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# PGM-IR SF<sub>6</sub> Monitor

Portable Gas Monitor for SF<sub>6</sub> Gas

## Instruction 3015-5150

Operation and Maintenance

Rev. 10 – January 2018



Patent 6,590,690

**Product Leadership • Training • Service • Reliability**

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# 1 Introduction

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## 1.1 How to Use This Manual

This manual provides important information on how to operate and service Bacharach's Sulfur Hexafluoride (SF<sub>6</sub>) 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 SF<sub>6</sub> 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.

Item	Qty.	Part Number
SF <sub>6</sub> Portable Monitor	1	3015-5148
Soft Carrying Case with Shoulder Strap	1	3015-5700
Battery Pack & Charger	1	3015-5743
Instruction Manual	1	3015-5150
External Filter Assembly	1	3015-5324
Stainless Steel Probe	1	3015-5326
Elbow	1	3015-3234
Tubing (3 ft)	1	0003-6182

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 **EMPTYBAG** function as described on page 16.

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## 1.8 Features and Capabilities

- Detects, measures, and displays the level of SF<sub>6</sub> 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/plotted 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<sub>6</sub>) Portable Monitor is designed to detect, measure, and display the concentration of SF<sub>6</sub> 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<sub>6</sub> 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<sub>6</sub> 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

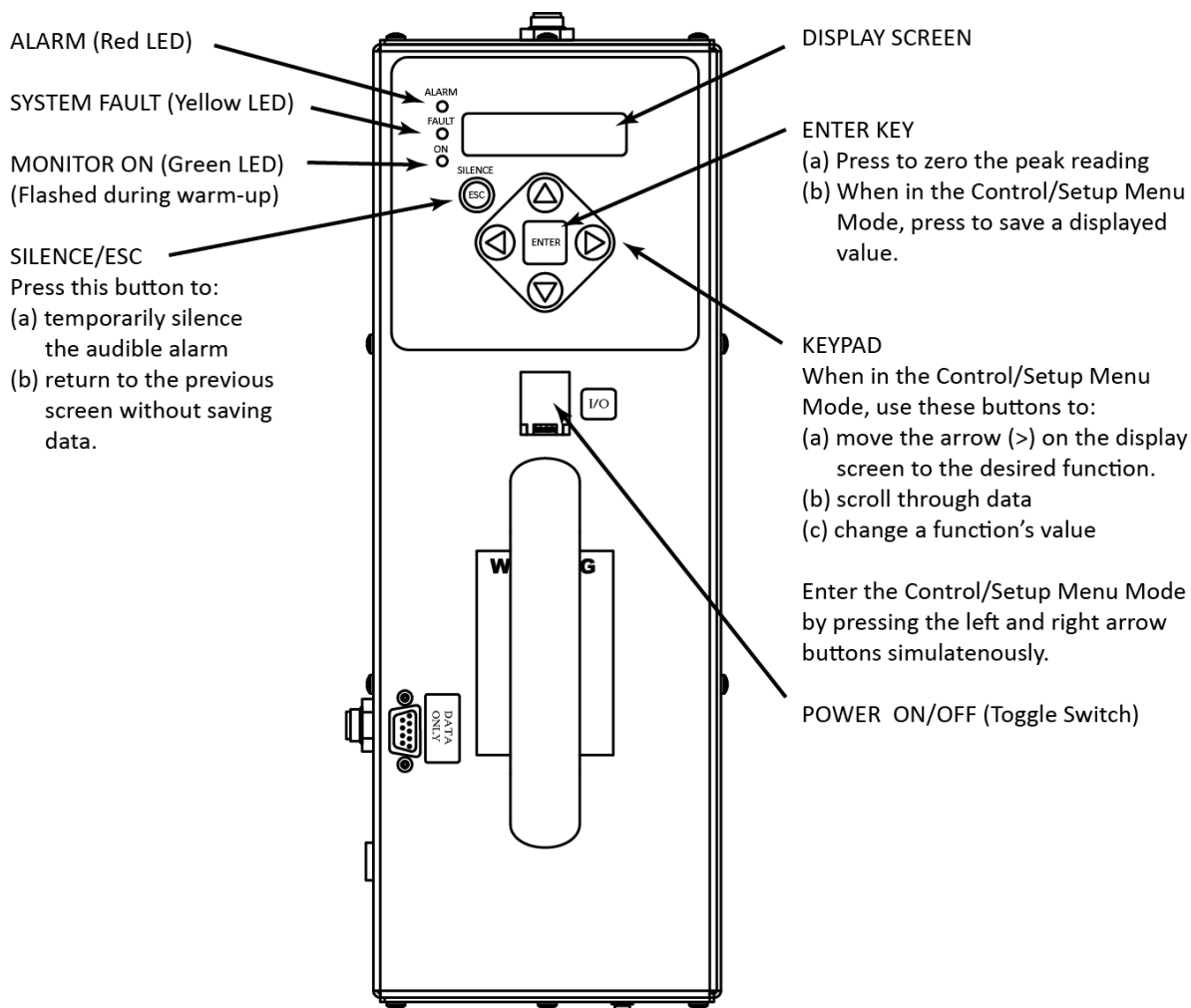
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Product Type.....	Portable SF <sub>6</sub> Gas Monitor
Measuring Range.....	0 to 1,000 ppm
Warm-Up Time .....	5 minutes
Detector Type.....	Infrared, Non-Dispersive
Sensitivity .....	1 ppm
Accuracy.....	±1 ppm
Response Time .....	90% of response within 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: <b>ON</b> – Green LED flashes during warm-up, and then glows steady during normal operation <b>FAULT</b> – Yellow LED flashes when there is a system fault <b>ALARM</b> – 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 SF<sub>6</sub> Monitor to the area to be monitored. If desired, an optional exhaust line can be installed to vent SF<sub>6</sub> gas away from the monitor.

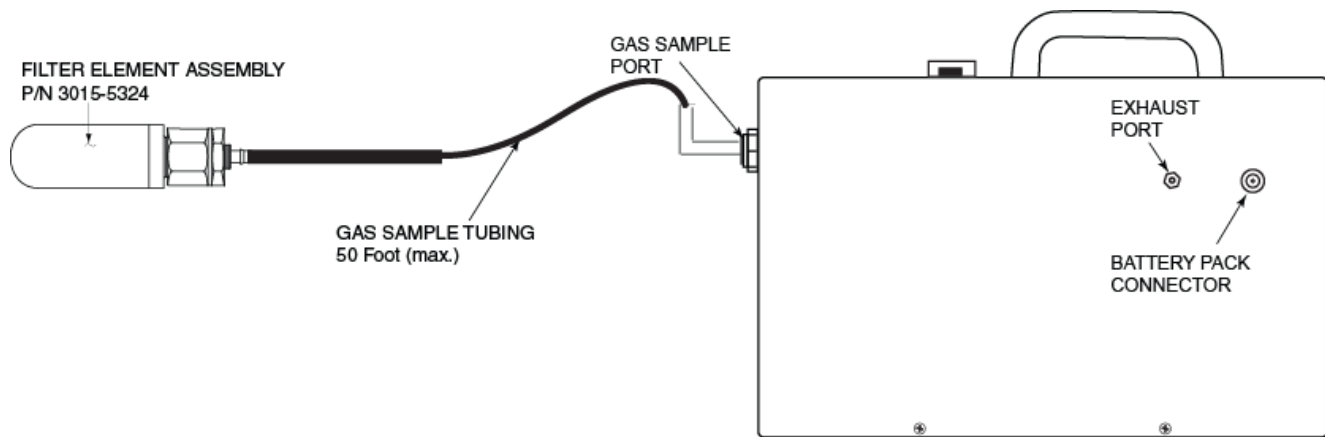
#### 3.2.2 Connecting the Gas-Sample Line

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 contaminants being drawn into the monitor.

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

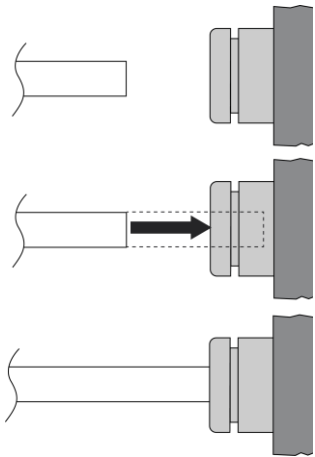


### 3.2.3 Connecting the Exhaust Line (optional)

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

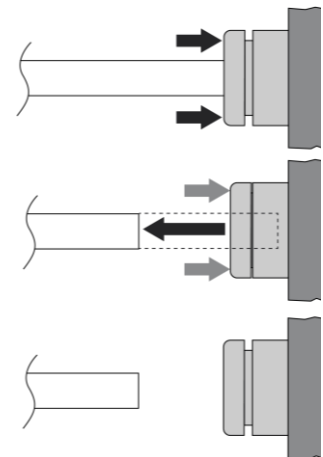
The exhaust line can be up to **50 ft (15.2 m)** in length. Ideally this line should terminate outdoors in a location that is not exposed to the elements.

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 than 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 SF<sub>6</sub> gas.

```
FIRMWARE
VERSION x.x
```

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

```
WARM UP
300
```

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

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

```
MEASURE 2ndUNIT
100ppm SF6
```

```
PURGE 2ndUNIT
100ppm SF6
```

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

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 SF<sub>6</sub> 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 SF<sub>6</sub> 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 SF<sub>6</sub> 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 users’s average ppm SF<sub>6</sub> 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
100ppm 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
100ppm 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 SF<sub>6</sub> 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).

```
PURGE      500pk
 100ppm SF6
```

The display above shows that currently the monitor is detecting 100 ppm SF<sub>6</sub> 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.

```
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 SF<sub>6</sub> gas.

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

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.

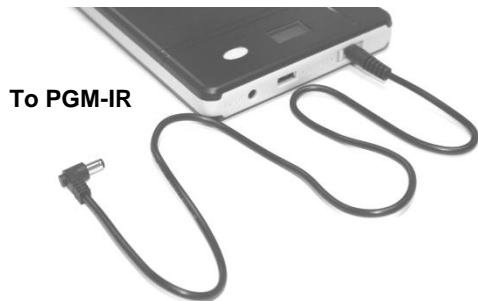
### 3.8.1 Charging the Battery

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.



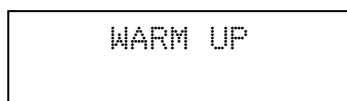
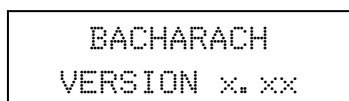
3. Ensure that the battery is powered ON per the instruction label on the battery pack.
4. Verify that the battery is properly connected to the PGM-IR (see above).

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.



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 SF<sub>6</sub> 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

MEASURE 2ndUNIT 100ppm SF6	PURGE 2ndUNIT 100ppm SF6
-------------------------------	-----------------------------

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 SF<sub>6</sub> 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 SF<sub>6</sub> gas.*

FILLING BAG. . .
------------------

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

```
DRAINING BAG...
```

**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**).

```
EDIT ALARM LEVEL
      300 ppm
```

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

```
AUDIBLE ALARM IS
      ALARM
```

- **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 **ALRMLVL** 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.

```
#025      7PPM @
07/11/05  15:35
```

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 07/11/2005 at 3:35 PM.

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.

```
LOG INTERVAL IS
      0001 min
```

**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.

```
#15 <1000> @
07/11/05  12:37
```

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

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

**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.

```
SILENCE TIMEOUT
      0030 sec
```

**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.

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

**GAS** – Displays Sulfur Hexafluoride (SF<sub>6</sub>) as the gas being monitored. No other gas types are available for selection.

```
SELECT GAS TYPE
      SF6
```

**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.

```
SET DATE & TIME
07/11/05   15:30
```

**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

```
MEASURE 00500pk
      100ppm SF6
```

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

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

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

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

**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.

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

## 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.

```
#03 <0800> @
07/11/05 08:17

#04 <0000> @
07/11/05 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> 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 9:00 AM.

```
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 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.

Code	Name	Description of Fault Condition
<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 <b>DIAG</b> 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	The manifold pressure is outside its normal operating range (or IR detector has failed). Enter the <b>DIAG</b> function and record ALL data. Call the factory with this information for further instructions.
<0040>	Fill Flow	The purge-air bag's pressure drop is outside expected limits. Use the <b>EMPTYBAG</b> and <b>FILLBAG</b> functions to refill the purge-air bag. If the fault still occurs, check for a punctured bag or disconnected tubing.
<0080>	Over Range Fault	Monitor exposed to a gas level that exceeded 65,000 ppm.
<0100>	Zero Filter Fault	The air-purge bag is contaminated with gas. Take monitor to a clean-air area and use the <b>EMPTYBAG</b> and <b>FILLBAG</b> functions several times to decontaminate the purge-air bag.
<0200>	Gain Set Fault	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.
<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 Time	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.
<4000>	Zero Range Fault	The IR detector's output voltage is out of tolerance. Enter the <b>DIAG</b> 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 <b>DIAG</b> function to check the IR detector voltage. Call the factory with this information for further instructions.

## 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

4.20885v <0000> 29.05cD 14.58psi	Bench Voltage Detector Temperature °C * Pressure Reading	Fault Code
0.00075n <0000> 35.40cB 14.59psi	Noise Box Temperature °C * Pressure Reading	Fault Code

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

0.1ppm 0.01 0.00004au 4.210v	PPM Level Avg. Absorption Unit *	µMole/Liter Detector Voltage
---------------------------------	-------------------------------------	---------------------------------

**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.

**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 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

14.59	AMB14.75	Current Manifold Pressure	*	Stored Ambient Pressure
-0.16dif	<0000>	Pressure Difference		Fault Code

**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.

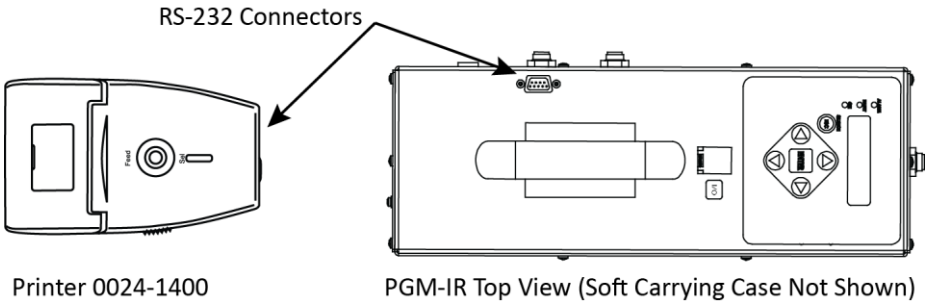
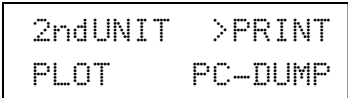
**Fault Code** – Current fault code (page 19).

**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 SF<sub>6</sub> 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):

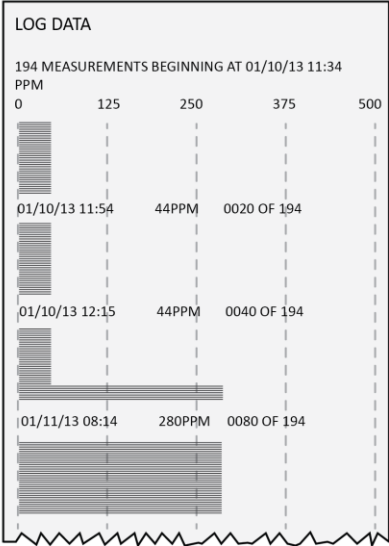
1. For a printout or plot to be made, the monitor must have been set up to record gas measurements using the **LOG INT** function (page 16).
2. Interconnect the RS-232 connectors located on the printer and monitor.
3. If not already done, refer to the printer manual and set the printer's communication 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.



EXAMPLE PRINTOUT  
Date / Time / PPM / Reading Number

DATE	TIME	PPM	Reading Number
01/10/13	11:34	OPP	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	0014 of 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



## 3.16 Downloading Stored Data to a Personal Computer

Using the monitor's **PC DUMP** feature (page 17), the last 200 SF<sub>6</sub> 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 SF<sub>6</sub> 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 SF<sub>6</sub> Monitor.
  - If HyperTerminal has never been run in association with the SF<sub>6</sub> 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.

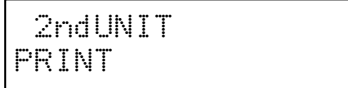
- e) Click **File**; click **Save**. This creates a file with an .ht extension in the folder C:\Program Files\Accessories\Hyper Terminal, using the name that was entered in Step b.
3. After HyperTerminal is running: click **Transfer**, click **Capture Text**, and then click **Start** to accept the default 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.

**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.



```
2ndUNIT
PRINT
```

5. Observe that the SF<sub>6</sub> Monitor's screen goes blank and that HyperTerminal displays the data as it is being received. After all data has been transmitted, the SF<sub>6</sub> 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 SF<sub>6</sub> 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

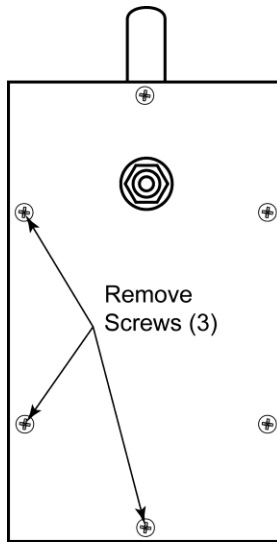
When servicing the parts inside the SF<sub>6</sub> Monitor, disassemble the monitor's metal chassis as follows:

**Items Required:**

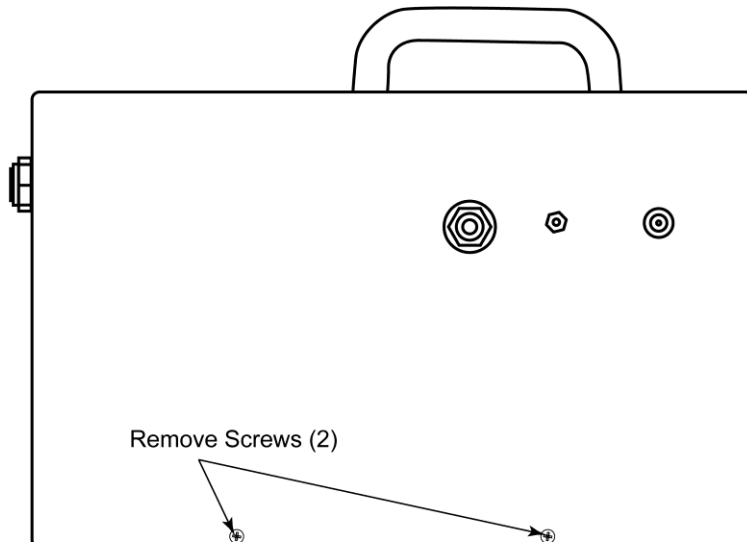
- Medium Phillips head screwdriver

**Procedure:**

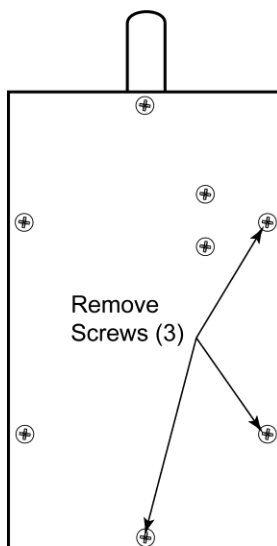
1. Remove monitor and its battery pack from the soft carrying case.
2. Unplug battery pack from monitor.
3. Remove a total of 10 screws from the locations shown in the illustrations below.
4. Carefully separate the metal chassis.



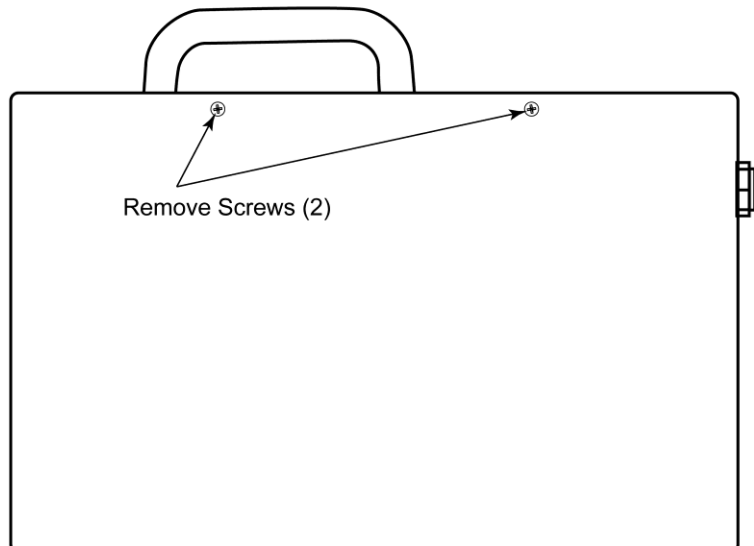
Front



Left Side



Rear



Right Side

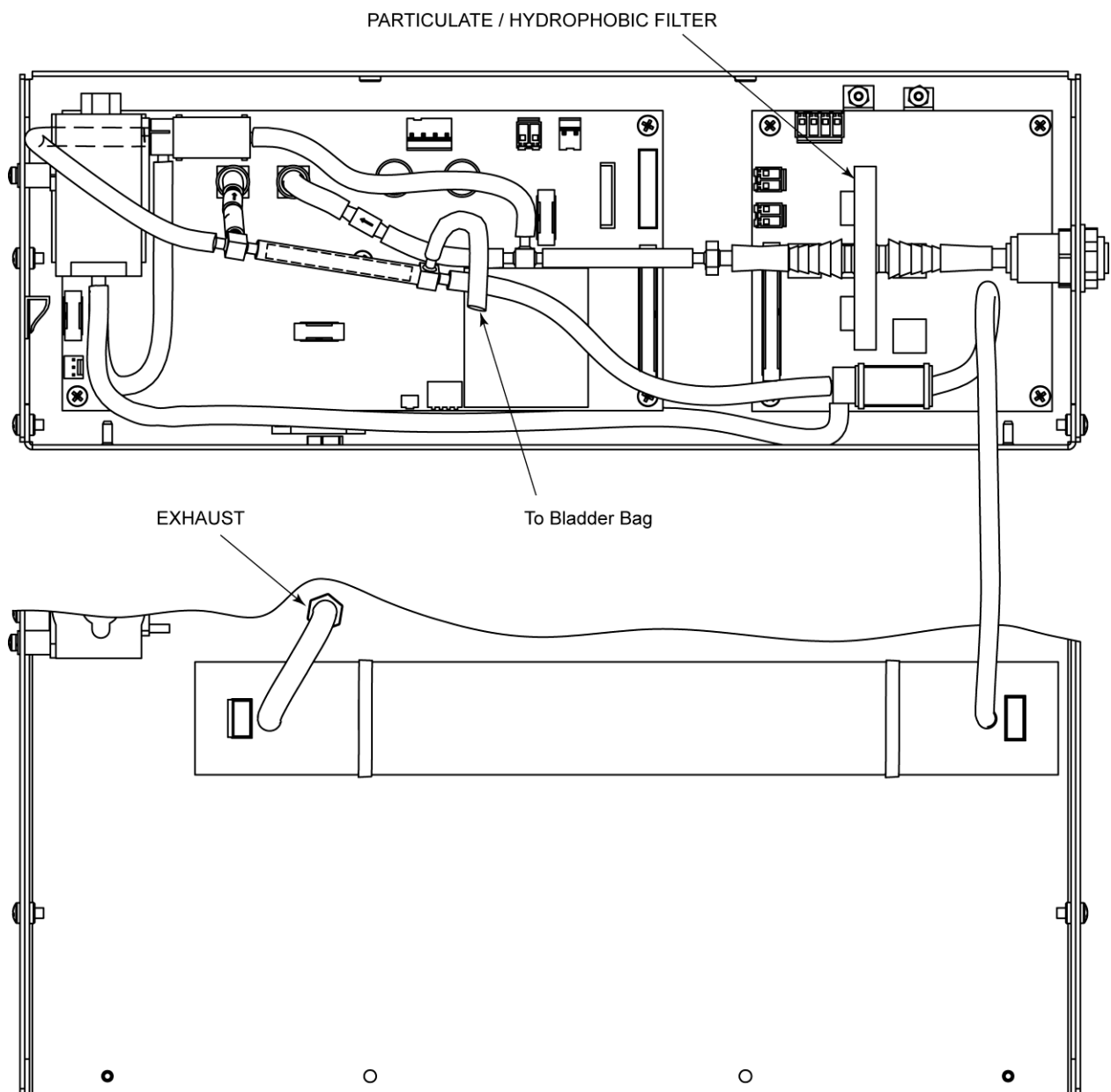
## 4.2 Internal Particulate / Hydrophobic Filter Replacement

### Items Required:

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

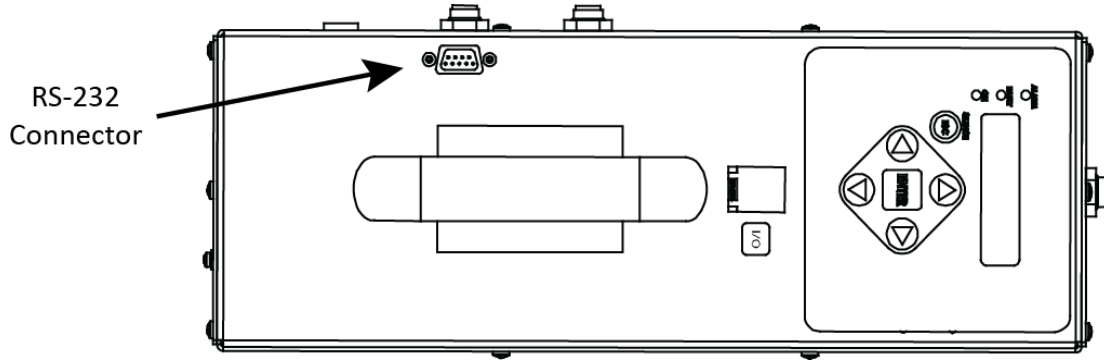
### Procedure:

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

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

### Optional Accessories

Item Description	Part Number
IrDA Printer (includes printer, roll of thermal paper, 4 × 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

## 5.2 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.

Location	Contact Information	Shipping Address
<b>United States</b>	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 <i>ATTN: Service Department</i>
<b>Europe</b>	Phone: +353 1 284 6388 Fax: +353 1 284 6389 Email: help@mybacharach.com	Bacharach, Inc. 114A Georges Street Lower Dun Laoghaire, Dublin, Ireland <i>ATTN: Service Department</i>
<b>Canada</b>	Phone: 905-882-8985 Fax: 905-882-8963 Email: support@bachcan.ca	Bacharach, Inc. 10 West Pearce Street, Unit 4 Richmond Hill, Ontario LB4 1B6, Canada <i>ATTN: Service Department</i>





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