

Non-Intrusive Pig Signaller Magnetic Topside Alkaline Operating Manual

The 4001D MAGSIG[®] is a fully ATEX and IECEx certified non-intrusive pig signaller which quickly and accurately detects, signals and logs the passage of magnetic pigs at critical points along a pipeline both on land and offshore.



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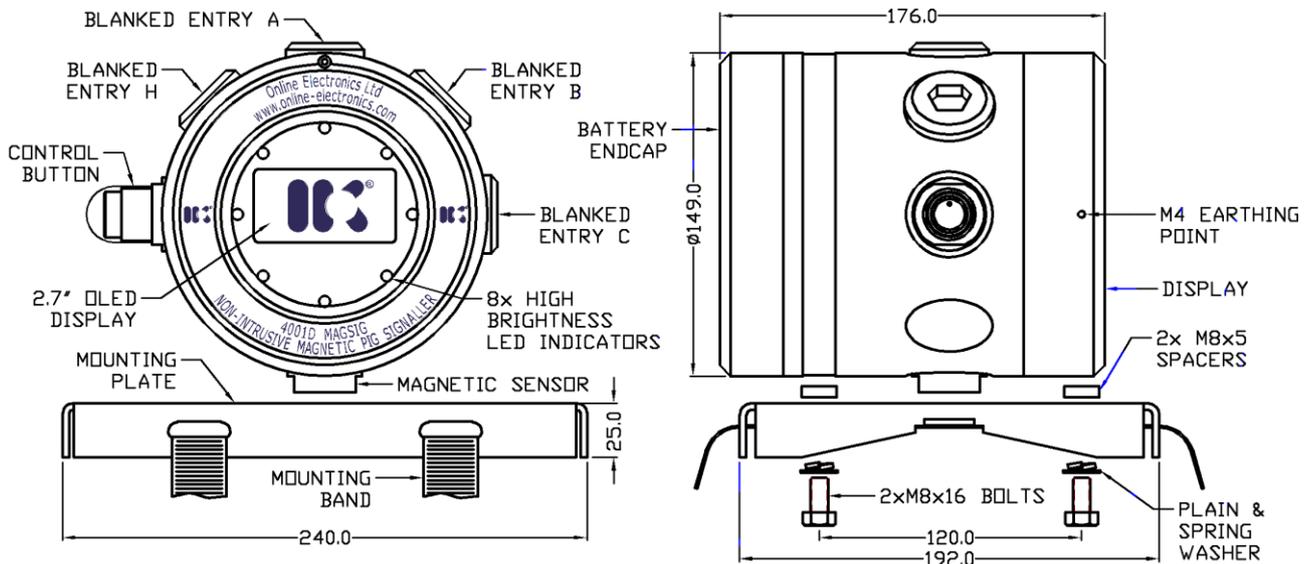
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1. GENERAL DESCRIPTION

The OnlinE 4001D MAGSIG® is a fully ATEX and IECEx certified, robust, non-intrusive magnetic pig signaller which detects, signals, and logs the passage of magnetic pigs at critical points along a pipeline both on land and offshore. Events are signalled as they occur via a 2.7" graphical display and high brightness LEDs positioned around the perimeter of the display.

The unit logs the time and date of up to 99 events. Logged events can be viewed locally on the graphical display, transmitted remotely over several optional interfaces, or downloaded using a laptop. The user can turn the unit ON and OFF as well as modify several settings using the single control button and intuitive menu system.

The unit can be quickly and easily attached to a pipeline using ratchet straps or steel banding. The unit is suitable for use on pipeline diameters up to 60" with wall thickness up to and in excess of 40mm (please contact Online Electronics Ltd when wall thickness exceeds 25mm). Detection speed ranges from 0.01 to 20 metres per second. Window of detection is typically 0.5m either side of the unit. The detection capabilities vary depending on the background magnetic noise, pig speed, pipeline diameter, wall thickness and the quality of magnets fitted. For optimum performance it is recommended that pigs are fitted with magnets as described in Section 4.10 RECOMMENDED MAGNET ARRANGEMENT.



REMOTE SENSOR OPTION: The magnetic sensor can be supplied on a cable up to 10m long for use with buried pipelines or when access is limited. The protection concept for the remote sensor is intrinsically safe 'ia'.

POWER OPTIONS: The unit can be powered from internal batteries or from an external +24Vdc supply. Batteries where specified and provided can be fitted to provide backup power should the external supply fail. The unit uses 7x individual 'D' sized cells and can be configured during manufacture for use with Alkaline (DURACELL ID1300) OR Lithium (SAFT LS33600) cells. The unit can only be configured for use with one cell type, to change the specified cell type, the unit must be returned to Online Electronics.

ENTRY OPTIONS: The standard unit comes with 4x M20x1.5 entries with blanking elements installed. There is generous room inside the unit to make electrical connections without the need for additional junction boxes or enclosures. ATEX Exd adaptor options are available for 1/2" NPT and 3/4" NPT.

MATERIAL OPTIONS: The unit can be supplied with an epoxy coated Aluminium Alloy 6082-T6 or uncoated 316L Stainless Steel housing. Alternative coatings can be catered for.

TEMPERATURE RANGE OPTIONS: Ambient temperatures of -50°C can be accommodated by installing a heater within the electronics housing. Higher pipeline surface temperatures can be accommodated using a thermally insulated remote sensor.

2. SPECIFICATIONS

External supply	+21.6Vdc to +26.4Vdc, <1.0W
Temperature range using external supply (NO CELLS FITTED)	-40°C to +85°C
Battery type	7x DURACELL ID1300 Alkaline cells
Battery life in LISTENING/LOW POWER MODE at +20°C	160 days
Temperature range while cells installed	Refer to Section 8 ATEX / IECEx APPENDIX
Ingress Protection	IP66
ATEX/IECEx code	II 1/2 G Ex d ia [ia Ga] IIC T4..T6X Gb
EC Type Examination Certificate Number	TRAC13ATEX0007X
IECEx Certificate Number	IECEx TRC 12.0017X
Weight in Aluminium.....	5.2kg
Weight in Stainless Steel	11kg
Pig Speed Range	0.01m/s to 20m/s

STANDARD OUTPUTS:

DPDT Relay Output (Volt Free Contacts)	2A @ 30Vdc
Current Loop Output	15.0mA ±1.0mA (LISTENING) / 19.0mA ±1.0mA (DETECTION)

3. RULES FOR SAFE OPERATION

⚠ WARNING: The Special Conditions for Safe Use detailed in Section 8 ATEX / IECEx APPENDIX of this manual must be observed at all times

⚠ WARNING: The purchaser of this equipment is responsible for the training and competence of operators and the manner in which it is used. This manual should be read through and understood before installation and commissioning so that the operator is familiar with the equipment. Contact Online Electronics Ltd immediately should any difficulty arise in the use of this equipment.

⚠ CAUTION: If the signaller is to be placed in storage, always ensure that it is turned OFF and the batteries are removed and stored separately.

4. OPERATION

4.1. TURNING ON

To turn the unit on simply press and hold the control button until the COMPANY LOGO appears on the display and then release, this takes approximately 5 seconds. The unit may be configured to turn on automatically as per section 4.9.1 FORCE ON FUNCTION.

The COMPANY LOGO will be displayed for 5 seconds as shown by the COUNTDOWN INDICATOR located at the bottom left hand side of the display.

A BATTERY LEVEL INDICATOR is shown at the bottom right hand side of the display. Refer to Section 4.8 BATTERY REMOVAL for further information on battery voltages.

When the COUNTDOWN INDICATOR reaches zero, the CONTROL BUTTON is pressed, or any serial command is received, the next screen will appear.

The next screen shows the PRODUCT LOGO and firmware version at the very bottom of the screen in LNN format. When the COUNTDOWN INDICATOR reaches zero, or the CONTROL BUTTON is pressed, or any serial command is received, the next screen will appear the next screen will appear.

The next screen shows the current STATUS of all settings as per 4.6.2 STATUS. When the COUNTDOWN INDICATOR reaches zero, or the CONTROL BUTTON is pressed, or any serial command is received, the next screen will appear the unit will enter STABILISATION.

During STABILISATION the unit will not detect or log any magnetic events and the LEDs will flash every 5 seconds. When the STABILISATION counter reaches zero, the CONTROL BUTTON is pressed, or any serial command is received, the unit will start LISTENING for a magnetic event. See section 4.2 STABILISATION for more information.

While LISTENING, the screen will show the live DIFFERENCE flux readings at the top of the display and the current number of events logged. If previous EVENTS have been logged then a graphical representation of the DIFFERENCE signal of the most recent event along with the date and time of the event, will be shown. The LEDs will flash every 5 seconds. See section 4.3 LISTENING for more information.



4.2. STABILISATION

The STABILISATION delay occurs at switch ON only. During the STABILISATION delay the unit will ignore all magnetic events. The LEDs will flash every 5 seconds and the relay and current loop outputs will be in the DETECTION state. The STABILISATION delay can be used during deployment to prevent any unwanted events from being logged due to movement of the unit in the earth's magnetic field and/or movement of nearby magnetic objects (such as vehicles).

The STABILISATION delay can be set to any value between 00:00:00 and 99:99:99 (in HH:MM:SS format) using the CONTROL BUTTON or via the serial link. During the STABILISATION delay a countdown timer is shown on the display and via the serial data link, once this timer reaches 00:00:00 the unit will start LISTENING. The STABILISATION delay can be bypassed by pressing the CONTROL BUTTON or by sending any serial command at any point during STABILISATION.

Remember that the STABILISATION delay occurs at switch ON only. If changes are made to the STABILISATION delay setting then the unit should be turned OFF. The new STABILISATION delay will occur whenever the unit is next turned ON.

4.3. LISTENING

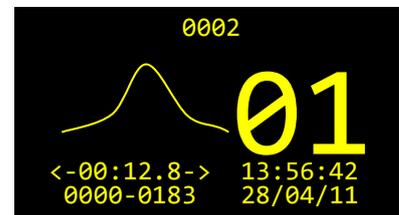
After STABILISATION the unit will display one of the screens shown opposite depending if there have been any previous EVENTS.

Listening with no events is shown when no events have occurred yet. This screen will show a large '00' with no graph, date or time. The LEDs below the display will flash every 5 seconds



LISTENING - NO EVENTS

Listening with events shows a graphical representation of the last EVENT recorded, showing EVENT number, time and date of the event, time span of the peak and peak difference (In this case, EVENT #01 occurred at 13:56:42 on 28/04/11).



LISTENING - WITH EVENTS

The four digits at the top of these screens show the live DIFFERENCE flux readings, in a magnetically quiet environment this number can be expected to flicker between 0000 and 0005.

While LISTENING the unit continually takes RAW flux readings which are FILTERED and the DIFFERENCE between the RAW and FILTERED values calculated. If the DIFFERENCE ever exceeds the THRESHOLD setting then the unit enters DETECTION MODE. While LISTENING, the LEDs around the display will flash every 5 seconds and the relay and current loop outputs will be in the LISTENING state. There are 4x things that may cause this screen to change:

MAGNETIC EVENT – If a DIFFERENCE flux reading greater than the THRESHOLD value is detected while the unit is LISTENING, the unit will go into DETECTION as per section 4.4 DETECTION MODE).

LOW POWER MODE – If LOW POWER MODE has been selected, the display will turn OFF after 15 seconds to preserve the batteries. A single press of the CONTROL BUTTON will force the display ON for the next 15 seconds. If a magnetic event is detected then the display will come on as normal and show the DETECTION screen.

CONTROL BUTTON – Pressing the CONTROL BUTTON while the display is ON will enter the DISPLAY MENU interface which is described in section 4.6 SINGLE BUTTON MENU INTERFACE of this manual.

SERIAL COMMAND – If a serial command is received via the serial data link then it will be processed before the unit continues LISTENING.

4.4. DETECTION MODE

There are two DETECTION MODES. The standard PIG PASS mode detects when the PIG has likely PASSED the signaller and DETECTION ONLY detects the presence of a pig but not necessarily if it has passed. The latter is useful when trying to determine when a PIG has been launched, where the pig is initially present, and the pig’s movement will be away from the signaller – i.e. will not create a magnetic peak.

4.4.1. DETECTION - PIG PASSED

PIG PASSED is signalled when the flux reading has peaked and fallen by a defined drop as specified by the DETECTION CRITERIA, reference section 4.6.11 SET DETCT CRITERIA. The larger the defined drop, the more likely that the pig has passed the unit. However, if the signaller is located close to the pig receiver, then a smaller drop should be considered as the pig’s magnetic signal may not fully clear the signaller.

Once the flux reading crosses the threshold, the pig state changes to PIG APPROACH and the pig approach screen is shown, the time and date shows when the threshold was crossed. The flux reading shows the live flux reading.

When the flux signal drops by the defined amount, a PIG PASSED is signalled; the PIG PASSED screen is shown and the three LEDs above the screen will flash every 1 second. The DETECTION DELAY is started, reference section 4.4.3 DETECTION DELAY.

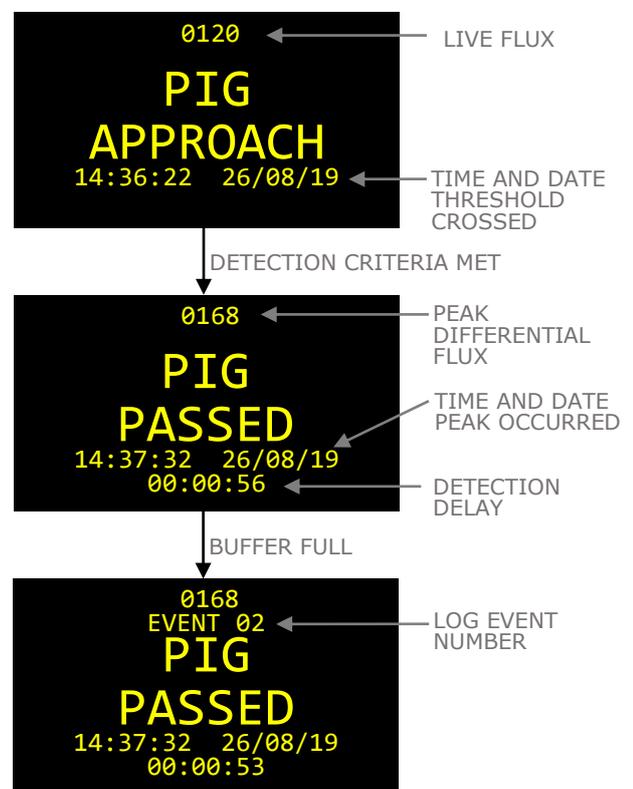
The PIG PASSED screen shows the PEAK DIFFERENTIAL flux that was detected, the time and date shows when the peak occurred.

On completion of the DETECTION DELAY or if the DETECTION DELAY is bypassed by pressing the CONTROL BUTTON, the signaller reverts to LISTENING.

During the DETECTION delay, the unit will keep logging until its internal buffer is full (or the CONTROL BUTTON is pressed), the event will then be logged. At this time the EVENT NN (event number) will be shown on the screen. No other EVENTS will be signalled during the DETECTION DELAY.

If DETECTION starts and the pig does not pass the signaller, the signaller will timeout after 3 minutes and 24 seconds. The signaller will revert direct to LISTENING, the data will be logged but no event will be signalled. In this situation, the pig has been detected but is likely to have stopped before the signaller. If the pig then moves and passes the signaller (providing it was far enough away to cause a peak – otherwise the signaller will timeout again and log the data), a PIG PASSED event is likely to be triggered

If the unit is in LP MODE, the screen will stay on until DETECTION completes or the unit times out and reverts to LISTENING where normal LP mode will resume.



4.4.2. DETECTION ONLY

PIG DETECTION is signalled when the flux reading has peaked and dropped or the peak lasts for a period of time. The pig has only been detected and has not necessarily passed the signaller.

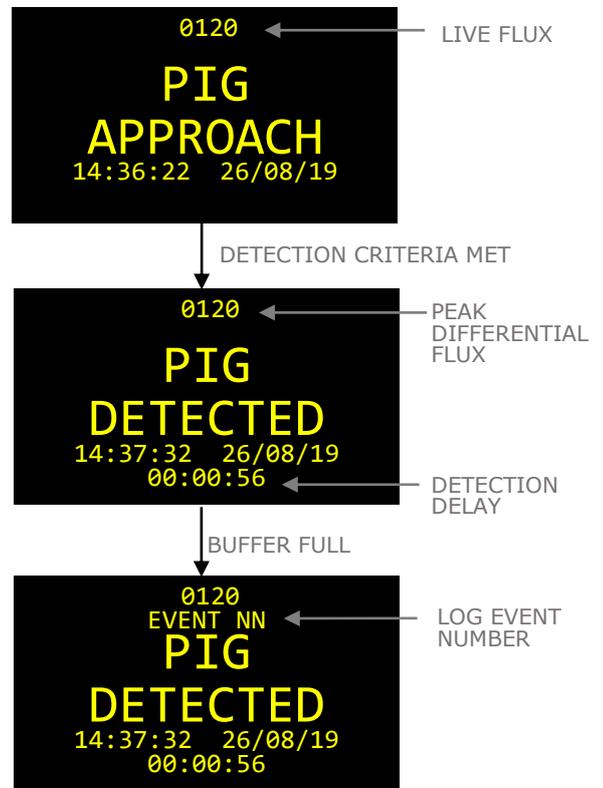
Once the flux reading crosses the threshold, the pig state changes to PIG APPROACH and the pig approach screen is shown, the time and date shows when the threshold was crossed. The flux reading shows live DIFFERENCE flux reading

When the flux signal reaches a peak and drops or maintains a peak for a period of time, a PIG DETECTED is signalled; the PIG DETECTED screen is shown and the three LEDs above the screen will flash every 1 second. The DETECTION DELAY is started, reference section 4.4.3 DETECTION DELAY.

The PIG DETECTED screen shows the PEAK DIFFERENTIAL flux that was detected, the time and date shows when the peak occurred.

On completion of the DETECTION DELAY or if the DETECTION DELAY is bypassed by pressing the CONTROL BUTTON, the signaller reverts to LISTENING.

During the DETECTION delay, the unit will keep logging until its internal buffer is full (or the CONTROL BUTTON is pressed), the event will then be logged. At this time the EVENT NN (event number) will be shown on the screen. No other EVENTS will be signalled during the DETECTION DELAY.



4.4.3. DETECTION DELAY

The DETECTION delay controls how long the unit will signal an event for. Usually it will be configured to give the magnetic pig enough time to get out of range of the sensor after it has been detected to avoid re-trigger. When dealing with pig trains, the expected pig speed and separation should be used to configure a suitable value for the DETECTION delay such that the unit will not detect the same pig twice but will enter LISTENING mode in time to detect the next pig.

The DETECTION DELAY can be bypassed by pressing the CONTROL BUTTON.

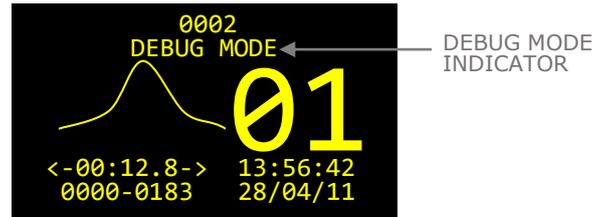
The DETECTION delay can be set to any value between 00:00:01 and 98:99:99 (in HH:MM:SS format) using the CONTROL BUTTON or the 4000SD CONFIG software. There are two special values which can be used:

- 00:00:00 DEBUG MODE (Normal Mode)
- 99:xx:xx LATCHED DETECTION MODE

Where x can be any value.

4.4.4. DEBUG MODE

If the DETECTION delay is set to 00:00:00 then the 4001D works in DEBUG mode. While in DEBUG mode the 4001D will show live DIFFERENCE readings and a DEBUG MODE message as shown but will not exit LISTENING mode and therefore will not signal or log magnetic events.



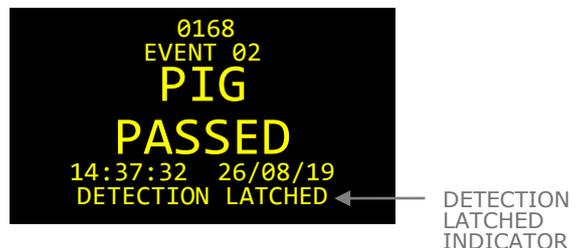
This setting can be very useful for determining the magnetic signature of a pig when used in combination with the 4000SD CONFIG software however should never be used for regular pig signalling. See also 4.5 SURVEY MODE.

If DEBUG MODE is set which in LOW POWER MODE, the signaller will exit LOW POWER MODE, which must be re-entered manually once DEBUG MODE is exited.

DEBUG MODE is exited by setting the DETECTION DELAY to 00:00:01 – 99:99:99.

4.4.5. LATCHED DETECTION

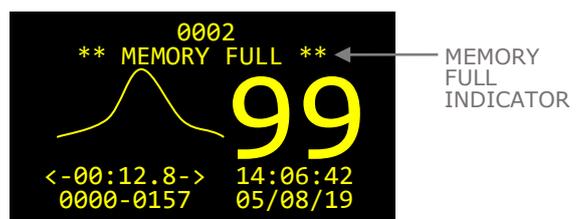
If the DETECTION DELAY HH (hours) field is set to 99 then when an EVENT occurs the 4001D will LATCH in DETECTION mode showing the EVENT information and flashing the 3x LEDs every 1 second as per section 4.4 DETECTION MODE. To begin LISTENING again the CONTROL BUTTON must be pressed.



In LP mode, the screen will remain on until LISTENING resumes where normal LP mode rules continue.

4.4.6. LOG MEMORY

The 4001D is capable of logging up to 99 events with date, time, and the peak DIFFERENCE flux reading. Each log entry is capable of recording between 6.4 seconds and 3 minutes 24.8 seconds of data depending on pig speed / detection time.



Once 99 events have been logged a MEMORY FULL warning will appear indicating that the logger memory is full, this warning will appear on PIG APPROACH, PIG PASSED and PIG DETECTED screens.

Subsequent events will be signalled but no data will be logged. Because of this behaviour it is important to erase all events prior to each deployment to ensure that the full memory space is available.

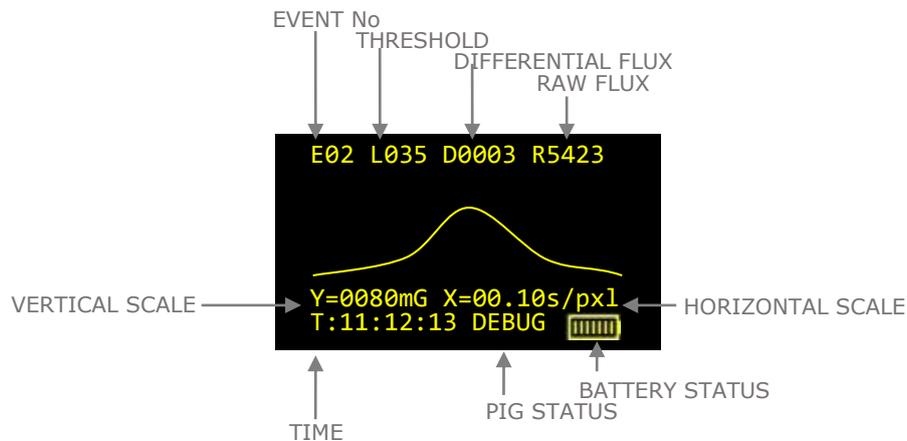
4.5. SURVEY MODE

SURVEY MODE is an extension of standard DEBUG MODE which gives a graphical representation of the flux readings received. The signaller remains in LISTENING mode and therefore does not signal magnetic events. Therefore, SURVEY MODE should not be used for regular pig signalling.

SURVEY MODE is entered via the POWER menu on MENU level 2. The DETECTION DELAY is not altered in SURVEY MODE and is retained when SURVEY MODE is exited.

The graph is displayed from the left and when full, scrolls left. The amplitude is auto scaled vertically upwards but must be rescaled to minimum the amplitude of 80mG vertical height. The horizontal scale can be set using the SET SURVEY TIME item in MENU level 3, this setting is not remembered after power cycle.

The MENU can be entered with a single button press of < 1 second. The graph can be reset (cleared) by pressing the CONTROL BUTTON for more than 1 second and less than 5 seconds. The data displayed can be logged by pressing the CONTROL BUTTON for 5 seconds, the DEBUG status changes to LOGGED and the CONTROL BUTTON can be released. Note that the displayed data logged is at the point where the PIG STATUS changes to LOGGED and not when the CONTROL BUTTON was pressed. The logged data can be viewed using the VIEW EVENT function in MENU level 1.



This setting can be very useful for determining the magnetic signature of a pig. However, this mode should never be used for regular pig signalling. See also 4.4.4 DEBUG MODE.

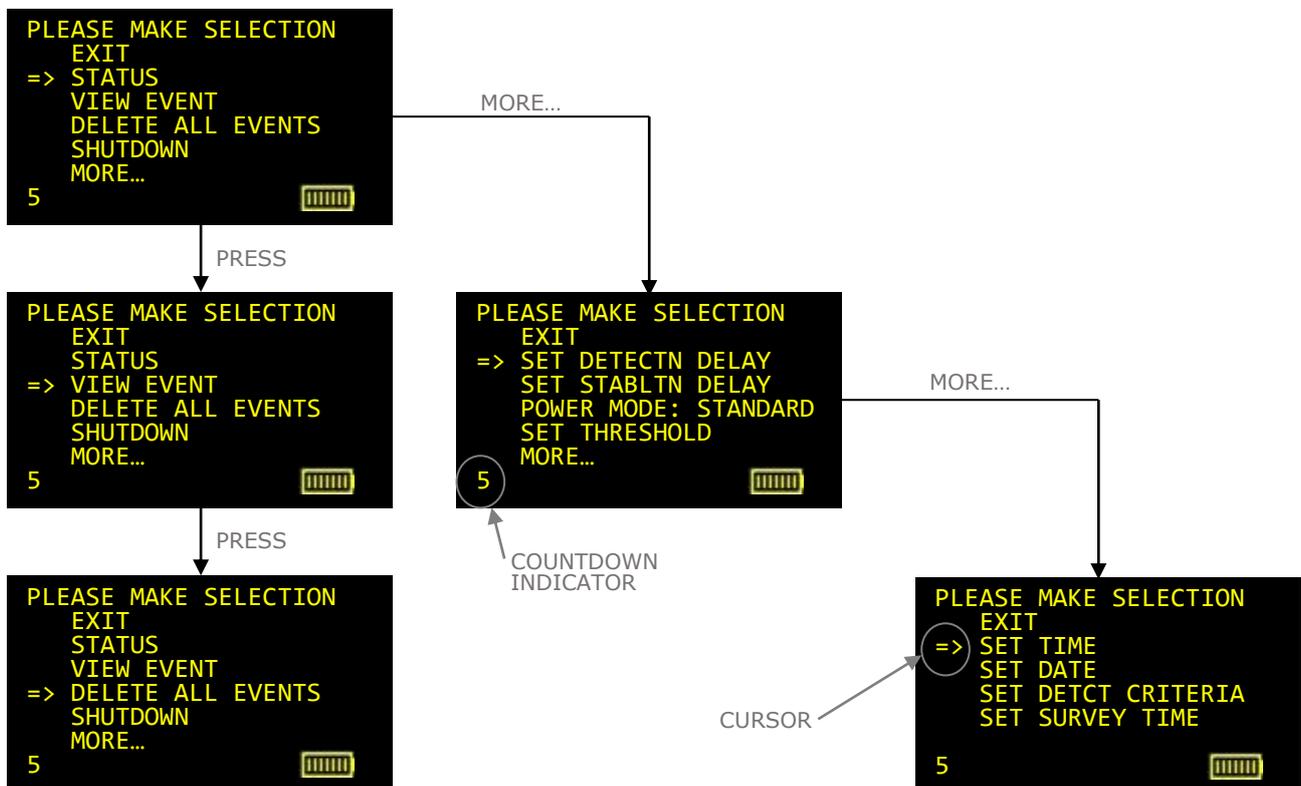
4.6. SINGLE BUTTON MENU INTERFACE

While LISTENING, the control button can be pressed to enter the menu interface. While in the menu interface, the unit will ignore all magnetic disturbances including PIG passages. From the menus the user can configure several parameters which are discussed in this section.

While in the menu system, every time the user presses the control button the CURSOR will move down one line and the COUNTDOWN INDICATOR will be reset to 5. Once the CURSOR is pointing at the desired item the user simply allows the COUNTDOWN INDICATOR to reach 0 and the selected item will be executed. This simple behaviour is used throughout the menu interface to modify settings and interact with the unit.

To modify parameters, simply follow the instructions provided on screen. All parameters are incremented by pressing the CONTROL BUTTON until they are at the desired value then allowing the COUNTDOWN INDICATOR to reach 0.

If you do not wish to modify a parameter then simply allow the COUNTDOWN INDICATOR to reach 0 without operating the CONTROL BUTTON. The menu system is designed so that the unit will always start LISTENING again if the CONTROL BUTTON is left released for a long enough time.



4.6.1. EXIT

The first item on every page of the menu system is EXIT. If EXIT is selected then the unit will exit the menu system and resume LISTENING.

4.6.2. STATUS

The STATUS screen is also shown at switch ON. It shows the Date, Time and Number of logged events, Stabilisation delay, Detection delay, Power Mode, Threshold setting, Battery type and

Firmware version. The STATUS screen can be halted by pressing and holding the control button. Ensure all of these settings are at the required values.

4.6.3. VIEW EVENTS

Selecting this item will allow the user to cycle through all logged EVENTS from newest to oldest. The peak DIFFERENCE flux reading, EVENT number, and EVENT date and time are shown. Pressing the CONTROL BUTTON will cycle to the next event. The CONTROL BUTTON can be held to pause at any event. If the COUNTDOWN INDICATOR reaches 0 then the unit will exit and resume LISTENING.

4.6.4. DELETE ALL EVENTS

Selecting this item will delete all logged EVENT data. A warning screen will be displayed saying “*WARNING* PRESS TO ERASE ALL EVENTS”. To erase all events press the CONTROL BUTTON before the COUNTDOWN INDICATOR reaches 0. To cancel the erase simply allow the COUNTDOWN INDICATOR to reach 0 without pressing the CONTROL BUTTON.

4.6.5. SHUTDOWN

Selecting this item switches off the unit. The unit has memory backup and will remember all settings (such as the DELAYS and THRESHOLD) until next time the unit is switched on. It is imperative that the unit is turned off using this command rather than simply disconnecting the battery to allow any memory storage processes to terminate prior to turning OFF.

See section 4.9.1 FORCE ON FUNCTION if using the force on function.

See section 4.11 MEMORY BACKUP for memory backup limitations.

4.6.6. MORE...

Selecting this item shows the next page of the menu system.

4.6.7. SET DETECTION / STABILISATION

Refer to section 4.4 DETECTION MODE for more information regarding the DETECTION delay.

Refer to section 4.2 STABILISATION for more information regarding the STABILISATION delay.

4.6.8. POWER MODE STD/LOW

Toggles between LOW POWER MODE, STANDARD MODE and SURVEY MODE

In STANDARD POWER MODE the display will be ON all of the time. In LOW POWER MODE the display will turn OFF after 10 seconds to preserve battery life. The detection routines are identical in each mode.

In SURVEY MODE, a graphical representation of the magnetic signal is shown along with DIFFERENCE and RAW magnetic readings. This is a DEBUG mode and hence no DETECTION will occur.

4.6.9. SET THRESHOLD

ADJUSTING THIS PARAMETER WITHOUT FIRST CONSULTING ONLINE ELECTRONICS LTD MAY CAUSE THE UNIT TO MISS PIG PASSAGES OR GIVE FALSE DETECTIONS.

Selecting this item allows the THRESHOLD level to be configured to control the sensitivity of the unit. The standard THRESHOLD value is 035mG. Reducing the THRESHOLD value increases the sensitivity. The THRESHOLD can be configured to any value between 005mG and 999mG. See section 4.3 LISTENING for a brief explanation of the THRESHOLD value.

4.6.10. SET DATE / TIME

Selecting these items allows the date and time to be adjusted. Ensure that a valid time is entered in 24hour, HH:MM:SS format and a valid date in DD/MM/YY format.

4.6.11. SET DETCT CRITERIA

DETECTION CRITERIA determines the function of the algorithm. The options are shown right. The "*" shows the current selection and the CURSOR shows the chosen selection.

```
SET DETCT CRITERIA
=>*50% BELOW PEAK
   25% BELOW PEAK
   10% BELOW PEAK
   05% BELOW PEAK
   DETECTION ONLY
5  PRESS TO CHANGE
```

XX% BELOW PEAK means that the detection criteria will be met when the flux value drops to XX% of the detected PEAK. This will trigger a PIG PASSED event. This mode means that the pig is likely to have passed when PIG PASSED is triggered. Reference section 4.4.1 DETECTION - PIG PASSED.

DETECTION ONLY is where the detection criteria is met when a PEAK is achieved, i.e. when the flux reading drops from a PEAK or when the PEAK value is maintained for a period of time. This time ranges from 6.4s to 3:24 minutes depending on time to reach a peak from crossing the THRESHOLD. Reference section 4.4.2 DETECTION ONLY

4.6.12. SET SURVEY TIME

This menu option is only available in SURVEY MODE. It allows the graph timescale to be set, default is 0.1s/pixel giving a visible graph time of 12.8 seconds. This value is not retained on power cycle.

Selectable options are:

Visible graph time	Time per pixel
00:06.4	50mS
00:12.8	100mS
00:25.6	200mS
00:51.2	400mS
01:42.4	800mS
03:24.8	1.6S

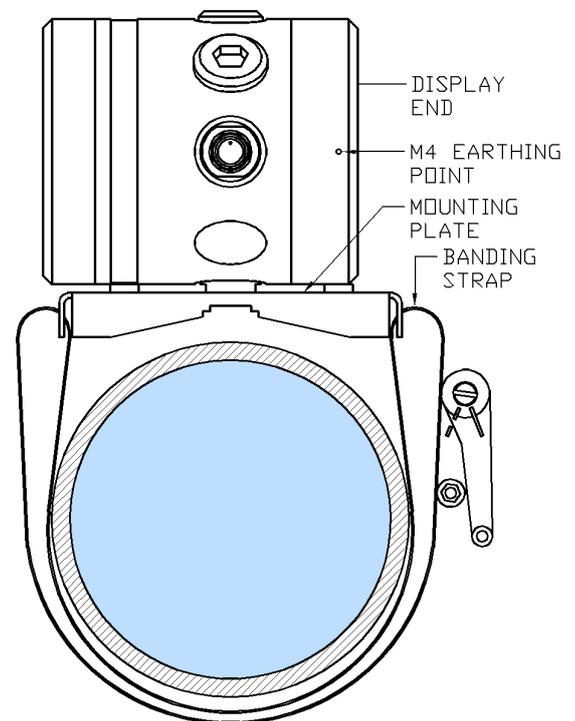
4.7. MOUNTING

Normally the unit is used to confirm whether or not a pig has passed a known point of interest in a pipeline such as a bend or valve. Ideally the unit should be mounted approximately 5m after the point of interest. If the unit is mounted too close then it may detect the pig before the pig has passed safely through the point of interest.

If it is not possible to mount the signaller 5m after the point of interest then a test run would be advantageous to determine the typical strength of magnetic signal coming from the pig and then the detection range can be reduced accordingly by increasing the THRESHOLD value referring to section 4.6.9 SET THRESHOLD of this manual.

The unit is supplied with a mounting plate. The unit can be mounted with a ratchet strap or steel band. For either method follow the procedure below, using the manufacturer's instructions which are provided with this equipment:

1. The Special Conditions for Safe Use detailed in section 8 ATEX / IECEx APPENDIX of this manual must be observed at all times.
2. Ensure the mounting plate is securely fitted to the housing with 2x M8x16 bolts. An M8x5mm thick washer should be sandwiched between the housing and the mounting plate.
3. Temporarily place the unit at the chosen location to ensure that the unit sits in place without rocking.
4. Loop the band through the slots provided as shown and then gradually tighten the band until the unit is held firmly. Do not use excessive force.
5. If equipotential bonding or earthing is required then the M4 threads around the perimeter of the display endcap may be used.

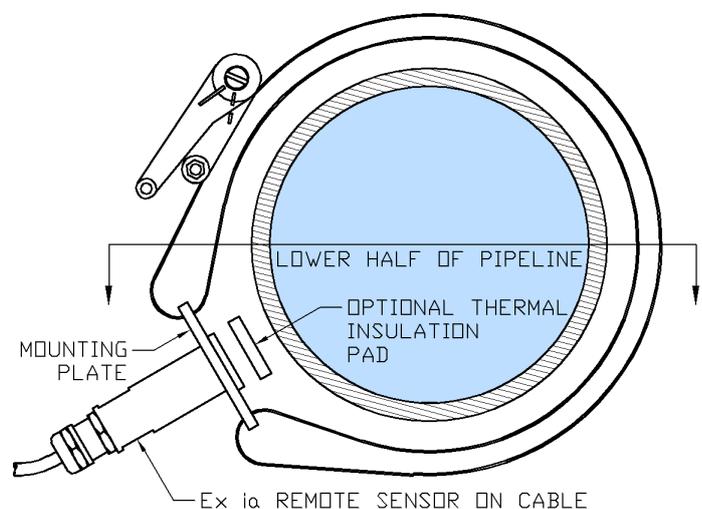


4.7.1. REMOTE SENSOR MOUNTING

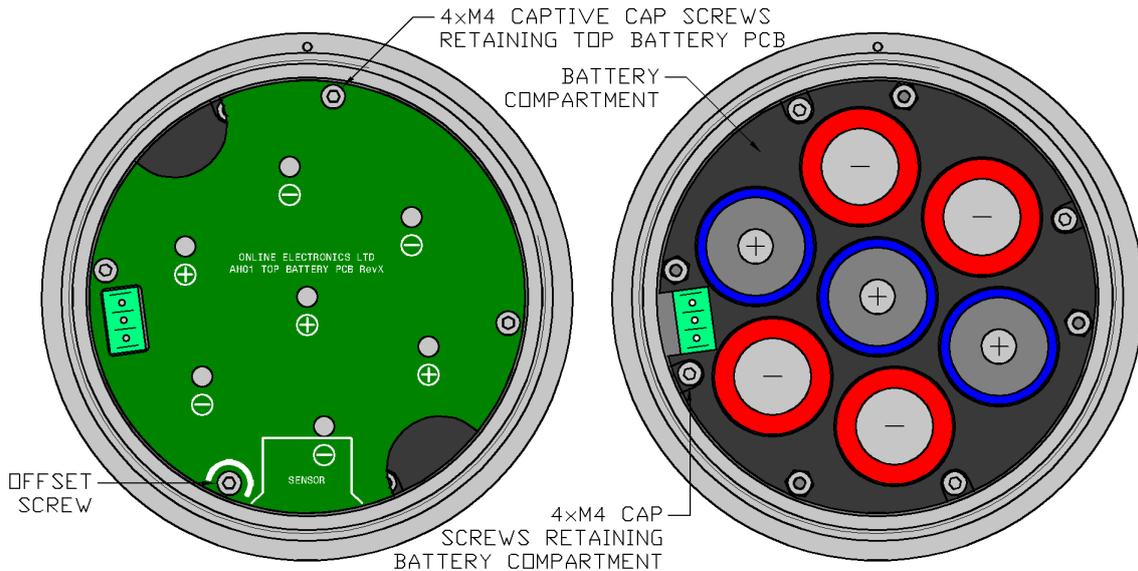
If fitted, the remote sensor is mounted using the supplied mounting plate and a ratchet strap or steel band similar to the main housing

Loop the band through the slots provided on the remote sensor mounting plate as shown and then gradually tighten the band until the sensor is held firmly. Do not use excessive force.

If the pipeline surface temperature is expected to exceed +85°C then a thermally insulating pad will be supplied fitted to the remote sensor. In this case the sensor must be fitted on the lower half of the pipeline as shown to minimise convection heating.



4.8. BATTERY REMOVAL



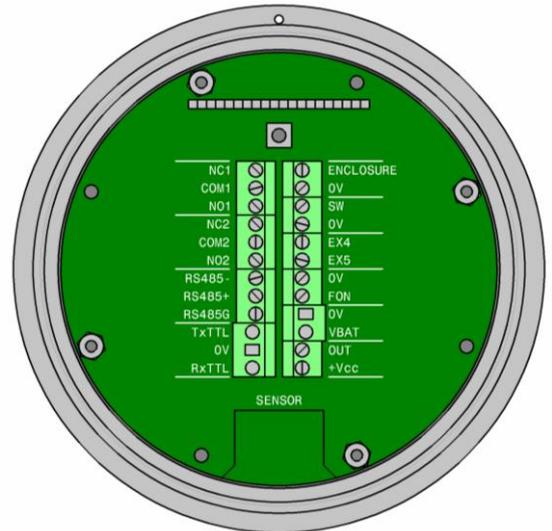
The unit will shut down when the battery voltage reaches 6.5V ALKALINE. To replace the batteries follow the steps below:

1. The Special Conditions for Safe Use detailed in section 8 ATEX / IECEx APPENDIX of this manual must be observed at all times. In particular only the cell type stated should be installed in the unit.
2. Using a 3mm AF allen key loosen the M4 locking screw located at the 12 o'clock position on the BATTERY ENDCAP 6x full turns.
3. Carefully unscrew the BATTERY ENDCAP while being prepared to take the weight when it disengages. There are 4x unthreaded holes around the perimeter of the endcap which may be used should leverage be required.
4. The TOP BATTERY PCB should now be visible as shown above. Using a 3mm AF allen key loosen all 4x captive cap screws 3x full turns each before fully disengaging all screws and removing the TOP BATTERY PCB.
5. Replace all batteries confirming that their polarity matches the information shown on the TOP BATTERY PCB. The negative end of each battery should be in contact with a spring. **REPLACE ALL BATTERIES AT THE SAME TIME. NEVER USE A MIX OF NEW AND USED BATTERIES. NEVER USE A MIX OF BATTERIES FROM DIFFERENT BATCHES. ENSURE THAT THE CORRECT BATTERY TYPE IS USED. ALWAYS OBSERVE CORRECT BATTERY POLARITY.**
6. Replace the TOP BATTERY PCB checking that the orientation is correct. Note that one of the retaining screws is offset to prevent incorrect orientation.
7. Replace the BATTERY ENDCAP and gently hand tighten. Do not use tools or over tighten otherwise the endcap will be difficult to remove. The M4 locking screw should be located close to the 12 o'clock position when the endcap is fully engaged, there should still be a small gap (<0.5mm) between the endcap and housing.
8. Using a 3mm AF allen key gently tighten the M4 locking screw. Do not over tighten, very little torque is required to lock the endcap in place.

4.9. EXTERNAL CONNECTIONS

To access external connections follow the steps below:

1. The Special Conditions for Safe Use detailed in section 8 ATEX / IECEx APPENDIX of this manual must be observed at all times.
2. Remove the BATTERY ENDCAP, TOP BATTERY PCB, and batteries as described in section 4.8 BATTERY REMOVAL of this manual.
3. Using a 3mm AF allen key, remove the 4xM4 cap screws which hold the battery compartment in place and remove the BATTERY COMPARTMENT to reveal the external connections as shown.



All connections are made using 5.08mm pitch removable terminal blocks which can accept up to 2.5mm² (12AWG) wire size. All connections must be made using suitable crimp ferrules. Connections are clearly labelled on the PCB and have the following functions:

- NC1/2 - Normally Closed contact of relay 1 and 2 respectively (see section 4.9.2)
- COM1/2 - Common contact of relay 1 and 2 respectively (see section 4.9.2)
- NO1/2 - Normally Open contact of relay 1 and 2 respectively (see section 4.9.2)
- RS485- - Do not use these connections
- RS485+ - Do not use these connections
- RS485G - Do not use these connections
- TxTTL - Do not use these connections
- RxTTL - Do not use these connections
- ENCL - Connected to enclosure (may be linked to 0V)
- 0V - PCB 0V connections
- SW - Switch connection (the main control button is connected across SW and 0V)
- EX4 - Do not use these connections
- EX5 - Do not use these connections
- FON - Force on function (see section 4.9.1 FORCE ON FUNCTION)
- VBAT - Positive side of battery (battery connected across VBAT and 0V)
- +Vcc - Positive side of external 24Vdc supply (supply connected across +Vcc and OUT)
- OUT - Negative side of external 24Vdc supply (supply connected across +Vcc and OUT)

Note that spring pins may be fitted at VBAT, TxTTL and RxTTL to make the connections to the BATTERY COMPARTMENT. Care must be taken to avoid damage or obstruction of these contacts. When replacing the BATTERY COMPARTMENT ensure that it is aligned correctly so that these connections are made properly.

4.9.1. FORCE ON FUNCTION

If the FON connection is linked to 0V the unit will automatically power on whenever there is 24Vdc present across +Vcc and OUT. This means that if there is an interruption to the external power supply then the unit will automatically turn on when the power supply recovers. The same power on sequence is followed as in section 4.1 TURNING ON except the control button does not need to be operated. The auto-power on feature will not operate if powered from internal batteries only.

If the unit is manually shutdown as per 4.6.5 SHUTDOWN then to re-activate the unit either temporarily remove external power or use the control button as per section 4.1 TURNING ON.

4.9.2. RELAY OUTPUT

The relay output is DPDT (Double Pole Double Throw) meaning that there are two separate sets of contacts (NC1 / COM1 / NO1 and NC2 / COM2 / NO2) which may be connected to two separate external circuits.

While in the LISTENING state (see section 4.3 LISTENING), the Normally Closed contacts of the relays will be connected to their respective Common contacts and the Normally Open contacts will be open.

While in the DETECTION state (see section 4.4 DETECTION MODE), the Normally Closed contacts of the relays will be open and the Normally Open contacts will be connected to their respective Common contacts.

4.9.3. CURRENT LOOP OUTPUT

Connect the positive side of the external 24Vdc supply to +Vcc and the negative side of the 24Vdc supply to OUT. Ensure that +21.6Vdc to +26.4Vdc is maintained at the unit connections.

While switched off the unit will consume less than 13.0mA.

While in the LISTENING state (see section 4.3 LISTENING), the unit will consume 15.0mA \pm 1.0mA.

While in the DETECTION state (see section 4.4 DETECTION MODE), the unit will consume 19.0mA \pm 1.0mA.

If the control button is pressed while in either state, then invalid (outside the ranges above) current levels may be seen.

4.10. RECOMMENDED MAGNET ARRANGEMENT

Refer to the table below for recommended quantities and type of magnets required for pipeline diameter and wall thickness. The magnets should be spaced equally around the pig body with all magnets oriented with the same poles facing outwards e.g. all north poles facing outwards (as shown) or all south poles facing outwards. It is critical that the magnets are not oriented with a mixture of north and south poles facing outwards as this may result in 'dead-spots' in the magnetic field around the pig. Magnets may be fixed to the pig body, embedded in the pig discs or embedded in foam pigs. The cost of quality magnets is insignificant compared to the potential cost of a lost pig which is more likely if unsuitable, cheaper magnets are used. Effective pig detection is dependent on several factors including:

PIPE WALL THICKNESS – The thinner the pipe wall, the stronger the magnetic signal.

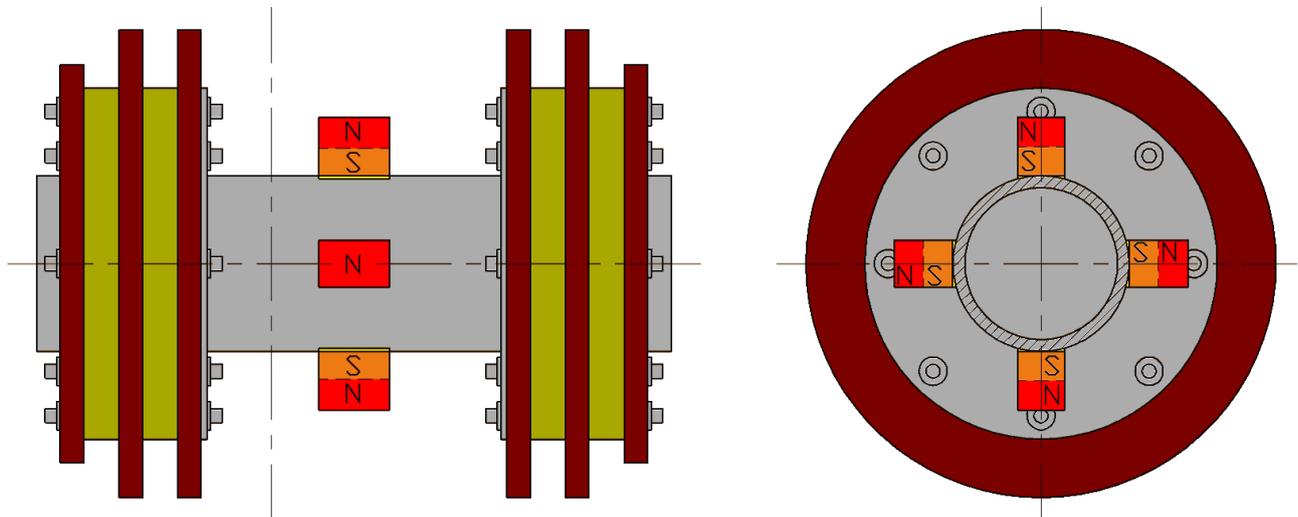
PIPELINE MATERIAL – Different materials cause different attenuations to the magnetic signals. For example, 50mm of concrete will affect the signal considerably less than 50mm of mild steel.

DISTANCE BETWEEN MAGNET AND SENSOR – The closer the magnets are to the magnetic sensor, the stronger the magnetic signal.

NUMBER OF MAGNETS FITTED TO PIG – The more magnets which are placed around the pig, the more uniform and effective the overall magnetic field is.

STRENGTH OF MAGNETS – The stronger the magnets, the stronger the magnetic signal.

BACKGROUND MAGNETIC NOISE – The more magnetically quiet the surrounding area is, the more sensitive the signaller can be set without the risk of false triggers. Movement of magnetic objects close to the signaller should be avoided to prevent false triggers.



PIPELINE DIAMETER	PIPELINE WALL THICKNESS	MAGNET TYPE & DIMENSIONS	NUMBER OF MAGNETS EQUISPACED AROUND PIG
10"	10.2mm	NdFeB N35 ø20x20mm	8
10"	10.2mm	NdFeB N35 ø48x18mm	4
12"	11.3mm	NdFeB N35 ø20x20mm	8
12"	11.3mm	NdFeB N35 ø48x18mm	4
14"	12.1mm	NdFeB N35 ø20x20mm	8
14"	12.1mm	NdFeB N35 ø48x18mm	4
16"	13.2mm	NdFeB N35 ø20x20mm	8
16"	13.2mm	NdFeB N35 ø48x18mm	4

4.11. MEMORY BACKUP

The unit includes memory backup to retain date, time and user settings such as detection delay and threshold while the unit is turned off.

If the unit is turned off but main batteries or external power is left connected then memory backup will retain these settings indefinitely.

If the unit is turned off and main batteries and external power are removed then memory backup will retain these settings for a minimum of 50 days.

If memory backup expires then the warning message below will be displayed for 5 seconds when the units is next turned on. At this point all settings will reset to the default values shown in the table below and the user shall be prompted to set the time and date as per 4.6.10 SET DATE / TIME prior to the Online Electronics Ltd logo being displayed.

Note that EVENTS will default to 99 which will allow all previously logged events to be read if required however it will not be possible to log any new events. To enable new events to be logged events must be deleted as per section 4.6.4 DELETE ALL EVENTS.

```
*BACKUP MEMORY ERROR*
ALL SETTINGS DEFAULT

DELETE EVENTS TO
ENABLE LOGGING

***SET TIME/DATE***
4
```

SETTING	DEFAULT VALUE
DATE	01/01/00
TIME	00:00:00
LOW POWER MODE	ENABLED
EVENTS	99
STABILISATION DELAY	00:01:00
DETECTION DELAY	00:01:00
THRESHOLD	35

5. ROUTINE MAINTENANCE AND STORAGE

All Online Electronics Ltd products are designed to require minimum maintenance. The housing should be cleaned using fresh water and cleaning agents as necessary.

If the unit is to be placed in storage for a long period of time ensure the unit has been cleaned, turned OFF and main batteries removed. Refer to Section 8 ATEX / IECEx APPENDIX.

6. DISPOSAL

Online Electronics Ltd (OEL) takes its responsibilities under the WEEE Regulations extremely seriously and has taken steps to be compliant in line with our corporate and social responsibilities. In the UK, OEL has joined a registered compliance scheme WeeeCare (registration number **WEE/MP3538PZ/SCH**).

Electrical and electronic equipment should never be disposed of with general waste but must be separately collected for the proper treatment and recovery.

The crossed out bin symbol, placed on the product, reminds you of the need to dispose of it correctly at the end of its life.

When buying a new product you will have the possibility to return, free of charge, another end of life product of equivalent type that has fulfilled the same functions as the supplied equipment. These items may be deposited at:

Online Electronics Ltd
Online House
Woodburn Road
Blackburn Business Park
Blackburn
Aberdeen
AB21 0PS
UK

Alternatively, to arrange a collection of any waste electrical equipment, obligated to OEL please telephone WeeeCare on **0844 800 2004**.

7. WARRANTY

Online products are guaranteed for one year from the date of purchase. Goods should be returned transportation prepaid to Online Electronics Limited.

There is no charge for parts or labour should any product require repair due to a manufacturing deficiency during the guarantee period.

In the event of a manufacturing deficiency the inward transportation costs will be repaid to the client.

8. ATEX / IECEX APPENDIX

EQUIPMENT: 4001D Magnetic Pig Signaller

MANUFACTURER: **Online Electronics Ltd**
Online House
Blackburn Business Park
Woodburn Road
Blackburn
Aberdeen
AB21 0PS
UK
Tel: +44 (0) 1224 714 714
Web: www.online-electronics.com

NOTIFIED BODY NUMBER: 2812

ATEX CERTIFICATE: TRAC13ATEX0007X

IECEX CERTIFICATE: IECEX TRC 12.0017X

MARKINGS:  II 1/2 G Ex d ia [ia Ga] IIC T4..T6 Gb

APPLICABLE STANDARDS: EN 60079-0:2012+A11:2013
EN 60079-1:2014
EN 60079-11:2012
EN 60079-26:2015
IEC 60079-0:2011
IEC 60079-1:2014
IEC 60079-11:2011
IEC 60079-26:2014

SPECIAL CONDITIONS FOR SAFE USE:

1. Do not open when an explosive gas atmosphere may be present.
2. Potential electrostatic charging hazard. The equipment should not be mounted in areas where it could be subjected to highly efficient charging mechanisms, such as fast moving dust or particle filled air, and shall only be cleaned with an anti-static or damp cloth.
3. Transducer, cable and electronics shall only be used as a complete assembly.
4. Internal and external threaded holes are provided for earthing and equipotential bonding. Protective earthing conductors employed shall be greater or equal to the size of the phase conductors, equipotential conductors shall have a minimum cross sectional area of 4mm². The end user shall ensure conductors cannot be readily loosened or twisted. Light metals shall not be used unless special precautions are taken to guard against corrosion.
5. External power supply shall not exceed 30Vdc.
6. External power and signals shall only be supplied according to manufacturers' instructions using suitable cable and suitable Ex certified cable glands.
7. External power and signals shall only be connected using suitable crimp ferrules to prevent accidental disconnection.
8. Unused cable entries shall be sealed using suitable Ex certified blanking elements.

9. The temperature at the cable entry point may exceed +70°C. Cables suitable for use at this temperature must be used.
10. Use only ALKALINE, 1.5V, 18Ah, D cells, rated for at least 250mA continuous current (DURACELL INDUSTRIAL ID1300 recommended).
11. As part of the routine maintenance schedule, the condition of the window cement shall be periodically inspected for any degradation or discolouration of the cement that may compromise the explosion protection.
12. Temperature class is reliant on the operating ambient temperature, the internal power dissipation (Pd), and whether internal cells are fitted. Refer to the tables below for the allowable operating ambient temperatures.

Pd	External supply (NO CELLS FITTED)		
	T4	T5	T6
<1W	-40 to +85°C	-40 to +85°C	-40 to +75°C
<5W	-40 to +85°C	-40 to +85°C	-40 to +70°C
<10W	-40 to +80°C	-40 to +70°C	-40 to +55°C

Pd	DURACELL INDUSTRIAL ID1300 FITTED		
	T4	T5	T6
<1W	-20 to +54°C	-20 to +54°C	-20 to +54°C
<5W	-20 to +54°C	-20 to +54°C	-20 to +54°C
<10W	-20 to +54°C	-20 to +54°C	-20 to +54°C