CONTENTS

KEY TO SAFETY SYMBOLS

'Caution, Risk of Electric Shock' Please isolate elsewhere before opening Detector door.

Please read this manual before installing or servicing the equipment.

971118
MN3101/7

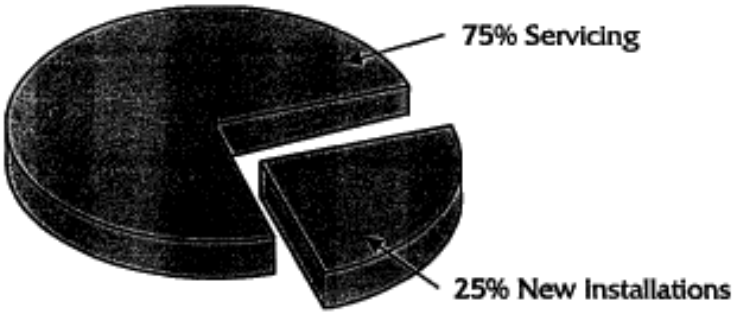
Parasense
REFRIGERANT DETECTION

INTRODUCTION

INTRODUCTION

Parasense Refrigerant Detection

It is recognised that 75% of refrigerant produced is used in 'topping up' leaking refrigeration systems.



This practice has been widespread for many years as refrigerant has been cheap and plentiful, with the leaks difficult and time consuming to find. With the advent of information proving that CFC's and HCFC's have a detrimental effect on the ozone layer, and a consequential impact on the world's environment, the elimination of leaks from refrigeration systems has taken a very high priority. The phase out of CFC's and HCFC's under the terms of the 'Montreal Protocol', coupled with an increase in price of these refrigerants and the new HFC's has made effective leak detection an essential part of all new and existing refrigeration systems.

The reasons for installing Parasense refrigerant detection can be described as follows:-

Environmentally Sound

CFC's and HCFC's damage the ozone layer and increase global warming, adversely affecting the world's environment. All refrigerants including CFC's, HCFC's and HFC's consume large amounts of energy in their production, which in turn generates "greenhouse gases" and add to the global warming. Reduction in refrigerant leakage can reduce ozone depletion and global warming, both directly and indirectly.

Reduction in Maintenance Costs

CFC's and HCFC's are expensive, will become more expensive, and difficult to source. The new blends of HFC's are very expensive. A great deal of time is spent in looking for leaks with hand held detectors, and is frequently unsuccessful. Parasense detectors will target the source of the emission, enabling leaks to be controlled with the minimum use of refrigerant and manpower, thus reducing maintenance costs.

Maintaining of System Efficiency

In many refrigeration systems the refrigerant charge is critical, and variations due to leakage adversely affect the system performance, leading to increased energy usage, or a failure to meet performance criteria. In addition, due to the nature of refrigeration, there are constant changes in pressure, temperature and vibration, which can lead to foreign matter being drawn into the system reducing efficiency and blocking orifi. Parasense detectors will find the smallest concentrations of refrigerant and allow leaks to be repaired before the system efficiency is impaired.

Complying with Legislation

In most countries in the world, it is illegal to "knowingly vent CFC's into the atmosphere". If a refrigeration system has a regular usage of refrigerant, then the owner or user of the system is knowingly venting refrigerant into the atmosphere which is illegal. The fines for venting CFC's and HCFC's vary from country to country, but are in the order of £20,000.00 for the first offence. Parasense detectors give an indication of very small concentrations of refrigerant, allowing leaks to be repaired before significant losses of refrigerant are incurred.

Health and Safety

Most refrigerants are classed as non toxic. However, in certain circumstances they do pose a significant threat to the Health and Safety of maintainers and operators of refrigerated equipment and machinery. In concentrations in excess of 10% in air, refrigerants can cause cardiac sensitisation, which can be a fatal condition in human beings. At much higher concentrations, refrigerants displace oxygen and can cause death by asphyxiation.

In most cases, sufficient ventilation prevents the likelihood of a threat to Health and Safety from refrigerants. However, there are a number of areas where refrigerant leaking into an enclosed or poorly ventilated space can pose a threat to Health and Safety. Parasense detectors help prevent the possibility of a threat to Health and Safety from refrigerant vapour by detecting refrigerant leakage at a very early stage, before dangerous concentrations can accumulate.

Excellent Value for Money

When the cost of a Parasense Refrigerant Detection System is compared with savings made from:-

- Reduction in refrigerant use
- Reduction in maintenance costs
- Maintaining constant system efficiency

Then the value for money becomes immediately apparent, and the

- Environmental
- Legislative, and
- Health and Safety Benefits from Parasense, become a spectacular bonus.

THE PARASENSE REFRIGERANT DETECTOR

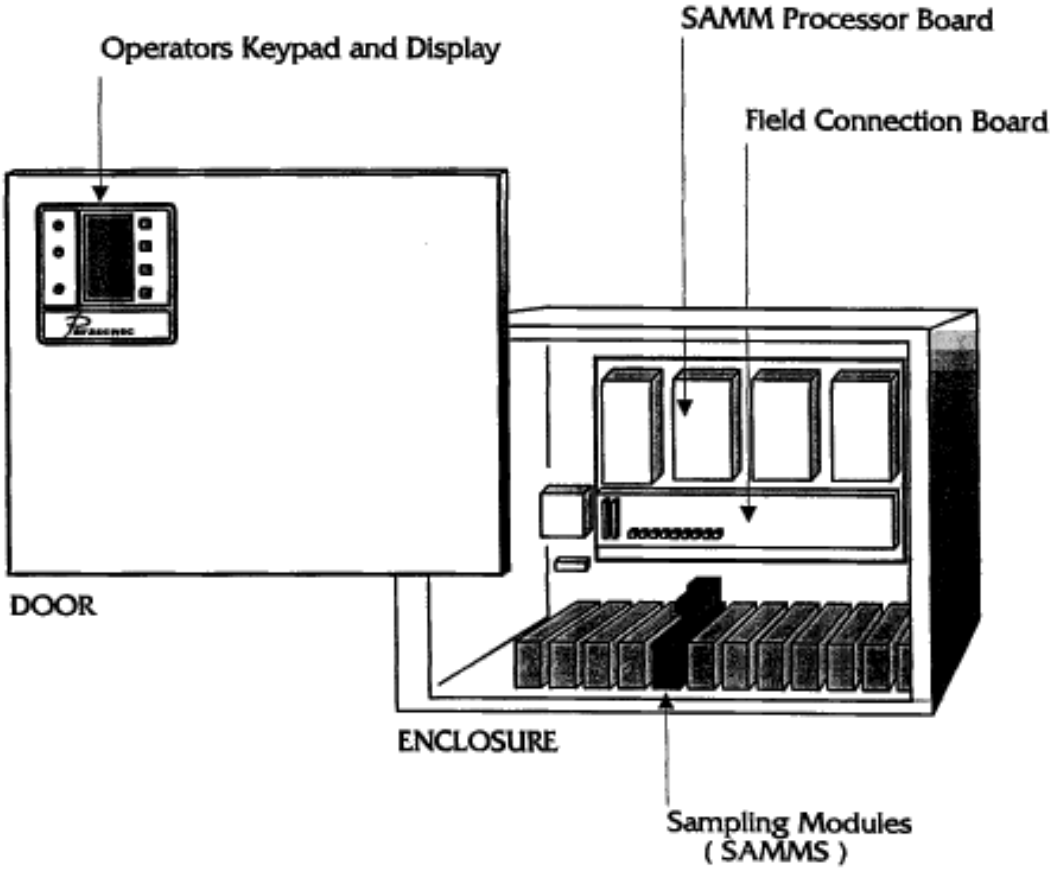
971118
MN3103/4

Parasense
REFRIGERANT DETECTION

THE PARASENSE REFRIGERANT DETECTOR

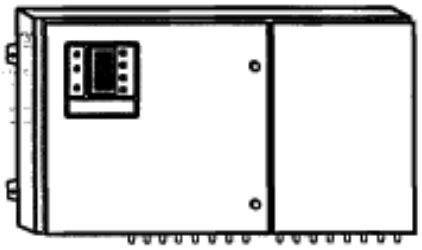
The first Parasense Refrigerant Detector was developed in 1988, after exhaustive studies into the causes and nature of refrigerant leakage. Parasense products are extremely easy to use, they are accurate and reliable and come with a lifetime guarantee of maintenance and support.

A schematic layout of a typical 3100 series Parasense detector is shown below.

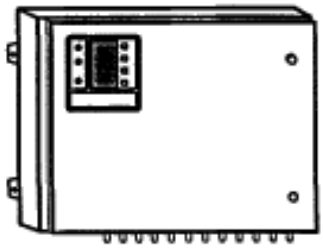


3100 Series Monitors

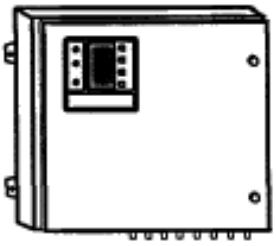
Each detector consists of an operators keypad and display, a field connection board, a number of sampling modules (SAMMS), and SAMM processor boards. The first two digits of the Parasense code give the type of detector, the second two digits specify the number of SAMMs installed, and the digits after the stroke shows the maximum number of SAMMs that will fit into that model. The 3100 detectors have a maximum of sixteen SAMMS. The various types of Parasense detectors are shown below.



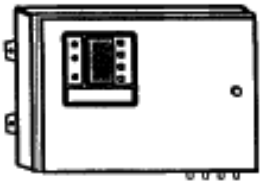
PARASENSE Detector
Code 3101/16 - 3116/16
3116/16 shown



PARASENSE Detector
Code 3101/12 - 3112/12
3112/12 shown



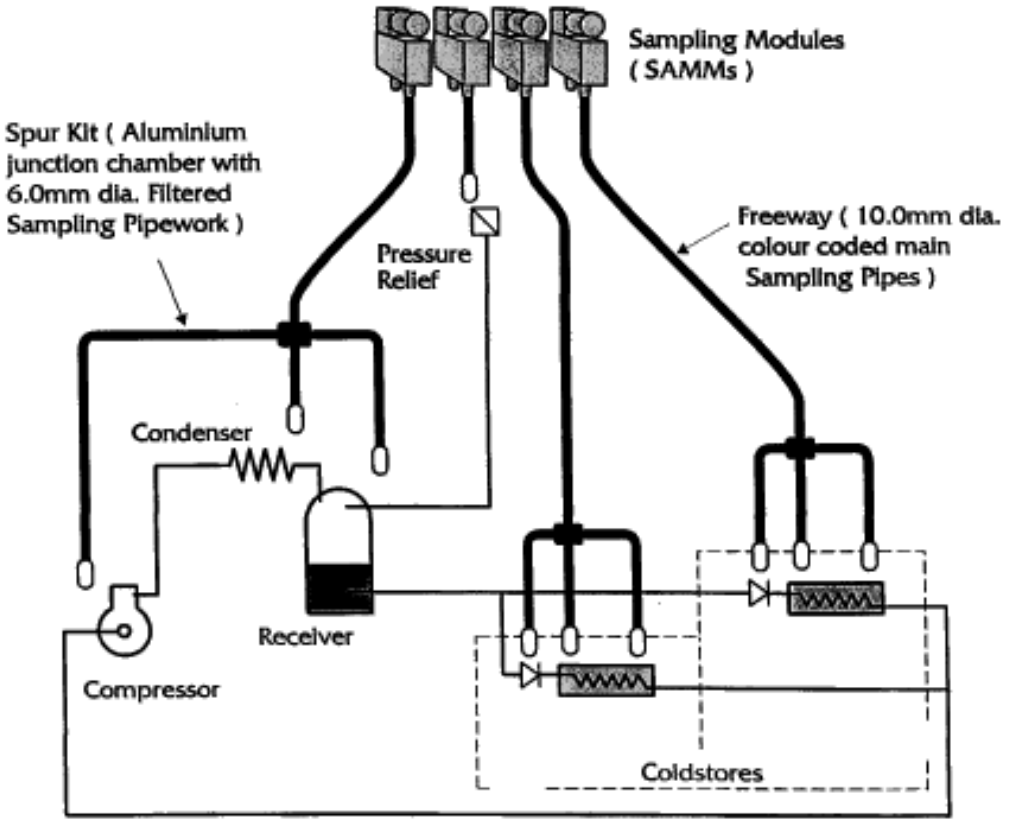
PARASENSE Detector
Code 3101/8 - 3108/8
3108/8 shown



PARASENSE Detector
Code 3101/4 - 3104/4
3104/4 shown

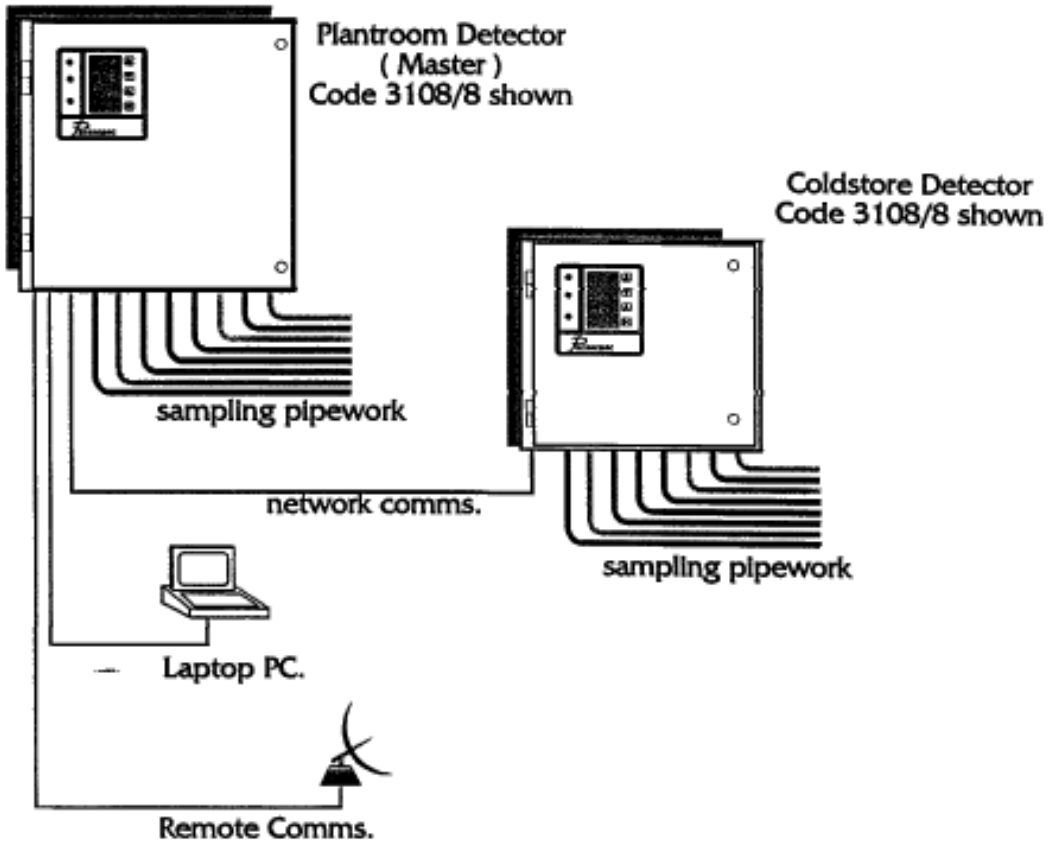
Schematic System Layout

A Parasense refrigerant detection system can consist of a single detector or a number of detectors with varying amounts of sampling modules. Each sampling module consists of a pump, sensor and remote pipework. The remote pipework consists of two components, a FREEWAY and a SPUR KIT. The SPUR KIT consists of up to seven filtered SPUR pipes connected into a junction. The SPUR KIT is located close to the plant or area being monitored, and the individual SPUR pipes fitted adjacent to the potential leakage site, or in suitable strategic positions to give the best detection possible. The FREEWAY consists of a colour coded 10mm pipe which links the SPUR KIT to its associated SAMM. The FREEWAY can be up to 120mtrs long thus enabling one Parasense detector to cover a large installation, consisting of different plant, environments and even refrigerants. This is possible as each SAMM has its own identity and can be set up for the particular application or environment concerned. Each of the SAMMS is programmed to draw a sample of air through the connected FREEWAY and SPUR KIT and measure the concentration of refrigerant present. The concentration of refrigerant is recorded by the detector concerned, and action is taken if it exceeds a particular alarm threshold. A typical application of SAMMS and sample pipework is shown below.



Typical Parasense Network Layout

The Parasense system has been designed with flexibility as a priority. Any system is capable of expansion by either inclusion of extra SAMMS or detectors. Each detector can act as a self contained unit or be linked with other detectors to form a network. If a network is constructed then each detector is connected together using a communication cable. Each network has a Master detector where the status and history of all SAMMS in the network may be viewed, whilst all other detectors give access to their individual SAMMS only. A typical network is shown below.



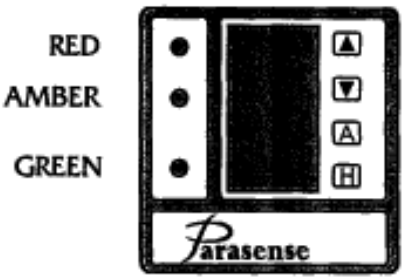
Standard Features of the 3100 Series Detectors

STANDARD FEATURES	DETECTOR TYPE			
	3101/4 TO 3104/4	3101/8 TO 3108/8	3101/12 TO 3112/12	3101/16 TO 3116/16
Max. No. of Sampling Modules (SAMMS)	4	8	12	16
Output Relays	4	4	4	4
Remote (Modem) RS232 Comms Channel	✓	✓	✓	✓
Local RS232 Comms Channel, External Port	✓	✓	✓	✓
Parasense Network Capability	✓	✓	✓	✓
Min. No. of Readings Stored In Memory for each SAMM	10,000	10,000	10,000	10,000
60 x 110mm Liquid Crystal Display	✓	✓	✓	✓
Traffic Light Alarm Display	✓	✓	✓	✓
Integral Keypad	✓	✓	✓	✓
I.P. 65 Enclosure	✓	✓	✓	✓

Standard Controls and Displays

All Parasense detectors have traffic light alarm displays and controls.

The standard display for 3100 detectors is shown below.



Each SAMM in a Parasense detector automatically draws samples of air through the connected sample pipework at regular intervals, measures the concentration of refrigerant present and reports the result. The concentration measured is then compared against three alarm thresholds known as LOCAL, CRITICAL and RELAY. The alarm status is shown on the traffic light display.

Traffic Light Display

The traffic light display gives a "snapshot" of the alarm status of any of the detector's SAMMS at a glance. In the case of a network of detectors, the traffic light display at the 3100 MASTER detector gives the alarm status of any of the SAMMS in the network. The significance of the traffic lights is as follows:-

- **Red Steady Light**

The most recent measurement of refrigerant concentration from one or more of the SAMMS has exceeded the relevant local alarm threshold.

- **Red Flashing Light**

The most recent measurement of refrigerant concentration from one or more of the SAMMS has exceeded the relevant critical or relay alarm threshold.

- **Amber Steady Light**

During the past 12hrs one or more of the SAMMS has measured a refrigerant concentration in excess of the local, critical or relay alarm threshold.

- **Green Flashing Light**

A fault exists in a refrigerant detector.

- **Green Steady Light**

The refrigerant detector or system is operating correctly to the design specification.

Liquid Crystal Display Screen and Controls

The display screen allows historic refrigerant concentration information, and alarm logs for the entire system, a group of SAMMS or an individual SAMM to be viewed. Input and adjustment to the detector set-up, and SAMM set-up parameters can also be achieved using the display screen in conjunction with the keypad. The function of the four keys is as follows:-

[Δ] Scroll Up and [▽] Scroll Down Keys

These keys are used to select a menu option, change a number or a character, or, scroll a list or graph past a pointer. The abbreviations in the User Guides have the following meaning:-

[Δ] SELECT [▽]	Using the [Δ] and [▽] keys SELECT a menu option or parameter type from a list.
[Δ] ADJUST [▽]	Use the [Δ] and [▽] keys to ADJUST a value, letter or feature of a parameter.

[A] Action Key

This key executes the option SELECTED or the parameter ADJUSTMENT that has been made.

[H] Help Key

A single operation of this key will provide instruction in the operation of the detector specific to the menu selected. If more than one page of text is available, this may be accessed by using the [Δ] and [▽] to Locate more information. A second operation of the [H] will return the screen to the selected menu.

Abbreviated Operator Instruction

The key symbols described previously are used to create simple operator instructions, some examples are as follows:-

[△]
ADJUST - Contrast
[▽]

Use the [△] and [▽] keys to increase or decrease the contrast on the display screen.

[△]
SELECT + [A]
[▽]

Use the [△] and [▽] keys to SELECT a menu option followed by [A] to execute the option.

[△]
ADJUST + [A]
[▽]

Use the [△] and [▽] keys to ADJUST a parameter followed by [A] to execute the adjustment.

In addition to the four detector control keys [△], [▽], [A] and [H], there are a number of standard screen types and commands that ensure operating or adjusting control parameters on the Parasense detector is as simple as possible.

USER GUIDE - 3100

971118
MN3104/4
From Software Version 31.6E onwards

Parasense
REFRIGERANT DETECTION

USER GUIDE - 3100

Standard Screens and Commands

If a network of detectors has been formed, then the Master detector will give access to all the SAMMs in the ENTIRE SYSTEM. All other detectors will only give access to their own SAMMs. The Master detector can be identified by scrolling Detector Name augmented by **MASTER DETECTOR**. If detectors are not networked, then the screen displays only refer to the SAMMs that are contained within that Detector.

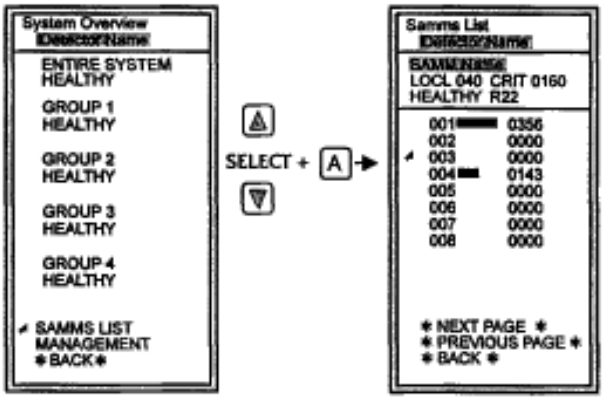
There are four types of screens and two standard commands used in the operation of the 3100 detector which are as follows:-

Idle Screen

If the control keys have not been used for approximately 5 minutes, the Idle Screen will appear. It is characterised by the Parasense logo at the top of the screen. The display screen contrast can be adjusted by using the [Δ] and [▽] keys, whilst [A] brings up the first selection screen.

Selection Screens

The Selection Screens allow the user to SELECT all of the SAMMs in the system, a group of SAMMs or an individual SAMM for viewing or adjustment. Selection Screens are characterised by having the detector name and the screen name at the top of the display, plus a help prompt at the bottom of the screen i.e.



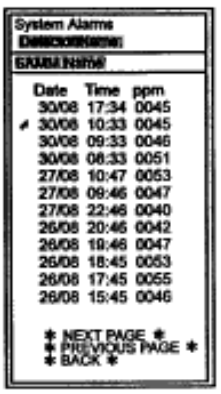
Menu Screens

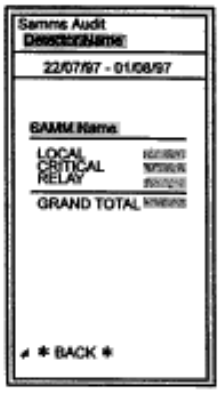
When all the SAMMs, a group of SAMMs or an individual SAMM in the system have been selected, a Menu Screen will appear giving a number of options. These options are shown below.

In the case of an individual SAMM, the option exists to take a manual sample.

Data Display Screens

These screens are provided for the user to view and analyse collected data. The screens take the form of lists, graphs or tables i.e.





Back

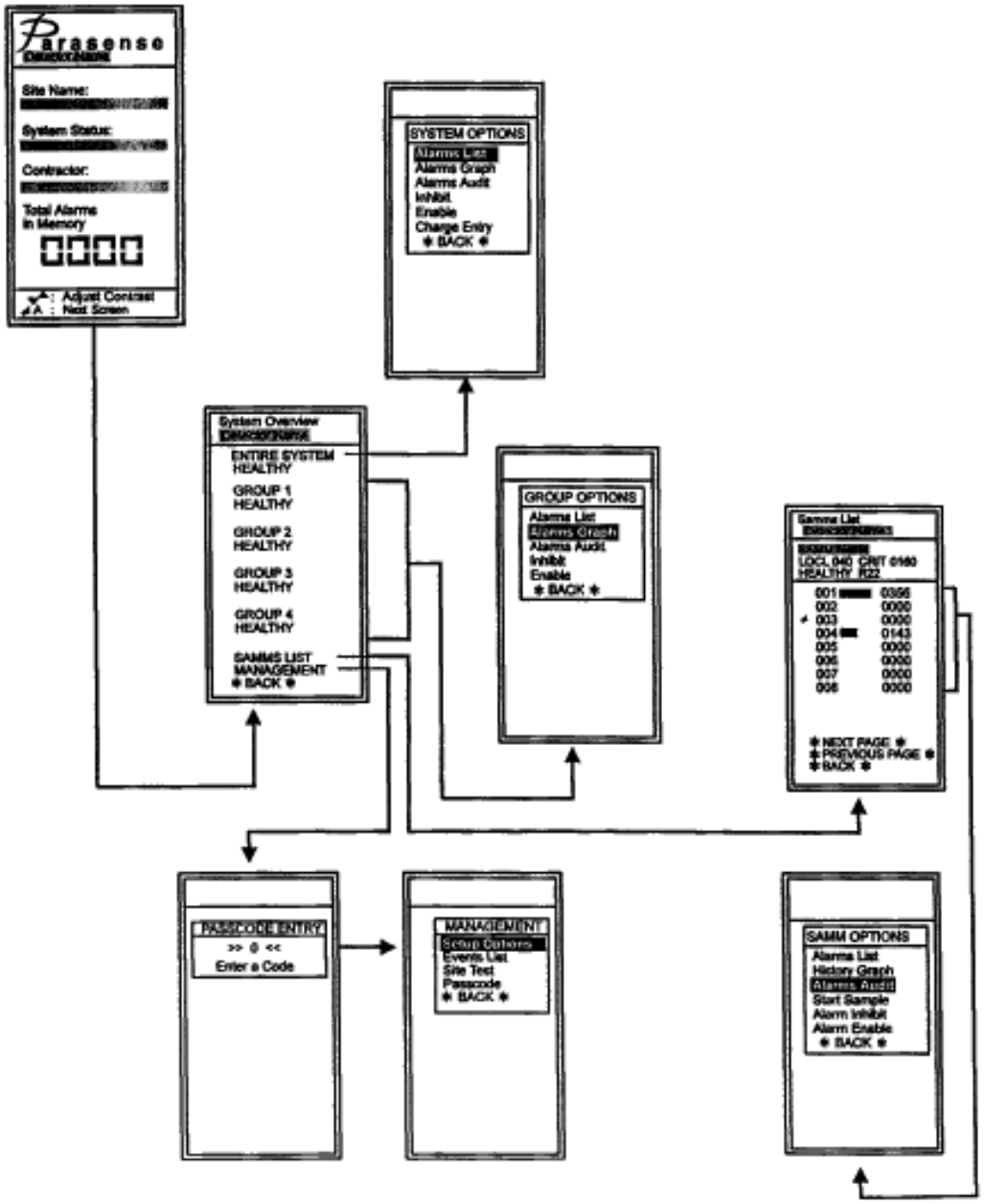
This is an option that occurs in every type of screen either as a direct option or an indirect option after [A] has been used. *BACK* allows the user to go back one screen at a time, thereby retracing the path taken. Repeated use of *BACK* will result in the Idle Screen i.e.

Passcode

Certain menu selections are protected by a four digit passcode to prevent unauthorised changes in set-up data or detector operation. The passcode is entered by using the [Δ] and [▽] keys to ADJUST the first digit of the code followed by [A] to accept that digit. The rest of the code is entered sequentially, in the same way. If the wrong code is selected on the entry of the sixth digit, entry will be denied and the previous screen displayed. To abort the passcode selection at any stage, select X and accept with [A]. An example of the selection of the passcode 2579 is a follows:-

Parasense 3100 Operation Diagram

The operator should be familiar with the detector controls and different display screens described in the Parasense Refrigerant detector section. All Parasense detectors make leaks easy to trace by giving the user the option to View and control the SAMMs as an Entire System, a Geographical Group or as an individual SAMM. This approach enables the user to identify the source of a leak quickly by first establishing the general area followed by the exact location. The 3100 detector Operation Diagram is shown below.



Normal Operation

In most cases the Management Options are only used when setting up the detector or viewing the set-up data, and are dealt with in the detector set up section.

The detector is operated by using the [Δ], [▽] and [A] keys to make menu selections, view data displays or adjustments. The detector is extremely easy to use and its functions are best understood by using the operation diagram and simply stepping through the various menus. If a network of detectors have been installed and the controls on the MASTER DETECTOR are used, then the data, controls and set-up information will relate to the ENTIRE SYSTEM, and not just to the Master Detector itself. The function of each of the screens is now described in detail.

Idle Screen

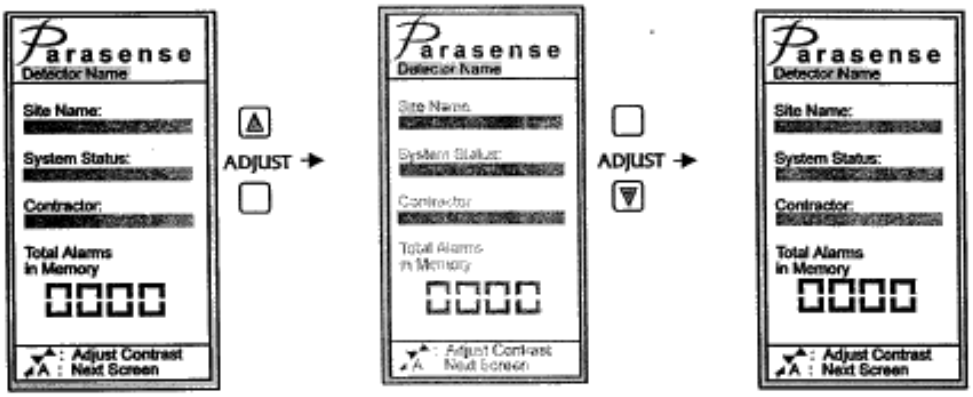
The Idle Screen is displayed when the detector controls have not been used for approximately 5 minutes. This screen displays the Detector location and if a Parasense network has been formed, if the detector selected is the Master.

Idle Screen Operator Options

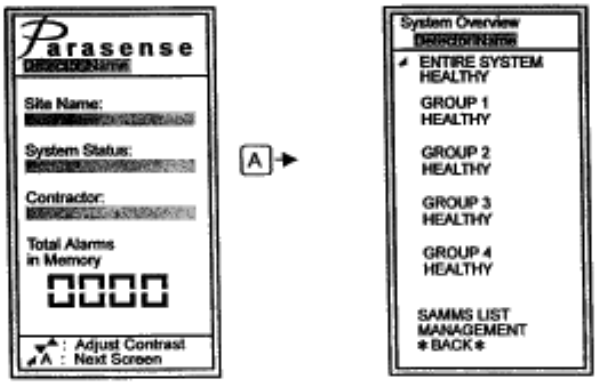
The Idle Screen has four functions:-

- To provide site information, i.e. detector name, site location and contractors name.
- To adjust the Display Screen contrast.
- To display the current system status.
- To display the total number of alarms recorded in the Detector memory for the entire system.

Adjust Contrast



Next Screen

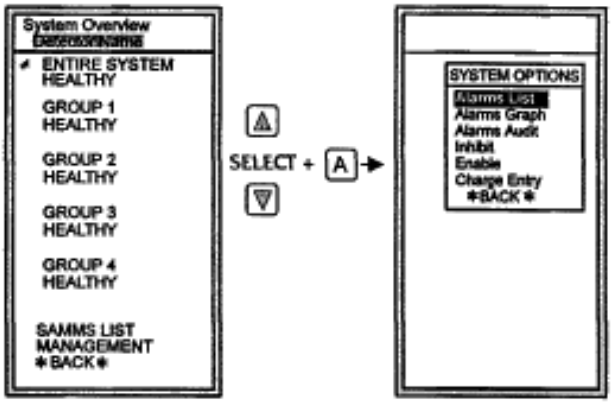


System Overview - Operator Options

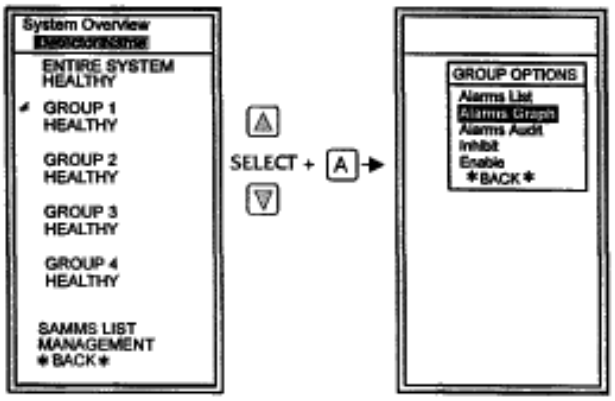
The System Overview Screen has four functions:-

- To provide, at a glance, the current status of the entire system.
- To provide an entry to menu screens, to give historic data and control to the entire system.
- To provide an entry to the data and status of all SAMMS within the system.
- To provide an entry to the Management Options screen.

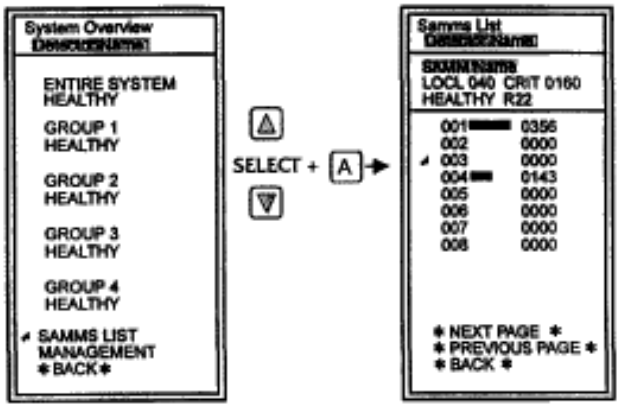
Select Entire System



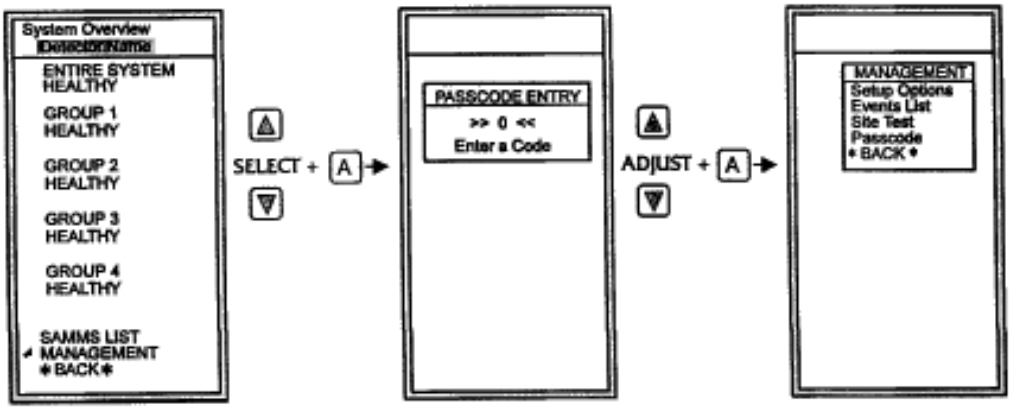
Select a Particular Group of SAMMs



Select an Individual SAMM



Select Management Option Screen

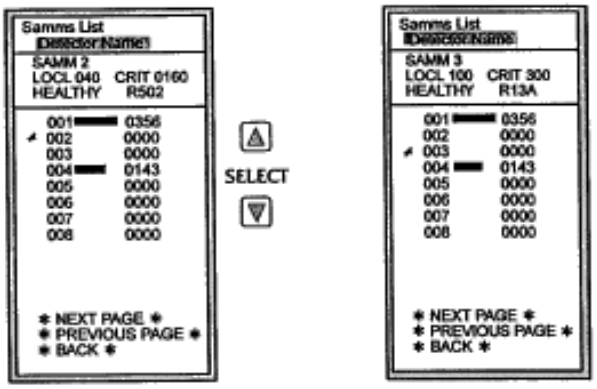


SAMMs List Operator Options

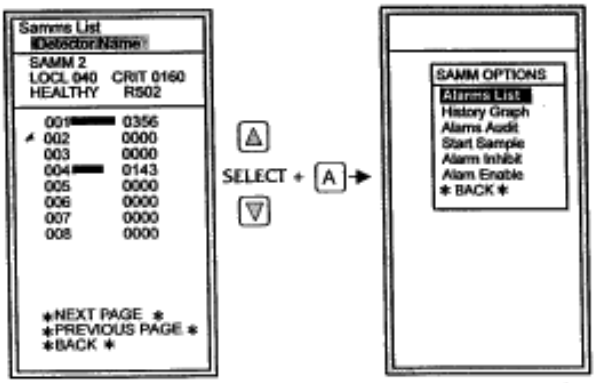
The SAMMs List Screen has three functions:-

- To display the local and critical alarm set points, the refrigerant being detected and the current status for every SAMM in the system.
- To display the most recent concentration of refrigerant measured for each SAMM in the system. The information is displayed as a list containing the SAMM I.D. a bar giving a graphical representation of the concentration and a value in p.p.m for all the SAMMs in the system.
- To provide an entry into the menu screens to give historic data and control to the individual SAMM selected.

Display Status and Set-Up for an Individual SAMM



Select an Individual SAMM Menu Screen

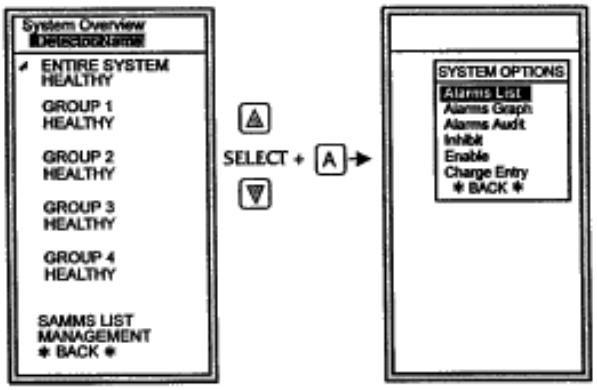


Parasense
REFRIGERANT DETECTION

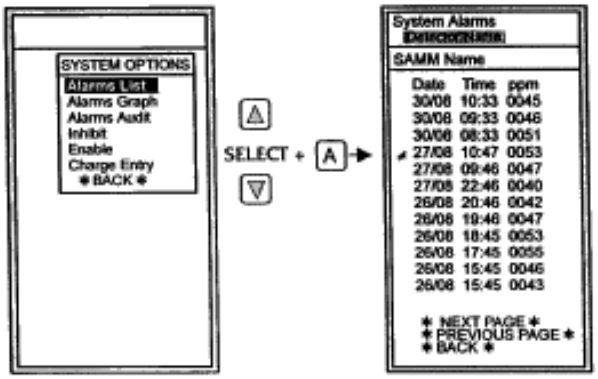
Menu Screens - Entire System

The Entire System menu screen has five functions:-

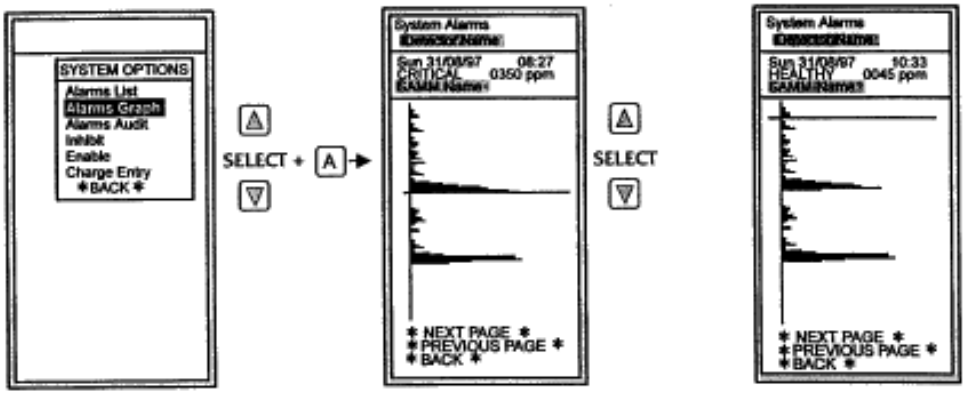
- To produce a list of all the alarms stored in the Detector memory for all of the SAMMs in the system.
- To produce a graph of all the alarms in the Detector memory for all of the SAMMs in the system.
- To produce an Audit of all the types of alarm that have been stored in the Detector memory for all of the SAMMs in the system.
- To inhibit all of the SAMMs in the system from operating the detector relays for a period of 12hrs (`Enable` to override inhibit).
- To record the adding of refrigerant to the system.



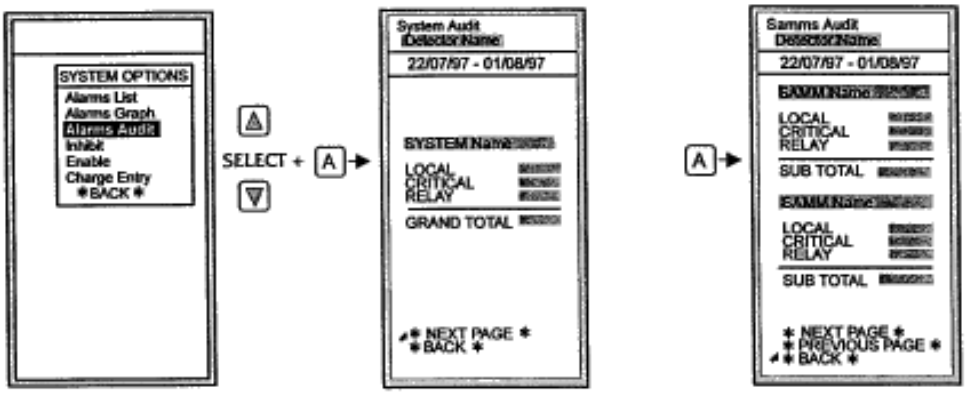
View Alarms List



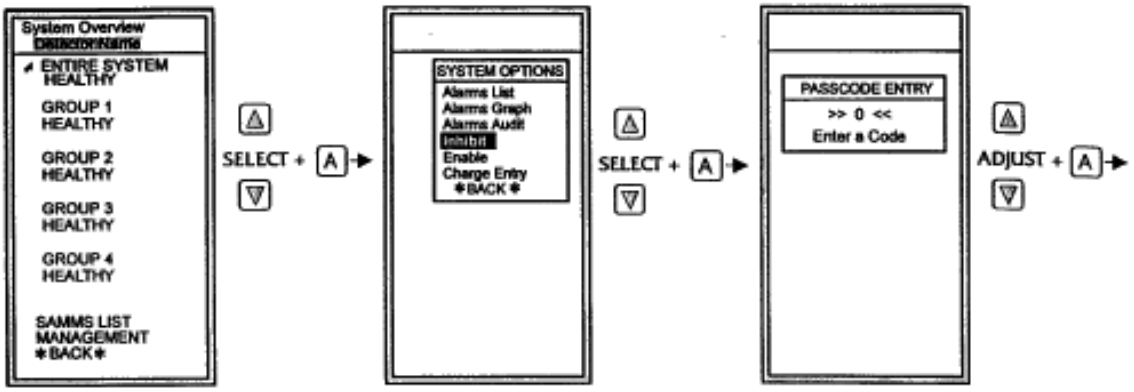
View Alarms Graph

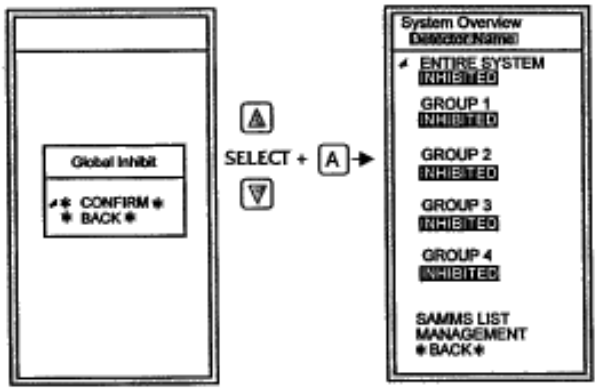


Produce Alarms Audit



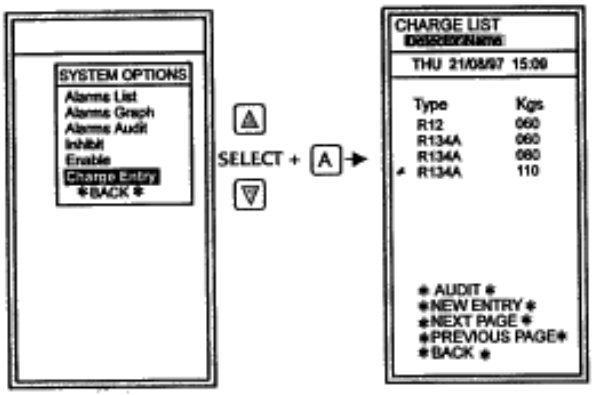
Inhibit Relay Operation



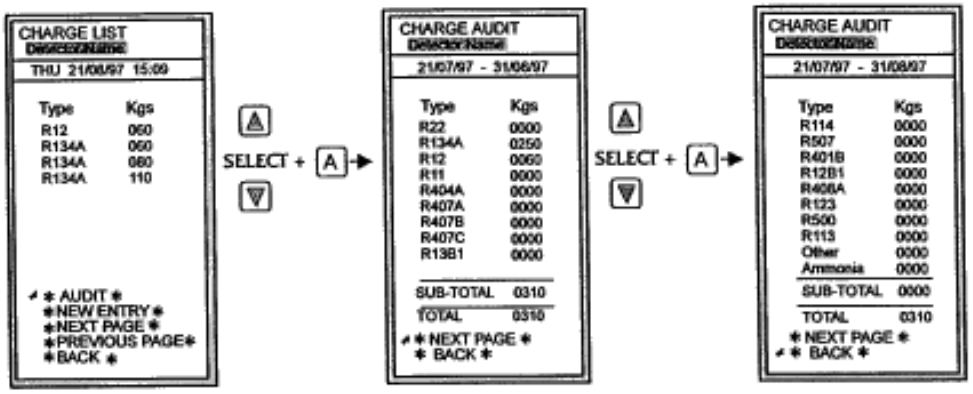


Parasense
REFRIGERANT DETECTION

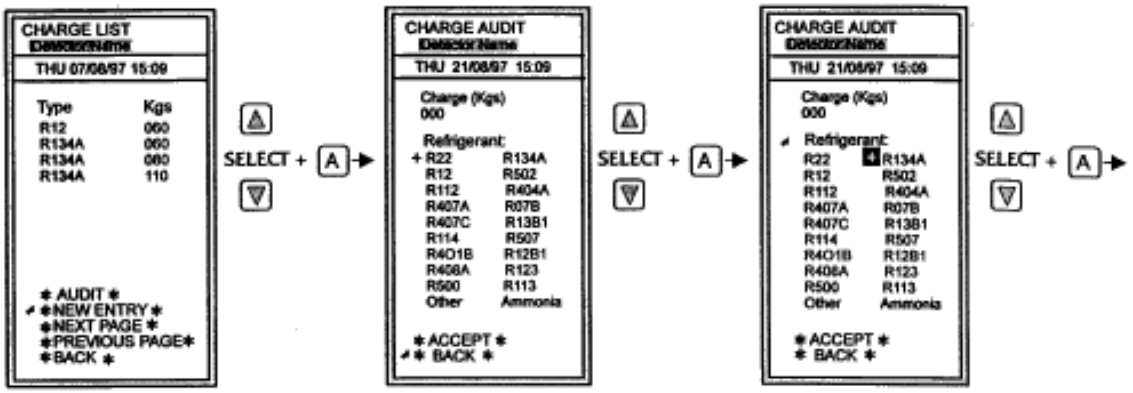
Refrigerant Charge Entry

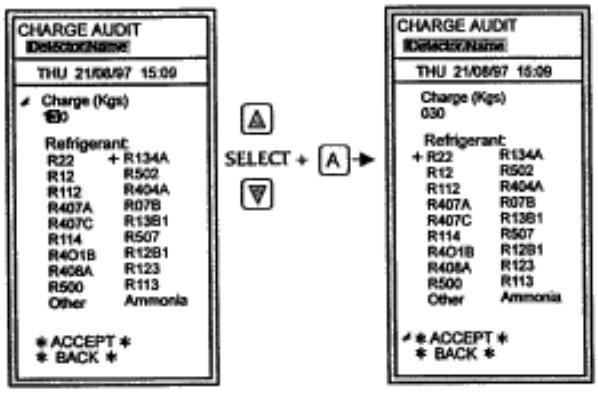


Product Audit



New Charge Entry

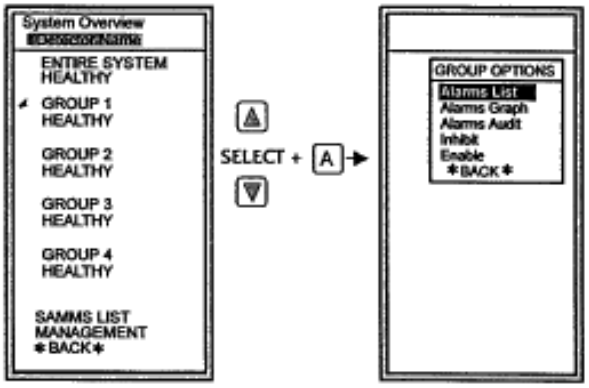




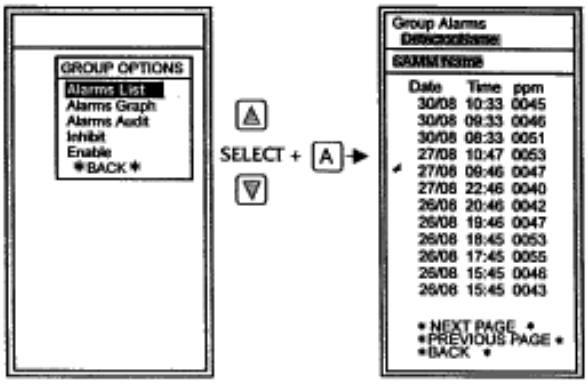
Menu Screens - SAMM Group - Operator Options

The SAMM group menu screen has four functions:-

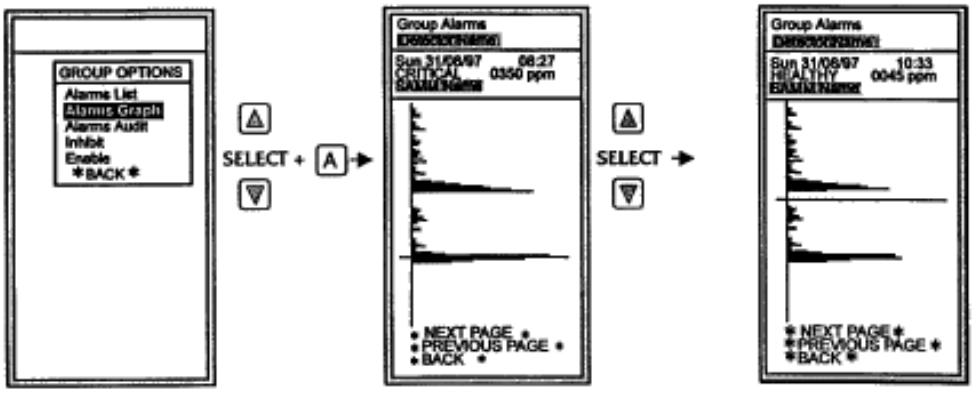
- To produce a list of all the alarms stored in the Detector memory for all of the SAMMs in the group selected.
- To produce a graph of all the alarms in the Detector memory for all the SAMMs in the group selected.
- To produce an Audit for all the types of alarm that have been stored in the Detector memory for all of the SAMMs in the group selected.
- To inhibit all the SAMMs in the group selected from operating the detector relays for a period of 12hrs (`Enable` to override inhibit).



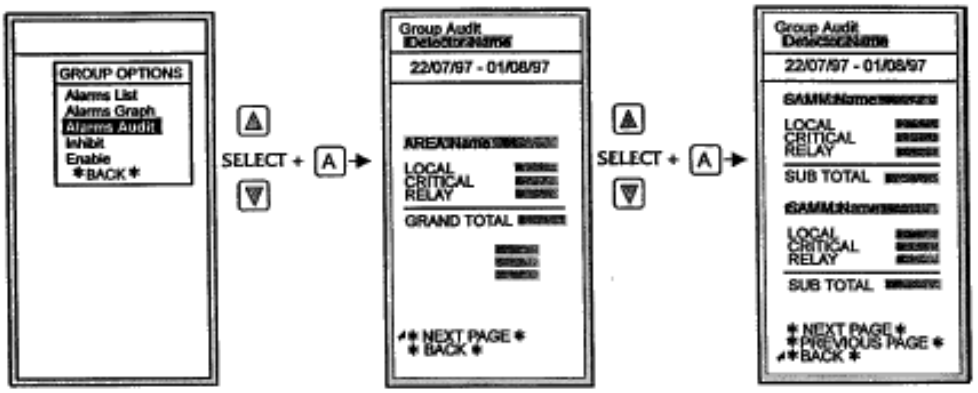
View Alarms List



View Alarms Graph

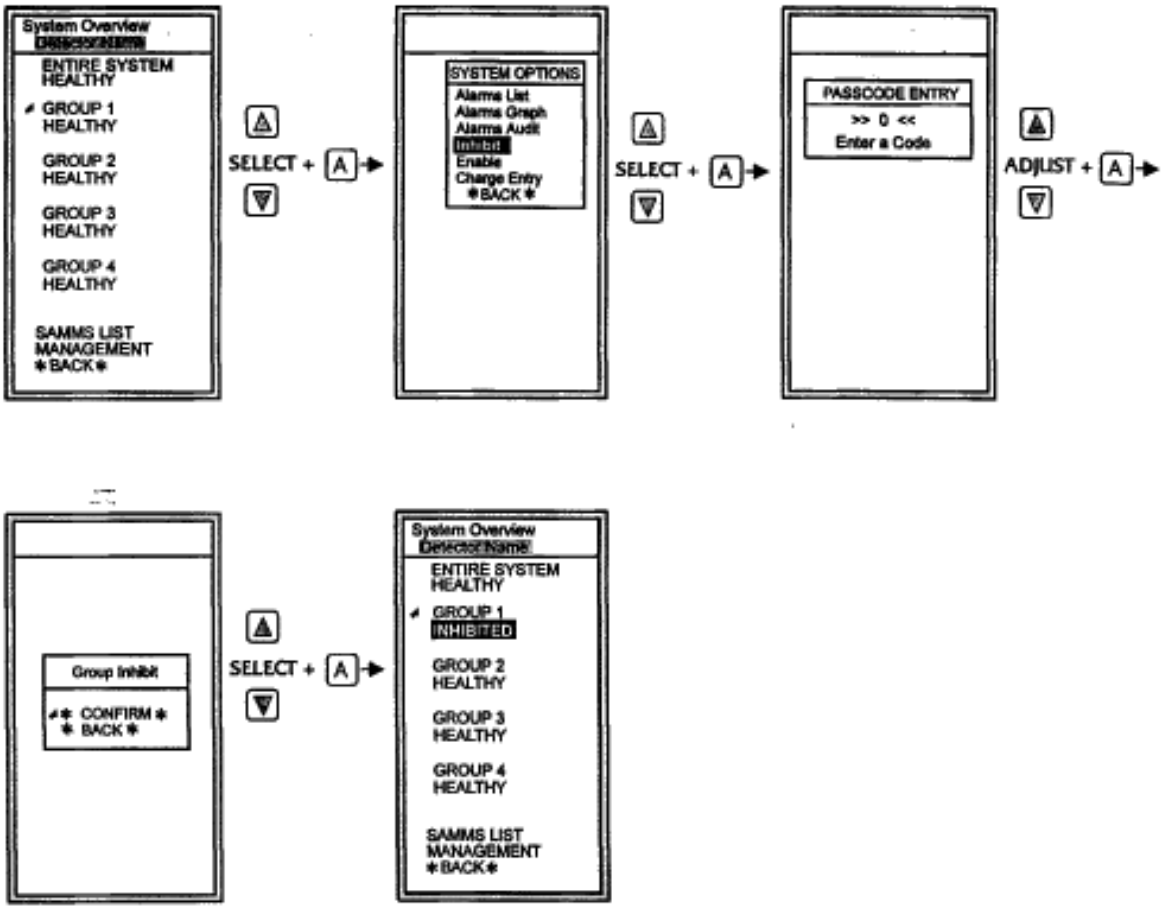


Produce Alarms Audit



Parasense
REFRIGERANT DETECTION

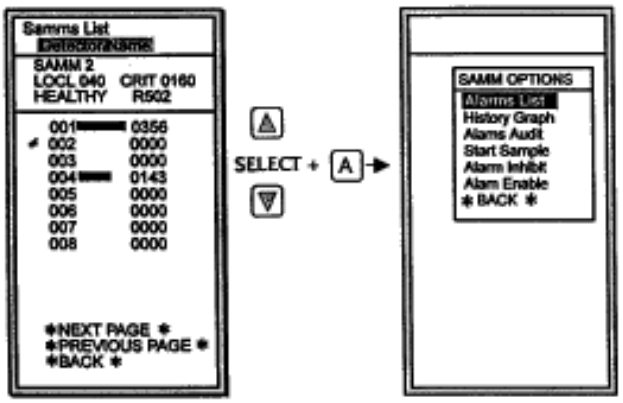
Inhibit Relay Operation



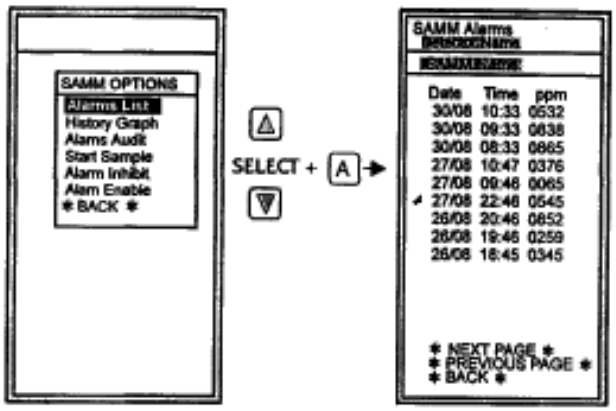
Menu Screens - SAMMs List - Operator Options

The SAMM LIST menu screen has five functions:-

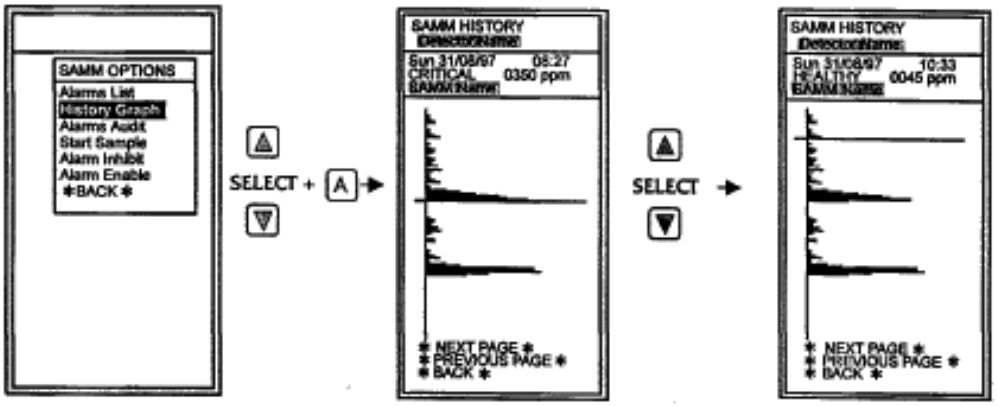
- To produce a list of all the alarms stored in the Detector memory for the individual SAMM selected.
- To produce a graph of all the measurements of refrigerant concentration in the Detector memory for the individual SAMM selected.
- To produce an Audit for all the types of alarm that have been stored in the Detector memory for the individual SAMM selected.
- To force the SAMM selected to sample continuously for a period of 15 minutes. If this option is selected, after the initialisation period (3 to 6 minutes, depending on sample pipe length), the refrigerant concentration shown on the SAMMS LIST screen will be updated every 2 seconds. Measurements of refrigerant concentration taken during the START SAMPLE option will not be stored in the Detector memory, operate the traffic light display or the alarm relays.
- To inhibit the individual SAMM selected from operating the detector relays for a period of 12hrs.



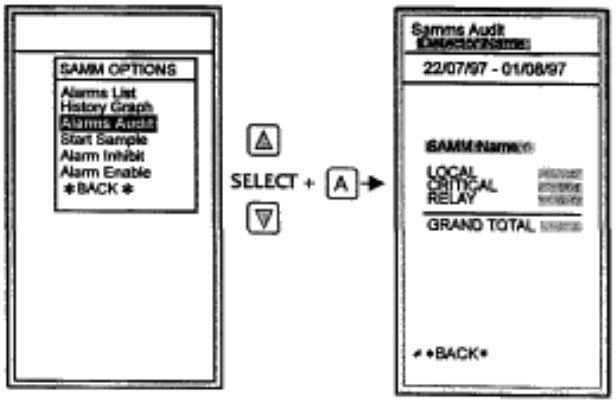
View Alarms List



View History Graph

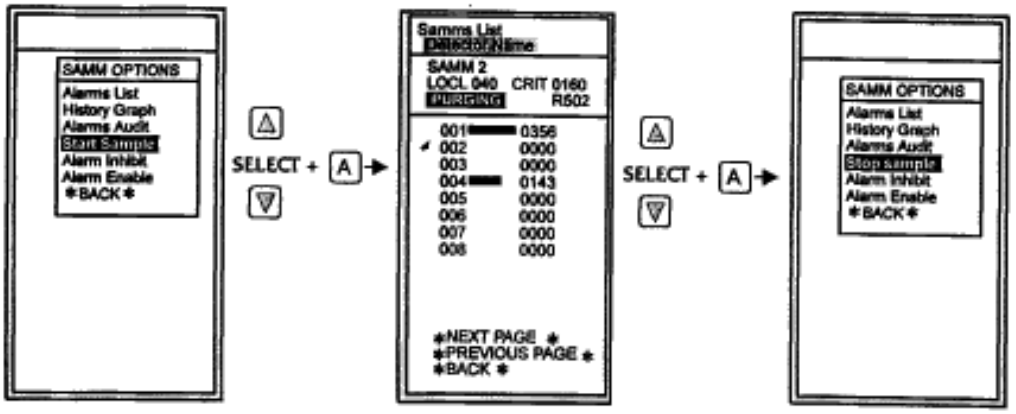


Produce Alarms Audit

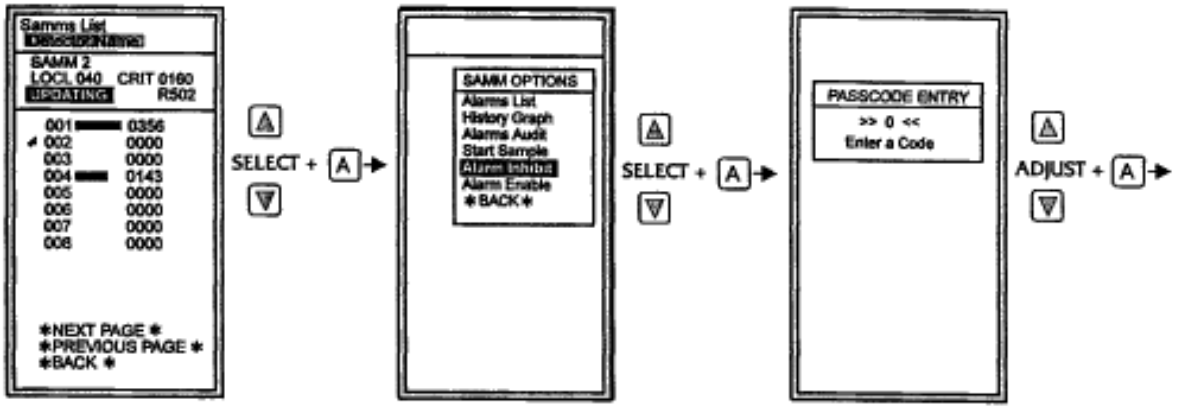


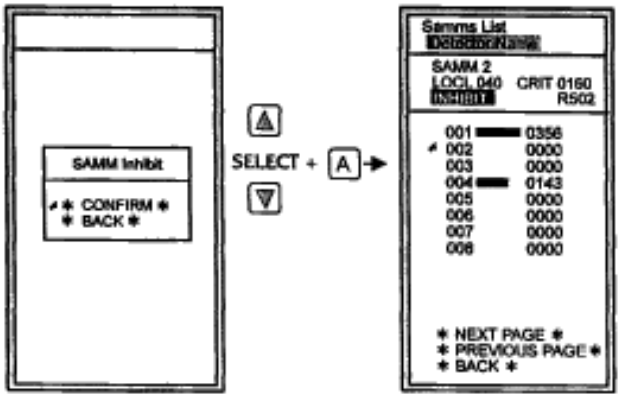
Parasense
REFRIGERANT DETECTION

Start Sample



Inhibit Relay





Parasense
REFRIGERANT DETECTION

DETECTOR SET-UP 3100

971014
MN3105/4
From Software Version 31.6E onwards

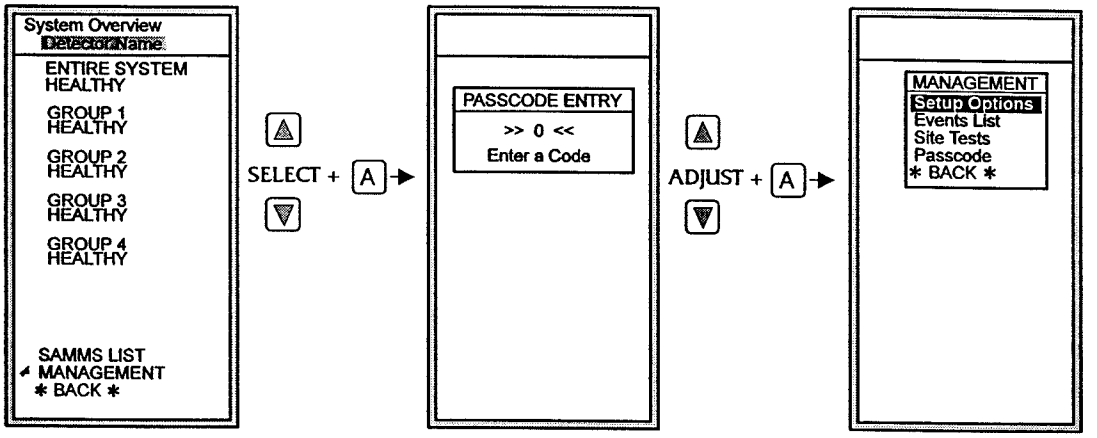
Parasense
REFRIGERANT DETECTION

DETECTOR SETUP - 3100

To set up a detector for the first time or to modify any of the existing configuration data then access must be obtained via the *Management* option on the System Overview Screen. If the appropriate password is used then the Management Options menu screen will be obtained.

The ("Basic") 'User Level' passcode and entry procedure is detailed in the 'User Guide'. The 'Management Level' passcode is available from Parasense.

Select Management Option Screen

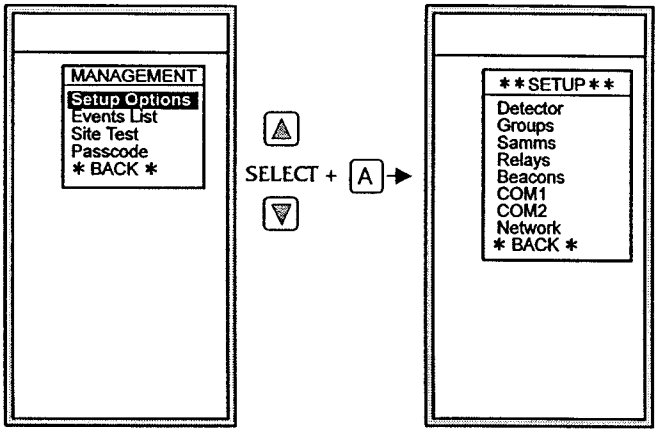


Management Options

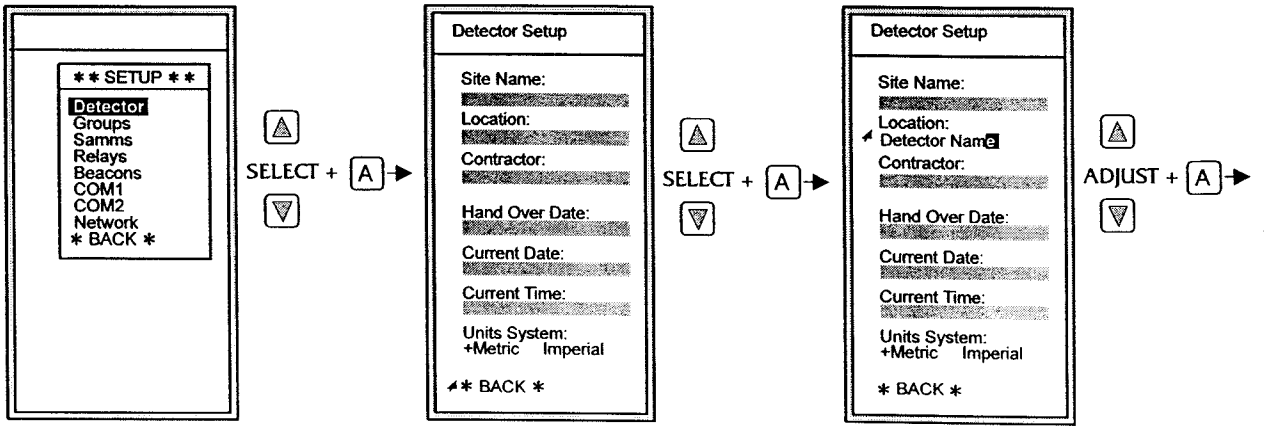
The management screen has four functions

- To access the options to configure, modify or 'setup' the operating data within the detector.
- To display a schedule of 'Management' generated events.
- To invoke a Site Test, selecting 'site test' will start manual sampling on all units, which will run for 30 minutes unless stopped.
- To input a user selected Passcode.

Detector Setup Options



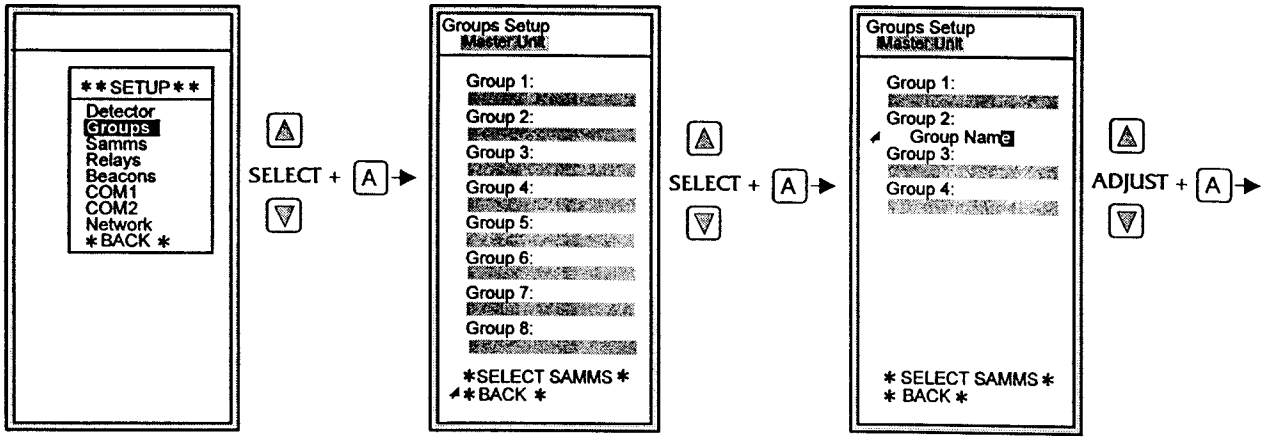
Edit Detector Configuration Data



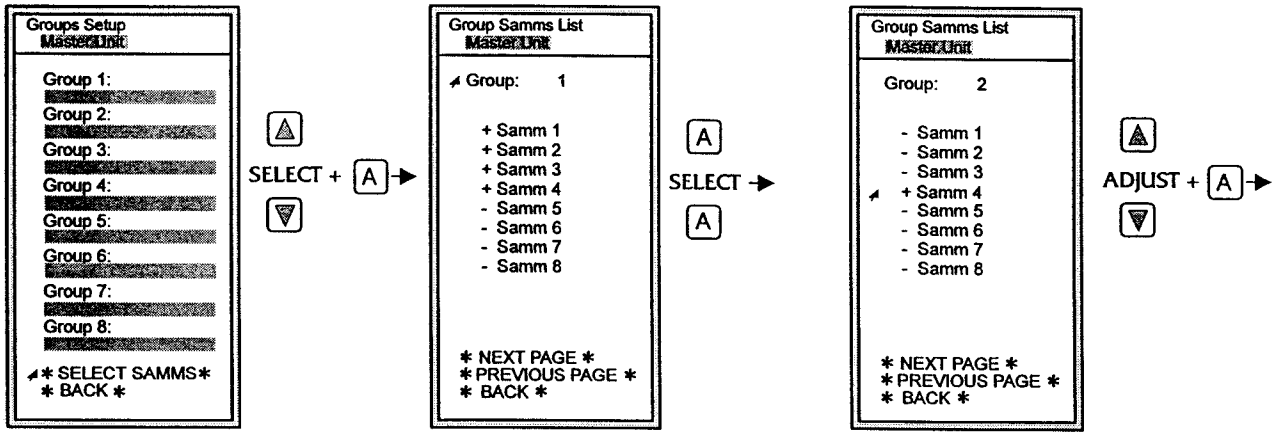
Parasense
REFRIGERANT DETECTION

Groups Setup

Change Group Name or Add Group

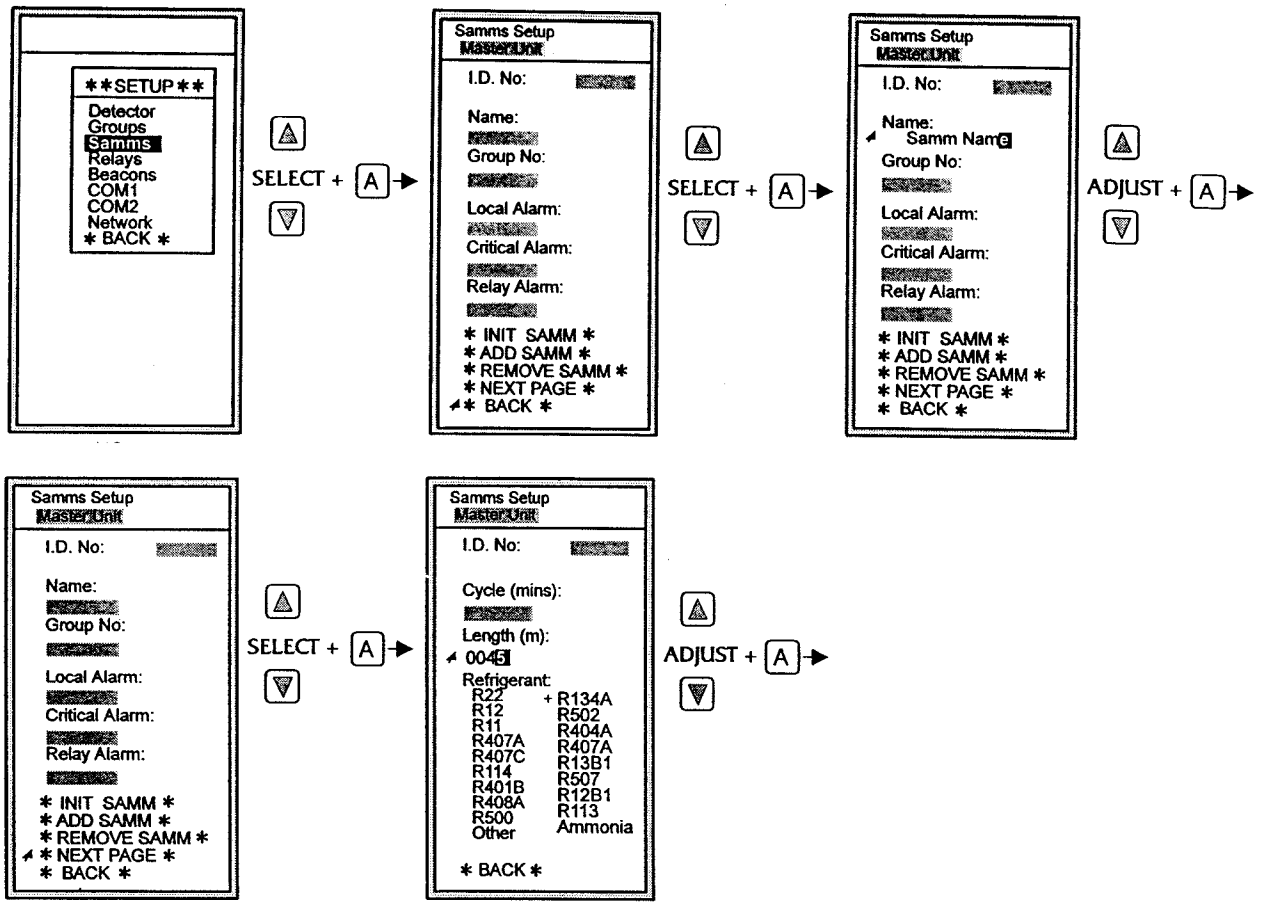


Allocate SAMMS to Groups

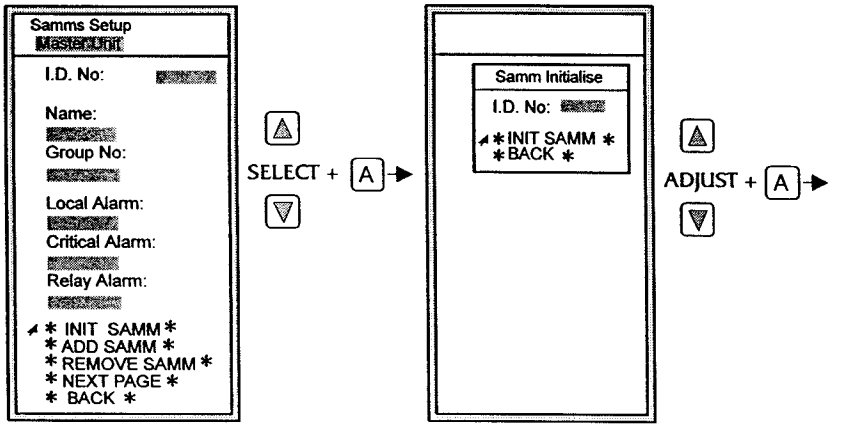


SAMMS Setup

Select SAMM I.D and Change Parameters

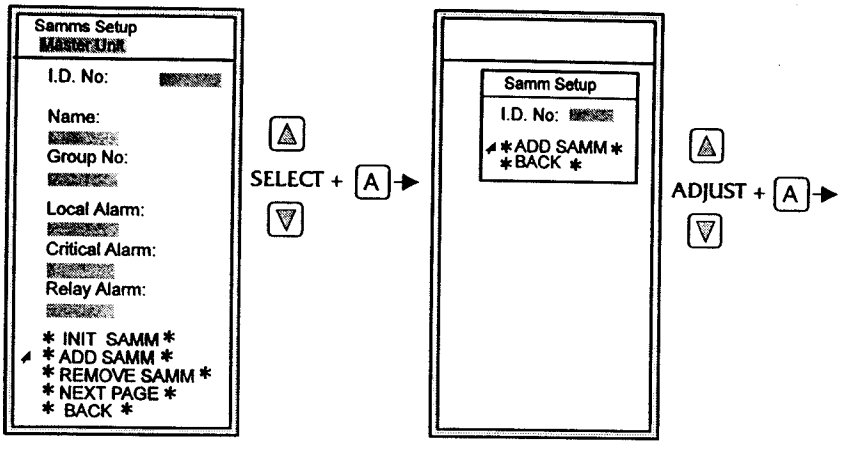


Initialise SAMM

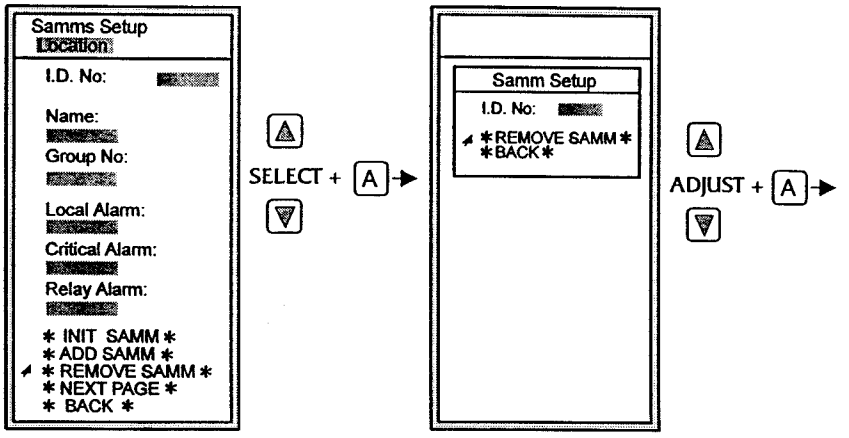


Parasense
REFRIGERANT DETECTION

Add Additional SAMM to Detector

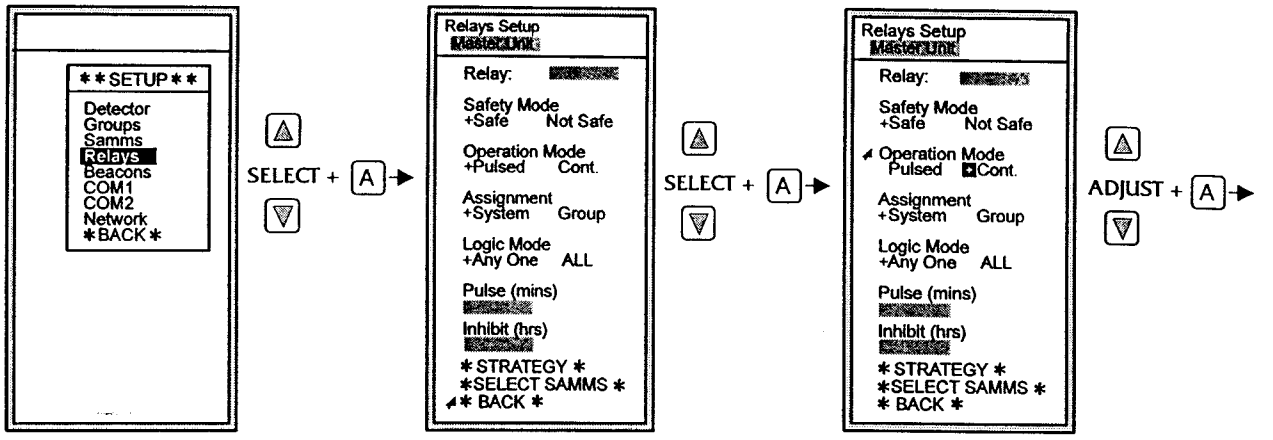


Remove SAMM from Detector

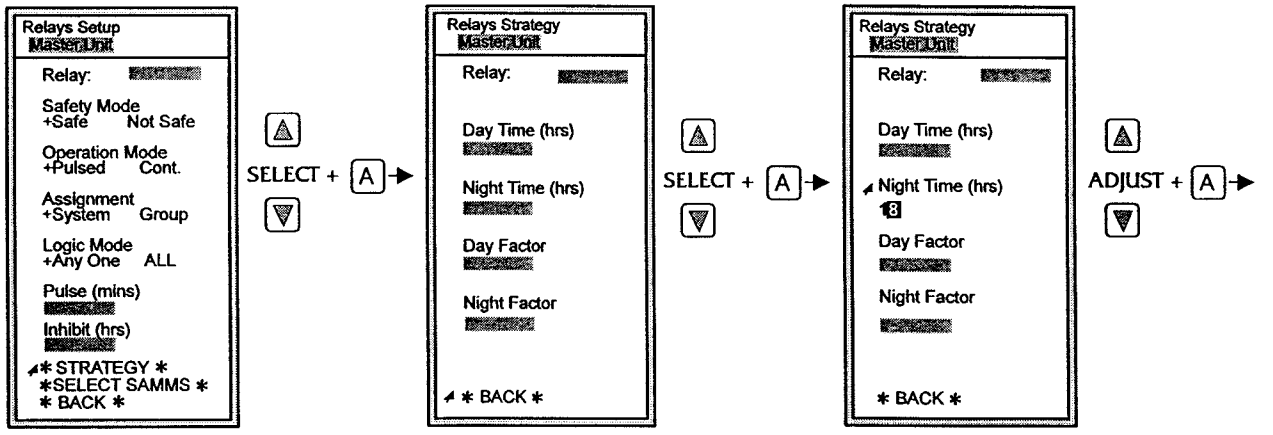


Relay Setup

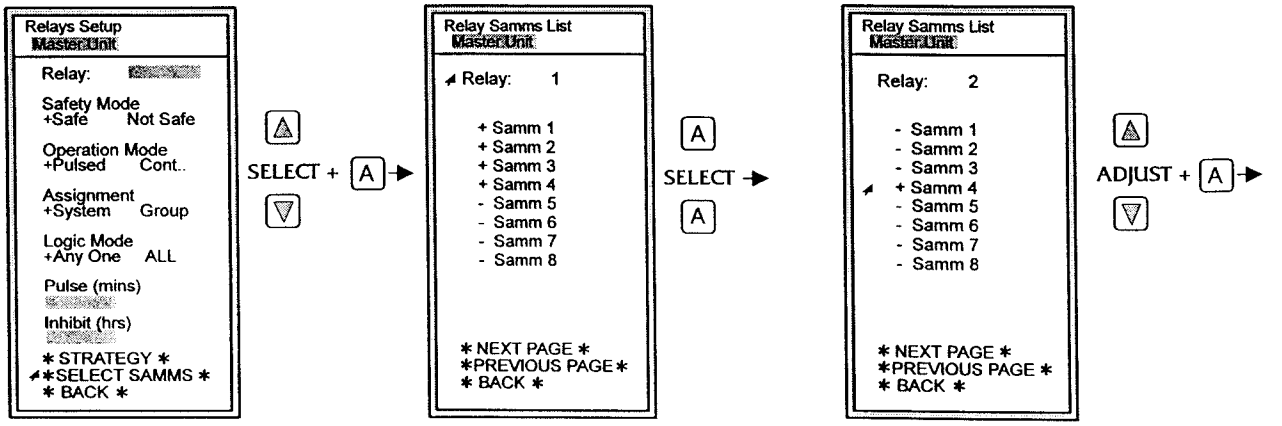
Select Relay and Change Parameters



Select Strategy and Night Setback



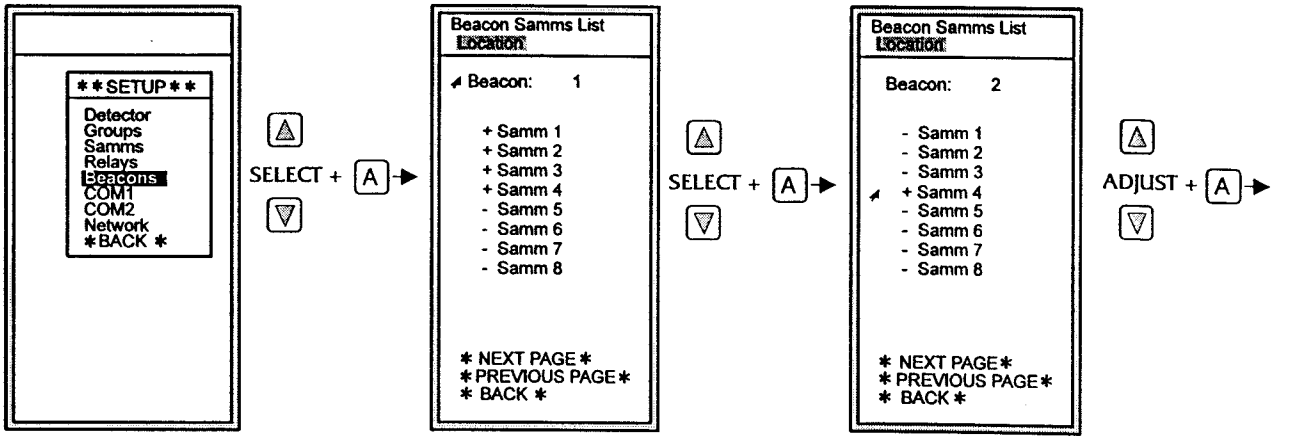
Assign SAMMs Associated with Relay



Parasense
REFRIGERANT DETECTION

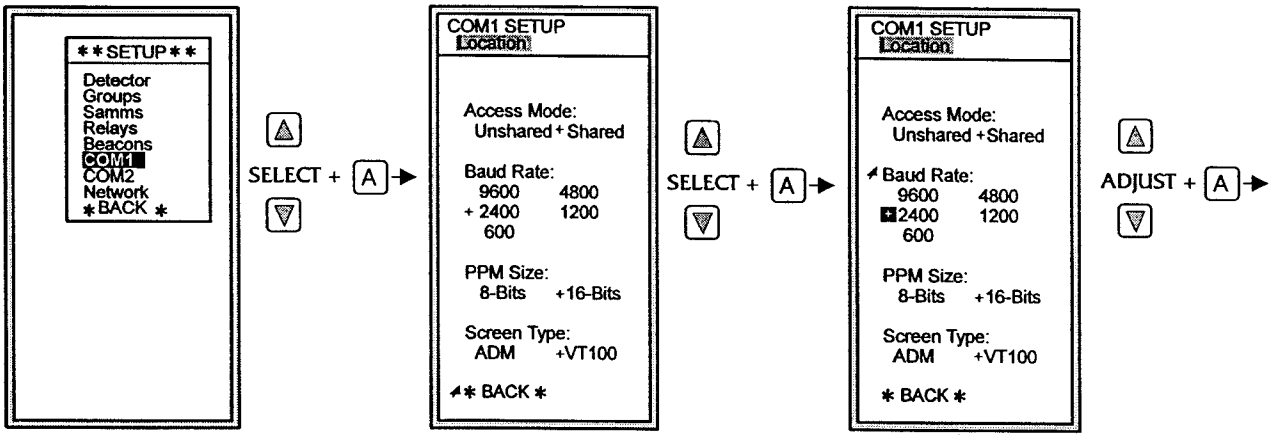
Beacons Setup

Assign SAMMS to Beacons

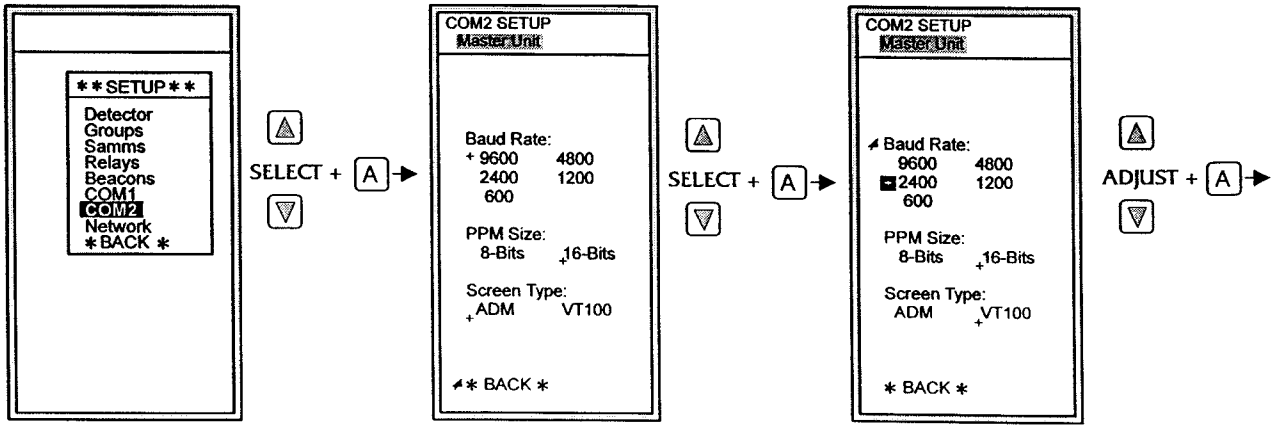


Comms Setup

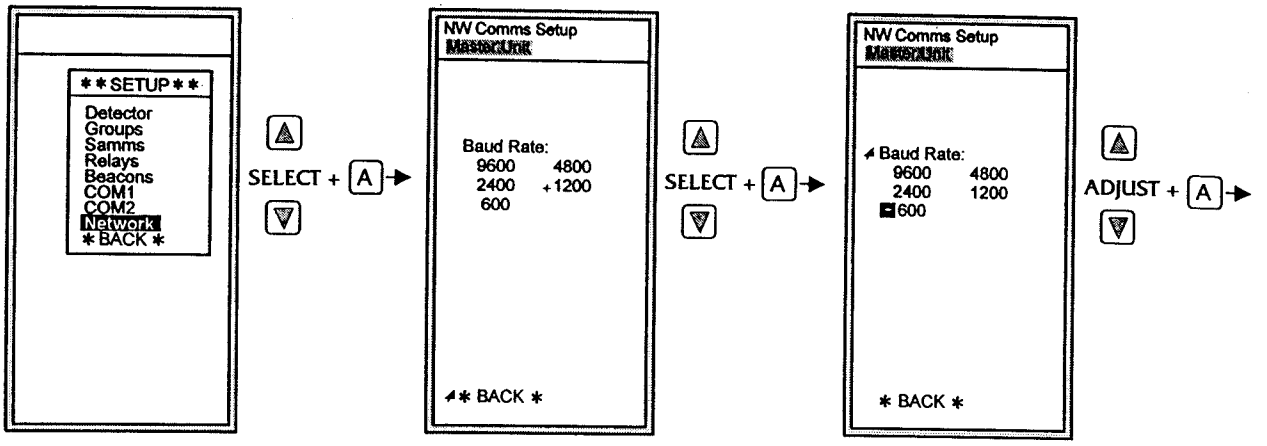
COM. 1 Setup



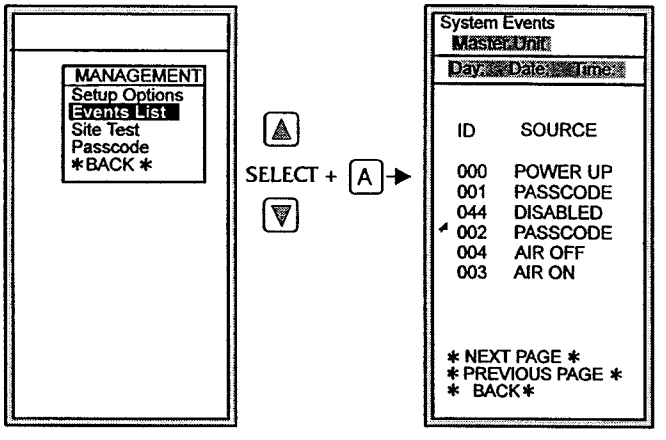
COM. 2 Setup



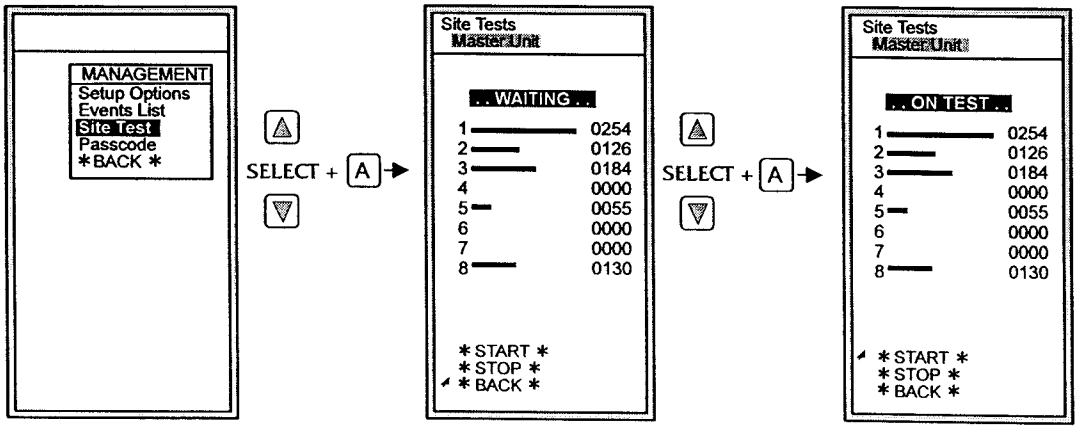
Network Comms



System Events

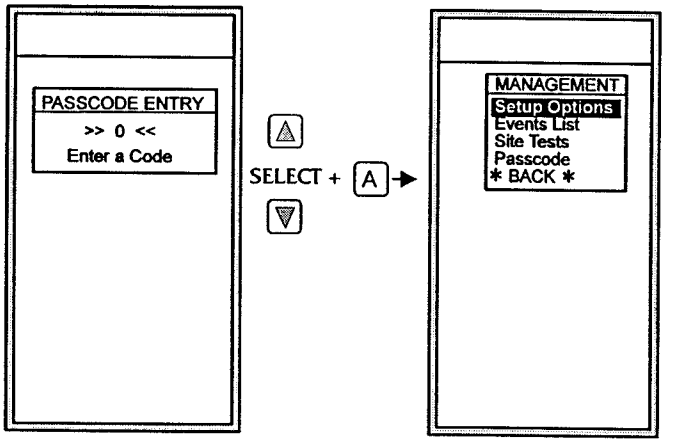


Site Tests

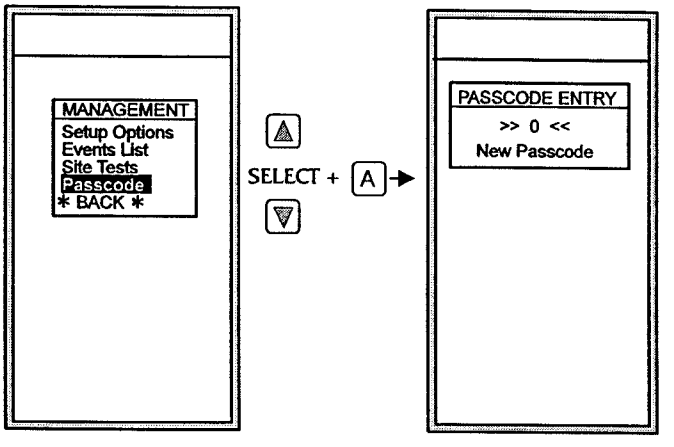


Passcode

Entry into the 'Management Level' is protected by a confidential passcode to prevent unauthorised changes in set-up data or detector operation.



To input a user selected Passcode



Getting Started

If the correct Parasense Setup information is submitted at the time of ordering then your 3100 detector will be fully configured and ready to go. If however, no configuration data has been provided then the detector will have been loaded with default data, which enables the detector to be powered up and operate. The default data can then be modified to preferred application data by reference to the Design and Installation Guide plus use of the Management Options.

If starting from scratch the suggested route is as follows:-

- Fill out the relevant Detector and SAMM configuration sheets.
- Set the detector bit switches to give the desired I.D and SAMM I.D range (see Design and Installation Guide).
- Select the *Management* option from the System Overview screen, followed by the password to arrive at the Management Options - Menu Screen.
- Select Detector Setup and enter all the relevant details.
- Select Group Setup, configure the groups required and remove the rest.
- Select SAMM Setup, configure all the SAMMs required and remove any unwanted ones.
- Select Relays Setup and configure the relays to be used.
- Select Beacons Setup and assign SAMMs. (Only required if a Parasense 12 Channel Alarm unit is fitted).
- Select Comms Setup and configure the two communication ports if required.
- Select Network Port and Configure the Baud Rate, if required.
- Switching the detector power 'off' then 'on' will lock the new data into the memory, the idle screen will be displayed and you are now in business.

DESIGN AND INSTALLATION GUIDE

971118
MN3106/4
From Software Version 31.60 onwards

Parasense
REFRIGERANT DETECTION

DESIGN AND INSTALLATION GUIDE

Refrigerant Leakages

Parasense has spent many years of research studying the causes and nature of refrigerant leakage, in a large variety of installations. Parasense Detectors have been used to log refrigerant leakage automatically, and the information collected loaded into a data base for analysis. At the time of writing this document, over 200,000 pieces of information are collected in a 24hr period. Analysis of this database has lead to the following conclusions regarding the causes and nature of refrigerant leakage.

The causes of refrigerant leakage

All refrigerant leakages are caused by material failure. The mechanism that creates the material failure is normally attributable to one or more of the following factors:-

- **Vibration** - Vibration is a significant factor in material failure and is responsible for "work hardening" of copper, misalignment of seals, loosening of securing bolts to flanges etc.

- **Pressure Changes** - Refrigeration systems depend on the changes in pressure for their operation. The rate of change of pressure has different effects on the various components in the system which results in material stress and differential expansion and contraction.

- **Temperature Changes** - Refrigeration systems frequently consist of different materials, or materials of differing thickness. Rapid changes in temperature result in material stress and differential expansion and contraction.

- **Frictional Wear** - There are many cases of frictional wear causing material failure and they vary from poorly fixed pipework, to shaft seals.

- **Incorrect material selection** - In a number of cases, materials are selected that are inappropriate i.e. certain types of flexible hoses have a known leakage rate, and materials that are known to fail under conditions of vibration and transient pressure and temperature changes are sometimes used.

- **Poor quality control** - Unless the materials used in the refrigeration system are of a high and consistent standard, changes in vibration, pressure and temperature will cause failure. In addition, inadequate training in brazing, welding and testing techniques leads to long term failures.

- **Accidental damage** - These are rare occasions and care should always be taken to protect pressurised systems from accidental damage.

The principle causes of refrigerant leakage have been outlined above, but the three most common causes are:-

- Vibration

- Temperature Changes

- Pressure Changes

As all these features are present in most refrigeration systems, the potential of refrigerant leakage due to material failure is always present. The most likely source of leakage is at a mechanical joint, where invariably dissimilar materials or dissimilar thickness materials form a junction.

The Nature of Refrigerant Leakage

The nature of refrigerant leakage is a complex subject, but the Parasense research has highlighted four significant areas.

- **All large leaks start as small ones** - With the exception of accidental damage, the material failure which is responsible for refrigerant leakage is a very slow process. Leaks invariably start as minute erratic emissions, and develop in time to failures that lose large quantities of refrigerant.

- **Leaks are not constant** - The quantity of refrigerant that is leaked is not constant, but varies with vibration, pressure and temperature changes within the refrigeration system.

- **Leaks are time dependent** - Material failure is also time dependent. What doesn't leak now, will eventually.

- **Some refrigerants leak more than others** - Leakage through a tiny fissure or orifice in some cases can be compared with diffusion, the smaller the molecule size the greater the leakage. In addition, different refrigerants have varying powers as solvents, some will attack sealing materials more than others.

Conclusions

From the foregoing observations of the causes and nature of refrigerant leakage, plus the data collected by Parasense, a number of conclusions may be drawn:-

- The greatest loss of refrigerant is due to a large number of small leaks, not a small number of large leaks. The best way of identifying these leaks is with a Parasense system.

- Small leaks are difficult to find. As refrigerant leakage varies with time and changes in vibration, temperature and pressure, manual refrigerant detection is ineffective. Manual leak detection merely gives a "snapshot", Parasense detection gives the long term picture enabling leakage to be dealt with effectively.

- It is inevitable that a refrigeration system that has either mechanical joints, rotating seals or dissimilar materials will eventually leak. Parasense refrigerant detection will ensure that the leakages are found at an early stage, thus reducing refrigerant losses.

System Design Guidelines

A Parasense refrigerant detection system can consist of a single detector, a group of detectors or a network of detectors. However, the design of a Parasense system is simple and consistent irrespective of the size of the installation. The Parasense system design falls into six distinct processes, which are -

- Identify the most likely sources of leakage.
- Allocate sample pipework to selected potential sources of leakage.
- Allocate sample pipework to SAMMS.
- Allocate SAMMS to a detector and a location.
- Decide whether to produce a network.
- Allocate relays and comms.

These design processes are defined in more detail.

- **Identify the most likely sources of leakage** - Some of the most common sources are as follows:-

a) Mechanical joints of all kinds, especially those which experience changes in vibration, temperature and pressure.

b) Rotating seals (i.e. shaft seals on compressors, and spindles on shut off valves).

c) Pipework that is subjected to excessive vibration.

d) Pipework that has rapid changes in direction.

e) Any refrigeration equipment that is in a confined or poorly ventilated space.

f) The air downstream of a direct expansion cooling coil in an A.H.U.

- **Allocate sample pipework to the selected potential sources of leakage** -Parasense sample pipework consists of two components, a SPUR KIT and FREEWAY. The SPUR KIT is a junction with up to seven sample pipes and filters radiating from it. The FREEWAY is a colour coded 10mm pipe which joins the spur kit to its relevant SAMM.

The SPUR KIT comes with three standard lengths of sample pipe 4mtrs, 6mtrs and 10mtrs. The FREEWAY is available in standard lengths of 25, 50, 75, 100 and 120mtrs. The choice of the number and length of the sample pipes is dictated by the size and the number of potential leakage sources, and the ventilation. It is always better to allocate too many sample pipes than too few. In addition, if cost considerations allow, it is better to dedicate a SPUR KIT to a particular piece of plant or equipment as it will make pinpointing leaks much easier.

- **Allocate sample pipework to SAMMS** - Allocate one SPUR KIT to one SAMM. NEVER tee or join several SPUR KITS together, the air sample drawn will not be consistent, and the detection erratic and unreliable. In general, the length of the FREEWAY should not exceed 120mtrs/390ft. Allocate the SAMMS to the SPUR KITS ensuring that no FREEWAY will be greater than 120mtrs.

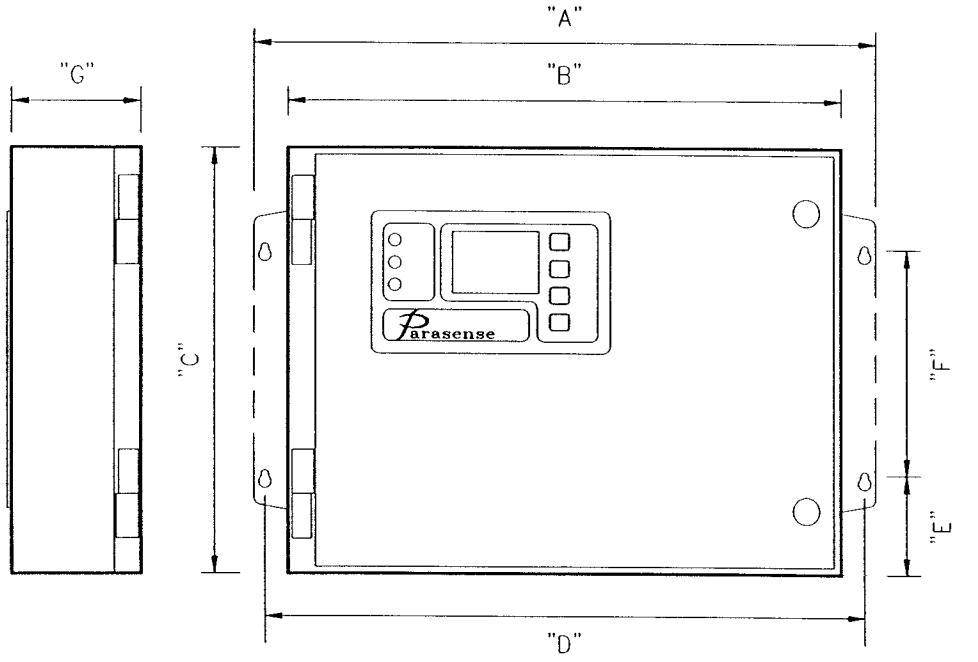
- **Allocate the SAMMS to a detector and a location** - In general. it is most cost effective to use the 3116 detector, but FREEWAY length and user access will also play a part in deciding the number of SAMMS per detector. The detector location is important; it should be positioned in a sheltered place at a height of no more than 1.800mtrs/6ft from floor level to the top of the enclosure, in an area where it is safe and convenient for the operator.

- **Decide whether to produce a network** - All Parasense detectors can operate as individuals, groups or part of other systems. If you wish to make a Parasense network, then all the detectors in the installation must be connected together using a 2-core, screened communication cable. Also, one of the detectors in the system must be nominated as the MASTER, as from this detector all the SAMMS in the system may be addressed and controlled. If the Parasense system is to become part of another communication network, then communications are available via an RS232 port from the MASTER using a private protocol. If an open system network is available, then a LON mark Parasense detector is available which uses private messaging and public messaging, using an approved set of SNVTs.

- **Allocate relays and comms** - Each detector has a number of relays that can be operated depending on the refrigerant concentration measured at any of the SAMMS linked with it. This is a unique feature of Parasense and can be used to signal leakages in particular areas, pieces of equipment or groups of equipment. There are four relays which can be used per detector. In addition to the relays, two communications channels are available which can be used for remote communication, or communication with other intelligent systems or devices.

Detector Installation Guidelines

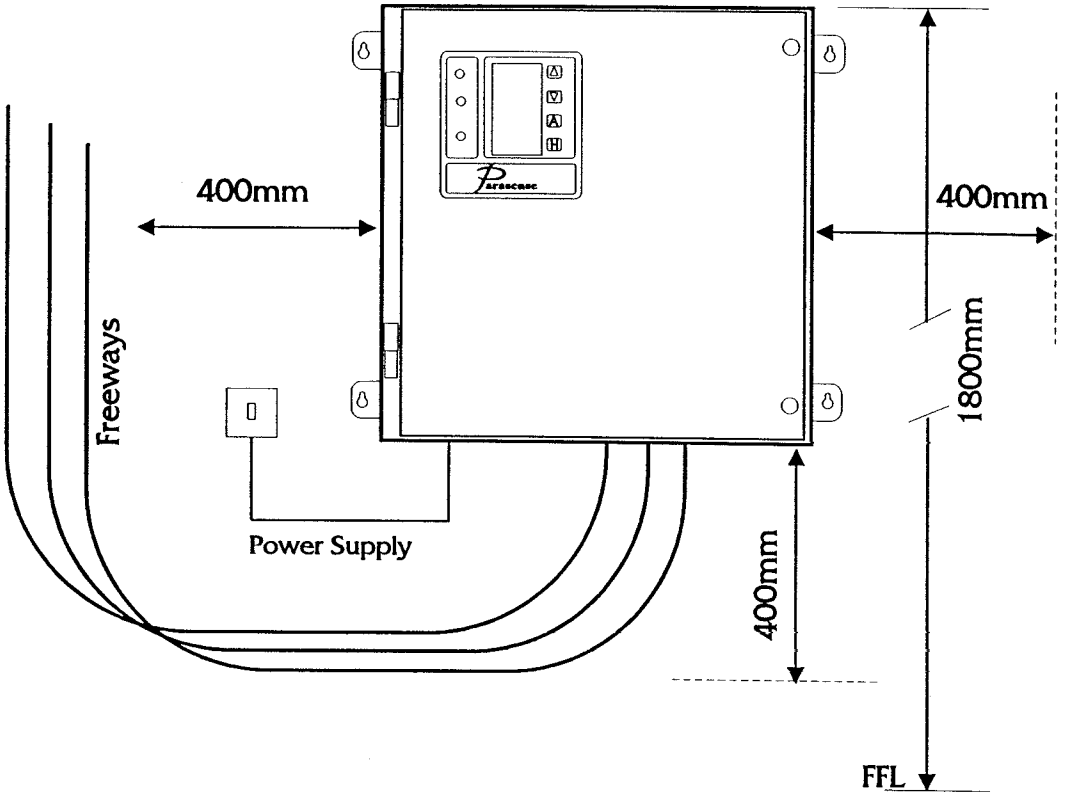
Parasense 3100 series refrigerant detectors are manufactured in a range of sizes, with varying numbers of SAMMS depending on the specification. The dimensions of the various Parasense detectors are shown below.



REF.No.	Sample Modules	A	B	C	D	E	F	G
3101/4	1	450.00	400.00	350.00	434.00	70.00	210.00	150.00
3102/4	2	450.00	400.00	350.00	434.00	70.00	210.00	150.00
3103/4	3	450.00	400.00	350.00	434.00	70.00	210.00	150.00
3104/4	4	450.00	400.00	350.00	434.00	70.00	210.00	150.00
3105/8	5	600.00	550.00	500.00	584.00	70.00	360.00	150.00
3106/8	6	600.00	550.00	500.00	584.00	70.00	360.00	150.00
3107/8	7	600.00	550.00	500.00	584.00	70.00	360.00	150.00
3108/8	8	600.00	550.00	500.00	584.00	70.00	360.00	150.00
3109/12	9	750.00	700.00	500.00	734.00	70.00	360.00	150.00
3110/12	10	750.00	700.00	500.00	734.00	70.00	360.00	150.00
3111/12	11	750.00	700.00	500.00	734.00	70.00	360.00	150.00
3112/12	12	750.00	700.00	500.00	734.00	70.00	360.00	150.00
3113/16	13	1010.00	960.00	500.00	994.00	70.00	360.00	150.00
3114/16	14	1010.00	960.00	500.00	994.00	70.00	360.00	150.00
3115/16	15	1010.00	960.00	500.00	994.00	70.00	360.00	150.00
3116/16	16	1010.00	960.00	500.00	994.00	70.00	360.00	150.00

Note: Dimensions in millimetres

A number of FREEWAYS radiate from the base of each detector, and it is vital to leave at least 400mm of unobstructed space beneath the detectors to marshal and connect the FREEWAYS. If the FREEWAYS are to rise vertically from the detector, then a clear space of 400mm should be left to one side of the detector to enable the pipework to be fitted. Each detector has a hinged door which is the full width of the enclosure. Sufficient space should be left in front of the detector to enable the door to be fully opened. A typical 3100 detector installation is shown below.



Note: Dimensions in millimetres

Detectors should be mounted on a solid, vertical surface at a height range of 1600mm to 1800mm from floor level to the top of the detector enclosure. The detector should be secured in position with fixings that are capable of supporting the unit using the external fixing lugs supplied.

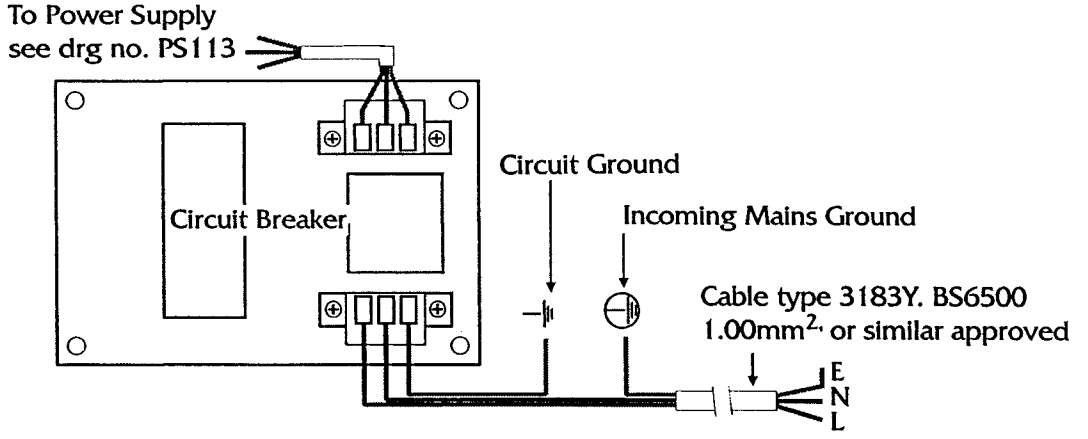
Recommended operating Ranges:
Temperature 0°C to + 40°C.
Humidity 20% to 80%.
Altitude max 2000 metres

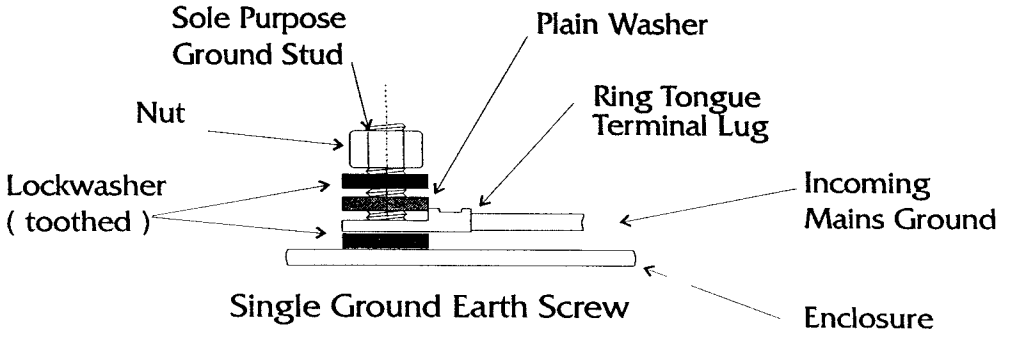
Electrical Requirements

Each detector requires an Earthed, AC single phase mains supply in the range of 100 to 240 volts. 50 to 60 Hz, protected by a 5amp fuse or similar overcurrent circuit breaker.
The final connection should be made as indicated below or with a similar approved cable, incorporating a water tight strain relief bush through the detector enclosure. In certain instances this equipment may be supplied with a moulded plug and cable which can be inserted into an appropriate socket.

Note: This monitor is an "Installation Category 2 product".

Power consumption for a 3104 Monitor is 20 watts.
Power consumption for a 3108 Monitor is 25 watts.
Power consumption for a 3112 Monitor is 30 watts.
Power consumption for a 3116 Monitor is 35 watts.





'Caution, Risk of Electric Shock' Please isolate elsewhere before opening monitor door.

Parasense Network and Relay Connections

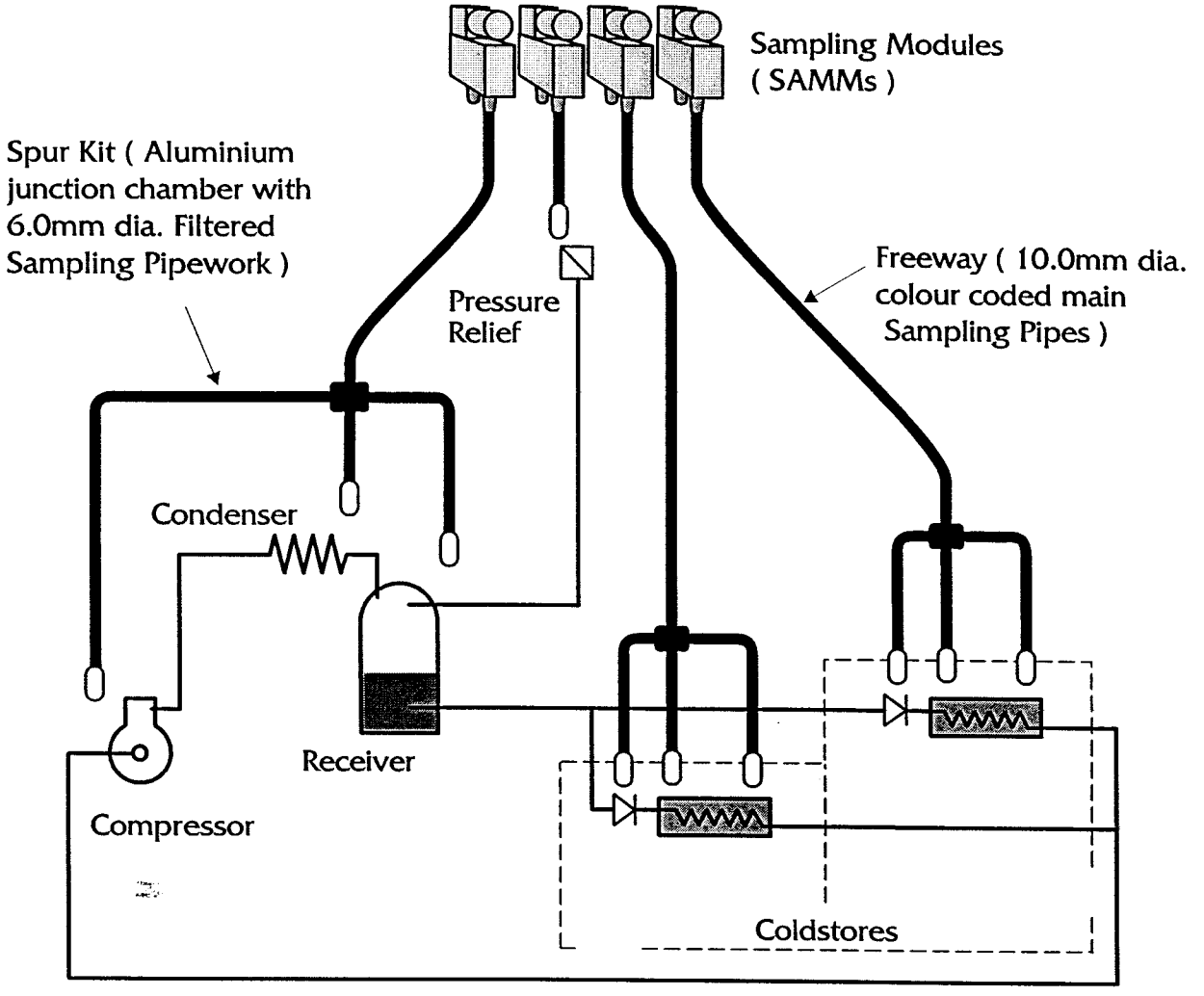
We recommend that all network and relay cabling be 1 twisted pair, 0.5 sq.mm., 16/0.22mm, overall screen to BS5308 Part 2, Type 1. This is a standard instrumentation and control cable with sufficient insulation to enable it to be run with mains voltage cables. Connection to the detector field board for the Parasense network cables, plus the relay cables, is via individual plug and sockets. When terminating cables, care should be taken to maintain the correct polarity and terminate the cable screen in the terminals provided.

Comms Cables

Two RS232 comms channels are available for communication with other intelligent systems and modems etc. Connection to these channels is via individual plugs and sockets on the detector field board.

Sample Pipework Installation Guidelines

Parasense sampling pipework is used to draw samples of air from areas of potential leakage to the respective SAMM. A typical installation is shown below.



The sample pipework consists of two components, the FREEWAY plus the SPUR KIT. The FREEWAY is a colour coded 10mm pipe which connects the SAMM to the SPUR KIT. The FREEWAY has sixteen unique colours, which are as follows:-

FREEWAY COLOUR	PARASENSE REF.	DETECTOR SAMM
Red	50101/	1
Yellow	50102/	2
Blue	50103/	3
Green	50104/	4
Black	50105/	5
White	50106/	6
Purple	50107/	7
Brown	50108/	8
Red/Black Stripe	50109/	9
Yellow/Black Stripe	50110/	10
Blue/Black Stripe	50111/	11
Green/Black Stripe	50112/	12
Black/White Stripe	50113/	13
White/Black Stripe	50114/	14
Purple/Black Stripe	50115/	15
Brown/Black Stripe	50116/	16

Each detector has its SAMM location stamped in the base of the enclosure and the SAMM/FREEWAY colour code (described above) should always be followed.

The SPUR KIT consists of a JUNCTION plus a number of colour coded 6mm SPUR pipes and filters. The SPUR KITS are available with a number of SPUR pipes at three different lengths. **It is imperative that the SPUR pipes are the same length, under no circumstances mix SPUR pipes of different lengths on the same SPUR KIT.** If a particular SPUR KIT is too long, neatly coil the excess material and tie wrap into place.

The SPUR KITS available are as follows:-

NO. OF SPUR PIPES	PARASENSE REF/SPUR PIPE LENGTH 4MTR (13FT)	6MTR (20FT)	10MTR (30FT)
1	5101/4 (5101/13)	5101/6 (5101/20)	5101/10 (5101/30)
2	5102/4 (5102/13)	5102/6 (5102/20)	5102/10 (5102/30)
3	5103/4 (5103/13)	5103/6 (5103/20)	5103/10 (5103/30)
4	5104/4 (5104/13)	5104/6 (5104/20)	5104/10 (5104/30)
5	5105/4 (5105/13)	5105/6 (5105/20)	5105/10 (5105/30)
6	5106/4 (5106/13)	5106/6 (5106/20)	5106/10 (5106/30)
7	5107/4 (5107/13)	5107/6 (5107/20)	5107/10 (5107/30)

All Parasense FREEWAY and SPUR KITS are manufactured from materials that will not affect the performance or sensitivity of the SAMMS. If alternative pipework is used, the performance of the detector will be affected, and Parasense will not guarantee or maintain the final installation.

PIPEWORK INSTALLATION ~ Starting from the Detector, run the (10mm diameter) coloured Freeway pipework to the area to be monitored. Cut the freeway pipe to length and insert into the Spur Kit junction manifold, fix the manifold to a firm surface. Run the (6mm diameter) sampling pipes to the equipment and locate evenly around the mechanical joints.

Clip, Tie wrap or Tape all pipework neatly in position ensuring that it is supported throughout its length, and that it is not kinked or crushed.

Follow the "Installation Do's and Don'ts".

Installation Do's

- Ensure that the FREEWAY is pushed right into the connection on the SAMM and SPUR KIT junction manifold.
- Fix the SPUR KIT junction manifold.
- Ensure that the SPUR KIT sample pipe filters always point downwards.
- Ensure that the SPUR pipes are pushed right into the connector on the junction.
- Ensure that the FREEWAY/SAMM colour connection is adhered to.
- Use continuous lengths of FREEWAY (DON'T JOINT).
- Locate sample fittings as closely as possible to the potential leakage areas.
- Cut the FREEWAY straight using the correct cutter.

Installation Don'ts

- Flatten or kink the FREEWAY or SPUR pipe.
- Bend the FREEWAY at a radius of less than 300mm/12".
- Bend the SPUR pipe at a radius of less than 150mm/6".
- Run the FREEWAY from a warm place through a very cold space.
- Expose the FREEWAY or SPUR KIT to temperatures in excess of 60°C or less than –30°C.
- Let the SPUR KIT filters ever be immersed in water, or any other liquids
- Ever adjust the length of the SPUR pipes.
- Run pipework in areas where they may be stood on or where they may restrict access to other equipment.

ALARM THRESHOLDS & CYCLE TIMES

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Parasense
REFRIGERANT DETECTION

ALARM THRESHOLDS & CYCLE TIMES

All of the individual SAMMS in any detector have individual alarm thresholds and cycle times. For ease of set-up, all these parameters have default values which enables the detector to operate as soon as it is powered up. However, the alarm thresholds and cycle times for each SAMM should be adjusted to suit the particular area of detection. The definition of these parameters is as follows:-

LOCAL ALARM

Values of refrigerant concentration measured below this value will be recorded in the Detector memory, but will not affect the traffic light or SAMM status display. The Local Alarm is normally set at the minimum concentration of refrigerant that is practical to find using standard techniques. This value will vary from location to location, depending on application, ventilation etc. The Local Alarm is selectable in the range of 30 to 990 p.p.m. Values measured at or above the Local Alarm threshold will cause the red traffic light to operate, update the SAMM status display with LOCAL and record the event in the Alarms List and Detector memory.

CRITICAL ALARM

Values of refrigerant concentration measured at or above the value will cause the red traffic light to flash, update the SAMM status display with CRITICAL and record the event in the Alarms List and Detector memory. The Critical Alarm threshold is set at a concentration where significant loss of refrigerant could take place. The value will vary from location to location, depending on application, ventilation etc. The Critical Alarm is selectable in the range 100 to 990 p.p.m.

RELAY ALARM

Values of refrigerant concentration measured at or above this value will cause the Relay to activate, the traffic light to flash, update the SAMM status display with RELAY and record the event in the Alarms List and Detector memory. The Relay Alarm threshold is set at a concentration where a significant loss of refrigerant is likely, and a threat to safety is possible. The value will vary from location to location, depending on application, ventilation etc. The Relay Alarm is selectable in the range from100 to 5000 p.p.m.

Cycle Time

This is the time interval measured in minutes between successive starts of a sample cycle for a particular SAMM. The length of the cycle time will be affected by such things as ventilation, vulnerability or safety and is selectable in the range of 5 to 99 minutes. Typical alarm thresholds and cycle times for various refrigerants and applications are as follows:-

Typical Alarm Levels for: R22, R113, R123, R236fa, R401B, R404A, R407A, R407B, R407C, R408A, R500, R502, R507, R1211

Sample Location	Local Alarm	Critical Alarm	Relay Alarm	Cycle Time
Packaged equipment, compressors, condensers. Equipment with a high degree of vibration and large amounts of refrigerant.	40	100	800	30
DX coils in A.H.U.'s, plantroom extract fans. Areas where detection is required in substantial air flows.	40	100	700	25
Expansion valves, solenoid valves, manifolds receivers. Equipment with mechanical joints in normally ventilated areas.	40	180	800	40
Coldstore interiors, brine rooms, unventilated hatches. Areas where ventilation is poor and a threat to safety is likely.	40	160	600	20
Static ducts and voids where access is restricted, or not possible.	40	140	800	60
H.P relief lines bursting disks, safety venting devices.	40	120	500	35

Typical Alarm Levels for: R11, R12, R134a

Sample Location	Local Alarm	Critical Alarm	Relay Alarm	Cycle Time
Packaged equipment, compressors, condensers. Equipment with a high degree of vibration and large amounts of refrigerant.	100	200	950	30
DX coils in A.H.U.'s, plantroom extract fans. Areas where detection is required in substantial air flows.	100	200	850	25
Expansion valves, solenoid valves, manifolds receivers. Equipment with mechanical joints in normally ventilated areas.	180	300	950	40
Coldstore interiors, brine rooms, unventilated hatches. Areas where ventilation is poor and a threat to safety is likely.	100	300	750	20
Static ducts and voids where access is restricted, or not possible.	180	300	950	60
H.P relief lines bursting disks, safety venting devices.	180	240	650	35

Typical Alarm Levels for: R114, R1301

Sample Location	Local Alarm	Critical Alarm	Relay Alarm	Cycle Time
Packaged equipment, compressors, condensers. Equipment with a high degree of vibration and large amounts of refrigerant.	400	800	3200	30
DX coils in A.H.U.'s, plantroom extract fans. Areas where detection is required in substantial air flows.	400	800	3000	25
Expansion valves, solenoid valves, manifolds receivers. Equipment with mechanical joints in normally ventilated areas.	720	900	3200	40
Coldstore interiors, brine rooms, unventilated hatches. Areas where ventilation is poor and a threat to safety is likely.	400	900	2800	20
Static ducts and voids where access is restricted, or not possible.	720	900	3200	60
H.P relief lines bursting disks, safety venting devices.	720	840	2600	35

In any Parasense installation, all the detectors and all of the SAMMS should be given a unique I.D. If a network is to be formed, then the detector I.D. 00 will be the master where access to all other SAMMS in the system will be available. The detector I.D. is set by the two rotary switches on the detector field board. The SAMM I.D.'s are selected using the detector controls. The Master Detector rotary switches will be set to I.D '00'. Slave Detector rotary switches will be set to the I.D of its first SAMM.

Detector Set-Up

System Configuration

The detector has been programmed with "Default Configuration Data", which can be modified to suit individual applications via the "Management" options menu screen.

Default Configuration

Refrigerant:	R22	
Alarm Levels:	Local	40 p.p.m.
	Critical	160 p.p.m.
	Relay	800 p.p.m.
Cycle Time:	60 minutes	
Pipe Lengths:	100 metres.	

SERVICE AND MAINTENANCE

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Parasense
REFRIGERANT DETECTION

SERVICE & MAINTENANCE

The Parasense Refrigerant detector has been designed to automatically collect and analyse samples of air, to record and report the time, presence and concentration of refrigerants, in accordance with the set configuration.

Parasense Ltd/Parasense Inc warrants the detector for a period of one year from the date of purchase against defects in materials and workmanship. This warranty will not apply to defects resulting from the non-compliance with the Design & Installation guide, over voltage, physical abuse or tampering with individual items. Use of equipment in a manner not specified by the manufacturer may impair the protection afforded by the equipment.

Parasense offers a wide range of Service and Maintenance contracts, Remote access software and Management reporting packages. Details and cost of "Service Exchange Units" can be obtained from Parasense Ltd, Chippenham, U.K., Parasense Inc, V.A., U.S.A. or their approved distributor

In the event of a fault occurring carry out the following:

1. If none of the LEDs or the display screen are lit, check that the mains supply is present.
2. If the display is blank but the Green LED is lit, adjust the contrast using the scroll up and down keys (down to darken).
3. If a system fault has occurred, indicated by a flashing Green LED, view the SAMMs List (see User Guide), then each individual SAMM, and note the 'Fault Message'. Contact Parasense Ltd/Parasense Inc or the supplier of the Parasense equipment.

Air filters should be periodically checked and replaced if obstructed. Re-calibration of the Sampling Modules (SAMMs) at regular intervals (normally annually), is essential to maintain the high degree of accuracy required in detecting small amounts of refrigerants.

The detector has no user serviceable components, but comprises of four basic 'building blocks'.

(i) The enclosure 'Body'.
(ii) The enclosure 'Door' which incorporates the operator key pad and display.
(iii) The 'Network Module (Insert Plate)' Incorporating the field connection board, power supply unit and SAMM processor boards.
(iv) The 'Sampling Modules' (SAMMs) which incorporate the pump, sensor and filter.

Should it become necessary to replace the 'Enclosure Door' the 'Network Module' or the 'Sampling Modules', the following procedures should be applied.

Observe precautions for handling electrostatic discharge sensitive devices, when maintaining this equipment e.g. use a wrist strap.

Replacing the Enclosure Door

The door assembly module houses all the configuration data for the detector. If replaced it will also be necessary to enter all the configuration details and initialise the SAMMs.

Switch off the mains supply and wait for a few seconds while the power supply discharges. Open the door, unplug the two ribbon cables and disconnect the earth strap on the door. The door can now be lifted off and a new one hung in place. Replace the earth strap and ribbon cables. Check connections are secure and reinstate mains supply.

Follow the detailed instructions supplied with the door.

Replacing the Network Module (Insert Plate)

Switch off the mains supply and wait for a few seconds while the power supply discharges. Open the door, disconnect the earth strap, unplug all the SAMMs, Mains supply connector, Ribbon cables to the door and orange BL connectors. Unscrew the four nuts holding the Network Module in position, located at each corner of the insert plate.

Replace the new Network Module assembly and tighten the nuts, using new shakeproof washers. Securely reconnect all the cables previously disconnected. Check the rotary address switches are correct for the detector and reinstate the mains supply.

Refer to the Parasense manual, Detector Setup section, and using the operator display screen work through to initialise SAMM, highlight the I.D of each SAMM in turn and select 'INIT SAMM' then Action. The data required will be automatically transmitted to each SAMM controller p.c.b.

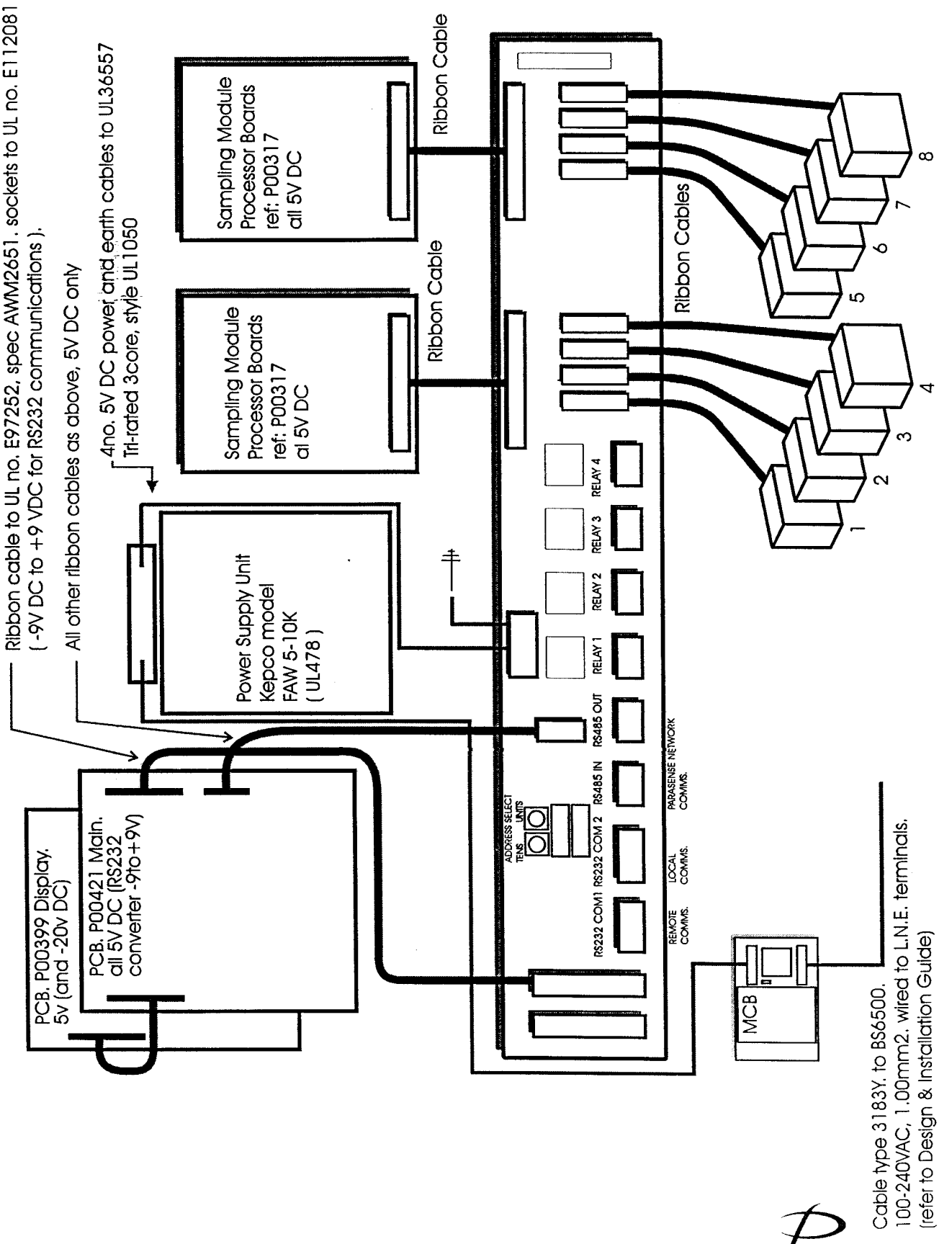
Replacing a SAMM

Switch off the mains supply and wait for a few seconds while the power supply discharges. Open the door, unplug the SAMM ribbon cable from the Network Module and remove the two fixing screws holding the SAMM at the base of the Parasense Detector, be careful not to damage the gasket.

To install the new SAMM, simply replace it in the vacant position. (Note: It will only fit with electronics towards the back). Re-connect the ribbon cable to the Network Module, and tighten the fixing screws with new shakeproof washers. Close the door and switch the Parasense Detector on.

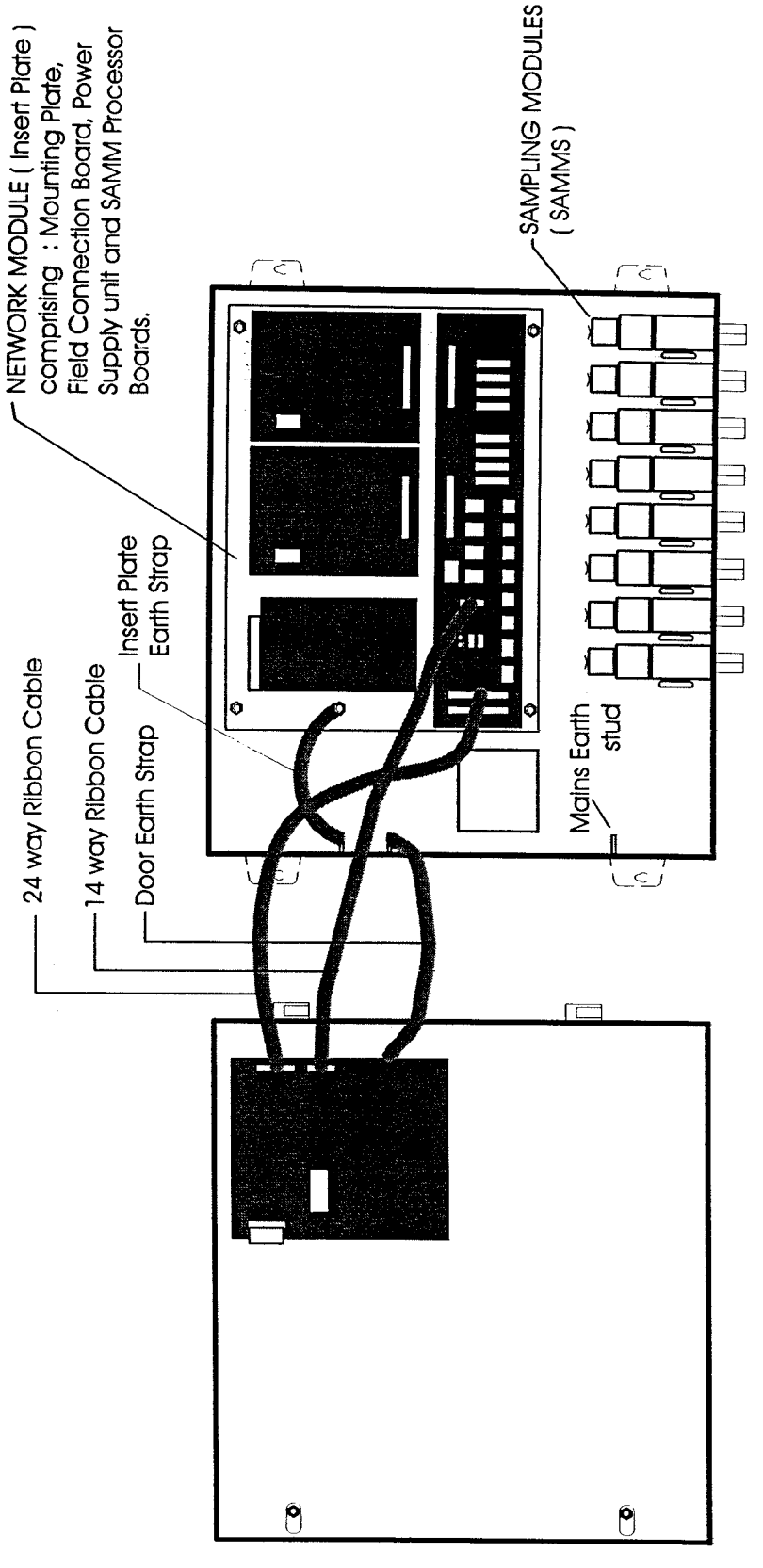
Refer to the Parasense manual, Detector Setup section, and using the operator display screen, work through to 'Initialise SAMM', highlight the I.D of the SAMM changed, select 'INIT SAMM' then Action. The data required will be automatically transmitted to the SAMM.

TYPICAL ELECTRICAL SCHEMATIC
(Model 3108/8)



Parasense
REFRIGERANT DETECTION

SCHEMATIC LAYOUT MONITOR INTERNAL
(Model 3108/8 shown)



Parasense
REFRIGERANT DETECTION