CROWCON
Gas Detection You Can Trust

TRIPLE PLUS+
INSTRUCTION MANUAL

Part No M07190

Issue 6
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WARNING - Do not change the battery in an explosive atmoshere.

WARNING - Classified by UL Inc. only for intrinsic safety for use in hazardous locations.

WARNING - Substitution of components may impair intrinsic safety.

WARNING - Read the instruction manual before use.

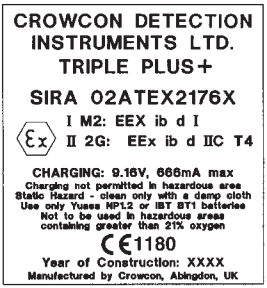
WARNING FOR UL CERTIFIED UNITS - Not classified for use in atmosphere containing greater than 21% oxygen.

Instructions specific to hazardous area installations

(reference European ATEX Directive 94/9/EC, Annex II, 1.0.6.)

The following instructions apply to equipment covered by certificate number Sira 02ATEX2176:

1 The certification marking is as follows:



2 The equipment is Category 2G and may be used in zones 1 and 2 with flammable gases and vapours with apparatus groups IIA, IIB & IIC and with temperature classes Tl, T2, T3 and T4

3 The Triple Plus+ is also certified as Category M1 equipment for use in mines

4 The equipment is only certified for use in ambient temperatures in the range -20°C to +40°C and should not be used outside this range

5 Only the battery types prescribed on the battery compartment label are permitted; other types may invalidate intrinsic safety compliance. Charging is only permitted in the non-hazardous area.

6 The equipment has not been assessed as a safety-related device (as referred to by Directive 94/9/EC Annex II, clause 1.5)

7 Repair of this equipment shall be carried out by the manufacturer or in accordance with the applicable code of practice.

QUICK OPERATING GUIDE

TURN ON - Press ON, press unmarked button to reset alarm, green LED flashes and display will show gas levels or will read "MONITORING" if the instrument is in the GO/NO-GO mode (see SETTING UP).

ALARM - Alarm sounds and red LED flashes. If gases are displayed, the word ALARM flashes next to the hazardous gas name. If in GO/NO-GO mode the display reads GAS HAZARD, EVACUATE AREA. If the toxic channel(s) are set for instantaneous and TWA alarms, the alarm sounds and the red LED flashes when the instantaneous threshold is reached. On pressing the unmarked button the sounder is cancelled but the red light will continue to flash if gas is present. The sounder operates again if the 15 minute or 8 hour TWA alarm level is reached.

RESET ALARM – Press unmarked button.

BACK LIGHT – Press button with light symbol. It stays on for 30 minutes unless the button is pressed again.

BATTERY LOW – Green LED flashes quickly, the sounder frequency increases and a warning is flashed on the display. Use charger/interface to charge instrument or battery pack separately (5 hours for full recharge).

CALIBRATION/SETTING UP – Pressing "CAL" and entering a password enables the instrument to be recalibrated and its operating modes changed.

USE OF BULB SAMPLING ASPIRATOR

Locate flowhead under lip above sensor apertures and secure with the two half-turn fasteners. Squeeze bulb once every second to obtain the required flow rate of 0.5 litre/min.

CALIBRATION CERTIFICATE

INSTRUMENT DETAILS

SERIAL NO. ☐ UL CLASSIFIED ☐

CERTIFICATE NO. SIRA 02ATEX2176X  I M2: EEX ib d I
II 2G: EEx ib d IIC T4 ☐

TYPE MONO ☐ DUAL ☐ TRIPLE ☐ QUADRUPLE ☐

☐ FLAMMABLE GAS CHANNEL
0-100% LEL METHANE
ALARM SETTINGS %LEL/ %LEL / %LEL

☐ OXYGEN CHANNEL.
0-25%/ %
ALARM SETTINGS 19%/ %/23.5%/ %/ %

☐ HYDROGEN SULPHIDE CHANNEL
0-50 ppm/ ppm
ALARM SETTINGS
INSTANTANEOUS 10ppm/ ppm/ ppm/ ppm
15 MIN TWA 15ppm/ ppm
8 HR TWA 10ppm/ ppm

☐ CARBON MONOXIDE CHANNEL
0-500ppm/ ppm
ALARM SETTINGS
INSTANTANEOUS 30ppm/ ppm/ ppm/ ppm
15 MIN TWA 200ppm/ ppm
8 HR TWA 30ppm/ ppm

☐ Special Version

CHANNEL	GAS	RANGE	ALARM SETTINGS		
			INSTANTANEOUS	15 MIN TWA	8 HR TWA

TEST ENGINEER / /

CROWCON EQUIPMENT IS TESTED AND CALIBRATED IN ACCORDANCE WITH PROCEDURES REFERRED TO IN CROWCON'S BSI VALIDATED QUALITY MANUAL, GUARANTEEING CALIBRATION TO ISO9000 STANDARDS OF RELIABILITY AND REPEATABILITY. STANDARD CALIBRATION GAS MIXTURES HAVE BEEN PREPARED IN ACCORDANCE WITH BS4559

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1 GENERAL DESCRIPTION

The Crowcon TRIPLE PLUS+ is a microprocessor controlled portable gas detector which is capable of monitoring up to four gas types simultaneously and providing warning of hazardous levels. Using electrochemical, catalytic and thermal conductivity sensors, the instrument may be configured to detect any practical combination of oxygen, toxic and flammable gas. See Appendix 4 for notes on sensor limitations.

The built in data logging facility records gas levels of all four channels at user definable intervals for subsequent downloading to a computer. This enables a more detailed evaluation of accumulated exposure to be made than is possible with the Time Weighted Average exposure integrator, may yield useful data about gas leak patterns and can provide essential information to an incident inquest.

The three part injection moulded TRIAX case is light yet durable and resistant to water and dust. It houses a digital electronic circuit board, up to four sensor modules, a piezo-electric alarm sounder and a power supply board which restricts available current to the rest of the instrument and so ensures intrinsic safety. The battery type is a rechargeable lead-acid which is accessible via an external hatch to permit easy replacement and maximum instrument usage, but it is more likely that the facility to recharge the instrument with the battery pack in situ will be used. The top panel incorporates a backlit liquid crystal alphanumeric display on which gas levels and instrument messages appear, four embossed tactile push-buttons to control instrument functions, a small green LED which flashes periodically to confirm operation and a large high intensity red LED which flashes when an alarm condition is encountered. Additionally, the top panel includes two small windows through which the instrument sends infrared signals when it is located in its dedicated Charger/Interface unit.

2 OPERATION

2.1 SWITCH ON To switch on the TRIPLE PLUS+ press the button marked 'ON.' The instrument will display the message Crowcon TriplePlus+ and the serial number. After a short pause the display will change to Testing System… and the current battery voltage. If the current date is past a presetable calibration due date, then the instrument will display Calibration Due. If there are less sensor modules in the instrument compared to previous switch on (possibly indicating sensor failure) the message Sensors changed? will be displayed. If the instrument's configuration has been lost or corrupted, then the message Loading default data will be displayed. With all three of these error/warning messages, the condition must be accepted by pressing the third button, indicated on the display with the word CONTINUE above it.

The red alarm LED will flash and the alarm will sound at switch on. Pressing the UNMARKED button will silence this, but only if the instrument perceives a safe air condition. If one of the switch-on warning messages is displayed then the instrument will sound the alarm and flash the alarm LED until the condition is acknowledged. If alarms are muted (see MUTE in section 3.2, Configuration Options) then the alarm will not sound and the alarm LED not flash during the switch on process.

The instrument can alarm on instantaneous gas levels, and on both short and long term cumulative gas exposure levels. Note that the cumulative short and long term gas exposures are reset to zero when the instrument is switched off.

A well charged battery will cause the display to indicate in excess of 5.8V; it is considered flat at 5.0V. Below 5.3V an operational instrument will display a low battery warning; an 'off' instrument will not switch on.

About 5 seconds after switch on the instrument completes its self tests, and will indicate the current gas levels.

If the instrument enters an alarm condition then the siren will sound and the alarm LED flash. The speed of flash and siren warble changes with alarm level. Once the gas levels are below all alarms levels (i.e. safe gas levels), the alarm warning may be switched off by pressing the unmarked button. If alarms are muted the red alarm LED will not flash nor will the alarm siren sound when the instrument is in alarm - the only indication of the alarm condition will be the word 'ALARM' alternately flashing with the gas value of the channel in alarm.

2.2 DISPLAY The information on the display is dependent on the type of sensors installed in the instrument. For each sensor module installed, the display indicates the gas concentration, the units of measurement (e.g. ppm) and the channel name (e.g. H2S). (Each sensor module contains analogue circuitry to support the sensor and a small digital memory which identifies it to the processor along with calibration data and alarm thresholds.) A quarter of the screen is reserved for each of a possible 4 gas channels, which means that in the popular 'triple' gas configuration one quadrant is left blank. It is often useful to know how the location of the sensor modules relates to the display. When viewing the instrument from the top with the sensor grilles facing away, reading the display from left to right like a book shows the location of the sensors installed from left to right along the front face. The normal mode of operation is diffusion monitoring whereby the instrument constantly samples air in its immediate vicinity.

The green 'power' LED flashes intermittently accompanied by a tick from the sounder to give confidence to the user that all is as it should be. The confidence blip will do a 'double blip' in low battery situations.

The instrument may be configured into one of several display modes, by the DISPY option in the menu system or by a programmable function on the left hand button – how this is done will be explained later. The possible display modes are:

Normal: All gas values, units and names are displayed

Average: The average gas reading since the instrument was switched on is displayed for toxic sensors. This is indicated by flashing avg with the sensor name. Non-toxic sensors will display their normal gas level.

Off: Display reads MONITORING whilst a safe condition is perceived, and flashes GAS HAZARD and EVACUATE AREA in alarm condition.

TWA Toxic: This display mode only affects toxic sensors, and is indicated by the letters TWA flashing with the sensor name. The gas value displayed will be the current long-term exposure level. Non-toxic gas sensors will display their normal gas level.

Peak hold: This options affects the displayed gas value for all sensors, and is indicated by the letters pk flashing with the sensor name. The greatest gas level that has been read since instrument switch on will be displayed, or in the case of oxygen, the least level read. The value that has been retained may be reset to the current gas level by pressing the unmarked button. The greatest (or least, as appropriate) gas level will then be displayed again from then on.

In addition to the messages described above, if alarms are muted the message 'MUTED' will flash with the sensor name and units.

2.3 OVERRANGE If a sensor's signal is out of range then the instrument may be configured, via a PC and the SetPortable software, to either flash the relevant numbers on the display, or to display a message of the form CH4 SENSOR FAILURE, where the failed sensor will be named, with the alarm sounding. This sort of error could indicate a high gas level or sensor failure. Calibration should be checked after such a warning.

2.4 CAUTIONS Sensors may be adversely affected by exposure to silicones, lead compounds, high levels of hydrogen sulphide and chlorine, and some industrial solvents.

A condition of certification is that the instrument is not used with ethyl nitrate vapours, or in hazardous areas containing IIC gases (e.g. hydrogen , acetylene) where the risk of mechanical damage to the enclosure is high.

2.5 BACKLIGHT In low ambient light conditions, a backlight can be activated to illuminate the display by pressing the button marked with a light symbol. The backlight may be switched off by pressing the light button again, or waiting until it turns itself off after a configurable timeout period of 10, 20 or 30 minutes. Alternatively the light may be configured to never timeout once it has been switch on, or to be permanently on. (See LIGHT in section 3.2, Configuration Options). In an alarm condition, the backlight is automatically turned on.

2.6 ALARMS When the TRIPLE PLUS+ encounters an alarm condition the red light flashes and the sounder emits a loud, fast bleep. Although it may be configured to indicate different types of alarm (see SETTING UP), the usual response would be to evacuate the area immediately. Where permitted however, instantaneous toxic gas

alarms may be accepted by pressing the UNMARKED RESET button. In this case, the bleeper is silenced but the red light continues to flash. With instantaneous alarms, the word ALARM will flash next to the gas name. Exposure limit alarms will flash the whole display with the warning. All instantaneous alarm types are latching which means that they may only be reset with the UNMARKED RESET button when the gas hazard has passed. If set up for time weighted average (TWA) alarms, the TRIPLE PLUS+ calculates a sliding average of recent gas concentration and triggers a non-resettable alarm if a short term (normally 15 minute) or long term (8 hour) exposure level is reached. Both TWA alarm types may only be reset when the average exposure has fallen below threshold levels. (See CONFIGURING THE INSTRUMENT WITH SETPORTABLE on setting these levels).

2.7 STATUS SCREENS/ALARM RESET The right-hand unmarked button has two functions. As described above in the Alarms section, it may be used to reset alarms. If the button is pressed when the instrument is not in an alarm condition then the instrument displays a series of status screens, showing the following information in sequence. Press the unmarked button to move onto the next screen, and eventually back to the main instrument display of gas levels. Also, if the button is not pressed for 20 seconds the instrument will 'timeout' and return to the main gas reading screen.

The date, current time, and the time elapsed since instrument switch on is displayed.

Serial number and calibration due date is displayed.

Alarm 1 levels are shown for all sensors.

Short-term exposure levels are displayed for toxic sensors.

Long-term exposure levels are displayed for toxic sensors.

Currently selected user and site are displayed.

2.8 SWITCHING OFF Provided the facility has not been denied with the SETTING UP function, the TRIPLE PLUS+ may be switched off by pressing the 'ON' button and the UNMARKED button simultaneously and holding them down for about half a second. This prevents accidental switch off through knocking the keypad.

3 SETTING UP

The TRIPLE PLUS+ has been designed to display as much or as little information to the actual user as is required by the controller of the equipment. On the one hand it is a four channel measuring instrument with continuous readout, on the other, a basic alarm only detector with status display and no way of switching it off. This section describes how to tailor the instrument to the application via the front panel buttons. The section on CONFIGURING THE INSTRUMENT WITH SETPORTABLE details other adjustments that may be made to the instrument configuration via a PC and the SetPortable software.

3 SETTING UP continued

3.1 MENU SYSTEM

The 'CAL' button is the means by which access to the SETUP menu is obtained. Pressing the button gives the following screen:

MENU EVENT LOG
<< >> QUIT LOG

The four buttons have above them a symbol or word: these are the 'soft key' functions currently assigned to that particular key. Pressing << or >> scrolls the top line left and right appropriately. Pressing the QUIT button returns the instrument to the normal gas readings screen, and pressing the UNMARKED button selects the menu option currently indicated by its soft key function. This will change as the display is scrolled.

The options available are:

EVENT	This marks an event in the data log. There is no menu beneath this option.
MENU	This selects the configuration menu. It is password protected, and described below
LOG	This selects the log menu, described below.

To pass the MENU password a 4 button sequence must be entered correctly within 5 seconds – counting the buttons 1 to 4 from left to right, the default password is 1, 2, 3, 4. This password can be changed via a PC and the SetPortable software.

Within the LOG and MENU selections, the method of choosing and changing an option is the same: Use the two left hand buttons to scroll the top line of options left and right, the third button (labelled QUIT) takes the instrument back to the gas measurement screen, the fourth button is labelled with the menu selection. Selecting this takes to user down to another level where an actual configuration parameter is viewed and the option may be changed.

To change an option, use the first two keys, labelled with the << and >> symbols, to change the current selection, and the third key (labelled QUIT) to finish changing the selection. If the QUIT button is pressed and the parameter has been modified then the user is prompted with a save changes message. Two keys are soft key function labelled, one with YES and one with NO. Press the desired button.

For example, the user may be viewing the following portion of the menu system:

DISPY ALARM ZERO PUMP

And the keys will be labelled (left to right) with the following soft key functions:

<< >> QUIT PUMP

Pressing the left arrow will change the display to:

ALARM ZERO PUMP START
<< >> QUIT START

Pressing the unmarked button, labelled with the soft key function START will allow viewing and editing of the START option. The display will become:

START : ZERO & LOG
<< >> QUIT

If this selection is correct, press the QUIT key and the menu system will move up a level. Pressing the first two keys moves through the various options. When the correct option is being viewed press the QUIT button. The display will become:

Save the changes made?

YES NO

Press the first button to save the change and move the menu back up a level, and the last key to leave the selection as it was (unchanged) and move back up a level.

The menu system has timeouts on all operations. If no keys are pressed within about 20 seconds the system steps back one level at a time. Changes that have been accepted by pressing YES to the save changes prompt are retained. Any change that has not been explicitly saved will be lost.

The following parameters are modifiable via the instrument front panel buttons, and are displayed on the screen in the following order:

ZERO FLAMM LEVEL PUMP CALIB DISPY ALARM START BUTTN TIME OFF LIGHT

3.2 CONFIGURATION OPTIONS

LIGHT Configures the backlight timeout option to be NEVER TIMEOUT, 10 MINS., 20 MINS., 30 MINS., or ALWAYS ON. Whatever option is selected, the backlight will always come on when the instrument is in alarm.

DISPY Display mode. Configures the instrument display mode, with one if the following options: Normal, Average, Off, TWA Toxic, Peak Hold. These are as described in the OPERATION section above. Note the action of the BUTTN option below.

ALARM Alarm mode. User can select one of the following: ALL ACTIVE, TWA ONLY, INSTANT.

Within this option, the instrument may be set up to acknowledge different toxic gas alarm types. INSTantaneous mode sets the instrument to alarm as soon as threshold toxic gas level is reached.

TWA mode will cause the instrument to ignore temporary excursions above instantaneous alarm thresholds but to go into alarm instead when the SHORT TERM or LONG TERM exposure levels have been reached. ALL ACTIVE enables both TWA and instantaneous alarm types but allows the user to silence instantaneous alarms (see OPERATION).

'ZERO' When this option is selected, the instrument will give the prompt **'ZERO ALL?'** Only if you are sure that the instrument is in fresh air and all sensors have settled down to a steady output should YES be pressed. The TRIPLE PLUS+ then calculates offset correction and gain factors necessary to make toxic and flammable gas channels read zero and oxygen channels read 20.9%. Following a successful zeroing, there is the option to END the set up and return to metering, or to CONTinue with setting up.

PUMP Turns the pump on and off. Options are GO and STOP.

START Selects functions to be enabled at start up (instrument switch on). Options are: NOTHING, ZERO, LOG, ZERO & LOG. ZERO enables the option of zeroing the sensors at start, as per the zero all option above – the prompt to zero the sensor will appear several seconds after start up (to give the sensors time to settle) and will timeout (without performing a zero) if the YES button is not pressed within about 5 seconds. LOG enables data logging at start up, and ZERO & LOG enables both zero and data logging at start up. Select NOTHING to disable zero and logging at start up.

BUTTN The left-hand button can be programmed to perform various functions when the instrument is in normal gas measurement mode. The options available are: NOTHING, PUMP, PEAK, TWA TOXIC, AVERAGE, NORMAL. NOTHING means all special functions on the button are disabled. PUMP allows the pump to be switched off and on without having to enter the menu system to perform this action. PEAK, TWA TOXIC and AVERAGE are as per the DISPY functions. Pressing the button when one of these options is selected will toggle the display mode between that set on the button and that set in the DISPY setting. NORMAL serves a similar function. If the DISPY mode has been set to something other than NORMAL then NORMAL allows the display mode to be toggled from that set in the DISPY option to the normal gas display. Note that these display functions have no effect if the DISPY mode is set to OFF, and that the instrument will always start up in the display mode set by the DISPY function. If the **MUTE** function is enabled then a SILENT ALARMS option will also appear as one of the possible selections in the **BUTTN** menu. This option allows the programmable button to toggle the **MUTE** feature between SILENT ALARMS and AUDIBLE ALARMS. Note that when SILENT ALARMS is selected no audible siren will sound when the instrument is in alarm, nor will the alarm light flash. There will be a visual indication of the alarm condition on the instrument's display.
When the programmable button is pressed the instrument will issue a double bleep sound as an audible confirmation that a feature has been selected or de-selected.

FLAMM This selects the flammable gas correction to be used for flammable (pellistor) sensors. It may be set to NO CORRECTION or to one of the gases defined in the flammable correction table. If a gas is selected, then this will change the name on the display and

use the selected correction factor for pellistor sensor modules. The exact list of gases and their corrections is configurable via a PC and the SetPortable software. The default of gas correction factors for flammable gases with respect to methane and pentane are listed in Appendix 2.

Note that if no table has been downloaded into the instrument then no correction factor can be selected (the only option is NO CORRECTION), and that it is possible for a table containing less than the full 12 corretion factors to be loaded into the instrument.

CALIB This allows re-calibration of the instrument, which must first have been ZEROed in clean air. You will need the TRIPLE PLUS+ aspirator and a supply of Crowcon calibration gas (see Maintenance and Calibration). The top line now displays one of the instrument's gas channels. This display will look like:

CALIBRATE: CH4 (Chan.1)
<< >> QUIT CAL

Use the first two keys to select the required gas. Press QUIT to move back up a menu level, or CAL to select the gas to calibrate. The display will now change to:

CALIBRATE: CH4 = 0
UP DOWN QUIT CAL

It is the actual gas reading being displayed on the top line, and should go up when the relevant TEST GAS is aspirated over the sensors. When the reading has stabilised use the UP and DOWN keys to make the reading match the known test gas concentration. Now press CAL to actually calibrate the instrument's gain. QUIT can be pressed to abandon the calibration. If the instrument is calibrated, it will either respond with CAL SUCCESSFUL or CAL FAILED. If the calibration failed the instrument's gain is not changed, and means that either the gas concentration was not equal to the value set (check both and repeat) or that the sensor has deteriorated with use (see Maintenance and Calibration for sensor replacement).

When a calibration is being performed with a gas from a pressurised source (e.g. a gas cylinder) the pump should be switched off on pumped units.

Note that when calibrating flammable sensors they will always appear in the **CALIB** menu as the sensor type they really are without any flammable correction factor applied. They should also be calibrated as per the gas they really are, and not as per the gas selected as a flammable correction factor. For example, if there is CH4 (methane) sensor in an instrument, and a flammable correction facor is applied so that the instrument reads PRO (propane) then the sensor would be selected as the CH4 (and not PRO) in the **CALIB** menu and methane used to calibrate the sensor.

TIME Selecting this will give a display of the form:

CURRENT TIME: 21:48:00

HOUR MINUTE QUIT

Press the key labelled HOUR to increment the hours and the key labelled MINUTE to increment the minutes until the correct current time is displayed

OFF Two options: OFF ENABLED, OFF DISABLED. Determines whether the instrument can be switched off.

MUTE If the mute function is enabled (which can only be done via SetPortable, see section 3.5 Configuring the Instrument with SetPortable) then a **MUTE** option will appear within the the menu system. This option can be selected as either SILENT ALARMS or AUDIBLE ALARMS. If SILENT ALARMS is selected then the word MUTED will flash on the main display with the gas units and name, no audible alarm will sound when an alarm is triggered, nor will the alarm LED will flash. There will be a visual indication of the alarm condition on the instrument's display. Note that this option will be ignored when the instrument's display mode is selected as OFF.

LEVEL This option displays and allows modification of alarm 1 for flammable L.E.L. channels. Use the two keys labelled on the display as UP and DOWN to adjust this alarm level between 1.0% and the level set for alarm 2.

Note that Crowcon does not generally recommend that alarm levels be set to a level that is less than 5% of the sensor's range because of the possibility of spurious alarms being triggered.

The **LOG MENU** acts similarly to the **MENU** system just described. Options are:

START or **STOP** One of these two options is displayed depending on the current state of the data logger. Press START to turn data logging on, and STOP to turn logging off.

USER Allows selection of a user name, which is used in the data log (see later). The act of changing the user is an event which is logged by the data logger.

SITE As user, but site location.

3.3 QUICKCAL

The instrument has the ability to perform a 'quick calibration' of four gas channels: CH4; CO; H2S and O2 in 'one go'. The system prompts the user through the procedure. Before QuickCal is initiated, the instrument should have been zeroed. Now follow this procedure:

Press both of the middle 2 buttons, and hold them down for 5 seconds. The instrument will announce that the QuickCalibration has been initiated, and remind the user that the instrument should have been zeroed before this procedure is invoked.

The instrument will now alternately flash the gas concentrations it is expecting to be applied and the prompt CALIBRATE ALL INPUTS, with the two outer keys labelled with YES and NO. Pressing YES moves on in the QuickCal sequence, NO abandons the QuickCal and the instrument returns to the normal gas monitoring screen.

The instrument will now issue the prompt Is gas on sensors? with the two outer keys labelled YES and NO as before. Ensure the correct test gas is applied to the instrument, and press YES. Pressing NO returns the instrument to the normal gas monitoring display.

If YES is pressed the display will change to SENSORS SETTLING, with a line of dots appearing on the bottom line of the display to indicate the instrument is working. The instrument will now wait until there appears to be a good steady flow of gas, and then the calibration will be performed. If the instrument perceives that the gas level is not steady then the message Gas not stable! will be displayed and the calibration aborted.

If all channels are successfully calibrated the instrument will display the message Calibration successful, otherwise the message Calibration failed! with the list of gases that failed the calibration displayed.

When performing a calibration with a gas from a pressurised source, the instrument's pump (if present) should always be turned off.

3.4 PELLISTOR SAVING

To avoid the pellistor sensor being damaged by exposure to excessive levels of flammable gas, it is protected automatically. Pellistor saving may be triggered in two ways: On dual range flammable instruments (i.e. those with a pellistor measuring LEL and a thermal conductivity block measuring % volume) a percentage volume of gas may be specified at which the pellistor will be switched off. This percentage is configurable by computer using the SetPortable software, and is 5% by default.

Additionally, a pellistor will switch itself off if it reaches a reading of 105% LEL or more – this action will happen irrespective of whether a % volume sensor is also fitted. If a pellistor switches itself off then it will stay off until it is manually switched on. This happens by pressing the unmarked button. The pellistor will warm up for 5 seconds before the pellistor channel will read.

Pellistor saving is indicated on the display by the gas level being blank for the flammable block.

3.5 CONFIGURING THE INSTRUMENT WITH SETPORTABLE

The following configuration settings may ONLY be set via SetPortable. The function of these parameters is explained here. See the SetPortable documentation for details of how these parameters are accessed and modified. Note that SetPortable also allows the parameters configurable via the front panel to be configured via a PC.

CONFIDENCE BLIP The green LED will always flash once every three seconds. This option determines if an audible blip is also made.

LOG PERIOD Allows setting of the data logging period, anywhere from 1 second to 24 hours. See section on data logging for description.

S.T.E.L. TIME The short term exposure limit (S.T.E.L.) averaging period, set between 5 and 15 minutes. 15 minutes is the UK standard.

SYSTEM TIME AND DATE Instrument time and date.

CALIBRATION DUE Sets the date at which the Calibration due warning message will appear at instrument start up.

USER AND SITE STRINGS The actual text associated with the 10 user and site names may be set via SetPortable. The information, once set, appears in the log menu.

VOLUME RANGE Set the volume of gas used by flammable volume channels to turn off flammable (LEL) channels (for Autoranging units only).

PASSWORD Allows the menu password to be changed from the default of 1 2 3 4.

CHANNEL NAME AND UNITS This is the text used for the gas readings display. It may be set via SetPortable.

FLAMMABLE CORRECTION DATA The name associated with a correction factor, and the actual correction factor itself may be modified.

INSTANTANEOUS ALARM LEVELS The gas level at which instantaneous alarms are triggered. This configuration data is available for all sensor channels with sensors having 3 rising alarm levels, except oxygen which has 2 falling and 1 rising alarm level.

SHORT AND LONG TERM ALARM LEVELS These parameters are only available for toxic channels, and set the level at which an exposure limit alarm will be triggered.

ALARM MUTE The mute function can be enabled. When this feature is enabled it is possible to access the MUTE parameter in the instrument's menu system and to mute alarms. Without enabling the Alarm Mute feature via SetPortable the MUTE function is not available.

OVERRANGE OPTION This selects the instrument's action when a sensor goes overrange. See section 2.3, Overrange.

ZERO OPTION By default, the ZERO option is in the passworded section of the configuration menu. It is possible to change the location of the ZERO option, and have it placed at the very top of the configuration system. If this is done, then pressing the CAL button will bring up the following list of options:

MENU EVENT LOG ZERO

QUICKCAL GAS MIXTURE The exact concentrations of gas in the multi-gas mixture being used with the quick calibration may be set here.

4 BATTERY CHARGING

The built-in CROWCON battery pack consists of a rechargeable lead acid battery pack. It has sufficient capacity to power the instrument for 12 hours with one flammable, one oxygen and two toxic gas sensors installed. Full recharge from flat is accomplished in 4 – 6 hours.

Using the TRIPLE PLUS+ CHARGER/INTERFACE:— locate the battery pack or the complete instrument in the charger housing (sprung contacts ensure connection), and observe that the red power LED glows more brightly. An overnight charge is convenient to ensure usability every day.

The Charger/Interface also allows communication between the instrument and a computer.

Using the TRIPLE PLUS+ CHARGING UNIT:— locate the instrument (do not switch it on), in the charger housing and observe that the charging indicator LED glows. A discharged instrument will draw current at the standard rate, indicated by the LED glowing red. As the battery approaches full charge, the current drops to the trickle rate and the LED switches to green. An instrument may be left at the trickle charge rate indefinitely, or removed for use. NOTE, full battery capacity may only be available after several complete discharge/recharge cycles.

The chargers are supplied with a mains lead for connection to a 110-240V, 50-60Hz supply. Connect brown – live, blue – neutral, green/yellow – earth.

For DC charging (12-40V), an optional lead is available incorporating a plug for a vehicle cigarette lighter socket. An optional interconnecting mains lead joins charger/interface units together for connection to a single outlet.

If the instrument is to remain unused for a length of time, it should be charged prior to the period of storage.

5 DATA LOGGING

The data logging aspect of the instrument can be configured to be active when the instrument is switched on by the START menu option. Additionally, the instrument records events (such as alarms) and an event will cause the logger to be switched on.

Data is logged for all gas channels at a rate set by the log period, which is configurable via SetPortable. For each channel, the maximum level (minimum in the case of oxygen) is recorded since the last reading was taken and stored in the log. Thus, even if the log period is set to 10 minutes (for example) and a brief gas hazard occurs, it will not be missed by the logger. Logged data is retained in battery-backed memory when the instrument is turned off. When the memory is filled, the new data over-writes the oldest.

A log is extracted from the instrument and saved as a file on the computer via the SetPortable software. LogManager is then used to inspect the log. See the separate documentation for these two pieces of software for additional details.

The instrument notes the following events in the log along with a note of the channel the event is associated with (if appropriate):

Log switched on – either from front panel or by event trigger
Log switch off – either front panel or by instrument switch off
Sensor channel overrange
Instantaneous alarm 1
Instantaneous alarm 2
Instantaneous alarm 3
Short term exposure alarm
Long term exposure alarm
User triggered event (from the instrument front panel)
Change of user (from the front panel)
Change of site (from the front panel)

The instrument is capable of storing just over 6300 data logs for all channels. Events take the space of 2 logs.

6 TROUBLESHOOTING GUIDE

SYMPTOM	DIAGNOSIS	REMEDY/CHECK
Does not switch on	**battery flat**	**recharge battery**
Does not switch off	**OFF disabled**	**alter configuration***
No audible tick	**tick disabled**	**alter configuration***
Alarm signals, no gas	**alarm latched**	**reset with unmarked button**
Flashing red alarm, Sounder silent	**INST toxic alarm accepted**	**reset if possible, check configuration***
Gas reading, no gas	**zero drifted**	**zero instrument***
Unstable/inaccurate reading	**sensor failed**	**recalibrate or replace sensor***
Loading Defaults message on display screen	**back up battery is discharged**	**recharge unit overnight switched on in charger, then re-configure and recalibrate.**

***See SETTING UP or CONFIGURING THE INSTRUMENT VIA SETPORTABLE**
**** see MAINTENANCE AND CALIBRATION**

7 MAINTENANCE AND CALIBRATION

Crowcon recommends monthly gas response checks and a recalibration interval of 6 months. Flammable sensors will respond to hydrogen and most hydrocarbons but will only be calibrated for a specific gas, typically methane.

7.1 RECALIBRATING Read about the 'CALIBRATE?' option in SETTING UP and the CALIBRATE function in SetPortable as either method may be used to adjust gain values, but a knowledge of both is helpful. Zero the instrument in fresh air. Locate the aspirator flowhead under the ledge above the sensor panel and secure with the half-turn fasteners. Starting with flammable gases and moving on to toxic, connect the cylinder of TEST GAS to the inlet of the flow head via a flow meter. Direction of flow is marked on the flowhead. Adjust the control valve on the flow meter to achieve a flowrate of 0.5 litre/min. Wait until the reading has stabilised on the TRIPLEPLUS+ display before programming in the new level. Now shut off the valve and disconnect the supply of TEST GAS. Aspirate fresh air through the flowhead using the rubber bulb until the reading has returned to zero. If there are signs of cross sensitivity between two or more sensors, wait for all readings to settle before proceeding with calibration of other channels

7 MAINTENANCE AND CALIBRATION - continued

7.2 CHANGING THE BATTERY PACK Unscrew the tamperproof screw which retains the battery hatch using a 2mm Hex. key. Remove the hatch and tip the battery pack out. Disconnect the spade terminals. When refitting, be sure to observe the correct polarity; red wire to positive, black to negative. Replace the battery pack and hatch and secure with the tamperproof screw. Alternative batteries should not be used because they will invalidate approvals and may impair performance.

7.3 REPLACING A SENSOR MODULE Disconnect the battery pack. Unclip the shoulder strap and remove the two upper case fixings with a 3mm Hex. key. Lift the lid assembly from the base and lay the instrument on its side, lid face down. Remove the two lower case fixings, split the halves and lay them alongside the lid. All circuit boards should now be facing up. Identify the sensor module to be replaced and disconnect the flexible pcb from it by lifting the shroud from the header and pulling gently on the tail. Remove the two Pozi-drive screws and the old sensor module. Remove the old gasket/membrane assembly. Fit the new components according to a reverse of the above procedure ensuring that the shroud is pushed home over the header to grip the flexible pcb tail securely. Fit the lower case shells together ensuring that the strap pins and captive nuts are located in the recesses of the side flanges, and that the gasket strip has not been displaced. WARNING, if the nuts are slightly rotated and not sitting deep in the recesses, the case halves will be wedged apart allowing moisture to enter the instrument. Taking care not to trap any of the leads, push the lid back onto the base and secure with the fasteners. Reconnect the battery pack.

TRIPLE PLUS+ sensor modules are supplied precalibrated from the CROWCON factory and will identify themselves to the instrument when it is switched on. It is advisable to check the response to TEST GAS to ensure that no damage has occurred in transit and that installation has been carried out successfully.

If any further maintenance is required, the instrument should be returned to CROWCON or a Crowcon Service Agent.

8 LIMITATIONS TO USE

	LONG TERM STORAGE LIMITS		OPERATING LIMITS	
	min	max	min	max
TEMPERATURE	0° C	20°C	-10°C	50°C
PRESSURE	900mbar	1100mbar	900mbar	3bar
HUMIDITY (non condensing)	15%RH	90%RH	0%RH	90%RH

INGRESS PROTECTION – IP65

9 ACCESSORIES FOR TRIPLE PLUS+

Carrying case and belt	C01297
Aspirator probe (1 metre long)	C01097
Extra aspirator hose (to extend normal 2 metre length)	M04032
Aspirator and pouch	C01685
Autocalibrator II*	C01552
Water trap	C01245
Computer interface lead 9 way	C01327
Computer interface lead 25 way	C01295
Charging lead for vehicle cigarette lighter socket	C01296
Baffle plate (to protect sensor apertures)	C01325
Charger 12-40VDC no power pack	C01546
Charger and UK 230V power pack	C01547
Charger and EU 230V power pack	C01548
Charger and US 110V power pack	C01549
Charger Interface II - UK	C01436
Charger Interface II - USA	C01437
Charger Interface II - Europe	C01438

*Supplied with interface lead, requires PC and charger/interface. Suitable for use with OX/H2S/CO/SO2/CH4/Pentane. Consult Crowcon for others.

10 SPARES

Membrane switch protector (sheet of 2)	M05364
Carrying strap	C01323
Main PCB	S01884
Safety component PCB	S01994
Sounder	S01261
Battery pack	C01253
Sensor assemblies:-	
0 – 100% LEL methane/flammable	S01238
0 – 100% vol methane	S01423
0 – 50 ppm hydrogen sulphide	S01240
0 – 500 ppm carbon monoxide	S01241
0 – 10 ppm sulphur dioxide	S01242
0 – 5 ppm chlorine*	S01829
0 – 10 ppm nitrogen dioxide*	S01244
0 – 100 ppm nitric oxide	S01245
0 – 25% vol oxygen, 1 Year sensor	S01849
0 – 25% vol oxygen, 2 Year sensor	S011157
0 – 10ppm hydrogen chloride*(sens)	S01724
0 – 25ppm hydrogen cyanide(sens)	S01725
0 – 50ppm ammonia (sens)	S01726
0 – 2000ppm hydrogen	S01250
0 – 1ppm ozone*	S01251
0 – 2ppm phosphine	S01252
0 – 100ppm volatile organics**	S01253
0 – 10ppm ethylene oxide	S01254
0 – 10ppm hydrogen fluoride(sens)	S01832

*Readily absorbed gases – they will not be detected if an aspirator or hose are used and are unsuitable for use in pumped instruments.

**This broad range sensor has a high level of cross sensitivity and it can be used to monitor many gases.

For additional spares please contact Crowcon

11 APPENDIX 1 - Pumped version (optional)

The internal pump, when used in conjunction with the external aspirator flowhead and sampling tube, enables the TRIPLE PLUS+ to monitor inaccessible atmospheres. It offers a consistent flowrate and is not fatigued, unlike the manual hand bulb.

The pump mode may be defined within the calibration menu to be either pump GO or STOP. This enables the instrument to be used in either pumped or diffusion monitoring mode. See the SETTING UP section above for details on how this can be configured. Additionally, it is possible to control the pump via the programmable button as described in section 3.2, Configuration Options.

If the STOP pump mode is selected the pump will not run, and the aspirator flow head and tubing must be removed to enable gas to enter the sensors by diffusion.

If the GO pump mode is selected the pump will now run and the aspirator flowhead should now be fitted. Ensure that flexible tubing connects between the pump inlet nozzle on the side of the instrument and the outlet ('BULB' side) of the flowhead. The sample tube should be connected to the 'INLET' side of the flowhead.

The pump mode is remembered while the instrument is switched off.

On increasing the length of the sample tube, the response time will be affected and some gases may be absorbed, e.g. chlorine. Add approximately 1.5 seconds per metre of sample tube for gas to reach the instrument (4mm I.D. tube). Be careful not to suck water or dust into the instrument, and avoid kinking the sample tube. If the flow is blocked for any reason, the pump is automatically stopped, and the warning message PUMP FLOW FAIL appears on the display. Attend to the blockage and then restart the pump by pressing the right hand button. (The Crowcon Water Trap may be used when there is the danger of water ingress). The pump draws power from the Triple Plus+ battery pack and so reduces the operating time between recharge. With one flammable sensor installed, the battery life will be around 9 hours, compared to 12 hours without the pump running.

When the instrument is being calibrated from a pressurised gas source, the pump should always be switched off.

12 APPENDIX 2 – Default Flammable Correction Factors

Gas	Correction with respect to methane	Correction with respect to pentane	3 character name
Pentane	2.0	1.0	PEN
Methane	1.0	0.5	CH4
Butane	1.7	0.9	BUT
Propane	1.4	0.7	PRO
Hydrogen	0.9	0.5	H2
Toluene	2.7	1.4	TOL
Ethanol	1.6	0.8	ETH
Petrol Vapour	2.5	1.3	PET
Ammonia	0.7	0.4	NH3
Methanol	1.3	0.7	MTL
LPG	1.4	0.7	LPG
Propanol	2.0	1.0	PRL

Note that these correction factors apply to VQ32 pellistor sensor modules. The factors only apply to the TriplePlus+ and may differ if an alternate sensor module is fitted to the instrument.

13 APPENDIX 3 – Front Panel Text Items

This Appendix lists all the possible values the front-panel configuration parameters may take.

Top level configuration items – accessible by pressing the CAL button:

Text	Description
MENU	Enter configuration menu, passworded
LOG	Enter data logging menu
ZERO*	Zero all channels
EVENT	Mark event in the data log

*Only present at this level if so selected via SetPortable.

MENU level configuration items:

Text	Description/Options
ALARM	Select alarm mode: INSTANT, ALL ACTIVE, TWA ONLY
BUTTN	Select programmable button funtion: NOTHING, NORMAL, AVERAGE, TWA TOXIC, PEAK HOLD, PUMP, SILENT ALARMS
CALIB	Calibrate selected channel
DISPY	Select display mode: NORMAL, AVERAGE, OFF, TWA TOXIC, PEAK HOLD
FLAMM	Select flammable correction factor: NO CORRECTION, …
LEVEL	Allows setting of flammable alarm 1, 1% L.E.L. and alarm 2 level
LIGHT	Select backlight timeout: ALWAYS ON, NO TIMEOUT, 10, 20 or 30 MINUTE TIMEOUT
MUTE	Select SILENT ALARMS or AUDIBLE ALARMS
OFF	Select instrument switch off mode :OFF ENABLED, OFF DISABLED
PUMP	Pump on or off: GO, STOP
START	Start up options: NOTHING, LOG, ZERO, ZERO & LOG
TIME	Allows edit of instrument time (hours and minutes)
ZERO*	Zero all channels

*Only if not selected to be at the higher level (via SetPortable).
**Only if MUTE function enabled (via SetPortable).

LOG level configuration items:

Text	Description/Options
START*	Start data logging
STOP**	Stop data logging
SITE	Select site: Site 1, Site 2, …. Or string programmed via SetPortable
USER	Select user: User 1, User 2, ...Or string programmed via SetPortable

*This option is only present if the logger is currently stopped.
**This option is only present if the logger is currently on.

14 APPENDIX 4 – Sensor Limitations

Standard TriplePlus+ units detect flammable gases using a catalytic flammable sensor which operates in the presence of oxygen. It is advisable to check the oxygen concentration as well as the flammable gas concentration before entering a confined space. 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 H_2S), lead or chlorine compounds (including chlorinated hydrocarbons).

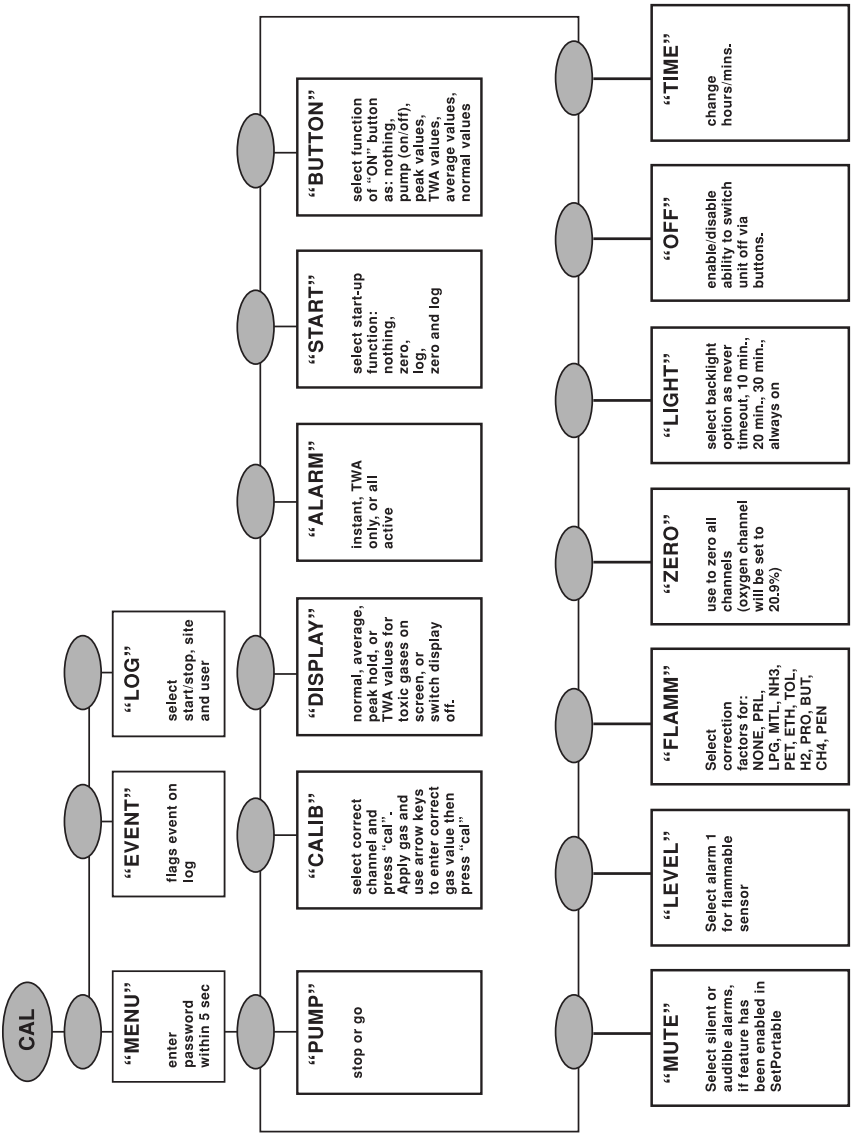
The instrument is not suitable for use in ambient temperatures above 50°C and electrochemical toxic gas sensors may be degraded at these temperatures.

Water should not be allowed to collect on the sensors as this may impede gas diffusion. Use with care in wet or humid environments where water may condense on the sensors, and check response after use.

Persistent exposure to high levels of toxic gas can shorten the life of toxic sensors. Toxic sensors may also be cross-sensitive to gases other than their specific target gas, and hence the presence of other gases may cause the sensor to respond. If unsure, contact Crowcon or your local agent.

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

15 APPENDIX 5 – Menu Map



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