TAC 2000

TAC 2411, TAC 2412, TAC 2413

Air handling controllers

C-31-72

1998-10-16

The TAC2000 family now includes a series of advanced system solutions for air handling. They are complete solutions for complete control, monitoring and supervision of air handling units in buildings.

The following controllers are available:

- TAC 2411, which offers a rational and efficient solution to air handling where the heating coil controls the room or supply air temperature.
- TAC2412, which has extended functionality. The room or supply air temperature is controlled in sequence using the heating coil and heat recovery.
- TAC2413, which is the most advanced controller. The room or supply air temperature is controlled in sequence using the heating coil, heat recovery and the cooling coil.

TECHNICAL DATA

Part numbers:
- TAC2411 200-3101-000
- TAC2412 200-3051-000
- TAC2413 200-3001-000

Power supply ..... 24 V AC ±20 %, 50–60 Hz (variations included)

Power consumption ..... 3 W

Ambient temperature:
- Operation ..... 0 °C – +50 °C
- Storage ..... –20 °C – +50 °C

Ambient humidity ..... max 90 % RH

Clock:
- Accuracy ..... ± 16 minutes/year at +25 °C
- Memory backup ..... 48 hours

Colour ..... grey/red/transparent

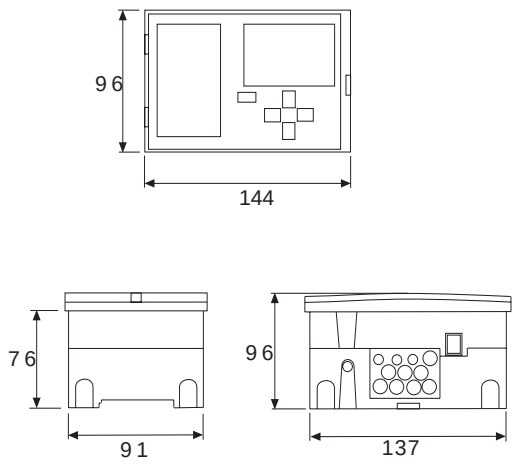
Weight ..... 0,7 kg

Dimensions B×H×D (mm) ..... 144×96×96

Material ..... ABS/PC plastic

Enclosure rating ..... IP 40

Recycling ..... all enclosure parts may be recycled



Measurements in mm.

APPLICATION EXAMPLES

This data sheet describes all functions that are part of the TAC 2000 air handling controllers. If a function is only available in one of the controllers, this is indicated in the text.

Apart from the functions already described, the TAC 2000 controllers have the following in common:

- Complete system solutions for air handling.
- Timed operation of fans.
- Built-in alarm central with A and B alarms during malfunctions.
- Pump control and exercise.
- Setpoint adjustment of the room or supply temperature from an external unit (SPC adjustment).

The controllers are easy to use for the operator. All setpoints and measured values may be read and changed by using a few buttons. Simple symbols in the display window make it easier to check on the current status of the installation.

Figures 1–3 show examples of system solutions for installations with a waterborne flat heat exchanger and waterborne heating and cooling coils.

TAC 2411, TAC 2412 and TAC 2413 may control a number of combined functions.

	Heating coil	H. recovery/Damper	Cooling coil
TAC 2411	X		
TAC 2412	X	X	
TAC 2413	X	X	X

Controller TAC 2411

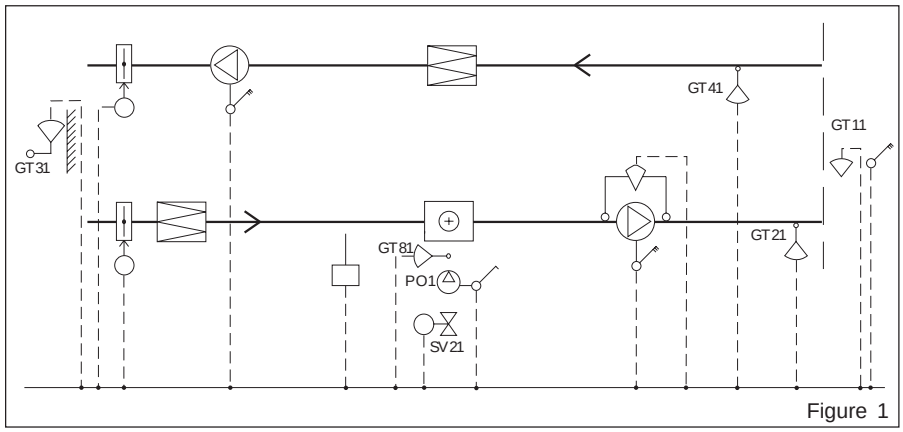


Figure 1

Controller TAC 2412

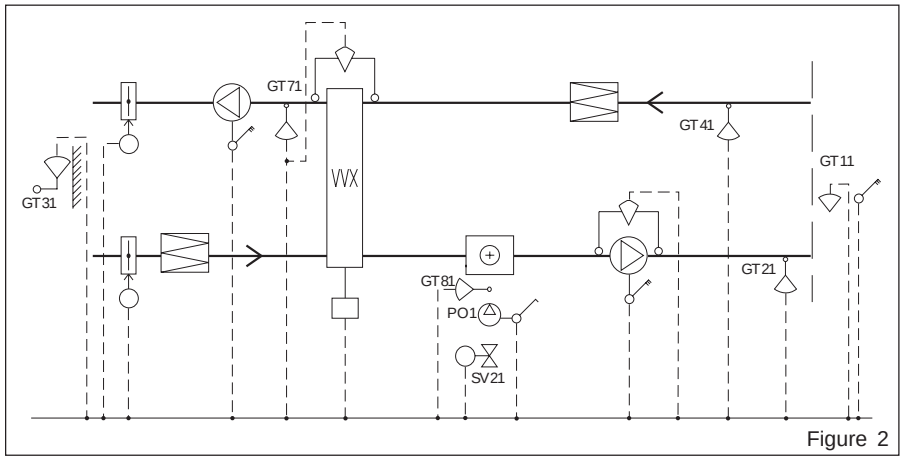


Figure 2

CONTROL

The main function of the TAC 2000 controllers is keeping the room or supply temperature constant by controlling a heating coil, heat recovery and a cooling coil in sequence.

The choice of room or supply air temperature control is made using DIP switch 1, which is factory set to control the supply air temperature.

When room control is chosen, the room controller works with the supply air controller in a cascade. The supply air temperature has maximum and minimum limits.

Separate minimum limitations apply to setpoints during heating and cooling control. When room control is chosen, it is possible to decide if the control is to be done from a room sensor or a return air sensor.

Controller TAC 2413

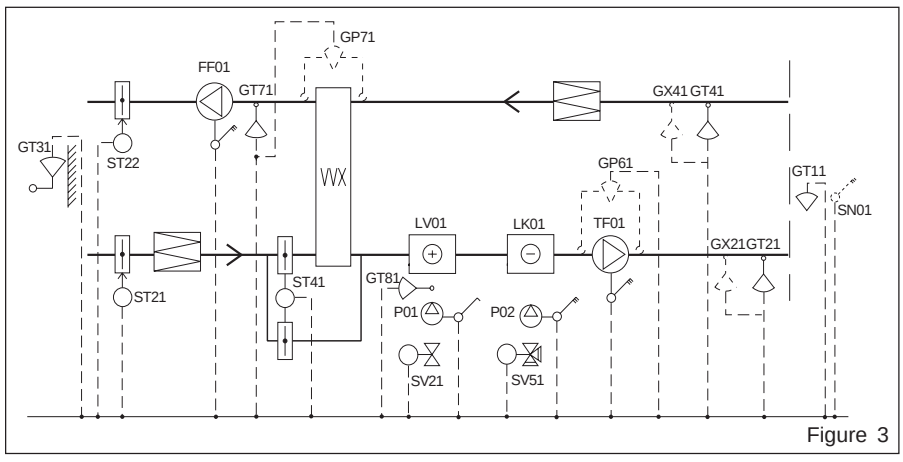


Figure 3

FAN CONTROL

The TAC 2000 controllers are able to control two speed fans. The AHU is started and stopped by pre-programmed times in weekly and yearly programs.

When the AHU is started, the fans start running after an adjustable and temperature controlled delay. The supply air fan (TF) is activated when the return air fan (FF) has been started.

Both fans start running on half speed no matter what speed has been chosen. If full speed has been chosen, it takes effect 30 seconds after TF has started.

During the transition from full speed to half speed, both fans are stopped for ten seconds. After that, FF is started first, then TF starts running.

In order to achieve full speed during timed operation, both the half and full speed programs must be active.

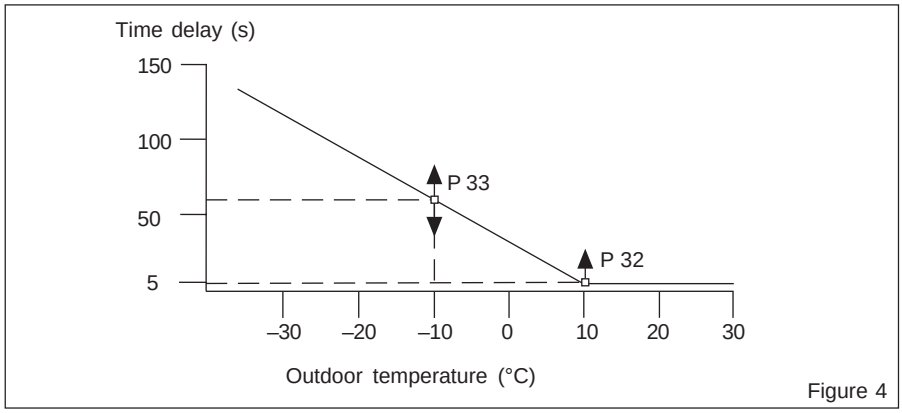


Figure 4

When FF starts running, the heat recovery is set to 100 %. The opening of the heat valve is controlled according to the outdoor temperature.

The valve opening is 0 % for outdoor temperatures equal to or greater than 10 °C and will increase in proportion to the decreasing outdoor temperature.

The slope of the line is determined by an adjustable time delay (P 33) at –10 °C, see figure 4. When electric heat is chosen, the same delay applies fo the fans, but the control signal to the electric heater is 0 % until TF starts.

The supply air temperature control sequence takes effect when TF is active.

SETPOINTS

The heating coil and heat recovery are controlled towards the ”Heating setpoint”.

TAC 2413 uses a separate setpoint for the cooling coil, “Cooling setpoint”. The setpoints may be adjusted separately, and the difference between them is at least 0,5 °C.

NIGHT HEATING

The AHU is controlled by an adjustable night setpoint at night. Normally, it is off, but it will start if the room temperature drops below the night setpoint.

When the temperature has risen to 1 °C above the night setpoint, the AHU stops. If the return air damper has been chosen in TAC 2412 and TAC 2413, it is closed during night heating.

The heat recovery is controlled normally. Normal setpionts apply in both cases. The function is activated automatically if a room sensor is installed.

NIGHT COOLING

During the summer period, there is a greater cooling demand, and in order to reduce the operating costs, TAC 2000 makes use of the comparatively cold night air to cool the building.

Provided that the outdoor and room temperature sensors have been installed, the night cooling function is activated automatically, even when supply air control has been chosen.

The night cooling will start when the room temperature is above the set starting limit and certain conditions apply.

OUTDOOR COMPENSATION

The setpoints for supply air or room temperature may be compensated directly by the outdoor temperature. There are two separate curves, one for the summer and one for the winter, see figure 5. The function is disabled if there is no outdoor temperature sensor installed.

The outdoor compensation is not active on delivery. It is activated by setting the desired compensation values for summer and winter, respectively.

The compensation may be positive or negative. The compensation rate in °C shows how much the setpoint for supply or return air temperature is to be shifted.

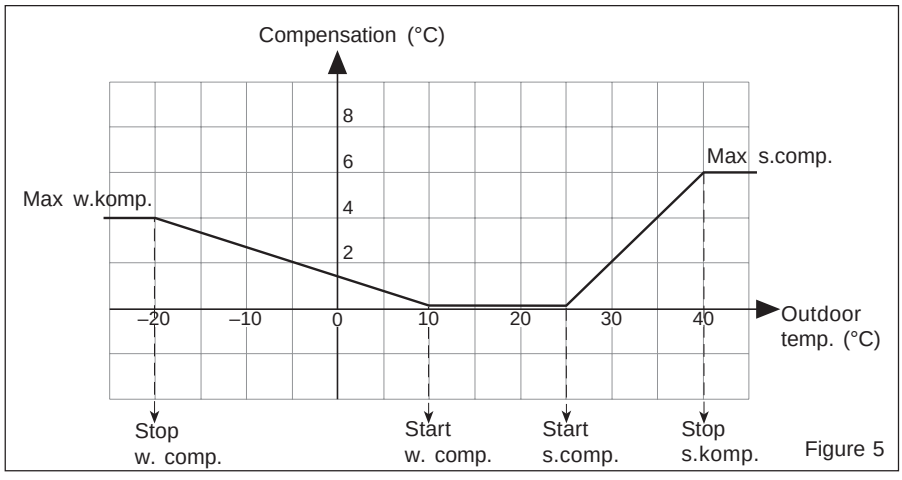


Figure 5

HEATING COIL

Heating coil (waterborne heat)
TAC 2411 offers one step control of a heating coil.

When heat recovery is not enough in TAC 2412 and TAC 2413, the control sequence shifts to the heating valve. During the start-up of the AHU, the heating valve opens according to the outdoor temperature curve.

The control signal is normally 2–10 V, but with DIP switch 7, it may be set to 0–10 V, where 0 (2) V is a closed valve (0 %) and 10 V is an open valve (100 %).

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

Pump
The circulation pump runs continuously when the outdoor temperature is less than "Outdoor temp. limit for pump stop, heating coil", which is factory set to 17 °C.

When the summer period applies, the pump is stopped with a 5 minute delay when the outdoor temperature is above the "Outdoor temp. limit for pump stop, heating coil".

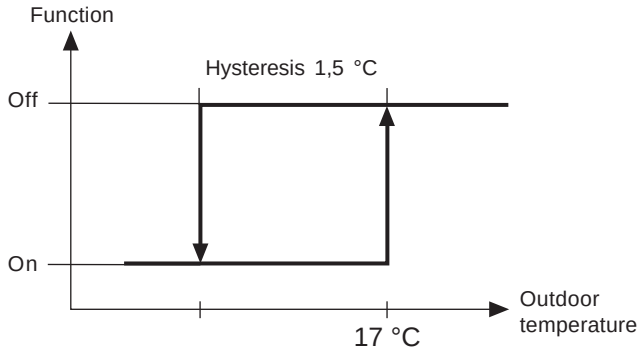


Figure 6

There is a fixed hysteresis during pump stops to prevent unnecessary starting and stopping when the outdoor temperature is close to the temperature limit, see figure 6. The pump is exercised once a day at 12.00 noon–12.01 to prevent seizures.

Electric heating
Electric heating is chosen using DIP switch 5. When it is chosen, the frost protection function is disabled and replaced with an overheating protection. The control signal controls an external step controller or a thyristor device. The battery is controlled in sequence with the heat recovery during heating.

When the heat recovery control signal is 100%, the digital output K4 first closes the control circuit. The control signal Y1 is then allowed to control the step controller.

When the AHU stops, K4 is opened immediately and the control signal is set to 0%. The fans will run after this for a certain time, factory set to 3 minutes. During fan alarm or overheating, the same procedure applies.

HEAT RECOVERY

Heat recovery
TAC 2412 and TAC 2413 are able to control all types of heat recovery or mixed air dampers by using the output Y2. The control strategy is chosen with DIP switches 3 and 4. The control signal is 0–10 V.

The efficiency is calculated by using an outdoor temperature sensor as well as return and exhaust air temperature sensors. There is an alarm which is tripped at low efficiencies, but if there is no sensor available, the function will not be avavailable.

The exhaust air temperature sensor is also used as a limitation sensor to prevent freezing of the HEX.

The heat exchanger may freeze, which will affect the efficiency of the heat recovery unit. In order to prevent this, TAC 2413 has a built-in defrosting function which is activated by short-circuiting the exhaust air sensor with the differential pressure sensor. The HEX signal is then controlled towards the closed position by using a separate controller.

If the defrosting is not finished within a time limit, which is factory set to ten minutes, the supply air fan is stopped in order to quicken the process. An alarm is tripped if the defrosting has not been completed within the maximum time limit, which is factory set to 30 minutes. Please refer to the section on alarms for details.

Mixed air damper
The control signal for the mixed air damper is 0–10 V, where 0 V is 0 % (closed outdoor damper) and 10 V is 100 % (open outdoor damper). The outdoor, return and exhaust air dampers are controlled with a set minimum outdoor air limit, which is factory set to 30 %.

There are two different settings for the control sequence, "Economy" and "Comfort".

In the "Comfort" position, the heating coil is controlled before the mixed air damper is controlled towards its minimum outdoor air position.

In the "Economy" position, the heating coil is controlled after the damper reaches its minimum outdoor position.

COOLING COIL

Cooling coil

The control principle for heating and cooling in TAC 2413 is built on an advanced technology to achieve the highest possible comfort using the least possible power.

By defining a neutral zone, see figure 7, which is between the heating and cooling setpoints, the heating or cooling sequence will be engaged only when there is a real heating or cooling demand. This means eliminating the risk of overlapping in the interval between heating and cooling.

When the temperature is within the neutral zone, neither of the coils are engaged.

It is only when the controlled room or supply air temperature has increased to the cooling setpoint that the cooling coil is engaged. TAC 2413 will then switch automatically from controlling the heating coil, using the heating setpoint, to control the cooling coil using the cooling setpoint.

The control signal of the cooling valve is 2–10 V, but it can be changed to 0–10 V using DIP switch 7.

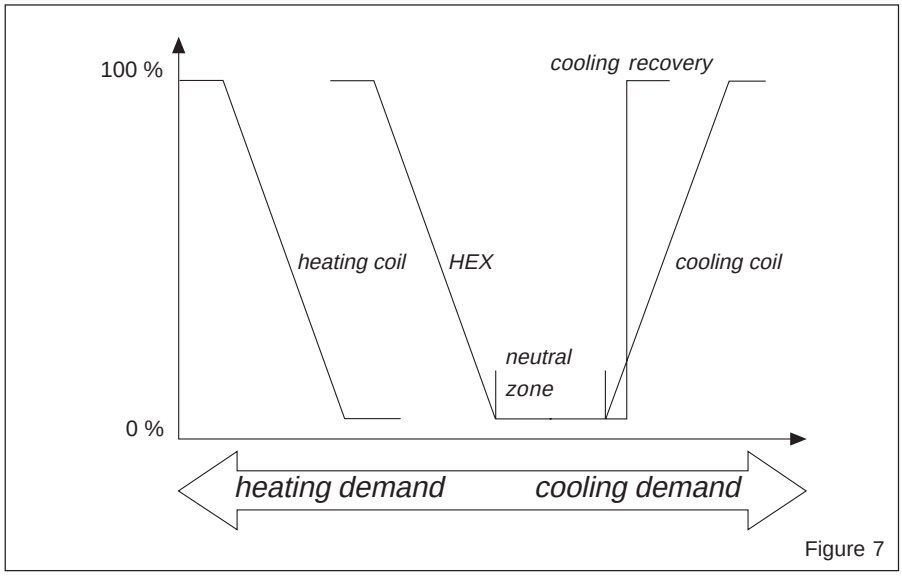


Figure 7

Pump

The pump of the cooling coil runs continously when there is a cooling demand. Otherwise, the pump is off and is exercised once a day at 12.00 noon–12.01.

DX cooling

DX cooling is chosen with DIP switch 6, and the choice is accepted only if the controller is set for room temperature control. During the cooling sequence, the DX cooling is controlled from the room sensor.

One DX step is controlled with the digital output K5; several DX steps are controlled using a 2–10 V signal over Y3 with a voltage relay such as TAC RY.

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

COOLING RECOVERY

In order to decrease the energy consumption during cooling, TAC 2413 has an economy function which uses any possible cooling content of the return air.

If the return air temperature is below the outdoor temperature (this limit may be set) the economy function is started, which means that the recovery unit runs on the maximum cooling recovery.

If the mixed air damper has been chosen, the dampers assume their minimum outdoor air positions and the cooling control continues.

The cooling recovery is stopped when the outdoor temperature is less than the return air temperature.

TIMED OPERATION

There are two weekly programs controlling how the AHU starts and stops: a full speed program (1/1) and a half speed program (1/2). Apart from the weekly programs, there is a yearly program with six holiday periods. During the start-up sequence of the AHU, the exhaust air fan (FF) is started first; then, the supply air fan is started afer a certain time delay.

Weekly program
The AHU is started and stopped according to the half speed program (1/2). The half speed program must be active if the full speed program (1/1) is to be started.

Yearly program
This program is used to shut down the AHU during holidays and longer time periods, such as long weekends. There are six holiday periods which may be programmed up to a year in advance. Each holiday period is limited by a start and stop date.

Summer time
The transition to/from summer time is done automatically.

Summer period
Some functions will depend on if the current date is within the summer or winter period.

The following conditions apply:

- The cooling control is only allowed during the summer period.
- The pump for the heating coil is only allowed to stop during the summer period.

ALARMS

TAC 2413 has a built-in alarm function which will provide information on the alarm states. When there is an alarm, the symbol ⚠ flashes together with the symbol which the alarm is referring to.

There are two types of alarms, A alarms and B alarms. Some alarms may be programmed so that they are tripped as A alarms or B alarms. Please refer to the parameter list if you wish to find out which possibilities there are for the different alarms.

A alarms must be reset manually and always activate the sum alarm.
B alarms are reset automatically and will only activate the sum alarm if you choose to have it activated.

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

During electric heating, the fan alarm works in a different fashion: it is tripped when the fan guard opens the contact on U4.

Fire alarm
The alarm is disabled during 60 seconds when TF has been started. If the supply air temperature is greater than 70 °C, the fire alarm for the supply air duct is tripped with a 60 second delay.

The fire alarm for the return air duct is tripped in the same manner if the return air temperature is greater than 50 °C.

This means that the alarm will be tripped if the sensor wire is short-circuited or a parallel closure is done by way of a fire thermostat.

Frost protection alarm
The frost protection is activated if the temperature is less than the set freezing limit. The AHU is stopped with a five second delay before an A alarm is tripped. If the frost protection guard is short-circuited, a special alarm, “Faulty sensor”, is tripped.

Pump/Overheating alarm
The pump of the heating coil and the overheating protection has the same alarm input. An alarm is tripped with a five second delay when the contact is open.

Freezing alarm
An alarm is tripped if the defrosting has not been completed within the “Maximum permitted defrosting time”.

Efficiency alarm
This alarm applies to the TAC 2412 and TAC 2413 controllers only. It is tripped if the following happens:

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

Deviation alarm
If the supply air temperature deviates by more than an adjustable limit from the setpoint for 60 minutes, the alarm is tripped. The factory setting is 3 °C.

INSTALLATION

N.B.! The wiring diagram below only shows the units that may be connected to TAC 2413 using a plate heat exchanger as well as waterborne heating and cooling. TAC 2413 may use other combined functions.

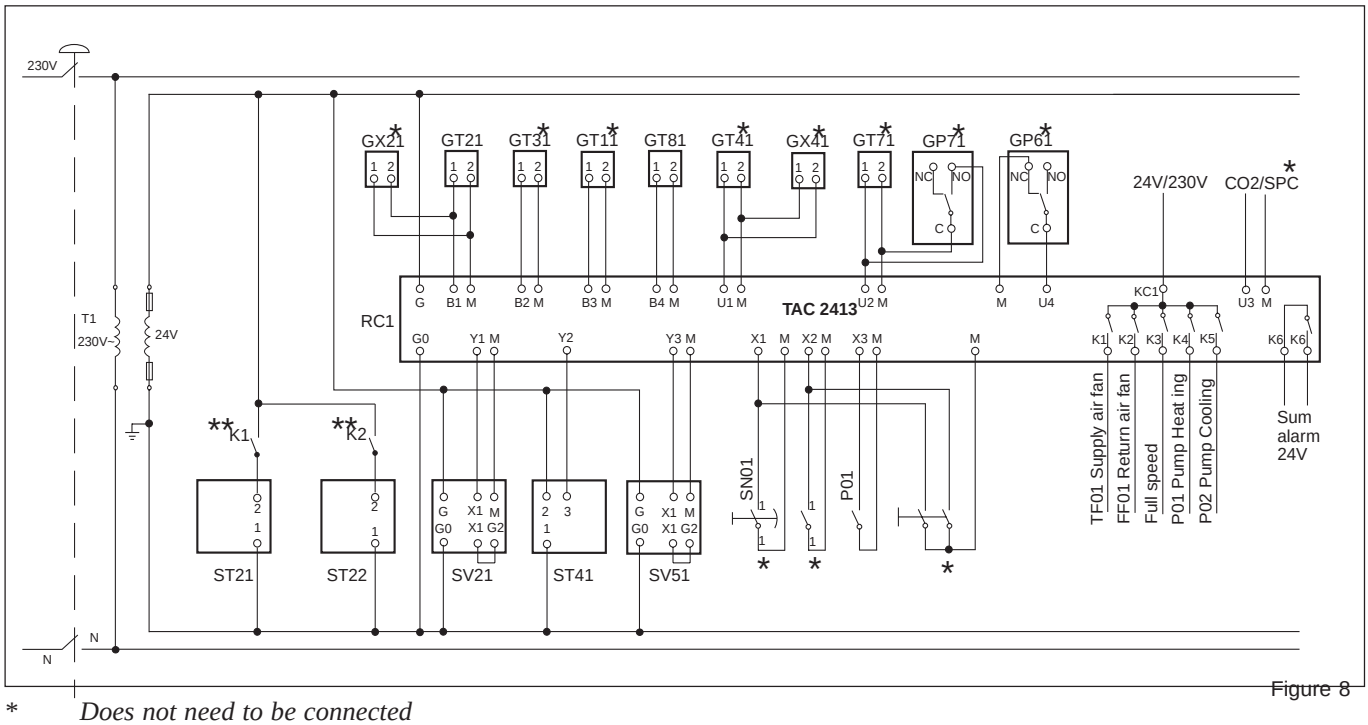


Figure 8

* *Does not need to be connected*

** *K1: Contactor TF01*

K2: Contactor FF01

CONNECTIONS/TERMINAL BLOCKS

The terminal blocks of figure 9 show what the TAC 2000 controllers have to offer. The figure illustrates how the terninal blocks are placed on the back plate of the controller.

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.

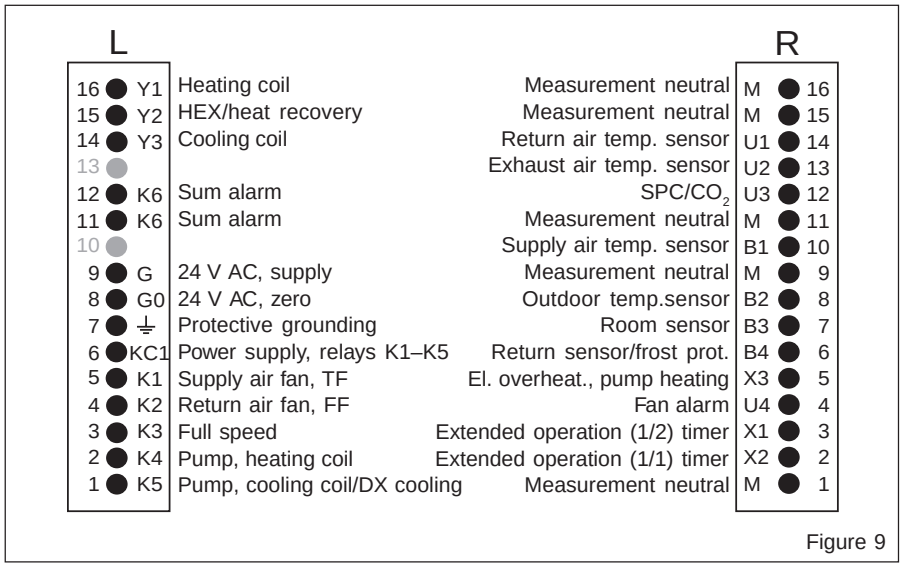
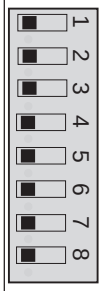


Figure 9

DIP SWITCHES

The DIP switches are located under the quick reference on the front of the controller. The control signals, type of control, functions, etc. are changed in a simple manner by using the DIP switches.

On delivery, all switches are OFF.



No.	OFF	ON
1	Supply air control	Room/Return air control
2	Room control (if 1=on)	Return air control (if 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, heating and cooling	0–10 V output, heating and cooling
8	Warm start. Resets the hardware, and all the settings except for the date and time are retained.	

CABLE LENGTHS

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

- 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.

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

MAINTENANCE

The controller does not require any special maintenance, but it should be kept clean. However, the control equipment should be kept under observation so that any possible faults do not cause the ducts to overheat or freeze.

The display window may be wiped with a damp cloth, if it is needed.

ACCESSORIES

Designation	Part no.
Transformer TR 32	341-3032-000
Apparatus box with enclosure rating IP 54	200-2993-000
Inta 2000V	200-1910-000

MEMORY BACKUP

The controller retains all its settings for an unlimited amount of time. However, the clock must be set after a power failure lasting longer than 48 hours.

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