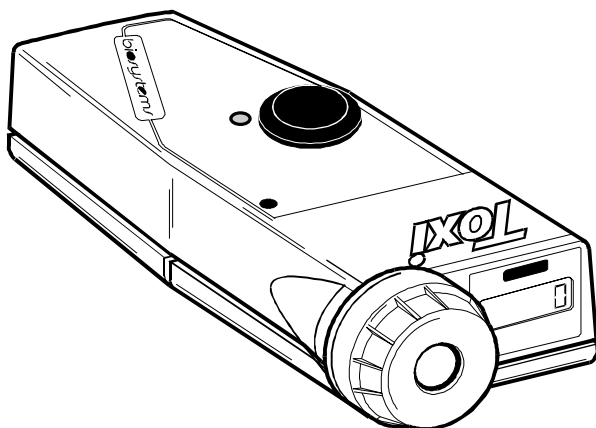


# Reference Manual

## Toxi Ultra

### Single Sensor Gas Detector



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Biosystems P/N: 13-045



# WARNING



THE TOXI ULTRA PERSONAL  
PORTABLE GAS DETECTOR 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.

**AVERTISSEMENT: LIRE ATTENTIVEMENT LES  
INSTRUCTIONS AVANT DE METTRE EN MARCHE.**

**Toxi Ultra Operation Manual**

**Version 3.62**

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**by**

**Biosystems**

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# Table of Contents

<b>INTRODUCTION.....</b>	<b>5</b>
<b>WARNINGS AND CAUTIONS.....</b>	<b>7</b>
<b>CHAPTER 1. TOXI ULTRA DESCRIPTION .....</b>	<b>9</b>
1.1. TOXI ULTRA CAPABILITIES.....	9
1.2. METHODS OF SAMPLING.....	9
1.3. SENSOR OPTIONS .....	9
1.3.1. <i>Electrochemical toxic sensors</i> .....	10
1.4. ONE BUTTON AUTO CALIBRATION .....	10
1.5. DISPLAY BACKLIGHT .....	10
1.6. ALARM LOGIC .....	11
1.6.1. <i>Atmospheric hazard alarms</i> .....	11
1.6.2. <i>Low battery alarms</i> .....	11
1.7. SPECIAL MICROPROCESSOR FEATURES.....	12
1.8. CLASSIFICATION FOR INTRINSIC SAFETY.....	12
1.9. OPTIONS .....	12
1.9.1. <i>Sensors</i> .....	12
1.9.2. <i>Vibrator alarm</i> .....	13
1.9.3. <i>Remote sample draw assembly</i> .....	13
1.9.4. <i>Training video</i> .....	13
1.9.5. <i>Computer Link Kit</i> .....	13
1.10 TOXI ULTRA DESIGN COMPONENTS .....	13
1.11. TOXI ULTRA ACCESSORIES .....	14
<b>CHAPTER 2. BASIC OPERATION.....</b>	<b>16</b>
2.1. OVERVIEW OF TOXI ULTRA OPERATION .....	16
2.1.1. <i>Operational warnings and cautions</i> .....	16
2.1.2. <i>Turning the Toxi Ultra on</i> .....	17
2.1.3. <i>Turning the Toxi Ultra off</i> .....	18
2.1.4. <i>Start-up sequence</i> .....	18
2.2. OPERATING MODES.....	19
2.2.2. <i>Basic mode</i> .....	19
2.2.3. <i>Technician mode</i> .....	20
2.2.4. <i>Changing operating modes</i> .....	21
2.3. TOXI ULTRA BATTERIES.....	22
2.3.1. <i>Low battery voltage alarms</i> .....	22
2.3.2. <i>Battery replacement</i> .....	22

2.4. METHODS OF SAMPLING.....	23
2.4.1. <i>Using the hand aspirated sample draw kit</i> .....	24
<b>CHAPTER 3. CALIBRATION .....</b>	<b>25</b>
3.1. VERIFICATION OF ACCURACY .....	25
3.1.1. <i>Effect of contaminants on Toxi Ultra sensors</i> .....	25
3.1.1.1. Effects of contaminants on toxic gas sensors .....	26
3.1.1.2. Biosystems “CO Plus” dual purpose carbon monoxide / hydrogen sulfide sensor .....	26
3.1.1.2.1. Relative response of the “CO Plus” sensor to carbon monoxide and hydrogen sulfide.....	27
3.2. FRESH AIR "ZERO" CALIBRATION .....	28
3.3. FUNCTIONAL (BUMP) TEST .....	28
3.4. AUTO-CALIBRATION .....	29
3.4.1. <i>Fresh air "zero" auto-calibration sequence</i> .....	29
3.4.1.1. Reading “Too High” or “Too Low” for zero adjust.....	30
3.4.2. <i>“Span” auto-calibration sequence</i> .....	30
3.5. MANUAL CALIBRATION PROCEDURE .....	32
3.5.1. <i>Fresh air "zero" through keypad buttons</i> .....	32
3.5.2. <i>Span calibration using keypad buttons</i> .....	33
3.5.3. <i>Calibration procedures for “corrosive gas” sensors</i> ....	35
<b>CHAPTER 4. SETTING ALARM LEVELS .....</b>	<b>37</b>
4.1. ALARM ADJUSTMENT SEQUENCE.....	37
4.2. “ALARM LATCH” COMMAND.....	38
4.3. RESTORING THE FACTORY DEFAULT ALARM SETTINGS .....	39
<b>CHAPTER 5. TOXI ULTRA ADVANCED FUNCTIONS.....</b>	<b>41</b>
5.1. TOXI ULTRA ADVANCED FEATURES OVERVIEW .....	41
<b>CHAPTER 6. RECORD KEEPING AND CONFIGURATION SOFTWARE .....</b>	<b>43</b>
6.1. HARDWARE SETUP .....	43
6.2. CONFIGURATION PROCEDURES .....	43
<b>CHAPTER 7: TROUBLE SHOOTING AND REPAIR.....</b>	<b>45</b>
7.1. CHANGING TOXI ULTRA SENSORS.....	45
7.2. TROUBLESHOOTING.....	45
7.2.1. <i>Unit will not turn on</i> .....	45
7.2.2. <i>Problem: Unit will not turn off</i> .....	46
7.2.3. <i>Problem: Sensor readings unstable</i> .....	46

7.2.4. Problem: Display is blank.....	46
7.2.5. Problem: No audible alarm.....	46
7.2.6. Problem: Keypad buttons (+, -, Cal, Alarm) don't work .....	46
7.2.7. Problem: Can't make a "One Button" auto zero.....	47
adjustment ("Too High" or "Too Low" for zero adjust).....	47
7.3. RETURNING YOUR TOXI ULTRA TO BIOSYSTEMS FOR SERVICE OR REPAIR.....	47
<b>APPENDIX A TOXIC GAS MEASUREMENT - CEILINGS, TWAS AND STELS.....</b>	<b>48</b>
<b>APPENDIX B HOW TO DETERMINE WHERE YOUR ALARMS SHOULD BE SET.....</b>	<b>50</b>
<b>BIOSYSTEMS TOXI ULTRA DEFAULT ALARM SETTINGS: .</b>	<b>52</b>
<b>APPENDIX C HOW TO CALIBRATE YOUR TOXI ULTRA IN CONTAMINATED AIR.....</b>	<b>52</b>
<b>APPENDIX D: SUGGESTED CALIBRATION GASES.....</b>	<b>54</b>
<b>APPENDIX E: PHD ULTRA TOXIC SENSOR CROSS SENSITIVITY DATA.....</b>	<b>55</b>
<b>APPENDIX F: TOXI ULTRA SENSOR RANGES .....</b>	<b>57</b>
<b>APPENDIX G: TOXILOG PROGRAMMABLE FEATURES.....</b>	<b>58</b>
<b>APPENDIX H: BIOSYSTEMS STANDARD WARRANTY FOR GAS DETECTION PRODUCTS.....</b>	<b>60</b>

## Introduction

The Toxi Ultra is a personal, portable, microprocessor controlled, single sensor gas detector. The hazard the Toxi Ultra is designed to detect is determined by the type of sensor installed at the time of purchase. The Toxi Ultra may be configured for the detection of carbon monoxide (CO), hydrogen sulfide (H<sub>2</sub>S), sulfur dioxide (SO<sub>2</sub>), ammonia (NH<sub>3</sub>), nitric oxide (NO), chlorine (Cl<sub>2</sub>), chlorine dioxide (ClO<sub>2</sub>), Phosphine (PH<sub>3</sub>) and nitrogen dioxide (NO<sub>2</sub>) or may be equipped with a dual purpose "CO Plus" sensor for the simultaneous measurement of both CO and H<sub>2</sub>S.

The Toxi Ultra uses a top-mounted LCD (liquid crystal display) to show readings of the gas being measured as well as other messages. An audible alarm and alarm light warn users of hazardous conditions. An optional vibrator type alarm is also available for use in high noise or other environments requiring additional warnings. A manually activated display back-light insures that the LCD may be easily read even in dim light conditions. The Toxi Ultra offers a choice of three modes of operation, ("OK", Basic and Technician) providing the right amount of information for users with different skill levels. Biosystems' "One Button" operating logic allows all procedures necessary for normal day-to-day operation, including fully automatic calibration adjustment, through use of the single on/off "Mode" button.

The Toxi Ultra is Classified by Underwriters Laboratories, Inc. and the Canadian Standards Association (pending) as to Intrinsic Safety for use in Hazardous Locations Class I, Division 1, Groups A, B, C, and D. Classification for intrinsic safety is based on tests conducted in explosive gas / air (21 % Oxygen) mixtures only.

**WARNING: SUBSTITUTION OF COMPONENTS MAY IMPAIR INTRINSIC SAFETY.**

**AVERTISSEMENT: LA SUBSTITUTION DE COMPOSANTS PEUT COMPROMETTRE LA SÉCURITÉ INTRINSÈQUE.**

**CAUTION: FOR SAFETY REASONS THIS EQUIPMENT MUST BE OPERATED AND SERVICED BY QUALIFIED PERSONNEL ONLY. READ AND UNDERSTAND THE INSTRUCTION MANUAL COMPLETELY BEFORE OPERATING OR SERVICING.**

**ATTENTION: POUR DES RAISONS DE SÉCURITÉ, CET ÉQUIPMENT DOIT ÊTRE UTILISÉ, ENTRETENU ET RÉPARÉ UNIQUEMENT PAR UN PERSONNEL QUALIFIÉ. ÉTUDIER LE MANUEL D'INSTRUCTIONS EN ENTIER AVANT D'UTILISER, 'ENTRETENIR OU DE RÉPARER L'ÉQUIPMENT.**

**CAUTION: ANY RAPID UP-SCALE READING FOLLOWED BY A DECLINING OR ERRATIC READING MAY INDICATE A GAS CONCENTRATION BEYOND UPPER SCALE LIMIT WHICH MAY BE HAZARDOUS.**

**AVERTISSEMENT: TOUTE LECTURE RAPIDE ET POSITIVE, SUIVIE D'UNE BAISSSE SUBITE AU ERRATIQUE DE LA VALEUR, PEUT INDIQUER UNE CONCENTRATION DE GAZ HORS GAMME DE DÉTECTION QUI PEUT ÊTRE DANGEREUSE.**



## **WARNINGS AND CAUTIONS**

- 1. Caution: The Toxi Ultra personal, portable gas detector has been designed for the detection of dangerous atmospheric conditions. An alarm condition indicating the presence of a potentially life threatening hazard 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.**

- 2. Caution: Hand aspirated remote sampling only provides continuous gas readings as long as the bulb is being squeezed.**
- 3. Caution: Accuracy of the Toxi Ultra must be checked with known concentration calibration gas before each day's use.**
- 4. Caution: Use of non-standard calibration materials may lead to dangerous error as well as voiding Biosystems standard warranty for gas detection products.**
- 5. Caution: The accuracy of the Toxi Ultra should be checked immediately following any known exposure to contaminants by testing with known concentration test gas before further use.**
- 6. Caution: Do not use multi-component calibration gas mixtures which contain both carbon monoxide and hydrogen sulfide when calibrating instruments with a "CO Plus" sensor installed.**
- 7. Warning: A sensor which cannot be calibrated or which is found to be out of tolerance should be replaced**

immediately. An instrument which 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.

8. **Warning:** Do not reset the calibration gas concentration unless you are using a calibration gas concentration which differs from that normally supplied by Biosystems for use in calibrating your instrument.

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

9. **Warning:** Use of non-standard calibration gas and / or calibration kit components when calibrating your Toxi Ultra can lead to dangerously inaccurate readings and may void the standard Biosystems warranty.

Biosystems offers calibration kits and long lasting cylinders of test gas specifically developed for easy Toxi Ultra calibration. Customers are strongly urged to use only Biosystems calibration materials when calibrating their Toxi Ultra.

10. **Warning:** If a new sensor type is selected verify that it has been properly installed. The new sensor must be calibrated before use.
11. **Warning:** Resetting the toxic sensor bias voltage requires opening the instrument and adjusting dip switches located on the main circuit board of the detector. This procedure should not be done by unauthorized persons. In many cases it may be better to return the detector to the factory for adjustment. Please call the factory for further information.

# Chapter 1. Toxi Ultra Description

## 1.1. Toxi Ultra capabilities

The Toxi Ultra gas detector design includes many user selectable features. The Toxi Ultra is designed to 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.

## 1.2. Methods of sampling

The Toxi Ultra may be used as either a "Diffusion" or "Sample-Draw" type monitoring device.

In normal operation, the Toxi Ultra detector is worn on the belt, clipped into the user's shirt pocket, suspended on the neck lanyard, or held by hand. Once turned on, the Toxi Ultra monitors continuously. The atmosphere being measured gets to the sensor by diffusing through a dust and water resistant protective filter directly into the sensor. Normal air movements are enough to carry the sample to the sensor. The sensor reacts to changes in the concentration of the hazard being measured. Values are constantly updated and displayed on the Toxi Ultra LCD.

This type of "diffusion" operation monitors only the atmosphere which immediately surrounds the detector.

It is possible to use a sample draw kit to obtain readings from locations which are remote from the instrument. A hand-operated squeeze-bulb is used to draw the sample in through a probe assembly, and suck it through a length of hose back to the instrument. **Use of the sample draw kit is covered in section 2.4.**

## 1.3. Sensor options

The Toxi Ultra can be configured to monitor for any one of several different atmospheric hazards. The hazard the Toxi Ultra is designed to detect is determined by the sensor. The type of sensor must be specified at the time the instrument is purchased. The types of sensors currently available include substance-specific electrochemical sensors for the detection of carbon monoxide (CO), hydrogen sulfide (H<sub>2</sub>S), sulfur dioxide (SO<sub>2</sub>), ammonia (NH<sub>3</sub>), nitric oxide (NO), chlorine (Cl<sub>2</sub>), chlorine dioxide (ClO<sub>2</sub>), Phosphine (PH<sub>3</sub>) and nitrogen dioxide (NO<sub>2</sub>). In addition, a dual purpose "CO Plus" sensor for the simultaneous detection of both CO and H<sub>2</sub>S is also available for occasions when a single sensor detector must be used to monitor for the presence of multiple hazards. Toxic gas readings are given in ppm (parts per million) concentrations.

### 1.3.1. Electrochemical toxic sensors

The Toxi Ultra uses highly specific, electrochemical toxic sensors that have been designed to minimize the effects of common interfering gases. Biosystems uses substance specific sensors to provide accurate, dependable readings for carbon monoxide (CO), hydrogen sulfide (H<sub>2</sub>S), sulfur dioxide (SO<sub>2</sub>), ammonia (NH<sub>3</sub>), nitric oxide (NO), chlorine (Cl<sub>2</sub>), chlorine dioxide (ClO<sub>2</sub>), Phosphine (PH<sub>3</sub>) and nitrogen dioxide (NO<sub>2</sub>). In addition to these substance specific sensors, Biosystems also offers the "CO Plus" electrochemical sensor. The CO Plus sensor is a dual purpose sensor designed to simultaneously respond to both to CO and H<sub>2</sub>S.

**Contact the factory for additional information concerning the appropriateness of the "CO Plus" sensor for specific applications.**

### 1.4. One Button Auto Calibration

The Toxi Ultra detector has been designed for easy verification of accuracy. Biosystems' "One Button" logic means that all normal day-to-day operating procedures, including automatic calibration adjustment, may be undertaken through the use of the single on/off Mode button.



**Caution:  
Accuracy of the  
Toxi Ultra should  
be checked with  
known**

**concentration calibration gas  
before any daily period of  
use.**

Calibration is a two step procedure. In the first step the Toxi Ultra is taken to an area where the atmosphere is fresh and a "zero" adjustment is made automatically on-demand by pressing the on/off Mode button. The second step of the calibration procedure is the sensor response or "span" adjustment. In this step the toxic sensor is exposed to known concentration calibration gas. If the instrument notes there is a deviation from the expected response, it will automatically adjust itself so that the readings match the concentration of the gas being used.

**Calibration procedures are  
discussed in detail in  
Chapter 3.**

### 1.5. Display backlight

A manually activated display back-light allows the LCD to be read even in dim light conditions. Pressing the on/off Mode button once at any time during normal operation causes the back-light to be activated for 10 seconds. In the event of a gas alarm the backlight turns on automatically and remains on until the alarm condition clears.

## 1.6. Alarm logic

Toxi Ultra alarms are user adjustable and may be set anywhere within the range of the sensor. When an alarm set point is exceeded a two-toned audible alarm sounds, a bright red LED alarm light flashes, and (if equipped) the optional vibrator type alarm is activated.

Toxi Ultra alarms are normally of the self-resetting type. When readings drop back below the pre-set alarm levels, the instrument reverts back to normal operation, and the visual and audible alarms cease.

It is possible, if desired, to set Toxi Ultra alarms so that they "latch." In the latched condition, once an alarm occurs both visual and audible alarms continue to sound even after the atmospheric hazard has cleared. The instrument must be manually reset before the alarms are silenced.

**Procedures for latching Toxi Ultra alarms are given in Section 4.2.**

### 1.6.1. Atmospheric hazard alarms

**Caution: The Toxi Ultra personal, portable gas detector has been designed for the detection of dangerous atmospheric conditions. An alarm condition indicating the presence of a potentially life threatening hazard 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.**

Three alarm set-points have been provided for Toxi Ultra detectors: TWA (Time Weighted Average), STEL (Short Term Exposure Limit), and Ceiling. Toxi Ultra alarm settings are set at the factory in the most conservative way possible.

**The procedures for adjusting alarm set points or restoring the factory default settings are given in Chapter 4.**

### 1.6.2. Low battery alarms

The Toxi Ultra uses 3 AAA alkaline batteries for power. A fresh set of batteries should provide up to 1,500 hours of normal operation.



When it is time to replace the batteries a "B" will appear in the lower left hand corner of the display screen, and the audible alarm will "beep" once per minute until the battery is replaced. The user should have approximately one to two weeks of useful life remaining. Batteries should be replaced as

soon as possible after any low battery message is displayed.

**Section 2.3 of the Toxi Ultra owner's manual covers battery replacement procedures.**

**1.7. Special microprocessor features**

Several automatic programs prevent tampering and misuse of the Toxi Ultra by unauthorized persons. Each time the detector is turned on, an electronic self-test is performed that assures the user of proper performance. The sensor, LED alarm light, and audible alarm are automatically evaluated, and the battery is monitored continuously for proper voltage.

It is also possible to make use of optional setup choices such as changing the concentration of the gas that is used during Auto Calibration adjustment and changing or restoring the factory alarm settings by using the 4 push-buttons on the instrument keypad.

The Toxi Ultra automatically remembers (logs) gas readings, as well as other important information such as turn-on / turn-off times, and whenever the instrument is calibrated.

The Toxi Plus can store up to 3,000 data points, enough for the storage of up to 50 hours of gas monitoring broken into as many as 300 individual monitoring "sessions." User selectable data-logging intervals

allow the collection of data for even longer duration monitoring projects.

**Chapter 5 describes how to use these advanced technical features and setup choices in greater detail. Chapter 6 describes record keeping, downloading, and other datalogging functions.**

**1.8. Classification for intrinsic safety**

The Toxi Ultra is Classified by Underwriters Laboratories, Inc., and the Canadian Standards Association (pending) as to Intrinsic Safety for use in Hazardous Locations Class I, Division 1, Groups A, B, C, & D.

**Classification for intrinsic safety is based on tests conducted in explosive gas / air (21 % Oxygen) mixtures only.**

**1.9. Options**

**1.9.1. Sensors:**

Toxi Ultra detectors may be configured for the detection of carbon monoxide (CO), hydrogen sulfide (H<sub>2</sub>S), sulfur dioxide (SO<sub>2</sub>), ammonia (NH<sub>3</sub>), nitric oxide (NO), chlorine (Cl<sub>2</sub>), chlorine dioxide (ClO<sub>2</sub>), Phosphine (PH<sub>3</sub>) and nitrogen dioxide (NO<sub>2</sub>) or equipped with a "CO Plus" sensor for the simultaneous measurement of both CO *and* H<sub>2</sub>S. The sensor selected must be specified at the time of purchase.

### **1.9.2. Vibrating alarm**

An internally mounted vibrator type alarm is optionally available for use in high noise or other environments requiring additional warnings. The vibrator alarm option must be specified at the time the instrument is purchased.

### **1.9.3. Remote sample draw assembly**

An optional hand aspirated (squeeze bulb) sample draw kit is available for use in situations where the sample must be obtained from locations which are remote from the instrument. The sample draw kit consists of a sample draw adapter, squeeze bulb, sample probe assembly, spare filters, and 10 feet of sample tubing.

### **1.9.4. Training video**

A comprehensive 25 minute training video is available to augment and support the written Owner's Manual.

### **1.9.5. Computer Link Kit**

A Toxi Ultra Gas Detection Database program and Computer Link Kit is optionally available, and recommended for users wishing to interface their Toxi Ultra with a computer. Biosystems Gas Detection Database Software allows recorded information to be downloaded to a computer to create a permanent record, or used to automatically generate and print reports, tables and graphs of time history data. The software also allows records to be exported to a

spreadsheet or "comma delimited" database files.

## **1.10 Toxi Ultra design components**

**(1) Case:** The instrument is enclosed in a durable, gasketed case constructed of a metal plated ABS / polycarbonate material.

**(2) LCD display:** A top mounted liquid crystal display (LCD) meter allows display of readings, messages, and other information. A manually activated back-light insures that the LCD may be easily read even in dim light conditions.

**(3) Alarm light:** A bright red top-mounted LED (light emitting diode) alarm light visually warns users when an alarm level is exceeded.

**(4) Audible alarm:** A loud two-toned audible alarm is also provided to warn users of hazardous conditions.

**(5) Mode button:** The on/off "Mode" button is used to turn the instrument on and off as well as control most other functions.

**(6) Protective cap:** A protective O-ring sealed cap and moisture barrier filter are protect the sensor from damage.

**(7) Sensor:** The top-mounted sensor may be easily accessed for replacement or repair.

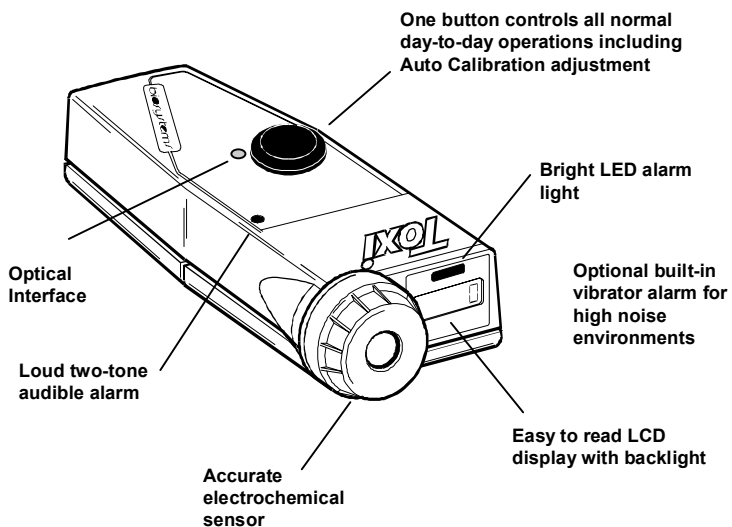
**(8) Bottom surface:** The stainless steel belt clip may be removed to allow access to the 4 hidden push-buttons ("Cal," "Alarm," "+," and "-") used to control advanced functions.

**(9) Optical interface:** The optical interface is used with the optional datalink kit to provide direct communication between the Toxi Ultra and a personal computer.

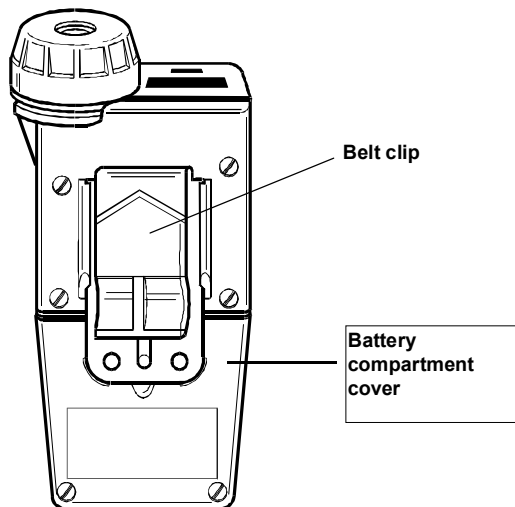
### **1.11. Toxi Ultra accessories**

Toxi Ultra detectors are shipped complete with sensor, belt clip, set of three AAA alkaline batteries (installed), alligator clip and lanyard, weather cover, calibration adapter, training video, owner's manual and quick reference card.

Optional Toxi Ultra accessories include sample draw kit, and internally mounted vibrator alarm (vibrator option must be specified at time of purchase).



**Figure 1.3: Toxi Ultra external features**



**Figure 1.4: Toxi Ultra bottom surface**

## Chapter 2. Basic operation

### 2.1. Overview of Toxi Ultra operation

The Toxi Ultra offers a choice of three modes of operation, "Text Only," "Basic," and "Technician". Which mode is selected is a function of how much information is required, the skill level of the user, and the nature of the job.

Whatever operating mode is selected, the Toxi Ultra automatically remembers (logs) gas readings, as well as other important information such as turn-on / turn-off times, and whenever the instrument is calibrated.

This information may be downloaded to a computer to create a permanent record by means of the optional Biosystems Gas Detection Database Software and Data Link Kit. Although it is not necessary to make use of this saved information, it is there and available to the user.

#### 2.1.1. Operational warnings and cautions

**1. Caution: The Toxi Ultra personal, portable gas detector has been designed for the detection of dangerous atmospheric conditions. An alarm condition indicating the presence of a potentially life threatening hazard 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.**

**2. Caution: Hand aspirated remote sampling only provides continuous gas readings as long as the bulb is being squeezed.**

**3. Caution: Accuracy of the Toxi Ultra must be checked with known concentration calibration gas before each day's use.**

**4. Caution: Use of non-standard calibration materials may lead to dangerous error as well as voiding Biosystems standard warranty for gas detection products.**

**5. Caution: The accuracy of the Toxi Ultra should be checked immediately following any known exposure to contaminants by testing with known concentration test gas before further use.**

**6. Caution: Do not use multi-component calibration gas**

mixtures which contain both carbon monoxide and hydrogen sulfide when calibrating instruments with a "CO Plus" sensor installed. **Caution:** The "Cal" button must be held down until the screen indicates that span calibration has been successfully completed.

**7. Warning:** A sensor which cannot be calibrated or which is found to be out of tolerance should be replaced immediately. An instrument which 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.

**8. Warning:** Do not reset the calibration gas concentration unless you are using a calibration gas concentration which differs from that normally supplied by Biosystems for use in calibrating your instrument.

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

**9. Warning:** Use of non-standard calibration gas and / or calibration kit components when calibrating your Toxi Ultra can lead to dangerously inaccurate readings and may void the standard Biosystems warranty.

Biosystems offers calibration kits and long lasting cylinders of test gas specifically developed for easy Toxi Ultra calibration. Customers are strongly urged to use only Biosystems calibration materials when calibrating their Toxi Ultra.

**10. Warning:** If a new sensor type is selected verify that it has been properly installed. The new sensor must be calibrated before use.

**11. Warning:** Resetting the toxic sensor bias voltage requires opening the instrument and adjusting dip switches located on the main circuit board of the detector. This procedure should not be done by unauthorized persons. In many cases it may be better to return the detector to the factory for adjustment. Please call the factory for further information.

#### **2.1.2. Turning the Toxi Ultra on**

The black switch on the top of the Toxi Ultra case is called the "Mode" button. It is used to turn the Toxi Ultra on and off, as

well as to control most other operations of the instrument. Press and hold the mode button for one second to turn the Toxi Ultra on.

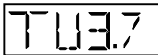
### 2.1.3. Turning the Toxi Ultra off

Turn the Toxi Ultra off by pressing and holding the mode button down for 3 seconds.

### 2.1.4. Start-up sequence

After the detector has been turned on, it will automatically go through an electronic self test and start up sequence that takes approximately twenty seconds. During the self test sequence the LCD backlight will be activated, the visual LED alarm light will flash, the audible alarm will sound, and (if equipped) the optional vibrator alarm will briefly activate. During start-up the LCD display will also show several messages or "screens" in sequence.

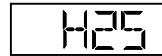
The first screen displays the software version number:



TU3.7

(Note: The software version installed may differ with that shown above. If the version starts with TU the sensors supported are CO, H2S, SO2, CO+, NO, NO2, NH3 and Cl2. If the version starts with TE the sensors supported are CO, H2S, CO+, Cl2, CLO2 and PH3)

The second shows the type of sensor installed:



H2S

Additional screens will briefly appear indicating the current peak, STEL, and TWA alarm set-points. For instance, a H2S Toxi Ultra being operated in the Technician mode would show the following sequence of factory installed (default) alarm set points when the instrument is first turned on:



PEAK



ALARM



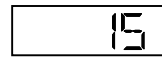
10



STEL



ALARM



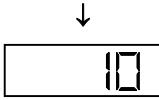
15



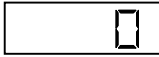
TWA



ALARM



This screen is followed by one which shows the current (actual) readings for the gas being measured. This screen cycles back and forth between another which identifies the type of gas being measured:



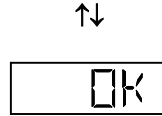
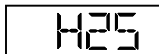
Note: The alarm set-point screens are omitted when the instrument is turned on while in the "Basic" or "Text Only" modes.

## 2.2. Operating modes

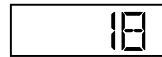
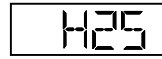
Three operating modes provide Toxi Ultra users with the right amount of information to meet their monitoring needs. The Toxi Ultra is designed to be as simple or as sophisticated as the job that needs to be done.

### 2.2.1. Text Only mode

The simplest mode of operation is the "Text Only" mode. In this mode, during normal operation the LCD screen does not display numerical readings, only the indication "OK". This screen cycles back and forth between another which identifies the type of gas being measured.



If an alarm condition occurs, that is, when the sensor readings exceed a pre-set alarm level, the indication changes from "OK" to the numerical value, the LED alarm light flashes, the audible alarm sounds, and (if equipped) the optional vibrator alarm is activated.



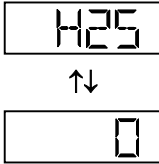
Toxi Ultra alarms are normally self-resetting. When readings drop back below the pre-set alarm levels, the screen reverts back to the "OK" indication, and visual and audible alarms cease.

### 2.2.2. Basic mode

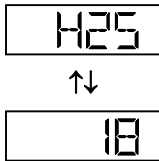
The "Basic" mode of operation is designed for users with a higher level of understanding, and a need for numerical readings, but who are not experts in gas detection. In the Basic mode, as in the Text Only mode, the user has access to only one "screen" of information; the current gas readings. The major difference between the two modes is that in the Basic mode numerical gas level readings are provided, whereas in the Text Only mode

only an indication that conditions are "OK" is provided during normal operation.

Basic mode current gas level screen:



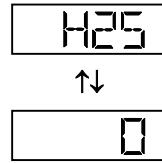
If an alarm condition occurs, that is, when sensor readings exceed a pre-set alarm level, the numerical reading changes to reflect the new value, the LED alarm light flashes, and the audible alarm sounds.



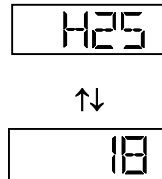
Toxi Ultra alarms are normally self-resetting. When readings drop back below the pre-set alarm levels, visual and audible alarms cease, and normal operation of the instrument resumes.

### 2.2.3. Technician mode

The "Technician Mode" provides access to all advanced functions and displays. When the instrument is turned on while in the Technician Mode, after the completion of the start-up and self-test sequence, the meter display will show numeric readings of the gas being measured.



If an alarm condition occurs, that is, when one of the sensor readings exceeds a pre-set alarm level, the numerical reading changes to reflect the new value, the LED alarm light flashes, and the audible alarm sounds.



Toxi Ultra alarms are normally self-resetting. When readings drop back below the pre-set alarm levels, visual and audible alarms cease, and normal operation of the instrument resumes.

Pressing the black mode button while in the Technician Mode allows the user to toggle between other available meter display screens. Several additional screens are available to the user in the Technician mode.

The first screen is the gas level display discussed above. Pressing the mode button once displays the peak reading of the gas being measured since the instrument was switched on.

PEAK



18

Pressing the mode button again displays the STEL (Short Term Exposure Level) of the toxic gas being measured. Since STEL calculations are made using the most recent fifteen minute monitoring interval, it is not possible to compute a toxic gas STEL until the Toxi Ultra has been monitoring for at least fifteen minutes. Until the minimum monitoring time has elapsed, the STEL screen will show an "X" where the reading should be.

STEL



X

Anytime after the first fifteen minutes have elapsed, the STEL screen will show the appropriate numerical value.

STEL



9

Pressing the mode button again displays TWA (Time Weighted Average) exposure levels. TWA values are calculated by projecting exposures over an eight hour period. It is not

possible to compute a toxic gas TWA until the Toxi Ultra has been monitoring for at least one hour. Until the minimum monitoring time has elapsed, the TWA screen will show an "X" where the reading should be.

TWA



X

Anytime after an hour has elapsed, the TWA screen will show the appropriate numerical value.

TWA



9

Pressing the mode button again toggles the display back to the first screen showing current gas levels.

No matter which mode is selected, anytime the Toxi Ultra is on it is remembering the peak readings of all gases measured, and is calculating both long term Time Weighted Averages and Short Term Exposure Levels (for toxic gas reading detectors) and will go into alarm whenever appropriate.

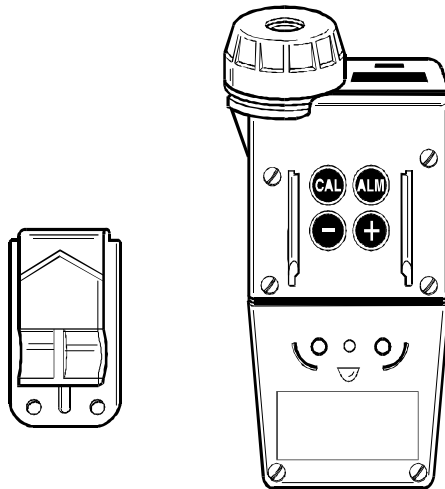
#### 2.2.4. Changing operating modes

It is easily possible to shift from one operating mode to another while the instrument is in use

without effect on the on-going calculations used to determine Peak, STEL and TWA alarms. It is not necessary to turn the instrument off before switching. Simply remove the belt clip on the bottom of the instrument to expose the four mini-push-buttons, and simultaneously press and hold the "+" and "-" buttons until the word "MODE" is displayed. Each time the

operating mode is changed the display screen will briefly indicate which operating mode has been selected.

**Shifting modes or otherwise reprogramming the instrument should only be done by employees who are authorized to do so.**



**Figure 2.2. Toxi Ultra with belt clip removed exposing the four keypad push-buttons**

### **2.3. Toxi Ultra batteries**

The Toxi Ultra uses a set of three AAA disposable alkaline batteries. A fresh set of batteries should allow up to 1,500 hours of operation.

#### **2.3.1. Low battery voltage alarms**

When it is time to replace the batteries a "B" will appear in the

lower left hand corner of the display screen, and the audible alarm will "beep" once per minute until the batteries are replaced. The user should have approximately one to two weeks of useful life remaining.

#### **2.3.2. Battery replacement**

Toxi Ultra batteries should be replaced as soon as possible

after a low battery ("B") message has been noticed.

Use the following procedure to change the batteries.

- (1) Make sure the instrument is turned off before replacing batteries.
- (2) Remove the belt clip from the bottom of the instrument by sliding it completely free of the belt clip mounts.
- (3) Loosen and remove the two screws securing the battery compartment cover to the instrument case. (The screws must be completely removed before the battery compartment cover can be detached from the instrument case.)
- (4) Gently remove the battery compartment cover by sliding it backwards then lifting it free from the instrument case.
- (5) Remove the old batteries.
- (6) Make sure the battery terminals are clean.
- (7) Install the new batteries. (Make sure that the batteries are aligned in the correct directions, and that all battery polarities are correct.)

If the batteries are removed for an extended period, a stabilization period will be required for the sensors before the instrument can be returned to use.

Sensor	Stabilization Period
All Toxic sensors except NH <sub>3</sub> and NO	15 minutes
54-08-04 NH <sub>3</sub> Sensor and 54-08-06 NO Sensor	24 hours

**Note: If the batteries are replaced immediately, the stabilization period can be largely reduced.**

- (8) Replace the battery compartment cover, screws, and belt clip.
- (9) Using the BioTrak software reset the date and time. See **section 4.4.** of the BioTrak manual for more information.
- (10) Accuracy of the Toxi Ultra detector must be verified by exposure to known concentration test gas before the instrument is put back into service.**

#### 2.4. Methods of sampling

The Toxi Ultra may be used as either a "Diffusion" or "Sample-Draw" type monitoring device.

In normal operation, the Toxi Ultra detector is worn on the belt, clipped into a shirt pocket, suspended from the neck lanyard, or held by hand. Once turned on, the Toxi Ultra monitors continuously. The

atmosphere being measured gets to the sensor by diffusing through a protective moisture barrier filter. Normal air movements are enough to carry the sample to the sensor.

The sensor reacts to changes in the concentration of the gas being measured. Values are constantly updated and logged by the Toxi Ultra detector, while readings are displayed on the LCD meter. This type of "diffusion" operation monitors



only the atmosphere which immediately surrounds the detector.

It is possible to use the Toxi Ultra to sample locations which are away or remote from the instrument by using a sample draw kit. The Toxi Ultra kit uses hand-aspirated squeeze bulb to draw a sample-back to the instrument through a hose and probe assembly.

#### **2.4.1. Using the hand aspirated sample draw kit**

- (1) Connect the slip-on sample draw cup with the squeeze bulb and hose assembly.

(Connect the end of the short length of hose closest to the bulb to the sample draw cup. Connect the other end of the hose to the sample probe.)

- (2) Cover the end of the sample draw probe assembly with a finger, and squeeze the aspirator bulb.

If there are no leaks in the sample draw kit components, the bulb should stay deflated for a few seconds.

- (3) Insert the end of the sample probe into the location to be sampled.
- (4) Squeeze the aspirator bulb several times to draw air from the remote location to the sensor compartment. Allow one squeeze of the bulb for every one foot of sampling hose.

**Caution: Hand aspirated remote sampling only provides continuous gas readings as long as the bulb is being squeezed.**

Each time a reading is desired, it is necessary to squeeze the bulb a sufficient number of times to bring a fresh sample to the sensor.

## Chapter 3. Calibration

The Toxi Ultra detector has been designed for easy calibration. A single button, the on / off "Mode" switch, is used to enter the "Auto-Calibration" mode, and automatically make all calibration adjustments.

It is also possible to manually calibrate the instrument by using simple push-button controls located on the instrument key-pad.

**"One-Button Auto-Cal" procedures are discussed in Section 3.4. Manual calibration procedures are discussed in Section 3.5.**

### 3.1. Verification of accuracy



**Caution:**  
**Accuracy of the Toxi Ultra must be checked with**

**known concentration calibration gas before each day's use.**

Verification of accuracy is a two step procedure. In the first step the Toxi Ultra is taken to an area where the atmosphere is fresh and the readings are checked. If the readings differ from those expected in fresh air a "zero"

adjustment must be made. The second step is to make sure the sensor is accurate by exposing it to known concentration test gas and noting the response. If the readings are accurate, it is safe to use the instrument with no further adjustment. If the readings are accurate, that is, if the instrument readings are within  $\pm 10\%$  of the expected value for the gas being used, there is no need to adjust your gas detector. If the readings are inaccurate, the instrument should be "Span" adjusted before further use.

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



**Caution: Use of non-standard calibration materials may lead to dangerous error as well as voiding Biosystems standard warranty for gas detection products.**

#### 3.1.1. Effect of contaminants on Toxi Ultra sensors

The atmosphere in which the Toxi Ultra monitor is being used can have an effect on the

sensor. Sensors may be poisoned or suffer degraded performance if exposed to certain substances.



**Caution: The accuracy of the Toxi Ultra should be**

**checked immediately following any known exposure to contaminants by testing with known concentration test gas before further use.**

#### **3.1.1.1. Effects of contaminants on toxic gas sensors**

Biosystems “substance-specific” electrochemical used to measure CO, H<sub>2</sub>S, SO<sub>2</sub>, NH<sub>3</sub>, NO, Cl<sub>2</sub>, ClO<sub>2</sub>, PH<sub>3</sub>, NO<sub>2</sub>, and HCN 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 be incidentally present. For instance, a “substance-specific” carbon monoxide sensor is deliberately designed not to respond to other gases which may be present at the same time, such as hydrogen sulfide or 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 which are higher than actual. In some cases the interference may be negative and produce readings which are lower than actual.

**Cross sensitivity of Toxi Ultra toxic sensors to common interfering gases is listed in Appendix E.**

#### **3.1.1.2. Biosystems “CO Plus” dual purpose carbon monoxide / hydrogen sulfide sensor**

Carbon monoxide and hydrogen sulfide are the two most widely occurring toxic gases found in the industrial workplace. In addition to “substance specific” sensors designed to measure these toxic hazards, Biosystems also offers a dual purpose sensor designed to simultaneously detect both carbon monoxide *and* hydrogen sulfide. The “CO Plus” sensor is ideal for situations requiring use of a single sensor to monitor simultaneously for both toxic hazards.

The “CO Plus” sensor has been designed to respond to both carbon monoxide and hydrogen sulfide, and can be calibrated for the direct detection of either

hazard. Since the sensor has been designed to respond to both hazards at once, it cannot discriminate between or tell which of the two gases is producing the reading. The sensor can't tell which hazard is present in what specific concentrations, but it will give an immediate indication whenever conditions become unsafe.

**Note: When a specific contaminant such as hydrogen sulfide is known to be potentially present the best approach is usually to use a direct reading substance specific sensor. If hydrogen sulfide is known to be potentially present, the sensor selected should be specifically for the detection of H<sub>2</sub>S, and calibrated directly to this hazard.**



**Caution: Do not use multi-component calibration gas mixtures which contain both carbon monoxide and hydrogen sulfide when calibrating instruments with a “CO Plus” sensor installed.**

Biosystems “CO Plus” sensors are designed for the simultaneous detection of both carbon monoxide and hydrogen sulfide. The calibration gas used to calibrate “CO Plus”

sensors may contain only one of these two gases. If a “CO Plus” sensor is calibrated with a mixture that contains both carbon monoxide and hydrogen sulfide readings may be dangerously low.

Biosystems multi-component calibration gas mixtures which contain both carbon monoxide and hydrogen sulfide are labeled as “Not for use with CO Plus sensors”.

**Note: “CO Plus” sensors are normally calibrated to carbon monoxide. The calibration gas normally used contains a mixture of 50 ppm CO.**

#### **3.1.1.2.1. Relative response of the “CO Plus” sensor to carbon monoxide and hydrogen sulfide**

A “CO Plus” sensor which has been properly calibrated to carbon monoxide will be exactly accurate for that substance. OSHA (1989) permissible exposure limits for carbon monoxide specify an 8 hour TWA limit of 35 ppm. If the “CO Plus” sensor is calibrated to carbon monoxide then exposed to 35 ppm carbon monoxide the reading will be 35 ppm.

The “CO Plus” sensor will also show a “relative response” to other interfering gases. When calibrated on carbon monoxide the relative response of the “CO Plus” sensor to hydrogen sulfide

is a ratio of about 3.5 to 1.0. This means a concentration of about 10 ppm hydrogen sulfide would produce a "CO+" sensor reading of 10 X 3.5 or 35 ppm.

This is a very convenient relative response. The 8 hour TWA permissible exposure limit for hydrogen sulfide is 10 ppm. This means that the "CO+" gas alarms will be tripped any time the concentration of hydrogen sulfide exceeds the permissible exposure limit.

**Note: Cross sensitivity of the "CO Plus" sensor to carbon monoxide, hydrogen sulfide and other common interfering gases is listed in Appendix E.**

### **3.2. Fresh air "zero" calibration**

The fresh air "zero" must be done in fresh, uncontaminated air. In this procedure the instrument automatically adjusts its readings to match the concentrations present in fresh air. Fresh air should contain 0 parts-per-million toxic gas.

If the Toxi Ultra cannot be taken to an area where the air is fresh, or if it is not certain whether or not the air is uncontaminated, special procedures are required. These procedures are discussed at greater length in **Appendix C**. The second step is to verify the accuracy of the sensor by exposing it to known concentration test gas.

### **3.3. Functional (bump) test**

A simple functional (bump) test is all that is needed to verify accuracy.

To perform a functional (bump) test, turn the Toxi Ultra on, and wait at least three minutes to allow the readings to fully stabilize. Make sure the instrument is located in fresh air. Check to see that the readings match the concentrations present in fresh air. If the Toxi Ultra is operated in either the Basic or Technician mode readings should equal 0 ppm. If the instrument is operated in the Text Only mode all readings should indicate conditions are "OK". If necessary, fresh air zero the instrument using the procedures discussed in **Section 3.4.1**.

Slip on the calibration adapter as discussed in **Section 3.4.2**, and flow calibration gas to the sensor. Wait for the readings to stabilize. (Forty-five seconds to three minutes is usually sufficient.) Note the readings. If the readings are accurate it is safe to use the instrument without further adjustment.

**Readings which are more than 10 percent higher or any amount lower than expected indicate the instrument must be adjusted using the "span" calibration procedures discussed in Section 3.4.2 before further use.**

**Note: It is necessary to be in either the Basic or Technician operating mode in order to make calibration adjustments. When the instrument is operated in the Text Only "OK" mode a functional (bump) test is the procedure used to verify accuracy. If the readings are accurate, it is safe to use the instrument with no further adjustment.**

### **3.4. Auto-calibration**

Biosystems "One-Button Auto-Calibration" mode may be used to verify accuracy any time during normal operation while the instrument is being used in either the Basic or Technician operating mode.

Pressing the on / off Mode button 3 times in rapid sequence places the instrument in the "Auto-Calibration" mode. Once in the Auto Calibration mode the adjustments are made automatically.

Auto-calibration is a two step procedure. In the first step the Toxi Ultra is taken to an area where the atmosphere is fresh and a "zero" adjustment is made automatically by pressing the on / off mode button. The second step is the sensor response or "span" calibration adjustment. In this step the accuracy of the Toxi Ultra sensor is established by exposing it to known

concentration calibration gas. Once again, the sensitivity or "span" is automatically adjusted by pressing the on / off mode button.

#### **3.4.1. Fresh air "zero" auto-calibration sequence**

The fresh air zero procedure may only be done while the instrument is being operated in either the Technician or Basic operating mode.

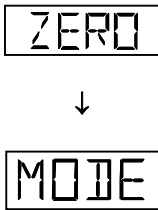
- (1) Turn the instrument on and make sure gas readings are given in numbers.

If readings are given in the form of "OK" text messages the instrument is currently being operated in the "Text Only" mode. It will be necessary to change to either the Basic or Technician operating mode. Switch modes (if necessary) by simultaneously holding down the "+" and "-" key as discussed in **Chapter 2**. Each time the operating mode is changed, the LCD screen will briefly indicate the current operating mode.

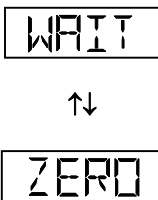
- (2) Wait at least three minutes after turning the instrument on to allow sensor readings to stabilize fully **before** initiating auto-calibration procedures.

- (3) Make sure the instrument is located in an area where the air is known to be fresh.
- (4) Press the mode button 3 times within two seconds. This will "wake up" the instrument from normal operation, and put it into the "Auto-Calibration" mode.

A screen will briefly display the message "ZERO MODE".



- (5) Pressing the mode button within five seconds causes the fresh air adjustment to be made. (If the Mode button is not pushed within 5 seconds, the instrument will return to normal operation.) The screen will show the message "WAIT ZERO" while the adjustment is being completed.



- 6) After successful completion of the "zero" auto-calibration, the display will prompt you with the message "SPAN MODE" to continue with a span calibration adjustment.

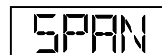
#### 3.4.1.1. Reading "Too High" or "Too Low" for zero adjust

To reduce the chances of the Toxi Ultra being inadvertently zeroed in contaminated air, only small adjustments are allowed through the use of the "One Button" auto-zero sequence. If the necessary adjustments are too large the display will indicate that the reading is too Low or too high for zero adjustment. In this case the instrument must be fresh air zeroed using the "Cal" button on the instrument keypad and procedures discussed in **Section 3.5.1.** of this manual.

Once the instrument has been successfully zeroed using the "Cal" button, subsequent calibration adjustments may be made using the mode button and "One Button Auto Cal" logic discussed in this section.

#### 3.4.2. "Span" auto-calibration sequence

After successful completion of the "zero" auto-calibration adjustment the display will show the message "SPAN MODE".





MODE

If the mode button is not pushed within five seconds a span calibration adjustment will not be made, and the instrument will be returned to normal operation.

- (1) Press the mode button within 5 seconds to initiate “span” auto-calibration. A screen will ask you to “FLOW GAS”. The instrument will continue to display this screen until it determines that calibration gas has been applied.

FLOW



GAS

**Note: It is possible to exit the auto-calibration mode at any time prior to completion by pressing and holding down the mode button for 3 seconds to turn the instrument off.**

- (2) Attach the cylinder of calibration gas, regulator, short section of tubing and

calibration adapter to the Toxi Ultra detector.

Note: Make sure the regulator, cylinder seating surfaces, and threads are clean and dry when attaching the regulator to the cylinder of gas. Introduction of contaminants through the regulator fittings may alter or degrade the concentration of the gas contained in the cylinder.

The regulator will automatically begin flowing calibration gas at the correct flow rate as soon as it is screwed into the cylinder of gas.

- (3) The instrument will display the sensor readings as they rise. When they have stabilized at their highest value, the instrument will note the response and, if necessary, adjust the readings to match the concentration of gas being used to calibrate the detector. (The instrument will beep as the adjustment is being made.)

**Verify that the concentration printed on the label of the calibration gas cylinder matches the concentration shown on the “Span Adjust” screen as the sensor is adjusted. If the concentration does not match it will be necessary to assign a new**

calibration gas concentration as discussed in Chapter 4 before continuing with the auto-span adjustment. The exception to this is calibrating chlorine dioxide (CLO<sub>2</sub>). When calibrating to standard 5.0ppm chlorine (CL<sub>2</sub>) gas, the calibration set point should be 1.7ppm on the chlorine dioxide scale.

- (4) When span adjustment has been completed, the display will show the message "DONE", after which the instrument will return to the gas indicator mode, and display the current gas readings.



**Note: Make sure the calibration adapter and all other fittings have been removed from the detector before it is returned to service.**

### 3.5. Manual calibration procedure

It is also possible to calibrate the Toxi Ultra manually using the four buttons on the instrument keypad.

**Note: Manual calibration is recommended when calibrating instruments with reactive gas sensors such as chlorine (CL<sub>2</sub>), chlorine**

**dioxide (CLO<sub>2</sub>), nitrogen dioxide (NO<sub>2</sub>), and hydrogen cyanide (HCN).**

#### 3.5.1. Fresh air "zero" through keypad buttons

- (1) Turn the instrument on.
- (2) Wait at least three minutes after turning the instrument on to allow sensor readings to stabilize fully **before** initiating the fresh air zero procedure.
- (3) Slide the belt clip towards the rear of the instrument exposing the four buttons on the instrument keypad.
- (4) Verify that the instrument is in the Basic or Technician operating mode. Switch modes (if necessary) by simultaneously holding down the "+" and "-" keys.
- (5) Make sure the instrument is located in an area where the air is known to be fresh.
- (6) Press the keypad button marked "Cal". The "GAS ZERO" calibration message will appear on the instrument LCD.



ZERO

- (7) Press "Cal" to automatically zero the instrument. The LCD will show the message "ZERO WAIT" while the adjustment is being made.

ZERO



WAIT

- (8) After completion of the zero adjustment the Toxi Ultra automatically returns to the gas reading screen display.

0

- (9) Pressing the mode button causes the calibration values in the memory to remain unchanged from the last time a fresh air adjustment was made. An information screen is displayed briefly which verifies that the zero values have not been changed. The instrument will then return to normal operation.

NO



SAVE

### 3.5.2. Span calibration using keypad buttons

Span calibration procedures using buttons on the instrument keypad are only necessary when the adjustment necessary to restore accuracy is outside the permissible window of adjustment for "One Button Auto Calibration" procedures or for the reactive gas listed in the "Note" of section 3.5. Span calibration using the keypad buttons may only be done while in the Basic or Technician operating mode.

- (1) Turn the instrument on.
- (2) Remove the belt clip by sliding it free from the belt clip mounts to expose the four mini-push-buttons.
- (3) Verify that the instrument is in the Technician or Basic operating mode. Switch modes (if necessary) by simultaneously holding down the "+" and "-" keys.

Each time that the operating mode is changed, the LCD screen will briefly indicate the current operating mode.

- (4) Turn the instrument off by pressing the mode button for three full seconds.

- (5) With the unit turned off, press and hold down the "Cal" button.
- (6) While holding down the "Cal" button, press the mode button to turn the Toxi Ultra back on. A screen showing the message "SPAN" will be displayed which alternates with the sensor readings.

SPAN



0

Pressing the mode button at any time for 3 seconds cancels the calibration mode.

- (7) Attach the cylinder of gas, regulator, short section of tubing and calibration adapter to the Toxi Ultra. Make sure the regulator, cylinder seating surfaces, and threads are clean and dry. **Note: For corrosive gas sensors use of the corrosive gas calibration kit (which includes the special Teflon (P/N 54-1681) adapter and FEP lined tubing) for to ensure the most accurate calibration.**
- (8) The regulator will automatically begin flowing

gas at the correct flow rate as soon as it is fully screwed in. When the readings stabilize, use the "+" and "-" keys to raise or lower the readings to match the concentration printed on the calibration cylinder label.

- (9) Make sure the correct cylinder of gas is attached before attempting to adjust the span! If the concentration of gas reaching the sensor is too low to allow the instrument to be adjusted, or if the wrong type of gas is applied to the sensor being adjusted, the alarms will be activated and a screen will be displayed indicating that the instrument "CANT / SPAN". Pressing the mode button clears the "CANT SPAN" message and returns the instrument to normal operation.

CANT



SPAN

In the event that a "CANT SPAN" message is displayed, verify the type and concentration of the gas being used is correct for the

sensor being calibrated, and replace the cylinder if necessary. Verify that the flow rate of the regulator is 1.0 lpm and that proper calibration materials are being used. If the "CANT SPAN" message is repeated it may indicate that the sensor is unresponsive, or dead, and requires replacement. **Note: For CLO2 units the calibration set point for Biosystems standard 5.0ppm chlorine gas mix should be 1.7ppm.**

- (11) When span calibration has been completed, press and hold the "Cal" button down until the LCD screen indicates that calibration is complete by showing the message "DONE". The Toxi Ultra will then turn itself off.

DONE



**Caution: The "Cal" button must be held down until the screen indicates that span calibration has been successfully completed.**

If the button is released before this message is displayed, span values will not be updated, and remain unchanged from the last time a span calibration was successfully completed.

Pressing the mode button at any time cancels the manual span calibration procedure. A screen will announce "NO SAVE" after which the instrument will turn itself off.

NO



SAVE



**Warning: A sensor which cannot be calibrated or which is found to be out of tolerance should be replaced immediately. An instrument which 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.**

Pressing the Mode button at any time during the span adjustment cancels the procedure, and causes the calibration values in memory to remain unchanged from the last time a span calibration adjustment was made.

### **3.5.3. Calibration procedures for "corrosive gas" sensors**

Highly reactive or “corrosive” gases such as ammonia, chlorine, hydrogen cyanide and nitrogen dioxide tend to react quickly with or be absorbed by other substances.

The calibration kits for these gases include a special single-sensor Teflon<sup>®</sup> calibration adapter, and a length of FEP (fluoro-polymer) lined tubing which is used in place of the standard tubing to connect the adapter to the cylinder of calibration gas.

Automatic span adjustment is done in the same manner as discussed in **section 3.5.2** for non-corrosive gases except that when prompted to “SPAN” the Teflon<sup>®</sup> adapter is attached directly over the sensor.

**Note: Some corrosive gas sensors may take several minutes to reach their final stable reading. Make sure to keep the adapter in place until the LCD screen indicates that adjustment is complete.**

## Chapter 4. Setting alarm levels

Toxi Ultra alarms are user adjustable and may be set anywhere within the range of the sensor channel. When an alarm set point is exceeded a loud audible alarm sounds, the bright red LED alarm light blinks, and (if equipped) the optional vibrator alarm is activated..

Toxi Ultra alarms are normally self resetting, that is, as soon as readings drop below the alarm set point, the alarm ceases. It is possible, if desired, to set Toxi Ultra alarms so that they "**latch.**" In the latched condition, once an alarm occurs both visual and audible alarms continue to sound even after the atmospheric hazard has cleared. The instrument must be manually reset by pressing the mode button. Pressing the mode button silences the alarms and restores normal operation. **Procedures for latching Toxi Ultra alarms are given in Section 4.2.**

### 4.1. Alarm adjustment sequence

It is necessary to be in the "Alarm Adjust" mode before it is possible to change alarm settings. Once in this mode, any and all alarm set points are user adjustable.

In many cases it is possible to comply with OSHA guidelines while using higher alarm points than those used by Biosystems. It is important to note that the default alarm point settings used in the Toxi Ultra design are very conservative in order to provide maximum worker safety.

### **Toxi Ultra default alarm setting are listed in Appendix B.**

To enter the alarm adjust mode, it is necessary to do the following.

- (1) Turn the instrument on.
- (2) Remove the belt clip to expose the four mini-push-buttons.
- (3) Verify that the instrument is in the Technician or Basic operating mode. Switch modes (if necessary) by simultaneously holding down the "+" and "-" keys. Each time that the operating mode is changed, the meter screen will briefly indicate the current operating mode.

- (4) Turn the instrument off by pressing the mode button for three full seconds.
- (5) With the unit turned off, press and hold down the "Alarm" button.
- (6) While holding down the "Alarm" button, press the mode button to turn the Toxi Ultra back on.
- (7) A screen will appear showing the first alarm point to be adjusted, and the current alarm set point.

ALRM



PEAK



10

- (8) Pressing the "Cal" button again will advance the display to the next available alarm adjustment option. Pressing the mode button at any time cancels the alarm adjustment mode, and returns the instrument to the gas reading screen.

- (9) When the desired alarm adjust option has been reached, the "+" and "-" keys are used to raise or lower the alarm set point.
- (10) When all alarm adjustments have been completed, press and hold the "Alarm" button down until an information screen indicates that alarm adjustment is complete.

DONE

#### 4.2. "Alarm Latch" command

Toxi Plus alarms are normally self resetting, that is, as soon as readings drop below the alarm set point, the alarm ceases.

It is possible, if desired, to set Toxi Plus alarms so that they "latch". In the latched condition, once an alarm occurs both visual and audible alarms continue to sound even after the atmospheric hazard has cleared. The instrument must be manually reset by pressing the mode button. Pressing the mode button silences the alarms and restores normal operation.

Use the following procedure to "latch" the Toxi Plus alarms:

- (1) Make sure the Toxi Plus detector is in the Technician mode (as

discussed in **Section 2.2.4**), then turn the instrument off.

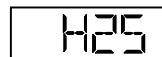
- (2) Turn the instrument on while pressing and holding down the "Alarm" button. This will place the instrument in the "Alarm Adjust Mode".
- (3) Adjust and save the current alarm settings, or press mode to exit without making changes to the current settings. As the instrument leaves the "Alarm Adjust Mode" the unit will display alternating "ALRM / LOCK" messages for 4 seconds. The instrument will then display the current status of the alarm latch feature ("ON" or "OFF").
- (4) Use the "+" or "-" key to change the alarm latch setting.
- (5) Once the proper setting has been selected, press and hold down the "Alarm" button for three seconds. Do not release the "Alarm" button until the LCD displays the message "DONE" to indicate that the new setting has been successfully entered. Pressing the mode button at any time cancels the procedure. The LCD will show the message "NO SAVE" to indicate that the

setting has not been changed.

### 4.3. Restoring the factory default alarm settings

Toxi Ultra alarm settings are set at the factory in the most conservative way possible. (See **Appendix B**) It is possible to restore these default settings at any time by doing the following.

- (1) Turn the instrument on and make sure it is in the Technician Mode. (See **Section 2.2.4**.)
- (2) Press the "Alarm" button on the instrument keypad. The display will briefly show the default alarm message, and the type of sensor currently installed.



- (3) This screen will be followed by several more showing the specific default alarm settings. These screens will be

shown in continuous rotation. In the case of a Toxi Ultra with a hydrogen sulfide sensor installed, the following sequence of screens would be shown.

PEAK



10



STEL



15



TWA



10

- (5) Push and hold the "Alarm" button to restore the factory default alarm settings. The display indicates when the settings have been restored:

DONE

- (6) If the "Mode" button is pushed, the current alarm settings remain unchanged, and the display shows the following screen:

NO



SAVE

- (7) After selection of the default or current alarm settings has been made, the display reverts to the current gas reading screen.

## Chapter 5. Toxi Ultra Advanced Functions

### 5.1. Toxi Ultra Advanced features overview

The Toxi Ultra microprocessor circuitry makes possible a number of advanced features and capabilities. Although this chapter has been designed primarily to be of benefit to "experts" there are several sections that may be of interest to other Toxi Ultra users.

The four mini-push-buttons located under the key pad cover on the bottom of the detector are used to program advanced Toxi Ultra functions. The technique for using these buttons requires several buttons to be pressed and held at the same time.



**Caution: Do not use this technique with any other combination of**

**buttons than those listed below. Doing so may result in unintended changes to the instrument setup.**

### 5.2. Re-setting the calibration gas concentration

During auto calibration adjustment the Toxi Ultra adjusts the sensitivity of the sensor to match the concentration of the gas used to calibrate the sensor. The value

the instrument uses to adjust the reading is the calibration gas concentration stored in the instrument memory.

For instance, Biosystems normally supplies 50 ppm carbon monoxide calibration gas for use in calibrating CO Toxi Ultra detectors. This is the default calibration gas concentration stored in the instrument memory. When gas is applied to the sensor during auto calibration, the instrument automatically adjusts the sensitivity of the carbon monoxide to produce readings which match this 50 ppm concentration.

Sensor	Gas Used	Concentration
CO	CO	50 ppm
CO+	CO	50 ppm
H <sub>2</sub> S	H <sub>2</sub> S	25 ppm
SO <sub>2</sub>	SO <sub>2</sub>	10 ppm
NH <sub>3</sub>	NH <sub>3</sub>	50 ppm
NO	NO	30 ppm
Cl <sub>2</sub>	Cl <sub>2</sub>	5 ppm
ClO <sub>2</sub>	Cl <sub>2</sub>	5 ppm
PH <sub>3</sub>	PH <sub>3</sub>	5 ppm
NO <sub>2</sub>	NO <sub>2</sub>	10 ppm

**Table 5.1. Default Toxi Ultra calibration gas concentrations**

It is necessary to re-set the calibration gas concentration

stored in instrument memory before making use of a different calibration gas concentration.



**Warning: Do not reset the calibration gas concentration**

**unless you are using a calibration gas concentration which differs from that normally supplied by Biosystems for use in calibrating your instrument.**

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

Use the following procedure to re-set the calibration gas concentration:

- (1) Make sure the Toxi Ultra detector is in the Technician mode (as discussed in **Section 2.2.4**), then turn the instrument off.
- (2) Turn the instrument on while pressing and holding down the “+” button.

The Toxi Ultra LCD will display alternating “CAL” and “GAS” messages for 4 seconds. The display will then alternate between the current concentration stored in memory and the “GAS” message screens.

- (3) Use the “+” and “-” buttons to change the concentration.
- (4) Once the proper new concentration has been selected, press and hold down the “Alarm” button for three seconds. Do not release the “Alarm” button until the LCD displays the message “DONE” to indicate that the new value has been successfully entered.

Pressing the mode button at any time cancels the procedure. The LCD will show the message “NO SAVE” to indicate that the calibration gas concentration values have not been changed.

## Chapter 6. Record Keeping and Configuration Software

### 6.1. Hardware setup

The Toxi Ultra download kit consists of an optical interface cradle, 110 VAC power supply, and Bio Trak software. The cradle includes a connector cable which plugs into the serial port of the user's Windows 95/98™ based computer. The Bio Trak Software comes with a users manual which guides you through the interface with Toxi Ultra.

### 6.2. Configuration procedures

The Toxi Ultra configuration form in the Bio Trak software allows users to setup or configure their Toxi Ultra exactly the way they want by filling out a form on the computer screen. The full configuration setup screen includes many programmable options such as timed security beeps, latching alarms, and assigning instrument ID numbers. **Appendix G** contains a complete list of programmable Toxi Ultra options.

It is also possible to use the configuration set up screen to select a new type of sensor for installation.



**Warning: If a new sensor type is selected verify that it has been properly installed. The new sensor must be calibrated before use.**

The Toxi Ultra microprocessor circuitry eliminates the need for manual switch setting and other laborious set-up procedures. It is still necessary, however, to verify the accuracy of the Toxi Ultra by calibration with known concentration test gas whenever a change is made to the sensors installed in the instrument.

If a change has been made to the type of toxic sensors installed, it may also be necessary to adjust the bias voltage for the sensor. Most of the toxic sensors available for use in the Toxi Ultra are "unbiased," that is, they do not require a constant voltage applied to them while the instrument is turned off. Two currently available toxic sensors do require a bias voltage. The bias must be set at the time they are installed. The two sensors are nitric oxide (NO) and ammonia (NH<sub>3</sub>).

It will be necessary to readjust the bias voltage whenever the new toxic sensor has a different bias voltage than the old one.



**Warning:**  
Resetting the toxic sensor bias voltage requires

opening the instrument and adjusting dip switches located on the main circuit board of the detector. This procedure should not be done by unauthorized persons. In many cases it may be better to return the detector to the factory for adjustment. Please call the factory for further information.

Failure to properly set the dip switches may lead to degraded performance, inability to calibrate, or instrument failure.

To access the dip switches simply remove the battery cover and batteries.

Bias voltages and dip switch settings are listed in Table 6.2.4.1

	DS1-1	DS1-2	DS1-3	DS1-4	Toxic Bias(MV)
CO	0	0	1	1	0
CO+	0	0	1	1	0
H <sub>2</sub> S	0	0	1	1	0
SO <sub>2</sub>	0	0	1	1	0
HCN	0	0	1	1	0
Cl <sub>2</sub>	0	0	1	0	0
ClO <sub>2</sub>	0	0	1	0	0
PH <sub>3</sub>	0	0	1	1	0
NO <sub>2</sub>	0	0	1	0	0
NH <sub>3</sub>	1	0	1	1	-300
NO	1	0	1	1	-300

1 = ON  
0 = OFF

DS1-1 = Sensor Bias (On -300mv)  
DS1-2 = Sensor Bias (On -250mv)  
DS1-3 = TOXIC AMPLIFIER GAIN (On 20.7k)  
DS1-4 = TOXIC LOAD RESISTOR ((On 10Ω Off 100Ω)

**TABLE 6.2.4.1 Toxi Ultra switch patterns**

**Note:** Oxy Ultras are specifically designed to measure oxygen concentrations. Oxygen sensors are not interchangeable with other Toxi

Ultra toxic sensors. It is not possible to use the setup screen to reconfigure toxic gas Toxi Ultras for the measurement of oxygen.

## Chapter 7: Trouble Shooting and Repair

### 7.1. Changing Toxi Ultra sensors



**Caution: The Toxi Ultra must be recalibrated before being**

**returned to service any time changes are made to the sensors installed.**

To replace a sensor:

- (1) Make sure the Toxi Ultra is turned off.
- (2) Gently unscrew (1/4 turn counter clockwise) and remove the protective sensor cap.
- (3) Gently pry the sensor out of its socket.
- (4) Verify that the type of sensor to be installed matches the label on the front of the Toxi Ultra detector.
- (5) Make sure the pins are properly aligned and gently press the replacement sensor into place.
- (6) Make sure the correct color coded filter in the protective sensor cap is replaced along with the new sensor. (A spare filter should have been supplied together with the replacement sensor.) The color of the filter should match the color of the ID ring on the upper surface

of the sensor. Use a blunt object to push the old filter out of the sensor cap, and using a finger, press the new filter into place. Be careful not to rip the filter membrane.

- (7) Replace the protective sensor cap.
- (8) Allow at least 15 minutes new sensors to stabilize prior to using the instrument. For NH3 Sensors and NO Sensors, allow 24 hours for the new sensor to stabilize.
- (9) Recalibrate the new sensor.

### 7.2. Troubleshooting

There are a few troubleshooting and repair procedures besides sensor and battery replacement which can be done in the field.



**Caution: The following repair procedures should only be performed by authorized personnel.**

#### 7.2.1. Unit will not turn on

##### **Possible causes:**

Battery discharged, microprocessor / software malfunction.

##### **Solution(s):**

Take the instrument to a non-hazardous location. Replace the batteries and

attempt to turn on. (Make sure that the batteries are properly aligned, and that all battery polarities are correct.) If the instrument still fails to turn on, return to factory for repair.

**7.2.2. Problem: Unit will not turn off**

**Possible causes:**

Microprocessor / software malfunction, low or bad battery, faulty on / off mode switch.

**Solution(s):**

Take the instrument to a non-hazardous location, replace the batteries, and attempt to turn the detector back on. If the instrument fails to turn on, return to factory for repair.

**7.2.3. Problem: Sensor readings unstable**

**Possible causes:**

Loose connection, bad sensor, improper calibration, expired calibration gas.

**Solution(s):**

Check that the sensor is firmly in place. Check calibration gas dating. Re-calibrate sensor. Replace sensor if necessary.

**7.2.4. Problem: Display is blank**

**Possible causes:**

Battery voltage too low.  
Operating temperature too

low. Bad LCD display assembly. Microprocessor locked-up or "crashed".

**Solution(s):**

Take the instrument to a non-hazardous location. If cold, allow instrument to warm back up to room temperature. Replace the batteries and attempt to turn the instrument back on. If the instrument still fails to turn on, return to factory for repair.

**7.2.5. Problem: No audible alarm**

**Possible causes:**

Loose connection, alarm failure.

**Solution(s):**

Return to factory for repair.

**7.2.6. Problem: Keypad buttons (+, -, Cal, Alarm) don't work**

**Possible causes:**

Not in Basic or Technician mode, microprocessor locked-up or "crashed", loose connection, switch failure.

**Solution(s)**

Switch to Technician operating mode. Take the instrument to a non-hazardous location. Replace the batteries and attempt to turn the instrument back on.

If keypad buttons still fail to operate properly return to factory for repair.

**7.2.7. Problem: Can't make a "One Button" auto zero adjustment ("Too High" or "Too Low" for zero adjust)**

**Possible causes:**

The atmosphere in which the instrument is located is contaminated (or was contaminated at the time the instrument was last zeroed); instrument is still attached to calibration fittings; a new sensor has just been installed; instrument has been dropped or banged since last turned on.

**Solution(s):**

Remove any calibration gas fittings, take the instrument to fresh air and allow readings to stabilize. Do a manual fresh air zero adjustment using buttons on the instrument keypad as discussed in **Section 3.51**.

**7.3. Returning your Toxi Ultra 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 Toxi Ultra packing materials, or other packing materials which similarly protect the instrument and accessories.

**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.

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

**Thank you for choosing the Toxi Ultra, and thank you for choosing Biosystems.**

## **Appendix A Toxic gas measurement - Ceilings, TWAs and STELs**

Many toxic substances are commonly encountered in industry. The presence of toxic substances may be due to materials being stored or used, the work being performed, or may be generated by natural processes. Exposure to toxic substances can produce disease, bodily injury, or death in unprotected workers.

It is important to determine the amounts of any toxic materials potentially present in the workplace. The amounts of toxic materials potentially present will affect the procedures and personal protective equipment which must be used. The safest course of action is to eliminate or permanently control hazards through engineering, workplace controls, ventilation, or other safety procedures. Unprotected workers may not be exposed to levels of toxic contaminants which exceed Permissible Exposure Limit (PEL) concentrations. Ongoing monitoring is necessary to insure that exposure levels have not changed in a way that requires the use of different or more rigorous procedures or equipment.

Airborne toxic substances are typically classified on the basis of their ability to produce physiological effects on exposed workers. Toxic substances tend to produce symptoms in two time frames.

Higher levels of exposure tend to produce immediate (acute) effects, while lower levels of long-term (chronic) exposure may not produce physiological symptoms for years.

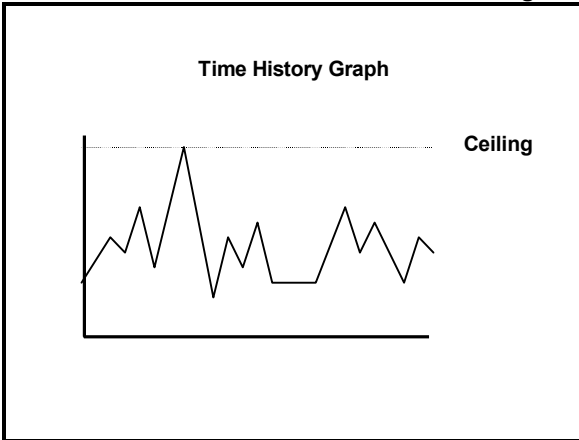
Hydrogen sulfide ( $H_2S$ ) is a good example of an acutely toxic substance which is immediately lethal at relatively low concentrations. Exposure to a 1,000 ppm (parts per million) concentration of  $H_2S$  in air produces rapid paralysis of the respiratory system, cardiac arrest, and death within minutes.

Carbon monoxide (CO) is a good example of a chronically toxic gas. Carbon monoxide bonds to the hemoglobin molecules in red blood cells. Red blood cells contaminated with CO are unable to transport oxygen. Although very high concentrations of carbon monoxide may be acutely toxic, and lead to immediate respiratory arrest or death, it is the long term physiological effects due to chronic exposure at lower levels that take the greatest toll of affected workers. This is the situation with regards to smokers, parking garage attendants, or others chronically exposed to carbon monoxide in the workplace. Exposure levels are too low to produce immediate symptoms, but small repeated doses reduce the oxygen carrying capacity of the blood over time to dangerously low levels. This partial impairment of the blood supply may lead over time to serious physiological consequences.

Because prudent monitoring programs must take both time frames into account, there are three independent exposure measurements and alarm types built into the Toxi Ultra design.

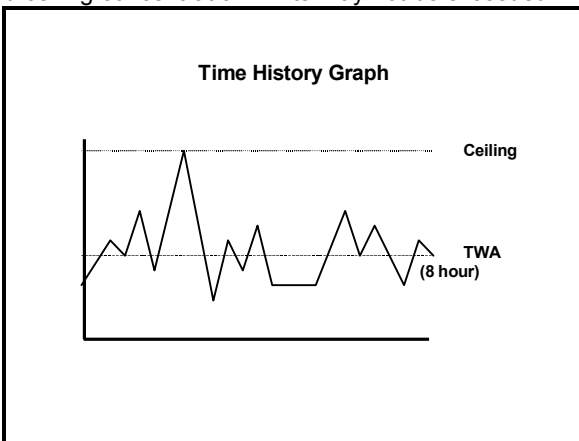
**1. Ceiling level:**

OSHA has assigned some, but not all, toxic substances with a ceiling level. This is the highest concentration of a toxic substance to which an unprotected worker should ever be exposed, even for a very short time. **Never enter an environment even momentarily when concentrations of toxic substances exceed the ceiling level.**



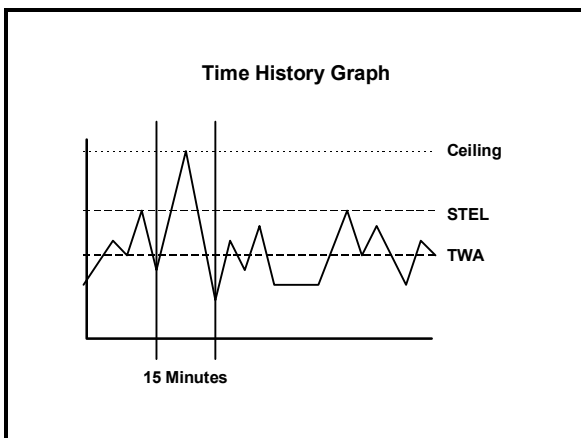
**2. Time Weighted Average (TWA):**

The maximum average concentration to which an unprotected worker may be exposed over an eight hour working day. During this time, STEL and ceiling concentration limits may not be exceeded.



### 3. Short Term Exposure Limits (STEL):

Toxic substances may have short term exposure limits which are higher than the eight hour TWA. The STEL is the maximum average concentration to which an unprotected worker may be exposed in any fifteen minute interval during the day. During this time, neither the eight hour TWA or the ceiling concentration may be exceeded.



Any fifteen minute periods in which the average STEL concentration exceeds the permissible eight hour TWA must be separated from each other by at least one hour. A maximum of four of these periods are allowed per eight hour shift.

## Appendix B How to determine where your alarms should be set

### 1. Toxic gas alarms

The Toxi Ultra has three separate alarm points for toxic gases: Ceiling, STEL, and TWA.

OSHA has assigned some, but not all, toxic substances with a ceiling or "Peak" exposure level. This is the highest concentration of a toxic substance to which an unprotected worker should ever be exposed, even for a very short time. Never enter an environment even momentarily when concentrations of toxic substances exceed the ceiling level.

The Time Weighted Average ( or TWA) is the maximum average concentration to which an unprotected worker may be exposed over an eight hour working day. During this time, STEL and ceiling concentration limits may not be exceeded.

OSHA has assigned some, but not all, toxic substances with a Short Term Exposure Limit. The STEL is the maximum average concentration to which an unprotected worker may be exposed in any fifteen minute interval during the day. During this time, neither the eight hour TWA or the ceiling concentration may be exceeded. Any fifteen minute periods in which the average STEL concentration exceeds the permissible eight hour TWA must be separated from each other by at least one hour. A maximum of four of these periods are allowed per eight hour shift.

The table below shows the highest levels at which these alarms should be set. If OSHA has not determined a ceiling value, for greatest safety the Toxi Ultra ceiling alarm should be set at the same value as the STEL alarm. If OSHA has not determined a STEL value, the Toxi Ultra STEL alarm should be set at the same value as the TWA.

**2. U. S. Department of Labor, Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits for select toxic gases:**

In the following table "NA" indicates no value has been assigned by OSHA.

**Note: Customers should be aware that OSHA permissible exposure limits may be subject to change. Recent court decisions have affected the enforcement of permissible exposure limits published or modified since the initial enactment of OSHA in 1971. The following table shows the OSHA permissible exposure limits as published in the 1989 edition of the Code of Federal Regulations (29 CFR 1910.1000). It is recommended that customers verify that the values given below are correct and current before using them to update their alarm set-points.**

**OSHA (1989) Permissible Exposure Limits:**

<b>Gas</b>	<b>Ceiling</b>	<b>TWA</b>	<b>STEL</b>
CO	200 ppm	35 ppm	NA
H2S	NA	10 ppm	15 ppm
SO2	NA	2.0 ppm	5.0 ppm
Cl2	NA	0.5 ppm (1989)	1.0 ppm
ClO2	NA	0.1 ppm	0.3 ppm
PH3	NA	0.3 ppm	1.0 ppm
NH3	NA	NA	35 ppm
NO	NA	25 ppm	NA
NO2	NA	NA	1.0 ppm

### 3. Toxi Ultra default alarm settings

The most conservative possible way to set alarms is the method used by Biosystems for the Toxi Ultra default alarm settings. The Ceiling alarm is set at the factory at the 8 hour TWA level (when this is given). With this setting, it is unlikely that either the STEL or TWA alarm will ever be activated. For other values, contact Biosystems or your authorized distributor.

#### Biosystems Toxi Ultra default alarm settings:

Gas	Ceiling	TWA	STEL
CO	35 ppm	35 ppm	100 ppm
H2S	10 ppm	10 ppm	15 ppm
SO2	2.0 ppm	2.0 ppm	5.0 ppm
Cl2	0.5 ppm	0.5 ppm	1.0 ppm
ClO2	0.3 ppm	0.3 ppm**	0.3 ppm
PH3	0.3 ppm	0.3 ppm	1.0 ppm
NH3	25 ppm	25 ppm	35 ppm
NO	25 ppm	25 ppm	25 ppm
NO2	1.0 ppm	1.0 ppm	1.0 ppm

\*\* Please note: the TWA default alarm value for ClO2 is higher than the OSHA Permissible Exposure Limit. The *down-scale alarm* = -1/2 TWA alarm value, therefore to avoid false alarms the TWA alarm was set to the higher value. Please use the Ceiling or STEL alarms as the take action points.

**Note:** When a “CO Plus” sensor is installed the default alarm settings are automatically assigned on the basis of the calibration gas selected for use. If carbon monoxide is selected as the calibration gas, carbon monoxide alarm settings are automatically assigned. If hydrogen sulfide is selected as the calibration gas, hydrogen sulfide alarm settings are automatically assigned.

## Appendix C How to calibrate your Toxi Ultra in contaminated air

Calibration of the Toxi Ultra is a two-step process. The first step is to expose the sensors to contaminate-free fresh air and perform a fresh air calibration.

Unfortunately, there are some locations which are never completely free of contaminants. An example would be a furnace intensive area which always has a background concentration of a few ppm CO. To

make calibration easy in this case, it is necessary to use special calibration "Zero Contaminant" gas. This gas cylinder, Biosystems part number 9039, is used in conjunction with the sample draw calibration adapter. Flow the zero contaminant gas across the sensors for a minute, just as if you were doing a span calibration. Then do the fresh air calibration steps described in Chapter 3 of the owners manual.

## Appendix D: Suggested Calibration Gases



**Warning:** Use of non-standard calibration gas and / or calibration kit components when calibrating your Toxi Ultra can lead to dangerously inaccurate readings and may void the standard Biosystems warranty.

Biosystems offers calibration kits and long lasting cylinders of test gas specifically developed for easy Toxi Ultra calibration. Customers are strongly urged to use only Biosystems calibration materials when calibrating their Toxi Ultra.

Gas	Part Number	Concentration	Comments
Carbon monoxide (CO)	54-9033	50 ppm in air	
Hydrogen sulfide (H <sub>2</sub> S)	54-9034	25 ppm in nitrogen	
Sulfur dioxide (SO <sub>2</sub> )	54-9037	10 ppm in nitrogen	
Ammonia (NH <sub>3</sub> )	54-9051	50 ppm in nitrogen	
Chlorine (Cl <sub>2</sub> )	54-9052	5 ppm in nitrogen	
Hydrogen cyanide (HCN)	54-9054	10 ppm in nitrogen	
Nitric oxide (NO)	54-9055	30 ppm in nitrogen	
Nitrogen dioxide (NO <sub>2</sub> )	54-9056	5 ppm in nitrogen	
Phosphine (PH <sub>3</sub> )	54-9065	5 ppm in nitrogen	
Zero air	9039	20.9 % oxygen in nitrogen	Use for fresh air calibration in contaminated areas.

## Appendix E: PhD Ultra Toxic Sensor Cross Sensitivity Data

The table below lists the cross sensitivity of electrochemical toxic sensors used in Biosystems portable 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.

	CO	H <sub>2</sub> S	SO <sub>2</sub>	NO	NO <sub>2</sub>	Cl <sub>2</sub>	H <sub>2</sub>	HCN	HCl	NH <sub>3</sub>	Ethylene
Carbon monoxide (CO)	100	< 3	0	< 10	≤ - 20	< 10	< 40	< 15	0	0	< 100
Hydrogen sulfide (H <sub>2</sub> S)	< 10	100	< 20	0	~ - 20	~ - 20	< 0.1	0	0	0	0
"CO Plus" (Cal to CO)	100	~ 350	~ 50	~ 25	- 60	~ - 40	< 40	~ 40	~ 5		
"CO Plus" (Cal to H <sub>2</sub> S)	25	100	~ 15	~ 6	- 15	~ - 10	< 15	~ 10	~ 1		
Sulfur dioxide (SO <sub>2</sub> )	0	0	100	0	~ - 100	- 5	0	< 50	0	0	0

	CO	H <sub>2</sub> S	SO <sub>2</sub>	NO	NO <sub>2</sub>	Cl <sub>2</sub>	H <sub>2</sub>	HCN	HCl	NH <sub>3</sub>	Ethyl-ene	PH <sub>3</sub>
Nitric oxide (NO)	0	~ 35	~ 5	100	< 40	0	0	0	≤ 15	0	0	
Nitrogen dioxide (NO <sub>2</sub> )	0	~ - 20	< - 0.5	0	100	≈ 100	0	0	0	0	0	
Chlorine (Cl <sub>2</sub> )	0	~ - 20	0	0	120	100	0	0	0	0	0	
Hydrogen cyanide (HCN)	< 3	~ 600	~ 395	0	~ - 120	~ - 140	0	100	~ 35	- 5	~ 25	
Phosphine (PH <sub>3</sub> )	-	~ 25						< 0.1			≤ 2	100
Ammonia (NH <sub>3</sub> )	0	~ 100	~ 60	~ 20	0	~ 50	0	~ 5	0	100		

## Appendix F: Toxi Ultra sensor ranges

The following tables display the ranges for currently available sensors for use in the Toxi Ultra. Nominal range values indicate the gas-level range which the Toxi Ultra can detect over extended periods of operation. "Max overload" values indicate the highest instantaneous reading that the Toxi Ultra will be able to attain for a given sensor type.

<b>Toxic Sensor Type</b>	<b>Nominal range (PPM)</b>	<b>Max overload</b>
CO	0-500	1000
H2S	0-100	100
SO2	0-20	150
"CO Plus" (Cal. to CO)	0-500	1000
"CO Plus" (Cal. to H2S)	0-100	250
NO	0-100	150
NO2	0-20	50
NH3	0-50	200
Cl2	0-10	50
ClO2	0-3	10
PH3	0-5	20

## Appendix G: Toxilog Programmable Features

Feature	Programmability	Toxi Ultra Programmed	PC Programmed
Operating modes	Technician / Basic / Text Only	X	X
Latching peak alarm	Enable / Disable		X
Programmable ceiling alarm set	0 to 4096 ppm	X	X
Programmable STEL alarm set	0 to 4096 ppm	X	X
Programmable TWA alarm set	0 to 4096 ppm	X	X
Programmable sensor type	Pick from menu. Nominal span set.	X	X
Display resolution	0.1 ppm / 1 ppm	X	X
Security beep enable	Enable / Disable		X
Security beep interval	Enable 1 second to 1 hour		X
Program user ID number	Four alphanumeric characters		X
Display name at power off	Enable / Disable		X
Recording interval	1 sec to one hour		X
Programmable serial number	0 TO 9999		X
Programmable 1 character string	31 alphanumeric characters		X
Time / Date	Time / Day / Date		X

**Other Features:**

Feature	Comments
Push button (on demand) zero calibration	Auto zeroes in fresh air
Push button span calibration	Calibration stored electronically - no pots
Calibration dates saved	Data sent to PC contains most recent zero and span calibration times and dates
Default alarm setting restore	Factory alarm settings for gas selected restored with press of push button
Alarm acknowledge (STEL/TWA)	STEL/TWA audible / visual alarms silenced for five minutes
Automatic data recording	Always recording data whenever turned on
Automatic data download / upload	Turn Toxilog off, place in interface cradle, instrument transmits and receives data automatically
Sampling modes	Diffusion / sample - draw
Number of monitoring intervals stored	3000
Size	4.4" X 2.1" X 1.1"
Weight	4.5 oz
Batteries	(3) AAA alkaline - up to six months normal operation
Operating temperature range	0 to 120° F
Data retention time	10 years
Case material	Water resistant ABS copolymer
Radio frequency rejection	Optional RFI-protected rain cover
Approvals: intrinsically safe	UL Class I, Division1, Groups A, B, C, and D; CSA Class I, Groups A, B, C, and D

## Appendix H: Biosystems Standard Warranty for Gas Detection Products

### General

Biosystems, A Division of Bacou-Dalloz Safety (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.

Abuse, mechanical damage, alteration, or repair procedures not made in accordance with the instrument Reference Manual void 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 to Biosystems at its manufacturing location in Middletown, Connecticut, with transportation and shipping charges prepaid. 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 <sup>5</sup> , PhD Lite, PhD Plus, PhD Ultra, Cannonball3, MultiVision, Toxi Vision and Toxi Series	As long as the instrument is in service								
Mighty-Tox	90 days after activation or 90 days after the "Must Be Activated By" date, whichever comes first								
Mighty-Tox 2 Mighty-Tox 2 prorated credit is given towards repair or purchase of a new unit.	<table> <tr> <td>0 – 6 months of use</td> <td>100% credit</td> </tr> <tr> <td>6 – 12 months of use</td> <td>75% credit</td> </tr> <tr> <td>12 – 18 months of use</td> <td>50% credit</td> </tr> <tr> <td>18 – 24 months of use</td> <td>25% credit</td> </tr> </table>	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
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								
Series 3000, Airpanel, Travelpanel, ZoneGuard, Gas✓Chek1, Gas✓Chek4 and Gas✓Chek Plus remote gas detector heads.	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 <sup>5</sup> , PhD Lite, Cannonball3	O <sub>2</sub> , LEL**, CO, CO+, H <sub>2</sub> S & Duo-Tox	2 Years
	All Other Sensors	1 Year
PhD Plus, PhD Ultra, Toxi Vision, MultiVision	O <sub>2</sub> , LEL**, CO, CO+, H <sub>2</sub> S	2 Years
	All Other Sensors	1 Year
Toxi Series	LEL**, CO, CO+, H <sub>2</sub> S	2 Years
	All Other Sensors	1 Year
All Others	All Sensors	1 Year

**\*\* Damage to combustible gas sensors incurred by exposure to known sensor poisons such as silicone and siliconized caulks/sealants (a.k.a. RTV - Room Temperature Vulcanizing), silicone rubber molded products & coatings, greases for laboratory glassware (stopcock, ground glass joints, etc.), toner fusing agent in photocopiers, die lubricants in cutting, stamping or other material converting operations, heat transfer fluids in fine chemical & pharmaceutical manufacture, lubricants, waxes & polishing compounds (neat or spray aerosols), mold release agents for plastics injection molding operations, waterproofing formulations, vinyl & leather preservatives, or release papers used as the backings of pressure sensitive adhesive backed roll or sheet goods may (at the discretion of Biosystems Instrument Service Department) void Biosystems' Standard Warranty as it applies to the replacement of combustible gas sensors.**