



AQ Unit Air Quality Sensor

Installation, Operation and Maintenance Manual

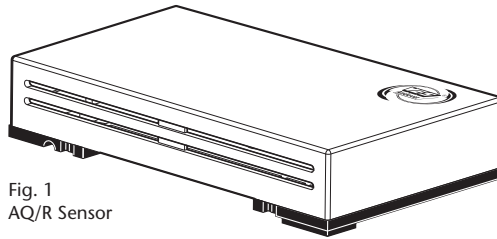


Fig. 1
AQ/R Sensor

Important

This manual must be read in full before Installation, Operation and Maintenance of the units supplied. When supplied with other equipment, please also refer to the accompanying documentation.

Please ensure that this document is passed to the end user. This manual forms an integral part of the product and should be kept for the working life of the product. Additional copies of this and supporting documents are available by contacting VES or by visiting www.ves.co.uk and following the 'Download O & M's' link.

The following symbols used within this document refer to potential dangers or advice for safe operation



Indicates hazards associated with electric current and high voltages



Indicates hazards that require safety advice for personnel and/or potential unit/property damage



Indicates important information

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Introduction **1**

The AQ Unit combines CO₂ (carbon dioxide) and VOC (volatile organic compound) measurements in one housing. This unit is suitable for demand control ventilation systems or Indoor Air Quality control, to be used as a room sensor or an extract duct sensor. The standard operating temperature of these units is -10 ~ +40°C, 5~70% RH. For further technical details regarding dimensions etc. see page 2, or contact VES on **08448 156060**, quoting the sales order (SO) number and the unit type as found on the unit nameplate, or visit www.ves.co.uk.

Receipt of Goods & Handling **2**

Immediately upon receipt of goods, check for possible damage in transit. In the event of any damage having occurred or if any item is found to be missing, it is essential to inform VES Andover Ltd. within 7 days of delivery quoting sales order number and the unit type, as found on the unit nameplate. After this period, VES would be unable to accept any claim for damaged or missing goods.



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Description 3 The AQ unit combines CO₂ (carbon dioxide) and VOC (volatile organic compound) measurements in one housing. This unit is suitable for demand control ventilation systems or Indoor Air Quality control, to be used as a room sensor (AQR) or an extract duct sensor (AQD).

CO₂ measurements are widely used for indoor occupancy detection. The detectable range of the AQ unit for CO₂ is up to 2000 parts per million [ppm]. CO₂ measurement is recommended for 'clean' area HVAC control systems.


VOC are oxidizable (combustible) gases and vapours, including body odour, tobacco smoke and emissions from materials (furniture, carpets, paints, glues, etc.).

The detectable gases for the AQ unit for VOC are methane, carbon monoxide, iso-butane, and ethanol. The detectable gases for the AQ unit for VOC include methane (CH₄), carbon monoxide (CO), iso-butane (C₄H₁₀), and ethanol (C₂H₆O).

VOC measurement is recommended for pub, club, garage, toilet, kitchen and canteen applications.

The AQ unit monitors CO₂ and VOC values, and depending on the weight input, proportion band set point and bandwidth, it will give out a proportional 0-10V signal to control ventilation rate and keep the CO₂/VOC value at the set point. For detailed operation and commissioning of AQ unit, please refer to the sections later in this manual.

The output of AQ unit is a 0-10V DC output signal, which can be connected to an inverter or similar speed controller to control the fan(s) speed. The 0-10V output changes linearly as CO₂ or VOC concentration changes. An ON/OFF signal is also available.

Important  It is the responsibility of the designer/commissioning engineer to ensure adequate ventilation at low speed

Features

The AQ Unit features:

- Maintenance free, auto calibration for CO₂ and VOC detection
- Built in temperature compensation
- Option for fast or slow response
- End of sensor life indicator
- Adjustable proportional band for 0-10V output signal to maintain the set point
- Alternative ON/OFF output
- AQ unit enables the demand control ventilation strategy, which can offer significant energy savings when compared to a constant ventilation strategy


Applications

The AQ unit requires no field calibration and is maintenance free. It can be used...

- In stand-alone mode
- In HVAC system for demand control ventilation or Indoor Air Quality control (via VES speed controller or inverter)
- As part of a building management system (BMS)

Technical Specification 4

Measuring ranges:	0 ~ 2000ppm of CO ₂ , 0 ~ 100% pollution of VOC	
Response time:	fast response - 2 minutes; slow response - 4 minutes	
Warm up time:	15 minutes (time from power up before giving output)	
0-10V Output:	0 ~ 10V DC, ±3mA	
Initial ventilation:	10V output for 15 minutes warm up time, otherwise 0V.	
Power supply:	Operating voltage: 24VAC ± 20%	
	Frequency: 50 Hz	
	<i>For advice on alternative power supplies please contact VES</i>	
Power consumption:	Max. 4VA	
Cable type :	3 Core 16/02mm (0.5mm ²) <i>not to exceed 50 metres</i>	
Operating temperature range:	-10 ~ 40°C, 5 ~ 70%RH (avoid condensation on the unit)	
Storage temperature range:	-20 ~ 60°C, 5 ~ 90%RH (sealed in a moisture proof bag)	
Housing material:	PC/ABS	
Dimensions (H×W×D):	Wall mounted (AQ/R)	70×121×25mm
	Duct mounted (AQ/D)	80×130×112mm

Caution  The AQ Unit is **NOT** suitable for use with life saving equipment or safety critical installations



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Technical Specification 4 continued

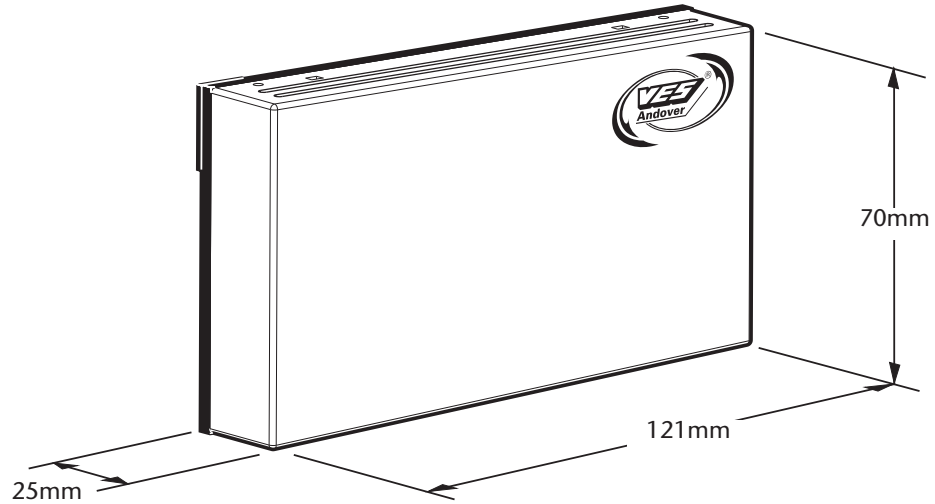


Fig. 2
AQ/R Room Mounted Sensor
Features and dimensions

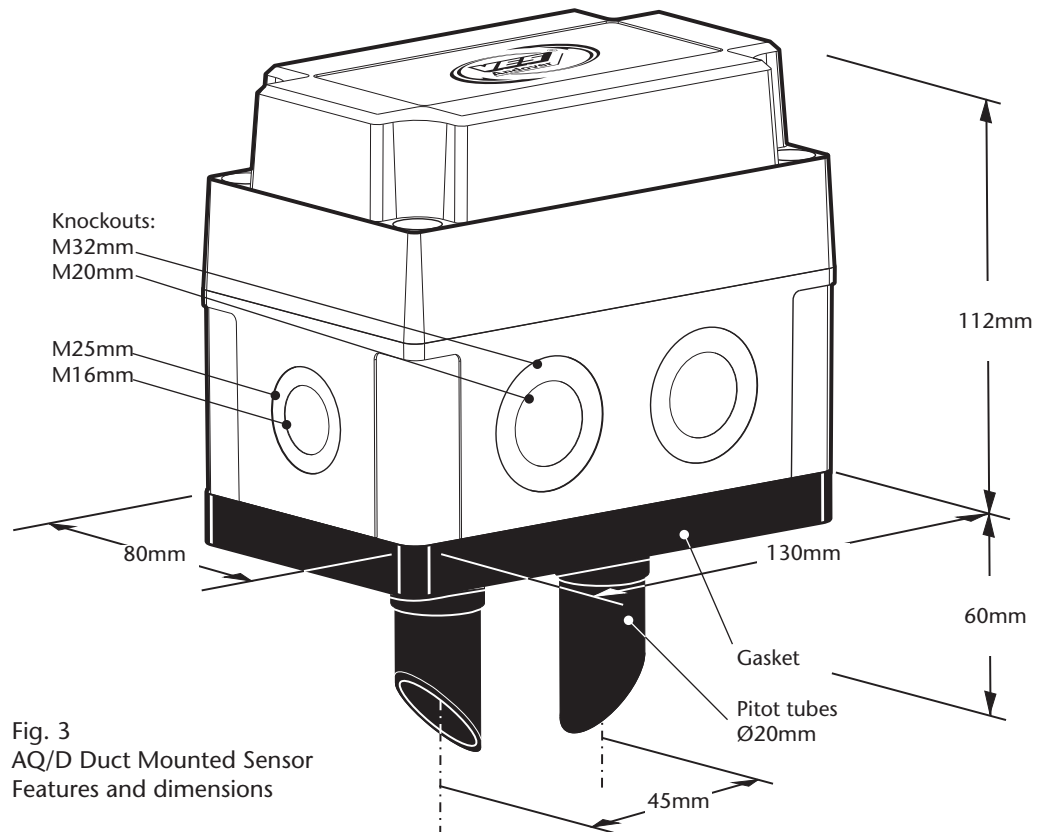


Fig. 3
AQ/D Duct Mounted Sensor
Features and dimensions



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Technical Specification

4 continued

Jumper Links

- L1 Initial ventiation
- L2 Response time
- L3 P-band adjustment

End of sensor life indicator

Jumper Links

- Weight selection
- L4
- L5
- L6

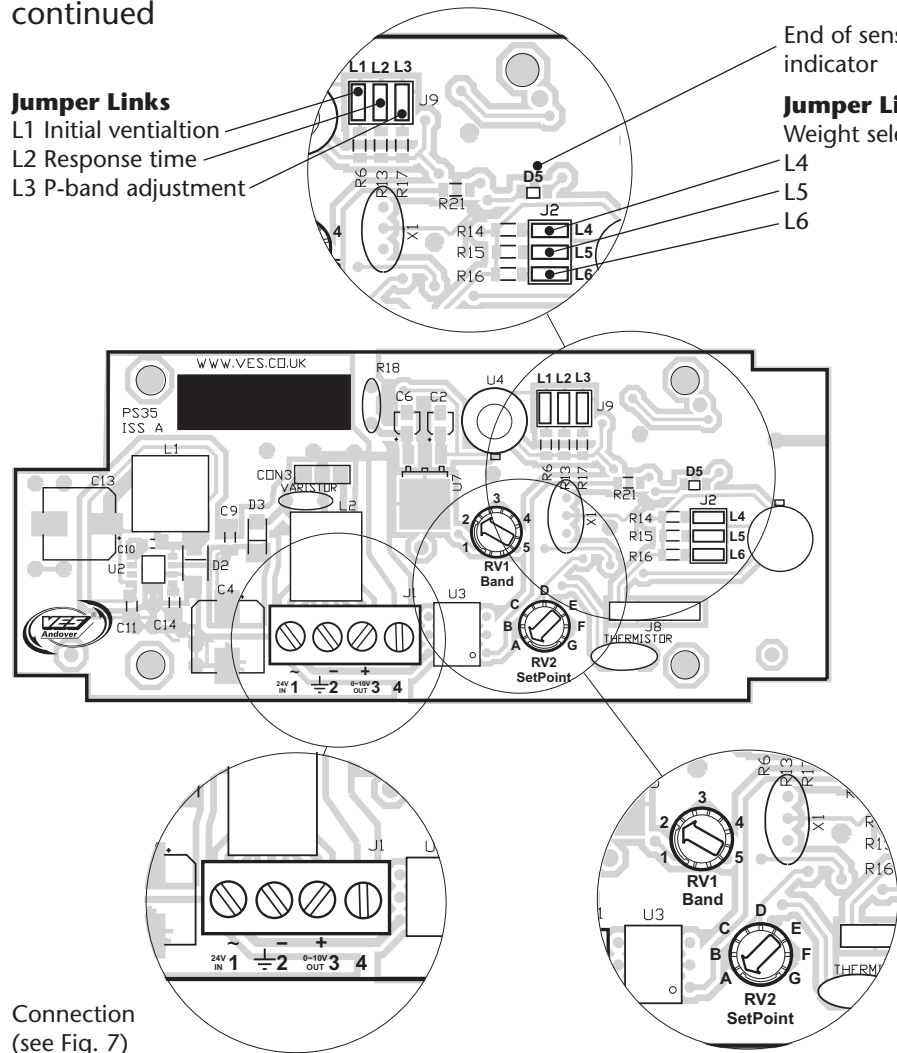


Fig. 4
AQ Sensor PCB
Features

Adjustment potentiometers
 RV1 Bandwidth
 RV2 Set point

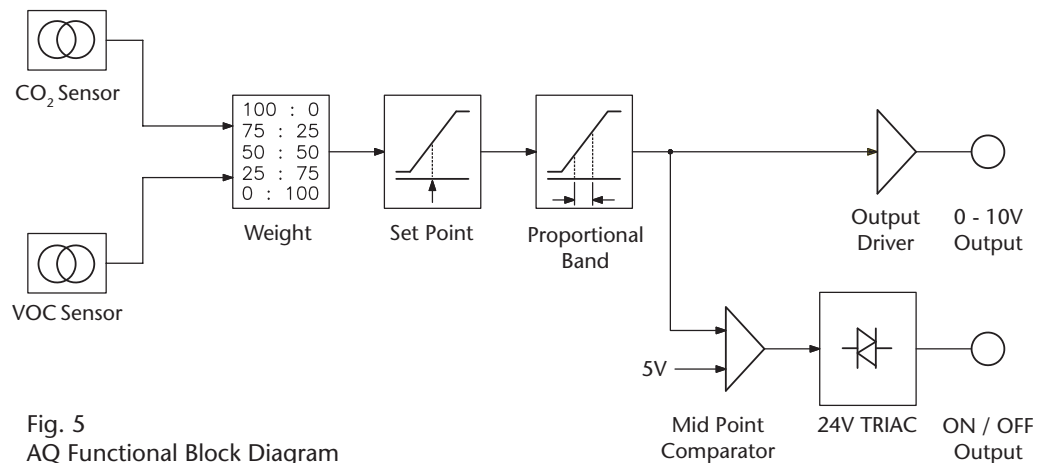


Fig. 5
AQ Functional Block Diagram

AQ Unit Air Quality Sensor

Installation, Operation and Maintenance Manual

Installation 5

Dos & Don'ts...

To ensure accurate readings and a good product life, the following conditions should be avoided:

- Do not mount the sensor outside. Suitable for indoor locations only
- Do not expose the sensor to direct sunlight
- Do not expose the sensor to rain, excessive condensation, soak or splash with water.
- It is ok to clean the outside of the sensor enclosure with a damp cloth.
- Do not expose the sensor to freezing conditions when condensation is likely as damage could occur to the sensing material.
- Do not mount close to radiant heat, e.g., above a radiator.
- Do not breathe directly on the sensor.
- Do not expose to excessive vibration or shock.
- Do not use the sensor when exposure to the following is likely:
 Silicone vapours (silicone adhesives, hair grooming products etc.)
- Avoid corrosive materials including H₂S (hydrogen sulfide), SO_x (sulphur oxides), Cl₂ (Chlorine gas), HCl (Hydrogen chloride).

This list is not exhaustive. If you are in any doubt please contact VES for further information.

The AQ sensor is available in two varieties, wall mounting (AQ/R) and duct mounting (AQ/D). For wall mounting, remove the front cover to access the fixing points. This cover can be removed by hand and does not normally require the use of tools. The fixing points can be seen in Fig. 6 below.

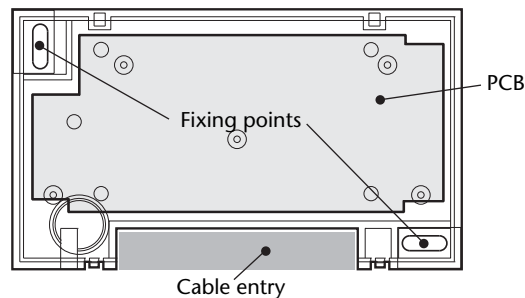


Fig. 6
 AQ/R Room Sensor
 Fixing points

Taking into consideration the good practice guidelines earlier in this section, fix through the back of the enclosure to the desired surface (fixings supplied by others), packing as necessary to ensure the mounting surface is even. When secure, the cover can be replaced again by hand.

For Duct mounting, using a Ø25mm holesaw make two holes, 45mm apart, in the ductwork, ensuring that the position of the holes is correct in relation to the airflow. Remove the sensor cover lid to access the fixing positions as shown in Fig 7. Position the enclosure so that the pitot tubes pass clearly through the pre-cut holes and fix the unit securely into position (fixings supplied by others). A gasket has been provided to ensure a good seal between the sensor enclosure and the ductwork. When used with smaller circular ductwork, e.g., <Ø200mm, additional sealing may be required.

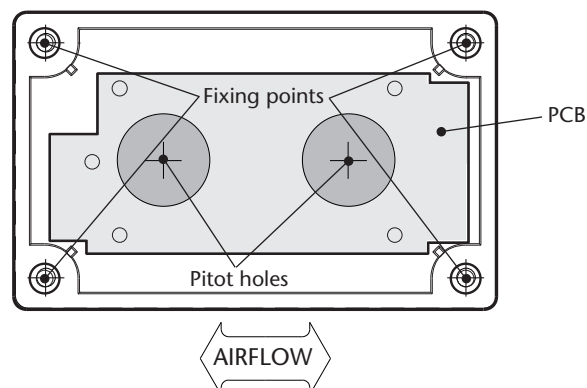


Fig. 7
 AQ/D Duct Sensor
 Fixing points



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Standard Wiring 6

The following wiring diagram is a guide to installing the AQ sensor. If in any doubt, or for special versions of the units, consult the wiring diagram in your document pack or contact our customer services department on **08448 156060**, quoting the sales order (SO) number and unit type as found on the unit name plate.

Warning

Electrical supply must be fully isolated before attempting to affect any work on this unit. All electrical connections to any unit must be carried out in accordance with the current edition of the **I.E.E Regulations** and only competent Electricians should be allowed to affect any electrical work to our units.

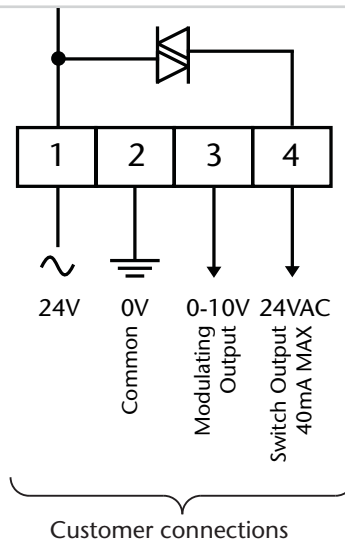
Caution

Do not connect any unit to an electrical supply voltage outside of the specification.



Take necessary precautions when handling the PCB; there is a risk of damage to the circuit board if handled incorrectly.

Fig. 8
AQ Sensor PCB
Wiring Diagram



AQ sensors require a 24VAC supply. This may come from a control panel, local transformer or similar, (to be supplied by others). For room sensors a section has been allocated at the bottom of the base to allow cable entry (see Fig. 6). For duct mounted sensors a variety of knock-outs have been provided in the enclosure suitable for cable gland entry (to be supplied by others). Take care when removing the knock-outs not to damage the PCB enclosed; if necessary take out the PCB prior to removal ensuring to replace the PCB securely when complete. Cable type to the sensor should be 3 Core 16/02mm (0.5mm²) not to exceed 50 metres; it is not good practice to run low voltage and mains rated cables together. Cut the wire back at the sensor so as to allow enough for a proper connection, strip the cables back and make good for termination. Terminal 3 is allocated for the modulating output. Terminal 4 is an optional ON/OFF output and is not modulating, giving a 24VAC output when the equivalent output would be at 5V and above (see Fig. 9). This might be appropriate for two-speed or 'trickle vent' systems.

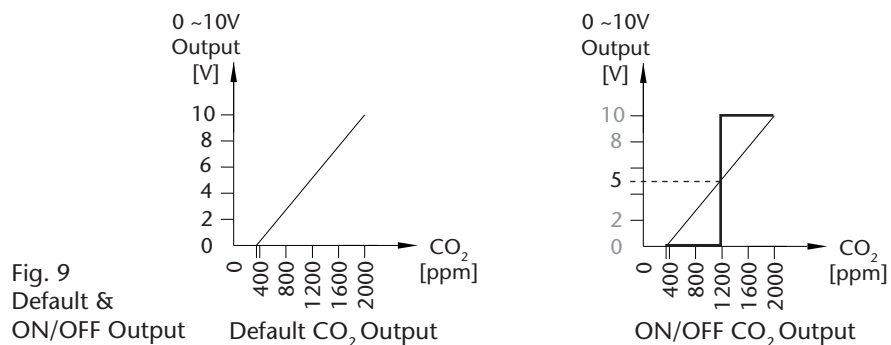


Fig. 9
Default &
ON/OFF Output



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Commissioning 7

To optimise the AQ Unit accuracy, a 15 minute warm-up time is required on power-up to stabilise the sensor output. During this warm-up time, if the L1 (Initial ventilation) jumper is linked, then AQ unit 0-10V-output will be 10V. After the 15 minutes warm-up time, the AQ unit acquires 2 sensors readings, and depending on the weight selection, the higher reading will represent the final output.

The carbon dioxide (CO₂) sensor will run a constant auto-calibration process whilst powered-up. This will guarantee the sensor accuracy and long-term measurement stability, for a period of 5 years or more, without the need for further external calibration.

For the purposes of this calibration process, the sensor requires an unoccupied time period during every 24 hours in order to establish a base (clean) level.

When first powered-up the CO₂ readings and output may not be very accurate, but after 24 hours running, this will stabilise.

The volatile organic compound (VOC) sensor requires a 3 day run-in to achieve an accurate reading. During the third day running an auto-calibration process will take place; again it is important to ensure that the air is not unnecessarily polluted during this time in order to achieve an accurate base level reading.

In order to allow correct adjustment of the ventilation system a commissioning mode has been provided. By removing links L4, L5 and L6 and following the correct procedure as shown on page 7 the sensor output will remain constant at 10V/100% allowing full output from the controlled system.

Important !

When commissioning is complete it is important that the system is fully powered-down, that links L4, L5 and L6 are correctly replaced and weighted (see Fig.14) and that the system is powered-up, in order to function correctly

Basic Setup 8

The following section details basic adjustment using the jumper links on the sensor board. The position of these jumpers can be seen in detail on page 4.

Important !

Changes to the initial ventilation (L1) and commissioning mode jumper links require a power up/down in order to activate any changes. This is not necessary for changes to other functions.

Initial Ventilation Selection

On initial power up, a 15 minute warm-up time is required to stabilise the sensor output. During this warm-up, if L1 (Initial ventilation) is linked, the AQ unit output will be 10V, allowing full system output. If the L1 link is removed prior to initial ventilation, the AQ output will be 0V during the warm-up period, allowing only minimum system output.

Initial Ventilation	Link L1
Activated	Yes
Deactivated	No

Fig. 10

Response Time

The response time is the rate at which the 0-10V output signal from the AQ unit is changed. There is no relationship between the response time and the frequency of sensor readings taken. The default value is set for slow response (L2 is not linked), which is every four minutes. This should be suitable for most applications.

The fast response time (L2 is linked) is set for a change every two minutes. This is most suitable for an environment where the occupancy levels change frequently.

Response Time	Link L2
Fast	Yes
No	No

Fig. 11



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Basic Setup P-band Adjustment

8

continued

P-band (proportional band) adjustment defines the limit of control around a given set point. With fine adjustment, a system can be setup to work at its most economical whilst ensuring optimum comfort levels.

When L3 is unlinked the relationship between the AQ unit output and the sensor reading is as shown in the graph below. This is the default setting and is suitable for most applications. Linking L3 initiates P-Band adjustment; for a full explanation please see **Advanced Setup**.

P-Band Adjustment	Link L3
Activated	Yes
Deactivated	No

Fig. 12

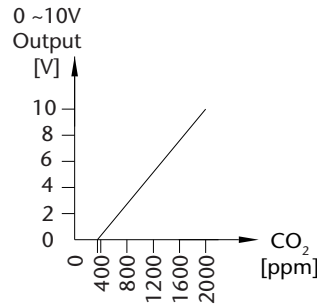
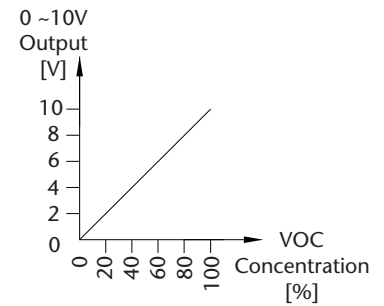


Fig. 13
Default Outputs



Default VOC Output

Weight Selection

Weight selection allows the bias between CO₂ and VOC to be changed. This is made via jumpers L4, L5, L6. To recap, CO₂ is inclined towards occupancy, and VOC towards environmental conditions.

The default weight setting is 50/50%. This would be recommended for most applications. The jumper connections and relevant CO₂/VOC weight relations are listed in Fig.14. This allows a range of weighting for 100% CO₂ to 100% VOC and in-between.

Weight %		Link		
CO ₂	VOC	L4	L5	L6
0	100	Yes	Yes	Yes
25	75	No	Yes	Yes
50	50	Yes	No	Yes
75	25	No	No	Yes
100	0	Yes	Yes	no
Commissioning *		No	No	No

Fig. 14

* 10V/100% Output - see **Commissioning** page 7

According to the above table:

If only L4 and L5 are linked (100/0%), only the CO₂ values affect the AQ unit 0-10V output.

If only L4 and L6 are linked (i.e., 50/50%), then AQ unit will compare the VOC and CO₂ concentrations equally and the higher will be that chosen.

If more CO₂ weight is selected (e.g., 75/25%); only when the VOC levels are much higher than CO₂ will the VOC values change the AQ unit output.



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Advanced Setup 9

Caution



The following setup should only be undertaken by a competent commissioning engineer. Incorrect adjustment will adversely affect the accuracy and performance of the AQ Unit.

Adjust with Care

Important



It is the responsibility of the designer/commissioning engineer to ensure adequate ventilation at low speed

Introduction

Before considering the application of CO₂ controlled ventilation systems it is important to address three essential aspects. First, minimum (fresh air) ventilation flow rates during occupancy have to be established. This will either mean conformance to mandatory requirements (ADBR Part F,) or selection from suitable design criteria (CIBSE Guides etc.). Second, estimates of occupancy patterns need to be established. Third, a CO₂ control or design level (or concentration) should be selected. The higher the control level the lower the fresh air volume supplied to the building. Conversely, the lower the control level the higher the fresh air volume and therefore a likely improvement in the indoor air quality at a higher running cost. There is much recorded evidence to support the theory that VOCs can contribute to Sick Building Syndrome (SBS). Indeed, even in relatively low concentrations, VOCs can have acute effects, which are similar in both type and time-course to SBS symptoms. The negative effect on the cognitive process when CO₂ levels are above 1000ppm have also been documented. The management of VOCs is dependant on the quality of the air used to substitute the contaminated air. Control of this kind needs careful consideration as the use of fresh air may mean risking further contamination if the outside air is also polluted.

CO₂ and VOC levels cannot normally be measured accurately without specific equipment, and as such choosing the ideal set point may be difficult. It may be necessary to readjust the unit several times in order to correctly commission the system.

P-band Adjustment

What is a P-band? P-band adjustment defines the limit of control around a given set point. With fine adjustment, a system can be setup to work at its most economical whilst ensuring optimum comfort levels.

There are two elements used to define the P-band setting, Set point (A) and Bandwidth (B). The set point is always at the centre of the bandwidth, and the output is 0~10V. The default bandwidth range for CO₂ is between 350ppm (parts per million) and 2000ppm, and for VOC is between 0~100% pollution. As a guide, the average CO₂ concentration in fresh air is around 350ppm (country side), rising up to 400ppm (city centre).

The set point value should represent the ideal average concentration levels, based on medium occupancy. The bandwidth then defines the upper and lower limits of this controlled range. It is important that these inputs are adjusted to suit the appropriate site conditions; incorrect adjustments will result in poor system performance. Too wide a bandwidth may cause a slow response and could result in poor ventilation. Too narrow a bandwidth may result in the output hunting causing the system to run uneconomically.

The table on page 10 show inputs to select the set point (RV2) and bandwidth selection (RV1), adjust the potentiometers as shown in Fig.4 with a small flat-bladed screwdriver.



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Advanced Setup Options P-band Adjustment

9

continued

Fig. 15

Comfort Levels

Average

Ideal

Excellent

Inputs		CO ₂ [ppm]		VOC [%]	
RV2	RV1	Output		Output	
Set Point	Bandwidth	Minimum (0V)	Maximum (10V)	Minimum (0V)	Maximum (10V)
A [1100ppm] [88%]	1	850	1350	75.5	100
	2	900	1300	78	98
	3	950	1250	80.5	95.5
	4	1000	1200	83	93
	5	1050	1150	85.5	90.5
B [1000ppm] [75%]	1	750	1250	62.5	87.5
	2	800	1200	65	85
	3	850	1150	67.5	82.5
	4	900	1100	70	80
	5	950	1050	72.5	77.5
C [900ppm] [63%]	1	650	1150	50.5	75.5
	2	700	1100	53	73
	3	750	1050	55.5	70.5
	4	800	1000	58	68
	5	850	950	60.5	65.5
D [800ppm] [50%]	1	550	1050	37.5	62.5
	2	600	1000	40	60
	3	650	950	42.5	57.5
	4	700	900	45	55
	5	750	850	47.5	52.5
E [700ppm] [38%]	1	450	950	25.5	50.5
	2	500	900	28	48
	3 ¹	550	850	30.5	45.5
	4	600	800	33	43
	5	650	750	35.5	40.5
F [600ppm] [25%]	1	350	850	12.5	37.5
	2	400	800	15	35
	3	450	750	17.5	32.5
	4	500	700	20	30
	5	550	650	22.5	27.5
G [500ppm] [13%]	1	350 ²	750	0.5	25.5
	2	350 ³	700	3	23
	3	350	650	5.5	20.5
	4	400	600	8	18
	5	450	550	10.5	15.5

¹Default Setting

²Minimum figure 350ppm, minimum output = 2V

³Minimum figure 350ppm, minimum output = 1.25V



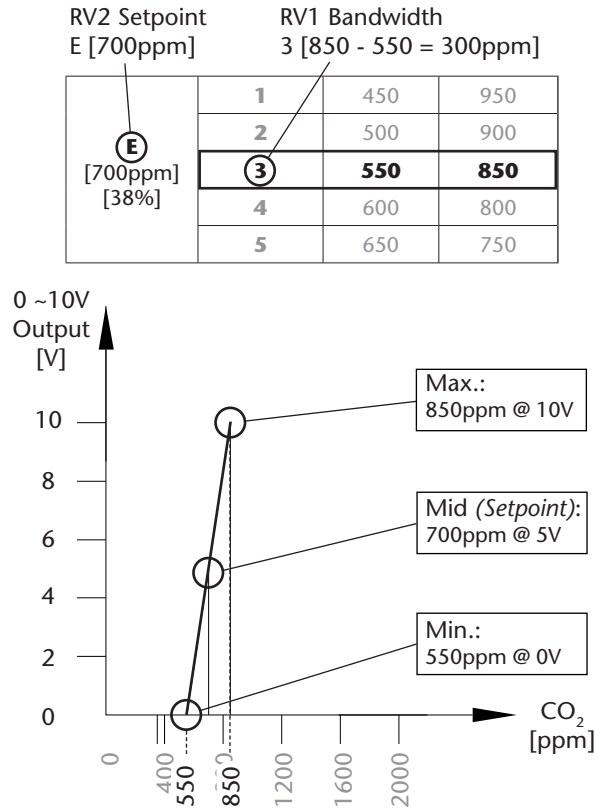
AQ Unit Air Quality Sensor

Installation, Operation and Maintenance Manual

Advanced Setup Options P-Band Adjustment

Example
Fig. 16

9 continued
Taking the ideal office setup to be RV2=E (700ppm), RV1=3 (300ppm), Fig. 16 shows the expected output range.



With this adjustment, the P-band range has been defined as between 550ppm (0V minimum sensor output) and 850ppm (10V maximum sensor output). The above example is based on a 100% weighted CO₂ system.

As a rule, if the system appears to constantly operate at 100% capacity, a higher set point (RV2 value) should be chosen. Similarly, if the system appears to hunt (unsettled, frequent adjustment of the system speed) then a wider bandwidth (RV1 value) should be used. If a fast response time is chosen, reselecting the slow response setting can also help to alleviate hunting problems.

Link Summary **10**

Fig. 17

The following is a summary to guide link selection. The default settings are highlighted in bold.

Initial Ventilation *	Link L1
Activated	Yes
Deactivated	No

Response Time	Link L2
Fast	Yes
Slow	No

P-Band Adjustment	Link L3
Activated	Yes
Deactivated	No

Weight %		Link		
CO ₂	VOC	L4	L5	L6
0	100	Yes	Yes	Yes
25	75	No	Yes	Yes
50	50	Yes	No	Yes
75	25	No	No	Yes
100	0	Yes	Yes	no
Commissioning *		No	No	No

* Changes to the initial ventilation (L1) and commissioning mode jumper links require a power up/down in order to activate any changes. This is not necessary for changes to other functions.



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Maintenance 11

Important

All accompanying documentation, including warning labels must be referred to prior to carrying out any work on our units.

Warning

Before attempting to carry out any maintenance work, investigative or repair work on our units, the unit **MUST BE COMPLETELY ISOLATED** from its electrical supply.

Ensure a minimum of two minutes after electrical disconnection before removing access panels. This will allow any moving parts to come to a rest.

When used in conjunction with an Inverter for speed control, a minimum of Five minutes should be given to allow for the capacitors to discharge before starting work.

Caution

Ensure that the AHU has been allowed to completely cool before attempting any work to the unit

Recommended Checks

In general, this series of units require very little maintenance. In the unlikely event of component failure, spares are available from stock at VES Andover Ltd.

Six Monthly Checks

The AQ/D Duct Sensor features a small filter, positioned behind the PCB, and can be accessed by removing the PCB. This should be checked periodically for an accumulation of dirt and cleaned as required. If the filter heavily soiled or damaged it should be replaced. Spare filter medium can be supplied upon request.

Each sensor features an end of life indicator on the PCB (see page 4). When the sensor ceases operation, the indicator will activate. This should be clearly visible through the enclosure of the AQ/R Room Sensor, and visible inside the AQ/D Duct Sensor during its periodic check. Should this be the case, the unit will need to be replaced.

Spares & Repairs

When enquiring after or ordering spares contact VES Spares Department, quoting the sales order (SO) number and unit type as found on the unit nameplate.

Telephone 08448 15 60 60 • Fax 02380 26 12 04

WEEE Directive



At the end of their useful life the packaging and product should be disposed of via a suitable recycling centre. Do not dispose of with normal household waste. Do not burn.



PLEASE ENSURE THAT THIS DOCUMENT IS PASSED ON TO THE END USER

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AQ Unit Air Quality Sensor

Installation, Operation and Maintenance Manual



Declaration of Conformity

Date: 1st. June 2008
Product: AQ Unit Air Quality Sensor
Type: AQ/R, AQ/D
Manufacturer: VES Andover Limited

The product above is produced in accordance with EC Council Directives:
2004/108/EC (Electromagnetic Compatibility Directive)

The European Harmonised Standards applied are:
EN61000

Basis of Self attestation:
Quality Assurance to ISO 9001-2000, BSI Reg. Firm Cert. No. Q5375

Signature of Manufacturer:

A handwritten signature in black ink, appearing to be 'C. White'.

Position of Signatory:

Technical Director



AQ Unit Air Quality Sensor

Installation, Operation and Maintenance Manual

Warranty

All VES Andover Products come with a one year guarantee from date of dispatch, which covers parts and labour.

You can now extend this with the following options:

Option 1. **FREE extended Warranty**

We can offer you a maintenance agreement that keeps this equipment in tip-top condition. If you take out this agreement, we will extend the warranty **free of charge for up to 5 years**, providing the regular maintenance agreement remains in place.

Option 2. **12-24 Month Extended Warranty**

12-24 months from the date of dispatch. This can be covered at a cost of just 3% of order value. (minimum charge £50.00).

Option 3. **12-36 Month Extended Warranty**

12-36 months from date of dispatch. For this cover, the charge is 6% of order value (Minimum charge £80)

Please State which option you require when you place your order. A transferable certificate will then be issued to you.

Please note, this offer excludes condensing units. We would be happy to quote you for these separately.

Register for separate spares reminders and get a 10% discount

Register for this free service and we will automatically send you a regular reminder detailing the consumable spares for this unit, together with their current list prices.

You will then be entitled to a 10% discount off any spares.

To arrange any of these options

Phone: 08448 15 60 60
or Email: spares@ves.co.uk

Stating the sales order and reference number from the unit.