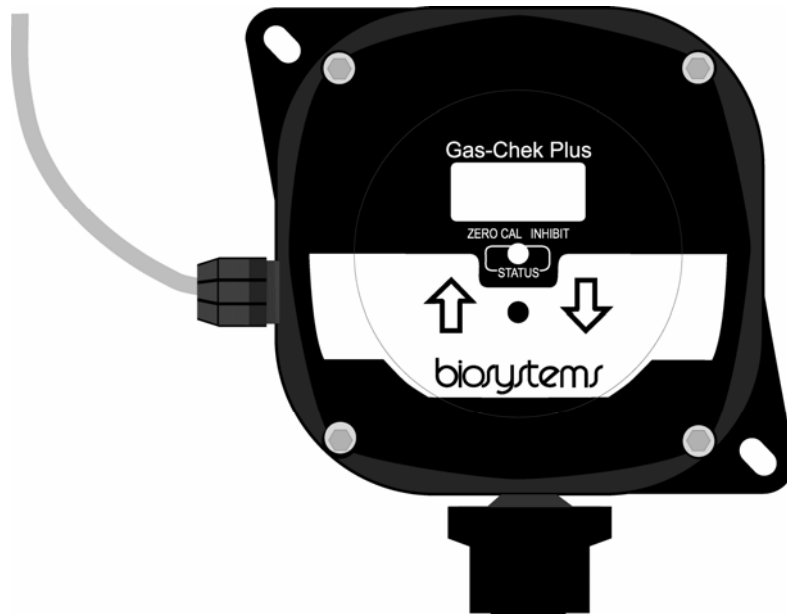


GasChek4 Mark II Fixed Gas Detection System Operations Manual



biosystems

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WARNING

THE GASCHEK4 MARK II MULTI-SENSOR FIXED GAS DETECTION SYSTEM HAS BEEN DESIGNED FOR THE DETECTION AND MEASUREMENT OF POTENTIALLY HAZARDOUS ATMOSPHERIC CONDITIONS.

IN ORDER TO ASSURE THAT THE USER IS PROPERLY WARNED OF POTENTIALLY DANGEROUS CONDITIONS, IT IS ESSENTIAL THAT THE INSTRUCTIONS IN THIS MANUAL BE READ, FULLY UNDERSTOOD, AND FOLLOWED.

**GasChek4 Mark II Operations Manual
Version 1.01
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651 South Main Street, Middletown, CT 06457**

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Signal Words

The following signal words, as defined by ANSI Z535.4-1998, are used in the GasChek4 Mark II Reference Manual.

 DANGER indicates an imminently hazardous situation which, if not avoided, will result in death or serious injury.

 WARNING indicates a potentially hazardous situation which, if not avoided, could result in death or serious injury.

 CAUTION indicates a potentially hazardous situation, which if not avoided, may result in moderate or minor injury.

CAUTION used without the safety alert symbol indicates a potentially hazardous situation which, if not avoided, may result in property damage.

Warnings and Cautions

1. **⚠️WARNING** The GasChek4 Mark II fixed gas detection system has been designed for the detection of dangerous atmospheric conditions. An alarm condition indicates the presence of a potentially life-threatening hazard and should be taken very seriously.
2. **⚠️WARNING** In the event of an alarm condition it is important to follow established procedures. The safest course of action is to immediately leave the affected area, and to return only after further testing determines that the area is once again safe for entry. Failure to immediately leave the area may result in serious injury or death.
3. **⚠️WARNING** Accuracy of the GasChek4 Mark II must be verified by exposure to known concentration calibration gas on a regular basis. A prudent schedule for verifying accuracy should be determined by using the following procedure: Initially, over a period of a few days, check the response daily to be sure there is nothing in the atmosphere which is poisoning the sensor. If these tests demonstrate that it is not necessary to make adjustments, the time between checks may be lengthened. This interval should not be lengthened beyond thirty days. Sensors should be replaced at two year intervals to minimize the risk of failure during the interval between sensor checks. Failure to check accuracy can lead to inaccurate and potentially dangerous readings.
4. **⚠️WARNING** The accuracy of the GasChek4 Mark II should be checked immediately following any known exposure to contaminants by testing with known concentration test gas before further use. Failure to check accuracy after a known sensor exposure can lead to inaccurate and potentially dangerous readings.
5. **⚠️WARNING** A sensor that cannot be calibrated or is found to be out of tolerance should be replaced immediately. An instrument that fails calibration may not be used until testing with known concentration test gas determines that accuracy has been restored, and the instrument is once again fit for use.
6. **⚠️WARNING** Use of non-standard calibration gas and/or calibration kit components when calibrating the GasChek4 Mark II can lead to inaccurate and potentially dangerous readings and may void the standard Biosystems warranty.

Customers are strongly urged to use only Biosystems calibration materials when calibrating the GasChek4 Mark II. Use of non-standard calibration gas and/or calibration kit components can lead to dangerously inaccurate readings and may void the standard Biosystems warranty.
7. **⚠️WARNING** For safety reasons this equipment must be operated and serviced by qualified personnel only. Read and understand this reference manual before operating or servicing the GasChek4 Mark II.
8. **⚠️WARNING** The combustible sensor used in the GasChek4 Mark II requires a minimum of 10% oxygen by volume in order to generate accurate combustible gas readings. Combustible sensor accuracy may be diminished if the instrument is used in oxygen-deficient atmospheres.
9. **⚠️WARNING** A rapid up-scale reading followed by a declining or erratic reading may indicate a hazardous combustible gas concentration that exceeds the GasChek4 Mark II's zero to 100 percent LEL detection range.
10. **⚠️DANGER** Hazardous voltages are present on exposed terminals in the GasChek4 Controller when the cover is open. Always disconnect the power supply before opening the controller.
11. **⚠️WARNING** The GasChek4 Controller must be located in a non-hazardous environment.

Chapter 1. Description

The GasChek4 Mark II is a microprocessor based fixed gas detection system designed to accept the input from 1 to 4 remotely located oxygen, combustible gas or toxic gas detector assemblies. Remote detector assemblies are available in explosion proof or non-explosion proof housing. Combustible sensors are only available in explosion proof sensor housing. The GasChek4 Mark II system is distinguished from the earlier version of GasChek systems by its use of the GasChek Plus remote sensor head assemblies.

Standard features include:

- Built-in digital readouts at both the controller and remote detector
- Two independently adjustable gas alarm set-points per channel
- Built-in audible alarm (at the controller)
- Bright channel-specific LED alarm light indicators for fault, low and high alarm conditions
- Channel specific relay contacts (rated 5A at 250V non-inductive load) for low and high gas alarms.

The GasChek Controller is designed for operation via 110/220/240 VAC 50-60 Hz or 12 or 24 VDC power, and includes an internal 12V sealed lead acid battery backup power supply.

Each GasChek4 Mark II system includes a controller with all standard alarms, relays and electronics installed in a NEMA 4X fiberglass housing. Remote detector assemblies include the appropriate input and alarm modules for the sensor specified (installed in the controller housing), remote sensor housing, and sensor. The GasChek4 system can be expanded easily. Additional remote detector assemblies (up to a maximum of 4 channels) can be added to the system at any time.

Note: Conduit, wire and other components necessary to connect the remote detector assembly with the instrument controller are not included and must be ordered separately.

The GasChek4 Mark II can be easily customized to meet specific customer requirements. This chapter discusses some of these special features as well as basic capabilities used on a day-to-day basis.

1.1 Method of sampling

Once it has been connected to a power source, the GasChek4 system continuously monitors readings from all remote detector assemblies (up to a maximum of 4) that are currently installed. Each installed remote detector is referred to as a “channel” of detection. The remote sensor assemblies are located in the area to be monitored. The atmosphere being measured reaches the sensor by diffusing through a protective filter into the sensor. Normal air movements are enough to carry the sample to the

sensors. The sensors react to changes in the concentration of the hazard being measured. Values are constantly updated and displayed on both the GasChek Plus remote detector assembly LCD and the GasChek4 Controller LED readouts.

⚠WARNING The GasChek4 Controller must be located in a non-hazardous environment.

The maximum distance between the remote sensor housing and the controller housing is a function of the type of sensor, gauge of wire used to connect the elements of the system, and the overall loop resistance of the remote sensor housing/wire combination.

1.2 Sensor options

GasChek4 systems can be configured to monitor for a number of different atmospheric hazards. The hazards the system is configured to detect are determined by the type of remote detector assemblies that have been installed. The types of sensors currently available include catalytic-bead pellistor for LEL combustible gas, galvanic oxygen (O₂), and substance-specific electrochemical sensors for the detection of carbon monoxide (CO), hydrogen sulfide (H₂S), sulfur dioxide (SO₂), chlorine (Cl₂), and nitrogen dioxide (NO₂). Oxygen readings are given in percent-by-volume, combustible gas readings in percent LEL, and toxic gas readings in PPM (parts per million) or 0.1 PPM increments.

Sensor	Range	Type
Oxygen (O ₂)	0–25%/Vol.	Oxygen
Combustible	0–100% LEL	LEL (Lower Explosive Limit)
Carbon monoxide (CO)	0–500 PPM	Toxic
Hydrogen sulfide (H ₂ S)	0–100 PPM	Toxic
Sulfur dioxide (SO ₂)	0–10 PPM	Toxic
Chlorine (Cl ₂)	0–10 PPM	Toxic
Nitrogen dioxide (NO ₂)	0–10 PPM	Toxic

1.3 Calibration

GasChek4 Mark II systems have been designed for easy verification of accuracy.

⚠WARNING Accuracy of the GasChek Plus remote detector assemblies must be verified by exposure to known concentration calibration gas on a regular basis. A prudent schedule for verifying accuracy should be determined by using the following procedure: Initially, over a period of a few days, check the response daily to be sure there is nothing in the atmosphere that is poisoning the sensor. If these tests demonstrate that it is not necessary to make

adjustments, the time between checks may be lengthened. This interval should not be lengthened beyond thirty days. Sensors should be replaced at two year intervals to minimize the risk of failure during the interval between sensor checks. Failure to check accuracy can lead to inaccurate and potentially dangerous readings.

Verification of remote detector accuracy is a two step procedure for toxic and LEL sensor-equipped remote detector assemblies, and a one-step procedure for oxygen sensor-equipped remote detector assemblies.

Calibration normally begins by exposing the GasChek Plus remote detector assembly to "fresh air" and checking the readings. If the readings differ from those expected in fresh air (20.9% oxygen, 0 PPM toxic, 0% LEL combustible gas), a "fresh air zero" adjustment must be made. The second step, which only applies to toxic and LEL sensors, is to verify sensor accuracy by exposing it to known concentration test gas and noting the response. Toxic and LEL readings are considered accurate if the readings are within 10% of the expected value as given on the gas cylinder. If readings are accurate, then the instrument requires no further adjustment. Toxic and LEL readings that are off by more than 10% of the expected value are considered inaccurate and indicate that the sensitivity of the sensor must be "span" adjusted before further use.

Calibration procedures are discussed in detail in Chapter 3.

1.4 Displays and controls

The GasChek4 Controller includes a red 3 digit, 7 segment LED readout used to display readings for all installed (1-4) channels of gas detection, and a channel specific 3½ digit LCD located at each remote detector housing.

GasChek4 Controllers include several other system status and alarm state indicators. Green LEDs are provided to indicate power and backup battery status, a "C" plus digit (1-4) to indicate the channel for which readings are currently being displayed, and a measurement units indicator (PPM, % LEL, % volume). In addition, channel-specific red LEDs are provided for "warning" (low) and "danger" (high) gas alarms; and amber for fault for each remote detector assembly installed.

Four push-button controls are also located on the controller housing: "Lamp Test", alarm "Accept / Reset", "Hold", and "Run". The Lamp Test button is used to verify the proper function of the controller readout and LED indicators. Pressing the Lamp Test button causes the illumination of all properly operating indicator lights and display segments on the GasChek4 Controller.

The Accept / Reset button is used to silence the alarms and reset the system alarms after an alarm state has cleared. (A more detailed discussion of which alarms are cleared under what circumstances by means of the Accept / Reset switch is contained in **Section 1.6.3.**)

The "Hold" button is used to "lock" the digital controller readout onto a specific channel.

The "Run" button is used to return the system to the normal mode of operation. During normal operation readings are shown sequentially for each channel of detection installed. A green "C" plus a digit (1-4) indicates the channel for which readings are currently being displayed. As an example, "C1" would indicate that the readings currently displayed are for the remote detector assembly installed in channel 1 of the GasChek4 system.

1.5 Gas Alarms

⚠WARNING The GasChek4 Mark II gas detection system has been designed for the detection of dangerous atmospheric conditions. An alarm condition indicates the presence of a potentially life-threatening hazard and should be taken very seriously.

In the event of an alarm condition it is important to follow established procedures. The safest course of action is to immediately leave the affected area, and return only after further testing together with other appropriate safety procedures determine that the area is once again safe for entry.

There are two levels of gas alarm for each channel, "Low" (warning) and "High" (danger). The alarms can be configured as either "ascending" (activated when gas readings exceed the alarm concentration threshold), or descending (activated when gas readings drop below the alarm threshold). Combustible and toxic alarms are normally configured as "ascending" alarms. Oxygen alarms are normally configured as "descending".

In the case of oxygen detector assemblies used to monitor for oxygen deficiency, both the "Low" (warning level) and "High" (danger level) alarms are normally configured as "descending" alarms. Typically the "Low" (warning) alarm is activated if the oxygen concentration drops below 19.5%, while the "High" (danger level) alarm is activated if the oxygen concentration continues to drop below 18%.

Note: Alarm levels are set at the factory and require specialized equipment for modification. If you need to change the alarm level for any of the channels, call Biosystems at the phone number on the front of this manual for further instructions.

1.6 Relays and outputs

GasChek4 Mark II systems include the following relays and outputs:

1.6.1 Channel-specific relays and outputs

Each detector channel includes a channel specific fault indicator LED (at the controller), and low and high gas alarm DPDT relays - contacts rated 5 Amp at 250 VAC, non-inductive load. Each channel also includes a user configurable analog output (1-5 Volt or 4-20 mA) which may be used for communication with external data

acquisition equipment such as strip-chart recorders or dataloggers.

1.6.2 Common relays and outputs

GasChek4 Mark II systems also include “common” fault, low and high alarm DPDT relays - contacts rated 5 Amp at 250 VAC, non-inductive load. Common relays are triggered by activation of one or more of the channel specific relays of the same category. For instance, conditions which cause the activation of the channel specific low gas alarm (for any channel) will cause the activation of the common low gas alarm relay as well.

1.6.3 Alarm / relay operation

If the gas concentration causes the activation of the warning level alarm at the controller, the channel specific low level alarm LED illuminates, and both the channel specific low alarm relay and the common low alarm relays are activated.

If the gas concentration causes the activation of the danger level alarm, the channel specific high level alarm LED illuminates, and the channel specific high alarm relay and common high alarm relays are activated.

GasChek4 alarms are normally of the “latching” type, and will continue to sound even after readings drop back below the pre-set alarm levels. Depending on which relays have been activated, and whether or not the alarm condition has actually cleared, the “accept / reset” button may be used to silence the alarms and reset the system.

Table 1.6.3. shows the relays that are deactivated under the specified circumstances when the accept / reset button is pressed. (If the alarm condition has already cleared at the time the accept / reset button is pushed, all relays are reset; if the alarm condition has not cleared, only the “common” relays are deactivated.)

Type of relay	Gas or alarm condition has cleared	Gas or alarm condition still present
Common low	Deactivated	Deactivated
Common high	Deactivated	Deactivated
Common fault	Deactivated	Deactivated
Channel specific low	Deactivated	Remains activated
Channel specific high	Deactivated	Remains activated
Channel specific fault indicator LED	Deactivated	Remains activated

Table 1.6.3. Effects of pressing the accept / reset switch on relays which have been activated as a consequence of a gas or fault alarm condition

Note: It is recommended that alarm devices required to be silenced on “accepting” an alarm state are

connected through the Common relays. Any equipment which needs to remain operational after “accepting” an alarm should be controlled by the Channel Specific relays which can be connected in series or parallel as required.

1.6.4 Analog outputs

Each GasChek4 Mark II channel includes a 4-20mA or 1-5V user configurable analog output for communication with external data acquisition equipment such as strip-chart recorders or dataloggers. The maximum total loop resistance is 250 ohms for the analog outputs.

Note: If you intend to make use of the analog outputs, initial setup procedures should include direct verification of the accuracy of the outputs by exposing the sensor to known concentration test gas, and noting the output. (When the analog outputs are used it is preferable to calibrate the system to the analog outputs rather than to the controller display as the resolution of the outputs is better than the resolution of the display.)

In a fresh air atmosphere containing no measurable contaminants the analog output should register 4mA (or 1.0V if configured for 1 -5V output); a “full scale” concentration of measurable contaminants should provide a reading of 20mA (or 5.0V if configured for 1 -5V output).

As an example, a combustible gas channel should be configured for a range of 0 - 100% LEL. In fresh air containing no combustible gas the analog output should be 4mA (or 1.0V). An atmosphere that containing 100% LEL combustible gas should produce an output of 20mA (or 5.0V).

An oxygen channel should be configured for a range of 0 – 25% by volume, meaning that in an oxygen-free atmosphere, the analog output should be 4mA (or 1.0V). An atmosphere containing 25% oxygen should produce an output of 20mA (or 5.0V). Fresh air containing 20.9% oxygen would then generate an output of approximately 17.4mA (or 4.4V).

The output value for a specific concentration of gas (when the output is configured as 4 - 20mA) can be calculated by using the following equation:

Expected output (mA) = (16 X percentage of full range of concentration of gas being used) + 4.

As an example, a concentration of 50% LEL combustible gas (which is 50% of the full range concentration) should provide an output of (16 X 0.50) + 4 = 12mA.

Similarly, if the output is configured as 1-5V, the value is calculated by the equation:

Expected output (V) = (4 X percentage of full range of concentration of gas being used) + 1.

In this case, a concentration of 50% LEL combustible gas (which is 50% of the full range concentration) should provide an output of (4 X 0.50) + 1 = 3V.

1.7 Power requirements

The GasChek4 Mark II controller is designed for operation via 110/220/240 VAC 50-60 Hz or 12 or 24 VDC power, and includes an internal 12V sealed lead acid battery backup power supply. Power is provided to the remote detectors by the controller. The green “power on” LED indicates power is being properly applied to the system. The green “battery backup” LED indicates the 12V lead acid backup power supply is installed and functioning properly.

Note: If line power is interrupted the green “power on” LED will flash as long as power to the system is being supplied by the backup power supply. The internal

audible alarm or “sounder” will remain activated until the ACCEPT/RESET button is pressed.

1.8 Classification for use in hazardous locations

GasChek Plus remote detector assemblies are available in both explosion proof and non-explosion proof versions. Explosion proof versions of the GasChek Plus remote detector assemblies have been Classified by Underwriters Laboratories, Inc. and the Canadian Standards Association as Explosion Proof for use in Class I, Division 1, Groups B, C, and D explosive atmospheres.

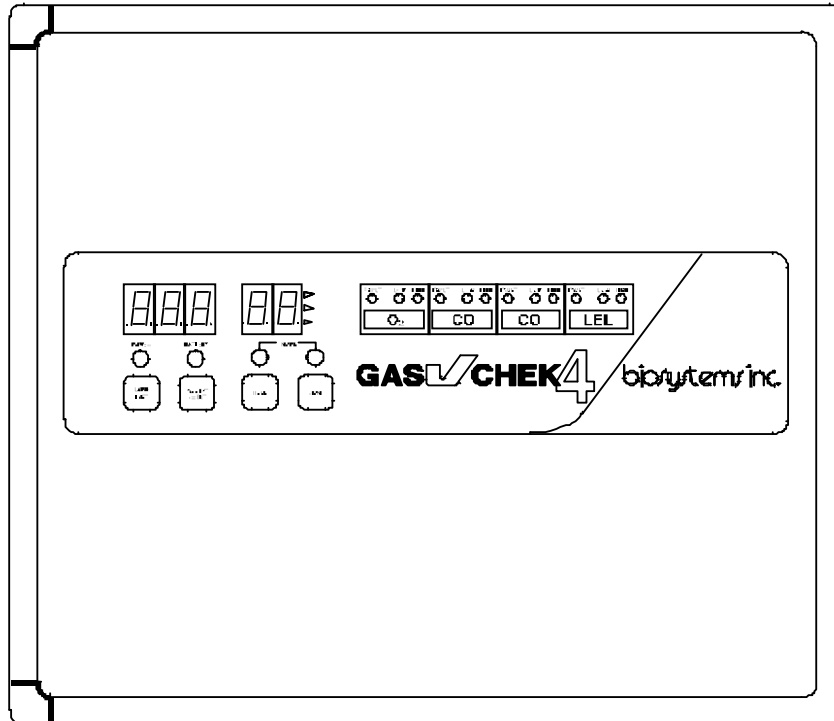


Figure 1.9. GasChek4 Controller switches, readouts and LED indicators

1.9 GasChek4 Controller

The GasChek4 Controller unit is enclosed in a durable, gasketed, fiberglass NEMA 4X case. A red 3 digit 7 segment LED readout is used to display gas readings and other information. Four push-button controls are located on the front of the controller housing, “Lamp Test” and alarm “Accept / Reset”, “Hold” and “Run”. Pushing the “Lamp Test” button activates and verifies the performance of all segments of the red LED readout as well as all individual LED status and alarm light indicators. (For safety reasons the Lamp Test switch does not activate alarm or fault relays.)

The Accept / Reset button is used to silence the alarms and reset the system alarms after an alarm state has cleared. (A more detailed discussion of which alarms are

cleared under what circumstances by means of the Accept / Reset switch is contained in **Section 1.6.3.**)

The “Hold” button is used to “lock” the digital controller readout onto a specific channel. The “Run” button is used to return the system to the normal mode of operation, in which readings are shown sequentially for each channel of detection installed. A green “C” plus a digit (1-4) indicates the channel for which readings are currently being displayed, (for instance “C1” would indicate that the readings currently displayed are for the remote detector assembly installed in channel 1 of the GasChek4 Mark II system). GasChek4 Mark II controller switches, readouts and LED indicators are shown in **Figure 1.9.**

1.9.1 LED alarm light indicators

GasChek4 Mark II controllers include 3 bright green system status LED indicators. The “Power” LED indicates

that external power is currently being supplied to the system. A steady green “Battery” LED indicates that the backup battery is installed and functional. A flashing green “Power” LED indicates that there has been an interruption in the external power source, and that power to the system is currently being supplied by means of the backup battery. The “Mode” indicator is used to show which operating mode (“Run” or “Hold”) is currently selected. The measurement units LED (PPM, % LEL, or % volume) indicates the units for readings for the channel being displayed.

GasChek4 Mark II controllers also include 3 “channel specific” alarm-state LED indicators for each installed channel of detection. Each channel of detection includes a red LED indicator for “warning” (low) gas alarms, a red LED indicator for “danger” (high) gas alarms; and an amber LED indicator for “fault”.

1.9.2 Audible alarm

A built-in audible alarm is provided to warn users of hazardous conditions.

1.10 GasChek Plus remote detector assemblies

Remote detector assemblies include sensor, sensor specific amplifier module (installed in the remote detector housing), sensor specific input module (installed in the controller unit), sensor specific alarm module (installed in the controller unit), and remote detector housing. The detector housing includes built-in mode and calibration adjust push-buttons and 3 ½ digit LCD readout. Oxygen and toxic gas remote detector assemblies are available in both “standard” (non-explosion proof) and “explosion proof” housings. Remote detector assemblies for combustible gas are only available in explosion proof housings.

Note: When the channels of detection to be installed are specified at the time of purchase, remote detector assembly components which are installed in the controller housing (display labels, alarm modules and input modules) will be pre-installed at the factory. If remote detector assemblies are purchased separately for later installation it will be necessary to install these components yourself. Installation procedures are discussed in Chapter 2.

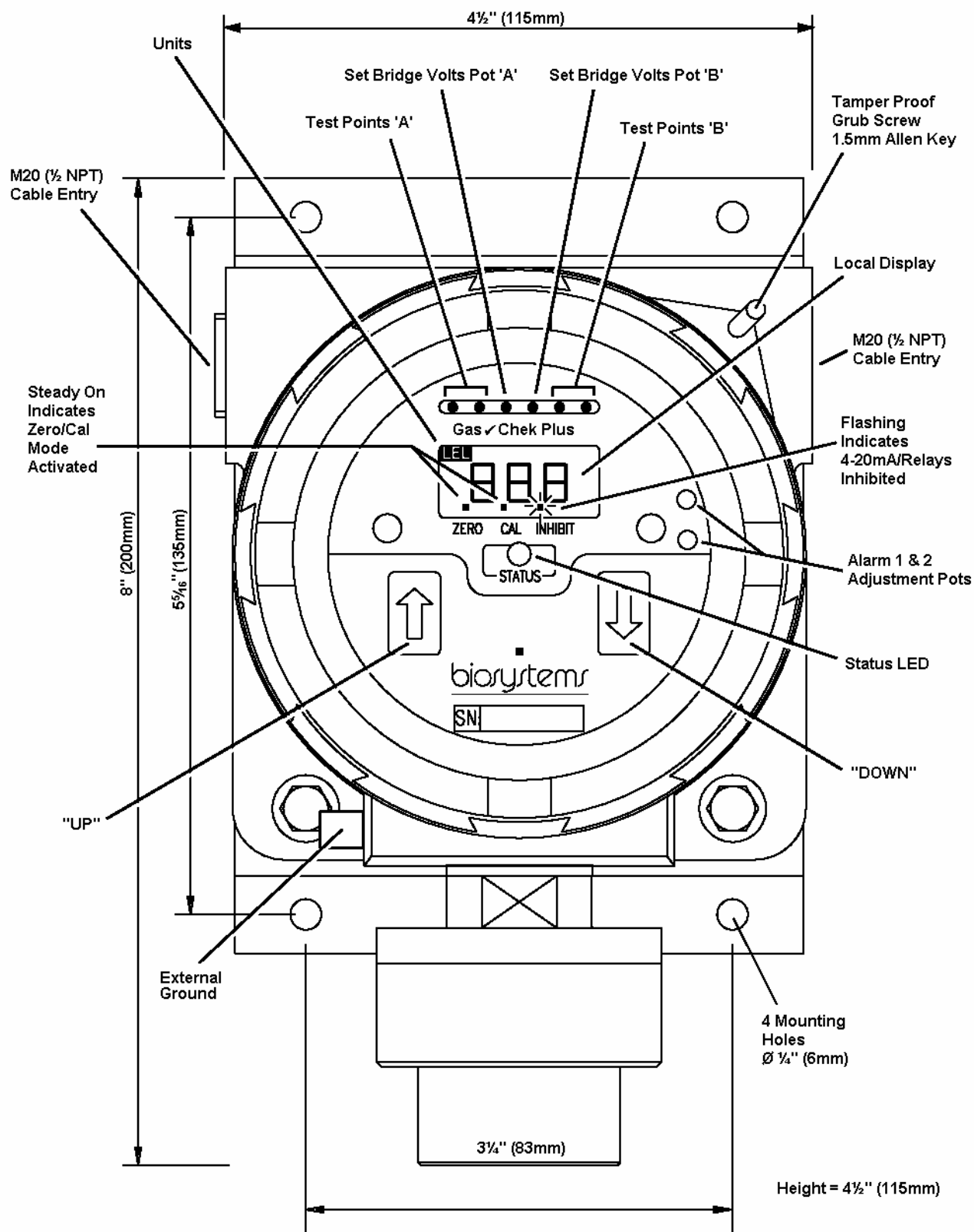
1.10.1 Standard GasChek Plus housing

“Standard” remote detector assemblies are housed in a heavy-duty, molded junction box with gasketed hinged cover. The detector housing includes built-in mode and calibration adjust push-buttons and 3 ½ digit LCD readout. A green LED labeled “Status” near the center of the head lets you know that the remote detector assembly is working properly.

⚠WARNING Standard (non-explosionproof) GasChek Plus remote detector assemblies are not for use in hazardous locations.

1.10.2 Explosion proof GasChek Plus housing

“Explosion proof” remote detector assemblies are housed in a heavy duty cast aluminum explosion proof (Class I, Division 1, Groups B, C, and D) junction box with threaded lid and clear glass port. The detector housing includes built-in magnetically activated mode and calibration switches, and 3 ½ digit LCD readout. Magnetic mode and calibration adjust switches allow for non-intrusive calibration adjustment by means of a bar magnet “key” through the clear viewing port in the lid of the detector housing. A green LED labeled “Status” near the center of the head lets you know that the remote detector assembly is working properly.



All dimensions are in inches (with approximate mm in prentices)

Figure 1.10 GasChek Plus remote detector assembly

Chapter 2. Installation and Basic Operation

2.1 Installation overview

1. Biosystems gas detection systems are fully tested and calibrated before they leave the factory. However, after installation we strongly recommend that full testing and verification of proper operation is carried out before the system is placed in normal service. Make sure all GasChek4 Mark II system elements and/or peripheral alarm, notification, or control devices are properly installed before connecting the system to a power source!
2. Make sure that the GasChek4 Mark II system is disconnected from both the external power source and the built-in battery backup power supply before installing, replacing, or handling GasChek4 Mark II system components!
3. Repair of system components damaged as a result of improper installation can be expensive! GasChek4 Mark II installation, initial setup, and / or system modification should only be undertaken by individuals who are qualified and authorized to do so. Call Biosystems' Service Department at (860) 344-1079 if you need help or have any questions.
4. In order to ensure the built-in 12V backup battery power supply is not damaged by depletion prior to installation, GasChek4 Mark II controllers are shipped from the factory with the backup battery disconnected. The backup battery should not be reconnected until the controller has been properly connected to a source of power.

2.2. GasChek4 Mark II controller unit

The GasChek4 Mark II controller unit is designed for wall mounting in any convenient non-hazardous location where a suitable power supply is available, (GasChek4 Controllers can be powered from 110, 220 or 240 VAC and 12 or 24 VDC.) Dimensions and mounting information are shown in **Figure 2.2**.

Note: GasChek4 Controller housing accessories include a set of 2 external mounting brackets. Use of these mounting brackets is optional. The controller housing may be mounted directly to the wall or other mounting surface by use of screws inserted through apertures in 4 mounting wells located inside the controller case, or by means of the external mounting brackets, whichever is more convenient.

GasChek4 Controller housing accessories also include a ½" NPT galvanized cable grab "gland" for each channel

of detection installed at the time of purchase. (If the cable connecting the remote detector housing with the controller is run through conduit, it will be necessary to remove the cable grab gland and replace it with a threaded ½" NPT conduit bushing (not provided).

When adding additional channels to an existing system it will be necessary to remove the appropriate "hole-seals" from the bottom of the controller case, and install the appropriate glands or bushings. To prevent dust and water ingress all cable entries and knockouts must be checked and sealed if necessary.

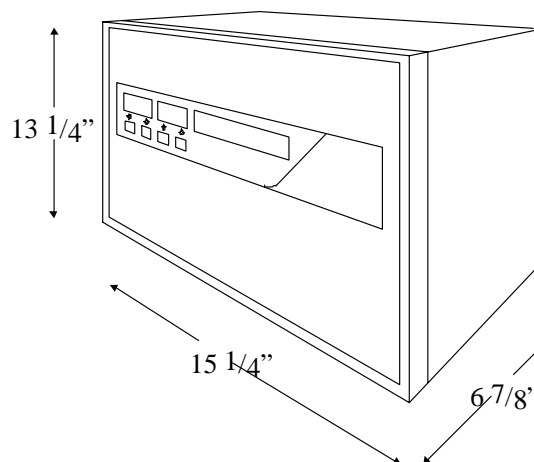


Figure 2.2. Dimensional and mounting layout of GasChek4 Mark II controller housing

2.2.1 Controller PCBs and modules

⚠ DANGER Hazardous voltages are present on exposed terminals in the GasChek4 Controller when the cover is open. Always disconnect the power supply before opening the controller.

The GasChek4 Mark II controller includes a display printed circuit board (PCB) located underneath the hinged controller case cover, and the power supply / alarm "Main" PCB located on an aluminum mounting plate inside the controller case. Each channel of detection requires a sensor-specific alarm card and a sensor-specific input module installed on the power/alarm main PCB. The alarm card for Channel 1 (furthest left) is integrated (permanently installed) on the power / alarm main PCB (printed circuit board). The input and alarm cards modules for channels 2 - 4 are installed by plugging them into the appropriate socket on the ribbon connector located on the aluminum power / alarm main PCB mounting plate. The alarm modules are secured in place by means of 3 PCB stand-offs and white plastic Phillips screws. Do not over-tighten these screws when installing a new alarm module!

Channels must be added in sequence from left to right when new remote detector assemblies are added to the system. For instance, a two channel system must have the remote detector assemblies installed in Channel 1 and

Channel 2. When adding a third remote detector to an existing two channel system, the new components must be installed in Channel 3. Do not leave a gap in the installed channels! Similarly, if a channel is removed from the system, take the necessary steps to keep the remaining channels in sequence.

Note: For further instructions on installing a new sensor channel, call Biosystems at the phone number on the front of this manual.

Sensor input cards are installed by plugging them into the appropriate sensor alarm module

Note: All components of the gas detection “channels” specified at the time of purchase will be pre-installed at the factory. This includes controller housing, display labels, alarm modules, input modules, and cable-grab glands. If remote detector assemblies are purchased separately, it will be necessary to install these components yourself.

The display PCB located underneath the hinged controller case cover must also be configured for the type and number of channels of detection installed in the controller. Four numbered dip-switches are used to activate display readouts and indicator LEDs for active channels. Simply slide the dip-switch to the “On” position corresponding to the total number of installed channels.

Figure 2.2.1.1. below shows the placement of the display channel dip-switches at the back of the display PCB, which is located on the back of the front cover of the controller.

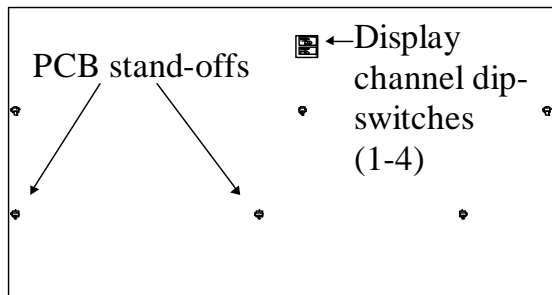


Figure 2.2.1.1. Controller display board showing placement of the display channel dip-switches and PCB stand-offs

Note: Sensor channels must be installed sequentially. The dipswitch corresponding to the number of remote channels installed (from 1-4) should be the only switch in the “On” position at any time! The other three dip-switches should be in the “Off” position.

It will also be necessary to add a label indicating the type of sensor being installed in the new channel. To add or change the channel label, it is necessary to remove the display PCB from the hinged controller case cover. The display PCB is secured in place by 5 PCB stand-offs. To remove the display PCB, squeeze the tip of each stand-off to move the stand-off catch to the center position, and gently work the display PCB in the vicinity of the stand-off over the rim of the stand-off catch. Do not force! Continue to work the PCB over the stand-off catches by squeezing each in turn until the entire board is free. Remove the board from the hinged controller case cover. Add or replace the sensor label for the channel being added or modified. To reinstall the display PCB, align it with the PCB stand-offs and gently press it back into place.

Figure 2.2.1.2. below shows placement of the display PCB labels on the front of the display PCB.

Note: Alarm and input cards are labeled as to the type of sensor they are designed to control. Make sure that the input module is plugged into the corresponding alarm module, and that the modules are installed in the correct controller channel. Be sure when connecting the remote detector housing with the controller to connect the sensor to the corresponding channel (as discussed later in Chapter 2).

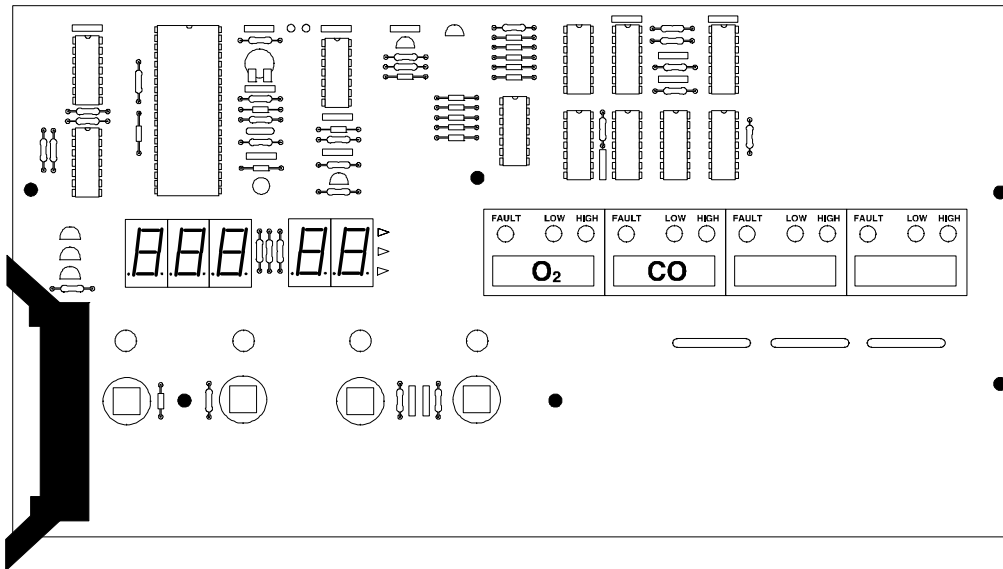


Figure 2.2.1.2. Controller display PCB showing placement of the display labels. Notice that the two sensor channels are installed sequentially from left to right.

2.3 Remote detector assemblies

Oxygen and toxic gas remote detector assemblies are available in both “standard” (non-explosion proof) and “explosion proof” housings. Remote detector assemblies for combustible gas are only available in explosion proof housings.

GasChek Plus remote detector assemblies provide a 4-20mA output and have a built-in LCD display for local notification of gas measurement results. Power is provided to the remote detector by the controller.

The gain resistors in GasChek4 Mark II remote detector assemblies are specific for the sensor contained in the assembly and are factory installed. The remote detector assembly is labeled as to the type of hazard it is designed to measure (i.e. Toxic, O₂ or LEL).

Note: When the channels of detection to be installed are specified at the time of purchase, remote detector assembly components, which are installed in the controller housing (display labels, alarm modules and input modules), will be pre-installed at the factory. If remote detector assemblies are purchased separately for later installation it will be necessary to install these components yourself.

2.3.1 Standard remote detector housing

Sensors for the measurement of oxygen and toxic gas may be installed either in explosion proof or “standard” remote detector housings. Standard detector housings include built-in mode and calibration adjust push-buttons and 3 ½ digit LCD readout.

⚠WARNING Sensors which are housed in “standard” remote detector housings may not be

installed in hazardous locations requiring an “Explosion Proof” classification.

2.3.1.1 “Standard” remote detector housing push-button controls

There are three push-button controls built into the “standard” (non-explosion proof) version of the remote detector assembly; “↑”, “↓”, and a hidden “Mode” switch located between the two arrows. (See Figure 2.3.1.1.)

Familiarize yourself with the placement of this hidden switch! You will need to make use of these push-button controls during setup and calibration procedures.

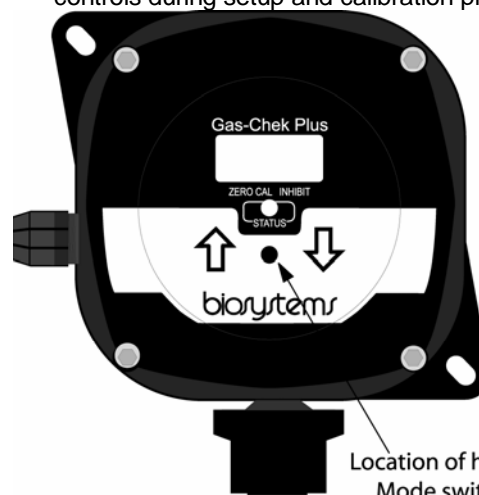


Figure 2.3.1.1. Standard GasChek Plus remote detector housing

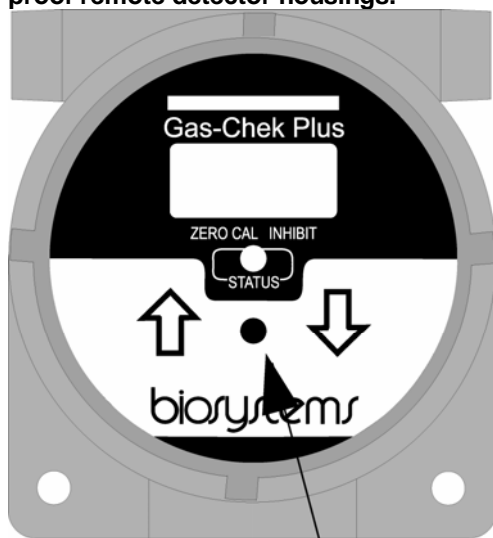
2.3.2 Explosion proof remote detector housing

Explosion proof remote detector housings can be installed in Class I, Division 1 Groups B, C, and D hazardous locations.

Explosion proof remote detectors are installed in a heavy duty cast aluminum explosion proof (Class I, Division 1, Groups B, C, and D) junction box with threaded lid and clear glass port. The detector housing includes built-in magnetically activated mode and calibration switches, and 3 ½ digit LCD readout. Magnetic mode and calibration adjust switches allow for non-intrusive calibration adjustment by means of a bar magnet “key” through the clear viewing port in the lid of the detector housing.

There are 3 magnetic switches built-in to the explosion proof version of the remote detector assembly; “↑”, “↓”, and a hidden “Mode” switch located between the two arrows under the clear port in the lid of the remote detector housing. (See Figure 2.3.2.) Familiarize yourself with the placement of these switches! You will need to make use of these switches during setup and calibration procedures. Use of the magnetic key and switches is discussed in detail in Chapter 3.

GasChek4 Mark II sensors for the measurement of combustible gas may only be installed in explosion-proof remote detector housings.



Location of hidden Mode switch

Figure 2.3.2. Explosion proof GasChek Plus remote detector housing

2.4 Siting of remote detectors

The specific placement of remote detector assemblies should be a function of the type of area being monitored, the type and source of atmospheric hazard being measured, prevailing wind patterns, and other information.

Call Biosystems Technical Service Department at (860) 344-1079 for additional advice.

In general, for gases lighter than air the detectors should be placed at a level slightly above the area where leaks are likely to occur. For gases that are heavier than air the detectors should be located close to floor level or in inspection pits or ducts in which gases that are heavier than air may collect.

There are many circumstances which may modify this general advice. For example, the molecular weight of nitrogen ($MW \cong 28$) is very close to that of air ($MW \cong 29$). When nitrogen is at the same temperature as the air into which it is introduced, it mixes readily, and tends to spread evenly through the affected atmosphere. On the other hand, if the nitrogen is under pressure, and then suddenly released into the atmosphere, as the gas expands (going from higher pressure to a lower pressure) it cools. Because the cooler gas is now denser than the air into which it is being introduced, it no longer mixes as readily. Instead, the nitrogen tends to fall to floor level and spread laterally. In this case remote detectors being used to monitor for oxygen deficiency should be located near floor level in order to detect the deficiency as quickly as possible.

The nearer in density to air a gas is, the more easily it will flow with air due to draughts, ventilation etc. A compromise approach for placement of detectors used to measure gases which are only slightly lighter (such as carbon monoxide) or heavier (such as hydrogen sulfide) than air is to mount the detectors at a height as close as possible to the breathing area of personnel being protected.

When installing detector assemblies it is important to ensure that the sensor is not exposed to liquid or dust contamination which would interfere with the passage of gas through the protective filter into the sensor. Remote detector assemblies should be placed so that the axis of the sensor points straight downward. Splash deflectors should be used when water or other liquid is chronically present in the area where the detectors have been located.

2.5 Wiring recommendations:

Recommendations for wire used to connect GasChek4 Mark II remote detector assemblies with the controller unit are listed in Table 2.5.

Type of remote detector	Conductor Size (gauge) AWG	No. of Conductors	Max. length
Toxic and oxygen	22	3	2000 ft
Toxic and oxygen	18	3	2000 ft
Combustible	18	3	600 ft
Combustible	16	3	900 ft
Combustible	14	3	1500 ft
Combustible	12	3	2000 ft

Table 2.5. GasChek4 Mark II system wiring recommendations

“Maximum length” indicates the maximum distance a remote detector may be located from the controller when using the indicated gauge of conductor. For all types of detector assemblies use 3 conductor shielded with drain.

The maximum distance between the controller and remote detector housing is determined by the type of detector, gauge of wire selected to connect the system components, and the overall loop resistance of the wire/detector combination.

Due to the relatively low signal levels carried by wiring between gas detectors and their control unit, it is essential not to run wire near high power electrical equipment. When GasChek4 Mark II systems are installed in environments which contain high power electrical equipment it is usually best to install the wire in conduit.

2.5.1 Grounding

Wire used to connect GasChek4 Mark II remote detector assemblies with the controller should always be with drain lead. In order to reduce the chances for electromagnetic interference (EMI), the screen (drain) of the wire should be connected to the ground plate of the detector head (long reach glands and/or the screen terminals should be used for this purpose). Ground loops must be avoided! Grounding is done through the normal safety earth of the system.

2.6 Connecting remote detector assemblies with the GasChek4 Mark II controller

2.6.1 Cautions

1. **Make sure that the GasChek4 Mark II system is disconnected from both the external power source**

and the built-in battery backup power supply before installing, replacing, or handling installed GasChek4 Mark II system components!

2. **Make sure that all components match when installing a new channel of detection! Input modules are labeled as to the type of sensor they are designed to control. Make sure that the correct input module is plugged into the correct alarm module, that the modules are installed in the correct controller channel, and that the controller display identifies the correct type of sensor installed in the channel being added.**
3. **Make sure the remote detector housing is properly connected to the correct controller terminal block connector as discussed below.**

2.7 GasChek4 Mark II controller connections

Figure 2.7. shows electrical connections for the GasChek4 Controller. Connections are shown by numbered screw terminal blocks. A diagram of the electrical connections on the inside of the hinged controller case cover is also provided to assist in installation.

1. Terminals at the top of the case are for relay connections, while terminals at the bottom are for mains input, external DC input, external battery, detecting heads, analog drive and alarm units.
2. Output Relays are DPDT, are isolated from the system power supply, and are rated at 250VAC, 5A.
3. When the channels of detection to be installed are specified at the time of purchase, remote detector assembly components which are installed in the controller housing (display labels, alarm modules and input modules) will be pre-installed at the factory. If remote detector assemblies are purchased separately for later installation it will be necessary to install these components yourself. It is essential to ensure all the components for the channel being installed match. Verify that alarm module, input module, display label, sensor and detector housing (with header chip) are correct, and properly connected to the correct controller connector terminals.

⚠ DANGER Hazardous voltages are present on exposed terminals in the GasChek4 Controller when the cover is open. Always disconnect the power supply before opening the controller.

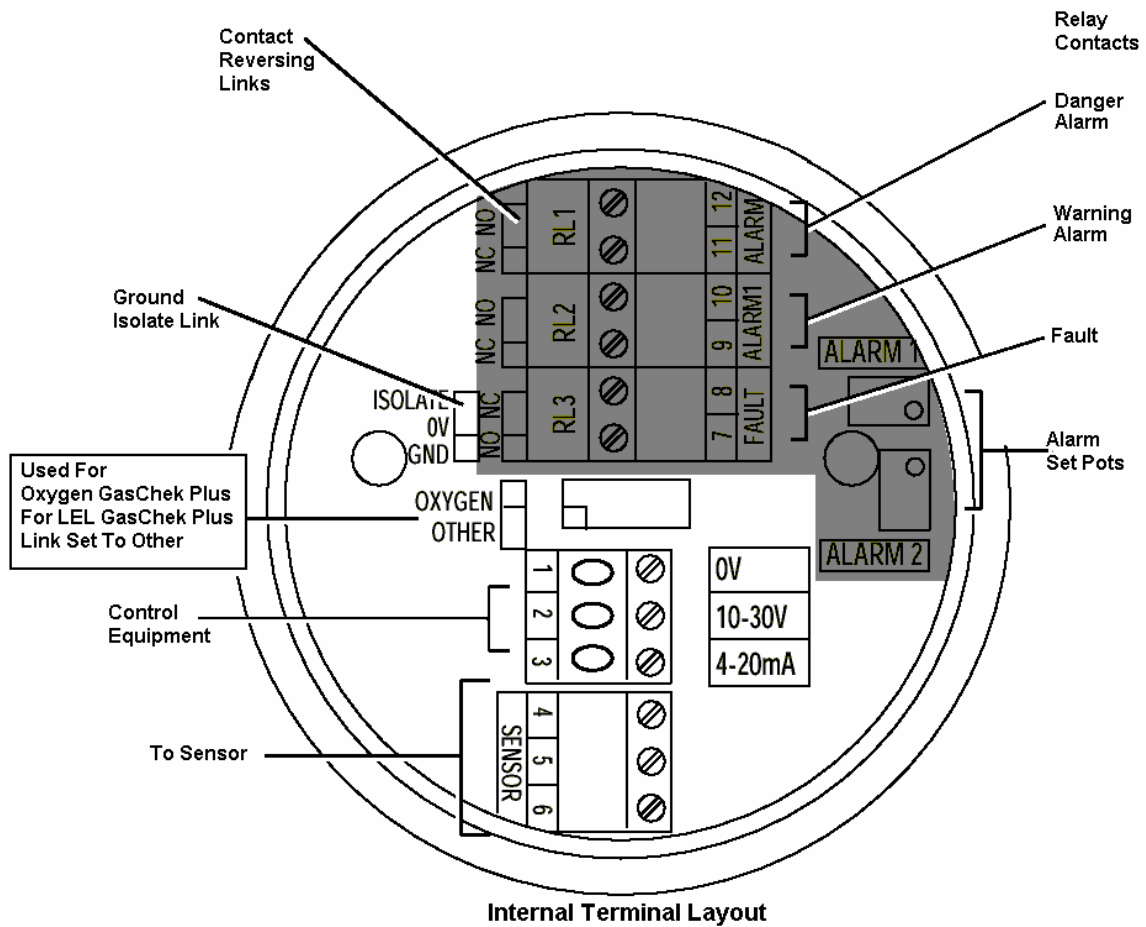
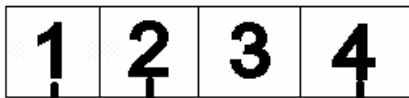


Figure 2.61 GasChek4 remote detector housing / sensor wiring

Input Card



Terminal Board

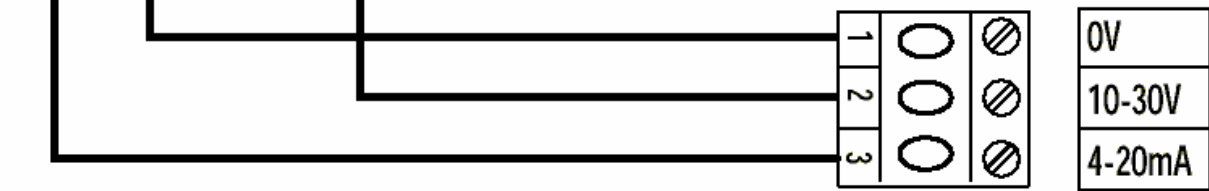


Figure 2.62 GasChek4 Wiring Diagram

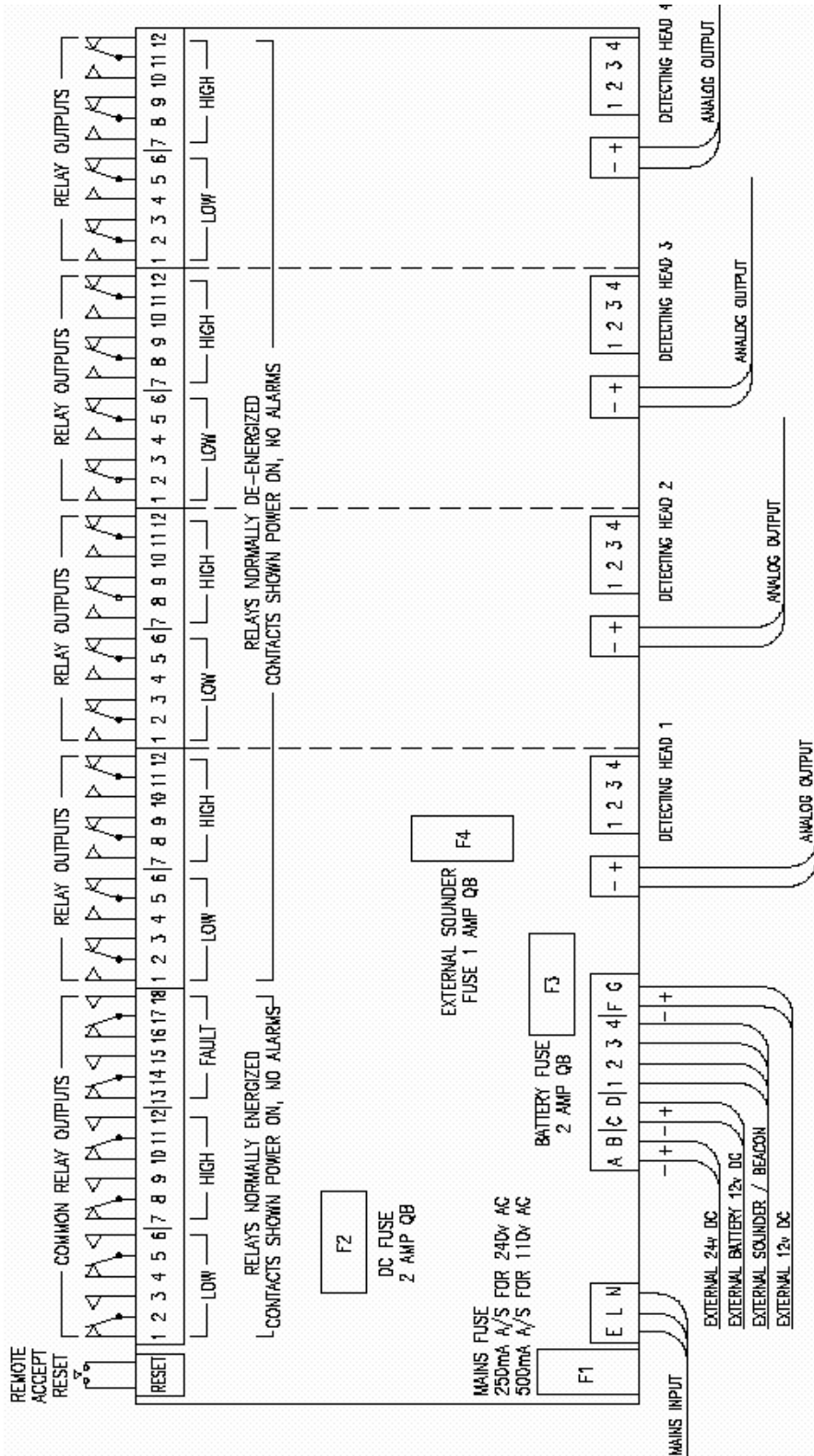


Figure 2.7. GasChek4 controller electrical connections

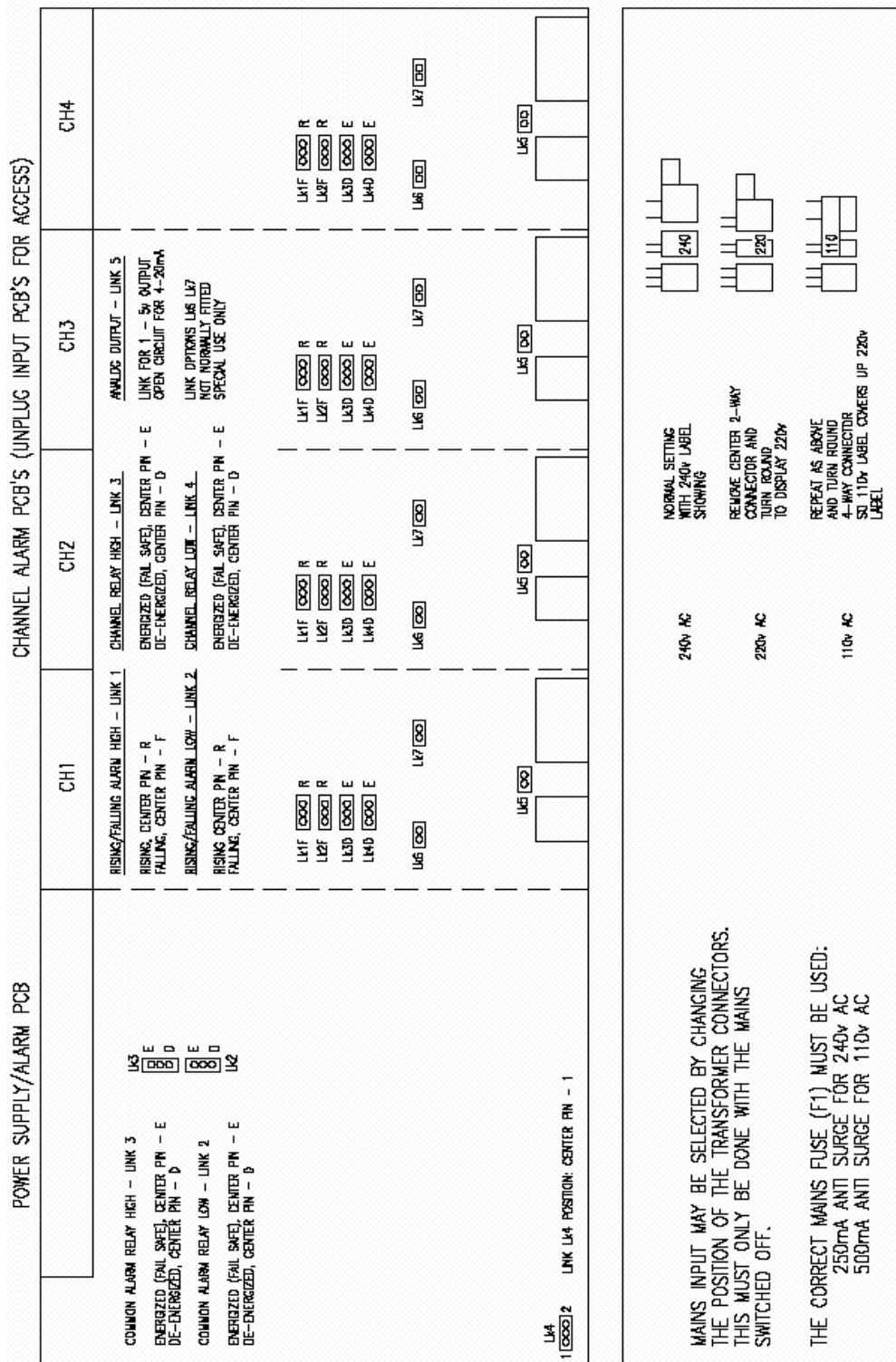


Figure 2.8. GasChek4 Controller input / output relay links

2.8 Input / output relay settings

GasChek4 Controllers are supplied with relays and outputs preset with the following standard factory setup:

Relay and output settings may be easily changed by re-positioning links on the circuit boards as shown in **Figure 2.8**.

Relay Type	Configuration
Common low alarm relay	Normally energized (fail safe)
Common high alarm relay	Normally energized (fail safe)
Common fault relay	Normally energized (fail safe)
Individual channel low alarm relay	Normally de-energized
Individual channel high alarm relay	Normally de-energized

Table 2.8. Factory setup for GasChek4 Mark II controller relays and outputs

2.9 Initial setup

Note: The following procedures should be carried out while the detector is located in fresh (contaminant free) air.

1. Make sure that all alarm and input modules have been properly installed in the correct channels, the remote detector assemblies have been properly connected to the correct controller terminal blocks, and that display board dip-switches have been properly set, and that the channels being installed are properly labeled.

(Display board labels and dip-switches are discussed in Section 2.1. of this chapter.)

2. Make sure the controller is not connected to any other peripheral or external equipment or alarm devices.

Note: There are two built-in audible alarms in the GasChek4 Controller; a loud (85dB) alarm, and a low-volume “sounder” alarm built into the Main Power / Alarm PCB.

3. Disconnect the built-in “loud” 85 dB audible alarm.
4. Connect mains or external DC power to the controller.

Note: In order to ensure the built-in 12V backup battery is not damaged due to depletion prior to installation, GasChek4 Controllers are shipped from the factory with the backup battery disconnected. The backup battery should not be reconnected until the controller has been properly connected to a power source.

5. Connect the backup battery connector to the power supply PCB.
6. The green power and battery indicators and displays should be on, and some alarm lamps may be lit.

Note: Activated fault LEDs indicate that there is a cable fault between the controller unit and the remote detector. The alarm relays for a channel in fault condition are inhibited.

7. Allow all detector channels to stabilize fully, then press the alarm “Accept / Reset” switch to reset the relays as discussed in **Section 1.6.3**.
8. Press the “Lamp Test” button. Make sure all “legs” of the LED readouts are illuminated, and that all system status and channel specific fault, low and high alarm LEDs are lit. (The low-volume audible alarm sounder will also be activated.)
9. Reconnect the 85dB audible alarm.
10. Press “Run” to place the GasChek4 Mark II system in the normal “Run” operation mode in which readings for all installed channels are sequentially displayed.

Note: In normal operation the red LED GasChek4 Controller readout continuously displays the current gas concentration. The green LED measurement unit indicator shows the scale of the gas concentration reading (parts-per-million for toxic gas, % LEL for combustible gas, or % volume for oxygen. A green “C” together with a numeral (1-4) indicates the channel for which readings are currently displayed. Pushing the “Hold” button locks the display reading on the currently displayed channel. Although all channels are still being monitored, once the “Hold” button is pressed the readings displayed on the controller readout will remain locked on the selected channel until the “Run” button is pushed to return to normal operation.

11. Both the remote detector assemblies and the controller unit should be calibrated as discussed in Chapter 3 at the time of initial installation before the system is first put into service

2.10 Power supply / alarm PCB

The power supply / alarm “Main” PCB is located on an aluminum mounting plate inside the GasChek4 Controller case. Each channel of detection requires a sensor-specific alarm module and a sensor-specific input module installed on the power/alarm main PCB.

The alarm module for Channel 1 is integrated (permanently installed) on the power / alarm main PCB (printed circuit board). The alarm modules for channels 2 - 4 are installed by plugging them into the appropriate socket on the ribbon connector located on the aluminum power / alarm main PCB mounting plate. Each alarm module is secured in place by means of 3 PCB stand-offs and Phillips screws. Sensor input modules are installed by plugging them into the appropriate sensor alarm module.

2.10.1 Configuration options set by links on the Main PCB

The power supply / alarm PCB (which includes the integrated alarm module for Channel 1) and the alarm modules for Channels 2 - 4 contain various re-configurable jumpers to allow flexibility in system operation. (See Figure 2.8.)

Changing function is accomplished by changing the position of the connector "link" on the main or alarm module PCBs.

Connectors are labeled to indicate which function has been selected.

Note: Channel specific links for Channel 1 are located on the alarm module section of the integrated power supply / alarm PCB. Channel specific links for Channels 2 - 4 are located on the alarm modules for those channels.

Configuration options are summarized in Tables 2.10.1 and 2.10.2.

Function	Configuration Choice		
Input Voltage Select (set by 3 position jumper)	110 VAC Input	220 VAC Input	240 VAC Input
Common Low Alarm Relay	Energized (Fail Safe)		De-energized
Common High Alarm Relay	Energized (Fail Safe)		De-energized

Table 2.10.1. Configuration options set by links (jumpers) on the main power supply PCB

Function	Configuration Choice	
High Alarm activation by rising (ascending) or falling (descending) signal	Rising (ascending) Alarm	Falling (descending) Alarm
Low Alarm activation by rising (ascending) or falling (descending) signal	Rising (ascending) Alarm	Falling (descending) Alarm
High Alarm Relay normal state	Energized (Fail Safe)	De-energized
Low Alarm Relay normal state	Energized (Fail Safe)	De-energized
Analog output configuration	1-5V Output	4-20 ma Output

Table 2.10.2. Channel specific configuration options set by links (jumpers) on the alarm module

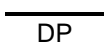
Jumper Designation	Function	Jumper Setting	Result	Comment
	Used to disable display of a decimal point on the LED controller readout.	When the link is installed in the first DP (DP "Bar") jumper position.	Decimal point not displayed.	Only one of the two DP links may be used at any time.
DP	Used to enable display of a decimal point on the LED controller readout.	When the link is installed in the second DP (no "Bar") position.	Decimal point displayed.	Only one of the two DP links may be used at any time.
VOL	Sets the units of measurement for display readings.	Link is installed in VOL position.	Readings in "Percent by Volume".	Only one of the three VOL, PPM, or LEL links may be specified at any one time.
LEL	Sets the units of measurement for display readings.	Link is installed in LEL position.	Readings in "Percent LEL".	Only one of the three VOL, PPM, or LEL links may be specified at any one time.
PPM	Sets the units of measurement for display readings.	Link is installed in PPM position.	Readings in "Parts Per Million".	Only one of the three VOL, PPM, or LEL links may be specified at any one time.

Table 2.11.1. Configuration options set by jumpers on sensor input module

2.11 Sensor input module

Each type of input module is labeled as to the type of sensor signal it is designed to receive, (i.e. H₂S, CO, O₂, etc.). Make sure that you connect the proper remote detector assembly (which indicates the type of sensor installed) and alarm module with the correct input module!

Re-configurable links (jumpers) located on the sensor input module are used to configure the controller readout for the channel. There are 5 links (jumpers) located on the back side of the input module. The function controlled by each link is printed on the input-module PCB immediately adjacent to the jumper. **Table 2.11.1.** summarizes the configuration settings controlled by these jumpers

Chapter 3 Calibration

3.1 Warnings and cautions concerning verification of accuracy

⚠WARNING Accuracy of the GasChek4 Mark II must be verified by exposure to known concentration calibration gas on a regular basis. A prudent schedule for verifying accuracy should be determined by using the following procedure: Initially, over a period of a few days, check the response daily to be sure there is nothing in the atmosphere which is poisoning the sensor. If these tests demonstrate that it is not necessary to make adjustments, the time between checks may be lengthened. This interval should not be lengthened beyond thirty days. Sensors should be replaced at two year intervals to minimize the risk of failure during the interval between sensor checks. Failure to check accuracy can lead to inaccurate and potentially dangerous readings.

⚠WARNING The accuracy of the GasChek4 Mark II should be checked immediately following any known exposure to contaminants by testing with known concentration test gas before further use. Failure to check accuracy after a known sensor exposure can lead to inaccurate and potentially dangerous readings.

⚠WARNING A sensor that cannot be calibrated or is found to be out of tolerance should be replaced immediately. An instrument that fails calibration may not be used until testing with known concentration test gas determines that accuracy has been restored, and the instrument is once again fit for use.

3.2 Overview of verification of accuracy

It is necessary to calibrate both the GasChek4 Controller and the remote detector assemblies at the time of installation before the GasChek4 Mark II system is first put into service. Once the system has been properly calibrated and put into service, the accuracy of the remote detector assembly should be regularly verified by exposing the sensors to known concentration test gas. A prudent

schedule for on-going verification of remote detector accuracy should be determined as discussed above.

The GasChek4 Mark II system has been designed for easy, single person, non-intrusive calibration. A hidden "Mode" switch located at the remote detector housing is used to enter the "Calibration" mode, while the built-in up and down arrows ("↑" and "↓") are used to adjust the sensor. A built-in 3 ½ digit LCD readout is used to display readings and messages at the remote detector.

Verification of remote detector accuracy is a one-step procedure for remote detector assemblies equipped with an oxygen sensor and a two step procedure for toxic and LEL remote detector assemblies.

Calibration normally begins by exposing the GasChek4 Plus remote detector assembly to "fresh air" and checking the readings. If the readings differ from those expected in fresh air (20.9% oxygen, 0 PPM toxic gas, 0% LEL combustible gas), a "fresh air zero" adjustment must be made. The second step, which only applies to toxic and LEL sensors, is to verify sensor accuracy by exposing it to known concentration test gas and noting the sensor response. Toxic and LEL readings are considered accurate if the readings are within 10% of the expected value as given on the gas cylinder. If readings are accurate, then the instrument requires no further adjustment. Toxic and LEL readings that are off by more than 10% of the expected value are considered inaccurate and indicate that the sensitivity of the sensor must be "span" adjusted before further use.

Oxygen sensor calibration is discussed in detail in section 3.4.

Toxic and LEL sensor calibration is discussed in detail in section 3.5.

Biosystems offers calibration kits and long lasting cylinders of test gas specifically developed for easy GasChek4 calibration. Customers are urged to use Biosystems calibration materials when calibrating their GasChek4 Mark II detectors.

⚠WARNING Use of non-standard calibration gas and/or calibration kit components when calibrating the GasChek4 can lead to inaccurate and potentially dangerous readings and may void the standard Biosystems warranty.

Customers are strongly urged to use only Biosystems calibration materials when calibrating the GasChek4. Use of non-standard calibration gas and/or calibration kit components can lead to dangerously inaccurate readings and may void the standard Biosystems warranty.

3.2.1 Remote detector modes of operation

Pressing or activating the hidden mode switch on the remote detector assemblies causes the remote detector to scroll through several modes of operation. In "Normal Mode" the status LED on the detector assembly is solid green and indicates that the sensor is functioning normally. Press or actuate the Mode switch once to enter the Fresh Air Zero Mode. Press it again to enter Span Calibration

Mode. Pressing it a third time causes the instrument to return to Normal Mode

3.3 Effect of contaminants on GasChek4 Mark II sensors

The atmosphere in which the GasChek4 Mark II remote detector is located can have a lasting effect on sensor accuracy. Sensors may be poisoned or suffer degraded performance if exposed to certain substances.

There are three basic types of sensors that may be installed in GasChek Plus remote detector assemblies; galvanic oxygen, catalytic hot-bead combustible gas (LEL), and electrochemical toxic. Each type of sensor uses a slightly different detection principle, so the conditions that affect the accuracy of the sensors vary from one type of sensor to the next.

⚠WARNING The accuracy of the GasChek4 Mark II should be checked immediately following any known exposure to contaminants by testing with known concentration test gas before further use. Failure to check accuracy after a known sensor exposure can lead to inaccurate and potentially dangerous readings.

3.3.1 Effects of contaminants on oxygen sensors

Oxygen sensors may be affected by prolonged exposure to "acid" gases such as carbon dioxide. The oxygen sensors used in Biosystems instruments are not recommended for use in atmospheres which continuously contain more than 25% CO₂.

3.3.2 Effects of contaminants on combustible sensors

Combustible sensors may be affected by exposure to silicone containing substances (found in many lubricants and hydraulic fluids), the tetra-ethyl-lead in "leaded" gasoline, and halogenated hydrocarbons (Freons[®], or solvents such as trichloroethylene and methylene chloride). Chronic exposure to high concentrations of hydrogen sulfide may also damage the combustible sensor.

For a complete list of known LEL sensor contaminants, see the sensor section of the Biosystems Standard Warranty in Appendix B.

Note: If sensitivity of the combustible sensor is lost due to poisoning, it tends to be lost first with regards to methane.

A partially poisoned sensor might still respond accurately to propane while showing a dangerously reduced response to methane.

Biosystems' "Propane Equivalent" calibration gas mixtures have been developed to eliminate this potentially dangerous source of calibration error. Biosystems' "Propane Equivalent" mixtures are based on methane so any loss of sensitivity to methane is detected (and can be corrected) immediately.

⚠WARNING The combustible sensor used in the GasChek4 Mark II requires a minimum of 10% oxygen by volume in order to generate accurate combustible gas readings. Combustible sensor accuracy may be diminished if the instrument is used in oxygen-deficient atmospheres.

⚠WARNING A rapid up-scale reading followed by a declining or erratic reading may indicate a hazardous combustible gas concentration that exceeds the GasChek4 Mark II's zero to 100 percent LEL detection range.

3.3.3 Effects of contaminants on toxic gas sensors

Biosystems "substance-specific" electrochemical used to measure CO, H₂S, SO₂, Cl₂, and NO₂ have been carefully designed to minimize the effects of common interfering gases. "Substance-specific" sensors are designed to respond only to the gases they are supposed to measure. The higher the specificity of the sensor the less likely the sensor will be affected by exposure to other gases which may also be present. For instance, a "substance-specific" carbon monoxide sensor is deliberately designed not to respond to other gases that may be present at the same time, such as hydrogen sulfide and methane.

Even though care has been taken to reduce cross-sensitivity, some interfering gases may still have an effect on toxic sensor readings. In some cases the interfering effect may be "positive" and result in readings that are higher than actual. In other cases the interference may be negative and result in readings that are lower than actual.

Cross sensitivity of GasChek4 Mark II toxic sensors to common interfering gases is listed in Appendix A.

3.4. Calibration of oxygen remote detector assemblies

For oxygen sensor-equipped remote detector assemblies, calibrating the oxygen sensor is a single procedure involving only the "fresh air zero" adjustment as discussed in section 3.4.1.

3.4.1 "Fresh air zero" adjustment for oxygen remote detector assemblies

The "fresh air zero" adjustment is made by exposing the oxygen sensor to an atmosphere containing 20.9% oxygen, 0 PPM toxic gas, 0% LEL combustible gas. If the air in which the oxygen sensor is located is suspected to contain a level other than 20.9 % oxygen, it is necessary to use a cylinder of "zero air" (which contains 20.9 % oxygen, 79.1 % nitrogen and no contaminants) to perform the "fresh air zero" adjustment.

1. Verify that power is on to the GasChek4 Mark II system (The "status" LED indicator at the GasChek4 Plus remote detector assembly should show a steady green light.) The oxygen reading should be shown. Allow sensor readings to completely stabilize in a

fresh air environment before attempting to make an adjustment.



2. If the GasChek Plus remote detector assembly is non-explosionproof, press the concealed Mode switch, which is located between the up and down arrows on the detector head assembly. See **Figure 3.4.1A** below. If the GasChek Plus remote detector assembly is explosion-proof, actuate the hidden Mode switch with the magnetic key as shown in **Figure 3.4.1B**. The green STATUS LED on the detector head will flash, the decimal point above the word "ZERO" will illuminate and the display backlight will illuminate. The Decimal point above 'INHIBIT' may flash if the option has been selected.

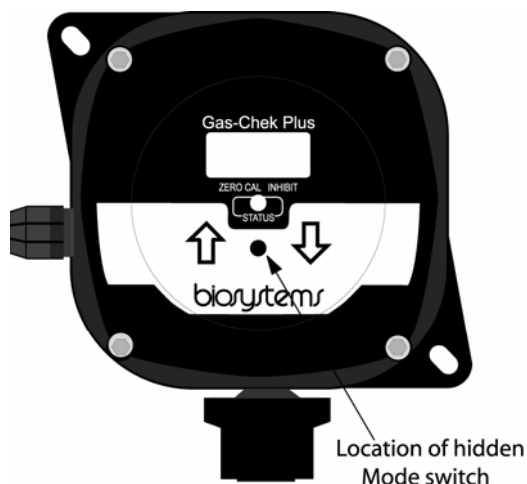
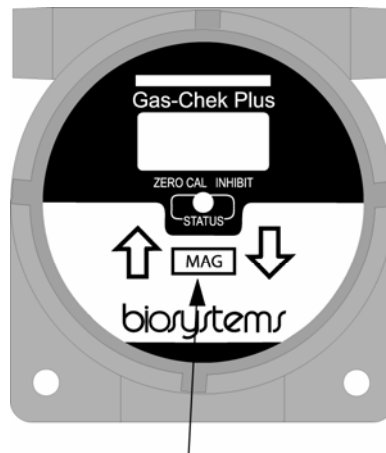


Figure 3.4.1A Mode Switch location on standard head

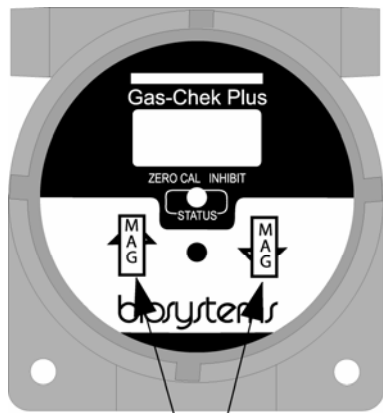


Hold magnet horizontally over hidden Mode switch to activate it

Figure 3.4.1B Mode Switch activation on explosion proof head

3. If the atmosphere is suspected to contain a level other than 20.9% oxygen and a cylinder of "zero air" (which contains 20.9 % oxygen, 79.1 % nitrogen and no contaminants) must be used with a 1 liter/minute regulator. Attach the cylinder of calibration gas, regulator, short section of tubing and calibration adapter to the remote detector sensor. Make sure the regulator, cylinder seating surfaces, and threads are clean and dry. The regulator will automatically begin to flow gas at the correct flow rate as soon as it is fully inserted.
4. With no target gas present at the detector, use the 'UP' or 'DOWN' arrow pads to adjust the display to read zero. If the remote detector is explosion-proof, hold the magnet vertically over the appropriate adjustment arrow to make the adjustments. See figure 3.4.1C below.





Hold magnet vertically over up or down arrow to adjust sensitivity

Figure 3.4.1C Up and down arrow activation with magnet of explosion-proof head

5. Press the concealed Mode switch or activate it with the magnetic key a second time. The decimal point above the word “CAL” will be lit and the STATUS LED will still flash. The detector reading will immediately increase. In a few seconds the reading should stabilize.



6. Adjust the reading again by using the up and down arrow keys or the magnetic key as shown above in figure 3.4.1C until the reading is 20.9%. Disregard the decimal point above CAL.



7. Press the Mode button once the instrument reads 20.9. The remote detector will return to Normal Mode. The backlight will go out and the gas detection reading will again be shown.

If a cylinder of “zero air” was used during the fresh air zero calibration, make sure to remove the calibration adapter and other fittings from the detector before returning to normal service.

Note: Always return the detector to NORMAL mode once a calibration routine is complete.

3.5 Calibration of toxic and LEL remote detector assemblies

Calibration of toxic and LEL sensors is a two step procedure. The first step involves a “fresh air zero” calibration in which the instrument is exposed to fresh air containing 0 PPM toxic gas and 0% LEL combustible gas and adjusting the detector accordingly. If the air in which the detector is located is suspected to contain

contaminants, it will be necessary to use a cylinder of “zero air” (which contains 79.1% nitrogen, 20.9% oxygen, 0 PPM toxic gas and 0% LEL combustible gas) to fresh air zero calibrate the sensor. The second step is to expose the sensor to calibration gas of known concentration. This is known as a bump test and is discussed in detail in section 3.5.2. If the bump test shows sensor readings to be off by more than 10% of the value given on the calibration gas cylinder, then a span calibration is necessary, which is discussed in sections 3.5.3.

3.5.1 Fresh air zero adjustment for toxic gas and LEL remote detector assemblies

1. Verify that power is on to the GasChek4 system. The “status” LED indicator at the GasChek Plus remote detector assembly should show a steady green light and a gas reading should be shown. Allow sensor readings to completely stabilize in a fresh air environment before attempting to make an adjustment.



2. If the GasChek Plus remote detector assembly is non-explosion-proof, press the concealed Mode switch located between the up and down arrows as shown above in **Figure 3.4.1A**. If the GasChek Plus remote detector assembly is explosion-proof, actuate the hidden Mode switch with the magnetic key as shown above in **Figure 3.4.1B**. The green STATUS LED will flash, the decimal point above the word “ZERO” will illuminate and the display backlight will illuminate. The decimal point above ‘INHIBIT’ may flash if the option has been selected.



3. If the atmosphere is suspected to contain a level other than 20.9% oxygen and a cylinder of “zero air” (which contains 20.9 % oxygen, 79.1 % nitrogen and no contaminants) must be used with a 1 liter/minute regulator. Attach the cylinder of calibration gas, regulator, short section of tubing and calibration adapter to the remote detector sensor. Make sure the regulator, cylinder seating surfaces, and threads are clean and dry. The regulator will automatically begin to flow gas at the correct flow rate as soon as it is fully inserted.
4. With no target gas present at the detector, use the ‘UP’ or ‘DOWN’ arrow pads to adjust the display to read zero. If the remote detector is explosion-proof, hold the magnet vertically over the appropriate adjustment arrow to make the adjustments as shown in figure 3.4.1C above.



5. If using a zero air cylinder, remove it from the assembly and unscrew the regulator.
6. Press the concealed Mode switch again, or activate it with the magnetic key. The decimal point above the word "CAL" will be lit and the STATUS LED will still flash.
7. Press the Mode button one more time to return to detection mode. The backlight will go out and the gas detection reading will again be shown.

Make sure to remove the calibration adapter and other fittings from the detector before returning to normal service.

Note: Always return the detector to NORMAL mode to avoid leaving the detector in a permanently inhibited state.

Upon successful completion of the fresh air zero calibration of a toxic or LEL sensor, the display should indicate a reading of 0 units of gas (provided that there are no contaminants in the atmosphere).

3.5.2 Functional (bump) test

Once the detector has been fresh air zero calibrated, a simple functional (bump) test is all that is needed to verify accuracy.

To perform a functional (bump) test, with the detector head in normal mode, slip the calibration adapter onto the sensor, attach the regulator and other fitting to the cylinder of test gas, and flow calibration gas to the sensor. Wait for the readings to stabilize, (forty-five seconds to one minute is usually sufficient).

Note: All alarms and relays which have been configured to indicate an alarm condition at the concentration of the test gas being administered will be activated during a functional "bump test" procedure unless disconnected or otherwise disabled.

If the readings are within 10% of the expected values as given on the calibration gas cylinder, then the detector head is considered accurate and may be used without further adjustment.

If the readings differ by more than 10 percent from the expected value as given on the calibration gas cylinder, then the detector head is considered inaccurate and must be adjusted using the "span" calibration procedures before further use.

Note: Span adjustment procedures are discussed in section 3.5.3.

3.5.3 Span adjustment for toxic gas and LEL remote detector assemblies

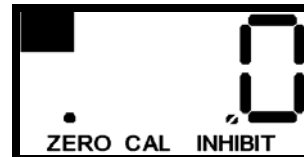
This procedure assumes that the remote detector assembly has been fresh air zero calibrated (as described

above in section 3.5.1) and that a bump test has shown that a span adjustment is necessary.

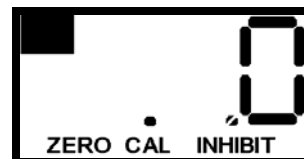
1. Verify that power is on to the GasChek4 system (The "status" LED indicator at the GasChek Plus remote detector assembly should show a steady green light.) The reading should be shown. Allow sensor readings to completely stabilize in a fresh air environment before attempting to make an adjustment.



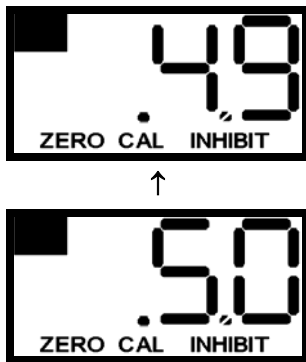
2. If the GasChek Plus remote detector assembly is non-explosionproof, press the concealed Mode switch located between the up and down arrows as shown in **Figure 3.4.1A**. If the GasChek Plus remote detector assembly is explosion-proof, actuate the hidden Mode switch with the magnetic key as shown in **Figure 3.4.1B**. The green STATUS LED will flash, the decimal point above the word "ZERO" will illuminate and the display backlight will illuminate. The decimal point above 'INHIBIT' may flash if the option has been selected.
- 3A. If you've just completed the fresh air zero calibration and used a bottle of zero air (which contains 79.1% nitrogen, 20.9% oxygen, 0 PPM toxic gas and 0% LEL combustible gas) disregard this reading if it is something other than zero.
- 3B. If the fresh air zero calibration was done in the surrounding atmosphere, then this reading should be zero. If the reading is anything other than zero, use the up and down arrow keys to make the adjustment.



4. Press the Mode switch again (or actuate it with the magnet – see figures 3.4.1B). The decimal point over CAL will be lit.



5. Attach the cylinder of calibration gas, regulator, short section of tubing and calibration adapter to the remote detector sensor. Make sure the regulator, cylinder seating surfaces, and threads are clean and dry. The regulator will automatically begin flowing gas at the correct flow rate as soon as it is fully inserted.
6. When the readings stabilize, use the "↑" or "↓" key to raise or lower the readings to match the concentration printed on the calibration cylinder label.



7. Remove the calibration adapter and all other calibration fittings from the remote detector. Be sure to remove the regulator from the calibration gas bottle or to turn it off if it has an on/off knob.
8. Allow readings to settle and verify zero reading. Make sure you wait long enough for the readings to completely stabilize! Repeat the fresh-zero procedure if necessary.
9. Press the Mode switch to return to normal operation.

Note: During normal operation, gas readings are displayed on both the remote detector and controller readouts. “Zero” and “Span” sensitivity adjustments are made while the remote detector is in the “Calibration” mode. The LED readout located at the controller will show a negative reading as long as the remote detector is being operated in the “Calibration” mode. Readings at the controller LED will be restored when calibration is completed and the instrument is returned to normal operation.

3.6 Calibration of GasChek4 Controller unit

The GasChek 4 Controller unit is calibrated at the factory before shipment. Controller calibration should not be necessary in the field.

Chapter 4 Installing a sensor channel

4.1 Purchase requirements

Adding a new sensor channel to an existing GasChek Controller will require the following items:

- GasChek Plus remote detector assembly
- Alarm Card
- Input Card
- Wiring
- Test cable
- Strain relief with nut
- 3 nylon screws

Biosystems offers all of these items as a GasChek Plus Remote Detector Assembly. The chart below shows the part numbers that should be used upon ordering.

Part Number	Gas✓Chek Plus remote detector assembly (includes input module, alarm module, sensor housing and sensor)
54-13-900	O ₂ Oxygen Non-Explosionproof
54-13-901	O ₂ Oxygen Explosionproof
54-13-801	LEL Combustible Explosionproof
54-13-010	CO Carbon monoxide Non-Explosionproof
54-13-011	CO Carbon monoxide Explosionproof
54-13-020	H ₂ S Hydrogen sulfide Non-Explosionproof
54-13-021	H ₂ S Hydrogen sulfide Explosionproof
54-13-030	SO ₂ Sulfur dioxide Non-Explosionproof
54-13-031	SO ₂ Sulfur dioxide Explosionproof
54-13-080	Cl ₂ Chlorine Non-Explosionproof
54-13-081	Cl ₂ Chlorine Explosionproof
54-13-090	NO ₂ Nitrogen dioxide Non-Explosionproof
54-13-091	NO ₂ Nitrogen dioxide Explosionproof

Note: Remote combustible sensor assemblies are only available in explosionproof versions. Remote detector assemblies for chlorine are only available in non-explosionproof versions.

4.2 Procedure

The alarm card and input card will arrive in a sealed package and will be joined together.

1. Remove the alarm card and the input card from the package and gently separate them.

⚠ DANGER Hazardous voltages are present on exposed terminals in the GasChek4 Controller when the cover is open. Always disconnect the power supply before opening the controller.

2. The alarm card is the larger of the two halves and should then be press fit into the ribbon cable on the back wall of the controller. Be sure to align the pins properly. Remember to install the alarm card as far to the left as possible. Sensor channels must be installed sequentially from left to right.
3. Secure the alarm card with the three nylon screws, two at the top and one at the bottom center.
4. Reattach the input card to the alarm card by press fitting the two connectors together inside the controller.
5. Install the test wire through the strain relieve and connect it to the remote detector.
6. Close the Controller.
7. Plug the controller back in. The new remote detector assembly should power up automatically.
8. Calibrate the remote detector assembly as described in chapter 3.
9. After successful calibration, remove the test cable.
10. Install the remote detector assembly.

Note: Siting recommendations for remote detector assemblies are given in section 2.4.

11. Permanently connect the remote detector assembly to the GasChek Controller.

Note: Wiring and connection guidelines are given in sections 2.5 and 2.6.

Chapter 5. Service

5.1 Returning your GasChek4 Mark II to Biosystems for service or repair

Please contact the Biosystems Service Department at (860) 344-1079 to obtain a "Return Authorization" number prior to shipment. A Biosystems Service representative

will record all relevant information or special instructions at that time.

To insure safe transport please use the original GasChek4 Mark II packing materials, or other packing materials which similarly protect the instrument and accessories.

Please contact the Biosystems Service Department at (860) 344-1079 if you require any additional information.

Note: The return authorization number must be clearly marked on the outside of the box.

Prominently showing the return authorization number on the outside of the box ensures that it is immediately identified and logged into our system at the time it is received. Proper tracking helps avoid unnecessary delays in completion of service procedures.

**Thank you for
choosing the
GasChek4 Mark II, and
thank you for choosing
Biosystems.**

Appendices

Appendix A GasChek4 Mark II Toxic Sensor Cross Sensitivity Data

The table below lists the cross sensitivity of electrochemical toxic sensors used in Biosystems gas detectors to gases other than their target gas. Depending on the nature of the reaction each gas has with the sensor, the effect can either decrease the signal (negative cross sensitivity) or increase the signal; (positive cross sensitivity). Each figure represents the reaction of the sensor to 100 PPM of gas, thus providing a percentage sensitivity to that gas relative to its target gas.

Type of Sensor	Interfering Gas										
	CO	H ₂ S	SO ₂	NO	NO ₂	Cl ₂	H ₂	HCN	HCl	NH ₃	Ethylene
Carbon Monoxide (CO)	100	<10	<10	<30	<15	<10	<40	<15	< 3	0	50
Hydrogen Sulfide (H ₂ S)	0	100	15	<5	20	<25	0	0	0	0	0
Sulfur Dioxide (SO ₂)	0	0	100	0	120	<5	0	< 50	0	0	0
Nitrogen Dioxide (NO ₂)	0	20	<0.5	0	100	90	0	< 1	0	0	0
Chlorine (Cl ₂)	0	20	0	0	120	100	0	0	0	0	0

Appendix B Biosystems Standard Warranty Gas Detection Products

General

Biosystems LLC (hereafter Biosystems) warrants gas detectors, sensors and accessories manufactured and sold by Biosystems, to be free from defects in materials and workmanship for the periods listed in the tables below.

Damages to any Biosystems products that result from abuse, alteration, power fluctuations including surges and lightning strikes, incorrect voltage settings, incorrect batteries, or repair procedures not made in accordance with the Instrument's Reference Manual are not covered by the Biosystems standard warranty.

The obligation of Biosystems under this warranty is limited to the repair or replacement of components deemed by the Biosystems Instrument Service Department to have been defective under the scope of this standard warranty. To receive consideration for warranty repair or replacement procedures, products must be returned with transportation and shipping charges prepaid to Biosystems at its manufacturing location in Middletown, Connecticut, or to a Biosystems Authorized Warranty Service Center. It is necessary to obtain a return authorization number from Biosystems prior to shipment.

THIS WARRANTY IS EXPRESSLY IN LIEU OF ANY AND ALL OTHER WARRANTIES AND REPRESENTATIONS, EXPRESS OR IMPLIED, INCLUDING BUT NOT LIMITED TO, THE WARRANTY OF FITNESS FOR A PARTICULAR PURPOSE. BIOSYSTEMS WILL NOT BE LIABLE FOR LOSS OR DAMAGE OF ANY KIND CONNECTED TO THE USE OF ITS PRODUCTS OR FAILURE OF ITS PRODUCTS TO FUNCTION OR OPERATE PROPERLY.

Instrument & Accessory Warranty Periods

Product(s)	Warranty Period
PhD ⁵ , PhD Lite, PhD Plus, PhD Ultra, Cannonball3, MultiVision, Toxi, Toxi/Oxy Plus, Toxi/Oxy Ultra, ToxiVision, Ex Chek	As long as the instrument is in service
ToxiPro [®] , MultiPro	2 years from date of purchase
ToxiLtd [®]	2 years after activation or 2 years after the "Must Be Activated By" date, whichever comes first
Toxi3Ltd [®]	3 years after activation or 3 years after the "Must Be Activated By" date, whichever comes first
Mighty-Tox	90 days after activation or 90 days after the "Must Be Activated By" date, whichever comes first
Mighty-Tox 2 Prorated credit is given towards repair or purchase of a new unit of the same type.	0 – 6 months of use 100% credit 6 – 12 months of use 75% credit 12 – 18 months of use 50% credit 18 – 24 months of use 25% credit
IQ Systems, Series 3000, Airpanel, Travelpanel, ZoneGuard, Gas✓Chek1 and Gas✓Chek4	One year from the date of purchase
Battery packs and chargers, sampling pumps and other components, which by their design are consumed or depleted during normal operation, or which may require periodic replacement	One year from the date of purchase

Sensor Warranty Periods

Instrument(s)	Sensor Type(s)	Warranty Period
PhD Plus, PhD Ultra, PhD ⁵ , PhD Lite, Cannonball3, MultiVision, MultiPro, ToxiVision, ToxiPro [®] , Ex Chek	O ₂ , LEL**, CO, CO+, H ₂ S & Duo-Tox	2 Years
	All Other Sensors	1 Year
Toxi, Toxi/Oxy Plus, Toxi/Oxy Ultra	CO, CO+, H ₂ S	2 Years
	All Other Sensors	1 Year
All Others	All Sensors	1 Year

** Damage to combustible gas sensors by acute or chronic exposure to known sensor poisons such as volatile lead (aviation gasoline additive), hydride gases such as phosphine, and volatile silicone gases emitted from silicone caulks/sealants, silicone rubber molded products, laboratory glassware greases, spray lubricants, heat transfer fluids, waxes & polishing compounds (neat or spray aerosols), mold release agents for plastics injection molding operations, waterproofing formulations, vinyl & leather preservatives, and hand lotions which may contain ingredients listed as cyclomethicone, dimethicone and polymethicone (at the discretion of Biosystems Instrument Service department) void Biosystems' Standard Warranty as it applies to the replacement of combustible gas sensors.