USER MANUAL

ACM 150 (Gen2)

Air Composition Monitor

Honeywell

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1. Introduction

Thank you for selecting a Honeywell Analytics product for your monitoring requirement.

Honeywell Analytics is committed to providing quality products and service. The information outlined in this manual is provided to assist our customers in the correct usage of our products. Therefore, it is important that before the installation or operation of this product, you take the time to read and have a full understanding of this manual.

ACM 150 systems provide multi-point monitoring of air for the presence of gases and the vapors of liquid chemicals. As with any processing system, malfunction and failure can occur due to unforeseen or uncontrollable circumstances. Honeywell Analytics, its officers, managers, engineers, and representatives cannot be held responsible for such failure nor for the customer's negligence or misuse of this equipment. At the very least, follow procedures and recommendations outlined in this document for proper system functioning.

The information in Honeywell Analytics' published engineering specifications, manuals, and guides are correct as of publication date. Honeywell Analytics is not responsible for product application, including but not limited to compatibility with other equipment. Honeywell Analytics shall not, under any circumstances, be liable to buyer or any other party for lost profits, diminution of goodwill, or any other special or consequential damages with respect to any claim. In addition, Honeywell Analytics' liability for warranty claims shall not, in any event, exceed the invoice price of the product claimed defective, nor shall Honeywell Analytics be liable for delays in replacement or repair of product.

Honeywell Analytics makes no warranties or representation with regard to the information outlined in this manual and reserves the right to make changes in the specification(s) of the product described within at any time without notice and without obligation to notify any person(s) of such modifications or revisions.

Gas detection equipment must be installed in the correct locations. Failure to do so will render the equipment ineffective. Please refer to local codes of practice or national standards for advice.

Installation in hazardous areas must comply with your local codes of practice or national standards. Equipment installed in hazardous areas must not be serviced in the area unless it is classified "non-hazardous".

Only authentic Honeywell Analytics spare parts may be used for repair and maintenance. Modifications of components are not authorized. Usage of any parts other than Honeywell Analytics render the warranty null and void.

NOTE

1. "Honeywell Analytics" is abbreviated "HA" throughout this document.
2. The ACM 150 monitor gas list is updated frequently. Please contact us for the latest version.

1.1. Contacts

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1.2. ACM 150 standard warranty

The following warranty is between the Purchaser and Honeywell Analytics known hereafter as Seller.

- Seller warrants that for a period of one year after on-site start-up, its products shall be free from defects in material and workmanship provided that inspection by seller indicates such defects developed under normal and proper use.
- Any product found to be defective shall be repaired or replaced at Seller's option. Goods that have been repaired or replaced during the warranty period are under warranty for the remainder of the unexpired portion of the original warranty period.
- Seller will replace or repair defective products when delivered F.O.B. Seller's plant freight prepaid or at another location designated by Seller. If upon Seller's examination it is determined that the equipment is defective and failed under normal use and service, Seller shall correct such defects at its expense including return freight charges.
- Seller's warranty does not apply to damage resulting from improper installation, misuse, abuse, neglect or accident. Components that are expendable in normal use are not covered by this warranty.
- If the Seller determines that failure of its products is not due to defective materials or workmanship or in the event that the failure occurs after expiration of the warranty period, Seller's standard charges for labor, materials, expenses and transportation shall be paid by Purchaser.
- End products supplied by Seller which are manufactured by others are covered by the manufacturer's standard warranty. Seller shall transfer its warranty for such items to Purchaser and shall assist Purchaser with his warranty claims on these products. Such products which might be included in Purchaser's order, but which are specifically excluded from Seller's warranty, are identified below:
    - Personal computers and peripherals
    - Printers
    - External monitors
    - Network hubs

The foregoing is in lieu of all warranties, expressed or implied, including the warranties of merchantability and fitness for a particular purpose; nor shall Seller be liable on the basis of a claim for negligent equipment design or manufacture; nor shall seller be liable for any consequential or incidental damages for any reason whatsoever.

2. Safety

This section highlights key safety and ergonomics issues related to using the ACM 150 monitor. Matters addressed include risk analysis, chemical safety, electrical safety, flammability, and ergonomics.

2.1. Safe and proper operation of the ACM 150 monitor

The ACM 150 monitor design assures that an operator using local keypad and display is protected from injury. Likewise, there is no danger to the operator from opening the inner door or removing the pump cover on the ACM 150 monitor for inspection purposes. No internal plates, shields or components should be touched, tested, removed or serviced except by a trained technician. The user must read and follow all warning labels on the monitor and the highlighted CAUTION, WARNING and DANGER notes contained in this manual.

If the ACM 150 monitor is used in a manner not specified in this manual, the protection provided by the equipment may be impaired.

2.2. End user responsibilities

Use only the most current revision of this manual. The information in Honeywell Analytics' published engineering specifications, manuals and guides are correct as of publication date. Honeywell Analytics is not responsible for product application, including but not limited to compatibility with other equipment.

The end user and their subcontractors must be responsible to assure that their respective employees receive hazardous communication training which meet or exceed OSHA 29CFR 1910.120 (hazardous waste operations and emergence response). End users and their subcontractors who work on the ACM 150 monitor are required to assure that their respective employees are provided with material safety data sheets from their Environmental Health and Safety (EHS) department for all gases and/or chemicals which are monitored by the ACM 150 monitor.

Proper functioning of the ACM air composition monitor must be verified after all repairs. The performance of the ACM air composition monitor may be impaired if it is not used as specified in this manual.

2.3. Safety notices and terms

Review this manual carefully. Always follow approved safety procedures, including the use of lockout/tagout devices, proper clothing, and eye and face protection. Pay particular attention to warnings and precautions in this manual.

The following is an example of warnings used in this manual

(Please carefully read instructions anywhere a Warning or Danger is used in the manual).

2.4. Danger/Warning/Caution/Note

DANGER

Warns about hazards that will cause serious personnel injury, death or major property damage if ignored.

WARNING

The warning notice identifies potentially dangerous situations, where improper actions could cause death or serious injury.

CAUTION

The Caution notice is a general hazard which identifies situations where improper actions could cause damage to the equipment or product.

NOTE

Indicates special instructions that are important but not related to hazards.

2.5. Levels of ACM 150 user

This manual is designed for three levels of users, which are described below. The levels are not intended to restrict sections of the manual to specific users. The purpose of the levels is to limit decisions and tasks to users that have the responsibility, experience and/or training to make the decisions and perform the tasks.

2.5.1. All users

All of customer's employees who have a responsibility to install, operate, program, service or use the ACM 150 are defined as All Users.

2.5.2. Authorized users

This icon identifies Authorized Users. The customer's employees who have EHS, ERM, facility and/or management level responsibility for the ACM 150 monitor are defined as Authorized Users. Such users make decisions about the ACM 150 monitor set-up and use, the location of monitoring points, the use of data produced by the ACM 150 monitor, response to warn and alarm activation levels and incidents and the response procedures.

2.5.3. Trained technician

This icon identifies Trained Technicians. Definition of a Trained Technician:

- A Honeywell Analytics employee who is a service technician, chemist or engineer.
- An employee of the user's company or a third party service company who is a service technician or engineer and who has received training from Honeywell Analytics or its agent on the operation and service of the ACM 150 monitor and who is authorized by his/her company to perform this service.
- A Honeywell Analytics agent who is a service technician or engineer and who has also received training from Honeywell Analytics on the operation and service of the ACM 150 monitor.

Personnel not included in one of these categories are not authorized service technicians. On an emergency basis, an operator who is not trained as an authorized technician may be asked to open the doors of the ACM 150 monitor, observe operations and report to a trained technician at Honeywell Analytics (or its agent company). Corrective actions may be recommended based on those observations.

DANGER

Electrocution can occur when dealing with electrical circuits. Under no circumstances shall an untrained person be permitted to access, test, touch or remove any electrical circuits, plates or shields in the ACM 150 monitor. Refer to Lockout / Tagout Procedure before servicing the ACM 150 monitor.

2.6. Risk analysis

The use of The ACM 150 Air Composition Monitor entails inherent safety risks. Hazards include fluidics hazards, chemical hazards, physical hazards and electrical hazards. Fluidics hazards come from pressurized sample and air lines. Chemical hazards include the hazards associated with the air sample and the hazards related to the various components within the monitor. Physical hazards involve maintenance or removal of some heavy components inside the monitor. Electrical hazards include the high voltage (110/220 VAC) located within ACM 150 enclosure.

2.7. Chemical safety

Located within the sample gas cell are two windows made of a potentially toxic material called ZnSe (zinc Selenide). An MSDS for ZnSe is included in Appendix B. Special attention to the MSDS should be given and appropriate precautions taken by the user when performing maintenance on the gas cell

Most of the time the ACM 150 monitor is operating, it is sampling ambient air without toxics. In the event of a toxic gas release at one of the sample points for the monitor, small amounts of toxic gas and/or residue may be trapped inside the sample tubing, filters and pumps inside the monitor. During normal operation these trapped gases will be purged through the monitor and pose little risk as they are diluted before being sent out the exhaust.

However, during maintenance procedures that involve disassembly of these components, care is advised to make sure that if the monitor has experienced a toxic gas release, appropriate protective equipment is used to ensure user safety. It is also the responsibility of the user to dispose of all contaminated parts and service items such as filters and wipes per local rules and procedures. Refer to section 9 for further details.

2.8. Process compatibility

All components are compatible with the materials in the ACM 150 monitor. All sample-wetted materials are PFA, PTFE, PVC, acrylic, stainless steel, anodized aluminum or glass. The normal operating pressure of the sample-wetted components is a vacuum, however most of these materials are designed to withstand a maximum pressure of 80 psi at room temperature.

Some of the flexible lines contain high pressures. The burst pressure of the internal flexible tubing as originally supplied is dependent on its sizes:

- 1/4” (heavy wall) has a burst pressure of 270 psig at 70°F
- 3/8” (heavy wall) has a burst pressure of 230 psig at 70°F
- 1/2” (heavy wall) has a burst pressure of 155 psig at 70°F

To protect against rupture from an abnormal pressure condition, a pressure relief valve is provided. Do not remove or modify this pressure relief valve.

CAUTION

Failure to operate the ACM 150 monitor within the pressure and temperature limits specified can cause leaks. Only operate the ACM 150 monitor within the pressure and temperature limits specified.

2.9. Electrical safety

Tools are required to access sections of the ACM 150 monitor with electrical connections. An appropriately sized ball driver or allen wrench is required to access the interior portions of the enclosure. A Phillips screwdriver is required to access the power cords at the AC power distribution unit, located immediately behind
the computer door. A Phillips screwdriver is also required to open the main power disconnect switch on the top of the cabinet. There are no hardware electrical interlocks on the ACM 150 monitor.

A “Lockout/Tagout” power isolation box is installed on the top of the monitor’s enclosure. Before any electrical repair work is started, turn the knob to the “0” position to isolate main power to the monitor. To return power to the monitor, turn the knob to the “1” position. If it is necessary to enter any electronic areas, electrical energy may be stored within the system. Allow sufficient time for any power to discharge and use a voltmeter to check before doing any work in the area. Do
not perform any internal electrical work on the monitor without using the correct procedures (Lockout/tagout (LOTO) disconnect). Lock out and tag out the main power switch per local safety procedures.

A circuit breaker for the main power supply must be provided by the user per local electrical codes.

2.10. Hazardous Energy Isolation

The ACM 150 monitor uses both high pressure CDA (compressed clean dry air up to 100 psig) and low pressure (5 psig) nitrogen. Both energies may be stored inside the monitor and must be relieved before performing any maintenance work involving the pneumatics. The CDA is used by the venturi vacuum generators located inside the main enclosure behind the computer door. Nitrogen is used to purge
the sample gases between analysis cycles and is plumbed to the solenoid valve assembly located next to the optics bench inside the cabinet.

It is the responsibility of the customer to install external lockable manual isolation valves for both the CDA and the nitrogen supply. The valves should be visible, easily accessible, properly labeled and close to the monitor. It is recommended that a pressure gauge be installed to visually indicate the supply pressure.

Refer to the installation instructions i for additional details and precautions. A class 1 laser is part of the ACM 150 monitor optics bench. During any maintenance procedures that involve servicing the optics bench or its components, electrical power should always be disconnected.

The noise generated during operation of the ACM 150 monitor has been measured to be less than 70 dB.

2.10.1. Compressed Air Isolation

Compressed air can be isolated by ensuring that during installation or setup of the ACM 150 monitor compressed air isolation valves for the supply have been installed. Since each site's requirements vary, it is up to the end-user to provide this isolation. Compressed air stored energy can be removed by first shutting off the air supply and then allowing time for the pressure to bleed down. Under normal automatic operation the pressure should bleed down through the venturis in seconds. Under manual operation, it may be necessary to actuate the venturi supply solenoid valve briefly
to bleed off the pressure. Pressure gauges are provided on the venturi manifold assembly to help verify that the pressure has been relieved.

2.10.2. Nitrogen Isolation

Nitrogen under low pressure purges sample gases between cycles. It also provides continuous purging of the optics bench mirrors through a small orifice. Shutting off the nitrogen supply should relieve any stored pressure through the optics bench purge without any further actions.

2.11. Emissions

The ACM 150 monitor does not emit or generate hazardous levels of ionizing/non- ionizing radiation or audio noise.

2.12. Ergonomics

Ergonomic factors such as the height and weight of the monitor do not pose a significant hazard. The height of the monitor should be at a comfortable level, with the computer approximately 4 feet above the ground. It is recommended that a work stool be used while working for long periods.

There are two heavy components that may need infrequent servicing or replacement every few years.

The optics bench contains components that can be replaced by Honeywell Analytics. Care should be exercised when lifting and removing the optics bench. When removing the optics bench for off-site service, Honeywell Analytics suggests an adjustable height wheeled platform or dolly be positioned level with the optics drawer. With the drawer open, the bench can then be slid onto the platform and transported as needed safely.

The backup exhaust pump is also heavy. Should the pump need replacing, care should also be exercised.

2.13. Flammability

The construction of the ACM 150 monitor enclosure consists of nonflammable materials. All high voltage (110/220VAC) is contained within nonflammable enclosures.

2.14. Potential key failure points and trouble spots

Potential key failure points and trouble spots can include, but are not limited to:

- Chemical exposure due to leaking fittings
- Chemical exposures due to maintenance activities
- Potential electric shock from servicing electrical components Methods to avoid potential hazards include the use of personal protective equipment, various system level safety interlocks and administrative controls.

2.15. Potentially hazardous maintenance activities

When performing maintenance on the ACM 150 monitor, especially for those installations that have had hazardous gas alarm incidents, purge all sample lines with air or nitrogen to prevent exposure to hazardous chemicals. Also, when performing maintenance on the sample cell or any components that may trap or collect hazardous gas, use appropriate protective equipment to limit exposure to any possible gas sample residue.

2.16. Environmental issues

Environmental issues involve the proper disposal of potentially hazardous wastes generated during maintenance procedures. The following ACM 150 monitor components are potential hazardous materials and may need infrequent replacement:

- Lithium battery inside computer
- Gas sample filter inside pump cabinet
- End-of-line filters and check valves if installed
- Cleaning wipes and materials such as gloves
- Sample tubing and solenoid valves

Other materials in the sample stream that may have contact with hazardous gases should also be considered potentially hazardous. Contact your local environmental management agency or a hazardous waste management company for proper recycling and/or disposal sites and procedures for these components.

2.17. Exhaust treatment

The ACM 150 monitor exhaust must be connected to the customer's exhaust system within their facility. In the event of a hazardous gas release and subsequent gas alarm, the sample gas is expelled out the exhaust connection. It is substantially diluted under normal conditions as it exits the monitor and poses little danger, however proper treatment is advised. Only the end-user can decide if those emissions should pass through an acid scrubber or alternatively, untreated through a general exhaust system. It is up to the end-user to abide by all local safety procedures.

2.18. ACM 150 labels

The exterior and interior labels for the ACM 150 monitor are shown on the following pages. These labels are applied by the factory prior to shipment.

NOTE

If any label is absent or loose, please notify Honeywell Analytics. A new adhesive label will be sent. It may be applied to the ACM 150 monitor, as shown in the drawings, by the user or by one of our service engineers.

2.19. Security guide

Establishing an Ethernet connection to the ACM 150 may expose the system to vulnerabilities. Honeywell recommends against connecting the ACM 150 to untrusted computers or equipment without taking appropriate measures to ensure security.

- Update firmware of vulnerable instruments as per the security notification.
- Always use passwords on installations of ACM150 to prevent unauthorized access.
- Allow only trained and trusted persons to have physical access to their system, including devices that have connection to the system through the Ethernet port.
- Isolate their system from the Internet or create additional layers of defense to their system from the Internet by placing the affected hardware behind a firewall or into a DMZ.
- If remote connections to the network are required, please consider using a VPN or other means to ensure security remote connections into the network device is on.

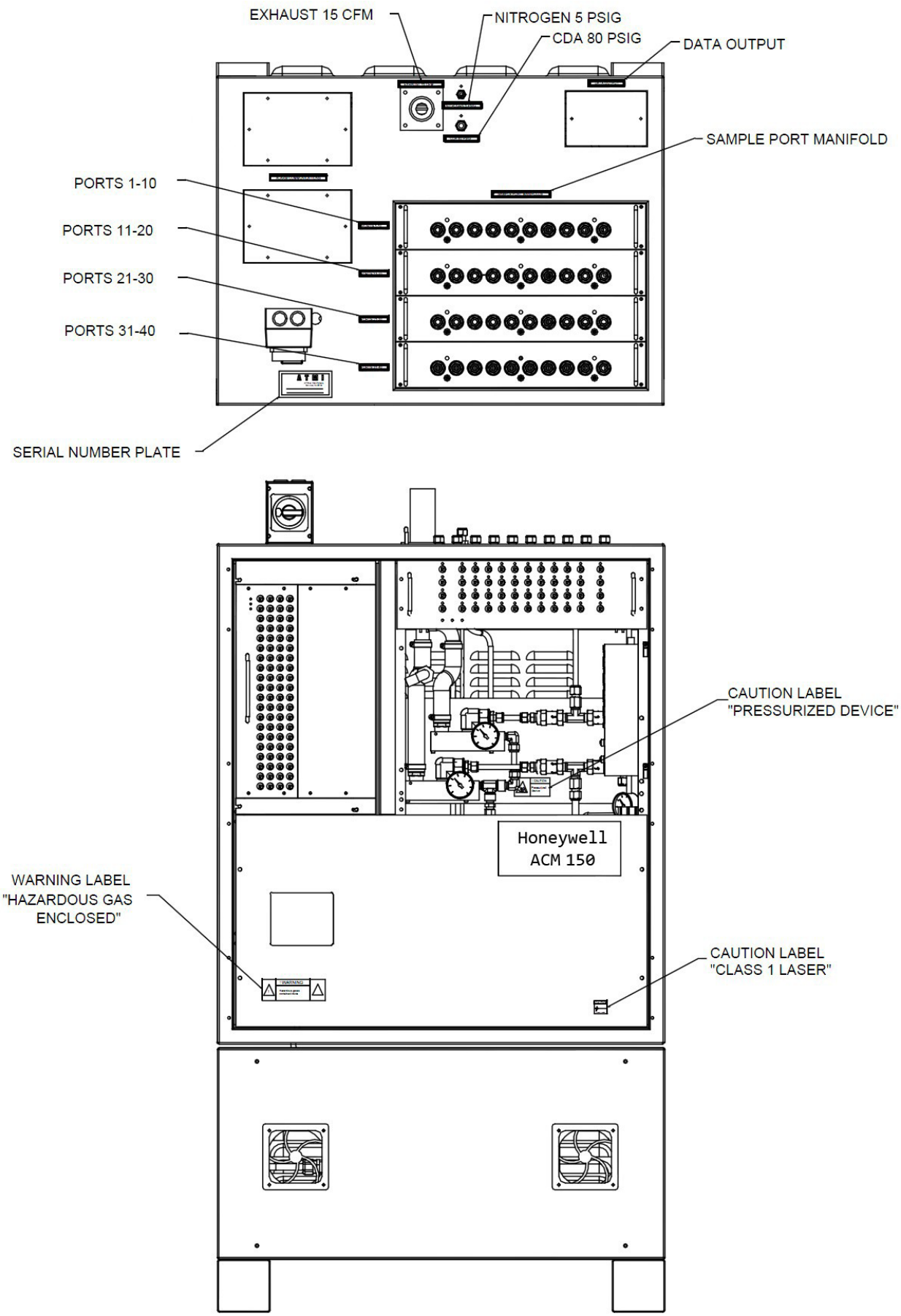


Figure 1. ACM 150 Outside Labels

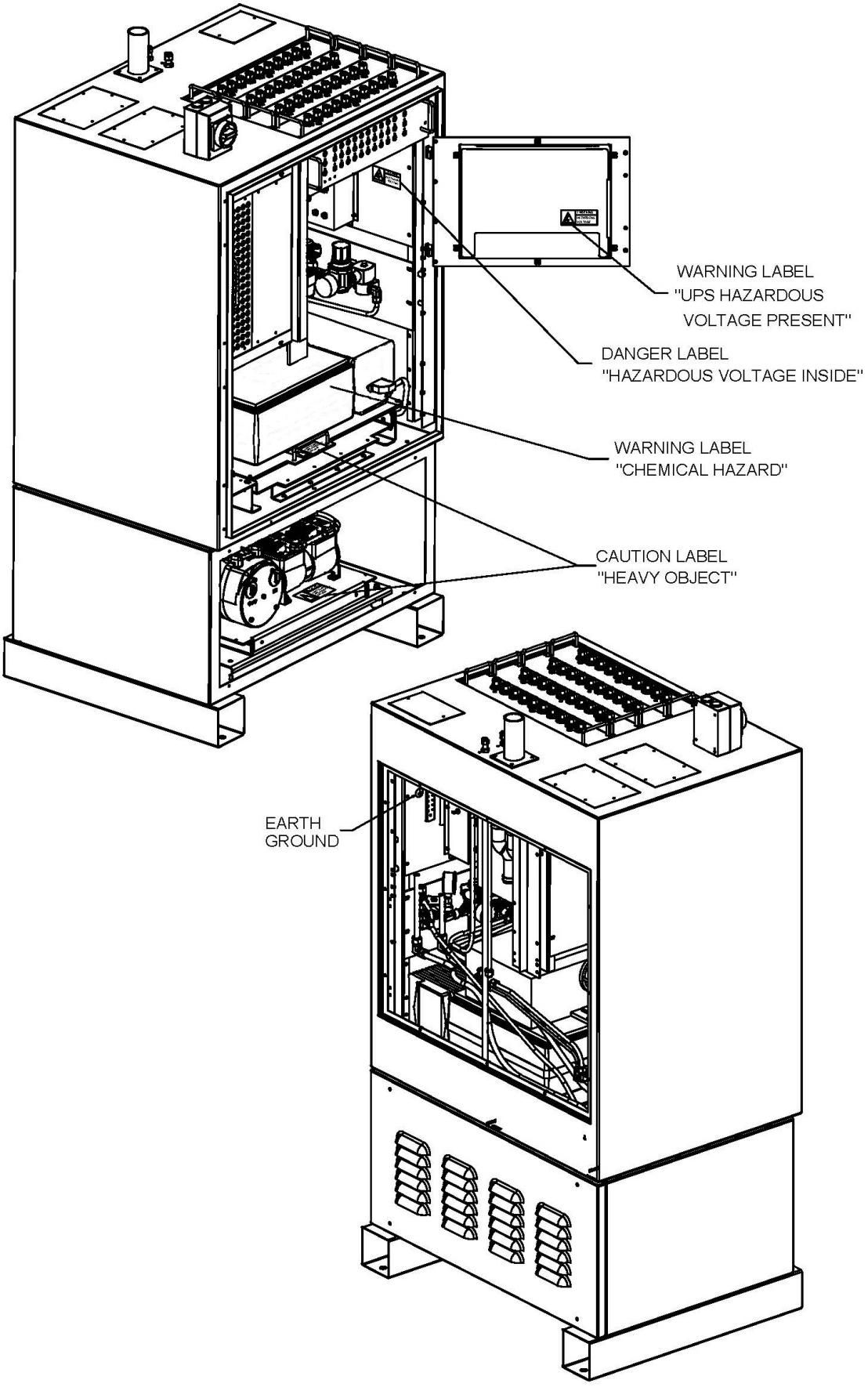


Figure 2. ACM 150 Inside Labels

ICON KEY
Authorized Users
Trained Technician

3. Technical Description and Theory of Operation

3.1. Overview of the ACM 150 monitor

The ACM 150 monitor can monitor any or all the following locations:

- Sources of a potential chemical leak, such as gas cabinets, valve boxes, pipes, process equipment, semiconductor tools and storage areas to alert emergency response teams of a pending problem and/or to shut off the flow of gases automatically.
- Plant emission ducts and stacks to determine the concentrations of various chemicals being released from the facility.
- Workplace areas to confirm that employees are not being exposed to chemicals and to alert workers should a leak spread into their breathing zone.

The ACM 150 samples the air in these locations and analyzes it for many gaseous chemicals. The samples are transferred to the ACM 150 monitor by 3/8-inch Teflon tubing or polypropylene. At or near the sample pick-up locations (tube inlets), an air filter is installed to keep the sample lines free of particles. As an option, a check valve can be added after the filter to allow the line to be pressurized with air from the ACM 150. This enables an automatic leak check of every sample tube once per day.

The ACM 150 monitor does not monitor all locations at once. It scans one area at a time, in sequence until all active areas have been monitored. It has the capacity to scan as many as 40 sample areas.

3.2. ACM 150 arrangement and assemblies

3.2.1. General arrangement

The ACM 150 monitor cabinet consists of these assemblies:

1. Main Power Switch
2. Sample Valve Manifolds
3. Sample Valve Control Panel
4. Touchscreen Computer Assembly
5. FTIR-Bench and Gas Cell Assembly
6. Pumps and Pump Cabinet
7. Cycle Valves and Cycle Valve Control Panel
8. Router
9. Relay Output Control Panel
10. Relay Outputs

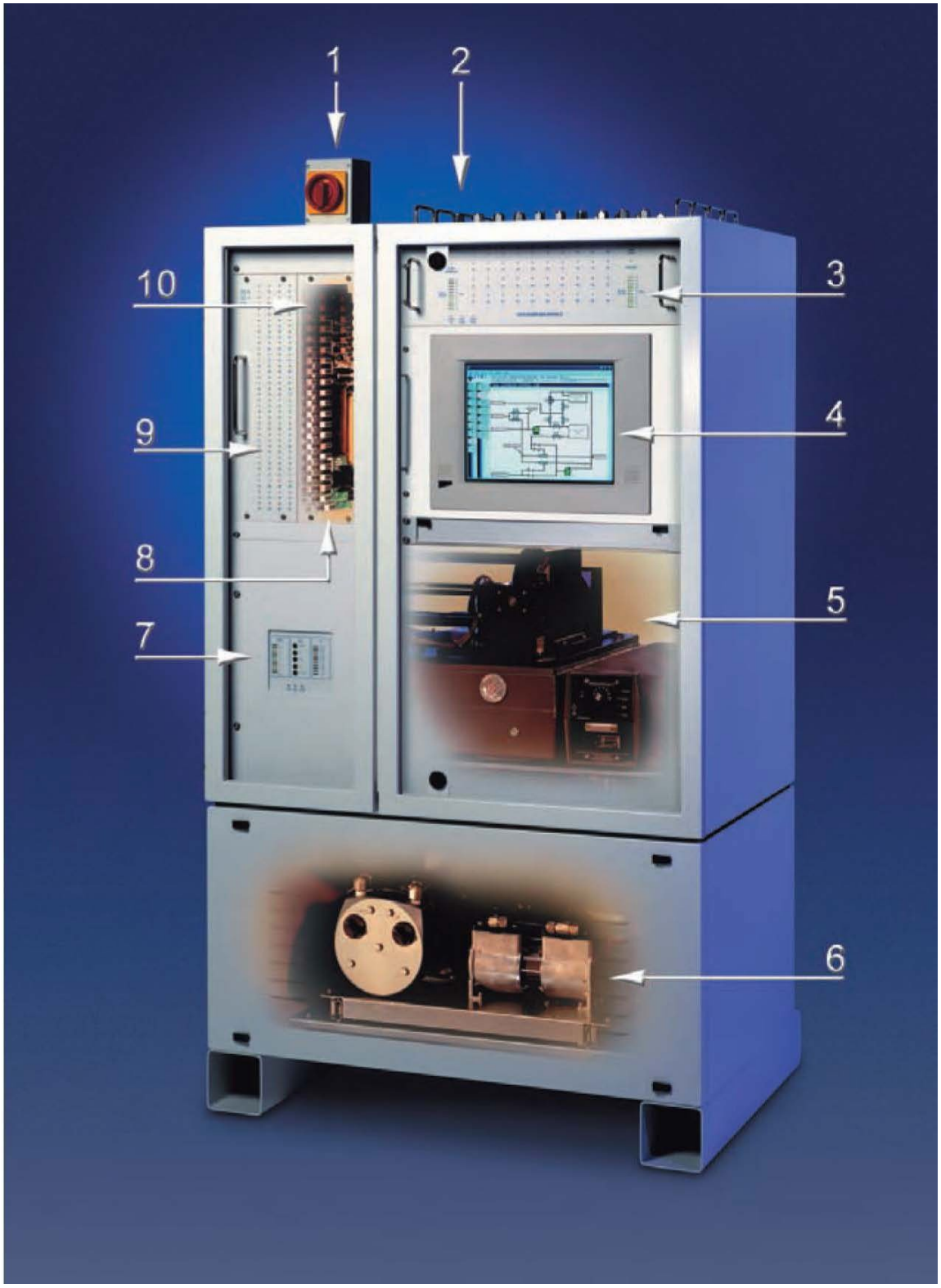


Figure 3. General Arrangement

3.2.2. Main power switch

This switch controls the line power. The ACM 150 monitor cannot operate unless it is switched ON. Switching it OFF disconnects line power to all ACM 150 assemblies. This is also a Lockout/Tagout (LOTO) switch. It accepts an external padlock in the OFF position.

Figure 4. Main Power Switch

3.2.3. Sample valve manifolds

Located at the top of the cabinet, these manifolds are aluminum and then Teflon impregnated and hard anodized to provide an inert surface.

Each manifold holds 10 valves. These are 3-way solenoid valves operated by 24 VDC. One-way flows to a bypass header and the other to a sampling header that connects to the cycle valves and the FTIR gas cell. The valves mount upside down. They are secured by screws and o-rings seal them to the manifold.

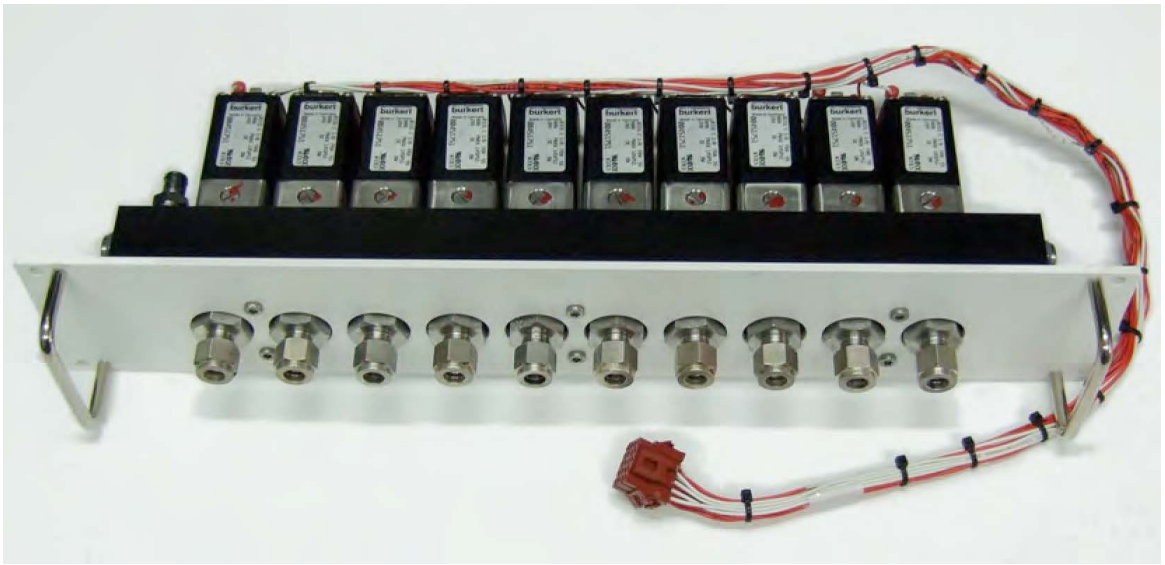


Figure 5. 10 Sample Valve Manifold

One to four manifolds are installed, providing 10, 20, 30 or 40 sample point inlet fittings. Blank plates seal off unused manifolds. Handles are provided for installation and removal of the manifold assemblies. Shown below are the sample tube fittings on the manifolds.

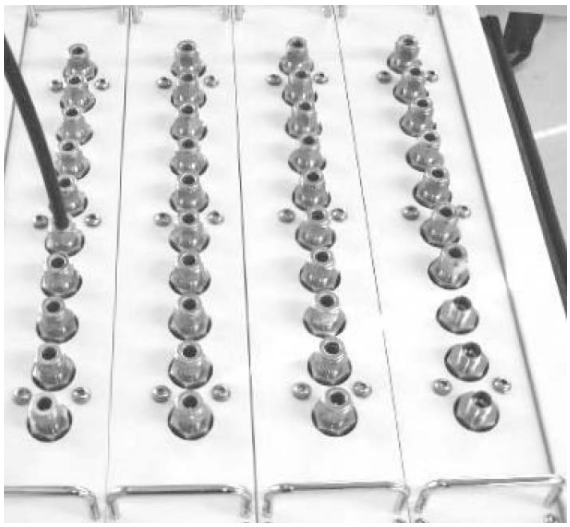


Figure 6. Sample Inlets 40-Point

3.2.4. Sample valve control panel

The Sample valve control panel provides both status and control. As the ACM 150 monitor switches the sample valves from one area to the next, the corresponding LEDs light indicate the current area being sampled and analyzed. Each area number is also a momentary test switch, which may be pressed and used for test purposes when the ACM 150 monitor is in the Front Panel Mode. In other modes the switches are inactive.

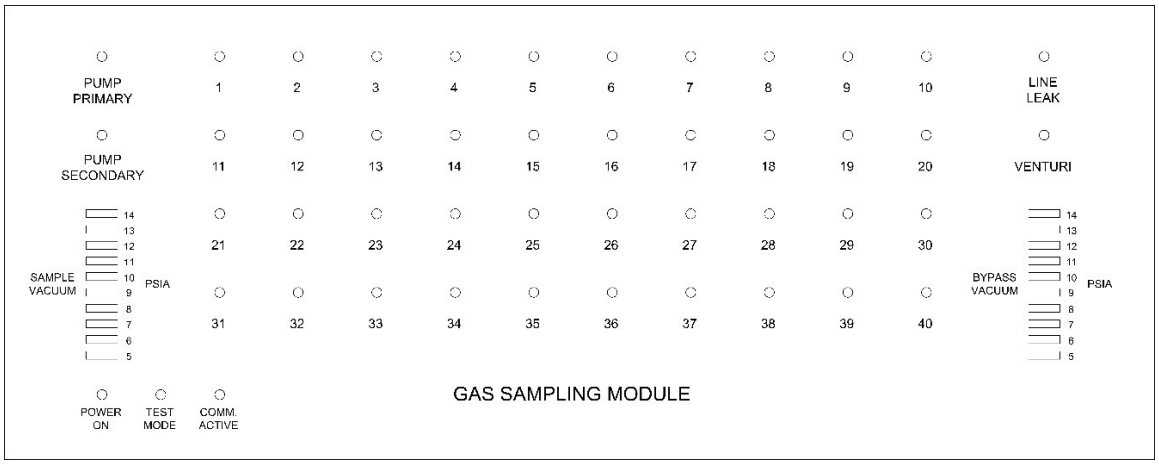


Figure 7. Sample Valve Control Panel

A column of LEDs on the left and right sides indicate the vacuum, measured in psia, in the bypass flow (Bypass Vacuum) and in the sample flow (Sample Vacuum). They are a troubleshooting aid should the vacuum fall below acceptable levels. Status LEDs are provided for the following:

- Pump Enabled: The LEDs indicate adequate sample pump vacuum
- Venturi: The LEDs indicate adequate venturi pump vacuum
- Line Leak: Lights when the ACM 150 monitor is performing a Line Leak Test, which may be initiated manually or automatically. For the Line Leak Test to perform properly, check valves must be installed in the sample lines connected to the ACM 150 monitor. This feature may be disabled via the configuration software.

3.2.5. Control panel status

The three control panels on the ACM 150 monitor have the same Status LEDs. These LEDs provide status on the following:

- Power On: Lights to confirm that power is supplied to the valves or relays associated with the Control Panel. This LED should be lit whenever the ACM 150 monitor is powered. Loss of power requires service attention.
- Test Mode: Lights when selecting the Manual Mode or Front panel Mode on the touchscreen.
- Comm. Active: Flashes when the computer and the control panel are communicating. Frequent communication is normal.

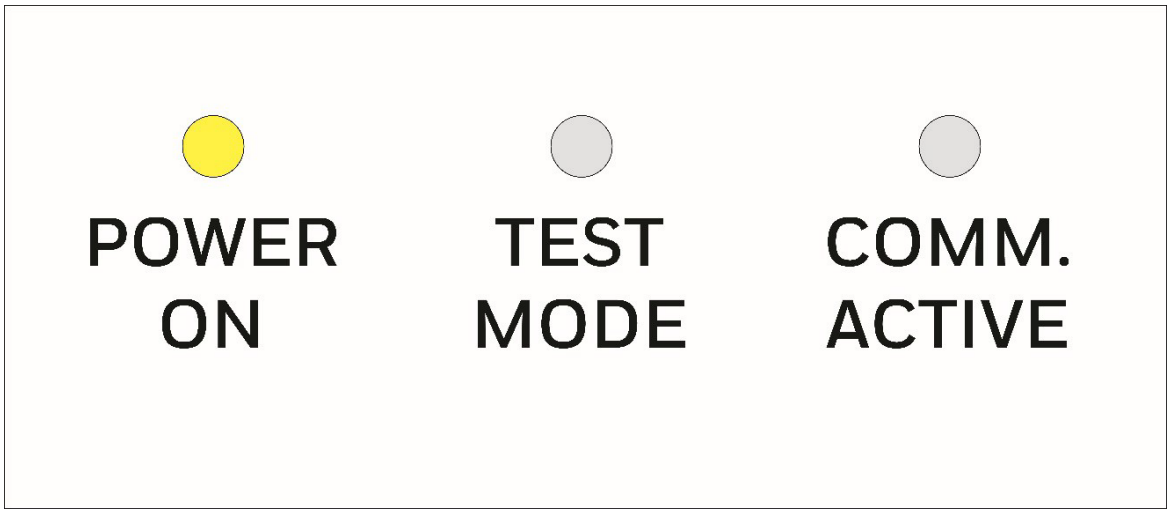


Figure 8. Control Panel Status LEDs

3.2.6. Cycle valves

When a sample area is selected by the computer, the corresponding sample valve diverts the flow path from bypass to sample. The boost pump draws the air sample in and pumps it to the gas cell. The boost pump connects to the gas cell through the cycle valve assembly.

Solenoid valves S1, S2, S5, and S6 are the cycle valves. They control the flow path of the air samples, ensuring the spent sample is evacuated from the gas cell and filled with fresh sample before each analysis. They also switch to nitrogen during the background cycle. The timing and switching are controlled by the computer using a program that is configurable.

All valves are 24 VDC, 2-way, and normally closed (energized to open). These valves are mounted on a removable plate.

Valves S1 and S2 contacting the air sample before it passes to the gas cell have Teflon bodies, S5 and S6 are made of stainless steel.

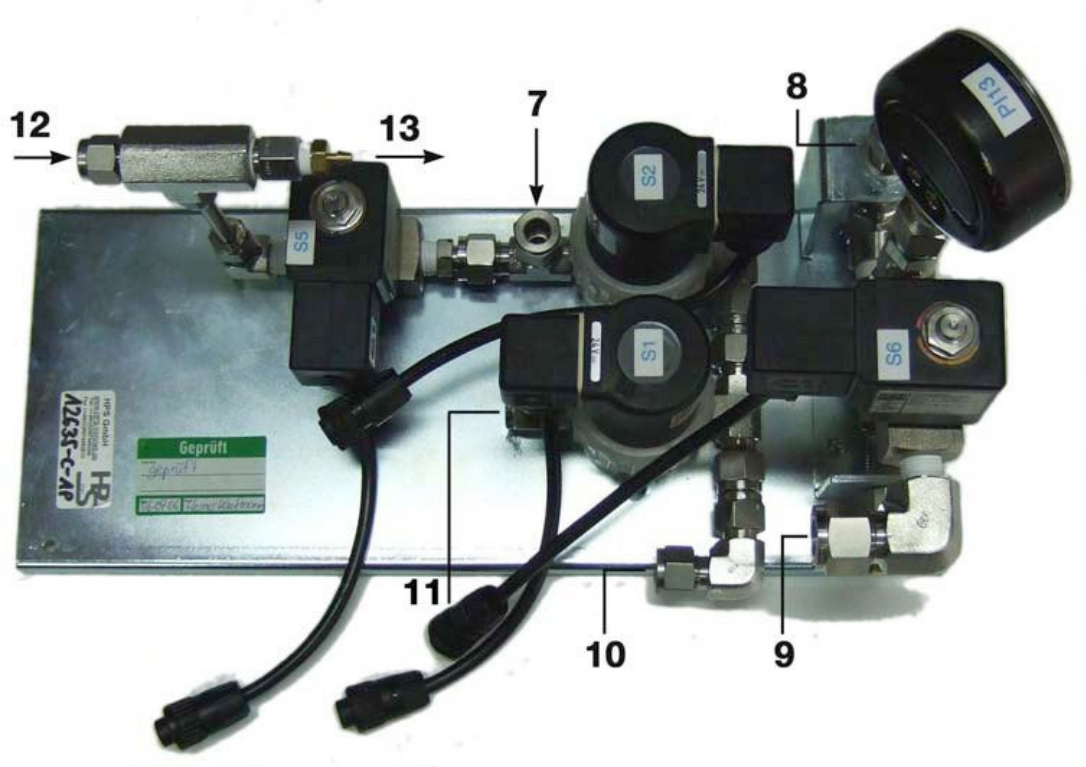


Figure 9. Cycle Valve Assembly

S1, S2, S5, S6: Solenoid Cycle Valves PI13 Pressure Indication

7. Gas Cell In
8. Gas Cell Out
9. Depending on option, either / or: To Venturi Manifold

Exhaust Pump In

10. From Boost Pump
11. To Exhaust
12. Nitrogen In
13. To Dust Cover Purge

3.2.7. Cycle valve control panel

The Cycle Valve Control Panel provides both status and control, much like the Sample Valve Control Panel. Status indicators include:

- Sample Pressure: This scale is psia or absolute pressure, as measured at the gas cell.

The pressure is lowest during the Evacuation cycle. It peaks during the Analyze and Background cycles (~ atmospheric or 14.7 psia). The scale is used to confirm proper operation of the pumps and cycle valves.

- Cycle Status: LEDs light to show the stages of the scan cycle from Evacuation to Analyze. The scan cycle is explained in "Air sampling system" on. Green LED indicates the status is OK. Amber LED indicates a possible problem, i.e. inadequate pressure during the cycle.
- ZPD: The Zero Path Difference indicates the intensity of the infrared signal measured by the detector.
- If the values are no longer in the green range, there may be a problem requiring service attention.
- Control Panel Status: Refer to Control panel status. The Power On, Manual Mode and Comm. Active LEDs have the same functions on all three control panels.

The LEDs 1 to 8 light to indicate which valves are active during each sampling cycle. LEDs 1 to 6 correspond to valves S1-S6 with S7 and S8 provided for future use.
When the ACM 150 monitor is in the Front panel Mode, press the buttons to activate the momentary test switches for test purposes. In other modes the switches are inactive.

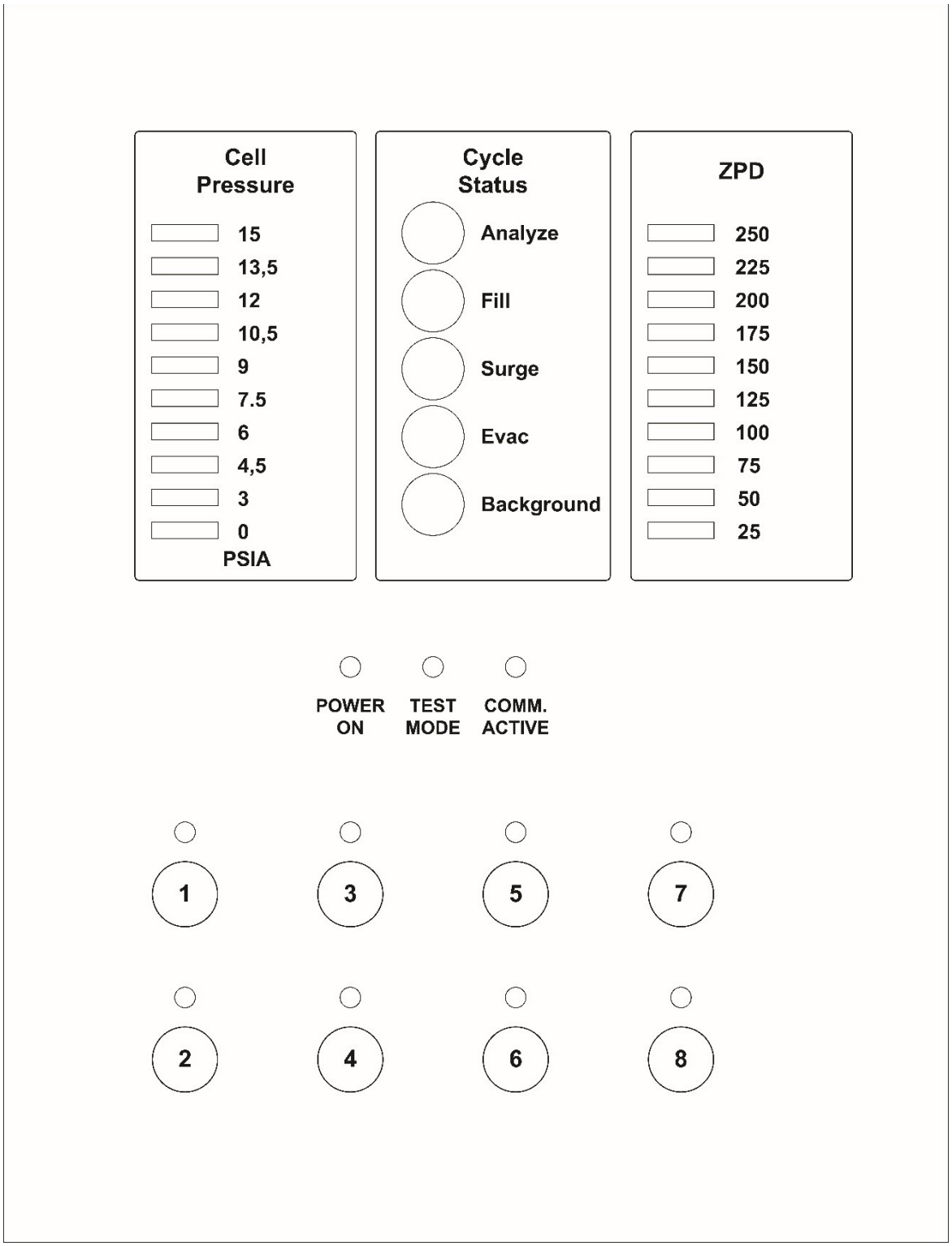


Figure 10. Cycle Valve Control Panel

3.2.8. Pump assemblies

3.2.8.1. Venturi Pumps

The ACM 150 monitor has two air-driven ducts (venturi pumps). One is the Bypass Venturi Pump. It draws a constant flow of air through the tubes and the sample valves. This flow is only interrupted when the sample valve is energized, i.e. when that area is being sampled by the ACM. When areas are not sampled, they flow to bypass. This assures that the samples lines are continuously flowing and refreshed.

The second pump is the Gas Cell Venturi Pump. It draws spent sample out of the gas cell during the Evacuation mode.

The advantages of the air-driven venturi pump are:

- no scheduled PM service because parts do not wear out
- generates virtually no noise or heat

Should the supply of air be interrupted, a mechanical pump turns on and takes over automatically.

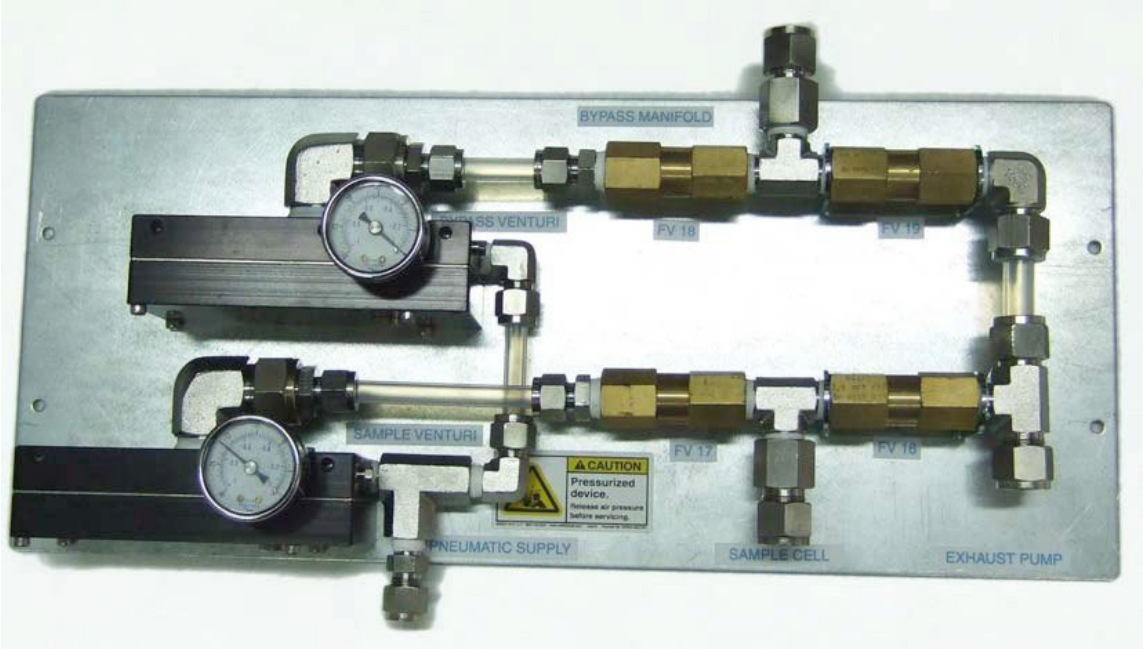


Figure 11. Venturi Pump Assembly

The venturi pumps are installed on a mounting plate. The check valves allow the venturi pumps and the mechanical Backup Exhaust Pump to be pneumatically coupled to common bypass and gas cell vacuum lines. This allows either one to provide the suction to draw the flow. The mechanical pump switches on automatically when the venturi pumps fail to provide adequate vacuum. The check valves permit flow in one direction only. This prevents the pump in use from drawing on the idle pump.

3.2.8.2. Mechanical pumps

The pumps are isolated in the bottom section of the ACM 150 monitor to muffle the noise and to isolate vibration and heat. Cooling fans in the bottom section of the cabinet direct air flow across the pumps and their motors. The pumps are accessed by removing the front panel. They are mounted with vibration eliminators on a common plate that slides out for service.

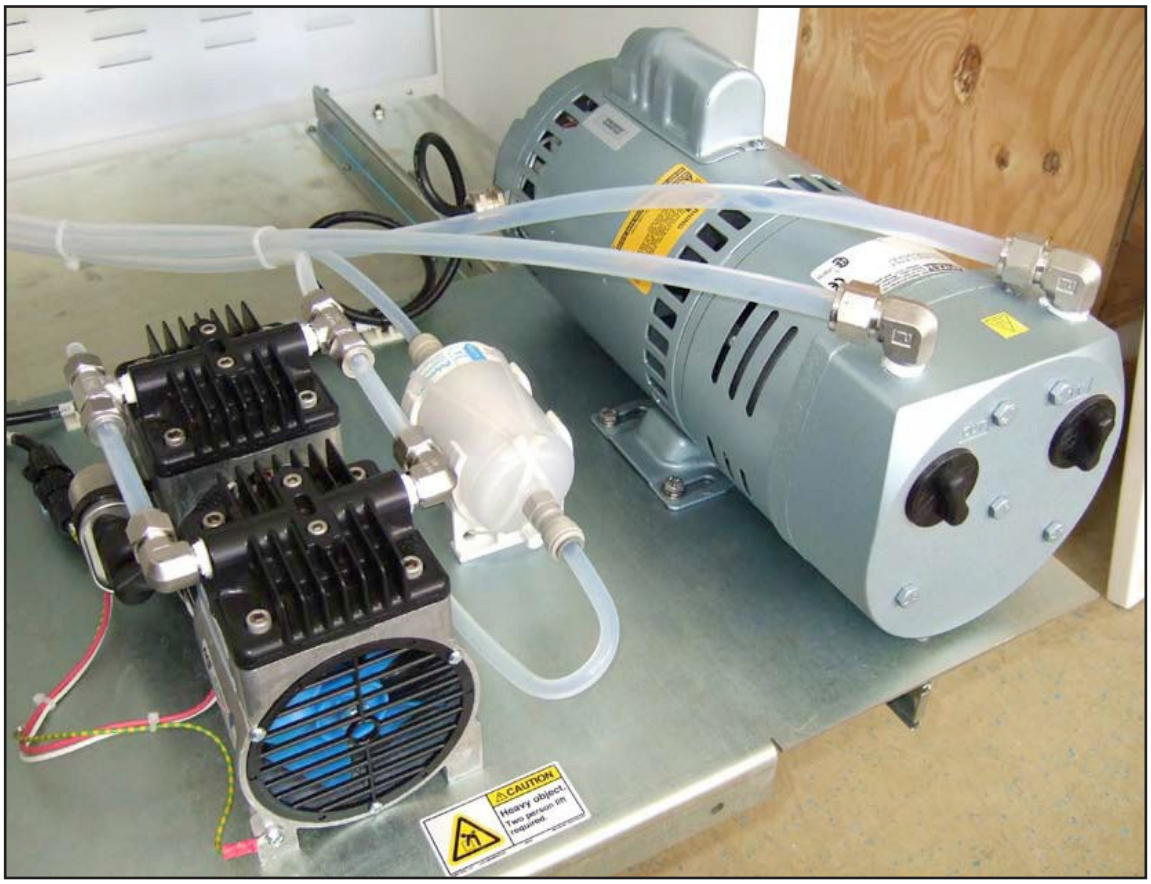


Figure 12. Mechanical Pump Assembly

The Backup Exhaust Pump is an oil-less carbon vane vacuum pump with a high flow capacity. If air is supplied to the venturi pumps and they are operating properly, this pump is inactive. Insufficient vacuum, when detected by an absolute pressure transducer, automatically applies power to the pump. The backup pump turns on for both venturi pumps under these conditions. When the air supply is restored or the problems are corrected, the user manually switches the ACM 150 monitor from the automatic mode into the manual mode and back to automatic mode, using the Diagnostic menu to use the venturi pumps again.

The Boost Pump speeds up the sampling cycle. It is a dual head diaphragm pump with Teflon coated internal parts. It is always on. In the surge and fill cycles, the boost pump provides a high rate of sample flow into the gas cell. In the evacuation and analyze cycles, it keeps the sampled air flowing to bypass.

3.2.9. FTIR bench & gas cells

3.2.9.1. FTIR optics bench assembly

Figure 13. FTIR Bench Assembly

The Optics Bench is a Perkin Elmer Model Spectrum Two FTIR (Fourier Transform InfraRed) analyzer. It is the heart of the ACM 150 monitor, providing the analytical power to identify and quantify a vast array of gases. For more information, refer to ACM 150 operating principle.

The optics bench always includes a gas cell.

3.2.9.2. Gas Cells

Sampled air never flows through the FTIR Optics Bench. Instead, the samples flow through a gas cell. The infrared beam from the FTIR Optics Bench passes through a window on top of the bench where it is reflected by mirrors and directed into the gas cell. The infrared beam passes through windows in the gas cell, where the gas molecules in the sampled air absorb infrared radiation at wavelengths specific to each gas type. The beam exiting the gas cell is focused by mirrors on the Optics Bench to a detector, where the signal is collected for analysis.

Most ACM 150 applications are for TLV-TWA level monitoring, which require higher sensitivity. The level of detection is at the low ppm and, sometimes, sub-ppm levels.

As the pathlength increases, more gas molecules come in contract with the infrared beam. For this reason, the pathlength of the gas cell is directly proportional to the detection sensitivity. The standard gas cell used in the ACM 150 monitor has a pathlength of 5 meters. The infrared beam is focused and directed into the cell and out to the detector by transfer optics, adjustable mirrors below the cell.

The beam enters and exits the gas cell through windows at the bottom It is reflected and forth by the internal mirrors at the top and bottom, making multiple passes through the gas cell. The mirrors have a highly reflective gold coating.

The gas cells mount to a plate that bolts to the FTIR Optics Bench.

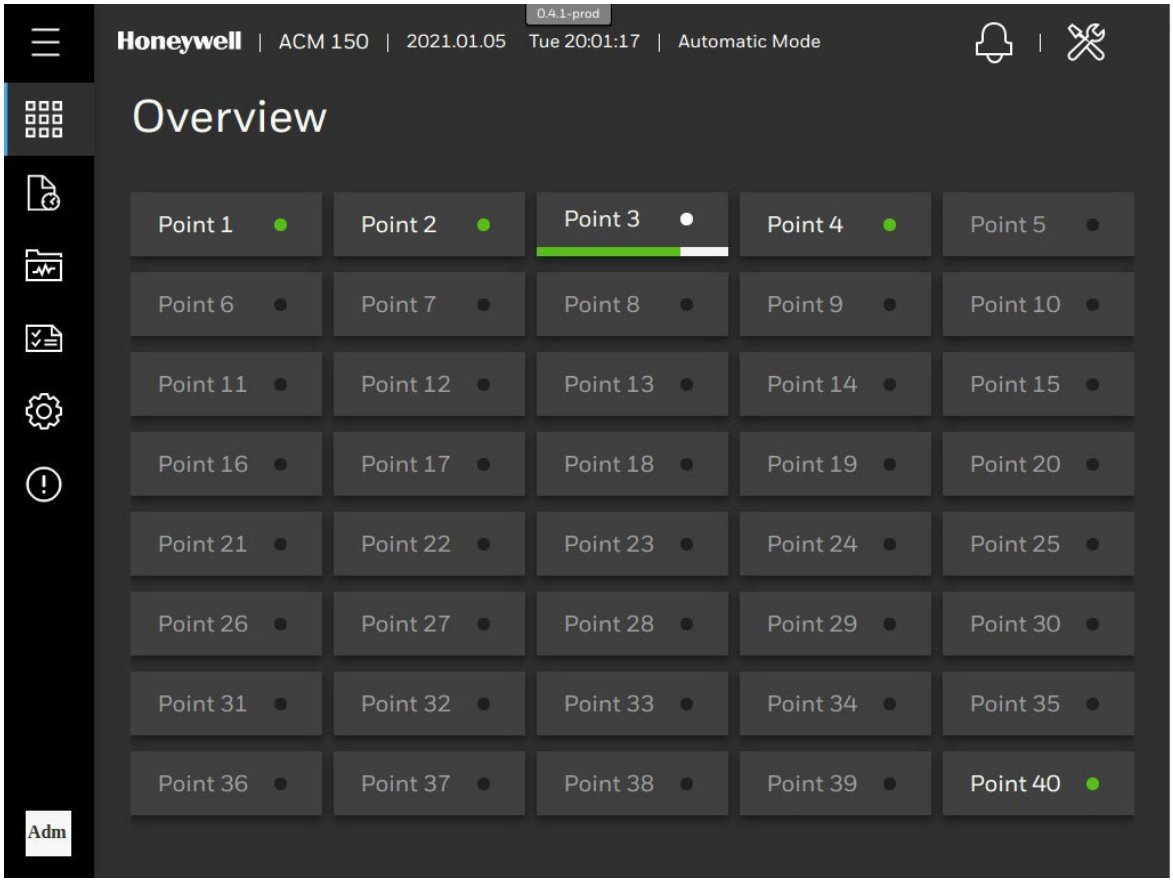
3.2.10. Touchscreen computer assembly

3.2.10.1. Computer assembly

The computer is a single assembly that is panel mounted on a door that swings out for access. The below rear view of the computer assembly shows the power cable and interconnecting cables. The computer connects to the FTIR optics bench via the SBC computer, receiving its data constantly. Cables connect it to all the valve and relay circuit boards. The computer directly controls all I/O functions. A connector is provided for interface via TCP/IP to internal networks or external computers via the internet.

3.2.10.2. Touchscreen

The computer has an integral touchscreen on the front. This serves as the user interface at the ACM 150 monitor. A typical display is shown below. Remote users have the same display on their computers and use the mouse instead of touch.



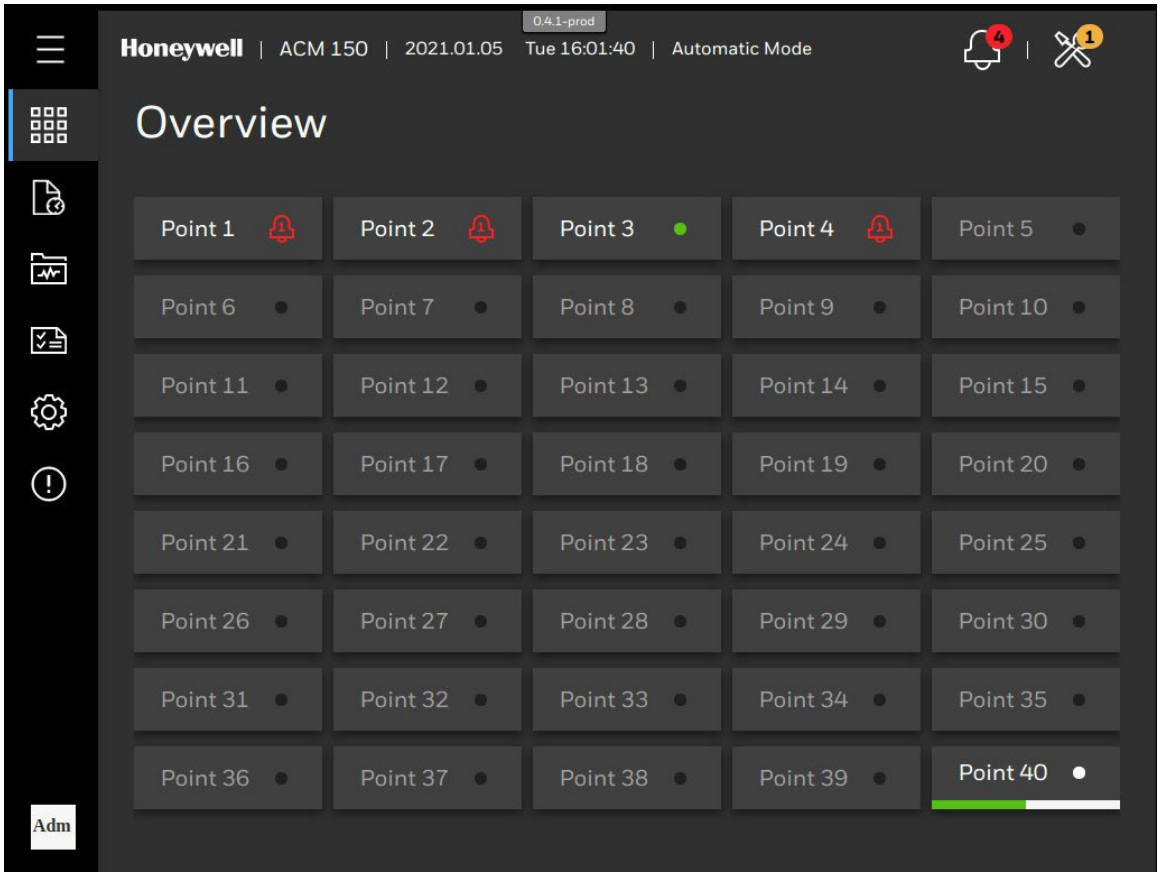


Figure 14. Touchscreen Overview and with Events

3.2.10.3. Keyboard

For the entry of alphanumeric characters, the ACM 150 monitor has a keyboard mounted on a slide out drawer below the computer assembly. Pull out the keyboard only when needed. Push the slide out drawer back in to eliminate the risk of injury caused by the protruding drawer.

3.2.11. Relay outputs

The ACM 150 monitor Relay Output Board is shown below. It has 86 relays. Relays #1 to #80 are arranged in 4 rows of 20 relays. These are the programmable relays. By default, they are preset to activate as follows:

Relay #1 to #40: Assigned in sequence to Areas #1 to #40. They are activated whenever any gas monitored at the specific Area (sample point) exceeds the Alarm 1 level set point.

Relay #41 to #80: Assigned in sequence to Areas #1 to #40. They are activated whenever any gas monitored at the specific Area exceeds the Alarm 2 set point.

The user has the option of reprogramming the function of each relay, changing the activation level, assigning specific gases and sample areas or groups of gases, and sample areas.

Relays #81 to #86 indicate the following:

- 81 Power fail
- 82 Watchdog timer
- 83 Manual mode
- 84 General malfunction
- 85 General alarm 1
- 86 General alarm 2

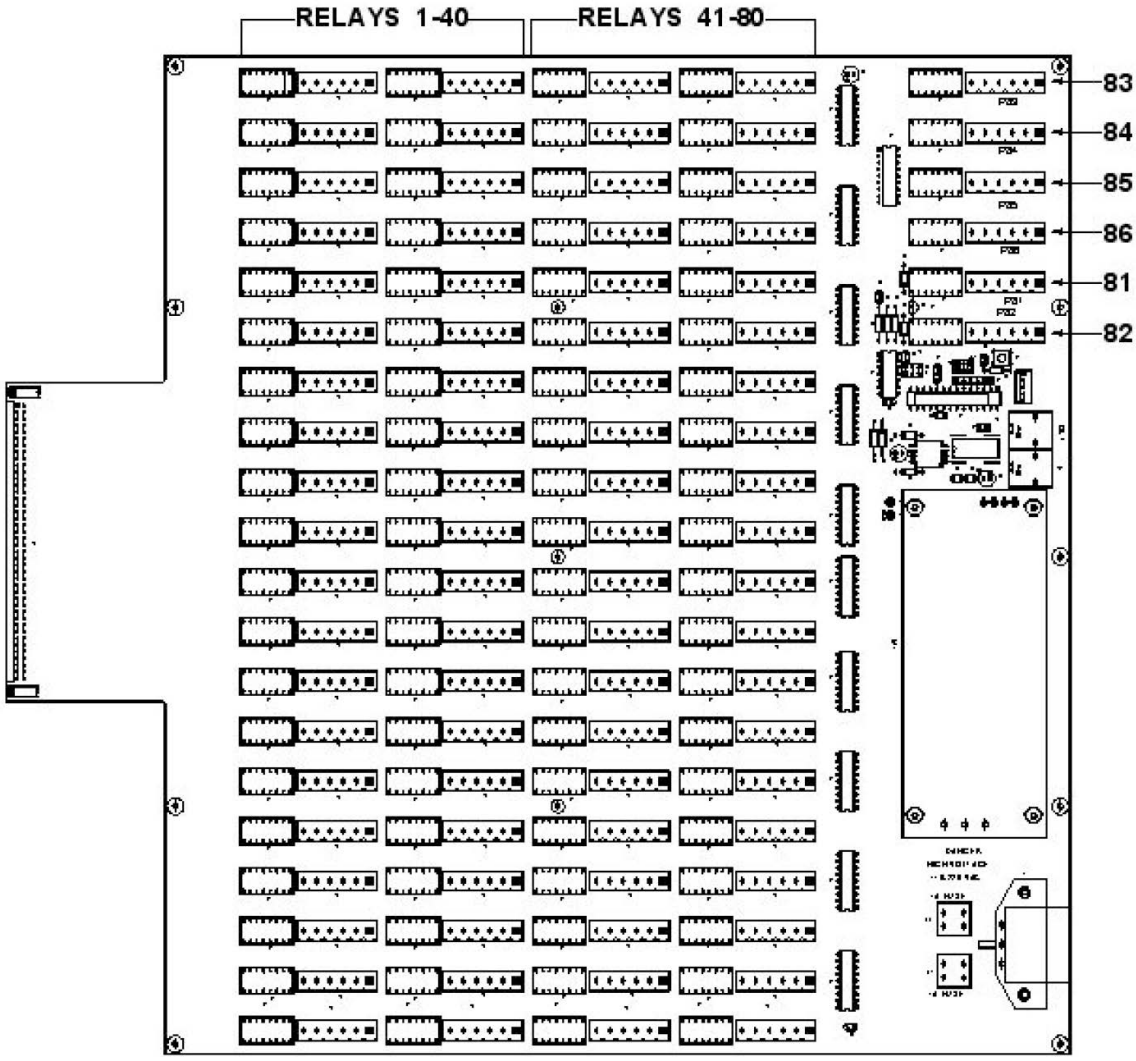


Figure 15. Relay Output Board

The output relays are provided for interface to PLCs, for direct activation or alarm devices and/or for direct initiation of automatic gas shutdown. They may also be wired to status panels. All relays are double-pole double-throw (DPDT) with dry contacts rated for maximum 30 VDC, 2 A.

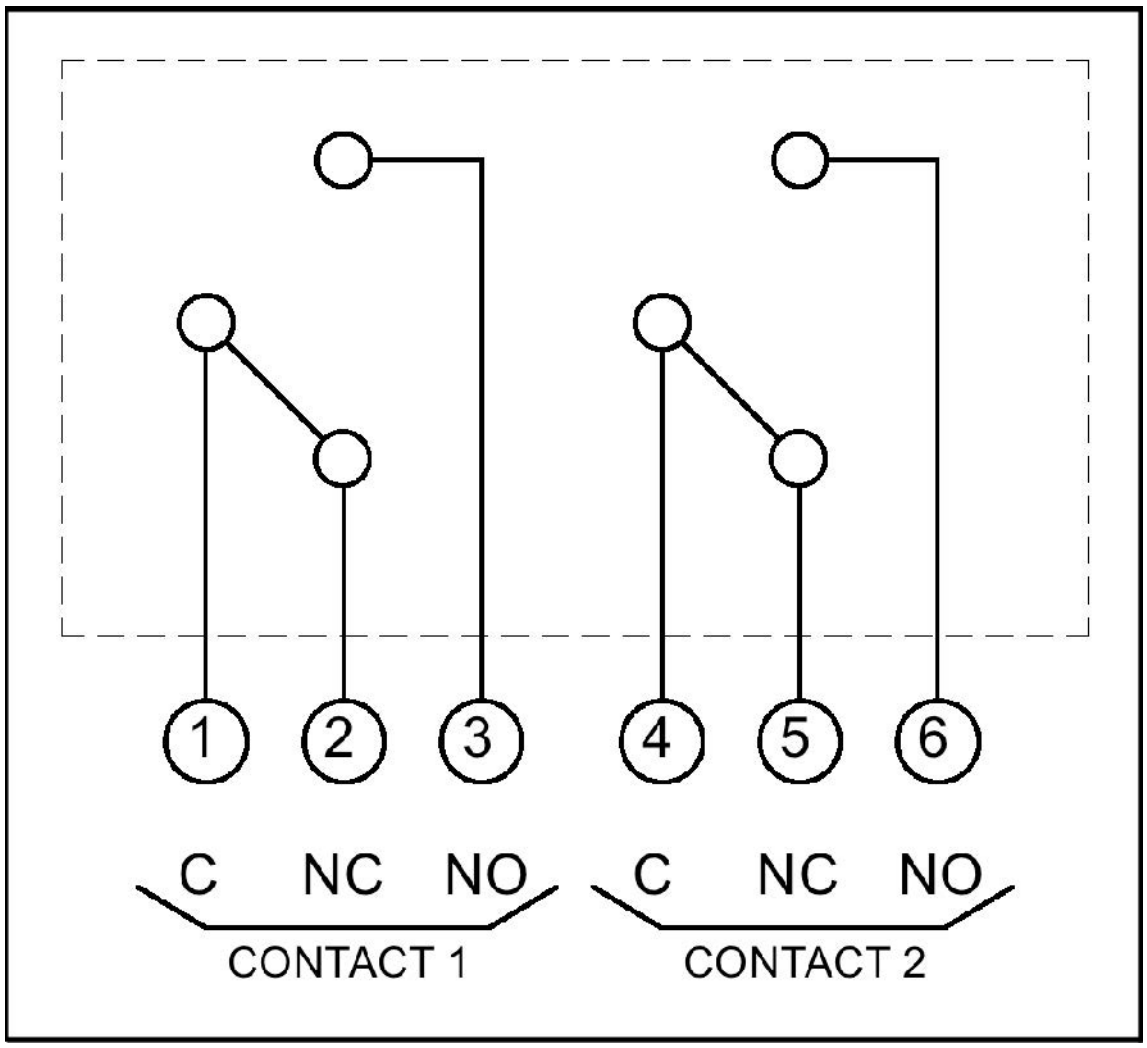


Figure 16. Relay Schematic

- Relay shown in normal position - (Deenergized with no alarm present).

This diagram is typical of all 86 relays. Relay number 81 (Power Fail) and relay number 82 (Watchdog) are inverted – power is always on and drops upon a trouble condition. Relay number 81 (Power Fail) and relay number 82 (Watchdog) are inverted – power is always on and drops upon a trouble condition.

- Relays number 1 to 80 are programmed by software, relays number 81 through 86 are fixed in function.
- Relays number 1 to 80 are programmed by software, relays number 81 through 86 are fixed in function.
- See Programming relays for additional information on programming.

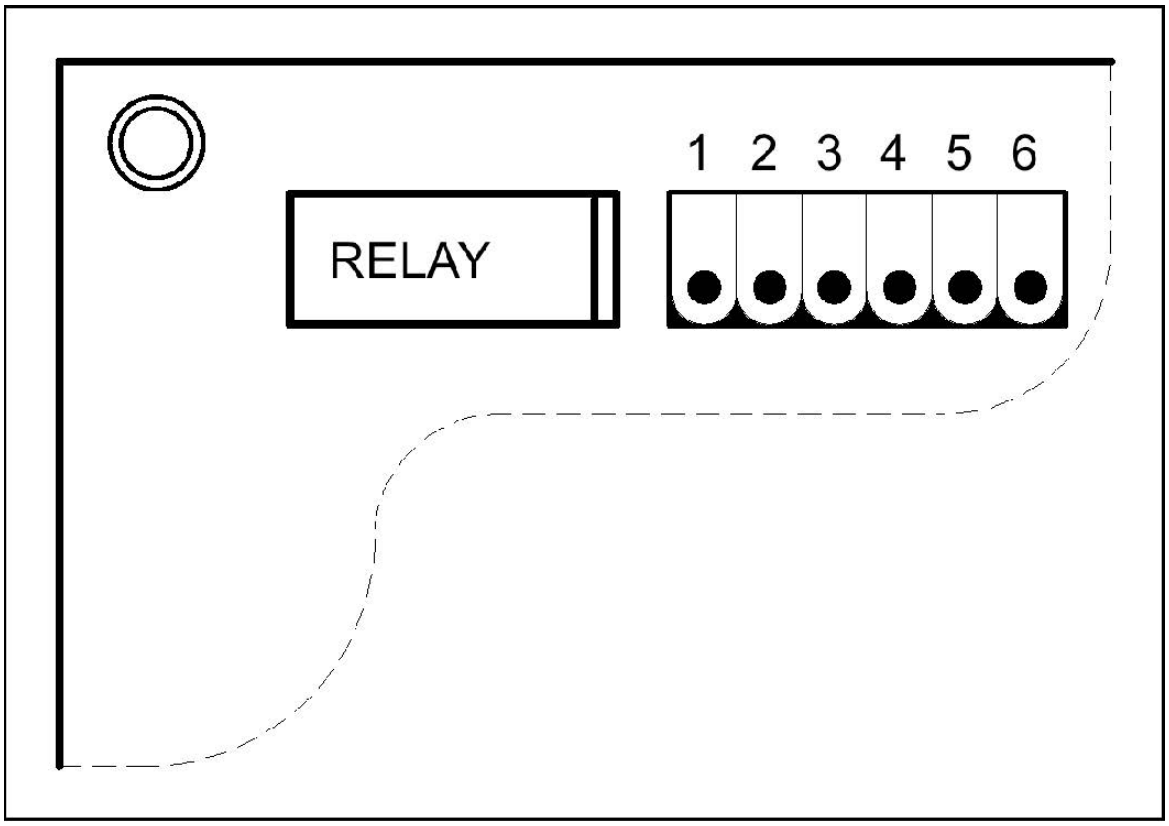


Figure 17. Typical Relay Layout

- Relay number 1 is shown.
- Typical of all 86 relays.
- See Figure 15 for layout and relay locations.

3.2.12. Relay output control panel

The Relay control panel provides both status and control. When the ACM 150 monitor activates a relay, the corresponding LED lights and remains lit until the condition clears or the relay is reset. The 80 alarm relays have a momentary test switch, which is active in the Front Panel Mode. Relays 82–86 can only be tested from the computer, in the Manual Mode. In other modes the switches are inactive.

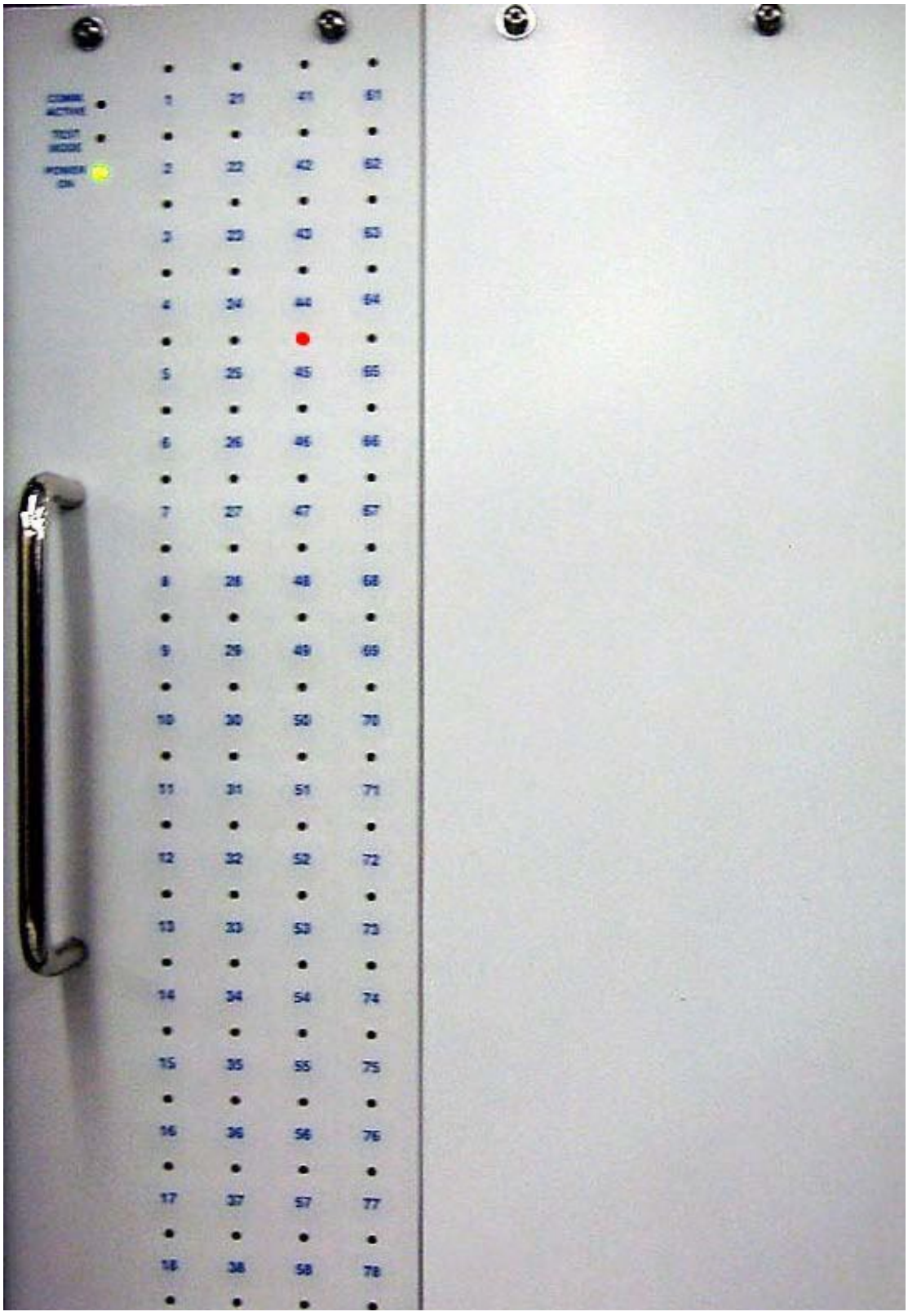


Figure 18. Relay Control Panel

The Control Panel Status LEDs for Power On, Manual Mode and Comm. Active have the same functions as the other control panels. Refer to Control panel status.

3.3. Electrical Layout

3.3.1. Power DISTRIBUTION PANEL

The AC line power from the main power switch wires into the power distribution panel, which is shown below. This panel provides grounded receptacles for power cords wired to the various subassemblies and mechanical pumps in the ACM 150 monitor. Each subassembly has its own DC power supply, if DC power is required. Power to any subassembly can be disconnected by unplugging it from the power distribution panel. The power distribution panel is divided into two fused circuits.

- One 120/230 VAC switched receptacle J20 for the Primary Pump. The power is normally on and is switched off when the vacuum falls below preset levels.
- One 120/230 VAC switched receptacle J21 for the Secondary Pump. The power is normally switched off and is switched on when the Primary Pump fails. A fault message is activated “ACTIVATING SECONDARY PUMP”.
- Twelve unswitched 120/230 VAC receptacles for all the powered subassemblies.

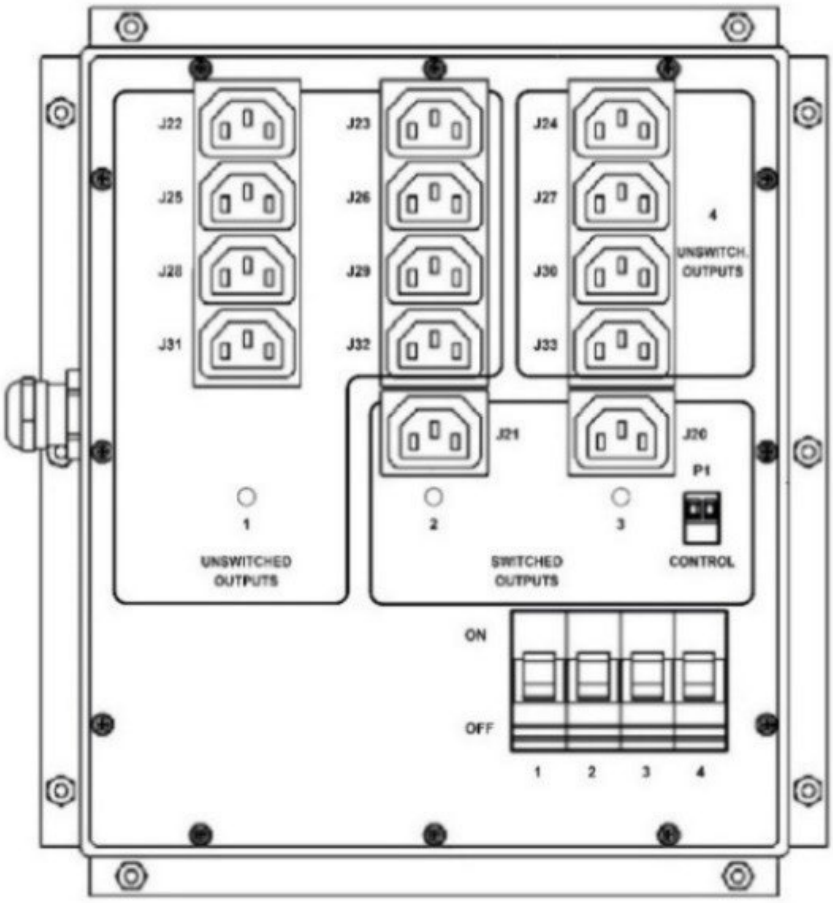


Figure 19. Power Distribution Panel

Un-switched outputs and plugs

	76-215-13480-01-E **(CB number)**	76-215-13480-01-F **(CB number)**
J22	Relay board (F1)	Relay board (F1)
J25	NOT USED (F1)	HMI PC and monitor (F1)
J28	Fans for low cabinet (F1)	Fans for low cabinet (F1)
J31	Sampling valve board (F1)	Sampling valve board (F1)
J23	Cycle valves board / SBC / FTIR Bench(F1)	Cycle valves board / SBC / FTIR Bench(F1)
J26	NOT USED (F1)	Ethernet switch (F1)
J29	Field Server – optional (F1)	Field Server – optional (F1)

	76-215-13480-01-E **(CB number)**	76-215-13480-01-F **(CB number)**
J32	Fans for top cabinet (F1)	Fans for top cabinet (F1)
J24	HMI PC and monitor (F1)	NOT USED (F4)
J27	Field Server – optional (F1)	NOT USED (F4)
J30	Ethernet switch (F1)	NOT USED (F4)
J33	Boost pump (F1)	Boost pump (F4)
J21	Secondary pump (F2)	Secondary pump (F2)
J20	Primary pump (F3)	Primary pump (F3)

Note: 76-215-13926-00-x for 115VA

3.3.2. Interconnecting cables

On request, Honeywell Analytic can provide a wiring diagram showing all the power cords and other interconnecting cables in the ACM 150 monitor and the connection points for each cable. Refer to this diagram to determine which cord to unplug when removing power from a specific pump or subassembly. Also, insert plugs into their receptacles as shown on the wiring diagram when power is restored to a pump or subassembly.

NOTE

A 24 vdc signal from the Sample Valve Control Panel goes to the Power Distribution Panel at P1. This controls the Secondary Pump, turning on the power when inadequate vacuum is sensed. To change back to the Primary Pump, switch the ACM 150 monitor from the automatic mode to the manual mode and back to automatic mode, using the Diagnostic menu.

3.4. Air sampling system

3.4.1. ACM 150 flow cycles

The ACM 150 monitor is designed to move air samples from one area to the next as quickly and efficiently as possible, while assuring that each sample is fresh and representative of the air at the sampled area when it is analyzed. The Cycle Valves are shown in Figure 9.

The ACM 150 monitor does this by sampling each area in four steps or flow cycles with the following valves opened:

- Evacuate: S1 and S6
- Surge: S2 and S6
- Fill: S2
- Analyze: S1

Table 1 shows the timing range for each flow cycle and the pressure or range of pressure in the gas cell during the cycle.

Evacuation cycle: The ACM 150 monitor starts each sampling cycle by switching the valves so that the Gas Cell Venturi Pump draws a vacuum on the gas cell. The inlet valve to the gas cell is shut off. This creates a large vacuum in the gas cell and efficiently removes the sample gas from the area just analyzed. While the gas cell is evacuated, the Boost Pump draws the sample air from the next area to be scanned, and its flow is diverted to bypass.

Surge cycle: The Gas Cell Venturi Pump continues to draw on the gas cell, but now the inlet valve to the gas cell is opened. This allows a surge of new sample from the Boost Pump into the gas cell. This replaces sample from the last area scanned with fresh sample from the current area.

Fill cycle: The valve to the Gas Cell Venturi Pump is shut and the gas cell fills with the new air sample until it reaches atmospheric pressure. The gas cell can equilibrate to atmospheric pressure before analysis begins. The calibrations for the measured components, used to develop the analytical methods, are all done at atmospheric pressure. If the analysis were not done at atmospheric pressure, the results would not be accurate.

Analyze cycle: The valves on the inlet and outlet of the gas cell are closed. The FTIR analyzer collects the infrared spectrum of the current air sample and sends it to the computer, where the data is extracted from the spectrum and reported as gas concentrations.

This sequence is automatically repeated for each area sampled on a continuous 24 hours cycle. It is only interrupted by Background scans or when the ACM 150 monitor is no longer in automatic mode.

3.4.2. Bypass and order of scan

When the air sample from an area is being analyzed by the ACM 150 monitor, the corresponding sample area number and name are displayed in the status bar on the touchscreen.

As soon as the Analyze cycle begins, the sample valve for the next area in the scan sequence opens. The Boost Pump draws the sample from that next area and bypasses it to exhaust (S1 opens). The purpose is to ensure that the internal tubing has been thoroughly purged of the last sample and replaced with a fresh sample.

As the ACM 150 monitor samples and analyzes areas, another bypass flow continues for all areas not currently sampled. This flow is drawn through the Sample Valves by the Bypass Venturi Pump. The flow rate is controlled and balanced by a flow control orifice located in each Sample Valve. This assures a continuous flow through all the sample tubes to maintain fresh, representative samples of air.

The user may program the sample Areas to be analyzed in any order, and even have some of the Areas analyzed more than once per complete scan cycle. This is determined by the Order of Scan. Some areas may also be scanned in groups, known as Composite Sample Groups. This is done to accelerate the scan cycle. Refer to Settings Menu for more information.

3.4.3. Background cycle

In order to sustain a permanent calibration for all monitored chemicals, it is necessary to periodically establish a baseline reference for the infrared spectrum. This is done by taking a Background or reference spectrum. This spectrum must not contain any of the measured chemicals. In fact, it should be free of infrared absorbing gases to the extent that it is practical. For that reason, background gas is nitrogen.

Once the Background spectrum is taken, the spectra collected for each analysis (the "scans") are compared to the latest Background. If the air samples were the same as the Background gas, the result would be a flat baseline along the x-axis
of the ratioed spectrum. But the gases are never the same, because the air samples always contain some infrared absorbing gases, such as water vapor and carbon dioxide. The water vapor in the air will always be higher than the water vapor in the Background gas (it must be for the analysis methods to work properly). The peaks in the analysis spectrum contain the absorbance peaks of the chemicals present in the air sample. This includes the normal gases in the air, any measured chemicals which are currently present in the air sample and any other chemicals that exist in that air sample ("chemical strangers" with unknown odors, etc.). The analysis spectrum compared to the Background spectrum results in the absorption "fingerprint" of all chemicals present in the air samples. This is the spectrum used for analysis by the analytical methods.

3.4.4. Valve switching and timing

ACM 150 flow cycles identifies the valves energized during each cycle. The flow schematic for these valves, including Sample Valves 1-10 and Sample Valves 11- 20, 21-30 and 31-40 may be obtained on request. All valves are shown in the de- energized state. For 3-way valves, the de-energized state is C—common to NO— normally open, which changes to C—common to NC—normally closed when the valve is energized. The 2-way valves are normally closed and energized to open.

The typical timing and pressure readings for the various modes of operation with the 5-meter gas cell are:

Table 1: Cycle Timing and Readings

MODE OF OPERATION	TIME IN SECONDS	GAUGE READING
Evacuate	1-2	20-30 vacuum
Surge	3-4	5-15 vacuum
Fill	0.5 to 1	increases to 0
Analyze/Bypass	6-8	stays at 0
Background	30-60	
(once every 2 hours)	stays at 0 or slightly positive	
Background	30-60	stays at 0

If you observe the Cycle Valve Control Panel, you can follow the modes for each area scan. You can also observe this on the local or remote computer screen by selecting View Cycle Valves.

The timing is set by the Honeywell Analytics service engineer in the configuration software. These times may be increased or decreased to get good sampling and analysis results in the minimum amount of time. Both the timing and the frequency of the Background mode may also be changed in the configuration software.

3.4.5. CDA panel

The panel shown below sets and controls the pressure of clean/dry air (CDA). It splits to two air set regulators, one for the Venturi Pump air supply and one for Line Leak Test.

Solenoid valve S9 is normally opened to supply air to drive the two Venturi Pumps. It shuts off automatically when the Backup Exhaust Pump takes over and is manually reset to open. The venturi regulator is set to 75-80 psig. If the Venturi option is used, the line leak regulator is set to approximately 15 psig when the test is active. The needle valve provides a flow restriction so that each line decreases approximately to 0 psig and increases for each tested line as it holds the pressure, as indicated on the gauge. S10 is closed except during the test mode, when it remains open.

Figure 20. CDA Panel

1. Line Leak to Sample Rail
2. Line Leak Gauge
3. Line Leak Needle Valve
4. CDA In
5. To Venturi Pumps
6. Line Leak and Venturi Regulators/Gauges
7. Isolation Valve S9 / Solenoid Valve S10 / Solenoid Valve

Figure 21. Venturi Supply (Option)

3.4.6. Other sampling components

3.4.6.1. *Filter*

A polypropylene filter is installed on the outlet of the Booster pump failure detection. It helps keep the gas cell clean by removing particulates down to 0.1 microns.

3.4.6.2. *Gas cell pressure gauge*

A gauge mounted onto the top of gas cell indicates vacuum to positive pressure, calibrated in inches of Hg (mercury). This gauge can confirm the Sample Pressure scale on the Cycle Valve Control Panel, Figure 10.

3.4.6.3. *Absolute pressure transducers*

The pressure scales on the Sample Valve and Cycle Valve Control Panels are the outputs of absolute pressure transducers. They measure both sample and bypass pressures. The computer uses these readings for multiple purposes:

- Identify a plugged sample line or an internal flow restriction
- Determine when the Backup Exhaust Pump is needed
- Optional Line Leak Test pass or fail

3.4.6.4. *In-line sample filters*

HA supplies the initial set of inline filters, one for each sample port on the ACM 150 monitor (from 10 to 40). The filters are installed near the sample inlet. They prevent a build-up of particulates in the tubes and protect the flow control orifices in the Sample Valves. The valves can become plugged and flow can be restricted if particulates are not filtered.

NOTE

An inline filter must be installed on every uncapped sample port to protect it, even if the filter is locally mounted at the inlet tie point on top of the ACM 150 monitor. Checking and replacing filters is required during periodic service.

3.5. Optional capabilities

The following options can be included with or added to any ACM 150.

3.5.1. Sample points

The ACM 150 monitor can be purchased with 10, 20, 30, or 40 sample points. There is a maximum of 40 sample points.

3.5.2. Automatic line leak test

Sample tube integrity must be confirmed whenever a new tube is installed. A leak test can be done using compressed air. Honeywell Analytics recommends using a test gas to confirm that the tube is connected to the correct port and that it is not diluted by outside air leaking in. After tubes are installed and tested, it is still possible to develop a leak in one of the sample tubes connecting the ACM 150 monitor to a sample point. Tube leaks can develop for various reasons, such as:

- disconnected at the sample point or at the monitor and not reconnected
- disconnected and reconnected but not properly seated or tightened
- accidentally cut by a contractor working in the facility

The automatic Line Leak Test is built into all ACM 150s; however, it may be turned on or off in the configuration by Honeywell Analytics. For every sample line in use, the test requires a check valve installed near the sample tube inlets, which is shown in the flow schematic that's available on request. The check valve passes flow in one direction only. It stops the flow of CDA coming from the ACM 150 monitor during the line leak test. This allows the entire sample tube to be pressurized. To eliminate particulates, an in-line filter is installed between the check valve and the inlet of each sample tube.

These check valves are available from Honeywell Analytics. They are SS check valves with 3/8-inch tube fittings and a cracking pressure of 1/3 psi.

If employed, automatic line leak is activated once a day at any time. CDA is directed down each sample tube, one at a time. If the tube holds pressure, it passes the test. If a tube fails to hold pressure, it fails the test and the ACM 150 monitor displays a malfunction message on the touchscreen.

3.6. ACM 150 Operating Principle

3.6.1. Basic operation

The ACM 150 monitor can provide qualitative identification and quantitative analysis of the chemicals in their gaseous state. Each time the ACM 150 monitor scans an air sample, it collects multiple spectra of that sample, typically 4 or 2. The FTIR spectrometer takes about 1.2 seconds to collect a single scan. The spectra collected for each air sample are averaged, and the resulting spectrum is what the ACM 150 monitor uses to analyze the air sample.

Except for the few chemicals that do not absorb infrared radiation, the vapor phase of every chemical has a unique absorbance spectrum. An absorbance spectrum is a plot of absorbance on the y-axis and wavenumber on the x-axis. Wavenumbers are expressed as cm^{-1} because the wavenumber is the inverse of wavelength in centimeters. These spectra cover what is known as the mid-infrared or fingerprint region of the infrared spectrum.

The air sample spectra collected by the ACM 150 monitor contains all the identifying absorption peaks of the gases that make up that air sample. However, the ACM 150 monitor will only report the gases that are set up as active for that sample area.

3.6.2. Wavenumber precision

The wavelength location of any chemical's absorbance peaks is fundamental and never changes, being fixed by the quantum mechanics of the molecule. The FTIR analyzer can reproduce the exact wavenumber location for each gas.

3.6.3. Absorbance and gas concentration

Absorbance is the extent to which the intensity of a beam of infrared radiation is decreased on passing through a sample of air in the ACM 150 monitor's gas cell. Transmittance is an expression of the intensity (or "radiant power") of the beam of infrared radiation passing through the same sample of air. If no gases are present at a given wavenumber, the transmittance is 1.0 or 100% and the absorbance is 0. The relationship between absorbance (A) and transmittance (T) is expressed as: A = - log T Absorbance, as defined by the Beer-Lambert Law, is directly proportional to the concentration of the absorbing chemical (provided other key variables are held constant), while transmittance is not directly proportional. Therefore, absorbance is used as a basis of measuring the concentration of gases present in the ACM 150 monitor's air samples. Variables other than concentration that effect absorbanceare:

- Path length of the sample cell
- Resolution of the FTIR analyzer
- Temperature and pressure of the sample
- Non-linearity of the direct proportional relationship
- Characteristics of a particular FTIR analyzer and gas cell

3.6.4. Permanent calibration

3.6.4.1. Controlling variables

The ACM 150 monitor eliminates or minimizes these variables so that their effects on calculating the concentration are insignificant, in the following manner:

- The path length is fixed, e.g. at 10 M or 5 M. All reference calibrations and analyses are adjusted in your ACM 150.
- The resolution of the FTIR analyzer is set at 4 wavenumbers and all reference calibrations and analyses use the same 4 wavenumber resolution. The FTIR analyzer resolution can be changed, but it will cause error messages if operated at a resolution other than 4 wavenumbers.
- Temperature and barometric pressure changes have a small effect on the gas concentration and may ignored without affecting accuracy of the ACM 150 monitor. In this installation, the temperature should be nearly constant in an indoor office-type facility. A cell heater should be added if there is a wide
fluctuation. The potential effect of changes in the absolute “gauge” pressure of
the sampled air is greater than temperature changes.

All reference calibration spectra are collected at 0 psig or 14.7 psia (1.0 atmospheric pressure). The ACM 150 monitor uses an absolute pressure transducer to assure that all analyses are done at 0 psig (14.7 psia).

- The relationship between concentration and absorbance becomes increasingly non-linear as the concentration increases and approaches saturation (which is 0% transmittance).
- As the concentration increases from, for example, 300 ppm to 1000 ppm the non-linearity increases and the accuracy of the reading decreases. The non-linearity varies for each chemical, for each absorbance wavelength and with cell path length. For the weakest IR absorbing chemicals and long cell path lengths, the non-linearity may be insignificant over the range of 0-1000 ppm. For the strongest IR absorbing chemicals, readings over 100 ppm may be significantly non-linear and less accurate.

3.6.4.2. Use of the background spectrum

It is critical that calibrations taken on one ACM 150 are valid for computing accurate concentrations on any other ACM 150. In that way, calibration spectra are valid for all ACM 150s and older models as well. This is accomplished by using a reference (or background) spectrum to which each analysis spectrum is ratioed. In the ACM 150 monitor a reference spectrum is collected every 2 hours while the gas cell is filled with nitrogen that is void of any monitored gases. For the next two hours each air spectrum collected is ratioed to the latest reference spectrum. If the gas composition of the air were identical to the background, the result would be a flat line on the x-axis. All variables that effect the spectrum are cancelled in this manner, because each air spectrum has same characteristics as the reference spectrum.

This cancels the effects of drift of the FTIR detector, IR source intensity changes, reduction of IR radiation in the gas cell as particles accumulate, etc. Each of these variables change slowly and has no effect on the accuracy of the measurement over a two-hour period. This has been verified over years of application experience.

With “instrument error” cancelled by the background reference, the only factor effecting the amount of absorbance at any wavenumber is the concentration of the vapor phase chemical that absorbs at that wavenumber. If no gas is present, the absorbance will be 0, i.e. a flat line on the x-axis. If the gas is present, it will absorb in direct proportion to its concentration.

The units of absorbance (A) are divided into milliabsorbance (mA) units, where 1000 mA = 1.0 A. When we calibrate for a chemical and collect that calibration spectrum, we are determining the number of milliabsorbance units per ppm of gas concentration for each wavenumber region where that chemical absorbs IR radiation. Or, if the ACM 150 monitor has a 10 cm cell for % LEL/LFL ranges, the relation may be expressed as milliabsorbance units per % concentration.

3.6.5. Analytical methods

3.6.5.1. Methods development

A method is a combination of individual calibration spectra for a group of chemicals. When we develop a method, we pre-select the absorbance peak regions that will be used to first identify and then quantify each chemical. A few chemicals have only one usable absorption peak, while many have six or more usable peaks. The average is three usable peaks for qualitative screening and for quantitative analysis.

For each absorbance peak region of each monitored chemical in a method, the relationship between milliabsorbance units and concentration (usually in ppm) is entered into a p-matrix that is used to compute the concentration of each gas in all new and unknown air spectra collected by the ACM 150 monitor.

Sometimes chemicals within the same method have absorbance peaks that overlap in the common peak regions. In the simplest expression of the Beer-Lambert Law, the resulting absorbance peak is the sum of absorbances of the over-lapping
peaks from each chemical. The matrix uses more calibration data sets from other wavelength regions to improve on this computation.

The computation accuracy is further improved using advanced data fitting statistical techniques, known by the broader term of Chemometrics. The technique of PLS (partial least squares) is employed in the ACM 150 monitor to fit a data set from the unknown air spectra to the “training” set in the method.

The relationship between the various peak heights in milliabsorbance units and the ppm concentration is determined and becomes the basis for quantitative identification of unknown air spectra.

To confirm that the methods correctly identify and accurately measure the concentrations of their chemicals, the methods are tested using calibration spectra. This simulates the analysis of unknown air samples using the methods developed to measure the chemicals of interest.

It proves that the methods correctly identify and measure all those chemicals, and it is a valid test of the calibration accuracy.

Of special interest is the ability of the ACM 150 monitor to identify and measure these chemicals at the alarm set points. Since the reference calibration spectra were not collected with these set points in mind, the concentrations are not the same. Nevertheless, the magnitude of the absorption is directly proportional to the chemical concentration, and the wavenumber region of every absorption peak is fixed. Therefore, spectra of the chemicals at any level of milliabsorbance units, including the set point level, will be read accurately. This can be confirmed by introducing any chemical at or near the set point level in your ACM 150.

3.6.5.2. Your Methods - Chemicals Monitored by Your ACM 150

The ACM 150 monitors the air samples for the presence of gases and the vapors of liquid chemicals. It will monitor only those chemicals for which it has been configured. The ACM 150 monitor is always provided with at least one analytical
methods, although several analytical methods may be used. These are the chemicals that were requested by the user and then grouped by a Honeywell Analytics application chemist into methods or groups of chemicals.

The method is identified with a customer code at the beginning followed by the method number. Each time it is revised to add or delete gases the method number is changed.

The user can assign any of these methods to a particular sample area. Once a method (group of chemicals) is selected for a sample area, the user must then decide which of the chemicals contained in the method may be present at the sample area. Those chemicals are selected as active.

The ACM 150 monitor will then monitor each sample areas for the all the chemicals set active for that sample area. Chemicals designated inactive are not reported by the ACM 150 monitor.

3.6.6. ZPD Values (ZPD Energy and ZPD Position)

The ZPD, Zero Path Difference, is a signal that is produced by the FTIR analyzer. The ZPD energy and ZPD position are performance indicators which are always monitored by the ACMs computer.

ICON KEY
 Authorized Users
 Trained Technician

4. Installation environment

4.1. Space requirement

No access is required from the rear or from either side. The ACM 150 monitor may be against a wall or set back-to-back with another monitor. Allow a space of 3 inches (8 cm) behind the rear for air circulation. Front access is required. Leave a clear space of 36 inches (91 cm) in front of the cabinet door.

The approximate overall dimensions of the cabinet are:

- Height: 60 inches (152 cm)
- Width: 40 inches (102 cm)
- Depth: 26 inches (66 cm)
- Weight: 800 pounds (363 kg)

4.1.1. Temperature and protection

Install indoors in a heated and air-conditioned environment. The recommended temperature range is 41 to 86°F (5 to 30 °C). The standard cabinet is designed to meet an IP 20 rating.

4.1.2. Electrical area

The ACM 150 monitor is designed to be in a non-hazardous or general-purpose electrical area.

Refer to Technical Specifications on Appendix E.

4.2. Utility requirements

The ACM 150 monitor requires the following utilities:

- Line power: 115V 60Hz 13 Amps or 230V 50Hz 6 Amps (setup at factory)
- Normal idle power consumption: ~8 amps @ 115 VAC
- Average power consumption: ~14 amps @ 115 VAC
- Peak power consumption: ~20 amps @ 115 VAC
- Clean, Dry Air (CDA): 90 psig, 12 SCFM, 3/8-inch OD tube
- Nitrogen: 5 psig, ~8 liters/minute, 1/4-inch OD tube
- Exhaust: 15 cfm, 1-1/2-inch OD tube
- Main supply voltage: ±10% of nominal voltage
- Overvoltage: Category II

4.3. Vacuum sampling system

The ACM 150 monitor samples up to 40 areas, which are scanned and analyzed in sequence, as described in Air sampling system. The main assemblies are:

Bypass Venturi Pump	Draws flow through sample tubes and bypasses the flow to exhaust to provide a constant flow of fresh sample to the monitor
Gas Cell Venturi Pump	Evacuates the sampled air from the gas cell after it is analyzed
Boost Pump (mechanical)	Fills the evacuated gas cell with fresh sampled air for each analysis cycle
Sample Valve Assembly	Valves installed in the 10-port sample manifolds (up to 40) that switch in sequence as the ACM 150 monitor scans the sample
Cycle Valve Assembly	Group of 6 valves that control the flow through the gas cell
Backup Exhaust Pump	Normally idle, this mechanical pump backs up the venturi pumps to provide operation in the absence of CDA

4.4. Available outputs

The following output relays are dry contact, double-pole/double-throw (DPDT), rated for 3 amps @ 30 VDC.

Programmable Output Relays (80)	Default programmable relay settings • Alarm 1 level set point for areas 1-40 • Alarm 2 level set point for areas 41-80 The default settings for each relay may be changed by the user to activate • At the Alarm 1 or Alarm 2 level • For any gas, for all gases or any selected group of gases • At any area, all areas or any selected group of areas
Additional Output Relays (6)	• Power fail • Watchdog timer • Manual Mode • General malfunction • General warning • General alarm

4.5. Data interface and protocol

Network	Ethernet
Protocols	TCP/IP webserver

Other communication networks are available. Contact Honeywell Analytics for more information.

ICON KEY
Authorized Users
Trained Technician

5. Installation

5.1. Receipt and unpacking

ACM 150 systems and parts may be shipped in one or more containers. Each packing slip indicates the number of crates. Report any signs of rough handling or damage during shipment to the transportation carrier. Inspect all equipment and/or parts after removal from shipping containers.

NOTE

Report any broken, damaged, or missing parts immediately to Honeywell Analytics or your local Honeywell Analytics representative.

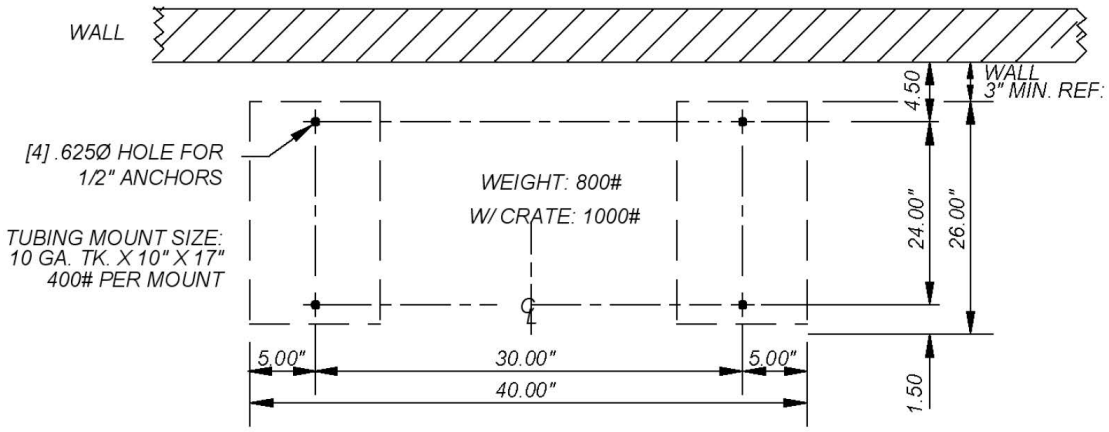


Figure 22. Floor Mounting Locations

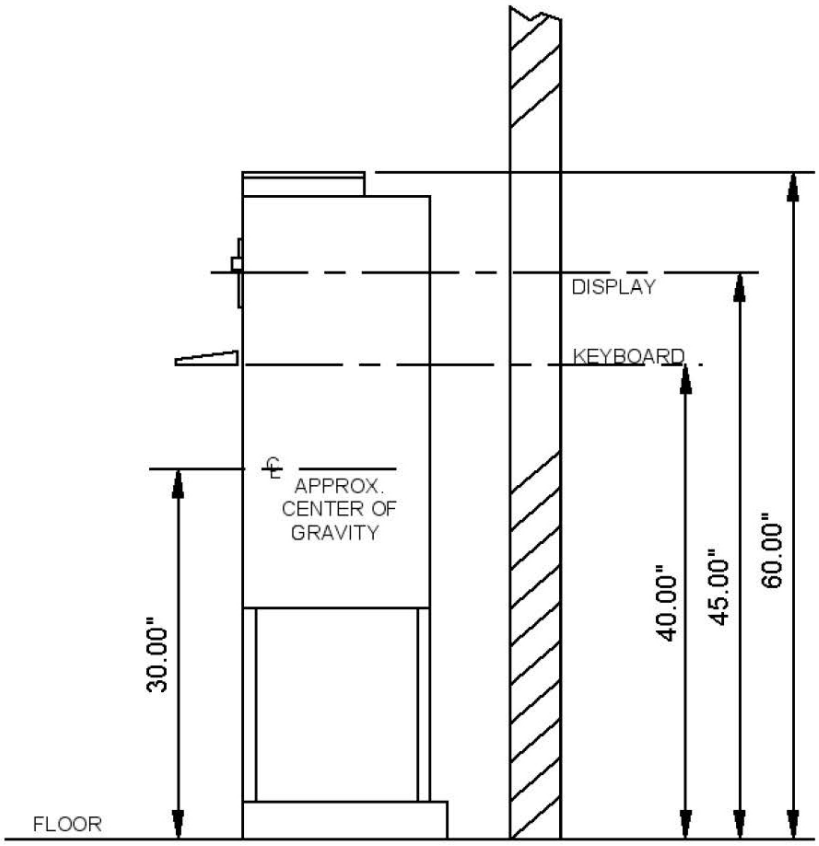


Figure 23. Ergonomic

5.2. Electrical power

5.2.1. Line power, 120 / 240 Volts AC

The ACM 150 operates on 120 V/60 Hz (240 V/50 Hz) single phase power. The peak starting load current does not exceed 20 amps. The average load is ~14 amps with the Backup Exhaust Pump running and ~ 8 amps idle load when it is not in use. The main power switch is not an interrupting circuit breaker. The user must install an external circuit breaker for the power supply line to the ACM 150. It should be dedicated and rated for 20 amps at 120 VAC with a minimum of 10,000 AIC (amperes interrupting capacity). Honeywell does not provide an external circuit breaker. The Main Power Switch is located on top of the ACM 150. Remove the cover and hard-wire the line power from the external breaker/switch to the terminal strip inside using enclosed wire conduit.

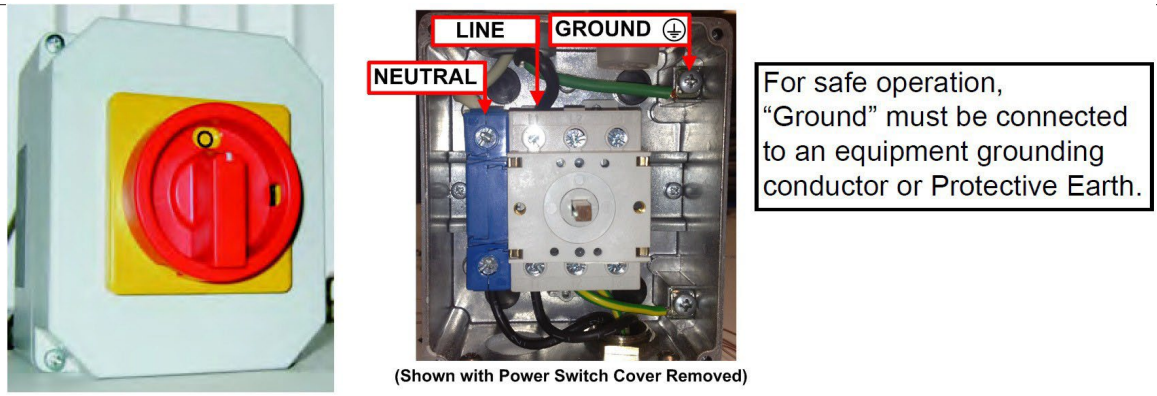


Figure 24. Main Power Switch and Supply Connections

NOTE

For safe operation, Ground must be connected to an equipment grounding conductor or Protective Earth.

DANGER!

Electrocution danger. Before removing the Main Power Switch cover or connecting line power, verify that the external AC supply power is disconnected at the source in accordance with your company's Lockout/Tagout procedures.

5.2.2. Emergency Power-Off (EPO) option

Some facilities require that equipment, like the ACM 150 monitor, have an EPO (or panic) switch. The user can add an EPO switch between the external breaker/switch and the Main Power Switch.

NOTE

The ACM 150 monitor is a life-safety monitor that is intended to operate under virtually all conditions. An EPO switch is not generally recommended, because unauthorized personnel might push it and take the ACM 150 monitor off-line when it should be on-line.

In the Off position the Main Power Switch disconnects AC line power from all internal parts and assemblies.

5.2.3. Lockout/Tagout (LOTO) disconnect

5.2.3.1. Integral LOTO

CE safety standards require the AC power line to be hard-wired inside conduit through a Lockout/Tagout disconnect. The Main Power Switch, Figure 24, provides this LOTO disconnect. A key lock may be added when it is switched to the Off position.

5.2.3.2. External LOTO

An external LOTO power disconnect is necessary only when the power terminal strip located inside the Main Power Switch is accessed. The appropriate LOTO method depends on the AC wiring option that is used. Follow your company procedures or, if none are established, follow these recommendations for circuit breaker or fused disconnect box: turn the power off at the box, and then close it and lock it, typically using a padlock.

5.2.4. International line power

The ACM 150 monitor will operate at either 50 Hz or 60 Hz, single phase power. If your line power is not within the range of 110-115 VAC, advise Honeywell Analytics prior to placing an order. The ACM 150 monitor can be set up at the factory to operate on AC power in the range of 200-230 volts AC. Appropriate sizing of the external circuit breaker is the user's responsibility.

5.2.5. Isolation transformer

The ACM 150 monitor is internally protected against voltage spikes and power fluctuations. If your line power quality is poor and/or subject to severe spikes or lightning strikes, an external isolation transformer (2.0 KVA) should be installed to protect the monitor. This is unnecessary if the ACM 150 monitor connects to a UPS.

5.2.6. Maintaining AC power

Most users want the ACM 150 monitor to continue to operate when line power is interrupted. The monitor may be wired to either a UPS, Uninterruptable Power Supply, or to an Emergency Power source.

5.3. Utility gases and exhaust piping

5.3.1. Nitrogen supply

The ACM 150 monitor requires a constant supply of nitrogen, which is used as a dry purge gas for the optics bench and as a zero gas for the Background cycle. The requirements are:

Source	plant bulk nitrogen supply or N_2 cylinders
Quality	99.9% or better
External Pressure Regulator/Shut-off	located near the ACM 150 monitor (by installation
Delivery Pressure	set external regulator to 5 psig (0.35 kg/
Connection	¼-inch tube fitting (per Figure 25)
Consumption	less than 8 liters/minute,

5.3.2. Air supply

Compressed air is required to operate the venturi pumps. It is also used for the optional Line Leak Test:

Source	clean, dry compressed air (CDA) or instrument-grade
External Pressure Regulator/Shut-off	locate near the ACM 150 monitor (by installation contractor)
Quality	filtered and oil-free with a dew point of -20°F (-
Pressure	75-80 psig. set on the internal regulator (included)
Connection	3/8-inch tube fitting (per Figure 25)
Consumption	venturi pumps 12 scfm (340 lpm)

CAUTION!

High pressure air is used inside the venturi pumps and can be hazardous. Shut off the air supply and verify that no stored pressure is present before servicing the venturi pumps.

5.3.3. Exhaust

The ACM 150 monitor exhausts the air it samples through an exhaust pipe located on the top. Connect this to an exhaust duct with no flow restriction that is compatible with the types of gases monitored by the ACM 150 monitor. The requirements are:

Flow Rate	12 scfm (340 lpm)
Connection	1 to 1/2-inch male pipe thread (per Figure 25)

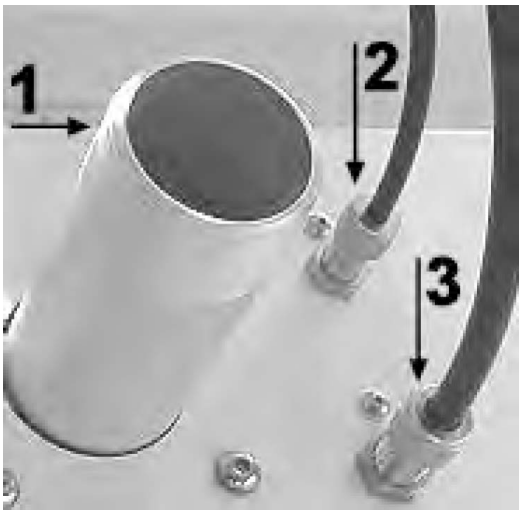


Figure 25. Nitrogen, CDA, and Exhaust Connections

1. Exhaust Pipe
2. Nitrogen
3. Air (CDA)

NOTE

Vent the monitor's exhaust properly in accordance with site or legislated safety policies governing the gases being monitored, workplace safety, and environmental requirements

5.4. Sample tubing and filters

5.4.1. Tubing material

Tubing is used to connect the ACM 150 monitor to the monitored sample points. The requirements for tubing are:

Size	3/8-inch O.D. by 1/4-inch I.D.
Recommended Material	PFE Teflon, 500-foot rolls
Alternate Material	Polypropylene, such as Parker PP- 64 (500-foot roll) or equal quality. Polypropylene is acceptable for most gases that are not reactive
Unacceptable Tubing **NOTE** If metal tubing is required by fire code, use 316 SS tubing or run Teflon or polypropylene in metal conduit. Before using SS tubing, consult with Honeywell Analytics about material	• all other plastics • all other metals • tubing with a smaller OD than 3/8 inch • thin wall tubing that can kink when bent

CAUTION!

Tygon, polyethylene, copper and aluminum absorb or react with many gases. Use only the materials listed above. Make no substitutions.

5.4.2. Tubing run lengths

The ACM 150 monitor should be located near the areas it samples to minimize tube lengths and response time. The maximum distance for tubing is 750 feet (230 meters) or 500 feet (150 meters) when composite sampling mode is used. Prevent leaks in sample tubes by making continuous runs with no fittings or unions, if possible. Discard short lengths that are left over instead of joining them to make longer runs.

5.4.3. ACM 150 tube connection points

Each sample tube is connected to an inlet on top of the ACM 150 monitor using 3/8-inch Swagelok tube fittings. The inlet fittings are numbered from 1 to 40, as shown in Figure 26.

5.4.4. Sample area connections

NOTE

The buyer is responsible for deciding which areas and gases to monitor and the exact location of the sampling points in gas cabinets, storage rooms, valve boxes, exhaust ducts, exhaust hoods, breathing zones, etc. Honeywell Analytics does not determine and cannot advise the exact point to sample for hazardous gases. The buyer, the equipment manufacturer or a third-party consultant must make such decisions.

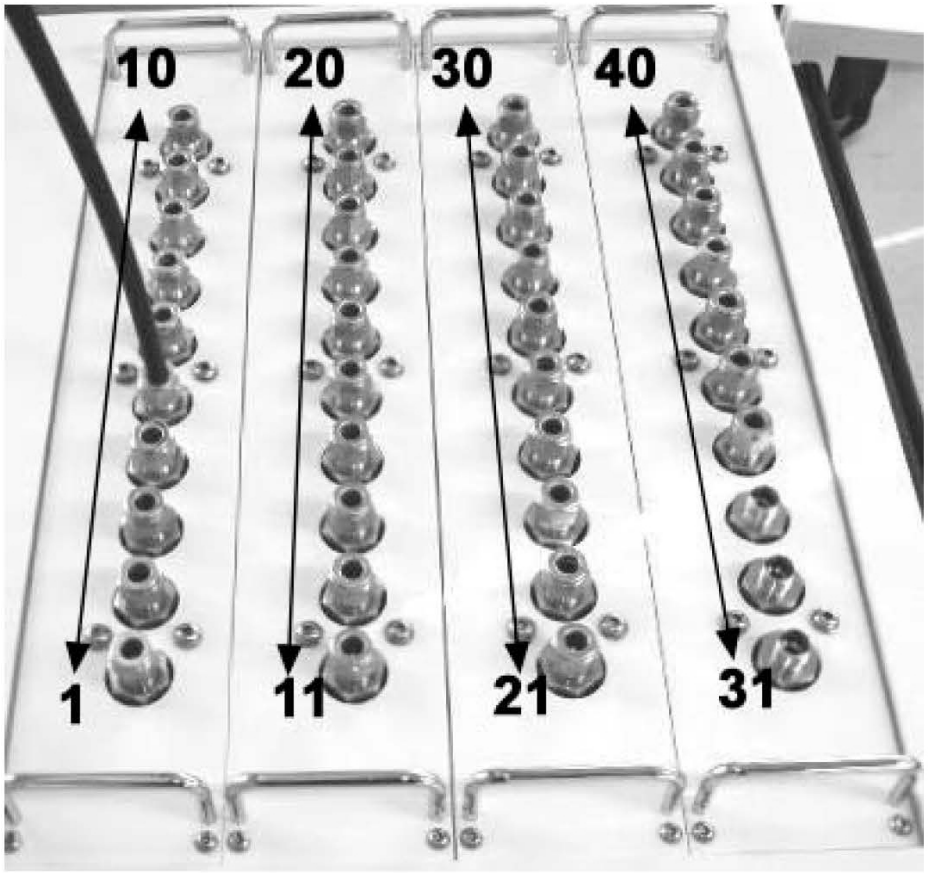


Figure 26. ACM 150 Tube connection points

5.4.4.1. Points and gases monitored

The ACM 150 monitor is designed for and intended to detect occasional leaks of hazardous gases at levels that are within its range of detection. The following conditions may harm the ACM 150 monitor and may violate the warranty terms:

- Continuous presence of oxidizing or corrosive gases at one or more sample point at levels exceeding 10 PPM, particularly if the air is humid.
- High PPM level leaks that saturate the ACM 150 monitor with oxidizing or corrosive vapors.
- Liquids (water, solvents or oil) present in the sampled air that enter the ACM 150 monitor via the sample tubing.
- Flammable gases above explosive levels that might increase the risk of fire inside the ACM 150 monitor.

The ACM 150 monitor is not suited for monitoring samples that contain high levels of corrosive and/ or condensable gases, such as the exhaust from treatment systems.

5.4.4.2. Application suitability and adaptability

Honeywell Analytics provides a list of typical gases for the ACM 150 monitor and its other gas detection products. The list also identifies limitations. Before you can use the ACM 150 monitor as a monitor, a Honeywell Analytics applications chemist must provide the software, or analytical methods. This requires an applications review, where suitability can be verified. The ACM 150 monitor has an enormous capacity for monitoring gases. It can accommodate changes in the gases it monitors. Ask Honeywell Analytics about the detectability of gases you need to monitor.

5.4.4.3. Record keeping

It is critical that an accurate record be maintained, correlating each ACM 150 sample point number to the name for the location of the monitoring point to which it connects. A form to record those numbers and names is provided in Form 1 on page 62.

Each sample line must also be numbered with the connection point it is associated with. It is also highly recommended that each line also be identified with a location. This identification is necessary so that sample lines can be safely disconnected and then later replaced correctly during maintenance and service procedures.

5.4.5. Filters, check valves, and probes

5.4.5.1. In-line filters

The ACM 150 monitor requires a filter at the inlet of each sample line to protect the tubing and internal sampling system from an accumulation of particulates. Honeywell Analytics supplies one filter for each sample port. Install the filters at the sample pick-up point when the tubing is run to each port.

If a port in not currently used, leave the cap over the inlet tube fitting, If there is no cap, install a short run of tubing with the filter at the inlet. This keeps particulates out of the bypass orifice which draws all on ports, used or not.

5.4.5.2. Check valves for line leak test (optional)

The ACM 150 monitors have the capability to perform an automatic Line Leak Test, however, not all users may want this feature. To implement it, check valves must be purchased and installed, one per sample port. They may be included with the original order for the ACM 150 monitor, or they may be added later.

The check valves allow flow to pass through to the tube inlets to each ACM 150 monitor sample port. They seal off when air flows in the opposite direction during the Line Leak Test. This causes pressure to build up in the sample tube. A tube that fails to hold pressure has a leak.

The check valves must be installed at or very near the inlet of each sample tube with the inline filters installed between the tube inlet and check valve. The inline filters also keep the check valves clean so that they will seal tightly during the Line Leak Test.

5.4.5.3. Locating the filters and check valves

The inline filters require periodic replacement, and the check valves may require occasional disassembly and cleaning. Try to locate both items where they are easily accessible.

5.5. Wiring the outputs

5.5.1. Access plates

Figure 27 shows two access plates on top of the ACM 150 monitor. They are provided for wiring the outputs. Remove one or both plates and cut or drill, as necessary to accommodate your preferred connection, such as:

Flange	mating to Wiremold or similar
Wiring Hubs	to connect to electrical conduit

Figure 27. Output Wiring Access Panels

5.5.2. Relay output wiring

All 86 relays on the Relay Output Board have plug-in connectors. Remove the connectors and wire to them outside of the monitor. Then, plug them into the board. The connectors have 6 terminals accommodating 18 AWG or smaller wire. The relays are numbered on the board, which is shown in Figure 28.

5.5.2.1. Standard output relays

There are 80 programmable relays. They have a default setup providing 40 Alarm 1 level and 40 Alarm 2 level outputs for up to 40 sample areas. Each relay is independently programmable. The user can change configure set points, sample areas and gases in any combination or grouping.

Six status relays are on the Relay Output Board. They activate when service request or malfunction incidents are detected by the ACM 150 monitor or when power is lost.

It is highly recommended that these relays be connected to a continuously monitored alarm system. These relays provide a verification of alarm conditions and operational status that is separate from all other alarm outputs. They can provide important information, if other communications links fail.

5.5.3. Relay terminals and activation options

5.5.3.1. Relay terminals

Since the output relays are DPDT, they may be connected to two separate devices, and each device can have a separate DC or AC power loop, wired through the common (labeled COM) terminals. Each set of terminals provides the choice of wiring to the normally open (NO) or normally closed (NC) contacts. Since the relay state is NC when de-energized and NO when activated, most users wire to the NO terminals. However, if your control logic allows you to trip on loss of signal, you can wire to the NC terminals. This has the benefit of alarming if a wire is broken or disconnected.

5.5.3.2. Fail safe configuration

The software can be configured to reverse the relay logic, so all the output relays are normally energized. You would wire to the NO terminals. An Alarm 1 or Alarm 2 condition, a broken or disconnected wire, or a failure of the relay would activate the alarm device, shutdown sequence and/or control logic for that relay. This is a fail-safe implementation, and it requires a change in the ACM 150 monitor software configuration by Honeywell Analytics.

NOTE

If you use the fail-safe configuration, all the ACM 150 monitor output relays will activate on loss of power, which is likely to cause wide-spread alarms and gas shut-downs. Even a reboot of the computer will cause this to occur. It is essential that a bypass switch be utilized to maintain power in the wire loop so that the ACM 150 monitor can be shut down for service or when loading new software.

5.5.3.3. Non-latching vs. latching configuration

The ACM 150 monitor output relays are non-latching in the standard configuration. This means that they reset automatically when the condition (alarms, malfunction, power loss) returns to normal.

The software configuration allows a change to latching relays. When the condition returns to normal, the latching relay contacts will remain activated. They can only be reset from the ACM 150 monitor touchscreen or via network remote computer. This is not recommended if you have latching relays in your control logic, because it would require a manual reset at two locations to silence alarms. However, if your control logic does not latch, i.e. holding the condition until manually reset, you should have the ACM 150 monitor configured with latching relays. This is especially important if the ACM 150 monitor alarm relays will directly activate automatic gas shutdown in your facility.

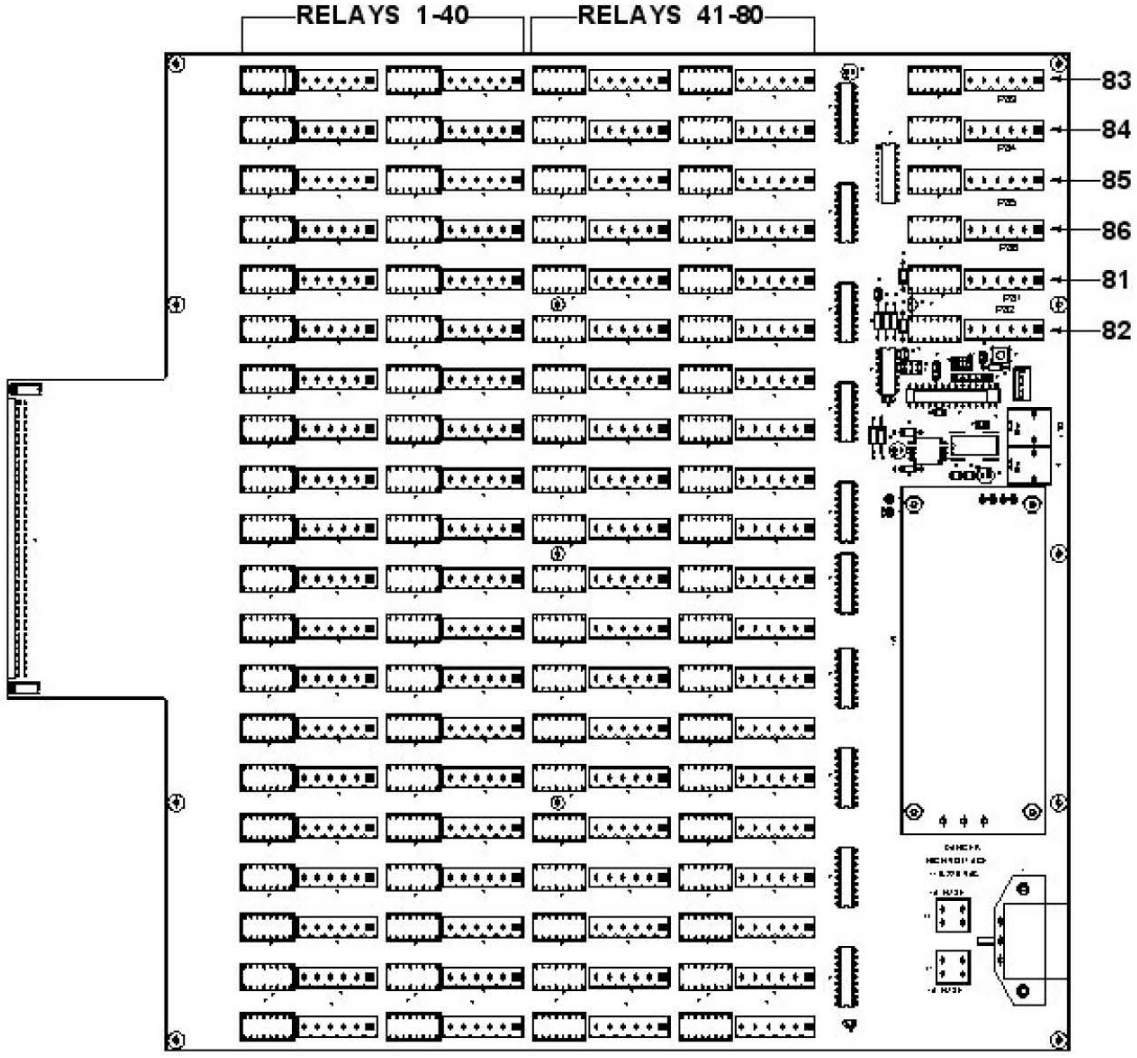


Figure 28. Relay Output Wiring

81 Power Fail

82 Watchdog Timer

83 Manual Mode

84 General Malfunction

85 General Alarm 1

86 General Alarm 2

WARNING!

This sequence can cycle repeatedly and may result in an exposure to toxic gas while ERT personnel are repairing the leak.

If the ACM 150 monitor output relays are used to shut down the gas source and interrupt the gas flow, a latching relay must be used in the control loop. If not, the ACM 150 monitor relay will shut down the gas source and stop the leak that was detected by the ACM 150 monitor. The alarm will soon clear and reset the relay, restarting the flow of gas, and the leak will be detected again.

5.6. Data interface

CAUTION

Establishing an Ethernet connection to the ACM 150 may expose the system to vulnerabilities. Honeywell recommends against connecting the ACM 150 to untrusted computers or equipment without taking appropriate measures to ensure security.

5.6.1. Remote computers

5.6.1.1. *Capabilities*

The ACM 150 monitor operates and performs all its functions as a stand- alone monitor. While it is not necessary to connect it to a remote computer, it is recommended. The remote computer can access all data, operations, setup selections and most of the test functions.

5.6.1.2. *Interface*

You can connect a remote computer to the ACM 150 monitor via the internet or local network. Authorized employees can then access the ACM 150 monitor from remote locations. If a local network is used, you may connect as many remote computers as you need to one or more ACM 150 monitors.

5.6.1.3. *Sending stored spectra*

The ACM 150 monitor saves the infrared spectra of its area scans. The remote computer can send the saved spectra to Honeywell Analytics via e-mail. These spectra provide a “fingerprint” of the air samples. They are often used to verify alarm incidents, and they can help identify unknown odors with the aid of spectral search software. Interpreting spectra and using FTIR lab software and spectral search libraries requires special training. Honeywell Analytics application chemists are experts in this field and offer this service to their customers.

5.6.2. Networks

Direct questions concerning network interfacing to your Honeywell Analytics representative.

5.6.3. Interfacing to PLC

5.6.3.1. Combining Relay Outputs and Remote Computer

If you are connecting the ACM 150 monitor to a PLC (Programmable Logic Controller) you can connect the relay outputs and/or the network. Many users connect only the relay outputs to the PLC so that ACM 150 monitor incidents trigger the desired control functions at the PLC automatically. They use a remote computer to access the monitoring data associated with the incidents.

5.6.3.2. Gas concentration data

Some users prefer to send gas concentration data to the PLC and use the PLC to read the data generated by incidents. This data may be sent via a network interface.

5.6.3.3. Ethernet interface

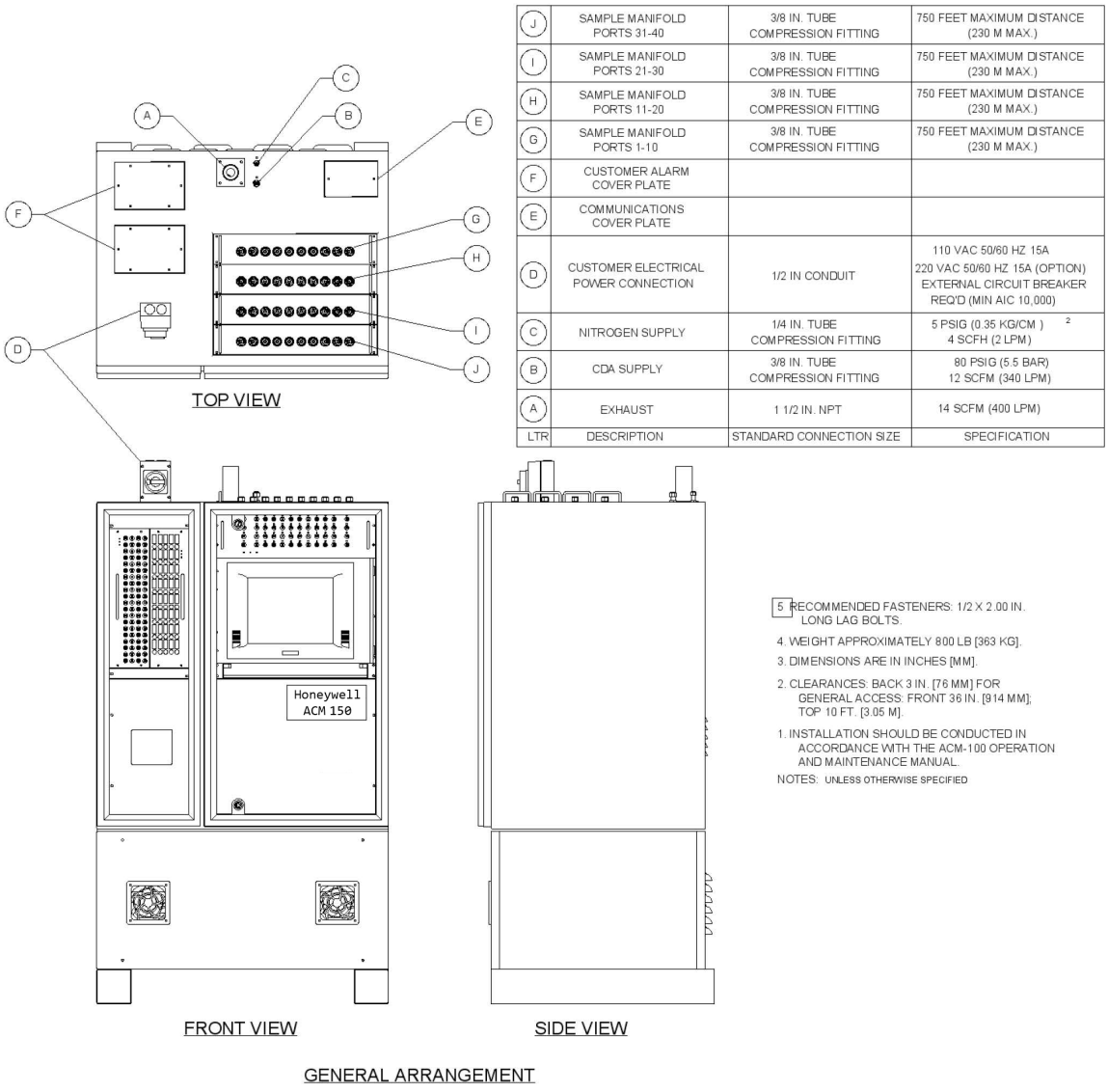
The ACM 150 monitor is designed to connect to a PLC via gateways. The ACM 150 monitor has an Ethernet interface and an OPC driver is available as an option. If you use this interface, all data is available to the PLC, i.e. the concentrations of all gases monitored on all ports.

5.6.3.4. Gateway Interface

The ACM 150 monitor can provide an optional built-in programmable gateway that can communicate with several different data protocols including many used in popular PLCs. Ask your Honeywell Analytics representative for information regarding your application.

5.7. Installation drawings

In addition to the drawings in this section, drawings may be separately provided to clarify the installation of special or modified assemblies.



LTR	DESCRIPTION	STANDARD CONNECTION SIZE	SPECIFICATION
J	SAMPLE MANIFOLD PORTS 31-40	3/8 IN. TUBE COMPRESSION FITTING	750 FEET MAXIMUM DISTANCE (230 M MAX.)
I	SAMPLE MANIFOLD PORTS 21-30	3/8 IN. TUBE COMPRESSION FITTING	750 FEET MAXIMUM DISTANCE (230 M MAX.)
H	SAMPLE MANIFOLD PORTS 11-20	3/8 IN. TUBE COMPRESSION FITTING	750 FEET MAXIMUM DISTANCE (230 M MAX.)
G	SAMPLE MANIFOLD PORTS 1-10	3/8 IN. TUBE COMPRESSION FITTING	750 FEET MAXIMUM DISTANCE (230 M MAX.)
F	CUSTOMER ALARM COVER PLATE		
E	COMMUNICATIONS COVER PLATE		
D	CUSTOMER ELECTRICAL POWER CONNECTION	1/2 IN CONDUIT	110 VAC 50/60 HZ 15A 220 VAC 50/60 HZ 15A (OPTION) EXTERNAL CIRCUIT BREAKER REQ'D (MIN AIC 10,000)
C	NITROGEN SUPPLY	1/4 IN. TUBE COMPRESSION FITTING	5 PSIG (0.35 KG/CM ^{2}) 4 SCFH (2 LPM)
B	CDA SUPPLY	3/8 IN. TUBE COMPRESSION FITTING	80 PSIG (5.5 BAR) 12 SCFM (340 LPM)
A	EXHAUST	1 1/2 IN. NPT	14 SCFM (400 LPM)

Figure 29. ACM 150 Installation Diagram 1

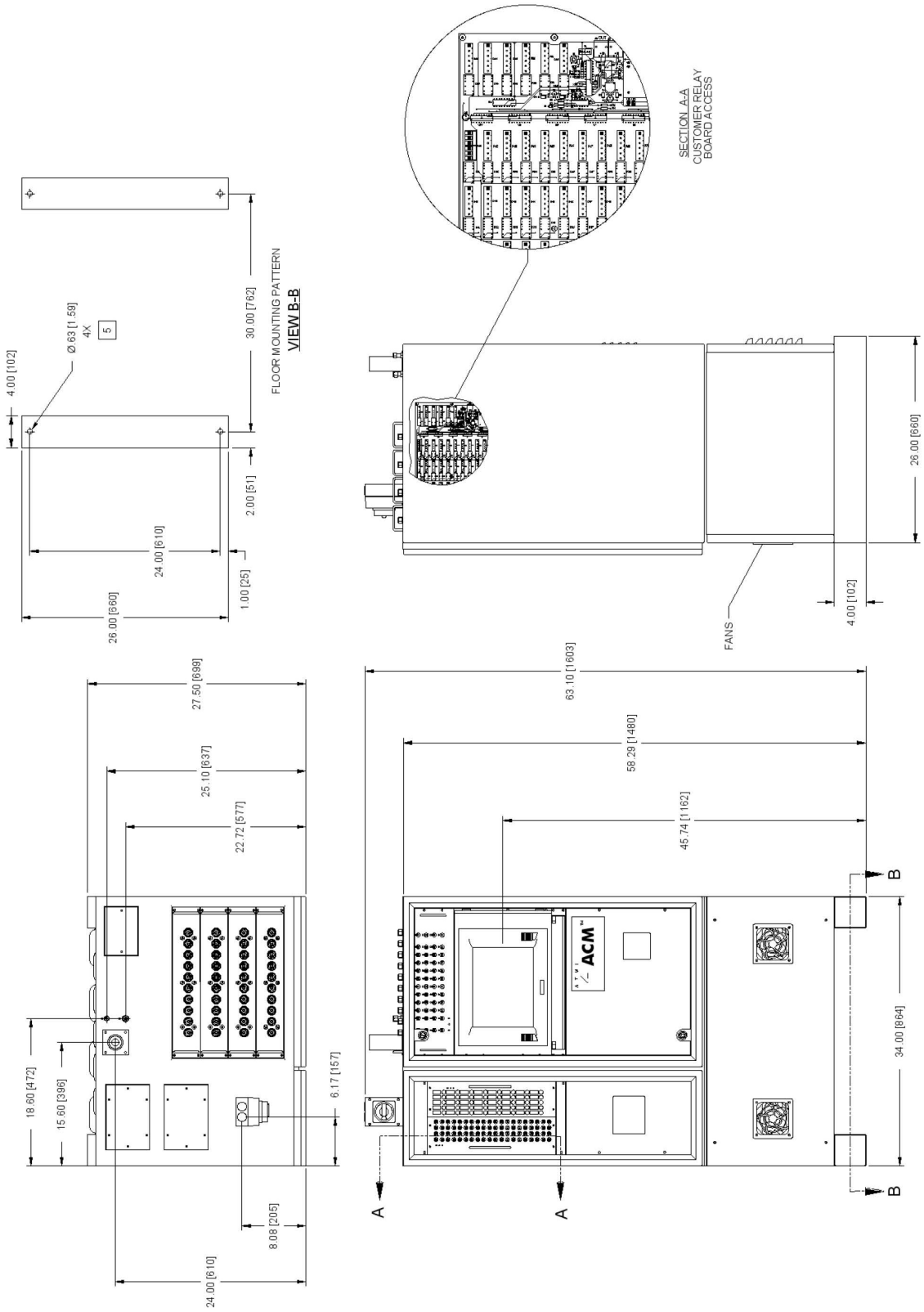


Figure 30. ACM 150 Installation Diagram 2

Form 1: Sample point matrix

ACM 150 Port#	Gases Monitored	Sample Point Name or	Installation Notes
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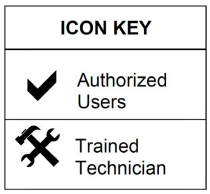

6. Operation

6.1. Safe and proper operation of the ACM 150 monitor

6.1.1. ACM 150 operating safety

The ACM 150 monitor design ensures that the operator is protected from injury when using the front panel touchscreen, keyboard and push buttons. There is no danger to the operator when opening any of the doors or the outside panels on the ACM 150 monitor for inspection purposes. No internal plates, shields or components should be touched, tested, removed or serviced except by a Trained Technician. The user must read and follow all warning labels on the monitor and the highlighted CAUTION, WARNING and DANGER notes contained in this manual. The ACM 150 monitor is designed to comply with CE safety standards.

CAUTION!

Do not use RF-generating devices such as two-way radios or cellular phones within 10 M of the installed ACM 150 monitor.

6.1.1.1. Laser and exterior label

Within the FTIR optics bench is a Class 1 laser. A laser-product label is displayed on the exterior door of the optics cabinet of the ACM 150 monitor.

6.1.1.2. Laser and interior labels

The front door of the Optics Cabinet may be opened without any danger of a direct exposure to the laser. The laser is installed inside the Perkin Elmer FTIR optics bench, and the laser light is contained within it. In the ACM 150 monitor configuration, the laser light does not exit from any aperture, and there is no danger of exposure to this laser radiation. Exposure to radiation from this laser is only possible under these conditions:

- The FTIR optics bench is physically removed from the ACM 150 monitor Optics Cabinet,
- The gas cell is removed while power is applied to the bench, and
- The bench is disassembled when power is applied.

DANGER!

High voltage AC power and laser source inside the FTIR optics bench can cause injury to eyesight or electrocution. Caution Labels have been applied to the FTIR optics bench by the manufacturer. Read and comply with those labels. Only trained personnel, including Honeywell Analytics service engineers, are qualified to open the FTIR optics bench and service the components inside with AC power applied.

6.2. Computer information

6.2.1. ACM 150 touchscreen and keyboard

When any entry requires alpha-numeric characters, use the keyboard.

6.2.2. Remote computer access

The ACM 150 monitor may be operated from a remote computer via network or Internet. All functions can be accessed remotely. The setup program is available to a remote user who has authorized access. Local users have priority and can logout remote users.

6.3. Status and scan results

6.3.1. Area scanning

Typically, the ACM 150 monitor operates in normal scanning mode. The display updates each time the ACM 150 monitor completes a scan of a sample area. A scan samples the air from that area, analyzes the sample and displays the results. The cycle time for each update depends upon the set up and configuration of the ACM 150 monitor. Typically, the scan rate is 15 seconds per sampled area. A longer scanning rate may be used to enhance lower detection sensitivity.

6.3.2. Background

Every two hours the ACM 150 monitor stops normal scanning and acquires a new Background spectrum. A message may display on the monitor while this occurs. After it the background spectrum is complete, normal scanning resumes automatically. The Background spectrum cannot be stopped. The operator must wait until the background spectrum is complete before changing operating modes.

6.3.3. Status bar

The ACM 150 monitor operates in normal scanning mode or Automatic Mode unless it is taken out of that mode for test/service purposes.

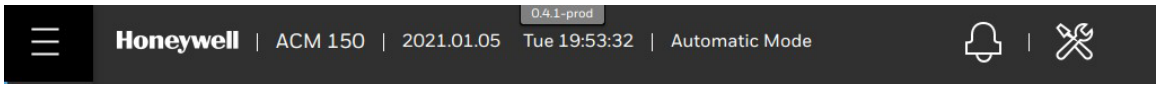

Figure 31. Status Bar

Alarm 1/ Alarm 2/ Service events:

If there are no current alarm incidents, the display indicates No Alarm 1, No Alarm 2 and No Warn.

Figure 32. Alarm Service Events

When an alarm or a fault or a condition requiring service attention is detected, this display indicates a status change:

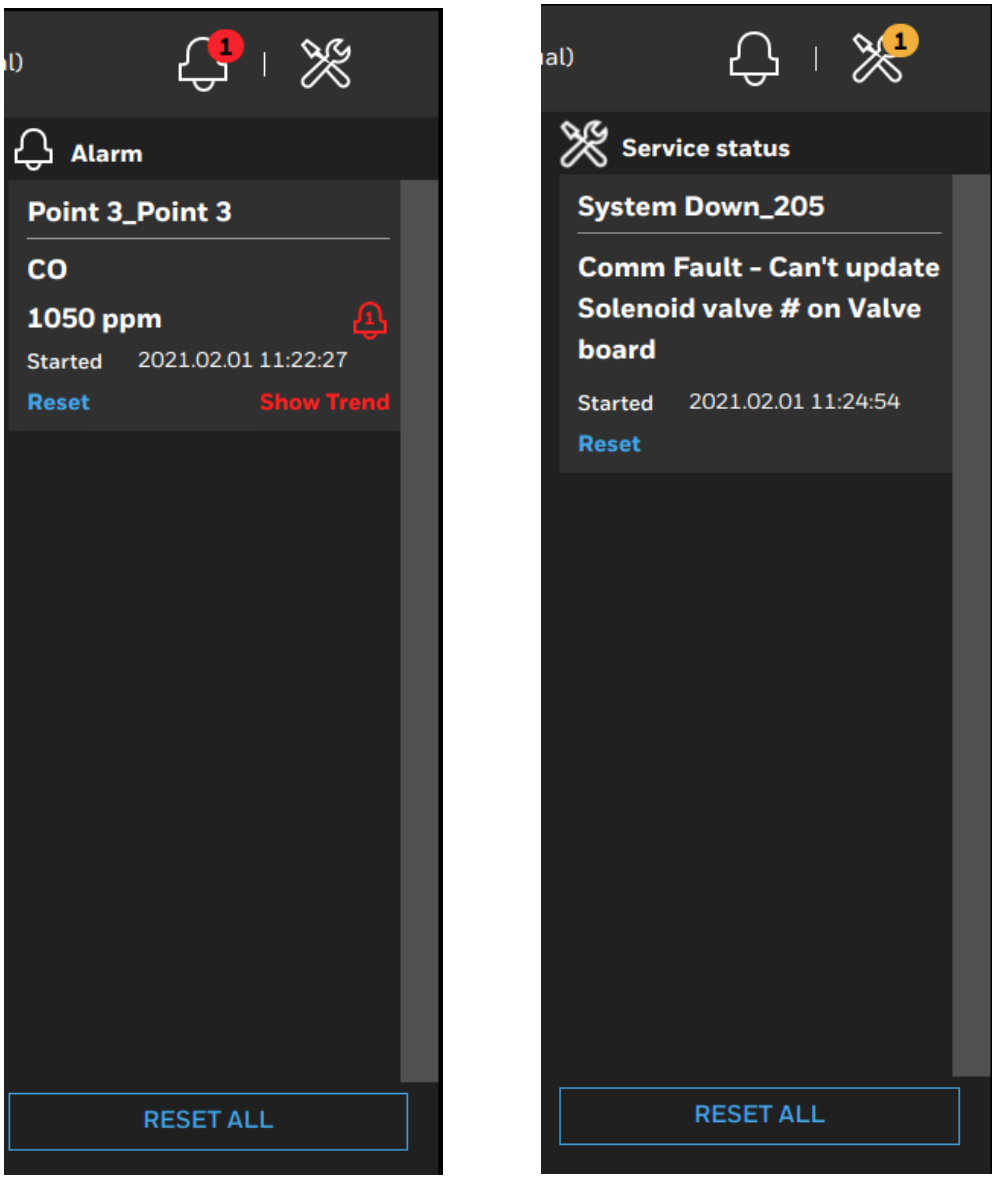

Figure 33. Alarms and Service Status Details

Manual and Frontpanel are test/service modes. When they are selected, normal scanning is interrupted, and the display changes from Automatic Mode to Manual Mode.

Figure 34. Status Bar (Manual Mode)

6.3.4. Overview and Recent scan results

Below is an image of Recent Scan Results. It updates as each area scan is completed, about every 15 seconds on a standard ACM 150 monitor. The display shows variables that are determined by the Setup program. These variables can be updated as conditions change (refer to Settings Menu).

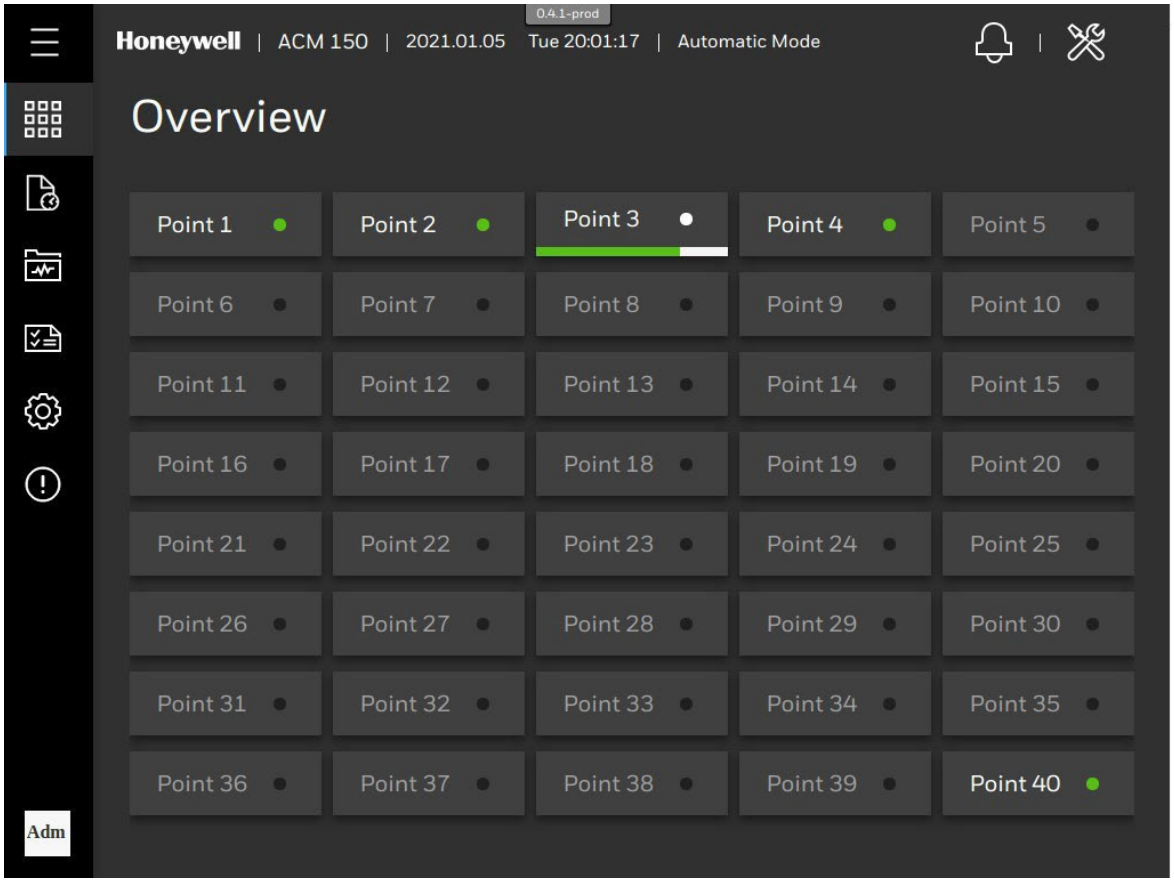

Figure 35. Normal Scan

Point **NOTE** Area Number, Port Number and Point Number all correspond to the inlet port number, 1 - 40, on top of the ACM 150 monitor. This is where the sample tube connects the ACM 150 monitor to the remotely sampled locations. Those sampled locations are always identified with the same 1 - 40 number, but they may be further identified using an area name.	This displays the name that the user designates for the sample area, corresponding to the area number. Since area number is unlikely to have any meaning to the operator, the ACM 150 monitor software allows you to enter the name or equipment ID #.
Status	Status for each active gas on the display • OK: Indicates the gas concentration is lower than the warn level set point. • Warn: Indicates the gas concentration is above LDL • Alarm 1: Indicates the gas concentration exceeds the Alarm 1 level but is lower than the Alarm 2 level. • Alarm 2: Indicates the gas concentration exceeds the Alarm 2 level set point.

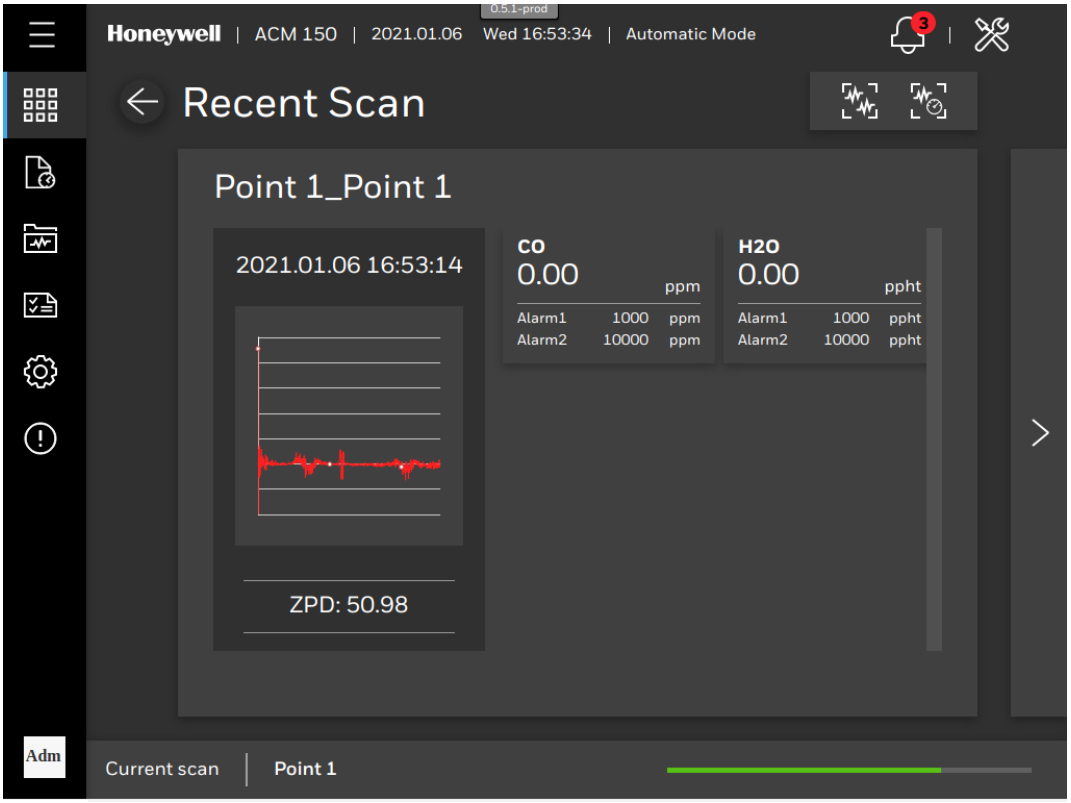

Figure 36. Recent Scan

Active Gases	The gases actively monitored at that area. If a gas is not shown as active, it is not being monitored at that area.
Started	The date and time of the scan is identified.
Concentration	Concentration of each active gas. Usually, the ACM 150 monitor confirms zero gas present, shown as 0. In most cases the scale is ppm (parts per mil- lion). Other concentration scales avail- able are % LEL for combustible gases and ppht for water vapor (these terms are defined in Appendix C). Spectrum Infrared spectrum of this air
Alarm 1 / Alarm 2	Alarm 1 and 2 level set points for this active gas.

6.4. Changing the mode of operation

To change from the Current Scan display at the ACM 150 monitor, touch the desired menu item.

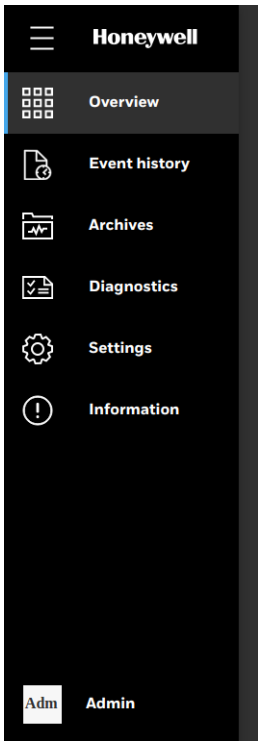

Figure 37. Menu Tree

Table 2: Menu Access Levels

Menu	Description	Access
Overview	Display all points and event status	All
Event history	Display event history	All
Archives	Archives Spectrum, Gas concentration trend, SNR trend and ZPD trend	All
	Download files	Service, Admin
Diagnostics	Run diagnostics: Demand scan, Lock on scan, background scan, hardware service, software service. Display spectrum and cycle valve operations.	Service, Admin
Settings	Set ACM configurations, account manager, Point configuration, Scan order, Method manager, Relay configuration and export/import configuration	Service, Admin

6.5. Alarm 1/Alarm 2 incidents and actions

The primary purpose of the ACM 150 monitor is to generate a Alarm 1/Alarm 2 Incident whenever the level of a hazardous gas exceeds set point limits. Such incidents cause several actions to occur automatically:

- The Alarm 1 or Alarm 2 condition changes on the status bar and on the recent scan results.
- The data is logged as a recent Alarm 1/Alarm 2 incident (Alarm 1/Alarm 2 event log).
- One or more relays activate, which is determined by the setup program for the relays (Relay activation).
- The incident is archived along with the infrared spectrum
- The data is available for graphical trending
- These incidents, along with the normal scan data, are available for interfacing to a PLC or network computer Ethernet or Lonworks.
- Network or remote computers connected via Internet protocol may be set to print each incident as it occurs.

6.5.1. Alarm 1/Alarm 2 Event log

Event history>

Press “Event History” to display the events of the past.

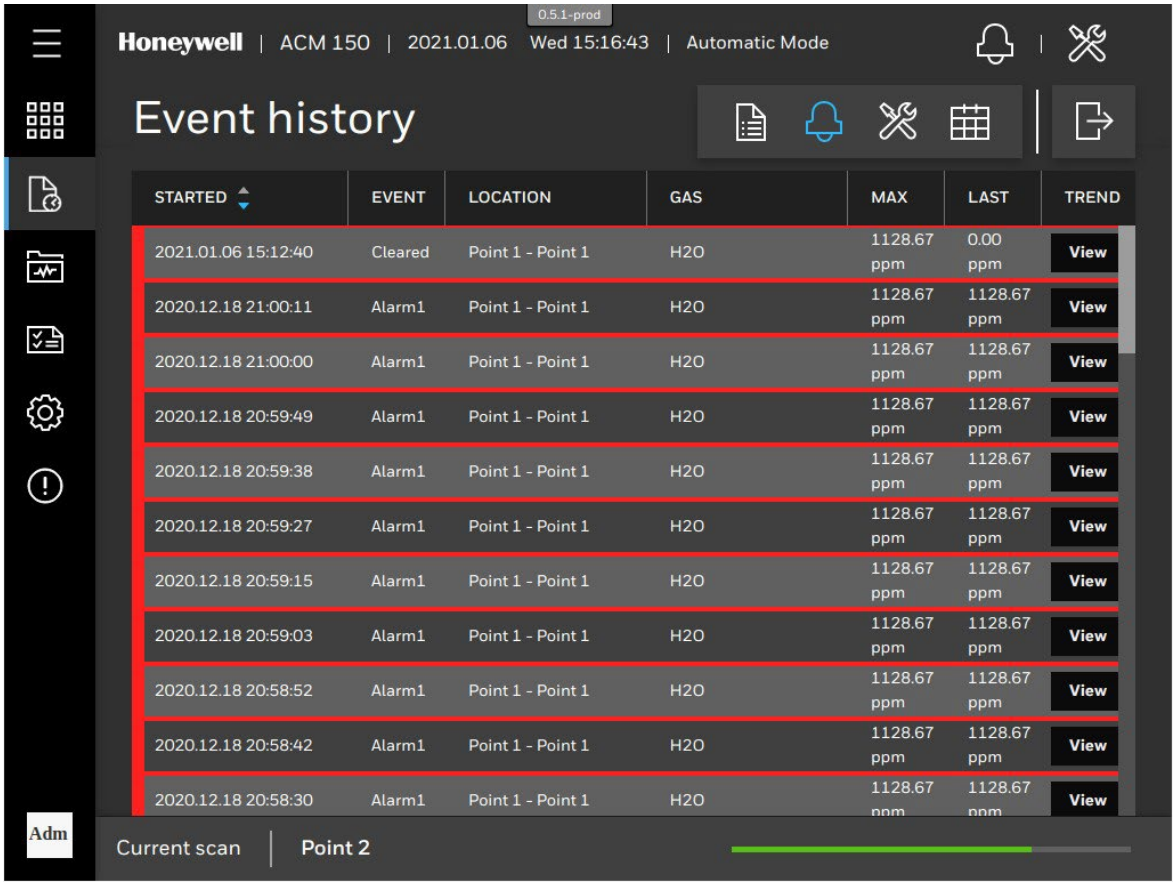

Figure 38. Alarm Event History

Press  button to export events. User can download files where “Archives>Download”.

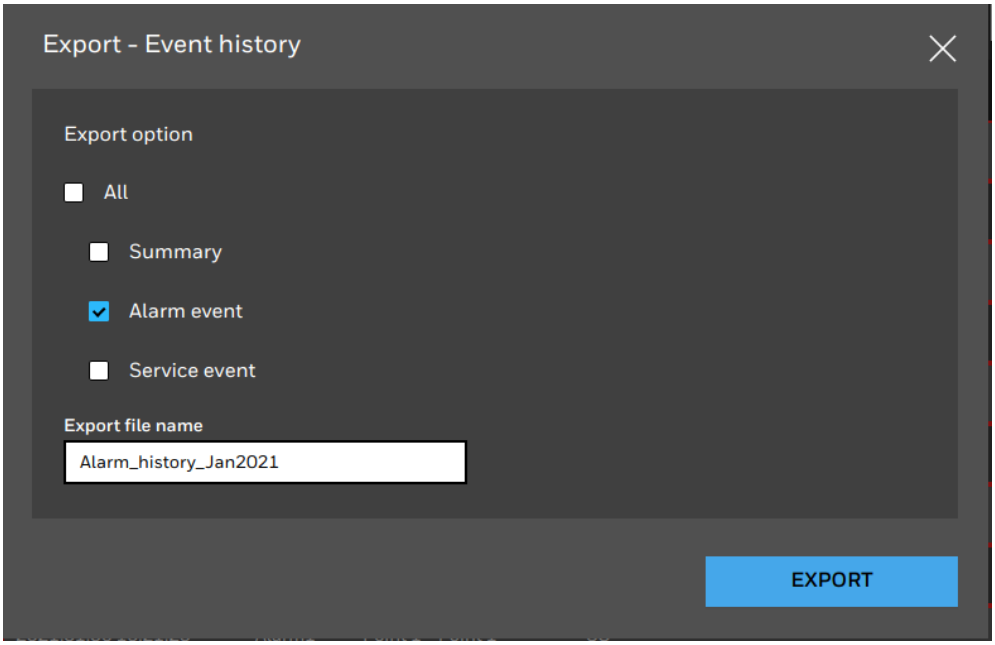

Figure 39. Export Events

6.5.2. Relay activation

When an Alarm 1/Alarm 2 Incident occurs, the ACM 150 monitor software activates the corresponding relays. All ACM 150 monitors have at least 80 output relays. The action of each relay is programmable. The default setup for the ACM 150 monitor assigns these relays to area 1-40. One Alarm 1 level and one Alarm 2 level relay is assigned to each area. The user can easily change the assignments, programming the relays for customized activation via the setup menu, Programming relays.

6.5.2.1. Default relay setup

- Relays 1-40 activate when the Alarm 1 level is exceeded for any active gas at areas 1-40 with one Alarm 1 level relay per area.
- Relays 41-80 activate when the Alarm 2 level is exceeded for any active gas at areas 1-40 with one Alarm 2 level relay per area.
- Example: For area 1, relay 1 and relay 41 are preassigned for Alarm 1 and for Alarm 2 level activation. This progression continues through to area 40.

6.5.2.2. Programming relays

The ACM 150 monitor output relays are all programmable. The relays may be configured by an authorized user to activate based on the following selections:

Trigger	The Alarm 1 or Alarm 2 level gas concentration
Mode	Direct or Latching
Activation Points (Areas)	For one point only or any group of points up to a maximum of 10 points
Gases	Select which monitored gases activate the relay

Each programmable relay is customized to activate for specific areas and under specific conditions. For example, it gives the user control over which conditions might shut down specific gas cylinders. It allows the user to set zones for personnel alarms so that entire facilities do not have to be evacuated if a leak is local or if the gas leaking is not hazardous at the level detected.

Typically, alarm incidents are brief and quickly clear if automatic gas shutdown is activated by the alarm event. With the gas supply cut off, the leak should dissipate. However, if the leak is not shut off, the ACM 150 monitor will most likely sense the alarm event each time it scans the leaking area(s).

NOTE

The Alarm 1 and Alarm 2 set point levels and the programmable relay groups are to be determined and set by EHS professionals. They must not be reset to different levels and the program groups must not be changed in any way unless determined and authorized by those professionals.

6.5.2.3. Standard Non-Latching Relays

The standard ACM 150 monitor configuration has the relays remain closed as long as the concentration of a gas exceeds a set point. Once the gas concentration reaches 0 ppm, the relay resets and opens. This is preferred by most users because they connect these relays to PLCs or external controls that latch, i.e. remain closed until manually reset.

6.5.2.4. Special Latching Relays

If you do not have latching relays in your control scheme, then Honeywell Analytics recommends that the ACM 150 monitor relays be changed to latch. This is a simple configuration change in the ACM 150 monitor software. When set to latch, the relays must be manually reset to open. This is done by selecting “Reset” in the alarms log.

DANGER!

Resetting a latching relay could cause a leak to restart and expose employees to hazardous conditions. Make certain that the leak causing the initial alarm event has been corrected before resetting a latching relay.

6.5.3. Action plan

Since the monitor can detect multiple gases per port, the action plan can be tailored for each gas. Every user should have a plan of action for Alarm 1/Alarm 2 incidents.
Refer to “Form 2: Plan for ACM 150 incidents” on page 83 for a suggested plan and format.

6.6. Lock-on mode and demand scan mode

6.6.1. Lock-on mode

The Lock-on Mode interrupt the normal scanning to lock onto an area and monitor it continuously for some period. It is often used following the detection of an Alarm 1 or Alarm 2 level leak. It allows you to monitor the area where the leak
occurred, observing the gas concentrations as they change to determine if the level is increasing or decreasing. It is a recommended procedure when ERT employees go to the sample point to check for the source of the leak. You can communicate with the ERT employees and report the readings to them if they start to change. The Lock-on Mode can help ERT determine when it is safe for workers to re-enter an area.

The Lock-on Mode is also used to introduce a test chemical while the ACM 150 monitor is locked onto the area. Lock-on Mode data is archived.

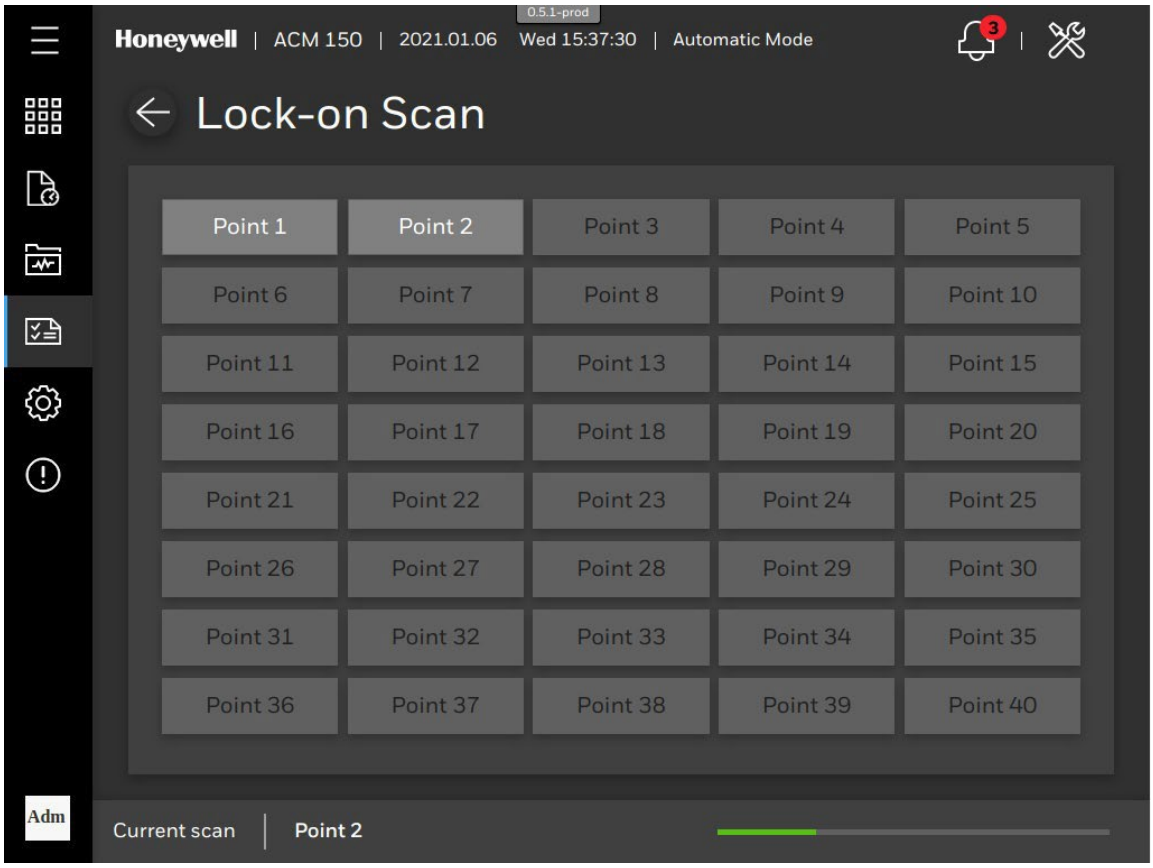

Figure 40. Select a Point Lock-on Scan

The Lock-on Mode screen, Figure 40, allows you to select the area you want to scan. You can only select an area that has been setup for monitoring, which is indicated by a green box. Areas with greyed-out boxes are not set up and cannot be selected.

Figure 41. Lock-on Button

Once selected, this area is scanned at the same rate as normal scanning. The display, Figure 40, identifies the point (area) number selected. Each time a scan is completed, the display updates to show the latest data as well as the number of passes (scans). It continues scanning the locked area repeatedly until you press “Cancel Lock-On” or the 60-minute time-out automatically returns it to the normal scanning mode.

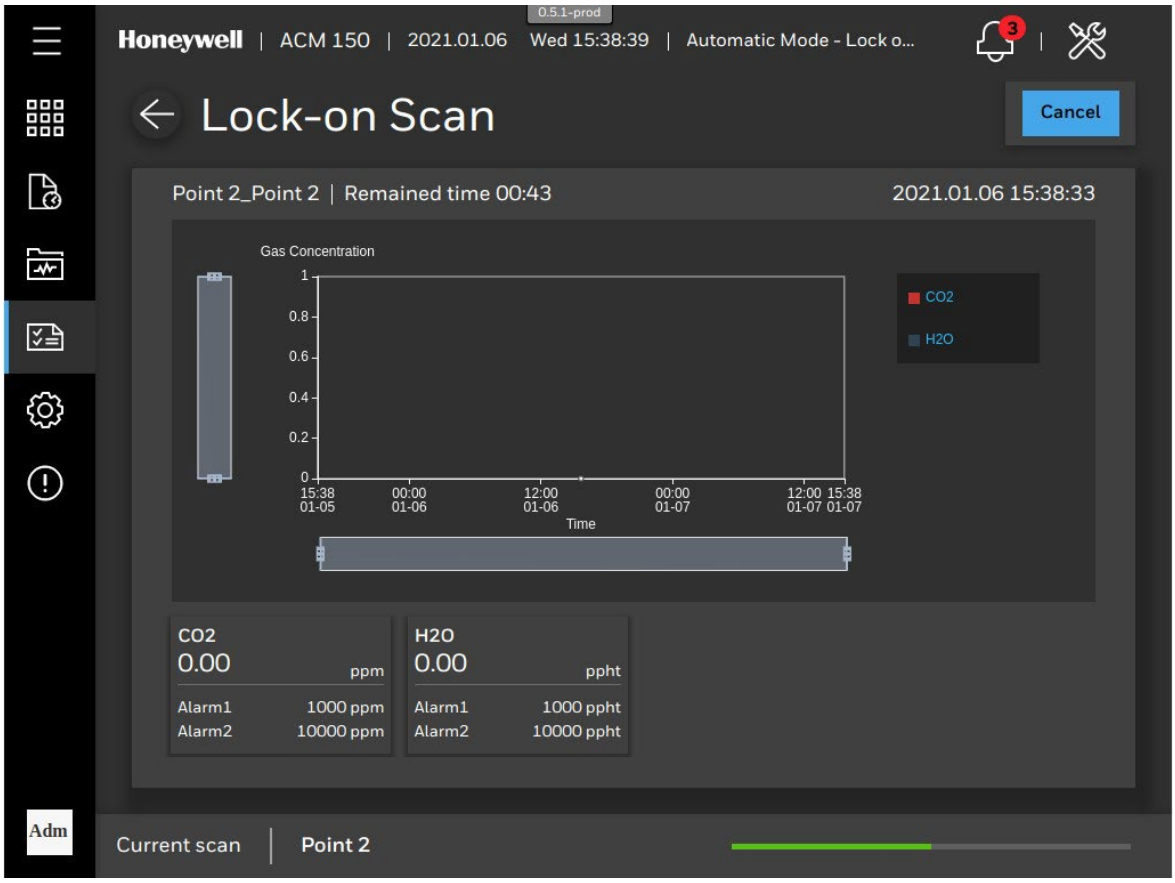

Figure 42. Lock-on Scan Spectrum

6.6.2. Demand scan mode

The Demand Scan Mode interrupts normal scanning to conduct 2 scans of the selected area. Normal area scanning resumes automatically.

Demand Scan is intended for the following uses:

- To provide a quick means of monitoring any area during an emergency and reporting the levels of hazardous gases present there.
- To help identify the chemical composition of unknown odors in the workplace, whether they are a monitored component or not.
- To store the infrared spectrum of the air sample from the selected area for off-line identification work later, e.g. using spectral search software.

The Demand Scan menu, Figure 43, is identical to Lock-on Mode, and selections are made in the same manner. Only areas with green boxes can be selected. Areas with greyed-out boxes cannot be selected.

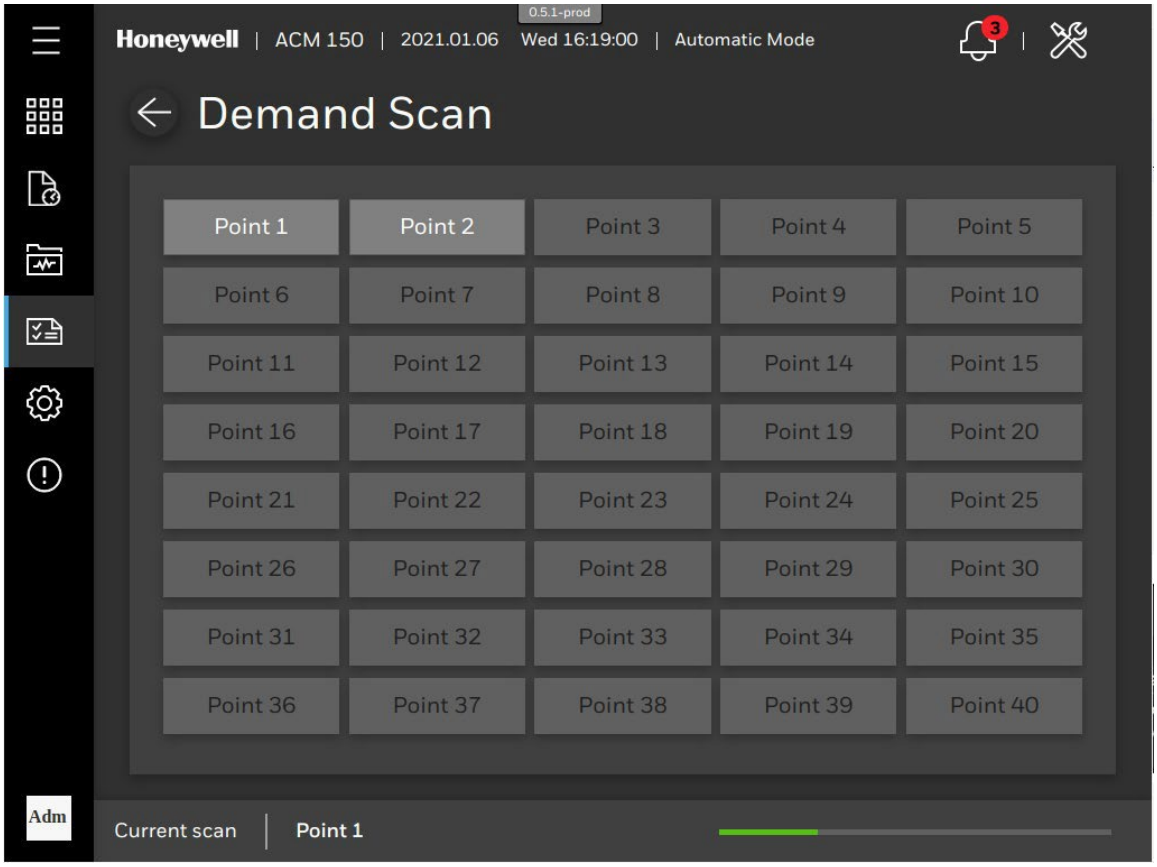

Figure 43. Demand Scan

After an area is selected, normal scanning is interrupted while two scans are collected. The results are displayed as shown in Figure 44. The concentration readings and status of each active gas at the sample point are displayed.
Programmable relays activate if Alarm 1/Alarm 2 set points are exceeded. Normal area scanning resumes in the background as soon as the Demand Scan is completed. Nevertheless, the display remains until another mode is selected on the touchscreen.

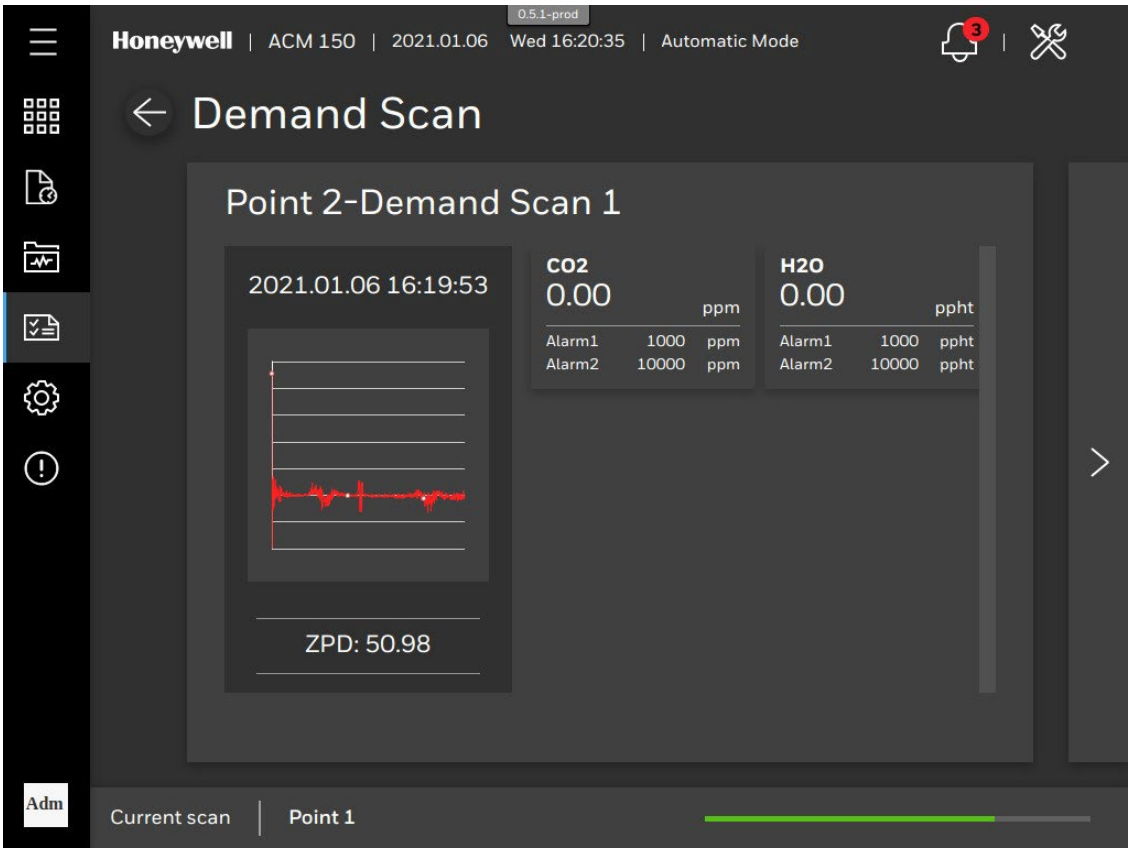

Figure 44. Demand Scan Spectrum

In Demand Scan the infrared spectrum is displayed, and it may be expanded for viewing by touching the display. At the same time, the data and the spectrum are archived automatically. The archived spectra may allow an application chemist identify gases which were in the sampled area at the time but not actively monitored.

6.7. Archived Spectrum and Trends

The ACM 150 monitor stores the infrared spectrum data from all its modes for the past 15 days. The Archived View allows you to selectively review and identify these spectra.

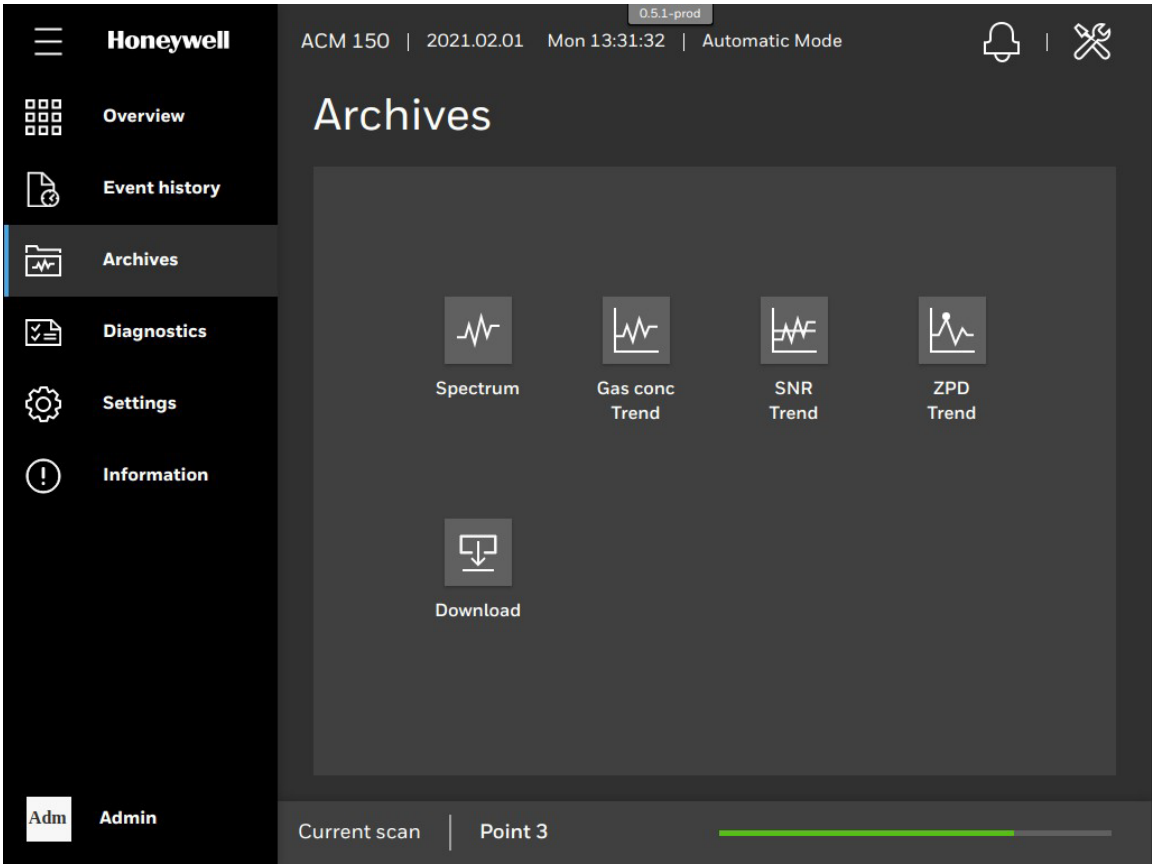

Figure 45. Archived Views

6.7.1. Archived spectrum view

When you select Archived Spectrum View, the menu shown in Figure 45 display. Use the number keys on the keyboard to enter the desired date and the time interval

Normal: Scans collected in the normal scan mode. Generally, only the Alarm 1 and Alarm 2 normal scans are important to the user. Validate some of these Alarm 1/ Alarm 2 incidents by reviewing the spectra.

Demand and Lock-On: Scans collected in either the Demand or Lock-On modes.

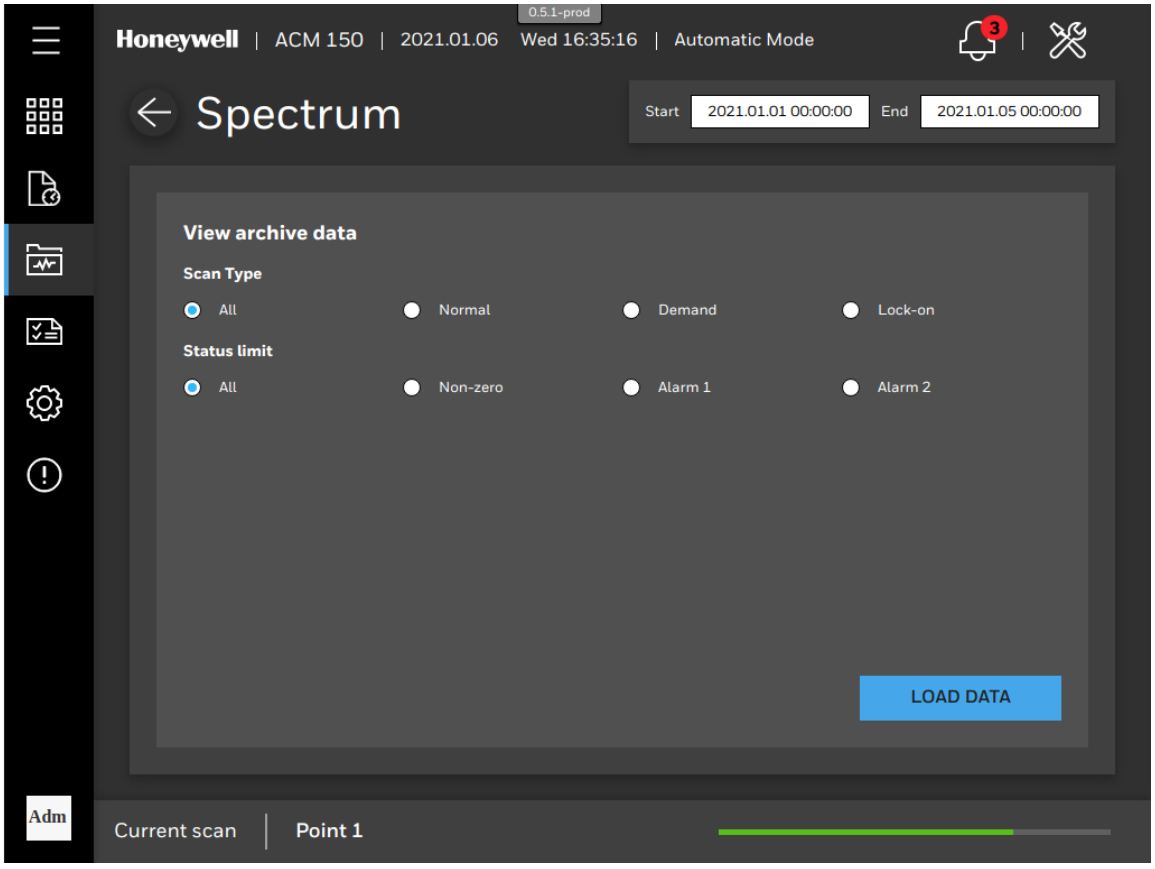

Figure 46. Archived Spectrum

6.7.2. Trend graphs

Trend Graphs are available for all the active gases on every scanned point. The data from each scan is stored for this purpose. Trend Graphs provide a means of viewing a leak incident from start to finish.

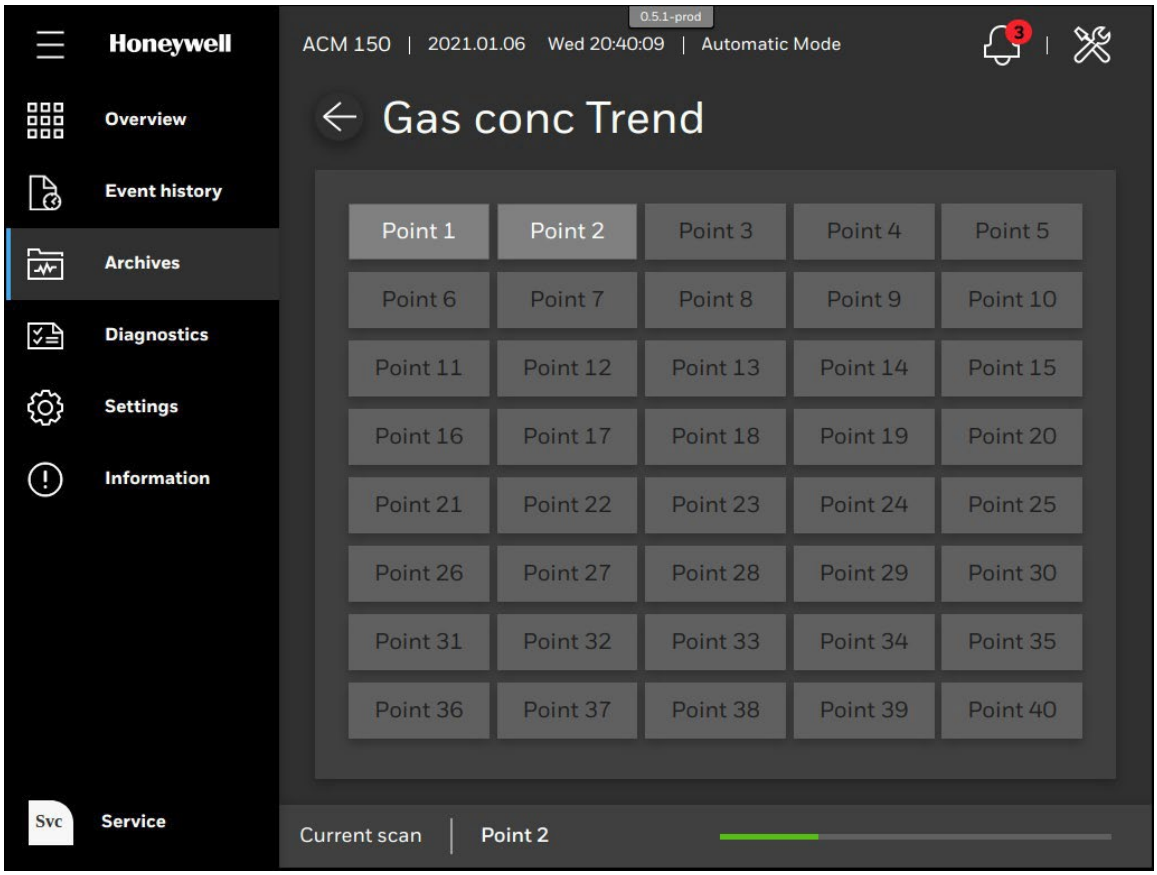

Figure 47. Gases Concentration in a Scanned Point

Pressing the selected area changes the display by generating a trend graph. Figure 48 shows a graph of four gases over a one-day time period. In this case, there is a constantly changing H_2S and CO concentration shown in green color.
To rescale the y-axis for a greater resolution, move scale x and y scale bar.

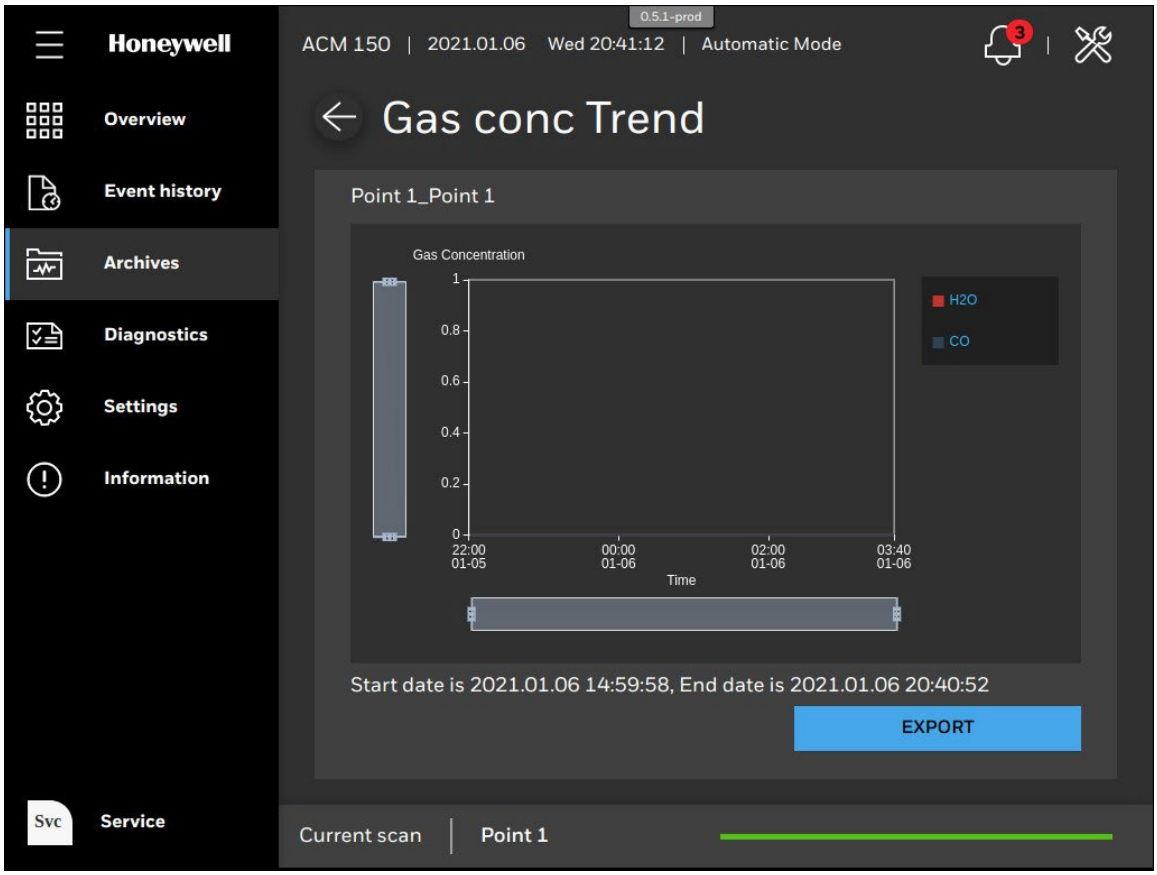

Figure 48. Trend Graph Display

6.8. Time-weighted average

The software features TWA (Time-Weighted Average) and MTD (Month-to-Date) reporting. Every eight hours an average gas concentration for each point and gas is calculated and saved to a TWA file on the ACM 150 monitor hard drive. In addition, an MTD file may be created to calculate an average gas concentration for the last 30 days.

You can download TWA and MTD data from the menu "Archives>Download".

6.9. ACM 150 checklist and incident plan

ACM 150 monitor is designed for continuous operation 24 hours a day. It performs all its functions automatically. Operator interface is only needed when an incident is detected by the ACM 150 monitor. In all cases, such incidents are noted on the Status Bar, Figure 31 and they activate one or more of the output relays.
Nevertheless, it is important to remember that the system is installed for the purpose of detecting chemicals which may be dangerous to workers and/or harmful to the environment. For this reason, it is imperative that the system not be taken for granted.

6.9.1. Plan for ACM 150 incidents

You can use Form 2 “Plan for ACM 150 incidents” to list and correlate the sample area numbers to the names for those areas and to the order of scan. The form may also be used to record and describe any Alarm 1/Alarm 2 or Malfunction Incidents. The telephone contact list can be part of your action plan to resolve issues.

The ACM 150 monitor’s computer continually checks for malfunctions in the analyzer and the sampling system. Some malfunctions are temporary and self-corrected. For example, if the ACM 150 monitor acquires a “bad scan”. That scan will be rejected, and the system will try again. If it cannot complete a good scan, a malfunction will be generated. Some malfunctions, such as a failure of the optional Line Leak
Check do not interrupt the operation of the ACM 150 monitor. It will continue to scan normally after this malfunction is detected. Other malfunctions, such as a “bench time-out” will cause scanning to be interrupted.

6.9.2. Screening data

Warn / Alarm 1/Alarm 2, questionable results and shakedown

During the first few weeks of operation, expect some “shakedown” of the ACM 150 monitor to be necessary. You may get some low-level readings for certain chemicals, especially if they are measured in the water vapor region of the infrared spectrum.
It may be necessary for the Honeywell Analytics application chemist to adjust the analytical method for the specific background purge gas and normal air chemistry at the user’s location.

During this initial operating period, collect infrared spectra and send it to Honeywell Analytics. The application chemist will use this information to adjust the analytical methods. If necessary, new methods will be generated and sent to the user or installed by HA or its agent. The user should also collect, and the spectra generated during any of the following events:

Demand Scans	Used when a chemical level is suspected or unknown odor (‘chemical stranger’) is present
Warn / Alarm 1/Alarm 2 Incidents	Includes both known and suspected events as well as questionable events, where a false alarm may be suspected
Gas Tests	Where a known chemical was introduced by the user and the ACM 150 monitor fails to report it or does not agree with the concentration level

Malfunction messages generated during this initial period may occur due to the characteristics of the installation. Notify Honeywell Analytics Service Department or its agent of all malfunctions, even if they are corrected by the user or are self-corrected, during the first few months of operation. Thereafter, the user can limit such notification to times when service assistance is needed to resolve a problem.

Record all of the incidents on Form 3, “Details of alarms, problems or non-spec performance.

Form 2: Plan for ACM 150 incidents.

Port #	Active Points	Sample Point Name or Equipment ID #	Actions for Warn/ Alarm 1/Alarm 2 Incidents
1			
2			
3			
4			
5			
6			
7			
8			
9			
10			
11			
12			
13			
14			
15			
16			
17			
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37			
38			
39			
40			

Form 3: Details of alarms, problems or non-spec performance

Noted by: Date/Time:

NOTE

Store spectra of all Alarm 1/Alarm 2 Incident(s).

For an expert evaluation, contact your local representative.

You can e-mail files directly to Honeywell Analytics.

6.9.3. Signal-to-noise ratio

Important warning and disclaimer:

Set enable SNR makes displaying SNR trend graph to monitor FTIR bench status.

Set enable SNR fault on samples can inhibit gas alarm event, which can help suppress potential false gas alarm event by potential system failure.

The customer enables the signal-to-noise ratio on samples at their own risk.

Honeywell Analytics disclaims all liability resulting from customers enabling signal-to-noise ratio on samples.

6.9.4. Maintenance gas

Important warning and disclaimer:

Set maintaining gases can suppress gas alarm events for the user's intended gas exposure like the cleaning process on the points.

Honeywell Analytics disclaims all liability resulting from customers Maintenance gas settings.

6.10. Spectrum Overlay

Menu: Diagnostics> View Spectrum

User can compare a spectrum vs other reference Spectrums.

User can select Spectrums by pressing “ADD SPECTRUM”.

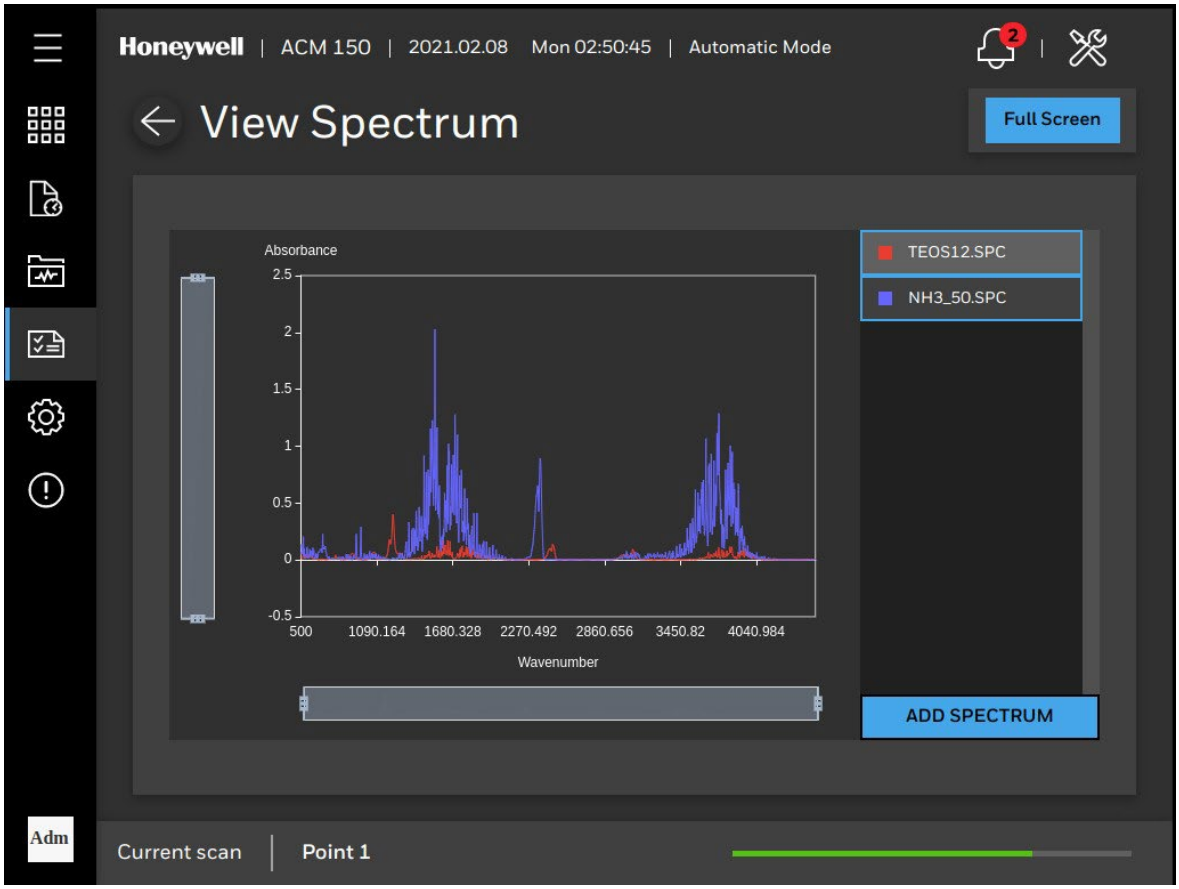

Figure 49. Spectrum Overlay

The user can compare a spectrum of a point vs other reference Spectrums by click the spectrum and can select Spectrums by pressing the “ADD SPECTRUM” button.

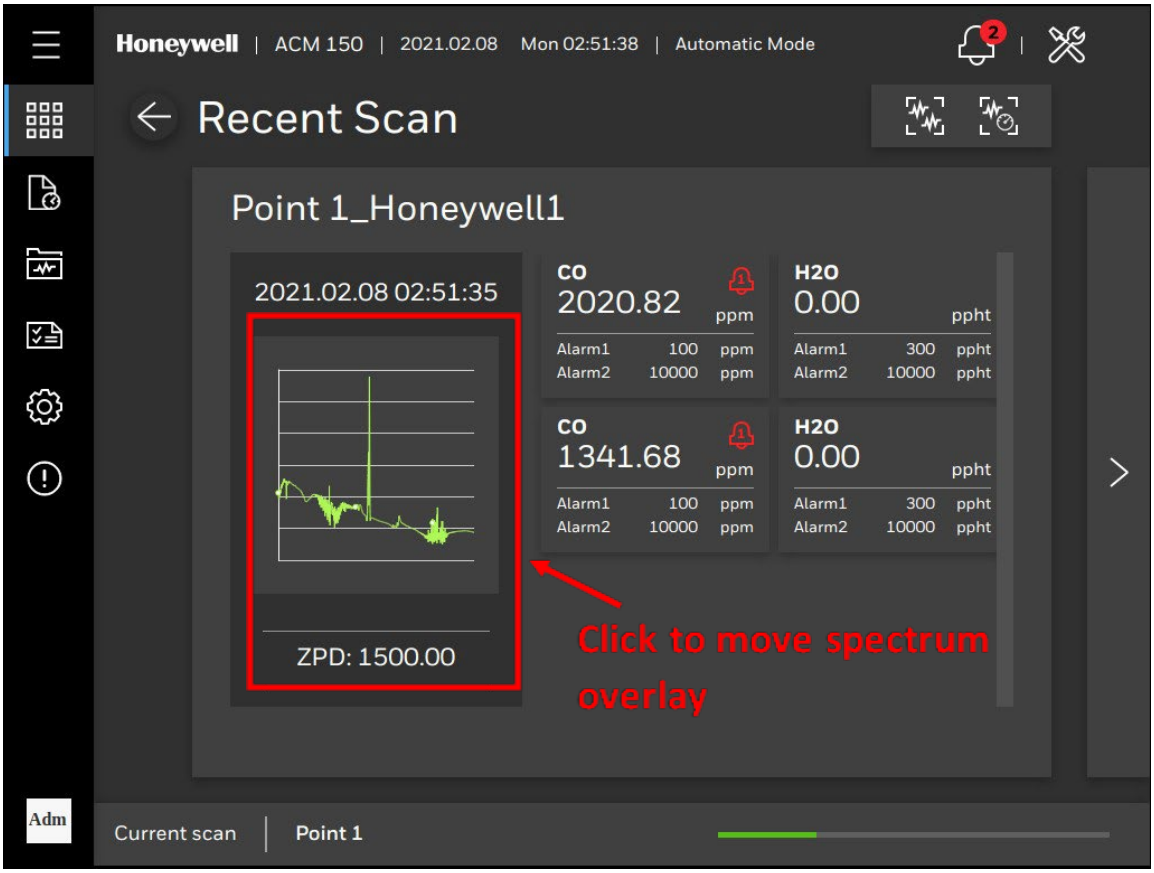

Figure 50. Move to Spectrum Overlay

6.11. Information

The user can check ACM 150 product information, system settings, user settings and basic current status.

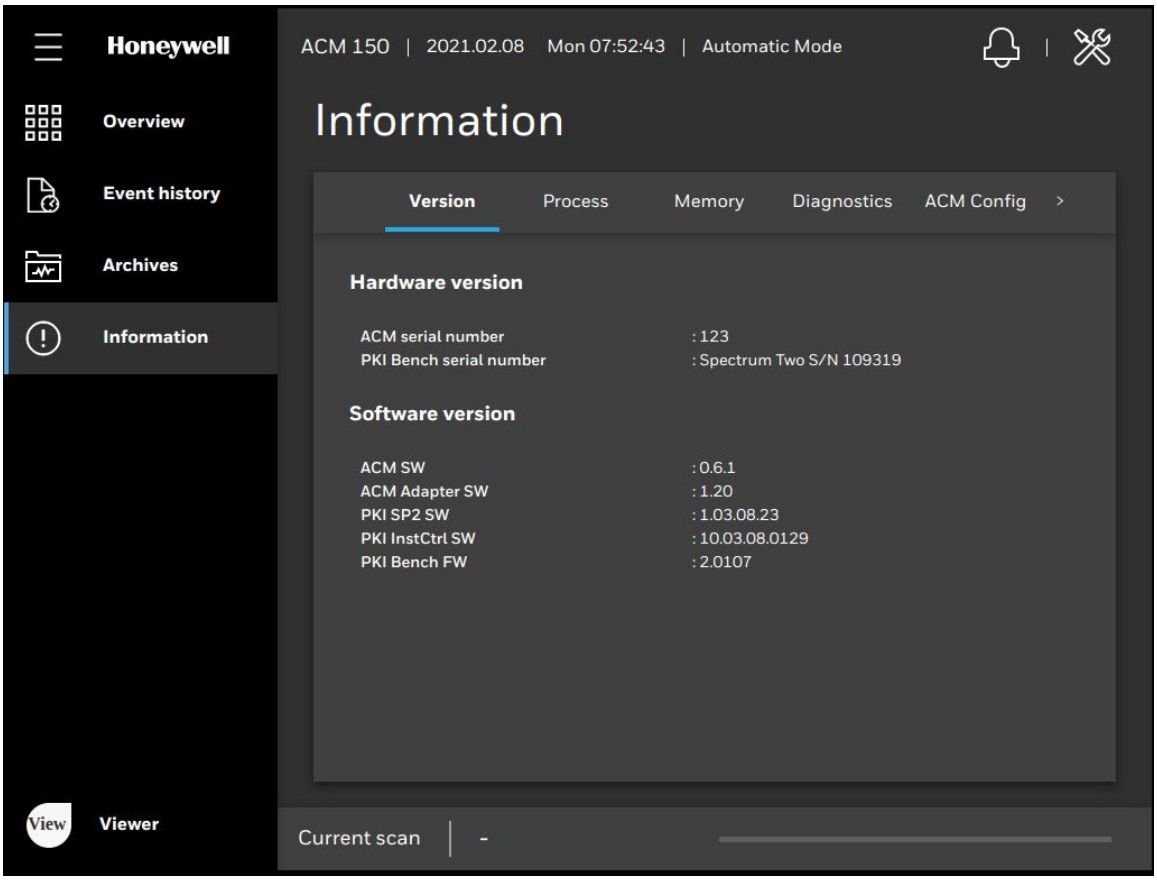

Figure 51. ACM 150 Product Information

ICON KEY
 Authorized Users
 Trained Technician

7. Settings Menu

7.1. Accessing the settings menu

Only authorized users with an access code are permitted to change the setup program. You must login before changes can be made. After making changes, logout to prevent unauthorized changes to the setup.

7.2. ACM Configuration

Settings> ACM Configuration

Admin user can set ACM configuration parameters.

CAUTION!

Please contact to Honeywell service for more information

7.3. Settings - General Configuration

7.3.1. Date and Time Configuration

Settings> General Configuration>Date/Time.

Set the time, using a 24-hour clock.

7.3.2. Network Configuration

Settings> General Configuration>Network

Set the IP address.

7.4. Settings – Account Manager

Settings> Account Manager

Access levels should be assigned only to personnel authorized to make changes to the setup program and to trained technicians who perform services and diagnostics. Select Login level, which prompts you to enter a password.

A default administrator account and password are created by Honeywell Analytics in the configuration software and given to the person in charge of the ACM 150 monitor. Log in administrator account can access Account manager menu as shown.

When creating an account, select an access level, access ID and password.

Access ID	6~16 characters long with numbers and upper/lowercase letters.
Password	8~12 characters long with numbers, upper/lowercase letters and at least 1 special character.

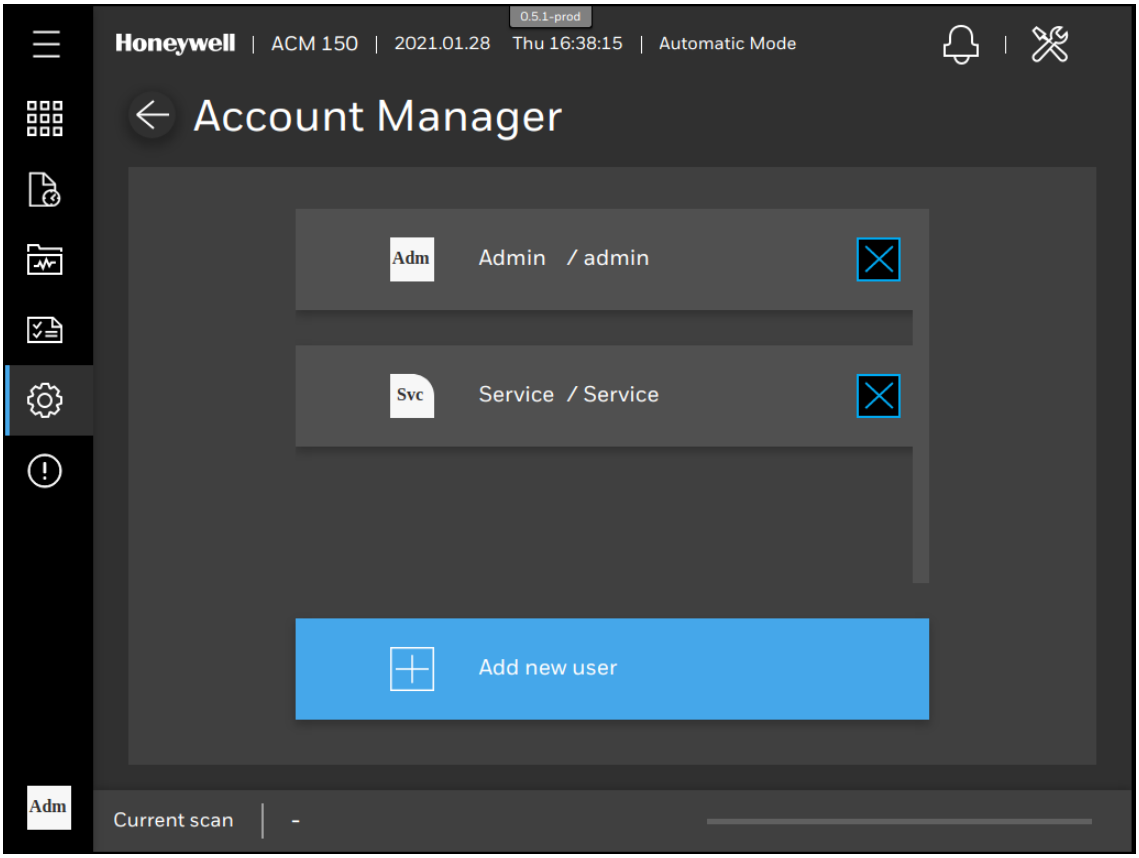

Figure 52. Account Manager Setup

Access level	Functional range
Viewer	Default Access Level. View most screens
Service	Viewer Service
Admin	Service Administrator

NOTE

Creating temporary Admin password when you forget admin password, please send information for S/N and date to HA service.

7.5. Settings – Point Configuration

Settings> Point Configuration

All users can access this menu. The Point Configuration, Figure 1 shows all the ACM 150 monitor sample points (areas) and their current status.

Points can only be scanned if they are listed in the Order of scan.

Enabled point only can be listed in the Order of scan. Disabled points cannot be scanned. Use this to prevent scanning points that are not ready, e.g. if the tubing or the equipment to be monitored is not yet installed.

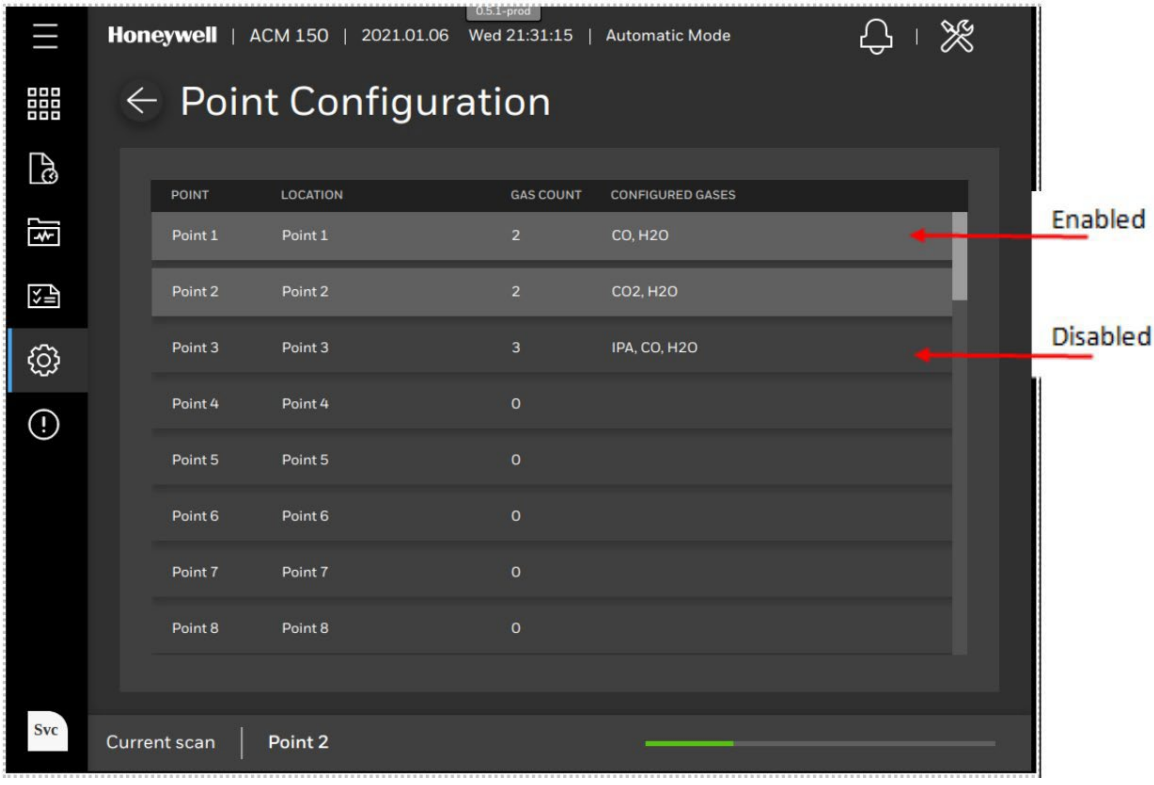

Figure 53. Point Configuration

If you know the name for a point but not the gases to be monitored, you can assign the name now and configure the gases later. If there is no status indicator next to the point, it has not yet been configured.

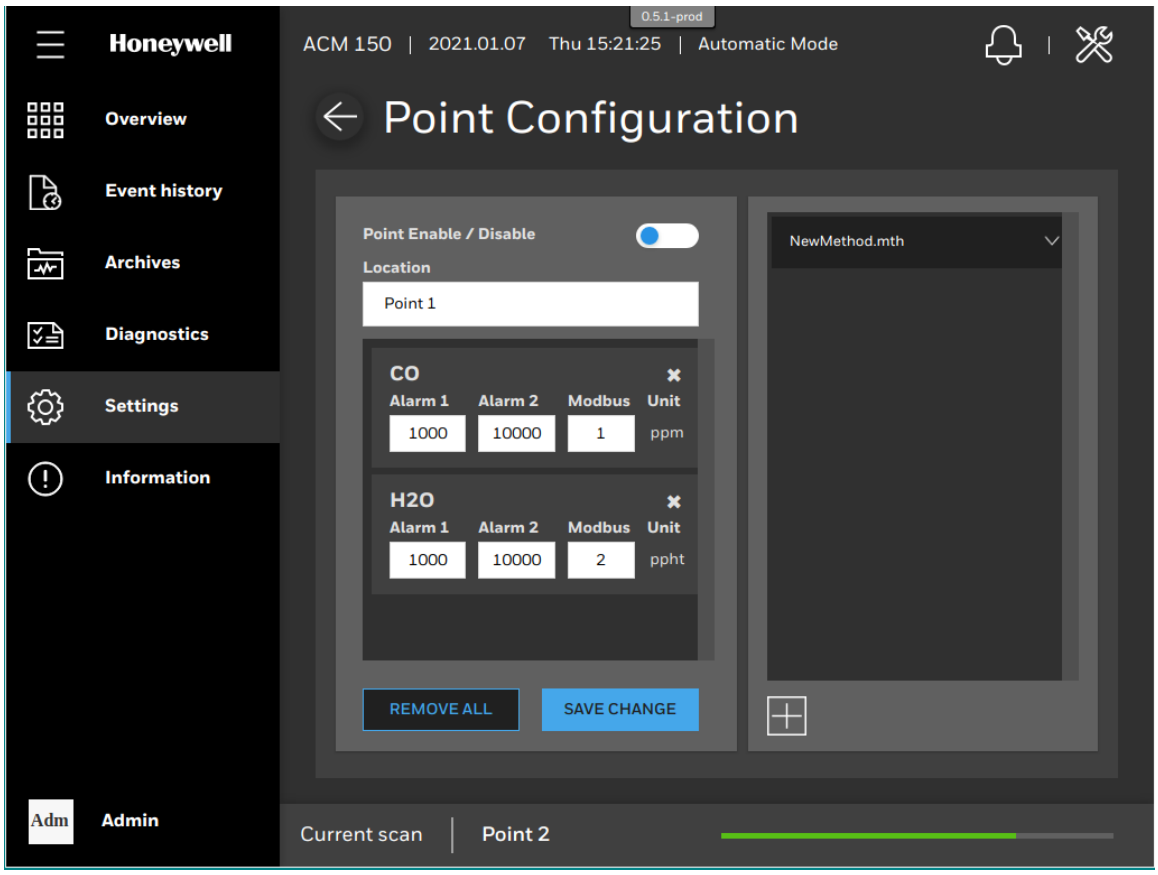

Figure 54. Edit Point Configuration

7.6. Settings – Order of Scan

Settings> Order of Scan

The Order of Scan defines the sequence of point scanning. Points may be scanned in any order, and points may be repeated in the sequence. It is also possible to have points in the sequence without making them active.

7.6.1. Reviewing the order of scan

Enabled points are listed. These points will be scanned. Not listed Points will not be scanned. Scroll down the page to view the complete sequence.

Figure 55.Order of Scan

7.6.2. Configuration key

For reference, a configuration key displays down the right side of the screen. This key indicates which of the points are enabled in Point Configuration.

NOTE

Only points with Scan Enabled in the Single Point Configuration can be scanned. The Configuration Key identifies the enabled points. Use this key as a reference for the Order of Scan, enabling only those points which are active.

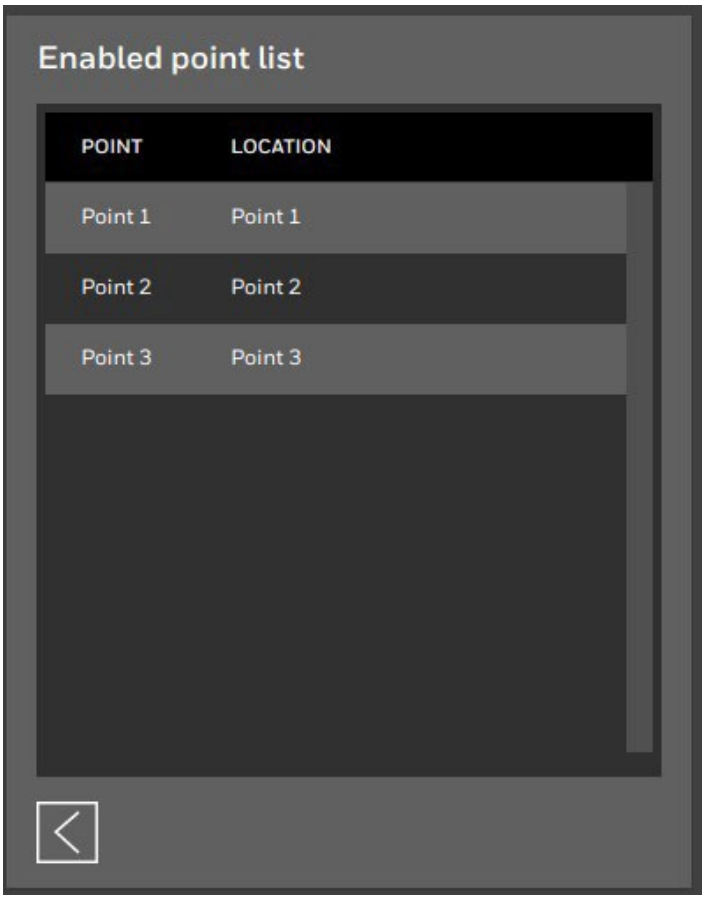

Figure 56. Enabled Point List

7.6.3. Reviewing and changing the order of scan

Until you login with an access code, you can only review but not change the order of scan. After you login, you may edit the sequence and enable or disable points. When editing Order of Scan follow the steps in Table 3.

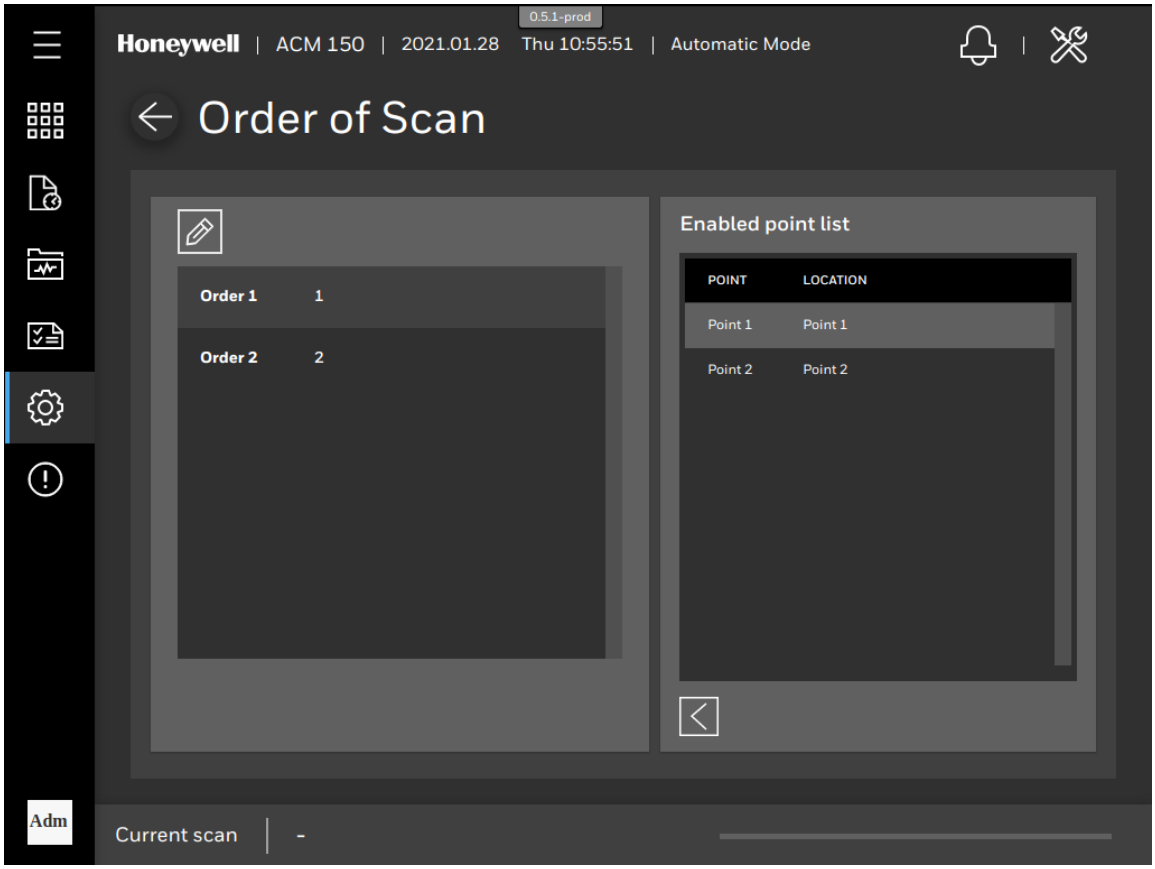

Figure 57. Review the Order of Scan

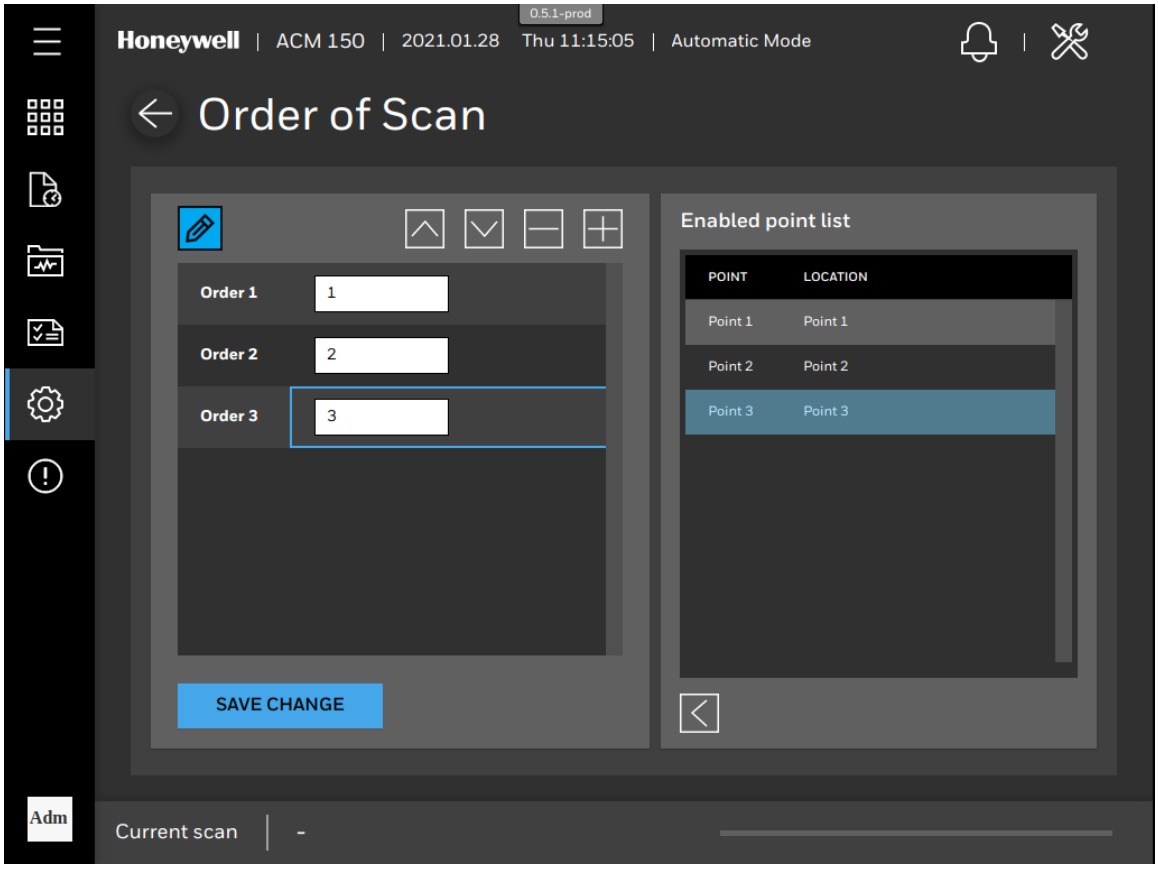

Figure 58. Editing the Order of Scan

Table 3: Scan Points Configuration

1	Decide on the scan sequence you want to use before you make any changes. *Note that points may be scanned in any sequence. If you want the ACM 150 monitor to spend more time scanning one or more critical points, you can repeat the point(s) in the sequence. Order of Scan allows a maximum sequence of 87 entries.*
2	Refer to Configuration key. This shows you which points are enabled for scanning. If you want to scan a point that is not enabled, go to the Single Point Configuration to enable it. *Note that if you are not ready to enable a point, you can put it in the sequence now and enable it later. To enable it later, first enable it in the Single Point Configuration. Then, enable it in the Order of Scan.*
3	If you change the order of scan, you will have to re-enter the scan points starting with the change you made until the new sequence is complete. Scroll down the list, as needed, to complete all your entries. *Note that if you want to scan points in their numerical order, enter a sequence.*
4	After you complete your selections, press “SAVE CHANGE” to make them active.

7.6.4. Composite Points

Up to 4 points may be sampled together by the FTIR to speed up the scan rate. The disadvantage of composite sampling is that the lower detection limit is raised because the sample from one point is diluted by the flow from the other sample points in the group.

When the ACM 150 monitor detects any non-zero gas concentration, it finds which point has the target gas by searching, one-by-one, through all the points in the group. Because any gas concentration other than zero will trigger a search, water detection should not be active on any composite points.

When the points are scanned individually, they are treated as any point in normal scanning. The dilution factor does not apply. Alarm 1 / Alarm 2 incidents initiate the actions as described in Alarm 1/Alarm 2 incidents and Actions.

Composite Point groups have only one advantage. They shorten the scan cycle. Since the ACM 150 monitor typically monitors air having no target gases present, the readings are zero most of the time. Composite sampling enables the ACM 150 monitor to increase its rate of scan until a gas leak occurs.

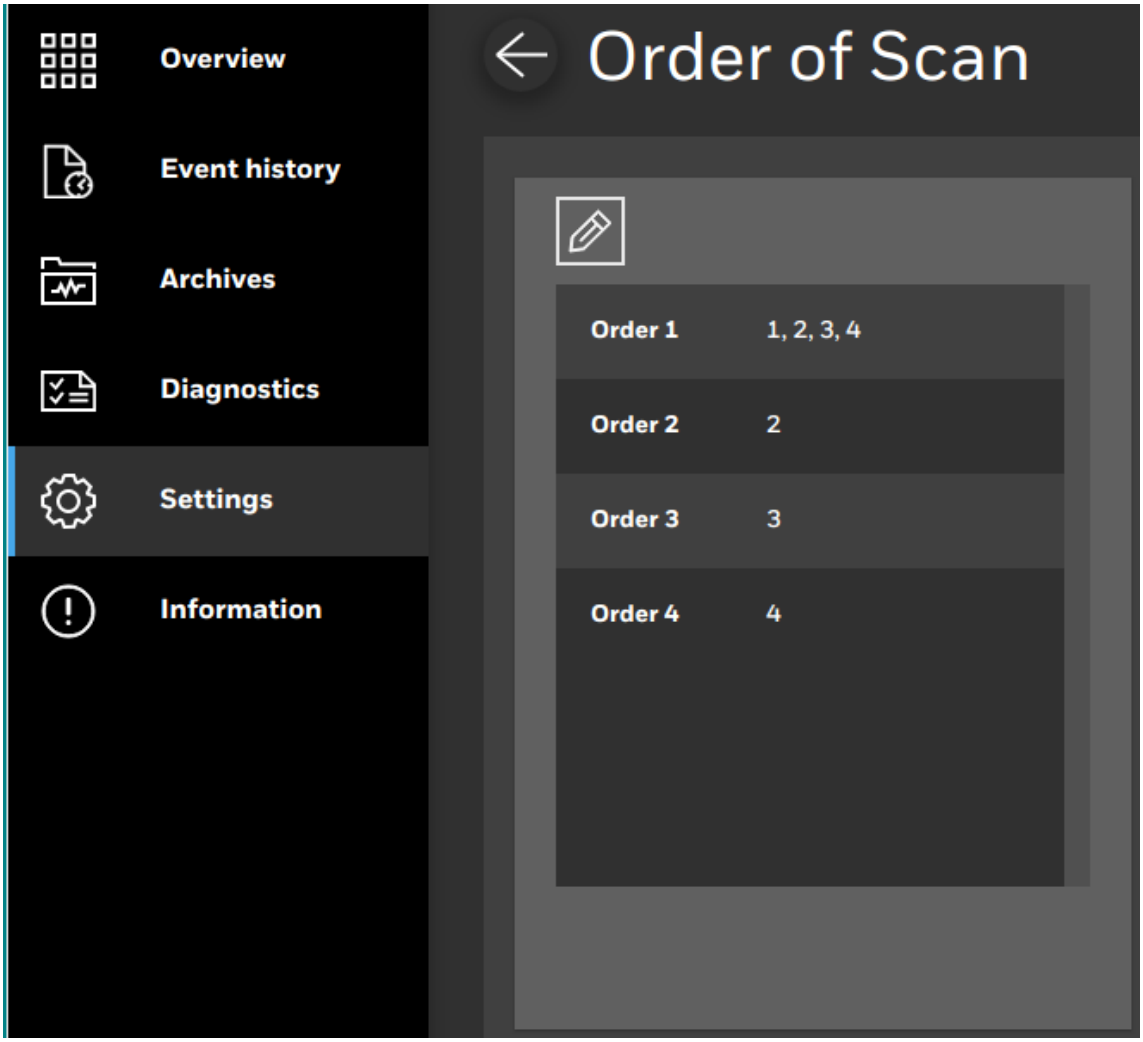

Figure 59. Composite Points

CAUTION!

Composite point sampling may expose employees to hazardous conditions by lowering the gas detection capability. Use Composite Points only if the rate of scan must be increased. The following rules apply and must be followed:

1. Group only the sample areas that are near to avoid combining long and short tube runs, which may cause an imbalance in the composite mixture.

2. Group points which have identical Single Point Configurations, i.e. the same method with the same active gases and the same Alarm 1 and Alarm 2 set points.

7.7. Settings – Method Manager

Settings> Method Manager

Analytical methods (defined in Analytical methods) are dynamic. Methods may be updated, new methods added, and old methods deleted, as often as required, to keep pace with the ever-changing R&D and production chemicals.

Use the Method Files key to import new and updated methods and to delete methods no longer used. The menu is shown in Figure 60.

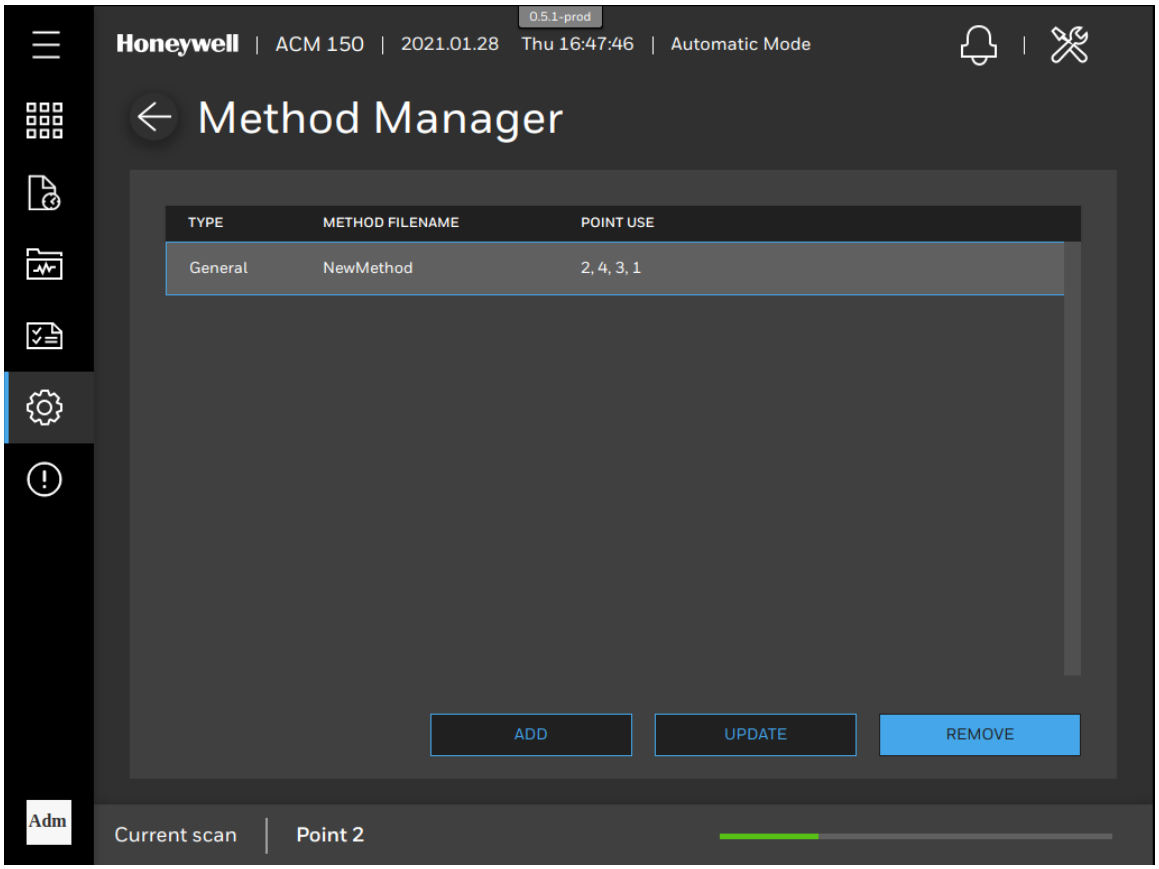

Figure 60. Method Manager

7.8. Settings – Relay Configuration

The ACM 150 monitor has 80 programmable relay outputs. The functions and uses of the relays are described in section Alarm 1/Alarm 2 incidents and actions. These relays have a default setup that controls their program until that setup is changed.

7.8.1. Reviewing the programmable relays

Relay 1 is preassigned to point 1. It activates when the Alarm 1 level set point is exceeded for “all gases”. Relay 2 is preassigned to point 2 at the warn level. This progression continues through relay 40 and point 40.

Relays 41-80 follow the same progression, i.e. relays 41-80 are preassigned to points 1-40. Relays 41-80 activate at the Alarm 2 level set point for all gases.

“All gases” applies to the gases actively monitored at that point. If one or more of these gases exceeds its Alarm 1 set point, relay 1 would activate. If any of these gases exceeds its Alarm 2 set point, relay 41 would activate.

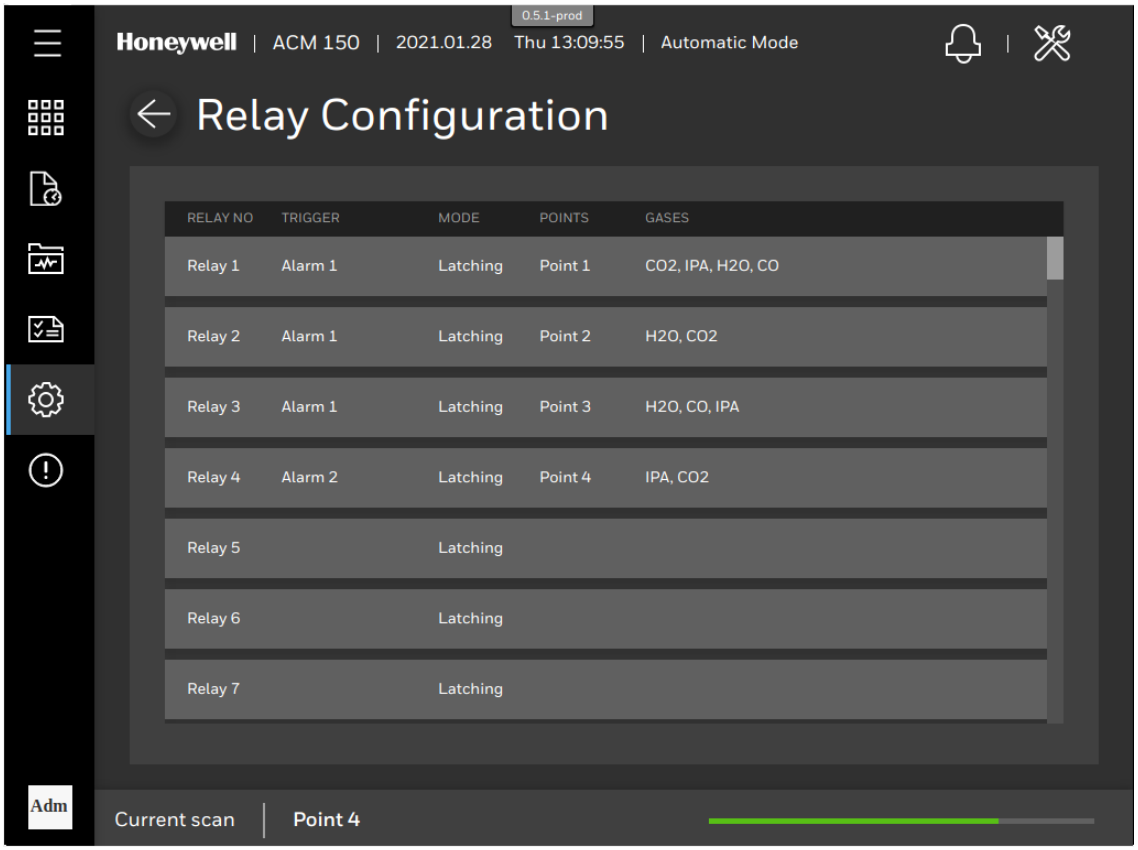

Figure 61. View Relay Configuration

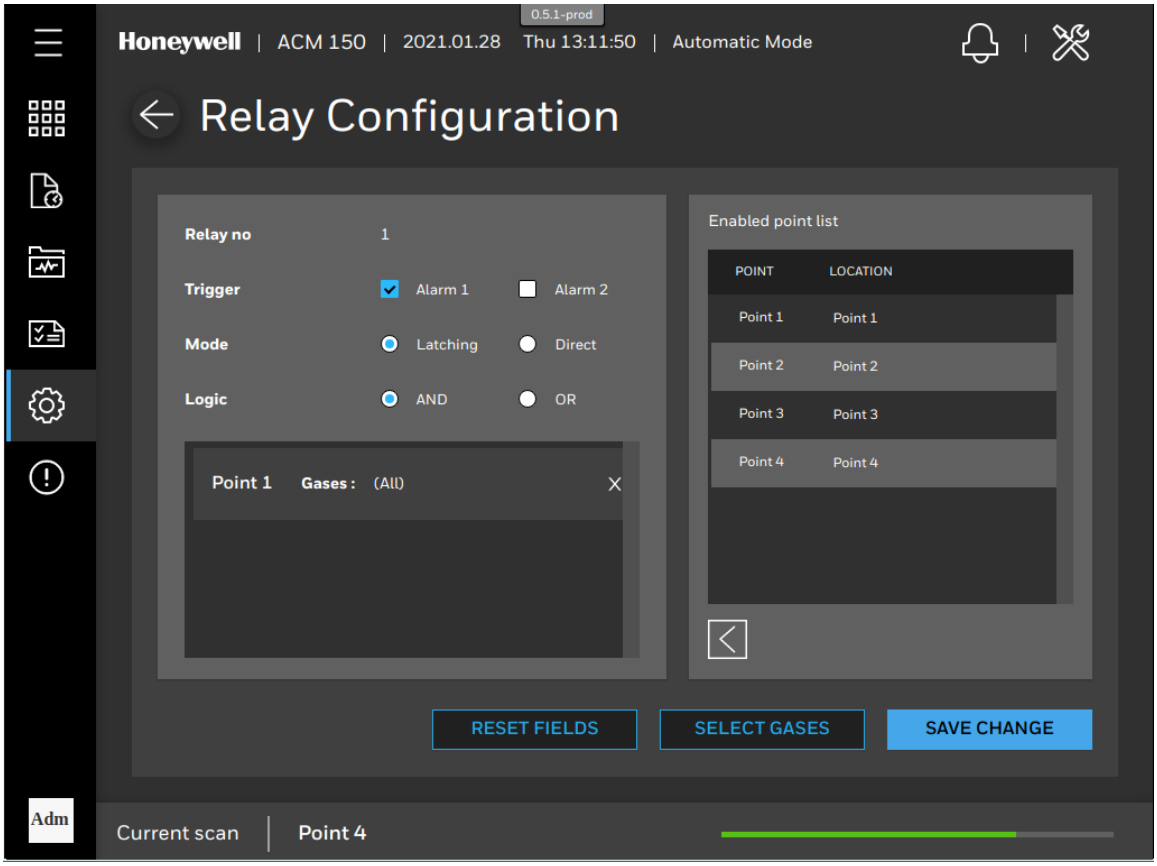

Figure 62. Relay Configuration

7.8.2. Selecting the relay program

Follow the steps in Table 4 when assigning levels, points and gases to a relay.

Table 4. Relay Programming Steps

1	Before you proceed to change the default relay program, you should first have a plan for each of the relays you want to program and use. Form 2: “Plan for ACM 150 incidents” may be used to record your plan.
2	After you login, press a Relay to selection and changing. Relays must be individually programmed.
3	Select the relay number, e.g. Relay 1. Once the relay is selected, you must make three selections: • First, select the activation level, Alarm 1 and / or Alarm 2 • Second, select the mode, either direct or latching • Third, select the activation point number(s) for this relay. *Note that a relay may be assigned to one point or multiple points, up to a maximum of 10.*
4	Press the “SELECT GASES” after entering your selection for point numbers. This takes you to the activation gas(es) screen, shown below. The active gases are listed for each point that you assigned to this relay. Now, select a gas or group of gases you want to assign to this relay. *Note that if you want to continue to have ‘all gases’ assigned, leave all gases selected (make no changes to the default program).*
5	Press RESET FIELDS, if you make a mistake and want to recover the original selections
6	After you complete your selections, press “SAVE CHANGE” to make them active.

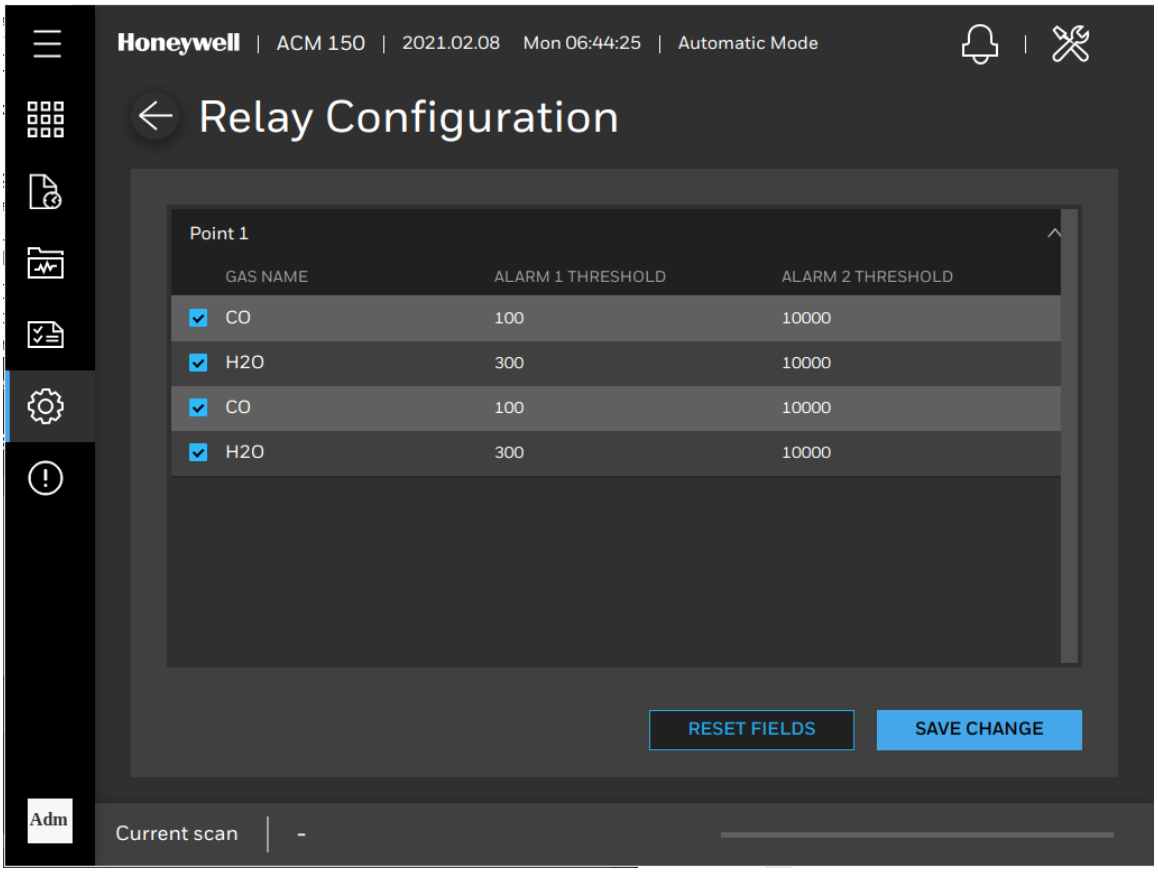

Figure 63. Selecting Relay Gases

NOTE

After programming relays, test them to verify that they are wired correctly to external devices so that they will perform their alarm and control functions properly.

7.9. Settings - Import/Export Configuration

Settings> Export/Import Configuration

After you setup the ACM 150 monitor and each time you change the setup, you want to save the configuration to the ACM 150 monitor hard disk. Also, you should backup the configuration to a USB flash drive. Then, if the software should get corrupted or the hard disk fail, you can save hours of work by loading the configuration from your storage drive.

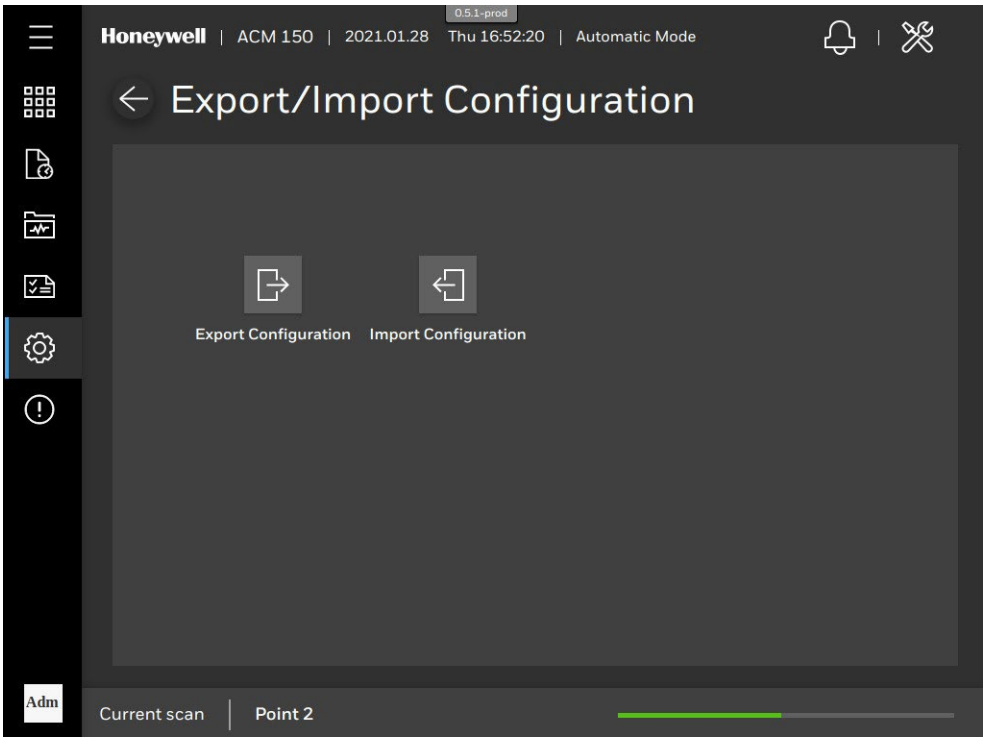

Figure 64. Export/Import Configuration

8. Shutdown Procedure

8.1. Emergency shut down

Immediately turn off the Main Power Switch located on top of the ACM 150 monitor to disconnect power to all the internal circuits.

Figure 65. Main Power Switch

8.2. Planned shut down

8.2.1. Line power

- Be aware of any impact that shutting down the ACM 150 monitor may have on your facility and prepare for it, e.g. 'fail-safe' relays that activate alarms on loss of power or shut off gases automatically when this system is not on-line. Use appropriate precautions, to avoid unscheduled interruptions of production.
- Turn off the Main Power Switch, Figure 65, located on top of the ACM 150 monitor.
- Follow Lockout / Tagout Procedure when shutting down the monitor for service or relocation.

8.2.2. Utility gases

The ACM 150 monitor uses compressed air (global) and nitrogen. The user is required to provide an external shut-off valve located nearby (refer to Utility gases and exhaust piping). These valves can remain open during shut down, provided these utility gases and the components they supply remain connected.

Under these conditions you should close the external shut off valves:

- The system is shut down for an extended period, taken out of service or relocated.
- The venturi pumps or gas cell are serviced.
- The utility external connections (Figure 25) or the internal supply lines are disconnected.

CAUTION!

This is a high-pressure safety hazard. The compressed air (CDA) supply pressure normally exceeds 100 psig (7 kg/cm2). After shutting off the external supply valve, check the internal pressure regulators on the CDA Panel, Figure 20, to ensure that they read zero. This confirms that the pressure has bled down and that it is safe to continue.

8.2.3. Internal disconnects

If you need to disconnect a specific assembly from line power to prevent it from starting when power is restored, unplug it from the Power Distribution Panel, Figure 19.

9. Maintenance

9.1. Lockout / Tagout Procedure

9.1.1. ACM 150

Before accessing, testing, touching or removing any electrical circuits, plates or shields in the ACM 150 monitor, disconnect the power following the procedure in Planned shutdown for both line power and utility gases. The Main Power Switch, Figure 24, is lockable in the Off position, and it provides Lockout / Tagout for the ACM 150 monitor. It disconnects all electrical power within the system.

DANGER!

Electrocution danger. The Main Power Switch is the tie point for line power, which connects to terminals inside the switch. Before removing the cover to this switch to access these terminals, disconnect line power via the external Lockout / Tagout switch.

After appropriately locking and tagging the switch, verify with a voltmeter or equivalent suitable device that all electrical voltage into the ACM 150 monitor has been isolated and de- energized. This procedure should be followed for both the integral Lockout / Tagout switch and any external disconnects that the user may have.

9.1.2. External

A means of disconnecting line power at the source is necessary to allow safe access to the power terminals at the ACM 150 monitor. An external Lockout / Tagout switch must be installed for this purpose. Follow your company's Lockout / Tagout procedure, shutting off and locking this switch when required.

9.2. Decontamination / Decommissioning Procedures

9.2.1. Purpose

To establish a safe procedure for decontamination and the eventual decommissioning of the ACM 150 monitor at a customers' site.

9.2.2. Procedures

Wear appropriate Personal protective Equipment. Standard Nitrile gloves are recommended.

1. Disconnect all gas sample lines from the fittings on the top of the ACM 150 monitor.
2. Allow the ACM 150 monitor to run in automatic sampling mode for 60 minutes to purge any residual gases in the system. The automatic mode should include the sample ports enabled during normal monitoring operation.
3. Shut off the CDA supply. The backup exhaust pump should automatically turn on. Allow to run for 10 minutes.
4. Shut down the ACM 150 monitor by turning off the power at the power disconnect switch. Lockout and tagout the electrical supply at the facility connection.
5. Shut off the nitrogen supply. Verify that the pressure in both the CDA supply and the nitrogen supply has been relieved. Disconnect both the CDA and nitro- gen supply lines.
6. Remove and disconnect all electrical power and communications lines.
7. Remove and replace the sample filter located in the lower pump cabinet. The panels of the lower cabinet are removable for access.
8. Inspect and clean the optics bench components, such as the sample cell, windows, and mirrors.
9. If moving the ACM 150 monitor, lock both the sliding optics bench drawer and the pump assembly drawer by installing the appropriately sized screws through the drawer plates and into the lock brackets.
10. Reinstall all outer panels removed during the cleaning procedure and close and latch the outer doors.
11. If decommissioning, please recycle all applicable parts. These might include the steel chassis, circuit boards, etc.
12. Please dispose the decontaminated unit according to all applicable local requirements.

NOTE

The FTIR optics bench will absorb ambient moisture when not powered. Long periods of storage will result in degraded performance of the optics bench and may result in non-operation. Storage of an ACM 150 in high ambient humidity environments is not recommended.

9.3. Inspection and service schedule

The ACM 150 monitor constantly monitors itself for proper operation. Problems are identified as Service Events and they change Service Status. At the same time, relays are activated to notify the user of service problems or a loss of power (refer to Troubleshooting). All users should utilize these relay outputs for immediate notification that a service problem has been detected.

Table 5: Service Events

No	Service	Description	Schedule	Remark
1	Checking CDA Pressure	CDA regulator 90 – 120 psig (320 L/min)	Every three months	
2	Checking N2 Pressure	N2 regulator 5 – 10 psig (10 L/min)	Every three months	
3	Replace End-line filters	Keep Sample vacuum pressure	Annual	
4	Replace booster pump diaphragm	Keep Booster pump vacuum pressure	Annual	
5	Checking PKI FTIR Bench IR source	Parameter checking by a Test program	Annual	
6	Replace PKI FTIR Bench desiccant	Run out desiccant. Refer to service code 54	Three Years or Service event	Turn Around Service
7	Checking Gas cell window	Monitoring ZPD level parameter. Refer to service code 52	Every tree months or Service event	
8	Checking FTIR Optics Bench	spectrum2 test program	Two years	
9	Checking Sample valve	Cleaning and check valve	Five years	
10	Checking Cycle valve	Cleaning and check valve	Five years	

9.3.1. Monthly service

It is highly recommended to reboot the ACM 150 monitor computer monthly. This ensures proper operation and avoids unexpected behavior.

9.3.2. Quarterly inspection

It is recommended that the ACM 150 monitor be inspected every 3 months (more frequently, if desired) and that service be performed, if any problems or failures are found.

A qualified service technician must be contacted and resolve them following Service inspections and procedures.

9.3.3. Annual PM services

Inspect and service the ACM 150 monitor in accordance with Service inspections and procedures. If you have not already done so during the past 12 months, replace these expendable items:

- Cabinet filters
- Gas cell filter
- In-line filters
- Gas cell windows
- Booster pump diaphragm / flapper valves
- Back-up pump vanes

(but only if the venturi pumps were not in use most of the time)

- FTIR Desiccant

If any of these items have been replaced during the past 12 months and pass inspection, there is no need to replace them during the annual service.

9.3.4. Two year service

These services are recommended at least once every 2 years:

FTIR Optics Bench: The infrared source, HeNe laser, and laser power supply have a limited operating life. HA can provide a reconditioned bench to exchange for your used bench, which is returned to HA for reconditioning.

9.3.5. Five year service

These services are recommended at least once every 5 years:

Sample Valves: Disassemble the valve manifolds and clean the valves with a solvent to assure that the accumulation of deposits and particles are removed.

Cycle Valves: These valves are expected to eventually wear out. They can be replaced as one subassembly.

9.4. Contract services

Our Service Department offers service contracts to perform on-site scheduled PM services for the ACM 150 monitor, other central monitors, and its gas detectors.
These contracts can encompass other HA products as well.

ACM 150 service contracts normally include the expendable parts for the annual PM service, and they can also include an FTIR bench exchange. Contact your local HA representative for additional information and a quotation.

ICON KEY
Authorized Users
Trained Technician

10. Service Operations

10.1. Archives Menu

This menu service export measured gas readings and other events.
User data exporting may take time to gather the database. User can download files from the “Download” menu when data extracting is ready.

NOTE

Archive data list in screen has size limit.
Please export Archive data if you want to check all items.

10.1.1. Spectrum

Archives>Spectrum

Select the spectrums and export

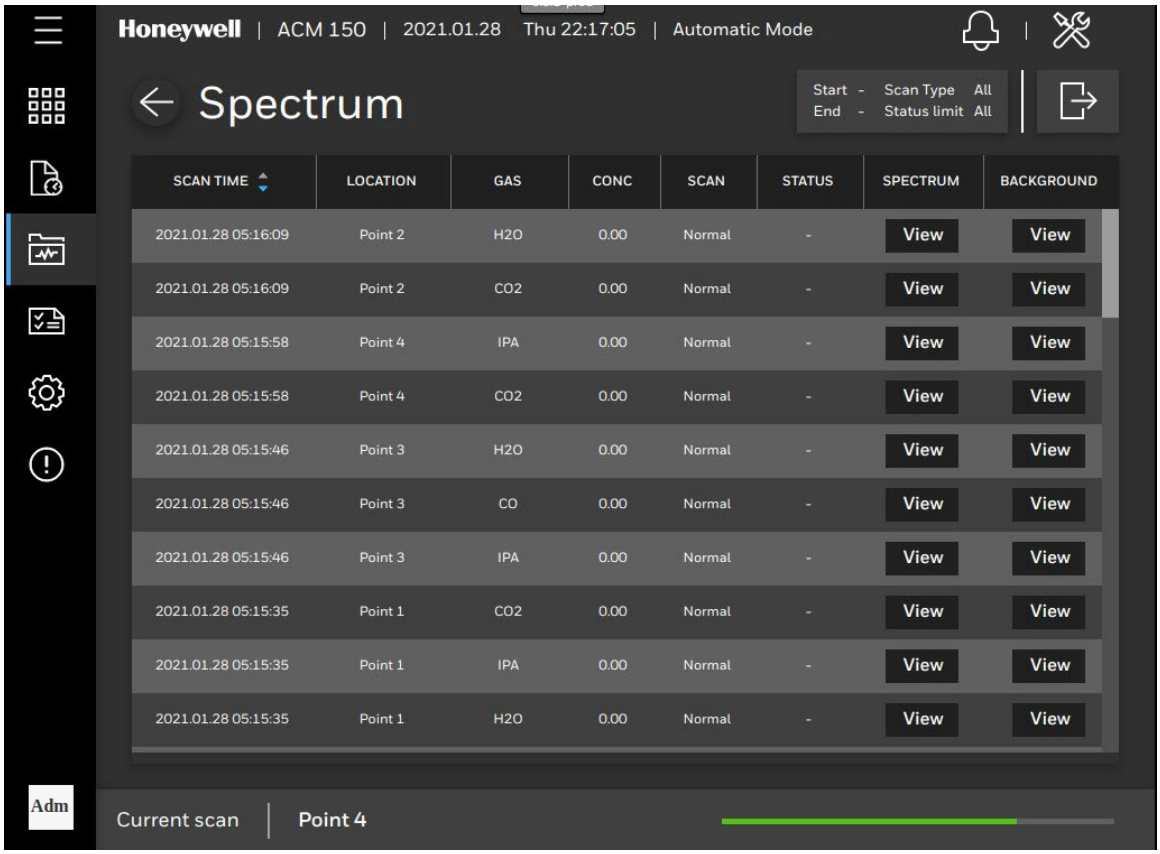

Figure 66. Archives Spectrum Data

10.1.2. Gas conc. Trend

Archives>Gas conc Trend

Select a point and show gases concertation trend. It can be exported.

10.1.3. SNR Trend

Archives> SNR Trend

S/N is the signal-to-noise ratio. It is calculated automatically during every ‘Background’.

S/N determines the lower detection sensitivity of the FTIR analyzer, the higher the value the better. If the S/N degrades below preset limits, the ACM 150 monitor generates an incident message. A degraded S/N indicates the need for service before it reaches unacceptable levels.

10.1.4. ZPD Trend

Archives>ZPD Trend

The ZPD Trends indicate changes in the FTIR detector signal, which is the relative intensity of the infrared radiation on the detector (refer to ZPD values (Energy and Position) for a complete explanation).

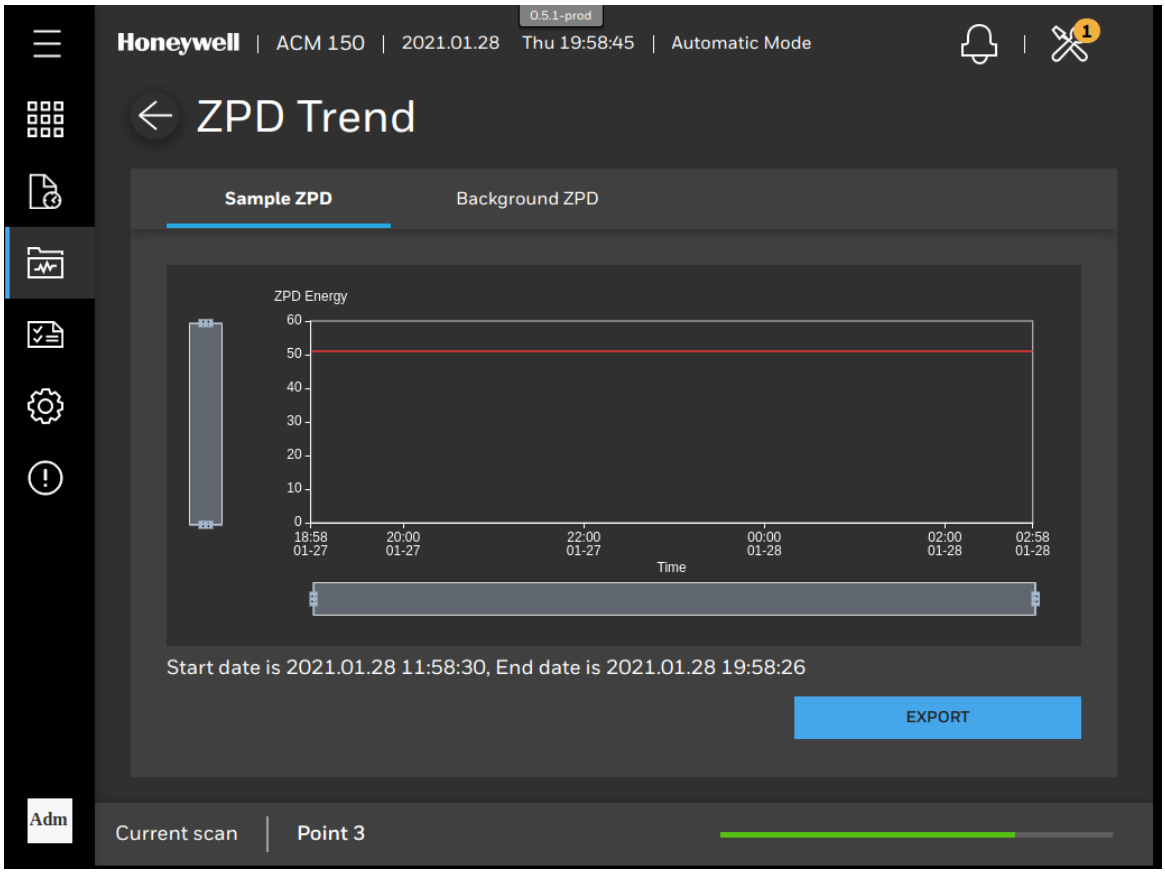

Figure 67. ZPD Trend

10.1.4.1. Background ZPD Trend

Archives>ZPD Trend>Background ZPD

The graph in Figure 67 is a daily average of the ZPD energy over a 15-day period. It is a trend for the 'Background', which occurs every 2 hours. Because the background gas (nitrogen) is consistent, the graph should be relatively flat.

Between service intervals, the trend is usually in the direction of a decreasing ZPD. A decreasing ZPD energy is an upward trend on the graph, because ZPD energy is a negative number. Following a service, where the magnitude of the ZPD energy increases, or following an upset condition, where the ZPD energy is reduced, you can expect a 'step-change' in the trend.

10.1.4.2. Sample point ZPD Trends

Archives>ZPD Trend>Sample ZPD

You can also trend the average daily value of the ZPD energy for any active sample point.

10.1.5. Download

Archives> Download

All user exported data are listed to download. It may show progress during gathering data. User can download the data to external USB drive.

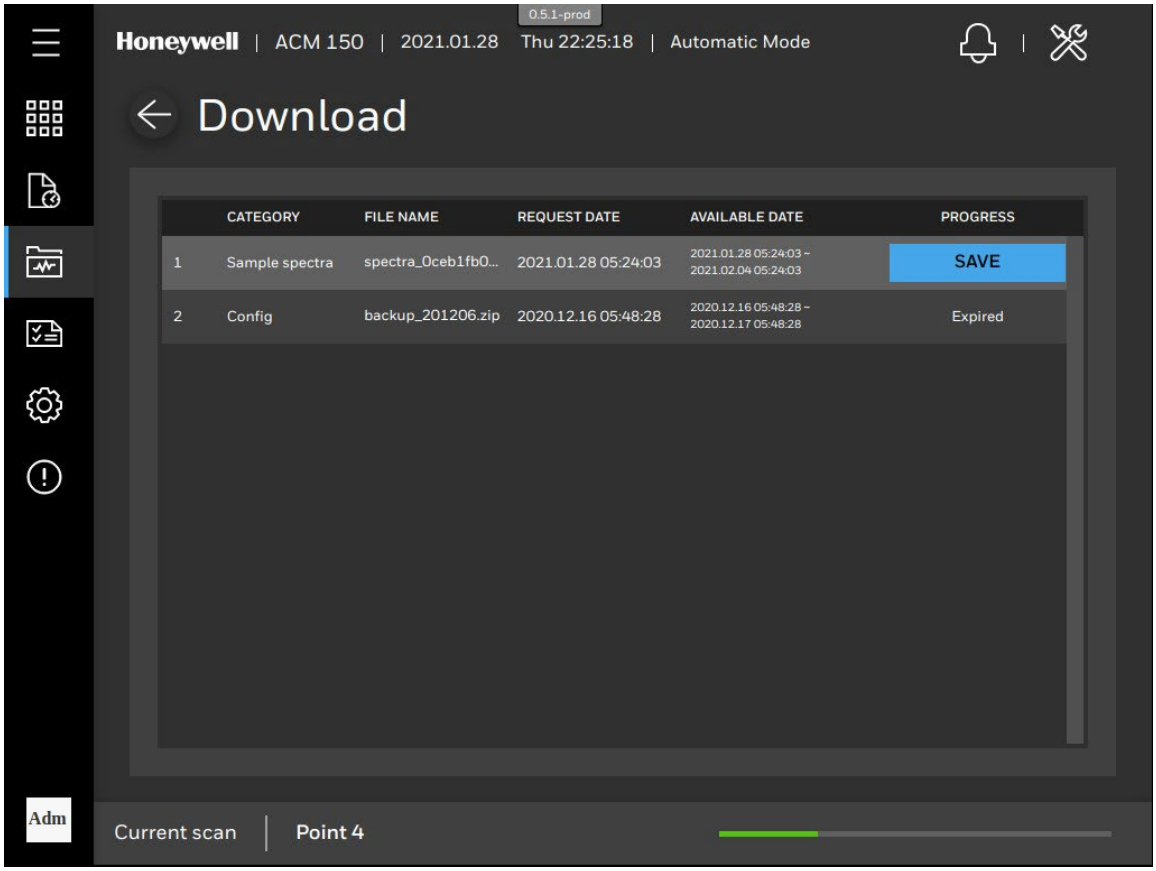

Figure 68. Download Exporting Data

10.2. Diagnostics Menu

Diagnostics>

Table 6: Diagnostics Menu

Menu	Sub menu	Description	Access	Mode
Background Scan	N/A	Manual background Scan	Service	Auto
View cycle valve	N/A	View valve cycles	Service	Auto
View Spectrum	N/A	View and compare spectrums	Service	Auto
Hardware Service	Cycle valve test	Manual test for cycle valves	Admin	Test
	Sample valve test	Manual test for sample valves	Admin	Test
	Relay test	Manual test for relays	Admin	Test
	Watchdog timer test	Manual test for Watchdog timer	Admin	Test
	Kinked tube test	Manual test for kinked tube	Admin	Test
	Line leak Test	Manual test for line leak	Admin	Test
Software Service	Memory Maintenance	Clear Log data	Admin	Test
	Alarm Simulation	Gas alarm event simulation	Admin	Test
	Fault Simulation	Fault event simulation	Admin	Test

NOTE

Please make sure ACM 150 can run normal scan on Auto Mode. User can see a Mode at status bar as following. Diagnostic menu may change from “Auto Mode” to “Test Mode”.

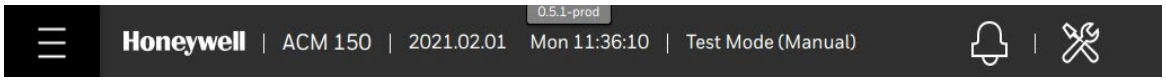

Figure 69. Status Bar

10.2.1. Background Scan

Diagnostics> Background Scan

You can obtain a background spectrum on demand by selecting ‘Background scan’. As shown in Table 6, the background spectrum is displayed for evaluation.

In this mode it is also possible to ‘Save New Factory Background’ Scan’, which would replace the prior reference background.

NOTE

Do not save a new factory background unless you are requested to do so by your HA service technician or application chemist. There should be a valid purpose for updating this reference.

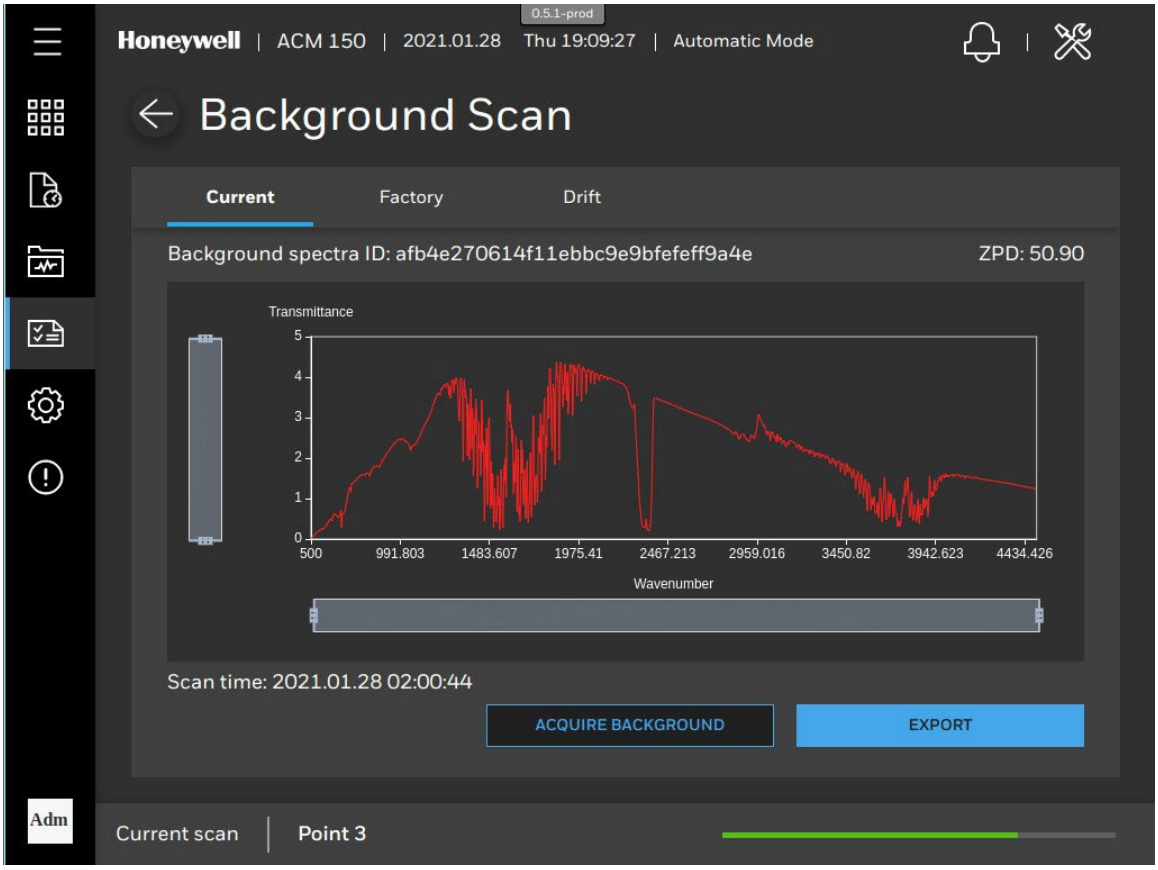

Figure 70. Acquire Background

10.2.2. View cycle

Diagnostics> View cycle

This mode displays the ACM 150 monitor flow schematic with the current activation state of each Cycle Valve, as shown in Figure 71.

As the ACM 150 monitor progresses through its sampling sequence, you can observe the changing activate states. The standard activation sequence is explained in ACM 150 flow cycles and the standard cycle timing and pressures are given in Table 1.

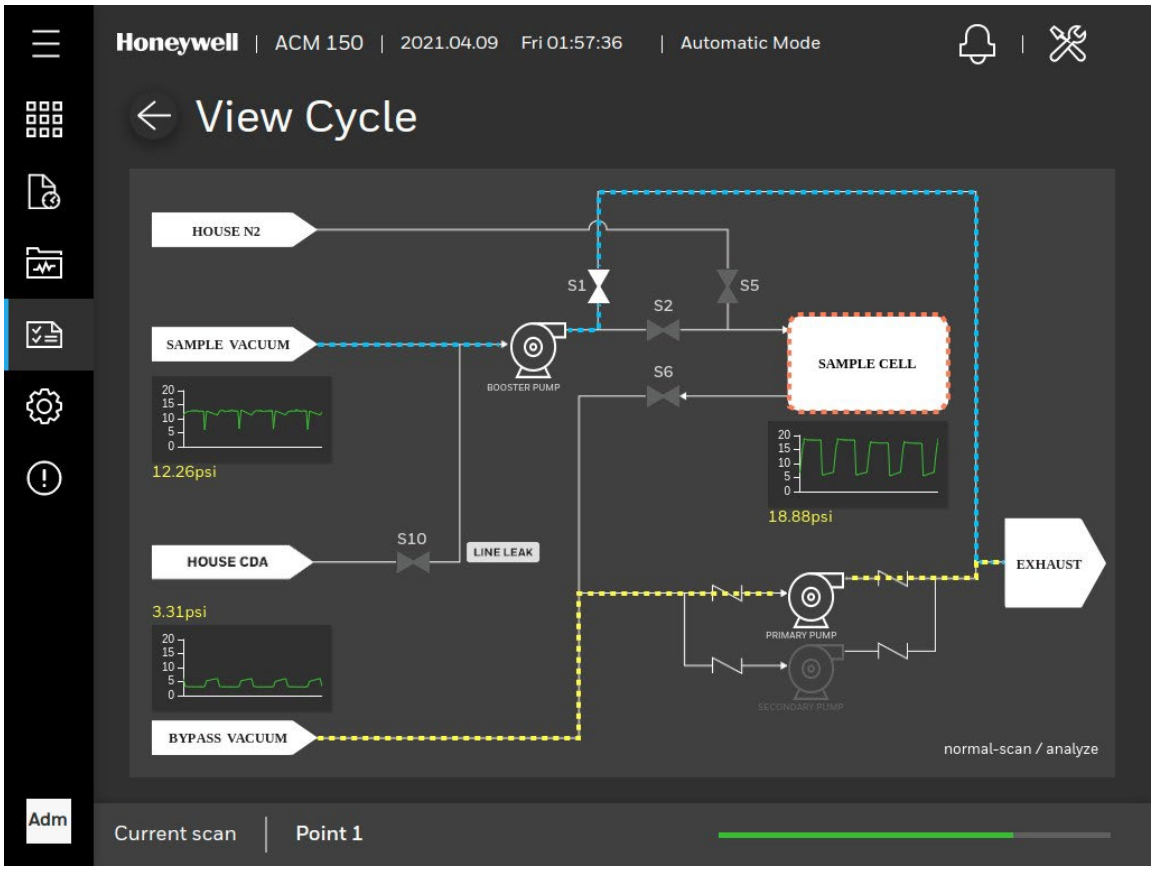

Figure 71. View Valve Cycles

10.2.3. View Spectrum

Diagnostics> View Spectrum

This screen shows selected the spectrum and can compare from reference spectrums:

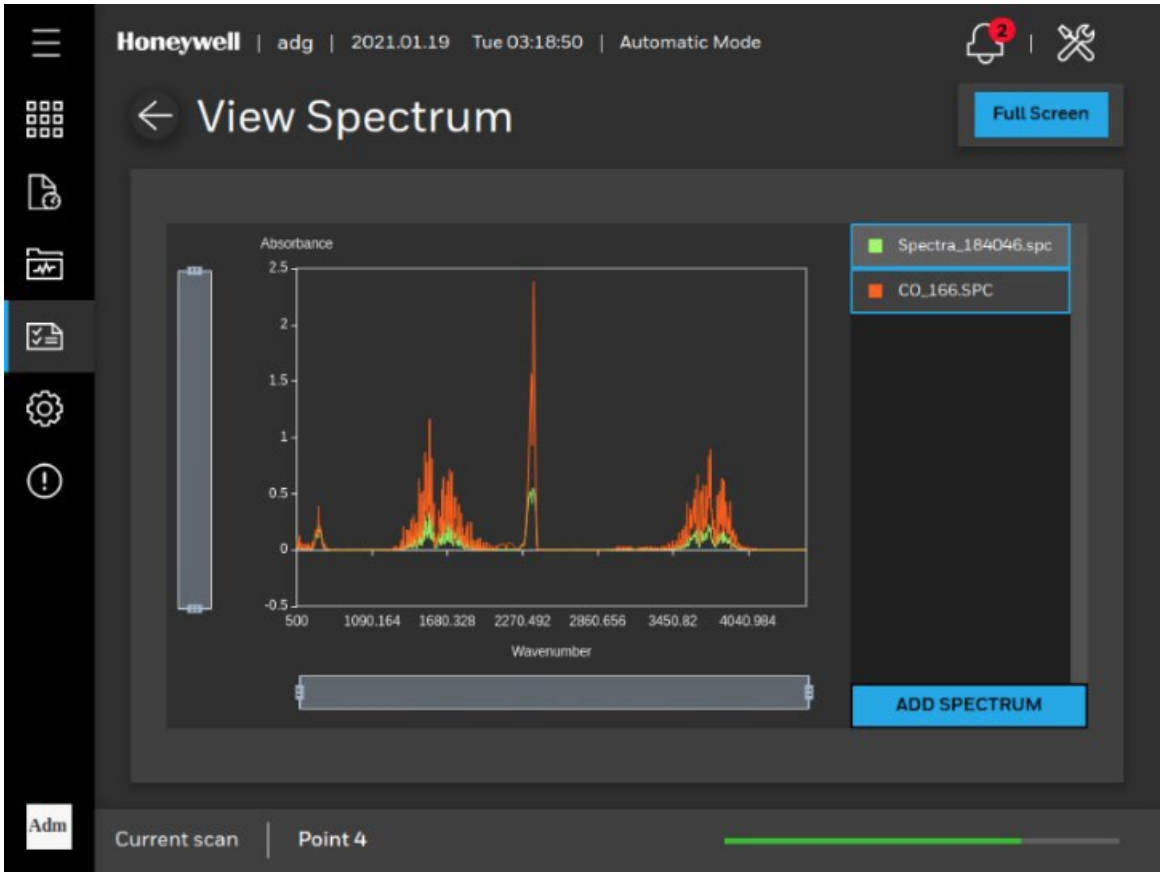

Figure 72. View Spectrums

10.2.4. Hardware Service

Diagnostics> Hardware Service

10.2.4.1. Cycle valve test

Diagnostics> Hardware Service >Cycle valve test

This mode displays the ACM 150 monitor flow schematic. It is the same schematic displayed in automatic mode, View valve cycles, except you have control over each valve.

Click the valve on screen for turn on and turn off.

	2-way valves show with a white fill when they are selected and activated to open. Flow can pass through these open valves. Select the white valve again to close the valve.
	When you enter this mode, all valves are inactive.

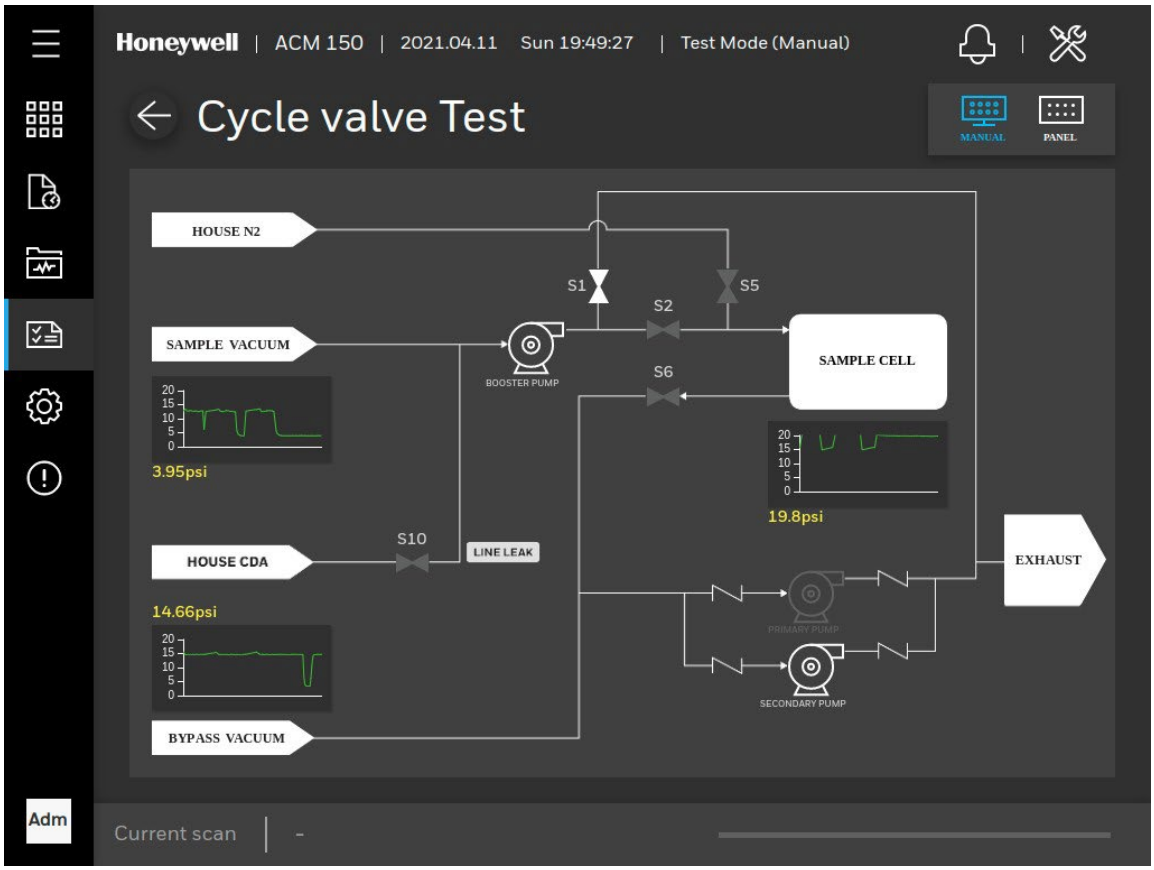

Figure 73. Cycle Valve Test (Dual pump, line leak option)

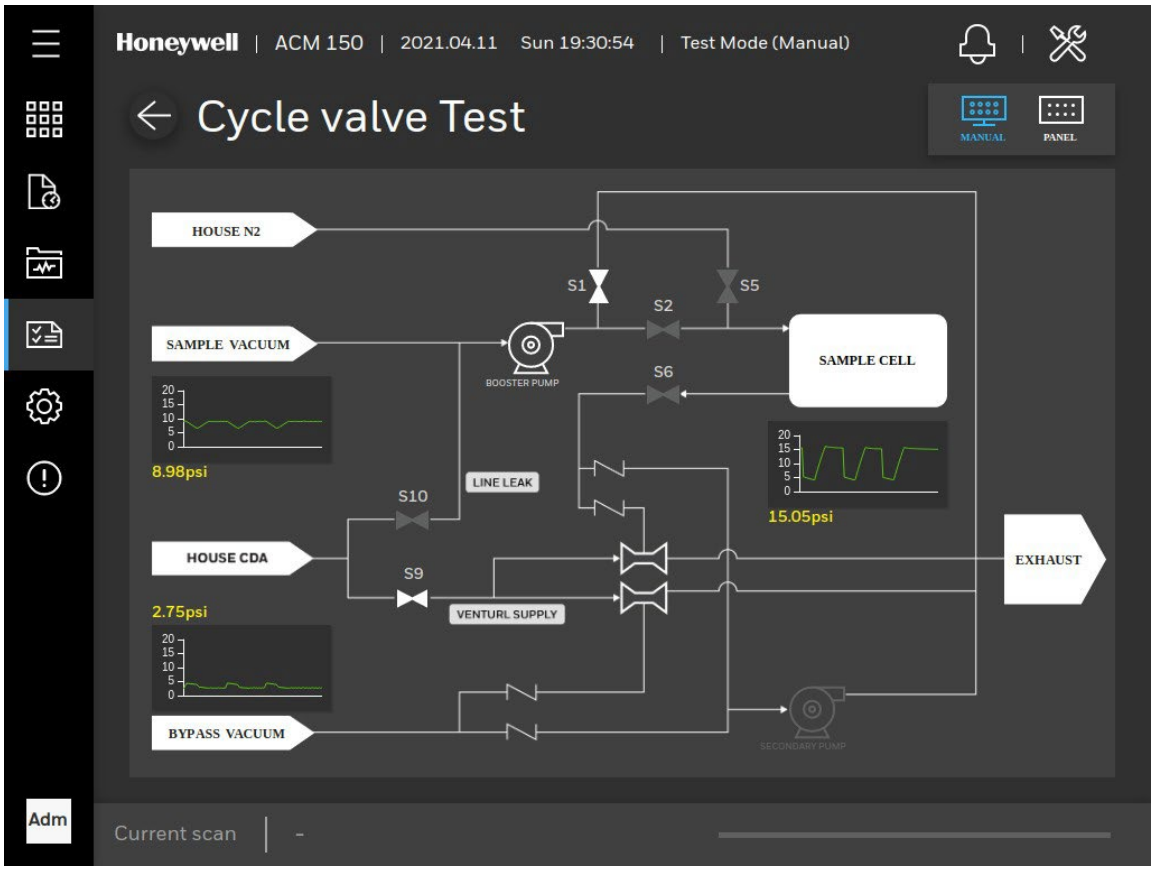

Figure 74. Cycle Valve Test (Venturi pump, line leak option)

10.2.4.2. Sample valve test

Diagnostics> Hardware Service>Sample valve test

All the sample valves, 1-40, may be controlled manually. The figure below shows valves 1-40.

No valves are activated when you enter this mode. Select the valve you want to activate to open it. Valves 1 and 6 are selected in the figure shown below. This mode is a convenient way to test any specific sample valve or all valves in sequence.

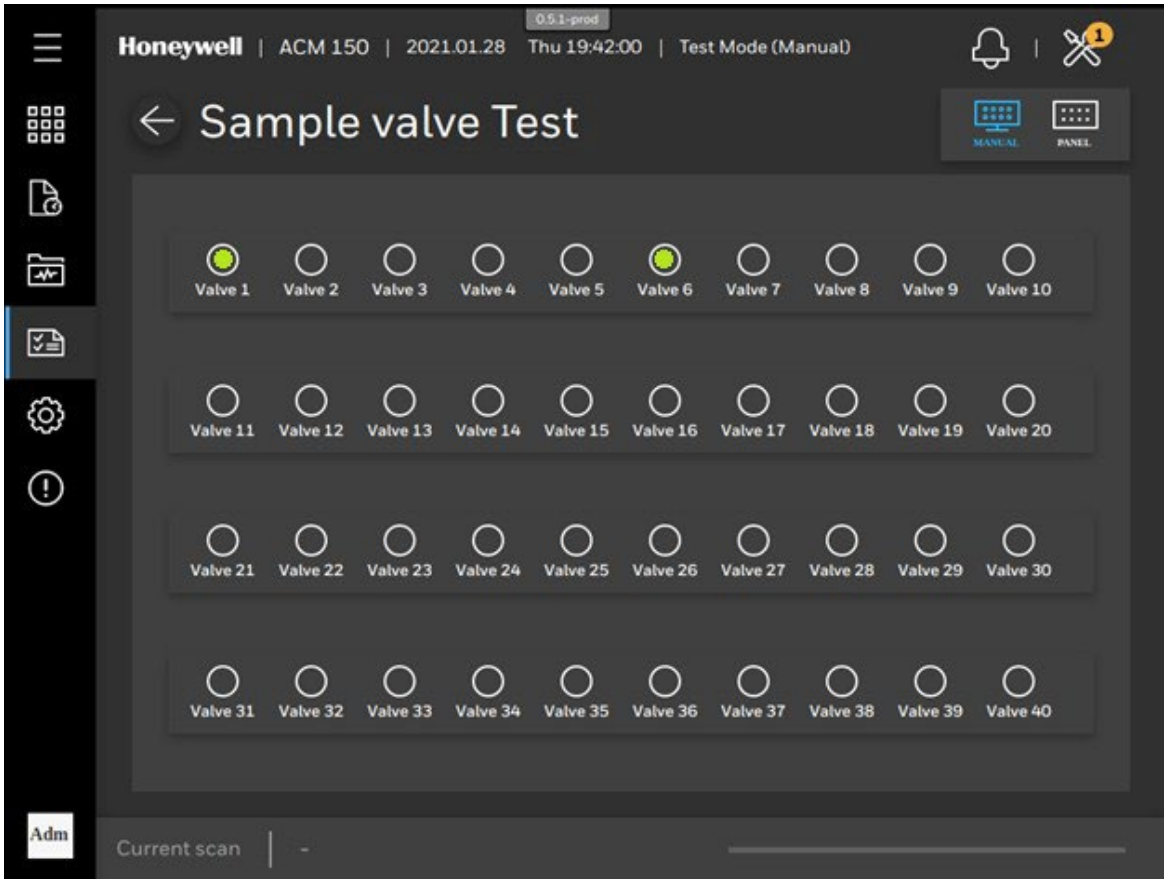

Figure 75. Sample Valves Manual Control

10.2.4.3. Relay test

Diagnostics> Hardware Service>Relay test

All the output relays may be controlled manually. The ACM 150 monitor has 40 programmable relays. The figure below shows only the first row of the menu, programmable relays 1-10. No relays are activated when you enter this mode. Select the relay you want to activate to open it.

Like the sample valves, the selected relays illuminate in green. This mode allows you to selectively test the relays and the devices wired to them.

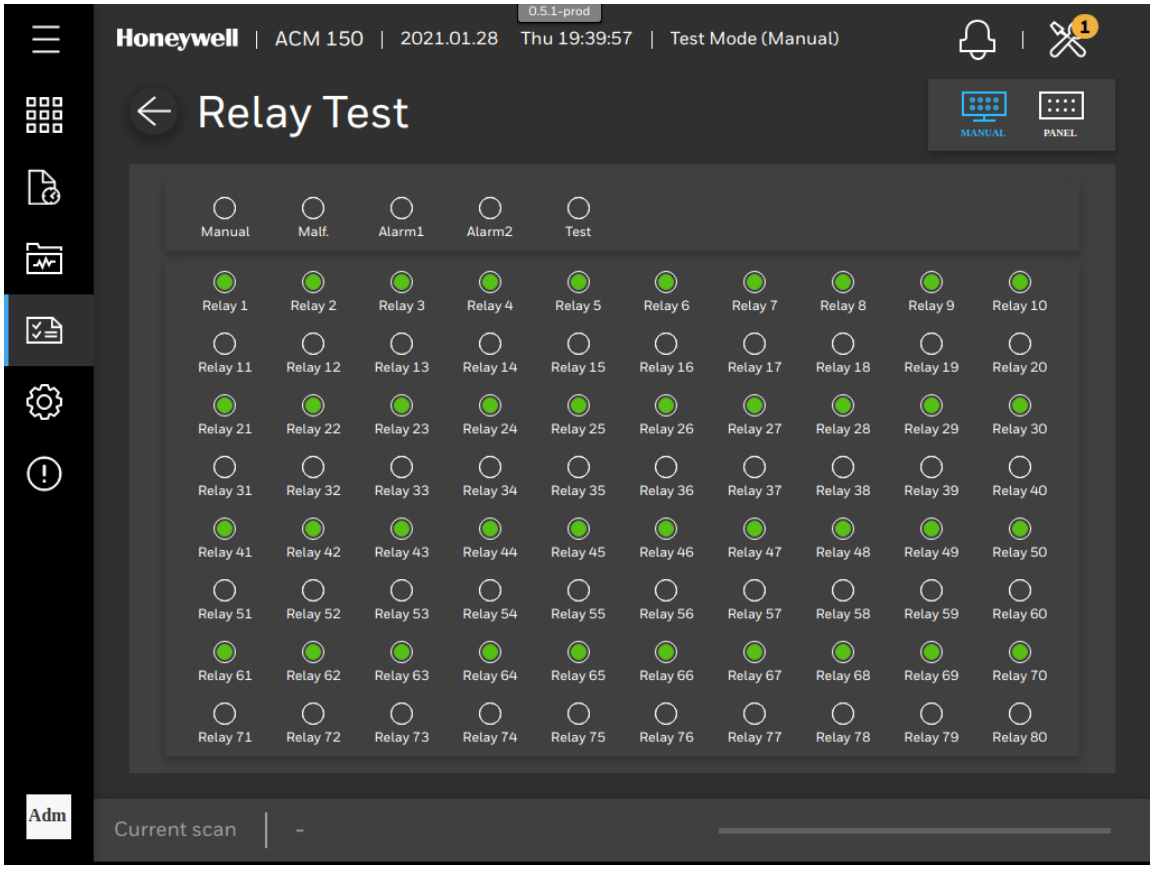

Figure 76. Relays Manual Control

10.2.4.4. Watchdog Timer Test

Diagnostics>Hardware Service>Watchdog timer Test

If the computer is operating properly the Watchdog Timer (WDT) will always be reset before it reaches the end of its interval and its relay, #82, will not activate. If the computer fails, then the WDT will timeout and activate its relay. The test function forces a WDT timeout.

10.2.4.5. Kinked Tube Test

Diagnostics>Hardware Service>Kinked tube Test

Allows the detection of kinked sample tubes by analyzing the Sample Flow pressure. If a tube is kinked or bent severely and the pressure does not reach the configurable setpoint Kinked Tube Threshold, a service event is generated indicating the port and the pressure value. The Kinked Tube Test may be triggered automatically or manually. For automatic triggering, the time of day and the interval may be chosen. For triggering the Kinked Tube Test manually, the user needs to login at the console and press the button “START”.

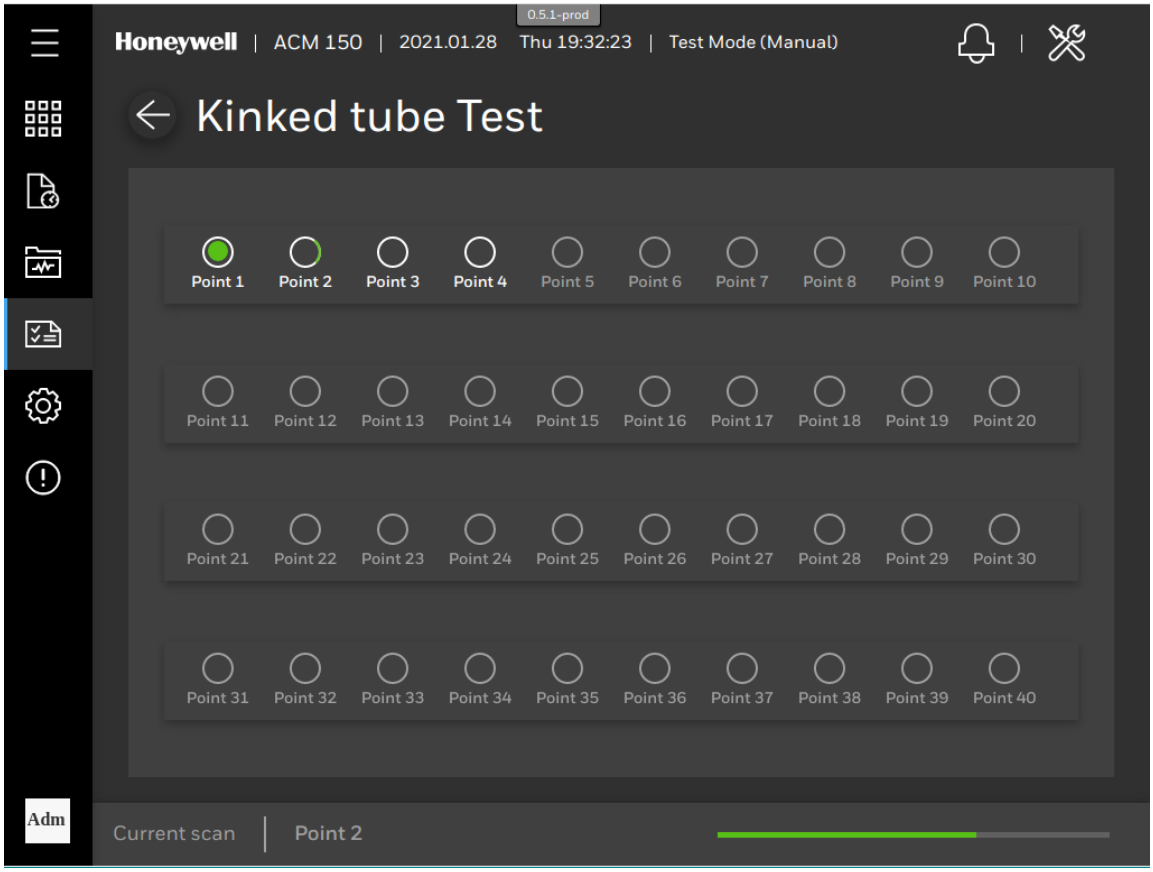

Figure 77. Kinked Tube Test

10.2.4.6. Line Leak Test

Diagnostics>Hardware Service>Line leak test

Any authorized user can perform this test, provided your ACM 150 is configured for automatic line leak tests. Typically, this test is initiated because one or more line failed its automatic test. If services were performed to resolve the failure, this test verifies successful corrective actions. In this mode you can observe the pressure test of each line as it occurs.

10.2.5. Software Service

Diagnostics>Software Service

10.2.5.1. Memory Maintenance

Diagnostics>Software Service>Memory Maintenance

The screen “Memory Maintenance” may be used to analyze and control the database on the ACM 150 monitor and is designed for our Field Service Engineers.

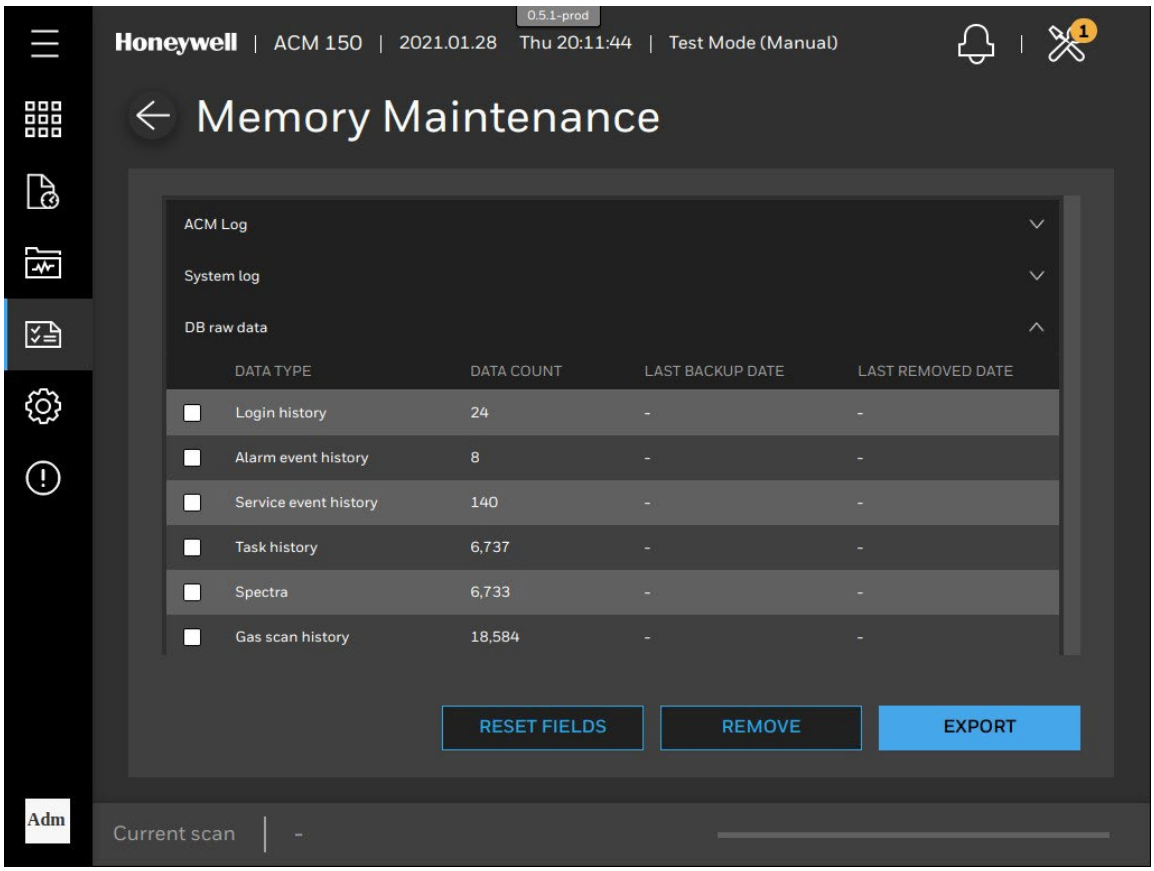

Figure 78. Memory Maintenance

10.2.5.2. Alarm Simulation

Diagnostics>Software Service>Alarm Simulation

For testing communication links to external devices via Modbus/TCP output, such as a PLC connection, the ACM 150 monitor, and higher features Alarm Simulation.

When simulating an alarm on a specific port and for one or more gases, a message assuming a concentration of Alarm Level + 5% for each selected gas is sent via Modbus/TCP.

For each selected gas the simulated alarm event is displayed on the Alarms screen of the ACM 150 user interface. Simulated alarms show up as auto-cleared alarms and do not trigger the red Alarm icon on the title bar.

1) Select the point you want to simulate gas alarms
2) Select the gases for simulating alarms
3) Press "START" to start simulating
4) Alarm simulation is running only on this screen. Press "QUIT" to stop the simulation.

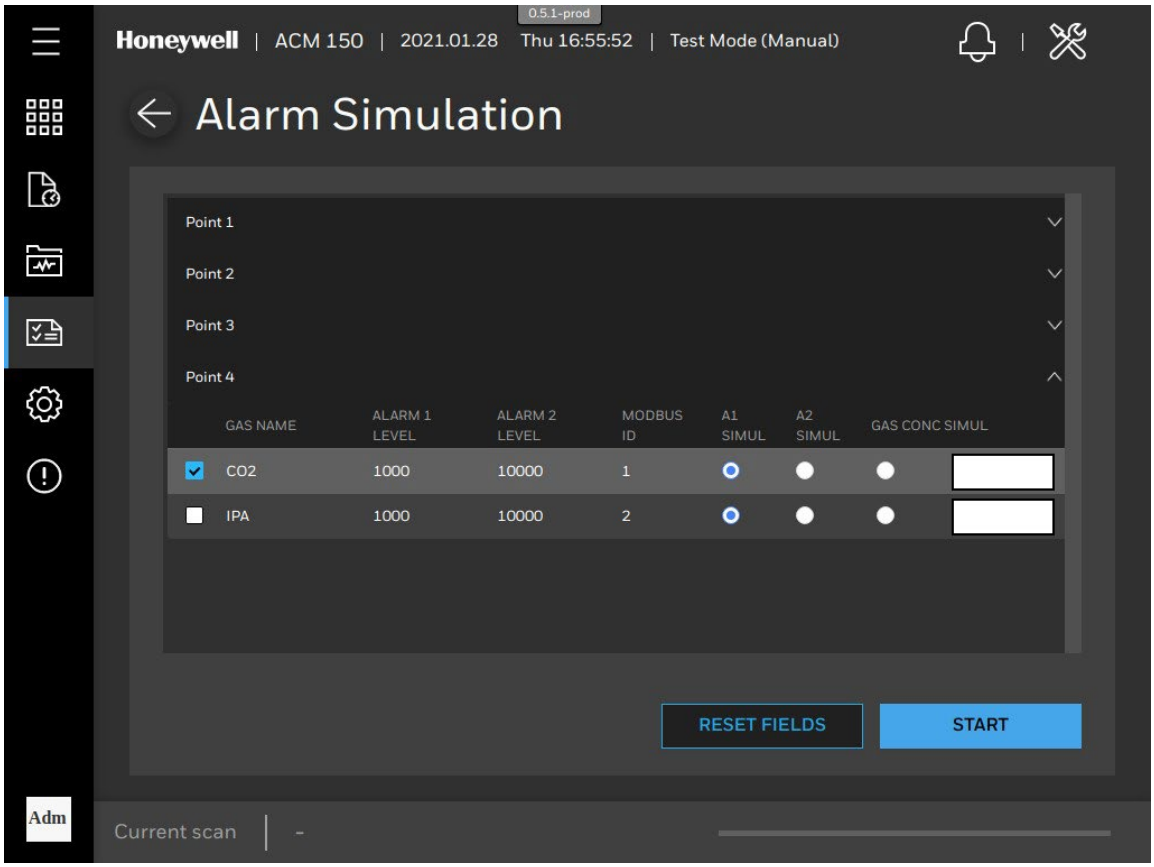

Figure 79. Alarm Simulation

10.2.5.3. Fault Simulation

Diagnostics>Software Service>Fault Simulation

For testing communication links to external devices via Modbus/TCP output, such as a PLC connection, the ACM 150 monitor, and higher features Fault Simulation

1) Select a fault to simulate
2) Press "START" to start simulating
3) Fault simulation is running only on this screen. Press "QUIT" to stop the simulation.

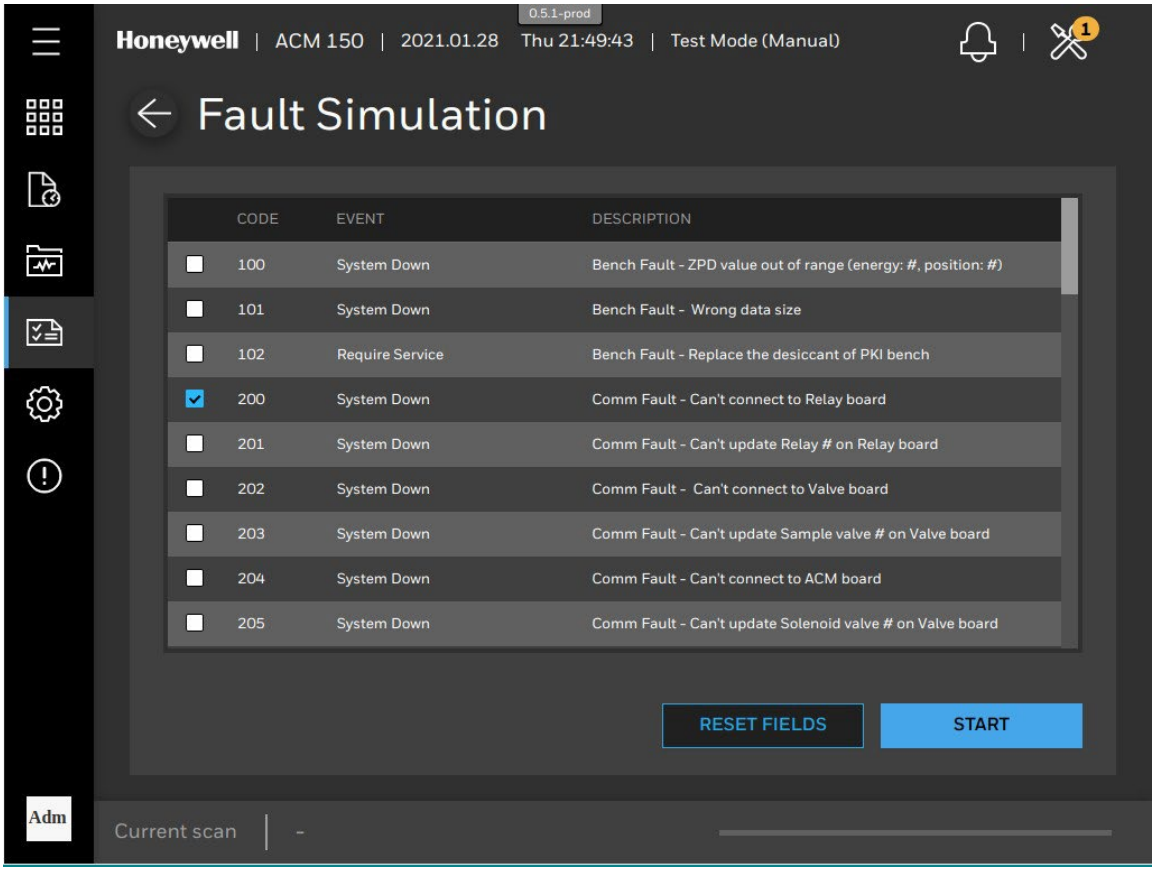

Figure 80. Fault Simulation

10.3. Service Inspections and Procedures

10.3.1. Preparation for Servicing

10.3.1.1. Expendable parts on hand

Expendable parts, which are inspected and possibly replaced during PM servicing, should be stocked on-site and available when needed.

10.3.1.2. Recommended spare parts

To minimize the time for repair, it is recommended that spare parts be stocked by the ACM 150 monitor user. You should review this with your local HA service representative to determine which of these spares should be stocked at your facility to support service. Refer to Sections 10.3 and 10.4 for lists of parts.

10.3.1.3. Qualified personnel

Services described in this chapter should only be performed by authorized or trained personnel, as defined in Levels of ACM 150 users, and as indicated in the following paragraphs.

10.3.1.4. Contaminated areas

During normal use, parts of the ACM may contain residual amounts of hazardous materials and service operations may generate contaminated waste. This is especially so for monitors that have been frequently exposed to hazardous material. Examples of service items that may be contaminated are cleaning materials, gas cells, filters, valves, pump parts, tubing, and ZnSe windows.

Service people should ensure that the ACM is safe before attempting repairs. The minimum recommended personal protection includes gloves and safety glasses. It is the user responsibility to dispose of contaminated waste safely and properly.

10.3.2. Servicing the filters

The rate of particulate accumulation varies with the local conditions. Follow the recommended intervals for replacing filters unless your periodic inspections/tests indicate that more frequent replacement is necessary.

10.3.2.1. Cabinet air filters and fans

Cooling fans are installed in the main cabinet and the lower pump cabinet.

Each cooling fan has a filter with a removable plastic cover. These filters should accumulate dust at the same rate. Therefore, they should all be replaced at the same time with the ACM 150 monitor off-line. When replacing filters, wipe dust off the plastic cover. Also, inspect the fans to assure they operate correctly and do not have accumulated dust. Wipe accumulated dust from the fans. Replace fans that do not operate correctly, i.e. do not spin freely.

10.3.2.2. Internal gas cell filter

The gas cell filter is part of the mechanical pump assembly, Figure 12, located in the lower pump cabinet. Replace it according to the recommended schedule or more frequently if required. The ACM 150 monitor should be taken off-line for this service. If not, expect to generate a Service Status message when temporarily interrupting the sample flow.

If flow through the filter is over-restricted, the pressure during the sampling cycles may be inadequate and create a Service Status message. Follow the test procedure, cycle valve tests, and replace the filter if the test indicates a flow restriction.

10.3.2.3. External in-line filters

These filters are located at or near each sample line inlet. Replace filters according to the recommended schedule or more frequently if required. You do not have to take the ACM 150 monitor off-line when replacing filters, because flow is not interrupted.

You can replace all the filters on the same schedule, or you can replace them in phases, e.g. 25% every three months. Since sample points are often added in phases, you might use the same phase interval for filter replacement. It is time consuming to locate, access and replace the in-line filters.

If flow through one or more filters is over-restricted, the vacuum on those lines should increase when they are sampled and create a Service Status message. Follow the test procedure, cycle valve tests, and replace the filter if the test indicates a flow restriction.

NOTE

Avoid unnecessary downtime. Do not wait until a Service Status message is generated before replacing filters. Replace filters on an established schedule. You can modify the schedule based on actual experience at your facility.

10.3.2.4. Visual inspection

You should visually inspect the gas cell filter and in-line filters during each service. The filter housing is white and semi-transparent when new. If the housing appears clean and, if testing indicates there is no flow restriction, you can postpone replacement until the next service.

If the filter appears dark and or deeply discolored, replace it. In-line filters on dirty and/or corrosive sample points appear this way much sooner than filters on clean points. Increase the replacement frequency of filters that foul ahead of schedule. Light discoloring is normal and not a reason to replace the filter before its scheduled replacement date.

10.3.3. Servicing the pumps

10.3.3.1. Self-monitoring and manual testing

The ACM 150 monitor constantly monitors its vacuum pumps. If either venturi pump fails to provide adequate vacuum, the Backup Exhaust Pump turns on automatically and a Service Status message notifies the user. A message is also generated if the Boost Pump fails to provide adequate flow, however, there is no backup for the Boost Pump. During scheduled PM services or following any Service Status messages that might indicate a pump problem, use the manual tests to check the pumps, Cycle valve tests.

10.3.3.2. Servicing the venturi pumps

The Bypass Venturi and Gas Cell Venturi are shown in Figure 11. There are no scheduled services for the venturi pumps. If testing indicates inadequate vacuum, try increasing the CDA pressure. If that does not restore adequate vacuum, run with the Backup Exhaust Pump, and contact HA for service advice.

10.3.3.3. Servicing the mechanical pumps

The mechanical pumps are shown in Figure 12. The Boost Pump has dual heads, each with a diaphragm and flapper valve that wear out and must be replaced periodically. The parts and instructions are provided in a service kit (Expendable Parts List, Section 10.3). After removing the old diaphragm and flapper valve, wipe the internal metal surfaces to remove particles before the new parts are installed.

The Backup Exhaust Pump is intended to operate infrequently. It should never require service if your venturi pumps operate most of the time. However, if your facility is unable to provide a supply of CDA sufficient to run the venturi pumps, such that the Backup Exhaust Pump is in continuous or frequent use, this pump must be serviced. After it accumulates a total run time of one year, service the pump. Detailed instructions are provided in Backup vacuum pump.

10.3.4. Servicing the valves

10.3.4.1. *Self-Monitoring and Manual Testing*

If any solenoid valve fails to switch or open, it will cause a change in absolute pressure or in the infrared spectrum that is sufficient to generate a Service Status message in most cases.

During scheduled PM services or following any Service Status messages that might indicate a sampling problem, use the manual tests to check the valves (Pneumatic tests).

10.3.4.2. Servicing the sample valves

The Sample Valves are mounted into 10-port manifolds, as shown in Figure 5. They are not expected to wear out and have no replacement schedule. However, a valve can always fail or develop a problem.

Since the valves mount upside down, there is a possibility that the screws holding the valves to the manifolds might loosen over time. Also, they have an internal orifice that controls and balances the bypass flow. If the orifices plug, they will limit the bypass flow and the response time. The in-line filters stop most particles that can plug the orifices. Sampling without a filter on any point or drawing in dirty, corrosive gases increase the possibility of plugging an orifice. Use the manual checks and tests, Sample valve tests, to identify any problems. Follow the service instructions in Sample valves.

10.3.4.3. *Servicing the cycle valves*

The Cycle Valves are the six solenoid valves installed on a removable plate shown in Figure 9. These valves are activated with far greater frequency than the Sample Valves. Expect them to wear out eventually. They should be replaced every five years, before problems develop in normal use. The valves contacting the sampled gas have Teflon bodies, which are resistant to both corrosion and the absorption of acid gases. Nevertheless, any of these valves can fail in normal use. Use the manual checks and tests, Cycle valve tests, identify any problems. Follow the service instructions in Cycle valves.

10.3.4.4. Tubing

When you disconnect any internal or external tube fitting from a valve or pump, inspect the end of the tube and the tube fitting. Look for signs of corrosion, particles and/or chemical coating. Replace tubes and fittings that show any of these signs.

Also, look for over-tight fittings that compress the tube diameter at the ferrules and create a flow restriction. Replace the fitting and the ferrules.

Inspect internal tubing for any crimps, worn spots and splits, especially around the fittings. Replace defective tubes.

NOTE

Compression tube fittings, e.g. Swagelok fittings, should be turned with a wrench 1/4 turn past finger tight. Avoid over-tightening the fittings.

10.3.5. Evaluating the FTIR optical path

The modulated infrared beam produced inside the FTIR analyzer (optics bench) passes through windows, reflects off mirrors and ultimately focuses onto a 2 mm diameter detector. To get the best performance from the ACM 150 monitor, the path through these optics must be clean and clear, and the optics must be in alignment.

Use this procedure to evaluate the condition of the optical path by examining, the ZPD Values, the Signal-to-Noise Ratio and Spectral Balance. After completing these three evaluations, proceed to Determining the next step.

NOTE

These evaluations help determine if it is necessary to inspect and clean the gas cell, adjust the gain and/or align the optics. If they indicate that everything is OK, it can save unnecessary work and downtime.

10.3.5.1. ZPD energy value

Follow the instructions in ZPD trends and look at the trend over the past 15 days. ZPD energy is a positive number for the Perkin Elmer bench.

- If the 15-day trend is within the range of 100~200 (1000~2000 for without gas cell) and if there are no significant changes in the trend, the IR signal is adequate.
- If the 15-day trend is outside these limits and/or if you see a significant change causing a signal degradation in the trend, it fails this evaluation.

NOTE

For more information about the ZPD values refer to ZPD values (Energy and Position).

10.3.5.2. Signal-to-noise ratio (S/N)

Follow the instructions in Background, S/N and drift and look at the trend over the past 15 days of the 'Background S/N Ratio'. Expect S/N to degrade slightly and trend downward over time. If there is a sudden drop in S/N or if the value falls below acceptable limits, it fails this evaluation.

10.3.5.3. Spectral balance

Evaluate the 'spectral balance' of this Background Spectrum by comparing it to the reference diagrams in Evaluating/ resolving spectral balance. Verify that the signal intensity at 4000 cm-1 is at least 20% of the signal intensity at 2000 cm-1. Look for any anomalies in the pattern of your Background Spectrum. If the spectral balance is inadequate or if the spectrum shows a dip or other pattern that deviates from normal, it fails this evaluation.

10.3.5.4. Determining the next step

The next step is determined by the results of the preceding three evaluations, and the choices are:

1) If these evaluations do not fail and if you have no other problems, e.g. related Service Status messages, there is no need to clean the gas cell, and there is no need to adjust the gain or optimize the optical alignment. You can proceed to Servicing the line leak test.

2) If the ACM 150 monitor failed one or more evaluations and/or if you have other problems, e.g. related Service Status messages, proceed to Servicing the gas cell (unless the problem is a ZPD energy value that is too high).

10.3.6. Servicing the gas cell

10.3.6.1. Service objective

The objective when servicing the gas cell is to correct any conditions which significantly reduce the infrared signal passing through it. The 5-meter long path gas cell also requires clean and clear windows, but it has the added complication of internal mirrors at both ends as well as external mirrors (or "transfer optics"). (The Perkin Elmer bench has all optics sealed away from service personnel.) The external mirrors must be clean and highly reflective. So, conditions which foul the windows should be avoided or controlled in the sample system design.

10.3.6.2. Lengthening the service interval

In previous generations of the ACM product line, the long path gas cell was mounted vertically. In this orientation, particles and condensable vapors would often accumulate at the bottom of the cell on the internal mirrors and the gas cell windows. The ACM 150 monitor is designed differently with the gas cell in a horizontal orientation. The low point for collecting particles and condensable vapors is the inside of the glass housing, which is not in the infrared path. This design results in less frequent servicing of the gas cell. Also, if you always have in-line filters installed on all the sample lines, the gas cell filter provides a second stage of filtration. Two-stage filtration minimizes particle accumulation in the gas cell.

10.3.6.3. Visual check of the gas cell and FTR optics

With the gas cell in place, visually examine the internal mirrors for any degradation of the highly reflective surfaces, which includes:

- Pitting of the mirror surfaces
- Flaking-off of the mirror coating
- Coating of dust or chemicals
- Water spots or a tarnished appearance

Take a flashlight at an angle to check the mirrors more thoroughly. Examine the pair of ZnSe windows for the same general problems. If you see any of these problems, the gas cell should be removed, cleaned, and the windows replaced.

You may not be able to see a chemical coating that absorbs infrared radiation and lowers the throughput and, subsequently, the infrared signal at the detector. Perhaps the signal is adequate, but the noise may be too high, resulting in a poor S/N. Try cleaning the gas cell and replacing the windows. Replace the gas cell if cleaning it does not resolve the problem.

Check the transfer optics (gas cell's external mirrors) for dust accumulation or tarnishing of the mirror finish. If you find dusty or tarnished mirrors, then also inspect the external mirrors and window on the FTIR optics bench. These mirrors can be cleaned.

10.3.6.4. Replacing the gas cell

Try cleaning the gas cell to remove dust, spots, or chemical coating. If cleaning does not correct the condition or if you see that the mirror coating is pitting, tarnished or flaking-off, replace the gas cell.

10.3.7. Servicing the line leak test

This applies only if your ACM 150 utilizes the optional Line Leak Test. There are no scheduled services. This daily test will generate a Service Status message and identify any sample point(s) failing the test. If you experience any failures, isolate and correct the problem following Line leak tests (optional).

10.3.8. Servicing the Desiccant Module

Check the service procedure document for details.
The desiccant module protects the bench from the effects of humidity and helps to keep the internal optics of the bench warm. The desiccant module has an indicator that has 4 numbers (20, 30, 40, 50) printed on a blue background. The color of the background turns to white when the humidity inside the bench exceeds the level indicated by the numbers. Replace the desiccant module every 12 months or when indicator exceeds 20%.

10.4. Manual tests and evaluations

The pneumatic tests identify problems with the sampling system, including the pumps, valves, filters, and tube fittings. Problems identified include:

- Interruption of sample flow
- Restriction of sample flow
- Cross-stream leaks
- Outside air leaks

10.4.1. Cycle valve tests

If you are at the monitor, refer to Cycle valve control panel, or if you are at a remote location, refer to View valve cycles. Observe the readings from the gas cell pressure transducer ('sample pressure' or 'sample cell') as the ACM 150 monitor scans through all its active points.

If you are using the long path gas cell, you should see the pressure changing in accordance with (or readings you have recorded for your specific monitor). Identify problems as follows:

- Fails to Draw a Vacuum: This indicates that either the Gas Cell Venturi Pump or the Back-up Exhaust Pump (if used) is not drawing a vacuum and needs servicing or that valve S6 is failing to open, S2 is stuck open or leaking or a leak has developed in the gas cell or its connections.
- Draws Vacuum but Vacuum Remains - All Points: If the pressure fails to rise during the Surge or Fill cycles all the time, S6 is stuck open or leaking, S2 is failing to open or the Boost Pump has failed.
- Draws Vacuum but Vacuum Remains - Specific Sample Point: If the pressure fails to rise during the Surge or Fill cycles for any specific sample point, the valve for that point is failing to open.
- Slowly Returns to 0 During Fill Cycle - Specific Sample Point: This indicates a flow restriction. Most likely, the in-line filter on that point needs to be replaced. To make sure the problem is not inside the ACM 150 monitor, disconnect the sample tube(s) from the problem point(s). If you observe that the Fill Cycle goes to 0 psig in 1-2 seconds with the line disconnected, assume the restriction is at the in-line filter or the sample tubing (or the check valve if the line leak option is used). If disconnecting the tube makes no difference, the flow restriction is in the sample valve for that point or in one of the 10–port manifolds.
- Slowly Returns to 0 During Fill Cycle - All Points: This indicates an internal flow restriction. The gas cell filter needs changing, or the Boost Pump needs servicing.

To confirm problems with the Cycle Valves, test the valves using "10.2.4.1 Cycle valve test" Selectively turn valves on and off observing the changes to the gas cell pressure readings. Service cycle valves following Servicing the cycle valves.

NOTE

The ACM 150 monitor's valve cycle timing can be changed using the configuration file. This file is to be accessed and modified only by HA, its agent company or the user's Authorized Service Technicians, who have been trained or are following the instructions of HA or its agent company.

10.4.2. Sample valve tests

Verify that vacuum is present by observing the Sample Vacuum and the Bypass Vacuum readings from the respective pressure transducers. At the monitor, you can observe the vacuum LEDs, Figure 7, or from a remote location, observe the readings using View Valve Cycles, Figure 71.

Continue to observe the Sample Vacuum as the ACM 150 monitor scans through all its active points. Minor fluctuations from one point to the next are normal. If you notice a significant increase in vacuum above normal at one or more point, suspect a flow restriction. The longest sample tube runs (from the most remote sample areas) may always show a bump in vacuum, which is the 'normal' reading for that point.

The following tests are done at the monitor with the pumps running. Select the Manual Control Mode and the Front panel Mode. Utilize the Sample Valve Control Panel, Figure 7, and proceed:

- *Valve Test*: Select one of the points, 1-40. Cycle the valve on and off. When off, you should see a large increase in the Sample Vacuum, returning to normal when switched on. Remote users can perform this test in the Manual Control Mode (see Figure 73). Identify any valve that fails to cycle properly and service it.
- *Flow Test*: With all the sample valves off, disconnect the inlet tube fittings and attach a flowmeter to each inlet port (a flowmeter test assembly is available from HA service). Measure the flow rate from point to point and compare the flows to each other and to prior tests.

NOTE

Avoid mixing sample tubes. Before disconnecting all the tube fittings, make sure that every sample tube is labeled with the correct ACM 150 port number. If not labeled correctly, disconnect one tube at a time and reconnect before moving on.

Points with flows that have changed significantly or are out of the normal range require service as per Servicing the cycle valves. Too low a flow indicates a restricted flow control orifice in the valve or a loose valve that is leaking in room air (service the valve). Too high a flow rate indicates that the valve is leaking across its seat or that the bypass orifice is allowing excess flow (replace the valve).

10.4.3. Line leak tests (optional)

If you are using the Line Leak Test, refer Hardware servicing and select 'Perform an Entire Line Leak Test'. Every point that is currently scanned (Programmable relays) is included in the test. The Line Leak LED on the Sample Valve Control Panel (Figure 7) lights while the test is running. The test starts with point 1 and progresses in sequence, skipping any points not in the Order of Scan, until the last point is tested.

You can observe the pressure as the valves switch from point to point. The line pressure should start low and build up for each line as it is pressurized.

Points either pass or fail the test. To pass, a pressure must build up in the sample line that is sufficient to exceed the set point of the sample pressure transducer. If one or more line fails the leak test, go to the ACM 150 monitor to identify the problem, as follows:

- *Leak at Fittings*: Verify that the fittings on both ends of the sample tube are tight (i.e. cannot be loosened by hand). Start with the connection port on top of the ACM 150 monitor. Then inspect the fitting that connects to the check valve at the opposite end (inlet) of the tube. If both fittings are tight the check valve may be failing to hold pressure (go to next step) or, less likely, the sample tubing has a leak.
- *Check Valve Leak*: The line can only pass if its check valve shuts off when pressurized during this test. Particles accumulating in a check valve may prevent it from sealing. Resolve this by disassembling and cleaning the check valve. At the same time, inspect the in-line filter and replace it, if necessary. Check the tubing if you cannot correct the leak.
- *Tubing Leak*: Verify this by removing the fitting from the check valve inlet and capping it off. Then, run the leak test and observe. If the tube fails to hold pressure, look for a cut or a hole. Replace damaged tubing and make changes to prevent a repeat of the same problem.
- *Setup Problem*: check the setup (Line leak test setup procedure) and correct any problems.

10.4.4. Evaluating/Resolving the ZPD Position

For the Perkin Elmer bench, start up the Perkin Elmer software and perform diagnostics. If the problem remains, contact Honeywell Analytics for service assistance.

10.4.5. Evaluating/Resolving spectral balance

You evaluate the spectral balance using a Background spectrum. A Background spectrum is provided in “Background Scan” Figure 70. It should look like Figure 81, having the same overall shape and peaks.

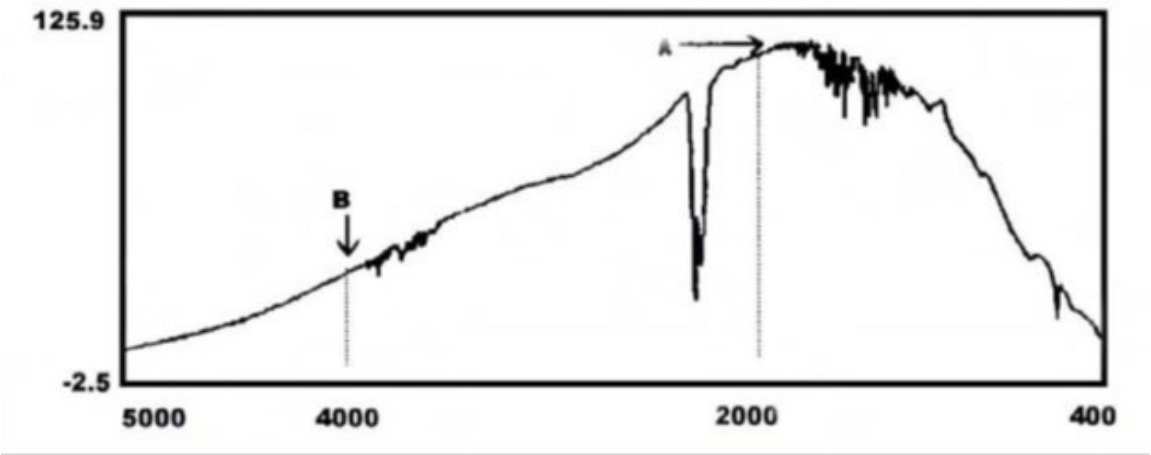

Figure 81. Correct Background Spectrum

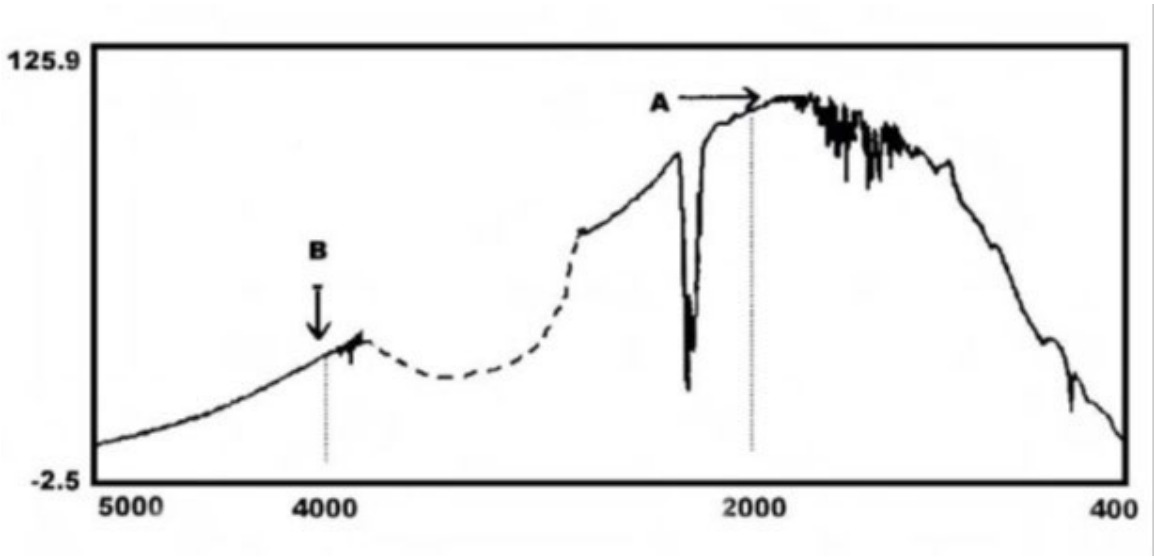

Figure 82. Problem Background Spectrum

1) Compare your Background spectrum to the spectrum shown in Figure 81.
Note the intensity of region A (2000 cm-1) and region B (4000 cm-1)

2) The intensity at region B should be at least 20% of the intensity at region A. If it is 20% or higher, the spectrum is balanced. If less than 20%, the spectrum is imbalanced, and It has an inadequate S/N in region B. This is resolved by cleaning (or replacing) the gas cell and/or by improving alignment.

3) Follow the instructions in Servicing the gas cell.

4) The spectrum in Figure 82 has a dip in the region around 3000 to 3500cm-1. This indicates that there is a chemical coating on the gas cell. It needs to be cleaned or replaced.

5) The ratio of energies at 5000cm-1 and 2500cm-1 are being evaluated as additional evaluation points for the Spectral Balance operation in the future. There is less absorbance due to water in the air at 5000cm-1 and 2500cm-1, and Honeywell expects a throughput of at least 20%. However, at this time, they have not expected throughput data for the Spectral Balance for the 5000::2500 ratio at this time.

10.5. Service and setup instructions

10.5.1. Solenoid valves

10.5.1.1. Sample valves

To service the valves, remove one 10-port manifold at a time. First, disconnect the inlet tube fittings, Figure 6, and remove the pair of screws at each end. Use the handles to lift the manifold up and out. Lay it on its side. Disconnect the tube fittings that connect to the two manifold headers and unplug the electrical connector.

The header tube fittings and connector are shown in Figure 5. Move each manifold to a work area.

Follow these procedures to correct problems:

- Valve fails to open: Replace the solenoid body.
- Valve leaks/fails to seal properly: Check for loose screws and tighten them. If no screws are loose, disassemble the valve and clean the metal base. Inspect and clean or replace the o-rings between the metal base and the manifold.
- Orifice is partly or completely plugged: Disassemble the valve and remove the orifice plug on the side. Clear the orifice using compressed air, tweezers, or alcohol, as needed and clean all surfaces.
- Any evidence of corrosion: Replace the entire valve.

For valves that are functioning properly and show no flow restriction, use a screwdriver to make sure that the screws securing the valves to their base and to the manifold are all tight (avoid using force to over-tighten the screws).

10.5.1.2. Cycle valves

Remove the Cycle Valves as a subassembly. First, disconnect the tube fittings connecting these valves to external components. Next, unscrew the electrical connectors. These tube fitting connections and electrical connectors are identified in Figure 9. As you disconnect each tube and connector, verify that it is properly labeled. If not, add an ID label (masking tape marked with a pen makes a good temporary label). Remove the screws connecting the plate and move it to a work area.

Follow these procedures to correct problems:

- Valve fails to open: Replace the entire valve.
- Valve is sticky or leaks/fails to seal properly: Disassemble the valve and clean the valve plunger, seat, and ports. The disassembled metal parts may be wiped with alcohol or even washed in warm soapy water. Check the valve to assure that it moves freely in its guide and that the springs have enough flex to hold the plunger closed. Place it back into service. Alternately, you can replace the valve body and reuse the coil if it is working properly.
- Any evidence of corrosion: Replace the entire valve.

NOTE

Bottom screws must be removed from the plate to take out a valve. These valves are disassembled by first removing the coils, then removing the valve guide (housing with plunger inside). If you replace the coil or the entire valve, you will need to install an amp connector on the coil wire lead.

10.5.2. Backup vacuum pump

Turn off the main power switch. You need the service kit for the Gas vacuum pump. If the kit includes instructions with diagrams, do not use them. Instead, refer to Figure 82 and Table 7 and use the following procedure:

1. Let the pump cool until it is no longer too hot to handle.
2. Disconnect the inlet and outlet sample tubes from the pump, noting the location of each tube so that they are reconnected to the correct fitting.
3. Remove the bolts on the pump plate (below the pump).
4. Slide out the pump to the front of the cabinet. Then, lift it and rotate it so that the pump head is facing you with the motor to the rear.

NOTE

Expect a release of carbon dust when this pump is disassembled. If this might create a problem where the ACM 150 monitor is installed, disconnect the power cord, and move the pump to an acceptable work area before continuing.

5. Remove the two End Caps and their O-Rings.
6. Remove the 5 bolts on the Muffler Box and tap it lightly with a small hammer to break it loose.
7. Scrape off the Gasket between the Muffler Box and the End Plate.
8. Remove the 6 bolts that hold the End Plate to the Body.
9. Remove the End Plate and the 4 Vanes.
10. Use steel wool to clean dirt and dust made by the old Vanes off surfaces.
11. Install the 4 new Vanes from the kit so that the beveled end slides into the slots in the same orientation as the old vanes.
12. Hold the End Plate to the Body and install the 6 bolts using a torque sequence.
13. Install a new Gasket from the kit between the End Plate and Muffler Box.
14. Get 5 new Bolt Gaskets from the kit and replace the old ones before bolting the Muffler Box to the End Plate. Screw in the bolts but leave them loose.
15. Using the 2 new O-Rings from the kit screw in and tighten both End Caps. Throw away the Felt Filters in the kit. No filters are used in the ACM 150 monitor pump.
16. Tighten the bolts attaching the Muffler Box to the End Plate.
17. Restore power and restart it while the pump is still pulled out. Assure that you have a strong suction and that there are no irregular noises or other problems.
18. Slide the pump back in place and reconnect the tubes and pump plate bolts.

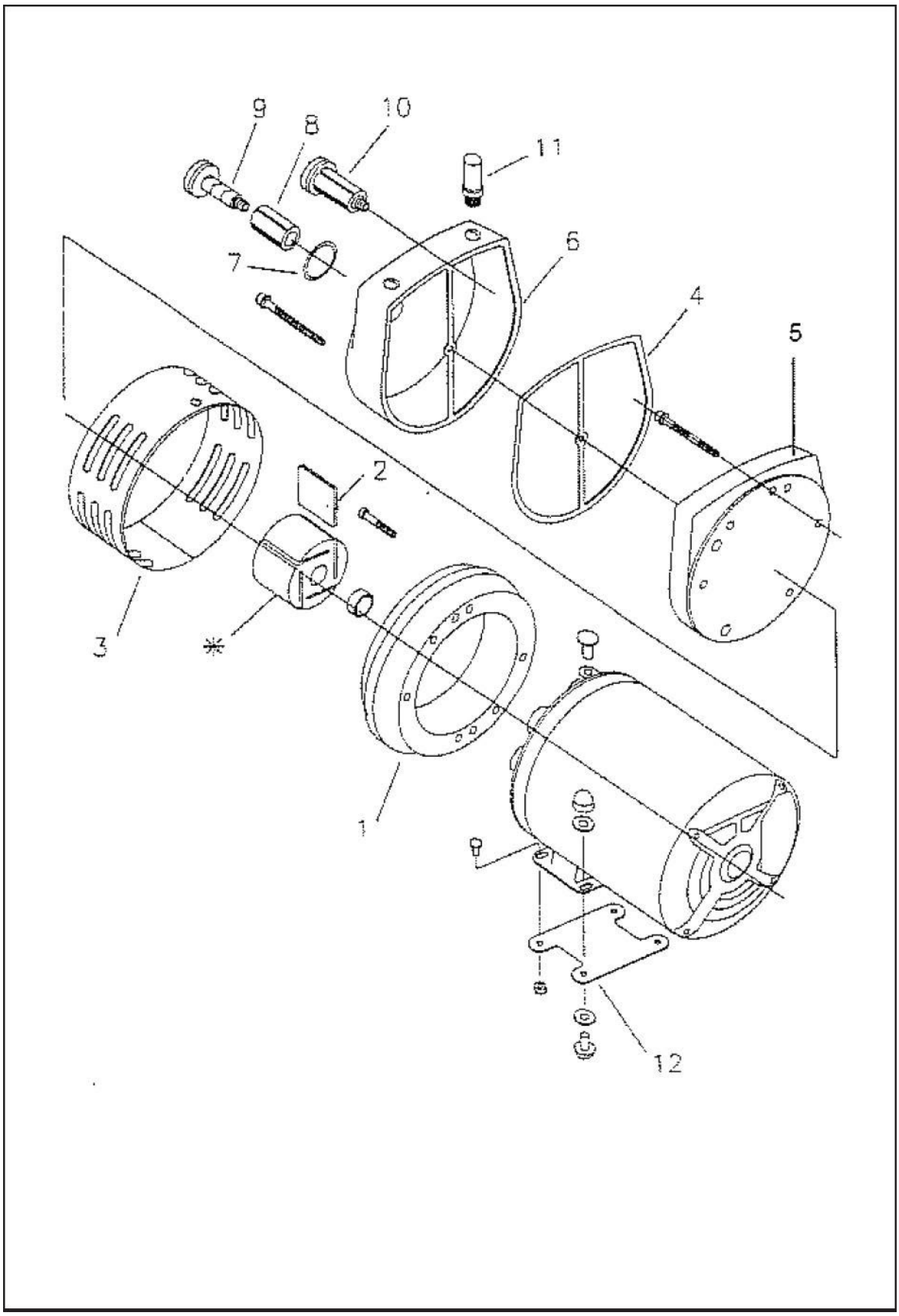

Figure 83. Backup Vacuum Pump Diagram

Table 7: Backup Vacuum Pump Parts List

Item #	Service Part	Quantity
1	Body	1
2	Vane*	1
3	Shroud	1
4	End plate	1
5	Gasket*	1
6	Muffler box	1
7	O-Ring*	2
8	Felt* (Do not use)	2
9	End cap	2
10	End cap arm	2
11	Nipple	2
12	Plate bolt	1
	Service Kit * denotes parts included in Service Kit	1

10.5.3. Line leak test setup procedure

These are the procedures recommended to set up the Line Leak Test so that it works correctly:

10.5.3.1. Prepare for test and setup

Disconnect a few sample tubes at inlet fitting, e.g. points 1 thru 4. Make sure that you have CDA supplied to the ACM 150 monitor and that you have installed check valves at all the sample point inlets.

10.5.3.2. Line leak test mode

From the Hardware Servicing menu, select 'Perform an Entire Line Leak Test'. Do the initial setup or check the setup while in this test mode. If the test mode runs to completion before you are done, start it over.

10.5.3.3. Adjust air regulator

Locate the air regulator on the CDA Panel (Figure 20). On the initial setup, adjust the air regulator to read 15 psig on its gauge as soon as the Line Leak Test starts (make sure the needle valve is not closed - open it one or two turns, if necessary). Once set up, the air regulator should not require adjustment.

10.5.3.4. Adjust needle valve

On the initial setup, close the needle valve all the way by turning clockwise. The pressure gauge between the needle valve and S10 should drop to 0. Now, open the needle valve about 1/8 turn or until the pressure reads about 2 or 3 psig. Once set up, the needle valve should not require adjustment.

10.5.3.5. Pass/Fail

You should observe that the test fails on the open lines (tubes disconnected) and passes on all the connected lines. It fails because it cannot build up adequate pressure on the open lines. However, if you plug off one of these ports with your finger, while it is being tested, it should pass. Observe the pressure gauge between the needle valve and S10 (Figure 20). On lines that pass, you will see the pressure build up from 0-3 psig to 10-15 psig. On lines that fail, you will see little or no pressure build up.

10.5.3.6. Configuration problems

You may still run into problems. The Line Leak Test has configurable variables, which are the pass/fail set point (typically 7-10 psig) and the test time per point. If some tubing runs are unusually long, more test time may be needed. HA can change the configuration, if necessary.

ICON KEY
Authorized Users
Trained Technician

11. Troubleshooting

11.1. Identifying problems

11.1.1. Utilizing relay outputs

The ACM 150 monitor computer constantly monitors the operating status of the system. If any problem develops that requires the user's attention, it generates a message identifying the problem. The sooner you are aware of a problem, the sooner you can take actions to resolve it and minimize (or even avoid) downtime. Therefore, it is critical that you utilize the relay outputs that activate under these conditions:

- 81 Power fail
- 82 Watchdog timer (computer problem)
- 83 Manual mode
- 84 General malfunction
- 85 General Alarm 1
- 86 General Alarm 2

NOTE

These relays should be wired to a central control system or alarm panel that is monitored by personnel so that conditions requiring service attention are known as soon as possible.

11.1.2. Utilizing daily inspections

As a backup to monitoring the output relays, a quick daily inspection of the ACM 150 monitor is recommended. It will help you identify problems, and it provides you with an inspection record.

If you are unable to go to the system, you can check the display from a remote location, looking at the Status Bar and Recent Scan mode, and check off the upper part of the form.

11.2. Resolving problems

Table 8 lists service messages that might be generated by the ACM 150 monitor software. Troubleshoot the problems by following the recommended actions. Use 'refer to' for guidance, additional information and/or step-by-step procedures.

Table 8: Service Request Messages

Service Message	Recommended Action	Refer To
Possible line leak problems in line xx	Test the line and its check valve for leaks	Line leak tests (optional)
Possible line leak problems in lines (all)	Check venturi regulator & air supply Check the line leak setup	• CDA panel • Line leak test setup procedure
Energy (ZPD) value too low (or too high)	Evaluate the optical path	Evaluating the FTIR optical path
No data from bench	Check the bench for a malfunction Evaluate optical path	Evaluating the FTIR optical path
System stopped	No action required	Stopped at user
System started	No action required	Stopped at user
No active scans are defined	Set up an Order of Scan	Order of scan
Cannot establish communication with control boards	Verify that the cables and power cords are connected to the control boards	Interconnecting cables
Cannot update relays	Verify that the cables and power cords are connected to the relay board(s)	Interconnecting cables
Cannot load factory background spectra	Check for missing file or path error (should not occur after initial start- up)	Contact Honeywell Analytics
Energy (ZPD) address out of range or can't determine	Too little reaching detector	Evaluating the FTIR optical path
Scan cancelled	Normal operation	
Incorrect data length (short/long scan)	Poor connection at FTIR data cable	Evaluating the FTIR optical path
Cannot evaluate equation for relay XX	SQL error in relay setup, advanced tab	Virtual relay setup.

11.3. Backup log files

User can monitor operating history include faults to investigate root cause.

Please refer to following procedures to export log files from HMI PC and SBC.

11.3.1. HMI PC log files

There are two methods to copy log files into a USB drive.

- Go to Diagnostics / Software service / Memory Maintenance / Export

- Go to Archives/ Download. Select the "SAVE" option for the export.

11.3.1.1. SBC log files

- Go to ‘C:\AcmAdapter\Log’ directory.

- Select the files what you want. SBC log files are named as ‘AcmAdapter-YYYY-MM-DD.log’

- Copy files and paste into USB directory.

12. Appendix

12.1. Appendix A Master parts list

1. BASE UNIT	
76-ACM 150-115-1	FTIR-based analyzer, for measurement of up to 15 gases per sample point. Includes primary venturi pump with automatic switch-over to electric backup pump, touchscreen user friendly interface (point and click), built-in diagnostics, configurable gas selection, web-based user interface, 10 point sample valve assembly including dust filter, 80 user-programmable relay contacts; requires method(s) for detection of gases according to customer's gas list. Power requirements: 120VAC, 5M path length gas cell
76-ACM 150-115-2	FTIR-based analyzer, for measurement of up to 15 gases per sample point. Includes primary electric pump with automatic switch-over to electric backup pump, touchscreen user friendly interface (point and click), built-in diagnostics, configurable gas selection, web-based user interface, 10 point sample valve assembly including dust filter, 80 user-programmable relay contacts; requires method(s) for detection of gases according to customer's gas list. Power requirements: 120VAC, 5 m path length gas cell
76-ACM 150-230-1	FTIR-based analyzer, for measurement of up to 15 gases per sample point. Includes primary venturi pump with automatic switch-over to electric backup pump, touchscreen user friendly interface (point and click), built-in diagnostics, configurable gas selection, web-based user interface, 10 point sample valve assembly including dust filter, 80 user-programmable relay contacts; requires method(s) for detection of gases according to customer's gas list. Power requirements: 240VAC, 5M path length gas cell
76-ACM 150-230-2	FTIR-based analyzer, for measurement of up to 15 gases per sample point. Includes primary electric pump with automatic switch-over to electric backup pump, touchscreen user friendly interface (point and click), built-in diagnostics, configurable gas selection, web-based user interface, 10 point sample valve assembly including dust filter, 80 user-programmable relay contacts; requires method(s) for detection of gases according to customer's gas list. Power requirements: 240VAC, 5 m path length gas cell
76-ACM150-115-1G2	76-ACM150-115-1 Gen 2 version
76-ACM150-115-2G2	76-ACM150-115-2 Gen 2 version
76-ACM150-230-1G2	76-ACM150-230-1 Gen 2 version
76-ACM150-230-2G2	76-ACM150-230-2 Gen 2 version
2. ACM Method Development	
100-12899-00	Method Generation / Setup (per gas) Please contact Sales or Service for a customized Method quote or method testing. Developing methods for gases that HA does not have spectra require further lab time in addition to the Method Generation charge of $800 per chemical.
3. OPTIONS AND ACCESSORIES	
76-215-12477-00-B	ACM internal hardware for Line Leak Option for dual electric pump systems
76-215-12475-00-D	ACM internal hardware for Line Leak Option for Venturi pump systems. Note: Assy, Line Leak requires qty 2 off item 76-220-13588-00-A when used as a replacement for ACM 100.
76-150-14393-04-1	10-point Sample Manifold includes Dust Filter. Up to 3 max may be added to base unit - 40 points total.
76-165-14594-00-1	Kit, Line Leak, 3/8T Check Valve
0235-0252	FEP tubing 0.25" ID x 0.375" OD, 300m length

3. OPTIONS AND ACCESSORIES	
76-150-14392-02	Kit, Data Interface, Control Net B3514
76-150-14398-02	Kit, Data Interface, Control Net, Redundant B3514
76-150-14391-10	Kit, Data Interface, Modbus TCP/IP
76-150-14390-04	Kit, Data Interface, Profibus DP
4. ACM 150 Gen 2 Spares	
3014B1214	Touch LCD monitor
3014B1215	HMI computer
5. ACM 150 Spares	
76-518-13260-00	15" HMI touch screen computer
6. ACM 150, ACM 150 Gen 2 Spares	
76-465-15101-00	PKI Spectrum2 bench w/plate
76-441-15551-00	Gas cell for PKI bench
76-150-15300-00-C	Network switch, Cisco, including bracket
76-150-14600-00-A	Kit, Single Board Computer ARK1123
3014B0453	FTIR bench IR Source Assy. Please contact Sales or Service
3014B1304	Spectrum 2 desiccant replacement kit. Please contact Sales or Service
3014B1305	Spectrum 2 KBr Window Replacement Kit. Please contact Sales or Service
3014B0455	Laser Module Assembly. Please contact Sales or Service
3014B0454	DTGS Detector Assembly. Please contact Sales or Service
3014D0329	Power Supply-70W. Pease contact Sales or Service
3014B1307	Replacement kit. Gas Cell O-ring. Please contact Sales or Service
3014B1308	Replacement kit. Gas Cell Window. Please contact Sales or Service
3014B1306	Replacement kit. Spectrum 2 Mainboard. Please contact Sales or Service
3014B1312	SCROUGE SWITCH – LED BD ASSY
76-0271-00	Fuse, 5x20mm, UL248-14,250V, 1.00A, medium time-lag, package of 10
76-0272-03	Fuse, 6.3x32mm, 250V,2.00A, medium time-lag, package of 10
76-161-14691-00	Kit, Repair, Booster Pump
76-215-12479-00-B	Assy, Venturi Supply
76-215-12635-00-E	Assy, Cycle Valve
76-220-13588-00-A	Assy, Adapter Solenoid Valve for new connector type
76-215-12705-00-A	Assy, Bench Status and Control
76-215-12816-00-A	Assy, Venturi Manifold
76-215-13423-00-A	Assy, Sampling System, Front Panel
76-215-13480-00-B	Assy, Power Distribution,115VAC
76-215-13480-01-B	Assy, Power Distribution,230VAC
76-215-13926-00-C	Assy, Pump, Primary,115VAC
76-215-13926-01-C	Assy, Pump, Primary,230VAC
76-215-13927-00-C	Assy, Pump, Secondary,115VAC
76-215-13927-01-C	Assy, Pump, Secondary,230VAC
76-215-14565-00-1	Assy, Pump, Booster,115VAC
76-215-14566-00-1	Assy, Pump, Booster,230VAC

6. ACM 150, ACM 150 Gen 2 Spares	
76-220-13875-01-A	Assy, Cable, Communication, Converter-P1
76-220-13987-00-A	Assy, Adaptor booster pump new type con
76-220-13985-01-A	Assy, Cable, Booster Pump
76-3420-10018	Kit, Repair, Exhaust Pump
76-3420-10025	O-Ring, Repair, Exhaust Pump
76-360-12223-00-C	Assy, Manifold,10 Point Sample
76-4680-10008	Optics, KRS-5 Crystal,25mm DIA x 22mm
76-560-11996-00-D	PCA, Sampling System, Main Board
76-560-12246-00-C	PCA, Relay Controller, Main Board
76-560-12247-00-B	PCA, Relay Controller, Front Panel
76-563-13765-00	Cable, RJ11 Modular,4-Wire,4"
76-575-13762-01	Sensor, Pressure, 30PSIA, PCB Mount
76-3920-10031	Window O-Ring, 3/16" x 1", Viton
76-165-14582-00-A	Kit, Dust Filter 3/8T
76-165-14600-00-A	Kit, Filter, Sample
7. Upgrade Kits from ACM 150 to ACM 150 Gen 2	
3014B1213	Complete upgrade kit – a HMI PC, an LCD monitor, and a bracket. * Not include the Spectrum2, gas cell, router, an SBC
8. Upgrade Kits from ACM 100 to ACM 150 Gen 2	
3014B1212	ACM100 complete upgrade kit-(The Spectrum2, the gas cell, a mounting hardware, an HMI PC, PC Bracket, an LCD monitor, a router, an SBC, and new HMI software)

12.2. Appendix B Event list

Fault Category	Event Level	Event Code	Displayed Message	Remark
Bench Fault	System Down	52	Bench Fault - ZPD value out of range on Point# (energy: #, position: #)	(Only for PKI) #ZPD energy #ZPD position
	System Down	53	Bench Fault - Wrong data size	(Only for PKI)
	Require Service	54	Bench Fault - Replace the desiccant of PKI bench	(Only for PKI)
Communication Fault	System Down	16	Comm Fault - Can't connect to Relay board	
	System Down	16	Comm Fault - Can't update Relay board	# Relay number
	System Down	17	Comm Fault - Can't connect to Valve board	
	System Down	17	Comm Fault - Can't update Valve board	# Sample valve number
	System Down	18	Comm Fault - Can't connect to ACM board	
	System Down	18	Comm Fault - Can't update ACM board	# Solenoid valve number
	Require Service	61	Comm Fault - ALIGN operation failed (SBC)	
	System Down	61	Comm Fault - SCAN operation failed (SBC)	
	Require Service	61	Comm Fault - INFO operation failed (SBC)	
	Require Service	51	Comm Fault - ALIGN operation failed (Bench)	
	System Down	51	Comm Fault - SCAN operation failed (Bench)	
	Require Service	51	Comm Fault - INFO operation failed (Bench)	
	System Down	51	Comm Fault - Can't connect to FTIR Bench	
Configuration Fault	System Down	14	Config Fault - No scan point configured	
	System Down	14	Config Fault - No scan sequence configured	
Pump Fault	Require Service	5	Pump Fault - Secondary pump is activated (Cell pressure on Point# during Surge : #psi)	#Point area id #Cell pressure
	System Down	10	Pump Fault - Check Secondary Pump (Cell pressure on Point# during Surge : #psi)	#Cell pressure (Background Scan)

	Require Service	9	Pump Fault - Check Booster Pump (Sample pressure during Evac: #psi)	#Point area id #Cell pressure
Scan Fault	System Down	41	Scan Fault - No background spectra available	
	Require Service	42	Scan Fault - No factory background spectra available	
	Require Service	6	Scan Fault - Cell pressure failed to reach 14.7 psi. (Cell pressure on Point # during Fill : 11.99 psi)	# Target pressure # Point area id #Cell pressure
	Require Service	7	Scan Fault - Sample pressure failed to reach 6 psi. (Sample pressure on Point # during Fill : 3.99 psi)	# Target pressure # Point area id #Cell pressure
Overrange Fault	System Down	44	Overrange spectra detected over #.	# Alarm threshold
	Require Service	44	Overrange spectra detected over #.	# Warn threshold
Diagnostics Information	Require Service	4	Diag Info - Possible kinked tube detected. (Sample pressure on point# : # psi)	# Sample valve number # Pressure
	Information	103	Diag Info - Kinked Tube Test is started	
	Information	104	Diag Info - Kinked Tube Test is completed	
	Require Service	3	Diag Info - Possible line leak detected. (Sample pressure on Point 1, 2, 3, 4, 5, 6, 7, 8: # psi) Diag Info - Possible line leak detected. (Sample pressure on Point 2: # psi)	# ~ # Sample valve number # Pressure
	Information	105	Diag Info - Line Leak Test is started	
	Information	106	Diag Info - Line Leak Test is completed	
	Require Service	43	Diag Info - Need to acquire New background spectra	
	Information	100	Diag Info - " " is logged in.	"User Name"
	Information	101	Diag Info - " " is logged out.	"User Name"
	Information	102	Diag Info - Operation mode is changed to " " mode.	"Operation mode"

	Information	107	Diag info - Succeed to create MTD	
	Require Service	108	Diag info - Failed to create MTD	
	Information	109	Diag info - Succeed to create TWA	
	Require Service	110	Diag info - Failed to create TWA	
System Information	Information	111	Diag info - Succeed to import configuration (*.zip)	
	Require Service	112	Diag info - Failed to import configuration (*.zip)	
	Information	113	Diag info - Succeed to export configuration (*.zip)	
	Require Service	114	Diag info - Failed to export configuration (*.zip)	
Version Compatibility fault	Require Service	62	Version fault - Update Bench FW to #	# version to update
	Require Service	63	Version fault - Update SBC SW to #	(Only for PKI) # version to update
	Require Service	64	Version fault - Update temp DB to #	# version to update
	Require Service	65	Version fault - Update main DB to #	# version to update
System fault	Require Service	2	System fault - Web browser problem	
	System Down	2	System fault - Temp DB problem	
	System Down	2	System fault - Main DB problem	
	System Down	2	System fault - Process manager problem	
	System Down	2	System fault - HMI problem	
	System Down	2	System fault - Bench process problem	
	System Down	2	System fault - Board process problem	
	Require Service	2	System fault - Task manager problem	
	System Down	2	System fault - Main process problem	
	Require Service	2	System fault - Event process problem	

	Require Service	2	System fault - Board simulator problem	
	Require Service	2	System fault - Bench simulator problem	
	Require Service	2	System fault - Board simulator utility problem	
	System Down	1	System fault - Restart ACM Software	
DB Fault	System Down	24	DB Fault - Can't connect to Temp DB	
	System Down	24	DB Fault - Temp DB command problem (Read)	
	System Down	24	DB Fault - Temp DB command problem (Write)	
	System Down	25	DB Fault - Can't connect to Main DB	
	System Down	25	DB Fault - Main DB command problem (Read)	
SNR Fault	System Down	47	SNR Fault - Low Background SNR detected (Noise: # areas, Total: # areas)	#: The number of low SNR detected areas #: The number of total SNR calculating areas
	Require Service	47	SNR Fault - Low Background SNR detected (Noise: # areas, Total: # areas)	#: The number of low SNR detected areas #: The number of total SNR calculating areas
	System Down	48	SNR Fault - Low Sample SNR detected (Noise: # areas, Total: # areas)	#: The number of low SNR detected areas #: The number of total SNR calculating areas
	Require Service	48	SNR Fault - Low Sample SNR detected (Noise: # areas, Total: # areas)	#: The number of low SNR detected areas #: The number of total SNR calculating areas
	System Down	49	SNR Fault - Check FTIR Bench signal	
	Require Service	58	Ignore Low SNR due to Target Gas “ “ (#ppm on point#)	"Gas name" #Gas concentration #point/sequence number
	Require Service	59	Ignore Low SNR due to Maintenance Gas “ “ (#ppm on point#)	"Gas name" #Gas concentration #point/sequence number

12.3. Appendix C MODBUS register map

Ref.	Function Code	Register	Channel	Type	Function	Value	Remark
Read/Write Discrete Outputs or Coils	**0x01**	00100	Ch #01	Byte	Alarm1 status per point#	0: Normal 1: Alarm1 is triggered	
		04000	Ch #40	Byte			
		00101-00116	Ch #01	Byte	Alarm1 status per gas# (of point#)	0: Normal 1: Alarm2 is triggered	
		04001-04016	Ch #40	Byte			
Read Discrete Inputs	**0x02**	10100	Ch #01	Byte	Alarm2 status per point#	0: Normal 1: Alarm2 is triggered	
		14000	Ch #40	Byte			
		10101-10116	Ch #01	Byte	Alarm2 status per gas# (of point#)	0: Normal 1: Alarm2 is triggered	
		14001-14016	Ch #40	Byte			
Read Input Registers	**0x04**	30101-30116	Ch #01	Unsigned short	Alarm1 threshold per gas# (of point#)	0-65535	
		34001-34016	Ch #40	Unsigned short			
		34101-34116	Ch #01	Unsigned short	Alarm2 threshold per gas# (of point#)	0-65535	
		38001-38016	Ch #40	Unsigned short			
Read/Write Output or Holding Registers	**0x03**	40101-40116	Ch #01	Unsigned short	Current Gas concentration per point# (word)	0-65535	
		48117-48148	-	Float (Mid-Little endian)	Current Gas concentration per point# (float)	-	New for ACM 150 G2
		44001-44016	Ch #40	Unsigned short	Current Gas concentration per point# (word)	0-65535	
		44017-44048	-	Float (Mid-Little endian)	Current Gas concentration per point# (float)	-	New for ACM 150 G2
		48100	-	Unsigned short	The latest scanned point# (1st point)	1-60	

		48101-48116	-	Unsigned short	Gas concentration of the latest scanned point# (1st point)	0-65535	
		48120	-	Unsigned short	The latest scanned point# (2nd point)	101-160 (NOTE. Value = 100 + Point#)	(only if compostie scan)
		48121-48136	-	Unsigned short	Gas concentration of the latest scanned point# (2nd point)	0-65535	(only if compostie scan)
		48140	-	Unsigned short	The latest scanned point# (3rd point)	101-160 (NOTE. Value = 100 + Point#)	(only if compostie scan)
		48141-48156	-	Unsigned short	Gas concentration of the latest scanned point# (3rd point)	0-65535	(only if compostie scan)
		48160	-	Unsigned short	The latest scanned point# (4th point)	101-160 (NOTE. Value = 100 + Point#)	(only if compostie scan)
		48161-48176	-	Unsigned short	Gas concentration of the latest scanned point# (4th point)	0-65535	(only if compostie scan)
		48200	-	Unsigned short	Heartbeat	0-65535	
		48201	-	Unsigned short	Major Malfunction (Service event level: System down)	0-100 (Need to update)	
		48202	-	Unsigned short	Minor Malfunction (Service event level: Required service)	0-100 (Need to update)	

		48203	-	Unsigned short	CCITT CRC16 Checksum Single Scan (B)	0x0000 ~ 0xFFFF	
		48204	-	Unsigned short	CCITT CRC16 Checksum Single Scan (B)	0x0000 ~ 0xFFFF	
		48205	-	Unsigned short	CCITT CRC16 Checksum Single Scan (C)	0x0000 ~ 0xFFFF	
		48206	-	Unsigned short	CCITT CRC16 Checksum Single Scan (D)	0x0000 ~ 0xFFFF	
		48207	-	Unsigned short	Information (Service event level: Information)	0-100 (Need to update)	New for ACM 150 G2
		48208	-	Unsigned short	Simulation mode on/off status 0x0000: Board simul OFF, Bench simul OFF 0x0001: Board simul OFF, Bench simul ON 0x0002: Board simul ON, Bench simul OFF 0x0003: Board simul ON, Bench simul ON	0-3	New for ACM 150 G2
		48301-48316	NA	ASCII (Char * 32)	Software version 0.4.1 (0x302E 342E 3100 … 0000.)	-	New for ACM 150 G2

		48317	NA	Unsigned short	High byte: Operation mode 0x01xx: Automatic mode 0x02xx: Test mode (Manual mode/ Panel mode) Low byte: Request type (Refer to Appendix)	-	New for ACM 150 G2
		48318	NA	Unsigned short	Point# Enabled status Bitmap for point #1~#16 bit[15]: Point#16 status … bit[0]:Point# 1 status	0x0000 ~ 0xFFFF	New for ACM 150 G2

		48319	NA	Unsigned short	Point# Enabled status Bitmap for point #17~#32 bit[15]: Point#32 status … bit[0]:Point# 17 status	0x0000 ~ 0xFFFF	New for ACM 150 G2
		48320	NA	Unsigned short	Point# Enabled status Bitmap for point #33~#48 bit[15]: Point#48 status … bit[0]:Point# 33 status	0x0000 ~ 0xFFFF	New for ACM 150 G2
		48321	NA	Unsigned short	Point# Enabled status Bitmap for point #49~#60 bit[15]: Point#60 status … bit[0]:Point# 49 status	0x0000 ~ 0xFFFF	New for ACM 150 G2
		48322	NA	Unsigned short	Relay# triggered status Bitmap for pRelayoint #1~#16 bit[15]: Relay#16 status … bit[0]:Relay #1 status	0x0000 ~ 0xFFFF	New for ACM 150 G2
		48323	NA	Unsigned short	Relay# triggered status Bitmap for Relay #17~#32 bit[15]: Relay#32 status … bit[0]:Relay #17 status	0x0000 ~ 0xFFFF	New for ACM 150 G2
		48324	NA	Unsigned short	Relay# triggered status Bitmap for	0x0000 ~ 0xFFFF	New for ACM 150 G2

					Relay #33~#48 bit[15]: Relay#48 status … bit[0]:Relay #33 status		
		48325	NA	Unsigned short	Relay# triggered status Bitmap for Relay #49~#64 bit[15]: Relay#64 status … bit[0]:Relay #49 status	0x0000 ~ 0xFFFF	New for ACM 150 G2
		48326	NA	Unsigned short	Relay# triggered status Bitmap for point #65~#80 bit[15]: Point#80 status … bit[0]:Point# 65 status	0x0000 ~ 0xFFFF	New for ACM 150 G2
		48327	NA	Unsigned short	Relay# triggered status Bitmap for point #81~#86 bit[15]: Point#86 status … bit[0]:Point# 81 status	0x0000 ~ 0xFFFF	New for ACM 150 G2
		48328	NA	Unsigned short	Sample valve status Bitmap for valve #1~#16 bit[15]: valve#16 status … bit[0]:valve# 1 status	0x0000 ~ 0xFFFF	New for ACM 150 G2
		48329	NA	Unsigned short	Sample valve status Bitmap for valve #17~#32 bit[15]: valve#32 status …	0x0000 ~ 0xFFFF	New for ACM 150 G2

				bit[0]:valve# 17 status		
		48330	NA	Unsigned short	Sample valve status Bitmap for valve #33~#48 bit[15]: valve#48 status … bit[0]:valve# 33 status	0x0000 ~ 0xFFFF	New for ACM 150 G2
		48331	NA	Unsigned short	Sample valve status Bitmap for valve #49~#60 bit[15]: valve#60 status … bit[0]:valve# 49 status	0x0000 ~ 0xFFFF	New for ACM 150 G2
		48332	NA	Unsigned short	Pump status Bitmap bit[1]: Primary pump status, bit[0]: Secondary pump status	-	New for ACM 150 G2
		48333	NA	Unsigned short	Pump type 0x0001: Venturi 0x0002: Dual 0x0003: Venturi + Line leak 0x0004: Dual + Line leak	-	New for ACM 150 G2
		48334-48335	NA	Float (Mid-Little endian)	Evacuation cell pressure (float)	-	New for ACM 150 G2
		48335-48336	NA	Float (Mid-Little endian)	Surge cell pressure (float)	-	New for ACM 150 G2
		48336-48337	NA	Float (Mid-Little endian)	Fill cell pressure (float)	-	New for ACM 150 G2

		48401-48402	NA	Float (Mid-Little endian)	System Running Counter (SRC) The counter starts from 0, and is increased by 1 per one second	0 .. (2^32)-1	New for ACM 150 G2
		48403-48404	NA	Float (Mid-Little endian)	System Parameter Update Counter (SPUC) The counter is SRC value updated when system parameters (ex. point enable status) were changed.	0 .. (2^32)-1	New for ACM 150 G2
		48405-48406	NA	Float (Mid-Little endian)	Point Parameter Update Counter (PPUC) The counter is SRC value updated when point#1 parameters were changed.	0 .. (2^32)-1	New for ACM 150 G2
		48407-48408	NA	Float (Mid-Little endian)	Point Parameter Update Counter (PPUC) The counter is SRC value updated when point#2 parameters were changed.	0 .. (2^32)-1	New for ACM 150 G2
		484583-48584	NA	Float (Mid-Little endian)	Point Parameter Update Counter (PPUC)	0 .. (2^32)-1	New for ACM 150 G2

					The counter is SRC value updated when point#40 parameters were changed.		
		484523-48524	NA	Float (Mid-Little endian)	Point Parameter Update Counter (PPUC) The counter means the value of the SRC when point#60 parameters were changed.	0 .. (2^32)-1	New for ACM 150 G2
		49001	NA	Unsigned short	Selected Target Point Number (TPN) (NOTE. Set TPN as enabled point# before reading point# parameters using function code 0x06 with the same register 9001)	1-60	New for ACM 150 G2
		49002	NA	Unsigned short	Error Code for Target Point Parameters (Need to update)	-	New for ACM 150 G2
		49003-49018	NA	ASCII (Char * 32)	Point name (Location) of TPN.	-	New for ACM 150 G2
		49019	NA	Unsigned short	Gas enabled status Bitmap for point #1~#16 bit[15]: Point#16	0x0000 ~ 0xFFFF	New for ACM 150 G2

				status … bit[0]:Point# 1 status		
		49101-49116	NA	ASCII (Char * 32)	Gas name of Gas#1 on TPN.	-	New for ACM 150 G2
		49117-49120	NA	ASCII (Char * 8)	Gas unit of Gas#1 on TPN.	-	New for ACM 150 G2
		49121-49122	NA	Float (Mid-Little endian)	Alarm2 threshold of Gas#1 on TPN. (float)	-	New for ACM 150 G2
		49123-49124	NA	Float (Mid-Little endian)	Alarm1 threshold of Gas#1 on TPN. (float)	-	New for ACM 150 G2
		49141-49156	NA	ASCII (Char * 32)	Gas name of Gas#2 on TPN.	-	New for ACM 150 G2
		49157-49160	NA	ASCII (Char * 8)	Gas unit of Gas#2 on TPN.	-	New for ACM 150 G2
		49161-49162	NA	Float (Mid-Little endian)	Alarm2 threshold of Gas#2 on TPN. (float)	-	New for ACM 150 G2
		49163-49164	NA	Float (Mid-Little endian)	Alarm1 threshold of Gas#2 on TPN. (float)	-	New for ACM 150 G2
		49701-49716	NA	ASCII (Char * 32)	Gas name of Gas#16 on TPN.	-	New for ACM 150 G2
		49717-49720	NA	ASCII (Char * 8)	Gas unit of Gas#16 on TPN.	-	New for ACM 150 G2
		49721-49722	NA	Float (Mid-Little endian)	Alarm2 threshold of Gas#16 on TPN. (float)	-	New for ACM 150 G2
		49723-49724	NA	Float (Mid-Little endian)	Alarm1 threshold of Gas#16 on TPN. (float)	-	New for ACM 150 G2

12.4. Appendix D Gas list

Please contact Honeywell Analytics for the latest version.

12.5. Appendix E Technical Specifications

Performance Specifications	
Analysis Method	Continuous scan FT-IR analyzer
(FT-IR = Fourier transform infrared) Gas Cell Path	5.0 m path length
Gases Monitored	Organic, PFC, CFC, HFC, Metal Organic, NF3 and a wide variety of other inorganic gases
Lower Detection Limit	0.1 to 2.0 ppm for 5.0 m path cell, gas dependent
Scanning Rate	15 seconds per point
Sample Point Capacity	Available in 10, 20, 30, and 40 points configurations composite sampling up to 4 points
Data Archiving	15 days for all spectra, 365 days for alarms
Applicable Standards	EN 50270, EN 61010, UL 61010
Installation	Indoor only
Altitude	Up to 2,000 m (6,562 ft.)
Temperature range	5°C to 30°C (41°F to 86°F)
Relative humidity	80% at temperatures up to 31°C (88°F), decreasing linearly to 50% RH at 40°C (104°F)
Main supply voltage	±10% of the nominal voltage
Overvoltage	Category II
Pollution degree	2
Ingress protection	IP 20
Facilities Requirements	
Sample Line Tubing	1/4” ID x 3/8” OD polypropylene
Sample Line Inlets	3/8” connector
Electrical Supply	230 VAC, 10 A or 115 VAC, 20 A
Purge Gas, N2	5 - 10 psi, 10 l/min
Venturi Requirements	90 - 120 psi, 320 l/min
Exhaust Pipe	1.5” NPT

Overall Dimensions	66 x 34 x 25 inches (HxWxD) 1,676 x 864 x 635 mm (HxWxD)
Weight	
Operating	349 kgs / 770 lbs
Shipping	470 kgs / 1036 lbs
Standard Outputs and Communications	
Relay Outputs contacts	80 x DPDT (double-pole double-throw), programmable by sample point and gas type
max. ratings	30 VDC, 2 A
Interfaces	Web based user interface (e-Diagnostics) Ethernet: HTML viewing / control; ODBC access Touchscreen user friendly interface (point and click)
Optional Outputs and Communications via Gateways	
Interface	LonWorks®, Allen Bradley®, Modbus®, Profibus®, OPC drivers others on request
Options and Accessories	
Automatic sample line leak test	user settable

12.6. Appendix F MSDS

12.6.1. Appendix F-1 KBr MSDS

Trade name: Potassium Bromide

1 Identification of the substance/mixture and of the company/undertaking

Product details

Article number: 09934418

Trade name: Potassium Bromide

Application of the substance / the preparation: Laboratory chemicals

Manufacturer/Supplier:

PerkinElmer Life and Analytical Sciences 710

Bridgeport Avenue

Shelton, Connecticut 06484 USA

Emergency information:

CHEMTREC (within U.S.) 800 424-9300 CHEMTREC

(from outside U.S.) 1(703)-572-3887

2 Composition/information on ingredients

Chemical characterization

CAS No. Description: 7758-02-3 potassium bromide

Identification number(s): EINECS Number: 231-830-3

3 Hazards identification

Classification of the substance or mixture

Classification according to Directive 67/548/EEC or Directive 1999/45/EC: Not applicable

Information concerning particular hazards for human and environment: Not applicable

Label elements:

- Labelling according to EU guidelines
- Observe the general safety regulations when handling chemicals.
- The substance is not subject to classification according to the sources of literature known to us.

NFPA ratings (scale 0 - 4)

- Health = 2
- Fire = 0
- Reactivity = 0

HMIS-ratings (scale 0 - 4)

- Health = 2
- Fire = 0
- Reactivity = 0

4 First aid measures

Trade name: Potassium Bromide

General information:

- Seek immediate medical advice.
- No special measures required.

After inhalation: Supply fresh air; consult doctor in case of complaints.

After skin contact: Generally, the product does not irritate the skin.

After eye contact: Rinse opened eye for several minutes under running water.

After swallowing: If symptoms persist consult doctor.

5 Firefighting measures

Suitable extinguishing agents:

- CO_2, extinguishing powder or water spray.
- Fight larger fires with water spray or alcohol resistant foam.

Protective equipment: No special measures required.

6 Accidental release measures

Person-related safety precautions:

- Avoid formation of dust.
- Ensure adequate ventilation

Measures for environmental protection: Do not allow to enter sewers/ surface or ground water.

Measures for cleaning/collecting: Pick up mechanically.

Additional information: No dangerous substances are released.

7 Handling and storage

Handling

Information for safe handling: No special measures required.

Information about protection against explosions and fires: No special measures required.

Storage

- Requirements to be met by storerooms and receptacles: No special requirements.
- Information about storage in one common storage facility: Not required.
- Further information about storage conditions:
  - This product is hygroscopic.
  - Store receptacle in a well-ventilated area.

8 Exposure controls/personal protection

- Additional information about design of technical systems: No further data; see item 7.
- Components with limit values that require monitoring at the workplace: Not required.
- Additional information: The lists that were valid during the creation were used as basis.

Personal protective equipment

Trade name: Potassium Bromide

General protective and hygienic measures: The usual precautionary measures for handling chemicals should be followed.

Breathing equipment: Not required.

Protection of hands:

- The glove material must be impermeable and resistant to the product/ the substance/ the preparation.
- Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
- Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation

Material of gloves: The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer.

Penetration time of glove material: The exact break through time has to be found out by the manufacturer of the protective gloves and has to be observed.

Eye protection: Not required.

9 Physical and chemical properties

General Information

Appearance

- Form: Crystalline powder
- Color: Colorless
- Odor: Odorless

Change in condition

- Melting point/Melting range: Undetermined.
- Boiling point/Boiling range: Undetermined.

Flash point: Not applicable

Flammability (solid, gaseous): Product is not flammable.

Danger of explosion: Product does not present an explosion hazard

Density at 20°C (68°F): 1.4 g/cm³ (11.683 lbs/gal)

Solubility in / Miscibility with

- Water: Soluble

Organic solvents: 0.0 %

10 Stability and reactivity

Thermal decomposition / conditions to be avoided: No decomposition if used according to specifications

Materials to be avoided:

Dangerous reactions No dangerous reactions known

Dangerous products of decomposition: No dangerous decomposition products known

11 Toxicological information

Acute toxicity

Trade name: Potassium Bromide

Primary irritant effect:

- on the skin: No irritant effect
- on the eye: No irritating effect

Sensitization: No sensitizing effects known.

Additional toxicological information: When used and handled according to specifications, the product does not have any harmful effects according to our experience and the information provided to us. The substance is not subject to classification.

12 Ecological information

General notes: Do not allow undiluted product or large quantities of it to reach ground water, water course or sewage system.

13 Disposal considerations

Product:

- Recommendation: Smaller quantities can be disposed of with household waste.

Uncleaned packaging:

- Recommendation: Disposal must be made according to official regulations.

Recommended cleansing agent: Water, if necessary, with cleansing agents.

14 Transport information

Land transport ADR/RID (cross-border):

- ADR/RID class: -

Maritime transport IMDG:

- Marine pollutant: No

Transport/Additional information: Not dangerous according to the above specifications.

15 Regulatory information

Sara

- Section 355 (extremely hazardous substances): Substance is not listed.
- Section 313 (Specific toxic chemical listings): Substance is not listed.

Proposition 65

- Chemicals known to cause cancer: Substance is not listed.
- Chemicals known to cause reproductive toxicity for females: Substance is not listed.
- Chemicals known to cause reproductive toxicity for males: Substance is not listed.
- Chemicals known to cause developmental toxicity: Substance is not listed.

Trade name: Potassium Bromide

Cancerogenity categories

EPA (Environmental Protection Agency): Substance is not listed.

IARC (International Agency for Research on Cancer): Substance is not listed. NTP

(National Toxicology Program): Substance is not listed.

TLV (Threshold Limit Value established by ACGIH): Substance is not listed.

NIOSH-Ca (National Institute for Occupational Safety and Health): Substance is not listed.

OSHA-Ca (Occupational Safety & Health Administration): Substance is not listed.

Product related hazard information:

- Observe the general safety regulations when handling chemicals.
- The substance is not subject to classification according to the sources of literature known to us.
- Chemical safety assessment A Chemical Safety Assessment has not been carried out.

16 Other information

Disclaimer

The information provided in this Material Safety Data Sheet is based on our present knowledge and believed to be correct at the date of publication. However, no representation is made concerning its accuracy and completeness. It is intended as guidance only and is not to be considered a warranty or quality specification.
All materials may present unknown hazards and should be used with caution. Although certain hazards are described, we cannot guarantee that these are the only hazards which exist. PerkinElmer Life and Analytical Sciences shall not be held liable for any damage resulting from handling or from contact with the product.

Department issuing MSDS: Safety and Health Contact:

- Within the USA: 1-(800)-762-4000
- Outside the USA: 1-(203)-712-8488

* Data compared to the previous version altered.

12.6.2. Appendix F-2 MSDS

Trade name: Zinc Selenide

1 Identification of the substance/mixture and of the company/undertaking

Product details

Trade name: Zinc Selenide

Article number: 09934409B

Application of the substance / the preparation: Laboratory chemicals

Manufacturer/Supplier:

PerkinElmer Life and Analytical Sciences

710 Bridgeport Avenue

Shelton, Connecticut 06484 USA

Emergency information:

CHEMTREC (within U.S.) 800 424-9300

CHEMTREC (from outside U.S.) 1(703)-572-3887

2 Hazards identification

Classification according to Regulation (EC) No 1272/2008:

- GHS06 skull and crossbones
- Acute Tox. 3: H301 Toxic if swallowed.
- Acute Tox. 3: H331 Toxic if inhaled.
- GHS08 health hazard
- STOT RE 2: H373 May cause damage to organs through prolonged or repeated exposure.
- GHS09 environment
- Aquatic Acute 1: H400 Very toxic to aquatic life.
- Aquatic Chronic 1: H410 Very toxic to aquatic life with long lasting effects.

Classification according to Directive 67/548/EEC or Directive 1999/45/EC:

- T Toxic
- R23/25: Toxic by inhalation and if swallowed.
- N Dangerous for the environment
- R50/53: Very toxic to aquatic organisms, may cause long-term adverse effects in the aquatic environment.
- R33: Danger of cumulative effects.

Information concerning hazards for human and environment: Not applicable.

Label elements:

- Labelling according to Regulation (EC) No 1272/2008: The substance is classified and labelled according to the CLP regulation.

Hazard pictograms: GHS06, GHS08, GHS09

Signal word: Danger

Trade name: Zinc Selenide

Hazard-determining components of labelling: zinc selenide

Hazard statements:

- H301 Toxic if swallowed.
- H331 Toxic if inhaled.
- H373 May cause damage to organs through prolonged or repeated exposure.
  H410 Very toxic to aquatic life with long lasting effects.

Precautionary statements:

- P260: Do not breathe dust/fume/gas/mist/vapours/spray.
- P261: Avoid breathing dust/fume/gas/mist/vapours/spray.
- P273: Avoid release to the environment.
- P264: Wash thoroughly after handling.
- P270: Do not eat, drink or smoke when using this product.
- P271: Use only outdoors or in a well-ventilated area.
- P301+P310 IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician.
- P321: Specific treatment (see on this label).
- P311: Call a POISON CENTER or doctor/physician.
- P304+P340 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
- P314: Get medical advice/attention if you feel unwell.
- P330: Rinse mouth.
- P391: Collect spillage.
- P405: Store locked up.
- P403+P233: Store in a well-ventilated place. Keep container tightly closed.
- P501: Dispose of contents/container in accordance with local/regional/national/ international regulations.

Other hazards: The product does not contain any organic halogen compounds (AOX), nitrates, heavy metal compounds or formaldehydes.

Results of PBT and vPvB assessment:

- PBT: Not applicable
- vPvB: Not applicable

3 Composition/information on ingredients

Classification of the substance or mixture

CAS No. Description: 1315-09-9 zinc selenide

Identification number(s):

- EINECS Number: 215-259-7
- Index number: 034-002-00-8

4 First aid measures

Trade name: Zinc Selenide

General information:

- Immediately remove any clothing soiled by the product.
- Remove breathing equipment only after contaminated clothing have been completely removed. In case of irregular breathing or respiratory arrest provide artificial respiration.

After inhalation:

- Supply fresh air or oxygen; call for doctor.
- In case of unconsciousness place patient stably in a side position for transportation.

After skin contact: Immediately wash with water and soap and rinse thoroughly.

After eye contact: Rinse opened eye for several minutes under running water. Then consult a doctor.

After swallowing: Do not induce vomiting; call for medical help immediately.

Information for doctor:

- Most important symptoms and effects, both acute and delayed No further relevant information available.
- Indication of any immediate medical attention and special treatment needed
- No further relevant information available.

5 Extinguishing media

Suitable extinguishing agents:

- CO2, powder or water spray.
- Fight larger fires with water spray or alcohol resistant foam.
- Special hazards arising from the substance or mixture: No further relevant information available

Protective equipment: No special measures required.

6 Accidental release measures

Personal precautions, protective equipment and emergency procedures: Not required.

Environmental precautions:

- Inform respective authorities in case of seepage into water course or sewage system.
- Do not allow to enter sewers/ surface or ground water.

Methods and material for containment and cleaning up: Dispose contaminated material as waste according to item 13. Ensure adequate ventilation.

Reference to other sections:

- See Section 7 for information on safe handling.
- See Section 8 for information on personal protection equipment.
- See Section 13 for disposal information.

7 Handling and storage

Handling

Trade name: Zinc Selenide

Precautions for safe handling:

- Thorough dedusting.
- Ensure good ventilation/exhaustion at the workplace. Open and handle receptacle with care.

Information about fire and explosion protection: Keep respiratory protective device available

Storage (conditions for safe storage, including any incompatibilities)

Requirements to be met by storerooms and receptacles: No special requirements.

Information about storage in one common storage facility: Not required.

Further information about storage conditions: Keep container tightly sealed.

Specific end use(s) No further relevant information available.

Additional information about design of technical facilities: No further data; see item 7.

8 Exposure controls/personal protection

1315-09-9 zinc selenide

- WEL: Long-term value: 0.1 mg/m³ as Se

Personal protective equipment

General protective and hygienic measures:

- Keep away from foodstuffs, beverages and feed.
- Immediately remove all soiled and contaminated clothing
- Wash hands before breaks and at the end of work. Store protective clothing separately.

Respiratory protection: In case of brief exposure or low pollution use respiratory filter device. In case of intensive or longer exposure use self-contained respiratory protective device.

Protection of hands:

- Protective gloves
- The glove material has to be impermeable and resistant to the product/ the substance/ the preparation.
- Due to missing tests no recommendation to the glove material can be given for the product/ the preparation/ the chemical mixture.
- Selection of the glove material on consideration of the penetration times, rates of diffusion and the degradation.

Material of gloves: The selection of the suitable gloves does not only depend on the material, but also on further marks of quality and varies from manufacturer to manufacturer.

Penetration time of glove material: The exact break through time must be found out by the manufacturer of the protective gloves and has to be observed.

Eye protection: Not required

9 Physical and chemical properties

General Information

Trade name: Zinc Selenide

Appearance

- Form: Solid
- Color: Dark brown
- Odor: Characteristic
- Odor threshold: Not determined

pH-value: Not applicable.

Change in condition

- Melting point/Melting range: >1100°C
- Boiling point/Boiling range: Undetermined.

Flash point: Not applicable.

Flammability (solid, gaseous): Product is not flammable.

Ignition temperature:

Decomposition temperature: Not determined.

Self-igniting: Not determined.

Danger of explosion: Product does not present an explosion hazard.

Explosion limits:

- Lower: Not determined.
- Upper: Not determined.

Vapour pressure: Not applicable.

Density at 20°C: 5.42 g/cm³

Relative density: Not determined

Vapour density: Not applicable.

Evaporation rate: Not applicable.

Solubility in / Miscibility with water: Not miscible or difficult to mix.

Segregation coefficient (n-octanol/water): Not determined.

Viscosity Dynamic: Not applicable.

Kinematic: Not applicable.

Organic solvents: 0.0 %

Solids content: 100.0 %

Other information: No further relevant information available.

10 Stability and reactivity

Thermal decomposition / conditions to be avoided: No decomposition if used according to specifications.

Possibility of hazardous reactions No dangerous reactions known.

Conditions to avoid No further relevant information available.

Incompatible materials: No further relevant information available.

Hazardous decomposition products: No dangerous decomposition products known.

11 Toxicological information

Trade name: Zinc Selenide

Acute toxicity

Primary irritant effect:

- on the skin: No irritant effect
- on the eye: No irritating effect

Sensitization: No sensitizing effects known.

Toxicity

Aquatic toxicity: No further relevant information available.

Persistence and degradability No further relevant information available.

Behavior in environmental systems:

- Bio accumulative potential No further relevant information available.
- Mobility in soil No further relevant information available.

Ecotoxical effects:

- Remark: Very toxic for fish
- Additional ecological information:
- General notes:
- Do not allow product to reach ground water, water course or sewage system.
- Danger to drinking water if even small quantities leak into the ground. Also poisonous for fish and plankton in water bodies.
- Very toxic for aquatic organisms

Results of PBT and vPvB assessment

- PBT: Not applicable.
- vPvB: Not applicable.

Other adverse effects No further relevant information available.

12 Disposal considerations

Recommendation: Must not be disposed together with household garbage. Do not allow product to reach sewage system.

Uncleaned packaging:

- Recommendation: Disposal must be made according to official regulations.

Recommended cleansing agent: Water, if necessary, with cleansing agents.

13 Transport information

UN-Number

- ADR, IMDG, IATA: UN2811

UN proper shipping name

- ADR: 2811 TOXIC SOLID, ORGANIC, N.O.S., ENVIRONMENTALLY HAZARDOUS
- IMDG, IATA: TOXIC SOLID, ORGANIC, N.O.S.

Transport hazard class(es)

- ADR
- Class: 6.1 (T5) Toxic substances.
- Label: 6.1

Trade name: Zinc Selenide

IMDG, IATA

- Class: 6.1 Toxic substances.

Packing group

- ADR: I

Environmental hazards:

- Marine pollutant: No
- Special marking (ADR): Symbol (fish and tree)

Special precautions for user Warning: Toxicsubstances.

Danger code (Kemler): 66

Transport in bulk according to Annex II of MARPOL73/78 and the IBC Code: Not applicable.

Transport/Additional information

ADR

- Tunnel restriction code: C/E

UN “Model Regulation”: UN2811, TOXIC SOLID, ORGANIC, N.O.S., ENVIRONMENTALLY HAZARDOUS, 6.1, I

14 Safety, health and environmental regulations/legislation specific for the substance or mixture

Labelling according to Regulation (EC) No 1272/2008: The substance is classified and labelled according to the CLP regulation.

Hazard pictograms GHS06, GHS08, GHS09

Signal word Danger

Hazard-determining components of labelling: zinc selenide

Hazard statements:

- H301 Toxic if swallowed.
- H331 Toxic if inhaled.
- H373 May cause damage to organs through prolonged or repeated exposure.
- H410 Very toxic to aquatic life with long lasting effects.

Trade name: Zinc Selenide

Precautionary statements

- P260: Do not breathe dust/fume/gas/mist/vapours/spray.
- P261: Avoid breathing dust/fume/gas/mist/vapours/spray.
- P273: Avoid release to the environment.
- P264: Wash thoroughly after handling.
- P270: Do not eat, drink or smoke when using this product.
- P271: Use only outdoors or in a well-ventilated area.
- P301+P310 IF SWALLOWED: Immediately call a POISON CENTER or doctor/ physician.
- P321: Specific treatment (see on this label).
- P311: Call a POISON CENTER or doctor/physician.
- P304+P340 IF INHALED: Remove victim to fresh air and keep at rest in a position comfortable for breathing.
- P314: Get medical advice/attention if you feel unwell.
- P330: Rinse mouth.
- P391: Collect spillage.
- P405: Store locked up.
- P403+P233: Store in a well-ventilated place. Keep container tightly closed.
- P501: Dispose of contents/container in accordance with local/regional/national/ international regulations.

Chemical safety assessment: A Chemical Safety Assessment has not been carried out.

15 Other information

Disclaimer

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All materials may present unknown hazards and should be used with caution. Although certain hazards are described, we cannot guarantee that these are the only hazards which exist. PerkinElmer Life and Analytical Sciences shall not be held liable for any damage resulting from handling or from contact with the product.

Department issuing MSDS: Safety and Health Contact:

- Within the USA: 1-(800)-762-4000
- Outside the USA: 1-(203)-712-8488

* Data compared to the previous version altered.

12.7. Appendix G Glossary

12.7.1. Access Codes

An access code is an 8 number or more sequence that must be entered for accessing many of the keypad menu selections to prevent unauthorized changes to the scanning program and use of the test functions. A generic code is provided to authorized users by HA. Upon request, HA will add a series of code numbers or change the generic access code. Authorized users can assign a specific code to each employee who requires access to these functions.

12.7.2. EHS

A professional employee, manager or consultant responsible for one or more of the following areas:

- Environmental
- Health
- Safety

12.7.3. ERT

An Emergency Response Team that responds when there is a leak or spill of hazardous production materials (including toxic gases).

12.7.4. FTIR

Fourier transform infrared (FTIR) is the ACM 150 monitor's analysis method. The analyzer collects infrared (IR) absorbance spectra of the air from each sample point. These spectra cover the "fingerprint" or mid-infrared wavelength region. Nearly all chemicals have an IR absorbance spectrum, which is always the same and unique for each chemical. The FTIR spectra have a high resolution which enables the distinct identification of one chemical from the another. The ACM 150 monitor only monitors for chemicals in their gas (vapor) phase.

12.7.5. HA

Honeywell Analytics

12.7.6. LAN

This refers to the HA Local Area Network, which includes a server computer, a network hub and usually one or more remote network computers. The LAN always interfaces to HA monitors. One network can accommodate as many as 32 monitors. The LAN utilizes HA proprietary ERM (Emergency Response Manager) software.

12.7.7. Lockout/Tagout

This is a means of protecting personnel from AC line voltage when accessing or servicing AC terminals or line-powered components. Lockout is a means of disconnecting the line power using a removable key switch, adding a lock over the line power plug or locking a power disconnect box after power is turned off. Tagout is a safety tag that serves notice when a circuit is locked-out.

12.7.8. PSIA

Pounds per square inch absolute, pressure relative to a vacuum.

12.7.9. PSIG

Pounds per square inch gauge, pressure relative to atmospheric pressure at sea level.

12.7.10. PPM

The ACM 150 monitor reports concentration values for gases in parts per million (PPM) and parts per hundred thousand (PPHT) (water vapor only).

A pure gas would have a value of 100% concentration (by volume). One part in one million (1 PPM) is 0.0001% or 100% divided by 1 million. 1 PPHT = 10 PPM. These are the relationships between PPB, PPM and %:

PPM	%
0.01	0.000001
0.1	0.00001
1	0.0001
10	0.001
1,000	0.1
1 million	100.0

12.7.11. TLV

Threshold limit value.

12.7.12. TWA

Time-weighted average.

12.7.13. PPC

Panel PC: It is a major part to display gas monitoring data and set input by touchscreen. It is Touchscreen computer.

12.7.14. SBC

Single board PC: It is a major part to connect PPC to FTIR bench.

12.7.15. QNX

It is an operating system. ACM 150 PPC use QNX.

ACM 150 Air Composition Monitor (Gen 2)
Manual part number: 3014M5000 English,
Revision 6
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Honeywell