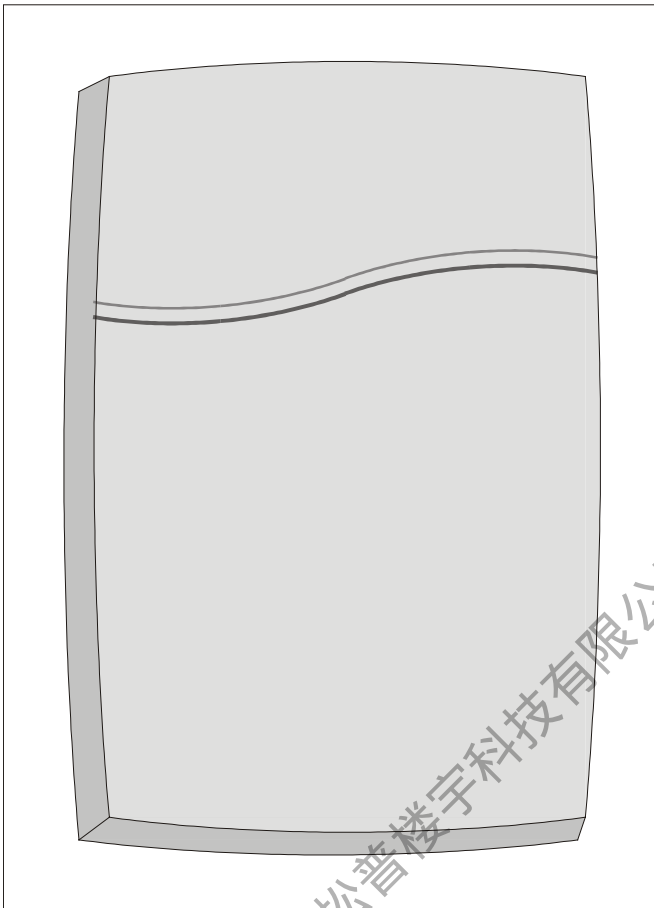# AQS51/61
CO2 / TEMPERATURE SENSOR WITH BUILT-IN CONTROLLER FOR WALL MOUNTING

INSTALLATION INSTRUCTIONS

GENERAL INFORMATION

The AQS51 and AQS61 CO_2 / Temperature Sensors are used to measure the concentration and temperature of carbon dioxide in indoor air. The units can be configured as controllers with programmable outputs for both ON/OFF relay control and the linear control of e.g. mixed air dampers and fans. The wall mounting housing has been designed with snap-in features to minimize installation time.

The units can be directly connected to common VAV (Variable Air Volume) controllers, Direct Digital Control (DDC) devices, or standalone control systems. The linear output functions are pre-programmed as CO_2 and temperature transmitters. In addition, the AQS51 and AQS61 have a relay output pre-programmed as a CO_2 limiter. All functions can be modified from a PC (Windows 95, 98, NT) using the AQS-USPxx (version 4.0 or higher) software together with the AQS3/4-CABLE communication cable.

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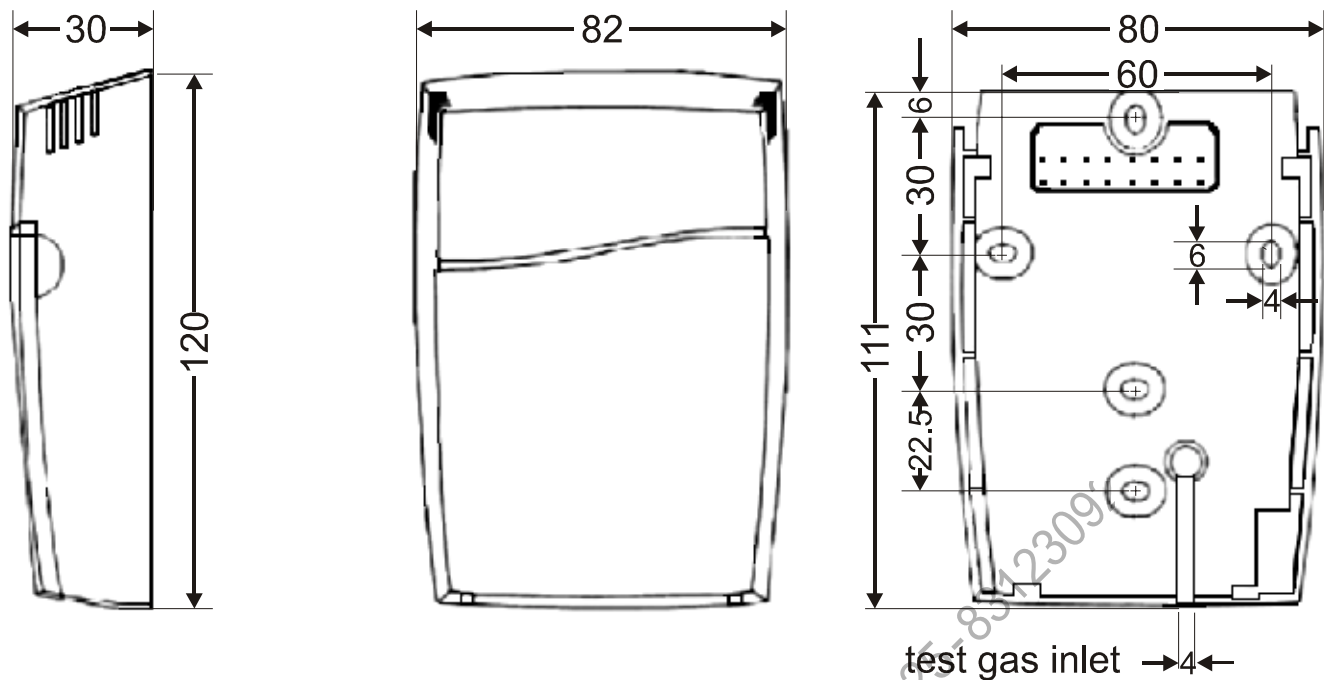
DIMENSIONS

Fig. 1. Dimensions (in mm) of AQS 51/61 (all oval holes have the same size)

WALL MOUNTING
Mounting the Wall Plate

The wall plate mounts vertically on the wall or on the wall wiring outlet box.

1. Position and level the wall plate on the wall and use a pencil to mark the mounting holes.
2. Remove the wall plate from the wall, drill two holes for M4 screws in the wall as marked, and insert dowel into the holes.
3. Position the wall plate over the holes and pull the wires through the wiring opening.
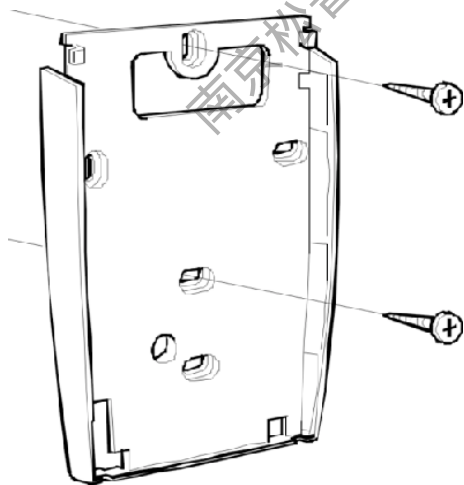4. Loosely insert the mounting screws into the holes and tighten them (see Fig. 2).

Fig. 2. Mounting of the wall plate

Mounting System Unit onto Wall Plate

1. Bend the wires to the top to allow wiring connections to the terminals.
2. Engage first the top tabs of the sensor/controller protection case into the top holes of the wall plate and then press the lower edge of the case onto the wall plate to latch (see Fig. 3). Be careful not to damage the temperature sensor.
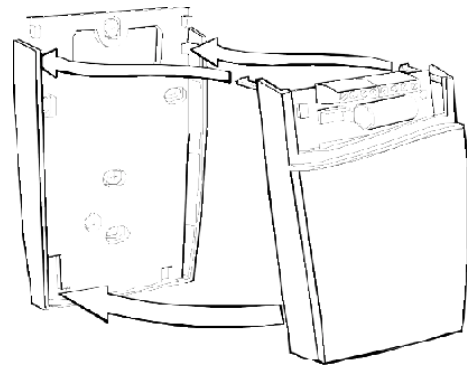

Fig. 3. Mounting the sensor/controller onto the wall plate
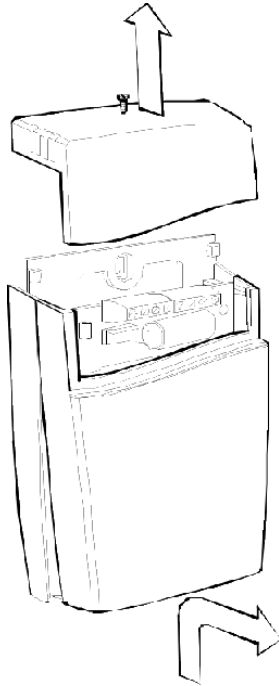
Removing System Unit from Wall Plate

Fig. 4. Removing the wiring terminal cover and the sensor/controller

1. Loosen the screw on top of the wiring terminal cover and remove the wiring terminal cover from the wall plate (see Fig. 4).
2. Pull out first the bottom of the sensor/controller, then disengage the top tabs and remove the top.
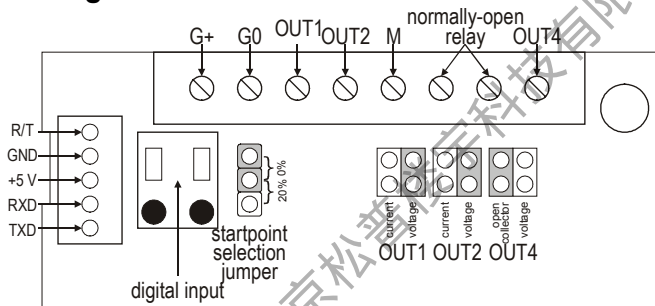
Wiring

Fig. 5. Connections and jumpers on AQS51/61. The shaded positions represent the default settings

⚠ CAUTION

Check that all wiring is correctly completed before turning the power on! Do not connect wires when the unit is powered. Do not detach the sensor/controller from the wall plate when the power is on!

The AQS51/61 signal ground (M) is not galvanically separated from the power supply G0 terminal. If the analog output signals are connected to controllers or DDC systems, these units must have the same ground. If necessary, use separate floating transformers for sensor and controller / DDC system.

1. Connect the correct wires to the terminals and securely tighten each terminal screw. Follow the actual job wiring diagrams if available or refer to Table 2 for terminal designations. A sticker is located on the inside of the terminal cover that identifies the terminals (see Fig. 5). All wiring must comply with local electrical codes, ordinances and regulations.
2. Place the wiring terminal cover by fitting the notches of the cover into the hooks of the wall plate. Tighten the locking screw (see Fig. 6).
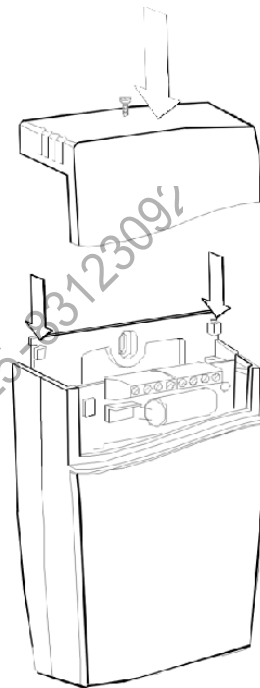

Fig. 6. Installing the wiring terminal cover

Electrical Connections

⚠ CAUTION

The power supply must be connected to G+ and G0. G0 is considered as system ground. If the analog output is connected to a controller, the same ground reference must be used for the AQS51/61 unit and for the control system! Unless different transformers are used, special precautions must be taken!

NOTE: The signal ground of the AQS 51/61 is not galvanically separated from its power supply!

Table 1. Default output configurations for AQS51/61

Terminal	Default output	Default output range
OUT1	0...10 Vdc	0...2000 ppm CO_2
OUT2	0...10 Vdc	0...50 °C
Relay	closed	> 1000 ppm CO_2
	open	< 900 ppm CO_2
OUT4	closed	> 2000 ppm CO_2
	open	< 1900 ppm CO_2

EN1B-0189GE51 R0102

Table 2. Electrical terminal connections for AQS51/61

Connection terminal	Function	Electrical data	Remarks
G+	power (+)	24 Vac/dc+ (±20%), 3 W	2 W without output load[1]
G0	power ground (-)	24 Vac/dc-	
OUT1	analog output 1 (+)	0...10 Vdc or 0...20 mA 2...10 Vdc or 4...20 mA	According to positions of OUT1 and start point of jumpers[2]
OUT2	analog output 2 (+)	same as output 1	According to positions of OUT2 and start point of jumpers[2]
M	signal ground (-)	connected to G0 via PTC fuse	See note 1!
Relay	normally open	contact-free relay; min. load: 1 mA / 5 V; rated load: 0.5 A / 125 Vac, 1 A / 24 Vdc	Triggered by register OUT3
OUT4	analog output 4 (+) or open collector	0...10 Vdc; max. 0.5 A, 60 Vdc / 40 Vac (half-wave rectifier protection)	According to positions of OUT4. See also notes 2 and 3!
DI1	digital input 1	closed contact current: 1 mA, open voltage contact: max. 5 V	Do not apply any voltage to this input!

NOTE 1:
The ground terminal is used as negative power supply DC input or AC phase ground G0 (half-wave rectifier). The signal ground M, protected by a PTC resistor, is the same as power ground G0 (permitting a "3-wire" configuration). A single transformer may be used for the entire system.

NOTE 2:
AQS51/61 can deliver both a voltage or a current loop for OUT1/OUT2. For OUT4 a voltage output or an open collector output is selected with jumper OUT4. To change between voltage and current output mode the hardware jumpers are used. There is one jumper for OUT1 and one for OUT2, so that one output can be a voltage output and the other a current output. Both voltage output and current output can have start points 0 % (0-10 VDC or 0-20mA) or 20% (2-10 VDC or 4-20mA). The same start point is used for both outputs. See Table 1.

NOTE 3:
The open collector's current is internally returned to the G0 terminal.

Output Configurations

The sensors/controllers are supplied from the factory (unless otherwise ordered) with 0...10 Vdc linear outputs for OUT1 and OUT2 and for OUT4 when it is used as an open collector output (see Table 1). If different outputs are needed for the application, these have to be configured before the unit is powered up. To select alternative output ranges, position the four jumpers as required for the application. Each jumper selection is independent from the others, except in the case of the "Start point selection" jumper, which affects both linear outputs (i.e. OUT1 and OUT2).

Table 3. Configuration jumpers for AQS51/61

Jumper	Position	Function
start point of the selection jumper	0%	Jumper top position provides a 0 Vdc or 0 mA start point for OUT1 and OUT2 (0...20 mA or 0...10 V). OUT4 has a 0 V output start point when jumper OUT4 is in the "voltage" position (0...10 V).
	20%	Jumper bottom position provides a 2 Vdc or 4 mA start point for OUT1 and OUT2 (4...20 mA or 2...10 V). OUT4 has a 0 V output start point when jumper OUT4 is in the "voltage" position (0...10 V).
OUT1	current	Connection in the "current" position provides a 0/4...20 mA output range for OUT1.
	voltage	Connection in the "voltage" position provides a 0/2...10 Vdc output range for OUT1.
OUT2	current	Connection in the "current" position provides a 0/4...20 mA output range for OUT2.
	voltage	Connection in the "voltage" position provides a 0/2...10 Vdc output range for OUT2.
OUT4	current	Connection in the "open collector" position provides an open collector output. Max. 0.5 A, 60 Vdc / 40 Vac (half-wave rectifier).
	voltage	Connection in the "voltage" position provides a 0...10 Vdc output range for OUT4.

Push Button Operation for AQS61

This sensor has two push buttons, MENU and ESC, located on the front panel behind the flip-down lid. The YELLOW LED will acknowledge a successful push by a short flash. The push button MENU is available for selection of display value or maintenance commands, whereas ESC is available to escape back from a selected level.

centration and temperature (alternating), error code, CO_2, temperature, output 1, output 2, or output 4. After the device is powered up, the display will always return to the default display mode

Display Modes

In the DISPLAY MODE, the push button MENU is used to select the value to be indicated on the display: CO_2 con-

Maintenance Level

A number of execution options are available from the MAINTENANCE MENU (see Table 4). This level is accessed only from the display mode in the OUT1 % selection. Simultaneously pressing two push buttons restricts access, intended for competent trained service personnel only (see Fig. 7). The ENTER command is issued by simultaneously pressing MENU and ESC.

Always use the ESC button to return to the MENU selection block in the left-hand portion of Fig. 7. Several pushes of the ESC button may be needed to return to the DEFAULT mode. The ENTER command (press MENU and ESC simultaneously) may result in the execution of functions with temporary or permanent changes to parameters affecting sensor/controller outputs and system operation.

Table 4. Maintenance functions available on the AQS61

Function line	Display	Time limit[1]	Functional description
1	FOUt	no	For checking/adjusting connected auxiliary equipment. Provides access to a sub-menu in which output selection XX = 1...4 is done by pressing MENU. The selected output FOXX (= OUT1-4) is fixed via ENTER[2]. For XX=1,2 LO always provides 2 V /4 mA regardless of the position of the start point selection jumper, but voltage or current according to the position of the jumper. OFF/ON is true for the relay and open collector outputs. FO 1,2 LO: selected output is fixed to 2V / 4 mA FO 3 LO: relay contact is open FO 4 LO: OUT4 is 0V/open state FOXX HI: selected output is fixed to 10V/20mA/closed state
2	bCAL	yes	CO_2-sensor calibration with fresh air. An easy way to correct a zero-point error of a sensor. The sensor needs fresh air (380...420 ppm CO_2). The calibration must be confirmed by pushing ENTER
3	CAL	yes	Zero-point calibration of the CO_2 sensor. The sensor needs zero gas. See the calibration instruction of zero-point calibration. The calibration must be confirmed by pushing ENTER.

[1]The phrase "time limit" refers to an internal time-out which returns the LCD and the maintenance function back to normal.
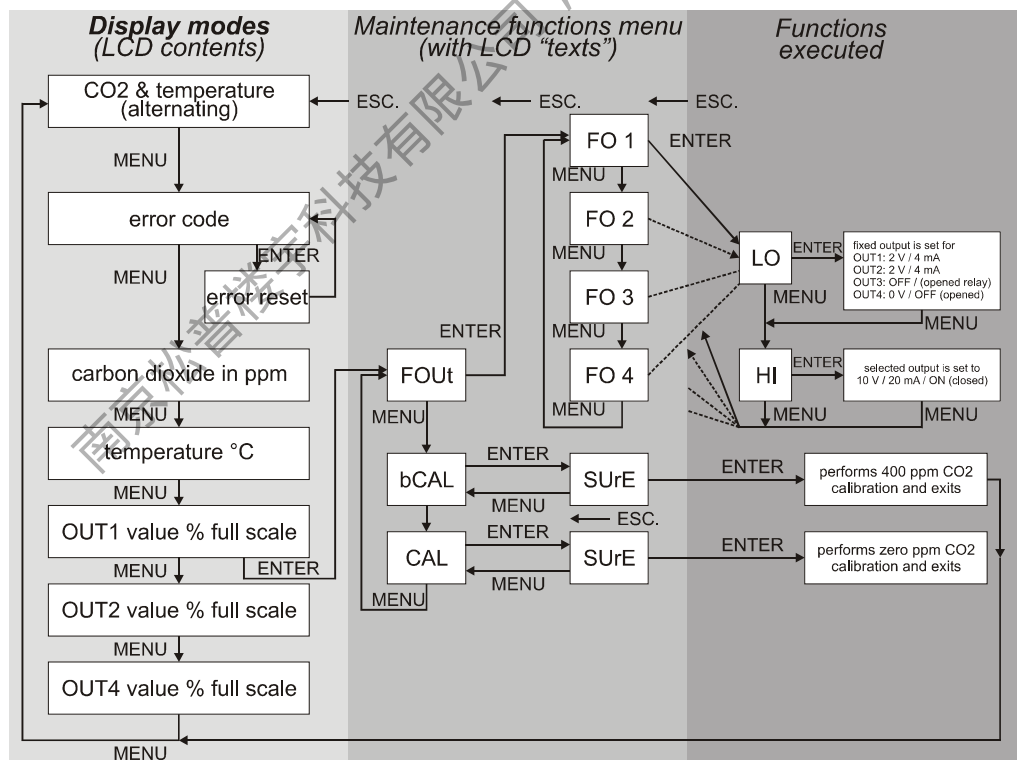[2]ENTER is achieved by simultaneously pressing MENU and ESC.

Fig. 7. Push-button menu flow-chart for the AQS61

EN1B-0189GE51 R0102

FUNCTIONAL TEST OF THE AQS51/61 CO2 AND TEMPERATURE SENSOR

AQS 51

AQS 61

Functional Test

The unit has two LED's - yellow and red - on the front panel (found under the front lid). These LED's indicate the controller's status.

Yellow LED - "Call for maintenance" is lit if an error flag has been set or the measurement is out of range. In the case of the AQS61, this information is also shown on the display by the wrench icon. Any push button press, or executed maintenance function, is acknowledged by this LED lighting up.

Red LED - "Relay active" is lit when the relay has been activated (contact closed).

A simple and visual functional test can easily be performed. Take a breath and blow the air from a distance of a few centimeters onto the sensor. The sensor will detect a rapid increase in the carbon dioxide concentration. As a result, the red LED will light up as the CO_2 level exceeds 1000 ppm (sensor default setting). If the sensor is connected to a controller, the flow of the ventilation system will eventually increase by change of the fan speed or opening of a damper actuator (depending on the installation/application).

In the case of the AQS61, the present output values of the outputs OUT1, OUT2 and OUT4 can be viewed on the LCD by pressing MENU four to six times. The displayed values are in %FS (percent full scale) and can be compared with the actual output value measured with a multimeter.

Test Gas Verification

Insert 4 mm plastic tubing in the test gas inlet at the bottom of the wall plate. The plastic tubing should be inserted as far as possible into the inlet. Flow test gas at a rate of about 0.5 liter/minute. Check the display (or OUT1 with a multimeter) to read the CO_2-value when it has stabilized.

NOTE: The sensor accuracy is defined at continuous operation (at least 3 weeks after installation).

Self Diagnostics

The system contains complete self diagnostic procedures. A full system test is executed automatically every time the power is turned on. In addition, the sensor probes are constantly checked against failure during operation by checking the valid dynamic measurement ranges. All EEPROM updates (initiated by the sensor itself or by external connections) are checked by subsequent memory read back and data comparisons. These different system checks return error bytes to the system RAM. If any error is detected, the yellow LED will light up until the error has vanished and the error flag is reset. "Warm up" and "Out of Range" are the only bits that are reset automatically after return to normal state. All other error bits have to be reset manually after return to normal state – either by pushing the MENU and ESC buttons simultaneously for ENTER (AQS61 only) or by power off and restart.

The error code *number Exxx* can be made to appear on the LCD (AQS61) by pressing the "MENU" push button. Descriptions of the different codes are listed below.

Bit #	Error code	Error description	Suggested action
0	N/A	Fatal error: The yellow LED flashes continuously. The push buttons do not function.	Try to restart the sensor by turning the power off and on again. Contact local distributor.
1	2	Reserved	
2	4	Ãlgorithm error: An incorrect EEPROM configuration is indicated.	Try to restart the sensor by turning the power off and on again. Check detailed settings and configuration with AQS-USP software version 4.0 and higher. Contact local distributor.
3	8	Output error: Detected errors during output signal calculation and generation.	Check connections and output loads. Check detailed status of outputs with AQS-USP software version 4.0 and higher.
4	16	Self diagnosis error: May indicate the need of zero-point calibration or sensor replacement.	Check detailed self-diagnostic status with AQS-USP software version 4.0 and higher. Contact local distributor.
6	64	Memory error: Non-fatal error during memory operations.	Check detailed settings and configuration with AQS-USP software version 4.0 and higher.
7	128	Warm-up state: Is always set after power-up or power failure. Resets after restart sequence.	If it doesn't disappear within 30 seconds, check power stability.

NOTE: One of the probes is out of range. Occurs, for instance, during over-exposure of the CO_2 sensor, in which case the error code will automatically reset when the measurement values return to normal. Could also indicate the need of zero-point calibration. A background calibration using push button function "bCAL" will remedy this error (a more exact zero-point calibration using "CAL" may be performed later, if required). If the CO_2 readings are normal but the error code remains, the temperature sensor might be broken.

REMARK:
If several errors are detected at the same time, the different error code numbers will be added together into one single error code.

Maintenance

Basically speaking, the AQS51/61 is maintenance-free. An internal self-adjusting calibration function takes care of normal long-term drift associated with the CO_2 sensor. To ensure the highest accuracy, a time interval of max. five years is recommended between CO_2 calibrations unless some special situations have occurred. A zero-point calibration can be performed using the push button functions (for AQS61), or for a complete overview, by using a PC together with the *AQS-USPxx software version 4.0* (or higher). This software and a special RS232-cable are included in the *AQS-F0005* service kit. The cable is to be connected to the UART port slide connector (see Fig.9). For changing control parameters and re-calibration (CO_2 and temperature), this PC tool must to be used. The check can be done on site without interfering with the ventilation system.

If, for some reason, the printed circuit board (PCB) needs to be removed, special precautions must be taken in order to avoid damaging the temperature probe. When putting the PCB back into the protective housing, the temperature probe must be gently positioned in the small probe compartment (see Fig. 8)!

Limited Warranty

This product has been accurately tested and examined for proper operation. Please operate this product only in accordance with the instructions.

The warranty period of the product against defects in workmanship and material is one year from date of purchase by the original owner. If the product should become defective within this warranty period, the customer owns the right for repair or exchange the product free of charge. Please contact your retailer for further information.

The retailer is not responsible for any consequential loss or damages, which may occur by reason of purchase and use of this product. The warranty is, in any event, strictly limited to the replacement/repair of the product.

This product is in accordance with the EMC Directive 89/336/EEC and the Low-Voltage Directive 73/23/EEC, including amendments by the CE-marking Directive 93/68/EEC.
This product fulfills the following requirements:
- EN50081-1
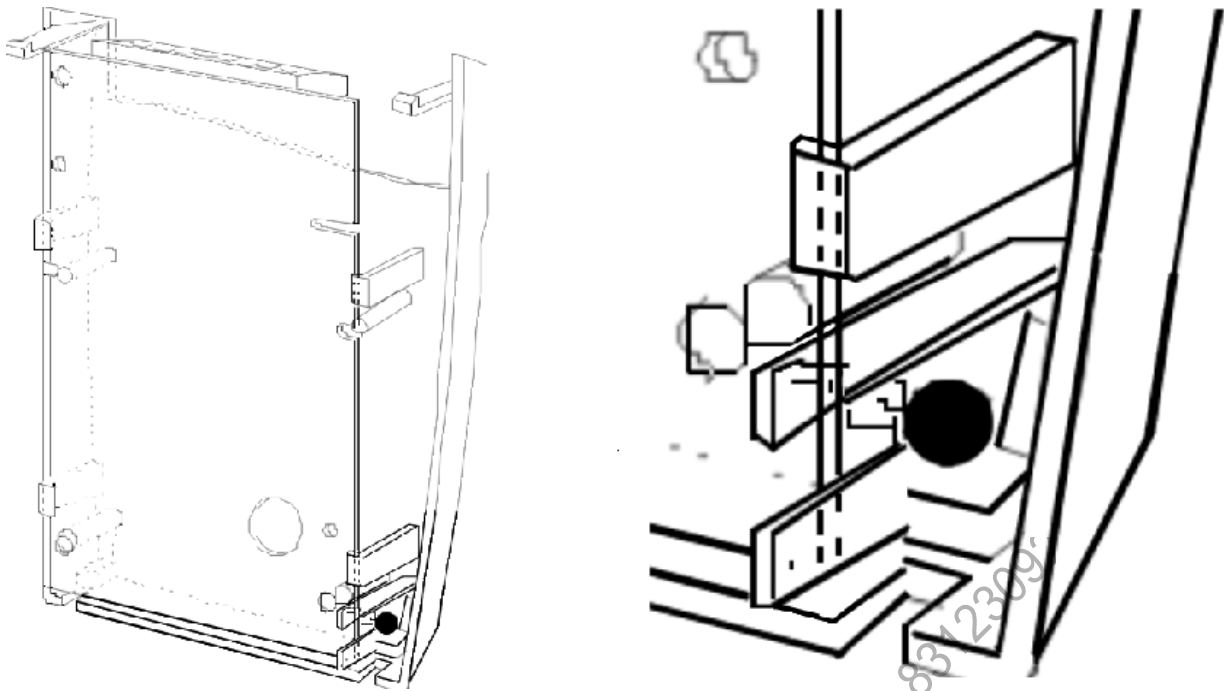- EN55011(B)
- EN50082-2
- EN61000-4-2.-3.-4.-5. Level 3

Fig. 8. Positioning the temperature sensor (the black dot), enlargement at right

Honeywell