

Custodian



Multichannel Personal Gas Monitor

Instruction Manual



This product has been tested and found to comply with the European Directive on EMC 89/336/EEC

Quick Operating Guide


Switch on:	Press main button
Normal condition:	Intermittent green LED flash and blip
Alarm condition:	Fast flashing red LEDs and sounder
Alarm reset:	Press main button
Activate backlight:	Press any button
Switch instrument off:	Press main and  buttons simultaneously
Zero instrument:	Press lower  button until bar on LCD moves from Run to Zero , then push main button to accept. If a key symbol appears on the display a password is required.*

***NOTE: If the lower cursor does not move, the Functions Timeout option has been enabled (see page 8).**

INSTRUMENTS FITTED WITH INTERNAL PUMP

Switching pump on and off: Pump is activated and de-activated by fitting or removing the flow adaptor.

NOTE: Do not connect to a pressurised gas cylinder with the pump running

The transparent finger guard supplied allows access to the main button &  key. This restricts access to instrument functions but does allow the unit to be switched on and off.

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2. Unpacking

Each Custodian is supplied in one or two boxes, depending on which options and accessories have been ordered. Each box has a label detailing the contents of the box. Should the contents not agree with the label, please contact Crowcon immediately and have ready the serial number of the instrument in question. The serial number can be found at the bottom of the label on the rear of the main instrument. The battery pack has its own code number found on the main battery pack label.

NOTE: When checking the contents of boxes, remove all items from the foam packing and remove the foam. This will expose a false bottom which can be opened by inserting a finger in the hole provided and hinging up. In most boxes, further contents will be found in this lower compartment.

The rechargeable batteries can occasionally discharge during transit. See Switch on Sequence on page 8 for details of the battery level indicator.

3. Introduction

The Crowcon Custodian is a portable gas detector which can monitor up to four gases simultaneously. It is designed to be carried or worn by individuals working in hazardous environments such as confined spaces, and will give a loud audible and bright visual alarm warning when preset concentrations of gas are exceeded.

Detailed mechanical design features have resulted in an easy to service instrument with sealing to IP66.

The user interface has been designed to combine the best features of 'one button operation' for routine applications, with simple multi-button operation for advanced functions. The shape of the instrument has been designed to fit comfortably against the body and pose the least restriction to movement. It can fit in a pocket, on a belt or a chest harness.

The detachable battery pack can be replaced in a hazardous zone for round the clock operation. Rechargeable packs utilise environmentally friendly nickel metal hydride batteries with a life of up to 1000 charge/discharge cycles. These will power an instrument with one flammable sensor and three electrochemical sensors for up to 14½ hours. Dry cell (disposable) packs are also available with a life in excess of 26 hours. The life is considerably longer if no flammable sensor is fitted (up to 80 hours with rechargeable battery and up to 140 hours with dry cells).

The sensor module can be detached and replaced for easy field maintenance.

4. Specification

Weight	500g (1.1lbs)
Dimensions	155mm x 102mm x 52mm (6.1" x 4" x 2")
Typical measuring ranges	0-100%LEL flammable gas, 0-25% volume oxygen, 0-50ppm hydrogen sulphide, 0-500ppm carbon monoxide, 0-5ppm chlorine, 0-10ppm sulphur dioxide, 0-1ppm ozone, 0-10ppm nitrogen dioxide, 0-2ppm phosphine (normal combination flammable gas, two toxic gases, oxygen)
Typical alarm levels (3 per channel plus TWA alarms for toxic channels)	20%LEL and 40%LEL, 17%, 19% and 23% oxygen, 10ppm and 20ppm hydrogen sulphide, 50ppm and 100ppm carbon monoxide instantaneous alarms and/or TWA alarms (STEL and LTEL)
Response times (T₉₀)	Methane 20 seconds, oxygen 10 seconds, typical toxic gas 20 seconds
Visual alarm indicators	Ultra bright flashing red LED pair in ALARM mode. Slow flashing green LED in NORMAL mode.
Audible alarms	Programmable from six different tones, 85dBA at 1 metre. Intermittent sound for discharged battery. Confidence blip (selectable).
Display	Custom 7 segment high contrast LCD. 8mm character height for gas readings. Symbols for low battery, TWA alarm, blocked pump, peak hold, and password protection. Bright backlight.
Operating temperature range	-20°C to 50°C (-4°F to 122°F)
Humidity	0-95% RH, non-condensing
Expected sensor life	Pellistor 5 years, toxic gas 3 years, oxygen 1 year (see page 25)

Detachable battery pack	1.1Ah nickel metal hydride rechargeable: typical life 14½ hours diffusion mode, 12 hours pumped. AA size alkaline replaceable: typical life 26 hours diffusion mode, 21 hours pumped
Aspirator/electric pump	Manual bulb type with 2m of hose, non-absorbant, hydrocarbon resistant. Internal electric pump option with auto on/off.
Safety Certificate Nos.	Instrument: Ex95C2349 Flam sensor block: Ex95Y1350 Battery pack: Ex95C2348X†
Approval code (Europe)	Instrument: EEx ia IIC T4 ($T_{amb}=55^{\circ}\text{C}$) Flam sensor block: EEx d IIC T4 Battery pack: EEx ia IIC T3/4*
Standards (USA & Canada)	Class 1, Division 1, Groups A, B, C and D.
Standards (Europe)	EN50014, EN50020, EN50018
Standards (USA & Canada)	UL 913, CSA 22.2
RF Immunity	Tested to IEC801-3 and meets EN50082-1
RF Radiation	Tested to EN55022 Class B and meets EN50081-1
Battery charging	Dual rate charger for instrument or detached battery pack. Fast charge in 6 hours, trickle charge will not damage batteries. Input 100-250 VAC, 12-30 VDC.

†The suffix X indicates a special condition whereby when disconnected, the ingress protection (IP) rating of the battery pack is lower than when it is attached to the instrument.

*T3 applies to the Rechargeable battery pack at $T_{amb}=50^{\circ}\text{C}$, T4 applies to the Non-rechargeable battery pack at $T_{amb}=55^{\circ}\text{C}$.

5. Operation

5.1 Switch-on Sequence

To switch on the instrument, press the main button.

The instrument tests all LCD segments, red alarm LEDs and sounder for 5 seconds, then displays the battery condition for 5 seconds before entering Run mode. The battery condition is indicated by a flashing battery symbol and a number representing the available battery voltage.

NOTE: For rechargeable battery packs, a reading below 4.5 indicates that the batteries require charging; for non-rechargeable batteries, a reading below 4.5 indicates that the batteries need replacing.

For the first 4-5 recharge/discharge cycles, rechargeable batteries cannot hold a full charge. Therefore, the operation time is around 7½ hours for the first few charges.



The green 'confidence' LED will flash and the speaker bleeps (if programmed) every few seconds to reassure users that the instrument is working and the environment is safe. It is now ready to be used. Note the audible bleep may be turned off using the SetCustodian program (see page 31).

NOTE: It is likely that the instrument may display an alarm condition immediately upon entering the Run mode (indicated by a flashing upper cursor). This is due to the sensors settling down after switch on. In most cases, pressing the main button to cancel the alarms after a few seconds will reset the instrument.

If the display shows an E number (eg. E2), this indicates that the diagnostic routines have found an error, such as Calibration Expired. Section 14.1 gives further details. Most E numbers can be accepted by pressing the main button.

NOTE: All units are shipped from the factory with the Functions Timeout option enabled. This means that the instrument is locked in Run mode 2 minutes after switch on and thereafter no adjustments are possible. To alter this, see Appendix A.

5.2 Run Mode

The instrument displays each gas reading in turn for several seconds, cycling back to the first. The channel displayed is indicated by a bar on the LCD under the gas name on the label. To hold on a particular channel, press the upper  key to select the channel of interest. Note that the **Run** indication disappears. Press the lower  key to return to **Run** mode. The display may be blanked by a selection in the SetCustodian configuration program (see page 35).

The display panel shown in figure 1 is for an instrument with 4 sensors fitted. The sensor 1 reading is displayed first, indicated by the upper cursor, showing 18.7% LEL CH₄ (methane) present. After a few seconds the cursor moves to the next position, and H₂S (hydrogen sulphide) ppm (parts per

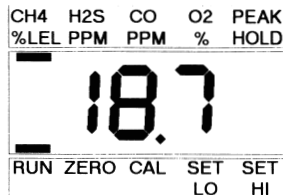


Figure 1 - Typical **Run** display

million) is displayed. A few seconds later it switches to sensor 3 which reads ppm CO (carbon monoxide) then to sensor 4 which displays % by volume oxygen. After completing this cycle, it returns to sensor 1 and repeats.

5.3 Instrument Settings

Unless otherwise specified, each instrument is set up and shipped from the factory using the default settings. These cover password configurations, alarm tones, logging period, confidence blip, and detailed operation of each alarm point. Full details are printed on the Configuration Report supplied with each instrument. Those functions which are changeable from the instrument

front panel are described in Section 8. All options listed on the report can be changed using the **SetCustodian** software described in Appendix A by editing the **c[Custodian serial number].set** file (see Section A1.5).

5.4 Display Symbol Guide



Battery Low

When this symbol is flashing (accompanied by faster confidence bleeps), this indicates that there is less than 20 minutes battery life remaining and the instrument requires recharging. An instrument fitted with a non-rechargeable battery pack may run for several hours in this condition.



Internal Pump

This symbol indicates that the built-in pump is running. When this symbol flashes (accompanied by a ticking noise) this indicates that the built-in pump or airway is blocked. Once this occurs the pump will automatically be stopped. Check that the flow adaptor and sample lines are free from water or dirt. Also check the sensor filter behind the baffle plate (Figure 10, page 24). Blockage can occur if a sampling pipe is lowered into a flooded cavity, as the pipe may then suck up water, or if the air intake is blocked with a finger, clothing etc.

Once blocked, the pump will not be restarted unless the flow adaptor is removed and re-attached, or the instrument is switched off and on again or the main button is pressed.



Password protection

Indicates that the function being selected cannot be accessed without a password. This may be encountered when attempting to Zero, Calibrate, Set Alarm levels or turn the instrument off. Password entry is described in Section 8.5.



Peak hold

Indicates that the reading displayed is the highest level recorded since the instrument was switched on or reset. For oxygen, Peak Hold records the lowest value encountered. Peak Hold works for all gases simultaneously. Selection is described in Section 8.1.



TWA alarm

This symbol flashes during an alarm to indicate that a time weighted average threshold has been exceeded (See Section 7).

6. Battery pack

6.1 Changing the battery pack

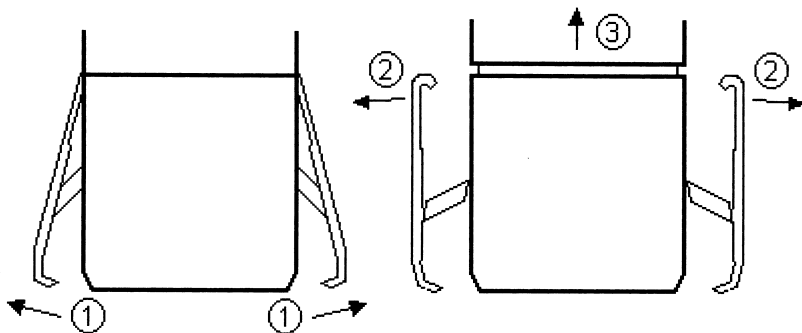


Figure 2 - Changing the Battery pack

1. Prise the clips away from the bottom of the battery pack.
2. Push the clips up towards the instrument to detach the hooks and release them from the main body.
3. Pull the battery pack away from the instrument.

Refit a charged pack by reversing the above procedure. A CommsPod may be fitted in the same way.

NOTE: Battery packs may be replaced but not charged in a hazardous area. CommsPods may only be fitted and used in a safe area. The rechargeable battery pack must only be connected to Crowcon detection instruments recommended charging facilities in the non hazardous area.

6.2 Recharging

NOTE: Do not use the charger in a hazardous area!

Switch the charger on and place the instrument in the charger with the charging contacts towards the rear.

The charger's red LED will light while the instrument is undergoing fast charge. Full recharge from flat takes about 6 hours, during which it is normal for the batteries to become warm. After fast charging, the red LED goes out and the green LED comes back on: the batteries are now charged and receiving a trickle current. The instrument can be used immediately or left on charge indefinitely.

Battery packs can be recharged on their own without being connected to the main instrument.

Nickel Hydride battery packs will self-drain in approximately 1 month. Instruments should therefore be regularly recharged even when not in use.

No damage will occur if dry cell packs are inadvertently placed in the charger, as no charging current will flow.

NOTE: The battery pack makes contact with the charger via the three small silver contacts on the base of the battery pack. As these are diode protected, no harm will come from these contacts being immersed in water, or otherwise shorted, during use.

6.3 Dry cell packs (non-rechargeable)

Dry cells come in a distinctly marked battery pack to avoid confusion. To change batteries, detach the battery pack from the instrument. Using the Allen key provided, remove the bolts securing the battery retaining plate. Replace the spent cells taking note of polarity indications.

NOTE: Cells may only be replaced in a safe area!

Use only the following battery types:

Duracell	MN1500	LR6
Ever Ready Energizer		LR6BA
Varta		4006

The use of alternative types will invalidate intrinsic safety approvals.

7. Alarm types

For each gas channel, there are three instantaneous alarms; level 1, 2 and 3. For toxic gas channels, there are also two time weighted average (TWA) alarms which operate at short term (15 minute) and long term (8 hour) exposure limits. Level 1 and 2 instantaneous alarms (referred to as **SET Lo** and **SET Hi** on the display label) may have their thresholds adjusted from the instrument keypad (see Section 8).

All alarms may have their thresholds set via the computer interface (see Section A1.4) and the following parameters may be set for instantaneous alarms:

- Normally triggered on a rising level, alarms may be set to trigger on a falling level as with oxygen deficiency alarms.
- Alarms may be latching, requiring manual reset, or self clearing when the hazard has passed.
- Normal alarms cannot be cleared whilst the gas hazard persists. It is possible to set them so they may be silenced (the red LEDs will continue to flash). This allows the user to set a 'pre-alarm' warning at a low gas level and a non-silenceable alarm at a higher level.
- Unused alarms may be deactivated.

If any alarm event is triggered, the red LEDs will flash and the sounder will emit a loud tone. This tone is selected from a menu available to the SetCustodian user (see Section A1.4).

The gas channel which has detected an alarm condition will be indicated by a flashing LCD bar below the gas name. The gas value of a channel in alarm will flash whilst it is being displayed. The instrument may be configured (A1.5.3) to lock the display on the first channel to go into alarm. Pressing the main button will restore **RUN** mode if previously selected.

If the TWA (time weighted average) symbol appears on the display, this indicates that the total cumulative exposure to a toxic gas has been reached for an 8-hour shift or a 15-minute 'window'. Health & Safety regulations require that workers should leave the hazardous area once they have exceeded this dose. A TWA alarm cannot be manually reset. The main button may be used to silence or clear certain instantaneous alarms as the configuration permits.

8. Keypad Functions

NOTE: Correct password entry or entering new zero, calibrate or alarm level values will cause the instrument to produce a multitone audible confirmation that the function has been carried out successfully.

8.1 Peak Hold

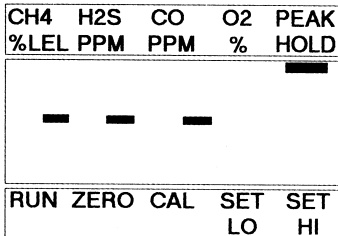


Figure 3 - Selecting Peak Hold

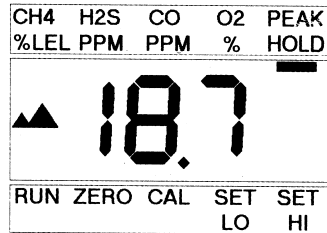






Figure 4 - Peak Hold symbol

Peak Hold can be selected from **RUN** mode by pressing the upper  button until the bar appears under the PEAK HOLD label legend and the displayed reading changes to three dashes (Fig 3). Press the main button to make the double-peak symbol appear (Fig 4). (Pressing the main button again at this stage restores normal display and removes the symbol.) Return to **Run** mode or a specific channel with the cursor keys  or .

The instrument will now display the peak reading of any sensor (lowest oxygen reading) since the instrument was switched on. Press the main button to clear the peak readings to current levels. (Press twice if alarm is operating).

8.2 Zeroing instrument in clean air

Press the lower  key until the bar on the LCD moves from **RUN** to **ZERO**. Press the main button to accept.

The instrument will zero all channels except oxygen which calibrates to 20.9. If purging with nitrogen, the oxygen channel will be zeroed.


NOTE: The instrument must be in clean air before performing this operation.






If a key symbol appears on the LCD, a password is required to zero the instrument (see Section 8.5).

If **E2** appears (see Error messages, Section 14.1), the zero offset is too great to be adjusted.



8.3 Calibrating instrument

Ensure the instrument reads zero (except oxygen) in fresh air.





Fit the flow adaptor as described in Section 9. From **Run** mode press the  key to progress the bar on the LCD to the **Cal** position.

Press the  key to select the gas channel to be calibrated. Pass calibration gas through the flow adaptor as described in Section 10. Press the  or  keys to adjust the reading to match the known gas concentration. (Pressing either   cursor key at this stage will result in the adjustment being scrapped.) Press the main button to accept the new value.

A key symbol may appear indicating that this value cannot be changed without a password. If so, enter the password as described in Section 8.5.



If **E3** appears (see Section 14.1) and the display does not achieve the desired value, the gain is being set out of range indicating probable sensor failure or incorrect calibration gas. Press the  key to select another channel for calibration or the  key to step via the alarm view/change options back to **Run** mode.

8.4 Viewing/Altering Alarm levels

Press the  key until the **Set Lo** function is indicated. Press the  key to select the channel. The low alarm level for that channel is now displayed and may be adjusted with the  /  keys. (Pressing either cursor key at this

stage will result in the adjustment being scrapped). Press the main button to accept the adjustment.

A key symbol may appear indicating that this value cannot be changed without a password. If so, enter the password as described in Section 8.5.

Press the  key to select another channel or the  key to step via the **SET Hi** option back to **RUN** mode.





The **SET Hi** function is identical in operation to the **SET Lo** function except that it operates on the Level 2 alarm.

8.5 Password Entry

Access to the functions **Zero**, **Calibrate**, **Set Lo**, **Set Hi** and **Switch off** may be restricted by the assignment of two passwords within the **SetCustodian** configuration program (Section A1.4). The default configuration is as follows:-

Password 1     **Protected function is ZERO**

Password 2     **Protected functions are ZERO, CAL, SET Lo, SET Hi**

If a protected function (eg zero, Fig 5(a)) is selected with the main button, the display is cleared and the key symbol appears (Fig 5(b)) to prompt the user to key in the relevant password. Enter the correct sequence of the    

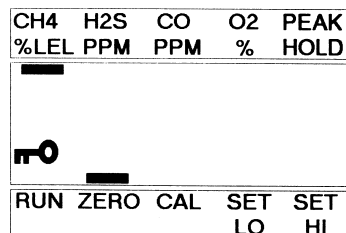
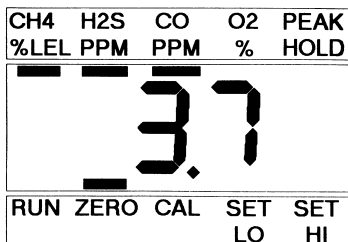


Figure 5(a) Selecting a protected function Figure 5(b) Password request

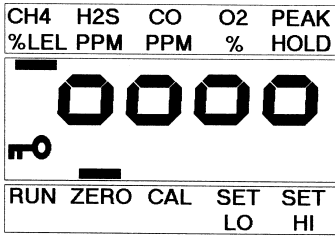


Figure 5(c) Password entry

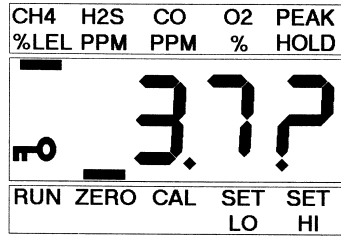


Figure 5(d) Incorrect password

keys. As each key is pressed, a small 'o' appears (Fig 5(c)). After four key entries, press the main button. The selected function will operate if the correct password was entered, otherwise a question mark appears (Fig 5(d)). Acknowledge the error by pressing the main button.

Once a password has been successfully entered, it remains valid until the instrument is returned to **Run** mode. All functions protected by this password now take immediate effect when they are selected.

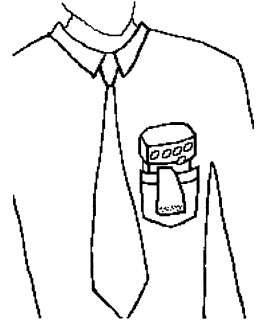
9. Fixing Accessories

Three fixing accessories are supplied as standard.

1. The transparent belt bracket may be fitted to the rear of the instrument for use with a normal trouser belt.

2. The pocket clip fits to the front of the instrument which enables it to be worn as shown in Figure 6.

NOTE: The battery pack fits inside the pocket so that the sensors face outwards.



3. The two small brackets may be fitted to the back of the instrument allowing the use of the shoulder strap.

Optional fixing accessories available are:

1. Waist belt
2. Carrying case complete with waist belt. This has a transparent top cover through which the display can be read and the controls operated. The standard shoulder strap, as well as the waist belt, may be fitted to the carrying case for securing the instrument to the body. The flap on the front allows access for the optional alarm earphone.
3. Chest harness (for use without carrying case - see figure 7).

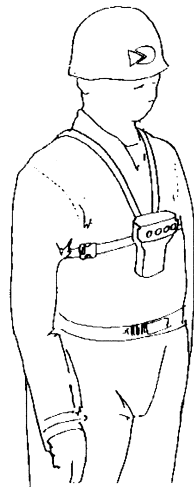


Figure 7 Chest harness

The full range of all accessories is shown on page 28.

10. Using Pumped versions or Aspirators

For calibration of non-pumped (diffusion) instruments the optional aspirator is required.

10.1 Diffusion Instruments

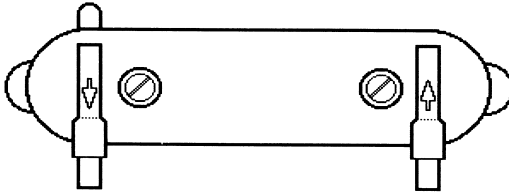


Figure 8 Aspirator flow adaptor

The Aspirator Flow Adaptor must be firmly fixed over the grille using the finger screws. The Flow Adaptor has an inlet and outlet nozzle marked by air flow direction arrows. The outlet must be connected to the hand aspirator bulb. A consistent style must be adopted when using hand aspirators - Crowcon recommend squeezing once per second to achieve a flow rate of approximately 0.5 - 1 litre/min.

This adaptor may also be used on pumped instruments in which case the internal pump will not run.

10.2 Pumped Instruments

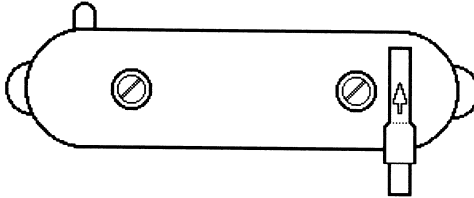


Figure 9 Pump flow adaptor

The internal pump switches on automatically when the Pump Flow Adaptor supplied is fitted over the grille. Ensure that the finger screws are firmly fixed. Air is drawn in through the nozzle on the adaptor and exhausted through the small nozzle below the sensor grille. In this configuration, the instrument continuously samples air in its immediate vicinity. A sample tube up to 20 metres may be connected to the inlet nozzle for remote sampling.

Should the flow become restricted or the pump blocked due to ingress of particles or water, the pump will automatically shut down and the PUMP BLOCKED symbol will be displayed and a rapid series of warning beeps will sound. To restart, remove the blockage, press the main button **or** remove and replace the flow adaptor **or** switch the instrument off and back on.

NOTES:

- 1. If the blockage remains, the pump will not restart.**
- 2. The instrument senses the presence of the flow adaptor using a magnet moulded into the adaptor. Keep the flow adaptor away from cassette tapes, floppy disks etc.**

10.3 Calibration Method

Pass calibration gas through the flow adaptor from a regulated cylinder. Use a flowmeter and needle valve set after the regulator to set a flow rate of 0.5 - 1 litre/min. Pumped units should be fed gas from an unpressurised gas bag, alternatively, a standard flow adaptor maybe used in which case the pump will not run.

NOTE: Where the calibration gas may represent a toxic risk, it is advisable to connect the outlet to an exhaust bag or fume extractor.

Typically, calibration gas must be applied for 30 seconds or more before the reading stabilises to its final level. This reading may then be adjusted to the desired level using the keypad (Section 8.3) or computer interface (Section A1.4).

An automatic calibrator is available to streamline batch calibration.

NOTE: When calibrating with reactive gases such as H₂S, care should be taken to ensure that suitable materials are used for piping, valves, etc. Examples of suitable pipe materials are given in the table below.

Pipe Material	Compatible Gases
HDPE/Nylon	Non-reactive gases (eg. CH ₄ , CO)
PTFE/PVDF	Highly absorbed gases (eg. H ₂ S, Cl ₂ , SO ₂)
Stainless steel (316)	Non-reactive gases (special)

Ensure sensor apertures are free from dirt and check condition of filter (Section 11.2) before calibrating.

11. Routine checking

Custodian is designed to operate almost maintenance free under most conditions. However, some small items of routine maintenance are recommended .

11 .1 General

If used in dirty or hostile conditions, a regular wipe over with a damp cloth will help in viewing the display and maintaining easy operation of the pushbuttons. This is also recommended for the three small silver contacts on the base of the instrument to maintain good contact for battery charging (where rechargeable battery packs are used).

11.2 Sensor filter

This is manufactured from a water repelling material to protect the sensors from immersion. If it becomes wet or dirty it may impede diffusion of gas into the sensors, thereby degrading their performance. The filter is simply cleaned by removing any flow adaptor that may be fitted, removing the sensor baffle plate (see Figure 10, page 24), and washing in warm, soapy water. Dry carefully, making sure the material does not rip or break, and replace.

11.3 Zero and Calibration

Because all gas sensors change their performance characteristics over time, regular zero and calibration checks are recommended at the following intervals:

- Zero Every 1 month
- Calibration Every 6 months

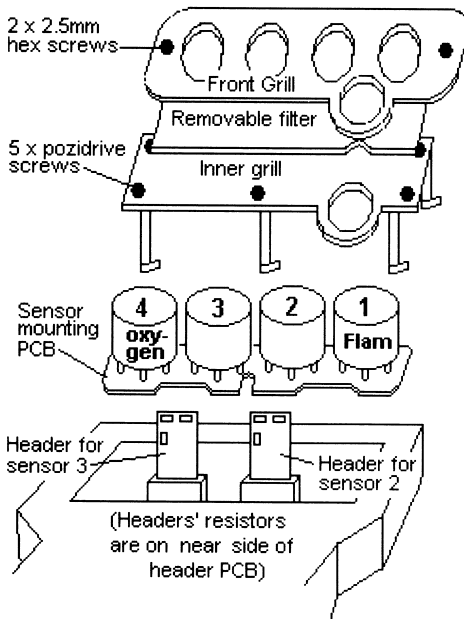
NOTE: Instructions on how to make these adjustments from the instrument front panel are on pages 15 & 16, and via the SetCustodian software on page 40.

Monthly Gas Check: Due to the safety nature of gas detection instruments, it is recommended that sensors are regularly gas checked. Instrument sensors may be adversely affected by certain environments (Section 13). A monthly test with a known gas mixture will ensure the dependability of the equipment.

If, during the course of a routine calibration, the instrument display indicates **E3** (Calibration failed), replace the sensor by following the instructions below. In the case of a flammable sensor an **E2** indication (Zero failed) may also indicate a sensor failure. In this case check that the sensor is exposed to gas free air and repeat the test.

12. Sensor Replacement

Remove the flow adaptor (if fitted). Remove the front grille which is secured by two Allen headed screws (an Allen key is provided with each instrument, and is located in the base of the main instrument. Access is gained by removing the battery pack). The removeable filter may come away with this component.



Remove the five screws securing the inner grille and withdraw it from the instrument.

Rotate the quick release fixings which retain the sensor mounting pcb and detach it from the sensor plate.

Individual plug-in sensors may now be replaced as required. If replacing a toxic sensor, it maybe necessary to replace the associated header pcb. If this is supplied with the spare sensor it should be exchanged with the header fitted to the socket on the marshalling pcb nearest to the sensor in question.

NOTE: Ensure that the new header board is fitted the correct way round. Refer to fig 10.

Figure 10 Sensor removal and replacement

When reassembling, ensure that all gaskets and filters are in good condition and correctly fitted.

13. Sensor Limitations

Custodian uses a catalytic flammable gas sensor which measures the flammability of the gas. For this reason, readings displayed on the unit will be unreliable over concentrations of approximately 120% LEL. Oxygen is necessary for catalytic sensors to operate. It is advisable always to check for oxygen concentration in addition to combustible gas concentration prior to entering a confined space. Depleted oxygen levels below 10% will reduce a flammable gas reading.

The performance of catalytic sensors may be permanently degraded if exposed to silicones, sulphur containing gases (such as H₂S), lead or chlorine compounds (including chlorinated hydrocarbons).

Use of the unit in ambient temperatures above 50°C may cause unstable readings due to inefficient temperature compensation at elevated temperatures. Water saturated air conditions may prevent diffusion of the gas through the sinter on the sensor housing due to build up of moisture.

Custodian uses electrochemical sensors which include a PTFE membrane. This membrane is unsuitable for use in temperatures above 55°C, or in saturated air conditions where condensed water build up on the surface will prevent diffusion of the gas into the sensing chamber. Electrochemical sensors are not wholly specific to their target gas and the presence of other gases may cause the sensor to respond. Full details of cross sensitivities are available from the Crowcon Sales department.

Use of high power radio transmitters in close proximity to the instrument may exceed rated RFI immunity levels and cause erroneous indications. If such problems are experienced, remove antennae to a reasonable separation from the instrument (eg 30 cm).

14. Troubleshooting guide

Symptom	Diagnosis	Remedy/check
Does not switch on	Battery flat	Recharge or replace battery
Does not switch off	Password required	Alter configuration
Display blank	Display disabled	Alter configuration
No confidence bleep	Function disabled	Alter configuration
Reading when no gas present	Zero drifted	Zero instrument in clean air
Unstable/inaccurate readings	Sensor failure	Recalibrate or replace sensor
Does not talk to PC	CommsPod unpowered	Connect power
Cannot Zero, Span or adjust alarms	"Functions Timeout" enabled	Switch off and back on or alter config.

14.1 Error codes

The instrument may display the following warning codes:

- E1:** Calibration Expired: indicates that the period between regular calibrations has elapsed.
- E2:** Zero Failed: results from attempting to zero a channel exposed to gas. The function request is aborted without effect.
- E3:** Calibration Failed: the gain is being set out of range indicating probable sensor failure or incorrect calibration gas. The gas reading

is set as close to the desired level as the gain limiting software will allow.

- E4:** Sensor Overrange (displayed in place of a legal sensor reading)
- E5:** High/low Temperature: gas readings may not be reliable at these extremes. Sometimes occurs on initial switch on.
- E6:** Electronic Hardware Failure: the instrument should be sent for repair.
- E7:** Keypad fault.

Most of these warning codes can be acknowledged (cleared) by pressing the main button.

15. Accessories and Spare Parts Lists

15.1 Accessories List

C01451	Waist belt
DC0104	Carrying case, includes waist belt
DC0101	Rechargeable battery pack, complete with batteries
DC0102	Replaceable battery pack, complete with disposable batteries
E01451	AA size battery Alkaline, disposable, 4 required
DC0107	Aspirator complete (pumped) with flow adaptor & tubing
DC0108	Aspirator complete (non pumped) with flow adaptor, tubing, bulb & pouch
C01097	Aspirator probe
C03141	6 metre drop line
DC0103	Battery charger with no power supply, for 12V DC input
DC0115	Battery charger with 230V power supply for UK only
DC0116	Battery charger with 230V power supply for Europe only
DC0117	Battery charger with 110V power supply for US only
DC0118	Battery charger with 230V power supply - no plug
DC0119	Battery charger with 110V power supply - no plug
C01296	Charging lead for vehicle lighter socket
DC0105	Comms pod. Requires 12 volt power supply
DC0120	Comms pod with 230V power supply for UK only
DC0121	Comms pod with 230V power supply for Europe only
DC0122	Comms pod with 110V power supply for US only
DC0123	Comms pod with 230V power supply without plug
DC0124	Comms pod with 110V power supply without plug
C01511	Alarm earphone with 1.5m of tubing
DC0114	Chest harness
DC0130	Transit Case (hard case complete with foam cut outs) for Custodian and all accessories
C01552	Autocalibrator II (requires PC and Comms pod)

15.2 Spare Parts List

DM0414	Pocket clip
DM0413	Belt clip
DM0403	Battery pack clip
DM0421	Finger guard
C01323	Shoulder strap
DM0430	Shoulder strap bracket
M04032	Aspirator hose by the metre
M04001	Aspirator bulb
DC0106	Aspirator pouch
DC0132	Aspirator flow adaptor, fittings, bulb and tubing
DC0107	Pumped flow adaptor, fittings and tubing
DC0128	Main assembly kit for 3/4 channels (main/LCD board, LCD & elastomers) EXCHANGE ONLY *
DC0129	Main assembly kit for 1/2 channels (main/LCD board, LCD & elastomers) EXCHANGE ONLY *
DS0103	Analogue board (standard) Dual toxic, flammable, oxygen
DE0108	Membrane keypad
DS0118	Pump and mounting kit
DE0101	LCD glass (2 elastomers required)
DE0703	Elastomer (for DE0101)
DS0104	Sensor board (standard)
DM0419	Sensor pcb clips(set of 6)
DM0410	Outer grill
DM0411	Inner grill
DC0111	Set of gaskets (set of 5, excluding sensor filter assembly)
DC0110	Sensor filter assembly
DM0409	Main body moulding
DM0412	Top cover moulding

* The main assembly can only be supplied if the serial number is given

Spare Parts List (continued)

DE0110	Sensor flammable 0-100% LEL methane
DE0113	Sensor HS 0-50ppm hydrogen sulphide
DE0111	Sensor OX 0-25% oxygen
DE0112	Sensor CO 0-500ppm carbon monoxide
DE0114	Sensor SO 0-10ppm sulphur dioxide
DE0115	Sensor ND 0-10ppm nitrogen dioxide
DE0116	Sensor CL 0-5ppm chlorine
DM0420	Dummy tox/ox sensor for blank channels
DM0207	Dummy flammable sensor for blank channels
C01009	Allen key 2.5mm
DM0701	Instruction card small, for shoulder strap
DM0703	Instruction card large, for carrying case
DM0702	Instruction manual, English
DC0109	SetCustodian software, 3½" disk
C01296	Charging lead for vehicle lighter socket to charger
E01535	Power supply for charger/comms pod 230V for UK only
E01536	Power supply for charger/comms pod 230V for Europe only
E01537	Power supply for charger/comms pod 110V for US only
E01552	Power supply for charger/comms pod 230V no plug
E01553	Power supply for charger/comms pod 110V no plug
M03650	Outer grill fixing hex headed screw, 2 required
M03651	Battery pack lid hex headed screw, 2 required
M03649	No. 2 self tapping screw, 20 required

APPENDIX A

SetCustodian Computer interface

A1.1 Introduction

SetCustodian is a Microsoft Windows™ based utility program for interfacing with a Custodian gas detector. Using industry standard RS232 from the PC serial port, the program allows full access to the instrument for routine operations such as calibrating and advanced functions such as altering passwords.

A1.2 Installation

The minimum hardware requirement for SetCustodian is a PC running Windows™ 3.0 or later.

To install SetCustodian on the hard disk, insert the floppy disk supplied with the Comms pod in drive **a**, click on the **File** menu in Program Manager, select **Run**, and type **a:setup** as the Command Line. The user will be asked to choose the target drive. Setup will create a directory and program group called **Custodian**. The installation procedure asks the user to select either Com 1 or Com 2 as the port for Custodian connection to the PC.

A1.3 Running SetCustodian

To run SetCustodian proceed as follows.

Run Windows.

Double click on the SetCustodian icon which can be found in the Custodian program group.



Figure 11 Custodian Program Group

If the Com port selected during setup is unavailable, an alternative is offered.

Ensure that the instrument is fitted with a CommsPod in place of the battery pack (see section 6.1 on battery pack removal). The CommsPod must be powered from a 12V supply such as the power pack for the Custodian charger, and the serial lead must be plugged in to the computer serial port.



SetCustodian

NOTE: The intrinsic safety certification does not permit this operation in a hazardous area.

Figure 12
SetCustodian icon

Switch on the instrument.

A1.4 Using SetCustodian

SetCustodian is used for modifying the way the instrument is setup performing zero and calibration functions altering alarm setpoint values and uploading data for use in LogManager (see Section A2).

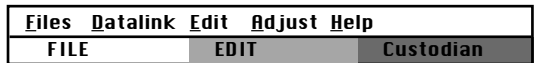


Figure 13 Status bar

NOTE: Some of these functions can be accomplished from the instrument front panel (see Section 8).

The opening screen includes a Menu bar and a Status bar. Menu bar functions are described below. The Status bar is in three sections labelled FILE, EDIT and Custodian, where FILE represents data stored on the PC

hard drive and saved as a **.set** file, **EDIT** represents the data that appears on the screen when the **Edit** menu option is selected and **Custodian** represents the data held in the instrument. A section coloured yellow indicates it is inactive. A section coloured green indicates changes have been made. A section coloured red indicates that changes have been made to the **Edit** screens, but not copied either to the instrument or the saved file.

A1.5 Menu options

A1.5.1 Files

New This allows a new setup file to be created. To do this select **New**, then **Edit** from the main menu bar. When editing is complete, select **Save** from the **File** menu, and type in a file name, making sure the **.set** file extension is saved.

Open... This allows you to open an existing file already saved on the PC. This can be edited, or copied to another instrument.

Save This allows you to save edited files.

Save As... This allows you to save edited files in a format other than **.set** or to a different drive or directory.

Print This allows you to produce a hard copy record of the setup information created in **Edit** (this will be similar to the Configuration Report originally supplied with the instrument). This will be printed on the default printer connected to the PC. If a high quality font (similar to the original Configuration Report) is required for a better presentation, click the **Quality Print** command.

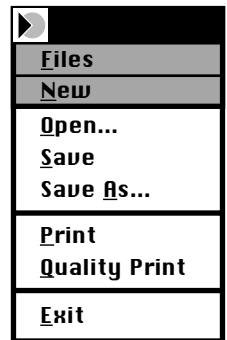


Figure 14 Files menu

A1.5.2 Datalink

Upload This allows you to transfer setup data from the instrument to the PC. This data can then be edited to modify the way in which the instrument operates.

Download This allows edited data to be transferred from the PC to the instrument.

Read gas This produces a “snap shot” of the instrument gas readings. This can be used, for example, to check that the sensors have returned to zero after a calibration.

Datalink
Upload
Download
Read Gas
Next Cal
Upload Log

Figure 15 Datalink menu

SetCustodian			
Files Datalink Edit Adjust Help			
FILE	EDIT		Custodian
	Channel	Values	Units
1	Methane	0.0	LEL
2	H2S	0.0	ppm
3	CO	0.0	ppm
4	Oxygen	20.8	%Vol

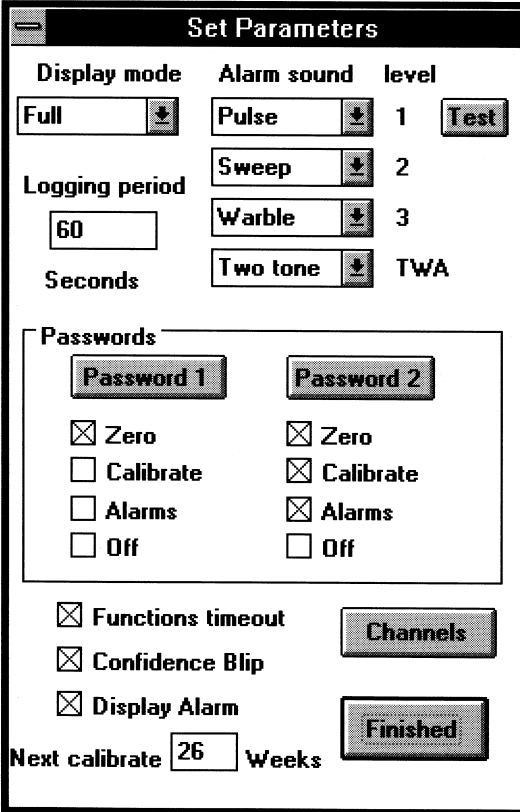
Figure 16 Read Gas display screen

Next Cal This indicates the number of days left before the next calibration is due. The calibration time is pre set to 26 weeks in the **Next Calibrate** box in the **Set Parameters** screen (For initial shipment, calibration time is set to 32 weeks). After calibration, the instrument will count down in days and when the time has elapsed, the instrument will display the **E1** (Calibration Expired) warning during the switch on routine. Calibration times can be set to a different time, but will only affect the instrument after calibration has been carried out.

Upload Log This transfers logged data stored in the instrument to the PC for viewing in **LogManager** (see Section A2).

A1.5.3 Edit

Selecting this option will cause the **Set Parameters** screen to be displayed.



The screenshot shows the 'Set Parameters' dialog box with the following settings:

- Display mode:** Full
- Alarm sound:** Pulse
- level:** 1
- Logging period:** 60
- Seconds:** (field)
- Alarm sound options:** Sweep, Warble, Two tone
- level options:** 2, 3, TWA
- Test button:** Test
- Passwords section:**
 - Password 1:**
 - Zero
 - Calibrate
 - Alarms
 - Off
 - Password 2:**
 - Zero
 - Calibrate
 - Alarms
 - Off
- Other options:**
 - Functions timeout
 - Confidence Blip
 - Display Alarm
- Buttons:** Channels, Finished
- Next calibrate:** 26 Weeks

Figure 17 Set Parameters dialog box

Display mode This can be selected as **Full** or **No display**. Selecting the **No display** option will cause the LCD to remain blank at all times, even under alarm conditions.

NOTE: If No Display is selected it is strongly advised that the Confidence blip is selected On (see below). With both of these options selected Off, the user has only the flashing green LED, under normal conditions, to indicate that the instrument is operating.

Alarm sound This allows the different type of alarms to be programmed with different sounds. Programming a particular sound for a Level 1 alarm, for example, will cause that sound to be activated for any Level 1 alarm that occurs, regardless of the gas. The 'silent' alarm sound option (visual only) is only available on Level 1 alarms for safety reasons.

For a computer simulation of the available sounds, select a sound in the Level 1 alarm box and click on **Test**.

NOTE: Use only the Level 1 option to Test sounds.

Logging period This sets the frequency with which the instrument stores logged data. The log operates on a rolling basis, so that when it becomes full the oldest data in the log will be deleted and replaced by current data.

Note: For an instrument with the logging period set to 60 seconds, the log will fill up in approximately one week.

Passwords These are used to prevent unauthorised adjustments being made to the instrument (for further information on use of passwords, refer to Section 8.5). The **Set Parameters** screen in Figure 17 shows that Password 1 will be required prior to making a zero adjustment and Password 2 will be required prior to adjusting zero, calibration or alarms. Clicking on any of the boxes will cause the option to toggle on or off.

The default passwords are:

Password 1    

Password 2    

To change these, click on the **Password 1** or **Password 2** box and the following screen appears

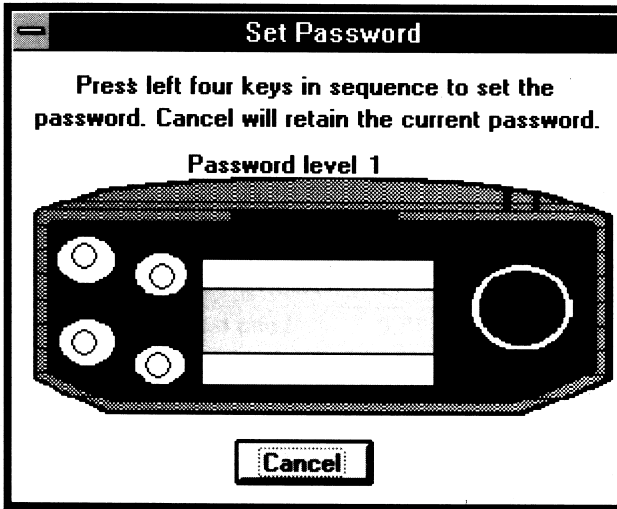


Figure 18 - Password entry screen

Clicking on the four buttons in order will cause the new password to be created.

NOTE: Any single button can be pressed more than once.

Functions timeout With this option selected, the instrument is locked in **Run** mode 2 minutes after switch on. This is to prevent accidental erroneous adjustments being made during normal operation.

Confidence blip This switches the audible confidence blip on or off (refer to the **Display** option above).

Display Alarm When selected, causes the instrument to lock its display on the first channel to go into alarm.

Next calibrate See **Next Cal** on page 34.

Pressing **Finished** will store any changes made and return you to the main **SetCustodian** screen.

Clicking on the **Channels** box will cause the **Setup Channels** screen to be displayed. To select a particular channel, click on the channel “page” at the top of the screen.

Setup Channels

Ch 1 Ch2 Ch3 Ch4

Gas Range Units

H2S 0-50 ppm

Time Weighted Averages

Short term level 15.0 Long term level 10.0

Alarm 1

- Active
- Rising Alarm
- Latching
- Can Mute

10.0 Value

Alarm 2

- Active
- Rising Alarm
- Latching
- Can Mute

20.0 Value

Alarm 3

- Active
- Rising Alarm
- Latching
- Can Mute

50.0 Value

Finished

Figure 19 Setup Channels dialog box

Gas, Range and Units are selected from pull down menus.

NOTE: These options are factory set and are used for displaying data in LogManager and setting calibration limits. They are determined largely by the sensors fitted in the instrument and correspond to the upper label on the instrument display. These options should not be adjusted without consultation with Crowcon or an authorised Distributor.

Time Weighted Averages (TWA) These are also factory set to reflect the Health and Safety requirements of the country to where the instrument is delivered and only apply to toxic gas channels. **Short term level** is the 15 minute exposure level and **Long term level** is the 8 hour exposure level.

Alarm 1, 2 and 3 determine the operating modes for each alarm. Click on any of the boxes to toggle on or off.

NOTE: Alarm 3 can only be configured using SetCustodian. All Alarm 3 settings are defaulted to Off and cannot be accessed from the instrument front panel.

Active	When selected, the alarm will operate
Rising Alarm	Always selected On , except for oxygen deficiency alarms, which are triggered on a falling concentration.
Latching	When selected, requires the alarm to be manually reset, by pressing the Main button, after the alarm condition has passed.
Can Mute	When selected, allows the audible alarm to be cancelled with the alarm condition still present.
Value	Sets the point at which the alarm trips

NOTES:

- 1. The number entered in the Value box must be between 5% and 100% of the number in the Range box, and can be entered to one place of decimal (for example, if the Range is 0-50, the Value can be between 2.5 and 50.0).**
- 2. It is not advisable to set Alarm Values for flammable gases higher than 60.0.**

Pressing **Finished** will store any changes made and return you to the **Set Parameters** screen.

A1.5.4 Adjust

Zero Selecting this option displays a dialog box allowing you to zero all channels or select one. Clicking on **OK** will zero the selected channels and produce a confirmation message that zero has been successfully completed.

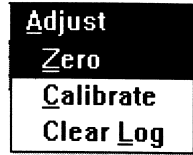


Figure 20 Adjust menu

NOTE: Only carry out this operation in clean air.

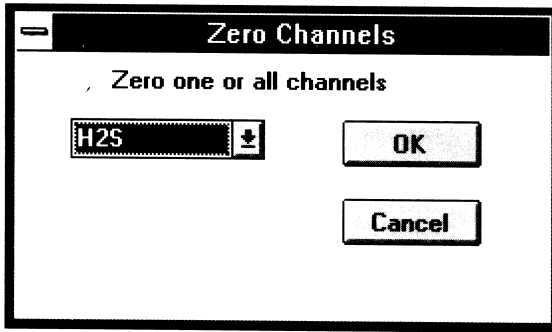


Figure 21 Zero Channels dialog box

Calibrate Select the channel to be calibrated and enter the concentration value of the calibration gas, as shown on the side of the cylinder. Ensure that the gas has been flowing for at least 30 seconds and click on **OK**. This will produce a confirmation message that calibration has been successfully completed.

NOTE: For full calibration instructions, see Section 10.3.

Clear Log Selecting this option displays a Warning box asking for confirmation. Selecting **OK** will clear all logged data in the instrument.

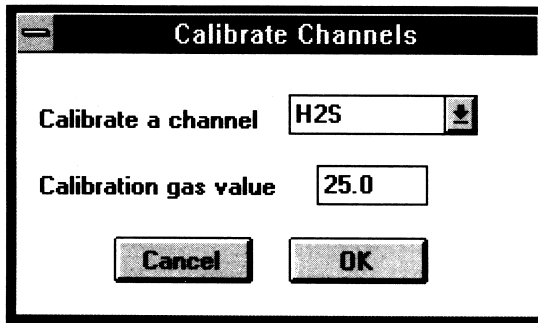


Figure 22 Calibrate Channels dialog box

A1.5.5 Help

Help provides the information given in this manual in an easy to use on screen help.



About displays an information box giving the version number and publication date of the **SetCustodian** software.

Figure 23 help menu



Figure 24 About screen

A1.6 Using SetCustodian - An Example

Problem

Your Health and Safety Manager has decided that a third level of alarm on flammable channels is desirable, set at 50%LEL, non-latching, non-mutable with the “Stair” audible warning.

Solution

Plug the instrument into the CommsPod, ensuring that the serial cable is connected to the correct serial port on the computer.

Switch the instrument on.

Launch the **Custodian** Program group by double clicking on the group icon. Open **SetCustodian** program by double clicking on the program icon.

From the **Datalink** menu, select **Upload**.

Click on **Edit** to display the **Set Parameters** screen.

In the **Level 3 alarm sound** box, select “**Stair**” from the pull down menu.

Click on **Channels** to display the **Setup Channels** screen.

Select **Channel 1** (this is always the flammable channel).

Click on **Active**. Ensure that **Rising Alarm** is selected **On**, **Latching** is selected **Off** and **Can Mute** is selected **Off**.

In the **Value** box, type **50.0**.

Click on **Finished** to return you to the **Set Parameters** screen.

Click on **Finished** to return you to the main screen.

From the **Datalink** menu, select **Download**. When completed, the screen will display a confirmation message.

NOTE: If the setup file for that instrument is saved on the computer hard drive, select Save from the Files menu, select the file (normally saved as c[Custodian serial number].set) and click on OK. For example, an instrument serial number 0000247 will correspond to file c247.set.

A2. LogManager



LogManager

To use **LogManager**, it is necessary to first upload the log.

Figure 25 LogManager icon

From the **SetCustodian Datalink** menu, select **Upload**, then select **Upload Log**. The screen will display a **Save File** screen. This asks you to name the log file. Either create a name by typing it into the **File Name** box (replacing the asterisk) or by selecting an existing file (this will append the new data to the end of that file).

Once a logged data file has been saved on disk, it may be analysed using **LogManager**. Launch the program by double clicking on the **LogManager** icon (Fig 25).



Figure 26 LogManager menu bar

Select **Open Log...** from the **File** menu (Fig 27). Select the file of interest (anyname.log) by typing the filename or clicking on a name from the list. Click **OK**.

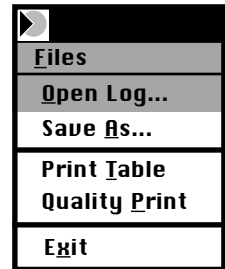


Figure 27 LogManager File menu

Data is presented graphically with an individual coloured trace for each gas. As the mouse pointer is moved around the screen, the gas level and event time are displayed in the upper left corner. An example is shown in Fig 28, but as a negative image for clarity. A vertical dotted line indicates that the Custodian has been switched off for a period during the log recording.

Use the horizontal scroll bar to move along the time axis. Gas values are scaled according to the maximum range on any channel shown. In order to see detail on a low range channel (eg 25ppm H₂S), it may be advantageous to turn off the traces of any high range channels (eg 500ppm CO). This is achieved by selecting the **View** menu (Fig 29) and clicking on channels to turn traces on or off.

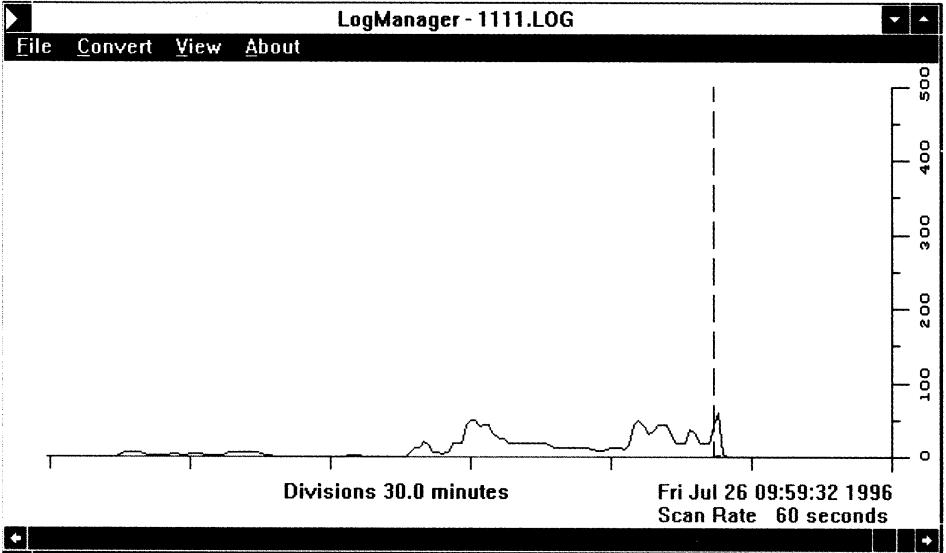
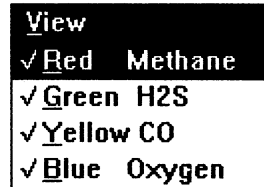


Figure 28 LogManager View screen

A tabular listing of the current log file is available by selecting **Print Table** from the **File** menu. The listing is directed to the default printer. Use Windows Control Panel - Printers to select the default printer. The chart may be printed directly by selecting the **Print Graph** command.



LogManager View menu

A2.1 Spreadsheet Files

For detailed analysis and presentation of logged data, files should be converted to comma separated variable (.csv) format and then imported into a proprietary spreadsheet program (eg Microsoft Excel, Lotus 123).

Select **Save as...** from the **File** menu and save the current logged data as **[anyname].csv**. By default, this selection converts the entire file to .csv format.

LogManager uses the Windows Country setting to select between comma and semi-colon data separators. If you wish to produce files with comma data separators, regardless of PC settings, select the **Convert** menu and check the box marked 'Produce true CSV file'.

This dialog box also enables a user to convert just part of the data file by entering the start and end reading numbers. By default, the complete file is selected.

Reading numbers can be determined by placing the cursor at the appropriate point on the graph and noting the reading number displayed in yellow at the top of the screen.

A tabular listing of the current log file is available either by selecting **Print** from the **File** menu or opening the relevant .csv file in a spreadsheet.

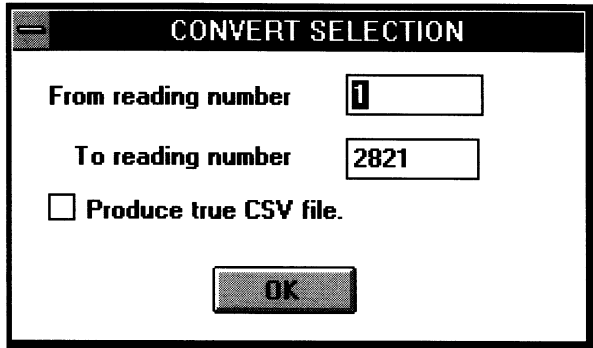


Figure 30 LogManager Convert dialog box

A3. ReadMe.Txt

Double clicking on this icon reveals general information on Custodian software, plus any new information valid for that version.

APPENDIX B

Default settings

Unless otherwise specified at the time of order, each instrument is shipped from the factory programmed with the default settings. These are listed below.

Function	Option set
Display mode	Full
Alarm sound level 1	Pulse
Alarm sound level 2	Two tone
Alarm sound level 3	Warble
Alarm sound TWA	Sweep
Logging period	60 seconds
Password 1	⊕ ⊖ ▶ ▶
Password 2	▶ ▶ ⊖ ⊕
Password 1 protection	Zero
Password 2 protection	Zero, Calibrate, Alarms
Functions timeout	On
Confidence blip	On
Calibration period	26 weeks (32 for initial shipment)

Channel 1 (Flammable) Alarm Settings

	Alarm 1	Alarm 2	Alarm 3
Active	On	On	Off
Rising Alarm	On	On	On
Latching	On	On	On
Can Mute	Off	Off	Off

Channels 2 & 3 (Toxic) Alarm Settings

	Alarm 1	Alarm 2	Alarm 3
Active	On	On	Off
Rising Alarm	On	On	On
Latching	On	On	Off
Can Mute	Off	Off	Off

Channel 4 (Oxygen) Alarm Settings

	Alarm 1	Alarm 2	Alarm 3
Active	On	On	On
Rising Alarm	Off	Off	On
Latching	On	On	On
Can Mute	Off	Off	Off

Detection Range and alarm trip point settings

	Range	Alarm 1	Alarm 2	Alarm 3
Flammable	0-100%LEL	20	40	60
Oxygen	0-25%v/v	19	17	23
H₂S	0-50ppm	10	20	50
CO	0-500ppm	50	100	500
SO₂	0-10ppm	2	5	10
Cl₂	0-5ppm	0.5	1	5
H₂CN	0-25ppm	5	10	25
O₃	0-1ppm	0.5	1	Not used

Service Record

Inst. Ser No:			Location:				
Due Date	Act Date	Zero	Span				Comments
			Ch1 Flam	Ch2	Ch3	Ch4 Oxy	

Crowcon Detection Instruments Ltd
2 Blacklands Way, Abingdon Business Park
Abingdon, Oxfordshire OX14 1DY, England
Tel: +44 (0) 1235 553057
Fax: +44(0) 1235 553062
Email: crowcon@crowcon.com