OPERATING MANUAL

for

V –SENSOR

LOW AIR PRESSURE / VELOCITY SENSOR

CMR CONTROLS Ltd
AIR MANAGEMENT SYSTEMS

22 Repton Court, Repton Close,
Basildon, Essex, SS13 1LN, GB.
Website: www.cmr.co.uk

Tel: +44 (0) 1268 287222
Fax: +44 (0) 1268 287099
E-mail: sales@cmr.co.uk

OPERATING MANUAL **V-SENSOR**

Contents

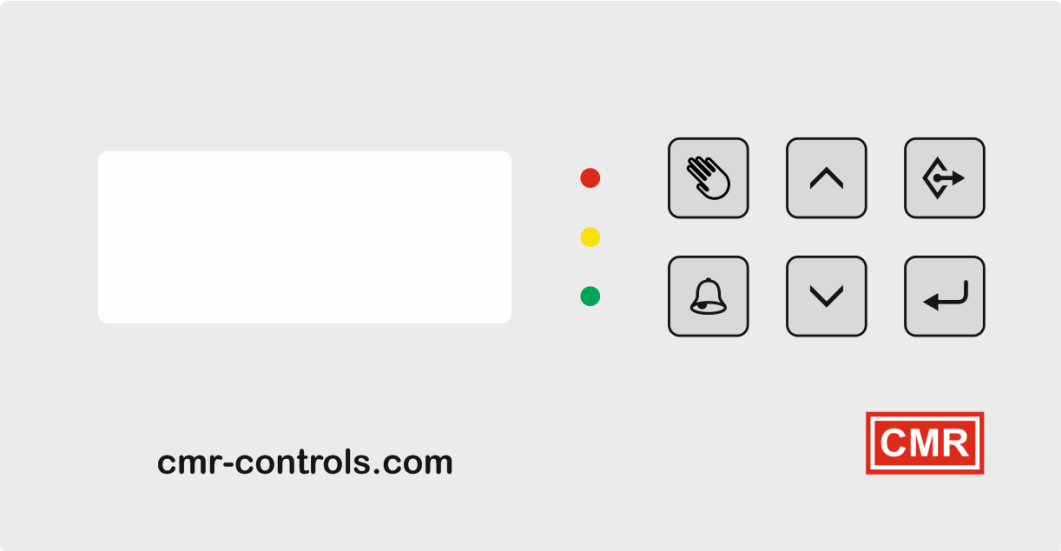
1.0 OVERVIEW

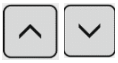
The V-SENSOR is a wall or panel back plate mounted air pressure / velocity sensor that provides an output signal of 0-10 V, 4-20 mA.

The unit has an alarm relay output, Modbus communications and a separate connection to drive a remote display.

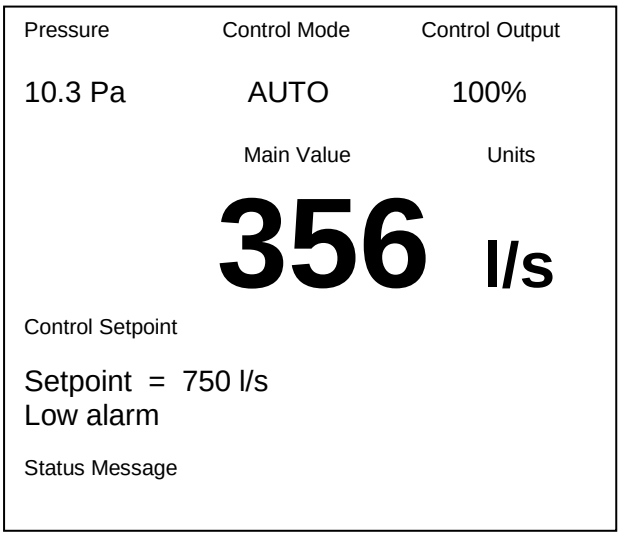
The display shows the actual pressure or velocity/volume in the selected units depending on the settings. All necessary adjustments can be made via the front membrane keyboard, the layout of which is shown below.

1.1 MEMBRANE KEYBOARD LAYOUT



	**Program key functions** Press to enter the configuration menu. Cancels parameter changes. Menu exit key.
	**Hand key functions** Hold to change control mode when PID control mode is enabled. Press to change hand setpoint in hand control mode. Acts as a digit select key when entering values. Parameter help key. Pressing this key in a menu will give information on the parameter.
	**Up & Down keys** Press to step through Normal, Information and Diagnostic screens. Hold to step through one screen at a time. Used to set values when modifying parameters.
	**Bell key functions** Alarm mute key. Sets the decimal point position when modifying parameters.
	**Enter key functions** Hold to automatically zero the sensor. Menu enter key. Confirms parameter changes.

1.2 DISPLAY



Main Value and units
The main value can be configured to show
Pressure in Pa, mB or kPa.
Velocity in m/s
Volume in l/s, m^3/s or m^3/h
Air change rate in ac/h (air changes per hour)

The number of decimal places shown can be configured from 0 to 4. If value is too large to be displayed with the set number of decimal places then the number of decimal places will be reduced so that the reading still fits on the display. If the number is too large to display in 5 digits, e.g. for m^3/h, the size of the characters will be reduced so that 6 digits can be displayed and then reduced further if needed so that 7 digits can be displayed.

Pressure
If the main value is not showing pressure, the value of the applied pressure will be displayed. This is useful for fault finding. For example if there is a negative pressure applied to a sensor displaying volume in m^3/s then it can be seen why the main display is showing zero.

Control Mode
If control mode has been enabled this will show OFF, AUTO or HAND. See the Control Mode section.

Control Output
If control mode has been enabled this will show the value of the control output in %.

Control Setpoint
If control mode has been enabled this will show the value of the setpoint.

Status message
This gives information on alarms, over pressure conditions and faults.

Up/ Down keys function
By pressing the Up key, the following information screens are displayed:

Information

V-Sensor SN 123456
Range = 2535 l/s
MODBUS Address = 26
Firmware: 4.15_1.17
Output: Square Root

The range is the full scale range of the sensor in the units that are being displayed. This information is required when scaling a BMS input for the sensor. When the sensor is reading 2535 l/s in this case, the output would be 10V or 20mA. See Section 3.

Factory Settings

V-Sensor SN 123456
Range= 100 Pa
Part: 242A0000P0100Q13
Power supply: 24 Vac
Span+ 9975 Span- 9910

This is a record of settings in the sensor that were made at the factory. This information will not change even if the sensor range is changed by the user. The span counts information could be used in calibration mode to restore the factory calibration settings.

Output

Volts: 0-10 V Control
mA: 4-20 mA Signal
-50 Pa = 0.0 V/ 4.0 mA
0 Pa = 5.0 V/ 12.0 mA
+50 Pa = 10.0 V/ 20.0 mA
Expected: 10.0 V/ 12.0 mA

This display is useful for diagnosing problems with the voltage and current outputs from the sensor.

The top two lines show the configuration of the voltage and current outputs. 'Control' means that the output has been configured as a control output and that control mode has been enabled. 'Signal' means that the output is a signal output from the sensor.

The next three lines show the voltage and current that will be output for minimum, zero and maximum pressures. If the sensor does not have a negative pressure range or if it is measuring velocity or volume then only zero and maximum will be shown.

The bottom line shows the voltage and current that the sensor is currently expected to produce. These values will change in real time as the pressure changes. The voltage or current output can be measured and compared with the display to check that the sensor outputs are working correctly.

Diagnostics

ADC Counts = 4500
Comms Rx = 123
Comms Tx = 32
Temperature = 29.3 C
Runtime 178.1 Days

ADC counts should be in the range -12,000 to +12000. A value below -15,000 or above +15,000 without pressure applied would indicate a fault with the sensor.

Rx increments when a packet is received over the communications network. Tx increments when the sensor transmits a reply. If Rx is changing but Tx is steady then it is likely that the sensor has not received communications for its address. Received data which is corrupt or not in the correct format could be another cause.

The temperature is read from a sensor on the internal circuit board and will normally be a few degrees above ambient.

2.0 CONFIGURATION

Press the Program key to access the Main Menu. Use the Up/Down keys to highlight the desired sub menu and then press the Enter key to open the sub menu. A list of parameters and their values is now displayed. There will be a short delay while the list is populated with values read from the sensor. Values will display as dashes ----- until loaded from the sensor.

If the HAND key is pressed while the sub menu is displayed, a help screen is shown which displays information on the highlighted parameter. The help message stays displayed for 30 seconds or can be closed by pressing any key.

To open a parameter for modification, use the Up/Down keys to highlight the parameter and then press Enter to view the parameter. If the parameter has units then they will now be displayed.

To change the value of the parameter either:

Single step up and down with the Up/Down keys.
Hold the Up/Down keys to change the value more rapidly.
Use the Hand key to select a digit and then modify that digit up or down.

Some parameters can have the decimal point position changed by pressing the BELL key.

To confirm the change to the setting press Enter key.
To cancel the change to the setting press Program key.

2.1 Sensor Menu

1. **Auto Zero**
   When set to ON, the internal electronic air valve will remove air pressure from the sensor periodically, and the sensor will be zeroed. During this period the Output Signal, the Display and the Modbus registers will be held at their current values.

2. **Pos range**
   This is the positive range of the sensor in Pa. This can be adjusted between 50% and 150% of the 'Range=' value shown on the Factory Settings screen without losing accuracy. The negative range below can also be adjusted by the same amount.

3. **Neg Range**
   This is the negative range of the sensor in Pa. This must be entered as a positive number. e.g. for a -100 Pa to +100 Pa sensor this value is entered as 100.

4. **Offset**
   A zero offset in Pa may be set. This value is added to the sensor reading so that for example, if -5.0 is entered the sensor will now read -5.0 Pa with no pressure applied to the instrument. For sensor ranges of less than 1000 Pa an offset of +/-199.9 Pa can be set. For sensor ranges of 1000 Pa or more an offset of +/-1999 Pa can be set.

5. **Zero Interval**
   The time in hours between auto zero cycles. 1 to 99 hours.

6. **Protection**
   When set to On, the internal valve will remove air pressure from the sensor when an over-pressure condition is detected. After a delay, the air valve will return to its normal operation. If the over-pressure condition is still present, the air valve will remove the air pressure once again. This routine will continue until the over-pressure condition is removed. If the over-pressure condition is positive, 'Overload' will be shown on the display, and the sensor output will go to 10 V/20 mA. If the over-pressure condition is negative, 'Underload' will be shown on the display and the sensor output will go to 0 V/0 mA.

2.2 Output Menu

1. **Smoothing Volts**
   This will set the smoothing of the voltage output signal. The value of between 0 and 99 represents a time constant of between 0 and 10 seconds.

2. **Smoothing mA**
   As above but for the mA output.

3. **Min Volts**
   The minimum output voltage. For example 0 for a 0-10 V sensor.

4. **Max Volts**
   The maximum output voltage. For example 10 for a 0-10 V sensor.

5. **Min mA**
   The minimum output current. For example 4 for a 4-20 mA sensor.

6. **Max mA**
   The maximum output current. For example 20 for a 4-20 mA sensor.

7. **Cal Freeze**
   If set to ON, the sensor output signal will be frozen at its last value during calibration mode.

8. **Square Root**
   This is set automatically when the display units are changed. If the display units are set for pressure (Pa, mB or kPa), then Square Root = OFF to give a linear output with pressure. If the display units are set to velocity, volume or air change rate (m/s, l/s, m^3/s, m^3/h or AC/h) then Square Root = ON to give a linear output with velocity or volume.

   If required, this setting can be changed manually. For example if the display is set to m^3/s but the square rooting of the output is being done externally by a PLC or BMS then the Square Root setting can be changed to OFF. Note that the setting will revert back to the automatic setting if the display units are changed.

2.3 Display Menu

1. **Smoothing**
   This will set the smoothing of the main display value. The value of between 0 and 99 represents a time constant of between 0 and 10 seconds.

2. **Units**
   Sets the units displayed by the sensor. For units in Pa, mB and kPa the sensor is a pressure sensor with the output linearly proportional to pressure. For m/s, l/s, m^3/s, m^3/h or Ac/h the output is square rooted so that it is linearly proportional to velocity or volume.

3. **Decimal places**
   The maximum number of places that will be shown after the decimal point for the main value. If the value is too big to be displayed with the selected number of decimal places then it will be truncated to fit.

4. **Negated**
   This is normally set to Pos. If set to Neg then the display will show a negative value when the sensor is actually measuring a positive pressure. This is useful when measuring an extract pressure by connecting to the negative port of the sensor to give a positive going output signal. The value can be made to show e.g. -500 Pa even though the sensor is actually measuring +500 Pa.

5. **Timeout**
   If this is set to On, the display will turn off after a period of two minutes. Pressing a key will wake it up.

6. **Brightness**
   Sets the brightness of the LCD backlight. 10 to 100%. Default = 50%.

7. **Contrast**
   Sets the display contrast. 0 to 100%. Default = 72%.

8. **LCD mode**
   W on B = white text on a black background (default). B on W is the reverse.

2.4 Flow Scaling Menu

1. **Method**
   This is the method used by the sensor to convert the differential pressure to a velocity or volume. It can be set to one of the following:

   MAG
   The magnification factor of the measurement device is used together with the air density to give velocity and then multiplied by the duct area to give volume. The mag factor is the ratio of the pressure produced by the measurement device to the pressure that would be produced by a pitot tube.

   LIN PT
   The volume for a given pressure is looked up from a table. See Linearization Table section for details.

   KFAC1 or KFAC2
   For use when an equipment manufacturer (Fan / CAV or VAV box), has given a K factor. Different fan manufacturers use different methods of calculating K factors. K-Factors may be given in different units e.g. m^3/s or m^3/h. The K-Factor needs to be in the same units that the sensor is set to display.
   KFAC1 Volume = K*root(Pa).
   KFAC2 Volume = K*root(Pa/Density).
   KFAC3 Volume = K*root(2*Pa/Density). *Software V4.19 or later.*

2. **Mag Factor**
   Used if the method is set to Mag Factor. See Method above.

3. **K Factor**
   Used if the method is set to K Factor. See Method above.

4. **Duct Width**
   The duct width in mm. This is used when the sensor is displaying volume or air change rate and the Method is set to Mag Factor. If flow elements are placed in attenuator airways, only enter the total airway width not the overall duct width. e.g. 3 airways at 200 mm = 600 mm.

5. **Duct Height**
   The duct height in mm for a rectangular duct. Enter 0 for a round duct. This is used when the sensor is displaying volume or air change rate and the Method is set to Mag Factor.

6. **Air Density**
   The air density in kg/m^3. This is used if 'Method' is MAG or KFAC2. Not used for LIN PT or KFAC1. The default value is 1.200.

7. **SVS**
   Small value shutoff. This clamps the display and signal output to zero if the pressure reading is less than this setting which is in % of full scale pressure range. The default value is 0.2%. This is utilised to ensure that the display reads zero when the ventilation plant is switched off, even though some natural passive air movement may remain.

8. **Room Size**
   The room size in cubic metres for use when the display units are set to ac/h.

9. **Rescaling**
   A value can be set here to change the full scale range of the sensor to a different value. This is particularly useful when the output is connected to an external system (BMS / PLC / Chart Recorder) which already has input scaling set. For example if this value is set to 5.000 m^3/s then when the sensor is measuring 5.000 m^3/s, the output will be 10 V/20 mA. This value defaults to 0 which means it is ignored.

   We would always recommend setting the BMS to match the sensor where possible because it is better to minimize the number of parameters that would need to be changed if the sensor was replaced.

10. **Bi-dir**
    Bi-directional Flow Enable. Factory set to OFF, bidirectional flow measurement disabled. It is possible to measure airflow in both directions. To achieve this, parameter must be set to ON, the Min Volts or Min mA (Output menu) must be set to 5 V or 12 mA and Max Volts or Max mA must be set to 10 V or 20 mA. Full scale forward flow will output 10 V/20 mA and full scale reverse flow will output 0 V/4 mA. The display will show a negative reading for a reverse flow.

    When bidirectional flow is enabled, the small value shutoff will operate in a band either side of zero.

2.5 Alarm Menu

The V-SENSOR can indicate an alarm condition by the red light on the keyboard, over Modbus or on a remote alarm display plate connected on Modbus.

1. **Low Threshold**
   The Low Alarm threshold. This will be in the same units as the display.

2. **Low Alarm**
   Low Alarm Enable. Set to ON to enable the low alarm.

3. **High Threshold**
   The High Alarm threshold. This will be in the same units as the display.

4. **High Alarm**
   High Alarm Enable. Set to ON to enable the high alarm.

5. **Timer 1**
   See Function below.

6. **Timer 2**
   See Function below.

7. **Relay Polarity**
   ND= normally de-energized. NE=normally energized. For normally de-energized, the relay is normally off and energizes when in alarm. For normally energized, the relay is energized for the healthy condition and drops out for an alarm condition.

8. Function

0 MODBUS DIRECT ALARM

The relay and buzzer can be driven directly via Modbus. See Section 8.0 Communications.

1 NOT USED

2 DEFAULT

If the signal is outside of either of the thresholds for longer than the Timer 1 setting then the Relay is set, the Buzzer sounds, and the keyboard LEDs change from green to red. If the BELL key is pressed then the Buzzer is muted.

If Self Reset is ON, the Relay, keyboard LED will be reset to normal once the signal has been within the thresholds for longer than the Timer 2 setting. If Self Reset is OFF, the Relay and LED won't reset until the BELL key has been pressed.

3 STAGE 1 / STAGE 2

If the signal is outside of either of the thresholds for longer than the Timer 1 setting, the buzzer sounds and the keyboard LED changes from Green to Red. Timer 2 then starts and if the signal is still out of threshold when Timer 2 expires, the relay is set.

Pressing the BELL key before Timer 2 expires will reset the buzzer. The relay will still be set when Timer 2 expires. Pressing the BELL key after Timer 2 expires will reset the buzzer and will also reset the relay if the Mute Mode parameter is set to RL+BUZ.

If Self Reset is set to ON, the alarm will reset automatically when the signal has come back into threshold.

If Self Reset is set to OFF, the alarm will reset automatically if the signal comes back within threshold before Timer 2 expires. The BELL key will need to be pressed to clear the alarm once Timer 2 has expired.

9. Self Reset

See 'Function' above.

10. Mute Mode

See 'Function' above.

11. Buzzer Mode

OFF =	The internal Buzzer does not function.
CONT =	The internal Buzzer will be on continuously for an alarm condition.
PULSE =	The internal Buzzer will be pulsed on and off for an alarm condition

12. Re-alarm Time

The re-alarm timer can be set between 1 and 999 minutes. If the re-alarm timer is set to zero then it is disabled. The re-alarm timer starts when the BELL key is pressed to mute the buzzer. If the alarm condition is still present when the re-alarm timer expires, the buzzer is turned on again.

13. **Timer Units**
    The default is seconds but can be changed to hours if the 0 to 9999 second range is not long enough.

14. **Pulse Relay**
    If this is set to ON then the Relay will pulse on and off when in alarm.

2.6 Control Menu

The V-SENSOR has a PID control function which can control the Voltage output or the mA output to control an actuator or a VSD.

When the control function is enabled, the control mode can be changed using the HAND key. Holding down the HAND key allows the mode to be changed to OFF, AUTO or HAND. In OFF mode the control output is set to 0 V or 0 mA. In HAND control mode, pressing the HAND key will allow the hand setpoint to be adjusted. The control mode and setpoints can also be changed over Modbus.

1. **PID Control**
   Set to ON to enable the control function.

2. **Power state**
   Sets the control mode at power up to OFF, HAND or AUTO. RETAIN keeps the settings.

3. **Auto SP**
   The setpoint for automatic control mode. In the same units as the display.

4. **Hand SP**
   The setpoint in % for hand control mode.

5. **Prop. Gain**
   Proportional Gain

6. **Integral Gain**
   Note that this is Integral Gain not Integral Time. Increasing this value will speed up the response of the control output

7. **Derivative**

8. **Deadband**
   The deadband is set as a percentage of the range of the sensor.

9. **Ramp Speed**
   The output may be slowed down by increasing the ramp speed. It is recommended to use the P and I settings to control the output rather than the ramp speed.

10. **Control OP**
    Either the Voltage output or the mA output can be set as the control output. The other output will be the sensor output. If a 2-10V actuator is being driven, the Min Voltage parameter on the Output Menu will need to be set to 2.

11. Smoothing

Smooths the value into the PID loop. A value between 5 and 10 is recommended. Values > 10 are likely to make the control loop hunt.

12. Direction

Positive. The control output will increase if the measured value is more negative than the setpoint. Used for volume control or for pressure control with the supply.
Negative, The control output will increase if the measured value is more positive than the setpoint. Used when controlling pressure with the extract.

13. Hand mode

Smooth. When switching to hand control, the control output will stay at its last position and can be adjusted from there. (Bumpless).
Fixed = When switching to hand control, the control output will go straight to the hand setpoint value.

14. Relay function

Alarm = The relay is an alarm relay (default).
Fan = The relay is a Fan on/off relay.
If PID control is enabled, the relay will be energized if the control mode is HAND or AUTO and de-energized if the control mode is OFF.

2.7 Calibration

If the sensor needs to be adjusted, Calibration Mode must be entered by selecting Calibration on the main menu. The Yellow keyboard LED will be on while the sensor is in Calibration Mode.

Calibration is performed by applying a known pressure to the positive nipple and then adjusting the positive span value so that the indicated pressure is the same as the applied pressure. If the sensor also needs to measure negative pressure then a known pressure will need to be applied to the negative nipple and the negative span value adjusted so that the indicated negative pressure matches the applied pressure.

It is recommended to apply a pressure equal to the full scale range of the sensor when adjusting the calibration.

Use the HAND key to step between the different fields on the screen.

Span+

This is the positive span value. Use the Up / Down keys to change the value. A positive pressure of at least 20% of the positive sensor range needs to be applied or this value cannot be changed.

Span-

This is the negative span value. Use the Up / Down keys to change the value. A negative pressure of at least 20% of the negative sensor range needs to be applied or this value cannot be changed.

Inc:

This is the amount that the span values will be incremented or decremented with the Up / Down keys. This can be set to 0.01%, 0.1%, 1.0% or 10% of the range of the sensor.

Smooth:

The normal display smoothing is turned off during calibration mode. The Smoothing setting allows a smoothing value to be set for calibration mode.

The number of decimal places for the measured value can be changed with the BELL key.
The sensor can be zeroed during Calibration Mode by holding down the ENTER key.

To exit Calibration Mode, press Enter to exit and saves changes or press Program to exit without saving changes.

2.8 Communications Menu

See also Section 8 – Communications

1. **COM1 (4,5,6)**
   COM1 is always set for Modbus RTU slave and cannot be changed.

2. **COM2 (7, 8, 9)**
   DISPLAY sets COM2 for a Remote Display. (Default)
   MODBUS sets COM2 for a Modbus RTU slave.

3. **Address 1**
   The address of the sensor on the MODBUS network.

4. **Address 2**
   If COM2 is set to MODBUS then this sets the address on the network.
   If COM2 is set to DISPLAY then this setting has no effect.

5. **Smoothing**
   Smooths the sensor measured value that is sent to the Modbus network.

6. **Float Format**
   Selects the format used to represent floating point values in the Modbus registers. See the Modbus Communications Specification for exact details.

7. **Remote Buzzer**
   Sets the operation of the buzzer on the remote display.
   REM Use the value that is set on the display.
   OFF Buzzer not enabled.
   CONT Continuous
   PULSE Pulsed

8. **Remote Alarm**
   Sets the alarm indication on the remote display.
   REM Use the value that is set on the display.
   OFF No indication.
   FLASH Flash the display.
   LH Flash ‘Lo’ or ‘Hi’ when in alarm.

2.9 Volume Linearization Table

This table can only be accessed if 'Method' on the Flow scaling menu = 'Lin Pt.' and the display units are set to m^3/s, l/s or m^3/h.

This is usually used for flow grids which are supplied with a table of pressures and corresponding volumes. The Linearization Table consists of a list of pressures against volumes. The sensor uses the table to look up the volume for the measured pressure. The volume value for a pressure which lies in between two points is interpolated using a straight line of volume against square rooted pressure between the two points. Volumes which are greater than the last point are extrapolated using a straight line from the last two points.

This table can be used with just one pressure / volume point which is a simple way of converting pressure to volume if the volume at a given pressure is known.

Entries in the table do not have to be entered in ascending order of pressure as the table is sorted internally.

There are 8 points in the table. The Up/Down keys switch between the top and bottom halves of the table. To enter or modify a point, use the HAND key to highlight the desired pressure or volume value and the press ENTER to adjust it. The volume must be entered in same units as the sensor display. If the display units are changed then the volume values in the table will get converted to the new units.

To clear a point from the table highlight the pressure value and then hold the BELL key.

It is possible to display Air Change Rate and use the Linearization Table. The display units have to be set to l/s, m^3/s or m^3/h first to set up the table and then can be changed to ac/h after.

2.10 Security

As shipped, the sensor does not have a password set. It is possible to set up a password, which is a sequence of 5 keypresses. Once a password is set, it is possible to view settings but not possible to change them without entering the password. If a password is set then when attempting to change a setting there will be a prompt to enter the password.

1. **Set password**
   This is used to enter a new password when there is no password already set. The display will prompt for a sequence of 5 keys and then ask for the sequence to be repeated. If both entries match, the password will be set.

2. **Change password**
   This is used to change the existing password. The existing password will need to be successfully entered and then a new password can be set.

3. **Clear password**
   This is used to clear an existing password so that no password is set. The existing password will need to be entered successfully first.

There is a default password, BELL PROG BELL PROG HAND.

2.11 Language

The language for the menus can be changed between English, French, German, Italian, Spanish, Portuguese, Dutch, Polish and Russian at this time.

Language will always be the bottom entry on the main menu. If the language has been set so that the menu cannot be understood it will be possible to enter the main menu, enter the bottom sub menu and then step through to find the correct country code.

3.0 BMS INPUT SCALING

To scale a BMS input to match the range of the sensor, use the UP key to show the INFORMATION screen. This will show 'Range=' which will be in one of the formats below.

Example	0 V or 4 mA =	10 V or 20 mA =
100 Pa	0Pa	100 Pa
-30 to +120 Pa	-30Pa	+120 Pa
3.85 m^3/s, (or m/s, l/s, m^3/h, ac/h)*	0	3.85 m^3/s

**For sensors which are measuring Velocity, Volume or Air Change Rate, note that the 'Range=' value will change if the Mag factor, or K-Factor gets changed. See also 2.4 item 9 'Rescaling'*

The OUTPUT screen is also useful for checking how the sensor output has been configured. See page 6.

4.0 MANUAL ZERO

To perform a Manual Zero, hold down the Enter key until the display shows "Zeroing sensor". The internal electronic air valve will be switched to remove the air pressure from the sensor allowing the sensor zero to be measured automatically and adjusted if necessary. The pressure tubes do not have to be removed during this procedure, as the internal valve will operate to remove the air pressure.

5.0 ERROR MESSAGES

Low Alarm
The displayed value is below the level of the Low Alarm threshold.

High Alarm
The displayed value is above the level of the High Alarm threshold.

Over pressure
An excessive positive pressure has been applied to the sensor. The detection threshold for the over pressure condition is typically 3 to 4 times the range of the sensor. If this condition persists when the tubes are removed then this indicates a fault with the sensor.

Under pressure
As above but for a negative pressure.

Comms fault to LCD
There is no communications from the sensor to the display. Check the ribbon cable from the sensor PCB to the display.

6.0 DIAGNOSTIC LEDs

The green, yellow and red LEDs on the keyboard indicate various conditions as shown below.

Green LED ON Red LED OFF	Normal operation
Green LED OFF Red LED ON	Alarm condition – see alarm section Overload condition *See status line on LCD.*
Yellow LED ON	Hand Control mode Calibration mode
Internal green LED on the main sensor PCB	Heartbeat Led. Flashes approximately 5 times per second.
Internal red LED on the main sensor PCB	On for overpressure

7.0 REMOTE DISPLAY

The CMR DIS110 remote display or DIS125 remote alarm display plate can be driven from the V-SENSOR. The display must be externally powered. The display can be driven in analogue mode by the 0-10 V or 4-20 mA analogue outputs or in digital mode via RS485 communications from the Modbus terminals.

7.1 REMOTE DISPLAY – ANALOGUE MODE

It is recommended to operate the display in digital mode. If Modbus communications are being used on the V-SENSOR, for example to communicate with a BMS, then the remote display cannot be connected in digital mode and analogue mode must be used instead. For analogue mode, the buzzer on the remote display cannot be used. The display must also be scaled to suit the range of the sensor. For details of how to connect and scale the remote display in Analogue Mode, refer to the DIS110/125 operating manual.

7.2 REMOTE DISPLAY – DIGITAL MODE

To operate the remote display in digital mode, COM1 (4, 5, 6) on the V-SENSOR Communications Menu must be set to REMOTE.

The remote display can be configured so that its buzzer operates when the V-SENSOR is in alarm. Pressing the mute button on the DIS125 will silence the buzzer. Pressing the Alarm key on the instrument will also silence the remote buzzer.

The remote display has its own parameters. To access the parameters the plate must be removed to access the two buttons on the rear of the circuit board. Hold down both

buttons until the first parameter is shown and then release. The top key will now increment the setting and the bottom key will decrement the setting. To move to the next parameter hold both keys down. Holding both keys on the final parameter will go back to normal operation.

INDICATOR	PARAMETER	RANGE	FACTORY SETTING
S	Software version		
o	Operating mode	SEn AnI dPC	SEn
Ad	Address	1 2	1
bU	Buzzer *	0 1 P	1
AL	Display alarm indication *	0 F LH	LH
* These settings can be overridden by parameters in the V-SENSOR. See Remote Buzzer and Remote Alarm in the Communications Menu.			

OPERATING MODE

This must be set to SEn to use the remote display with the V-SENSOR.

ADDRESS

This value can be set to 1 or 2. The V-SENSOR can communicate with two remote displays. If two displays are connected then they must be set to different addresses. If only one display is connected then this setting can be ignored.

BUZZER & ALARM INDICATION

The buzzer and alarm indication functions on the remote display can be set on the V-SENSOR or they can be set on the remote display. If the rb or rA parameter on the V-SENSOR is set to show a dash then the setting on the remote display is used otherwise the setting on the V-SENSOR is used.

BUZZER

0 = Off. The buzzer will not sound.

1 = On. The buzzer will sound continuously when in alarm until muted.

P = Pulsed. The buzzer will pulse on and off when in alarm until muted.

ALARM

0 = No display alarm indication.

F = The display will flash when in alarm.

LH = The display will flash LO when in low alarm or HI when in high alarm.

FAULT DISPLAY

If communications to the display fails for more than 30 seconds, or if the number to be displayed is outside the range of the display, then ----- is displayed.

8.0 COMMUNICATIONS

Protocol	Modbus RTU
Interface	2 Wire EIA/TIA-485 (RS485) 1/4 unit load. Line polarization is not required. Driver is fault protected to ± 60 V.
Communication parameters	9600 baud, no parity, 8 bits, 1 stop bit
Response time	The V-SENSOR will start to reply within15 ms

Available registers					
Reg 1 based	**Description**	**Data Type**		**Read/ Write**	**Function Code**
138	Low alarm threshold	u16	For backwards compatibility. Use 216/217 and 218/219 instead.	R/W	0x03 read 0x06 write
139	High alarm threshold	u16			
140	Alarm timer 1	u16	In seconds if timer units are in seconds or 0.1h if timer units are in hours. See Alarm Function parameter in Section 2.6 for more information.	R/W	0x03 read 0x06 write
141	Alarm 1 status	u16	0=Healthy, 1=Low Alarm	R	0x03
142	Alarm 2 status	u16	0=Healthy, 1=High Alarm		
143	Alarm timer 2	u16	As Timer 1 above.	R/W	0x03 read 0x06 write
144	Alarm bits *V3.91 onwards*	u16	Bit 0 = Low Alarm. Bit 1 = High Alarm. Bit 2 = Common alarm. Bit 3 = Unmuted alarm present. Bit 4 = Healthy (no alarm).	R/W	0x03 read 0x06 write
145	Buzzer *V3.91 onwards*	u16	1 = Unmuted alarm is present. Otherwise = 0.	R/W	0x03 read 0x06 write
146	Heartbeat	u16	Increments once per second. Rolls over to zero after 65535.	R	0x03
147	Alarm Mode 0 Relay	u16	For alarm mode 0, write 1 to energize the relay.	R	0x03 read 0x06 write
148	Alarm Mode 0 Buzzer	u16	For alarm mode 0, write 1 to turn on the buzzer.	R	0x03 read 0x06 write
149 150	Display value	real	The value displayed on the V-SENSOR display as a floating point value.	R	0x03
151 152	Pascals	real	The measured pressure as a floating point value.	R	0x03
153 154	Control setpoint	real	The setpoint for the PID control loop. If PID control is not being used then the PID setpoint can be set to a value by the keyboard and read back here e.g. to show the normal operating setpoint.	R/W	0x03 read 0x10 write
155	PID output	s16	PID control output as a signed integer. Range is ±4095	R	0x03
156	Off/ Auto/ Hand *V4.15 onwards*	u16	0 = Control mode disabled (read only). 1 = Automatic control. 2 = Hand control at hand setpoint. 3 = Controller off. 4 = Hand control at current output. (hand setpoint will get changed and this register will read back as 2)	R/W	0x03 read 0x06 write

158	Pascals	s16	The measured pressure as a signed integer. The resolution is 0.1 Pa for sensor ranges < 2500 Pa or 1 Pa for ranges >= 2500 Pa	R	0x03
164	Text Display *Software version V3.89 upwards.* *LED version of product only.*	u16	Display text on LED. 0=Normal sensor display. 1="Error", 2="Fault",3="Off", 4="Stop" Add 16 to make the text alternate with the normal display.	R/W	0x03 read 0x06 write
165	Hand setpoint *V4.15 onwards*	real	Setpoint for hand control mode 0-100%	R/W	0x03 read 0x10 write
167 168	Control output *V4.15 onwards*	real	The control output in % between 0 & 100%, as a floating point value.	R	0x03
216 217	Low alarm *V3.91 onwards*	real	The low alarm threshold in display units.	R/W	0x03 read 0x10 write
218 219	High alarm *V3.91 onwards*	real	The high alarm threshold in display units.	R/W	0x03 read 0x10 write

ADDRESSING

A maximum of 128 instruments may be connected or up to 247 if a bus repeater is used. Addresses of 1-255 may be configured but addresses 248-255 are reserved in the Modbus specification. Do not use address 255.

DATA TYPES

Real	IEEE 32 bit floating point value. See below for formats.
s16	Signed 16 bit integer -32768 to 32767
u16	Unsigned 16 bit integer 0-65535

FLOATING POINT VALUES

Floating point values are represented as IEEE 754 32 bit floating point numbers which are stored in 2 consecutive registers. The float format parameter (parameter FF on the range key menu) specifies the byte order used to store the floating point numbers. This value is factory set to 1 but can be changed to suit the application.

For example, if the display value was 123.456 then the IEEE 754 representation is 0x42F6E979. The table below shows the register values for each of the formats.

Float Format Parameter	Storage method	Registers	
		40149	40150
0	Little Endian	0x79E9	0xF642
1	Little Endian, with bytes swapped	0xE979	0x42F6
2	Big Endian	0x42F6	0xE979
3	Big Endian, with bytes swapped	0xF642	0x79E9