

**Form for quotation, functions and scope of service of AIR CONTROL controllers for the AIRTECH and AIRCLEAN ranges**

Date:	CIAT quotation number:	AHU customer reference:
Customer:	Signature:	
CIAT sales representative:	Signature:	

**Climaciat AHU selection**

The following components must be included in the AHU selection: Damper actuator (see page 4), variable frequency drives, frost protection thermostat & damper, smoke detector (if necessary).

One form must be completed for each control (unless several AHUs are strictly identical in terms of composition and operating principle). The AHU selection must be attached with this form.

**Definition of the control system**

1	Location of the electrical cabinet: <ul style="list-style-type: none"> <li>• Mounted on the AHU (impossible on single-flow units smaller than size 150)</li> <li>• Remote (a 10m cable harness is supplied)</li> </ul>	<input type="checkbox"/> <input type="checkbox"/>
2	Fan management: <ul style="list-style-type: none"> <li>• <b>Constant flow</b> control</li> <li>• <b>Constant supply air pressure</b> control</li> </ul> <i>Plug fan with inverter, and EC motor only. Multi speeds fans not included in the software</i>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
3	Management of a rotary or plate-type heat recovery system (including monitoring of frosting for plate model)	<input type="checkbox"/>
4	Free cooling function	<input type="checkbox"/>
5	Choice of controlled temperature: <ul style="list-style-type: none"> <li>• Supply air</li> <li>• Return air</li> <li>• Room temperature</li> </ul> <i>Action on hot and cold water coils, electric heaters and GGS gas generators. See details of temperature management on page 6</i>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
6	Air humidity control: <ul style="list-style-type: none"> <li>• Humidification</li> <li>• Dehumidification</li> </ul> Humidity control mode: <ul style="list-style-type: none"> <li>• Return air control</li> <li>• Room air control</li> </ul>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
7	Single-zone air quality management (effect on fresh air rate and superventilation) <ul style="list-style-type: none"> <li>• CO<sub>2</sub> detection sensor in duct</li> <li>• CO<sub>2</sub> detection sensor in room air</li> </ul>	<input type="checkbox"/> <input type="checkbox"/>
8	Water heating coil: <ul style="list-style-type: none"> <li>• Three-way valve and actuator supplied loose</li> <li>• Two-way valve and actuator supplied loose</li> </ul> <i>Steam coils and superheated water coils not included in the software</i>	<input type="checkbox"/> <input type="checkbox"/>

9	Water change-over coil: three-way valve and actuator supplied loose	<input type="checkbox"/>
10	Frost protection management as standard for AHUs handling fresh air. <b>Including:</b> isolation damper, on/off actuator with return spring and auxiliary switch, capillary tube thermostat on the coil to be protected. <i>See the description of the frost protection function on page 7.</i>	<input checked="" type="checkbox"/>
11	Water cooling coil: <ul style="list-style-type: none"> <li>• Three-way valve and actuator supplied loose</li> <li>• Two-way valve and actuator supplied loose</li> </ul> <i>DX coils not included in the software</i>	<input type="checkbox"/> <input type="checkbox"/>
12	Electric heater: <ul style="list-style-type: none"> <li>• On/Off control (number of stages as per AHU data sheet)</li> <li>• Proportional control (TRIAC type)</li> </ul> <i>Remark : in case of on/off control, only return air and ambient air control are available.</i>	<input type="checkbox"/> <input type="checkbox"/>
13	Optional communication board: <ul style="list-style-type: none"> <li>• ModBus RTU</li> <li>• ModBus TCP/IP</li> <li>• BACnet IP</li> <li>• LON</li> <li>• KNX</li> </ul> <i>Exchange table not modifiable, available with the custom range.</i>	<input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/> <input type="checkbox"/>
<b>Note:</b>		

**Equipment included as standard in the main electrical cabinet**

- ✓ Main circuit-breaker fitted on the cabinet front panel
- ✓ Protective devices for the cabinet control and power circuitry
- ✓ 24 V transformer to power the control circuitry
- ✓ PLC-type controller (standard CIAT AIR CONTROL software)
- ✓ Carel PGD IP55 man-machine interface flush-mounted on the cabinet front panel (On/Off, configuration, machine status and fault display)
- ✓ 400/230 V transformer to power a variable speed rotary heat exchanger or burner if selected

**Control functions available as standard**

- ✓ Programmable timer (see details on page 9)
- ✓ Input for remote On/Off contact
- ✓ Continuous ventilation and fan delay management if necessary (electric heater, GGS, etc.)
- ✓ Air flow presence verification via  $\Delta P$  measurement
- ✓ Filter fouling measurement via  $\Delta P$  sensor (0-10 V)
- ✓ Two fault summary contacts: “maintenance fault” and “hazard fault”
- ✓ Input for fire protection fault (see fire protection management procedure on page 9)
- ✓ Fault display depending on AHU composition: motor, air flow presence, filter fouling, frost protection, electric heater safety thermostat, high and low supply air/return air temperature limits, heat exchanger frosting, isolation damper problem.

**Scope of service (work not included)**

- Assembly of AHU modules
- Water and air connections
- Main electric power supply(ies) (one or more cabinets depending on AHU composition)
- Electrical connections between cabinets and electrical components (e.g. sensors/actuators, motors, variable frequency drives)
- Provision of cables between the cabinet and the AHU if the distance is greater than 10 m
- Wiring for air handling units delivered as several modules
- Mounting of the electrical cabinet on the AHU, and wiring, if the electrical cabinet is delivered not mounted (please refer to the offer)
- Mounting of the electrical cabinet on the AHU and wiring, in case of electrical cabinet delivered in kit (please refer to the offer)
- Valves assembling, and by-pass piping.
- Installation of fresh air, supply air, return air or room temperature, duct pressure and CO<sub>2</sub> sensors.
- Control and management of ancillary devices (pumps, heaters/chillers)
- Provision and connection of a communication bus or IP network. The bus cable must be installed and connected in accordance with best current practice.
- Transfer and processing of data available for communication protocols. The installer must allow for this aspect; an integration specialist will be required.
- Tuning of the system and balancing of air and water networks.

**Prerequisites for commissioning**

The following conditions must be met before the unit can be commissioned:

- The unit must be connected mechanically, hydraulically and electrically.
- The hot water and chilled water generators must be operational.
- The assembly completion note must be filled in and sent to CIAT Service at least two weeks beforehand.

**Date and customer signature :**

### **Description of the electrical cabinet**

A standard off-the-shelf electrical cabinet (Sarel or equivalent) is used, in the manufacturer's standard colour, with IP 55 protection rating, sized depending on the power rating of the components and the AHU options.

Three-phase 400 V 50 Hz supply without neutral.

Note: For the electric heater and steam humidifier functions, one or more additional electrical cabinets are used. These electrical cabinets require a separate power supply and are controlled by the main electrical cabinet.

Cabinet with natural or forced ventilation as appropriate (depending on the components in the cabinet). Control software incorporating CIAT's air handling expertise, configurable depending on the composition of the AHU.



*Photos for illustrative purposes only*

### **Types of sensor (depending on the composition of the AHU and the options selected)**

- Air temperature: passive sensors (e.g. NTC probe)
- Frost protection: capillary tube thermostat
- Water temperature (for mixed coil): contact thermostat to be installed on the piping.
- Humidity: active sensor
- Differential pressure (filters, fans): active sensor
- Fire detection: smoke detector in accordance with current standards
- Safety mechanism for electric heaters: one thermostat with automatic reset and one with manual reset.

### **Types of actuator (depending on the composition of the AHU and the options selected)**

- Isolation dampers: 24 V on/off servomotor with return spring and travel limit contact
- Heat exchanger and mixing bypass: 24 V on/off (controlled with a 3-point modulating signal)
- Valves: 24 V progressive servomotor, 0-10 V

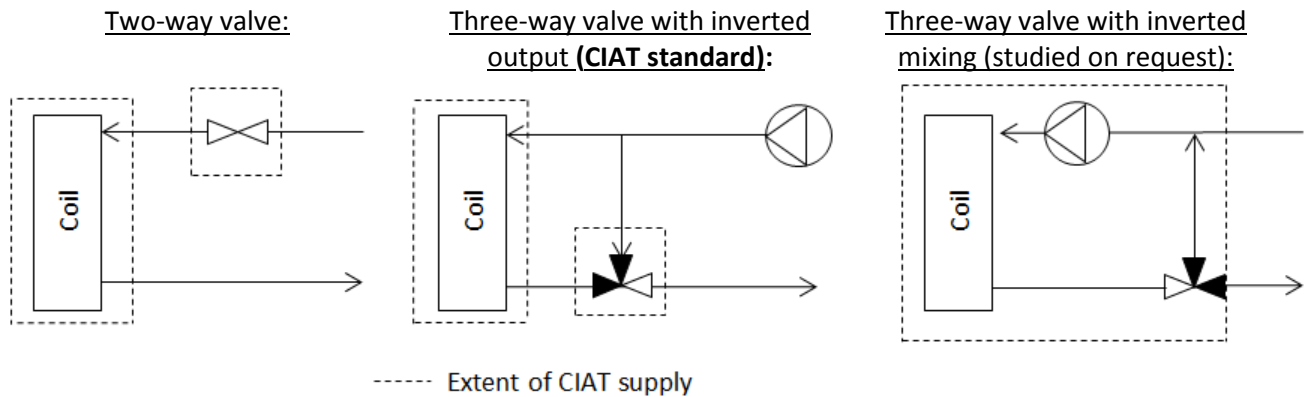
### **Heater control components**

- a. Electrical heaters

Electric heaters can be controlled in on/off mode (number of stages specified in the AHU selection) or at variable power (TRIAC type). The power variator only controls one stage of the heater; the others are powered in a cascade arrangement depending on demand (see control laws page 6).

b. Water coils

Up to two water coils and one electric heater can be controlled. Several valve and mounting options are available for water coils.



**Control modes**

The control modes described below depend on the composition of the AHU.

**I. Ventilation control**

The fans are controlled by the isolation damper limit switch. If the AHU does not feature isolation dampers, the fans start up directly when the unit is switched on from the control terminal.

**a. Constant flow rate control**

For this control mode, variable speed plug fans must be used (variable frequency drive or EC motor). They are controlled on the basis of a flow rate setpoint in  $m^3/h$ , set from the man-machine interface. For dual-flow AHUs, it is possible to set different supply and exhaust setpoints, within the allowable limits for the internal components (e.g. pressure difference between flows for plate heat exchanger units).

**b. Constant pressure control**

For this control mode, variable speed plug fans must be used (variable frequency drive or EC motor). The intake fan is controlled on the basis of a duct pressure setpoint in Pa, set from the man-machine interface. The exhaust fan is controlled automatically on the basis of the supply air fan control signal.

**II. Temperature management**

**a. Rotary exchanger**

Constant speed rotary heat exchanger

The controller manages free cooling only. The rotation of the rotary heat exchanger is stopped when free cooling / night cooling is enabled.

The controller handles auto-cleaning of the rotary heat exchanger: if the heat exchanger is stopped for a period of more than 4 hours, the exchanger rotation is restarted for 5 minutes every 4 hours in order to avoid excessive fouling.

Variable speed rotary heat exchanger

The controller manages the rotation speed of the rotary heat exchanger (0-10 V signal) proportionally to the heating or cooling recovery demand. Free cooling / night cooling mode is also taken into account, and auto-cleaning is managed by the heat exchanger controller. A sensor detects rotation of the heat exchanger and signals a fault in the event of a broken belt.

**b. Plate heat exchanger**

Only plate heat exchangers with a fresh air bypass are handled.

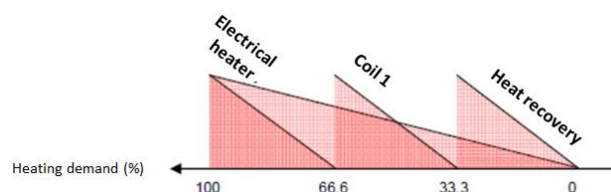
Frosting of the plate heat exchanger is measured by a  $\Delta P$  sensor on the exhaust air flow. When the frost threshold is reached (adjustable parameter), the bypass is opened progressively until the value measured drops below the threshold again.

The controller handles free cooling / night cooling, opening the bypass fully when one of these functions is active.

**c. Heaters (water and electric)**

*Note that a frost protection thermostat is mandatory for coils not using glycol solution.*

The controller preferentially uses the heat recovery system (if available) to meet heating demand. If the recovery capacity is not sufficient, the heaters are then turned on in a cascade arrangement to provide additional heating. The water coil (heater 1) takes priority over the electric heater.



- Electric heaters: staged control

The first control mode for the electric heaters entails powering the stages in turn depending on the heating demand.

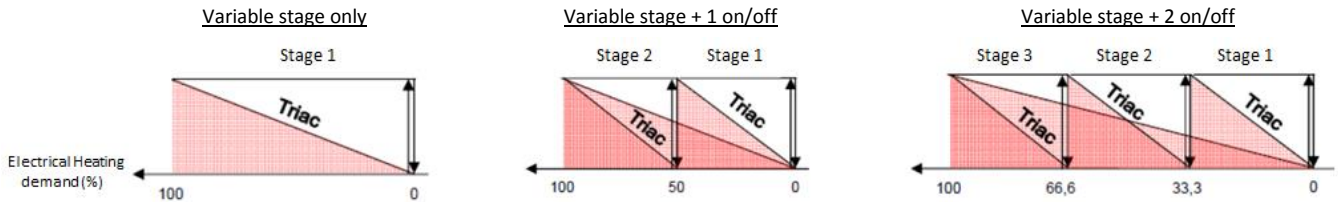
The controller can handle a maximum of three stages.



- Variable power control (TRIAC)

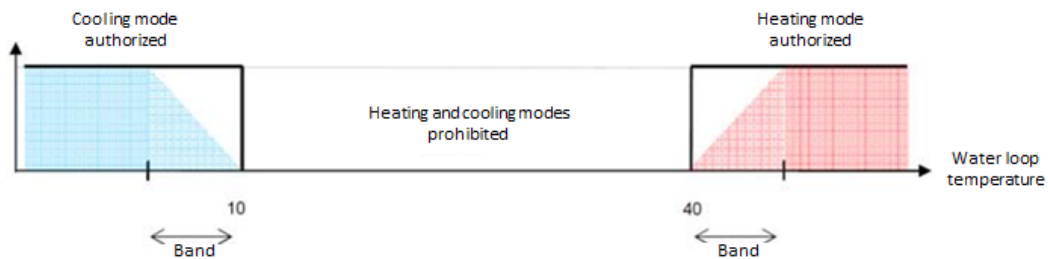
The power of the variable stage can be set to between 10% and 100%. The heater can thus be adjusted to suit demand.

The maximum capacity of the variable power stage is 60 kW. If the heater power so requires, a combined TRIAC + on/off solution is used:



**d. Change-over coils**

If a mixed coil is used, a changeover sensor is provided in order to determine the operating mode of the associated heat pump. The PLC then automatically controls valve opening in order to adjust the temperature to the requested setpoint. The opening is limited to avoid a drift in the temperature of the water return to the heat pump.



**e. Management of frost protection faults**

If a frost protection fault is detected (via the capillary tube thermostat), the procedure is as follows:

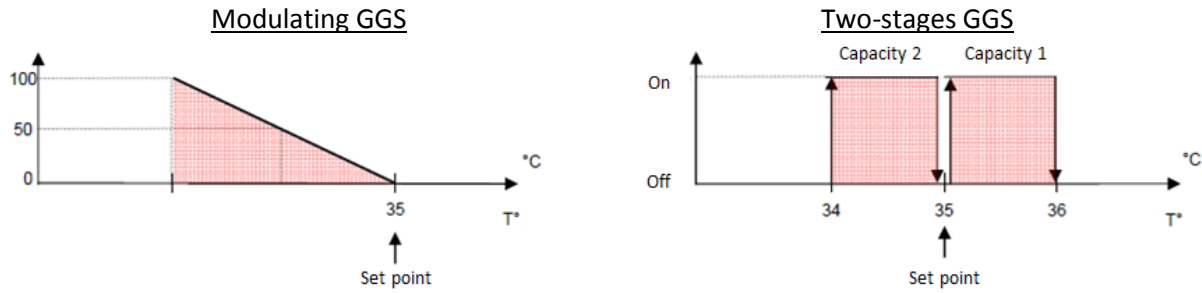
- Turn off fans
- Close isolation dampers
- Open heating coil valve to 100%
- Display a warning on the control terminal

**f. Gas generator with combustion chamber (GGS)**

GGS operation is authorised up to a supply air temperature of 45°C. At higher temperatures the risk of starting the gas generator is too high.

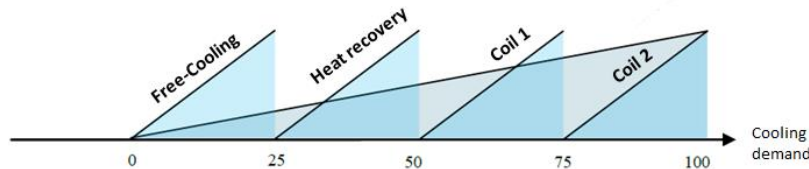
On the modulating model, a PID loop adjusts the power depending on the setpoint (control must depend on the return air temperature or room temperature). High and low supply air temperature limits may be set.

On the two-stage model, the stages are enabled depending on the difference between controlled temperature and the setpoint.



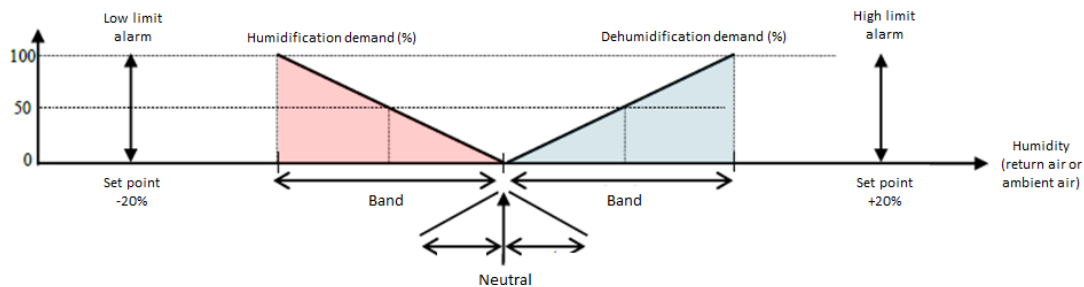
**g. Management of cooling coils**

The controller preferentially uses the heat recovery system (if available) to meet cooling demand. If the recovery capacity is not sufficient, the cooling coil is activated by proportional control of the valve.



**III. Management of humidity**

Humidity must be controlled relative to the return air or room air.



In humidification mode, the PID algorithm sends an 0-10 V signal to the steam humidifier (cooling coil operation prohibited).

In dehumidification, the supply air temperature is adjusted by the heating coil if this coil is located downstream the cooling coil.

The humidity is controlled to a precision of +/- 10%.

**IV. Free cooling**

The conditions for authorising free cooling are as follows:

- The fresh air temperature is at least 3°C lower than the return air temperature.
- Cooling demand is detected by the controller.

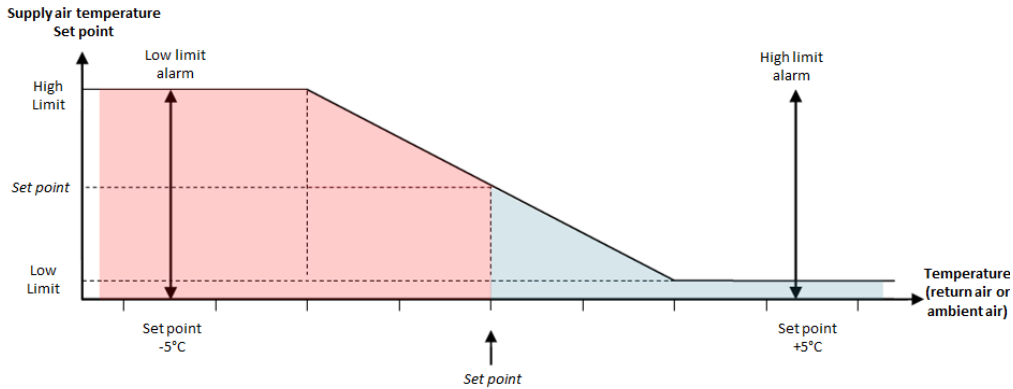
During free cooling operation, the rotary heat exchangers is off and the plate heat exchanger bypass is fully open.

If a mixing damper is fitted, the percentage of fresh air varies depending on the cooling demand from the controller. A minimum value fresh air value can be set.



**V. Supply air temperature limits**

If the controlled temperature is the return air temperature or room temperature, high and low limits for the supply air temperature may be set in order to maintain comfortable conditions.



**Fire fault**

If a fire fault is detected (on/off input available on the controller), the fans are stopped and the isolation dampers are closed. A specific pictogram is displayed on the control terminal.

**Programmable times**

Three types of time range are available:

- Daily
- Weekly
- Annual

Up to four different time ranges may be set, using one of the following modes:

- Reduced temperature
- Normal temperature
- Minimum flow rate
- Nominal flow rate
- Minimum pressure
- Nominal pressure
- Standby

**AHU air flows**

