PGM-IR SF₆ Monitor
Portable Gas Monitor for SF₆ Gas

Instruction 3015-5150
Operation and Maintenance
Rev. 10 – January 2018
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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 Sulfur Hexafluoride (SF₆) Portable Monitor.

To assure operator safety and the proper use of the monitor, please read, understand, and follow the contents of 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 not been designed to be intrinsically safe for use in areas classified as hazardous locations. For your safety, DO NOT 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.

1.5.1 Explosive Atmosphere

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.

1.5.2 Misuse and Modifications to Monitor

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.

1.5.3 Altitude Limit

6,562 ft (2,000 m)

1.5.4 Cleaning

Clean the outside of the monitor's case using a dry cloth — DO NOT use soap and water.

1.6 Unpacking and Initial Checks

Your SF₆ Portable 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.

<table>
<thead>
<tr>
<th>Item</th>
<th>Qty.</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>SF₆ Portable Monitor</td>
<td>1</td>
<td>3015-5148</td>
</tr>
<tr>
<td>Soft Carrying Case with Shoulder Strap</td>
<td>1</td>
<td>3015-5700</td>
</tr>
<tr>
<td>Battery Pack &amp; Charger</td>
<td>1</td>
<td>3015-5743</td>
</tr>
<tr>
<td>Instruction Manual</td>
<td>1</td>
<td>3015-5150</td>
</tr>
<tr>
<td>External Filter Assembly</td>
<td>1</td>
<td>3015-5324</td>
</tr>
<tr>
<td>Stainless Steel Probe</td>
<td>1</td>
<td>3015-5326</td>
</tr>
<tr>
<td>Elbow</td>
<td>1</td>
<td>3015-3234</td>
</tr>
<tr>
<td>Tubing (3 ft)</td>
<td>1</td>
<td>0003-6182</td>
</tr>
</tbody>
</table>

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 5.2 Service Centers).

1.7 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 16.
1.8 Features and Capabilities

- Detects, measures, and displays the level of SF$_6$ gas in the area being monitored
- Measurement range of 0–1,000 ppm with a resolution of 1 ppm
- Self contained purge-air bag, allowing the monitor to be used in a contaminated atmosphere
- Automatically logs up to 200 gas readings that can be printed/printed for analysis
- Eliminates false alarms with use of non-dispersive IR source and sample draw system
- Visual and audible gas alarm indicators 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

1.9 Functional Overview

The Bacharach Sulfur Hexafluoride (SF$_6$) Portable Monitor is designed to detect, measure, and display the concentration of SF$_6$ gas in the area being monitored. To ensure accurate gas measurements, the monitor self-zeros every 4 minutes using its internal supply of fresh air.

During normal operation the SF$_6$ Monitor displays both the current gas level and the peak gas level detected 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 SF$_6$ Monitor 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 quickly identify the cause of the fault.
# 2 Specifications

Product Type .................. Portable SF₆ Gas Monitor
Measuring Range ................. 0 to 1,000 ppm
Warm-Up Time .................. 5 minutes
Detector Type .................. Infrared, Non-Dispersive
Sensitivity ..................... 1 ppm
Accuracy ....................... ±1 ppm
Response Time .................. 90% of response within 3 seconds; 100% in 5 seconds
Temperature Drift ............... 1.5 ppm per °C between purge cycles
System Noise .................... Less than 40 dB(A) at 10 ft (3 m)
Operating Temp .................. 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
Front Panel ..................... 3 Indicator lights:
                                  ON – Green LED flashes during warm-up, and then glows steady 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 (DxLxW) ............. 9” x 14.5” x 5” (229 x 368 x 127 mm)
Weight .......................... Less than 9 lbs (4 kg) including battery
Valid Calibration Period to Specifications ............... 12 months
Warranty ....................... 2 Years from date of shipment
3 Operation

3.1 Front Panel Display and Controls

3.2 Connecting Gas-Sample & Exhaust Lines

3.2.1 Overview

A single gas-sample line needs to be run from the SF₆ Monitor to the area to be monitored. If desired, an optional exhaust line can be installed to vent SF₆ gas away from the monitor.

3.2.2 Connecting the Gas-Sample Line

To connect the gas-sample line to the monitor, simply push the tubing onto the elbow connector and attach the elbow to 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 insure proper airflow. If kinks or obstructions occur in the line the monitor may not function properly.

The end of this line 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.

An external filter (P/N 3015-5324) should be attached to the end of this line. See figure below.
3.2.3 Connecting the Exhaust Line (optional)

The optional exhaust line carries the exhausted gas sample away from the monitor.

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.

Connect the exhaust line to the monitor by firmly pushing the tubing into the Exhaust Port’s push-to-connect (PTC) fitting. (See previous figure.) 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.
3.3 Gas Detector Operation

CAUTION: 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.

Turn ON the monitor as follows:

1. Lift up the shield located in front of the handle
2. Press the red power ON/OFF toggle switch.
3. Observe monitor's firmware version is briefly displayed.
4. Observe that the NEW TWA/twa screen may appear, depending on the configuration of the monitor's TWA/twa function (refer to Section 3.4 for detailed TWA operation).
5. Observe the monitor starts counting down its warm-up period of 300 seconds (5 minutes).
6. At the end of warm up, take the monitor to an area that contains fresh air and press the ENTER button to fill the monitor's internal purge-air bag with clean, fresh air that is of the same temperature and humidity as the area being monitored for gas. DO NOT fill the purge-air bag in an area that is contaminated with SF₆ gas.

After the purge-air bag is filled, observe the following as the monitor makes gas measurements in the area being sampled:

- **MEASURE** indicates when the monitor is actively measuring the level of SF₆ gas at the sampling point. The screen to the right shows that currently 100 ppm is being measured. The measurement cycle runs for 4 minutes.

A log of up to 200 previous measurements can be viewed using the PPM LOG function (page 16), or printed as described in 3.16.

The 2ndUNIT value (Blank, Peak PPM, Continuous TWA, or 8 Hr TWA) is user-selected (refer to 2ndUNIT function on page 17).

- **PURGE** indicates when the monitor is resetting its infrared detector to a baseline of 0 ppm using the air contained in the monitor’s internal purge-air bag. The purge cycle runs for 10 seconds.

The monitor will operate for approximately 40 minutes before the purge-air bag needs refilled. When the message "PURGE AIR EMPTY" appears, take the monitor to a clean, fresh-air environment and press the ENTER button to refill the bag.

Work with gas alarms and system faults as follows:

**ALARM** (red) light turns ON if the detected gas level exceeds a programmed alarm point. An audible alarm also sounds if the AUDALRM function is activated (page 16) Pressing the front panel SILENCE button turns OFF the audible alarm, but the ALARM light will continue to flash for 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 17).

**FAULT** (yellow) light turns ON if a fault occurs (see Fault Code list on page 19). An audible alarm also sounds if the AUDALRM function is activated (page 16). Pressing the front panel SILENCE button turns OFF the audible alarm, but the FAULT light continues to flash for 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 17). 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 16).
3.4 Time Weighted Average Operation

3.4.1 Overview
In addition to displaying the current SF₆ level, the monitor can also calculate and display a Time Weighted Average 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 SF₆ exposure in the working environment.

TWA operation is selected by using the 2ndUNIT function (page 17).

The two TWA formats are identified by the appearance of either “TWA” or ‘twa” in the upper-right corner of the Data Display screen.

- **TWA** (upper case letters) is calculated over an 8-hour period. This format is designed to show the user’s average ppm SF₆ 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.

  PURGE     00TWA
  100 ppm SF₆

- **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.

  PURGE     00twa
  100 ppm SF₆

3.4.2 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.

ELAPSED TWA TIME
IS xx MINUTES

Where: xx is the accumulated time used by the monitor in calculating the TWA/twa.
3.5 Peak Reading Operation

In addition to displaying the current SF₆ 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 (page 17).

![Display showing current SF₆ level and peak measurement](PURGE 500pk 100ppm SF₆)

The display above shows that currently the monitor is detecting 100 ppm SF₆ and that a peak measurement of 500 ppm has occurred.

The peak reading is reset by pressing the ENTER button.

3.6 Leak Detector Operation

The monitor can be configured to operate as a Leak Detector by setting the AUDALRM function (page 16) 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 a tic every 2 seconds with the tic rate increasing up to 20 tics per second when the ppm level reaches the ALRMLVL (page 16) setting.

3.7 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.

![Standby Mode](STAND BY)

Take the monitor out of standby by again pressing both the ENTER and ESC buttons.

When the monitor is taken out of standby the operator must refill the purge-air bag by pressing the ENTER button. Refilling the bag after coming out of standby re-establishes the monitor's ambient pressure reading and ensures that the purge-air bag is filled at the start of taking gas measurements.

**WARNING:** 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 SF₆ gas.

![Purge Air Empty](PURGE AIR EMPTY)

As soon as the purge-air bag has been refilled with fresh air, the Data Display screen appears and the monitor resumes normal operation.
3.8 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.

3.8.1 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.

3.8.2 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.

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.

3.9 Display Screens

3.9.1 Initial Power ON

When the monitor is first powered ON, all front panel lights turn ON and a splash screen appears showing the monitor’s current firmware revision level. After a brief moment the **Warm Up** screen is displayed along with the front panel **ON** light (green) blinking.

```
BACHARACH
VERSION  x.x.x

WARM UP
```

The monitor requires 5 minutes to warm up from a cold start; after which, the **ON** light glows steady and the **Data Display** screen appears.
3.9.2 Filling the Purge-Air Bag

**CAUTION:** 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 SF₆ 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. Press the ENTER button to start the refill process.

**PURGE AIR EMPTY** <ENTER> TO FILL  **RECHARGING PURGE AIR...**

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

3.9.3 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 above the monitor is currently detecting 100 ppm of SF₆ gas. The **2ndUNIT** value (Blank, Peak PPM, Continuous TWA, or 8 Hr TWA) is user-selected (refer to 2ndUNIT function on page 17). The measurement cycle runs for 4 minutes.

**PURGE** is displayed when the monitor is resetting its infrared detector to a baseline of 0 ppm using the fresh air in the monitor's internal purge-air bag. The purge cycle runs for 10 seconds.

3.9.4 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 SILENCE P-CHK GAS CLOCK > 2ndUNIT PRINT PLOT PC-DUMP

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.

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

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

**WARNING:** 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 SF₆ gas.
EMTYBAG – Press ENTER to manually empty the purge-air bag. Use this function to drain the bag if it becomes contaminated with gas.

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).

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 a tic every 2 seconds with the tic rate increasing up to 20 tics 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 (page 17).

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 7 ppm was measured on 07/11/05 at 15:35.

The PPM Log can be cleared per Section 3.11.

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.

FAULTS – Contains records of the last 30 fault events. The most recent event is displayed when the Fault screen is first displayed. After 30 events have been recorded, the newest record overwrites the oldest. Each record lists an event’s numeric fault code (refer to Section 3.10) plus the date and time at which the event occurred. Use any of the Keypad buttons to scroll through the other fault events. Press ESC to return to the previous screen.

To the right, record #15 shows that a Purge Flow Fault (fault code <1000>) occurred on 07/11/2005 at 12:37.

DIAG – Enters the diagnostic function. Refer to Section 3.13.
**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.

**P-CHK** – The Pressure Check function displays the current manifold pressure and the stored ambient pressure in psia, along with the difference between these two pressures and the current fault code. Refer to Section 3.14.

**GAS** – Displays Sulfur Hexafluoride (SF₆) as the gas being monitored. No other gas types are available for selection.

**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.

**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

**PRINT** – Refer to Section 3.15 Print/Plot Logged Gas Levels.

**PLOT** – Refer to Section 3.15 Print/Plot Logged Gas Levels.

**PC-DUMP** – A personal computer can be connected to the monitor's DB9 RS-232 connector (refer to illustration in Section 3.15) for the purpose of downloading logged ppm measurements. These measurements can later be analyzed using any common spreadsheet program. Refer to Section 3.17 for detailed instructions on how to transfer stored data to a personal computer.
3.10 Working with System Faults

3.10.1 Functional Overview
If a system malfunction occurs (see Fault Code list, page 19), the front panel FAULT light will flash and the audible alarm, if activated (refer to AUDALRM function page 16), will start beeping.

3.10.2 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 17). The front panel FAULT light will continue to flash as a reminder that a fault condition still exists. At the end of the silence period if the cause of the fault has not been corrected the audible-alarm circuit will reactivate.

3.10.3 Viewing the Faults Log
From the Data Display screen, press any of the Keypad buttons to display the first 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.

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> along with 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 07/11/2005 at 08:17 AM, while record #04 shows that the fault was cleared on 07/11/2005 at 09:00 AM.

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 under the heading Clearing the PPM and Faults Data (Section 3.13).
# 3.11.4 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.

<table>
<thead>
<tr>
<th>Code</th>
<th>Name</th>
<th>Description of Fault Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;0001&gt;</td>
<td>Box Temperature Fault</td>
<td>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.</td>
</tr>
<tr>
<td>&lt;0002&gt;</td>
<td>Bench Temperature Fault</td>
<td>Optical bench is outside normal operating range (or IR detector has failed). Check that the monitor is not being subjected to extreme temperatures.</td>
</tr>
<tr>
<td>&lt;0004&gt;</td>
<td>Manifold Pressure Fault</td>
<td>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.</td>
</tr>
<tr>
<td>&lt;0040&gt;</td>
<td>Fill Flow</td>
<td>The purge-air bag’s pressure drop is outside expected limits. Use the EMTYBAG and FILLBAG functions to refill the purge-air bag. If the fault still occurs, check for a punctured bag or disconnected tubing.</td>
</tr>
<tr>
<td>&lt;0080&gt;</td>
<td>Over Range Fault</td>
<td>Monitor exposed to a gas level that exceeded 65,000 ppm.</td>
</tr>
<tr>
<td>&lt;0100&gt;</td>
<td>Zero Filter Fault</td>
<td>The air-purge bag is contaminated with gas. Take monitor to a clean-air area and use the EMTYBAG and FILLBAG functions several times to decontaminate the purge-air bag.</td>
</tr>
<tr>
<td>&lt;0200&gt;</td>
<td>Gain Set Fault</td>
<td>The digipot autotune sequence has failed. This fault will only occur on first boot up or after a firmware upgrade. Call the factory for further instructions.</td>
</tr>
<tr>
<td>&lt;0400&gt;</td>
<td>A/D Fault</td>
<td>A fault has occurred in the analog-to-digital circuitry. Contact the factory with this information for further instructions.</td>
</tr>
<tr>
<td>&lt;0800&gt;</td>
<td>Sample Flow Fault</td>
<td>Check for a restriction in the gas-sample inlet or exhaust, a blocked internal filter, or a failed pump.</td>
</tr>
<tr>
<td>&lt;1000&gt;</td>
<td>Purge Flow Fault</td>
<td>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.</td>
</tr>
<tr>
<td>&lt;2000&gt;</td>
<td>Bag Fill Time</td>
<td>The purge-air bag did not fill within the expected time allotment, or too many purge cycles occurred indicating a leak in the purge-air system. Check for a punctured bag or disconnected tubing.</td>
</tr>
<tr>
<td>&lt;4000&gt;</td>
<td>Zero Range Fault</td>
<td>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.</td>
</tr>
<tr>
<td>&lt;8000&gt;</td>
<td>Clipping Fault</td>
<td>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.</td>
</tr>
</tbody>
</table>
3.11 Working with the Gas Alarm

3.11.1 Gas-Alarm Light
If the detected gas level reaches the gas-alarm level as set by the ALRMLVL function, the front panel ALARM (red) light will flash and the audible alarm, if activated (refer to AUDALRM function on page 16), will start beeping. The ALARM light and audible alarm will automatically turn OFF once the detected gas level drops below the gas-alarm level.

3.11.2 Silencing a Gas Alarm
Pressing the SILENCE button while the alarm circuit is activated causes the audible alarm to turn OFF for a period of time as set by the SILENCE function (page 17). The front panel ALARM light will continue to flash as an indication that an alarm condition still exists. At the end of the silence period if the detected gas level is still above the gas-alarm level the audible alarm will reactivate.

3.12 Clearing the PPM and Faults Data
Up to 200 gas measurements and 30 fault events are stored by the monitor.
To clear stored data, first display the data to be cleared by selecting the PPM LOG or FAULTS function per Section 3.9.4. 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.

3.13 Working with the DIAG Function

3.13.1 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.

3.13.2 Keypad Functions
From the Data Display screen, press any one of the Keypad buttons to display the first 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.
### 3.13.3 First Diagnostic Screen

<table>
<thead>
<tr>
<th></th>
<th>Bench Voltage</th>
<th>Detector Temperature °C</th>
<th>Pressure Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>4.20885v</td>
<td>&lt;0000&gt;</td>
<td></td>
<td></td>
</tr>
<tr>
<td>29.05°C</td>
<td>14.58 psi</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th></th>
<th>Noise</th>
<th>Fault Code</th>
<th>Box Temperature °C</th>
<th>Pressure Reading</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.00075m</td>
<td>&lt;0000&gt;</td>
<td></td>
<td>35.4°C</td>
<td>14.59 psi</td>
</tr>
</tbody>
</table>

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. A value of <0000> indicates that no faults are being detected.

**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 purge-air port.

### 3.13.4 Second Diagnostic Screen

<table>
<thead>
<tr>
<th></th>
<th>PPM Level</th>
<th>åMole/Liter</th>
<th>Avg. Absorption Unit</th>
<th>Detector Voltage</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.1 ppm</td>
<td>0.01</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0.00004 au</td>
<td>4.210v</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**PPM Level** – Parts Per Million Level is the current detected gas level, and is the volume concentration referenced to standard temperature and pressure.

**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.

**åMoles/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 purge-air port.
3.14 Working with the P-CHK Function

3.14.1 Overview
The P-CHK function (Pressure Check function) (page 17) 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.

3.14.2 Keypad Functions
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 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).

3.14.3 Screen Display

<table>
<thead>
<tr>
<th>14.59</th>
<th>AMB 14.75</th>
</tr>
</thead>
<tbody>
<tr>
<td>-0.16</td>
<td>dif &lt;0000&gt;</td>
</tr>
</tbody>
</table>

**Current Manifold Pressure** – Current manifold pressure in psia.

**Stored Ambient Pressure** – Stored ambient pressure in psia.

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

**Fault Code** – Current fault code (page 19).

**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.
3.15 Print/Plot Logged Gas Levels

A printout or plot of the last 200 SF₆ ppm measurements can be made by connecting the optional Bacharach printer and printer cable to the monitor as follows (refer to Section 5.1 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 (page 16).
2. Interconnect the RS-232 connectors located on the printer and monitor.
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 first 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.
5. Press ENTER to start the print/plot process.
3.16 Downloading Stored Data to a Personal Computer

Using the monitor’s PC DUMP feature (page 17), the last 200 SF₆ 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 having a 25-pin COM port, either 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 SF₆ 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 SF₆ Monitor.
   - If HyperTerminal has never been run in association with the SF₆ 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 such as “SF6”. 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 the Connect using 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\HyperTerminal, 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.*

*Tip: 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, 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 **PC-DUMP**, and then press the **ENTER** button to begin the download process.

5. Observe that the SF₆ Monitor’s screen goes blank and that HyperTerminal displays the data as it is being received. After all data has been transmitted, the SF₆ 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 SF₆ Monitor can now be closed.

### 3.17 Importing Saved Data to a Spreadsheet

A text file that was created as described in Section 3.16 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 2003. If you are using a different spreadsheet program, please refer to its instruction manual for information on how to import comma-delimited text files.

1. Start Microsoft Excel.

2. Click **Data, Import External Data**, and **Import Data** to display the “Select Data Source” dialog box.

3. Locate file saved earlier. Select file, then click “Open” to display Excel’s “Text Import Wizard.”

4. Choose the “Delimited” original data type option and click Next.

5. Check the “Tab,” “Comma,” and “Space” delimiters and click Finish.

6. Choose “Existing worksheet” or “New worksheet” and click OK to create spreadsheet.

*Note: A worksheet must be open in order to import data.*
4 Maintenance

4.1 Disassembly

When servicing the parts inside the SF₆ Monitor, disassemble the monitor's metal chassis as follows:

Items Required:
- Medium Phillips head screwdriver

Procedure:
1. Remove monitor and its battery pack from the soft carrying case.
2. Unplug battery pack from monitor.
3. Remove a total of 10 screws from the locations shown in the illustrations below.
4. Carefully separate the metal chassis.
4.2 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 4.1.
2. See illustration below and locate the internal particulate / hydrophobic filter.
3. Pull off tubing from both ends of filter and remove filter from instrument.
4. Attach tubing to new filter
5. Reassemble monitor.
4.3 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.
5 Parts and Service

5.1 Replacement Parts and Optional Items

Replacement Parts

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replacement Battery Kit</td>
<td>3015-5743</td>
</tr>
<tr>
<td>Replacement Battery Charger (for 87 Wh battery 3015-5743)</td>
<td>3015-5847</td>
</tr>
<tr>
<td>Replacement Cable (connects battery to PGM-IR)</td>
<td>3015-5757</td>
</tr>
<tr>
<td>Soft Carrying Case with Shoulder Strap</td>
<td>3015-5700</td>
</tr>
<tr>
<td>Bladder Bag Kit</td>
<td>3015-5325</td>
</tr>
<tr>
<td>Stainless Steel Probe</td>
<td>3015-5326</td>
</tr>
<tr>
<td>External Filter (fits onto probe tip)</td>
<td>3015-2906</td>
</tr>
<tr>
<td>Hydrophobic Filter (internal)</td>
<td>0007-1654</td>
</tr>
<tr>
<td>External Filter Assembly</td>
<td>3015-5324</td>
</tr>
<tr>
<td>Probe Tubing (3 ft)</td>
<td>0103-6105</td>
</tr>
<tr>
<td>Replacement Pump</td>
<td>3015-4239</td>
</tr>
<tr>
<td>Battery (for main PCB board)</td>
<td>0204-0020</td>
</tr>
<tr>
<td>Replacement Bench Kit</td>
<td>3015-5509</td>
</tr>
<tr>
<td>Replacement Power Cord (AUS)</td>
<td>0304-3469</td>
</tr>
<tr>
<td>Replacement Power Cord (UK)</td>
<td>0304-3471</td>
</tr>
<tr>
<td>Replacement Power Cord (EU)</td>
<td>0304-3470</td>
</tr>
<tr>
<td>Replacement Power Cord (US)</td>
<td>0304-3466</td>
</tr>
</tbody>
</table>

Optional Accessories

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Part Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>IrDA Printer (includes printer, roll of thermal paper, 4 × AA batteries, manual)</td>
<td>0024-1400</td>
</tr>
<tr>
<td>Thermal printer paper, 1 roll</td>
<td>0006-8733</td>
</tr>
<tr>
<td>Thermal printer paper, 5 rolls</td>
<td>0024-1310</td>
</tr>
<tr>
<td>Cable (DB9 to RJ-45)</td>
<td>3015-4214</td>
</tr>
<tr>
<td>Computer Communications Cable (DB9 male to DB9 female)</td>
<td>0104-4027</td>
</tr>
</tbody>
</table>
## 5.2 Service Centers


<table>
<thead>
<tr>
<th>Location</th>
<th>Contact Information</th>
<th>Shipping Address</th>
</tr>
</thead>
</table>
| **United States** | Phone: 724-334-5000  
Toll Free: 800-736-4666  
Fax: 724-334-5001  
Email: help@mybacharach.com | Bacharach, Inc.  
621 Hunt Valley Circle  
New Kensington, PA 15068, USA  
**ATTN**: Service Department |
| **Europe** | Phone: +353 1 284 6388  
Fax: +353 1 284 6389  
Email: help@mybacharach.com | Bacharach, Inc.  
114A Georges Street Lower  
Dun Laoghaire, Dublin, Ireland  
**ATTN**: Service Department |
| **Canada** | Phone: 905-882-8985  
Fax: 905-882-8963  
Email: support@bachcan.ca | Bacharach, Inc.  
10 West Pearce Street, Unit 4  
Richmond Hill, Ontario L9B 1B6, Canada  
**ATTN**: Service Department |