



INSTALLATION AND OPERATION MANUAL ENVIRONMENTAL SYSTEM IR-SNIF-MCD MODELS MCD-1, 4, 8 & 16



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APPLICABILITY

Information presented in this manual can be generally applied to all IR-SNIF-MCD refrigerant monitors. Specific details of programming and operator interface apply to software version **5327K and later** versions. To determine the version of an IR-SNIF-MCD, press the “*” key. This will display momentary screens that provide contact information for SenTech Corporation, the software version and any options enabled in the monitor. If your monitor has a version that is older (smaller version number **such as 2143**), a version specific appendix A, Programming and Operator Interface, is available. It can be downloaded from the SenTech Corporation website, www.sentechcorp.com, or directly from SenTech Corporation at 888-248-1988.

Contents

SAFETY PRECAUTIONS and WARNINGS.....	1
Models MCD-1, 4, 8 & 16 Specifications	2
INTRODUCTION and OVERVIEW	3
Functional Description.....	3
Sensitivity to Refrigerants.....	8
Factory Calibration	8
PPM vs. Leak Rate.....	8
SYSTEM Block Diagram	9
INSTALLATION	12
Unpack and Inspect Material	12
Identify Location for Monitor, Sample Points and Alarms	12
Electrical Power Connection.....	13
Electrical Alarm Connections.....	14
Other External Connections.....	15
STARTUP and PROGRAMMING.....	18
Apply Power	18
Initial Screens.....	18
Normal Operation	19
Initial Programming	19
FINAL TESTS	25
Monitor Sequencing.....	25
Integration with External Devices	25
Response to Refrigerant.....	26
End-to-End System Test	27
Documentation.....	28
PREVENTIVE MAINTENANCE & REPAIR	29
Preventive Maintenance.....	29
Commonly Ordered Parts	29
Monitor Repair.....	29
APPENDIX A: Programming and Operator Interface.....	30
Summary	30
Start-up Screens	30
Operational Screens	30
Menu Screens.....	32
APPENDIX B: SenTech Room Volume Considerations	40
APPENDIX C: Parts List and Wire List.....	44
TROUBLESHOOTING GUIDE	47
SenTech Manufacturer's Limited Warranty.....	50

SAFETY PRECAUTIONS and WARNINGS

The following general safety precautions and warnings must be observed during all phases of installation, operation, service and repair of equipment. Failure to comply with these precautions, given here and elsewhere in the manual violates safety standards of design, manufacture, and intended use. SenTech Corporation assumes no liability for the customer's failure to comply with these requirements.

Definitions of safety symbols used on equipment and in manuals.



AC Voltage Terminal: Indicates areas of equipment where AC line voltages are used and present a potential risk of electrocution. Areas using line voltages should not be accessed during operation.



AC-to-DC Power Supply: Indicates AC line voltages are used and present on portions of the power supply, including the heat sinks. A potential risk of electrocution exists. Areas using line voltages should not be accessed during operation.



Protective Grounding Terminal: The protective ground is to prevent electric shock in case of an electrical fault. This symbol indicates that the terminal must be connected to earth ground before operation of the equipment.



Caution: This sign calls attention to a procedure or practice which if not adhered to could result in damage or destruction to a part of the product.

Other information and precautions:

Input Power: Power should be supplied through a two-pole circuit breaker located in a reasonable proximity to the equipment. Ensure that the voltages are correct and an appropriate ground connection is provided.

Do Not Open the Monitor with Power Applied: Line voltages exist on the terminal board inside the monitor and on the power supply inside (including the heat sinks). The door to the monitor and the power supply itself are marked with AC Voltage shock hazard warning labels. Remove power prior to opening the door.

Installation, Maintenance and Repair: These functions should only be done by qualified personnel following the instructions outlines in this manual. This is Installation Category III equipment.

Pollution Degree: This equipment is designed for a Pollution Degree of 1.

Cleaning: This equipment should be cleaned by wiping with a soft clean cloth.

Intended Purpose: This equipment is designed to be used as a continuous refrigerant monitor. It should not be used for any other purpose.

Models MCD-1, 4, 8 & 16 Specifications

Size:	16.5" x 15" x 6.75" (42cm x 38.1cm x 17cm)
Weight:	Model MCD-1 - 30.4 lbs. (13.8 kg) Model MCD-4 - 31.4 lbs. (14.2 kg) Model MCD-8 - 33.8 lbs. (15.3 kg) Model MCD-16 - 36.0 lbs. (16.3 kg)
Power:	120 or 240 Volts AC 50/60hz (41 Watts)
Temperature:	32 deg F – 125 deg F (0 deg C – 50 deg C)
Humidity:	0 – 95 % non-condensing
Atmospheric Pressure:	75-106 Kpa Equipment rated for indoor use only
Range:	0 – 1000 ppm Standard
Tube Length:	0 – 250 ft (0 – 76 m)
Sample Areas:	Model MCD-1 - 1 Area Model MCD-4 - 4 Areas Model MCD-8 - 8 Areas Model MCD-16 - 16 Areas
Trip Point:	Low Alarm 0 – 1000 ppm Main Alarm 0 – 1000 ppm High Alarm 0 – 1000 ppm Horn Alarm Programmable to Low, Main or High
Leak Wait:	Varies from seven (7) seconds to three (3) minutes depending on refrigerant concentration
Alarm Output:	Low, Main, High and Horn alarm relays, each with four (4) form C contacts rated 5 amps maximum
Analog Output:	0 – 10 volt proportional to 0 – 1000 ppm 4-20 mA (optional)
Computer Interface:	RS-485 (optional)

INTRODUCTION and OVERVIEW

The SenTech Environmental System IR-SNIF-MCD refrigerant monitor provides an early warning of developing refrigerant leaks. The unit samples ambient air and measures the amount of halogen based refrigerant gas in the air sample. When the proportion of refrigerant present exceeds a trip point, the system goes into alarm mode. Should the system assess the presence of refrigerant as a leak, using SenTech's "LEAK WAIT" algorithm, the user is notified. By discovering a leak shortly after it starts, the potential loss can be reduced to ounces of refrigerant, saving money and helping protect the environment.

Functional Description

The refrigerant monitor is composed of four major functional blocks: Pneumatics, Infrared Bench, Control Electronics and Power Supply. Refer to figure 1 for an overall block diagram. The pneumatics pulls sample air or reference air from up to 250 feet and pumps the air through a filter, to a pressure sensor, through the infrared bench and out the exhaust port of the monitor. The infrared bench provides an infrared source and measures the presence of refrigerant based on measured changes in the infrared light. The control electronics switches the pneumatic valves from one area to reference air and on to the next area, measures and stores the information from the infrared bench, provides a human machine interface for programming and provides analog, digital and relay outputs to interface with building systems and alarms.

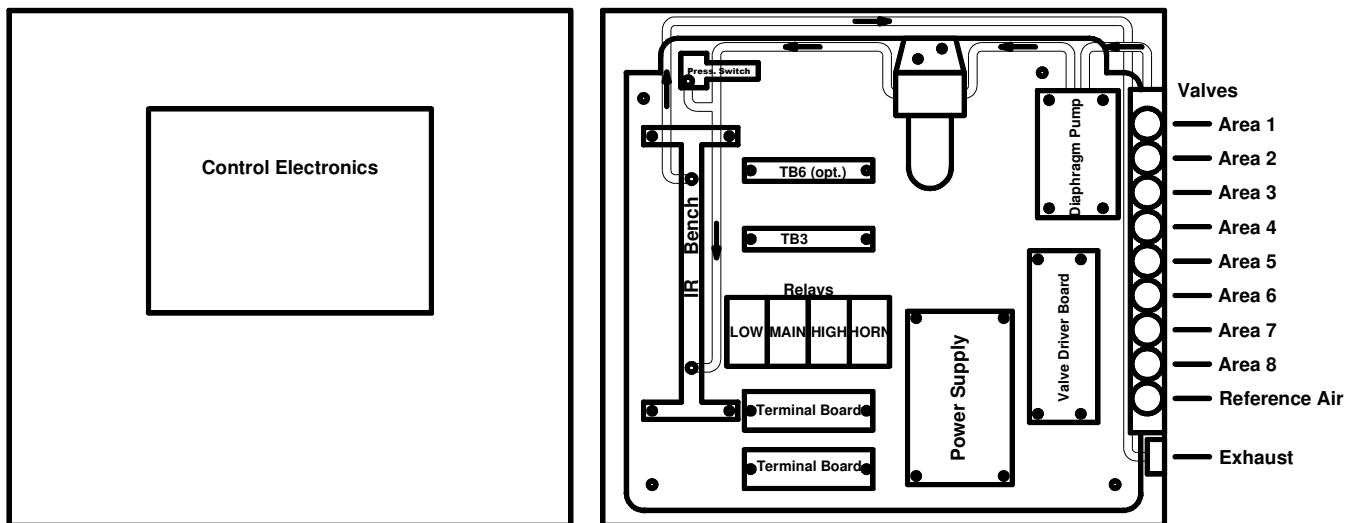


Figure 1 Overall Block Diagram

Pneumatics: Refer to the figure 2 for pneumatics block diagram. Tubing from the areas to be monitored and from a reference air source (either fresh, outside air, or interior conditioned air that is free of refrigerants) is connected to the valve manifold. The MCD1 has a single sample valve and a reference valve, for a total of two valves. The MCD4 has four sample valves, the MCD8 has eight and the MCD16 has 16, for a total of five, nine and seventeen valves respectively. The electronics alternates between energizing the Sample air and the Auto zero air valves. Following an Auto zero cycle, the pneumatics will be switched to the next sample valve in order. The diaphragm pump draws air from the selected inlet and feeds the air through a five micron filter, through an orifice restrictor, through the infrared bench and to the exhaust port located on the lower right side of the unit. The pressure switch monitors the pressure created by the flow from the pump and the restriction created by the orifice. Should pressure fall, a flow failure is detected, and signal is sent to the electronics.

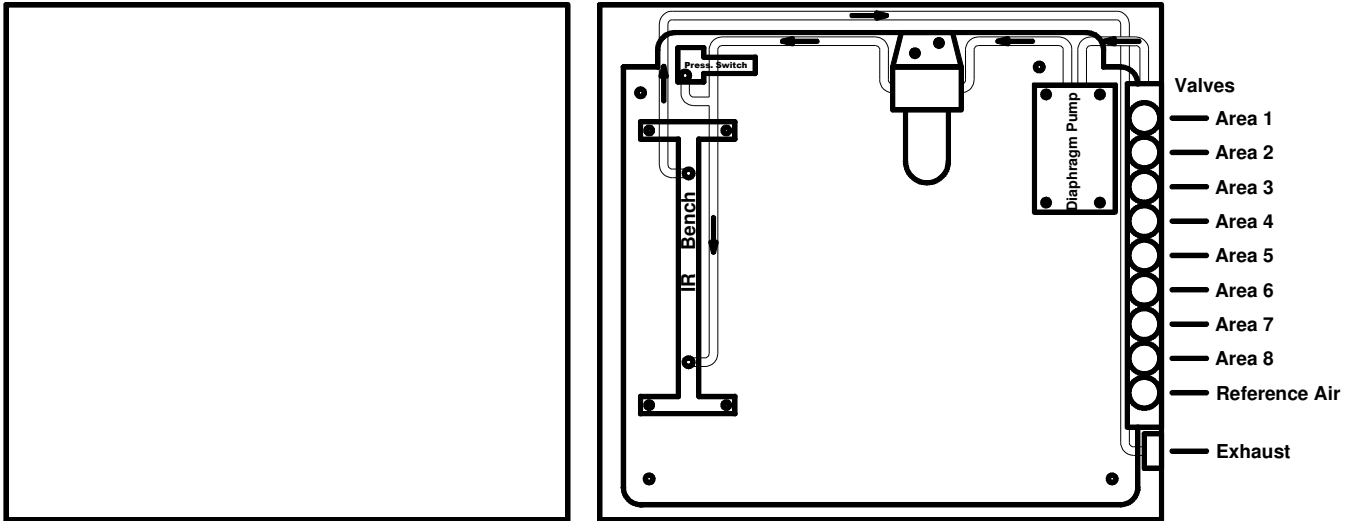


Figure 2 Pneumatics Diagram

Infrared Bench: Refer to the figure 3 for Infrared Bench diagram. The infrared bench has an integrated source circuit with infrared source at one end and an integrated detector circuit with filter and detector at the other. Presence of refrigerant in the sample air will cause a change in the output of the detector.

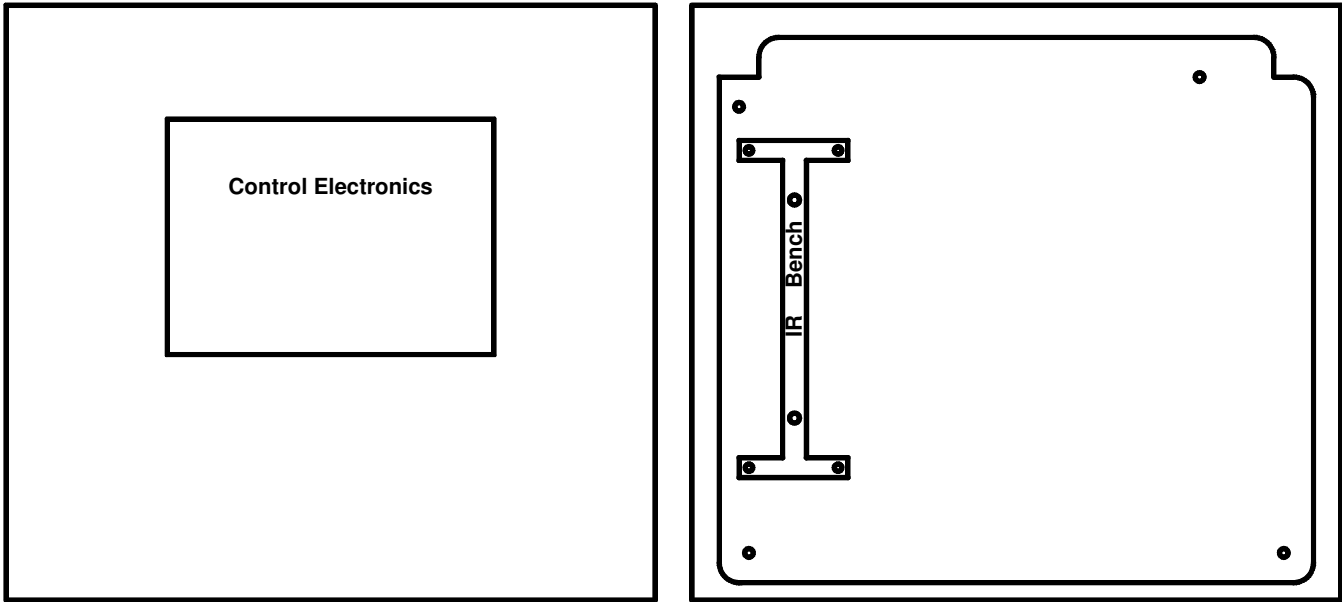


Figure 3 Infrared Bench

Control Electronics: Refer to the figure 4 for control electronics block diagram. The signal from the infrared bench is analyzed by the control circuit and converted into a digital measurement in ppm (parts per million). The ppm level is compared to trip points set for Low, Main and High alarm levels. If the ppm level exceeds the Low alarm threshold, the “Leak Wait” algorithm is used to determine whether the monitor has experienced a transient exposure, or a leak truly exists. If the ppm level remains above the Low alarm threshold on completion of leak wait, the Low alarm relay is energized. If the signal continues to increase, the Main alarm relay will be energized and ultimately the High alarm relay. Once the system enters Low, Main or High alarm, it will remain in that mode until the problem is cleared and the system is reset.

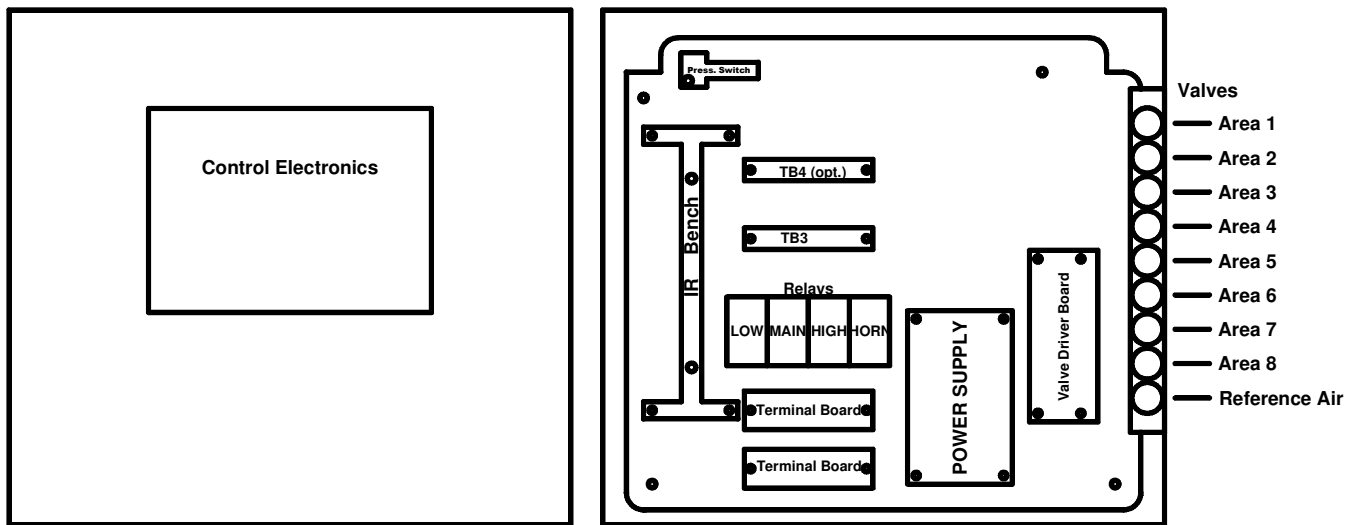


Figure 4 Control Electronics Diagram

Power Supply: Refer to the figure 5 for Power Supply diagram. Power is supplied to the monitor through terminals 1, 2 and 3 of the terminal board. Line voltage is fed through the fuse on the left side of the monitor (not shown), and to the diaphragm pump and power supply. The power supply converts AC line voltage to dc voltage. DC Voltage is fed through the terminal board to all of the electrical components of the monitor.

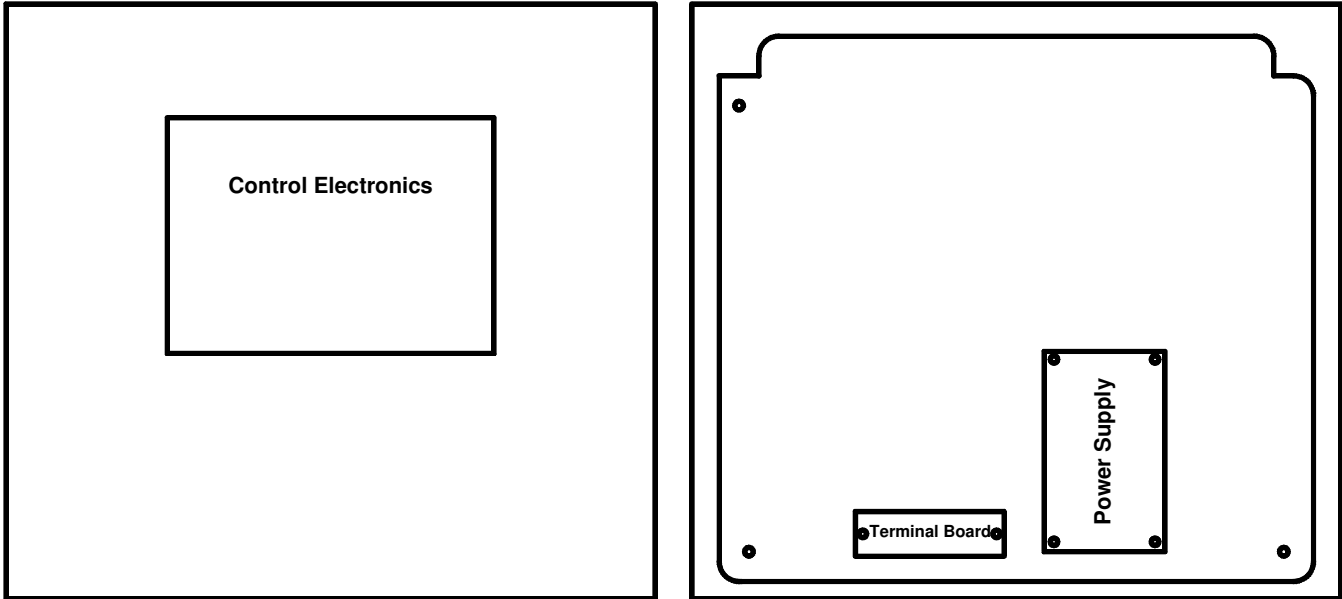


Figure 5 Power Supply Diagram

Sensitivity to Refrigerants

The system is sensitive in varying amounts to all of the halogen-based refrigerants, those containing molecules of fluorine, chlorine or both. As part of the initial setup, the specific refrigerant to be monitored is entered into the system. The control electronics compensates for the differing sensitivities, resulting in a true ppm reading for the refrigerant specified.

Factory Calibration

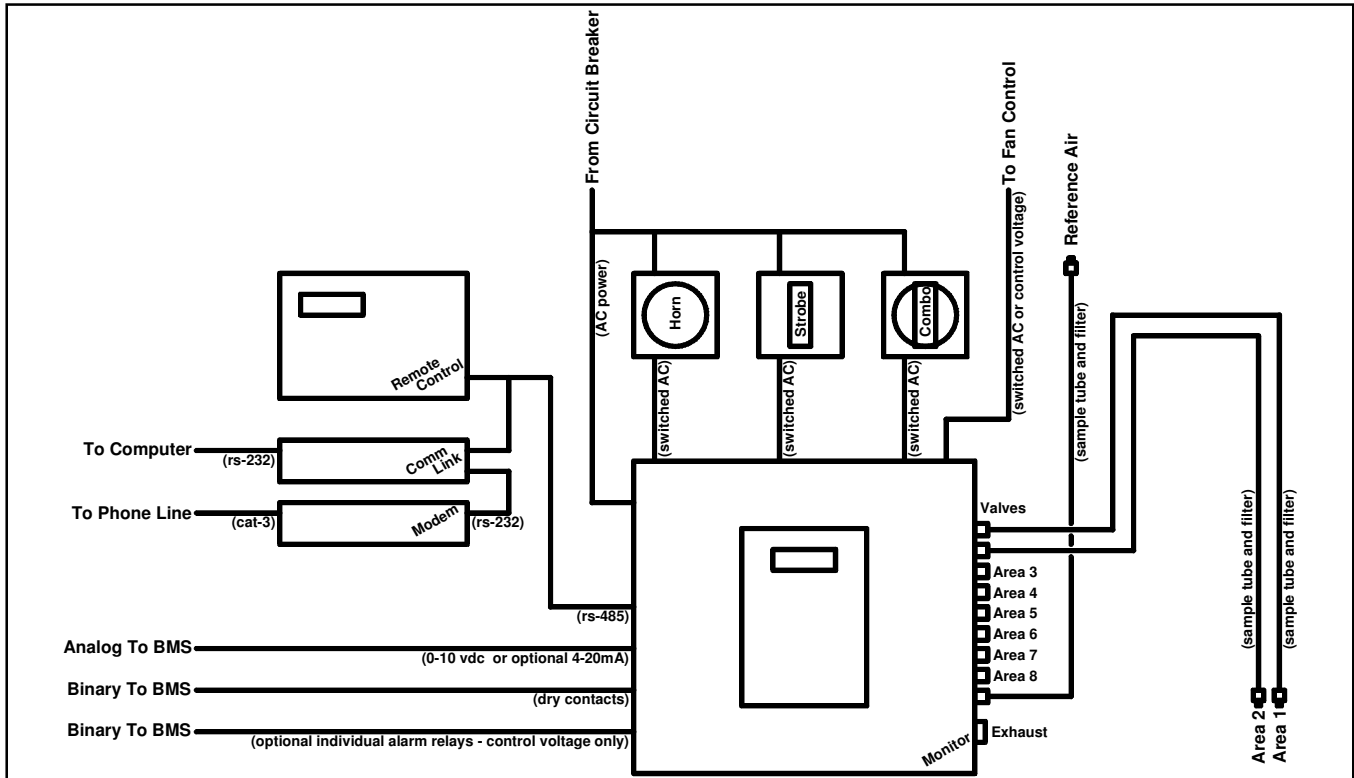
The IR-SNIF-MCD is calibrated at the factory prior to shipment. The system maintains accuracy through automatic rezeroing. Periodically, the system switches to the fresh air inlet, and reestablishes a reference signal to which it compares sample air. This process eliminates the potential variations caused by changes that develop in electronics as components age. If a change in infrared energy or detection of the infrared energy develops, that change will be first measured in the reference signal, then also in the sample. The ppm level is based on the ratio of the sample to the reference. This

ratio eliminates the effect of any variations, and eliminates the need to periodically calibrate a monitor in the field.

PPM vs. Leak Rate

The relationship between the actual amount of product lost and the resulting ppm level refrigerant in the air is complex. There is no direct relationship between the amount of refrigerant leaking and the concentration being measured. The size of the room, the location of the pick up point, the location of the leak and airflow in the room will all affect the actual concentration at the inlet. However, by judicious location of the inlets (see installation section) and maintaining the alarm set points at a level not too far above ambient, leaks should be detected substantially before they otherwise would be noticed. See Appendix B for a detailed discussion of room volume considerations. This appendix will help to provide a correlation between pounds of refrigerant lost over a given period to the ppm level measured. This correlation can be developed for a specific application.

SYSTEM Block Diagram



Item	Part Number	Description	Comments
Monitor Model: IR-SNIF-MCD1 IR-SNIF-MCD4 IR-SNIF-MCD8 IR-SNIF-MCD16	MCD1 MCD4 MCD8 MCD16		
Sample Area Connections:	ACC 030 410144 410357	1 to 16 sample tubes, routed to each sample area 1 /4" OD 1/8" ID, FRPE Tube, 250 ft roll Coarse Tube Filter Barb Fitting for FRPE Tube	Terminate tube 12"-18" above floor Purchased separately from monitor, or customer supplied Included inside monitor Included inside monitor
Reference Air Connection:	ACC 030 410144 410357	Reference air for 'Auto Zero' 1 /4" OD 1/8" ID, FRPE Tube, 250 ft roll Coarse Tube Filter Barb Fitting for FRPE Tube	Terminate tube in area free of refrigerants and interfering chemicals (12"-18" from ceiling if indoors) Purchased separately from monitor, or customer supplied Included inside monitor Included inside monitor
Power Connection:	Field Wiring	120 or 240 VAC 50/60 hz 12 or 14 AWG	Voltage jumper selected inside monitor Provided by customer, Install in accordance with NEC and local codes

Alarm Connections:	ACC 020	Combination Horn/Strobe Alarm 120 vac alarm, surface mounted using included 4x4 box, or flush mounted using customer provided 4x4 box installed in finished wall, horn and strobe portions of alarm can be controlled by separate relays, or common relay, multiple tones available (switch selectable inside alarm)	Optional - Purchased separately from monitor, Install in mechanical room so that it can be seen and heard from all areas, control Strobe portion with LOW alarm relay, control Horn portion with HORN relay	
	ACC 026	Strobe Alarm 120 vac alarm, surface mounted using included 4x4 box, or flush mounted using customer provided 4x4 box installed in finished wall	Optional - Purchased separately from monitor, Install outside mechanical room so that it can be seen prior to entrance into area, Control with LOW alarm relay	
	ACC 025	Horn Alarm 120 vac alarm (240 vac version available), surface mounted	Optional - Purchased separately from monitor, Install in mechanical room so that it can be heard from all areas	
	Field Wiring	12 or 14 AWG	Provided by customer, Install in accordance with NEC and local codes, Provide power for alarms from same circuit providing power to monitor, use alarm relays to switch line voltage	
Exhaust Fan Control:	Field Wiring	12 or 14 AWG (line voltage control) or 18 or 22 AWG (low voltage control)	Provided by customer, Install in accordance with NEC and local codes, use HIGH alarm relay to switch line voltage for contactor, or to switch control voltage for exhaust fan control	
BMS Control Connections:	Analog:	---	Analog 1 output, 0-10 volts, provides measurement of current area being monitored	Standard feature of monitor, Optional connection – useful in measuring trends, DO NOT use to determine alarm conditions, to do so defeats key features of the refrigerant monitor
		OP 001	Analog 1 output, 4-20 mA, provides measurement of current area being monitored	Optional feature of monitor, used for control systems that prefer 4-20 mA input, DO NOT tie control system loop power to monitor 24 volts
		OP 001 (2 nd)	Analog 2 output, 0-10 volts and 4-20 mA, provides current area being measured	Optional feature of monitor, Order qty 2 OP 001 to have analog 2 installed, Not normally used, Typically most sample areas are in the same room
	Binary:	Field Wiring	18 or 22 AWG	Provided by customer, Install in accordance with NEC and local codes
		---	LOW, MAIN and HIGH alarm relays, each with 4 sets of dry contacts	Standard feature of monitor, NO and NC contacts are available for BMS connection
		OP 002	Individual Zone Alarm Output, provides 8 relays, each with 1 set of NO/NC contacts, for control voltages only (24 vac or vdc only)	Optional feature of monitor, provides indication of which area is in alarm, can be selected for different alarm configurations, refer to separate Individual Zone Alarm Output Manual for details
Field Wiring	18 or 22 AWG	Provided by customer, Install in accordance with NEC and local codes		

Remote Digital Interface Connections:	ACC 065	Remote Control Panel Interface, full function remote control for monitor	Optional – Purchased separately from monitor, provides complete remote interface for all monitors in building via rs-485 interface (subject to cable length limitations of rs-485), powered by 24 vac transformer
	Field Wiring	14 or 16 AWG (Line voltage supply to transformer) 18 or 22 AWG (24 VAC from transformer to Remote) 18 or 22 AWG (twisted shielded wire for rs-485 connection to monitor)	Provided by customer, Install in accordance with NEC and local codes
	ACC 070	COMM LINK, PC to refrigerant monitor interface	Optional – Purchased separately from monitor, provides complete remote interface from PC to all monitors in building via rs-485 interface (subject to cable length limitations of rs-485), used with Windows based software provided with COMM LINK
	Field Wiring	Wall outlet transformer (Provides 24 VAC to COMM LINK) Cable and Adapters (rs-232 interface from COMM LINK to PC) 18 or 22 AWG (twisted shielded wire for rs-485 connection to monitor)	Provided with COMM LINK, if multiple devices are powered by the same transformer, polarity must be maintained the same for all devices Provided with COMM LINK Provided by customer, Install in accordance with NEC and local codes
	ACC 071	MODEM, Interface for Remote PC Connection to COMM LINK	Optional – Purchased separately from monitor, provides connection via phone line from PC to COMM LINK, allows off premises remote PC to dial in to all monitors in building via rs-485 interface (subject to cable length limitations of rs-485), Requires COMM LINK and Windows based software provided with COMM LINK
	Field Wiring	Wall outlet transformer (Provides 24 VAC to Modem) Cable and Adapters (rs-232 interface from Modem to COMM LINK)	Provided with ACC 071, if multiple devices are powered by the same transformer, polarity must be maintained the same for all devices Provided with ACC 071

INSTALLATION

Unpack and Inspect Material

IR-SNIF-MCD Package: The IR-SNIF-MCD package contains the following material:

1. IR-SNIF-MCD Refrigerant Monitor
2. Installation and Operation Manual
3. Hose barb fittings and coarse tube end filters (one hose barb and filter for each sample area and one each for fresh air reference – two, five, nine or seventeen of each are provided)
4. CTS/Warranty form to be completed and returned to Sentech

Optional Purchases: The IR-SNIF-MCD package may also contain the following material:

1. Plastic FRPE tubing, ¼ inch OD for sample tube
2. Combination Horn/Strobe alarm
3. Horn alarm
4. Strobe alarm

Other Required Material: The following material is required but not provided by SenTech:

1. Primary power wiring
2. Wiring for connection to alarm devices or other building systems
3. Relay contactors for building system loads greater than 5 amps
4. ¼ inch tubing (if not purchased from SenTech, or if copper tube is required by local code)

If any material is missing, or appears to be damaged, contact Sentech Corporation for assistance.

Identify Location for Monitor, Sample Points and Alarms

Monitor Location: ASHRAE-15 specifies that the refrigerant monitor is to be located in the mechanical room. There are two interpretations of this: the unit itself is to be installed in the mechanical room; or the sample point is to be located in the mechanical room. Because the IR-SNIF-MCD is an active air draw monitor, it can be installed nearly anywhere in the vicinity of the area to be monitored.

If local codes allow, the monitor can be installed at the entrance to the mechanical room, with the sample tube routed into the mechanical room and the fresh air reference routed to an appropriate location. If the monitor is located outside the mechanical room, a fitting should be installed and an exhaust tube routed either into mechanical room, or outdoors. If it is routed outdoors, it must not be located near the fresh air reference.

If local codes require the monitor to be physically installed in the mechanical room, it should be installed in the best location for ease of use and routing of sample and fresh air tubing. If the monitor is installed in the same room as the sample pick-up-point, no exhaust tube is required.



Caution: Liquid can affect the performance of the monitor. Pick-up-points must be protected from exposure to water and other liquids.

Sample Location: Since the monitor measures the concentration of refrigerant in

the air, the pick up point should be mounted where it is most likely to sense leaking refrigerant. The criteria to consider in selecting the sample pick up point location include:

1. As close to the area of potential leaks as possible. On the 'downstream' side of the air flow pattern in the room.
2. Since refrigerants are typically heavier than air, the pick up tube should be terminated approximately 18 inches above the floor.
3. The sample tube should be located such that it will require no more than 250 feet (75 m) of tubing.

Reference Location: Since the monitor compares a fresh air reference to the sample, care must be taken in choosing a location. The fresh air reference tube should be routed to a location that will be free of refrigerant. This can be, but does not necessarily have to be, located outdoors. When routing the fresh air reference, the following criteria should be used:

1. Since refrigerants are typically heavier than air, the fresh air reference should be terminated above any possible source of refrigerant.
2. The tube end filter must be located such that it can be inspected as part of the recommended quarterly preventive maintenance.
3. If located indoors, the fresh air reference should be located in an area free of refrigerants, and located approximately 18 inches from the ceiling.
4. If located outdoors, the tube end filter must be protected from the elements. Water, ice or insects can

partially obstruct the tube end filter and change the reference signal.

5. If located outdoors, the tube end filters must not be located near exterior HVAC equipment, or any potential source of refrigerant.

Exhaust Location: The exhaust tube is required only if the monitor is not located in the same room as the sample pick-up-point. If an exhaust tube is installed, it should be run to the room being monitored, or to an exterior location. An exhaust tube must not be terminated near the fresh air reference.

Alarm Location(s): A combination horn/strobe alarm is recommended for a mechanical room. The alarm should be located inside the room such that it can be seen and heard from any area of the room. Additionally, a strobe alarm can be installed at each entrance to the room to alert the user of an alarm prior to entry to the room itself. Note that the IR-SNIF-MCD has visual indicators of its alarm status. If the monitor is installed at the entrance to the room, a strobe should not also be required.

Electrical Power Connection



Caution: All installation wiring, service and maintenance should be performed by a qualified electrician in accordance with national and local codes.

TB-1 Power Wiring: The IR-SNIF-MCD monitor is designed to operate on only 110 vac or 240 vac, but not both. It will operate on either 50 or 60 hz. The power supply in the monitor automatically detects the supply voltage. The diaphragm pump is designed to operate only on 110-120 vac or on 220-

240 vac. Refer to figure 6 for a diagram of the TB1 terminal board.



Caution: Verify that the monitor is designed for the appropriate line voltage. Connection of the incorrect voltage will damage the unit.

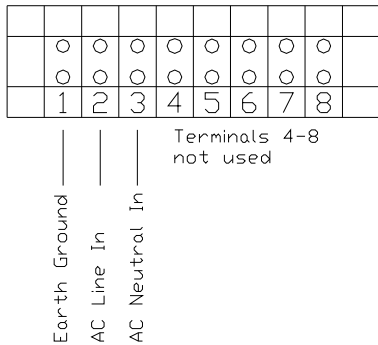


Figure 6.

Connect primary power to TB1 as follows:

1. Connect Earth Ground to TB1-1
2. Connect AC Line to TB1-2
3. Connect AC Neutral or Common to TB1-3

It is strongly recommended that power be supplied from a two-pole circuit breaker, located in reasonable proximity to the system. Power MUST NOT be supplied by plugging into a wall socket. The unit is a continuous monitor, and as a continuous monitor should be provided dedicated, permanent power. If a wall socket is used, there is a risk that the unit will inadvertently be unplugged, putting it off-line.

Electrical Alarm Connections

Relay Connections: The IR-SNIF-MCD monitor alarm relay sockets have four sets

of NO/NC dry contacts. Refer to figure 7 for a diagram of the relay socket.

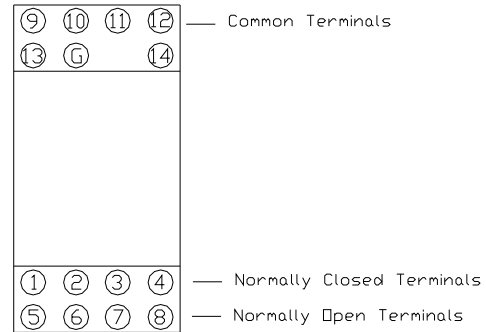


Figure 7.

The terminals are grouped as follows:

Terminal 9 = Common
 Terminal 1 = NC
 Terminal 5 = NO

Terminal 10 = Common
 Terminal 2 = NC
 Terminal 6 = NO

Terminal 11 = Common
 Terminal 3 = NC
 Terminal 7 = NO

Terminal 12 = Common
 Terminal 4 = NC
 Terminal 8 = NO



Caution: Ensure that external relay connections do not touch relay control terminals 13 and 14. A short circuit from the alarm wiring to the relay control wiring could damage the monitor, the alarms or both.

TB2 Relay Interface: One set of contacts from each relay is wired to TB2 terminal board to allow easier connection of field wiring. The normally open contact, and common contact of each relay is wired to

TB2 to provide a switch closure for external control of alarms. Refer to figure 8 for a diagram of the terminal board.

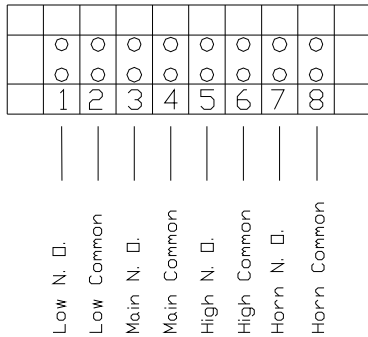


Figure 8.

Alarm-to-Relay Connection: The typical Alarm connection uses the common terminal and normally open (NO) terminal to switch AC line voltage to the strobe alarm, horn alarm or combination horn strobe. Unless specified otherwise, SenTech Corporation recommends the following connections for alarms:

1. Strobe Alarm, or Strobe portion of Combination Horn/Strobe connected through LOW RELAY, terminals 1 and 2 on TB2.
2. Horn Alarm, or Horn portion of Combination Horn/Strobe connected through HORN RELAY, terminals 7 and 8 on TB2.



Caution: Ensure that external relay connections do not touch relay control terminals 13 and 14. A short circuit from the exhaust fan wiring to the relay control wiring could damage the monitor, the alarms or both.

Fan-to-Relay Connection: The IR-SNIF-MCD monitor alarm relay can support a load of up to 5 amps at line voltage. The

typical high-speed exhaust fan will have a startup current in excess of the relay rated amp capacity. A pilot relay or contactor will normally be required to energize an exhaust fan. Unless specified otherwise, SenTech Corporation recommends the following connections for exhaust fans:

1. Fan, pilot relay or contactor connected through HIGH RELAY, terminals 5 and 6 on TB2.

BMS-to-Relay Connection: The IR-SNIF-MCD monitor alarm relay can provide alarm indications to the typical building management system (BMS) for Low, Main and High alarm levels. This connection is normally accomplished by switching a control voltage through the normally open (NO) contacts of the respective relay. Unless specified otherwise, SenTech Corporation recommends the following relay connections for building management systems:

1. BMS discrete input connected through LOW, MAIN and/or HIGH RELAYS, terminals 7 and 11.

Other External Connections

TB3 User Interface: Terminal board TB3 The IR-SNIF-1,2,3 is designed to provide two standard 0-10 volt analog outputs *or* two optional 4-20 mA analog outputs, and external reset input and optional rs-485 interface for use with ACC 070 SenTech COMM LINK PC to Refrigerant Monitor Interface, or ACC 065 SenTech Remote Control Panel Interface. Refer to figure 9 for a diagram of TB3 terminal board.

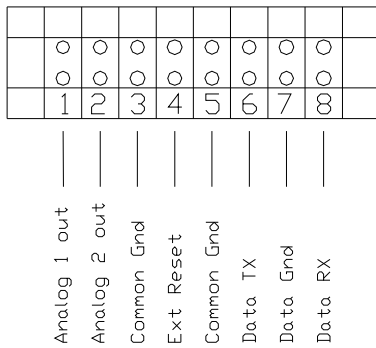


Figure 9.

0–10 Volt Analog Outputs: The IR-SNIF-MCD monitor provides two 0–10 volt analog outputs. Analog 1 provides a signal proportional to 0-1000 ppm indicating the current ppm level. Analog 2 provides a signal proportional to the area being measured, based on 0-10 volts proportional to 0 to 32 areas. For simple installations this signal will not normally be used. For applications where the IR-SNIF-MCD is installed inside a mechanical room, the analog 1 signal can be used to drive an optional remote analog display at the entrance to the room. This signal could be used to provide an analog input to building management systems for remote monitoring of the ppm level and for trending of levels. This signal should NOT be used as a replacement for discrete alarm relay connections to a BMS. Analog output connections are as follows:

1. Use twisted pair wire for analog 1 connection, or four conductor twisted wire for both analog 1 and analog 2. Typical low voltage solid conductor wire is suitable for this signal. Shielded cable is preferred, but not always required.
2. Route twisted pair wire into the monitor and along the wire harness from the back-plate to the TB3 on the back-plate. Secure the twisted

pair periodically to the wire harness using tie wraps.

3. Connect the appropriate wires to TB3-1, analog 1 plus, and TB3-3, reference ground.
4. Connect the appropriate wires to TB3-2, analog 2 plus, and TB3-3, reference ground.

4–20 mA Optional Analog Outputs: The IR-SNIF-MCD monitor provides a optional 4–20 mA analog outputs in place of the standard 0-10 volt analog outputs. To identify whether a monitor has 4-20 mA analog output installed, examine the control board installed on the door of the monitor. Locate the chip sockets labeled U13 and U14. U13 and U14 are located in the center of the board, approximately 3.5 inches and 2 inches from the bottom of the board. If the monitor is configured for the standard 0-10 volt analog outputs, the sockets will be empty. If configured for 4-20 mA outputs, the sockets will have 4-20 mA drive chips installed. Connection to the 4-20 mA outputs is the same as for 0-10 volt outputs.

RS-485 Optional Serial Output: The IR-SNIF-MCD monitor provides an optional RS-485 interface for use with ACC 070 SenTech COMM LINK PC to Refrigerant Monitor Interface, or ACC 065 SenTech Remote Control Panel Interface.

This interface provides the ability to display the refrigerant levels in each area and modify setpoints via a pc based interface. Used in conjunction with the ACC 070 COMM LINK, the interface allows for complete remote monitoring of multiple refrigerant monitors in the same facility.

This interface also provides the ability to display the refrigerant levels in each area and modify setpoints via a digital remote

control interface. Used in conjunction with the ACC 065 Remote Control Panel Interface, the RS-485 interface allows for complete remote control and monitoring of multiple refrigerant monitors in the same facility.

RS-485 digital connections are as follows:

1. Use twisted wire for RS-485 connection, either twisted triple wire, or four conductor twisted wire. Shielded cable is preferred, but not always required.
2. Route twisted pair wire into the monitor and along the wire harness from the back-plate to the TB3 on the back-plate. Secure the twisted wire periodically to the wire harness using tie wraps.
3. Connect the transmit conductor to TB3-6.

4. Connect the receive conductor to TB3-8.
5. If twisted triple wire is used, connect the remaining wire to TB3-7, reference or shield ground.
6. If two twisted pairs are used, connect one conductor from each pair to TB3-7, reference ground or shield.

Custom Control Inputs/Outputs: The IR-SNIF-MCD monitor has the capability to be programmed for additional optional inputs or outputs. The control circuit in the monitor is versatile and can accommodate additional analog or discrete measurement and control signals. This circuit also has the capability to provide additional discrete control signals. Please contact SenTech Corporation technical support to determine whether specific requirements can be provided.

STARTUP and PROGRAMMING

Apply Power



Caution: Before applying power, double-check all wiring.

Once the installation has been completed, and wiring has been checked, close the door to the monitor and apply power. The unit will go through its normal startup checks and warm-up procedure. It is important that the door remain closed to ensure a proper operation.

Initial Screens

If the IR-SNIF-MCD has never been programmed, it will access default memory settings and display the following screen:

RESETTING DEFAULTS

Once the defaults have been stored, or if the monitor has been previously programmed, the following screen will be displayed. Since the monitor is factory calibrated, and factory programmed during quality control, it should display this screen on initial application of power.

restore from memory

Following memory initialization, the monitor will display the copyright screen.

SenTech Corporation
IR-SNIF-MCD16
Gas Monitor
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The monitor will next display two Contact and Model Information screens. (Note: these screens can be accessed anytime during normal operation by pressing the "*" key.)

SenTech
Corporation
Phone 1-888-248-1988
www.sentechcorp.com

Model IR-SNIF-MCD
Version 4261
Option Code 0
www.sentechcorp.com

Following display of the contact and model information screens, the IR-SNIF-MCD will restore any alarms that have been saved into memory. The corresponding lights and relays will be energized. Any external alarms, exhaust fans or building management system connections will be activated. The monitor will then display the following optics warm-up screen.

Optics Warm up
Timer 540 12:00
Press ENT for Menu

On completion of the warm-up, the monitor will enter Auto zero mode and begin normal operation.

If during the startup, a fault condition is detected, follow the instructions on the screen, and refer to the trouble-shooting section of this manual.

Normal Operation

During normal operation, the monitor will display one of two basic screens. First, it will measure the fresh air reference and display the Auto Zero screen. Then it will measure the sample air and display the Auto Sample screen.

The Auto Zero measurement will take approximately 25 seconds, and will be performed approximately every 3 minutes. If the monitor senses refrigerant in the sample air, it will lengthen the Auto Zero time to approximately 45 seconds.

```
  ** Auto Zero**  
  Timer 24  12:00  
  
  Press ENT for Menu
```

The Auto Sample measurement will be taken for between 1 minute and 3 minutes, depending on the tube length programmed into the monitor. This screen will display the ppm reading, the time of day and the refrigerant programmed for the sample area.

```
  Auto Sample AREA 1  
  PPM  0  12:00  
  R-134A  
  Press ENT for Menu
```

Initial Programming

Once the IR-SNIF-MCD has completed warm-up, and entered Auto Zero, it can be programmed. While in Auto Zero or Auto Sample modes, press the “ENT” key to access the main menu.

```
  1)...Status  
  2)...Rezero  
  3)...Manual  
  4)...Setup      ABORT
```

Key selections 1, 2 and 3 are used to display current alarms, manually initiate Auto Zero and enter the Manual Override mode. These functions are discussed in Appendix A of manual.

To program the monitor, press the “4” key to enter Setup. The monitor will require a password to access the setup screens. There are five setup passwords: 111, 222, 333, 444, 999. The first four passwords can be changed to user-defined codes. 999 cannot be changed.

```
  * SenTech Monitor *  
  ENTER PASSWORD  
  Followed By ENT  
  Code :  0
```

If an incorrect password is entered, the fourth line of the screen will change to “Access Denied” and the monitor will return to normal operation.

```
  * SenTech Monitor *  
  ENTER PASSWORD  
  Followed By ENT  
  ACCESS DENIED
```

When the correct password has been entered the monitor will display the setup screen.

1)...IR Setup
2)...N/A
3)...System Setup
4)...Contact ABORT

Press the “3” key to enter System Setup. System setup consists of two screens that allow the user to change passwords, change system flags, test the alarm circuits and set the time and date. The user can toggle from one screen to the other by using the left and right arrow keys.

1)...Change Code
2)...System Flags
3)...Alarm Test
ABORT ->

4)...Date/Time
5)...Trending

Key selections 1, 3 and 5 are used to: change passwords, test the alarm relays and program data trending. Refer to Appendix A of manual for instructions to change passwords. The alarm test function is described in the Final Test section of this manual. Refer to Appendix A of the manual for instructions to program trending.

Press the “2” to enter the System Flags screens. The system flag screen will display information for five settings, displayed on two screens. Press the ENT key to move the cursor from one line to the next, and press the left arrow key to move from one line to the previous.

The autozero flag can be used to limit the frequency of autozero cycles. It can be set between 0 and 100. If a 0 is entered, the monitor will enter an autozero cycle after every area is sampled (this is the normal default configuration). Increasing this number will allow the monitor to skip the autozero cycle if the raw measurement from the IR-Bench has not changed significantly. That is, if the raw signal varies by less than plus or minus 10 millivolts, and the autozero flag is set to 10, the monitor will not perform an autozero cycle. *NOTE: This is effectively reducing the extreme low-level sensitivity of the monitor.* If this feature is desired, set this flag by increasing it in small steps, 1 or 2 digits at a time, until the monitor stops autozeroing after every zone.

The password flag can be set to either 0 or 1. If a 1 is entered, the monitor will require the user to enter a password to perform any functions of the monitor. This feature is useful if the monitor is installed in a public area, and controlled access to the monitor is needed. This flag is set to 0 by default.

Press the “ENT” to move the cursor to the horn relay flag. The horn relay flag can be set to 0, 1, 2 or 3. This flag changes the function of the horn relay to control an audible alarm. With the flag set to the 0, the horn relay will be disabled. The monitor can be programmed to allow the horn relay to be de-energized while the monitor is still in alarm. This feature is useful when the user is troubleshooting an alarm, and wants to work in silence. Set the horn relay flag to 1 to activate the horn relay when the monitor is in LOW alarm. Set the horn relay flag to 2 to activate the horn relay when the monitor is in MAIN alarm. Set the horn relay flag to 3 to activate the horn relay when the monitor is in HIGH alarm. This flag is set to 2 by default.

The unit number flag is used to identify the monitor on a RS-485 network, if that option has been purchased. This flag is set to 1 by default.

AUTOZERO FLAG 0	-
PASSWORD FLAG 0	
HORN RELAY FLAG 0	
UNIT NUMBER FLAG 1	

Press the “ENT” key to move the cursor to the next entry. When all entries have been viewed, press the “ENT” key again to display the second system flag screen

SLOPE FLAG 50	-
TWA ALARM 0	
FULL SCALE 1000	
TWA REFRESH 5	

The slope flag is used for circumstances where an individual zone might be exposed to large levels of refrigerant. This flag will hold the monitor in its current mode, whether it be autosample or autozero, if the raw measurement has not leveled off to a constant measurement. *For instance, after an extremely large level of refrigerant has been measured, the monitor might run in autozero longer than expected if the measured level is still falling.* Set this flag to the factory default of 50 if no large levels are expected. Set this flag lower if large levels are expected.

Press the “ENT” key to move the cursor to the TWA ALARM flag. This flag is reserved for future implementation of TWA measurement. This flag should be left at the factory default of 0.

Press the “ENT” key to move the cursor to the FULL SCALE flag. This flag is used to adjust the full scale measurement for the

analog output. The factory default is 1000, meaning that the 0-10 volt analog output corresponds to 0-1000 ppm. This flag should be left at the factory default unless a custom measurement range has been implemented in the monitor. Consult factory technical support for further information if needed.

Press the “ENT” key to move the cursor to the TWA refresh flag. This flag is used to save peak ppm measurements if Trending is not implemented. A TWA refresh rate of 5 minutes corresponds to a theoretical ten-hour time weighted average (5 minute refresh rate times 120 saved data points yields ten-hour average). As with the TWA ALARM flag, this feature is not yet implemented.

Press the “ENT” key to move the cursor to the next entry. When all entries have been viewed, press the “ENT” key again to display the third system flag screen.

LOW DELAY	0	-
MAIN DELAY	0	
HIGH DELAY	0	
LATCH FLAG	0	

The DELAY FLAGS are used to implement an additional time delay, in minutes before energizing the respective alarm relays. This time delay is similar to the LEAK WAIT, except that the user is able to create a time definite delay, rather than the ppm level defined LEAK WAIT delay. The factory default setting is 0 for each delay.

Press the “ENT” key to move the cursor to the next entry. Once the DELAY entries have been viewed, press the “ENT” key to move the cursor to the LATCH FLAG. The LATCH FLAG is used to determine if the

LOW and MAIN alarms are self-resetting or are latched. If the LATCH FLAG is set to 0, the alarms will function as a conventional latching alarm. If the LATCH Flag is set to 1, the LOW and MAIN alarms will function as self-resetting alarms. The HIGH alarm will always be a latching alarm.

NOTE: The ASHRAE-15 standard specifies that an alarm relay must be latched, but that if more than one alarm level is provided, the additional alarms may be self-resetting. Care must be used when implementing this feature, as the alarm level that corresponds to the ASHRAE-15 required alarm MUST be a latching alarm. If there are any questions regarding the correct implementation of this feature, call SenTech technical support.

Press the “ENT” key to move the cursor to the next entry. When all entries have been viewed, press the “ENT” key again to return to the previous menu. The monitor should again display the system setup menu.

```

1)...Change Code
2)...System Flags
3)...Alarm Test
      ABORT      ->
  
```

Press the right arrow “->” key to access the second system setup screen.

```

4)...Date/Time
5)...Trending
      <-      ABORT
  
```

Press the “4” key to set the date and time. The program time/date screens allows the user to set the day of the week, hour, minute, month, day, and year for the real time clock (RTC) in the controller. Entering

information, or pressing the “ENT” key will move the cursor down to the next entry.

```

Program Time/Date
Day (Sunday = 0): 3
Enter Hr (0-23): 12
Enter Minute: 35
  
```

Note that the RTC operates on a 24-hour clock. For example to enter 2 PM, enter the hour as 14, rather than 2.

```

Program Time/Date
Month (1-12): 10
Day (0-31): 27
Year (00-99): 04
  
```

When the date and time have been entered, press the “ENT” key to return to the system setup screen.

When the date, time and system flags have been set correctly, press the “ABORT” key to return to the Setup menu.

```

1)...IR Setup
2)...N/A
3)...System Setup
4)...Contact      ABORT
  
```

As of January 1, 2003 the standard IR-SNIF monitor is capable of detecting and responding to the following list of refrigerants.

R-11, R-12, R-13, R-22, R-113, R-114, R-123, R-134A, R-401A, R-401B, R-402B-HP81, R-404A-HP-62, R-407A-AC9000, R-408A, R-409A, R-410A-AZ20, R-500, R-502, R-503, R-507-AZ50

This list changes over time, so it is recommended that the operator review the

Gas Code screens for a complete list of gasses a given monitor is capable of monitoring.

Press the “1” key to enter IR Setup. The setup screens allow the user to program the refrigerant to be monitored, the distance of the tube used for the sample, and the Low, Main and High alarm thresholds for each sample area. Note that different settings can be programmed for each area, and that every area must be programmed for proper operation. The first setup screen will display 1 to enter parameters, or 2 to enable or disable sample areas.

```

Program Setpoints
For Each AREA
1 – Setup
2 – Enable  ABORT
    
```

Press the “1” key to setup parameters for each area.

```

AREA      1      <- ->
R-134A    8
Distance  250
          ENT or ABORT
    
```

Press the left or right arrow keys to change from one sample area screen to another. Press the “ENT” key to move the arrow cursor from line one to line two.

```

AREA      1
R-134A    8      <- ->
Distance  250
          ENT or ABORT
    
```

Press the left or right arrow keys to change from one gas type to another. The gasses are organized in numerical order, with refrigerants first, and fire suppression

agents or blowing agents following refrigerants. Once the appropriate gas is displayed, press the “ENT” key to move the cursor from line two to line three.

```

AREA      1
R-134A    8
Distance  250      -
          ENT or ABORT
    
```

Enter the tube length, in feet, if the tube length is greater than 100 feet. If the tube is shorter than 100 feet, leave the setting at the factory default of 100. When the distance has been entered, press the “ENT” key to display the second sample setup screen.

```

Alarm Low   25  -
Alarm Main  50
Alarm High  500
          ENT or ABORT
    
```

Unless specified otherwise, SenTech Corporation recommends the following alarm settings for all refrigerants *except R-123*:

- Low = 25 ppm
- Main = 50 ppm
- High = 500 ppm

Unless specified otherwise, SenTech Corporation recommends the following alarm settings for R-123:

- Low = 25 ppm
- Main = 50 ppm
- High = 150 ppm

These settings are based on the current acceptable exposure levels and short-term exposure levels on a time weighted average for refrigerants. SenTech recommends that under no circumstances should a refrigerant monitor be set above

the short-term exposure level. These are recommended settings only. Refer to local codes and regulations for the appropriate settings for a given application.

Once the gas code, distance and alarm settings have been entered, press the "ABORT" key to return to the Setup Menu.

```
Program Setpoints
For Each AREA
1 - Setup
2 - Enable  ABORT
```

If any of the available sample ports are not used, press the "2" key to enter the enable/disable screen.

```
AREA      1      <- ->
Status    1
1-Enable  0-Bypass
          ENT or  ABORT
```

Press the left or right arrow keys to change from one sample area screen to another. Press the "ENT" key to move the arrow cursor from line one to line two.

```
AREA      1
Status    1      -
1-Enable  0-Bypass
          ENT or  ABORT
```

To bypass, or disable a sample area, change the "1" to a "0" and press the "ENT" key. Once the appropriate areas have been disabled, press the "ABORT" key to return to the IR-Setup screen, again to return to the Setup Screen, and again to return to normal operation. The monitor should enter Auto zero mode.

FINAL TESTS

At this point, the system should have all settings programmed and it should be monitoring in the Auto sample mode. There are four stages to the final checks: Correct Monitor Sequencing, Correct Integration with External devices, Response to Refrigerant and End-to-End System Test

Monitor Sequencing

Watch the unit as it measures the sample area. Make certain that it periodically switches from the Auto sample mode to the Auto zero mode, and back again. Make a note of the ppm reading in the sample area. The reading should be zero. It may periodically measure a transient level of between 0 and 10 ppm, but it should never stay above 10 ppm if no leak is present. If the reading is consistently higher than 10 ppm, or if it enters alarm, it is likely there is a leak present. A high reading may also result from the recent use of a chlorinated cleaning agent. Many industrial degreasers use chlorine based organic compounds. Examples are trichloroethylene, or perchloroethylene. If there is no leak and there are no other sources of halogen vapors in the room, contact SenTech technical support.

Integration with External Devices

Once a monitor has been connected to external alarms, fans and building systems, integration can be checked using the Alarm test function of the monitor. The Alarm test screen is found in the System Setup menus described previously in the start up and programming section of this manual.

The setup menu is accessed by pressing the "ENT" key. Press the "4" key to enter setup, followed by the password "999". From the setup menu, press the "3" key to enter system setup. From the System setup menu, press the "3" key to enter the alarm test screen.

Alarm Test 1)...Low 2)...Main 3)...HIGH 4)...All Press Key To Test

Key selections 1, 2, and 3 are used to energize the Low, Main and High alarm relays respectively. Key selection 4 will initiate a cycle that turns on the low relay, then the main relay, then the high relay, until all three relays are energized. If any relay has been energized, the fourth line of the display will change to instruct the user to press the "RESET" key to de-energize the relays.

Alarm Test 1)...Low 2)...Main 3)...HIGH 4)...All RESET To Clear
--

With the alarm relays energized, confirm that the monitor is correctly integrated into the building systems. Once this test has been completed, press the "ABORT" key. The monitor will restore any alarms that existed prior to entering this test mode, and will return to the system setup screen. Press the "ABORT" key again to return to normal operation.

Response to Refrigerant

After checking the alarms, the next step is to check for a proper response to the presence of a refrigerant. This will be done by preparing a sample of refrigerant for testing, and then presenting it to the system to make certain it measures refrigerant. It is suggested the following steps are completely reviewed before starting. This test is best done after the monitor has been running normally for an hour or two.

Step 1: Remove the inlet tubing from the sample inlet.

Step 2: Prepare a refrigerant sample. Note that refrigerants can be Chlorofluorocarbons (CFC's), Hydrochlorofluorocarbons (HCFC's) or Hydrofluorocarbons (HFC's). HFC's are the only refrigerants considered to be truly "Ozone Friendly". Because of this, SenTech Corporation recommends use of an HFC, such as R134A for field-testing of the IR-SNIF series of monitors. Any field-testing of a refrigerant monitor, by its very nature, will release an amount of refrigerant into the environment through the exhaust port of the monitor.



Caution: Follow all national and local codes for safe handling of refrigerants.

Because the IR-SNIF-MCD is factory calibrated, and no field calibration is necessary, the refrigerant sample is not required to be of a known level. A calibrated "test gas" kit is available from SenTech Corporation, should the user desire to perform the following tests with a sample of known PPM level. The following paragraphs describe a procedure for

preparation of a refrigerant sample using pure refrigerant.

Three items are needed to prepare a sample:

- A Refrigerant
- A Container
- A short piece of 1/4" Tube.

The Refrigerant should be available on-site, but if not, R-134A is readily available at local stores. Note that many local office supply stores sell a 'pressurized air duster'. Often, this product is simply pressurized Tetrafluoroethane, or R-134A. This is a cost effective, readily available source of pure test gas, as long as the contents have been verified to be Tetrafluoroethane.

The sample container may also be available on-site. Suitable sample containers range from lab quality sealed bags with twist valves to a simple plastic bag or even an open top jar or can. The container should be at least 4 liters, or about a gallon. The container should be able to be loosely closed, e.g. twisting a plastic bag, or closing a lid.

The 1/4 inch tubing should be long enough to connect to the sample inlet and extend into the bottom of the sample container. Because refrigerants are heavier than air, pulling the sample from the bottom of the container will ensure introduction of the refrigerant into the selected zone.

a) Gaseous Refrigerants: Insert a refrigerant fill hose into the container opening. Crack the valve for a second or less so that a small squirt of refrigerant enters. Keep in mind that the monitor reads in PPM (parts per million) and a tiny amount of gas will make a relatively high concentration sample. Pull out the hose, and loosely close the container.

b) Liquid Refrigerants: Open the container slightly and put in a few drops of liquid refrigerant. Loosely close the container and allow time for the refrigerant to gasify. A bag will expand some as the liquid evaporates.



Caution: Do not close a rigid sample container tightly, because refrigerants expand and can create pressure. Do not allow pressure to build up in the sample container.

Step 3: Manual measurement of sample. Switch the monitor to manual override. Manual Override is accessed by pressing the "ENT" (enter) key on the front panel display of the monitor. Press the "3" key to enter Manual Override. Place the 1/4 inch tube into the sample container and connect it to the sample inlet to simulate a concentration of refrigerant in the air.



Caution: Never connect a pressurized refrigerant bottle directly to the monitor. The unit is designed to operate only at atmospheric pressure. Doing so can damage the unit.

After approximately 5 seconds, the PPM reading should start to rise. Within 30 to 45 seconds, the PPM level should level off. A sample prepared as described in step 2 should easily contain more than 150 PPM. If the PPM reading does not rise above the highest alarm setting in the monitor, repeat the sample preparation procedure with a larger amount of refrigerant. Readings of 150 or higher indicate a successful test of the monitor's ability to sense refrigerant. Disconnect the sample from the monitor and save for the next step. The sample container should now have a measured concentration of refrigerant greater than the

highest alarm level. This will be used to test the end-to-end performance of the system in the next step.

Once the sample tube has been disconnected from the monitor, the readings should fall slowly down to at or near zero PPM. When the PPM level reaches near zero, press the "ENT" (enter) key to exit Manual Override and return to normal operation.

End-to-End System Test

After manually verifying the operation of the monitor, and obtaining (creating) a sample known to have a PPM level higher than the highest alarm, the next step is to perform an end-to-end test of the system. This test will verify that the monitor will correctly trigger alarms and the external devices connected. This will be done by connecting the sample of refrigerant from the previous test to the sample inlet and observing the alarms. This test is best done after the monitor has run through at least two complete auto sample and auto zero cycles.

After approximately 5 seconds, the PPM reading should start to rise. When the monitor exceeds the alarm threshold, it will switch to "Leak Wait" mode. This mode ensures the presence of a leak before triggering an alarm. The leak wait period can be as short as 7 seconds and as long as 3 minutes. **Note: The more the reading exceeds the alarm trip point, the shorter the time to enter alarm.** The system should progress from Low alarm, through Main alarm and into High alarm. **Note: If the monitor exceeds high alarm while in leak wait, it will appear to trigger Main alarm and High alarm at the same time. This is normal, correct operation.**

When a relay is programmed for an audible alarm and energizes, the external horn should sound (if so equipped) and the bottom line of the display should change to "RESET to Silence". This instructs the operator to push the "RESET" key to silence the Horn.

If the Horn has been silenced, the fourth line of the display should change to "RESET to Clr Alarms". This instructs the operator to clear the alarms.

Remove the gas sample from the inlet and wait until the PPM reading drops back to normal. Push the "RESET" button. The System should clear the alarms and be back in normal Automatic operation.

Reconnect the sample inlet tube and dispose of the gas sample in an appropriate manner.

Documentation

Fill out the CTS/Warranty form completely and return it to SenTech in the envelope provided. This is an important step to

establish warranty. Please use this opportunity to make any suggestions for improvements.

If you are part of the user organization, store this manual in a safe place. If you are an installing contractor, please turn over the manual to the user.

If you need any additional manuals, call SenTech and we will be pleased to provide them at no charge (make a note of the unit serial number when requesting a manual). Installation and Operation Manuals for every Monitor ever produced by SenTech Corporation are available at the SenTech website:

www.sentechcorp.com

Basic installation and start-up is now complete. The unit should be on line and monitoring.

The remainder of this manual includes further information on operational characteristics, programming, preventive maintenance, troubleshooting, parts lists, and a detailed wiring diagram.

PREVENTIVE MAINTENANCE & REPAIR

Preventive Maintenance

The recommended periodic preventative maintenance is as follows:

Perform Quarterly Filter Inspection and replace as necessary.

Perform Quarterly Performance Verification.

Filter Inspection and Replacement

Coarse Filters (Tube End Filters) are located in each sample zone and fresh air zone on the ends of the 1/4 inch tubes. The Coarse Filters are sintered brass or bronze, and will naturally discolor to a dark bronze color. Inspect the filter for obvious clogging or build up of dust. Replace, rather than clean the filters.

5 Micron Filter is located inside the monitor, inside a clear moisture separator. The 5 micron filter should be 'paper white', and will turn gray, or off color when dirty. Replace, rather than clean this filter.

Quarterly Performance Check: Once per quarter, perform the End-to-End system test described in the Final Checks Procedure on page 12.

Commonly Ordered Parts

<u>P/N</u>	<u>Description</u>
410144	Filter, Coarse Tube
410162	Filter, 5 Micron
410136-GRAY	Orifice, .016
410224	Diaphragm Pump

Monitor Repair

Most monitor repairs can be performed in the field by the typical service technician. Refer to the Troubleshooting Guide found at the end of this manual for assistance. Additionally, SenTech Corporation provides telephone technical support for all SenTech refrigerant monitors. If assistance is needed, call 888-248-1988 (317-248-1988 internationally).

Should a repair be beyond the normal scope of field service, contact SenTech Corporation for a Return Authorization number for factory repair.

APPENDIX A: Programming and Operator Interface

Summary

The operator interface is composed of three sets of screens:

START-UP SCREENS - Displayed when power is applied to the system.

OPERATIONAL SCREENS - Displayed for the multiple gas monitoring modes.

MENU SCREENS - Screens used to change the operational mode of the monitor, set the configuration of the refrigerant monitoring zones and change system parameters for the monitor.

Start-up Screens

When power is applied to the system, it will step through a series of start-up screens.

RESETTING DEFAULTS

restore from memory

Copyright: The Copyright screen will be displayed on completion memory initialization.

SenTech Corporation
IR-SNIF-MCD16
Gas Monitor
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Contact Screens: The Contact Screens display the company name, phone number and website. After a short pause, a second screen is displayed to identify the Model, Version and Options installed in the software of the monitor.

SenTech
Corporation
Phone 1-888-248-1988
www.sentechcorp.com

Model IR-SNIF-MCD16
Version 3017
Option Code 0
www.sentechcorp.com

Optics Warm-Up: The Optics Warm-Up Screen is displayed while the monitor is stabilizing internal temperature. Currently this is set at about 9 minutes.

Optics Warmup
Timer 540 12:00

Press ENT for Menu

Operational Screens

When the monitor completes Start-Up and Optics Warmup, it will enter Auto zero, and then proceed to measure in Auto sample mode. Under normal circumstances the monitor will cycle from Auto sample to Auto zero, and back to Auto sample. If an alarm condition is detected the monitor will enter Leak Wait mode to ensure a leak is detected. If the operator manually overrides the auto sample operation, the monitor will display Manual Override until the operator exits manual operation or the

monitor time outs and returns to normal operation.

Auto zero: Auto zero measures the fresh air (refrigerant free) zone between each zone. Auto zero takes approximately 24 seconds under normal conditions. If the monitor senses a high concentration of refrigerant, the Auto zero measurement time is extended to approximately 45 seconds.

```
    ** Auto Zero**  
    Timer 24  12:00  
  
    Press ENT for Menu
```

Auto Sample: Auto sample mode is the normal measurement mode of the monitor. It displays the PPM level beings measured, the refrigerant and the current time. If the Horn relay has been energized, the fourth line will instruct the operator to press the "RESET" key to silence the horn. If the monitor is in alarm, the fourth line will instruct the operator to press the reset key to clear alarms.

```
Auto Sample AREA 1  
PPM  0  12:00  
    R-134A  
    Press ENT for Menu
```

Leak Wait: When the monitor is in Auto sample mode and first senses a change in PPM, it enters Leak Wait mode. This ensures the monitor truly detects a leak before activating the Low Alarm relay and the Main Alarm relay. The length of the wait period depends upon the difference between the concentration level and the alarm trip point. The larger the difference, the shorter the wait time. If the concentration falls below the alarm trip

point, the system will determine that it was a transient, and return to normal operation.

```
LEAK WAIT AREA 1  
PPM  0  12:00  
    R-134A  
    Press ENT for Menu
```

Fault Mode: When the monitor detects a fault condition, it will enter fault mode. The Main relay will energize and "Trouble Alarm" will be displayed in the third line of the display.

```
Auto Sample AREA 1  
PPM  0  12:00  
    Trouble Alarm  
    Press ENT for Menu
```

Alarm Modes: When the monitor has sensed concentrations above the alarm trip points, the associated relays will be energized. The Low, Main and High relays will be energized if the measured ppm level has exceeded the corresponding alarm levels. The Horn relay will be energized depending on its programming. The monitor can be set up to energize the Horn relay when the Low alarm is activated, the Main alarm is activated or the High alarm is activated. This is programmed via the System Setup menus described later in this document.

If an alarm is activated, the fourth line in the operational screens will change to instruct the operator how to clear the alarm. When the "RESET" is pressed, the monitor will switch directly to the Alarm Status screen described later in this appendix.

If the monitor has also energized the Horn relay, it can be silenced by pressing the "RESET" key. The fourth line in the

operational screens will change to instruct the operator how to silence the Horn. When the alarm condition is cleared, the Horn is enabled and will be activated should another alarm occur.

Clear Alarm:

```
Auto Sample AREA 1
PPM 0 12:00
R-134A
RESET to Silence
```

Silence Horn:

```
Auto Sample AREA 1
PPM 0 12:00
R-134A
RESET to Silence
```

Manual Override: Manual Override mode is useful to temporarily measure without processing alarms. It displays the ppm level, the refrigerant and the current time. Alarm processing is suspended during Manual Override. Manual Override mode is entered by via the menus described later in this document.

Menu Screens

The Menu Screens can be accessed from any Operational Screen by pressing the "ENT" or enter key. In the first menu, the operator is given the choice to review Zone Alarms, manually perform an Auto zero, enter Manual Override mode or enter Setup.

```
1)...Status
2)...Rezero
3)...Manual
4)...Setup      ABORT
```

Status: The Status Screen is accessed by pressing the "1" key. The status screen will allow the operator to review alarms and to review trend data, if trending is enabled on the monitor.

```
1)...Alarms
2)...Trending

ABORT
```

If trending is not enabled, choice 2) trending, will not be displayed.

Alarm Status: The alarm status screen is accessed by pressing the "1" key. If any zones are in alarm, the operator will have access to a series of screens formatted to show the alarm level, the peak ppm, and the time and date of the alarm. Additional alarm screens can be accessed by pressing the left and right arrow keys. If there are no alarms to display, or the last alarm has displayed, "No More Alarms". If the "RESET" or "ABORT" keys are pressed, the monitor will exit and return to normal operation.

```
Alarm Status
AREA 1 LOW PK 26
3/12/03 12:00
<- RESET or ABORT ->
```

Once all of the measurement alarms have been displayed, the Monitor will check for Trouble Alarms. Trouble Alarms will be generated if the monitor senses a fault in the Infrared Bench (sensor), a fault in the remote reset connection, a calibration fault and a flow related failure.

IR Bench Fault: The Bench Voltage trouble alarm will be displayed if the monitor senses a fault in the Infrared Sensor.

```

Trouble Alarm
Bench Voltage
Call Factory
<- RESET or ABORT ->

```

Remote Reset Fault: The Remote reset trouble alarm will be displayed if the remote reset connection detects a shorted circuit. This is helpful to prevent malfunctions in the operation of the monitor caused by external connections.

```

Trouble Alarm
Remote Reset
Call Factory
<- RESET or ABORT ->

```

The monitor will also generate a trouble alarm if it has never been calibrated, or if it has had a control failure that erased the calibration settings in read only memory.

```

Trouble Alarm
Monitor Is Not
Calibrated
<- RESET or ABORT ->

```

The Pump Failure Possible trouble alarm will be displayed if the monitor detects a flow failure.

```

Trouble Alarm
Pump Failure
Possible
<- RESET or ABORT ->

```

Press the "RESET" or "ABORT" keys to return the monitor to normal operation.

Trend Status: The Trending screens can be accessed by pressing the "2" key while the Status screen is displayed. *Note: the*

trending screen will display two lines of information that is twenty lines long, and up to 120 columns wide. This feature is best used in conjunction with the ACC 070 Comm Link and a windows based PC to view and track trend information.

```

Display Trend Data
Use Arrows to Change
Time, Use ENT to
Change Zone

```

After a pause, the monitor will display trend information, showing date, time and the first two area information.

```

10/28 12:05
AREA 1 0 ppm
AREA 2 0 ppm
<- ENT or ABORT ->

```

Press the ENT key to display other areas for the same time. Press the left arrow and right arrow to display trend information for different times. Press the ABORT Key to return to normal operation.

Rezero: The monitor can be switched into Auto zero Mode manually by pressing the "2" key. On completion of the manually initiated Auto zero, the unit will return to normal operation.

```

** Auto Zero**
Timer 24 12:00

Press ENT for Menu

```

Manual Override: The monitor can be switched into Manual Override mode manually by pressing the "3" key. The unit will return to normal operation if the "ENT" (enter) key is pressed, or after

approximately 15 minutes, whichever comes first.

```
Manual Override 1
PPM 0 12:00
R-134A
Press ENT for Menu
```

Setup: The Setup Menus are accessed by pressing the "4" key. The operator will be asked to enter a password to continue into the Setup Menus. There are five passwords. Passwords 1 through 4 are user definable (default passwords are "111", "222", "333", "444"). The last password is permanently set at "999".

```
* SenTech Monitor *
ENTER PASSWORD
Followed By ENT
Code : 0
```

Setup Menu: If the correct password is entered, the unit will display the Setup Menu Screen. From the Setup Menu, the operator can access the refrigerant monitoring settings (Sample Setup), the gas code assigned to each refrigerant programmed in the monitor, system configurations settings and the contact screen.

```
1)...IR Setup
2)...N/A
3)...System Setup
4)...Contact ABORT
```

Sample Setup: Press the "1" key to enter Sample Setup. The sample setup screens allow the user to set the gas code for the refrigerant to be monitored, the distance of the tube used for the sample, and the Low, Main and high alarm thresholds. The first

sample setup screen will display 1 to enter parameters, or 2 to enable or disable sample areas.

```
Program Setpoints
For Each AREA
1 - Setup
2 - Enable ABORT
```

Press the "1" key to setup parameters for each area.

```
AREA 1 <- ->
R-134A 8
Distance 250
ENT or ABORT
```

Press the left or right arrow keys to change from one sample area to another. Press the "ENT" key to move the arrow cursor from line one to line two.

```
AREA 1
R-134A 8 <- ->
Distance 250
ENT or ABORT
```

Press the left or right arrow keys to change from one gas type to another. The gasses are organized in numerical order, with refrigerants first, and fire suppression agents or blowing agents following refrigerants. Once the appropriate gas is displayed, press the "ENT" key to move the cursor from line two to line three.

As of January 1, 2003 the standard IR-SNIF monitor is capable of detecting and responding to the following list of refrigerants.

R-11, R-12, R-13, R-22, R-113, R-114, R-123, R-134A, R-401A, R-401B, R-402B-HP81, R-404A-HP62,

R-407A-AC9000, R-408A, R-409A, R-410A-AZ20, R-500, R-502, R-503, R-507-AZ50

This list changes over time, so it is recommended that the operator review the Gas Code screens for a complete list of gasses a given monitor is capable of monitoring.

```

AREA      1
R-134A   8
Distance 250  -
          ENT or ABORT
  
```

Enter the tube length, in feet, if the tube length is greater than 100 feet. If the tube length is shorter than 100 feet, leave the setting at the factory default of 100. When the distance has been entered, press the "ENT" key to display the second sample setup screen.

```

Alarm Low      25  -
Alarm Main     50
Alarm High     500
              ENT or ABORT
  
```

Unless specified otherwise, SenTech Corporation recommends the following alarm settings for all refrigerants *except R-123*:

- Low = 25 ppm
- Main = 50 ppm
- High = 500 ppm

Unless specified otherwise, SenTech Corporation recommends the following alarm settings for R-123:

- Low = 25 ppm
- Main = 50 ppm
- High = 150 ppm

These settings are based on the current acceptable exposure levels and short-term

exposure levels on a time weighted average for refrigerants. SenTech recommends that under no circumstances should a refrigerant monitor be set above the short-term exposure level. These are recommended settings only. Refer to local codes and regulations for the appropriate settings for a given application.

System Setup: The System Setup menus are accessed from the Setup menu by pressing the "3" key. System setup consists of two screens that allow the user to change passwords, change system flags, test the alarm circuits and set the time and date. The user can toggle from one screen to the other by using the left and right arrow keys.

```

1)...Change Code
2)...System Flags
3)...Alarm Test
          ABORT  ->
  
```

```

4)...Date/Time
5)...Trending
<-          ABORT
  
```

Change Code

The operator can change passwords 1 through 4 by pressing the "1" key. The operator then enters the code number (1-4) and is able to enter the new password.

```

Select Code # To
View Or Change Code

Access Code # 1
  
```

```

Access Code # 1
Code 111

ENT-Exit
  
```

System Flags

Press the “2” to enter the System Flags screens. The system flag screen will display information for five settings, displayed on two screens. Press the ENT key to move the cursor from one line to the next, and press the left arrow key to move from one line to the previous.

Autozero Flag: The autozero flag can be used to limit the frequency of autozero cycles. It can be set between 0 and 100. If a 0 is entered, the monitor will enter an autozero cycle after every area is sampled (this is the normal default configuration). Increasing this number will allow the monitor to skip the autozero cycle if the raw measurement from the IR-Bench has not changed significantly. That is, if the raw signal varies by less than plus or minus 10 millivolts, and the autozero flag is set to 10, the monitor will not perform an autozero cycle. *NOTE: This is effectively reducing the extreme low-level sensitivity of the monitor.* If this feature is desired, set this flag by increasing it in small steps, 1 or 2 digits at a time, until the monitor stops autozeroing after every zone.

Password Flag: The password flag can be set to either 0 or 1. If a 1 is entered, the monitor will require the user to enter a password to perform any functions of the monitor. This feature is useful if the monitor is installed in a public area, and controlled access to the monitor is needed. This flag is set to 0 by default.

Horn Relay Flag: Press the “ENT” to move the cursor to the horn relay flag. The horn relay flag can be set to 0, 1, 2 or 3. This flag changes the function of the horn relay to control an audible alarm. With the flag set to the 0, the horn relay will be disabled. The monitor can be programmed to allow the horn relay to be de-energized

while the monitor is still in alarm. This feature is useful when the user is troubleshooting an alarm, and wants to work in silence. Set the horn relay flag to 1 to activate the horn relay when the monitor is in LOW alarm. Set the horn relay flag to 2 to activate the horn relay when the monitor is in MAIN alarm. Set the horn relay flag to 3 to activate the horn relay when the monitor is in HIGH alarm. This flag is set to 2 by default.

Unit Number Flag: The unit number flag is used to identify the monitor on a RS-485 network, if that option has been purchased. This flag is set to 1 by default.

```
AUTOZERO FLAG 0 -  
PASSWORD FLAG 0  
HORN RELAY FLAG 0  
UNIT NUMBER FLAG 1
```

Press the “ENT” key to move the cursor to the next entry. When all entries have been viewed, press the “ENT” key again to display the second system flag screen

```
SLOPE FLAG 50 -  
TWA ALARM 0  
FULL SCALE 1000  
TWA REFRESH 5
```

Slope Flag: The slope flag is used for circumstances where an individual zone might be exposed to large levels of refrigerant. This flag will hold the monitor in its current mode, whether it be autosample or autozero, if the raw measurement has not leveled off to a constant measurement. *For instance, after an extremely large level of refrigerant has been measured, the monitor might run in autozero longer than expected if the measured level is still falling.* Set this flag to the factory default of 50 if no

large levels are expected. Set this flag lower if large levels are expected.

TWA Alarm Flag: Press the “ENT” key to move the cursor to the TWA ALARM flag. This flag is reserved for future implementation of TWA measurement. This flag should be left at the factory default of 0.

Full Scale Flag: Press the “ENT” key to move the cursor to the FULL SCALE flag. This flag is used to adjust the full scale measurement for the analog output. The factory default is 1000, meaning that the 0-10 volt analog output corresponds to 0-1000 ppm. This flag should be left at the factory default unless a custom measurement range has been implemented in the monitor. Consult factory technical support for further information if needed.

TWA Refresh Flag: Press the “ENT” key to move the cursor to the TWA refresh flag. This flag is used to save peak ppm measurements if Trending is not implemented. A TWA refresh rate of 5 corresponds to a theoretical ten-hour time weighted average. As with the TWA ALARM flag, this feature is not yet implemented.

Press the “ENT” key to move the cursor to the next entry. When all entries have been viewed, press the “ENT” key again to display the third system flag screen.

LOW DELAY	0	-
MAIN DELAY	0	
HIGH DELAY	0	
LATCH FLAG	0	

Delay Flags: The DELAY FLAGS are used to implement an additional time delay, in

minutes before energizing the respective alarm relays. This time delay is similar to the LEAK WAIT, except that the user is able to create a time definite delay, rather than the ppm level defined LEAK WAIT delay. The factory default setting is 0 for each delay.

Latch Flag: Press the “ENT” key to move the cursor to the next entry. Once the DELAY entries have been viewed, press the “ENT” key to move the cursor to the LATCH FLAG. The LATCH FLAG is used to determine if the LOW and MAIN alarms are self-resetting or are latched. If the LATCH FLAG is set to 0, the alarms will function as a conventional latching alarm. If the LATCH Flag is set to 1, the LOW and MAIN alarms will function as self-resetting alarms. The HIGH alarm will always be a latching alarm.

NOTE: The ASHRAE-15 standard specifies that an alarm relay must be latched, but that if more than one alarm level is provided, the additional alarms may be self-resetting. Care must be used when implementing this feature, as the alarm level that corresponds to the ASHRAE-15 required alarm MUST be a latching alarm. If there are any questions regarding the correct implementation of this feature, call SenTech technical support.

Press the “ENT” key to move the cursor to the next entry. When all entries have been viewed, press the “ENT” key again to return to the previous menu. The monitor should again display the system setup menu.

Alarm Test: The Alarm Test screen is used to enable the installer to verify that the monitor is correctly integrated into the building systems.

Alarm Test
 1)...Low 2)...Main
 3)...HIGH 4)...All
 Press Key To Test

Key selections 1, 2, and 3 are used to energize the Low, Main and High alarm relays respectively. Key selection 4 will initiate a cycle that turns on the low relay, then the main relay, then the high relay, until all three relays are energized. If any relay has been energized, the fourth line of the display will change to instruct the user to press the "RESET" key to de-energize the relays.

Alarm Test
 1)...Low 2)...Main
 3)...HIGH 4)...All
 RESET To Clear

With the alarm relays energized, confirm that the monitor is correctly integrated into the building systems. Once this test has been completed, press the "ABORT" key. The monitor will restore any alarms that existed prior to entering this test mode, and will return to the system setup screen. Press the "ABORT" key again to return to normal operation.

Date/Time: The Date/Time menu is accessed by pressing the "4" key. The program time/date screens allows the user to set the day of the week, hour, minute, month, day, and year for the real time clock (RTC) in the controller. Entering information, or pressing the "ENT" key will move the cursor down to the next entry.

Program Time/Date
 Day (Sunday = 0): 3
 Enter Hr (0-23): 12
 Enter Minute: 35

Note that the RTC operates on a 24-hour clock. For example to enter 2 PM, enter the hour as 14, rather than 2.

Program Time/Date
 Month (1-12): 10
 Day (0-31): 27
 Year (00-99): 04

When the date and time have been entered, press the "ENT" key to return to the system setup screen.

Trending: The Trending screens enable the end user to track measured levels over time. This feature will be helpful in isolating low level, intermittent alarms. Trending currently saves the peak ppm level measured in each zone periodically at a user defined rate and time. The trending screens allow the user to select save rates of once per hour, once per day, once per week and once per month.

Program Trend Data
 Trend Rate:
 (< ->) Hourly
 ENT or ABORT

Press the Left and Right arrow keys to display the desired trend rate. Press the ENT key to select the desired trend rate. The monitor will automatically request the appropriate time and date information. When complete, press the ABORT key to return to normal operation.

For Monthly trend rate, the monitor will request:

Day of month (1-31)
 Hour (0-23)
 Minute (0-59)

For Weekly trend rate, the monitor will request:

Day of week (0-6)

Hour (0-23)

Minute (0-59)

For Daily trend rate, the monitor will request:

Hour (0-23)

Minute (0-59)

For Hourly trend rate, the monitor will request:

Minute (0-59)

APPENDIX B: SenTech Room Volume Considerations **(English)**

Normal industry practice has been to think about refrigerant leaks in terms of pounds of refrigerant per unit time, such as lbs/hr or oz/yr. This is a natural and logical way of looking at it. The system monitors the amount of refrigerant present in the air in parts per million (ppm) by volume or refrigerant molecules as compared to air molecules. In order to develop a correlation between the leak rate in weight per unit time and parts per million, there are a number of items that need to be considered. These are:

1. Room volume.
2. The weight of refrigerant per unit volume at ambient temperature and pressure.
3. The amount of time the refrigerant has been leaking.
4. The rate at which fresh air enters the room and existing air is exhausted.
5. The location of the inlet, relative to the leak, airflow in the room and the rate at which the refrigerant expands to fill the room.

For a specific application, items 1 through 4 can be calculated, or estimated. Item 5 is virtually unpredictable, therefore in all calculations; it is assumed that the leaking refrigerant will expand to fill the room with an even distribution of refrigerant. This assumption will yield safer, conservative calculations. If the monitor sample and reference locations have been appropriately chosen, the monitor will see a higher

concentration than calculated from the ideal formulas.

Formula Definitions:

ppm – refrigerant concentration
LR – leak rate in cubic feet/hour
FA – fresh air into the room in cubic feet/hour
VOL – room volume in cubic feet
t – time in hours
R – volume of refrigerant in cubic feet
LRmin – minimum leak rate that will result in a given ppm
RD – refrigerant density in lbs/cubic foot

To be able to convert between ppm and leak rate in cubic feet/hour, the refrigerant density must be calculated. If the molecular weight of the refrigerant is known, the refrigerant density can be calculated.

$$\frac{[\text{MolWt(gms)/1(mole)}]}{[28.32(\text{l})/1(\text{cuft})]} \times \frac{[1(\text{mole})/22.4(\text{l})]}{[273(\text{K})/293(\text{K})]} \times \frac{[1(\text{lb})/454(\text{g})]}{1} = \text{RD}(\text{lb/cuft})$$

Calculating for R-22, 86.48(g/mole), RD22 = .22 lb/cuft and
1/RD22 = 4.46 cuft/lb

Other densities are as follows:

R-22	RD22 = .22 lb/cuft
R-12	RD12 = .31 lb/cuft
R-11	RD11 = .36 lb/cuft
R-502	RD502 = .29 lb/cuft
R-123	RD123 = .41 lb/cuft

Two examples have been developed to demonstrate the conversion. **Case I** is for a sealed room, with no air turnover. **Case II** is for a room with a known air turnover.

Case I: Sealed room 40 ft x 30 ft x 10 ft high

1. *How much R-22 (in lbs) is necessary to cause a measurement of 25 ppm?*

Given 25 ppm R-22 in the sealed room:

$$\text{Volume of R-22} = \frac{\text{parts per million}}{\text{million}} \times \text{room volume}$$

$$R(\text{cuft}) = \frac{[25(\text{ppm})/1,000,000] \times [40 \times 30 \times 10](\text{cuft})}{1}$$

$$R(\text{cuft}) = .3 \text{ cuft of R-22 in the sealed room}$$

Given .3 cuft R-22, calculate weight in lbs:

$$\text{Weight} = \text{volume}(\text{cuft}) \times \text{density}(\text{lb}/\text{cuft})$$

$$\text{Weight} = R(\text{cuft}) \times \text{RD22}(\text{lb}/\text{cuft})$$

$$\text{Weight} = .3(\text{cuft}) \times .22(\text{lb}/\text{cuft})$$

Weight = .066 lbs

2. *If the leak rate is 300 lb/yr, how long will it take to reach 25 ppm?*

Given the same refrigerant in the same room, 25 ppm weighs .066 lbs:

$$\text{Time}(\text{hr}) = \frac{\text{weight of R-22}(\text{lb})}{[\text{weight}(\text{lb})/\text{time}(\text{yr})]} \times [\text{time}(\text{hr})/\text{time}(\text{yr})]$$

$$\text{Time}(\text{hr}) = .066(\text{lb}) / [300(\text{lb})/1(\text{yr})] \times [8760(\text{hr})/1(\text{yr})]$$

Time(hr) = 1.93 hrs

Case II: 40 ft x 30 ft x 10 ft high room with fresh air makeup of 100 cfm

1. *How much R-22 (in lbs/yr) is necessary to cause a measurement of 25 ppm?*

Given air turnover of 100cfm, calculate the fresh air volume in cuft/hr:

$$\text{Air flow (cuft/hr)} = \text{air flow (cfm)} \times [60(\text{min})/1(\text{hr})]$$

$$\text{Air flow}(\text{cuft/hr}) = 100\text{cfm} \times 60 \text{ min/hr} = 6000 \text{ cuft/hr}$$

Given 6000 cuft/hr, calculate the leak rate that is required to *maintain* a measurement of 25 ppm:

$$\text{Leak rate min (cuft/hr)} = \frac{\text{parts per million}}{\text{million}} \times \text{fresh volume}(\text{cuft/hr})$$

$$\text{Leak rate min (cuft/hr)} = \frac{[25(\text{ppm})/1,000,000] \times 6000(\text{cuft/hr})}{1}$$

$$\text{Leak rate min}(\text{cuft/hr}) = .15 \text{ cuft/hr}$$

Given .15 cuft/hr, calculate the leak rate in lb/yr needed to *reach* 25 ppm:

$$\text{Leak rate}(\text{lb/yr}) = \text{leak rate}(\text{cuft/hr}) \times \text{density}(\text{lb}/\text{cuft}) \times [8760(\text{hr})/1(\text{yr})]$$

$$\text{Leak rate}(\text{lb/yr}) = .15(\text{cuft/hr}) \times .22(\text{lb}/\text{cuft}) \times 8760(\text{hr/yr})$$

Leak rate(lb/yr) = 289 lb/yr, therefore the leak rate must be **GREATER THAN 289 lb/yr.**

2. *If the leak rate is 500 lb/yr, how long will it take to reach 25 ppm?*

Calculate LR in cuft/hr:

$$\text{LR}(\text{cuft/hr}) = \frac{[\text{leak rate}(\text{lb/yr}) / \text{density}(\text{lb}/\text{cuft})]}{8760(\text{hr/yr})}$$

$$\text{LR}(\text{cuft/yr}) = 500(\text{lb/yr}) / .22(\text{lb}/\text{cuft}) / 8760(\text{hr/yr})$$

$$\text{LR}(\text{cuft/yr}) = .26 \text{ cuft/hr}$$

Calculate time in hr:

$$\text{Time}(\text{hr}) = \frac{[\text{Room volume}(\text{cuft})/\text{Air flow}(\text{cuft/hr})] \times \ln[\text{LR}(\text{cuft/hr}) / [\text{LR}(\text{cuft/hr}) - \text{Leak rate min}(\text{cuft/hr})]]}{1}$$

$$\text{Time}(\text{hr}) = [12000(\text{cuft})/6000(\text{cuft/hr})] \times \ln[.26(\text{cuft/hr})/ [.26(\text{cuft/hr}) - .15(\text{cuft/hr})]$$

$$\text{Time}(\text{hr}) = 2(\text{hr}) \times \ln[2.3636] \quad \text{Time}(\text{hr}) = 1.72 \text{ hr}$$

SenTech Room Volume Considerations (Metric)

Normal industry practice has been to think about refrigerant leaks in terms of pounds of refrigerant per unit time, such as lbs/hr or oz/yr. This is a natural and logical way of looking at it. The system monitors the amount of refrigerant present in the air in parts per million (ppm) by volume or refrigerant molecules as compared to air molecules. In order to develop a correlation between the leak rate in weight per unit time and parts per million, there are a number of items that need to be considered. These are:

1. Room volume.
2. The weight of refrigerant per unit volume at ambient temperature and pressure.
3. The amount of time the refrigerant has been leaking.
4. The rate at which fresh air enters the room and existing air is exhausted.
5. The location of the inlet, relative to the leak, airflow in the room and the rate at which the refrigerant expands to fill the room.

For a specific application, items 1 through 4 can be calculated, or estimated. Item 5 is virtually unpredictable, therefore in all calculations, it is assumed that the leaking refrigerant will expand to fill the room with an even distribution of refrigerant. This assumption will yield safer, conservative calculations. If the monitor sample and reference locations have been appropriately chosen, the monitor will see a higher

concentration than calculated from the ideal formulas.

Formula Definitions:

ppm – refrigerant concentration
LR – leak rate in cubic meter/hour
FA – fresh air into the room in cubic meter/hour
VOL – room volume in cubic meter
t – time in hours
R – volume of refrigerant in cubic meter
LRmin – minimum leak rate that will result in a given ppm
RD – refrigerant density in kg/cubic meter

To be able to convert between ppm and leak rate in cubic meter/hour, the refrigerant density must be calculated. If the molecular weight of the refrigerant is known, the refrigerant density can be calculated.

$$\frac{[\text{MolWt(gms)/1(mole)}]}{[273(\text{K})/293(\text{K})]} \times \frac{[1(\text{mole})/22.4(\text{l})]}{[1(\text{kg})/1000(\text{g})]} \times [1(\text{kg})/1000(\text{g})] = \text{RD(kg/cubic meter)}$$

Calculating for R-22, 86.48(g/mole), RD22 = 3.59 kg/cubic meter and
1/RD22 = .28 cubic meter/kg

Other densities are as follows:

R-22 RD22 = 3.59 kg/cubic meter
R-12 RD12 = 4.96 kg/cubic meter
R-11 RD11 = 5.76 kg/cubic meter
R-502 RD502 = 4.64 kg/cubic meter
R-123 RD123 = 6.56 kg/cubic meter

Two examples have been developed to demonstrate the conversion. **Case I** is for a sealed room, with no air turnover. **Case II** is for a room with a known air turnover.

Case I: Sealed room 15 m x 10 m x 3 m high

1. How much R-22 (in kg) is necessary to cause a measurement of 25 ppm?

Given 25 ppm R-22 in the sealed room:

$$\text{Volume of R-22} = \frac{\text{parts per million}}{\text{million}} \times \text{room volume}$$

$$R(\text{cubic meter}) = \frac{25(\text{ppm})}{1,000,000} \times [15 \times 10 \times 3](\text{cubic meter})$$

$$R(\text{cuft}) = .01125 \text{ cubic meter of R-22 in the sealed room}$$

Given .01125 cubic meter R-22, calculate weight in kg:

$$\text{Weight} = \text{volume}(\text{cubic meter}) \times \text{density}(\text{kg}/\text{cubic meter})$$

$$\text{Weight} = R(\text{cubic meter}) \times \text{RD22}(\text{kg}/\text{cubic meter})$$

$$\text{Weight} = .01125(\text{cubic meter}) \times 3.59(\text{kg}/\text{cubic meter})$$

$$\text{Weight} = .040 \text{ kg}$$

2. If the leak rate is 150 kg/yr, how long will it take to reach 25 ppm?

Given the same refrigerant in the same room, 25 ppm weighs .040 kg:

$$\text{Time}(\text{hr}) = \frac{\text{weight of R-22}(\text{kg})}{[\text{weight}(\text{kg})/\text{time}(\text{yr})]} \times \frac{\text{time}(\text{hr})}{\text{time}(\text{yr})}$$

$$\text{Time}(\text{hr}) = .040(\text{kg}) / [150(\text{kg})/1(\text{yr})] \times [8760(\text{hr})/1(\text{yr})]$$

$$\text{Time}(\text{hr}) = 2.34 \text{ hrs}$$

Case II: 10 m x 15 m x 3 m high room with fresh air makeup of 225 cubic meter/hr

1. How much R-22 (in kg/yr) is necessary to cause a measurement of 25 ppm?

Given air turnover of 225 cubic meter/hr, calculate the leak rate that is required to *maintain* a measurement of 25 ppm:

$$\text{Leak rate min}(\text{cubic meter}/\text{hr}) = \frac{\text{parts per million}}{\text{million}} \times \text{fresh volume}(\text{cubic meter}/\text{hr})$$

$$\text{Leak rate min}(\text{cubic meter}/\text{hr}) = \frac{25(\text{ppm})}{1,000,000} \times 225(\text{cubic meter}/\text{hr})$$

$$\text{Leak rate min}(\text{cubic meter}/\text{hr}) = .005625 \text{ cubic meter}/\text{hr}$$

Given .005625 cubic meter/hr, calculate the leak rate in kg/yr needed to *reach* 25 ppm:

$$\text{Leak rate}(\text{kg}/\text{yr}) = \text{leak rate}(\text{cubic meter}/\text{hr}) \times \text{density}(\text{kg}/\text{cubic meter}) \times [8760(\text{hr}) / 1(\text{yr})]$$

$$\text{Leak rate}(\text{kg}/\text{yr}) = .005625(\text{cubic meter}/\text{hr}) \times 3.59(\text{kg}/\text{cubic meter}) \times 8760(\text{hr}/\text{yr})$$

$$\text{Leak rate}(\text{kg}/\text{yr}) = 176.9 \text{ kg}/\text{yr}, \text{ therefore the leak rate must be } \mathbf{GREATER \text{ THAN } 177 \text{ kg}/\text{yr}}.$$

2. If the leak rate is 300 kg/yr, how long will it take to reach 25 ppm?

Calculate LR in cubic meter/hr:

$$\text{LR}(\text{cubic meter}/\text{hr}) = \frac{\text{leak rate}(\text{kg}/\text{yr})}{\text{density}(\text{kg}/\text{cubic meter})} / 8760(\text{hr}/\text{yr})$$

$$\text{LR}(\text{cubic meter}/\text{yr}) = 300(\text{kg}/\text{yr}) / 3.59(\text{kg}/\text{cubic meter}) / 8760(\text{hr}/\text{yr})$$

$$\text{LR}(\text{cubic meter}/\text{yr}) = .009539 \text{ cubic meter}/\text{hr}$$

Calculate time in hr:

$$\text{Time}(\text{hr}) = \frac{\text{Room volume}(\text{cubic meter})}{\text{Air flow}(\text{cubic meter}/\text{hr})} \times \ln \left[\frac{\text{LR}(\text{cubic meter}/\text{hr})}{[\text{LR}(\text{cubic meter}/\text{hr}) - \text{Leak rate min}(\text{cubic meter}/\text{hr})]} \right]$$

$$\text{Time}(\text{hr}) = \frac{450(\text{cubic meter})}{225(\text{cubic meter}/\text{hr})} \times \ln \left[\frac{.009539(\text{cubic meter}/\text{hr})}{[.009539(\text{cubic meter}/\text{hr}) - .005625(\text{cubic meter}/\text{hr})]} \right]$$

$$\text{Time}(\text{hr}) = 2(\text{hr}) \times \ln[2.437] \quad \mathbf{Time}(\text{hr}) = 1.78 \text{ hr}$$

APPENDIX C: Parts List and Wire List

Parts List: Refer to figure 6 for approximate location of the following parts:

- | | |
|---|--|
| <ol style="list-style-type: none"> 1. 421009, Door, IR-SNIF-MCD 2. 421014, Box, IR-SNIF-MCD 3. 421016, Backplate, IR-SNIF-MCD 4. 410144, Tube End Filter, (not shown) 5. 410357, Fitting, 1/8 Hose Barb, (not shown) 6. 420040, Manifold, Single Zone
420041, Manifold, Four Zone
420042, Manifold, Eight Zone 7. 420224, Diaphragm Pump 110 vac 8. 410043, Filter Assembly 9. 410162, 5 Micron Filter (inside filter assembly) 10. 420038, Pressure Switch 11. 410136-Gray, Orifice .016 (not shown) 12. 430010, IR Bench, IR-SNIF-MCD | <ol style="list-style-type: none"> 13. 422031, Processor, Control 14. 421036, Display (not shown) 15. 421031, Keypad, IR-SNIF-MCD and IR-SNIF-1,2,3 (not shown) 16. 410040, Socket, Relay 17. 410087, Relay, 24VDC 18. 421072, Terminal Board, 8 Position 19. 421042, Valve Driver Board 20. 410033, Fuse Holder (not shown) 21. 410034, Fuse, 3A (not shown) 22. 422036, Power Supply |
|---|--|

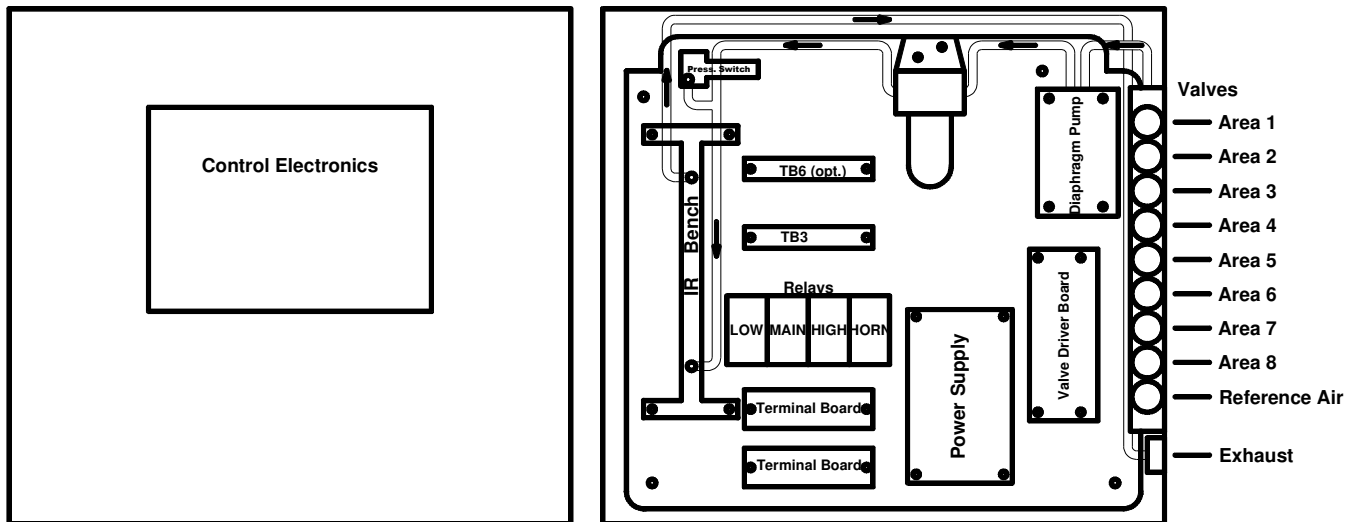


Figure 6. Parts Diagram

Wire List: The following list defines every wire in the monitor. Abbreviations are defined as follows:

- P1 = Power Supply
- F1 = Fuse Holder
- TB1, TB2, TB3, TB4 = Terminal Board
- K1, K2, K3, K4 = Relays
- A1 = Control Board
- A2 = IR Bench
- A3 = Valve Driver Board
- A4 = Keypad
- A1-JPx = Connector on Control Board A1

Wire #	From	To	Type	Description
1	TB1-1	GND	18 AWG ,Green/Yellow	Earth Ground
2	TB1-1	PS1-GND	18 AWG ,Green/Yellow	Earth Ground
3	TB1-1	Pump GND	18 AWG ,Green/Yellow	Earth Ground
4	GND	Door GND	18 AWG ,Green/Yellow	Earth Ground
5	TB1-2	F1-1	22 AWG ,Black	AC Line In
6	F1-2	TB1-4	22 AWG ,Black	Fused AC Line
7	TB1-4	PS1-P1-L	22 AWG ,Black	Fused AC Line
8	TB1-4	Pump Line In	22 AWG ,Black	Fused AC Line
9	TB1-3	PS1-P1-N	22 AWG ,White	AC Neutral
10	TB1-3	Pump Neutral	22 AWG ,White	AC Neutral
11	PS1-P2-1	A1-P9-1	24 AWG, Red	24 VDC
12	PS1-P2-3	A2-SRC-P1-2	24 AWG, Blue	5 VDC
13	PS1-P2-4	A1-P9-3	24 AWG, Black	DC Gnd
14	PS1-P2-5	A2-SRC-P1-1	24 AWG, Black	DC Gnd
15	A3-J2	A1-PJ1	CAT 3 (6Cond.)	Control Cable
16	A3-J3-1	A1-P9-4	24 AWG, Red	24 VDC
17	A3-J3-2	A1-P9-2	24 AWG, Black	DC Gnd
18	A3-J3-3	A1-P5-3	24 AWG, Red	24 VDC
19	A3-J3-4	A1-P5-4	24 AWG, White	Switched Gnd, Autozero Valve
20	A3-J4-1	Area 1 Gnd In	18 AWG, Black	Part of Valve Assembly
21	A3-J4-2	Area 1 Power In	18 AWG, Black	Part of Valve Assembly
22	A3-J4-3	Area 2 Gnd In	18 AWG, Black	Part of Valve Assembly
23	A3-J4-4	Area 2 Power In	18 AWG, Black	Part of Valve Assembly
24	A3-J4-5	Area 3 Gnd In	18 AWG, Black	Part of Valve Assembly
25	A3-J4-6	Area 3 Power In	18 AWG, Black	Part of Valve Assembly
26	A3-J4-7	Area 4 Gnd In	18 AWG, Black	Part of Valve Assembly
27	A3-J4-8	Area 4 Power In	18 AWG, Black	Part of Valve Assembly
28	A3-J4-9	Area 5 Gnd In	18 AWG, Black	Part of Valve Assembly
29	A3-J4-10	Area 5 Power In	18 AWG, Black	Part of Valve Assembly
30	A3-J4-11	Area 6 Gnd In	18 AWG, Black	Part of Valve Assembly
31	A3-J4-12	Area 6 Power In	18 AWG, Black	Part of Valve Assembly
32	A3-J4-13	Area 7 Gnd In	18 AWG, Black	Part of Valve Assembly
33	A3-J4-14	Area 7 Power In	18 AWG, Black	Part of Valve Assembly

34	A3-J4-15	Area 8 Gnd In	18 AWG, Black	Part of Valve Assembly
35	A3-J4-16	Area 8 Power In	18 AWG, Black	Part of Valve Assembly
36	A3-J4-17	Ref Air Gnd In	18 AWG, Black	Part of Valve Assembly
37	A3-J4-18	Ref Air Power In	18 AWG, Black	Part of Valve Assembly
38	K1-14	A1-P4-1	24 AWG, White	Low Relay Control
39	K1-13	A1-P4-2	24 AWG, Red	Low Relay Power
40	K2-14	A1-P4-3	24 AWG, White	Main Relay Control
41	K2-13	A1-P4-4	24 AWG, Red	Main Relay Power
42	K3-14	A1-P4-5	24 AWG, White	High Relay Control
43	K3-13	A1-P4-6	24 AWG, Red	High Relay Power
44	K4-14	A1-P4-7	24 AWG, White	Horn Relay Control
45	K4-14	A1-P4-8	24 AWG, Red	Horn Relay Power
46	K1-5	TB2-1	22 AWG, Black	Customer Power to Low Relay
47	K1-9	TB2-2	22 AWG, White	Switched Power from Low Relay
48	K2-5	TB2-3	22 AWG, Black	Customer Power to Main Relay
49	K2-9	TB2-4	22 AWG, White	Switched Power from Main Relay
50	K3-5	TB2-5	22 AWG, Black	Customer Power to High Relay
51	K3-9	TB2-6	22 AWG, White	Switched Power from High Relay
52	K4-5	TB2-7	22 AWG, Black	Customer Power to Horn Relay
53	K4-9	TB2-8	22 AWG, White	Switched Power from Horn Relay
54	TB3-1	A1-P8-1	24 AWG, White	Analog 1 Out
55	TB3-2	A1-P8-3	24 AWG, White	Analog 2 Out
56	TB3-3	A1-P8-2	24 AWG, Black	Ref Gnd
57	TB3-4	A1-P3-2	24 AWG, White	External Reset In
58	TB3-5	A1-P8-4	24 AWG, Black	Ref Gnd
59	TB3-6	A1-P6-1	24 AWG, Blue	RS485 tx
60	TB3-7	A1-P6-1	24 AWG, Black	Ref Gnd (Shield Gnd)
61	TB3-8	A1-P6-1	24 AWG, White	RS485 rx
62	TB4-2	A1-P5-2	24 AWG, Red	24 VDC Loop Power (optional)
63	TB4-3	A1-P3-4	24 AWG, White	Channel 2 Analog Input (optional)
64	TB4-4	A1-P3-5	24 AWG, White	Channel 3 Analog Input (optional)
65	TB4-5	A1-P3-6	24 AWG, White	Channel 4 Analog Input (optional)
66	TB4-6	A1-P3-7	24 AWG, White	Channel 5 Analog Input (optional)
67	TB4-7	A1-P3-8	24 AWG, Black	Ref Gnd
68	A1-P7-1	A2-DET-P1-1	24 AWG, Red	Detector Power
69	A1-P7-2	A2-DET-P1-2	24 AWG, White	Detector Signal
70	A1-P7-4	A2-DET-P1-3	24 AWG, Black	Ref Gnd
71	A1-P7-3	SW1-COM	24 AWG, White	Switched Gnd (Flow)
72	A1-P7-4	SW1-NC	24 AWG, Black	Ref Gnd
73	A4-J2	A5-J2	Ribbon	Part of Keypad Assembly
74	A3-J2	A5-J1	Ribbon	Part of Keypad Assembly

TROUBLESHOOTING GUIDE

This guide is written for a technician familiar with the operation and programming described previously in this manual. All procedures in this can be performed with simple hand tools and a volt-ohm meter. If at any time, additional assistance is required, call SenTech Corporation at 888-248-1988 for technical support.

1. No Power

- a) Check the fuse and replace if failed.
- b) Check incoming AC Power at TB1-2 and TB1-3.

2. No Display

- a) Verify AC Power.
- b) Check for red lights on the control board. The power light in the upper left corner of the control board should be lit. Shortly after initial power up, the red light labeled "RYL6" should light (closest to the hinges). This signifies that the reference air valve has been energized. During normal operation, this light will be off when in Auto Sample mode, and on when in Auto Zero mode. If any alarms exist, one two or three lights will light corresponding to "RLY1", "RLY2" and "RLY3" (Low alarm, Main alarm and High alarm respectively).

If no power lights are lit, there is a DC power fault.

If the power lights are lit, but the "RLY6" does not light, or the controller is not periodically lighting the "RLY6" light, the control board has a fault.

3. DC Power Fault

- a) If there is AC power to the monitor, but there are no lights lit on the control board, check the control board DC voltage:

Identify the power resistor R53 in the lower left corner of the board. Measure the DC voltage between the right side of the resistor and chassis ground on the lower left corner of the board. The DC voltage should be between 20.4 and 24.0 vdc.

Identify the 12 volt voltage regulator VR2 in the lower left corner of the board. Measure the DC voltage between the *LEFT PIN* of the voltage regulator and chassis ground on the lower left corner of the board. The DC voltage should be between 11.8 vdc and 12.2 vdc.

If either dc voltage measurement is out of spec, there is a

power fault in the control board, or a wiring short causing a power fault in the control board. Turn off the monitor and remove one connector at a time from the control board. Apply power between each step. If the dc voltages remain out of spec, the control board has failed.

4. Pneumatics Failure

a) Check that the diaphragm pump is operating and replace if it has failed.

b) Check that the tubing inside the monitor has not come loose from any fitting, or become kinked at any point.

c) Check that the orifice or tube end filter have not become clogged or restricted.

d) Check that the tubes connected to the sample air inlet and fresh air inlet have not become clogged or restricted.

e) Check that the solenoid valves are switching. Verify that the light labeled "RLY6" is switching on and off. Verify that the red LED's on turning on an off, according to which area is being sampled. Verify that the voltages on Valve Driver Board, J4 are changing from approximately 24 vdc to approximately 0 vdc, according to which area is being sampled. Temporarily block the air inlet and listen for the diaphragm pump to draw a vacuum. If the pump does not change tone, and is known to work, the valve is not switching.

5. Failure to Detect a Leak or Suspected Low Sensitivity

a) Alarm lights are on, but external alarm devices are not actuated. Repeat the "Integration with External Devices" from the Final test portion of this manual.

b) Alarm light is not on, but a leak is suspected. Verify that the alarm settings are not set too high.

Refer to "Startup and Programming" section of this manual for instructions.

c) Repeat the complete procedures described in the "Final Tests" section of this manual.

d) Verify that the sample air and fresh air pick up point locations are appropriate in accordance with the "Installation" section of this manual.

6. System Alarms when no Leak is Found

e) If the monitor does not respond to refrigerant, contact SenTech Corporation technical support.

a) Verify that the alarm is not a "Trouble Alarm" as described in Appendix A.

b) Verify that the alarm settings are not set too low. Refer to "Startup and Programming" section of this manual for instructions.

c) Inspect the area for the presence of halogenated organic chemicals. Some degreasers and cleaning agents are made of organic chemicals containing chlorine, fluorine or bromine. Such chemicals might cause an alarm.

d) Inspect the area for oil leaks. Oil can contain trace amounts of refrigerant, and will likely cause a transient alarm.

e) Verify that there truly is no refrigerant leak in the area. This includes all machines and stored refrigerants.

If none of the above resolves the problem, the unit has likely failed. Contact SenTech Corporation technical support for assistance.



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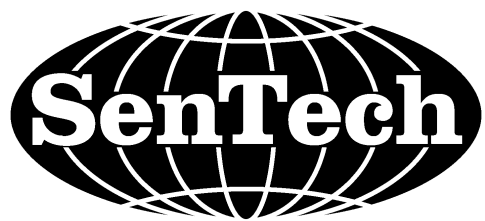
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