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# User's Guide

## AQ Series

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***Senva Sensors***  
***9290 SW Nimbus Ave***  
***Beaverton, OR 97008***

**154-0011-0B**

| <b>Rev.</b> | <b>Release Date</b> | <b>Description of Change</b>         | <b>ECR</b> |
|-------------|---------------------|--------------------------------------|------------|
| 0A          | 10/10/2014          | Initial Release                      | ---        |
| 0B          | 10/30/2014          | Added firmware version to setup menu | ---        |
|             |                     |                                      |            |
|             |                     |                                      |            |
|             |                     |                                      |            |

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**References:**

- 152-0160      AQ Series Analog Installation Instructions
- 152-0161      AQ Series BACnet Installation Instructions
- 154-0012      AQ Series BACnet Protocol Guide

# User Menu

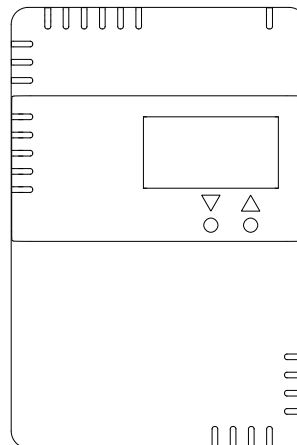
Access this menu by pressing the ▾ and △ buttons for one second.

## Navigation

- Pressing ▾ advances to the next menu item.
- If a menu item is visible, pressing △ displays the current value.
- If a value is visible, pressing △ selects the next value option.
- If a value is visible, pressing ▾ returns to the menu item list.

NOTE 1: If the installer has configured both °F and dSP in the *Setup Menu* (page 6), then the *User Menu* may be inaccessible.

NOTE 2: If the BACnet option is installed, and the user set point slider is NOT installed, pressing the ▾ and △ buttons separately will display and/or alter the set point value.



°F

Selects the unit system for displayed temperature measurements.

If the installer has already configured the units in the *Setup Menu*, (page 12) this parameter will not be accessible.

°F      Degrees Fahrenheit (default)

°C      Degrees Celsius

dSP

Selects the set of measurements for display.

If more than one measurement is selected, each measurement will display in rotation. The *dSt* parameter in the *Setup Menu* (page 12) controls the rotation interval. If an optional sensor is not factory installed, its measurement will be skipped in the rotation.

If the installer has already configured the set of measurements in the *Setup Menu*, (page 12), this parameter will not be accessible.

cht      CO2 Concentration, Relative Humidity, and Temperature (default)

c      CO2 Concentration only

h      Relative Humidity only

t      Temperature only

ch      CO2 Concentration and Relative Humidity

ct      CO2 Concentration and Temperature

ht      Relative Humidity and Temperature

d      Dew Point Temperature

S      User Set Point

OFF      Display disabled

ESC

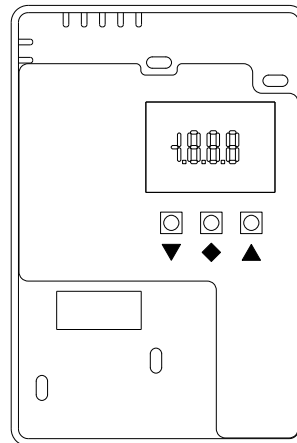
Close the menu.

# Quick Start Menu

Access this menu by removing the front cover and pressing the ▼ and ◆ buttons for one second.

## Navigation

- Pressing ◆ advances to the next menu item.
- If a menu item is visible, pressing ▼ or ▲ displays the current value.
- If a value is shown, pressing ▼ decreases the value, while pressing ▲ increases the value. If the button is held, the value will continue to change, at an accelerated rate. Pressing ▲ and ▼ together resets the value to the factory default. Changes are effective immediately.
- If a value is shown, pressing ◆ returns to the menu item list.



**SPT** Sets the relay turn-on threshold.  
For complete documentation, see **Pth** in the *Setup Menu* (page 7).  
Default: **800**

**SPH** Sets the relay turn-off hysteresis.  
For complete documentation, see **PHY** in the *Setup Menu* (page 8).  
Default: **100**

**SCL** Sets the CO2 concentration high output limit.  
For complete documentation, see **Chi** in the *Setup Menu* (page 11). If a value other than 2000 PPM or 5000 PPM has been previously set in the *Setup Menu*, the display will show **P (?)**. **Chi** always displays the exact value.

|          |                    |
|----------|--------------------|
| <b>2</b> | 2000 PPM (default) |
| <b>5</b> | 5000 PPM           |

**ADU** Sets the CO2 concentration calibration offset.  
For complete documentation, see **CAF** in the *Setup Menu* (page 10). Range: **-250** to **250**.  
Default: **0** PPM

**CAL** Sets the CO2 auto calibration period.  
For complete documentation, see **ACE** in the *Setup Menu* (page 11).

|            |                           |
|------------|---------------------------|
| <b>OFF</b> | Auto calibration disabled |
| <b>7d</b>  | 7 days                    |
| <b>14d</b> | 14 days (default)         |
| <b>30d</b> | 30 days                   |
| <b>60d</b> | 60 days                   |

°FC

Selects the unit system for displayed temperature measurements.

When *US°* is selected, the corresponding *User Menu* setting (page 3) controls the display units. When a unit system is selected, this setting controls the display units, and the *User Menu* setting is disabled. This parameter is equivalent to *°FC* in the *Setup Menu* (page 12).

*US°* User defined (default)

*°F* Degrees Fahrenheit

*°C* Degrees Celsius

LVL

Sets the analog output full-scale voltage.

This parameter is equivalent to *LVL* in the *Setup Menu* (page 9).

*5V* 5.0V full scale

*10V* 10.0V full scale (default)

FIN

Close the menu.

# Setup Menu

---

Access this menu by removing the front cover and pressing the ▲ and ▼ buttons for one second.

## Navigation:

- Same as the *Quick Start Menu* (page 4)

VER

Displays the device firmware version string.  
The version string contains the major, minor, and patch levels of the device firmware.  
This parameter is only available in firmware version 1.0.3 and later.

AdP

Sets the BACnet MS/TP MAC address. The full address range 0 to 127 is supported.  
This parameter can be changed through BACnet (see AV0 in the *Protocol Guide*).  
IMPORTANT: The device will not connect to the BACnet network until an address is set. Ensure there are no address conflicts on the network. For an alternate method of setting the MAC address, see *Auto Configuration* in the *Protocol Guide*.  
This parameter is only available on BACnet models.  
Default: 255 (Disabled)

id.1

Sets the least significant byte of the BACnet device instance. To facilitate setting the value on the LCD, the device instance is broken into three hexadecimal bytes ( id.1, id.2, and id.3) that can be modified separately. The full device instance range 0 to 4194302 is supported. Given an example desired device instance 665003, with its equivalent hexadecimal value 0x0A25AB,

id.1 corresponds to the digits AB

id.2 corresponds to the digits 25

id.3 corresponds to the digits 0A

The device instance can also be set over BACnet by writing the object identifier property of the device object (see *Device* in the *Protocol Guide*). Whenever the device instance is changed, the I-Am service will broadcast the new object identifier. For an alternate method of initializing the device instance, see *Auto Configuration* in the *Protocol Guide*.

IMPORTANT: Ensure the device instance is unique on the network. Multiple devices with the same device instance can cause unpredictable network operation.

These three parameters are only available on BACnet models.

Default: AB

id.2

Sets the middle byte of the BACnet device instance (see id.1).  
Default: 25

id.3

Sets the most significant byte of the BACnet device instance (see id.1).  
Default: 0A

## br

Sets the RS485 baud rate.

If automatic baud rate detection is enabled, the device will pause after every restart to detect the baud rate before joining the network. Automatic baud rate detection samples other network traffic to determine the active baud rate and cannot succeed when the network is quiet. The device will not transmit until automatic baud rate detection is successful.

**IMPORTANT:** Configuring an incorrect baud rate can cause unpredictable network operation. If the automatic baud rate detector is selecting the wrong baud rate, set the baud rate manually. For an alternate method of initializing baud rate, see *Auto Configuration* in the *Protocol Guide*.

This parameter is only available on BACnet models.

|                 |                               |
|-----------------|-------------------------------|
| <del>Ab</del>   | Automatic baud rate (default) |
| <del>96</del>   | 9600 baud                     |
| <del>192</del>  | 19200 baud                    |
| <del>288</del>  | 28800 baud                    |
| <del>384</del>  | 38400 baud                    |
| <del>576</del>  | 57600 baud                    |
| <del>768</del>  | 76800 baud                    |
| <del>1152</del> | 115200 baud                   |
| <del>2304</del> | 230400 baud                   |
| <del>4608</del> | 460800 baud                   |

## ms

Selects a measurement source for the relay threshold comparison.

When the relay becomes active, and the selected measurement is also displayed on screen, the measurement displays with blinking units. If the measurement becomes invalid, the relay output will default to **OFF**. (If the BACnet option is installed, the default value is configurable, see *BO0* in the *Protocol Guide*.)

**IMPORTANT:** When the measurement source is changed, the threshold (**rlh**) and hysteresis (**rlh**) values are not automatically updated. Always review these values after changing the measurement source.

This parameter can be changed through BACnet (see *MSV4* in the *Protocol Guide*).

|            |                             |
|------------|-----------------------------|
| <b>t</b>   | Temperature                 |
| <b>h</b>   | Relative Humidity           |
| <b>d</b>   | Dew Point Temperature       |
| <b>c</b>   | CO2 Concentration (default) |
| <b>S</b>   | User Set Point              |
| <b>OFF</b> | Relay disabled              |

## rlh

Sets the relay turn-on threshold.

When the relay comparison polarity (**rlp**) is active high, the relay will activate when the measured value is greater than the threshold. When the polarity is active low, the relay will activate when the measured value is lower than the threshold.

The units of this value vary with the current selected measurement source.

This parameter can be changed through BACnet (see *AV23* in the *Protocol Guide*).

Default: **800**

PHY

Sets the relay turn-off hysteresis.

When the relay comparison polarity is active high, the turn-off threshold is found by subtracting the hysteresis from the turn-on threshold. When the relay comparison polarity is active low, the turn-off threshold is found by adding the hysteresis to the turn-on threshold.

The units of this value vary with the current selected measurement source.

IMPORTANT: Negative hysteresis can cause relay instability. The device always takes the absolute value of the hysteresis in calculations.

This parameter can be changed through BACnet (see AV 24 in the *Protocol Guide*).

Default: 100

PPo

Sets the polarity of the relay comparison.

See the relay turn-on threshold and turn-off hysteresis for behavior of this menu item.

This parameter can be changed through BACnet (see MSV 5 in the *Protocol Guide*).

HI Active high (default)

LO Active low

POt

Sets the relay minimum on time, in seconds.

When the relay becomes active, it cannot become inactive again until the minimum time has elapsed. (EXCEPTION: BACnet models have a commandable relay, and can be overridden.)

This parameter can be changed through BACnet (see BO 0 in the *Protocol Guide*).

Default: 60 seconds

POFt

Sets the relay minimum off time.

When the relay becomes inactive, it cannot become active again until the minimum time has elapsed. (EXCEPTION: BACnet models have a commandable relay, and can be overridden.)

This parameter can be changed through BACnet (see BO 0 in the *Protocol Guide*).

Default: 60 seconds

SUn

Selects the user set point units.

The units are for display only; the set point value has no numeric significance to the device. When OFF is selected, the set point value will not be displayed when changed. Pressing the ▽/△ buttons (or adjusting the slider) still affects the internal set point value, and the controller can still read over the network interface.

This parameter is only available on BACnet models.

This parameter can be changed through BACnet (see MSV 3 in the *Protocol Guide*).

OFF User controlled

NU No units

°F Degrees Fahrenheit (default)

°C Degrees Celsius

RH Percent Relative Humidity

CO2 Parts Per Million

PSI Pounds per Square Inch

KPA Kilo-Pascals

H2O Inches of Water



- S.h 1** Sets the maximum user set point value.  
 If the slider is installed, the maximum corresponds to the top of the slider's travel range. Set the minimum value larger than the maximum to invert the slider range.  
 This parameter is only available on BACnet models.  
 This parameter can be changed through BACnet (see AV 20 in the *Protocol Guide*).  
 Default: 95
- S. lo** Sets the minimum user set point value.  
 When the slider is installed, the minimum corresponds to the bottom of the slider's travel.  
 This parameter is only available on BACnet models.  
 This parameter can be changed through BACnet (see AV 21 in the *Protocol Guide*).  
 Default: 50
- S. in** Sets the minimum user set point value increment/resolution.  
 When the slider is installed, the position is rounded to the nearest multiple of the increment, anchored from the minimum set point value. Otherwise, the set point value is decremented or incremented by this amount each time the ▽ or △ button is pressed, respectively.  
 This parameter is only available on BACnet models.  
 This parameter can be changed through BACnet (see AV 22 in the *Protocol Guide*).  
 Default: 10
- LVL** Sets the analog output full-scale voltage.  
 This parameter is only available on analog models.
- |     |                            |
|-----|----------------------------|
| 5v  | 5.0V full scale            |
| 10v | 10.0V full scale (default) |
- t.of** Sets the temperature calibration offset.  
 The calibration offset is applied to the raw sensor reading. The display and output use the adjusted value. The output value will always match the display value.  
 This parameter can be changed through BACnet (see AV 6 in the *Protocol Guide*).  
 Default: 0 °F / 0 °C
- t. lo** Sets the temperature low-output limit.  
 The low output corresponds to the analog output 0.0V. Set the low output limit above the high output limit to invert the output scale.  
 This parameter is only available on analog models.  
 Default: 50 °F ( 10 °C)
- t.h 1** Sets the temperature high-output limit.  
 The high output corresponds to the analog output full scale (either 5.0V or 10.0V).  
 This parameter is only available on analog models.  
 Default: 95 °F (35 °C)

- t.r.t** Sets the temperature response time (90% step).  
This parameter can be changed through BACnet (see AV 7 in the *Protocol Guide*).  
Default: 30 seconds
- H.o.F** Sets the relative humidity calibration offset.  
The calibration offset is applied to the raw sensor reading. The display and output use the adjusted value. The output value will always match the display value.  
This parameter is only available on models with a humidity sensor.  
This parameter can be changed through BACnet (see AV 9 in the *Protocol Guide*).  
Default: 0 %RH
- H. l.o** Sets the relative humidity low output limit.  
The low output corresponds to the analog output 0.0V. Set the low output limit above the high output limit to invert the output scale.  
This parameter is only available on analog models with a humidity sensor.  
Default: 0 %RH
- H.h. i** Sets the relative humidity high output limit.  
The high output corresponds to the analog output full scale (either 5.0 V or 10.0 V).  
This parameter is only available on analog models with a humidity sensor.  
Default: 100 %RH
- H.r.t** Sets the relative humidity response time (90% step).  
This parameter is only available on models with a humidity sensor.  
This parameter can be changed through BACnet (see AV 10 in the *Protocol Guide*).  
Default: 30 seconds
- C.o.F** Sets the CO2 concentration calibration offset.  
The calibration offset is applied to the sensor reading. If the internal auto-calibration is enabled, the auto calibration compensation is applied before the manual offset. The display and output use the adjusted value. The output value will always match the display value.  
This parameter is only available on models with a CO2 sensor.  
This parameter can be changed through BACnet (see AV 15 in the *BACnet Protocol Guide*).  
Default: 0 PPM
- C. l.o** Sets the CO2 concentration low-output limit.  
The low output corresponds to the analog output 0.0V. Set the low output limit above the high output limit to invert the output scale.  
This parameter is only available on analog models with a CO2 sensor.  
Default: 0 PPM

Ch1

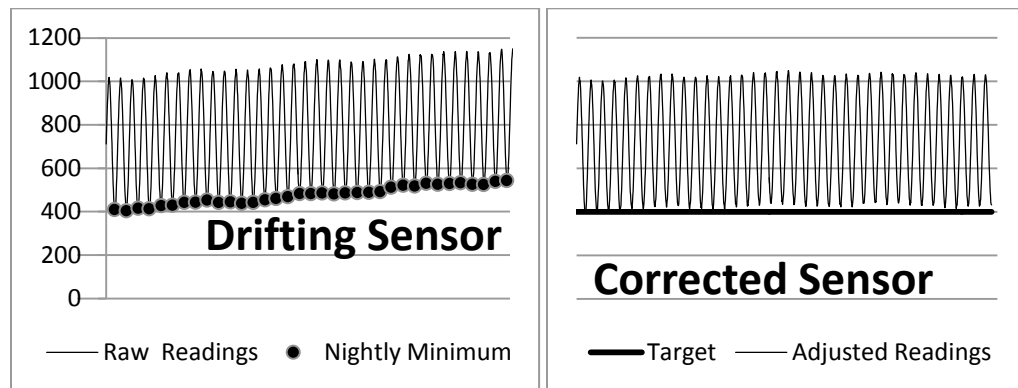
Sets the CO2 concentration high output limit.  
The high output corresponds to the analog output full scale (either 5.0V or 10.0V).  
This parameter is only available on analog models with a CO2 sensor.  
Default: 2000 PPM

Cr1

Sets the CO2 concentration response time (90% step).  
This parameter is only available on models with a CO2 sensor.  
This parameter can be changed through BACnet (see AV 16 in the *Protocol Guide*).  
Default: 30 seconds

AC1

Sets the CO2 auto-calibration target, between 400 and 1000 PPM.  
The target defines the expected nightly CO2 minimum readings when an environment is regularly flushed with outside air. If the environment is continuously occupied, with no regular CO2 flushes, disable auto-calibration with *ACd* (page 12).  
Auto-calibration compensates long-term CO2 sensor drift in the sensor element. The algorithm aligns the actual minimum nightly readings with the calibration target. For best results, define the target based on the expected CO2 concentration profile in the installed location.



This parameter is only available on models with a CO2 sensor.  
This value can be changed through BACnet (see AV 18 in the *Protocol Guide*).  
Default: 400 PPM

ACr

Sets the CO2 auto-calibration window range, between 100 and 1000 PPM.  
The range is added to the auto-calibration target to define a window for CO2 sensor drift compensation. The range helps exclude periods when an environment may be occupied unexpectedly and the CO2 concentration does not return to the baseline. CO2 minimum nightly readings outside the window are discarded. For best results, define the range based on the expected CO2 concentration profile in the installed location.  
EXAMPLE: Consider a facility with typical background CO2 levels of 450 PPM on weeknights that is continuously occupied on weekends with CO2 levels of 600 PPM or higher. Setting an auto-calibration target of 450 PPM with a window of 100 PPM allows the algorithm to select only the stable weeknight minima for background sensor compensation.  
This parameter is only available on models with a CO2 sensor.  
This value can be changed through BACnet (see AV 19 in the *Protocol Guide*).  
Default: 200 PPM

**ACd**

Sets the CO2 auto-calibration period.

The period defines (in days) a rolling window for CO2 sensor drift compensation. Only minimum nightly readings in the last N days are included in the calculation. Increase the length of the period when CO2 readings in the environment are irregular or noisy. The maximum period is **60** days. If the environment is continuously occupied, with no regular CO2 flushes, disable auto-calibration by setting the period to **0**.

This parameter is only available on models with a CO2 sensor.

This value can be changed through BACnet (see *AV 17* in the *Protocol Guide*).

Default: **14** days

**oFC**

Selects the unit system for displayed temperature measurements.

When **USP** is selected, the °FC parameter in the *User Menu* (page 3) controls the display units. Otherwise, this parameter controls the display units, and the *User Menu* parameter is disabled.

This value can be changed through BACnet (see *MSV 1* in the *Protocol Guide*).

**USP** User defined (default)

**oF** Degrees Fahrenheit

**oC** Degrees Celsius

**dSP**

Selects the set of measurements for display.

If more than one measurement is selected, each measurement displays in rotation. The **dSt** parameter (below) controls the rotation interval. If a measurement is selected, but an optional sensor is not installed, that measurement will be skipped in the rotation. The measurement is continuously refreshed during the display interval.

When **USP** is selected, the **dSP** parameter in the *User Menu* (page 3) controls the set of selected measurements. Otherwise, this parameter controls the display units, and the *User Menu* parameter is disabled.

This value can be changed through BACnet (see *MSV 0* in the *Protocol Guide*).

**USP** User controlled (default)

**cht** CO2 Concentration, Relative Humidity, and Temperature

**c** CO2 Concentration only

**h** Relative Humidity only

**t** Temperature only

**ch** CO2 Concentration and Relative Humidity

**ct** CO2 Concentration and Temperature

**ht** Relative Humidity and Temperature

**d** Dew Point Temperature

**S** User Set Point

**OFF** Display disabled

**dSt**

Sets the display rotation interval.

The display rotation interval applies when more than one measurement is selected.

This value can be changed through BACnet (see *AV 4* in the *Protocol Guide*).

Default: **10** seconds

CON

Sets the display contrast.

Large values correspond to a darker screen.

This value can be changed through BACnet (see AV 3 in the *Protocol Guide*).

Default: 50 %

ESC

Close the menu.

RESET

Reset the configuration to factory defaults.

WARNING: All configuration changes will be lost. There is no way to recover configuration. Cumulative CO2 auto-calibration data will also be lost. If the BACnet option is installed, the device will disconnect until the network is re-configured.

# Diagnosics

---

The firmware continuously monitors sensor and communication data for error conditions. Many conditions are transient and self-correcting. To assist in troubleshooting, the device can display unique codes identifying many common faults. Use the following table to identify each code a device may display. If any error persists, or if an unlisted code appears, please contact technical support.

|             |  |
|-------------|--|
| <b>E08</b>  | <b>CO2 Framing Error</b><br>A connection fault was detected in the CO2 sensor communications. Check the sensor module and connections; re-seat if necessary.   |
| <b>E 10</b> | <b>CO2 CRC Mismatch</b><br>Invalid data was received from the CO2 sensor module. Check the sensor module and connections; re-seat if necessary.  |
| <b>E 11</b> | <b>CO2 Internal Error</b><br>The CO2 sensor module detected an internal fault. Sometimes occurs when the CO2 sensor module is warming up after device power-on.  |
| <b>E 13</b> | <b>BACnet Framing Error</b><br>Invalid data was received by the MS/TP receiver. Check device baud rate; it must match the network baud rate. Check the RS485 signaling levels and terminations.  |
| <b>E 17</b> | <b>MS/TP Header CRC Mismatch</b><br>An invalid MS/TP header was received. Check the RS485 signaling levels and terminations.   |
| <b>E 18</b> | <b>MS/TP Data CRC Mismatch</b><br>An invalid MS/TP frame was received. Check the RS485 signaling levels and terminations.  |
| <b>E 19</b> | <b>MS/TP Frame Too Long</b><br>An MS/TP frame was truncated in the device RX buffer. Truncated frames are discarded with no reply. The maximum supported frame length is 512 bytes.  |
| <b>E20</b>  | <b>Humidity Sensor Module Fault</b><br>The humidity sensor module failed to acknowledge a measurement request. Check the sensor module and connections; re-seat if necessary.  |
| <b>E23</b>  | <b>Remote Restart Pending</b><br>The device cannot process APDUs or NPDUs until the restart has been completed.  |
| <b>E24</b>  | <b>Dropped I-Have Reply</b><br>This error occurs when the current MS/TP master dispatches multiple Who-Has queries that match objects on the device without releasing the token. This is an inherent device limitation. To work around this limitation, release the MS/TP token so this device can broadcast each I-Have reply before dispatching another Who-Has query. |
| <b>FFF</b>  | <b>Failed Internal FLASH Memory test</b><br>The device firmware may be corrupted. This error can only be displayed at device power-on. Contact technical support.  |