Pulsar™ +
Single Gas Detector

Operating Manual

In North America, to contact your nearest stocking location, dial toll-free 1-800-MSA-2222
To contact MSA International, dial 1-412-967-3354 or 1-800-MSA-7777

This manual is available on the internet at www.msanet.com

Manufactured by

MSA INSTRUMENT DIVISION

P.O. Box 427, Pittsburgh, Pennsylvania 15230

(L) Rev 1 **10038620**

⚠ WARNING

THIS MANUAL MUST BE CAREFULLY READ BY ALL INDIVIDUALS WHO HAVE OR WILL HAVE THE RESPONSIBILITY FOR USING OR SERVICING THE PRODUCT. Like any piece of complex equipment, this instrument will perform as designed only if it is used and serviced in accordance with the manufacturer's instructions. OTHERWISE, IT COULD FAIL TO PERFORM AS DESIGNED AND PERSONS WHO RELY ON THIS PRODUCT FOR THEIR SAFETY COULD SUSTAIN SEVERE PERSONAL INJURY OR DEATH.

The warranties made by Mine Safety Appliances Company with respect to the product are voided if the product is not used and serviced in accordance with the instructions in his manual. Please protect yourself and others by following them. We encourage our customers to write or call regarding this equipment prior to use or for any additional information relative to use or repairs.

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Chapter 1
Instrument Safety and Certifications

The Pulsar+ Single Gas Detector is for use by trained, qualified personnel. It is designed to be used when performing a hazard assessment to:

- Assess potential worker exposure to a toxic gas
- Determine the appropriate gas monitoring needed for a workplace.

The Pulsar+ Single Gas Detector can be equipped to detect:

- Oxygen-deficient or oxygen-rich atmospheres

  NOTE: Although the Pulsar+ unit will detect up to 25% oxygen, it is neither certified nor classified for use in atmospheres containing more than 21.0% oxygen

- Specific toxic gases for which a sensor is installed.

⚠ WARNING

- Read and follow all instructions carefully.
- Check calibration before each day's use; adjust if necessary.
- Recheck calibration if unit is subjected to physical shock.
- Use only to detect a gas for which a sensor is installed.
- Do not block sensors.
- Do not use low pressure air to clean the sensor holes.
- Wait for accurate reading; response times vary, based on the gas being detected.
- Leave area immediately if oxygen reading exceeds 21.0%.
- Do not replace the battery in a combustible atmosphere.
- Do not alter or modify instrument.
- All instrument readings and information must be interpreted by someone trained and qualified in interpreting instrument readings in relation to the specific environment, industrial practice and exposure limitations.

- Do not alter this instrument or make repairs beyond those specified in this manual. Only MSA-authorized personnel may repair this unit; otherwise, damage may result.

INCORRECT USE CAN CAUSE SERIOUS PERSONAL INJURY OR DEATH.

Certifications

Tests completed by MSA verify that the Pulsar+ Single Gas Detector meets applicable industry and government standards as of the date of manufacture.

Chapter 2
Using the Pulsar+ Single Gas Detector

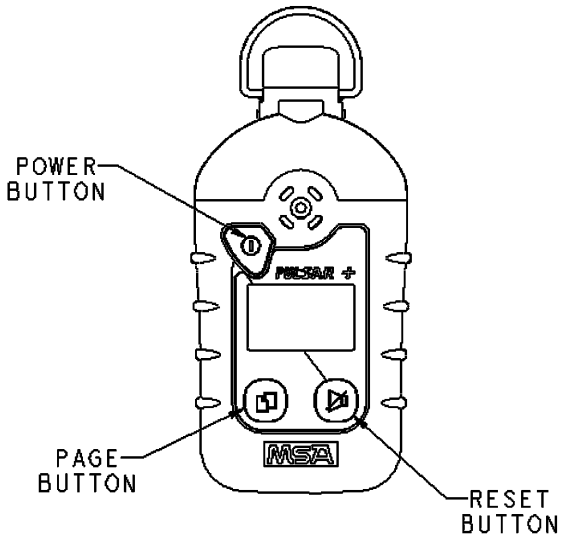

Figure 2-1. Pulsar+ Buttons

Turning ON the Pulsar+ Single Gas Detector

To turn ON the Pulsar+ Detector, push the POWER button (FIGURE 2-1); the instrument performs the following sequence:

1) Power-ON Self-test checks operation of:

- Display (all segments light) (see FIGURE 2-2)
- Alarm Lights
- Display back-light
- Audible Horn

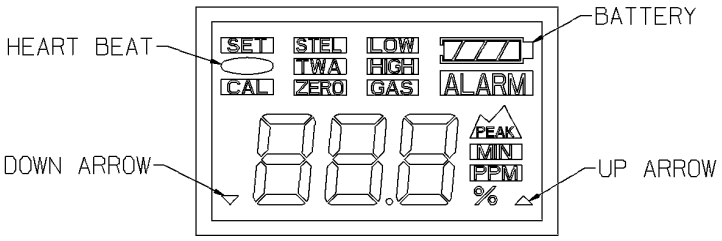

Figure 2-2. Pulsar+ Display

2) Display Alarm Setpoints display the:

- Low Alarm Setpoint for three seconds
  - LOW and ALARM icons turn ON
- High Alarm Setpoint for three seconds
  - HIGH and ALARM icons turn ON
- STEL Alarm Setpoint for three seconds
  (If enabled in a CO or H_2S instrument only)
  - STEL and ALARM icons turn ON
- TWA alarm setpoint for three seconds
  (If enabled in a CO or H_2S instrument only)
  - TWA and ALARM icons turn ON
- Calibration gas value for three seconds
  (in CO and H_2S instruments only)
  - CAL and GAS icons turn ON

3) Software Version Displays for three seconds.

4) The instrument counts down to 0 with the ZERO flag flashing.

During this time, if the power button is pressed, a “Fresh Air Setup” (FAS) can be performed to allow for automatic zero adjustment of the Pulsar + sensor.

- If a “Fresh Air Setup” is successful, the horn beeps three times.

NOTE: The Fresh Air Setup has limits. If a hazardous level of gas is present, the Pulsar + instrument will go into error displaying “FAS” and “Err” on the display. Press the RESET button to acknowledge the error. An instrument calibration should be performed.

- If instrument was configured for Oxygen, it displays:
  - oxygen reading
  - % icon
  - Battery indicator
- If instrument configured for a toxic gas (CO or H_2S), it displays:
  - gas reading
  - PPM icon
  - Battery indicator.

Heartbeat Indicator (see FIGURE 2-2)

The Heartbeat indicator flashes once every 30 seconds to notify the user that the instrument is ON and operating normally.

Battery Life Indicator (see FIGURE 2-2)

The Battery condition icon is continuously displayed in the upper right-hand corner of the display, regardless of the selected page.

As the battery depletes, Battery icon segments go blank until only the outline of the battery icon remains. Each battery indicator segment represents approximately 1/4 of the total battery capacity.

Battery Warning

A battery warning indicates that a nominal two days of operation remain before the instrument's battery is depleted.

NOTE: Duration of remaining instrument operation during battery warning depends on:

- Ambient temperature
  (Colder temperatures may reduce battery life)
- The number and duration of alarms during battery warning.

When the Pulsar+ goes into Battery Warning the:

- Battery outline indicator flashes
- Audible alarm sounds every 30 seconds
- Alarm lights flash every 30 seconds.

⚠ CAUTION

During Battery Warning condition, prepare to exit the work area since the instrument could go into Battery Shutdown at any time, resulting in loss of sensor function.

Battery Shutdown

When the battery can no longer operate the instrument, the instrument goes into Battery Shutdown mode:

- Battery outline indicator flashes
- Alarm icon turns ON
- Alarm sounds
- Alarm lights flash
- No gas reading displayed
- Display alternates between “Err” and “1”
- No other instrument pages can be viewed.
- The instrument remains in this state until it is:
  - Turned OFF or
  - Battery is completely depleted.
- The alarm lights and the horn can be silenced by pushing the RESET button.

⚠ WARNING

If a Battery Shutdown condition occurs, stop using the instrument and leave the area immediately. The instrument can no longer alert you of potential hazards since it does not have enough power to operate properly.

Failure to follow this warning can result in serious personal injury or death.

When the instrument battery is running low, remove it from service and replace the battery.

Calibration Check (Toxic gas instruments only)

The calibration check is simple and should only take about one minute.

1. Turn ON the Pulsar+ Detector in fresh air.
2. Verify that the reading indicates no gas present.
3. Connect one end of the calibration tubing to the response check cylinder and the other end to the fitting on the Pulsar+ Detector.
4. Turn ON the cylinder valve. Verify that the reading on the Pulsar+ display is within limits stated on the calibration cylinder or limits determined by your company. If calibration check gas concentration exceeds the instrument alarm setpoint(s), the:
   - Display must indicate an alarm
   - Alarm lights, horn, and vibrator (if installed) must activate.

NOTE: If readings are not within these limits, the Pulsar+ requires calibration. See Chapter 4, “Calibrating the Pulsar+ Detector.”

Measuring Gas Concentrations

Toxic Gas Measurements (see FIGURE 2-1)

The Pulsar+ Detector can be purchased to detect the following gases in the atmosphere:

- Carbon Monoxide (CO) or
- Hydrogen Sulfide (H_2S).

The Pulsar+ Detector displays the gas concentration in parts per million (PPM) on the Measure page. The instrument remains on this page until another page is selected or the instrument is turned OFF.

If a gas concentration exceeds an alarm setpoint, the:

- Audible alarm sounds
- Alarm lights flash
- Vibrator activates (if installed)
- Alarm type displays, alternately flashing the ALARM icon and:
  - LOW icon (the Low alarm setpoint was exceeded)

    The LOW alarm:

- Is non-latching
- Automatically resets once the gas concentration falls below the LOW alarm setpoint
- Can be silenced for five seconds by pushing the RESET button
- Continues to alarm for as long as the gas level exceeds the LOW alarm setpoint

- HIGH icon (the high alarm setpoint has been exceeded)

  The HIGH alarm:

  - Is latching
  - Will *not* reset when gas concentration falls below HIGH setpoint. (To reset alarm, push RESET button)
  - Can be silenced for five seconds by pushing the RESET button
  - Continues to alarm for as long as the gas level exceeds the HIGH alarm setpoint.

NOTE: The HIGH and LOW alarm setpoints can be set anywhere within the instrument measurement range.

If the HIGH alarm is set to a concentration that is lower than the LOW alarm, the HIGH alarm has priority and the LOW alarm will not appear at all.

The STEL and TWA alarms sound only if the STEL/TWA option was enabled. See Chapter 3, “Setting Up the Pulsar+ Detector” for information on enabling or disabling the STEL/TWA alarms.

- STEL icon (the STEL alarm setpoint was exceeded)

  The STEL alarm:

  - Is latching
  - Can be silenced for five seconds by pushing the RESET button
  - Continues to return for as long as the calculated STEL value exceeds the STEL alarm setpoint

- TWA icon (the TWA alarm setpoint was exceeded)

  The TWA alarm:

  - is latching

- Can be silenced for five seconds by pushing the RESET button
- Continues to return for as long as the calculated TWA value exceeds the TWA alarm setpoint

- Under Range Alarm (instrument reading is below zero)
  - The gas reading appears as "---" and the alarm icon illuminates
- Under Range alarm
  - Is non-latching
  - Automatically resets when reading exceeds zero
  - Can be silenced for five seconds by pushing the RESET button
  - Continues to return for as long as the reading remains below zero.
  - An instrument calibration should be performed.

Alarm Priorities

Instrument displays alarms with the following priority in the event of multiple alarms occurring at the same time.

1. High Exposure Alarm
2. Low Exposure Alarm
3. Under Range Alarm
4. Stel Alarm
5. TWA Alarm

⚠ WARNING

If a toxic gas alarm condition is reached while using the instrument as a personal or area monitor, leave the area immediately: the ambient condition has reached a preset alarm level. If using the instrument as an inspection device, do not enter the area without proper protection. Failure to follow this warning will cause over-exposure to toxic gases, which can result in serious personal injury or death.

Oxygen Measurements

The Pulsar+ Detector can be purchased to measure the concentration

of oxygen in an atmosphere. The value displayed is percent by volume of oxygen in the atmosphere. High and Low alarm setpoints can be configured to alarm in any combination of oxygen:

- enrichment (greater than 20.8%) or
- depletion (less than 20.8%).

When an alarm setpoint is reached, the:

- Audible alarm sounds
- Alarm lights flash
- Vibrator activates (if installed)
- Type of alarm displays by alternately flashing the ALARM icon and the LOW or HIGH icon, depending on how the Low and High alarms were set. Refer to TABLE 2-1.

Table 2-1. Alarm Setting

ALARM TYPE	ALARM SET AT LESS THAN 20.8%	ALARM SET AT GREATER THAN 20.8%
LOW ALARM	Activates on decreasing oxygen concentrations	Activates on increasing oxygen concentrations
	Non-Latching	Non-Latching
HIGH ALARM	Activates on decreasing Oxygen concentrations	Activates on increasing Oxygen concentrations
	Non-Latching	Non-Latching
	Takes priority over a Low alarm set to less than 20.8% (if HIGH alarm set closer to 20.8% than Low alarm)	Takes priority over a Low alarm set to greater than 20.8% (if HIGH alarm set closer to 20.8% than Low alarm)

NOTE: False oxygen alarms can occur due to barometric pressure (altitude) changes or extreme changes in ambient temperature. It is recommended that an oxygen calibration be performed at the temperature and pressure of use. Be sure that the instrument is in known fresh air before performing a calibration.

⚠ WARNING

If the Oxygen alarm condition is reached while using the instrument as a personal or area monitor, leave the area immediately; the ambient condition has reached a preset alarm level. If using the instrument as an inspection device, do not enter the area without proper protection. Failure to follow this warning will cause exposure to a hazardous environment, which can result in serious personal injury or death.

Accessing the Instrument Pages

Information pages are accessed by pushing the PAGE button.

NOTE: Pushing the POWER button returns the unit to the Measure page, regardless of the page currently displayed. The unit automatically returns to the Measure page if:

- No buttons are pushed for 10 seconds or
- An alarm condition occurs.

For Toxic Gas-Reading Pulsar+ Instruments

From the Measure page, push the PAGE button once to access the Peak page.

- PEAK icon lights
- Peak (highest) reading that the instrument recorded since it was powered-ON displays.
- To reset the peak value, push the RESET button.

From the Peak page, push the PAGE button once to access the STEL Page (if enabled)

- STEL icon lights
- STEL (Short Term Exposure Limit) reading that instrument calculated since power-ON displays
    - To reset the calculated STEL value to zero, push the RESET button while on the STEL page.
- STEL value is automatically reset to zero when the instrument is turned ON

- STEL value is calculated over a 15-minute exposure.

- The following formula is used to calculate the STEL value:

$$\frac{\text{(Minute \#1 PPM value) + (Minute \#2 PPM value) +.....+ (Minute \#15 ppm value)}}{\text{15 minutes}} = \text{ppm STEL value}$$

  - If the instrument is ON for less than 15 minutes, the balance of the minute ppm values is set to zero and the total is divided by 15 minutes.

From the STEL page, push the PAGE button once to access the TWA page (if enabled).

- TWA icon lights
- TWA (Time Weighted Average) reading that the instrument calculated since it was powered ON displays
  - To reset the TWA reading to zero, push the RESET button while on the TWA page
- TWA value is automatically reset to zero when the instrument is turned ON
- TWA value is calculated over an eight-hour exposure
- The following formula is used to calculate the TWA value:

$$\frac{\text{Sum of 1-minute gas readings}}{\text{480 minutes (8 hours)}} = \text{TWA value}$$

- If the instrument is ON for less than eight hours (480 minutes), the balance of the minute ppm values is set to zero, but the accumulated reading is always divided by eight hours.
- If the instrument is ON for more than eight hours, the sum is still divided by eight hours.

From the TWA page, push the PAGE button once to return to the Measure page.

For Oxygen Reading Pulsar+ Instruments

From the Measure page, push PAGE button once to access Peak page:

- PEAK icon lights
- Peak (highest) oxygen reading that the instrument recorded since it was powered ON displays

        - To reset the peak value, push the RESET button while on the PEAK page.

From the Peak page, push PAGE button once to access the Min page.

- MIN icon lights
- Minimum (lowest) oxygen reading that the instrument recorded since power ON displays
    - To reset the minimum value, push the RESET button while on the MIN page

From the Min page, push the PAGE button once to return to the Measure page.

Turning OFF the Pulsar+ Detector

1. Push and hold the POWER button for three seconds until "OFF" displays.
2. Release the POWER button.

Chapter 3
Setting Up the Pulsar+ Detector

The Pulsar+ Set-Up mode can be accessed to:

- Enable the STEL and TWA pages
- Change the LOW, HIGH, STEL and TWA alarm setpoints
- Change the expected calibration gas value for the toxic gas instruments.

The Set-Up mode is password-protected to prevent unauthorized tampering of instrument configuration.

Each page of the Set-Up mode has a five-minute time limit.

To Access the Set-Up Mode:

1. Turn the instrument OFF.
2. Push and hold the PAGE button while pushing the POWER button to turn the instrument ON.
   - Display will show “500”
   - The SET icon and the instrument password appear in the upper left-hand corner of the display
   - The UP arrow appears over the RESET button
   - The DOWN arrow appears over the PAGE button

   NOTE: Throughout the Set-Up mode, pushing and holding the PAGE (down) and RESET (up) buttons causes the display to increment/decrement by tens.
3. Using the PAGE and RESET buttons, scroll to the correct password and push the POWER button to accept and enter the Set-Up functions.
   - If the password is correctly entered, the instrument beeps three times and enters the Low Alarm Set page.
   - The factory-set password is **672**.
   - If the password is incorrectly entered, the instrument alarms and enters Measure mode (see Chapter 2).

Low Alarm Page

- The LOW, ALARM, and SET icons light.

1. Use the PAGE and RESET buttons to set the Low alarm value.
2. Push the POWER button to accept a setting and move on to the High Alarm page.

High Alarm Page

- The HIGH, ALARM, and SET icons light.

1. Use the PAGE and RESET buttons to set the High Alarm value.
2. Push the POWER button to accept the setting and move on to the STEL/TWA Enable page.

NOTE: See TABLE 2-1 for more information on setting the Low and High alarm setpoints for oxygen instruments.

STEL/TWA Enable Page (Toxic Gas Instruments Only)

- The STEL, TWA, ALARM, and SET icons light.

1. To enable or disable the STEL and TWA functions, use the PAGE or RESET button to toggle the display between:
   - ON (enable) and
   - OFF (disable).
2. Push the POWER button to accept the setting and move on to the:
   - STEL page (if STEL/TWA enabled) or
   - Calibration Gas page (if STEL/TWA disabled).

NOTE: The STEL and TWA functions are enabled and disabled as a pair and cannot be separately controlled.

STEL Alarm Page (Toxic Gas Instruments Only)

- The STEL, ALARM, and SET icons light.

1. Use the PAGE and RESET buttons to set the STEL alarm value.
2. Push the POWER button to accept the setting and move on to the TWA Alarm page.

TWA Alarm Page (Toxic Gas Instruments Only)

- The TWA, ALARM, and SET icons light.

1. Use the PAGE and RESET buttons to set the TWA Alarm value.
2. Push the POWER button to accept and move on to the Calibration Gas page.

Calibration Gas Page (Toxic Gas Instruments Only)

- The SET, CAL and GAS icons light.

1. Use the PAGE and RESET buttons to set the instrument calibration gas value.
   - The calibration gas value must match the gas concentration listed on the calibration cylinder being used to calibrate the instrument.

⚠ WARNING

Incorrect setting of the instrument calibration gas value could result in incorrect instrument calibration. If using calibration gas other than the gas listed in TABLE 7-2, the calibration gas value must be set to match the calibration gas. Failure to do so may result in the instrument not notifying the user of a potentially dangerous atmosphere. Failure to follow this warning can result in serious personal injury or death.

2. Push the POWER button to accept the calibration gas value.
   - The instrument enters the Measure mode.

Chapter 4
Calibrating the Pulsar+ Detector

The Pulsar+ Detector is equipped with an autocalibration feature to make the calibration process as easy as possible.

The Autocalibration sequence:

- Resets the instrument zero and
- Adjusts sensor calibration for a known concentration of calibration gas.

For instruments equipped with **toxic gas** sensors, refer to Chapter 3, “Setting Up the Pulsar+ Detector” for information on setting or changing the calibration gas value. This does not apply to instruments equipped with **oxygen** sensors as the oxygen instruments are always calibrated to 20.8%.

Calibrating Toxic Gas Instruments (CO and H_2S)

To Enter the Calibration Mode:

1. Turn ON the instrument.
2. From the Measure page, push and hold the RESET button for three seconds.
   - CAL icon lights.
   - ZERO icon flashes alternately with a zero (0) on the gas display.

To Zero the Instrument:

1. Be sure that the instrument is in known fresh air.
2. Push the POWER button to perform the zero process.
    - If no button is pushed for 30 seconds after entering the zero mode, the:
        - Instrument returns to the Measure page
        - Zero value remains unchanged.
    - If the RESET button is pushed while the ZERO icon and a zero (0) display are flashing, the instrument:
        - Skips the zero process
        - Proceeds to the span process.
    - During the zero process, the CAL and ZERO icons illuminate and the Heartbeat indicator flashes.
    - If the instrument has successfully zeroed, the instrument beeps three times and moves to the Span page.
    - If the zero process was not successful, "CAL" and "Err" alternately flash on the display and the zero remains unchanged.
        a. Push the RESET button to acknowledge the calibration error
            - The instrument returns to the Measure page.
        b. REMOVE THE INSTRUMENT FROM SERVICE UNTIL THE PROBLEM CAN BE RECTIFIED.
    - If the zero process is successful, the:
        - CAL icon lights
        - GAS icon flashes alternately with the expected calibration gas value.

To Span the Instrument:

1. Push the calibration tubing into the fitting on the sensor cover.
2. Turn ON the cylinder valve.
3. Push the POWER button to perform the span process
    - If no button is pushed for 30 seconds after entering the span mode, the:

- Instrument returns to the Measure page
- Span calibration remains unchanged.

- If the RESET button is pushed while the GAS icon and a the expected calibration gas value are flashing, the instrument:
  - Skips the span process
  - Returns to the Measure page
  - Span calibration remains unchanged.
- If the instrument has successfully spanned, it:
  - Beeps three times
  - Returns to the Measure page.

NOTE: For one minute after the instrument has entered the Measure mode from the Calibration mode, the alarms are suppressed to allow residual calibration gas to clear.

NOTE: If the instrument is able to calibrate the sensor, pressing the POWER button will perform span calibration.

- If the calibration was not successful:
  - "CAL" and "Err" alternately flash on the display
  - Calibration remains unchanged.

  a. Push the RESET button to acknowledge the calibration error.
     - The instrument returns to the Measure page.

  b. REMOVE THE INSTRUMENT FROM SERVICE UNTIL THE PROBLEM CAN BE RECTIFIED.

Calibrating an Oxygen Instrument

1. Turn ON the instrument.
   - Be sure that the instrument is in known fresh air
2. From the Measure page, push and hold the RESET button for three seconds, the:
   - CAL and O_2 (for oxygen) icons light for three seconds
   - GAS icon, % icon and 20.8 light on the display.

The calibration process takes approximately 10 seconds.

NOTE: If the instrument is able to calibrate the sensor, pressing the POWER button will perform span calibration.

- If the calibration is successful, the instrument:
  - Beeps three times
  - Returns to the Measure page.
- If the calibration was not successful:
  - "CAL" and "Err" alternately flash on the display
  - Calibration remains unchanged.

  a. Push the RESET button to acknowledge the calibration error. The instrument :
     - Returns to the Measure page.

  b. REMOVE THE INSTRUMENT FROM SERVICE UNTIL THE PROBLEM CAN BE RECTIFIED.

Chapter 5
Warranty, Maintenance, and Troubleshooting

MSA Portable Instrument Warranty

1. **Warranty-**

ITEM	WARRANTY PERIOD
Chassis and electronics	Lifetime (MSA will support product for five years after production ends)
All sensors, unless otherwise specified	Two years

This warranty does not cover filters, fuses, etc. Certain other accessories not specifically listed here may have different warranty periods. This warranty is valid only if the product is maintained and used in accordance with Seller's instructions and/or recommendations. The Seller shall be released from all obligations under this warranty in the event repairs or modifications are made by persons other than its own or authorized service personnel or if the warranty claim results from physical abuse or misuse of the product. No agent, employee or representative of the Seller has any authority to bind the Seller to any affirmation, representation or warranty concerning this product. Seller makes no warranty concerning components or accessories not manufactured by the Seller, but will pass on to the Purchaser all warranties of manufacturers of such components. **THIS WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESSED, IMPLIED OR STATUTORY, AND IS STRICTLY LIMITED TO THE TERMS HEREOF. SELLER SPECIFICALLY DISCLAIMS ANY WARRANTY OF MERCHANTABILITY OR OF FITNESS FOR A PARTICULAR PURPOSE.**

2. **Exclusive Remedy-** It is expressly agreed that Purchaser's sole and exclusive remedy for breach of the above warranty, for any tortious conduct of Seller, or for any other cause of action, shall be the repair and/or replacement at Seller's option, of any equipment or parts thereof, which after examination by Seller is proven to be defective. Replacement equipment and/or parts will be provided at no cost to Purchaser, F.O.B. Seller's Plant. Failure of Seller to successfully repair any nonconforming product shall not cause the remedy established hereby to fail of its essential purpose.

3. **Exclusion of Consequential Damages-** Purchaser specifically understands and agrees that under no circumstances will seller be liable to purchaser for economic, special, incidental or consequential damages or losses of any kind whatsoever, including but not limited to, loss of anticipated profits and any other loss caused by reason of nonoperation of the goods. This exclusion is applicable to claims for breach of warranty, tortious conduct or any other cause of action against seller.

Cleaning and Periodic Checks

As with all electronic equipment, the Pulsar+ Single Gas Detector will operate only if it is properly maintained.

⚠ WARNING

Repair or alteration of the Pulsar+ Single Gas Detector, beyond the procedures described in this manual or by anyone other than a person authorized by MSA, could cause the instrument to fail to perform properly. Use only genuine MSA replacement parts when performing any maintenance procedures described in this manual. Substitution of components can seriously impair instrument performance, alter intrinsic safety characteristics or void agency approvals.

FAILURE TO FOLLOW THIS WARNING CAN RESULT IN SERIOUS PERSONAL INJURY OR DEATH.

Troubleshooting

The Pulsar+ Single Gas Detector will operate reliably for years when cared for and maintained properly. If the instrument becomes inoperative, follow the Troubleshooting Guidelines in TABLE 5-1; these represent the most likely causes of a problem. You may return inoperative instruments to MSA for repair.

- **MSA Instrument Division**
  Repair and Service Department
  1000 Cranberry Woods Drive
  Cranberry Township, PA 16066-5207
  1-800-MSA-INST

To contact MSA International, please call:

- **1-412-967-3000 or 1-800-MSA-7777**

The instrument displays an error code if it detects a problem during startup or operation. See TABLE 5-1 for a brief description of the error and proper corrective action. When an inoperative component is located by using the guidelines, it may be replaced by using one of the following "Repair Procedures."

Table 5-1. Troubleshooting Guidelines

PROBLEM	DESCRIPTION	ACTION
Display Toggles Between:		
Err & 1	Low Battery Alarm	Replace battery
Err & 2	EEPROM Error	Replace main pc board
Err & 3	Program Memory Checksum Error	Replace main pc board
Err & 4	EEPROM Checksum Error	Replace main pc board
Err & 5	Sensor Configuration Error	Replace main pc board
Err & 6	Temperature Sensor Error (temperature sensor reported a value <-55°C or >130°C)	Replace main pc board
Err & CAL	Span Calibration Error (sensor is not within expected span limits at the given calibration setpoint)	• Verify calibration gas concentration • Verify instrument calibration setpoint • calibrate sensor zero while in Fresh Air; then, recalibrate Span (if this fails again, replace sensor and recalibrate)
Err & FAS	Fresh Air Setup Error (instrument cannot perform a Fresh Air Setup because the sensor is not within the expected zero limits)	• calibrate sensor zero while in Fresh Air
Instrument does not turn ON; Alarm LEDs flash when instrument is turned ON		• Replace Battery • If new battery does not remedy problem, replace main pc board

Repair Procedures

⚠ CAUTION

Before handling the PC board, ensure you are properly grounded; otherwise, static charges from your body could damage the electronics. Such damage is not covered by the warranty. Grounding straps and kits are available from electronics suppliers.

Replacing the Pulsar+ Battery

1. Remove the four screws with the hex key (supplied).
2. Carefully remove the front cover to expose the battery.
   - The circuit board should remain with the back half of the case.
3. Remove the depleted battery and replace it only with a battery listed on the instrument label.
   - Be sure to observe proper polarity on the battery.
4. Replace the front cover, making sure that the gasket is properly seated in its channel.
5. Replace the four screws.
   - Do not over-tighten the screws or the case may be damaged.

Replacing the Pulsar+ Sensor

1. Remove the four screws with the hex key (supplied).
2. Carefully remove the front cover to expose the sensor (located near the top of the instrument and near the alarm lights).
   - The sensor looks like the coin-cell batteries sometimes used in calculators.
3. Remove the sensor by gently prying it out of its holder.
   - Pry the sensor from the right side first; then, lift it out of its holder (see FIGURE 5-1).
   - A small, flat-blade screwdriver is helpful.
4. Install the new sensor by gently pushing it back into the holder.
   - Be sure that the hole in the sensor is facing upward and not toward the circuit board.
   - Insert the sensor into the left side of the sensor holder first;

then, snap sensor completely into the holder (FIGURE 5-1).

5. Replace the front cover, making sure that the gasket is properly seated in its channel.
6. Replace the four screws.
   - Do not over-tighten the screws or the case may be damaged.

⚠ WARNING

Verification of calibration response is required; otherwise, the instrument will not perform as required, and persons relying on this product for their safety could sustain serious personal injury or death.

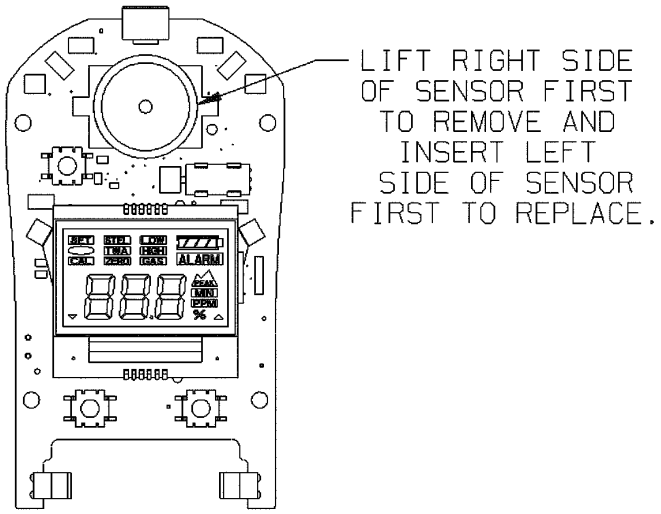

Figure 5-1. Sensor Replacement

Chapter 6
Performance Specifications

Table 6-1. Certifications

HAZARDOUS LOCATIONS	**US**	Class 1, Div. 1, Groups A, B, C and D, T4
	CANADA	Class 1, Div. 1, Groups A, B, C and D, T4
	EUROPE	EN 50014/EN 50020/EN EExiaIIC -20°C to +50°C, T4
EMC/RFI	**EUROPE**	EN 50270 (EN 50081-1/50082-2)
ENCLOSURE		IEC60529 IP54
CE	**EUROPE**	CE EX II 2G EExiaIIC -20°C to +50°C, T4
		ATEX Directive 94/9/CE
		EMC Direc**tive** 89/336/EEC

Table 6-2. Instrument Specifications

TEMPERATURE RANGE	**H_2S**	-20 to 50°C -40 to -20°C for short time periods
	CO	-20 to 50°C
	OXYGEN*	-10 to 50°C
WARM-UP TIME		<30 seconds

***NOTE:** Extended temperature range indicates gas readings may vary slightly if calibrated at room temperature. For optimal performance, calibrate instrument at temperature of use.

MEASUREMENT METHOD	Electrochemical Sensor

FACTORY-SET ALARM SETPOINTS	**LOW ALARM**	**HIGH ALARM**	**STEL**	**TWA**
CO	35 PPM	100 PPM	400	35
H_2S	10 PPM	15 PPM	15	10
O_2	19.0%	23.0%	--	--

Table 6-3. OXYGEN - Typical Performance Specifications

RANGE	0 to 25% O_2	
RESOLUTION	0.1% O_2	
REPRODUCIBILITY	0.4% O_2, for 2 to 25% O_2	
RESPONSE TIME	90% of final reading	35 seconds (normal temperature range)

Environment and Oxygen Sensor Readings

A number of environmental factors may affect the oxygen sensor readings, including changes in pressure, humidity and temperature. Pressure and humidity changes affect the amount of oxygen actually present in the atmosphere.

Table 6-4. CARBON MONOXIDE (appropriate models only) - Typical Performance Specifications

RANGE	500 ppm CO
RESOLUTION	1 ppm CO
REPRODUCIBILITY	$\pm$5 ppm CO or 10% of reading, whichever is greater
RESPONSE TIME	90% of final reading in 60 seconds (normal temperature range)

Table 6-5. HYDROGEN SULFIDE (appropriate models only) - Typical Performance Specifications

RANGE	200 ppm H_2S
RESOLUTION	1 ppm H_2S
REPRODUCIBILITY	$\pm$2 ppm H_2S or 10% of reading, whichever is greater
RESPONSE TIME	90% of final reading in 60 seconds (normal temperature range)

Chapter 7
Replacement and Accessory Parts

Table -7-1. Replacement Parts List

ITEM NO.	PART/COMPONENT	PART NO.
1	Screw, cap, hex, stainless steel, 2-56 x .375 lg	637433
2	Back cover assembly	10036798
3	Wafer, Versapor	10023431
4	Battery, Lithium, 3 volt	10038063
5	Front Cover Assembly, O_2	10040841
5	Front Cover Assembly, CO	10040842
5	Front Cover Assembly, H_2S	10040840
6	Black Gasket Kit	10040843
6	Red Gasket Kit	10040844
7	PC Board Assembly, O_2, Vibrating	10036179
7	PC Board Assembly, O_2, Non-vibrating	10036176
7	PC Board Assembly, CO, Vibrating	10036180
7	PC Board Assembly, CO, Non vibrating	10036177
7	PC Board Assembly, H_2S, Vibrating	10036181
7	PC Board Assembly, H_2S, Non-vibrating	10036178
8	O_2 Sensor Replacement Kit	10040397
8	CO Sensor Replacement Kit	10040395
8	H_2S Sensor Replacement Kit	10040396
	Allen Wrench	60208

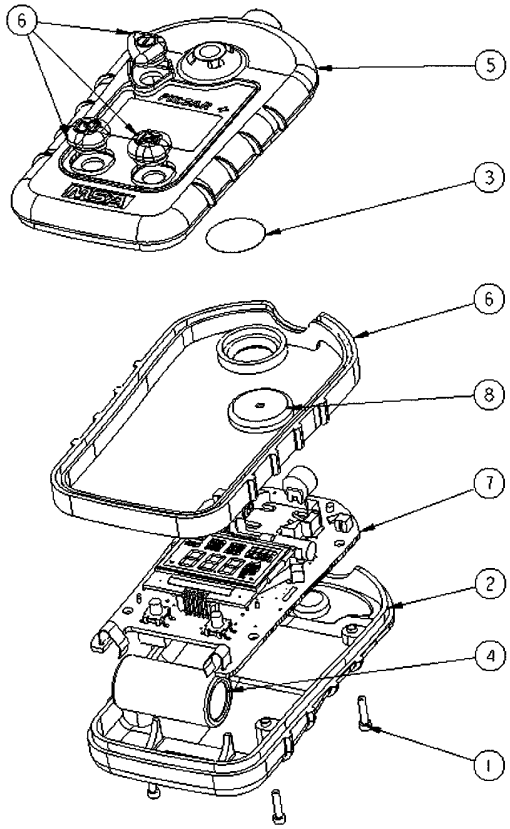

Figure 7-1. Replacement Parts (see Table 7-1)

Table 7-2. Accessory Parts List

PART/COMPONENT	PART NO.
Aspirator Assembly	10040799
Lanyard Kit	10041107
Carrying Case (Cordura)	10042191
Cylinder, 40 PPM H_2S, RP	467897
Cylinder, 40 PPM H_2S, Econocal	711062
Cylinder, 10 PPM H_2S, RP	467898
Cylinder, 10 PPM H_2S, Econocal	711060
Cylinder, 300 PPM CO, RP	473180
Cylinder, 300 PPM CO, R	461769
Cylinder, 5.0% O_2, RP	493580
Cylinder, 20.8% O_2, RP	479857
Regulator, 0.25 lpm, for use with Type RP Cylinders	467895
Regulator, 0.25 lpm Combination, for use with Type RP Cylinders	711175
Regulator, 0.251 LPM, for use with Type R Cylinders	459949
Tubing, 40 cm (16")	10030325
Suspender Clip Kit - with Suspender Clip and Screw	10041106
Cell Phone Clip Kit - with Clip, Clip Tab, Two-sided Tape, and Screw	10041105

NOTE: Do not calibrate H_2S Pulsar+ instrument with calibration gas containing CO. (e.g., Quad Gas P/N 804770).