SECTION 1: SYSTEM 16 OVERVIEW

This section describes the components of the System 16 and provides a basic understanding of instrument operation.

Introduction

This overview introduces the System 16. There are four parts to this section:

- **Modular Design** (1.1) explains the component parts of the instrument.
- **Sampling and Monitoring** (1.2) explains how the System 16 obtains and monitors air samples from as many as 16 locations, with one or two gases at each location.
- **Detection** (1.3) explains how the System 16 uses Chemcassette systems and nondispersive infrared (NDIR) detection systems to determine the gas concentrations at active monitoring points.
- **Alarms** (1.4) explains how the System 16 warns of alarm-level concentrations of target gases and provides instrument diagnostics.

1.1 Modular Design

Illustration 1-1 shows a front view of the System 16, including all of the modules which make up the instrument. Each module performs a specific function in the detection and analysis of gases.

A System 16 may contain one Chemcassette system and/or one nondispersive infrared (NDIR) detection system, two Chemcassette systems or two NDIR systems. Your instrument will not contain all of the modules shown if it does not use both types of detection.

The module descriptions are keyed to **Illustration 1-1**.

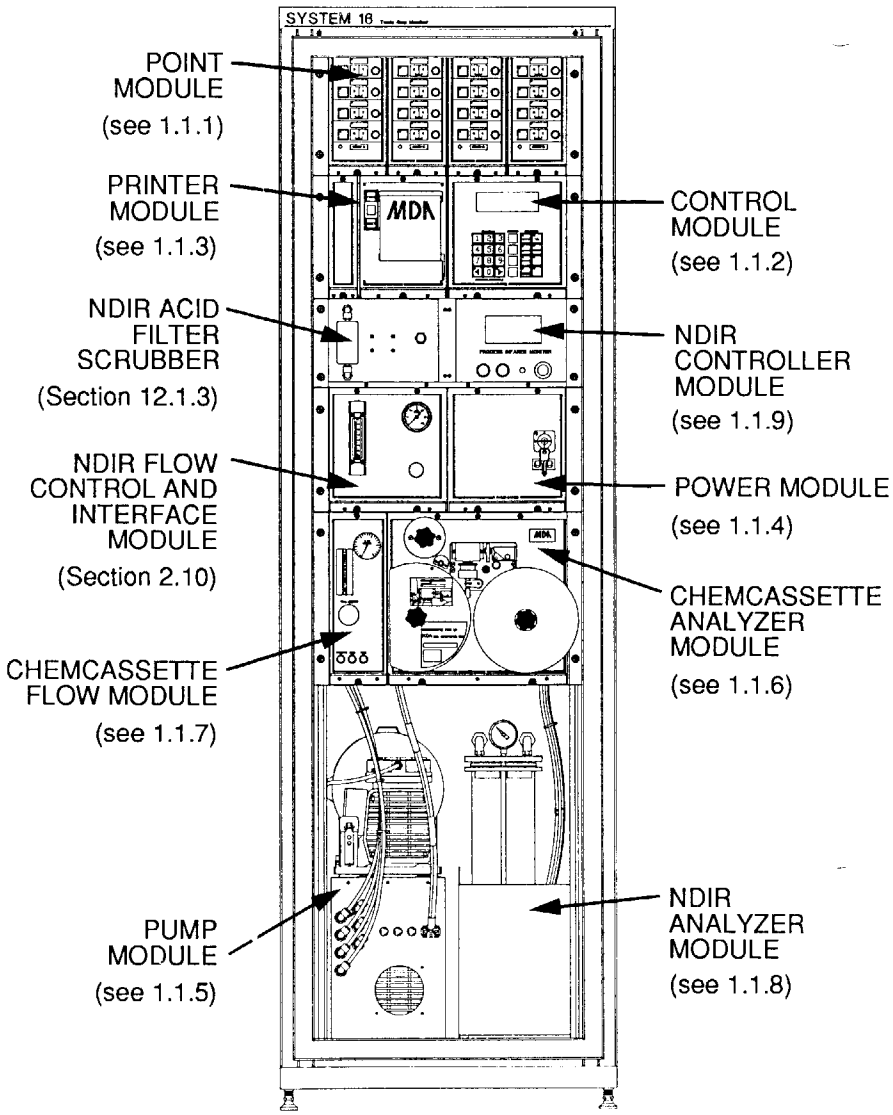

Illustration 1-1
System 16 Front View

1.1.1 Point Module

Each Point Module acts as a monitoring center for sample lines running from four locations to four points. The four points in a particular Point Module are called a Point Group. As they apply to the System 16, the words **point, line** and **location** require definition:

- A location is a place to be monitored.
- Sample atmosphere runs from the location to the System 16 via a line.
- The line attaches to the System 16 at a part of the point module called a point (see **Illustration 1.2**).

Use the Point Module to program sample monitoring sequences and to enable or disable monitoring of sampling points. The System 16 may contain as many as four Point Modules, allowing for monitoring of up to 16 locations via sample lines.

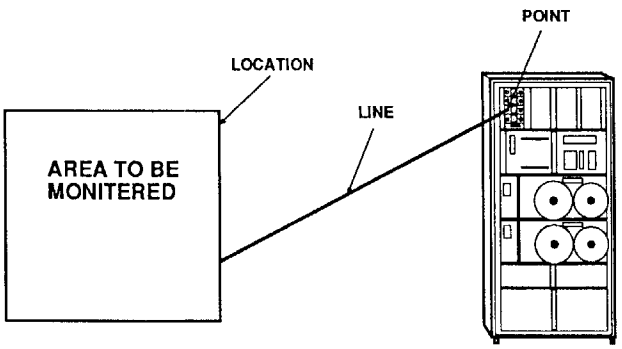

Illustration 1-2
Point, Line and Location

1.1.2 Control Module

The Control Module is the location of programming, control, operation, and communications. In addition to handling operator command inputs, the Control Module reports point monitoring and instrument functions such as power distribution and internal monitoring for instrument faults.

1.1.3 Printer Module

The 40-column printer provides a hard copy of data from the Control Module.

1.1.4 Power Module

This module contains the main AC power switch, circuit breakers and step-down transformer. Use the Power Module to turn the System 16 on and off.

1.1.5 Pump Modules

The Pump Modules provide a vacuum source for air flow during the analysis and purge cycle. The number of pumps in the System 16 depends on the configuration of the analyzers. The chart below describes the different analyzer and pump configurations:

Analyzers	Pumps
Dual Chemcassette	Purge and Sample
Dual NDIR	Evacuation (1 only)
Combination NDIR and Chemcassette	Purge, Sample, and Evacuation

1.1.6 Chemcassette Analyzer Modules

Instruments with Chemcassette systems have one or two Chemcassette Analyzer Modules. Chemcassette Analyzer Modules sample and detect a specific gas or family of gases.

1.1.7 Chemcassette Flow Control Module

The Chemcassette Flow Control Module governs the sample flow from the Point Modules to the Chemcassette Analyzer Module and allows for necessary adjustments.

1.1.8 NDIR Analyzer Modules

Your System 16 may be factory-equipped with one or two NDIR Analyzer Modules. Each NDIR Analyzer Module samples and detects a specific gas.

1.1.9 NDIR Flow Control and Interface Module

The NDIR Flow Control and Interface Module controls the sample flow and evacuation cycle of the NDIR Analyzer, and is an electrical interface between the NDIR Controller and the System 16 Control Module.

1.1.10 NDIR Controller

The NDIR Controller processes information from the NDIR Analyzer Module.

1.2 Sampling and Monitoring

All of the modules work together to sample air and monitor gas levels. The instrument's Sample Pump Modules pull air samples through lines running from remote locations to the System 16.

Within each Point Module, a needle valve provides line balance to minimize the differences caused by varying line lengths. A three-way valve selects the point that is sampled within a group. A two-way valve combines the remaining points in the group and purges them. Only one Point Module is purged at a time.

Purging provides rapid, continuous movement of air samples within the flow modules. The Sample Pump channels and balances air flow at specific flow rates and vacuum levels for analysis.

Three different types of air movement require definition:

- The high-velocity large-volume air movement through the lines is transport flow.
- The air admitted to the analyzer is sample flow.
- Air movement through a line while the air it is carrying is not being monitored is purge flow.

The analyzers monitor the air samples in a specific order that is established through the control module. There are two basic monitoring patterns:

- In the **Sequential** mode, the System 16 monitors the sample flow to only one point at a time.
- In the **Parallel** mode, the System 16 simultaneously monitors samples to the points in one Point Module (a point group).

The following two sections explain the differences between these two alternative monitoring patterns.

1.2.1 Sequential Monitoring Mode

The System 16 sequential monitoring mode monitors each of the active points individually, according to a factory-programmed or user-programmed monitoring sequence (see **Section 5** for programming instructions.) The System 16 microprocessor automatically calculates the required length of the sampling period for each point based on the gas and alarm levels selected for that point. While monitoring one point, the system purges the next group in the programming sequence. You can set the printer to document the gas concentration for each point as it is sequentially monitored. Information about gas concentrations is stored for use in reporting the 8-hour Time Weighted Average. Sequential monitoring is especially useful in applications where the monitoring requirements vary widely from point to point.

1.2.2 Parallel Monitoring Mode

The System 16 monitors each active point group in a programmed order when operating in the parallel mode. This allows simultaneous monitoring of four points for situations in which frequent surveilance is needed. Each Point Module is monitored in a defined sequence. While one Point Module is being monitored, the next module in the sequence is being purged to prepare for monitoring. The microprocessor determines sampling times and alarm levels based on the individual point programming.

You can use the parallel mode to continuously monitor a critical location by running separate sample lines from that location to each of the Point Modules. As groups are monitored that location will be monitored in every group providing 100% coverage.

1.2.3 Dual Gas Monitoring

A System 16 equipped with two Analyzer Modules can monitor two different gases (or a group of gases such as hydrides or mineral acids.) However, an individual monitoring point can be programmed to monitor only one gas per analyzer. Thus, to set up a monitoring sequence for two different gases from a single location, you must run two sample lines to two different points and program the two points individually.

During sequential or parallel monitoring in any system with a Chemcassette, the analyzers in a dual analyzer system sample the same point at the same time. You may choose not to have a point monitored by one of the analyzers, but they cannot monitor different points at the same time.

Dual NDIR systems can monitor different points in different sequences. While one analyzer is sampling the air from a point, the other is purging.

Sampling times are based on the time it takes for the slowest analysis to be completed. See **Appendix** for sampling times and transport flow rates. In dual Chemcassette units, the analysis times vary based on the particular gases being measured and the alarm level.

See **Section 5** for instructions about programming sequential and parallel sequences.

See **Section 6** for more information about sequential and parallel monitoring.

1.3 Detection

To monitor a single line or point group, the Analyzer Module detects and measures a specific gas or family of gases in the air sample. This data goes to the Control Module which interprets the data and responds appropriately. The System 16 then initiates purging and proceeds to monitor the next point or Point Module in the sequence. See **Section 3** for instructions on determining sample locations and installing sample lines.

The detection technique used by the Analyzer Module may be either Chemcassette detection or NDIR detection.

The following two sections explain the two different detection processes.

1.3.1 Chemcassette Detection

A Chemcassette is a cassette tape specially formulated to react with a specific gas or group of gases. In an analyzer with a Chemcassette detection system, the target gas in the sample flow reacts with the tape of the Chemcassette. The reaction produces a stain in a density proportional to the gas concentration. The stain is optically measured, digitally interpreted, and reported by the System 16 as a precise concentration level in parts-per-million (ppm) or parts-per-billion (ppb). **Illustration 1-3** shows the main components of the Chemcassette detection system: a gas sampling head, optics, photodetector and Chemcassette.

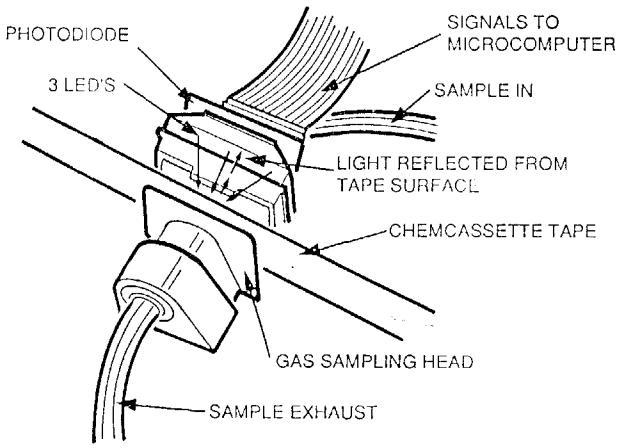

Illustration 1-3
Chemcassette Detection

MDA Chemcassettes are available for measurement of the following gases:

Ammonia	Nitrogen Dioxide
Chlorine	Hydrogen Sulfide
Phosgene	Sulfur Dioxide
Hydrogen Cyanide	

Chemcassettes are also available for the measurement of families of gases. If your System 16 is equipped to detect hydrides or mineral acids, you can program your System 16 to respond to a specific gas within the gas group at each monitoring point. This feature is available for the following hydrides and mineral acids:

Hydrides	Mineral Acids
Arsine	Hydrogen Bromide
Diborane	Hydrogen Chloride
Germane	Hydrogen Fluoride
Hydrogen Selenide	
Phosphine	
Silane	
Stibine	

1.3.2 Nondispersive Infrared Detection

The nondispersive infrared (NDIR) spectrometer system detects gases by measuring changes in infrared energy which occur when specific wavelengths of infrared light pass through those gases. An energy source in the NDIR Analyzer emits broadband infrared light which passes through the narrow band filters on the filter wheel. The infrared light, now in alternating measurement and reference wavelengths, passes through the sample cell. If the target gas is present in the cell, the measurement infrared light is absorbed in proportion to the concentration present. The reference infrared light passes through unaffected.

A detector assembly detects and amplifies the measurement and reference energy levels, and sends them to signal-processing circuitry in the NDIR Controller. The NDIR Controller processes this data and communicates the information to the System 16 Control Module via the NDIR Interface Module.

In a similar manner to Chemcassette detection, the NDIR system reports ppm or ppb gas concentrations.

The NDIR Analyzer is composed of a source, a sample cell, and a detector assembly. The source contains a platinum wire source, a filter wheel, a chopper motor, three lenses and the associated electronics. The detector module consists of a focusing lens, a solid state infrared detector and a preamplifier.

Each NDIR unit is specific for one gas. Current capabilities include Nitric Oxide, Nitrogen Trifluoride, Carbon Monoxide, Vinyl Chloride, Methylene Chloride and Ethylene Oxide.

1.4 Alarms

The System 16 has programmable dual alarms which warn of high or low concentrations of the monitored gas, and trigger relays to any associated alarms or emergency equipment in use.

1.4.1 Level 1 and Level 2 General and Point Alarms

The default setting for the Level 1 alarm is the Threshold Limit Value (TLV) of the monitored gas. The default setting for the Level 2 alarm is two times the TLV.

You may set a single set of alarm levels for the entire system, or you may set individual alarm levels for each sample line. Separate alarm levels for each point provide added protection in critical locations while eliminating unnecessary alarms in areas where high "background" concentrations are acceptable.

For parallel monitoring of points, the System 16 microprocessor automatically calculates and sets an alarm level for the Group. This alarm level is referred to as the group alarm level and is based on the alarm level of the point in the Point Module with the lowest programmed alarm level.

1.4.2 System 16 Response to Alarm Conditions

The System 16 response to an alarm condition depends on whether the System 16 is operating in the sequential or parallel mode. The major difference is that in parallel mode, when a gas concentration reaches an alarm level, the System 16 will switch to sequential monitoring within the alarming group to determine which point or points are responsible for the alarm condition.

Sequential Mode:

When the System 16 detects a gas concentration which exceeds a programmed point alarm level, it activates a series of signals.

- The appropriate Level 1 or Level 2 alarm LEDs light.
- The point relay contacts activate.
- The general Level 1 or Level 2 alarm contact in that group activates.
- The corresponding Analyzer 1 or Analyzer 2 contact activates.
- The Printer Module prints out the date, time, point and gas concentration.
- The display shows the alarms information.

These data are also stored in memory. During an alarm condition, the System 16 continues monitoring using the programmed sequential monitoring sequence.

Parallel Mode:

if the gas concentration exceeds the group alarm level while the System 16 is in parallel mode,

- The level 1 alarm LEDs for all four points in the alarming point group will flash on and off.
- The Level 1 Group relay contact will activate.
- The Printer Module will print.

PARALLEL ALARM (A, B, C or D)

- The System 16 will begin monitoring the individual points in the alarming point group.

By monitoring individual points, the System 16 can determine if any location gas concentration has exceeded a programmed alarm level.

If an alarm condition does exist, the System 16 initiates the alarm condition routine described above under "Sequential Mode."

It is possible for a group alarm to activate even though none of the points in the point group show gas concentrations greater than their programmed TLV. Low concentration leaks, appearing simultaneously at two or more location, can trigger the group alarm. The combined concentration of the two leaks may exceed the group alarm level.

See **Section 6.3** for a more detailed description of gas concentration alarm procedures.

1.4.3 Instrument Diagnostics

The System 16 provides diagnostic responses to instrument faults and maintenance requirements. These warnings activate a series of signals:

- The bottom two LEDs on the Control Module will light orange.
- An appropriate relay will activate.
- The printer will document the condition, date and time. See **Section 6.5** for instructions on reading fault printouts. See **Appendix** for fault lists.
- The memory will store the information for later recall.

In addition, a low flow condition in a Point Module will cause the Point Module LED to light orange.