

# MONITOR



## ***Monibus Sensor*** **INSTALLATION AND OPERATION MANUAL** **INFORMATION FOR STANDARD SENSORS**

**MONITOR SENSORS (AUST.) PTY LTD**

ABN 98 077 697 986  
sales@monitorsensors.com  
service@monitorsensors.com  
www.monitorsensors.com

Unit 1 250 Leitchs Road  
PO Box 5692  
Brendale QLD 4500  
AUSTRALIA  
Phone: 07 3490 9000  
Fax: 07 3889 7246

# CONTENTS

<b>1</b>	<b>SPECIFICATIONS</b>	<b>3</b>
1.1	ELECTRICAL SPECIFICATIONS	3
<b>2</b>	<b>SENSOR OVERVIEW</b>	<b>4</b>
2.1	CONNECTING THE SI-8 RS232 INTERFACE	4
2.2	IDENTIFYING THE SENSOR	4
<b>3</b>	<b>SENSOR CONFIGURATION</b>	<b>5</b>
3.1	THE SETUP MENU	5
3.2	PRESS 0 FOR REPORT	5
3.3	PRESS 1 TO CHANGE THRESHOLD A	6
3.3.1	THRESHOLD VALUE	6
3.3.2	THRESHOLD ENABLE	6
3.3.3	THRESHOLD INVERT	6
3.3.4	THRESHOLD MODES	6
3.4	PRESS 3 TO SET FILTERS	8
3.5	PRESS 4 TO SET DISPLAY MODE	8
3.6	PRESS 5 TO CHANGE ADDRESS	8
3.7	PRESS 6 TO AUTO ZERO	9
3.8	PRESS 7 TO SET THE TIME	10
3.9	PRESS 8 TO CHANGE CONFIG	11
3.9.1	AVERAGE MODE	11
3.9.2	LONG/SHORT AVERAGE	11
3.9.3	ECONOMY MODE	11
<b>4</b>	<b>MONIBUS PROTOCOL</b>	<b>12</b>
4.1	MONIBUS OVERVIEW	12
<b>5</b>	<b>SENSOR COMMANDS</b>	<b>14</b>
5.1	SENSOR COMMANDS	14
5.2	DAISY CHAIN MODE	15

# 1 SPECIFICATIONS

## 1.1 Electrical specifications

**Operating voltage:** 6 – 28 Vdc  
**Supply current:** as listed on individual sensor datasheets  
typically < 5mA

**Operational  
Temperature range:** 0-60°C

**Measurement channels:** up to 4

**Interface:** *Modbus* serial data 1200 baud

**Options:** 0...1 volts output – 2 channels  
0...2.5 volts output – 2 channels  
0...5 volts output – 2 channels  
0...10 volts output – 2 channels ( 12 Vdc supply )  
4...20mA output – up to 4 channels ( 12 Vdc supply )  
0...10mA output – up to 4 channels ( 12 Vdc supply )  
2...10 Hz output – 1 channel

**Warranty:** **12 months** – full details can be found in the  
Monitor Sensors standard warranty document ...  
[http://www.monitorsensors.com/docs/std\\_warranty.pdf](http://www.monitorsensors.com/docs/std_warranty.pdf)

## 2 SENSOR OVERVIEW

All Monitor Sensors products communicate over a shared 3-wire communication bus at a baud rate of 1200.

Each sensor has a built in menu system that allows the changing of many sensor parameters. Sensors respond to commands sent over the communication bus. The simplest commands allow the viewing of the current sensor reading. Other commands sent to the sensors consist of a combination of characters, which must be sent as a string without time gaps between characters. These strings cannot be sent directly from the keyboard, but can be sent by specific programming or the macro facility of many terminal programs. They allow a logger or programmer to alter sensor setup without the sensor setup menu.

Each sensor should have a unique address assigned. If two or more sensors have the same address, communication responses may be corrupted.

Sensors can communicate with a PC when connected to a Monitor Sensors *μSmart* Logger or when connected directly to a Monitor Sensors SI-8 interface. This document describes the communication process using a SI-8 interface and a PC terminal program.

### 2.1 Connecting the SI-8 RS232 interface

1. Connect the SI-8 DB9 connector to a PC RS232 communication port.
2. Connect a power source to the SI-8.
3. Connect a single sensor to the SI-8.
4. Run the terminal program and set the communication to...

baud speed	1200 baud
start bits	1
data bits	8
stop bits	1
parity	none
flow control	none
local echo	off

5. Open the communication port. On HyperTerminal the program will indicate *CONNECTED* and the SI-8 LED should be lit.
6. Press the PC space bar – some text should be seen on the terminal program window.

### 2.2 Identifying the sensor

Typing a question mark will display the sensor identification message.

#### Example:

```
Address is b
Type of sensor is WL4
Serial number is 00096
Date of last cal was 01Aug 00
Software version is 4.06
website: www.monitorsensors.com
For setup menu type bset
```

## 3 SENSOR CONFIGURATION

### 3.1 The setup menu

Display the setup menu by typing the address of the sensor, and then typing the lower case letters **s e t**. Just follow the on screen instructions to adjust sensor parameters such as thresholds, time, offset, address, etc.

To display the setup menu for sensor **B**, it is necessary to type **Bset** within a 5-second period. Type **B** and wait for the sensor to display the current reading, then type the letters **s e t**. If more than 5 seconds elapses between the keystrokes the sensor will not respond. The user has up to 60 seconds to make a response to a menu. If there is no response, the sensor will revert to normal operation. To re-enter setup, just type **Bset** again.

The sensor setup menu will be cancelled if there is any other communications taking place on the bus. If a logger is attached to the Monibus and is logging on a very short interval it will be necessary to suspend logging, while sensor setup is taking place. Setting logger option A3 will suspend logging. See the Logger manual for details.

#### Example sensor main menu:

```
welcome to setup of WL400096

Press 0 for report
Press 1 to change threshold A
Press 2 to change threshold B
Press 3 to set filters
Press 4 to set display mode
Press 5 to change Address
Press 6 to auto zero
Press 7 to set the time
Press 8 to change config
Press 9 to exit setup
```

Type a number to display a sub menu.

### 3.2 Press 0 for report

Type 0 at the main sensor menu to display the sensor report. The report format will vary with the sensor type.

#### Example water level report:

```
time is 11:16,
current reading is 0.742 m,
Today: max 0.761 m, min 0.741 m, average 0.748 m,
Yesterday: max 0.743 m, min 0.739 m, average 0.741 m,

threshold A      threshold B
"on" level 1.283 1.200
"off" level 1.088 1.100
```

The report gives a summary of some of the more important details. After the report is sent, the main menu is not re-displayed, but it is still in active. Pressing 1 will display the threshold A sub menu.

### 3.3 Press 1 to change threshold A

Threshold parameter changes are non-volatile and will be restored each time a sensor is connected to power.

#### 3.3.1 Threshold value

Type 1 or 2 at the sensor setup menu to display the threshold menu.

**Example:**

```
Press 1 to change threshold A "on" level
Press 2 to change threshold A "off" level
Press 3 to shutdown threshold A
Press 4 to invert threshold A
Press 5 to put threshold A in control mode
Press 6 to return to main menu
Press any other key to exit setup
```

Pressing 1 or 2 will display the current value of the threshold and permit the entry of a new value.

```
threshold A "on" level is 1.283 m
enter new value
```

When entering numerical values use the negative sign and decimal point as required, but do not enter any units. Press the **ENTER** key to complete the entry. The entry will terminate automatically after 6 digits are typed. The new value will be displayed. To accept the new value, type **1**. To cancel the change type **2** or press the **ESC** key.

```
threshold A "on" level is 1.283 m
enter new value 3.8297
```

```
3.8296 m has been entered
Press 1 to accept
Press 2 to return to main menu
Press any other key to exit setup
```

#### 3.3.2 Threshold enable

Pressing 3 at the threshold menu will enable or disable the threshold output.

When the threshold is disabled, the control output will not change. It will remain in the condition in force when the threshold is disabled.

#### 3.3.3 Threshold invert

Pressing 4 will invert or normalise the control output, if the threshold circuit is enabled. This allows the user to manually change the state of the control output, and is useful for testing the system.

#### 3.3.4 Threshold modes

Pressing 5 will switch between two different modes of operation, called Control Mode and Alarm Mode. Control Mode is normally selected when the threshold will control the operation of a motor, pump, heater, valve, etc. Alarm Mode is normally selected when the controlled device is a warning light or bell.

In Control Mode the control output will become active when the measured parameter exceeds the "on" level but will not go off until the measured parameter falls below the "off" level. The separation between the "on" and "off" values is the degree of hysteresis of the system. The user may set the "on" and "off" levels to be the same for zero hysteresis, but the stability of the controlled system may be adversely affected. The normal/invert function may be used to change the polarity of the control output.

In Alarm Mode the two threshold levels are used to specify a range of values which are considered normal or safe. Whenever the measurement falls within this range, the alarm output is inactive. When the measurement exceeds the higher level, or drops below the lower level an alarm output becomes active. If only a maximum alarm is required, the lower limit may be set just below the operating range of the sensor to disable this limit. The normal/invert function may be used to change the polarity of the alarm output.

**Example water pump control:**

**WARNING the sensor must not be electrically connected to 240VAC equipment**

Suppose the Water Level Sensor is to control a water pump to fill up a water tank, in which the sensor is immersed. The tank should be refilled to within 0.5m of the overflow, which is at 3.0m, whenever the level drops to 1.0m. A fault alarm is also required.

This can be achieved by...

1. Connecting the pump to threshold A output via a relay
2. Connecting the alarm light to threshold B output via a relay
3. Threshold A "on" level = 1.0
4. Threshold A "off" level = 2.5
5. Make Threshold A active
6. Invert Threshold A output
7. Put Threshold A in control mode
8. Threshold B "on" level = 2.75
9. Threshold B "off" level = 0.75
10. Make Threshold B active
11. Threshold B output should be normal
12. Put Threshold B in alarm mode

With the above settings, the pump will be switched on whenever the water level falls below 1.0m and will be switched off when the level reaches 2.5m. If the water level falls below 0.75m or exceeds 2.75m, the warning light is switched on, indicating that something has failed.

### 3.4 Press 3 to set filters

Type 3 at the sensor setup menu to display the set filter menu.

```
Noise reduction filter is set to 12 dB
Press 1 for 0 dB
Press 2 for 3 dB
Press 3 for 6 dB
Press 4 for 9 dB
Press 5 for 12 dB
Press 6 to switch Noise Blanker off
Press 7 to return to main menu
Press any other key to exit setup
```

The default Noise Reduction Filter setting is 12 dB with the Noise Blanker is normally on. For fast sampling a lower value of filtering will give a faster response. Very rapid changes in the measured parameter may be ignored with the Noise Blanker active. Ask Monitor Sensors Engineering Staff for advice on filter settings for special applications.

### 3.5 Press 4 to set display mode

Type 4 at the sensor setup menu to display the set filter menu.

```
Press 1 for high Resolution
Press 2 to switch Interval on
Press 3 to switch Daisychain on
Press 4 to switch Verbosity off
Press 5 to switch time display on
Press 6 to switch P1 display off
Press 7 to switch P2 display on
Press 8 to return to main menu
Press any other key to exit setup
```

The display mode menu indicates the current state of the display mode settings. To change a setting type the menu option number. The option will toggle between the available states.

high resolution	displays all digits in the reading
low resolution	suppresses the last digit of the reading
Interval on	the sensor reports a reading at 1-second intervals
Daisychain on	the sensor commands a 2 <sup>nd</sup> sensor to report a reading
Verbosity off	the sensor does not display engineering units
time display on	the sensor internal time is displayed with each reading
P1 display off	the sensor does not display the 1 <sup>st</sup> channel reading
P2 display off	the sensor does not display the 2 <sup>nd</sup> channel reading

### 3.6 Press 5 to change Address

Type 5 at the sensor setup menu to display the change Address menu.

```
current Address is b
enter new Address
```

```
Address entered is k
Press 1 to accept and exit setup
Press 2 to return to main menu
Press any other key to exit setup
```

Setup mode is terminated, when the sensor address is changed. To make further changes to sensor parameters, the setup menu must be reactivated – see 3.1

### 3.7 Press 6 to auto zero

Type 6 at the sensor setup menu to display the auto zero menu.

Typing 1 will cause the present reading to become the new zero reference point. Pressing 2 will restore the original factory calibrated zero. The factory-calibrated value is stored in non-volatile memory and cannot be overwritten.

```
Press 1 to auto zero and exit
Press 2 to restore original zero and exit
Press 3 to change offset
Press 4 to return to main menu
Press any other key to exit setup
```

The offset may also be changed through the sub sub menu:-

```
current offset is    0.0000 m
enter new value
```

The new value will be displayed for confirmation.

```
1.2378 m has been entered
Press 1 to accept
Press 2 to return to main menu
Press any other key to exit setup
```

#### **WARNING**

When using the sensor with a Monitor Sensors Data Logger, changing the offset will not alter the logged readings, unless the logger is forced to re-detect the sensors. Also the threshold settings will not be changed in absolute terms when the offset is changed. Rather the indicated values will change to reflect the new setting. For example, if the threshold A is set to operate at 3.000 m and the offset is changed from zero to 1 m, the threshold A "on" level will now say 4.000 m, but it will still operate when the sensor exceeds 3.000 m of true depth.

### 3.8 Press 7 to set the time

Type 7 at the sensor setup menu to display the set time menu.

```
Press 1 to change sensor time
Press 2 to change Interval time
Press 3 to return to main menu
Press any other key to exit setup
```

Type 1 to display the set time sub menu.

```
sensor time is 11:25,
enter new time
```

The time should be entered in 24-hour system format. All digits must be entered. Times before 10:00 should be entered as 09:00. The sensor will display a colon after the first two digits are entered. There is no source of power within the sensor, therefore the clock will stop when power is removed and will restart at 00:00.

It is not necessary to set the time in sensors connected to a Monitor Sensors Data Logger. The Logger synchronises all sensor clocks just before midnight every day.

```
21:57 has been entered
Press 1 to accept
Press 2 to return to main menu
Press any other key to exit setup
```

Type 2 at the set time menu to display the set time sub menu.

```
Press 1 for Interval of 2 seconds
Press 2 for Interval of 5 seconds
Press 3 for Interval of 15 seconds
Press 4 for Interval of 1 minute
Press 5 for Interval of 5 minutes
Press 6 for Interval of 15 minutes
Press 7 for Interval of 1 hour
Press 8 for Interval of 4 hours
Press 9 to return to main menu
Press any other key to exit setup
```

### **3.9 Press 8 to change config**

Type 8 at the sensor setup menu to display the change config menu.

Press 1 to switch average mode off  
Press 2 for long average  
Press 3 to switch economy mode on  
Press 4 to return to main menu  
Press any other key to exit setup

#### **3.9.1 Average mode**

Average mode, is only used when the sensor is connected to a Monitor Sensors Data Logger. The averaging period is determined by the logging period (schedule) selected in the logger.

For example, if the logger is set to log the sensor every hour (schedule m) the values recorded will be the average value for the preceding hour.

When the averaging mode is switched off, the value logged will be the current reading at the time of the logging. When the sensor responds to its address with a reading, it will still send the current reading regardless of whether the averaging mode is selected or not. Averaging mode does not affect the 24-hour average.

#### **3.9.2 Long/short average**

Short averaging mode is recommended for averaging periods of ten minutes or less.

For longer averaging periods, the long average setting provides greater accuracy.

#### **3.9.3 Economy mode**


Economy mode reduces the power consumption of the sensor. Most sensors will reduce current consumption to approximately 700 microamperes in economy mode. However the measured parameter is only monitored at approximately one-minute intervals. Economy mode is not suitable if logging is required at less than two-minute intervals, as the sensor will simply repeat the last valid reading.

## 4 Monibus Protocol

### 4.1 Monibus overview

The Monibus is a three-wire communications interface for all Monitor Sensors Products. The cabling topography can be daisy chain, or star and can include stubs. The total cable length should be less than 1000m.

The full Monibus specification document is available by request from Monitor Sensors.

<b>Monibus</b>		
Pin 1	6...28 Vdc sensor supply	
Pin 2	GND communications ground	
Pin 3	Data	

As the sensors communicate over a shared wire connection. One failed sensor may inhibit the logger communication with some or any of the sensors.

The data line uses nominal TTL positive logic levels, i.e. 0 volts = logic 0 and 5 volts = logic1. The data line is idle high. Communications is asynchronous 1200 baud, 8 bit, 1 stop bit, no parity, half duplex. An SI-8 interface unit is available to convert the signal to RS232 levels to allow a sensor to converse with a PC.

Up to 220 sensors may be paralleled in one system. Each must be assigned a unique one byte address. When a sensor is not sending characters, the sensors tri-state the data line.

A sensor will respond to its single byte address with the current sensor reading, if the data line remains idle for two further byte periods. By default, space characters pad the reading to 18 bytes followed by CR/LF bytes. eg.

```
send >> 1          hex
                    31
recv << 12.65 °C   20 30 31 32 2E 36 35 20 B0 43 20 20 20 20 2C 0D 0A
```

Some sensors made before 2006 may respond with null characters padding the sensor reading. The engineering units occupy six bytes. If the value is negative, the negative sign is sent immediately before the first digit. Leading zeroes (hex 30) are replaced by spaces (hex 20).

Commands can be sent to the sensors to change the reading output format.

```
Options include increasing the resolution...      27.392 °C
Removing the engineering units by toggling verbosity... 27.39,
Prefacing the sensor's clock time...             12:35 27.39 °C
Appending a derived unit...                       27.39 °C 81.3 °F
Suppressing the CR/LF bytes
```

Or combinations of the above.

When only one sensor is connected to the **Monibus**, pressing the space bar (sending ASCII code 32, hex 20) will cause the sensor to return the current reading.

Sending a question mark ? (ASCII code 63, hex 3f) or the ID command **jid** will cause the sensor to respond with its identification message. Eg.

```
Address is 2
Type of sensor is TA1
Serial number is 00882
Date of last cal was 22 July 02
Software version is Z41
For setup menu type 2set
```

When more than one sensor is connected to the Monibus, it is not possible to use the space bar to read the sensors, as all the sensors will respond simultaneously, causing a garbled message. In this case, prefix the command with the unique sensor address, to communicate with a particular sensor.

Example – communicating with sensor address 2

```
send >> 2
recv << 12.65 °C ,-ꠄ

send >> 2}id
recv << Address is 2
      Type of sensor is TA1
      Serial number is 00882
      Date of last cal was 22 July 02
      Software version is Z41
      For setup menu type 2set
```

Each sensor has a built in setup menu system that allows the changing of many sensor parameters. Display the setup menu by typing the address of the sensor, and then typing the lower case letters **s e t**. Just follow the on screen instructions to change thresholds, time, offset, address etc of the sensor.

Other commands sent to the sensors consist of a combination of characters, which must be sent as a string without time gaps between characters. These strings cannot be sent directly from the keyboard. They allow a logger or programmer to alter sensor setup without the sensor setup menu.

These commands begin with the right hand brace symbol } (ASCII code 125, hex 7d). All sensors will obey these commands. To send a command to only one sensor, prefix the command with a unique sensor address.

## 5 SENSOR COMMANDS

These commands begin with the right hand brace symbol ( } ASCII code 125, hex 7d). All sensors will obey these commands. To send a command to only one sensor, prefix the command with a unique sensor address. **Use with care – mistakes may cause communication problems.**

### 5.1 Sensor commands

- }hh toggle resolution  
*A sensor that displays as 12.65 °C, will display as 12.654 °C,*
- }ii toggle interval timer  
*Sensor will report reading at interval – default is 1 second ( set by ... ).*
- }id report sensor ID  
*Sensor reports serial number, calibration date, etc*
- }jj toggle daisy chain  
see section 5.2 below
- }kk maximum/minimum/average reset  
*Resets the sensor internal averages, etc*
- }mm maximum/minimum/average report  
*Report the sensor internal averages, etc*
- }pp read p2, or if p2 is not active, reads p1 in different units  
*eg. 25.4mm 12.65 °C or 12.65 °C 54.77 °F*
- }reset reset sensor
- }s1 auto zero and store  
*The current sensor reading will be used as an offset so that the sensor reads 0.00*
- }s0 restore default zero  
*The factory zero will be restored.*
- }sc store calibration factors
- }sr sensor report  
*some sensors have special reports – eg. sap flow sensors*
- }st report auxiliary temperature
- }sv report sensor supply voltage
- }sx report sensor firmware version
- }sA set P1 analogue output voltage to maximum for 10 seconds
- }sB set P1 analogue output voltage to minimum for 10 seconds
- }sC set P2 analogue output voltage to maximum for 10 seconds
- }sD set P2 analogue output voltage to minimum for 10 seconds
- }tt sensor time  
*Sensor displays internal time – not real time*
- }t1 toggle insert time in reading  
*Sensor reports reading prefixed by the current sensor time – eg. 11:25:34 45.6 %,*
- }t2 toggle append p2 to reading  
*Sensor reports reading followed by P2 reading – eg. 45.6 %, 31.2 °C,*
- }t3 toggle append p3 to reading  
*Sensor reports reading followed by P2 & P3 reading – eg. 45.6 %, 31.2 °C, 15.9 g/ml*
- }tv toggle sensor verbosity  
*sensor units display can be switched OFF*
- }tx reset event counter
- }ur=x change sensor address to x  
*must be sent twice to confirm the change*
- }ur=? Set sensor address to a random value between hex 80 and hex 9F  
*can be used to resolve sensor address clashes in a remote situation*
- A}= sensor A current binary reading & start new partial minimum/maximum/average period
- A}\$ sensor A partial ASCII maximum
- A}% sensor A partial ASCII minimum, maximum, average

## 5.2 Daisy chain mode

In daisy chain mode, one sensor can trigger another sensor to report.

### Example:

- There are three sensors connected together on the Monibus.
  - Each sensor has a unique address.
  - A SI-8 RS232-Monibus interface converter is connected to the sensors.
  - A terminal program is active and connected to the RS232 communication port.
  - Temperature sensor address = A
  - Humidity sensor address = B
  - Wind speed sensor address = K
1. Connect the temperature sensor to the SI-8 with no other sensors connected.
  2. Set the temperature sensor daisy chain address to B
  3. Active daisy chain mode – sensor menu 4-3
  
  4. Connect the humidity sensor to the SI-8 with no other sensors connected.
  5. Set the temperature sensor daisy chain address to K
  6. Active daisy chain mode – sensor menu 4-3
  
  7. Connect all sensors to the SI-8.
  8. Type A in the terminal program – the sensors should report their current reading, separated by a comma. eg. 15.34 °C, 35.6 %, 5.6 m/s,