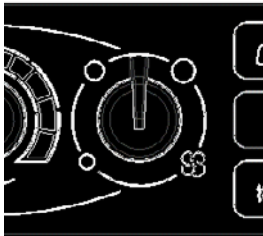
4.2 Set value of the front-box temperature



the blowout temperature of the front box can be set in a range between 14 and 60 °C.

Left stop: Water valve to
right stop : Water valve opened to max.

4.3 Fan speed



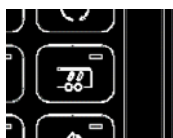
The potentiometer serves as speed setting in the front box. The relationship between the angle of rotation and the PWM actuation is stored in a parameter definable characteristic curve. The speed can be set from 0 – 100 % with the vehicle engine running.

4.4 Smog



The inflow of fresh air can be blocked for the entire bus with the Smog button. The button is illuminated when the Smog function is active. The skylights and fresh air flaps are closed for a defined time period while the function is active.

4.5 Passenger compartment heating



The driver no longer has the ability to access the fully automatic passenger compartment control. The passenger compartment control is only e. g. switched off for transferring buses. If the button is illuminated, the automatic function is activated.

4.6 Auxiliary heating



The auxiliary heating is only switched on manually by default. If the button is illuminated, the auxiliary heating is activated.

4.7 Reheat



Air-conditioning system operation can be switched on with the Dry/Reheat button. This causes the compartment to dry out and reheating to take place.

4.8 Driver's area climate



This function switches the coolant solenoid valve on for the front box. The button is illuminated when the air conditioning is active.

Note:

With every "Switch ignition on" procedure, the front box flap is switched on for determining the respective end positions, i. e., the end positions are moved to and stored in the control panel. If the flap is actuated by the potentiometer then, the intermediate positions are then moved to.

4.9 Temperature set value changes for the passenger compartment

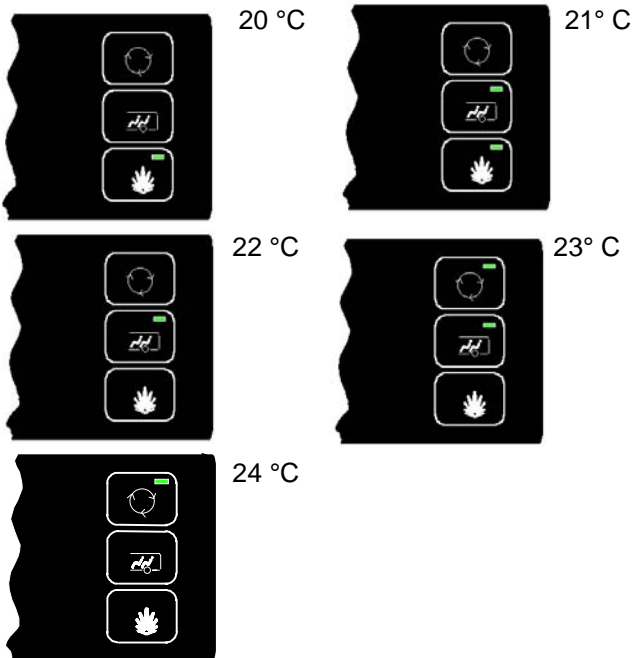


The temperature set value for the passenger compartment can be adjusted on the control panel as described in the following segment:

In order to achieve the adjustment mode, the button for the passenger compartment heating must be pressed for at least 10 seconds. After achieving the set value adjustment mode, the LEDs that are integrated in the 3 right-hand buttons flash according to the defined set value.

The set value can be increased or decreased with the Smog and auxiliary heating buttons. The set value, which is allocated to the middle LED and the step interval parameters can be defined.

The currently defined set value is indicated with the respective function lighting for this button flashing. The assignment of flashing LEDs to a set value is indicated in an exemplary manner in the following table for an average set value of 22°C and a step interval of 1°C.



You can then use the middle button for the passenger compartment heating to confirm the set value and exit the setting mode. The control panel goes back into normal operation mode.

As an alternative to the temperature set value adjustment for the passenger compartment via the keyboard, there are two additional room temperature set value adjustments possible:

Set value adjustment via external potentiometer

Optionally, an external set value potentiometer can be connected on PIN 3 of the 15-pin plug connector of the control panel. In this case, you need the parameters changed accordingly by the vehicle manufacturer. The set value can be set within a fixed range for the passenger compartment temperature control in accordance with these parameter definitions. The setting capability via the keyboard is then deactivated.

2. Set value adjustment only via parameters

If this option is actuated for the set value setting, the set value can only be set with a parameter change (by the vehicle manufacturer).

5 Vehicle CAN Bus in MAN bus

The CAN Bus (Controller Area Network) is a serial databus system, which was developed for networking controllers in automobiles. Instead of using an electrical circuit for each transmitted signal, the "bus" is based on a communication platform which regulates the relaying of messages between several devices.

There are two different types of CAN structures used in a MAN bus.

- NES (older CAN structure)
- TEPS (Twin Electric Platform System) is the later CAN structure with driver's workplace DMUX (central display and I/O control unit in the instrument panel).

The WABCO ATC system is connected to the central on-board computer on both CAN structures via the car body K-CAN Bus. This is the so-called vehicle data bus.

On older vehicles however, the WABCO ATC system is connected via a separate system bus. This greatly differs from the vehicle databus where technical specifications are concerned.

The entire parameter set is stored in the control panel, which can be seen as the master unit. Only when replacing the control panel does the vehicle-specific parameter set have to be read again.

If only a substation has to be replaced, this is automatically provided with or "programmed with" the correct parameter set that is already set up for you.

The diagnosis is only possible via the vehicle CAN Bus.

5.1 CAN structure NES

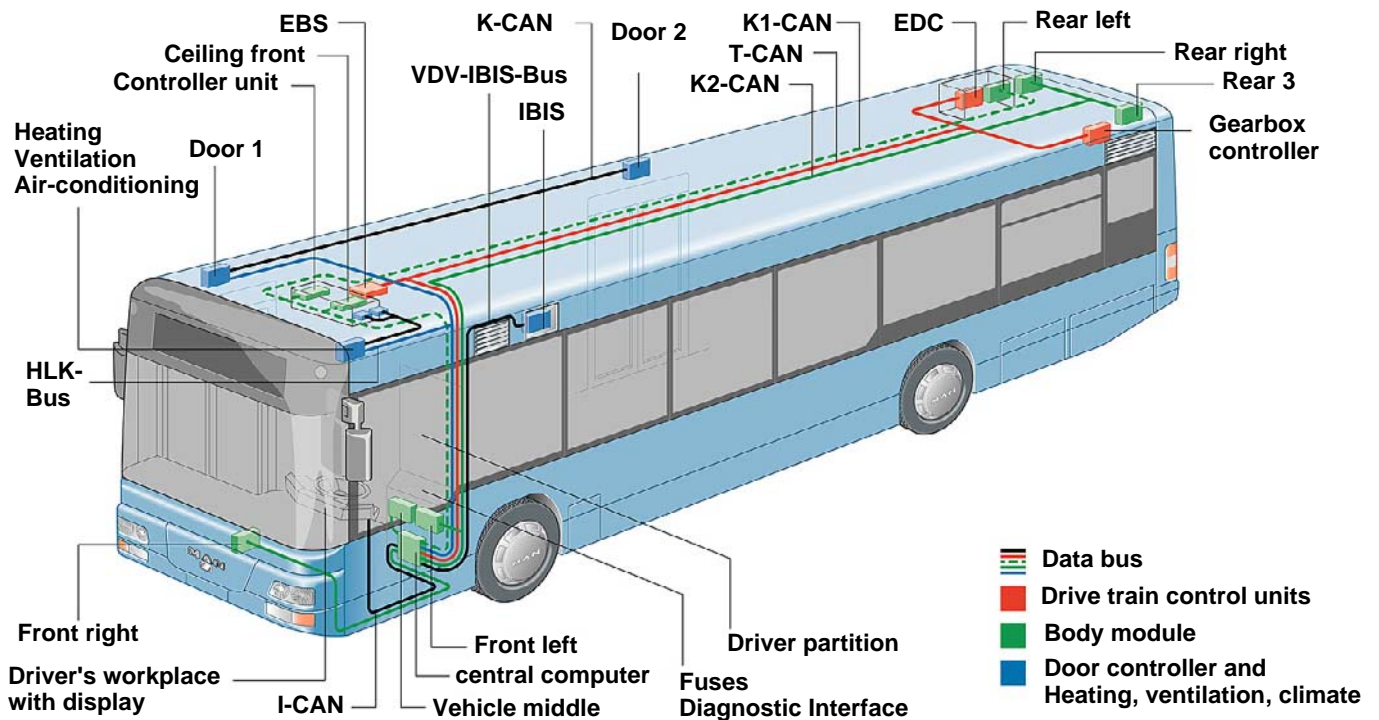
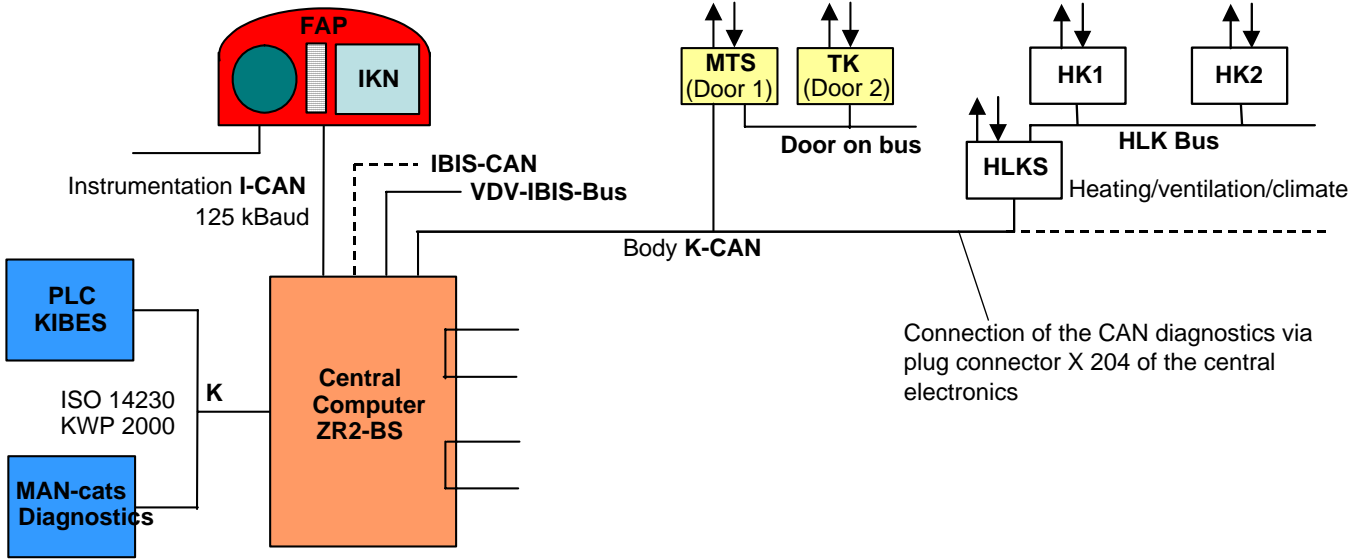
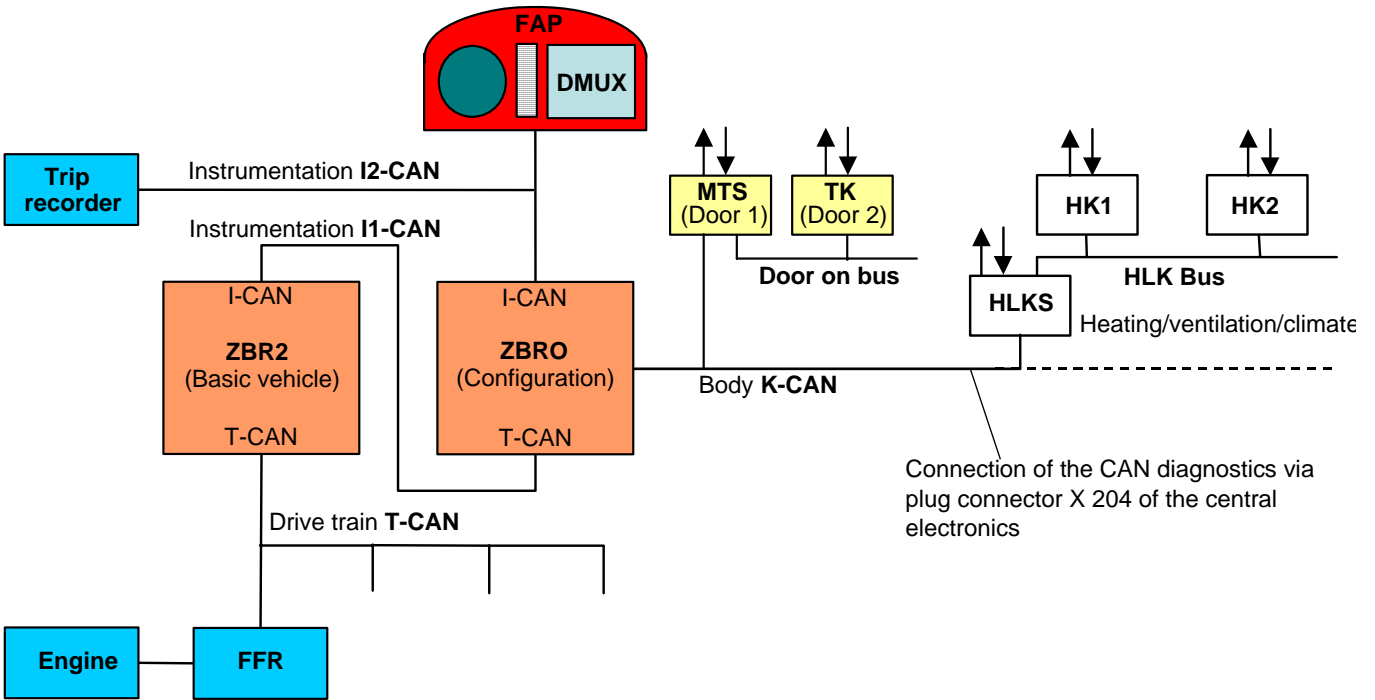


Diagram of the CAN structure NES



5.2 CAN structure TEPS



6 Diagnostics

WABCO offers the PC diagnosis exclusively for the ATC system. For the diagnosis, you need either

- a PC or a laptop,
- a diagnostics interface,
- a connection cable to the vehicle
- and the "ATC-CAN Standard" diagnostics software

6.1 PC / laptop

WABCO offers you a workshop-suitable, impact-resistant and grime-proof laptop. It can also be delivered upon request with preinstalled diagnostics software. The "Toughbook" can be procured from WABCO under order number 446 302 040 0.



"Toughbook" laptop (order number 446 302 040 0)

The diagnostics software will also run on all standard PCs with an operating system as of Microsoft Windows 2000 however.

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

6.2 Diagnostic Interface Set

The WABCO Diagnostic-Interface Set with the order number 446 301 021 0 (serial) or 446 301 022 0 (USB) is required for setting up diagnosis of the control unit. The set comprises the interface and a connecting cable to the PC or Laptop.

The vehicle side connection to one or both diagnostic interfaces is done via a special connection cable, which can be obtained under MAN no. 88.25414.6632 from MAN. The respective plug connector is connected to socket connector X 204.

Diagnostic Interface Set (USB) 446 301 022 0



The set includes:

- Diagnostic Interface,
- USB connecting cable to PC/Notebook

Diagnostic Interface Set (serial) 446 301 021 0

As an alternative to the diagnostics interface with a USB connection, WABCO offers a diagnostics interface with serial connection.

6.3 Diagnostics Software

There are three ways to obtain the diagnostics software for the ATC system.

Offline as a USB-Stick version

Diagnostic Software "ATC-CAN Standard" as USB-Stick version: 446 301 XXX 0

Online as a Single Download

Diagnostic Software "ATC-CAN Standard" as Single Download: 246 301 XXX 0

The XXX value in the order number stands for the current language version of the diagnostics software:

- 564 – German
- 565 – English
- 603 – Spanish
- 614 – Italian

Part of a WABCO System Diagnostics Subscription

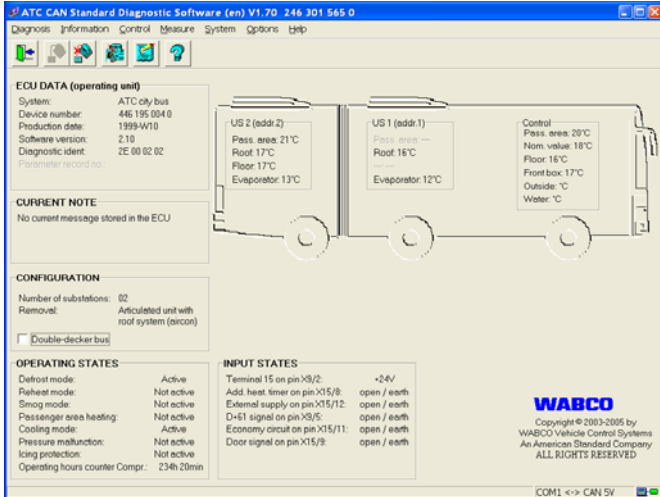
For the diagnosis of multiple WABCO systems, WABCO offers you four different Diagnostic Software Subscriptions via the Internet. These contain numerous diagnostic programs at a very low price. The program can be downloaded from the Internet at any time in its most current form and can be used immediately thereafter.

The means of graphic representation that a PC provides imparts a clear and structured view of diagnosis. Thanks to the repair information in great detail and circuit diagrams with measured values diagnosis and repair is getting easier and faster.

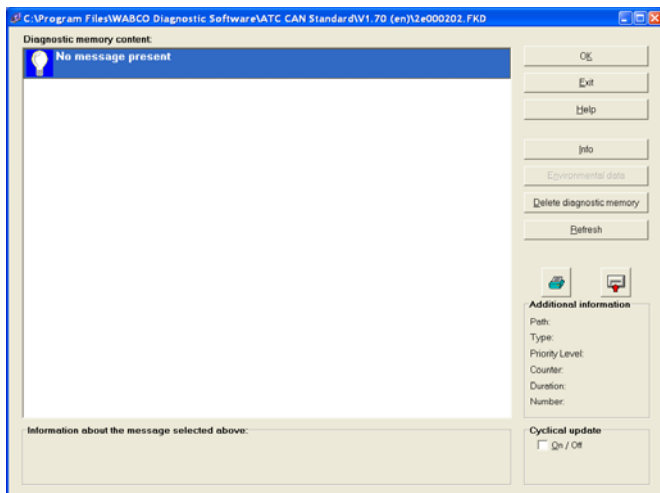
The diagnosis with the Diagnostic Software may be performed by any user. If parameters are to be changed however, an authorization (PIN) is required. This PIN can

be obtained through the "Electronic WABCO Systems in Powered Buses" training at the WABCO university. More information on the trainings at the WABCO university can be found on the internet under www.wabco-auto.com via the "WABCO University/Training" button.

6.3.1 Start screen



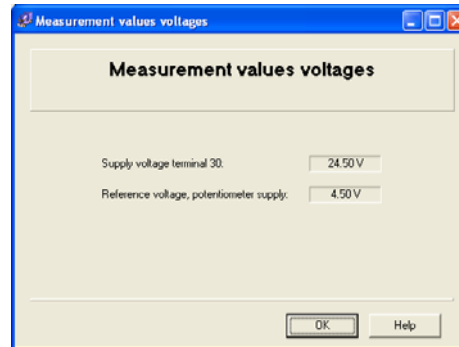
6.3.2 Messages: Diagnostics memory



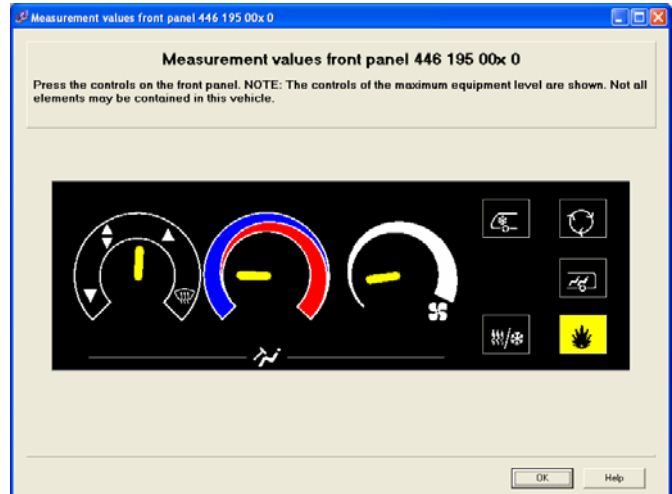
- Path: Recognised, problem-afflicted components
- Type: Type of recognised problem
- Priority Level: Importance of the problem: 0 > Mild error
- Counter: Definition of how much time (hours of operation) has elapsed since the last error save

6.3.3 Measure

Voltage displays

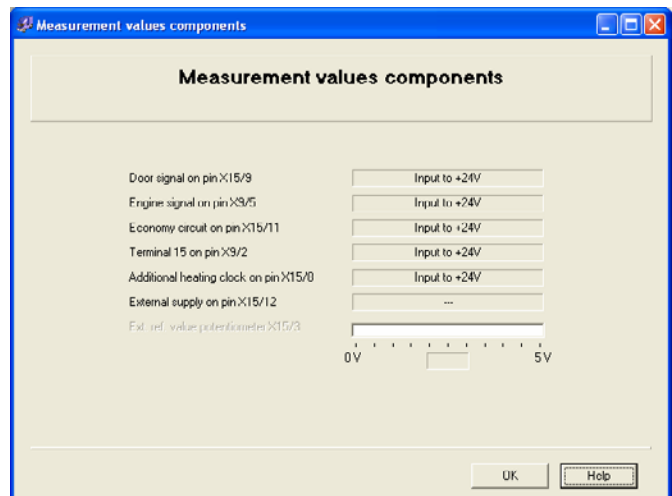


Display of function elements of the front panel



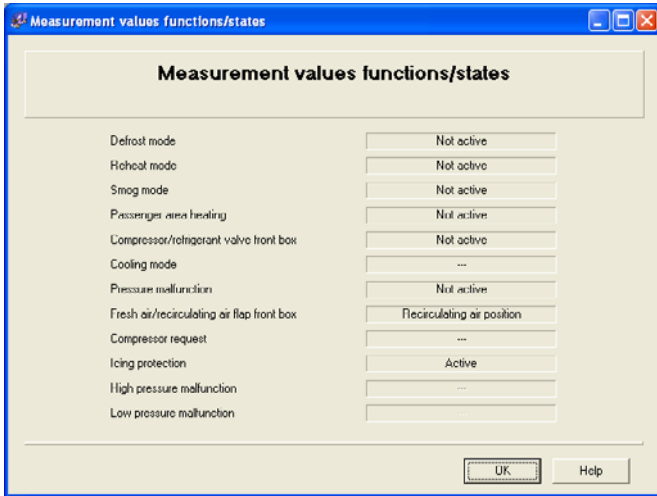
If e. g. a rotary knob is actuated, correct functionality is made obvious on the display.

Component measurement values



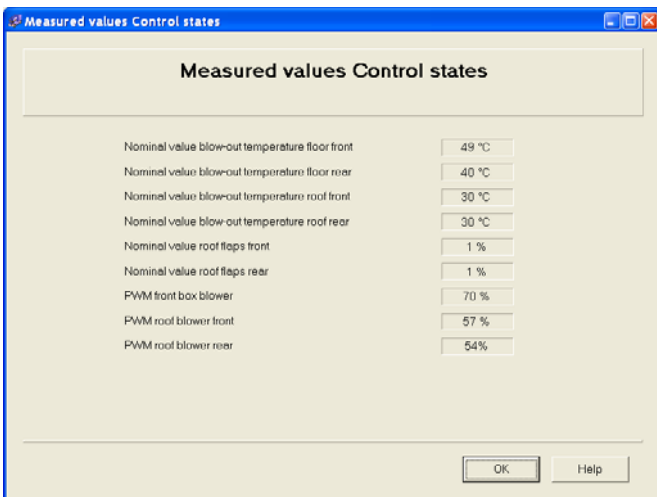
In this inspection display, the status of the inputs recorded by the control panel is indicated as values.

Functions and status measurement values.



E. g. Reheat operation of the ATC system

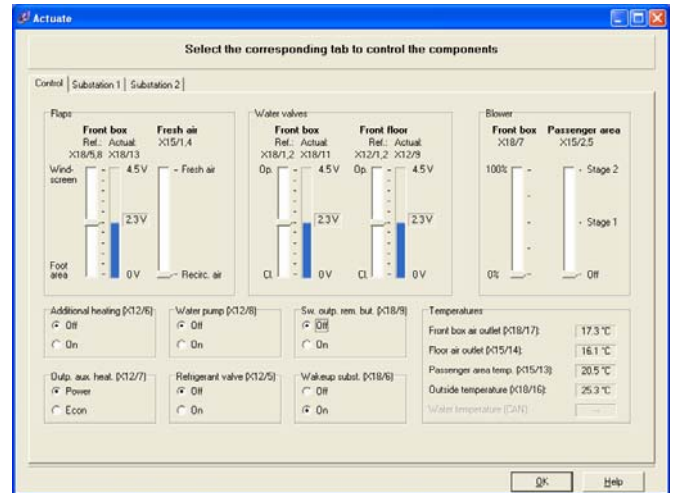
Control status measurement values



The set values of the ATC system are mainly displayed here

6.3.4 Control

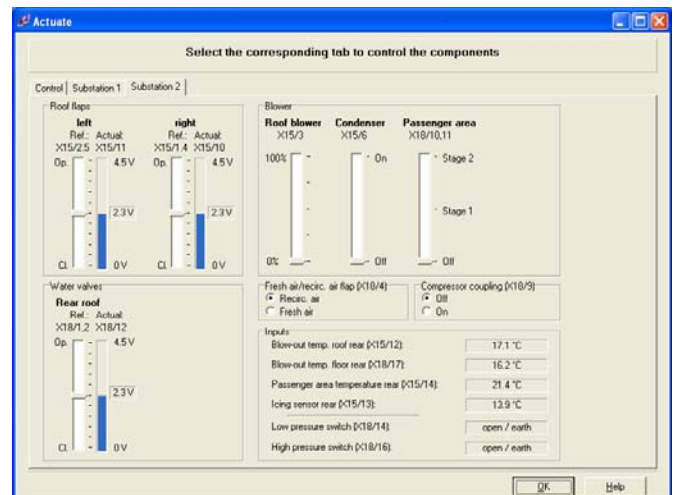
Component actuation



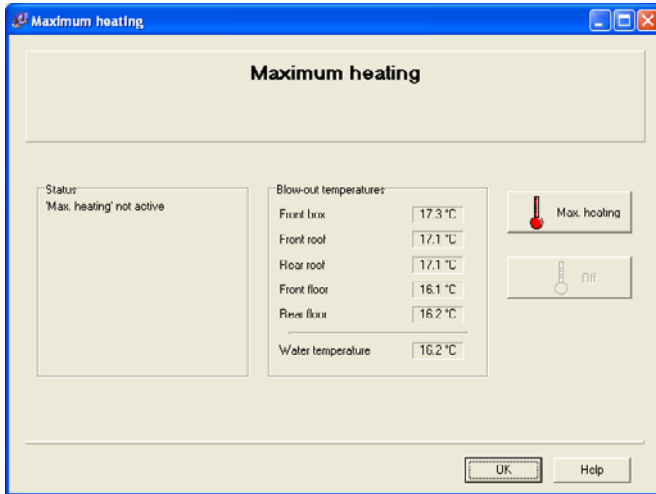
The mouse can be used to make changes, such as e. g. flap settings, by hand. This makes it possible to check functionality.

The "Fan" actuation is only possible with the appropriate parameter definitions. As of the diagnostics version higher than 1.3, the actuation is possible independent of the parameter definition.

Checking can be done on the substations as described above.

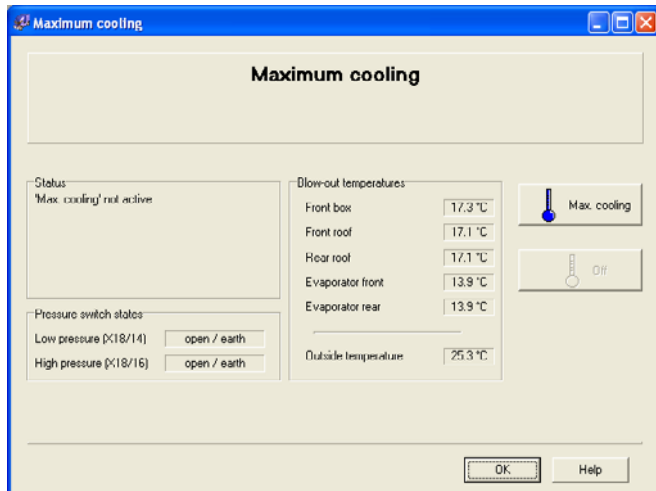


Maximum heat



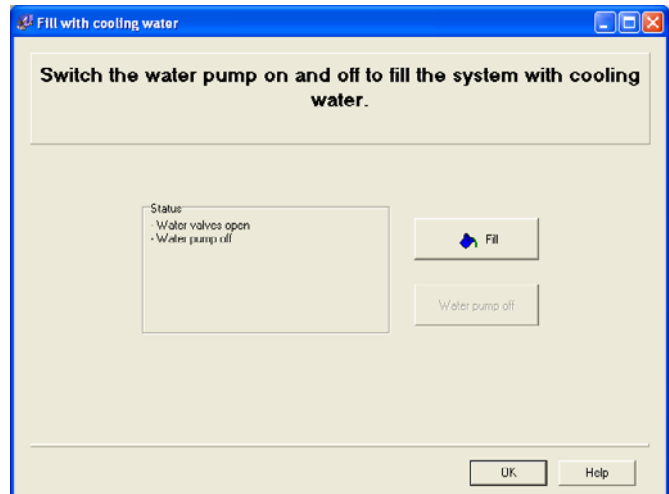
This function can be used to show whether a regular heating operation is guaranteed in a vehicle, i. e., all heating heat exchangers are supplied with warm water. The motor must be brought to operating temperature in this case.

Maximum cooling

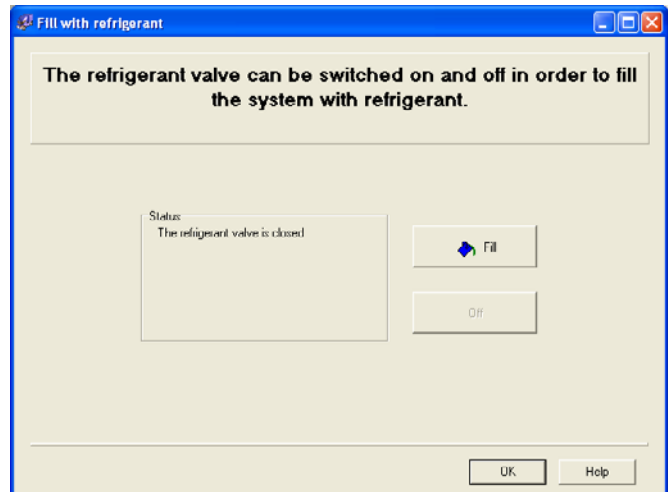


The air conditioning system can be checked with this function. The motor must run in this case as well, because otherwise the cooling compressor will not run.

Filling the system with cooling water



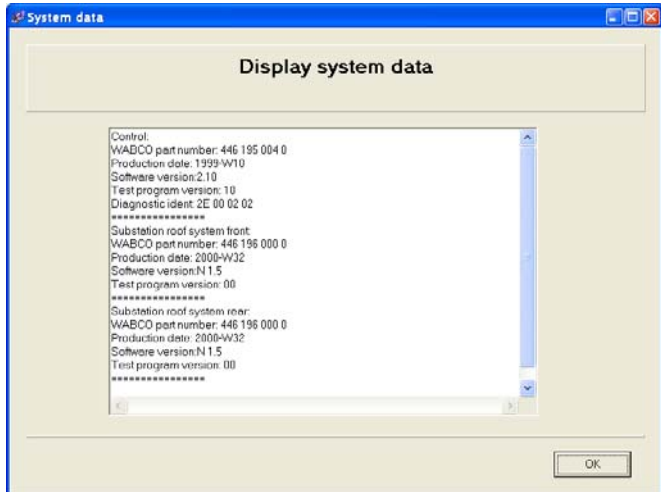
Filling the system with coolant



6.3.5 System data and fingerprint

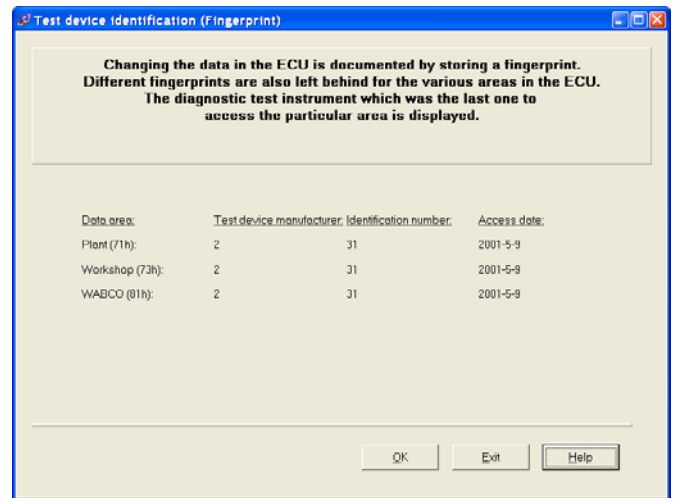
This data is subject to data protection conditions. Passing on of the data behind this information (Serial No., i. e. name of the user of the respective diagnostics program) is not fundamentally possible by WABCO.

System data



All of the relevant data of the installed or recognised electronics are to be read in an overview upon calling up the system data.

The fingerprint (PIN)



So-called "Fingerprint" information is displayed via menu call "Test device identification" (Menu bar: System).

This command is used to read the "fingerprint" out of the control unit.

When the HLK system is parameterised, the serial number of the diagnostic program is written to the "fingerprint" in the electronics. This makes it possible, at a later date, to determine who was the last to change the parameters.

There are different fingerprints held in the electronics depending on which parameters were changed. The key for the fingerprint is as follows:

- Test device manufacturer
Code of the test device manufacturer (Wabco = 2)
- Vehicle ident no.
Serial number of the diagnostic program used
- Access date
Date, when the access occurred

7 Parameters

The diagnosis with the Diagnostic Software may be performed by any user. If parameters are to be changed however, an authorization (PIN) is required. This PIN can be obtained through the "Electronic WABCO Systems in Powered Buses" training at the WABCO university. More information on the trainings at the WABCO university can be found on the internet under www.wabco-auto.com via the "WABCO University/Training" button.

After participating in a respective training course at the WABCO University, they can request a Personal Identification Number (PIN) for their WABCO Diagnostic Software from WABCO. With this PIN you can release extended functions in the Diagnostic Software and change the settings in the controller electronics.

7.1 Saving and transferring parameter sets

Saving and transferring parameter sets refers to the complete (100 %) parameter set. The parameter set, which can be called up and viewed from the System menu point only return approx. 25 % of the complete parameter. Normally, modifying a control panel parameter set only requires copying the set into the "new" device.

Saving parameter sets

This function can be used to save the complete parameter set from the control panel on the PC, in order to transfer it back to (another) controller at a later time with the Update function (Transferring parameter sets).

Transferring parameter sets

The stored data sets may not be changed because they will otherwise not be accepted by the PC Diagnostics program. The parameters are also only to be copied to control units with the same WABCO number and diagnostics version. Control units with a newer software version are downwards compatible where parameter sets are concerned. If you attempt to copy a data set from a new control unit into an older version, the older device may not take on some parameters, if they are not recognised.

Hint for the Workshop

The control panel contains the entire parameter set for the entire ATC system, therefore all parameters for the submodules.

If one or more submodule(s) have to be replaced, no other settings are possible, since these are defined by parameters in the control panel and will automatically be transferred to the submodule(s).

To replace the control panel, the vehicle manufacturer must be contacted because the standard parameter set could have been changed or modified for the specific vehicle at line-end. Therefore, e. g. the respective parameter set must be determined using the chassis No. Naturally, the parameter set can also be read from the "old" ECU using the diagnostics software and then written to the new ECU again, to the greatest extent possible.

7.2 Setting possibilities

When calling the system parameters, the setting possibilities are shown in grey in the input mask. This means that they **cannot** be changed.

It is possible e. g. to graduate training on the respective system at the vehicle manufacturer training courses. Upon successfully completing this type of training, you are authorised, with the respective certification, to receive a so-called PIN (secret number).

No parameter changes are permitted by entering the "PIN" with this ATC diagnostics program. The PIN only allows parameter sets to be copied to the control panel.

The parameter sets defined on the respective vehicle must either be prepared by the affected vehicle manufacturer or can also, if possible, be copied out of the control panel to be replaced.

Parameter changes always have to be discussed with the vehicle manufacturer to i. e. guarantee suitable documentation.

7.3 Control panel configuration



The first image after calling up the system parameters shows the configuration of the control panel.

Submodules

The substations that are to be constructed in the system or should be used in the system are shown here.

Fan room temperature sensor diagnosis

If a normally closed room temperature sensor is used and it delivers a speed-proportional diagnostic signal, with which the function of the fan can be monitored, it creates the possibility of reading and evaluating this signal via pin X18/15 on the control panel or pin X15/9 on the substation. This requires that error recognition is activated. In all other cases, this must be inactive.

Digital switch outputs

For the function of the switch outputs, the error recognition does not necessarily have to be activated. If the output signals are read from a central computer for example, with suitable high-impedance inputs and the signals are to be processed by these, the error recognition must be switched off so that a line break error message does not get detected by mistake.

Motor bypass/Servo drive

The error recognition should be activated for the connected water valves and flap drives.

Temperatures sensor inputs

If a temperatures sensor is to be connected to the respective pin, the error recognition must also be activated so that the control can work with the real measurement value.

Driver's workplace control panel Fresh air/recirculating air flap Servo motor actuator

A motor drive for a fresh air/recirculating air flap can be connected to the control panel on pins X15/1.4. This DC motor is either actuated with a time limitation of max. 10 seconds in one direction or the other or without time restriction. In the last case, the drive must be switch itself powerless with a limit switch. Another possibility is with an electro-pneumatic drive. In this case, the option "without time limitation" is to be selected as well.

Control panel PWM output for front box fan

The PWM signal on output X18/7 can be output as normal and as inverted. In this case, "Normal" means that the output voltage is approx. 0 volts at 0% PWM and approx. 24 volts at 100% PWM. When the signal is inverted, 0% PWM corresponds with 24 volts and 100% corresponds with approx. 0 volts output voltage.

Auxiliary heating button on the control panel

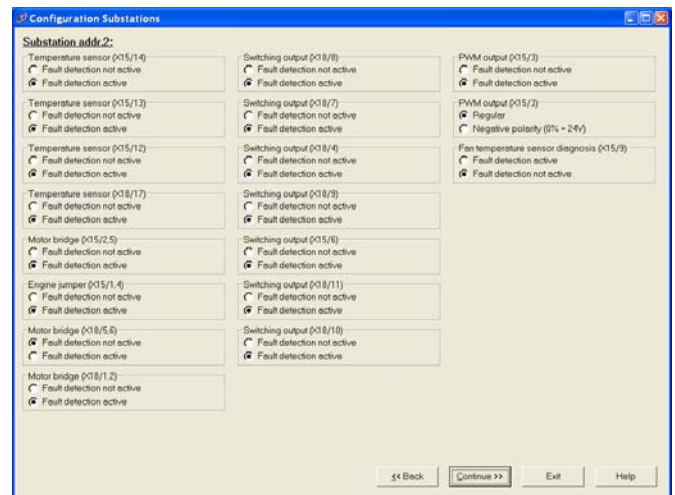
In order to deactivate the auxiliary heating button, the button must be blocked here and the error recognition for X12/6 must also be deactivated. Deactivated, in this

case, means that the LED for the button does not illuminate as function indicator.

CAN error recognition on the control panel

The control panel has 2 CAN interfaces, one for the vehicle bus for communicating with a vehicle central computer and one for the heating or system bus for communication with the substations. Messages from the central computer and an MTS (Modular Door Control from WABCO) can be processed via the vehicle bus. If the control panel is to deliver an error message, if one of the CAN messages is not received, the respective error recognition must be activated. Furthermore, a BusOff recognition can be activated for both CAN busses.

7.4 Substation configurations



The second image of the system parameters shows the configuration of the substation with the respective addressing. All parameter defined substations are shown with the respective images when scrolling further.

Digital switch outputs, motor bypasses/servo drive, temperature sensor inputs

The parameter definition possibilities are defined with these options as with the configuration of the control panel.

Control panel PWM output for front box fan

The PWM signal on output X18/7 can be output as normal and as inverted. In this case, "Normal" means that the output voltage is approx. 0 volts at 0% PWM and approx. 24 volts at 100% PWM. When the signal is inverted, 0% PWM corresponds with 24 volts and 100% corresponds with approx. 0 volts output voltage.

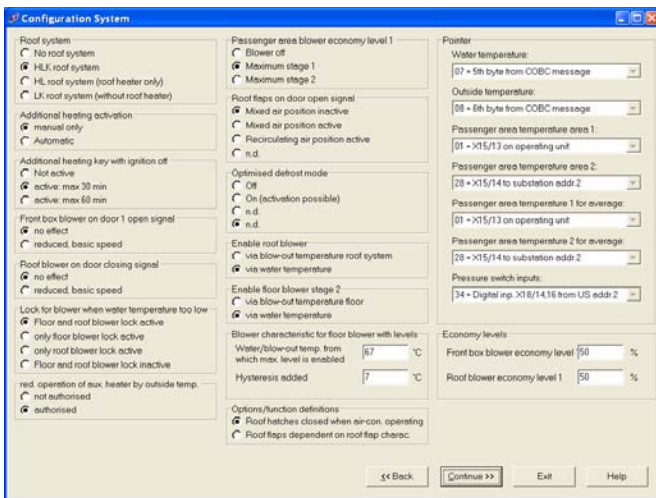
Fan temperature sensor diagnosis

If a normally closed room temperature sensor is used and it delivers a speed-proportional diagnostic signal, with which the function of the fan can be monitored, it

creates the possibility of reading and evaluating this signal via pin X18/15 on the control panel or pin X15/9 on the substation. This requires that error recognition is activated.

In all other cases, this must be inactive.

7.5 System configuration



Roof system

Indicate here whether the bus has a roof system for heating and/or air conditioning.

HLK = Heating/Ventilation/Air conditioning, Roof heating with evaporators (air conditioning)

HL = Heating/Ventilation, only roof heating

LK = Ventilation/Air conditioning, without heating heat exchanger

Auxiliary heating actuation

Manual operation means that the auxiliary heating can only be activated via the button.

In automatic mode, the auxiliary heating is switched on, if either the outside temperature is under 20 °C with the passenger compartment control switched on or the blowout temperature set value is greater than 40 °C for the front box (approximate middle position for the set value potentiometer). If the button is actuated one time, the control panel switches back to manual mode until the ignition is switched off and back on again.

Auxiliary heating operation with ignition off

In this case, you can decide whether the auxiliary heating should even run upon ignition off. And if yes, how long it should run, if it has been activated one time with the button.

Front box fan with door 1 open signal

To ensure that the paper money does not fly away when door 1 is open, it is possible to run the front box fan at a reduced speed in this case.

Roof fan with door signal

Since problems can occur when closing air-tight doors with a roof system working in fresh air mode, it is possible to briefly reduce the roof fan to minimum speed with this parameter, if the "last door closing" signal is received via the CAN Bus from the MTS or a respective signal exists on pin X15/9.

Water temperatures block

To prevent blowing cold with fan supported heating, the fan can be blocked or throttled if the water is still cold. It is possible to activate this block only for the roof system or only for the floor heating.

Auxiliary heating reduced operation (energy saving level)

If you choose reduced operation depending on the outside temperature, output pin X12/7 on the control panel is activated for energy saving mode of the auxiliary heating over an outside temperature of +5°C.

Room fan in energy saving mode

Replaced by load management via the vehicle CAN Bus.

Load management recognises to energy saving modes. In stage 1, the fan speed is limited to a parameter defined maximum value, in stage 2, the fan is switched off.

Roof flaps with door signal

Since problems can occur when closing air-tight doors with a roof system working in fresh air mode, it is possible to briefly set the roof fan mixed air operation with this parameter, if the "last door closing" signal is received via the CAN Bus from the MTS or a respective signal exists on pin X15/9.

Optimised defrost mode

When in optimised defrost mode, the water valve of the floor circuit (in articulating units, only in the front car), is completely open and the fan is actuated in stage 1 if the motor is running, the passenger compartment control is switched off, the auxiliary heating is switched on and defrost mode is activated. This causes the auxiliary heating unit to cycle less in cases.

Roof fan enable

For vehicles that cannot provide water temperature for the control panel, it is possible to enable the roof fan and the first stage of the floor fan if the blowout temperature has exceeded a minimum value in the roof.

Enable floor fan stage 2

The enable for the second stage of the floor fan can be linked with exceeding a certain water temperature. When dropping below the difference of the water temperature limit and hysteresis, the second stage is blocked again.

For vehicles that cannot provide water temperature for the control panel, it is possible to enable the second stage of the floor fan if the blowout temperature of the floor heating has exceeded a minimum value.

Fan characteristic curve for staged floor fan

If a water temperature is available, the limit value for the water temperature is entered, from which the floor fan is enabled, i. e. allowed to run.

For vehicles that cannot provide water temperature for the control panel, it is possible to enable the second stage of the floor fan if the blowout temperature of the floor heating has exceeded a minimum value. This is also entered here in this case

Skylight in air conditioning operation

On pin X18/4 of the substations, an actuation signal can be used for the skylights. The actuation is either done via the vehicle CAN Bus and is overamplified in air conditioning mode in cases or it occurs according to the roof flap characteristic curve, whereby the output is active in the fresh-air position of the flaps. Accordingly, the output can then also be used for electro-pneumatically actuated fresh air/circulating air flaps.

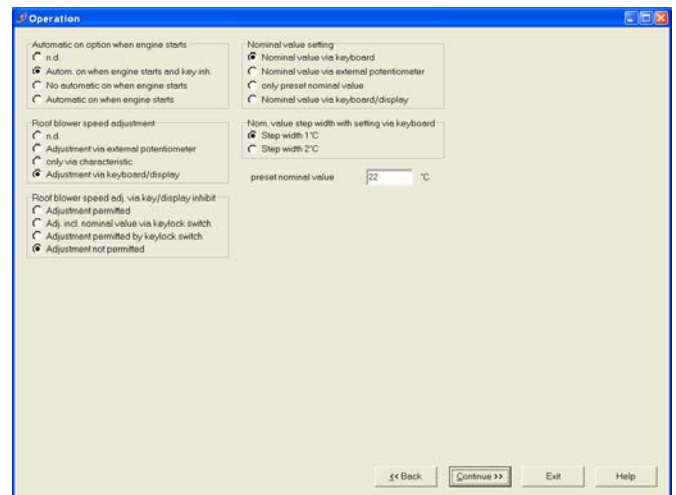
Pointer

This parameter defines where the control panel gets the information on the room temperature, the outside temperature, water temperature and the pressure switch.

Fan energy saving stages

If an energy saving signal exists on pin X15/11 of the control panel or if a respective request comes via the vehicle CAN Bus, the front box and in cases the roof fan run at the PWM speeds defined here.

7.6 Operation



Automatic On at motor start

- Automatic "On" at motor start and button blocked
If the vehicle motor is started, the vehicle room control is activated automatically. If only the motor is stopped without switching the ignition off, the passenger compartment control is deactivated automatically. The driver cannot switch the control on or off by a button.
- No automatic On at motor start
The driver can switch the control on or off anytime with a button. No automatic activation.
- Automatic On at motor start
If the vehicle motor is started, the vehicle room control is activated automatically. If only the motor is stopped without switching the ignition off, the passenger compartment control is deactivated automatically. The driver can switch the control on or off at any time with a button.

Roof fan speed adjustment

- Speed adjustment via external potentiometer
An external fan set value potentiometer (see cabling plan) can be connected to pin X18/14 as an option. The speed for the roof or the evaporator fan defined via the fan characteristic curve can be increased or decreased with this.
- No adjustment, only via characteristic curve
Purely automatic operation according to fan characteristic curve.
- Speed adjustment via keyboard and display on driver's workspace display
This option only makes sense along with a display that is accessed via the vehicle CAN Bus.

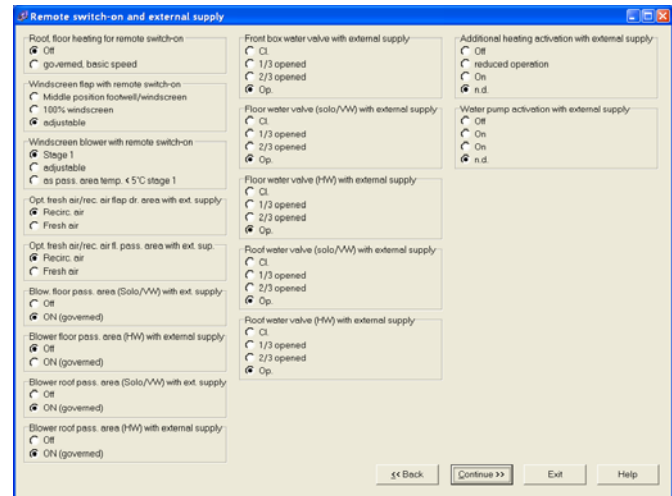
Speed adjustment via Keyboard/Display/Lock

- Adjustment allowed
This option only makes sense along with a display that is accessed via the vehicle CAN Bus.
- Adjustment incl. set value via key switch
This option only makes sense along with a display that is accessed via the vehicle CAN Bus. Additional locking of the set value and the fan adjustment via key switch on pin X18/14.
- Adjustment via key switch
This option only makes sense along with a display that is accessed via the vehicle CAN Bus. Additional locking of the the fan adjustment only via key switch on pin X18/14.
- Adjustment not allowed
Standard setting if no display exists.

Set value adjustment

- Set value adjustment only via the keyboard
In order to achieve the adjustment mode, the button for the passenger compartment heating must be pressed for at least 10 seconds. After entering adjustment mode, the LEDs for the 3 buttons on the right flash according to the defined set value. The set value can be corrected increasing or decreasing with the Smog and auxiliary heating buttons. The preset set value, which is allocated to the middle LED and the step interval parameters can be defined.
- Set value adjustment via external potentiometer
An external set value potentiometer (see cabling plan) can be connected to pin X15/3 as an option. It can now be used to set the set value for the passenger compartment temperature control in a range of 16 - 32 °C. The setting capability via the keyboard is then deactivated.
- Only preset set value
If this option is actuated for the set value setting, the set value can only be set with a parameter change (by the diagnostics device).
- Set value adjustment via keyboard and display on driver's workspace display
This option only makes sense along with a display that is accessed via the vehicle CAN Bus.

7.7 Remote actuation and supply



Remote actuation operating mode

If the control panel is not activated via terminal 15 input but through the remote actuation input X15/8, the auxiliary heating is switched on in any case. All other functions and parameter definition capabilities correspond with those of remote supply operation. This remote actuation input mainly serves for actuating with a preset clock.

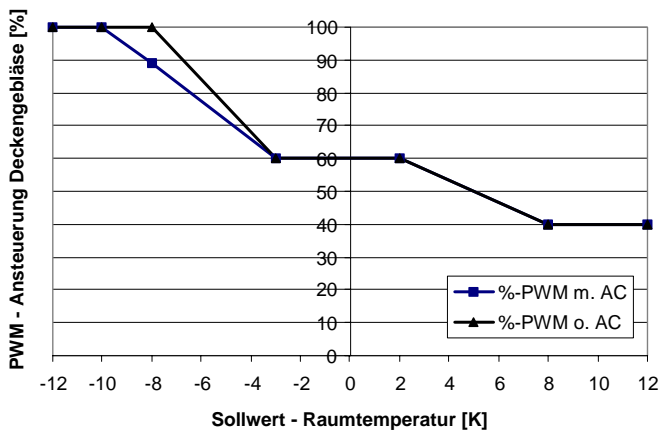
Remote supply operating mode (as of version 4.0)

Another possibility of activating the control panel with the ignition switched off is via the remote supply input X15/12. This is used for setting the system to a defined state in case of remote supply with warm water and/or power. Using the Roof/Floor heating option controlled with remote actuation, an automatic room temperature control is created with reduced fan speeds. The other options then have no effect. This is only active with the Roof/Floor heating option with remote actuation. Using the parameters shown here, the fan functions, the water valve settings, flap settings and the functionality of the auxiliary heating and the water pump can then be set.

7.8 Characteristic curve control

7.8.1 Roof-/Evaporator fan characteristic curve

The fan characteristic curve is defined with 4 coordinate values. To the left of the first coordinate and to the right of the fourth coordinate, the characteristic curve always has an incline of 0. The first parameter coordinate exists twice, once for the ventilation operation and once for vehicles with air conditioning (AC).



The fan characteristic curve can also increase or decrease depending on the outside temperature. Therefore, we define an upper and lower limit for the outside temperature range, the value for the PWM offset and a hysteresis for the temperature limits.

The maximum value for open doors (more precise for closing doors) is only effective if "Roof fan with door running according to signal" has been selected accordingly on the configuration system side.

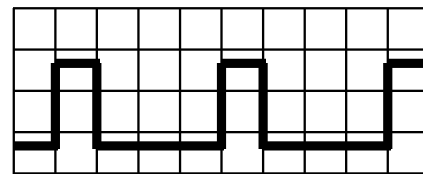
If the blocks for the fan for water that is too cold are active (see Configuration System), the water temperature limits, from which the fan is enabled, can be entered here.

For vehicles that cannot provide water temperature for the control panel, it is possible to enable the roof fan and the first stage of the floor fan if the blowout temperature has exceeded a minimum value in the roof. The blowout temperature limit values are then to be defined here.

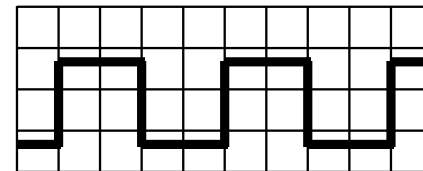
Smog- and reheat duration

If the Smog or Reheat function is activated with a button, the respective function duration is limited. This maximum duration is to be entered in minutes here.

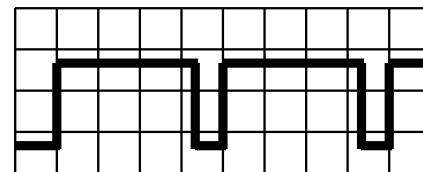
7.8.2 Pulse-width modulated signal for the fan



PWM = 25 %



PWM = 50 %



PWM = 90 %

The "PWM" percentage corresponds with fan speed (e. g. 25 %). With roof systems with inverted PWM output, 25 % corresponds with PWM => 75 % fan speed.

Control parameters

The solenoid coupling of the cold compressor is actuated if a certain temperature (heat) is exceeded outside and inside the vehicle:

The compressor is enabled at an outside temperature > set value – 1st parameter and locked again at an outside temperature < set value – 1st parameter – 2nd parameter (Hysteresis).

The 3rd parameter indicates as of which outside temperature the reheat operation is permitted.

The room temperature dependency can be defined by the 4th parameter:

The compressor is switched off, if (set value - room temperature) > 4th parameter and allowed again, if (set value - room temperature) < 4th parameter - 2nd parameter (Hysteresis).

Floor heating options

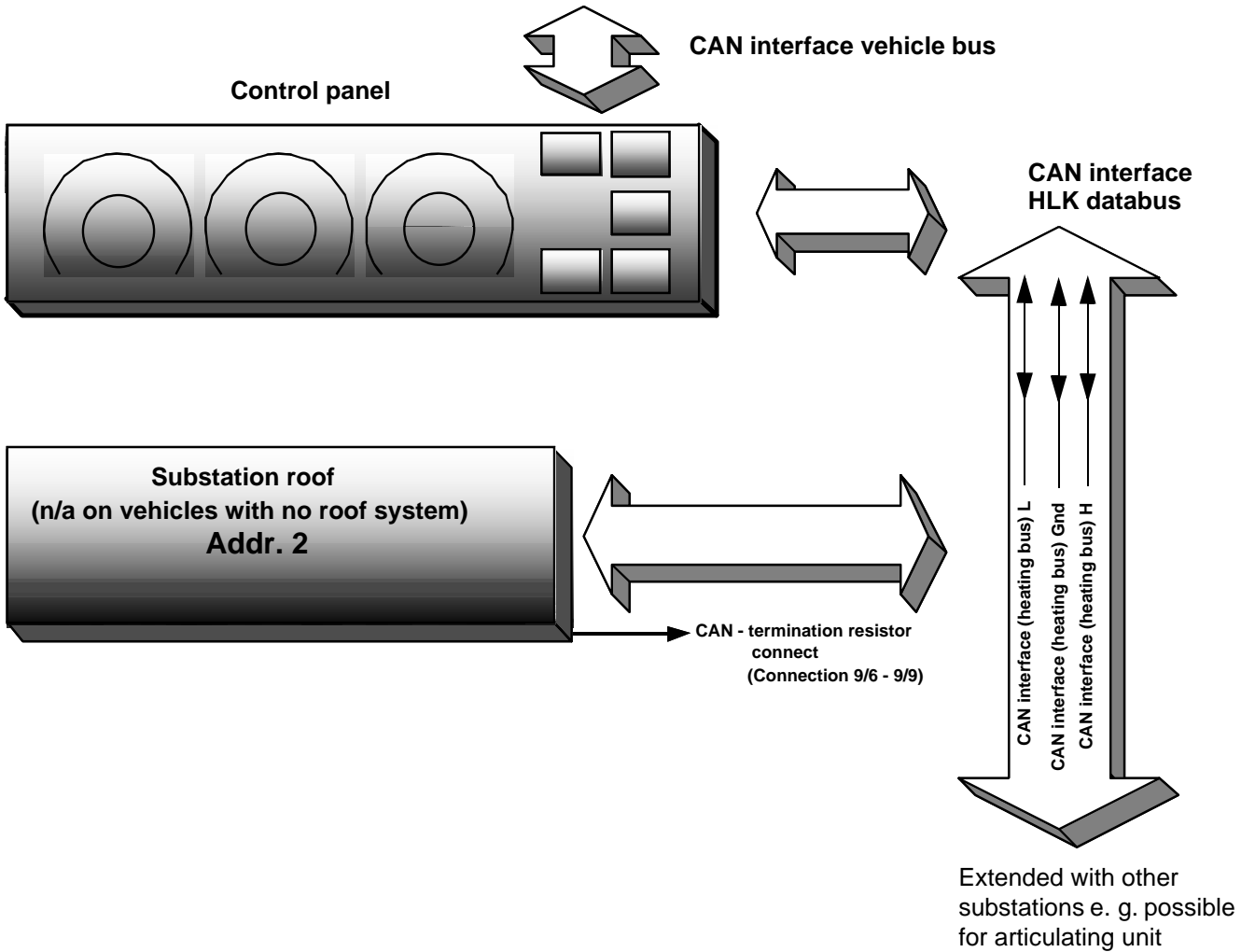
The floor heating is switched off or back on depending on the difference between the set value and the outside temperature. Switching off means that the water valves close for the floor circuits and the fan switches off if

necessary. Switched on means that the floor heating is in control mode in this case.

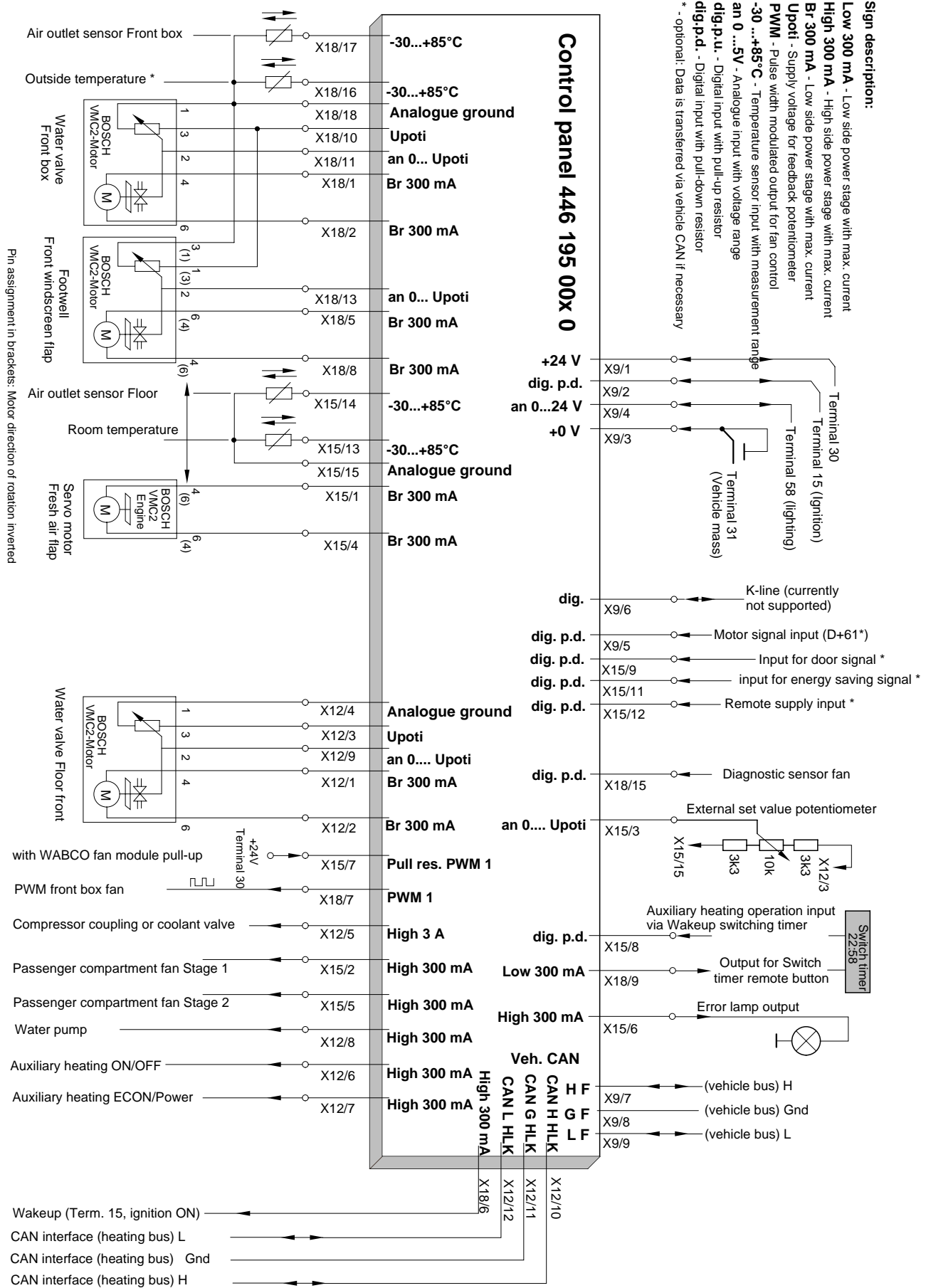
It is switched off at an outside temperature $>$ set value – 1st parameter and switched on again at an outside temperature $<$ set value – 1st parameter – 2nd parameter (Hysteresis).

8 Appendix

8.1 Overview plan for ATC CAN
City bus Power-driven vehicle



Cabling plan Control panel ATC CAN / City bus Power-driven vehicle



Cabling plan Substation Roof ATC CAN
City bus Power-driven vehicle

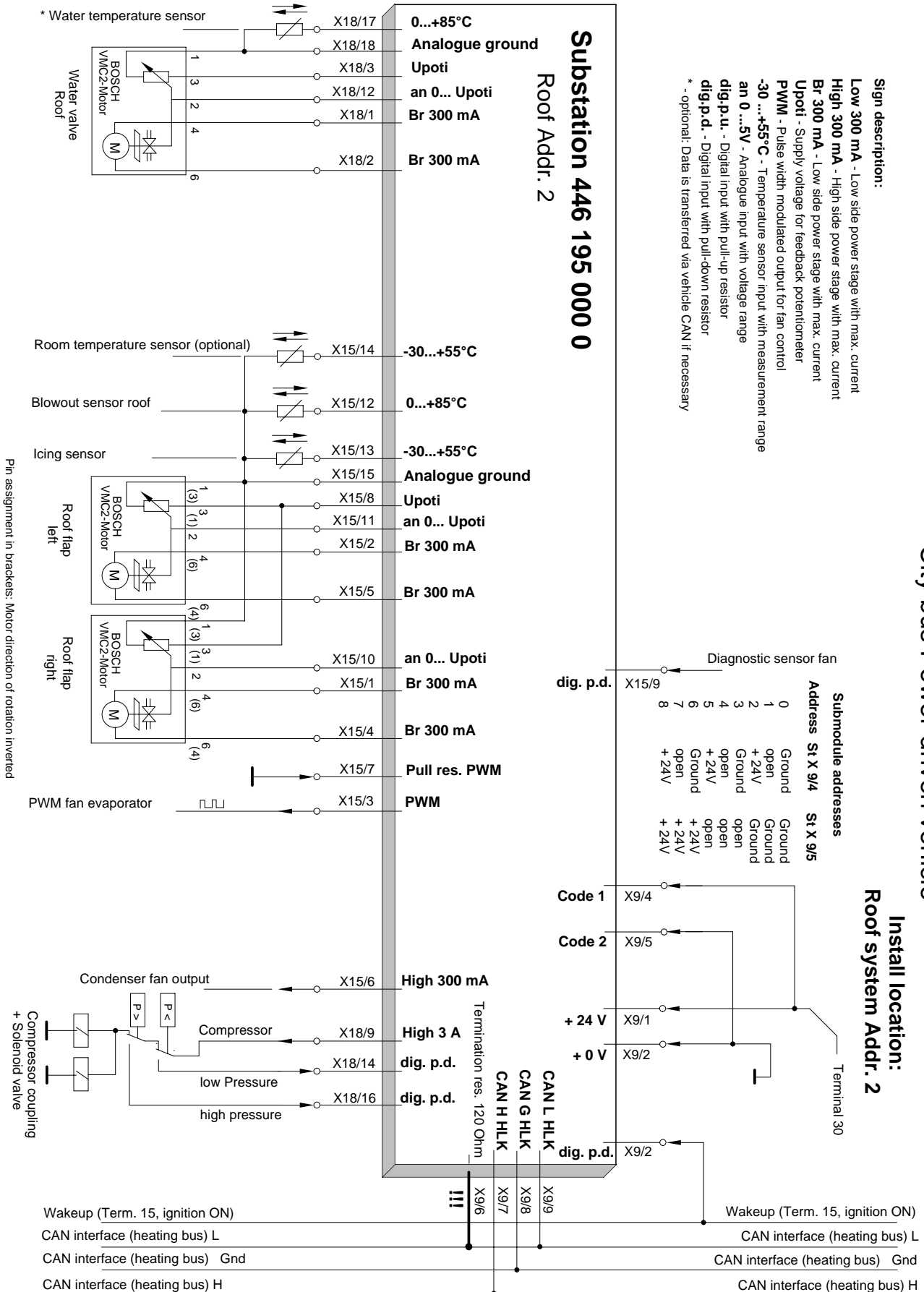
Install location:
Roof system Addr. 2

Sign description:

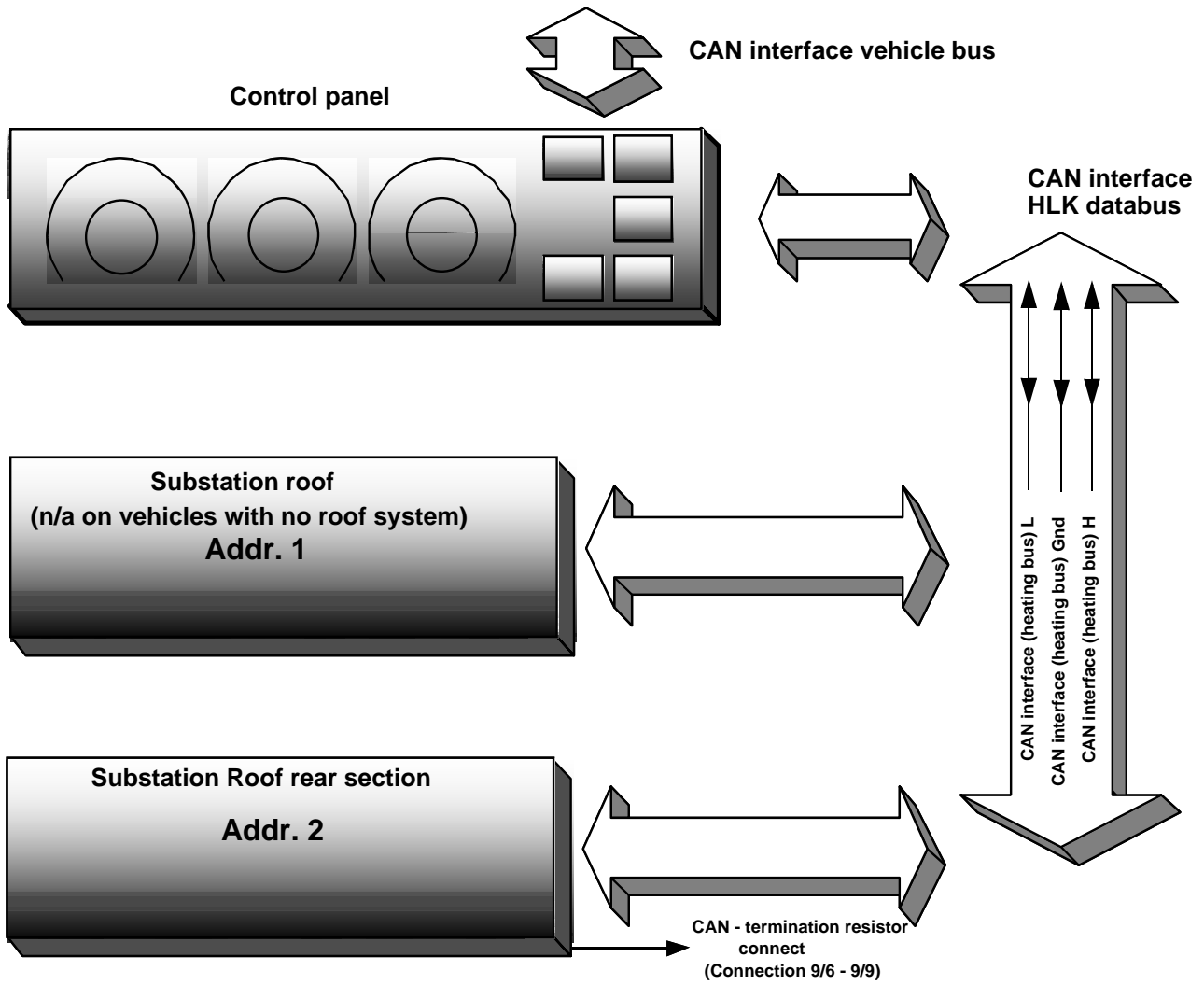
- Low 300 mA - Low side power stage with max. current
- High 300 mA - High side power stage with max. current
- Br 300 mA - Low side power stage with max. current
- Upoti - Supply voltage for feedback potentiometer
- PWM - Pulse width modulated output for fan control
- 30 ... +55°C - Temperature sensor input with measurement range
- an 0 ... 5V - Analogue input with voltage range
- dig.p.u. - Digital input with pull-up resistor
- dig.p.d. - Digital input with pull-down resistor
- * - optional: Data is transferred via vehicle CAN if necessary

Substation 446 195 000 0

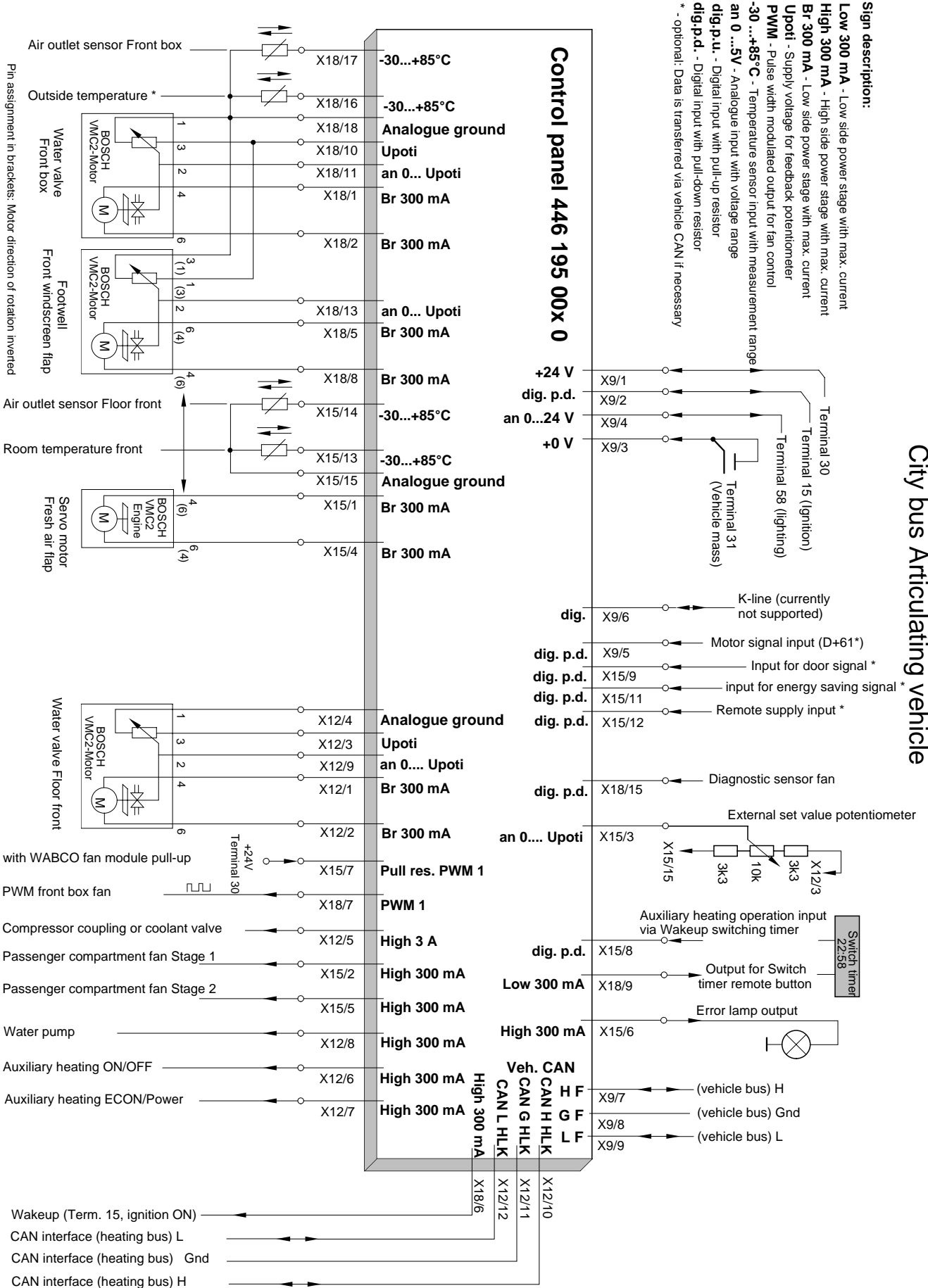
Roof Addr. 2



8.2 Overview plan for ATC CAN
City bus Articulating vehicle



Cabling plan Control panel ATC CAN
City bus Articulating vehicle



Cabling plan Substation Roof front ATC CAN

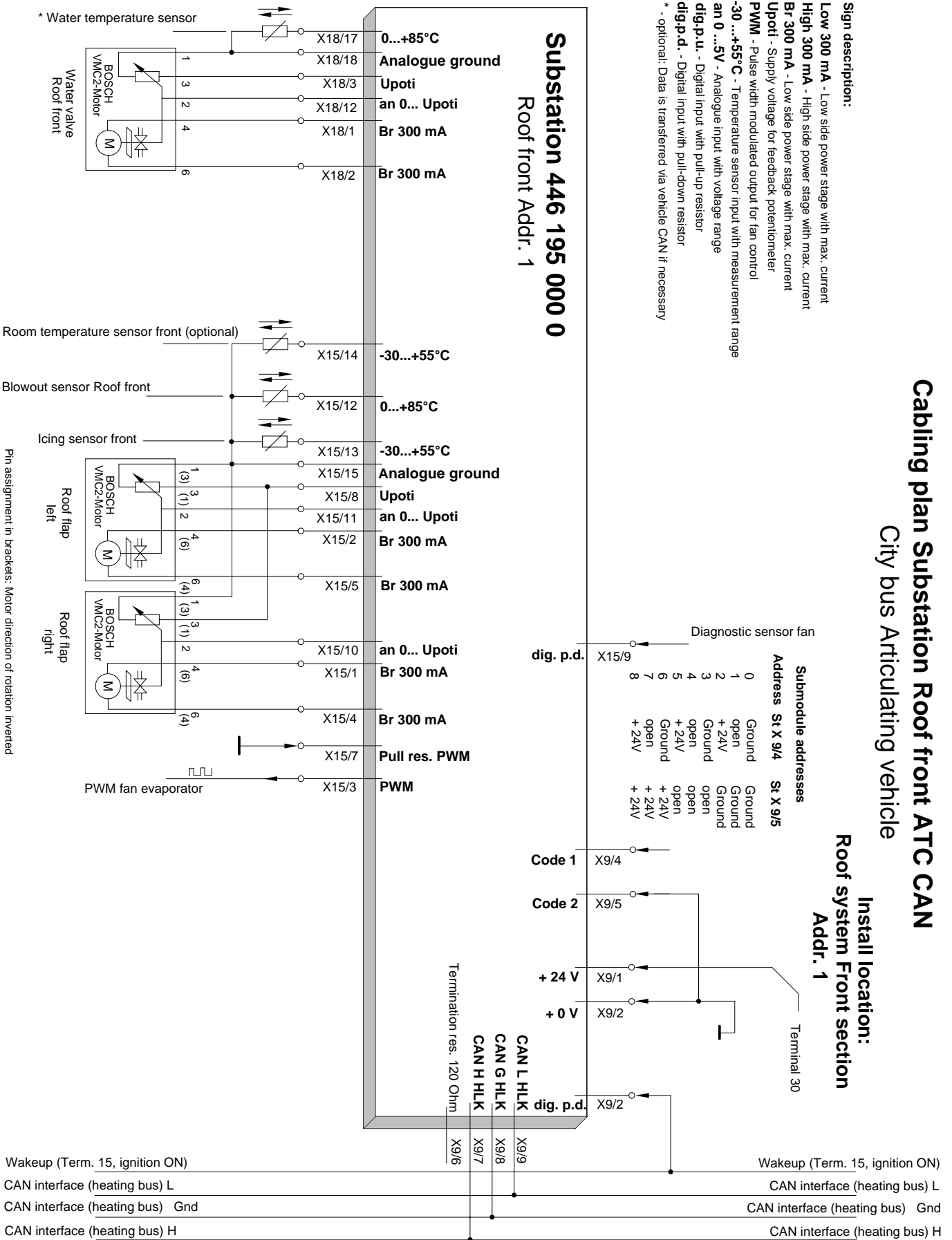
City bus Articulating vehicle

Install location:
Roof system Front section
Addr. 1

Sign description:

- Low 300 mA - Low side power stage with max. current
- High 300 mA - High side power stage with max. current
- Br 300 mA - Low side power stage with max. current
- Upoti - Supply voltage for feedback potentiometer
- PWM - Pulse width modulated output for fan control
- 30...+55°C - Temperature sensor input with measurement range
- an 0...5V - Analogue input with voltage range
- dig.p.u. - Digital input with pull-up resistor
- dig.p.d. - Digital input with pull-down resistor
- * - optional: Data is transferred via vehicle CAN if necessary

Substation 446 195 000 0
Roof front Addr. 1



Cabling plan Substation Roof rear ATC CAN City bus Articulating vehicle

Install location:
Roof system rear section
Addr. 2

Substation 446 195 000 0
Roof rear Addr. 2

Sign description:
Low 300 mA - Low side power stage with max. current
High 300 mA - High side power stage with max. current
Br 300 mA - Low side power stage with max. current
Upoti - Supply voltage for feedback potentiometer
PWM - Pulse width modulated output for fan control
-30...+55°C - Temperature sensor input with measurement range
an 0...5V - Analogue input with voltage range
dig.p.u. - Digital input with pull-up resistor
dig.p.d. - Digital input with pull-down resistor
 * - optional: Data is transferred via vehicle CAN if necessary

