

HAZMATCADTM

Users Manual

Version 2.0. (02-04)

P/N M100100M



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Introduction

HAZMATCAD™ is a handheld instrument that detects and alarms to a range of chemical vapor threats such as nerve, blister and other chemical warfare agents. HAZMATCAD™ is fast to respond to any chemical threat conditions. HAZMATCAD™ can warm-up and indicate the presence of hazardous vapors in less than one minute.

HAZMATCAD™ is easy to operate and maintain. Press the “ON” button and the system will automatically perform a self-diagnostic check, purge its sampling system and begin analyzing ambient air for trace levels of chemical agents. Instrument status is indicated by a combination of LED status lights and a 4 character LED alphanumeric display. HAZMATCAD™ has two modes of operation. The Fast Mode requires 20 seconds to perform a sample analysis and the High Sensitivity Mode requires 120 seconds to complete an analysis. HAZMATCAD™ is equipped with a wireless infrared port for external communication and its large buttons and displays permit easy operation in a level A protective suit.

Principle of Operation

HAZMATCAD™ uses a SAW microsensor array for the detection of nerve and blister agents and electrochemical cells to detect blood or choking agents. This combination of both SAW and electrochemical technology provides a comprehensive solution for the detection of chemical warfare agents.

SAW Sensor Technology

SAW sensors are small solid state devices that are extremely sensitive to minute changes in mass. These devices are coated with different polymers that act as a sponge which selectively absorb air contaminants. The polymer surface responds rapidly and reversibly to air contaminants. Using an array of three different SAW sensors provides a response pattern or “fingerprint” that is unique to a chemical or a chemical class. This multi-sensor pattern response is one of the key reasons why HAZMATCAD™ is highly specific to chemical agents and rejects other common environmental chemicals that could otherwise cause false alarms.

Electrochemical Sensor Technology

HAZMATCAD™ uses an electrochemical sensor to detect hydrogen cyanide (AC), or phosgene (CK).

An electrochemical sensor contains an aqueous electrolyte, sealed behind a hydrophobic (water-resistant) gas permeable membrane. As a gas diffuses through the permeable membrane and dissolves in the electrolyte it is oxidized or reduced. This oxidation/reduction reaction releases electrons that are collected by the measuring electrode. The resulting signal is proportional to the amount of gas reacted.

Sampling System

The HAZMATCAD™ sampling system collects and concentrates a vapor (air) sample. This sampling technique enriches the sample and helps to reject potential vapor interferences. The HAZMATCAD™ flow system is illustrated in Figure 1.

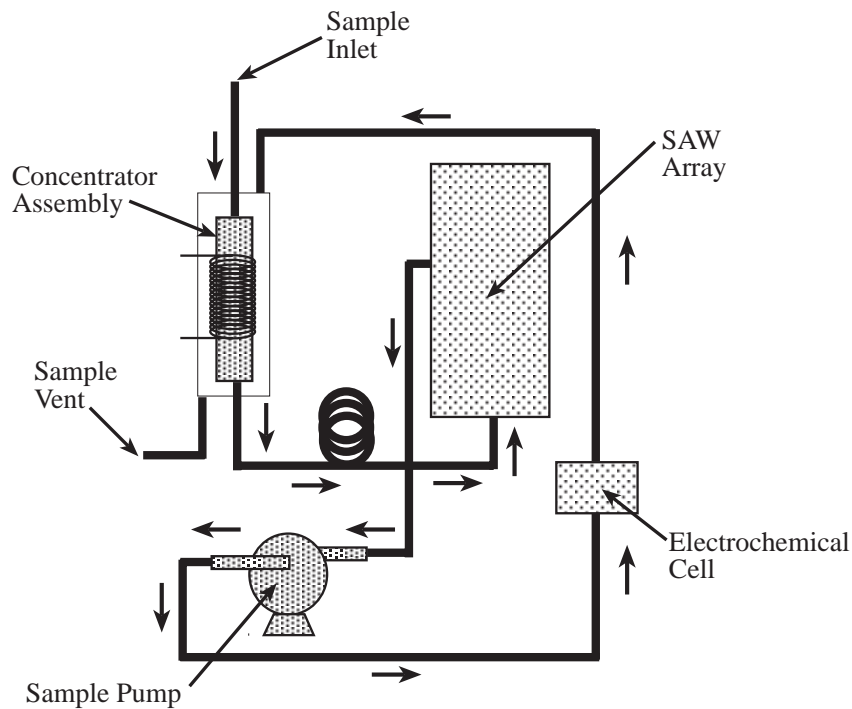


Figure 1 - Schematic of HAZMATCAD™ Layout

System Specifications

Weight	0.64kg (22oz) including batteries
Dimensions	5.8 x 6.2 x 19.8cm (2.3" x 2.6" x 7.8")
CW Agents Detected	VX ¹ , GA, GB, GD, GF, HD, HN-3, AC, CG
Alarm Levels	
Fast Mode	G Agents- 0.2 to 0.9 mg/m ³ H Agents- 1.2 to 1.4 mg/m ³
High Sensitivity Mode	G Agents- 0.05 to 0.23 mg/m ³ H Agents- 0.3 to 0.35 mg/m ³
Response Time	Fast Mode - 20 seconds High Sensitivity – 120 seconds
E-Chem Alarm Levels	
Hydrogen Cyanide	Low 5.0ppm, Med 20.0ppm and High 40.0ppm
Phosgene	Low 0.3ppm, Med 1.2ppm and High 2.5ppm
Warm Up Time	30 seconds @ 25°C
Batteries	Li-Ion rechargeable (Sony NP-F550)
Audible Alarm	85dbA @ 1 meter
Visual Display	4 character alphanumeric and status LED's
Data Logging	8 hours time date alarm and level
Data Output	9600 baud Infrared or RS232c with adapter cable
Shelf Life	SAW sensors 5 years Electrochemical Sensors 1 year
Operating Temp.	0 to 40 °C
Operating Humidity	0 to 95% non condensing
Warranty	1 year's labor and material from ship date

¹ Responds to impurity in technical grade VX

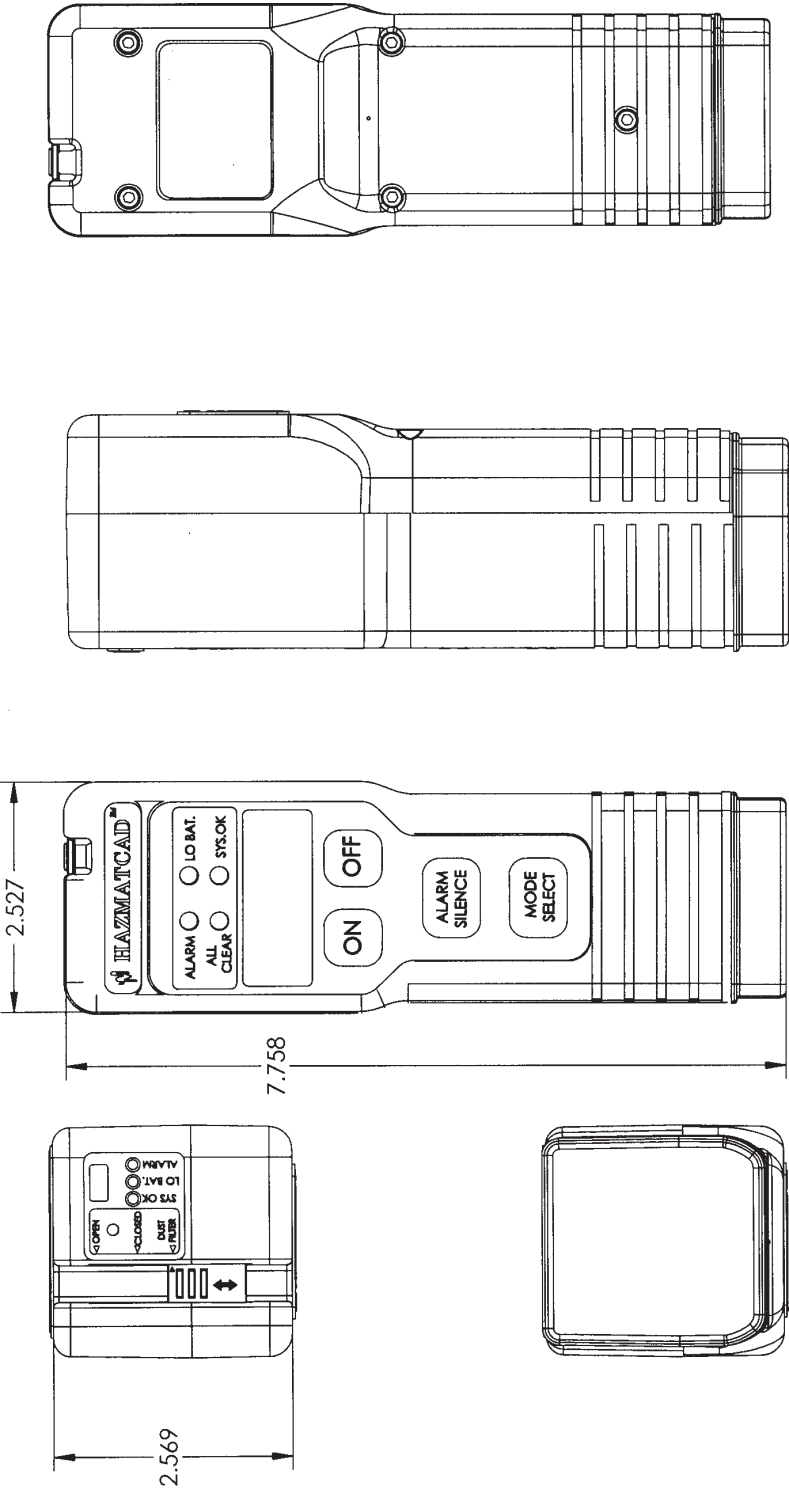


Figure 2 - HAZMATCAD™ Package Configuration

Description of HAZMATCAD

Arrival and Unpacking of Instrument

HAZMATCAD™ is shipped in a rugged plastic carrying case. This case is designed to provide a safe way to transport the instrument and to keep the instrument and its accessories together in one convenient place. Please retain the outside shipping container for future use, should you need to return the instrument for service.

Inspect the contents received and verify the shipment is complete. Should there be any items missing, call Microsensor Systems, Inc. at (270) 745-0099 to report the shipment omission. If any item is damaged from shipment, report the occurrence to the shipping company and file a damage claim.

Instrument Controls

The main parts of the HAZMATCAD™ control panel are illustrated in Figure 3. Each item is described below.

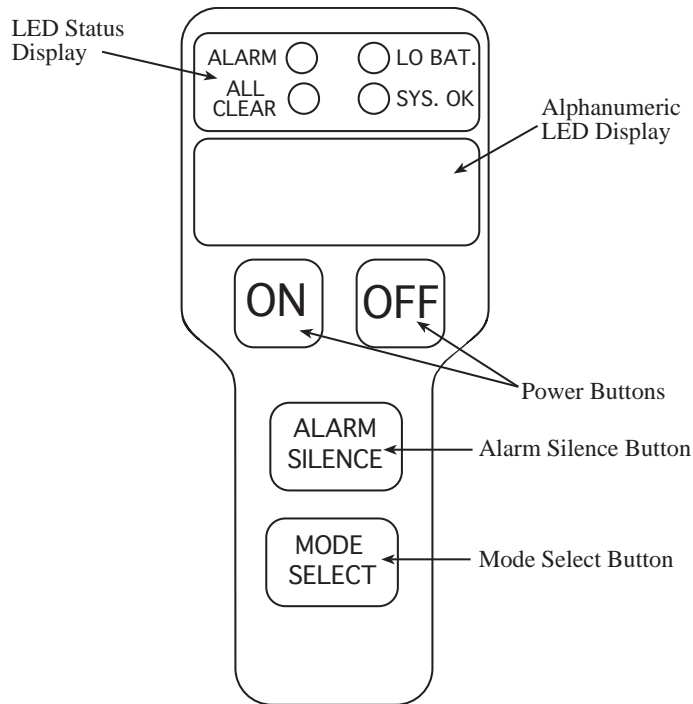


Figure 3 - HAZMATCAD™ Keypad / Control Panel

Front Panel Keypad – Consists of four push button keys, which enable the functions defined below. These buttons are large and have tactile response when pushed.

1. Power On/Off Buttons – These buttons turn the instrument on and off.

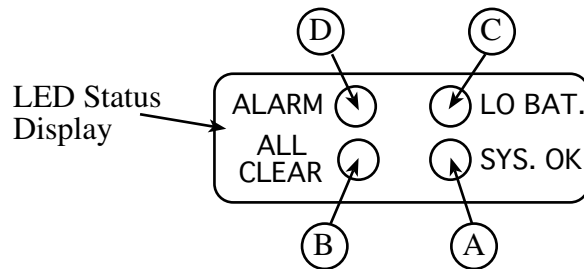
2. Mode Select Button, (Fast Mode) or (High Sensitivity) – This button toggles between the two modes of operation. Pressing this button will display the current mode of operation as (HI S) (MODE) or (FAST) (MODE).

3. Silence Alarm Button – This button has two alarm functions, one to silence the alarm horn during a single analysis and the other is to enable or disable the alarm horn function.

LED Displays - Instrument status is indicated by discrete LED status lights. The type and level of alarm is reported using the alphanumeric LED display.

1. Alphanumeric LED Display – This is a four character LED display which communicates the alarm classification and the concentration level, (low, medium or high). This display also presents start up test screens, remaining battery power and fault condition information.

2. The Status LED's – These LED's indicate the HAZMATCAD™ instrument status.



Status LED	Color	Meaning
A. SYS OK	Green Blinking	Indicates proper electrical operation of the instrument
B. ALL CLEAR	Green	Indicates that no threat vapors are present
C. LOW BATT.	Yellow	Indicates that battery power is low
D. ALARM	Red Blinking	Indicates that a threat vapor has been detected

Figure 4 - LED Display Status and Definitions

3. Top Display Panel – This display consists of three status LED’s providing system information. The display is visible to a user carrying the HAZMATCAD in a vertical orientation, such as on a belt clip. The Top Panel system status LED’s are (SYS. OK), (LO BAT.) and (ALARM). The color of the LED’s follows the same profile as the status LED on the front keypad. The top display panel also provides information on the position of the HAZMATCAD™ dust cover slide.

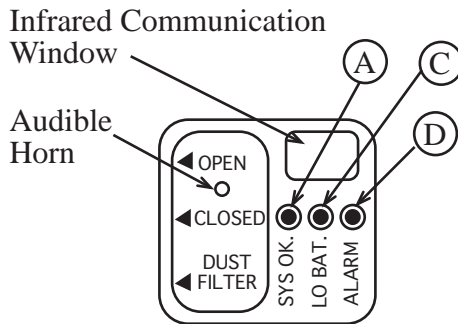


Figure 5 - HAZMATCAD™ Top Display Panel

Sample Inlet

HAZMATCAD™ has a three-position sample port slide cover which is illustrated below.

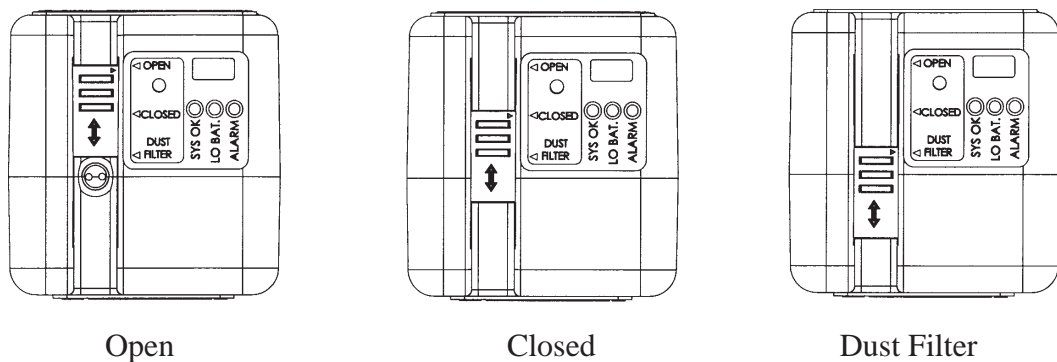


Figure 6 - HAZMATCAD™ Sample Cover Slide

1. The (Open) position provides for direct access to the sample inlet used for check source (simulant) testing.
2. The (Closed) position secures the sample inlet. HAZMATCAD™ should be stored with the sample inlet in the closed position

3. The (Dust Filter) enables a sample pathway that is designed to prevent particulate matter and water from entering the sampling inlet. (Dust Filter) enabled is the general monitoring position.

Battery Compartment

Access to HAZMATCAD™ battery compartment is illustrated in (Figure 7). The battery cover is located at the base of the instrument. By gently squeezing on the sides of the instrument base and pulling it away from the case body the battery compartment door will release. The battery cover is attached to the instrument by an alignment rod. This alignment rod is designed to slide out approximately one inch. Rotating the battery door 180° provides clear access to the Li-Ion batteries. The Li-Ion batteries can be removed by sliding them away from the case. To re-insert the batteries reverse the removal procedure, face the 2 battery terminals towards the battery compartment centerline (middle) opening and slide the batteries in until they meet the resistance of the male connector. Realign the battery compartment door and gently push closed until secure.

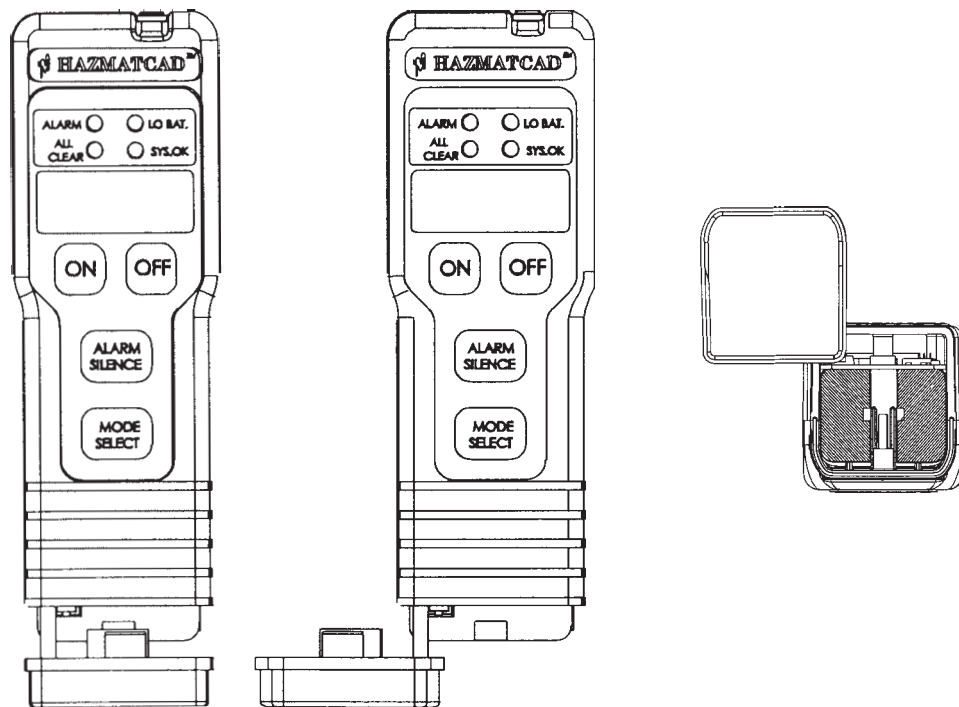


Figure 7 - HAZMATCAD™ Battery Door Access

Lithium Ion Battery Pack

HAZMATCAD™ uses a Sony Lithium Ion Battery NP-550 (Part Number MS603002). One battery will power HAZMATCAD™ for 4 to 6 hours depending on the mode of operation. Using HAZMATCAD™ in the fast mode one battery will last 4 hours and high sensitivity will last 6 hours. Two batteries can be used to obtain maximum mission life of 8 to 12 hours.

Lithium Ion batteries are not subject to a memory effect and can be fully charged without being fully discharged.

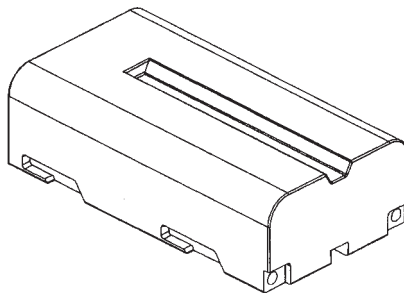


Figure 8 - HAZMATCAD™ Lithium Ion Battery Pack



Warning! When using Lithium Ion batteries observe the following precautions:

1. Use only the specified charger SIMA Model SPM-13N when charging.
2. To prevent accidental shorts do not allow metal objects to come in contact with the battery terminals.
3. Do not expose the battery pack to temperatures above 60°C or (140°F)
4. Keep the battery pack dry and avoid unnecessary mechanical shock.
5. Do not attempt to disassemble or modify the battery pack.
6. Dispose of a defective battery promptly and properly.



Warning! In some areas disposal of Lithium Ion batteries in household or business trash may be prohibited. Please recycle the Li-Ion battery by calling Sony Service Center at (800.222.SONY)

External Battery Re-Charger

HAZMATCAD™ uses an external battery re-charger for the lithium ion batteries. The charger is a SIMA Model SPM-13N. Please refer to the charger instruction booklet for up to date product information. This information is included in the HAZMATCAD documentation provided with the instrument.

When a battery is properly charging the green LED on the charger will flash. The battery charger will indicate a fully charged battery by a solid green LED when completed. The typical charge time for a Sony NP-550 battery is approximately four hours.



Warning!

A defective battery will be indicated by the power and charge LED blinking.

Serial Data Communication

The HAZMATCAD™ is factory configured to provide serial data communication via either an infrared communication port (located on the top display panel) or a hard wire-wire RS232c port (located inside the battery compartment).

Infrared Communication Port

HAZMATCAD™ configured to use the infrared communication prt are shipped with an IR Wireless Transceiver Interface (NSI Part Number M1700010). This interface has an intergral cable that plus into a 9-pin serial port on a computer. The other end of the interface has an infrared transceiver which must be placed within several inches of the infrared port of the HAZMATCAD for data transmission. The computer should be configured to capture normal serial data at 9600 baud, 8 data bits, 1 stop bit and no parity. The data can be collected using a terminal emulation program such as Hyperterminal or ProComm.

RS 232c (Hard Wire) Communication Port

HAZMATCAD's™ configured to use the hard-wire RS232c port are shipped with a special Communication Adaptor (MSI Part Number M2200090) transitioning from a flat ribbon cable to a male DB-9 connector. The flat ribbon cable plugs into a connector in the battery comartment (on the end of the PCB, accessible only when the battery dorr is open), with the black side of the flat ribbon cable toward the batteries. The communication parameters are the sameas the Infrared using,, 9600-N-8-1.

HAZMATCAD™ Accessories

Vapor Simulant Check Source

An optional vapor diffusion check source (Part Number MS201112) can be used to test HAZMATCAD™ for a nerve “G” response. This tube contains less than 50mg (a drop) of dimethylmethylphosphonate (DMMP), a nerve simulant.



Warning!

These tubes have an operational life of six months. Each check source is dated. Check expiration date before using.

Lithium Ion Battery Replacement

HAZMATCAD™ is designed to use only one type of Sony Lithium Ion battery. It is recommended to have at least two Lithium Ion batteries for maximum performance. Additional Lithium Ion batteries (Part Number MS603002) can be purchased from Microsensor Systems.

Rubber Protective Boot

HAZMATCAD™ has a protective rubber boot that is designed to provide additional protection from accidental mistreatment. This protective case is removable and should be discarded and replaced if the instrument has been exposed to a hazardous chemical.

Electrochemical Cell Accessory Operation

An electrochemical cell can be installed in the HAZMATCAD to detect either hydrogen cyanide or phosgene. Upon instrument power up, power is applied to the electrochemical cell. The cell is allowed to warm up for a period of 30 seconds, at which point the baseline potential of the cell is measured. The cell is then monitored for excursions from this baseline. A “TOX (LOW, MED, or HI)” alarm is generated when any such excursion exceeds programmed thresholds. For valid operation, the HAZMATCAD should be turned on and left in a clean environment until the electrochemical sensor baseline potential has been established (30 to 40 seconds).

HAZMATCAD™ Operation



General Precautions and Warnings

1. HAZMATCAD™ is a vapor (gas) detection instrument. If liquids are aspirated into the sample inlet the instrument will be damaged.
2. The inlet slide should be positioned in the (Dust Filter) position for general use.
3. HAZMATCAD™ has not been tested for intrinsic safety and should not be used in environments having a potentially explosive atmosphere.
4. HAZMATCAD™ is a very sensitive instrument, which is intended for low level analysis. Sampling high concentration atmospheres (e.g. over pools of liquid) may overload the sampling system, increasing the clear down or recovery period.
5. HAZMATCAD™ has been designed to minimize false alarms. However, high concentrations of some vapors can cause a false detection. These high concentration environments are usually associated with a strong smell of chemical vapors.
6. Should HAZMATCAD™ be exposed to high concentration levels of chemical agents it is possible that some of its internal components may become contaminated. Allow for an extended clear down period and handle the instrument using personal protection (e.g. protective mask and glove) following known exposures to high concentrations of CW agents.
7. The expiration date of the e-chem cell (phosgene) or (hydrogen cyanide) is located in the battery compartment door. The format for the date is month/day/year.

User Interface

HAZMATCAD™ has an easy to operate and understand user interface. Communication with HAZMATCAD™ is accomplished by using the keypad function buttons. These functions buttons are “ON”, “OFF”, “MODE SELECT” and “ALARM SILENCE”. HAZMATCAD™ reports its analysis data by using LED status lights and a four-character LED alphanumeric display.

Preparing to use HAZMATCAD™



Warning!

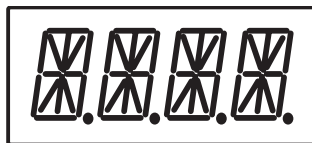
Before powering up HAZMATCAD™ make sure the Li -Ion batteries are fully charged.



Warning!

Open the sample inlet to the dust filter position

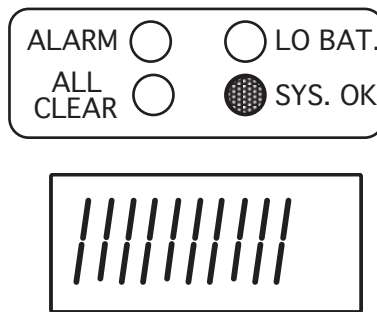
HAZMATCAD™ will power up by pressing the “ON” button. HAZMATCAD™ will start the microcomputer and begin a series of diagnostic self-checks. The instruments alpha-numeric display will activate and display (HCAD) and then display a visual segment test activating all LED segments.



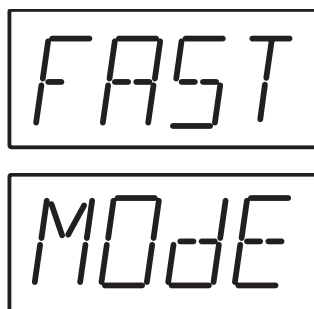
HAZMATCAD™ will then display (SYS) (TEST) as the microprocessor completes its testing.



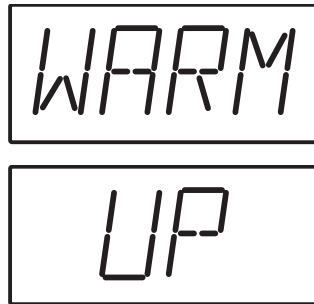
After a successful completion of the self-test the green (SYS. OK) status LED will begin flashing. The (SYS. OK) LED also functions as the system heartbeat of a normally operating HAZMATCAD™. This LED will remain flashing as long as HAZMATCAD™ is operating properly. (Should a fault be detected HAZMATCAD™ will display the fault information on the alphanumeric LED). The remaining battery power will then be indicated on the LED display. This is displayed as a 12-line bar graph indicating the relative amount of power remaining in the batteries.



The current mode of operation will be displayed. The default mode for HAZMATCAD™ is (FAST) (MODE). HAZMATCAD™ is pre-set to begin sampling in Fast Mode analysis unless reprogrammed by the user.



HAZMATCAD™ will then begin a system clean down purge. During the initial start up of a non-thermally equilibrated instrument “Cold Weather Operation” the LED display will flash (WARM) and (UP) e until thermal stability is achieved and then perform a system purge.



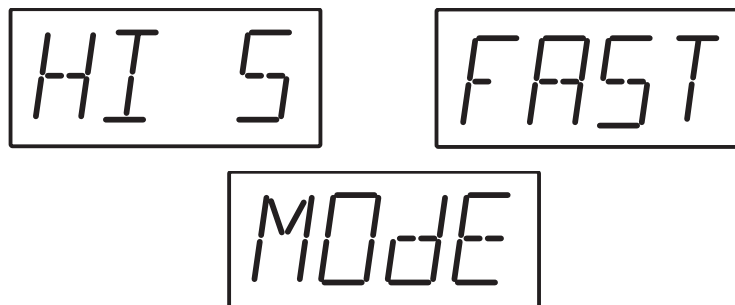
HAZMATCAD™ will begin sampling in the (FAST) (MODE), until stopped or the mode of analysis is changed.

Mode Select

The mode select button commands HAZMATCAD™ to operate in the (FAST) (MODE) or (HI S) (MODE). The (FAST) (MODE) analysis is the power up default position. Each (FAST) (MODE) sample analysis requires only 20 seconds to complete. The (HI S) (MODE) high sensitivity mode requires 120 seconds to complete a sample analysis.

The analysis mode can be checked at any time by pressing the mode select button. The HAZMATCAD™ alphanumeric LED will display the current mode. The operator can check this function at any time and this will not interrupt the current sample analysis.

To change the analysis mode, press the mode select button. HAZMATCAD™ will respond by displaying the current mode of operation. This information will display for 5 seconds and turn off. To change the analysis mode, the mode select button must be pressed again during the displaying of the current mode condition. This will cause HAZMATCAD™ to terminate the current analysis cycle and start up in the other mode. This start up includes a sample purge cycle in preparation for the next analysis mode. The alphanumeric display will also flash the current analysis mode confirming the change.



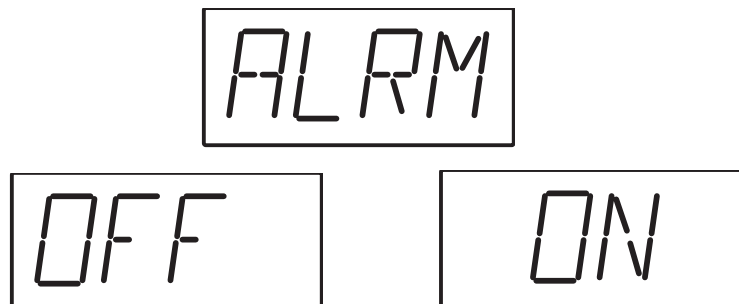


Warning! Should HAZMATCAD™ be turned off, upon re-powering HAZMATCAD™ will begin the (FAST) (MODE).

Alarm Silence

Pressing the “ALARM SILENCE” button will disable the horn during an alarm. “ALARM SILENCE” only resets the current alarm and will not de-activate the alarm feature should future alarms occur. If there is an alarm condition on the next analysis the alarm horn will sound.

Pressing and holding the alarm silence button (approximately 3 seconds) will indicate if the audio alarm horn feature is enabled or disabled. The alphanumeric LED displays this information as (ALRM)/(ON) or (ALRM)/(OFF). This information will be shown for five seconds. To toggle the audible alarm on or off permanently, the alarm silence button must be pressed again while the LED is displaying the (ALRM)/(ON) or (ALRM)/(OFF) condition. Toggling the alarm silence button will activate or deactivate the audible alarm horn as desired. The default state of the audible alarm is on. The unit will power up with the Alarm on. If the alarm is turned off the audible alarm will not sound on an alarm condition.

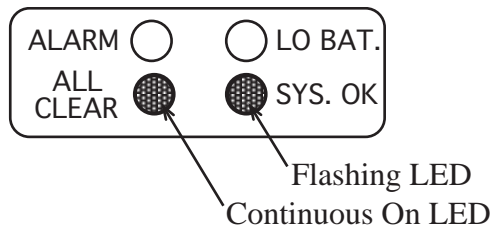


Analysis Information

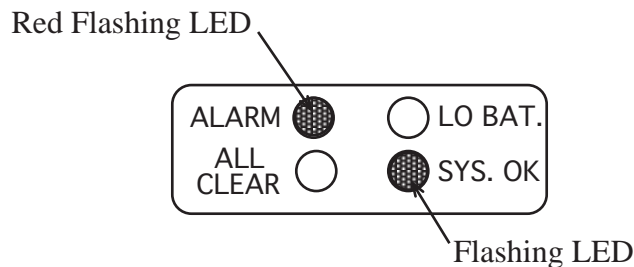
HAZMATCAD™ indicates either the presence of a chemical agent or toxic gas by signaling an (ALARM) or it reports an (ALL CLEAR). HAZMATCAD™ has preprogrammed alarm thresholds for the suite of chemical agents and toxic gases as defined in the system specifications. Should any of these concentration thresholds be exceeded the instrument will alarm until the concentration value returns below the set point value.

System Analysis Conditions

ALL CLEAR- All clear indicates that there was no chemical agent or toxic gas detected above the alarm concentration threshold. HAZMATCAD™ reports this information by illuminating the green (ALL CLEAR) LED on the front panel keypad. This LED does not flash and will remain lighted as long as (ALL CLEAR) is reported. The alphanumeric LED display will remain blank.

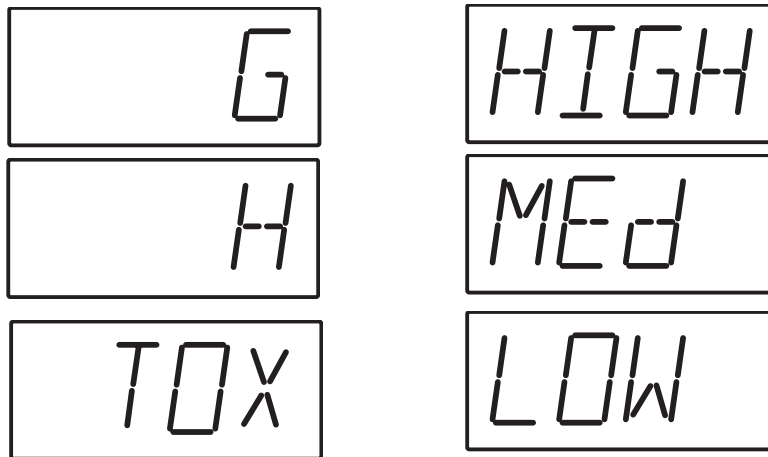


ALARM- If an alarm occurs, HAZMATCAD rapidly and dramatically reports this information to the user. Both of the alarm status LED's will begin flashing relative to the concentration. The Alarm status LED's will flash at a rate that is correlated to the alarm level. A low-level alarm will flash slower than a high level. Therefore, without viewing the front panel the top panel display can provide relative concentration information.





HAZMATCAD™ has three types of alarm classifications, Nerve “G”, Blister “H” and Toxic “TOX” and three alarm concentration levels, low “LOW”, medium “MED” and high “HIGH”. On an alarm condition the classification message will toggle back and forth with the concentration level. The audible alarm horn will sound. The alphanumeric LED display will report the alarm classification and level.



Performing a Simulant Test

Operational testing of the HAZMATCAD™ can be performed by using a simulant check source provided as an instrument accessory. The check source is a Teflon diffusion tube which contains a small amount of DMMP (dimethylmethylphosphonate) a simulant for nerve “G” agent. The MSDS information for DMMP is contained in the appendix of this manual.

To use the vapor check source.

- a. Set the sample inlet position to open.
- b. Power the HAZMATCAD™ in the Fast Mode and let run for 2 minutes.
- c. Prepare the DMMP diffusion tube by removing the vinyl end caps.
- d. Position the DMMP diffusion tube against the sample inlet.
- e. Hold the diffusion tube at the sample inlet for 4 to 5 seconds and remove.
- f. HAZMATCAD™ should alarm during the next sample run usually about 10 to 30 seconds after sampling. (If there is no alarm, repeat the procedure and hold the DMMP diffusion tube for 6 to 10 seconds.)
- g. HAZMATCAD™ should alarm “G” and the concentration level will be displayed.
- h. Continue running HAZMATCAD™ until the instrument reports (ALL CLEAR).
- i. Replace the vinyl caps on the ends of the diffusion tube and return to the plastic container.



Warning!

Before ending the simulant test make sure HAZMATCAD™ returns to ALL CLEAR. Failure to allow the instrument to clean down before turning off could cause an alarm condition on the next power up.



Warning!

Do not leave the check source exposed to HAZMATCAD™ for prolonged periods in excess of the recommended time. It will overload the sampling system and require a long clean down time to return to all clear.

There is no need to test HAZMATCAD™ for blister “H”. When the sensor array is working properly for nerve “G” it will yield a pattern response that indicates correct performance for “H”.

Instrument Maintenance Test Intervals

Simulant Test Frequency

It is strongly recommended to perform a confidence vapor check on HAZMATCAD™ whenever the instrument is used. This confirms the instrument performance and will yield the best performance.

Storage

Should HAZMATCAD™ not be used on a regular basis, it is recommended that the instrument should be tested at least once every month. This should include recharging the Li Ion batteries and performing a vapor confidence check test to assure satisfactory operation.

Decontamination External



Warning!

HAZMATCAD™ is not designed to be waterproof, and damage will result to the internal components if immersed in liquid.



Warning!

While it is important to practice decontamination procedures, care must be taken not to draw liquids into the instrument.

- 1) Turn OFF HAZMATCAD™
- 2) Place the three position sample port slide cover to the closed position
- 3) Wipe the instrument completely with a moist soapy cloth.
- 4) Shake the HAZMATCAD™ briskly to remove residual liquids and to prevent any liquids from being drawn inside the instrument.
- 5) Place the three position sample port slide cover in the open position and place the HAZMATCAD™ in an inverted position for 2 minutes.
- 6) Wipe the instrument dry with a clean paper or cloth.
- 7) Place the HAZMATCAD™ in a sealed bag for at least one hour. This will allow any residual contamination to off gas.
- 8) Sample the headspace of the bag using another HAZMATCAD™, M256 Kit or other appropriate device to confirm there is no residual contamination.
- 9) If residual contamination is detected repeat steps 1 through 8.

If the instrument has been exposed to high levels of CW agent it may be advisable to remove and properly dispose of the external covering (rubber boot). The internal components that may be contaminated are the inlet sampling tube, SAW array, sampling pump, concentrator and the electrochemical cell pneumatic pathway. Often running the instrument in clean air for several hours will eliminate this contamination.

To check for internal contamination use the following procedure.

- 10) Place the operating HAZMATCAD™ in a large plastic bag.
- 11) Let the HAZMATCAD™ run for 60 minutes
- 12) Sample the headspace of the bag with another HAZMATCAD™, M256 Kit or other appropriate device for trace contamination.
- 13) If contamination is detected, run the HAZMATCAD™ in clean air for several hours and repeat steps 1 through 12 in a well ventilated area.

If the HAZMATCAD™ still shows traces of contamination contact Microsensor Systems or the appropriate Government Agency for further assistance.

Data Log

HAZMATCAD™ has an internal data log that records each alarm or instrument fault detected. The data log is automatically enabled on power up. HAZMATCAD™ has a maximum data storage of 1350 one-line alarm/fault reports. For example, if the HAZMATCAD™ were detecting “G” agent only and running in the (FAST) (MODE), it could log all of these alarm reports for a period of 8 hours of continuous operation. If under the same condition HAZMATCAD™ were running in the (HI S) (MODE) mode the reports could be logged for 45 hours.

The data log report follows the format described below:

Time	Hours & Minutes	1100
Date	Month, Day and Year	6/5/0
Alarm Status	Clear or Alarm	(HI, MED, LOW) (G, H, TOX)
Mode	HS or FM	HS= High Sensitivity FM= Fast Mode
(12345)	Peak Signal	SAW Sensor 1
(12345)	Peak Signal	SAW Sensor 2
(12345)	Peak Signal	SAW Sensor 3
27	Array Temperature	
System Status	OK: Operating Correctly FAULT: XXXX	CONC = Concentrator PUMP = Sample Pump S1 {2 or 3} = SAW Sensor TOX = Electrochemical Sensor

Typical HAZMATCAD™ Data Log

```

1052    6/8/0 HI H      FM   494   3482  3420  300   OK
1053    6/8/0 CLEAR   FM   136   500   541   300   FA

```

Electrochemical Cell (TOX) Data Log Report

TOX alarms are logged into the data log, only when the alarm status changes (from CLEAR to LOW TOX). A TOX CLEAR report is sent out the RS232 port at a rate of once per 5 seconds, as long as the alarm condition persists. One CLEAR report is sent out the RS232c port when an alarm condition subsides.

The format of the TOX alarm report is as follows:

TIME DATE HI/MED/LOW/CLEAR TOX MODE mV 0 0 TEMP

In this report the “mV” field reports the change in cell potential from its baseline value. All the fields in the report are separated by a TAB, and a CR/LF terminates the report.

Accessing the Data Log

The data log can be sent from a properly configured HAZMATCAD™ to an external computer over the infrared serial data link, using the IR Transceiver/Cable. The Transceiver converts the infrared signal to RS-232 (9600 baud, 8 data bits, one stop bit, no parity) that can be monitored and/or saved via a terminal emulation program (such as Procomm) on the external computer. Place the sampling end of the HAZMATCAD™ within 10 inches of the Transceiver. Turn the HAZMATCAD™ off. Then turn the HAZMATCAD™ back on while depressing the MODE SELECT button. The data log will automatically be transmitted to the external computer as an ASCII text file.

Low Temperature Operation

The HAZMATCAD™ is equipped with a sensor module heater that allows the detector to be operated at temperatures down to 0°C. Two temperature setpoints (T1 and T2, with T1 > T2) are stored in the detector.

Upon power up, if the sensor module temperature is below T1 the heater will come on. The sensor module must warm to above T2 before normal operation will commence. The alphanumeric display will show WARM/UP during this warm-up period.

During operation, if the sensor module temperature ever drops below T1, the heater will again come on. The instrument will continue normal operation unless the sensor module temperature drops below T2. If the temperature drops below T2, then the detector goes into WARMUP mode, where it remains until the sensor module temperature warms to T2. While the detector is in WARMUP mode, the sample pump does not run and neither the chemical agent nor the toxic chemical sensors are operative.

Warm-up time for the HAZMATCAD™ when the instrument has been stored at, and then is operated at 0°C, is approximately 5 minutes. The heater draws about 250 mA of current.

Low Battery Indication

An amber LED on the front panel, and another amber LED on the end face of the HAZMATCAD™, illuminate when the lithium-ion battery needs to be recharged/replaced. The HAZMATCAD™ will continue to operate on the low battery for approximately 20 minutes, before shutting down. When the detector “shuts down”, the low battery LEDs remain illuminated, but all other functions are disabled.

Fault Conditions

Should the computer fail to start properly, HAZMATCAD™ will indicate this failure by not activating the (SYS OK.) LED. The (SYS OK.) LED is the system heartbeat and serves as a continual monitor of system performance. This LED must remain flashing while HAZMATCAD™ is being operated.

Should a fault condition be determined, HAZMATCAD™ will display the text (FAIL) and the fault. There are 4 fault conditions and they are displayed as follows:



SAW 1 – SAW Sensor (1), (2) or (3)



TOX – Electrochemical Sensor Failure

A rectangular box containing the word "FAIL" in a stylized, outlined, monospace font.A rectangular box containing the word "CONC" in a stylized, outlined, monospace font.

CONC – Concentrator Failure

A rectangular box containing the word "FAIL" in a stylized, outlined, monospace font.A rectangular box containing the word "PUMP" in a stylized, outlined, monospace font.

PUMP – Pump Failure

These fault alerts will toggle back and forth. HAZMATCAD™ will continue to operate under most fault conditions, though the fault may impact the validity of an alarm condition. A pump fault will cause the HAZMATCAD™ to shut down.

Should failure condition occur, contact Microsensor Systems, Inc. for assistance at (270) 745-0099 between 0900 and 1600 (Central Standard Time).

Special Applications

For special applications requiring unattended operation, long-term monitoring or diagnostic studies, the HAZMATCAD™ can be configured to allow two-way hardwire or infrared RS232 communication. The following paragraphs describe the special capabilities that can be accessed in this special configuration.

Report at End of Each Analysis

A one-line ASCII text report is sent over the RS232 link at the end of each analysis cycle, reporting the status of the detector. The format of this report is the same as that of the records placed in the data log, with the following changes:

- (1) Under “all clear” conditions a report documenting such is transmitted over the RS232 link, but not placed in the data log.
- (2) A “LOW/MED/HI TOX ” reports are transmitted over the RS232c approximately every five seconds as long as the alarm condition persists, but only changes in the alarm status are put into the data log.
- (3) If the detector shuts down due to a low battery, a report is transmitted in the format: “LOW BATT xxxx”, where xxxx is the final battery voltage in mV.

Raw Data Points

A one-line ASCII text report is sent over the RS232 link at a frequency of approximately twice per second, reporting the SAW sensor frequencies, the electrochemical sensor output (if sensor is installed) and the sensor module temperature.

The format of this report is as follows:

= 63 1 DP S1 S2 S3 ECHEM TEMP

Each quantity is separated by a TAB. A CR/LF terminates each report. The variable fields are defined as follows:

DP- data point counter; starts at 1, increments by 1 each half-second.

S1,S2,S3 – SAW sensor frequencies (difference frequencies in Hz, with respect to a reference sensor)

ECHEM – electrochemical sensor output (change in potential (in mV) since sensor baseline frequency was determined. Sensor baseline frequency is determined at 30 seconds after instrument is powered up. This field will be present only if the instrument is factory-configured to incorporate an electrochemical cell.

TEMP – SAW sensor module temperature, in degrees Celsius.

For additional information regarding the data collection programs please contact MSI.

Data Log Dump and Clear

Typing LOG <CR> (These commands must be in all capital letters) on the keyboard of an correctly attached computer will cause the HAZMATCAD™ to temporarily stop its analytical process, then to send the data log out the RS232c port. The HAZMATCAD™ will then execute a purge cycle and resume normal operation.

Typing CLR <CR> on the keyboard of an attached computer will cause the HAZMATCAD™ to clear its data log.

Holding down the “MODE SELECT” button on power up will also cause the HAZMATCAD™ to send the data log out the RS232 port.

Troubleshooting

<u>Symptom</u>	<u>Possible Remedy</u>
Won't Power Up	<ol style="list-style-type: none"> 1. Check Battery and or Replace 2. Recharge Battery
"LOW BATT" On	<ol style="list-style-type: none"> 1. Replace Battery
All Status LED'S Flashing	<ol style="list-style-type: none"> 1. Fault will be indicated on alphanumeric LED Display.
WARM/UP	<ol style="list-style-type: none"> 1. Instrument has not yet reached proper operating temperature. 2. (If WARM/UP persists), malfunction of temperature sensor or manifold heater. Call MSI for repair assistance/information.
Won't Alarm on Simulant Test	<ol style="list-style-type: none"> 1. Check expiration date of simulant tube, replace if expired. 2. Hold tube on sample inlet for twice as long as recommended. 3. Call MSI for assistance
SAW (1), (2) or (3)/ FAIL	<ol style="list-style-type: none"> 1. Failure of SAW Sensor to Oscillate. Call MSI for repair information. <p>Sensor array may need to be repaired or replaced.</p>
CONC / FAIL	<ol style="list-style-type: none"> 1. Concentrator is not heating correctly. Call MSI for repair information. The concentrator may need to be replaced.
PUMP / FAIL	<ol style="list-style-type: none"> 1. Pump is not operating. Check inlet for blockage, and sample slide position. Pump may need to be replaced.

HAZMATCAD™ Replacement Parts List

Part Number	Part Description
M3350200	Belt Clip
M3350210	Tab for Belt Clip
M3350220	Adhesive Mount for Tab
M3250170	Li-Ion Battery NF 550
MS604001	Battery Recharger Model SPM-13N
MS201112	Check Source
M3340140	Rubber Boot Cover
M3340150	Rubber Boot Battery Access Door
M3340120	Plastic Battery Door
MS207131	Black Pelican Case 1400
M3310180	Replacement Foam Insert
M230070	Replacement Sample Pump
M2200090	DIN-9 Communication Adapter
M1700010	Transceiver IR Wireless Interface
M2200090	Replacement HardWire Communication Adaptor
M100100M	HMC Users Manual

Appendix A Training Mode Operation

The training mode allows the HAZMATCAD™ user to simulate chemical warfare agents by using commonly available chemicals. In this mode, the software bypasses the normal agent identification algorithm. Two useful chemical for this training mode are isopropyl alcohol and gasoline. Isopropyl alcohol will give a nerve “G” agent alarm. Gasoline will give a blister “H” agent alarm.

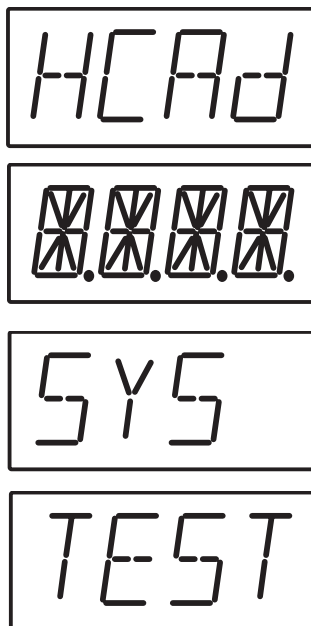


HAZMATCAD™ is designed to respond to trace amounts of chemical warfare agent. It only takes three or four drops of chemical to generate enough vapors to make the instrument respond.

Activating the Training Mode

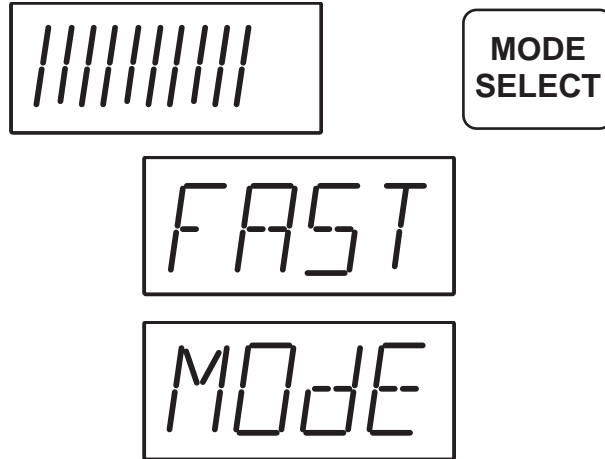
The training mode can be activated by following these steps.

1. Power up the HAZMATCAD™ by pressing the “ON” button.
2. The instrument will perform a self check. This is indicated by the following messages on the LED display.



3. After the (SYS) (TEST) message the LED display will display the battery life indicator.

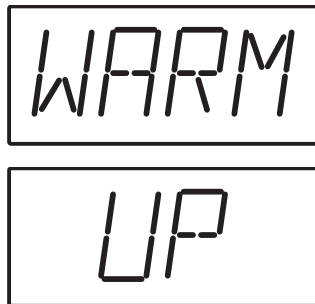
When the LED display indicates the first bars of the battery life indicator, press and hold the MODE button until the LED display shows the mode of operation (e.g. (MODE) (FAST)).



5. The audible alarm will activate (beep) during the (MODE) (FAST) display if the HAZMATCAD™ has been successfully placed in the Training Mode.



6. The HAZMATCAD™ will continue with its normal warm up sequence.



7. When the warm up is complete, the audible alarm will “**chirp**” approximately every 3 seconds to indicate that the HAZMATCAD™ is operating in the training mode.



Training Mode Algorithm

The training mode operates by adding the signals from all three SAW sensors. If the sum is higher than the preset alarm threshold, an alarm message is displayed. If the output of sensor one is higher a “G” alarm will be displayed. If the output from sensor two is higher an “H” alarm will be displayed. The total signal of the three SAW sensors will dictate the level of the alarm, “LOW” - “MEDIUM” or “HIGH” values.

De-Activating the Training Mode

To return to normal operation, press the “OFF” button and restart the instrument.

Using an External Computer to Activate the Training Mode

If the HAZMATCAD™ is connected to a computer via the RS232 or infrared port, pressing the “%” key will place it in the training mode. Pressing the “%” key a second time will return the HAZMATCAD™ to normal operation.

Alarms that occur while in the training mode will be DATA LOGGED with the following format:

Time, Date, Alarm Status, Sensor 1, Sensor 2, Sensor 3, Temperature, Status, Fail Tran

The (Fail) (Tran) message appended to the alarm report allows the user to distinguish between alarms logged in the training mode of operation from actual alarms.

Creating a Vapor Source for Operational Training in the Training Mode.

It only takes three or four drops of chemical to generate enough vapors to make the instrument respond. It is easy to create a “source vapor” by placing a few drops of liquid on paper towel. We recommend using isopropyl alcohol to give a nerve “G” agent alarm or gasoline to give a blister “H” agent alarm.

To sample the test chemical, place the HAZMATCAD™ in the training mode. Hold the HAZMATCAD™ sample inlet approximately 3 to 4 inches from the “source vapor” and wait for the unit to alarm. The alarm should occur in less than 60 seconds after exposure. Remove the HAZMATCAD™ from the proximity of the “source vapor” to a clean environment to clear the alarm.



Caution! The HAZMATCAD™ is a trace chemical analyzer! High concentrations of solvent vapors may damage the HAZMATCAD.



Caution! Consult applicable MSDS sheets and follow all safety precautions when handling solvents and flammable liquids