Section 1: CM4 Overview

This section describes the components of the CM4 and provides a basic understanding of instrument operation

1.1 Introduction

See **Illustration 1-1**

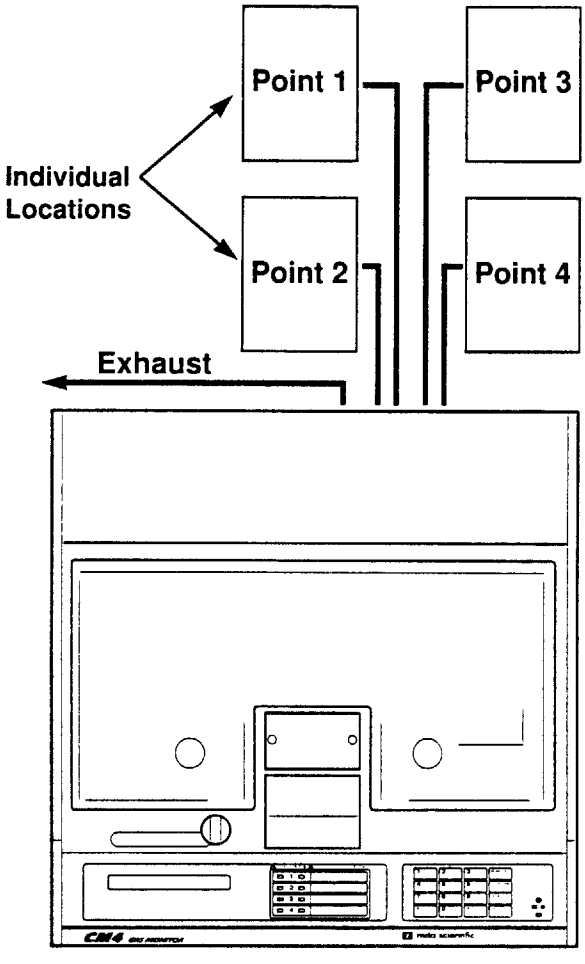

Illustration 1-1
Monitoring Points

The MDA Scientific CM4 continuously monitors four locations (called *points*) for toxic gases. It responds to gases that exceed a programmed alarm level by:

- Triggering alarms and LEDs that warn of high or low concentrations
- Triggering relays to external devices
- Displaying the point number, gas type, and gas concentration
- Printing the alarm information and storing it in memory

The CM4 triggers relays for each individual point for two levels of gas concentrations. These programmable limits are factory-set at TLV and 2 TLV.

Each point may be up to 300 feet (90 m) from the CM4 location. This allows operators to monitor gas concentrations in an area removed from the location where gas may actually be leaking.

The CM4 provides fast response to a wide range of gases. It was designed for maximum uptime, so filters, detector tape, and even the entire chassis can be replaced quickly and easily.

The CM4's flexibility allows it to be easily configured for tabletop use, rack mounting or wall mounting. The CM4 uses MDA Scientific's patented Chemcassette® technology for rapid, accurate gas detection.

Chemcassette is a registered trade mark of Zellweger Analytics, Inc.

This section includes information on the CM4's:

- Sampling and Monitoring System (**Section 1.2**)
- Detection System (**Section 1.3**)
- Displays and Controls (**Section 1.4**)
- Electrical Connections (**Section 1.5**)
- Alarms (**Section 1.6**)
- Instrument Diagnostics (**Section 1.7**)

Illustration 1-2 shows CM4 components and controls.

☐ **Note**

On newer style CM4 (S/N XXX-5000 and greater) and all CM4-P models, the flow controls (item 6) are located on the lower left of the front panel. An ambient air filter (item 10) is located on the lower right.

1.2 Sampling and Monitoring System

See **Illustration 1-2**

The system draws sample flow simultaneously from all four points. Two different types of sample movement are:

- Transport flow: high-velocity, large-volume air movement through the lines
- Sample flow: air admitted to the Chemcassette detection system

The high speed of transport flow allows rapid monitoring and response time when using long lines from monitoring points to the CM4. A small portion of the transport flow is analyzed to determine concentration levels.

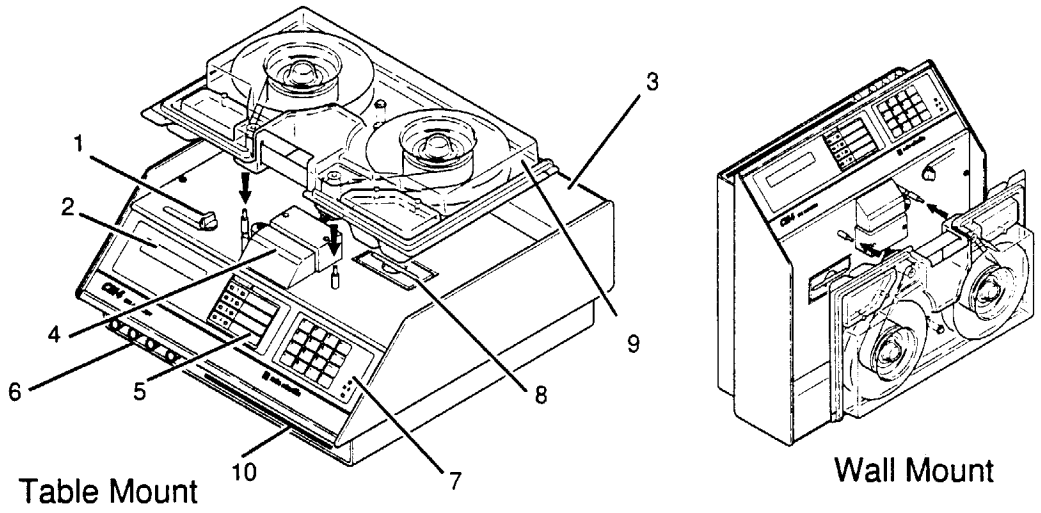

Illustration 1-2
CM4 Components and Controls

LEGEND

1. **Tape load lever**
2. **20-character display**
3. **Alarm relays**
4. **Detectors and electronics**
5. **Status and alarm LEDs**
6. **Flow controls**
7. **Keypad**
8. **Filter block**
9. **Carrier**
10. **Air filter**

The flow system includes:

- Flow connections (Manifolds)
- Pump
- Filters
- Orifice
- Valves
- Transducers

1.2.1 Flow Connections

Flow connections consist of quick-connect ports on the back of the CM4. There are four inlets, one for each monitored point, and an exhaust outlet.

1.2.2 Pump

The pump provides a vacuum source for transport and sample flow during monitoring.

1.2.3 Filters

Filters protect the internal precision orifice from dust particles. Filters are located in a removable filter block on the top of the instrument. See **Section 9** for information about filter replacement.

1.3 Detection System

The CM4 uses the patented MDA Scientific Chemcassette detection system. Chemcassettes sample and detect a specific gas or family of gases. The Chemcassette detection system is included on an analyzer plate on top of the CM4. The analyzer plate:

- Retains the Chemcassette carrier
- Manages Chemcassette transport
- Provides optical detection of stain
- Directs sample flow through the Chemcassette

Components of the detection system include:

- Chemcassette carrier containing Chemcassette detection tape
- Optics and electronics for the detection system
- Chemcassette tape transport mechanism

1.3.1 Chemcassette Carrier

The Chemcassette carrier can be pre-loaded with Chemcassette tape for rapid tape change.

1.3.2 Optics and Electronics

The heart of the Chemcassette system is an optical detection system that measures the stain that develops on the Chemcassette tape. The CM4's unique design has four individual detectors, one for each monitoring point. See **Illustration 1-3** for point stain location.

To monitor a point, the detection system detects and measures a specific gas or family of gases in the sample. The CM4 interprets the data and responds appropriately. See **Section 3.4** for instructions on determining sample locations and **Section 3.6** for information on installing sample lines.

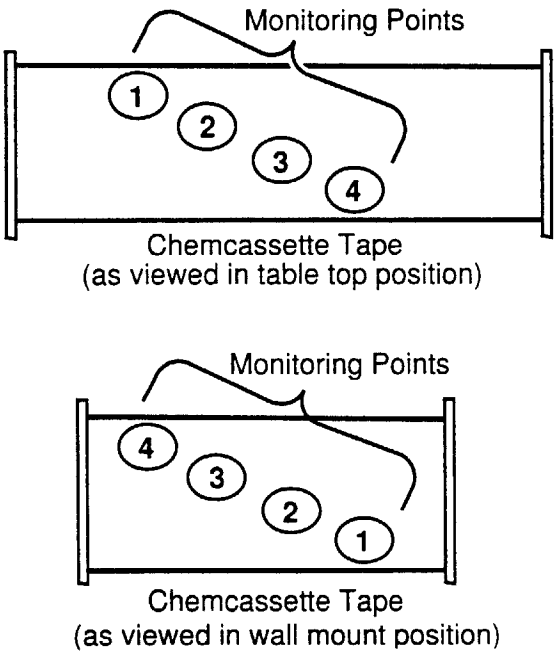

Illustration 1-3
CM4 Point Stain Pattern

1.3.3 Chemcassette Detection System

See **Illustration 1-4**

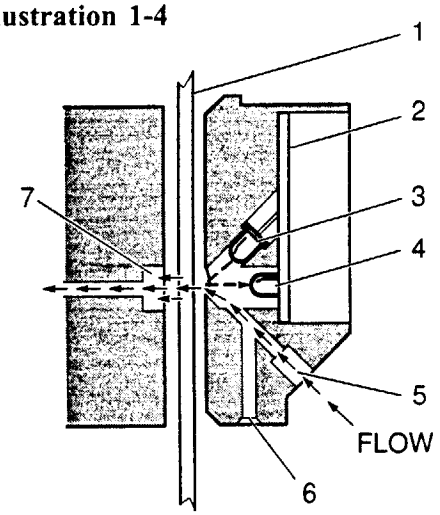

Illustration 1-4
Chemcassette Detection System

LEGEND

1. **Chemcassette tape**
2. **Electronics**
3. **LED light source**
4. **Detector**
5. **Sample inlet**
6. **Pressure transducer port**
7. **Sample outlet**

1. The sample enters the inlet (5) and passes through the Chemcassette tape (1) to the sample outlet (7).
2. Target gas in the sample flow reacts with the Chemcassette tape (1) and produces a stain density proportional to the gas concentration.
3. An LED (3) in the CM4 detector head illuminates the sample stain. The detector (4) optically measures the stain.
4. The CM4 CPU interprets the stain, then reports a precise concentration level in parts-per-million (ppm) or parts-per-billion (ppb).

1.3.4 Measuring Gases

MDA Chemcassettes are available for measurement of gases as well as families of gases. If your CM4 is equipped to detect hydrides or mineral acids, you can program it to respond to a specific gas within the gas group at each monitoring point. Gases and families of gases the CM4 detects include:

Amines
Ammonia (NH_3)
Arsine (AsH_3)
Boron Trifluoride (BF_3)
Bromine (Br_2)
Chlorine (Cl_2)
Clorine Dioxide (ClO_2)
Diborane (B_2H_6)
Germane (GeH_4)
Hydrogen Bromide (HBr)
Hydrogen Chloride (HCl)
Hydrogen Cyanide (HCN)
Hydrogen Fluoride (HF)
Hydrogen Sulfide (H_2S)
Nitrogen Dioxide (NO_2)
Phosgene ($COCl_2$)
Phosphine (PH_3)
Silane (SiH_4)
Sulfur Dioxide (SO_2)
Tert-butyl Arsine (TBA)
Tert-butyl Phosphine (TBP)
Triethyl Amine (TEA)

1.4 Displays and Controls

See **Illustration 1-2**

The displays and controls clustered on the front panel of the CM4 include:

- Display
- Status and Alarm LEDs
- Keypad
- Power LED
- Flow Control

1.4.1 Display

The CM4 uses a 1-line, 20-character display. The CM4 display includes information about concentration and instrument faults and provides menus for CM4 programming. For more information on the display panel, see **Section 2.**

1.4.2 Status and Alarm LEDs

Status LEDs light green when the CM4 is monitoring the point. There is one LED for each point.

- Light green for normal operation
- Flash green for point lock-on or display lock-on at that point
- Light yellow for a fault on that point
- Turn black when not monitoring that point

☐ **Note**

Status LEDs also turn yellow or flash to indicate fault.

Alarm LEDs signal gas level alarms for each point. Alarm LEDs:

- Light for Level 1 alarm concentration
- Flash for Level 2 alarm concentration

1.4.3 Keypad

Use the keypad to:

- Program the CM4
- Select specific points to monitor
- Print and display programming parameters

1.4.4 Power LED

The power LED at the bottom right of the panel indicates the CM4 is powered up. A blinking yellow power LED indicates the keypad is locked, requiring a passcode for any CM4 operation.

1.4.5 Flow Control

Four metering valves, one for each point, control the sample flow through the Chemcassette detection system.

1.5 Electrical Connections

All electrical connections are made at the rear of the CM4. User installed wiring connects to a removable relay panel at the top of the instrument, allowing the chassis to be removed without disturbing connections.

1.5.1 I/O Panel

The I/O (Input/Output) panel contains connections to 14 form C relays to activate external devices:

- A watch dog relay (RY12) which indicates power loss or a CPU failure
- Eight gas alarm relays which indicate Level 1 and Level 2 alarms
- Two general gas alarm relays which indicate Level 1 and Level 2 alarms at any point
- A monitoring relay (RY6) which indicates the instrument is not monitoring one or more points
- A Maintenance fault relay (RY8) which indicates the CM4 needs attention but is continuing to monitor
- An Instrument fault relay (RY10) which indicates the CM4 is unable to monitor one or more points

In addition, the I/O panel includes:

- Terminals for the current loop options, which produce a 4-20 mA output signal in direct variation to the gas concentration at each point
- Terminals for the remote reset option, which permit resetting of faults and alarms for specific points

1.5.2 Power Connection

Connect AC power to the CM4 at the rear panel. The power switch is located above the power line connection.

1.5.3 Optional Serial Output

Install the optional DB9 (nine-pin) serial data and printer connectors on the back panel.

1.6 Alarms

See **Table 1-1**.

The CM4 has alarms that:

- Warn of Level 1 or Level 2 high or low concentrations of the monitored gas
- Trigger relays to external devices

Section 3.10 describes wiring.

Section 4 describes operation modes and basic operating procedures.

1.6.1 General and Point Gas Alarms

The factory 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 can also set individual alarm levels for each sample point. Separate alarm levels for each point provide added protection in critical locations and allow you to customize the settings to meet the specific needs of your site.

Condition	Point Status LED	Point Alarm LED	Relays Activated	Beeping Audio Alarm	Display
Monitoring	Green	OFF	All OFF	OFF	Current concentrations (each point displayed for four seconds)
Level 1 alarm	Green	Red (steady)	- Low level alarm for affected point - General low level alarm	ON	Current concentrations
Level 2 alarm	Green	Flashing red	- High and low level alarms for affected point - General high and low level alarms	ON	Current concentrations
Low Chemcassette maintenance fault (monitoring continues)	Green	OFF	Maintenance fault	OFF	Current concentrations followed by fault message
Power interruption or CPU fault	OFF or random	OFF or random	Watch dog fault	OFF	Blank or random
Flow failure	Solid yellow	OFF	Instrument fault	OFF	Current concentrations followed by fault message (as last message in sequence)
Instrument fault (monitoring suspended)	Yellow	OFF	Instrument fault	OFF	Fault message

Table 1-1
Instrument Alarms

1.6.2 Activating an Alarm

When the CM4 detects a gas concentration that exceeds a programmed alarm level, it activates a series of signals. The CM4 continues monitoring during an alarm condition.

☐ **Note**

When a Level 2 alarm activates, the Level 1 alarm always activates:

- Alarm LEDs indicate Level 1 and Level 2 alarms for the appropriate point
- The gas alarm relay contacts activate for the appropriate point
- The general alarm contacts activate
- The display continues to show the point number, gas type and gas concentrations
- The instrument generates the appropriate current loop signal (2-20 mA/4-20 mA) and an audible tone
- Alarm information is sent to the printer for printing (if enabled)
- Alarm data (16 alarm events) is stored in memory

1.7 Instrument Diagnostics

The CM4 provides diagnostic instrument fault and maintenance requirement indications. These warnings activate a series of signals:

- One or both fault relays activate
- On-board memory stores eight fault events for later recall
- Fault information is sent to the printer (if enabled)
- Status LEDs light yellow for the appropriate point to indicate instrument faults
- The display shows the fault information
- The instrument generates a 2mA current loop signal at the appropriate point (if enabled)