



**INSTALLATION AND OPERATION MANUAL  
ENVIRONMENTAL SYSTEM IR-SNIF  
SINGLE ZONE MONITOR  
MODEL IR-SNIF-1,2,3**



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## **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.

## Model IR-SNIF-1,2,3 Specifications

<b>Size:</b>	10" x 12.5" x 4.75" (25.4cm x 31.2cm x 12cm)
<b>Weight:</b>	16 lbs. (7.2 kg)
<b>Power:</b>	120 or 240 Volt 50/60hz (41 Watts) (voltage must be specified at time of order)
<b>Temperature:</b>	32 deg F – 125 deg F (0 deg C – 50 deg C)
<b>Humidity:</b>	0 – 95 % non-condensing
<b>Atmospheric Pressure:</b>	75-106 Kpa Equipment rated for indoor use only
<b>Range:</b>	10 – 1000 ppm Standard
<b>Tube Length:</b>	0 – 250 ft (0 – 76 m)
<b>Trip Point:</b>	Low Alarm 0 – 1000 ppm Main Alarm 0 – 1000 ppm High Alarm 0 – 1000 ppm
<b>Leak Wait:</b>	Varies from seven (7) seconds to three (3) minutes depending on refrigerant concentration
<b>Alarm Output:</b>	Low, Main and High alarm relays, each with four (4) form C contacts rated 5 amps maximum
<b>Analog Output:</b>	0 – 10 volt proportional to 0 – 1000 ppm
<b>Computer Interface:</b>	RS-232 (optional)

## INTRODUCTION and OVERVIEW

The SenTech Environmental System IR-SNIF-1,2,3 single zone 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.

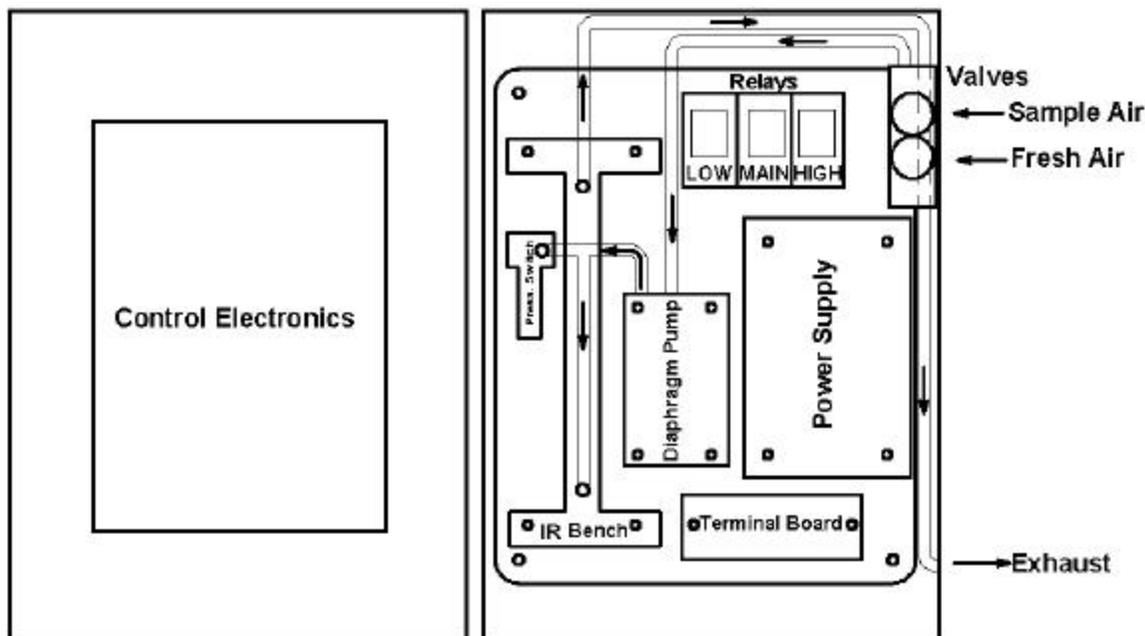


Figure 1 Overall Block Diagram

**Pneumatics:** Refer to the figure 2 for pneumatics block diagram. Tubing from the area 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 electronics alternates between energizing the Sample air and the Auto zero air solenoids. The diaphragm pump draws air from the selected inlet and feeds the air 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.

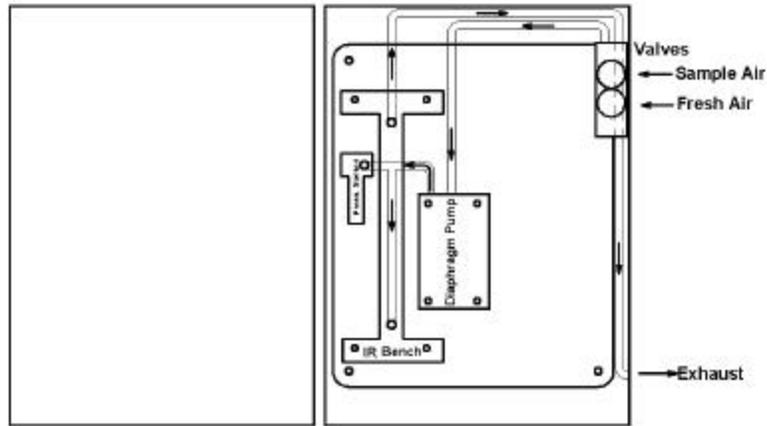


Figure 2 Pneumatics Diagram

**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.

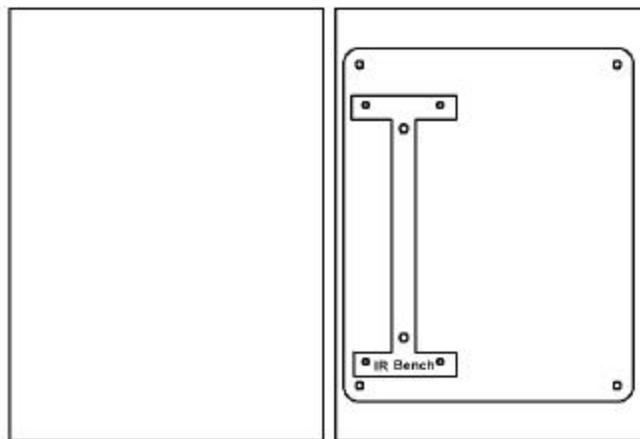


Figure 3 Infrared Bench

**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.

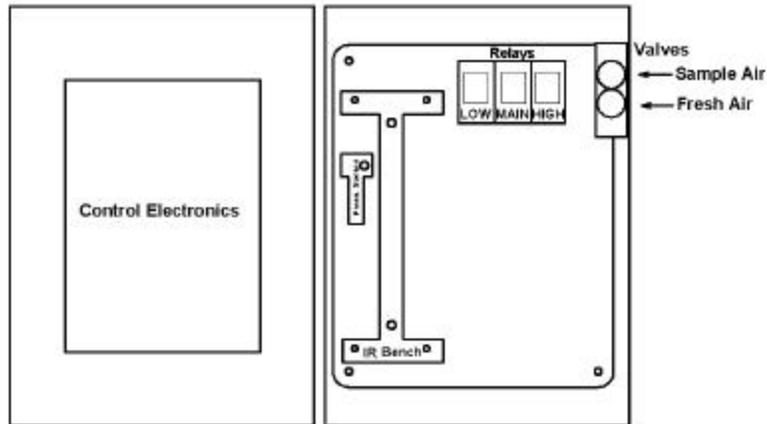


Figure 4 Control Electronics Diagram

**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.

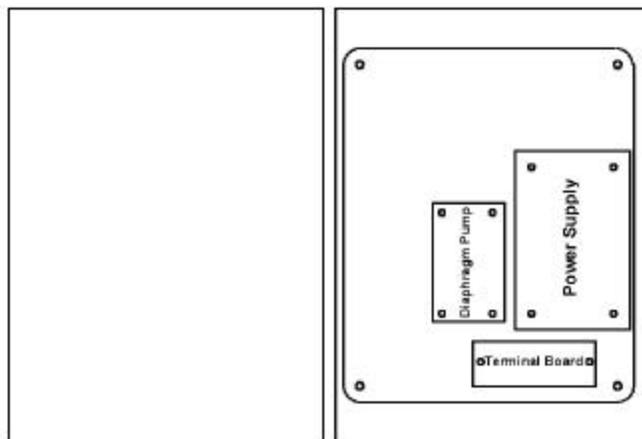


Figure 5 Power Supply Diagram

### **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 -1,2,3 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.

## INSTALLATION

### **Unpack and Inspect Material**

**IR-SNIF-1,2,3 Package:** The IR-SNIF-1,2,3 package contains the following material:

1. IR-SNIF-1,2,3 Single Zone Monitor
2. Installation and Operation Manual
3. Hose barb fittings and 10 micron tube end filters (one hose barb and filter for each inlet – two of each are provided)
4. CTS/Warranty form to be completed and returned to Sentech

**Optional Purchases:** The IR-SNIF-1,2,3 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-1,2,3 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. If the fresh air reference is routed outdoors, the following criteria should be used:

1. 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.
2. The tube end filter must be located such that it can be inspected as part of the recommended quarterly preventive maintenance.
3. 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.

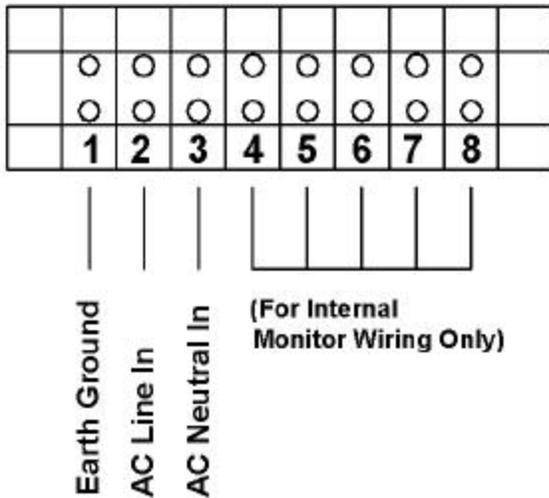
**Alarm Location(s):** A combination horn/strobe alarm is recommended for a mechanical room. The alarm should be located inside the room such that it can be seen and heard from any area of the room. Additionally, a strobe alarm can be installed at each entrance to the room to alert the user of an alarm prior to entry to the room itself. Note that the IR-SNIF-1,2,3 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-1,2,3 monitor is designed to operate on only 110 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 vac or on 220 vac. Refer to figure 6 for a diagram of the terminal board.



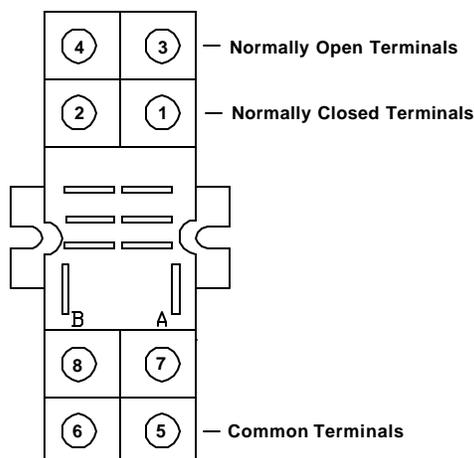


Figure 7.

The terminals are grouped as follows:

Terminal 5 = Common  
 Terminal 1 = NC  
 Terminal 3 = NO

Terminal 6 = Common  
 Terminal 2 = NC  
 Terminal 4 = NO



**Caution:** Ensure that external relay connections do not touch relay control terminals 7 and 8. A short circuit from the alarm wiring to the relay control wiring could damage the monitor, the alarms or both.

**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 6 and 10.
2. Horn Alarm, or Horn portion of Combination Horn/Strobe connected through MAIN RELAY, terminals 6 and 10.



**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-1,2,3 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 6 and 10.

**BMS-to-Relay Connection:** The IR-SNIF-1,2,3 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**

**0–10 Volt Analog Outputs:** The IR-SNIF-1,2,3 monitor provides two 0–10 volt analog outputs proportional to 0–1000 ppm. Analog 1 provides a signal proportional to the current ppm level. Analog 2 provides a signal proportional to the maximum ppm level measured. For simple installations this signal will not normally be used. For applications where the IR-SNIF-1,2,3 is installed inside a mechanical room, this 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 connections, 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.

2. Route twisted pair wire into the monitor and along the wire harness from the back-plate to the control board on the door. Secure the twisted pair periodically to the wire harness using tie wraps.
3. Route the twisted pair behind the control board and to terminal TB2, labeled “ANALOG OUTPUTS”. The terminals are labeled A1, A2 and G for Analog 1 output, Analog 2 output and reference Ground respectively.
4. Connect the appropriate wires to A1, A2 and G and tighten the screw terminals.

### **Custom Control Inputs/Outputs:**

The IR-SNIF-1,2,3 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, or serial digital output of RS232 or RS485 data. 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-1,2,3 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

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.)

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

Model IR-SNIF-1,2,3  
Version 3017  
Option Code 0  
www.sentechcorp.com

Following display of the contact and model information screens, the IR-SNIF-1,2,3 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  
Please Wait  
90

On completion of the warm-up, the monitor will display a copyright screen and enter normal operation.

IR-SNIF-1,2,3  
Refrigerant Monitor  
Copyright (c) 2003

If during the startup, a fault condition is detected, follow the instructions on the screen, and refer to the troubleshooting 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-1,2,3 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)...Alarms  
  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)...Sample Setup
2)...Find Gas Codes
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

<-      ABORT
```

Key selections 1 and 3 are used to change passwords required to enter setup and to test the alarm relay integration with building wiring. 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.

Press the “2” to enter the System Flags screen. The system flag screen will display information for

two settings, and a cursor to the right of the 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.

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 one relay to control an audible alarm. With the flag set to the 0, the alarm relays will be energized so long as the monitor is in an alarm state. If the user **dedicates** one alarm level to energize an audible alarm, the monitor can be programmed to allow one 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 use the LOW relay as a dedicated horn relay. Set the horn relay flag to 2 to use the MAIN relay as a dedicated horn relay. Set the horn relay flag to 3 to use the HIGH relay as a dedicated horn relay. This flag is set to 0 by default.

```
PASSWORD FLAG 0  -
HORN RELAY FLAG 0
```

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. Press the “4” key to set the date and time. The screen allows the user to set the month, day, hour and minute 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. Note that the RTC operates on a 24-hour clock. For example to enter 2 PM, enter the hour as 14, rather than 2.

```
RTC Month      3  -
RTC Day        10
RTC Hour       12
RTC Min        31
```

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)...Sample Setup
2)...Find Gas Codes
3)...System Setup
4)...Contact      ABORT
```

Press the “2” key to identify the list of programmed refrigerants. Each

refrigerant has an associated ‘gas code’ that will be entered in the sample setup program. This set of screens is informational only. Use the left and right arrow keys to scroll through the complete list of codes available.

```
Gas Code Selections
1-R11      2-R12
3-R13      4-R22
<-        ABORT      ->
```

```
5-R113     6-R114
7-R123     8-R134A
9-R401A    10-R401B
<-        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.

When the appropriate code has been found, press the “ABORT” key to return to the Setup menu.

```
1)...Sample Setup
2)...Find Gas Codes
3)...System Setup
4)...Contact      ABORT
```

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 the gas code and the distance. The cursor can be moved by entering information, or if the information is correct, pressing the “ENT” key.

Gas Code	4
	R-22
Distance	100
	ENT or ABORT

Enter the gas code identified in the previous step. 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, and again to return to normal operation.

## **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 10 and 15 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-1,2,3 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](http://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.

**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>
422050	Filter, 1,2,3 Coarse Tube
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

**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-1,2,3  
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 Warm-Up  
Please Wait  
90

**Copyright:** The Copyright screen will be displayed on completion of Optics Warm-Up. After a short pause, the monitor will begin normal operation.

IR-SNIF-1,2,3  
Refrigerant Monitor  
Copyright (c) 2003

## Operational Screens

When the monitor completes Start-Up, 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 being 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)...Alarms
2)...Rezero
3)...Manual
4)...Setup      ABORT
    
```

**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 ->

**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)...Sample Setup
2)...Find Gas Codes
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 the gas code and the distance. The cursor can be moved by entering information, or if the information is correct, pressing the “ENT” key.

```

Gas Code  4
R-22
Distance  100
          ENT or ABORT

```

Enter the gas code associated with the refrigerant to be monitored. The gas code look-up screens are

described later in this appendix. 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.

**Gas Codes:** From the Setup Screen, press the “2” key to identify the list of programmed refrigerants.

Each refrigerant has an associated 'gas code' that will be entered in the sample setup program. This set of screens is informational only. Use the left and right arrow keys to scroll through the complete list of codes available.

```

Gas Code Selections
1-R11      2-R12
3-R13      4-R22
<-        ABORT        ->
  
```

```

5-R113     6-R114
7-R123     8-R134A
9-R401A    10-R401B
<-        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-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.

**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
<-        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 screen. The system flag screen will display information for two settings, and a cursor to the right of the password flag.

**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 one relay to control an audible alarm. With the flag set to the 0, the alarm relays will be energized so long as the monitor is in an alarm state. If the user **dedicates** one alarm level to energize an audible alarm, the monitor can be programmed to allow one 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 use the LOW relay as a dedicated horn relay. Set the horn relay flag to 2 to use the MAIN relay as a dedicated horn relay. Set the horn relay flag to 3 to use the HIGH relay as a dedicated horn relay. This flag is set to 0 by default.

PASSWORD FLAG 0 -  
HORN RELAY FLAG 0

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. This menu will allow the operator to enter the Month, Date, Hour and Minute stored by the real time clock

in the processor. Note that Time is based on a 24-hour clock, or military time. Pressing "ENT" (enter) enters the current information and moves the cursor to the next entry. Pressing "ABORT" saves the information and returns to the previous menu.

RTC Month	3	-
RTC Day	10	
RTC Hour	12	
RTC Min	31	

## 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.

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

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:

Volume of R-22 = parts per million / million x room volume

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

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

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:

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

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

**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:

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

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

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

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

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

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

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

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

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

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:

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

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

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

Calculate time in hr:

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

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

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

## SenTech Room Volume Considerations (Metric)

Normal industry practice has been to thin about refrigerant leans 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.

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

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:

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

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

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

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

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

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

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

**Weight = .040 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:

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

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

**Time(hr) = 2.34 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:

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

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

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

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

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

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

Leak rate(kg/yr) = 176.9 kg/yr, therefore the leak rate must be **GREATER THAN 177 kg/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:

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

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

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

Calculate time in hr:

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

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

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

## 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"> <li>1. 422009, Door, IR-SNIF-1,2,3</li> <li>2. 422015, Box, IR-SNIF-1,2,3</li> <li>3. 422017, Backplate, IR-SNIF-1,2,3</li> <li>4. 422050, Tube End Filter, IR-SNIF-1,2,3 (not shown)</li> <li>5. 420053, Fitting, 1/8 Hose Barb to 1/8 NPT (not shown)</li> <li>6. 420040, Manifold, Single Zone</li> <li>7. 420224, Diaphragm Pump 110 vac (422224, Diaphragm Pump 240 vac)</li> <li>8. 420038, Pressure Switch</li> <li>9. 410136-Gray, Orifice .016 (not shown)</li> </ol> | <ol style="list-style-type: none"> <li>10. 422010, IR Bench, IR-SNIF-1,2,3</li> <li>11. 422001, RTU-17 Control</li> <li>12. 421035, Display Interface (not shown)</li> <li>13. 421031, Keypad, IR-SNIF-MCD and IR-SNIF-1,2,3 (not shown)</li> <li>14. 410040, Socket, Relay</li> <li>15. 410087, Relay, 24VDC</li> <li>16. 421072, Terminal Board, 8 Position</li> <li>17. 410033, Fuse Holder (not shown)</li> <li>18. 410034, Fuse, 3A (not shown)</li> <li>19. 422036, Power Supply, Triple Output</li> </ol> |
|---|--|

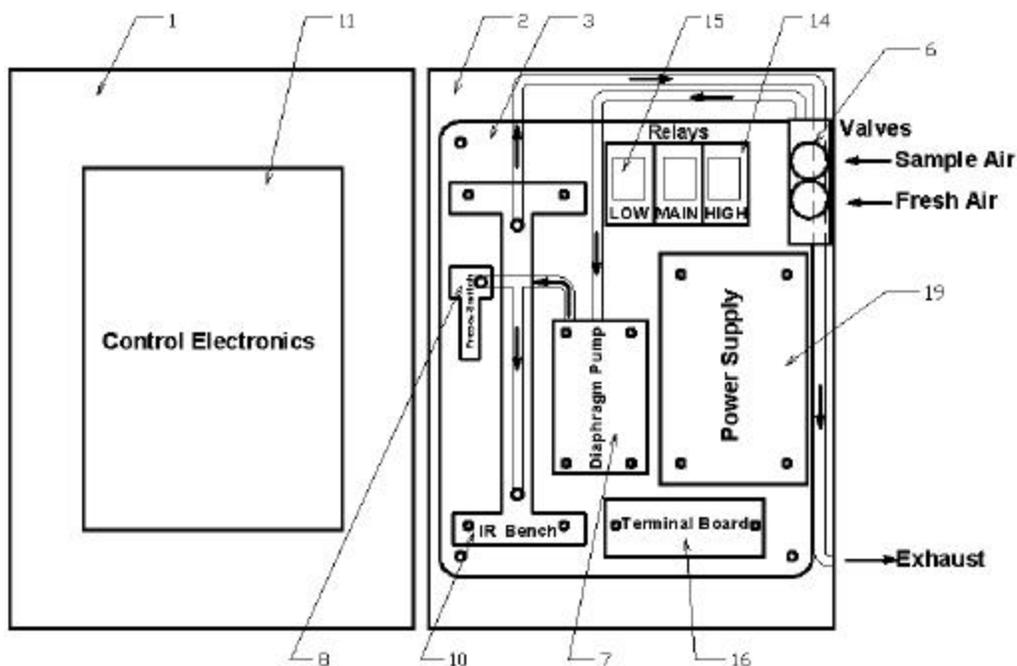


Figure 6. Parts Diagram

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

- PS = Power Supply
- F1 = Fuse Holder
- TB1 = Terminal Board
- K1, K2, K3 = Relays
- A1 = Control Board
- A2 = Display Interface Board
- A3 = Diode Adapter Board
- A1-TBx = Terminal Connector on Control Board A1

Wire #	From	To	Type	Description
1	TB1-1	GND	22 AWG ,Green/Yellow	Earth Ground
2	GND	Door GND	22 AWG ,Green/Yellow	Earth Ground
3	TB1-1	Pump GND	22 AWG ,Green	Earth Ground
4	TB1-1	PS GND	22 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	TB1-3	Pump Neutral	22 AWG ,White	AC Neutral
8	TB1-3	PS P1-N	22 AWG ,White	AC Neutral
9	TB1-4	Pump Line In	22 AWG ,Black	Fused AC Line
10	TB1-4	PS P1-L	24 AWG ,Black	Fused AC Line
11	PS P2-1	TB1-6	24 AWG ,Red	24Vdc
12	PS P2-4	TB1-7	24 AWG ,Black	DC Ground
13	PS P2-2	TB1-8	24 AWG ,Blue	5Vdc
14	TB1-6	Valve, Sample Air-1	24 AWG ,Black	24Vdc
15	TB1-6	Valve, Fresh Air-1	24 AWG ,Black	24Vdc
16	TB1-6	K3-13	24 AWG ,Red	24Vdc "High Alarm"
17	K3-13	K2-13	24 AWG ,Red	24Vdc "Main Alarm"
18	K2-13	K1-13	24 AWG ,Red	24Vdc "Low Alarm"
19	TB1-6	A1-TB4-24V	24 AWG ,Red	24Vdc
20	A1-TB4-24V	A3-24V	24 AWG ,Red	24Vdc
21	TB1-7	A1-TB4-GND	24 AWG ,Black	DC Ground
22	TB1-7	A1-TB5-GND	24 AWG ,Black	DC Ground
23	A1-TB5-GND	A1-TB6-GND	24 AWG ,Black	DC Ground
24	A1-TB6-GND	A1-TB7-GND	24 AWG ,Black	DC Ground
25	A1-TB7-GND	A1-TB10-GND	24 AWG ,Black	DC Ground
26	A1-TB10-GND	A1-TB11-GND	24 AWG ,Black	DC Ground
27	TB1-7	SOURCE P1-2	24 AWG ,Black	DC Ground
28	TB1-8	SOURCE P1-1	24 AWG ,Blue	5Vdc
29	A1-TB5-OUT1	K3-14	24 AWG ,White	Switched Ground "High Alarm"
30	A1-TB5-OUT1	A3-R1	24 AWG ,Black	Switched Ground "High Alarm"
31	A1-TB6-OUT2	K2-14	24 AWG ,White	Switched Ground "Main Alarm"
32	A1-TB6-OUT2	A3-R2	24 AWG ,Black	Switched Ground "Main Alarm"
33	A1-TB7-OUT3	K1-14	24 AWG ,White	Switched Ground "Low Alarm"
34	A1-TB7-OUT3	A3-R3	24 AWG ,Black	Switched Ground "Low Alarm"
35	A1-TB10-OUT6	Valve, Fresh Air-2	24 AWG ,Black	Switched Ground "Auto Zero"
36	A1-TB11-OUT7	Valve, Sample Air-2	24 AWG ,Black	Switched Ground "Auto Sample"
37	A1-TB1-V	DET-P1-1	24 AWG ,Red	Detector 12V Power
38	A1-TB1-1	DET-P2-1	24 AWG ,White	Detector Signal
39	A1-TB1-2	SW1-C	24 AWG ,White	Switched Ground "Flow"
40	A1-TB1-G	SW1-NC	24 AWG ,Black	Flow Switch Ref. Ground
41	A1-TB1-G	DET-P1-2	24 AWG ,Black	Detector Ref. Ground
42	DET-P1-2	DET-P2-2	24 AWG ,Black	Detector Ref. Ground

## 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 be 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. Three lights should be lit on the control board. Two power lights will be lit in the lower right area of the control board. One light should be lit in the upper right area of the board. This will be either the red light labeled "OUT6" or "OUT7". Following "Optics Warm-up", the controller will alternate between "OUT6" (fresh air) and "OUT7" (sample air), at approximate two-minute intervals.

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

*If the power lights are lit, but the neither "OUT6" nor "OUT7" are lit, or the controller is not alternating between them, the control board has a fault.*

- c) If the power lights are lit, and "OUT6" and "OUT7" are lit one at a time, check the Gray Ribbon cable connected to P1 "EXP BUS" connector on the control board. With the power turned off, unseat the connector and verify that all pins P1 are straight and even. Reseat the connector and apply power to the monitor.

*If reseating the cable does not correct the problem, the Display Interface 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. Measure the DC voltage between terminals 6 and 7 on TB1. TB1-6 should read between 22vdc and 25vdc. TB1-7 is DC ground.

*If there is no DC voltage on TB1-6, turn off the monitor and remove one device at a time from the DC power circuit. The 24 vdc relays can be removed from the relay socket. The control board can be disconnected at the input terminal on the board. The solenoid valves can be disconnected at TB1-6. Note: the power supply must have a load to operate, so each item must be disconnected, then tested and replaced.*

b) If there is DC voltage on TB1-6, check the 24 vdc terminals on the alarm relays and the 24 vdc terminal on the control board itself. Using the wire-list from the previous section, isolate the fault to a wiring problem.

#### 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 lights labeled "OUT6" and "OUT7" are switching on and off. 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.

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

#### 6. System Alarms when no Leak is Found

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 resolve the problem, the unit has likely failed. Contact SenTech Corporation technical support for assistance.*



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Since 1987

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