SandAlert Lite

2 CHANNEL PORTABLE SAND MONITORING SYSTEM

OPERATING HANDBOOK

SECOND EDITION

September 2004

WARRANTY AND LIABILITY

Pulsar Process Measurement Limited guarantee for a period of 12 months from the date of delivery that it will either exchange or repair any part of the Sand Monitoring System returned to Pulsar Process Measurement Limited if it is found to be defective in material or workmanship, subject to the defect not being due to fair wear and tear, misuse, modification or alteration, accident, misapplication or negligence.

LICENCE

The Pulsarguard sensor is manufactured under licence from the Rolls-Royce group of companies.

DISCLAIMER

Pulsar Process Measurement Limited gives nor implies any process guarantee for the Sand Monitoring System or other products, and shall have no liability in respect of any loss, injury or damage whatsoever arising out of the application or use of any product or circuit described herein.

TECHNICAL ENQUIRIES

Please contact Pulsar Process Measurement Limited or your local distributor for technical support.

COMMENTS AND SUGGESTIONS

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CONTENTS

What's New?

This is the first edition of the manual and therefore nothing is new, but in future editions new features will be indicated with a NEW! symbol throughout this handbook.

1 Introduction

The Portable SandAlert Lite System is a dual channel monitoring system that utilises an intrinsically safe acoustic sensor to non-invasively detect the impacts and abrasions of produced solids against the inside of the pipe wall. The signal processing of the sensor output signal provides a reading of the sand impact rate which may be calibrated to give a solids mass flow rate, the values are then regularly (normally every minute) transmitted via the serial port.

2 Stress Wave Sensing - The Technology

Stress wave sensing relies on the detection of high frequency sounds, or stress waves, which are generated by processes such as fluid turbulence, cavitation, friction and impacts. At the frequencies involved sound propagates easily through solids and fluids, but is heavily attenuated in air. As a result, the Pulsar Process Measurement acoustic sensor can readily provide a non-intrusive method of detecting the impacts and abrasions of solid particles in the fluid flow, and is immune to interference from airborne noise and structural vibration. This makes it highly suitable for detecting solids particles in both oil and gas flowlines.

3 System Overview

The SandAlert Lite system is callled ‘Lite’ as it does not have an inbuilt screen and does not log data internally. The purpose of the unit is to allow sand detection on two separate channels and transmit the data serially to the customers data collection system.

The ‘Lite’ comprises two main elements, the acoustic sensors and the SandAlert Lite processor unit.

The control unit is designed to be run without any user intervention, the unit can be connected to the transducers and a suitable serial cable and the system will start to send data once power is applied.

The system can be setup by connecting a standard VGA monitor and IBM (5 pin 180deg connector) keyboard, this allows access to the menu system described in chapter 6.

A schematic diagram showing the general layout of the system is shown in Figure 1. (Note: Only one transducer is shown, but two can be connected.

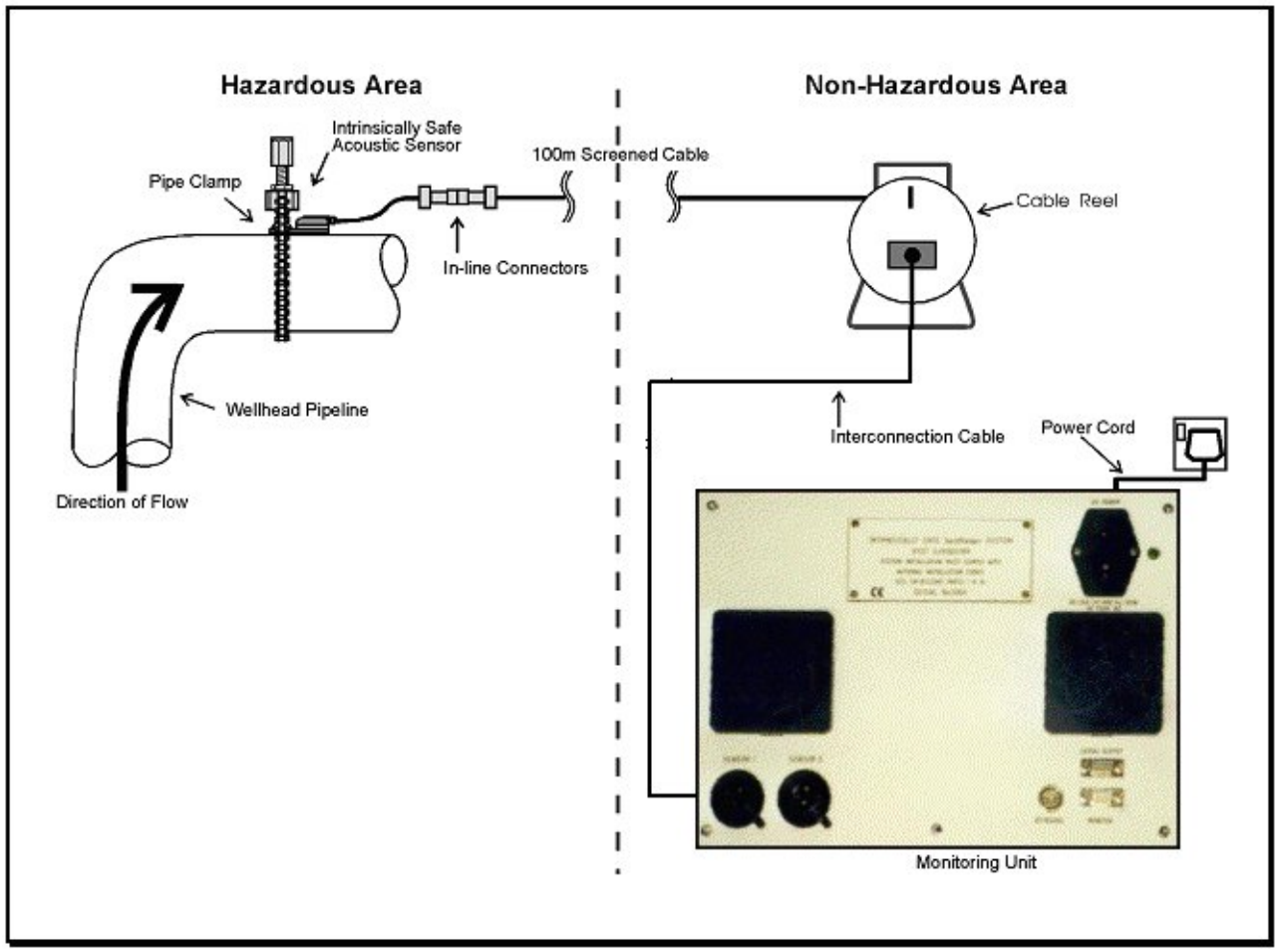


Figure 1 Schematic Diagram of the SandAlert Lite

3.1 Acoustic Sensor

There are two transducers suitable for sand monitoring:

Pulsarguard 2011G

This sensor is the 'G' version, suitable for use with the inbuilt galvanic barriers of the SandAlert Lite. The sensor transducer is housed in a robust cast Type 316 stainless steel enclosure. There are two sensor variants available, the Pulsarguard 2011 sensor which is approved to EEx ia IIC T6, or EEx ia IIC T5 for T_{amb} up to 92 ºC.

Explanation of the IS approval description:

EEx denotes a CENELEC approval.

ia denotes the device is intrinsically safe category 'ia', and therefore is suitable for all zones (0, 1 and 2).

IIB denotes the gas group. Group IIB gases cover the majority of hydrocarbon gases.

T4 denotes the temperature classification. The surface temperature of the sensor will not exceed 135 ºC under fault conditions with a 40 ºC ambient temperature.

The sensor housing is rated at IP68 giving protection against temporary immersion to a depth of 3 metres.

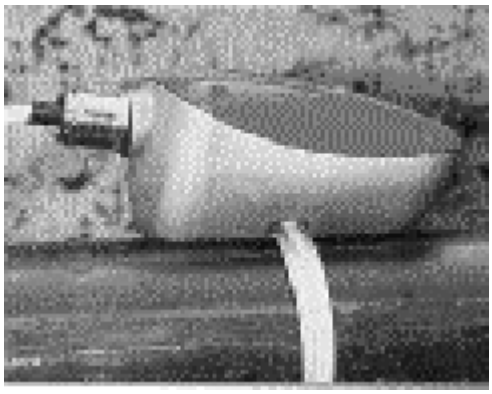
The sensors are powered from a power supply via a galvanically isolated safety barriers, in the SandAlert Lite unit.

The sensors are attached to the outside of the pipe, on or just after a bend, by means of a universal pipe diameter (3" to 8") stainless steel sensor/pipe clamps. The sensor is connected to the SandAlert Lite via in-line connectors and a 100 metre extension cable, although it can be extended to 1000 metres if required.

Note: The Pulsarguard 2011 is available in G or Z form for use with the SandAlert Lite they should be have a 'G' stamped next to the serial number on the tab.

PULSARguard 2001

A new exiting development is the PULSARguard 2001 sensor, this is designed to be more sensitive to sand and less prone to flow noise making it ideal for use on gas and multi phase wells.



PulsarGuard 2001

The sensor is a Pulsar Process Measurement intrinsically safe acoustic sensor. The sensor is housed in a robust cast Type 316 stainless steel enclosure. The Sensor is called the PulsarGuard 2001 and is intrinsically safe, certified to EEx ia IIC T4

Explanation of the IS approval description:

EEx denotes a CENELEC approval.

ia denotes the device is intrinsically safe category 'ia', and therefore is suitable for all zones (0, 1 and 2).

IIC denotes the gas group. Group IIC, typical gas hydrogen..

T4 denotes the temperature classification.

The sensor housing is rated at IP68 giving protection against temporary immersion to a depth of 3 metres.

The sensor is powered from a power supply via galvanic safety barriers, both of which are housed in the SandAlert Lite unit.

3.2 SandAlert Lite

The SandAlert Lite is housed in a rugged painted steel case. The electrical interface between hazardous and non-hazardous area is provided by an internal galvanically isolated safety barrier.

The SandAlert Lite uses a compact processor board with 2 MB RAM, and a hard disk drive on which the software is installed. An analogue to digital converter (ADC) card converts the analogue sensor signals to allow further signal processing by the microprocessor.

The SandAlert Lite unit is a blind unit, but provision is made to connect a standard VGA monitor (15pin high density D type) and keyboard (via a 5 pin Din 180 degree connector), this allows the user to set up the unit.

Data is transmitted via the RS232 serial port. The SandAlert Lite does not store data on its internal drive.

UNDER NO CIRCUMSTANCES MUST THE SANDALERT LITE BE OPERATED IN A DESIGNATED HAZARDOUS AREA.

3.3 Power Supplies

The SandAlert Lite is powered from a mains power supply which can be within the range of 85 - 264 V ac. In the event of power failure during monitoring, the unit will continue monitoring when the power is returned, with no loss of data (apart from during the time power was lost). The mains supply is fused by a 1A antisurge fuse, accessible on the main panel. When power is supplied, the green 'Power' LED, which is to the right of the power inlet socket, will be illuminated.

3.4 Signal Processing Technique

The high frequency structure borne acoustic signal generated by a sand impact on the internal wall of the pipe, travels through the pipe structure and is detected by the acoustic sensor. The acoustic signal is then converted to an electrical signal by the sensor, see Figure 2.

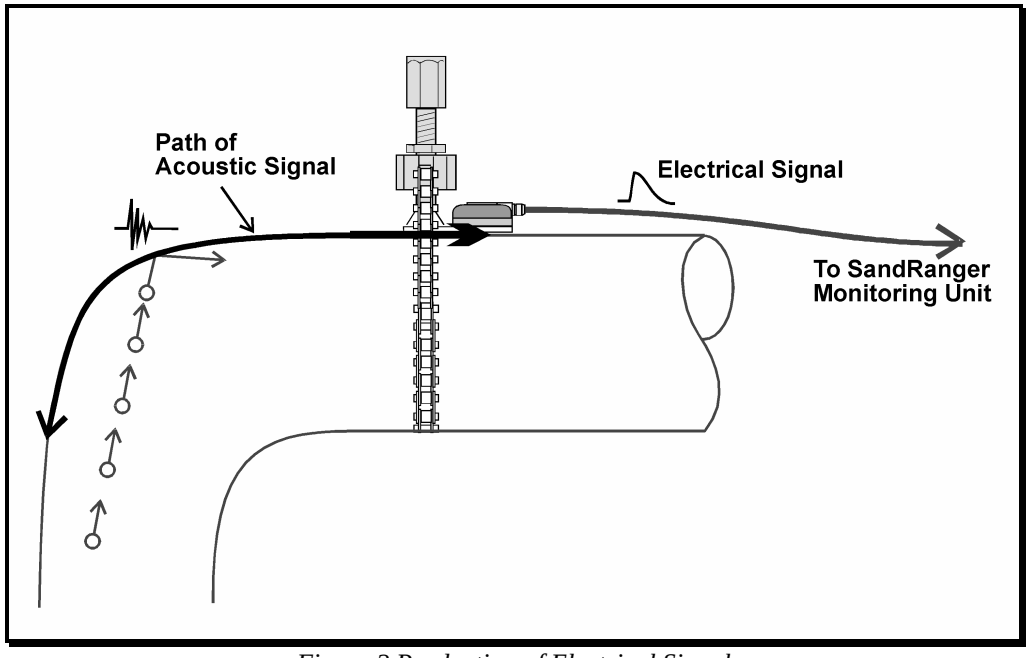


Figure 2 Production of Electrical Signal

The electrical signal or sensor output is converted into a digital signal by the ADC in the SandAlert Lite. The sensor output is then processed to provide a sand impact rate (SIR) in impacts per second (IPS).

To be counted as a sand impact the peak amplitude of the pulse must exceed the low threshold but not exceed the high threshold. Therefore, referring to Figure 3, pulse 1 is not counted as the low threshold > peak amplitude.

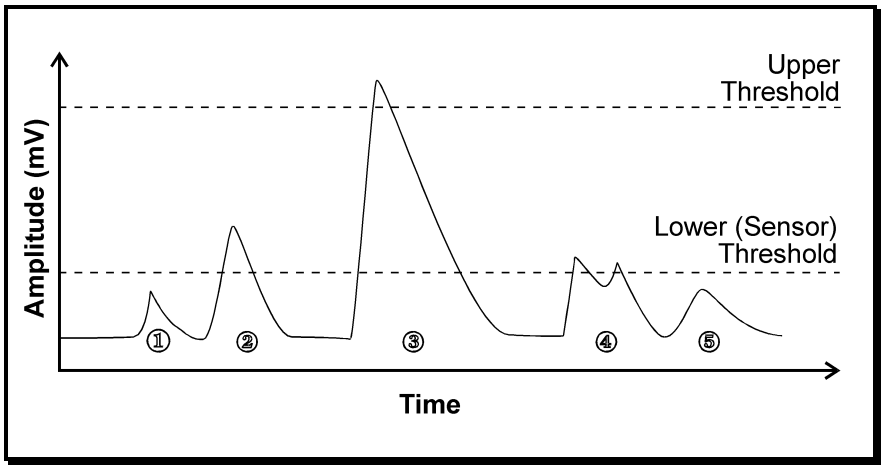
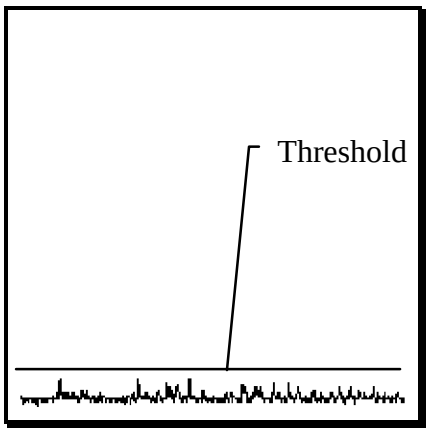


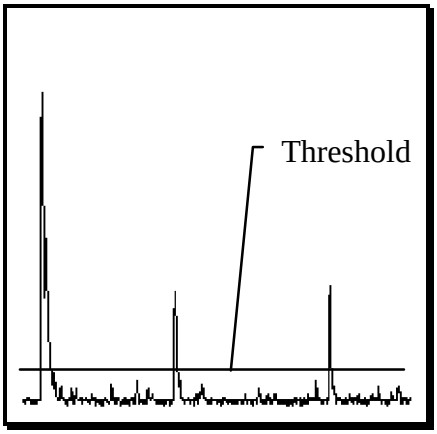
Figure 3 Sensor Output

Pulse 2 is counted as 1 sand impact, pulse 3 is not counted as the peak amplitude > high threshold and is therefore excluded. This is to prevent high energy events, e.g. excessive pipe vibration from being counted as sand impacts. Pulse 4 counts as 2 sand impacts as it is generated by two sand particles impacting almost simultaneously. Pulse 5, like pulse 1 does not have sufficient energy to be counted as the peak amplitude < low threshold.

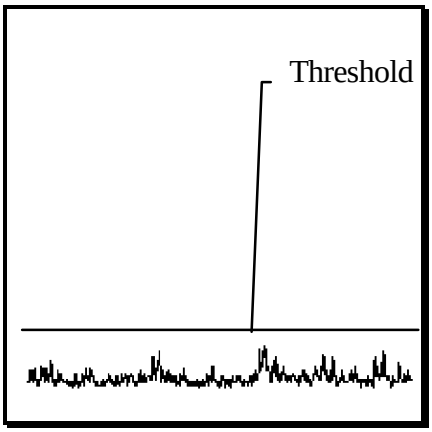
The SandAlert Lite unit can calculate the lower threshold automatically. This is done by examining the signal and eliminating the flow related noise in the signal, and counting the number of sand impacts. To illustrate this, different signals under conditions of high and low flow rates, both with and without sand impacts are shown below.



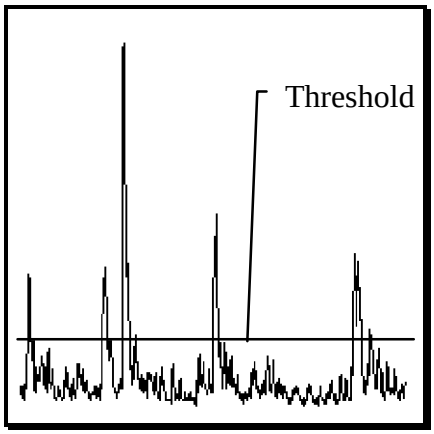
a - Low Flow, No Sand



b - Low Flow, With Sand



c - High Flow, No Sand



d - High Flow, With Sand

The SandAlert Lite unit eliminates the flow noise by placing a threshold automatically just above the flow related noise signal, and if the signal goes higher than this then it is due to solid impacts, which can be seen in *b* and *d* as short duration, high energy spikes, as compared with the flow related noise that is longer duration, and of lower energy. The threshold is visibly higher in *d*, due to the higher level of flow related noise.

There is also an option with the SandAlert Lite to utilise the auto-calibration function of the unit in order to produce a reading in grams/hour (or lbs/hour). It should be noted however, that because of the number of variables associated with the conversion from IPS to grams/hour, this reading is only approximate. The calibration is much more accurate if undertaken by manual sampling, such as injection or filtration.

The SIR reading remains largely unaffected by the variables, as these relate mainly to flow rate and solids particle parameters and the SIR is independent of both of these.

The SIR is calculated from the sensor output continuously, once a run has been initiated, and the words “Time Left = xxx” appear in the title bar of the screen. This happens in the background, whatever the operator is doing on the SandAlert Lite, i.e. even if the operator is transmitting data via the serial port, the monitoring still continues. If required the SIR can be converted to a solids mass flow rate by a calibration routine. The SIR is also averaged and can be plotted both on-screen and stored to file to provide a trend history. The stored data files can be printed on the internal printer, displayed on the screen, or transferred to another device via the RS232 serial port.

The SIRs are stored, and at the end of each averaging period (operator selectable), the average of all the SIR samples is calculated and stored to disk for trend analysis.

4 Installation

Installation, commissioning and servicing of the system must be strictly in accordance with BS5345 Parts I and IV. All equipment and system approvals, specifications, warranties and statements of fitness for purpose are conditional upon this requirement being met.

The sensor is certified for use in hazardous areas and it is important to ensure that this level of certification is adequate for the area in which the sensor is intended to be installed. The SandAlert Lite unit must be situated in a non-hazardous area.

4.1 Sensor Positioning

The acoustic sensor detects the high frequency sound generated by the impacts of sand and other solid particles e.g. proppant on the inside of the pipe wall. Therefore, the best results will be

obtained if the sensor is positioned on or just after a bend (within two pipe diameters of the bend), or fixed restriction to the flow. See Figure 4.

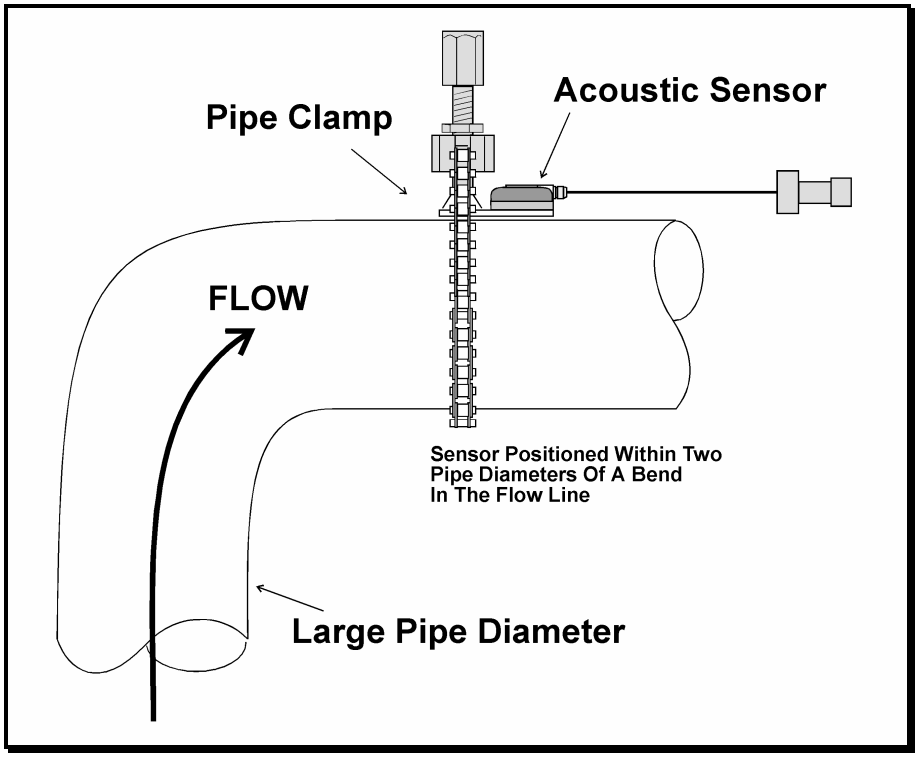


Figure 4 Sensor Positioning

Do not position the sensor in close proximity to a choke, or other variable restriction, since changes in the choke position may affect the SIR readings. It may be necessary to experiment with the sensor position to obtain the best results.

4.2 How to fit the pipe clamp to the pipe

The pipe clamp is suitable for pipes with an external diameter range from 3" (75 mm) to 8" (200 mm) by the use of a chain that tightens around various pipe sizes. It has a sensor stud that fits into the hole in the sensor tab, which ensures the sensor is in contact with the pipe wall after tightening.

IMPORTANT: The point of contact with the pipe should be cleaned of paint, to ensure that the sensor contacts with bare metal. Some suitable grease, such as silicon grease, should be applied between the pipe and the clamp. This improves the acoustic coupling.

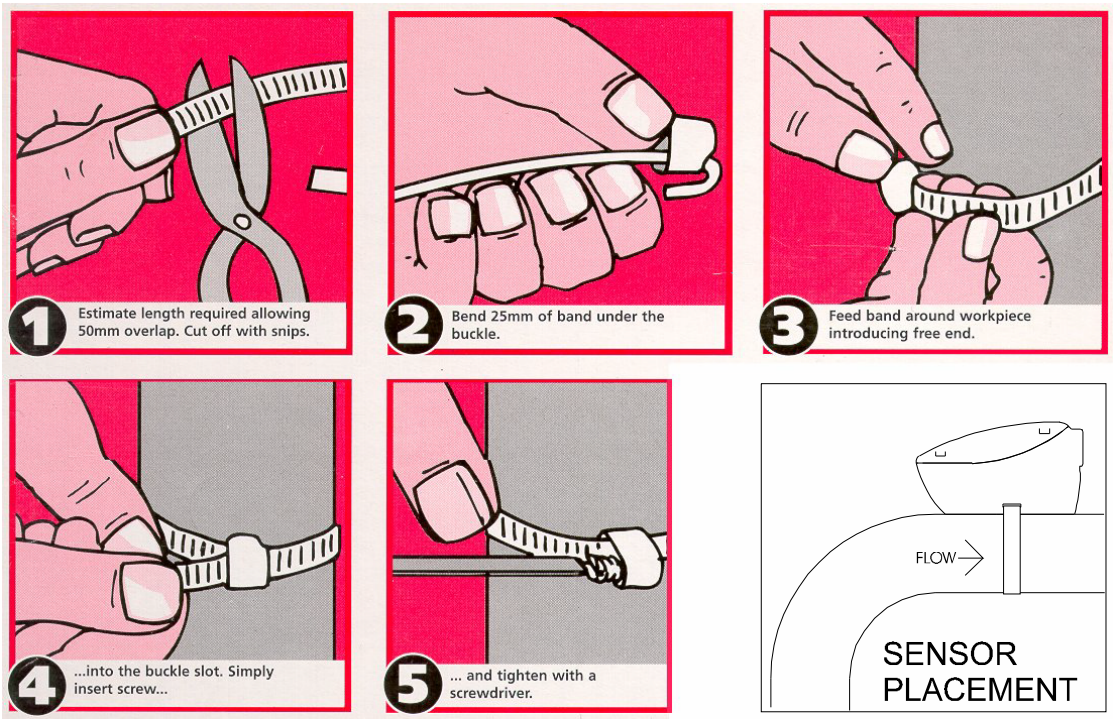
To assemble the pipe clamp pass the guide bar end of the chain assembly around the pipe and through the pivot block on the saddle, and lock the pivot lever into the chain. Place the sensor between the clamp foot and the pipe, using a smear of grease, and tighten the threaded stud using the spanner provided so that there is a solid physical connection between the sensor and the pipe. Tighten the locking nut with the spanner provided to give a solid, secure attachment.

IMPORTANT: The sensor cannot be damaged by overtightening since the clamp is in contact with the metal tab part of the sensor and not the electronics which are contained within the dome part of the housing.

It is recommended that the clamp is tightened to at least 40 lbf/ft, and the locking nut is tightened.

Where vibratory conditions exist it is recommended that a thread locking adhesive is used. Also it is important to ensure that the free end of the chain is cannot fret against the clamp or the pipe, by tying it up with cable ties.

The PULSARguard 2001 is fitted using stainless steel banding (11mm wide), you can either use a re-usable "jubillee" clip type toothed band, or by a plain band with crimpable clips. All the above points regarding position and surface preparation above apply. Always ensure that the pipe is cleaned to bare metal and that the silicon grease acoustic coupling compound is used between the base of the sensor and the pipe.



4.3 Electrical Installation of SandAlert Lite

The SandAlert Lite must not be operated in a designated hazardous area. It must be located in a designated non-hazardous area. The mains supply voltage must be the same as that marked on the SandAlert Lite, i.e. 85-264 V ac. Irreparable damage may occur if the wrong supply voltage is applied. Damage of this nature is not covered under warranty.

The cable reel supplied contains 100 metres of two pair screened cable, although it is possible to extend this to 1000 metres. The free end of the cable connects to the sensor via an in-line connector. The cable reel connects to the SandAlert Lite via the short interconnection cable.

Route the cable from the non-hazardous area, in which the SandAlert Lite is to be operated, to the sensor position. Avoid running the cable parallel to HV cables to reduce the risk of electrical noise. Be careful not to route the cable in such a way as to obstruct doorways or walkways.

Connect the sensor to the cable using the in-line cable plugs and sockets, the plug and socket will only mate in the correct way, tighten the collet to secure the connection.

Connect the short interconnection cable from the cable reel to the SandAlert Lite.

Refer to the system diagram (Figure 1) to ensure that all the electrical connections have been made correctly.

5 Quick guide to installing the system

This section describes how to quickly install the system. For more detailed information, see section 4.

5.1 Attach the Sensor to the Pipe

The acoustic sensor detects the high frequency sound generated by the impacts of sand and other solid particles e.g. proppant on the inside of the pipe wall. Therefore, best results will be obtained if the sensor is positioned on or just after a bend (within two pipe diameters of the bend), or a fixed restriction to the flow. Do not position the sensor in close proximity to a choke or other variable restriction, since changes in the choke position may affect the SIR readings.

Attach the sensor to the pipe with the chain clamp and tools provided, remembering that the point of contact with the pipe should be cleaned of paint, to allow the clamp to contact with bare metal. Some suitable grease, such as silicon grease, should also be applied between the pipe and the clamp, and the clamp tightened securely.

In the case of the PULSARguard 2001 use the banding as described in 4.2.

5.2 Connect the Sensor to the SandAlert Lite

Run the cable reel from the sensor back to the SandAlert Lite and connect the plug to either the channel one or channel two sensor connector.

5.3 Switch on the SandAlert Lite

Ensure that the SandAlert Lite is plugged into the correct power supply, switch on using the power switch, and the green LED will illuminate. After approximately 1 minute the unit will start monitoring.

5.4 Connecting to the data collection system

The SandAlert Lite connects to yoour data collection system via its RS232 serial port.

The serial connection is made via the 9 way ‘D’ type connector on the front panel next to the VGA socket, connections are as detailed in the table below:

SandAlert Lite (9way FEMALE)	PC (25way MALE)	PC (9way MALE)
PIN 3 (RxD)	PIN 2 (TxD)	PIN 3 (TxD)
PIN 2 (TxD)	PIN 3 (RxD)	PIN 2 (RxD)
PIN 5 (SIGNAL GND)	PIN 7 (SIGNAL GND)	PIN 5 (SIGNAL GND)

The SandAlert Lite could be connected to a PC running terminal to check the data is transmitting and is of the expected format. Details for connecting to terminal are below:

Start 'Terminal'

To use 'Terminal', start Windows (by typing "Win" from the Windows directory), and locate the 'Terminal' within the Windows 'Program Manager'. It is likely that it will be found in the 'Accessories' group, and the icon should look like that shown below:

If it cannot be found on the computer being used, run 'File Manager' (found in the 'Main' group), locate the program 'terminal.exe' which will be located in the Windows directory then double-click the mouse on this since this is the 'Terminal' program.

Setup the Communications Parameters

Once the program is running, the "Terminal" must be setup to communicate with the SandAlert Lite. If using 'Terminal', then select the 'Communications...' option from the 'Settings' menu bar, and make the selections as shown in Figure 5.

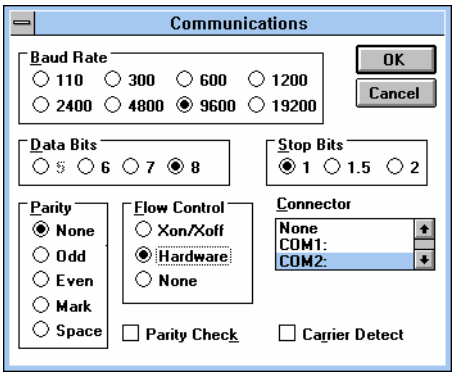


Figure 5 Communications Parameters

The 'Connector' section should refer to the Com (serial) port you have connected to.

As data is being transferred, it will be displayed in the 'Terminal' window, and will scroll as more data is received.

Data Format

The data is sent from the SandAlert Lite every minute (this is the default averaging period), the information is formatted as follows:

DATE - TIME- SIR ch.1 – weight ch.1 - SIR ch.2 – weight ch.2

Typical data:

16/03/04 17:40:00 0000.0 000000.0 0297.0 000000.0

16/03/04 17:41:00 0000.0 000000.0 0185.0 000000.0

16/03/04 17:42:00 0000.0 000000.0 0124.0 000011.2

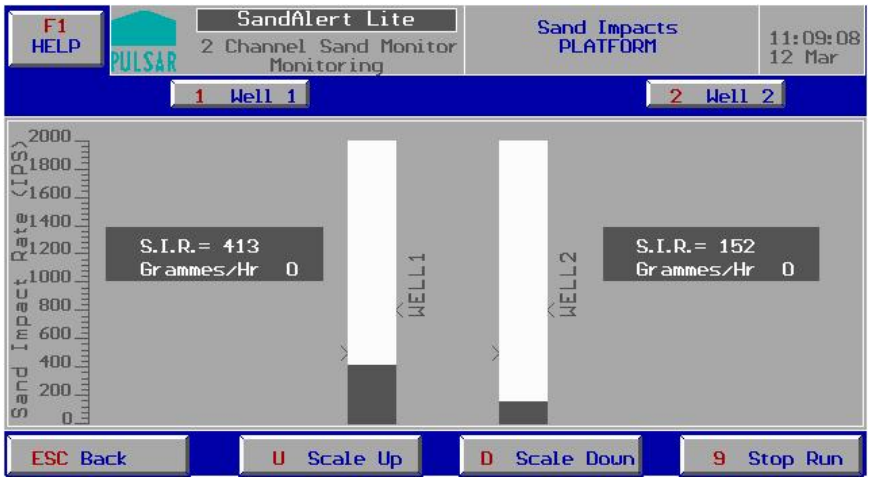
16/03/04 17:43:00 0000.0 000000.0 0296.0 000026.6

6 SandAlert Lite user interface

This section describes the set-up of the

Navigating the software menus:

Title screen, this does not stay visible for long as the default operation of the unit is to go straight to monitoring after power-up.

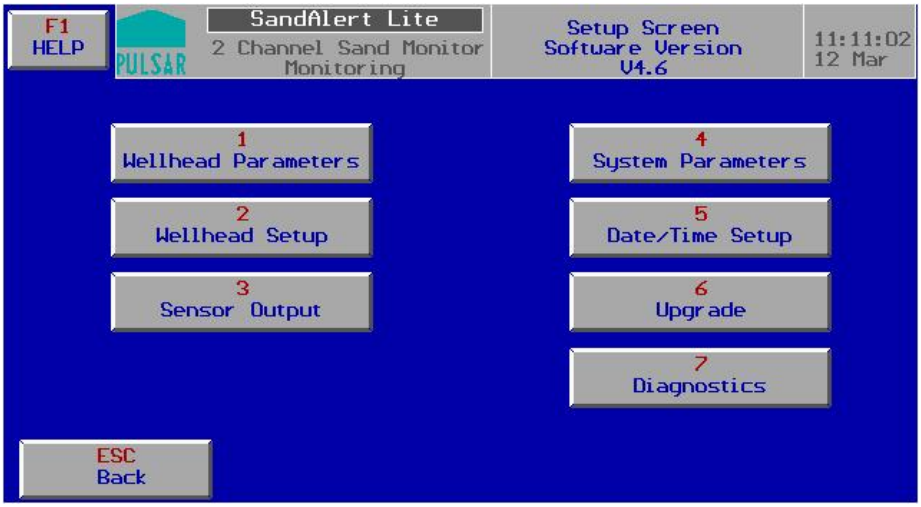


This is the monitoring screen, the system will automatically go to this screen on power-up.

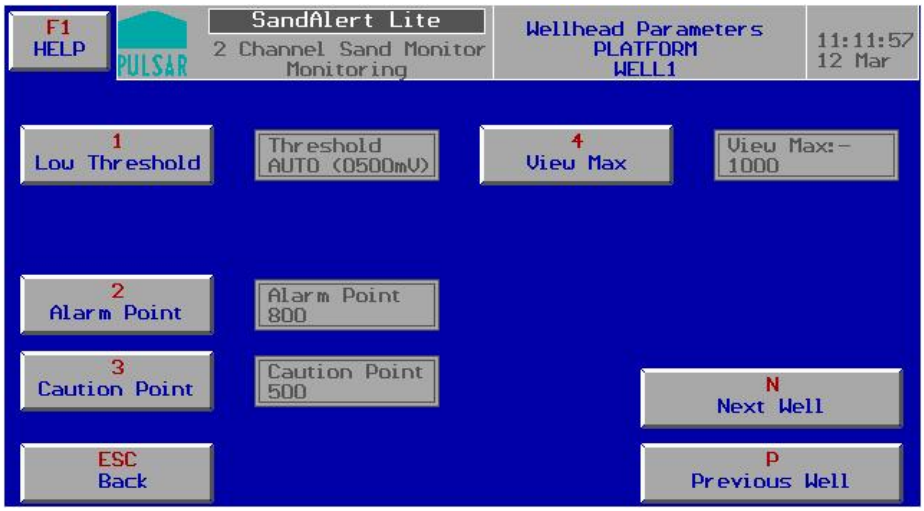
6.1 To get to the main menu press ESC.

This is the main menu screen, Type the red number to choose, 1 will take you to the screen above. 2 will take you to ther setup menu below:

6.2. SET-UP



6.2.1 Type 1 to goto the wellhead set-up, then choose the well to be setup, up down arrow keys allow you to choose well 1 or 2, see below:



The above mennu allows setup of the well:

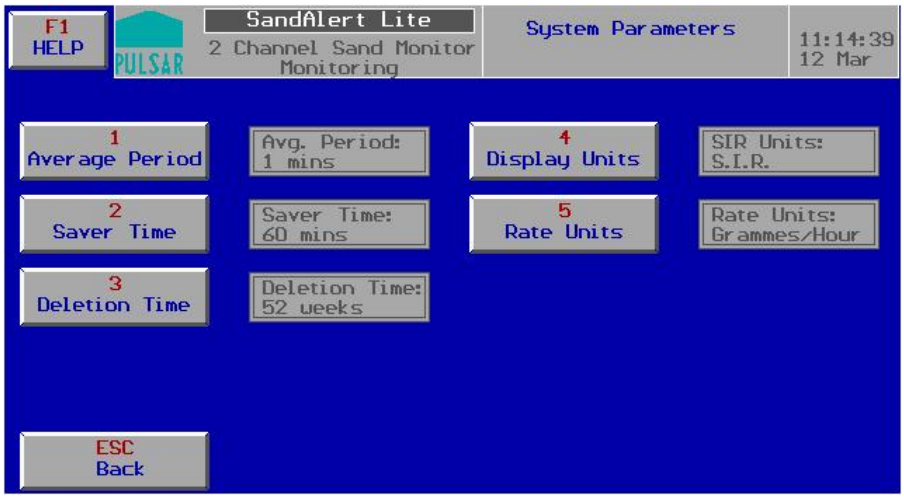
1. Threshold: Lets you set the threshold, this is the level that a signal must cross for it to be counted as an impact. The default and recommended setting is Automatic.
2. Alarm Point: Let you set an Alarm Point based on the number of SIR's (Sand Impact Rate), this figure must be higher than the Caution Point. When this level is reached an audible sound will be heard (medium pitched sound)
3. Caution Point: Let you set a Caution Point based on the number of SIR's (Sand Impact Rate), this figure must be lower than the Alarm Point. When this level is reached an audible sound will be heard (low pitched sound).
4. View Max: This figure is used to scale the display if you set 1000 then a SIR of 500 would half fill the display. Any value expressed as a percentage would be related to this setting.

N. Next Well: moves you on to the other well

P. Previos Well: this alo moves you to the next well as there are only two . . available in the SandAlert Lite.

2.2. and 2.3 Wellhead setup and 3. Sensor Output are not available in this software

6.2.4. System Parameters



1. Average Period: The SandAlert Lite is designed to connect to a logging system via an RS232 serial port. The data that is transmitted is averaged over the period set in this parameter.

2. Saver Time: This is the time before the screen saver is activated.
3. Deletion Time: Not appplicable to SandAlert Lite.
4. Display Units: Choose between Sand Impact Rate (SIR) and a % of sand impact rate, based on View max set up for the wellhead earlier.
5. Rate Unit: Sets the units to be displayed when you have calibrated the system to display weight

ESC. Takes you back to the Set-up menu.

6.2.5. Allows the setting of the time and date:

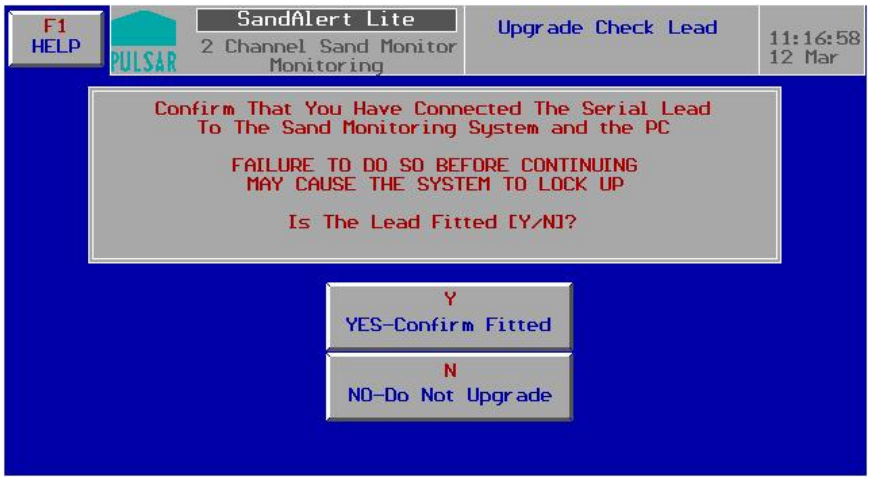
You have three choices:

1. Change Date: See below, Enter the correct date.
2. Change Time: Enter the correct time
3. Date Format: Set the date format, English or American

This is an example of the Date set-up screen

6.2.6.Upgrade

This is to allow the software of the unit to be upgraded, follow the on screen instructions carefully to update the internal software (This action is normally carried out by a Pulsar Engineer).



The first of the Upgrade screens showing the detailed instructions.

6.2.7.Diagnostics

1. Scandisk, this runs the DOS program scandisk to check the internal hard disk. It should not be necessary to run this on the SandAlert Lite as no data is written to the hard drive.
2. Defragment, this runs the DOS progrem Defrag, this again should not be necessary with the SandAlert Lite unit as no changes are made to the files on the hard drive and therefore will not become fragmented.
3. Check Files, this is to check the logged data files, this is not applicable s\to SandAlert Lite.
4. Factory Defaults, this button resets the system to as it was the day it left the factory.

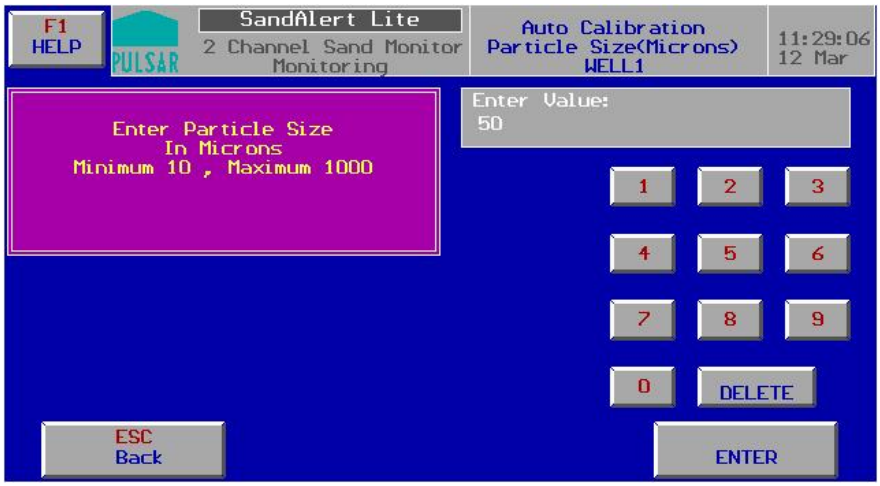
6.3.Calibration

This set of menus allow you to calibrate the system so it will show quantity rather than just SIR.

Type 3 and Select 1. for Manual Calibration, 2. for Auto Calibrate and 3. for Editing the calibration figure. It is recommended that the Auto Calibrate mode is chosen and is the one described below: Type 2 for Auto Calibrate

Choose the application, oil or gas

Enter the flow rate



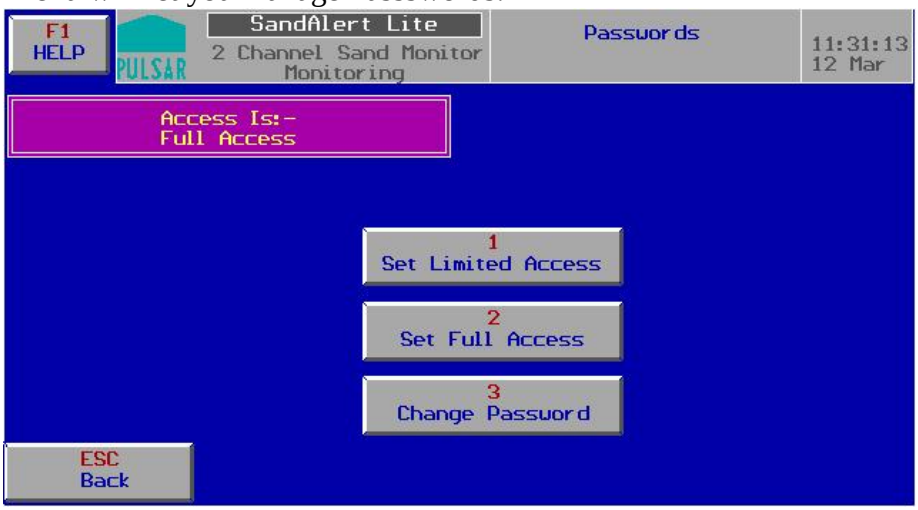
Enter the average particle size, and the system then calculates the calibration factor.
This figure can be modified with choice 3 Edit Factor. Be careful changing the factor as it can change the weight figure dramatically. It is best to stick with Auto Calibrate unless a known weight of sand is being produced and the system is calibrated at that time.

Edit Factor Screen, it is not recommended to change the calibration factor unless you are sure it is necessary and understand the consequences.

4. and 5. File Handling and Event Log are not functional in the Lite software

6.6. Passwords:

The system is protected with two levels of passwords, Limited Access and Full Access, typing 6 from the main menu will let you manage Passswords:



Main password screen,

1. Sets Limited access, only 1. monitoring and 6. passwords are available in the main menu once this level has been set.
2. Sets Full Access, this allows all areas and settings to be accesssed.
3. Change Password, this allows for the default passwords to be changed.

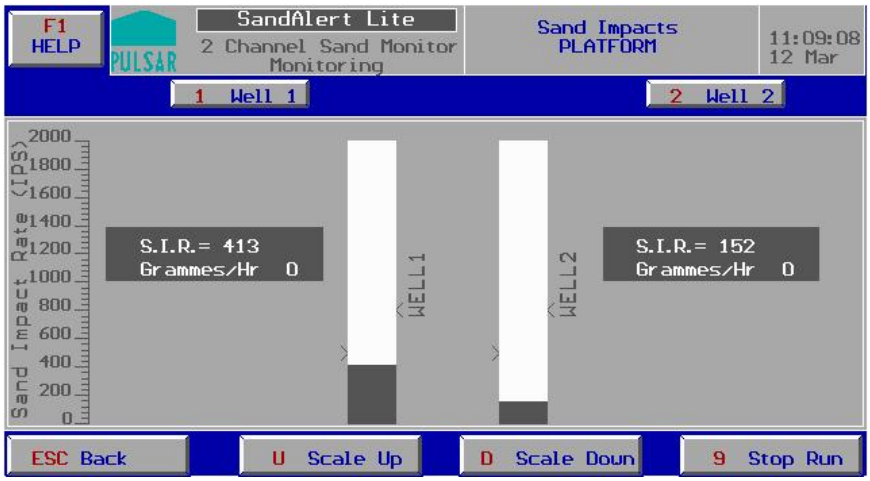
The default Passwords are pass1 to pass8, you can view the passwords that are set by entering the password 44332211. You can change pass1 to pass8 to anything (maximum 8 characters).

This screen shows the keyboard you enter the passwords on.

Note if you find you only have two buttons in the main menu screen then it means you are in Limited Access mode, enter a valid password to get the 6 buttons in the main menu.

6.7. Monitoring:

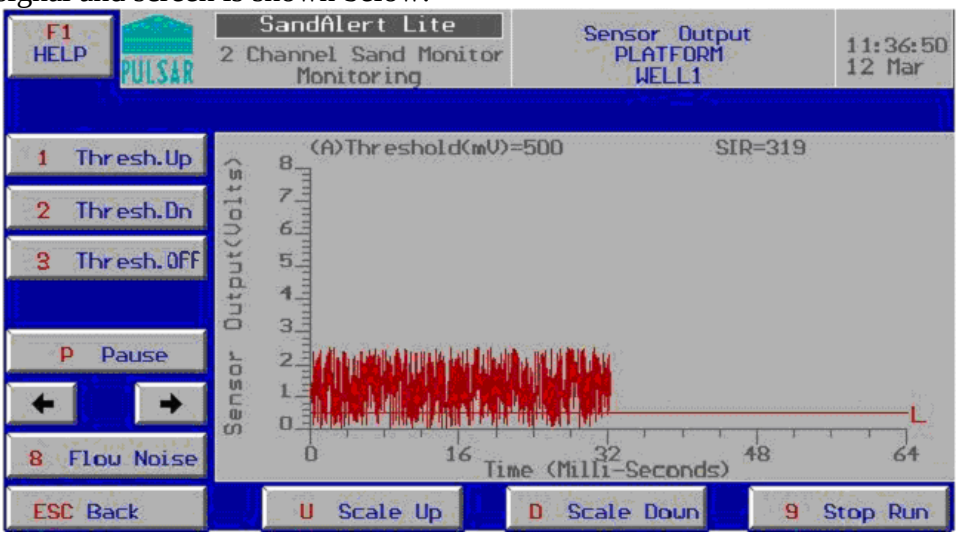
This section has been put at the end of this section as it is normal to check the other settings before going to the monitoring screen.



This is the main monitoring screen, The two bars in the centre of the screen show instantaneous SIR (Sand Impact Rate).

Type 1 to see the real signal of wellhead 1
Type 2 to see the real signal of wellhead 2

Wellhead 1 signal and screen is shown below:



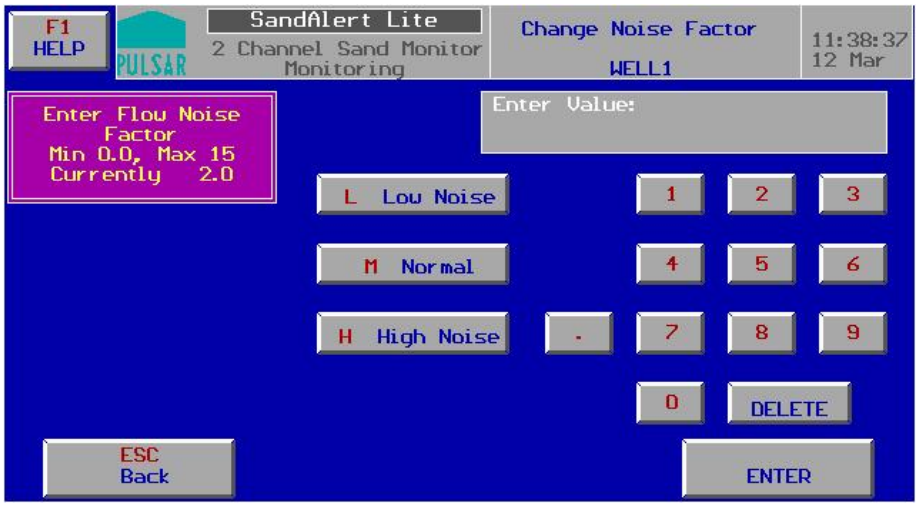
1 and 2 allow you to change the threshold if you are set to manual threshold. The default and recommended setting is Automatic. In automatic threshold these buttons have no effect.

3 – Threshold offset, this figure is used in conjunction with Flow noise to set the auto threshold, a value can be set for each channel, default value 200. (See Flow noise)

P- Pause stop the signal trace to allow closer inspection.

The arrows change the scale of the time axis

8 – Flow noise, the settings in this menu affect the way the automatic threshold reacts.



Select Low(1.5), medium(2) or high(3.5) dependant on flow noise, fine tuning is achieved by typing a value that is not set by the buttons. These values have no affect unless the threshold is set to automatic. Increasing the value causes the threshold to move higher in response to the back ground noise. See the earlier section on Sand impacts to see how the level should be set. After changing these values have a look at the Real signal page for the well head that has been changed and ensure that the threeshold is not too high or too low. If it is too high there will be no crossings and if too low all the signal will be above the threshold.

The Threshold offset works in conjunction with Flow Noise to allow fine tuning when a difficult application is encountered. The Threshold adds the value set (in mV) to the calculated auto threshold. The reason is that if you increase the Flow noise figure to raise the threshold in quiet conditions then when the noise increase the threshold will rise too high. Using Threshold offset instead will allow an offset to be added that is not dependent on the current signal.

Suggested figures are:

Condition	**Flow Noise**	**Threshold offset**
Low Noise	1	200
Normal	2	300
High Noise	3.5	500

(High Noise is for extreme conditions, view sensor output screen after changing any of these settings prior to finalising settings)

U and D are to change the Y-axis scale (U =up and D =down).

STOP RUN, will stop the unit from monitoring, this button is not normally used. When the unit is re-booted monitoring is restarted automatically.

7 SYSTEM SPECIFICATION

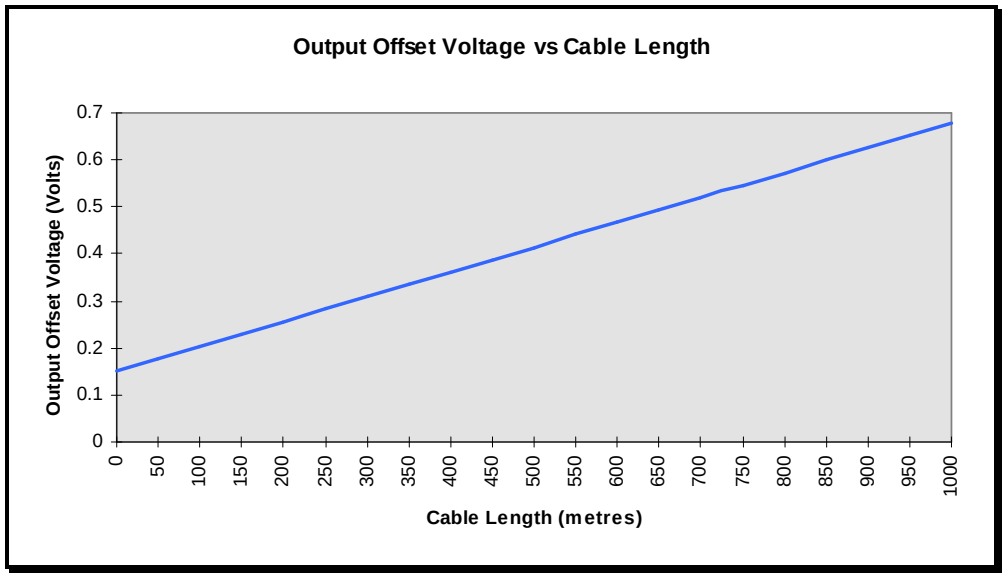
7.1 Senaco^{Plus} Sensor (Superceded by Pulsarguard 2011 ATEX Version)

Approvals

- CE approval (Certificate of Conformity available on request).
- *SENACO* ^{Plus} sensor housing rated to IP68 / NEMA 4.
- CENELEC Intrinsically safe certificates held to EEx ia IIC T6 (this rating applies when the ambient temperature is below +40 ^{o}C) or EEx ia IIC T5 T_{amb} = 92 ^{o}C (this rating applies when the ambient temperature is below +92 ^{o}C). Certifying body SIRA Certification Services.

Construction

- Rugged two part housing in cast Type 316 stainless steel.
- Cap casting is polyester powder coated, in Cornflower Blue.
- Neoprene O-ring.
- Polycarbonate reverse printed badge bonded to cap casting.
- 4 metre double screened, black PVC jacketed 4 core (7 x 0.2 mm) PVC insulated cores cable assembly. OD 6 mm nominal terminated with a lockable 4 way connector
- All sensors manufactured under an ISO 9002 accredited Quality System. Certificate number 950136. Approval body SIRA Certification Services.
- Operating Temperature = -40 ^{o}C to +85 ^{o}C.
- Output = Buffered & short circuit protected (current limited to 10 mA) analogue voltage nominally 150 mV to 10 V. 2 µs / 240 µs time constant (rise / decay).
- Maximum cable length between power supply / monitoring device and sensor is 1.0 km. However, additional cable length will affect the output voltage offset as shown below. The sensitivity of the sensor will not be affected.



Pulsarguard 2011 (ATEX)

This sensor is the same as Senaco except it has been approved under ATEX, the specification and use are the same as Senaco.

See specific manual for details.

7.2 PULSARguard 2001 (Superceded by ATEX Version)

Is designed to be more sensitive to sand and less prone to flow noise making it ideal for use on gas and multi phase wells.

The sensor is a Pulsar Process Measurement intrinsically safe acoustic sensor. The sensor is housed in a robust cast Type 316 stainless steel enclosure. The Sensor is called the PulsarGuard 2001 and is intrinsically safe, certified to EEx ia IIC T4

Explanation of the IS approval description:

EEx denotes a CENELEC approval.

ia denotes the device is intrinsically safe category ‘ia’, and therefore is suitable for all zones (0, 1 and 2).

IIC denotes the gas group. Group IIC, typical gas hydrogen..

T4 denotes the temperature classification.

The sensor housing is rated at IP68 giving protection against temporary immersion to a depth of 3 metres.

The sensor is powered from a power supply via galvanic safety barriers, both of which are housed in the SandAlert Lite unit.

Pulsarguard 2001 (ATEX)

This sensor is the same as Pulsarguard 2001 except it has been approved under ATEX, the specification and use are the same as Pulsarguard.

See Specific manual for details.

7.3 SandAlert Lite contol unit:

Construction	Epoxy coated steel case with hinged lid
Computer Hardware	IBM compatible computer running the Pulsar Sand Alert Software loaded on an internal Hard drive, RS232 communications port, A/D with 100kHz sampling rate 12 bit resolution.
Power Supply	Mains 85 to 240 V at 50 to 60 Hz. The internal power supplies provide dc power to the computer hardware and the sensor.
Weight	10 kg
Dimensions	Overall height 150mm Overall depth 300mm Overall length 400mm

Revision Record

Date	Issue	Revison
Issue 2	9/9/04	Add Threshold offset and add ATEX transducers