PGM-IR CO$_2$ Monitor

Portable Gas Monitor for Carbon Dioxide (CO$_2$) Gas

Instruction 3015-9000

Operation and Maintenance

Rev. 4 – March 2016

Patent 6,590,690

Product Leadership • Training • Service • Reliability

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Table of Contents

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1 Introduction

1.1 How to Use This Manual

This manual provides important information on how to operate and service Bacharach's CO$_2$ Monitor.

To assure operator safety and the proper use of the monitor, please read, understand, and follow the directions in this manual.

If you have a working knowledge of gas monitors, you will find this manual useful as a reference tool. If you are new to the use of gas monitors, you can educate yourself about the principles of gas detection and the proper operation of this device by reading this manual thoroughly.

1.2 Warning Statements

The use of the word **WARNING** in this manual denotes a potential hazard associated with the use of this equipment. It calls attention to a procedure, practice, or condition, or the like, which if not correctly performed or adhered to, could result in personal injury or death.

1.3 Caution Statements

The use of the word **CAUTION** in this manual denotes a potential hazard associated with the use of this equipment. It calls attention to a procedure, practice, condition, or the like, which if not correctly performed or adhered to, could result in damage to the equipment.

1.4 Hazard Symbols on Monitor
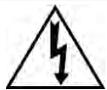
This symbol indicates the need to consult this operating instruction manual when opening the enclosure.

 WARNING: A potential risk exists if the operating instructions are not followed.

This symbol indicates the presence of electric shock hazards when the enclosure is opened.

 WARNING: To avoid risk of injury from electric shock, do not open the enclosure when power is applied.

1.5 Safety Precautions

HAZARDOUS AREA WARNING: This instrument has <u>not</u> been designed to be intrinsically safe for use in areas classified as hazardous locations. For your safety, <u>**DO NOT**</u> use it in hazardous (classified) locations.

COMBUSTIBLE/FLAMMABLE GAS WARNING: This is NOT a safety device. Some gases which this instrument can detect may be combustible/flammable. When properly configured, this instrument is designed to alarm at concentrations that are lower than the explosive limit of the gas. As such, it is the buyer's responsibility to initiate an immediate planned response to any gas leaks as soon as they are detected. This equipment should NEVER be used to measure or sample gases at or above their respective lower explosive limits.

WARNING: Do not operate this equipment in the presence of flammable liquids, vapors or aerosols. Operation of any electrical equipment in such an environment constitutes a safety hazard.

CAUTION: The protection provided by the monitor may be impaired if the monitor is used in a manner not specified by these instructions. Changes or modifications to this monitor will void the warranty.

IMPORTANT: This device is designed for operation at or below an altitude of 6,562 ft (2,000 m). Do not operate this device above this altitude limit.

NOTE: To clean the outside of the case use a dry cloth. DO NOT use soap and water.

1.6 Unpacking and Initial Checks

Your CO$_2$ Monitor was carefully inspected at the factory before shipment, and packed so as to be highly resistant to damage while in transport. When you receive the instrument, however, please unpack it promptly and make a visual inspection to make sure that no damage has occurred during shipment. Also check that all the following items have been received.

Item	Qty	Part Number
CO$_2$ Monitor	1	3015-8001 (Bacharach case)
	1	3015-8002 (OEM case)
Soft Carrying Case with Shoulder Strap	1	3015-5700 (for 3015-8001 units)
	1	3015-5752 (for 3015-8002 units)
Battery Pack and Charger	1	3015-5743
Sample Probe	1	3015-5694
Instruction Manual	1	3015-9000

If damage was found, immediately file a claim with the carrier. If an item is missing, please contact Bacharach's Service Department for assistance (refer to Section *Service Centers*).

1.7 Features & Capabilities

- Detects and measures CO$_2$ in refrigerant applications
- CO$_2$ detection range of 20 to 100,000ppm, relative to ambient
- Automatically logs up to 200 gas readings that can be recalled later for analysis
- Eliminates false alarms with use of non-dispersive IR source and sample draw system
- Visual and audible gas alarm indictors that are turned ON when the detected gas level exceeds a user defined trip-point
- Extensive self diagnostics, providing both visual and audible indications when a fault occurs
- Battery powered, providing a minimum of 8 hours of operation

1.8 Shipping Precaution

When shipping the instrument by air, deflate the purge-air bag to prevent it from bursting due to changes in air pressure. Deflate the bag by selecting the **EMTYBAG** function as described on page 13.

1.9 Functional Overview

1.9.1 General Description

The Bacharach CO$_2$ PGM-IR is a portable CO$_2$ gas monitor designed to determine the presence and level of CO$_2$ gas. The monitor self-zeros using an internal zero-air (purge) bag every 4 minutes to ensure accurate gas measurements.

During normal operation the monitor displays the type of gas being monitored (CO$_2$) along with displaying both the current gas level and (optionally) the peak gas level detected in that area on its front panel LCD. The monitor retains a log of previous readings that can be easily accessed at a later time for analysis.

Front panel indicators and an audible alarm are provided to signal gas alarm and instrument fault conditions. The audible alarm can temporarily be silenced by a push of a button, but will reactivate if the gas level is still above the alarm trip point after a user defined time period has elapsed.

The unit requires only minor periodic maintenance such as the occasional replacement of filters. The monitor incorporates active diagnostics that continuously check the system for proper operation. A front panel indicator is provided to alert an operator of system malfunctions, and fault codes are generated that enable the operator to identify the cause of the fault.

1.9.2 Ambient vs. Relative CO$_2$ Readings

CO$_2$ gas is present in ambient air at a concentration of approximately 386 ppm. CO$_2$ gas is also in the "air" that we exhale. This should be considered when testing for CO$_2$ refrigerant leaks in confined spaces and/or densely-occupied locations.

The CO$_2$ PGM-IR has an internal purge air bag that is filled with ambient air prior to performing CO$_2$ testing. This air is used to purge the IR detector of sample gas and establish a "zero" ppm baseline. Therefore, for greatest accuracy, it is important to:

(1) ensure the purge air bag is filled with clean ambient air (away from breathing, car exhaust, etc.), and

(2) fill the purge air bag with air that is as close as possible in temperature and RH level as the area to be sampled for leaks.

IMPORTANT: If the purge air bag is known or suspected to be filled with "contaminated" air, use the EMPTY BAG function to clear the bag, then fill the bag with clean air.

IMPORTANT: The CO$_2$ PGM-IR displays CO$_2$ PPM gas readings that are *relative to ambient air*, **NOT** absolute CO$_2$ PPM readings.
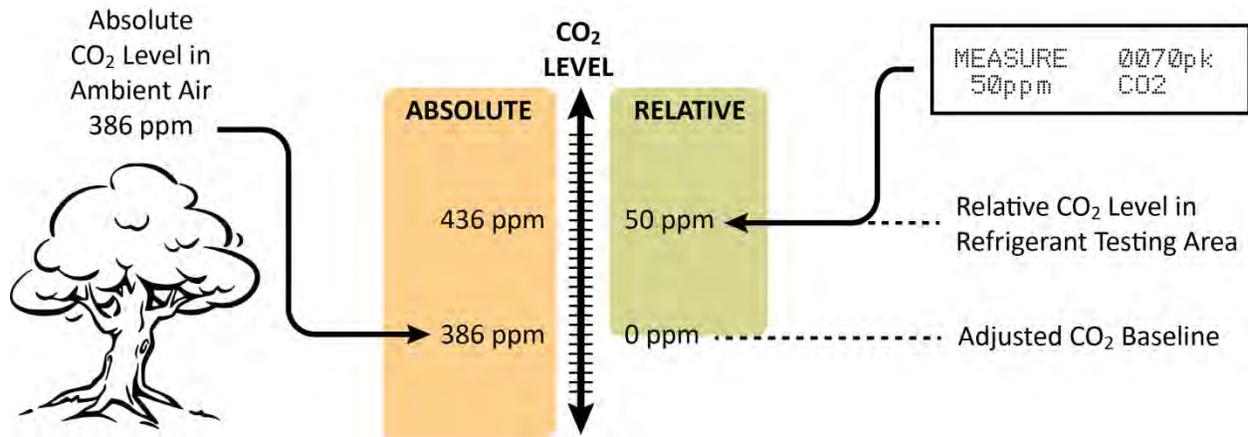
1.10 Specifications

Specification	Description
Gas Detected	CO$_2$ (R744)
Measuring Range	20 to 100,000ppm (10% vol.)
Warm-Up Time	5 minutes (300 seconds)
Detector Type	Infrared, Non-Dispersive
Display Resolution	1 ppm
Accuracy	±1 ppm ±10% of reading from 0-10,000 ppm
Response Time	90% of response within 5 seconds
System Noise	Less than 40dB (A) at 10 ft (3 m)
Operating Temperature	32 to 122°F (0 to 50°C)
Ambient Humidity	5 to 90% RH (non-condensing)
Altitude Limit	6,562 ft (2,000 m)
Power	DC power pack, provides a minimum of 8 hours of operation
Power Consumption	15 Watts maximum
Front panel	3 indicator lights: ON Green LED flashes during warm-up, then glows steadily during normal operation FAULT Yellow LED flashes when there is a system fault ALARM Red LED flashes when the gas level is above its alarm setting
Audible Alarm	Internal audible alarm programmable for any of the following conditions: OFF, FAULT/ALARM, ALARM
Dimensions (D x L x W)	9.0 x 14.5 x 5.0 inches (229 x 368 x 127 mm)
Weight	Less than 9 lbs (4 kg) including battery
Warranty	2 years from date of shipment

2 Operation

2.1 Front Panel Display & Controls

ALARM (Red LED)

SYSTEM FAULT (Yellow LED)

MONITOR ON (Green LED)
(Flashed during warm-up)

SILENCE/ESC
Press this button to:
(a) temporarily silence
the audible alarm
(b) return to the previous
screen without saving
data.

DISPLAY SCREEN

ENTER KEY
(a) Press to zero the peak reading
(b) When in the Control/Setup Menu
Mode, press to save a displayed
value.

KEYPAD
When in the Control/Setup Menu
Mode, use these buttons to:
(a) move the arrow (>) on the display
screen to the desired function.
(b) scroll through data
(c) change a function's value

Enter the Control/Setup Menu Mode
by pressing the left and right arrow
buttons simulatenously.

POWER ON/OFF (Toggle Switch)

2.2 Connecting Gas-Sample & Exhaust Lines

2.2.1 Connecting the Gas-Sample Probe

To connect the gas-sample probe to the monitor, simply push the elbow connector into the Gas Sample Port on the front of the monitor as shown in the illustration below.
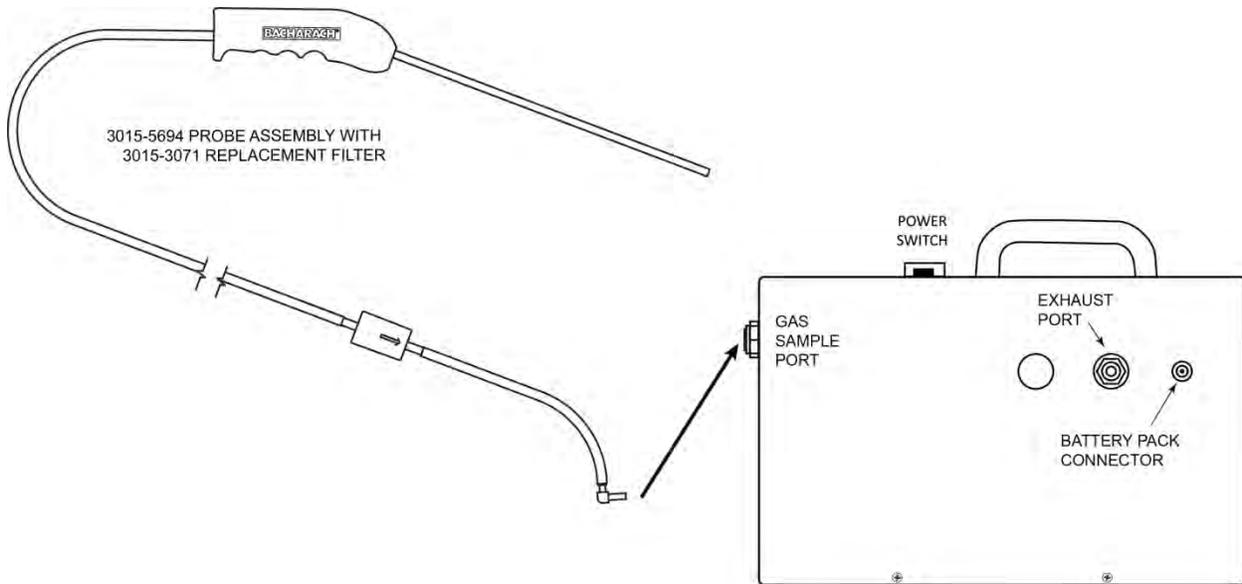
The gas-sample line can be up to **50 ft (15.2 m)** in length. All tubing bends should have a radius of no less than 5" to ensure proper airflow. If kinks or obstructions occur in the line the monitor may not function properly.

When searching for leaks, the end of the probe should be placed near the potential leak source and positioned to reduce the possibility of mists, aerosols, oil, water, dust, or other contaminates being drawn into the monitor.

2.2.2 Connecting the Exhaust Line (Optional)

The exhaust line carries the exhausted gas sample away from the monitor, and should be installed if the monitor is located in a confined, poorly ventilated area.

The exhaust line can be up to **50 ft (15.2 m)** in length. Ideally this line should terminate outdoors in a location that is not exposed to the elements.

2.2.3 Using the Push-to-Connect (PTC) Fittings

Connect the exhaust line to the monitor by firmly pushing the tubing into the Exhaust Port's push-to-connect (PTC) fitting. See below. If the exhaust line terminates outside the building, position the tubing so that no water or moisture can enter the line. Note that this line does not require a termination filter.

To connect the exhaust line to the exhaust port's PTC fitting, firmly push the appropriate tubing into the hole in the center of the connector until it seats in the connector. Refer to the figures at the left.

To remove tubing from a PTC connector, push and hold the spring-loaded collar inwards, then simultaneously withdraw the tubing. Refer to the figures at the right.
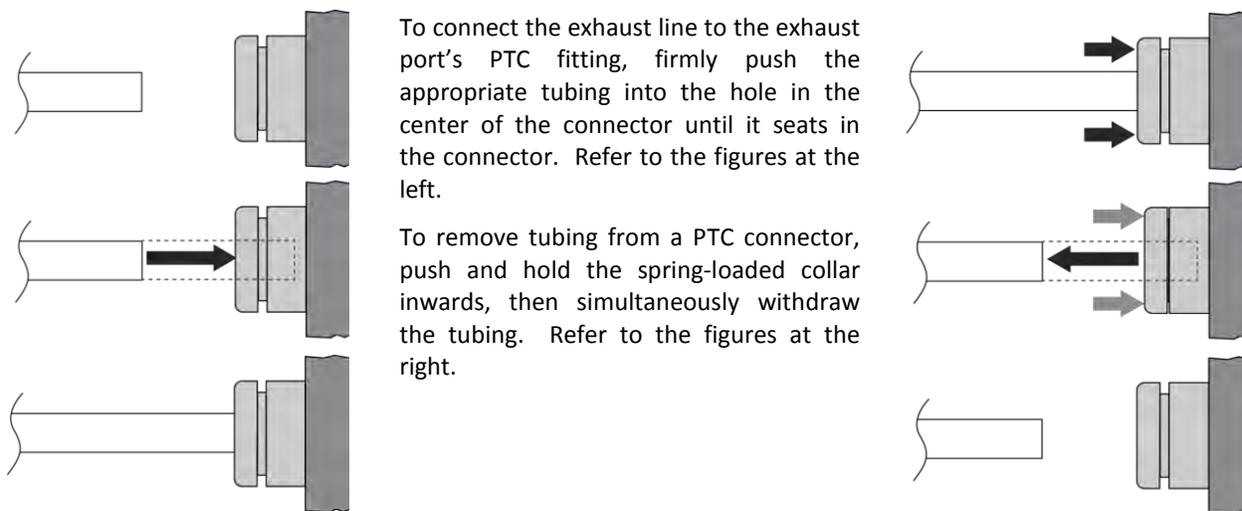
2.3 General Operation

☝ **WARNING:** Operate the monitor in its horizontal position (handle facing upwards). Tilting the monitor to a vertical position while in operation may cause inaccurate measurements to occur.

To turn ON the monitor, lift up the shield located in front of the handle and press the ON/OFF toggle switch. When the monitor has been powered ON, allow it to warm up for 5 minutes.

```
MEASURE   0070pk
    50ppm CO2
```

MEASURE indicates when the monitor is actively measuring gas. The screen to the left shows that currently 50 ppm of CO_2 gas is being detected, and that a peak measurement of 70 ppm has been made. The operator can reset the peak value to zero by pressing the **ENTER** button. The measurement cycle runs for approximately 4 minutes between purge cycles. A log of up to 200 previous measurements can be viewed using the **PPM LOG** function (page 11).

```
PURGE
```

PURGE indicates when the monitor is resetting its infrared detector to a baseline of 0 ppm (relative) by using the 386 ppm (absolute) zero-air from the internal purge bag. The purge cycle runs for approximately 10 seconds.

If the detected gas level exceeds a preset gas-alarm point, the unit will respond by turning ON the front panel **ALARM** (red) light. If the **AUDALRM** function is activated (page 11), the audible alarm will also turn ON. Pressing the front panel **SILENCE** button turns OFF the audible alarm, but the **ALARM** light will continue to flash as long as the detected gas level is above the alarm point. The audible alarm will reactivate if the gas-alarm condition is not cleared within the time period set by the **SILENCE** function (page 13).

If a system fault occurs (see Fault Code list on page 14), the monitor responds by turning ON the front panel **FAULT** (yellow) light. If the **AUDALRM** function is activated (page 11), the audible alarm will also turn ON. Pressing the front panel **SILENCE** button turns OFF the audible alarm, but the **FAULT** light will continue to flash as long as the fault is present. The audible alarm will reactivate if the fault condition is not cleared within the time period set by the **SILENCE** function (page 11). Both the **FAULT** light and audible alarm will automatically turn OFF after the cause of the fault has been eliminated.

A log of the last 30 fault events can be viewed using the monitor's **FAULTS** function (page 12).

2.4 Time Weighted Average (TWA) Operation

2.4.1 Overview

In addition to displaying the current gas level, the monitor can also calculate and display a **T**ime **W**eighted **A**verage ppm value. This value is available in two formats (8 Hour or Continuous). This provides users with the most appropriate data on their average ppm exposure in the working environment.

TWA operation is selected by using the **2ndUNIT** function.

The two TWA formats are identified by the appearance of either "TWA" (for an 8-hour TWA) or 'twa' (for a continuous TWA) in the upper-right corner of the **Data Display** screen.

```
MEASURE      0TWA
100ppm       CO2
```

TWA (upper case letters) is calculated over an 8-hour period. This format is designed to show the user's average ppm exposure level during a typical work day. After 8 hours has expired, an asterisk (*) will be displayed but the TWA will continue to be updated.

```
MEASURE      0twa
100ppm       CO2
```

twa (lower case letters) is continuously calculated over the operating time of the monitor. This mode is useful for monitoring an area for a few minutes or more and is the preferred mode of operation for checking operating room atmospheres.

2.4.2   Starting a New or Continuing TWA/twa

When the monitor is turned ON the following message appears if the monitor is set up to display TWA/twa.

```
PRESS ENTER FOR
     NEW TWA/twa
```

Press either . . .

- **ENTER** to start a new TWA/twa

- **ESC** to continue with the current TWA/twa.

    Tip: *If NO button is pressed within 60 seconds the monitor automatically continues with the current TWA/twa.*

NOTE: During the time the monitor is OFF, the gas measurement is assumed to be zero and will be factored into the TWA/twa calculation.

After selecting whether to start or continue a TWA/twa, the next screen shows the current elapsed TWA/twa time, where:

xx   is the accumulated time used by the monitor in calculating the TWA/twa.

```
ELAPSED TWA TIME
IS xx MINUTES
```

2.5   Peak Reading Operation

In addition to displaying the current CO_2 level, the monitor can also be set up to display its peak ppm measurement. The peak reading display is selected by using the 2ndUNIT function.

```
MEASURE    00070pk
50ppm          CO2
```

The display above shows that currently the monitor is detecting 50 ppm CO_2 and that a peak measurement of 70 ppm has occurred. The peak reading is reset by pressing the **ENTER** button.

2.6   Leak Detector Operation

The monitor can be configured to operate as a Leak Detector by setting the **AUDALRM** function (page 11) to **LEAK DETECTOR**.

When configured as a Leak Detector, the monitor will produce a leak detector type of audible feedback. At zero ppm there will be an audible beep every 2 seconds with the beep rate increasing up to 20 beeps/second when the ppm level reaches the **ALRMLVL** setting.

2.7   Standby Mode

After becoming operational, the monitor can be placed into a Standby Mode. When taken out of standby the monitor is ready for operation without waiting an additional 5 minutes to warm up. While in standby the monitor will stop taking gas samples and stops purging itself from the purge-air bag.

Place the monitor into its Standby Mode by pressing both the **ENTER** and **ESC** buttons at the same time.   Take the monitor out of standby by again pressing both the **ENTER** and **ESC** buttons.

```
    STAND BY
```

2.8   Battery – Charging and Using

IMPORTANT: If you replace the original PGM-IR battery, refer to the installation instructions included in the replacement kit, as the new replacement battery and cable may differ from the original cable and battery.

IMPORTANT: Cables and sockets are sized appropriately. As general rules of thumb:

- Note the initial orientation of your power cable, and
- Never force a connector into a socket.

2.8.1   Charging the Battery

The monitor is powered by a rechargeable battery pack located in a pouch on the side of the monitor's soft carrying case. The battery pack can be recharged at any time, regardless of the battery's current charge state. The lithium-ion battery will likely be partially charged. However, you should fully charge the battery prior to operating the PGM-IR. Refer to the battery manufacturer's instruction sheet for the proper charging procedure.

2.8.2   Using the Battery

To properly use the battery, follow the steps below.

1. The PGM-IR is designed for a 16VDC input. Set battery voltage output to 16V (refer to the battery manufacturer's instruction sheet for details).

2. The battery pack provided with your PGM-IR uses a power cable with a straight connector and a 90-degree elbow connector. The battery provided with your PGM-IR may differ slightly from the photos shown in this manual, however, the 90-degree elbow connector must ALWAYS be the connector used to supply power to the PGM-IR. Refer to the figure below.

To PGM-IR

3. Ensure that the battery is powered ON per the instruction label on the battery pack.

4. Verify that the battery is properly connected to the PGM-IR (see above).

A fully charged battery pack will power the monitor for a minimum of 8 hours.

2.9   Display Screens

2.9.1 Initial Power Up

When the monitor is first powered up, all front panel lights turn ON and a splash screen appears showing the monitor's current firmware revision level.

```
WARM UP

```

After a brief moment the **Warm Up** screen is displayed along with the front panel **ON** light (green) blinking.

```
    FIRMWARE
 VERSION x.xx
```

The monitor requires 5 minutes to warm up; after which, the **ON** light glows steadily and the **Data Display** screen is displayed.

If the monitor is turned OFF and then turned back ON, the latter warm-up time may be less than 5 minutes depending on the temperature of the IR detector.

2.9.2   Filling the Purge-Air Bag

⚠️   **IMPORTANT:** Fill the purge-air bag in a clean, fresh-air environment that is at the same temperature and humidity as the area being checked for gas. DO NOT fill the bag in an area that is contaminated with gas.

The following message is displayed and an audible alarm is sounded when the monitor's purge-air bag is empty. This message appears immediately after warm-up, and approximately every 40 minutes during normal operation.

```
PURGE AIR EMPTY
<ENTER> TO FILL
```

Press the **ENTER** button to start the refill process.

```
RECHARGING PURGE
AIR...
```

After the air bag has been filled, the monitor starts or resumes normal operation by displaying the **Data Display** screen.

2.9.3 Data Display Screen

During normal operation, the **Data Display** screen shows when the monitor is performing the following two functions.

MEASURE indicates that the monitor is actively measuring gas. In the screen shown to the right, 50 ppm of CO_2 gas is currently being detected, and that a peak measurement of 70 ppm has occurred sometime in the past.

```
MEASURE   00070pk
   50ppm      CO2
```

To reset the peak value to zero, press the **ENTER** button.

```
PURGE

```

2.9.4 Function Screens

The Function screens are used to set up the monitor and display stored data.

From the **Data Display** screen, press both the **Keypad Left** and **Right** buttons at the same time to display the first **Function Menu** screen. Next, use the **Keypad** buttons to move the arrow (>) until it points to the desired function, and then press the **ENTER** button to select that function.

```
>FILLBAG EMTYBAG
 ALRMLVL AUDALRM
```

```
>PPM LOG LOG INT
 FAULTS   DIAG
```

Once a function has been selected, use the **Keypad** to scroll through the displayed data or to change a parameter associated with that function. Press **ENTER** to save any newly entered parameters. Press the **ESC** button to return to the previous screen without saving.

```
>SILENCE  P-CHK
 GAS      CLOCK
```

Note that if no buttons are pressed within 90 seconds after selecting a function, the unit returns to the **Data Display** screen.

```
>2ndUNIT PRINT
 PLOT    PC-DUMP
```

```
FILLING BAG...
```

FILLBAG – Press **ENTER** to manually fill the purge-air bag.

⚠ **IMPORTANT:** Fill the purge-air bag in a clean, fresh-air environment that is at the same temperature and humidity as the area being checked for gas. DO NOT fill the bag in an area that is contaminated with gas.

```
DRAINING BAG...
```

EMTYBAG – Press **ENTER** to manually empty the purge-air bag. Use this function to drain the bag if it becomes contaminated with gas or before shipping the instrument via air transportation.

```
EDIT ALARM LEVEL
      300 ppm
```

ALRMLVL – Detected gas level that causes the front panel **ALARM** (red) light to turn ON and the audible alarm to sound (if AUDALRM function is set to ALARM or ALARM/FAULT).

```
AUDIBLE ALARM IS
     ALARM
```

AUDALRM – The internal audible alarm is programmable to function as follows:

- **OFF** – Audible alarm is disabled.

- **ALARM** – Alarm sounds when detected gas level exceeds the ALRMLVL level as evidenced by the front panel ALARM (red) light turning ON.

- **ALARM/FAULT** – Alarm sounds when either the detected gas level exceeds the ALRMLVL value, or if a system fault occurs, as evidenced by the front panel ALARM (red) light or FAULT (yellow) light turning ON.

- **LEAK DETECTOR** – When selected, the monitor will produce a leak detector type of audible feedback. At zero ppm there will be an audible beep every 2 seconds with the beep rate increasing up to 20 beeps per second when the ppm level reaches the ALRMLVL setting.

- **TWA ALARM** – Audible alarm sounds when the TWA or twa, whichever is selected by the **2ndUNIT Function**, exceeds the ALARMLVL value.

The audible alarm can be temporarily silenced by pressing the **SILENCE** button.

```
#025      2PPM @
07/11/12  15:35
```

PPM LOG – Contains records of the last 200 measurements. Each record shows the measurement's date, time, and ppm level. Measurements are logged at an interval determined by the **LOG INT** function. After all 200 locations are filled the newest entries overwrite the oldest entries.

Use the Keypad Up and Down buttons to change the record number by a factor of 1. Use the Right and Left buttons to change the record number by a factor of 10. Press ESC to return to the previous screen.

To the right, record #025 shows that a gas level of 22 ppm was measured on 07/11/2012 at 3:35 PM.

The PPM Log can be cleared using the information discussed in Clearing the PPM, Alarms and Faults Data on page 14.

```
LOG INTERVAL IS
        0001 min
```

LOG INT – Sets the interval at which measurements are logged to memory from 1 to 9999 minutes. Factory default is 1 minute. The logged measurements can be viewed using the **PPM LOG** function. Use the **Keypad** to enter the desired value, and then press **ENTER** to save that value and return to the previous screen.

```
#15  <1000>   @
07/11/12  12:37
```

FAULTS – Contains records of the last 30 fault events. Refer to section 2.11 System Faults (page 13) for more information.

```
4.2159v   <0000>
29.05cD 14.58psi
```

DIAG – The Diagnostic function displays monitor information that can be helpful when troubleshooting. Refer to Section 2.13 for more information.

```
SILENCE TIMEOUT
        0030 sec
```

SILENCE – Sets the length of time the internal audible alarm is turned OFF when the front panel **SILENCE** button is pressed. The factory default is 30 seconds. If the cause of the gas-alarm has not been cleared at the end of this time period, the internal audible alarm will reactivate. Use the **Keypad** to enter the desired time period, and then press **ENTER** to save that value and return to the previous screen.

```
14.07 * AMB14.05
-0.02dif  <1000>
```

P-CHK – The **Pressure Check** function displays additional diagnostic information that can be helpful when troubleshooting. Refer to Section 2.14 for more information.

```
SELECT GAS TYPE
             CO2
```

GAS – Displays the gas type being monitored. For the CO₂ PGM-IR, CO₂ is the only available gas.

```
 SET DATE & TIME
07/11/12   15:30
```

CLOCK – Sets the monitor's date and time. Use the **Keypad** to enter the correct date and time, and then press **ENTER** to save those values and return to the previous screen. Note that time is displayed in a 24 hour format, while the date is displayed as mm/dd/yy.

```
MEASURE  00500pk
    100ppm   CO2
```

2ndUNIT – One of following second measurements can be selected to appear in the upper-right hand corner of the **Data Display** Screen:

* **NONE** – Blank

* **Peak PPM** – Peak gas reading

* **Cont twa** – Time Weighted Average calculated on a continuous basis

* **8hr TWA** – Time Weighted Average calculated over an 8 hour period

```
2ndUNI  >PRINT
PLOT      PC-DUMP
```

PRINT – Prints the log data to an optional printer. Refer to Section 2.15 for additional information.

```
2ndUNIT   PRINT
>PLOT     PC-DUMP
```

PLOT – Plots a graph of the log data to an optional printer. Refer to Section 2.15 for more information.

```
2ndUNIT PRINT
PLOT     >PC-DUMP
```

PC-DUMP – Downloads the log data to a computer using the RS-232 connection on the top of the monitor. Refer to Section 2.16 for more information.

2.10 Gas Alarm

2.10.1 Gas-Alarm Light

If the detected gas level reaches one the gas-alarm levels as set by the **LEAKLVL**, **SPILLLVL**, or **EVACLVL** functions, the front panel **ALARM** light will flash and the audible alarm, if activated (refer to **AUDALRM** function page 11), will start beeping. The **ALARM** light and audible alarm will automatically turn OFF once the detected gas level drops below the gas-alarm level.

2.10.2 Silencing a Gas Alarm

Pressing the **SILENCE** button while the alarm circuit is activated causes the internal audible alarm to turn OFF for a period of time as set by the **SILENCE** function (page 11). The front panel **ALARM** light will continue to flash, however, as an indication that an alarm condition still exists. The audible alarm will reactivate at the end of the silence period if the detected gas level is still above the gas-alarm level.

2.11 System Faults

2.11.1 Functional Overview

If a system malfunction occurs (see Fault Code list, page 14), the front panel **FAULT** light will flash and the audible alarm, if activated (refer to **AUDALRM** function page 11), will start beeping.

2.11.2 Clearing / Silencing a Fault Alarm

The **FAULT** light and audible alarm will automatically turn OFF after the cause of the fault has been eliminated.

Pressing the **SILENCE** button while a fault condition still exists causes the internal audible alarm to turn OFF for a period of time as set by the **SILENCE** function (page 11). The front panel **FAULT** light will continue to flash, however, as a reminder that a fault condition still exists. The audible-alarm circuit will reactivate at the end of the silence period if the cause of the fault has not been corrected.

2.11.3 Viewing the Faults Log

From the **Data Display** screen, enter the **Function Menu** screen. Next, use the **Keypad** buttons to move the arrow (>) until it points to the **FAULTS** function, and then press the **ENTER** button to display the **Faults Log** screen.

```
#03 <0800> @
07/11/12   08:17
```

```
#04 <0000> @
07/11/12   09:00
```

The **Faults Log** screen shows the monitor's current fault status. If the fault is still present when the **FAULTS** function is selected, then the current cause of the fault is displayed along with the date and time it occurred. If the cause of the fault has been cleared, then the **Faults Log** screen will show <0000> and the date and time the fault was cleared. Use the **Keypad** buttons to scroll through the fault log. In the screens shown to the left, record #03 shows that a Sample Flow Fault (fault code <0800>) occurred on 07/11/12 at 08:17, while record #04 shows that the fault was cleared on 07/11/12 at 9:00.

```
FAULT CODE<1800>
12    SAMPLE FLOW
```

```
FAULT CODE<1800>
13    PURGE FLOW
```

The cause of the fault is identified by a numeric fault code. To convert the fault code into a text description of the fault, first press the **ENTER** button and then use the **Keypad** buttons to scroll through the display until the text description of the fault appears. If the fault code is a combination of two or more faults, then continue to use the **Keypad** buttons until all fault text descriptions have been displayed. For example, the fault code <1800> represents the combination of both a Sample Flow <0800> and a Purge Flow <1000> fault as shown to the left.

The Fault Log can be cleared as described in *Clearing the PPM, Alarms and Faults Data* on page 14.

2.11.4 Fault Codes

FAULT CODES ARE ADDITIVE. For example: A fault code of <0003> indicates that both a Box Temperature Fault <0001> and a Bench Temperature Fault <0002> have occurred.

Code	Fault Name	Description
<0001>	Box Temperature Fault	Enclosure temperature is outside normal range (or IR detector has failed). Check that the monitor is not being subjected to extreme temperatures. Use the **DIAG** function to check the Box Temperature.
<0002>	Bench Temperature Fault	Optical bench is outside normal operating range (or IR detector has failed). Check that the monitor is not being subjected to extreme temperatures.
<0004>	Manifold Pressure Fault (Sensor 1)	The manifold pressure is outside its normal operating range (or IR detector has failed). Enter the **DIAG** function and record ALL data. Call the factory with this information for further instructions.
<0020>	Manifold Pressure Fault (Sensor 2)	See fault code <0004>.
<0040>	Fill Flow Fault	The purge-air bag's pressure drop is outside expected limits. Check for a punctured bag or disconnected tubing.
<0080>	Over Range Fault	Monitor exposed to a gas level that exceeded the IR sensor limits.
<0100>	Zero Filter Fault	The purge-air bag is contaminated with gas. Take monitor to a clean-air area and use the **EMPTYBAG** and **FILLBAG** functions to decontaminate the purge-air bag.
<0200>	Gain Set Fault	The digipot autotune sequence has failed. Call the factory for further instructions.
<0400>	A/D Fault	A fault has occurred in the analog-to-digital circuitry. Contact the factory with this information for further instructions.
<0800>	Sample Flow Fault	Check for: A restriction in the gas-sample inlet or exhaust; a blocked internal filter; or a failed pump.
<1000>	Purge Flow Fault	Check for: A restriction in the gas-sample exhaust; a blocked internal filter; or a failed pump. Once the purge air stream has been restored, the monitor will return to normal operation after it completes a purge cycle.
<2000>	Bag Fill Fault	The purge-air bag did not fill within the expected time allotment. Check for a punctured bag or disconnected tubing.
<4000>	Zero Range Fault:	The IR detector's output voltage is out of tolerance. Enter the **DIAG** function and record all data. Call the factory with this information for further instructions.
<8000>	Clipping Fault	The detector voltage may be out of tolerance. Use the **DIAG** function to check the IR detector voltage. Call the factory with this information for further instructions.

2.12 Clearing the PPM, Alarms and Faults Data

Up to 200 gas measurements and 30 alarm and fault events are stored by the monitor.

To clear stored data, first display the data to be cleared by selecting the **PPM LOG, ALARMS** or **FAULTS** function. Next, press both the **ENTER** and **Keypad Right** buttons at the same time. A single, long tone should be heard when the data has been successfully cleared.

2.13 The DIAG Function

2.13.1 Overview

The **DIAG** function displays sensor data and status information useful to a service technician for troubleshooting various fault conditions. Explanations of the data shown in these screens are given below.

2.13.2 Keypad Functions

From the **Data Display** screen, enter the **Function Menu** screen. Next, use the **Keypad** buttons to move the arrow (>) until it is next to the **DIAG** function, and then press **ENTER** to display the first of two **Diagnostic** screens.

Press the **Keypad Up** button to toggle between the **First** and **Second Diagnostic** screen.

2.13.3 First Diagnostic Screen

Bench Voltage → `4. 20885v   <0000>`   ← Fault Code
Detector Temperature °C → `29. 05cD  14. 58psi`   ← Pressure Reading

Noise → `0. 00075n   <0000>`   ← Fault Code
Box Temperature °C → `35. 40cB  14. 59psi`   ← Pressure Reading

In the **First Diagnostic** screen, the user can toggle between displaying Bench Voltage / Detector Temperature, and Noise / Box Temperature by pressing the **Keypad Right** button.

Bench Voltage – This is the current peak-to-peak output of the IR detector. In the absence of gas this value can range from 3.90000V to 4.50000V.

Noise –The Noise value is a 16 point running average of the noise portion of the IR detector's output. This reading is valuable mainly when gas is NOT present.

Detector Temperature – This is the current detector temperature in °C.

Box Temperature – This is the current internal enclosure temperature in °C.

Fault Code – Current fault code.

Pressure Reading – This is the pressure as measured every purge cycle with the sample pump off and the gas-sample inlet open. Its value is weather and altitude dependent and can range from 10.0 to 15.5 PSIA.

Purge Valve Asterisk (∗) – The purge valve can be opened and closed by pressing the **Keypad Left** button. An asterisk appears on the display when the purge valve is *open* causing the monitor to draw air from its internal purge-air bag.

2.13.4 Second Diagnostic Screen

PPM Level → `   0. 1ppm    0. 01`   ← µMole/Liter
Average Absorption Unit → `0. 00004au∗4. 210v`   ← Detector Voltage

PPM Level – Parts Per Million Level is the current detected gas level relative to purge air.   (When the purge air bag is filled, the CO₂ concentration it contains is subtracted from all subsequent measurements. So if the bag contains normal outdoor ambient CO₂ at 386 ppm and you then measure outdoor ambient, the display will show 0 ppm.)

Average Absorption Unit – This is the optical absorbency. In the absence of gas the absorbency is 0.00000 au. When sampling gas, its value varies proportionally with the gas concentration.

µMoles/Liter – This is the absolute concentration in micro-moles per liter of gas.

Detector Voltage – This is a running average of the IR detector's bench voltage.

Purge Valve Asterisk (∗) – The purge valve can be opened and closed by pressing the **Keypad Left** button. An asterisk appears on the display when the purge valve is *open* causing the monitor to draw air from its internal purge-air bag.

2.14 The P-CHK Function

2.14.1 Overview

The **P-CHK** function (Pressure Check function) is useful to a service technician for troubleshooting a flow-fault problem. The monitor will trigger a flow fault if the pressure drop from ambient is less than 0.2 psi during a purge cycle, and 0.5 psi during a measurement cycle.

2.14.2 Keypad Functions

From the **Data Display** screen, enter the **Function Menu** screen. Next, use the **Keypad** buttons to move the arrow (>) until it points to the **P-CHK** function, and then press **ENTER** to display the **Pressure** screen.

The **Keypad Left** button toggles the purge valve open and closed. Note that an asterisk (*) appears when the purge valve is *open* causing the monitor to draw air from the purge-air bag.

The **Keypad Down** button toggles the pump ON and OFF.

Pressing the **ENTER** button stores the current manifold pressure shown on the left to the ambient pressure shown on the right (must be done with the pump OFF).

2.14.3 Screen Display

Current Manifold Pressure → | `14.78      AMB14.79` | ← Stored Ambient Pressure
Pressure Difference → | `-0.02dif   * <0000>` | ← Fault Code

Current Manifold Pressure – Current manifold pressure in psia.

Stored Ambient Pressure – Stored ambient pressure in psia.

Pressure Difference – The difference between the current manifold pressure and the stored ambient pressure.

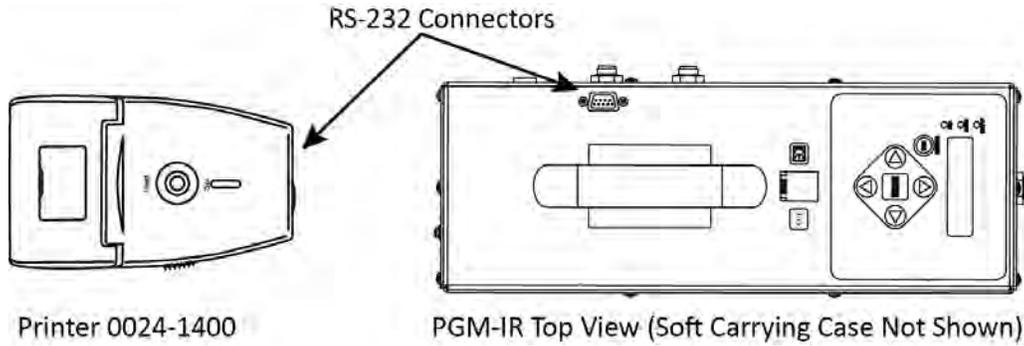**Fault Code** – Current fault code (see page 14).

Purge Valve Asterisk (∗) – The purge valve can be opened and closed by pressing the **Keypad Left** button. An asterisk appears on the display when the purge valve is *open* causing the monitor to draw air from the purge-air bag.

2.15 Print/Plot Logged Gas Levels

A printout or plot of the last 200 ppm measurements can be made by connecting the optional Bacharach printer and printer cable to the monitor as follows. (Refer to Replacement Parts on page 23 for printer and cable part numbers).

1. For a printout or plot to be made, the monitor must have been set up to record gas measurements using the **LOG INT** function.

2. Connect the RS-232 port on the monitor to the RS-232 port on the printer.

3. If not already done, refer to the printer manual and set the printer's communication parameters to:

    - Data bit = 8
    - Parity = None
    - Baud rate = 19200
    - Handshaking = DTR

4. From the **Data Display** screen, press *any* **Keypad** button to display the **Function Menu** screen. Next, use the **Keypad** buttons to move the arrow (>) until it points to either **PRINT** to produce a printout, or **PLOT** to generate a plot.

    | `2ndUNIT   >PRINT` |
    | `PLOT      PC-DUMP` |

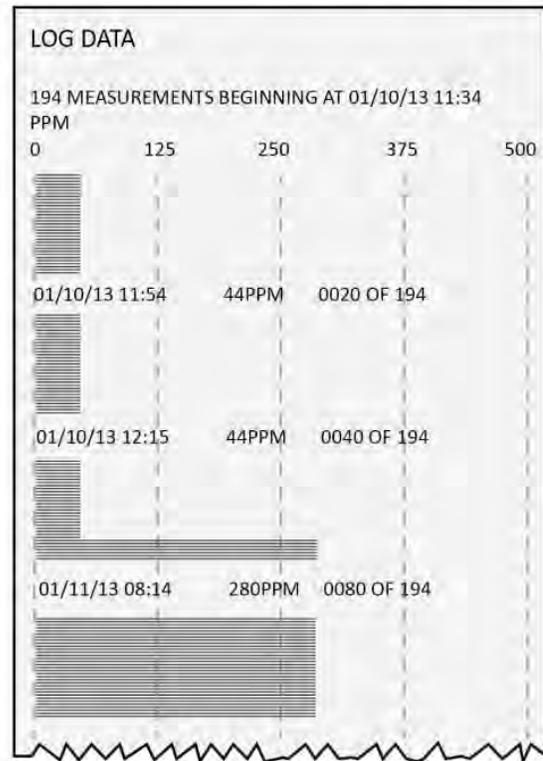5. Press **ENTER** to start the print/plot process.

RS-232 Connectors

Printer 0024-1400   PGM-IR Top View (Soft Carrying Case Not Shown)

EXAMPLE PRINTOUT
Date / Time / PPM / Reading Number

LOG DATA

DATE	TIME	PPM	
01/10/13	11:34	0PPM	0001 of 194
01/10/13	11:35	45PPM	0002 of 194
01/10/13	11:36	45PPM	0003 of 194
01/10/13	11:37	44PPM	0004 of 194
01/10/13	11:38	46PPM	0005 of 194
01/10/13	11:39	45PPM	0006 of 194
01/10/13	11:40	44PPM	0007 of 194
01/10/13	11:41	44PPM	0008 of 194
01/10/13	11:43	45PPM	0009 of 194
01/10/13	11:44	45PPM	0010 of 194
01/10/13	11:45	44PPM	0011 of 194
01/10/13	11:46	44PPM	0012 of 194
01/10/13	11:47	45PPM	0013 of 194
01/10/13	11:48	45PPM	0014of 194
01/10/13	11:49	45PPM	0015 of 194
01/10/13	11:50	45PPM	0016 of 194
01/10/13	11:51	44PPM	0017 of 194
01/10/13	11:52	45PPM	0018 of 194
01/10/13	11:53	45PPM	0019 of 194
01/10/13	11:54	45PPM	0020 of 194
01/10/13	11:55	44PPM	0021 of 194
01/10/13	11:56	45PPM	0022 of 194
01/10/13	11:57	44PPM	0023 of 194
01/10/13	11:58	44PPM	0024 of 194
01/10/13	11:59	44PPM	0025 of 194
01/10/13	12:00	45PPM	0026 of 194
01/10/13	12:01	44PPM	0027 of 194
01/10/13	12:02	44PPM	0028 of 194
01/10/13	12:04	44PPM	0029 of 194
01/10/13	12:05	44PPM	0030 of 194
01/10/13	12:06	45PPM	0031 of 194
01/10/13	12:07	44PPM	0032 of 194
01/10/13	12:08	44PPM	0033 of 194

EXAMPLE PLOT
Date / Time / PPM Bar Graph

LOG DATA

194 MEASUREMENTS BEGINNING AT 01/10/13 11:34
PPM
0   125   250   375   500

01/10/13 11:54   44PPM   0020 OF 194

01/10/13 12:15   44PPM   0040 OF 194

01/11/13 08:14   280PPM   0080 OF 194

2.16 Downloading Stored Data to a Personal Computer

Using the monitor's **PC DUMP** feature, the last 200 gas readings that were stored in memory can be downloaded to a personal computer in ASCII text, comma-delimited format, which can then be imported into most spreadsheet programs for analysis.

The following describes how to download data to a computer using Windows® HyperTerminal as the communications program. If a different operating system and/or communications program is being used, then consult the appropriate instruction manuals for those products.

1. Install serial data cable P/N 104-4027 (straight through, 6 foot, DB9 male to DB9 female) between the computer's COM port and the analyzer's RS-232 connector. (For computers with a 25-pin COM port, use a 25-pin to 9-pin adapter or use a serial cable with appropriate connectors on each end.)

2. At the computer, start HyperTerminal by doing one of the following:

    *   If HyperTerminal has already been set up to communicate with the CO₂ Monitor, then click **Start**, point to **Programs**, point to **Accessories**, point to **Communications**, click **HyperTerminal**, and double-click the file name or icon that has been associated with the monitor.

    *   If HyperTerminal has never been run in association with the monitor, then a new HyperTerminal connection needs to be made as follows:

        a) Click **Start**; click **Run**. In the Run box, type "hypertrm.exe*"* and click **OK.** The **New Connection** dialog box should appear.

        b) Type in a New Connection Name. Click **OK** to select the default icon (if desired, select a different icon before clicking OK). The "**Connect To"** dialog box should appear.

        c) Click on **Connect from the** drop-down menu and choose the **COM** port to which the analyzer is connected. Then click **OK** to display the **COM Properties** dialog box for that COM port.

        d) Set Port Settings to:
            - Bits per second: 19200
            - Data bits: 8
            - Parity: .... None
            - Stop bits: 1
            - Flow control: .... None

            Then click **OK** to display HyperTerminal's main window.

        e) Click File; click Save. This creates a file with an .ht extension in the folder C:\Program Files\Accessories\Hyper Terminal, using the name that was entered in Step b.

3. After HyperTerminal is running: click **Transfer**, click **Capture Text**, and then click **Start** to accept the default drive\directory\filename to which all received data will be stored as an ASCII text file.

> **NOTE:** By default, the captured text file will be stored on the hard drive at C:\Program Files\Accessories\HyperTerminal\CAPTURE.TXT. If desired, click **Browse** to select a different drive, directory and filename. The next time data is captured, it will be stored under the same location and filename.

> **NOTE:** Changing the filename extension to "CSV" (comma separated variable) will allow the file to be directly opened in the spreadsheet program. For example, double clicking the filename CAPTURE.CSV in Windows Explorer will automatically start Microsoft Excel and load the file.

4. From the **Data Display** screen, enter the **Function Menu** screen. Next, use the **Keypad** buttons to move the arrow (>) until it points to **PC-DUMP**, and then press the **ENTER** button to begin the download process.

```
2ndUNIT   PRINT
PLOT     >PC-DUMP
```

5. Observe that the monitor's screen goes blank and that HyperTerminal displays the data as it is being received. After all data has been transmitted, the CO$_2$ Monitor re-displays the **Function Menu** screen.

6. To stop capturing data and save it, click **Transfer**, click **Capture Text**, click **Stop**.

7. HyperTerminal and the connection to the monitor can now be closed.

Example of Text File Capture by HyperTerminal

2.17 Importing Saved Data into a Spreadsheet

A text file that was created as described in Section 2.16 can be imported into spreadsheet programs that are capable of importing comma-delimited files.

The following describes how to generate a spreadsheet from a comma-delimited text file using Microsoft Excel. If you are using a different spreadsheet program or a different version of Excel, please refer to its instruction manual for information on how to import comma-delimited text files.

Step	Instructions	
1.	Start Microsoft Excel.	
2.	**For Excel version 2003:** Click Data, Import External Data, and Import Data to display the "Select Data Source" dialog box.	**For Excel versions 2007-2013:** Click the DATA tab, then click the FROM TEXT button. The IMPORT TEXT FILE dialog box is displayed.
3.	Locate file saved earlier.	
4.	**For Excel version 2003:** Select file, then click "Open" to display Excel's "Text Import Wizard."	**For Excel versions 2007-2013:** Select file, then click the "IMPORT" button.
5.	Choose the "Delimited" data option and click Next.	
6.	Check the "Tab," "Comma," and "Space" delimiters and click Finish.	
7.	Choose "Existing worksheet" or "New worksheet" and click OK to create spreadsheet.	

NOTE: A worksheet must be open in order to import data.

A sample spreadsheet is shown below.

	A	B	C	D
1	ZONE	1	LOG	START
2	12/19/2012	12:32	0	
3	12/19/2012	12:35	1	
4	12/19/2012	12:36	2	
5	12/19/2012	12:37	3	
6	12/19/2012	12:38	4	
7	12/19/2012	12:40	0	
8	12/19/2012	12:41	2	
9	12/19/2012	12:42	3	
10	12/19/2012	12:43	5	
11	12/19/2012	12:44	7	
12	12/19/2012	12:45	8	
13	12/19/2012	12:46	9	
14	12/19/2012	12:47	10	
15	12/19/2012	12:48	11	
16	12/19/2012	12:49	12	
17	12/19/2012	12:50	13	
18	12/19/2012	12:51	14	
19	12/19/2012	12:52	15	
20	12/19/2012	12:53	17	
21	12/19/2012	12:54	17	
22	12/19/2012	12:55	19	
23	12/19/2012	12:56	20	
24	12/19/2012	12:57	21	

⋮　　⋮　　⋮　　⋮

	A	B	C	D
145	12/20/2012	7:42	45	
146	12/20/2012	7:43	50	
147	12/20/2012	7:44	0	
148	1/14/2013	9:52	0	
149	1/14/2013	9:53	1	
150	1/14/2013	9:54	2	
151	1/14/2013	9:55	2	
152	1/14/2013	9:56	0	
153	1/14/2013	9:57	0	
154	END	OF	ZONE	1
155	L			

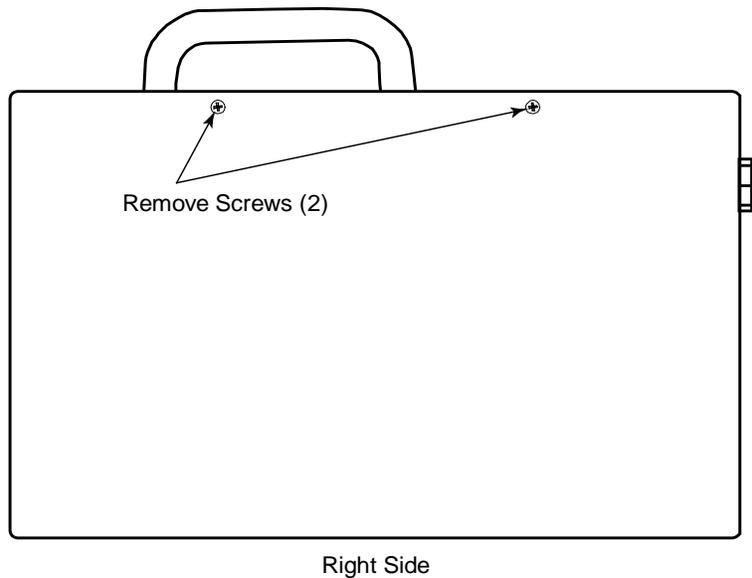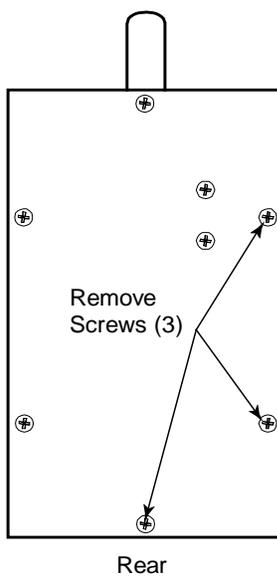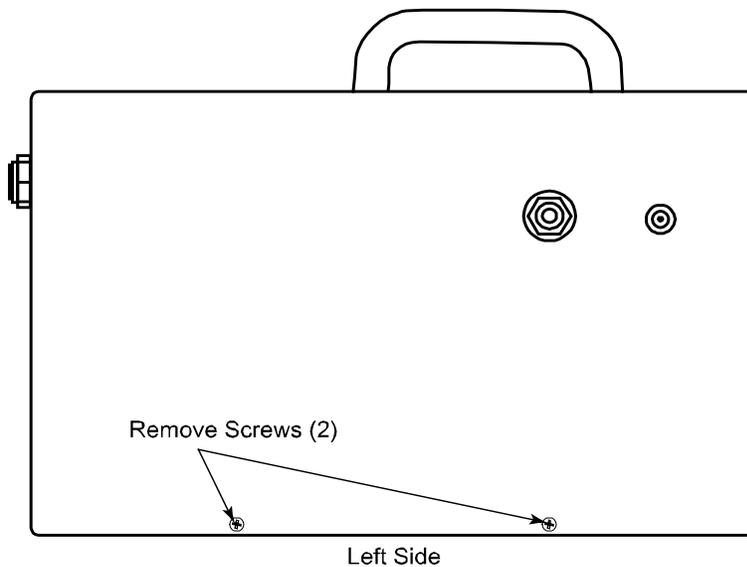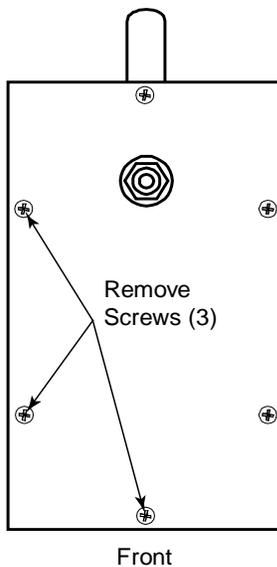# 3 Maintenance

3.1 Disassembly

When servicing the parts inside the CO_2 monitor, disassemble the monitor's metal chassis as follows:

Items Required:

- Medium Phillips head screwdriver

Procedure:

1. Unplug battery pack from monitor.

2. Remove the monitor from the soft carrying case.Remove a total of 10 screws from the locations shown in the illustrations below.

3. Carefully separate the metal chassis.

Remove
Screws (3)

Front

Remove Screws (2)

Left Side

Remove
Screws (3)

Rear

Remove Screws (2)

Right Side

3.2 Internal Particulate/Hydrophobic Filter Replacement

Items Required:

- Replacement filter (P/N 0007-1654)
- Medium Phillips head screwdriver

Procedure:

1. Disassemble the monitor's metal chassis per Section 3.1.

2. See illustration below and locate the internal particulate / hydrophobic filter to be replaced.

3. Pull off tubing from both ends of filter and remove filter from instrument.

4. Attach tubing to new filter

5. Reassemble monitor.

Particulate/Hydrophobic Filter
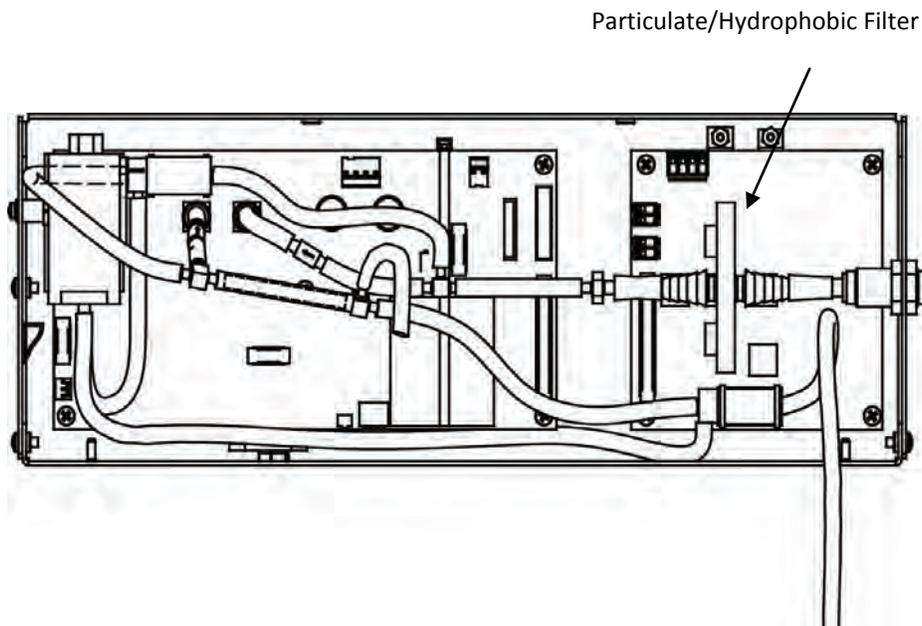
3.3 Updating Firmware

An RS-232 connector, located on the top panel, is used to update the monitor's firmware. Reprogramming the instrument with updated firmware should be done by qualified service technicians only using instructions provided by Bacharach.

RS-232 Connector
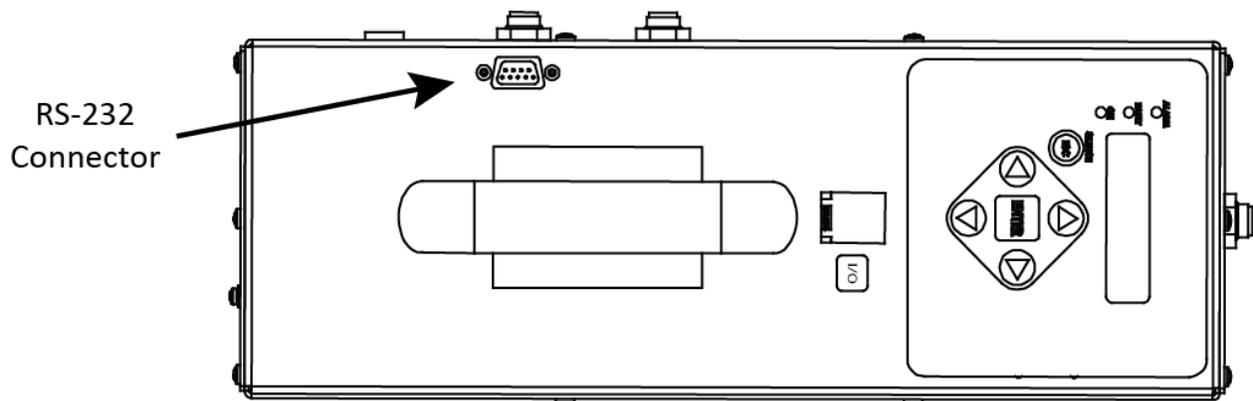
4 Parts and Service

4.1 Replacement Parts

Item Description	Part Number
Replacement Battery Kit	3015-5743
Replacement Battery Charger (for 87 Wh battery 3015-5743)	3015-5847
Replacement Power Cord (US)	0304-3466
Replacement Power Cord (AUS)	0304-3469
Replacement Power Cord (UK)	0304-3471
Replacement Power Cord (EU)	0304-3470
Replacement Cable (connects battery to PGM-IR)	3015-5757
Soft Carrying Case with Shoulder Strap	3015-5700
Bladder Bag Kit	3015-5325
Sample Probe	3015-5694
External Coalescing Filter	3015-3071
Hydrophobic Filter (internal)	0007-1654
Replacement Pump	3015-4239
Battery (for main PCB board)	0204-0020
Replacement Bench Kit	3015-5759

4.2 Optional Accessories

Item Description	Part Number
IrDA Printer (includes printer, roll of thermal paper, 4 x AA batteries, manual)	0024-1400
Thermal printer paper, 1 roll	0006-8733
Thermal printer paper, 5 rolls	0024-1310
Cable (DB9 to RJ-45)	3015-4214
Computer Communications Cable (DB9 male to DB9 female)	0104-4027

4.3 Service Centers

Service and replacement parts can be obtained by contacting the Bacharach Service Centers listed below. Access **http://mybacharach.com/rmaform/** on the web for return materials authorization.

United States
Bacharach, Inc.
621 Hunt Valley Circle
New Kensington, PA 15068
USA
Phone: 724-334-5051
Fax: 724-334-5723

Ireland
Bacharach - Europe
114A Georges Street Lower
Dun Laoghaire, Dublin
Ireland
Phone: +353 1 284 6388
Fax: +353 1 284 6389

Canada
Bacharach - Canada
20 Amber St. Unit #7
Markham, Ontario L3R SP4
Canada
Phone: 905-470-8985
Fax: 905-470-8963

$C\,E$ Declaration of Conformity

Product(s):	Leak Detector
Model(s):	PGM-IR and derivatives
The manufacturer of the products covered by this declaration:	Bacharach, Inc. 621 Hunt Valley Circle New Kensington, PA 15068 U.S.A.
Year(s) conformity is declared:	2015
Directive(s)	2014/30/EU Electromagnetic Compatibility (EMC)

This declaration of conformity is issued under the sole responsibility of the manufacturer.

Object of the declaration	

The object of the declaration described above is in conformity with the relevant Union harmonisation legislation.

Harmonised Standard(s)

EN 61326-1:2013	Electrical equipment for measurement, control and laboratory use - EMC requirements - Part 1: General requirements

Signed for and on behalf of Bacharach, Inc.

New Kensington, PA, U.S.A., 07 March 2016

Aaron E. Kennison, Engineering Manager

The technical documentation file required by this directive is maintained at the corporate headquarters of Bacharach, Inc.

The technical documentation file required by this directive is maintained at the corporate headquarters of Bacharach, Inc.

NOTE: The Directives **or Harmonized Standards** to which this product has been evaluated **may have** changed. Bacharach, Inc. however continues to market this product under a presumption of conformity even though the Standards **may** no longer be harmonized.

BACHARACH
The Measurable Difference