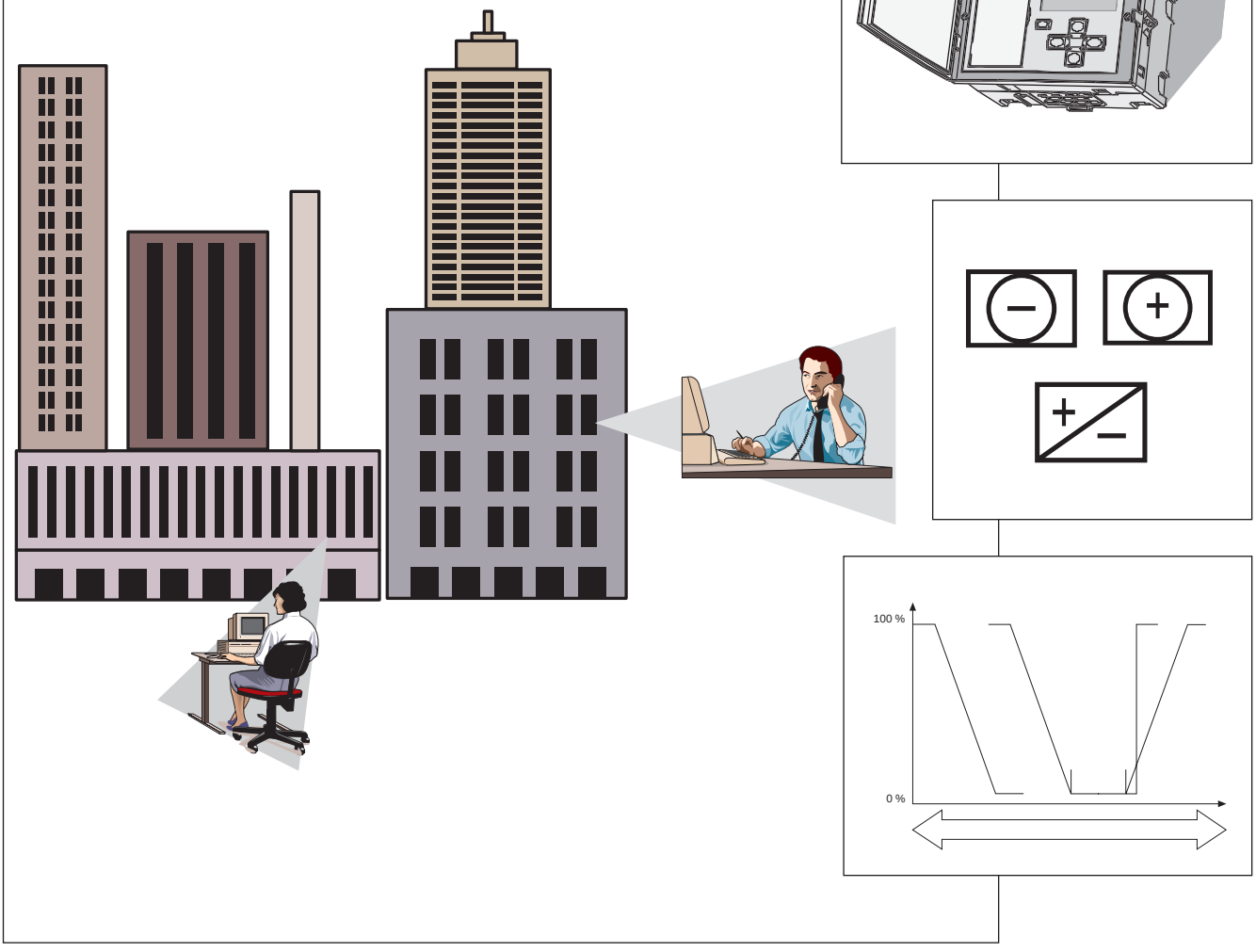
Controller TAC 2413

Handbook

TAC improves indoor climate and reduces operating costs through open solutions for demanding users.



0-004-7614-0 (GB), 1998-10-23

TAC 2413 Handbook

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1.1 Overview

Chapter 2, The air handling controller TAC 2413

This chapter provides a short introduction to the controller.

Chapter 3, Using the operator's panel

This chapter will provide you with a more detailed explanation of how to read and set values using the buttons and the display window.

Chapter 4, Day-to-day usage

This chapter will give you enough information to be able to handle the controller during normal operation.

Chapter 5, Installation

This chapter will show you how to install, connect and get the controller to operate.

Chapter 6, Troubleshooting

This chapter contains measures, which you may take on your own, to find and remedy a possible malfunction in the control system.

Chapter 7, Functional description

There is a description in detail of all the functions and parameters of the controller here.

Chapter 8, Technical data

You will find all the technical data of TAC 2413 here.

Appendix A, Commissioning protocol/List of parameters

There is a commisioning protocol here which will provide you with support when you are commissioning the controller. All the parameters of the controller are listed here.

Index

At the end of the handbook, you will find an index containing page references.

1.2 How you may use this handbook

The TAC 2413 Handbook describes all the functions and procedures that are needed to install, commission and use the controller.

The TAC 2413 controller, as well as other products in the TAC 2000 family, must not be used for purposes other than that which it was constructed for.

The installation, connection and maintenance is required to be performed by authorized staff.

During normal operation

If you are only going to read or set temperatures and other parameters during normal operation, it is sufficient to read **Chapter 3, Using the operator's panel**, and **Chapter 4, Day-to-day usage**. You may also make use of the *Quick Reference* which is located on the front of the controller.

During installation and commissioning

If you are going to install and commission the controller, you should read **Chapter 5, Installation**. The document which is included with the controller, *TAC2413 Installation instructions*, may be used for this purpose as well. The commissioning protocol is included in that document, but it is appendix A in this handbook as well.

During troubleshooting

When there is something wrong with the controller, you should read **Chapter 3, Using the operator's panel**, **Chapter 4, Day-to-day usage** and **Chapter 6, Troubleshooting**.

1.3 Documentation for the controller

Enclosed documentation

The documents below are supplied with the controller. They contain all the information you need to be able to install and commission the controller.

- *TAC2413 Installation instructions/Commissioning protocol* (part number 0FL-3891)
- *TAC2413 Quick Reference* (part number 0FL-3898)

Supplementary documentation

There is more information to be found in the document below. It may be ordered from your nearest TAC sales or service office:

- *Data sheet TAC 2000* (part number 0-003-1745)

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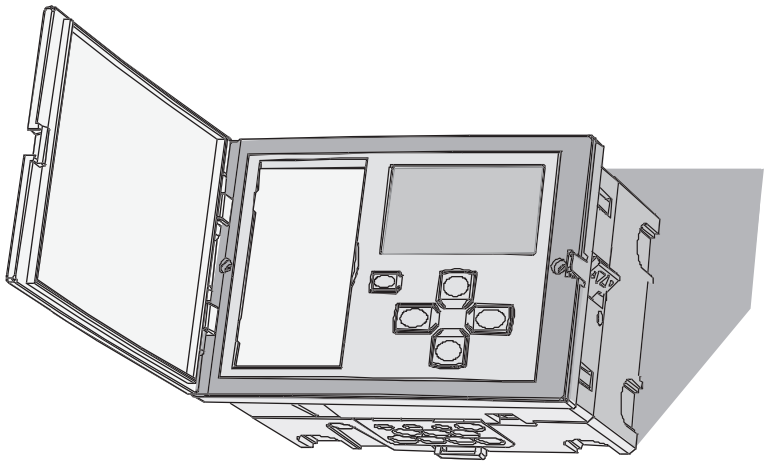
2 The air handling controller TAC 2413

TAC 2413 is a digital controller which is able to control, monitor and supervise air handling units (AHU) in buildings.

TAC 2413 controls the room temperature or the supply air temperature by controlling a heating coil, a cooling coil and heat recovery in sequence. The controller also contains functions for timed operation, alarms, pump and fan control, and so on.



TAC 2413 has a clock which may be used to set weekly and yearly programs, as well as powerful control functions for automatic operation. Reading and setting temperatures and other parameters is a simple process. The display window provides you with clear information in the form of numbers and symbols.

The controller may be mounted on a norm rail EN 500 22 (TS 35 mm), in a panel or on a wall.

2.1 Function

When the AHU starts, the return air fan (FF) is always started first; then, supply air fan (TF) starts running. Both fans start on half speed, no matter what speed has been chosen. If full speed has been chosen, it is activated 30 seconds later than TF starts. During the transition from full speed to half speed operation, both fans are stopped for 10 seconds, then, FF is started before TF.

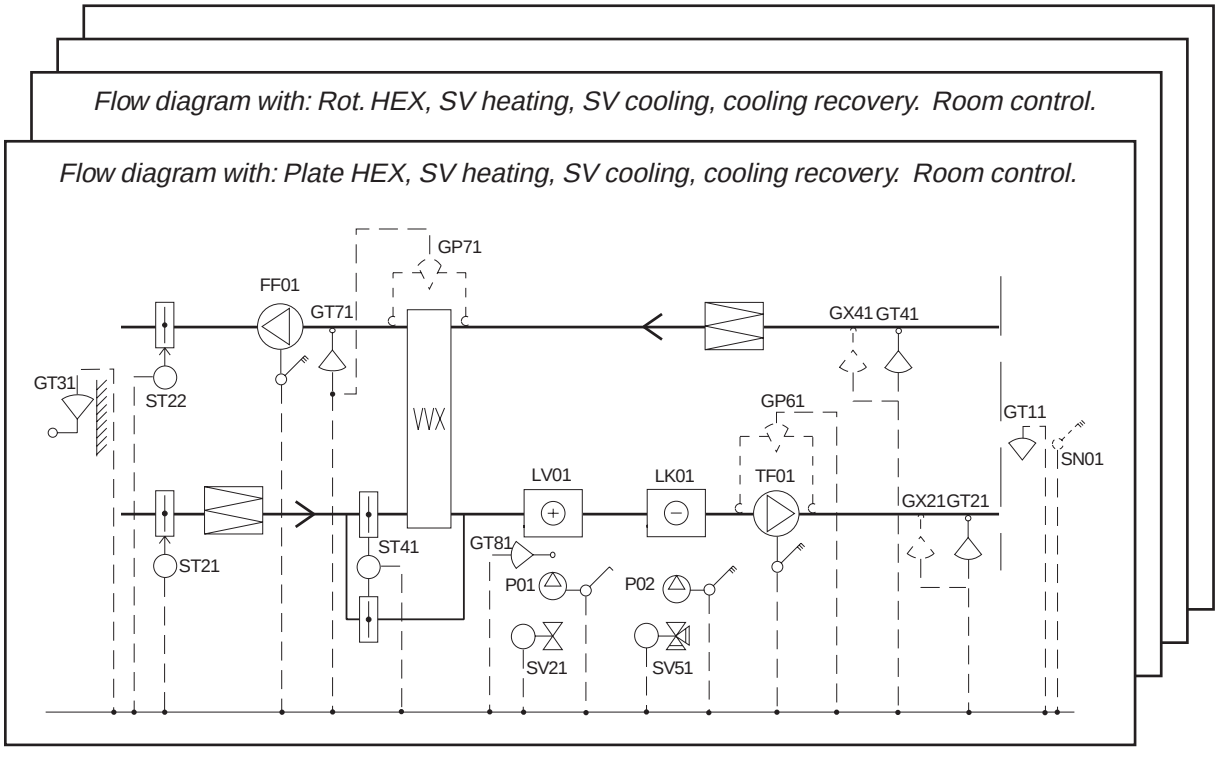
You can choose if you want room or supply air control by using DIP switch 1. During room control, the control is done from the sensor GT11, or possibly GT 41, which is chosen with DIP switch 2. The supply air temperature is controlled in cascade via the sensor GT21 which has a minimum and maximum limitation function.

The control signal for the heating coil actuator SV21 is 2–10 V, but you can set it to 0–10 V by using DIP switch 7. If the heating coil temperature drops below a set value, SV21 is opened to provide a minimum limitation. If the temperature keeps dropping in spite of this, the AHU is stopped and a freezing alarm is tripped. If the AHU stops, the GT81 sensor helps hold the return temperature.

The control signal for heat recovery (HEX, or VVX in the pictures) is 0–10 V. The efficiency is calculated using the sensors GT31, GT41 and GT71. An alarm is tripped if it is too low. During defrosting, the control signal for the VVX is controlled to an optimum setting, and if the defrosting is not complete, TF is stopped to quicken the process further. If the defrosting will run for too long, the AHU stops and an alarm is tripped. The alarm is reset in the controller.

The control signal to SV51 is 2–10 V, but you may set it to 0–10 V by using DIP switch 7. The cooling coil actuator is allowed to control the cooling valve only when the room temperature has reached the cooling setpoint. Both SV21 and VVX have to be closed, and the date has to be within the summer period, for this to apply.

Flow diagram for TAC2413.



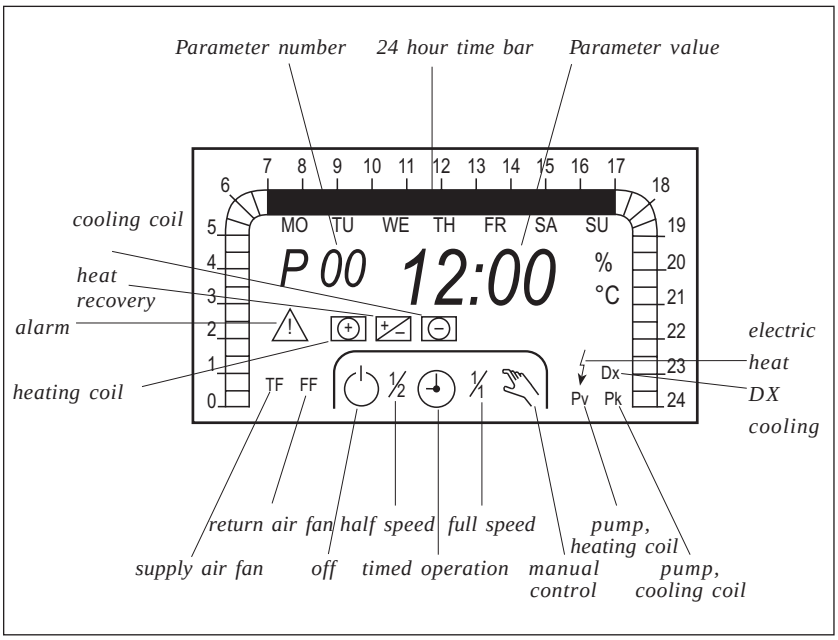
3 Using the operator's panel

3.1 Introduction

This chapter will show you how to use the buttons of the operator's panel to read and set parameters, such as temperatures, for example.

3.2 What is shown in the display window?

The display window provides you with information from the AHU in the form of numbers and symbols.

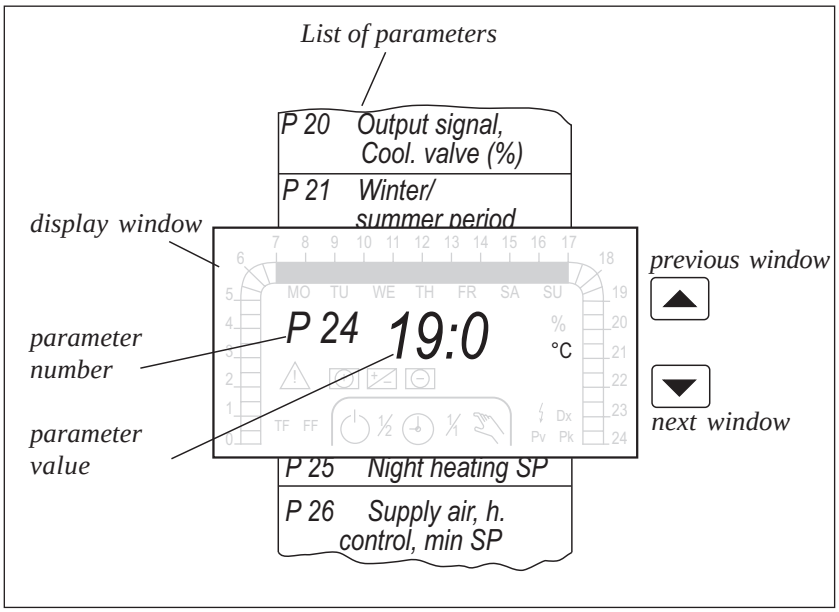


The information in the display window

3.2.1 Parameter numbers and parameter values

The controller has a list of 100 parameters ranging from 0 to 99. Some of these parameters may be set, such as the room temperature setpoint; others, however, can only be read, such as the outdoor temperature. Some parameters are not shown if the corresponding function is disabled. For example, night cooling and night heating are both disabled if there is no room sensor.

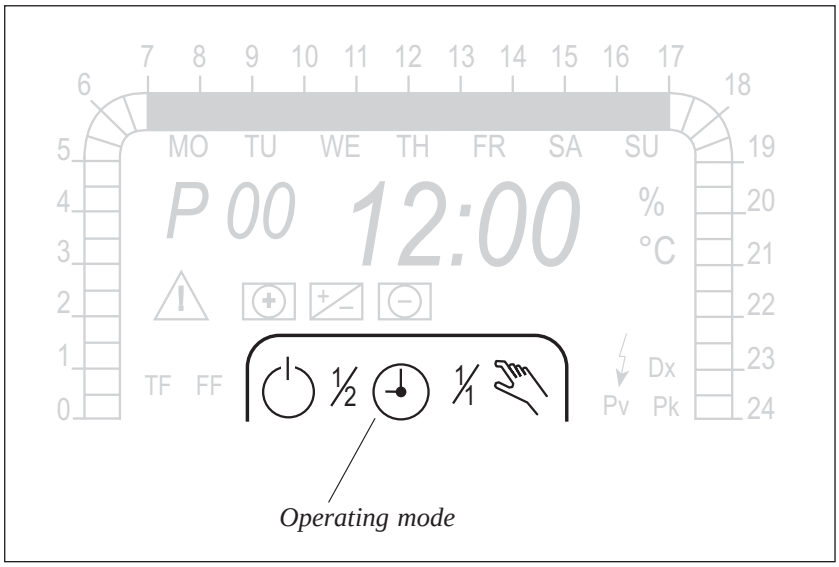
The parameter number and the parameter value constitute a "window" for the list of parameters, see the figure below.



The ▲ and ▼ buttons are used to move the window up and down on the list of parameters.

3.2.2 Operating modes

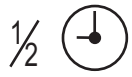
The different operating modes of the controller are shown in the display window by means of the symbols below.



The symbols of the operating modes of the controller

The symbols are interpreted as follows:


Off


Timed one speed operation/halv speed operation


Timed full speed operation


Manual control, one speed operation/half speed operation

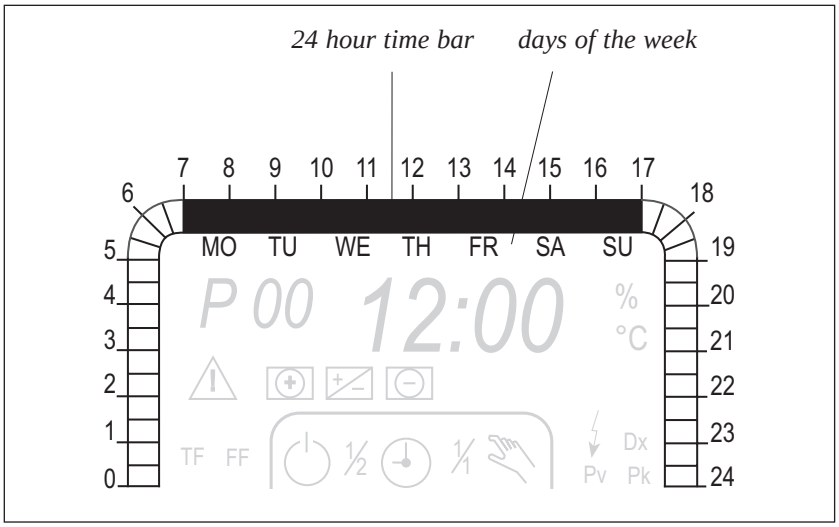

Manual control, full speed operation

A flashing hand and the 1/2 speed or 1/1 speed symbol denotes manual control by means of an external contact (X1, X2).

You may find information on how to set the operating mode in Chapter 4, in the section **Setting the weekly program for timed operation**. For a more detailed explanation of the operating modes, please refer to Chapter 7, and more specifically the section **Operating modes of the controller.**

3.2.3 Weekly program

The weekly program is shown as a 24 hour time bar from 00:00 to 24:00 for each day of the week. The part of the bar that is filled shows when daytime operation applies.



The symbols of the weekly program

Each field in the time bar represents 30 minutes. If the field is filled, the AHU is in operation. An empty field means that the AHU is not running.

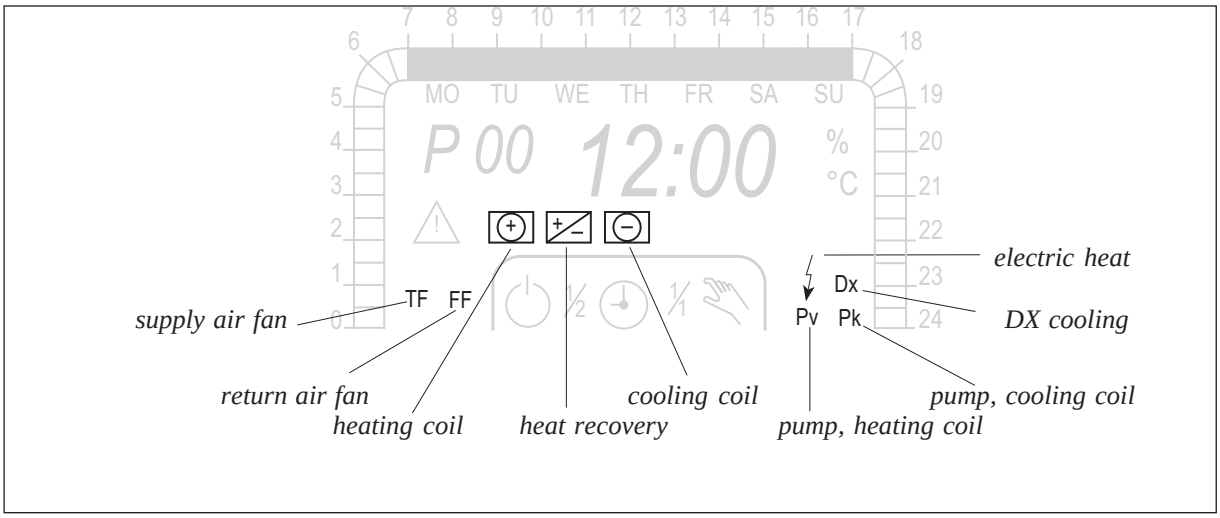
Below the time bar, you will find the days of the week. They show which day of the week the time bar applies to.

- MO: Monday
- TU : Tuesday
- WE: Wednesday
- TH : Thursday
- FR : Friday
- SA : Saturday
- SU : Sunday

How to set a weekly program is described in Chapter 4, in the section **Setting weekly programs for timed operation**. For more information on time schedules, please refer to the section **Time schedules** in Chapter 7.

3.2.4 Outputs of the controller

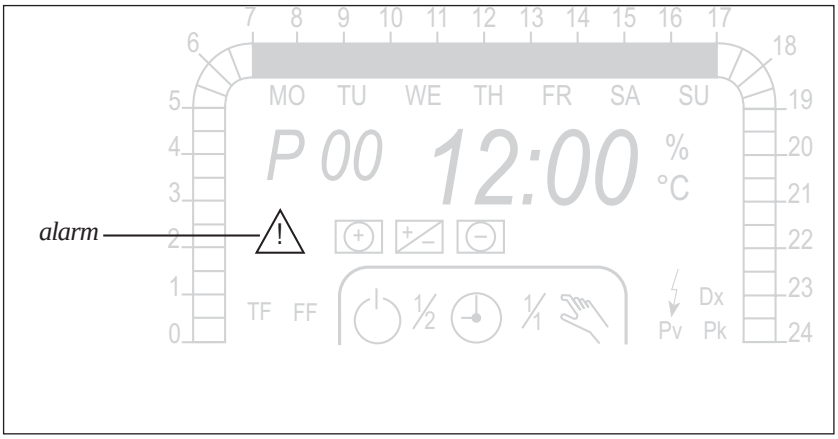
The controller has a number of outputs for control, such as for the heating coil, and for controlling external units, such as the heating coil pump. When an output is active, its symbol is shown in the display window.



The symbols for the outputs of the controller

3.2.5 Alarms

When there is an alarm, an alarm symbol will flash in the display window together with the symbol of the part of the installation that the alarm is referring to. For example, when the frost protection guard has been triggered, the alarm symbol and the heating coil symbol will flash.

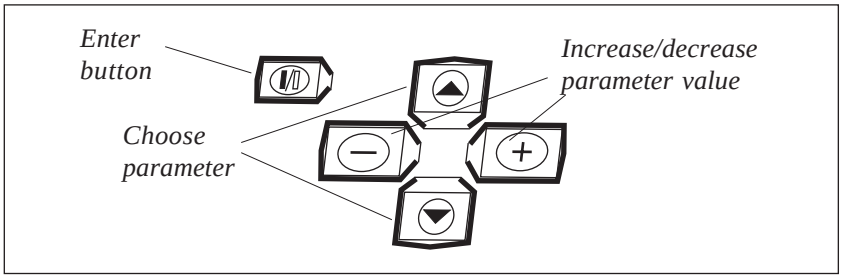


The alarm symbol

Chapter 4 describes how to read alarms in the section **Reading alarms**. There is further information on the alarms of the controller in the **Alarms** section in Chapter 7.

3.3 How are the buttons used?

The controller has five buttons located below the display window.



The buttons on the operator's panel

The ▲ and ▼ buttons are used to choose a parameter.

The − and + buttons are used to change a parameter value.

The □/■ button is used as an enter button. Each change made to a parameter must be confirmed with this button if it is to be registered in the controller. A flashing "P" in the display window will give you confirmation that you have pressed □/■ .

The □/■ button is also used to alternate between a full and empty field in the 24 hour time bar.

4 Day-to-day usage

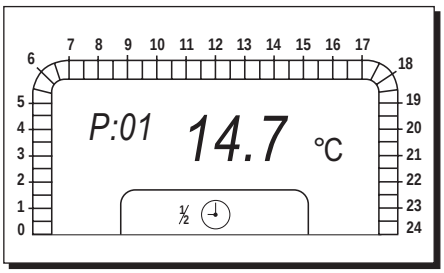
4.1 Introduction

This chapter provides enough information for you to be able to read and set temperatures and other parameters during normal operation. All parameters and functions are explained in detail in Chapter 7, **Functional description**.

If you want to switch between the parameter groups P 00–P 17 and P 18–P 99, press ▲ and ▼ at the same time.

4.2 Reading temperatures

▶ **Procedure for reading a temperature:**

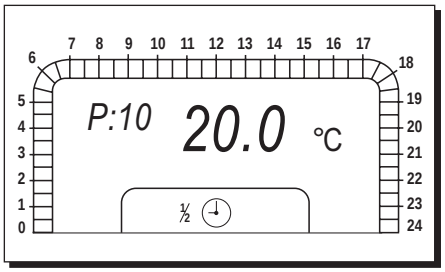


1 Choose the parameter number (P No.) using ▲ or ▼ according to the list below. You can increase the number by pressing ▼ and decrease it by pressing ▲.
2 Hold the button down for fast increase/decrease.
3 Read the value.

Temperature	P No.
Supply air temperature	P 01
Calculated SP for supply air temperature	P 02
Room temperature	P 03
Calculated SP for room/return air temp.	P 04
Return air temperature	P 05
Exhaust air temperature	P 08
Outdoor temperature	P 09

4.3 Setting temperatures

▶ Procedure for setting a temperature:



1 Choose the parameter number (P No.) by using ▲ or ▼ . You can increase the number by pressing ▼ and decrease it by pressing ▲.

2 Change the temperature by using + or −.

3 Confirm by using □/■.

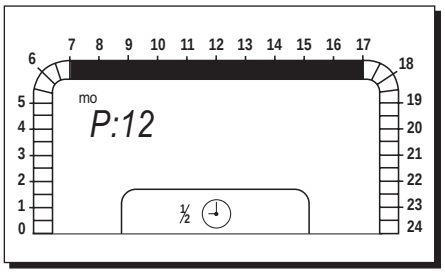
Parameter	P No.
Heating setpoint	P 10
Cooling setpoint	P 11

4.4 Setting weekly programs for timed operation

4.4.1 Weekly program one speed operation, 1/2 speed operation

The controller is factory set so that the AHU is in operation 07.00–17.00 on Monday to Friday according to this weekly program. For an explanation in detail of time schedules, please refer to the section **Time schedules** in Chapter 7.

▶ Procedure for changing the weekly program:



1 Choose parameter number P 12 by using ▼ or ▲. Increase the number by using ▼ and decrease it by using ▲.

2 When the parameter number has been chosen, the 24-hour time bar is shown along with MO for Monday.

3 Move forward on the time bar with + and backward with − to the segment which is to be changed. The segment will flash.

4 Change the half-hour segments by using □/■. A filled segment means that the AHU is in operation. When one segment has been changed, the next segment starts to flash.

5 Move on by using + until TU for Tuesday is shown.

6 Change the half-hour segments for Tuesday by using □/■.

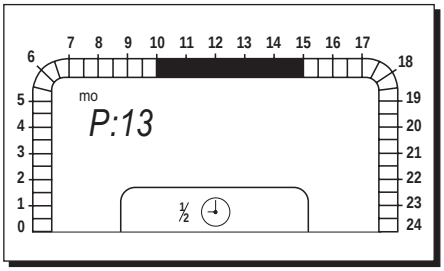
7 Repeat steps 5 and 6 for the rest of the days of the week.

Parameter	P No.
Weekly program 1/2 speed	P 12

4.4.2 Weekly program 1/1 speed

For 1/1 speed to take effect, the weekly programs for both 1/2 speed and 1/1 speed operation have to be active. The 1/1 speed program is not set on delivery.

▶ **Procedure for setting the weekly program:**



1 Make sure that the weekly program for half speed operation (P12) is set.

2 Choose parameter number P 13 by using ▼ or ▲. The parameter number is increased by using ▼ and decreased by using ▲.

3 When the parameter number has been chosen, the 24-hour time bar is shown along with MO for Monday.

4 Move forward on the time bar by using + and backward by using − to the segment which you wish to change. The segment will flash.

5 Change the half-hour segments by using □/■. A filled segment means that 1/1 speed operation will be active. When a segment has been changed, the next segment will start to flash.

6 Move on by using + until TU for Tuesday is shown.

7 Change the half-hour segments for Tuesday by using □/■.

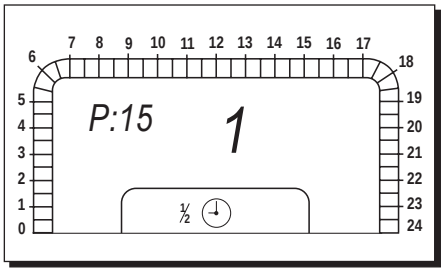
8 Repeat steps 5 and 6 for the rest of the days of the week.

Parameter	P No.
Weekly program 1/1 speed	P 13

4.4.3 Yearly program for holidays

You may use the yearly program to shut down the AHU during longer periods of time. There are six holiday periods that may be programmed up to a year in advance. Each holiday period is limited by a start and stop date, and the 24 hours of the day are affected. There are no holidays programmed on delivery. For an explanation in detail of time schedules, please refer to the section **Time schedules** in Chapter 7.

▶ Procedure for setting a holiday period:



1 Choose parameter number P 15 by using ▲ or ▼. The parameter number is increased by using ▼ and decreased by using ▲.

2 Choose a holiday period (1–6) by using + or −.

3 Confirm by using □/■.

4 Go to P 16 by using ▼.

5 Set the start date (month.day) by using + or −. Hold the button down for fast increase/decrease.

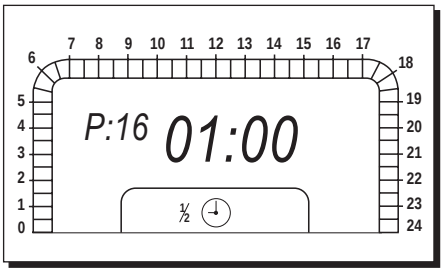
6 Confirm by using □/■.

7 Go to P 17 by using ▼.

8 Set the stop date (month.day) by using + or −.

9 Confirm by using □/■.

▶ Procedure for deleting a holiday period:



1 Choose parameter number P 15 by using ▲ or ▼. The parameter number is increased by using ▼ and decreased by using ▲.

2 Choose a holiday period (1–6) by using + or −.

3 Go to P 16 by using ▼.

4 Change the start date to day 0 of the month (month.00) by using + or −. Hold the button down for fast increase/decrease.

5 Confirm by using □/■.

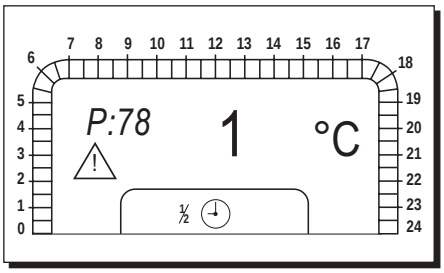
You may also set the *stop date* to day 0 if you wish to delete a holiday period.

Parameter	P No.
Yearly program, choice of holiday period 1–6	P 15
Start of holiday. Start date of holiday period as per above.	P 16
End of holiday. Stop date of holiday period as per above.	P 17

4.5 Reading and resetting alarms

When an alarm is tripped, the symbol ⚠ will flash together with the symbol that the alarm is referring to. There are two types of alarms, A alarms and B alarms. Some alarms offer the opportunity of being tripped as A alarms or B alarms. Please refer to the parameter list for information on which possibilities exist for the different alarms. A alarms have to be reset manually and always activate the sum alarm. B alarms are reset automatically, and there is a choice of whether the sum alarm is to be activated or not. When the alarm condition is gone, the reset is done by pressing the enter button □/■, upon which the AHU is restarted. Please refer to the section **Alarms** in Chapter 7 for more information.

▶ **Procedure for reading alarms:**



1 Choose the parameter number by using ▲ or ▼. The parameter number is increased by using ▼ and decreased by using ▲.

2 Hold the button down for fast increase/decrease.

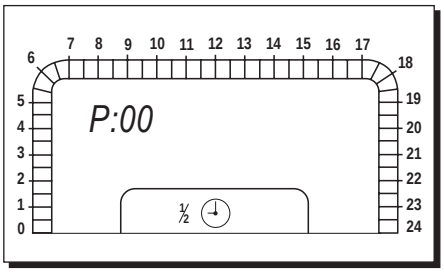
3 Read the value. 1=ALARM, 0=NO ALARM

Parameter	P No.
Fire alarm tripped	P 78

4.6 Choosing the operating mode

The controller normally runs on timed operation, that is the weekly or holiday programs decide whether the AHU is to be on or off. The controller may also be set to other operating modes. For more information on operating modes, please refer to the section **The operating modes of the controller** in Chapter 7.

▶ **Procedure for choosing the operating mode:**



1 Choose parameter number P 00 by using ▲ or ▼. The parameter number is increased by using ▼ and decreased by using ▲.

2 Change the operating mode by using + or −.

3 Confirm by using □/■.

Chosen mode	Symbols in the display window
Off	⏻

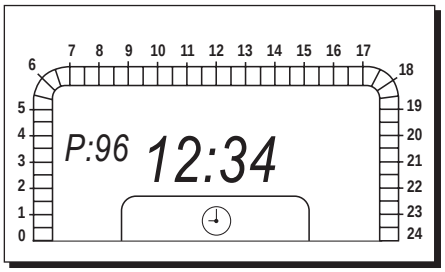
(continued on the next page)

Chosen mode	Symbols in the display window
Timed operation	, and depending on the time schedule, 1/1 or 1/2 .
Manual control	1/2 (one speed operation) or 1/1 with .

4.7 Setting the clock

To show the current time, choose parameter number P 00 (it is normally shown). The clock must be set after a power failure which has lasted longer than 48 hours. For more information on the clock, please refer to the section **Clock** in Chapter 7.

▶ Procedure for setting the clock:

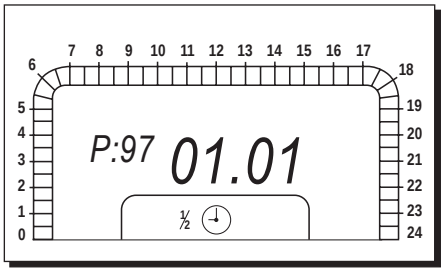


1 Choose parameter number P 96 by using ▲ or ▼. The parameter number is increased by using ▼ and decreased by using ▲.

2 Change the clock by using + or −. Hold the button down for fast increase/decrease.

3 Confirm by using □/■ .

▶ Procedure for setting the date:

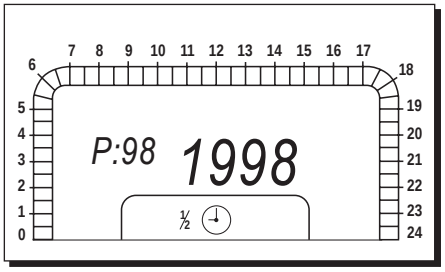


1 Choose parameter number P 97 by using ▲ or ▼. The parameter number is increased by using ▼ and decreased by using ▲.

2 Change the date (month.day) by using + or −. Hold the button down for fast increase/decrease.

3 Confirm by using □/■.

▶ Procedure for setting the year:



1 Choose parameter number P 98 by using ▲ or ▼. The parameter number is increased by using ▼ and decreased by using ▲.

2 Change the year by using + or −.

3 Confirm by using □/■.

Days of the week are calculated automatically by the controller and therefore they do not need to be set.

5 Installation

5.1 Mounting

Controller

Position the controller so that it is easy to read and to set values and so that the cover can be opened.

The permissible ambient temperature and humidity range must not be exceeded.

The controller is enclosed in a plastic box which includes four parts:

- Transparent cover
- Electronic part
- Backplate and terminal blocks
- Metal brace

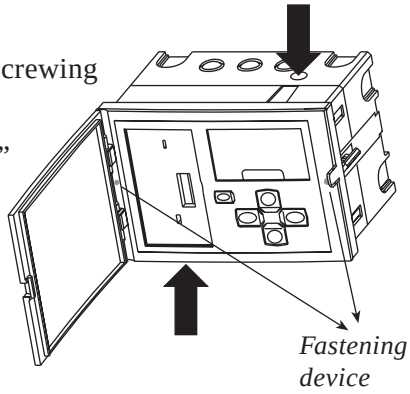
The backplate must be removed from the electronic part in order to gain access to the terminal blocks.

There is a modular jack on the electronic part for connecting the information tool Inta 2000.

WARNING! Check that there is no power supply to the terminals before you detach the back.

▶ **Procedure for removing the backplate:**

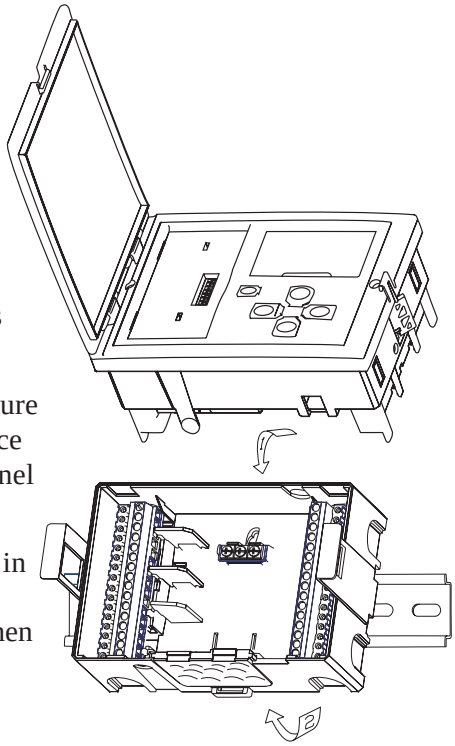
1. Remove the metal brace by unscrewing the fastening device.
2. Press in the two round “buttons” on the sides of the controller.
3. Hold the “buttons” in while carefully pulling the electronic part out of the back.



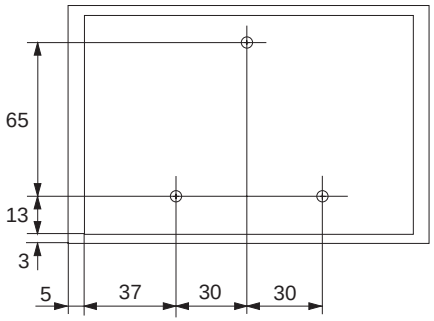
The controller can be mounted in three different ways:

- Directly on a wall
- On a norm rail EN 500 22 (TS 35 mm)
- In a panel, with or without a backplate

▶ Procedure for mounting controller on a norm rail EN 500 22:



1. Place the backplate of the controller with the metal brace on the upper side of the rail (arrow 1).
2. Turn it downwards until it snaps onto the rail (arrow 2).
3. Press on the electronic part. Secure the controller into the metal brace with the fastening device for panel mounting.
4. To remove, place a screwdriver in the lock on the bottom of the controller and pull down. It is then possible to lift the controller diagonally upwards and off the rail.



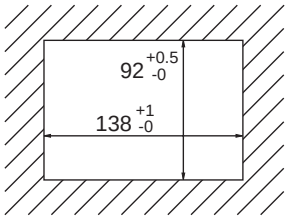
▶ Procedure for mounting controller on a wall:

1. Drill holes for the three screws as shown in the adjacent scale drawing.
2. Remove the backplate from the electronic part.
3. Mount the backplate and the metal brace.
4. Connect the cables.
5. Push the electronic part onto the backplate and secure the controller into the metal brace with the fastening device for panel mounting.

▶ Procedure for mounting controller in a panel:

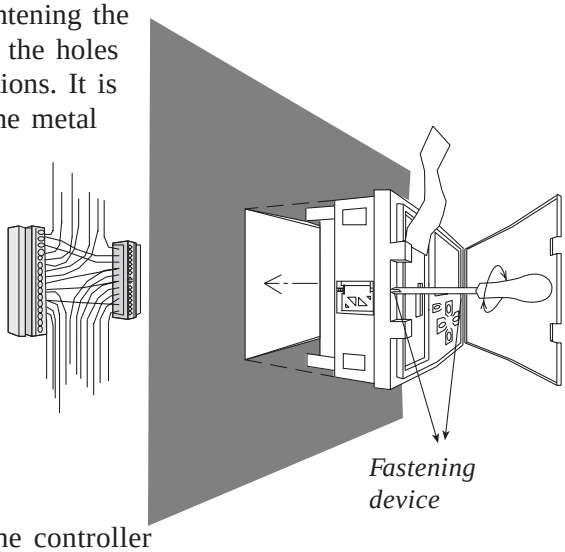
1 Make an opening in the panel as shown in the adjacent scale drawing. The maximum panel thickness is 5 mm.

2. Remove the backplate from the electronic part (see above). Remove the terminal blocks from the backplate.



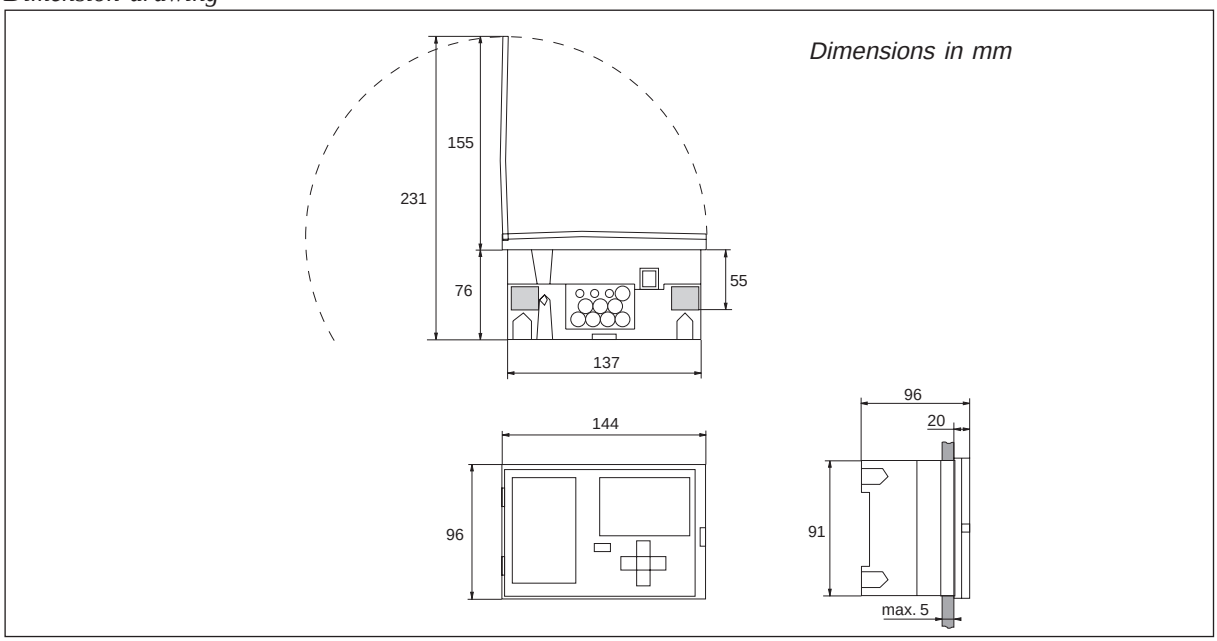
3. Place the controller in the panel and lock it in position by tightening the two locking screws. Seal the holes using the two gasket sections. It is not necessary to install the metal brace when mounting in a panel.

4. Attach the terminal blocks to the pins on the backplate of the controller. Note that the terminal blocks are "coded", so they cannot be interchanged.



It is also possible to use the backplate when mounting the controller in a panel.

Dimension drawing



5.2 Connection

Connect the cables to the controller as shown in the wiring diagram.

WARNING! All power cables should be installed by an authorised electrician.

All equipment which is connected to the controller must comply with the following standards:

- **EN 60 742** (or other applicable safety standard) for air handlers which provide ELV-type power supply (normally 24 V AC) to the controller and other connected equipment.
- **EN 61 010** or **IEC 950** (or other applicable safety standard) for computers, modems and other equipment supplied by 230 V mains.

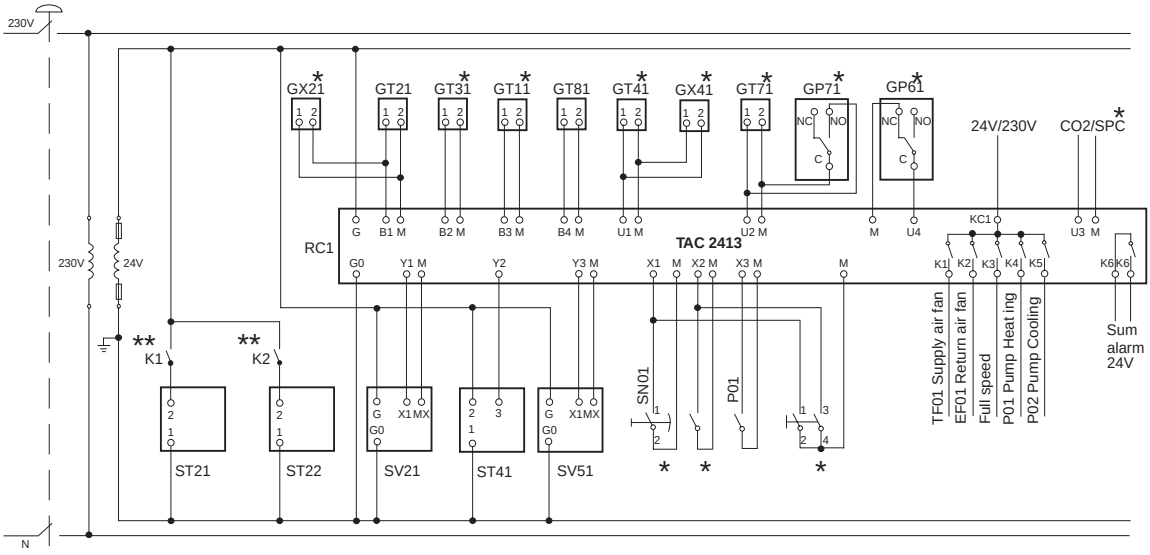
The controller has 25 cable entries in the back. Make sure that power and signal cables are drawn through separate entries and are kept well apart.

Wires to the controller should be held in place by e.g. clamps.

The rail with three screws in the middle of the back is insulated. It can be used as measurement neutral. A connection must then be made between the rail and measurement neutral (M) in the terminal block.

There should be a switch in order to break the power to the controller. It does not have to be a separate switch for the controller; it may also cut the supply voltage to the installation. The function of the switch should be marked clearly.

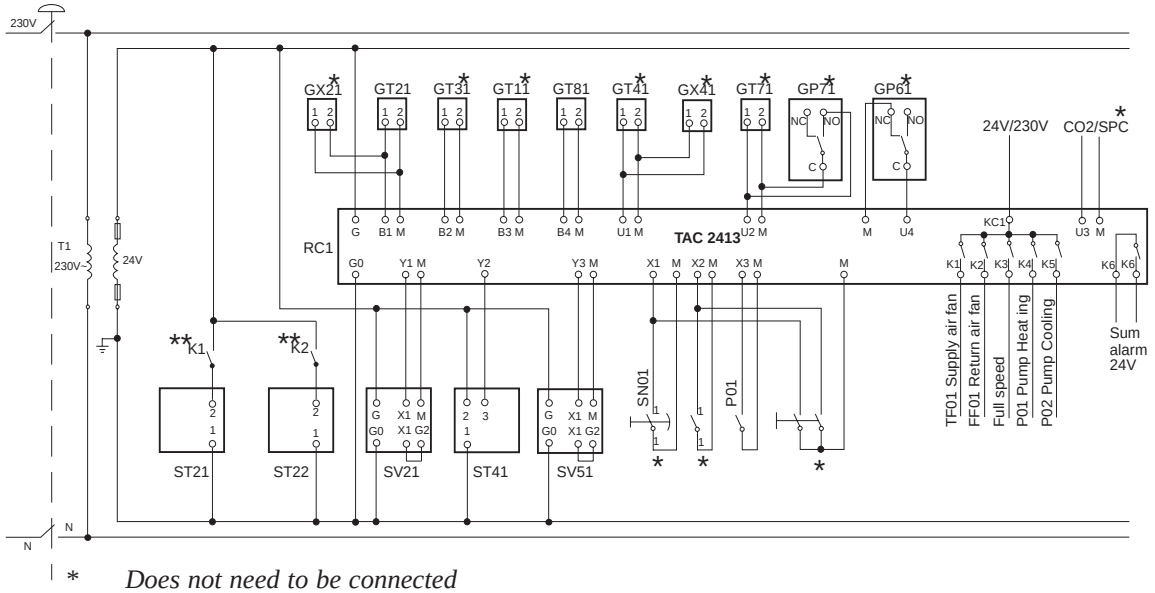
Wiring diagram with the valve actuators M300, M750



* *Does not need to be connected*

** *K1: contactor TF01*
K2: contactor FF01

Wiring diagram with the valve actuators EM5, EM42



* *Does not need to be connected*

** *K1: contactor TF01*

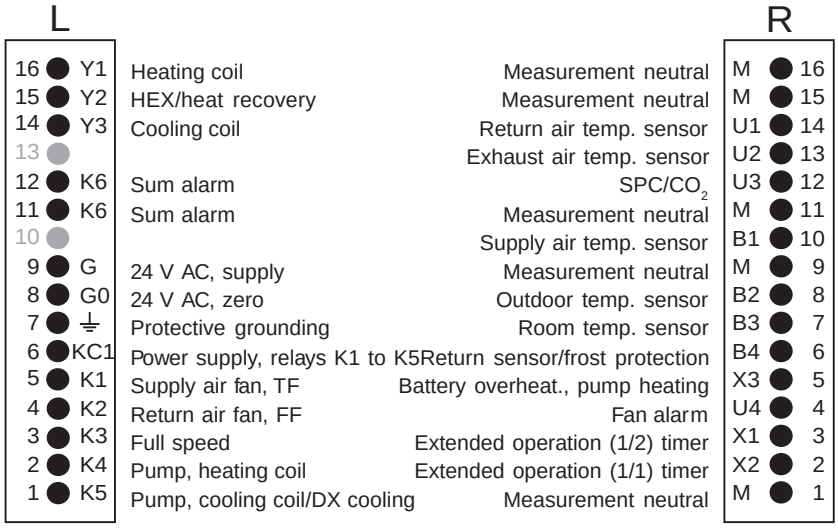
K2: contactor FF01

N.B.! These drawings only show the units that may be connected to TAC 2413 using a heat exchanger as well as waterborne heating and cooling. TAC 2413 may use other combined functions.

Designation	Description	Type
RC1	Controller	TAC 2413
ST41	Damper actuator	EM 24
SV21	Valve actuator	M300 - M750
SV51	Valve actuator	M300 - M750
SV21	Valve actuator	EM5, EM42
SV51	Valve actuator	EM5, EM42
GT11	Temperature sensor	EGRL
GT21	Temperature sensor	EGL
GT31	Temperature sensor	EGU
GT41	Temperature sensor	EGL
GT71	Temperature sensor	EGL
GT81	Temperature sensor	EGXA1 or EGX2
GP61	Pressure sensor	KS 500 C2
GP71	Pressure sensor	KS 500 C2
GX41/GX21	Smoke detector	Other supplier
SNO1	Timer	Other supplier
ST21	Damper actuator	FMA24
ST22	Damper actuator	FMA24
T1	Transformer	YT96

5.3 Terminal blocks

The location of the terminal blocks in the back of the controller can be seen in the figure below.



If the SPC signal is connected from equipment which has a different transformer, then the G0s from each transformer must be connected to one another.

The rail with three screws in the middle of the back is insulated. It can be used as measurement neutral. A connection must then be made between the rail and measurement neutral (M) in the terminal block.

The terminal for protective grounding only provides a connection for a possible protective wire and has no connection in the device.

Clamp the cables together using straps or the like next to the terminals in order to limit their mobility.

5.4 Cable lengths

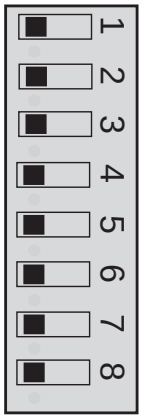
The following applies when the TAC 24 V transformer is installed in direct connection to TAC 2413:

- The cables to G, G0 and other terminal blocks on TAC 24 V actuators must not exceed 50 m in length, and shall have a minimum cross-sectional area of 0,8 mm^2. If the cables exceed 50 m in length, then the minimum cross-sectional area should be 1,5 mm^2.
- Cables connected to the terminal blocks KC1 and K1 to K6 must not exceed 100 m, and shall have a minimum cross-sectional area of 1,5 mm^2.
- Cables connected to terminal blocks types B, U, and X must not exceed 200 m, with a minimum cross-sectional area of 0,5 mm^2.

5.5 Commissioning

The following should be done before switching on the power:

1. Check that sensors and actuators are connected correctly.
2. Set the DIP switch to configuration. Access to the DIP switch can be gained by pulling out the quick reference and removing the plastic sheet in front of it.



No	OFF	ON
1	Supply air control	Room/return air control
2	Room control (1=on)	Return air control (1=on)
3	HEX	Mixed air damper
4	HEX at stop = 0% (3=off)	HEX at stop = 100% (3=off)
5	Waterborne heating	Electric heating
6	Waterborne cooling	DX cooling (only if 1=on)
7	2–10 V output for heating and cooling	0–10 V output for heating and cooling
8	Warm start. Resets the hardware, but all the settings except for the date and time are retained. If all settings are to be reset (cold start), please refer to the section **Cold start** in Chapter 7.	

3 Switch on the power to the controller.

4 Set the clock, see Chapter 4.

5 Check that all the temperatures are reasonable. Follow the instructions of the quick reference.

6 Make sure the controller is running in timed operation mode. There is a description of how to set the operating modes in the quick reference.

The controller should now control using the default parameters. If any of the DIP switches has been altered after having commissioned the controller, perform a cold start. Please refer to the section **Cold start** in Chapter 7.

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6 Troubleshooting

TAC 2413 is normally a very reliable controller. If there should be any problem in spite of this, you may use the following tips for troubleshooting. If you need further help, please contact your nearest TAC service office.

Problem	*Check that...*
The window is empty	• the controller has power
An alarm has stopped the AHU	• the alarm has been acknowledged or reset, please refer to the section **Alarms** in Chapter 7
The temperature in the ventilating system is too low	• the AHU is in timed operation and that a holiday program is not active • an alarm has not stopped the AHU • high current protectors and power switches are on • the pump for the heating coil is running • the plumbing system is not full of air and the pressure is normal • the main pump is running • the heating source (district heating or boiler) has the correct temperature • heat recovery provides the normal rise in temperature • the cooling coil is not engaged

Problem	*Check that...*
The temperature in the ventilation system is too high	• the AHU is in timed operation and no holiday program is active • an alarm has not stopped the AHU • high current protectors and power switches are on • the heating valve is controlled, but if the cooling is active, that it is completely closed • heat recovery is active, but if the cooling is active, that cooling recovery is active • the cooling valve is controlled • the cooling media temperature is correct • the cooling compressor/ the DX step is correctly installed
The calculated setpoint does not appear to be correct	• setpoints and their maximum and minimum limits are correct • the setting of any possible outdoor compensation is correct • any possible SPC effect at 2 and 10 V is set correctly

7 Functional description

7.1 Introduction

This chapter contains a description of all the functions of the controller. At the end of every section is a list of parameters. How parameters are read and set is described in **Chapter 3, "Using the operator's panel".**

7.2 Operating modes of the controller

The controller normally works in timed operation, that is the weekly and yearly programs will determine how the AHU is running. During two speed operation it is controlled toward 1/1 speed or 1/2 speed operation by these programs. The controller may be changed to other operating modes, that is manual operation or off, by changing parameter P 00.

Timed operation, one speed operation or 1/2 speed

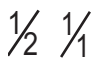
When the weekly program orders 1/2 speed operation, the 1/2 speed and clock symbols are shown in the display window.

Timed operation, 1/1 speed

When the weekly program orders 1/1 speed operation, the 1/1 speed and clock symbols are shown in the display window.

Manual control

If you select 1/1 or 1/2 speed operation, the controller is set to manual operation automatically. The following symbols are shown in the display window:



- The hand symbol on the left is shown together with the chosen 1/1 or 1/2 speed symbol.

If the controller is manually controlled from an external contact by using input X1 or X2, this is shown by the hand symbol, and the 1/1 or 1/2 speed symbol will flash in the display window. It is possible to obtain manual control by using parameter P 00.

Yearly program

The yearly program is used to stop the AHU during longer periods of time, such as holidays or school breaks. A total of six holiday periods may be programmed up to a year in advance.

When the controller is in the timed operating mode, and the holiday period starts, the clock symbol will be shown in the display window and the AHU stops.

Air handling off

When the controller is "Off", the symbol on the left is shown in the display window and the AHU stops. Externally controlled stops via X1 or X2 are shown by a flashing symbol.

P No.	Parameter	Min.	Max.	Factory set. Change	Comment
P 00	Time. Indication and choice of operating mode.				Off, Manual, Auto 1/2 and 1/1 speed.
P 12	Weekly program 1/2 speed			07-17	Mon-Fri, one speed op.
P 13	Weekly program 1/1 speed				
P 15	Yearly program	1	6		Choice of holiday period
P 16	Holiday start date	01 00	12 31	0100	Start date of holiday period chosen above
P 17	Holiday end date	01 00	12 31	0100	End date of holiday period chosen above

Changing the operating mode

The operating mode of the controller may be changed by the following:

- The operator's panel, by changing parameter P 00. Every change must be confirmed by pressing the enter button for it to be registered in the controller.
- The input for 1/2 speed operation (one speed operation) (X1).
- The input for 1/1 speed operation (X2).
- The holiday periods of the yearly program.
- The weekly program times of operation.

Priorities

Operating modes may be changed only by a function with equal or higher priority than the function which has initiated the current operating mode. The functions have the following priority (1 is the highest priority):

1. Operating modes set from the operator's panel of the controller
2. Input for half speed operation (one speed operation), X1

   Input for full speed operation, X2
3. Yearly program during timed operation
4. Weekly program during timed operation

For example: The yearly program cannot affect the control if the input for half speed operation is on.

7.3 Air handling

7.3.1 Fan operation

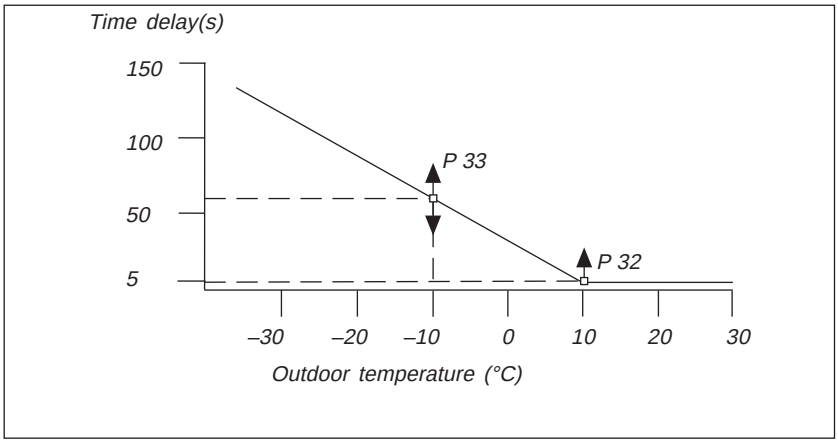
The fans are controlled by the built-in time program with separate times for half and full speed, respectively, or via manual control by using the buttons. Full speed is disabled if the outdoor temperature is below the set limit in P90.

The times for 1/2 speed apply to one speed operation as well.

It is also possible to control the AHU by closing an external contact between M and X1 for 1/2 speed (one speed operation) and between M and X2 for 1/1speed or via a pulse on input X1 or X2 which activates a built-in timer function. The timer may be set; each pressing of the button will activate the timer from its zero position.

Forced “Off” is achieved by using manual control from the buttons or by closing the X1 and X2 to M at the same time.

The fans are started with an adjustable and temperature controlled time delay between them, where FF (return air fan) starts first, and then TF (supply air fan) starts. This time delay is adjustable; it is factory set to 5 seconds, for outdoor temperatures ≥10 °C. After



that, it will increase in proportion to decreasing outdoor temperatures. The slope of the curve is determined by an adjustable time delay, P 33, which is factory set to 60 seconds at –10 °C, see the figure. One or two speed fans may be controlled. For two speed fans, the switch to full speed operation is done by closing a digital output (K3) which is common to TF and FF. The fans are always started on half speed, and if full speed has been chosen, the changeover to full speed will take effect when both fans have been running for 30 seconds.

During the changeover from full speed to half speed, both fans are stopped for ten seconds; then, FF starts, and after five more seconds, TF starts. Full speed operation may be activated by using the time program, manual control by using the buttons or via an external switch. Note that if full speed is to be achieved during timed operation, both the half speed and full speed programs have to be active.

The heat recovery is controlled to 100 % when FF starts, and the position of the heating valve is determined by the outdoor temperature. It is completely closed at outdoor temperatures ≥ 10 °C, and opens on a linear basis without breakpoints with decreasing outdoor temperatures.

The slope of the curve is defined at –10 °C and is factory set to 50 %. If no outdoor sensor has been installed, the slope is equal to that at –10 °C.

During electric heating, the same time delay applies between the fans, but the control signal to the electric battery is 0% until TF starts. The control sequence is started together with TF.

P No.	Parameter	Min	Max	Factory set. Change	Comment
P 32	Delay, start TF at +10 °C	5 sec	300 sec	5 sec	
P 33	Delay, start TF at –10 °C	5 sec	300 sec	60 sec	
P 12	Weekly program 1/2 speed			07-17	Mon-Fri, one speed op.
P 13	Weekly program 1/1 speed				
P 14	Timer	0 min	300 min	120 min	Extended operation
P 90	Outd. temp. block 1/1 speed	–50°C	20°C	–50°C	

Status

The display shows the functions that are activated using the P No.

When an output signal is active for the AHU, its symbol is displayed. The following symbols are found on the display:


: Alarm operation


: Manual


: Heating coil

½ : Half speed, one sp.


: Cooling coil

1/1 : Full speed


: Heat recovery


: Off

: Electric heating


: Timed operation

FF : Return air fan

D_X : DX cooling

TF : Supply air fan

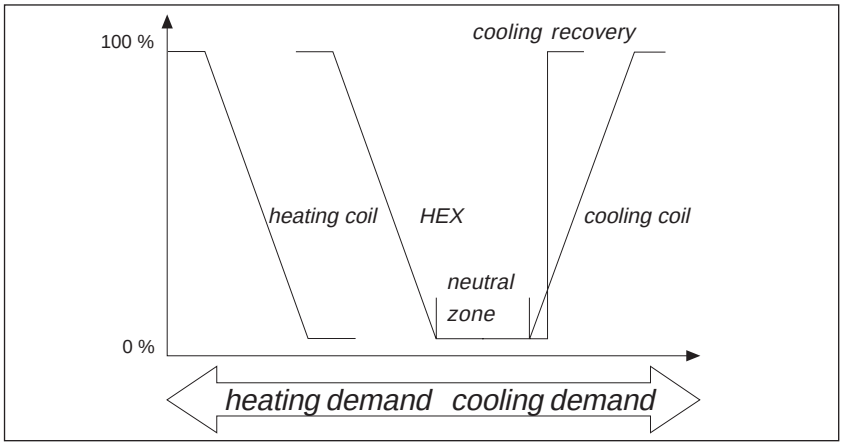
P_K : Pump, cooling coil

P_V : Pump, heating coil

P No.	Parameter	Min	Max	Factory set.	Change	Comment
P 18	Output signal to HEX (%)	0	100			
P 19	Output to heating valve (%)	0	100			
P 20	Output to cooling valve (%)	0	100			
P 21	Winter/Summer period	0	1			(0/1) Confirms the status
P 22	Night cooling	0	1			(0/1) Confirms the status
P 23	Defrosting	0	1			(0/1) Confirms the status

7.3.2 Temperature control

TAC 2413 holds the temperature by sequence control of the heating coil, heat recovery and cooling coil, see the figure below.



When there is a heating demand, the HEX increases the control signal to 100 %; then, the heating valve opens. During a cooling demand, the heating valve closes first, and then the control signal to HEX is decreased to 0 %. Only at this point does the cooling valve open.

The HEX and heating control have the same setpoint, “Heating setpoint”. The cooling coil uses a separate “Cooling setpoint”. The “Heating” and “Cooling” setpoints may be adjusted separately and the difference between them must be at least 0,5 °C.

If the temperature is within the neutral zone, none of the heating coil, heating recovery or the cooling coil are active. The separate heating and cooling setpoints mean that heat or cold is only supplied when there is a real demand, in addition to eliminating the risk of overlapping between the steps.

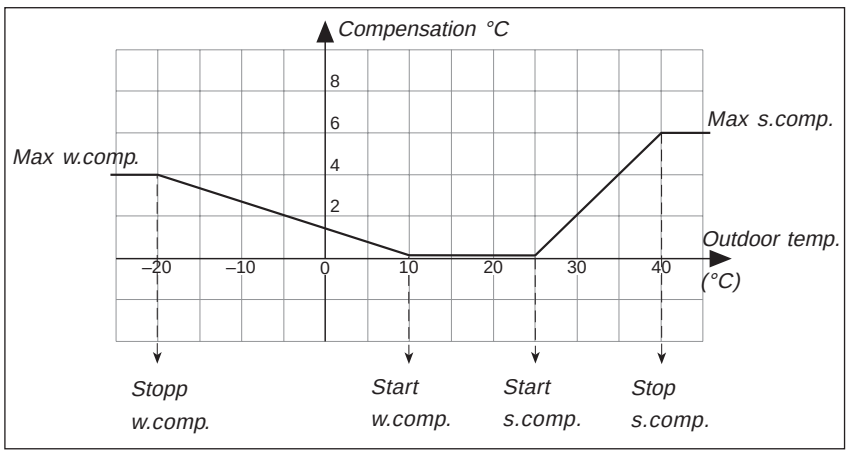
During normal operation, the room or supply air temperature is controlled. The choice is made using DIP switch 1, which is factory set to supply air control. During room control, the supply air temperature is controlled in cascade, and it may also be maximum and minimum limited. Separate min. limits apply to heating and cooling, respectively. When room control is chosen, further choices may be made if the control is to be done from the room or return sensor by using DIP switch 2. The room temperature reading can be adjusted using P 89.

P No.	Parameter	Min	Max	Factory set. Change	Comment
P 02	Supply air temp. setpoint				Calculated
P 04	Room/exhaust air temp. SP				Calculated
P 10	Heating setpoint	0 °C	50 °C	20 °C	
P 11	Cooling setpoint	0 °C	50 °C	22 °C	
P 26	Min. SP supply air, heating	0 °C	50 °C	14 °C	
P 27	Min. SP supply air, cooling	0 °C	50 °C	12 °C	
P 28	Max. setpoint supply air	0 °C	50 °C	35 °C	
P 70	Gain, room controller	1	20	2	
P 71	I time, room controller	1min	60 min	20 min	
P 89	Room sensor adjustment	–5 °C	5 °C	0 °C	°C/°C
P 92	Dead zone, supply air c.	5	20	5	×0,1 (5=0,5°C)

7.3.3 Outdoor compensation

If no outdoor sensor is installed, this function will not be available, and the P No. is not shown. The supply air or room temperature setpoint can be compensated directly by the outdoor temperature. The compensation, which may be positive or negative, states in °C how much the supply air or room/return air temperature setpoint is to be shifted.

There are two curves, one for the summer and one for the winter compensation, see the figure below.



The outdoor compensation is not active on delivery. It is activated by setting the desired compensation values in the list, P 50 for winter compensation and P 53 for summer compensation.

The summer compensation starts when the outdoor temperature is greater than “Start summer compensation”. The maximum compensation is achieved when the outdoor temperature is greater than or equal to “Stop summer compensation”.

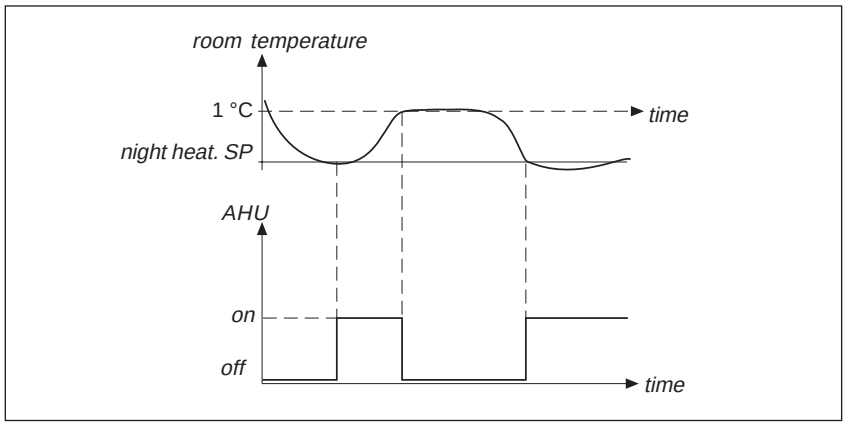
The winter compensation starts when the outdoor temperature is below “Start winter compensation”. The maximum compensation is achieved when the outdoor temperature is less than or equal to “Stop winter compensation”.

P No.	Parameter	Min.	Max.	Factory set. Change	Comment
P 01	Supply air temperature				Measured value
P 02	Supply air temperature SP				Calculated value
P 03	Room temperature				Measured value
P 04	Room/exhaust air temp. SP				Calculated value
P 49	Start winter compensation	–20 °C	20 °C	10 °C	
P 50	Max. winter compensation	–20 °C	20 °C	0 °C	
P 51	Stop winter compensation	–30 °C	20 °C	–20 °C	
P 52	Start summer compensation	0 °C	50 °C	25 °C	
P 53	Max. summer compensation	–20 °C	20 °C	0 °C	
P 54	Stop summer compensation	5 °C	50 °C	40 °C	

7.3.4 Night heating

Night heating is activated automatically if a room sensor is installed. This applies even if supply air control has been chosen. During two speed operation, the fans run at full speed.

During the night, the AHU is controlled by the adjustable “Night heating setpoint”. The AHU is normally off, but it is restarted if the room temperature is below the setpoint, see the figure below.



When the temperature has reached 1 °C above the night heating setpoint, the AHU stops. There is a choice of running only TF during night heating.

If the mixed air damper has been chosen, 100 % return air applies during night heating operation. If heat recovery is chosen, there is normal operation. In both cases, the normal setpoints apply.

P No.	Parameter	Min.	Max.	Factory set.	Change	Comment
P 25	Night heating setpoint	0 °C	50 °C	16 °C		
P 91	FF stop during night heating			0		1=TF in operation only

7.3.5 Night cooling

The cooling demand which exists during the summer period in order to keep the right temperature will result in high operating costs. For this reason, TAC 2413 makes use of the relatively cold night air to cool the building down as well. The consequences are that less cool air, if any, needs to be supplied on the following day, and in all, the energy consumption has been decreased.

Night cooling is activated automatically if a room sensor is installed on the condition that there is an outdoor temperature sensor. This applies even if supply air control is chosen.

To achieve the maximum efficiency, night cooling will not start before a number of conditions are valid, see below:

1. The date falls within the summer period.
2. The remaining time to the next normal operation cycle is less than the set time; factory setting: 10 hours. 0 will disable this.
3. The outdoor temperature is higher than “Min. outdoor temp for night cooling”.
4. The difference between the room and outdoor temperature is >5 °C.
5. The room temperature is >1.0 °C above “Night cooling setpoint”. Night cooling is stopped when the room temperature has dropped to the “Night cooling setpoint”.

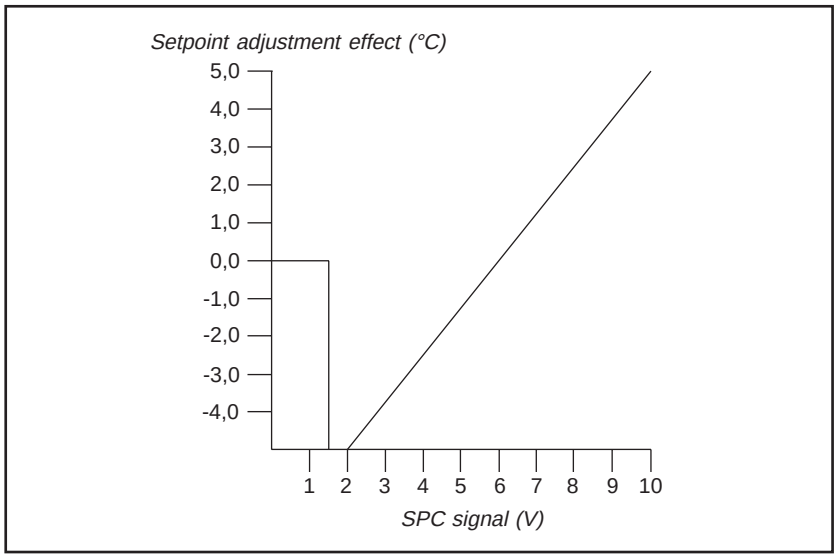
When the night cooling is active, the heat exchanger and heating coil are disabled during an adjustable time of th next normal operation period in order to prevent heating of the building.

P No.	Parameter	Min.	Max.	Factory set.	Change	Comment
P 22	Night cooling (status)					(0/1)
P 24	Night cooling setpoint	0 °C	50 °C	19 °C		
P 43	Min. outdoor temperature for night cooling	0 °C	50 °C	12 °C		
P 44	Maximum time to next normal operation period	0 h	20 h	10 h		
P 45	Disabling of Y1, Y2 after night cooling	0 min	300 min	180 min		

7.3.6 CO_2 / SPC

This function is chosen by using parameter P 55; 0 = no function, 1 = SPC, and 2 = CO_2.

By connecting an external 2–10 V DC control voltage to the SPC input, the current setpoint can be shifted, see the figure below.



There is no change to the setpoint at 6 V, but 2 V and 10 V provides the set effect with a – or + sign. This means that 2 V will give the (–) effect and 10 V will give the (+) effect. However, an input signal that is < 1.5 V will achieve the same effect as 6 V, that is no change to the setpoint.

When CO_2 is chosen, the air quality is controlled by comparing the measured signal 0-10 V from a carbon dioxide sensor with an adjustable value, P 57. As long as return air control is not chosen, full speed is activated at this setpoint and deactivated with 1 V minus the hysteresis.

When return air control has been chosen, the damper is controlled towards its open position by using the P function. The P band is calculated symmetrically around the setpoint ±1 V. When the input signal is 1 V less than the setpoint, the damper control starts.

For example, if the setopint is 4 V, the damper starts to open at 3 V and the full control signal is achieved at an input signal of 5 V. If there is not a significant change (5 %), either an increase or decrease, of the CO_2 concentration, the damper is allowed to remain in its current position, which eliminates unneccessary intervention. The minimum limitation controller for the supply air temperature limits the opening of the damper.

Full speed is activated at 10 V control signal and deactivated with 1 V minus the hysteresis. Full speed is disabled if the outdoor temperature is less than the set limit P90.

P No.	Parameter	Min.	Max.	Factory set. Change	Comment
P 55	SPC/CO_2			0	0=no function, 1=SPC, 2 = CO_2
P 56	SPC effect at 2 and 10 V, respectively	0 °C	32 °C	0 °C	
P 57	CO_2 setpoint	0 V	10 V	4 V	
P 93	SPC/CO_2 input signal	0 V	10 V		Measured value

7.3.7 Mixed air damper

The outdoor, return and exhaust air dampers are controlled between an adjustable minimum air level (30 %) and 100 % outdoor air. The damper control is chosen using DIP switch 3. The control signal of the damper is 0–10 V, where 0 V is equal to 0 % (closed outdoor damper) and 10 V is equal to 100 % (open outdoor damper). Parameter P 30 may be used to set the control sequence to either “Economy” or “Comfort”. “Economy” will control the damper to the minimum outdoor air level first; then, the heating coil is controlled. “Comfort” will control the heating coil first; then, the damper is controlled toward the minimum outdoor air setting.

If “Economy” has been chosen, the following applies during the cooling sequence:

- If the return air temperature is more below the outdoor temperature than the “Economy limit”, an economy function is started which controls the damper to full cooling recovery, that is the minimum outdoor position.

The economy function is stopped when the return air temperature is equal to or above the outdoor temperature. If there is no sensor, the function will not be available, and the parameter is not shown.

P No.	Parameter	Min.	Max.	Factory set. Change	Comment
P 30	Damper control, choice of function			0	0 = Economy, 1 = Comfort
P 31	Min. damper position	0 %	100 %	30 %	
P 37	Economy limit outdoor–return air	0 °C	50 °C	2 °C	Difference for activating the cooling recovery

7.3.8 Heat recovery 

TAC 2413 is able to control all types of heat recovery by using the output Y2. The control strategy is chosen using DIP switches 3 and 4.

The control signal is 0–10 V, where 0 V = 0 % recovery and 10 V =100 % recovery.

The efficiency is calculated using the temperature sensors of the outdoor, return and exhaust air according to the formula on the next page. An alarm is tripped at low efficiencies, but if there is no sensor, the function will not be available, and the parameter is not shown.

$$\eta = \frac{T(\text{return air}) - T(\text{exhaust air})}{T(\text{return air}) - T(\text{outdoor air})} \times 100 = (\%)$$

The exhaust air sensor is also used as a limitation sensor to prevent freezing of the HEX. A separate controller monitors the temperature compared to the value of P 38 and will limit the output signal to the heat exchanger if there is a risk of freezing. If there is no sensor, the function is not available, and the parameter is not shown.

If the sensor is available, but no limitation is desired, the limit is to be set to its minimum level, P 38.

There may be freezing in heat exchangers, which will have effect on the efficiency of the recovery AHU. For this reason, TAC 2413 has a built-in defrosting function which is activated by short-circuiting the exhaust air sensor with the differential pressure sensor. The signal of the HEX is controlled towards its closed position using a separate controller.

This controller strives for holding the minimum supply air temperature, while the main controller continues to control the heating valve according to the normal setpoint. This means that the defrosting status will depend on the capacity of the heating coil.

If the defrosting is not stopped within an adjustable time, which is factory set to 10 minutes (0=no stopping of TF), TF is stopped in order to quicken the process. When the pressure sensor is released, the defrosting continues for another three minutes before being stopped. An alarm is tripped if the defrosting has not stopped within the “Maximum allowed defrosting time, which factory set to 30 minutes. Please refer to the section on alarms.

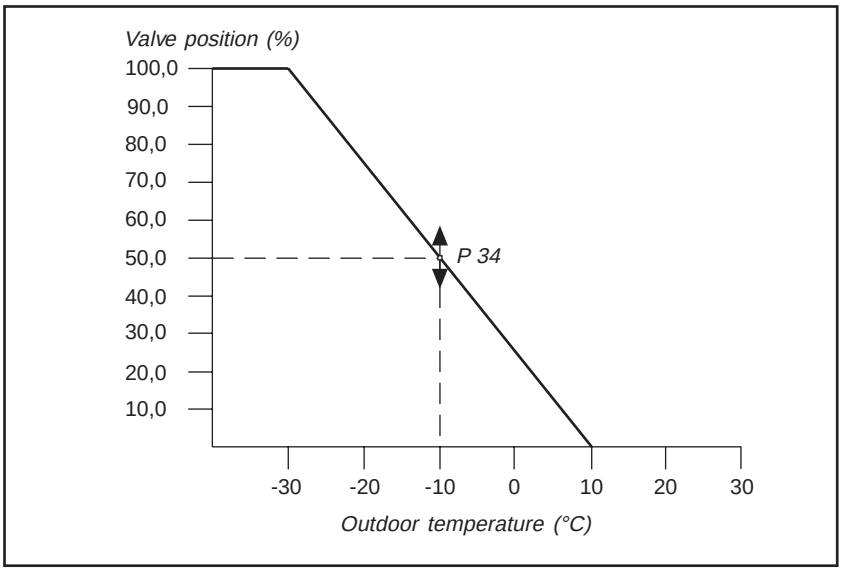
P No.	Parameter	Min.	Max.	Factory set. Change	Comment
P 05	Return air temperature				Measured value
P 07	HEX efficiency (%)				Measured value
P 08	Exhaust air temperature				Measured value
P 10	Heating setpoint	0 °C	50 °C	20 °C	
P 18	Output signal to HEX (%)				
P 38	Setpoint at min. temp., HEX	–20 °C	10 °C	–3 °C	
P 39	P band, defrosting controller for HEX	1 °C	200 °C	50 °C	
P 40	I time, defrosting cont., HEX	1 min	60 min	8 min	
P 41	Time to TF stop, rapid defrosting	0 min	30 min	10 min	0=supply fan is not stopped
P 42	Max. allowed defrosting time	0 min	60 min	30 min	(will trip an A alarm if it is exceeded)
P 58	P band, supply air controller during HEX control	1 °C	100 °C	25 °C	
P 59	I time, supply air controller during HEX control	1 min	20 min	4 min	

7.3.9 Heating coil

When the heating demand cannot be met, in spite of the heat recovery AHU controller being set to maximum recovery, the control sequence will include the heating coil. The control signal of the heating valve is 2–10 V, but by using DIP switch 7, 0–10 V can be chosen, where 2 (0) V = 0 % is equal to a closed valve and 10 V = 100 % is equal to an open valve.

The output is controlled either by the supply air controller, a minimum limitation controller or a holding controller.

During the start-up sequence of the AHU, the heating valve opens according to the outdoor curve, see the figure below. During the transition from 1/2 to 1/1 speed, the P band of the supply controller is cut in half.



The minimum limitation controller makes sure that the return water temperature is kept above the set minimum temperature. However, this particular temperature may never be set lower than 1 °C above the frost protection temperature.

During the heating sequence, the heating coil is controlled in sequence with the HEX/mixed air damper. When the heating coil is in danger of freezing, the frost protection guard in the return duct will force the valve actuator to open. If there is still a risk of freezing, the AHU is stopped and an alarm is tripped. When the AHU is stopped, the frost protection sensor maintains the return water temperature at a constant level (holding).

The holding controller keeps the return water temperature at an adjustable value when the AHU has stopped, regardless of the reason for the stop. When the supply air fan is started, the supply air controller takes over.

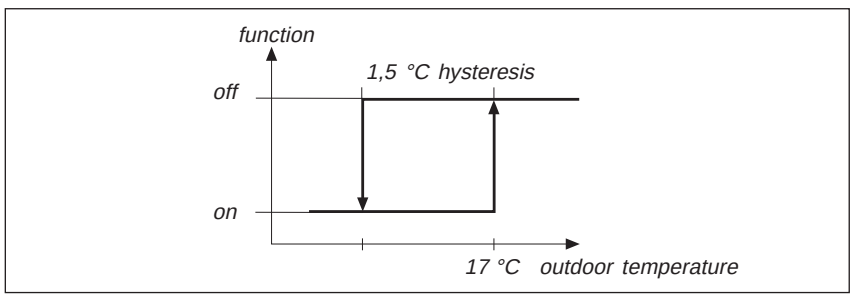
P No.	Parameter	Min.	Max.	Factory set. Change	Comment
P 06	Return temp., heating coil				Measured value
P 19	Output signal, heating valve				
P 26	Min. supply air temp. setpoint, heating control	0 °C	50 °C	14 °C	
P 28	Max. supply air temp. SP	0 °C	50 °C	35 °C	
P 29	Frost protection setpoint	4 °C	50 °C	8 °C	
P 34	Heating valve opening at start, –10 °C	0 %	100 %	50%	
P 60	P band supply air controller during heating control	1 °C	100 °C	25 °C	(0,5x at 1/1 speed)
P 61	I time supply air controller during heating control	1 min	20 min	4 min	
P 62	Return limitation controller setpoint for heating coil	0 °C	50 °C	12 °C	
P 63	P band of the return limitation controller	1 °C	100 °C	25 °C	
P 64	I time of the return limitation controller	1 min	20 min	4 min	
P 65	Holding controller setpoint for heating coil	0 °C	50 °C	25 °C	
P 66	P band, holding controller	1 °C	400 °C	200 °C	
P 67	I time, holding controller	1 min	20 min	4 min	

Pump control, P_V

When the outdoor temperature is below the “Outdoor temperature limit” (factory set to 17 °C), the circulation pump of the heating coil runs continuously. The pump is stopped with a five minute delay when the temperature is above the “Outdoor temperature limit” and the summer period applies. If the pump control is on at the same time as the pump indication is off, the pump alarm is tripped.

Restarting the pump

There is a fixed hysteresis of 1,5°C which acts to prevent unnecessary starting and stopping of the pump during stops when the outdoor temperature is close to its limit, see the figure below.



The circulation pump is restarted when the temperature is 1,5 °C below the “Outdoor temperature limit”, which is equal to the hysteresis.

Pump exercise

The pump is exercised once a day at 12:00 noon–12:01 in order to prevent seizures during the summer months, for example.

P No.	Parameter	Min.	Max.	Factory set.	Change	Comment
P 35	Outdoor temp limit for pump stop, heating coil	0 °C	50 °C	17 °C		

7.3.10 Electric heating

Electric heating is chosen by using DIP switch 5. The control signal to the battery is 2–10 V, but by using DIP switch 7, 0–10 V can be chosen, where 0 (2) V = 0 % (electric heating) och 10 V = 100 % (electric heating).

When electric heating has been chosen, the frost protection function, its alarm and return limitation are all disabled. The pump alarm is replaced with an overheating guard. The control signal controls an external step controller or a thyristor device. During heating control, the battery is controlled in sequence with the HEX/mixed air damper. When the control signal to the HEX is 100 %, input K4 for the control circuit closes first; then, the control signal is allowed to control the battery.

When the AHU stops, K4 is released immediately and the control signal is set to 0 %. The fans will run for re-blowing during an adjustable time, which is factory set to three minutes. If there is a fan alarm or overheating, the same process applies.

P No.	Parameter	Min.	Max.	Factory set.	Change	Comment
P 36	Re-blowing time during electric heating	0 min	9 min	3 min		

7.3.11 Cooling coil

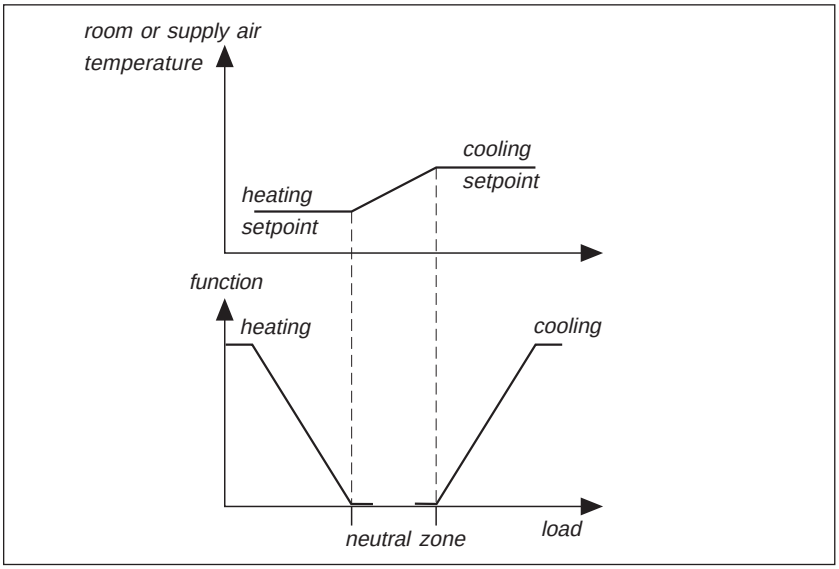
The control signal of the cooling valve is 2–10 V, but by using DIP switch 7, 0–10 V can be chosen instead. 2(0)V=0 % is equal to a closed valve and 10V=100% is equal to an open valve.

The cooling coil will be engaged only when the temperature has increased so much that it has reached the cooling setpoint. TAC 2413 then switches from controlling by the heating setpoint to controlling by the cooling setpoint automatically. These conditions apply:

- The cooling valve starts controlling only when the supply air or room temperature reaches the “Cooling setpoint”
- The HEX and heating valve are closed
- The current date is within the “Summer period” (cooling control).

The controller will return to heating control only when the supply air or room temperature has dropped to the “Heating setpoint”. The control principle for both heating and cooling is to provide the highest possible comfort using the least possible energy by using advanced technology.

Since there is a neutral zone between the heating and cooling setpoints, the heating/cooling will apply only when there is a real need for control, and the risk of overlapping is eliminated as well. The neutral zone is the difference between the cooling and heating setpoints, and it cannot be less than 0,5 °C, even if the cooling setpoint (P 11) is set below the heating setpoint (P 10).



If the temperature lies within the neutral zone, neither the heating nor the cooling coil is active, see the figure above.

Pump control, P_K

The circulation pump of the cooling coil runs continuously when cooling control applies. Otherwise, it is off, but it is exercised once a day at 12:00 noon–12:01.

P No.	Parameter	Min.	Max.	Factory set.	Change	Comment
P 10	Heating setpoint	0 °C	50 °C	20 °C		
P 11	Cooling setpoint	0 °C	50 °C	22 °C		
P 27	Min. supply air setpoint, cooling control	0 °C	50 °C	12 °C		
P 47	Start month of summer period	1	12	5		
P 48	Start month of winter period	1	13	10		
P 68	P band, supply air controller during cooling control	1 °C	100 °C	25 °C		
P 69	I time, supply air controller during cooling control	1 min	20 min	4 min		

7.3.12 Cooling coil, DX cooling, D_x

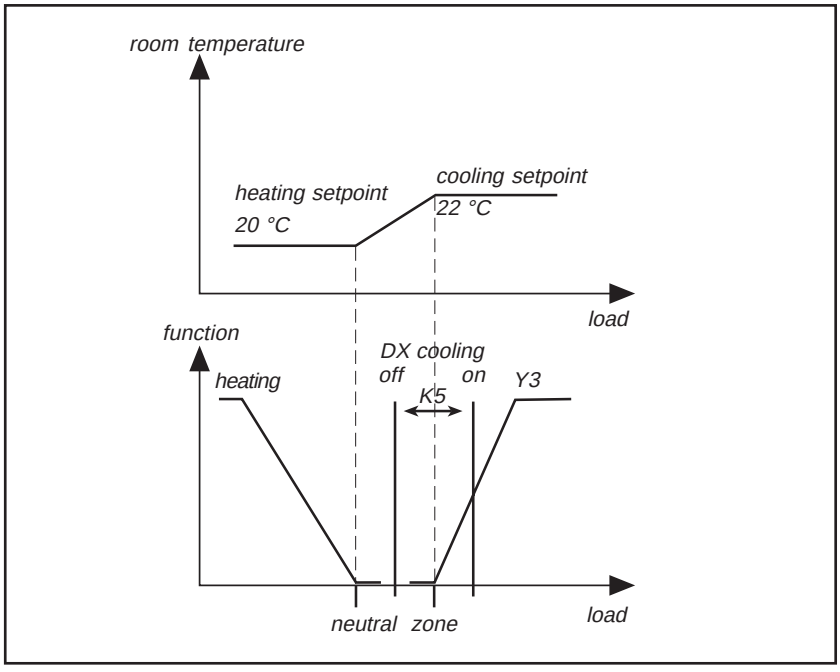
DX cooling may be chosen by using DIP switch 6, and the choice is only valid if room control applies. One step is controlled using K5, and if there are several steps, they are controlled via Y3. The control signal is 2–10 V and by using DIP switch 7, 0–10 V can be chosen. When the control signal is 2(0) V, it equals 0 % (no control signal); when it is 10 V, it equals 100 % (full control signal).

DX cooling starts only when the following conditions apply:

- the room temperature has increased to the “Cooling setpoint”
- the HEX and heating valve are both closed
- the current date is within the “Summer period” (cooling control).

The heating control takes effect only when the room temperature has decreased to the “Heating setpoint”.

During cooling control, the DX cooling is controlled directly from the room sensor. The control is done using only the P function. The proportional band is set to the difference between the heating and cooling setpoints automatically. The control is done above the cooling setpoint, see the figure below.



Example: If the cooling setpoint is 22 °C, and the heating setpoint is 20 °C, then the P band is 2.

The result is that if the room temperature is 22 °C, the output signal will be 0 %, and if it is 24 °C, the output signal will be 100 %. The digital output K5 uses “on/off” control with ±1 °C around the cooling setopint; this means that if the temperature is 23 °C, output K5 is set, and it is reset at 21 °C.

The negative hysteresis may not be greater than the difference between the heating and cooling setpoints, however. In this way, one DX step may be controlled via K5, or several DX steps may be controlled by using a 2–10 V signal with a voltage relay such as RY.

The supply air sensor has no controlling function apart from disabling the DX cooling, if the supply air temperature drops below the set minimum temperature.

If the supply air temperature becomes too low, the control signal of the controller is stopped for five minutes; then, it is decreased. After a decrease of 20 %, the DX step K5 is disabled, and the control signal continues to decrease. When the supply air temperature is 1 °C above the set minimum temperature, the control cycle is allowed to start again.

P No.	Parameter	Min.	Max.	Factory set.	Change	Comment
P 10	Heating setpoint	0 °C	50 °C	20 °C		
P 11	Cooling setpoint	0 °C	50 °C	22 °C		

7.3.13 Cooling recovery

TAC 2413 is able to make use of possible cooling content in the return air in order to decrease the energy consumption during cooling.

When the return air temperature during cooling is lower than the outdoor temperature, and the difference exceeds the “economy limit”, an economy function is started, which has the effect that the recovery HEX is running in maximum cooling recovery mode. Alternately, the damper assumes its minimum outdoor air positions, and the cooling continues.

The cooling recovery ends when the outdoor temperature is less than the return air temperature. If any sensor is not installed, the function will not be available, and the parameter will not appear.

P No.	Parameter	Min.	Max.	Factory set.	Change	Comment
P 05	Return air temperature					Measured value
P 37	Economy limit outdoor–return air	0 °C	50 °C	2 °C		Difference for activating the cooling recovery

7.4 Clock

The controller contains a calendar clock which switches to and from summer time automatically, as well as compensating for leap years.

The clock must be set manually after a power failure which lasts for longer than 48 hours.

P No.	Parameter	Min.	Max.	Factory set. Change	Comment
P 96	Clock			00:00	
P 97	Date			01.01	
P 99	Year			1998	

7.4.1 Summer time

The automatic switch to/from summer time may be omitted by setting parameter P 46, “Choice of summer time”.

P No.	Parameter	Min.	Max.	Factory set. Change	Comment
P 46	Choice of summer time			1	0=ej aktiv, 1=mars till okt

7.4.2 Summer period

Some functions depend on whether TAC 2413 is set for the summer period or winter period. The cooling control is only allowed to apply, and the pump for the heating coil is only allowed to stop, during the summer period.

The parameter list contains adjustable “start months” for the summer and winter periods, respectively. The period is started on the first day of the set “start month”.

If the cooling demand applies all year round, set the parameters as follows: P 47=1 and P 48=13.

P No.	Parameter	Min.	Max.	Factory set. Change	Comment
P 47	Start month of summer period	1	12	5	
P 48	Start month of winter period	1	13	10	

7.5 Timer programs ½ 1/1

TAC 2413 contains two weekly programs (1/1 and 1/2 speed) which control how the AHU starts and stops. Apart from the weekly programs, there is a yearly program containing six holiday periods. 1/1 speed is disabled if the outdoor temperature is less than the limit set in P90.

The times of 1/2 speed apply to one speed operation as well.

The weekly program for 1/2 speed operation (one speed operation) starts and stops the AHU. During two speed operation, the fans will always start at half speed. In order to acquire 1/1 speed operation, the weekly programs for both 1/2 speed and 1/1 speed have to be active.

The yearly program may be used to stop the AHU during longer periods, such as during holidays and school breaks. There are six holiday periods that may be programmed up to a year in advance. Each holiday period is limited by a start and end date. The holiday period will run until the set end date is over.

A holiday period is removed by setting the day of the start or end date to zero, such as the start or end date = 01.00.

P No.	Parameter	Min.	Max.	Factory set. Change	Comment
P 12	Weekly program 1/2 speed			07–17	Mon-Fri, one speed op.
P 13	Weekly program 1/1 speed			–	
P 15	Yearly program	1	6		Choice of holiday period 1–6
P 16	Start holiday	01 00	12 31		Start date of holiday period chosen above
P17	End holiday	01 00	12 31		End date of holiday period chosen above

7.6 Alarms ⚠

The controller has a built-in alarm function.

When an alarm is tripped, the ⚠ will flash in the display window together with the symbol which the alarm is referring to. There are two different types of alarms, A alarms or B alarms. On some alarms, there is a choice of acquiring an A or B alarm when the alarm in question is tripped.

A alarms have to be reset manually, and they will always acivate the sum alarm. B alarms are reset automatically, and there is a choice of activating the sum alarm or not. When the reason for the alarm is gone, the reset is done by pressing the enter button, är borta sker återställning genom att trycka på Enter-knappen, upon which the AHU is restarted.

During manual control of the AHU, the sum alarm can be set by using P 88.

7.6.1 Fan alarms

Fan alarm during waterborne heating

When there is a fan alarm, the ⚠ symbol flashes, and “TF” and “FF” are shown in the display window.

The alarm is disabled during 60 seconds when TF is started. If it is tripped, that will happen with a 60 second delay after the fan guard *closes* the contact on input U4.

This alarm may be tripped as an A alarm or B alarm. The A alarm will stop the AHU, trip the sum alarm and must be reset manually. The B alarm will not stop the AHU, it will be reset automatically and it will trip the sum alarm by option.

Fan alarm during electric heating

When electric heating is chosen, the fan alarm works in a different fashion; it is tripped when the fan guard *opens* the contact on input U4. The alarm is an A alarm which stops the AHU. This means that the sum alarm is activated and that the alarm must be reset manually.

P No.	Parameter	Min.	Max.	Factory set. Change	Comment
P 72	Fan alarm tripped				A alarm or B alarm
P 81	Fan alarm, choice of type			0	0=B, 1=B+sum, 2=A

7.6.2 Fire alarm

When the fire alarm is tripped, the symbols ⚠ and “°C” will flash in the display window. The alarm is disabled for 60 seconds after the start of TF. If the supply air temperature is above 70 °C, the fire alarm for the supply air duct is tripped after a 60 second delay. If the return air temperature is above 50 °C, the fire alarm for the return air duct is tripped after a 60 second delay. This means that short-circuiting the sensor connection or a connection in parallel via a fire thermostat will trip the alarm.

This alarm may be tripped as an A alarm or B alarm. The A alarm will stop the AHU, trip the sum alarm and must be reset manually. The B alarm will not stop the AHU, it will be reset automatically and it will trip the sum alarm by option. *N.B.! If electric heating has been chosen, no re-blowing is done when the alarm is tripped. This must be considered during testing.*

P No.	Parameter	Min.	Max.	Factory set. Change	Comment
P 78	Fire alarm tripped				A alarm or B alarm
P 82	Fire alarm, choice of type			2	0=B, 1=B+sum, 2=A

7.6.3 Frost protection alarm

When the frost protection alarm is tripped, the symbols ⚠ and ⊕ will flash in the display window. When there is a risk of the heating coil freezing, the frost protection sensor in the return pipe will control the valve actuator so that it opens.

If the temperature goes below the set freezing limit, the "frost protection guard" is released, the AHU is stopped after a five second delay, and an A alarm is tripped.

If the "frost protection guard" is short-circuited, a special alarm, "Faulty sensor" is tripped. The AHU is stopped, and an A alarm is tripped.

A alarms will always trip the sum alarm and must be reset manually.

P No.	Parameter	Min.	Max.	Factory set.	Change	Comment
P 73	Frost protection alarm tripped					A alarm
P 74	Faulty frost sensor alarm tripped					A alarm
P 29	Frost protection setpoint	4 °C	50 °C	8 °C		

7.6.4 Pump/Overheating alarm

When the pump alarm is tripped, the symbols ⚠ and "P_V" will flash in the display window. When the overheating alarm is tripped, the symbols ⚠ and ϟ apply. The same input is used fot the heating coil pump alarm as for the overheating protection of the electric battery. Both will trip an A alarm which will stop the AHU and activate the sum alarm. The alarm must be reset manually.

The alarm is tripped after a five second delay when the contact is open if the control (K4) is on.

P No.	Parameter	Min.	Max.	Factory set.	Change	Comment
P 75	Pump alarm for the heating coil tripped					A alarm
P 76	Overheating alarm for the electric battery tripped					A alarm

7.6.5 Freezing alarm

The symbols ⚠ and ± will flash when the freezing alarm is tripped. It is tripped if the defrosting has been activated by way of a closing contact from the pressure sensor and not been stopped within the “Max. allowed defrosting time”. The AHU is stopped and an A alarm is tripped. The alarm activates the sum alarm and must be reset manually.

P No.	Parameter	Min.	Max.	Factory set. Change	Comment
P 42	Max.allowed defrosting time	0 min	60 min	30 min	(will trip an A alarm if it is exceeded)
P 77	Freezing alarm tripped				A alarm

7.6.6 Efficiency alarm

When the efficiency alarm is tripped, the symbols ⚠ and ± will flash in the display window. The efficiency alarm is tripped when the following things happen:

- The HEX signal is 100 % and the limitation is not active.
- The efficiency is below the set alarm limit for 60 minutes.

It is possible to choose between an A or B alarm. The A alarm will stop the AHU, activates the sum alarm and must be reset manually. The B alarm may activate the sum alarm as an option and is reset
automatically.

P No.	Parameter	Min.	Max.	Factory set. Change	Comment
P 79	Efficiency alarm tripped				A alarm or B alarm
P 83	Efficiency alarm, choice of alarm type			0	0=B, 1=B+Sum, 2=A
P 84	Efficiency alarm, alarm limit	0 %	100 %	50 %	

7.6.7 Deviation alarm

The symbols ⚠ and "°C" will flash in the display window when the deviation alarm is tripped. If the supply air temperature deviates from the setpoint by more than an adjustable limit, which is factory set to ±3 °C, for 60 minutes, the alarm is tripped. An A or B alarm may be chosen. A alarms will always trip the sum alarm, stop the AHU and be reset manually. B alarms may trip the sum alarm as an option and are reset automatically.

P No.	Parameter	Min.	Max.	Factory set.	Change	Comment
P 80	Deviation alarm tripped					A alarm or B alarm
P 85	Deviation alarm, summer period			0		(0=disabled, 1=active)
P 86	Deviation alarm, choice of alarm type			0		0=B, 1=B+Sum, 2=A
P 87	Deviation alarm limit	0 °C	20 °C	±3 °C		

7.7 Memory backup

All the set parameters, such as setpoints, weekly programs etc, are stored permanently in the controller. They will remain in the memory of the controller even after a long power failure.

However, after a power failure which has lasted for longer than 48 hours, the clock must be set.

7.8 Cold start

If there is a need for restoring the factory settings of the controller, this is done by going to parameter P--. The reset is done by pressing the plus button and then the enter button.

This procedure is recommended if any DIP switch has been altered since the controller was commissioned.

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8 Technical data

Thermistor inputs

Thermistor type ..... 1800 Ω/25 °C

Measurement range:

Supply air temperature, B1 ..... 0 °C – +45 °C
Outdoor temperature, B2 ..... -30 °C – +45 °C
Room temperature, B3 ..... 0 °C – +45 °C
Return sensor, B4 ..... 0 °C – +120 °C

Maximum deviation[1]:

–30 °C – ±0 °C ..... ±1 °C
±0 °C – +30 °C ..... ±0,5 °C
+30 °C – +120 °C ..... ±1 °C

Relay outputs

Maximum voltage *(N.B.! does not apply to K6)* ..... 250 V AC
Maximum current (cos ϕ>0,5) ..... 2 A

Inputs

Sensory inputs, B1-B4, U1, U2 ... thermistor inputs, see above
Remote setpoint control (SPC/CO_2), U3 ..... 2–10 V DC
Pump alarm, X3 ..... closing contact on M
Half speed operation (1/2), X1 ..... closing contact on M
Full speed operation (1/1), X2 ..... closing contact on M
Fan alarm, U4 ..... closing contact on M

Outputs

Supply air fan (TF), K1 ..... relay output, see above
Return air fan (FF), K2 ..... relay output, see above
Full speed (1/1), K3 ..... relay output, see above
Pump, heating coil, K4 ..... relay output, see above
Pump, cooling coil, K5 ..... relay output, see above
Sum alarm, K6 ..... relay output, 24 V
Heating coil, Y1 (2 mA) ..... 0–10 V DC or 2–10 V DC
Heat recovery, Y2 (2 mA) ..... 0–10 V DC
Cooling coil, Y3 (2 mA) ..... 0–10 V DC or 2–10 V DC

[1] The accuracy of the sensor is not included.

Clock

Accuracy ..... ±16 minutes/year at +25 °C
Memory backup .....48 hours; no battery is required

Power supply

Operating voltage .....24 V AC ±20%, 50–60 Hz (variations included)
Power consumptoin .....3 W

Electromagnetic compatibility

Emission ..... EN 50081-1
Immunity ..... EN 50082-1

Ambient conditions

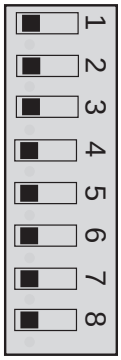
Temperature, operation ..... 0 °C – +50 °C
Temperature, storage .....–20 °C – +50 °C
Humidity ..... maximum 90% R.H., non-condensing

Enclosure

Material, lid ..... PC
Material, other plastic details..... ABS/PC
Material, packing, cable entries ..... TPE
Flammability, plastic materials .....UL 94-V0
Enclosure rating..... IP 40, enl IEC 529
Colour ..... grey/red/transparent
Weight ..... 0,7 kg
Dimensions B×H×D ..... 144×96×96 mm
Recycling ..... all enclosure parts may be recycled

Appendix A: Commissioning protocol/ List of parameters

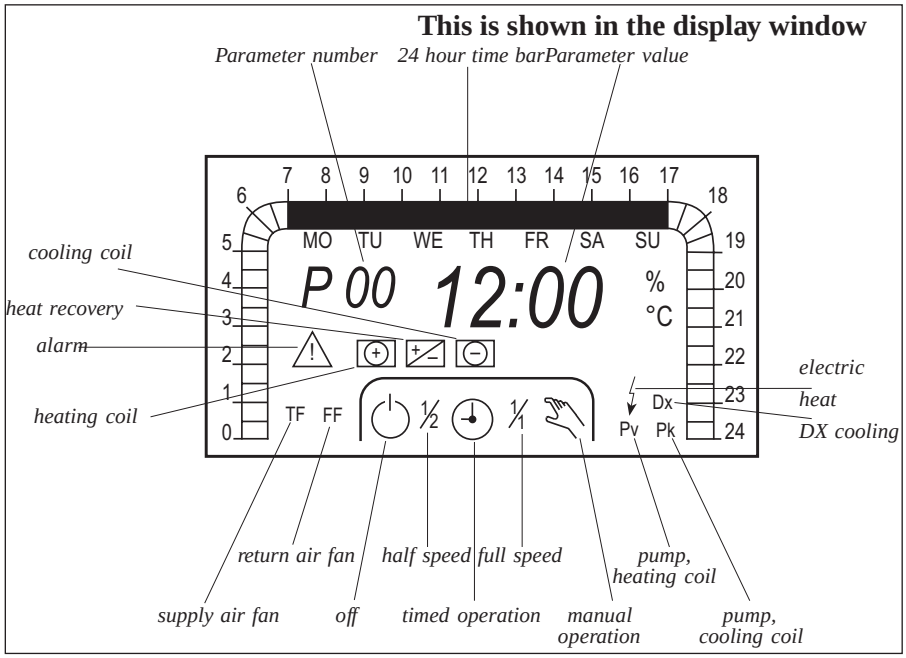
This protocol is used during commissioning of the TAC 2413 controller. Note the changed settings in the column labeled “Change”.

DIP switch				
off **on**	**off**	**on**	**Default**	**Change**
	Supply air control	Room/Return air control	off	
	Room control (if 1=on)	Return air control (if 1=on)	off	
	HEX	Mixed air damper	off	
	HEX at stop = 0% (if 3=off)	HEX at stop = 100% (if 3=off)	off	
	Waterborne heating	Electric heating	off	
	Waterborne cooling	DX cooling (only if 1=on)	off	
	2—10 V output for heat. and cool.	0—10 V output for heat. and cool.	off	
	Warm start. Resets the hardware, and all the settings except for the date and time are retained. If all settings are to be reset (cold start), see p.13 P--.		off	Switch on and off again.

N.B.! If any of the DIP switches is changed when the controller has been put into operation, a cold start should be performed. Please refer to parameter number P--.

Setting a parameter value

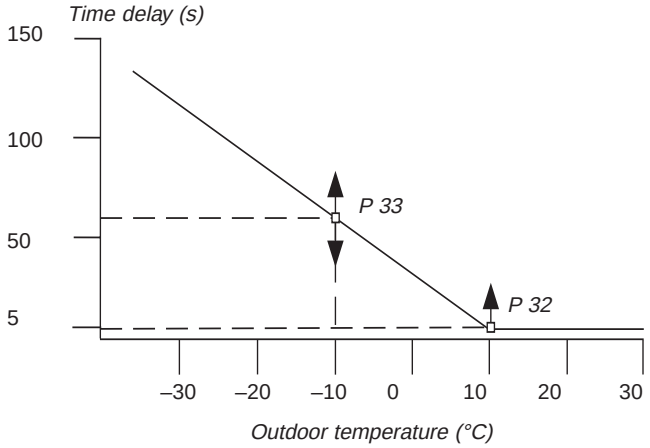
1. Select the parameter number (P No.) by pressing or .
2. Press and at the same time to get to P 18–P 99.
3. Change the value using or .
4. Hold the button down for fast increase/decrease.
5. Confirm by using the enter button .



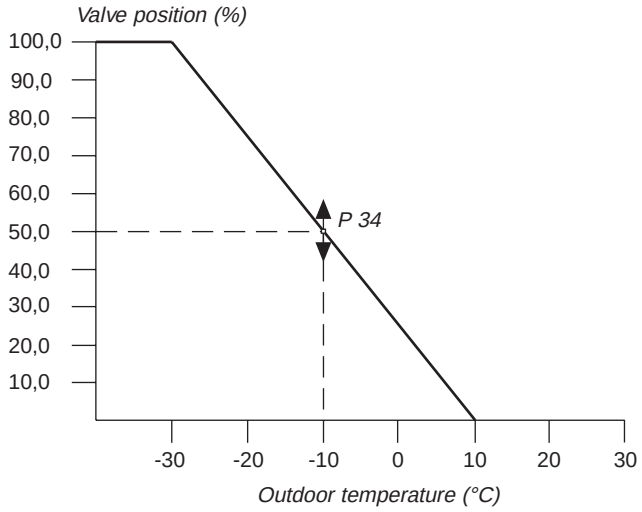
Date	Commissioned by	Aggregate designation
Type of controller	Version of controller	Order number
Name of the installation		Drawing number

P No.	Parameter	Min.	Max.	Step	Default	Change	Comment
P 00	Time. Indication and choice of operating mode						Off, Manual, Timed operation 1/2 and 1/1 speed
P 01	Supply air temperature			0,1 °C			Measured value
P 02	Supply air temperature setpt			0,1 °C			Calculated value
P 03	Room temperature			0,1 °C			Measured value
P 04	Room temperature setpoint			0,1 °C			Calculated value
P 05	Return air temperature			0,1 °C			Measured value
P 06	Return temp. heating coil			0,1 °C			Measured value
P 07	HEX efficiency (%)			1 %			Measured value
P 08	Exhaust air temperature			0,1 °C			Measured value
P 09	Outdoor temperature			0,1 °C			Measured value
P 10	Heating setpoint	0 °C	50 °C	0,1 °C	20 °C		
P 11	Cooling setpoing	0 °C	50 °C	0,1 °C	22 °C		
P 12	Weekly program 1/2 speed			1/2 hr	07–17		Monday to Friday (single speed op.)
P 13	Weekly program 1/1 speed			1/2 hr	–		
P 14	Timer, extended operation	0 min	300 min	1 min	120 min		
P 15	Yearly program	1	6	1	1		Choice of holiday period 1–6 (below)
		1	2	3	4	5	6
	Start (P 16):						
	Stop (P 17):						
P 16	Holiday start date	01 00	12 31		0100		Start date for holiday period in P 15
P 17	Holiday end date	01 00	12 31		0100		End date for holiday period in P 15
P 18	Output signal to HEX (%)	0	100	1 %			N.B.! Check the actuator's direction
P 19	Outp. signal, heat. valve (%)	0	100	1 %			N.B.! Check the actuator's direction
P 20	Outp. signal, cool. valve (%)	0	100	1 %			N.B.! Check the actuator's direction
P 21	Winter/Summer period (stat.)						0=Winter, 1=Summer
P 22	Night cooling (status)						(0/1)
P 23	Defrosting (status)						(0/1)
P 24	Night cooling setpoint	0 °C	50 °C	0,1 °C	19 °C		
P 25	Night heating setpoint	0 °C	50 °C	0,1 °C	16 °C		
P 26	Supply air heat., min. setpt.	0 °C	50 °C	0,1 °C	14 °C		
P 27	Supply air cool., min. setpt.	0 °C	50 °C	0,1 °C	12 °C		
P 28	Supply air, max. setpoint	0 °C	50 °C	0,1 °C	35 °C		
P 29	Frost protection setpoint	4 °C	50 °C	0,1 °C	8 °C		
P 30	Damper control, mode choice				0		0 = Economy, 1 = Comfort

P No.	Parameter	Min.	Max.	Step	Default	Change	Comment
P 31	Min. damper position	0 %	100 %	1 %	30 %		
P 32	Delay—start TF at +10 °C	5 sec	300 sec	1 sec	5 sec		
P 33	Delay—start TF at –10 °C	5 sec	300 sec	1 sec	60 sec		

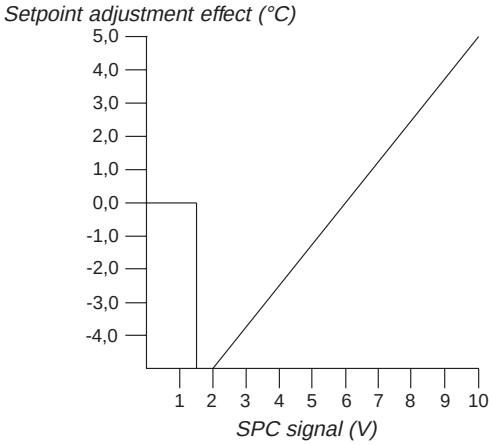


P 34	Heating valve starting pos'n at –10 °C	0 %	100 %	1 %	50%		



P 35	Outdoor temp. limit for pump stop, heating coil	0 °C	50 °C	0,1 °C	17 °C		
P 36	Re-blowing time, el. heat	0 min	9 min	1 min	3 min		
P 37	Ec. limit outdoor–return.	0 °C	50 °C	0,1 °C	2 °C		Diff. for making cool. recovery active
P 38	Setpoint at min. temperature limitation of HEX	–20 °C	10 °C	0,1 °C	–3 °C		
P 39	P band defrost. cont., HEX	1 °C	200 °C	0,1 °C	50 °C		
P 40	I time defrost. cont., HEX	1 min	60 min	1 min	8 min		
P 41	Time, TF stop rapid defrost.	0 min	30 min	1 min	10 min		0 = supply fan is not stopped
P 42	Max permitted defrost. time	0 min	60 min	1 min	30 min		(will trip an A alarm if exceeded)

P No.	Parameter	Min.	Max.	Step	Default	Change	Comment
P 43	Min outd. temp. for night cool.	0 °C	50 °C	0,1 °C	12 °C		
P 44	Max. time to next normal operation period	0 h	20 h	1 h	10 h		0 = disabled function
P 45	Disabling of Y1, Y2 after night cooling	0 min	300 min	1 min	180 min		
P 46	Choice of summer time				1		0 = not active, 1 = March to October
P 47	Start month of summer period	1	12	1	5		
P 48	Start month of winter period	1	12	1	10		
P 49	Start winter compensation	–20 °C	20 °C	0,1 °C	10 °C		
P 50	Max. winter compensation	–20 °C	20 °C	0,1 °C	0 °C		
P 51	Stop winter compensation	–30 °C	20 °C	0,1 °C	–20 °C		
P 52	Start summer compensation	0 °C	50 °C	0,1 °C	25 °C		
P 53	Max. summer compensation	–20 °C	20 °C	0,1 °C	0 °C		
P 54	Stop summer compensation	5 °C	50 °C	0,1 °C	40 °C		
P 55	SPC/CO_2, choice				0		0=no function, 1=SPC, 2=CO_2
P 56	SPC effect at 2 and 10 V (– or +)	0 °C	32 °C	0,1 °C	0 °C		
P 57	CO_2 setpoint	0 V	10 V	0,1 V	4 V		
P 58	P band supply air controller during HEX control	1 °C	100 °C	0,1 °C	25 °C		



P 59	I time supply air controller during HEX control	1 min	20 min	1 min	4 min		
P 60	P band supply air controller during heating control	1 °C	100 °C	0,1 °C	25 °C		(0,5x at 1/1 speed)
P 61	I time, supply air controller during heating control	1 min	20 min	1 min	4 min		
P 62	Return limitation controller setpoint for heating coil	0 °C	50 °C	0,1 °C	12 °C		
P 63	P band, return limitation control	1 °C	100 °C	0,1 °C	25 °C		
P 64	I time, return limitation control	1 min	20 min	1 min	4 min		
P 65	Holding controller setpoint for heating coil	0 °C	50 °C	0,1 °C	25 °C		

P No.	Parameter	Min.	Max.	Step	Default	Change	Comment
P 66	P band, holding controller	1 °C	400 °C	0,1 °C	200 °C		
P 67	I time, holding controller	1 min	20 min	1 min	4 min		
P 68	P band, supply air control during cooling control	1 °C	100 °C	0,1 °C	25 °C		
P 69	I time, supply air control during cooling control	1 min	20 min	1 min	4 min		
P 70	Gain, room controller	1	20	0,1	2		°C/°C
P 71	I time , room controller	1 min	60 min	1 min	20 min		
P 72	Fan alarm tripped						A alarm or B alarm (60 sec)
P 73	Frost protection alarm tripped						A alarm (5 sec)
P 74	Faulty sensor, frost pr. tripped						A alarm (5 sec)
P 75	Pump alarm heating c. tripped						A alarm (5 sec)
P 76	Alarm for battery overheating tripped						A alarm (5 sec)
P 77	Freezing alarm tripped						A alarm (30 min)
P 78	Fire alarm tripped						A alarm or B alarm (60 sec)
P 79	Efficiency alarm tripped						A alarm or B alarm (60 min)
P 80	Deviation alarm tripped						A alarm or B alarm (60 min)
P 81	Fan alarm, choice of type				0		0=B alarm, 1=B alarm+Sum, 2=A alarm
P 82	Fire alarm, choice of type				2		0=B alarm, 1=B alarm+Sum, 2=A alarm
P 83	Efficiency alarm, choice of alarm type				0		0=B alarm, 1=B alarm+Sum, 2=A alarm
P 84	Efficiency alarm, alarm limit	0 %	100 %	1 %	50 %		
P 85	Deviation alarm				0		(0=disabled, 1=active) summer per.
P 86	Deviation alarm, type choice				0		0=B alarm, 1=B alarm+Sum, 2=A alarm
P 87	Deviation alarm, alarm limit	0 °C	20 °C	0,1 °C	3 °C		positive or negative deviation
P 88	Manual control, alarm choice				0		0=no sum, 1=sum alarm
P 89	Room sensor adjustment	–5 °C	5 °C	0,1 °C	0 °C		
P 90	Outd. temp. block 1/1 speed	–50 °C	20 °C	0,1 °C	–50 °C		
P 91	FF stop during night heating				0		1=TF in operation only
P 92	Neutral zone, supply air cont.	5	20	1	5		x0,1 (5=0,5°C)
P 93	SPC/CO_2 input signal	0V	10V	0,1			Measured value
P 94	---						
P 95	---						
P 96	Clock				00:00		Setting
P 97	Date				01.01		Setting
P 98	Year				1998		
P 99	Version. Type of controller and program version						
P --	Cold start. First, press the plus button, then press the enter button.						Complete reset. All parameters will assume their factory set values.

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