TQ 4200

INFRARED
REFRIGERANT LEAK
DETECTION SYSTEM

OPERATING MANUAL

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PROPRIETARY

WARNINGS, CAUTIONS AND NOTES

Warnings identify an operating or maintenance procedure, practice, condition, or statement that, if not strictly followed, could result in death or injury to personnel.

Cautions, which appear elsewhere in this manual, identify an operating or maintenance procedure, practice, condition, or statement that if not strictly followed could result in equipment damage or serious impairment of system operation.

Notes highlight certain operating or maintenance conditions or statements that are essential but not of known hazardous nature as indicated by Warnings and Cautions.

Warnings, Cautions and Notes are included throughout this manual, as required. Additionally, this section contains important Warnings that may not be contained elsewhere within this instruction manual.

SAFETY WARNINGS

- **FOR SAFETY REASONS, THE TQ4200 MUST BE INSTALLED, OPERATED AND SERVICED BY QUALIFIED PERSONNEL ONLY. READ AND UNDERSTAND THIS INSTRUCTION MANUAL COMPLETELY BEFORE OPERATING THE TQ4200**
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- **THE OPERATION DESCRIBED IN THIS DOCUMENT IS THE INTENDED USE OF THE TQ4200. TQ ENVIRONMENTAL LTD CANNOT BE HELD RESPONSIBLE IF THE TQ4200 IS USED FOR ANY OTHER PURPOSE OTHER THAN THAT STATED. ANY OTHER USE OF THE TQ4200 WILL CAUSE ANY CERTIFICATES ISSUED TO NOT APPLY.**

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*** See section Sub Index for contents**

1.0 INTRODUCTION

The ***TQ4200*** is an Aspirated Infrared Refrigerant Leak Detection System (IRLDS). This system utilises infrared gas analysing technology to detect the signatures of the designated gas, thus eliminating any nuisance alarms from other gases, a selection of which are mentioned below;

a) Hydrogen
b) Carbon Monoxide
c) Carbon Dioxide
d) Hexane
e) Heat resistance aluminium paint fumes
f) Epoxy finishing paint fumes.
g) Epoxy finish white base paint fumes.
h) Bioguard water based paint
i) Methane

The ***TQ4200*** system has the capability of monitoring up to 16 sample points by sequentially cycling through each location. Individual sample lines can be configured to detect differing refrigerant gases.

The ***TQ4200*** is currently programmed to monitor the following default refrigerants. The gas list is regularly updated to include the latest refrigerants and additional refrigerant can also be programmed on request.

a) R134a
b) R407a
c) R407c
d) R407f
e) R404A
f) R410a
g) R422d

Each sample point will also have three individual alarm trip levels. Any gas sample concentration reaching the ‘low’, ‘high’ and ‘high-high’ trip levels will operate the common alarm relays and provide an output to actuate audible/visual alarm devices.

The ***TQ4200*** front panel provides the operator interface via four pushbuttons and a backlit LCD display. During normal operation the LCD display will provide the ‘location’, ‘gas type’ and sample ‘concentration’ for each individual location.

The ***TQ4200*** also has the ability to store the last twenty alarms which can be displayed in alarm/time/date format in time order.

Each of the sample transport lines are constantly monitored for flow restrictions. In the event of a reduction or loss of flow, a ‘system flow alarm’ will be initiated.

The ***TQ4200*** is available in either ‘top’ or ‘bottom’ entry versions for sample lines and cabling, at 85-264V 50/60 Hz.

PART NO	**DESCRIPTION**
370-520	TQ420016-way bottom entry 85-264V
370-522	TQ4200 8-way bottom entry 85-264V

2.0 DESCRIPTION

2.1 Infrared Sensor (GD134, GD137)

The operation of the infrared sensor within the ***TQ4200*** has been developed from the infrared heat source detector utilised in the thermal imaging cameras measuring infrared radiation.

These detectors have now developed into non-dispersive infrared analysers.

Dispersive analysers use a wide band of infrared to identify a gas, the none-dispersive type narrows the wavelength specific to a gas. The narrow infra-red band produced is passed through the gas sample and a gas specific to this wavelength will absorb this infrared depending on the concentration. The electronics converts this absorption of infrared into an electrical signal for processing.

The narrowing of the band of infrared light is produced utilising filters made of specific material such as calcium fluoride, sapphire, etc.

The light source is modulated by a mechanical chopper to give a high performance on very small signal. This modulated light source together with a reference sensor, which is not exposed to the gas sample, gives a very accurate signal for a concentration of the target gas.

2.2 Pneumatic System

The gas sample is brought into the ***TQ4200*** at approximately 4 litres/min from one of the 15 sample lines, into the solenoid bank manifold by a diaphragm pump and presented to the infrared sensor.

A particulate filter is fitted before the pump. (Please refer to Figure 3 & 4).

2.2.1 External Catch-Pot

The external catch-pot will remove the majority of moisture within the sample line. If the bowl is allowed to fill the catch-pot will automatically shut-off the sample line causing a flow fail alarm.

2.2.2 Flow Fail

The flow fail is detected by the PCB mounted differential pressure switch sensing across a differential pressure tube (See Figure 4).This PCB will provide an alarm output when there is a reduction in air flow.

2.2.3 Pressure Sensor

A pressure sensor monitors the air pressure in the vent line of the TQ4200 to provide the electronics with pressure information when calculating the gas concentration. This pressure sensor is also a PCB mounted device.

2.2.4 Solenoid Valves

The solenoid valves in either an 8-way or 16-way configuration, are mounted on an eight way common manifold and have 24V DC operating coils. Fitted within the solenoid valve connector covers are back EMF diodes and LED indicators.

The common manifold also provides the individual sample line inlet ports. Each port is 1/8" BSP and can be fitted with a union connector to suit the transport tubing. (Note: these inlet connectors are not included with the standard unit).

2.2.5 Sampling Pump

The sampling pump is a single ended unit power by 24VDC from the internal power supply. The pump is fitted with viton diaphragm and seals, and requires very little maintenance. Flow rate for this application is 4 litres/min.

The electrical supply to the pump is wired through Fuse 4 (See Figure 5).

2.2.6 DC Electrical Supplies

The DC electrical supplies for the ***TQ4200*** are provided by its internal 110 Watt power supply unit. This is a universal input device and will accept an input of 85 to 250 Volts AC. (See Figure 5).

The mains input to the ***TQ4200*** unit is connected to TBF-01 and then to a fused isolator via the EMC suppresser.

2.2.7 Outputs

Outputs from the ***TQ4200*** are in the form of:-

- Volt Free Contacts for Alarm 1, 2 and 3
  and Common Fault
- 24V DC @ 100mA for Visual Alarm
- 24V DC @ 100mA for Audible Alarm
- One 4-20mA analogue output
  RS485 Modbus
  4-20ma Output with respect to concentration (0-2000ppm)
  4-20ma Output with respect to location (1ma per location)

2.2.7 MODBUS O/P

The MODBUS bus output can be connected to any MODBUS configurable device. The standard register addresses and communications protocol are defined as follows:-

Input Register (0x04)	**Starting Address (High)**	**Starting Address (Low)**	**Number of Registers (High)**	**Number of Registers (Low)**	**Number of Bytes**
Station Number Read (0x04) Write (0x10)	0x00	0x10	0x00	0x01	2
Zone 1 Conc.	0x00	0x00	0x00	0x01	2
Zone 2 Conc.	0x00	0x01	0x00	0x01	2
Zone 3 Conc.	0x00	0x02	0x00	0x01	2
Zone 4 Conc.	0x00	0x03	0x00	0x01	2
Zone 5 Conc.	0x00	0x04	0x00	0x01	2
Zone 6 Conc.	0x00	0x05	0x00	0x01	2
Zone 7 Conc.	0x00	0x06	0x00	0x01	2
Zone 8 Conc.	0x00	0x07	0x00	0x01	2
Zone 9 Conc.	0x00	0x08	0x00	0x01	2
Zone 10 Conc.	0x00	0x09	0x00	0x01	2
Zone 11 Conc.	0x00	0x0A	0x00	0x01	2
Zone 12 Conc.	0x00	0x0B	0x00	0x01	2
Zone 13 Conc.	0x00	0x0C	0x00	0x01	2
Zone 14 Conc.	0x00	0x0D	0x00	0x01	2
Zone 15 Conc.	0x00	0x0E	0x00	0x01	2
Zone 16 Conc.	0x00	0x0F	0x00	0x01	2
Discrete Inputs (0x02)	**Starting Address (High)**	**Starting Address (Low)**	**Number of Registers (High)**	**Number of Registers (Low)**	**Number of Bytes**
Alarm Status	0x00	0x00	0x00	0x01	2
	Input Number				
Alarm 1	0				
Alarm 2	1				
Alarm 3	2				
Fault	3				
Communications Protocol					
Baud Rate	**Data Bits**	**Parity**	**Stop Bits**	**Transmission**	**Error Check**
19200	8	Even	1	RTU	CRC-16

3.0 SYSTEM SOFTWARE

This section explains in detail the system set-up and operation of the ***TQ 4200*** main board. Four keys are used to navigate through and access the system software functions, namely: *MENU, SELECT, UP,* and *DOWN.*

3.1 System Start-up

When the system is powered on or a hardware system reset occurs, the ***TQ 4200*** main board will boot up showing the Start-up screen in Figure 3-1 below:

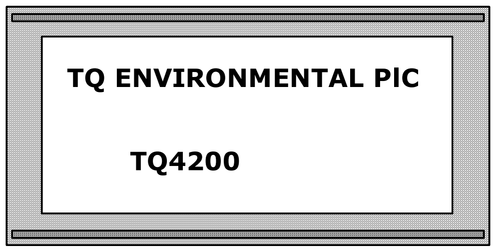

Figure 3-1 Start-up Display

3.1.1 NVRAM Test

The ***TQ 4200*** will perform an internal non-volatile memory self-test. The result of the test being displayed on the LCD as shown below:

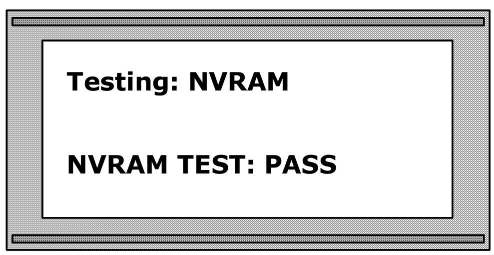

Figure 3-2 NVRAM Self Test

3.2 Power-on Reset*

The power-on reset function is used to load the default data into the system. The user must initiate the power-on reset by pressing and holding the *SELECT* key, *UP* key, and *DOWN* key simultaneously for approximately two seconds when the power is turned on.

If the user does not initiate a power-on reset then the system will begin initialisation by downloading the previous parameters into system memory from the non-volatile serial RAM. This stage is indicated on the liquid crystal display by Figure 3-3 shown below:

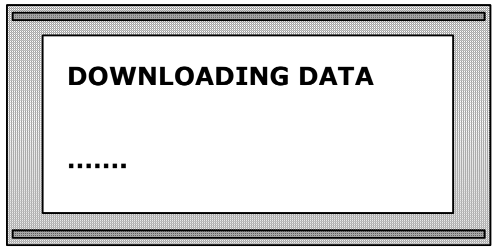

Figure 3-3 System Initialisation Display

* The system start up is only required on the very first power up or if any data becomes corrupt.

3.3 System Warm-up

When the ***TQ 4200*** main board is powered on or a hardware reset is applied, the system will undergo a warm-up period. This warm-up period will last no longer than 2 minutes and the liquid crystal display will be as shown in Figure 3-4 below:

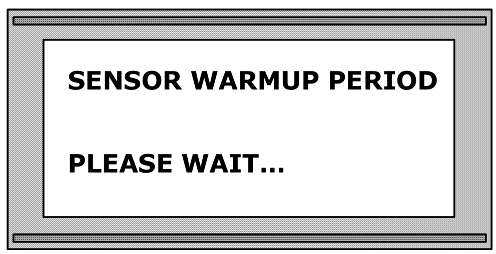

Figure 3-4 Warm-up Period Mode

If the warm-up period is unsuccessful and 15 minutes has elapsed since the power has been turned on, the system will select the System Fault mode.

N.B. Due to the temperature changing within the cabinet the sensor will take time to obtain 95% accuracy. After 8 hours the system will reached its peak accuracy. The systems are therefore designed for continuous operation and should not be powered down as necessary.

When the system has settled, any opening of the door on the cabinet will reduce the accuracy again of the system. Therefore several hours are required for true readings to be obtained. This is due to the fact explained in section one where originally these sensors were used for thermal imaging and the difference in temperatures affects their accuracy.

Additionally the detector and reference elements in the system have different coefficients of heat dissipation which results in loss of accuracy.

3.3.1 Internal System Leak Test

After the warm-up period is complete the system will initiate a Pressure Test. This will test for any internal leaks within the system.

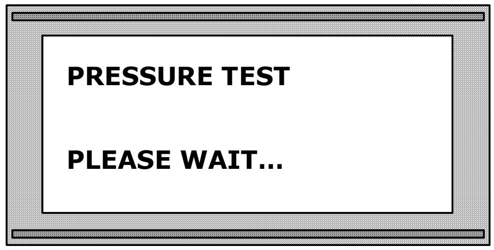

Figure 3-5 Pressure Test

3.3.2 Sensor Auto-Zero

At initial start up the system will initiate a sensor auto-zero. This will then be performed at the end of every cycle.

Figure 3-6 Sensor Auto-Zero

3.4 Normal Operating Mode

The ***TQ 4200*** main board has two distinct modes of operation: the Normal Operating Mode and the Menu Mode. After system initialisation, the ***TQ 4200*** main board will automatically select the Normal Operating Mode. In this mode the system will scan each zone location sequentially, displaying on the liquid crystal display the current zone location, the sampled gas, and the sampled gas concentration in parts per million (ppm). This information is displayed as shown in Figure 3-7 below:

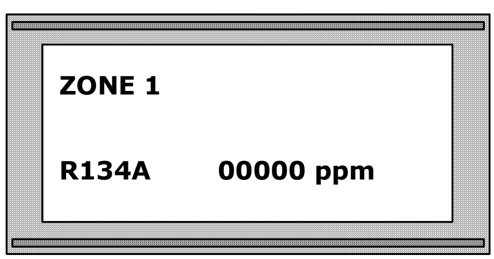

Figure 3-7 Normal Operating Mode

When selecting a particular zone location, its corresponding solenoid is activated in order to sample the gas concentration. At the end of the 'solenoid on' sequence the sampled gas concentration is measured and compared with two user defined alarm levels. If the sampled gas concentration has exceeded the stored alarm levels then an appropriate alarm relay will be activated. The display will confirm the alarm condition by displaying the zone location, alarm number, and alarm status. An example of an alarm condition is shown in Figure 3-8 below, together with either the first and second red alarm LED's.

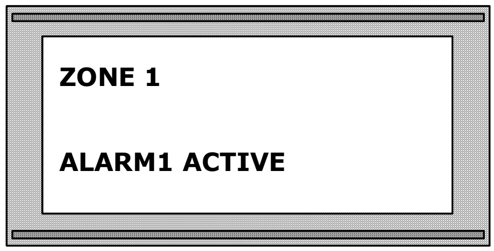

Figure 3-8 Example of Alarm Condition

A more detailed discussion of alarm conditions will be presented in section 4 of this manual.

3.5 Entering Passwords

To gain access to the Menu Mode, the user must enter a password (four-digit code). The numbers must be selected and entered one at a time. The *UP* and *DOWN* keys are used to scroll through the numbers. When the desired number is displayed, pressing the *SELECT* key will ENTER that number. The entered number will be blanked out after the *SELECT* key is pressed to ensure restricted access to the menu system. The cursor will now move to the next digit to the right of the blanked out digit and pressing the *UP* and *DOWN* keys will again change the number as required.

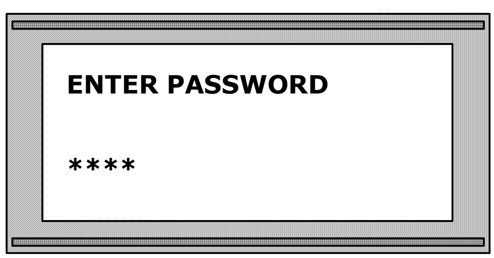

Figure 3-9 Display Password Prompt

After the four digits have been entered the system will check the entered password against the correct password. If the entered password is correct, the display will indicate this by displaying that the password has been accepted. The system will now select the Menu mode. If the entered password is incorrect the display will indicate this by displaying that the password is invalid. If the entered password is invalid, the user is again prompted to enter a password. (System default Password number is **6197**).

3.6 Overview of the Menu System

The menus are accessed from the Normal Operating Mode by pressing the *MENU* key. A password must be entered by the user to access the Menu Mode. Once the password has been accepted, the user will be presented with the Menu Screen. The menu may be navigated by pressing the *UP* and *DOWN* keys, which will enable the user to scroll through the menu items. The menu items will wrap around from the last menu item to the first menu item and vice-versa. For example, if the *UP* key is pressed when the last menu item, **EXIT MENU**, is displayed, the first menu item, **SET TIME**, will be displayed. Conversely, if the *DOWN* key is pressed when the first menu item, **SET TIME**, is displayed, the last menu item, **EXIT MENU**, will be displayed. To select the desired menu item, the user must press the *SELECT* key.

3.6.1 Main Menu - Set Time

When the **SET TIME** menu item is entered from the display, shown below in Figure 3-10, the system time may be altered. This real time clock will remain active and maintain an accurate time even when power to the system is turned off.

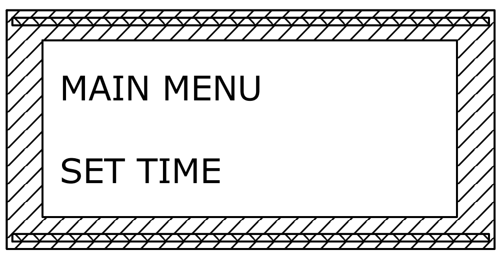

Figure 3-10 Set Time Menu Option

If the **SET TIME** menu item is selected the user will be prompted to enter the desired hours and minutes. The time is configured in the 24-hour clock mode. The **SET TIME** menu item display is shown in Figure 3-11 below. When first entered, the ‘hours’ value will flash indicating that this is the active field. Pressing the *UP* and *DOWN* keys will alter this field. To accept the displayed value the user must press the *SELECT* key. The ‘minutes’ value will now flash enabling the user to alter this field. Pressing the *SELECT* key again will set the minutes value. The *SELECT* key in this menu item acts as a toggle between selecting the ‘hours’ field and the ‘minutes’ field. When the desired time has been set the user must press the *MENU* key to exit the **SET TIME** menu item and return to the main menu.

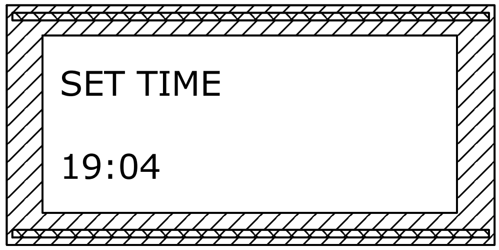

Figure 3-11 Set Time Menu Item

3.6.2 Main Menu - Set date

When the **SET DATE** menu item is entered from the display, shown below in Figure 3-12, the system date may be altered. This real time clock will remain active and maintain an accurate date even when power to the system is turned off.

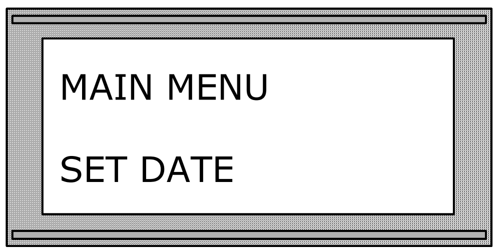

Figure 3-12 Set Date Menu Option

If the **SET DATE** menu item is selected the user will be prompted to ENTER the desired date, month, and year (dd/mm/yy). The date format is as shown in Figure 3-13 below. When first entered, the date value will flash indicating that this is the active field. Pressing the *UP* and *DOWN* keys will alter this field. To accept the displayed value the user must press the *SELECT* key. The month value will now flash enabling the user to alter this field. Pressing the *SELECT* key again will set the month value. Pressing the *SELECT* key again will enable the user to set the year value. The *SELECT* key in this menu item acts as a toggle between selecting the three date fields. When the desired date has been set the user must press the *MENU* key to exit the **SET DATE** menu item and return to the main menu.

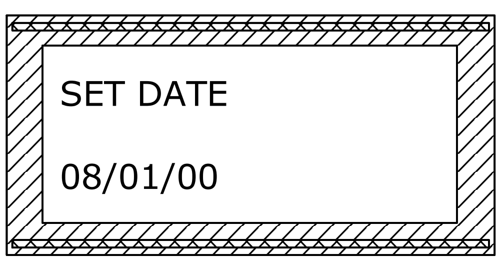

Figure 3-13 Set Date Menu Item

3.6.3 Main Menu - Channel Functions

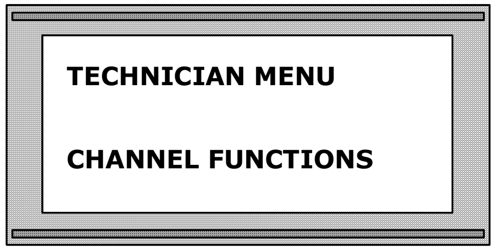

Figure 3-14 Channel Functions

When this menu option is selected, the user is provided with a Channel Functions sub-menu. This sub-menu allows the user to select a particular zone location and then Skip, goto, hold, or remove hold that zone location. When the zone location is in the hold state, that particular zone location will be held for a maximum period of 20 minutes before automatically reverting to normal operation. The user may remove the hold state at any time using the Remove Hold sub menu function. Please note, the channel may alarm and be muted while using this function.

The Skip function allows the user to turn off a redundant zone. This can prove useful if the user requires to do any maintenance on that line or if the line becomes obsolete.

3.6.4 Main Menu - Change Password

The user may change the password if desired. (Default 6197). This is achieved through the **CHANGE PASSWORD** menu option as shown in Figure 3-15 below:

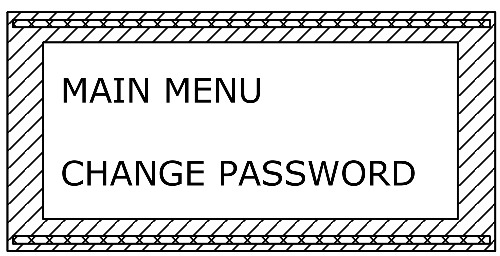

Figure 3-15 Change Password Menu Option

When this option is selected the user is prompted to enter the new password. This procedure is carried out in the same manner as entering password explained previously. Once the new password has been entered the user is prompted to re-enter the new password to ensure that it is the desired password, i.e. to ensure that it was entered correctly the first time. If the password was not entered correctly the display will indicate that an invalid password was entered and prompt the user to repeat the procedure. The user will be prompted a maximum of two times and if the password is still invalid the previous password will take effect. The system will return to the main menu mode.

3.6.5 Main Menu - Parameters

System parameters may be set and edited by entering the **PARAMETERS** menu option. This option is shown overleaf in Figure 3-16:

Figure 3-16 Parameters Menu Option

Once entered, the display will prompt the user to select a desired zone location for editing. The user must press the *UP* and *DOWN* keys to display the required zone location and then press the *SELECT* key to accept that zone location.

When a zone location has been selected, the user may cycle through the Parameters Sub Menu using the *UP* and *DOWN* keys and select the required Parameters Sub Menu Item using the *SELECT* key. A detailed description of the Parameters Sub Menu items now follow:

3.6.5.1 Set Location

The 16 zone locations are set by default to 'ZONE 1', 'ZONE 15'. This option will allow the user to change the name of the zone locations to a more meaningful description up to 16 characters in length, including the <SPACE> character. An example of which is shown in Figure 3-17 below:

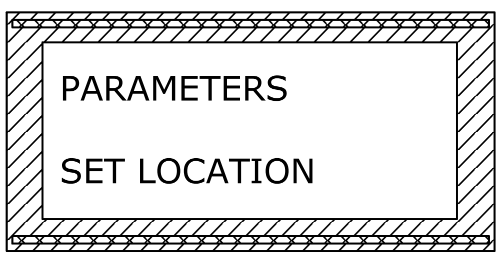

Figure 3-17 Example of Zone Description

The user must use the *UP* and *DOWN* keys to cycle through the alphanumeric characters, pressing the *SELECT* key when the display shows the required character. To leave spaces, select the <SPACE> character and press the *SELECT* key. When the *SELECT* key has been pressed the next digit on the right will be displayed.

Figure 3-18 Example of Location Name

To accept the zone location description the user must press the *MENU* key to exit the **PARAMETERS** MENU OPTION.

3.6.5.2 Set Gas Type

This option is used to set a particular gas to a particular zone location. (Refer to page 4 of this manual for refrigerant gas list). The current zone location is the one entered at the beginning of the parameters sub menu. To select a particular gas the user must press the *UP* and *DOWN* keys to cycle through the available gases. These gases have already been calibrated via the technical menu using sample line 1. When the desired gas is displayed the user must press the *SELECT* key to make that gas active for that zone location. This is shown in Figure 3-18 below:

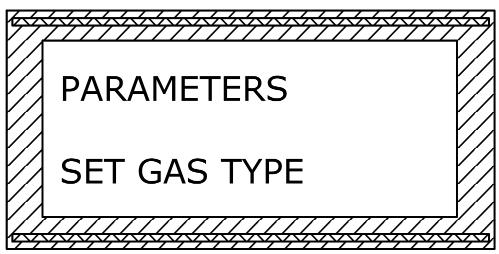

Figure 3-19 Set Gas Type Display

3.6.5.3 Set Alarm 1

This option is used to set the alarm level for Alarm 1. The alarm level is set in conjunction with the **SET ALARM TYPE** option which will be explained in section 3.6.5.5.

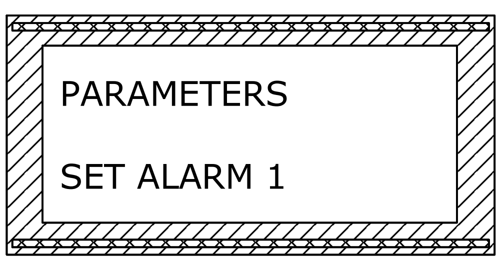

Figure 3-20 Set Alarm 1 Option

When selected this option allows the *UP* and *DOWN* keys to set the gas Alarm 1 level. This level is displayed in ppm and can be set in the range 0000ppm to 10,000ppm. To select the desired alarm level the user must press the *SELECT* key. When the desired alarm level is set the system will go back to the **PARAMETERS** menu option and prompt the user to select another zone location. If the user wishes to exit the Parameters sub menu the user must select a zone location and use the **EXIT SUB MENU** option to return to normal system operation. (System default for alarm 1 is set to 1000 ppm).

3.6.5.4 Set Alarm 2 & 3

This option is identical to the **SET ALARM 1** menu option but corresponds to Alarm 2 & 3 and works in conjunction with the **SET ALARM 2 & 3 TYPE** option. (System default for alarm 2 is 1250 ppm and alarm 3 is 1500 ppm).

3.6.5.5 Set Alarm 1 Type

This option is used to select whether an alarm is generated when the concentration is rising (+) or falling (-). When selected the user is presented with the display shown in Figure 3-22 below:

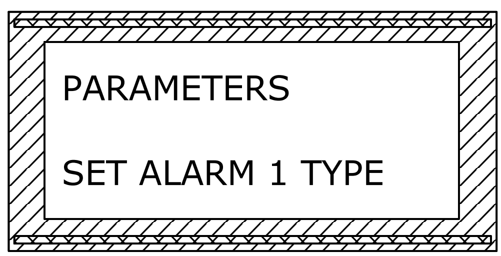

Figure 3-21 Set Alarm 1 Type Option

To change between positive going and negative going alarm levels the user must toggle between (+) and (-) using the *UP* and *DOWN* keys. When the required alarm type is displayed the user must press the *SELECT* key to enter the alarm type. (System default for alarm 1 is (+)).

3.6.5.6 Set Alarm 2 & 3 Type

This option is identical to the **SET ALARM 1 & 3 TYPE** described above but corresponds to the Alarm 2. (System default for alarm 2 is (+)).

3.6.5.7 Set Dwell Time

This option allows the user to specify the time in seconds that the system will remain in a particular zone location before sequentially incrementing to the next zone location. The dwell time is variable in the range from 0 to 300 seconds. On start up this is always 20 seconds

Figure 3-22 Set Dwell Time Option

To change the dwell time for a particular zone the user must press the *UP* and *DOWN* keys and the *SELECT* key when the desired dwell time is displayed. (System default dwell time is 20 seconds).

3.6.5.8 Exit Sub Menu

This option will allow the user to return to the Normal Operating mode and continue sampling the zone locations. The user must press the *SELECT* key to accept this option.

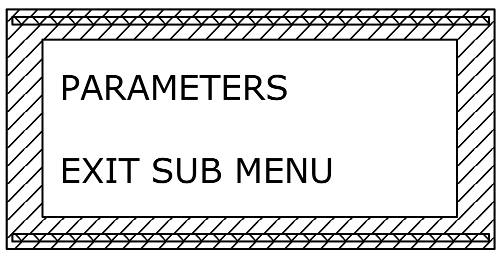

Figure 3-23 Exit Sub Menu Option

3.7 Overview of the Alarm Operation

As explained previously an alarm condition will occur if the sampled gas level exceeds the set alarm level. That is, for a rising (+) alarm type the alarm will be activated if the sampled gas level is greater than the alarm level, and for a falling (-) alarm type the alarm will be activated if the sampled gas level is less than the alarm level.

When an alarm occurs the zone location, alarm number, and alarm status is displayed on the LCD and the relevant alarm relays are activated. The display will freeze on the first alarm activated and the system will then continue scanning the other zone locations sequentially. If a second alarm is detected while the first alarm is still active, the system will store the zone location, alarm number, and alarm status of the second alarm and place this into a queuing system while still only displaying the first alarm conditions on the LCD. Further alarms will continue to be stored up to a maximum value of 20 alarms. The following sections will describe in detail the various functions available to control the alarm status.

3.7.1 Alarm Control Functions

3.7.1.1 Main Menu - Mute Alarm (Acknowledge)

This option is used to mute the most recent alarm. When selected on the main menu, the system will display for a period of approximately 5 seconds that the alarm has been acknowledged. This is shown in Figure 3-24 and Figure 3-25 below:

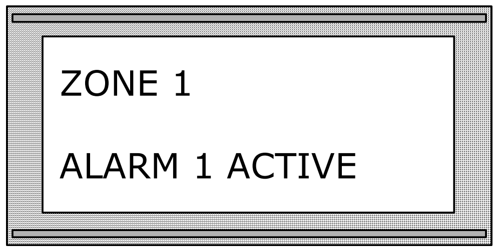

Figure 3-24 Example of Alarm 1 Active

When a mute alarm has been selected the display will be as shown in Figure 3-25 below:

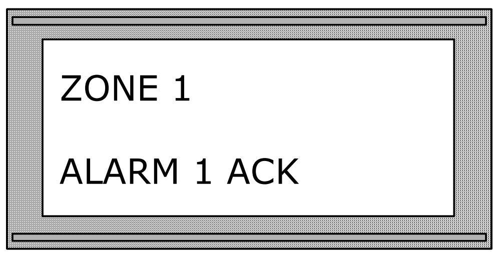

Figure 3-25 Example of alarm mute

If no other alarms are active the system will resume normal operation and continue scanning the zone locations. However, if another alarm is active the display will show this active alarm until cleared as shown in Figure 3-26 below:

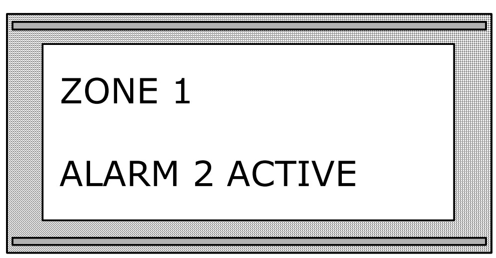

Figure 3-26 Example of Pending Alarm Active after Mute Alarm

When the user has muted an alarm and the system has cycled through the zone locations back to the muted zone location, that muted zone location will be indicated by a flashing alarm status LED to indicate the alarm location has been acknowledged but not reset. The only way to clear a muted zone location is to use the **RESET ALARM** option.

3.7.1.2 Main Menu - Reset Alarm

This option is used to reset the most recent alarm. The **RESET ALARM** option may be performed on an active alarm or on a muted alarm. The **RESET ALARM** function is invoked by pressing the *SELECT* key when the display is as shown in Figure 3-27 below:

Figure 3-27 Reset Alarm Menu Option

When selected on the main menu, the system will de-activate the relevant alarm relay and display for a period of approximately 5 seconds that the alarm has been acknowledged. This is shown in Figure 3-28 and Figure 3-29 below:

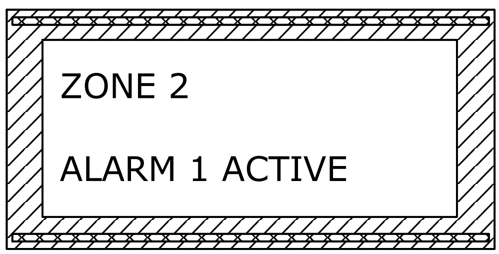

Figure 3-28 Example of Alarm 1 Active

When a Reset Alarm has been selected the display will be as shown in Figure 3-29 below:

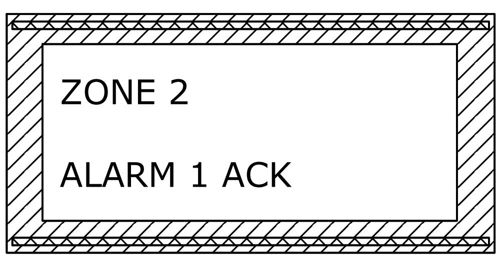

Figure 3-29 Example of Alarm Reset

If no other alarms are active the system will resume normal operation and continue scanning the zone locations. However, if another alarm is active the display will show this active alarm until cleared as shown in Figure 3-30 below:

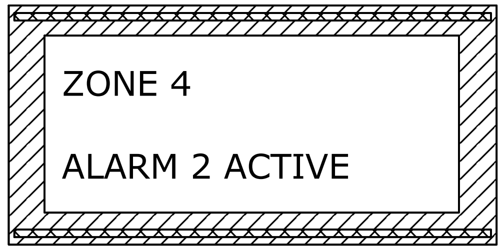

Figure 3-30 Example of Pending Alarm Active after Reset Alarm

When the user has reset an alarm and the system has cycled through the zone locations back to the reset zone location, then that reset zone location will alarm again if the alarm level has been or still is exceeded.

3.7.1.3 Main Menu - Display Alarms

This option is used to display the last 20 stored alarms.

Figure 3-31 Display Alarms Menu Option

The information displayed is the date and time of alarm, zone location and the order that the alarm occurred in. This is as shown in Figure 3-32 below:

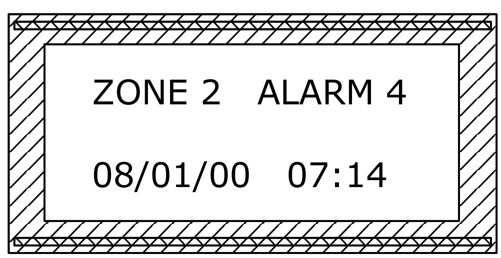

Figure 3-32 Example of Display Alarms Information

In the example shown in Figure 3-32 above, the alarm number is 4. This implies that this was the fourth alarm to become active. Pressing the *SELECT* key will display the alarm information for the third alarm to become active. Subsequent presses of the *SELECT* key will display the second alarm to become active, then the first alarm to become active. When Alarm 1 is displayed, pressing the *SELECT* key again will return the system to the Normal Operating Mode and the system will continue scanning the zone locations.

3.7.1.4 Main Menu - Erase Alarms

This option is used to erase the stored alarms. To invoke this function the *SELECT* key must be pressed by the user on the **ERASE ALARMS** menu option as shown in Figure 3-33 below:

Figure 3-33 Erase Alarms Menu Option

This option will erase all the stored alarms at once.

3.8 Menu - Technician Menu

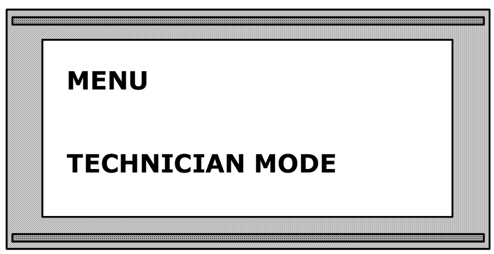

Figure 3-34 Technician Menu Option

This allows the user to define the number channels required by the system, calibrate the pressure being drawn thorough the system or skip a redundant zone. Once entered, the display will prompt the user to enter another password as in Section 3.5 (Entering Main Menu). This password however is different from the one mentioned in Section 3.5 and cannot be changed from the default setting: **Phone TQ for Password**.

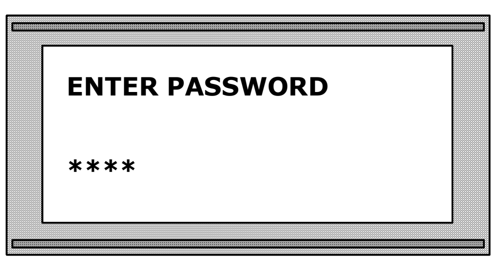

Figure 3-35 Display Password Prompt

3.8.1 Technician Menu - Set Number of Zones

When the password has been successfully entered the **SET NUMBER OF ZONES** menu item appears, shown below in figure 3-36

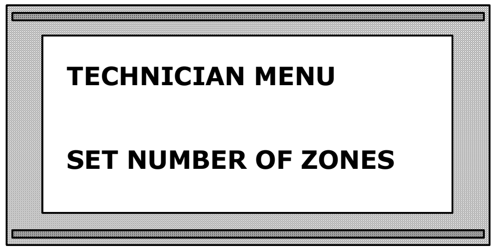

Figure 3-36 Display Set Number of Zones Prompt

If the **SET NUMBER OF ZONES** menu is selected the user will be prompted to ENTER the number of points to be sampled. The system requires ranging from 1-15; remembering that during installation sample line 0 is reserved as a zero calibration line. Pressing the *UP* and *DOWN* buttons will alter this field from the default 15 zones. Then to accept the displayed value the user must press the *SELECT* buttons. From here the user will return to the technical mode menu. (System default is 15 zones)

3.8.2 Technical Menu - Skip Zone Number

This part of the technical menu allows the user to turn off a redundant zone. This can prove useful if the user requires to do any maintenance on that line or if the line becomes obsolete.

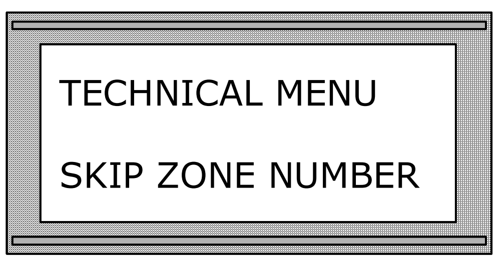

Figure 3-36 Skip Zone Number

When this menu option is selected the user is prompted to select which zone is to be skipped. Using the *UP* or *DOWN* keys will scroll through each zone in operation. When the desired zone is highlighted the *SELECT* key will accept that zone as the one to be ignored.

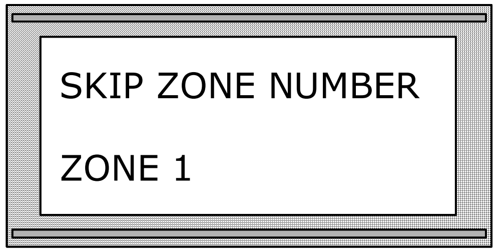

Figure 3-37 Select Zone Number

3.8.2 Technician Menu - Calibrate Pressure

This part of the technical menu is used to calibrate the pressure sensor on the Infra-red sensor.

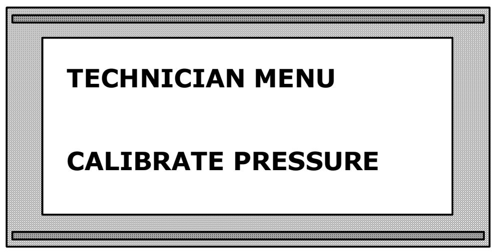

Figure 3-37 Calibrate Pressure

This is already factory set and should not be attempted by anyone other than TQ personnel.

3.8.3 Technician Menu – Calibrate Gas

This option is factory set and will not require any attention from anyone other than ***TQ personnel***.

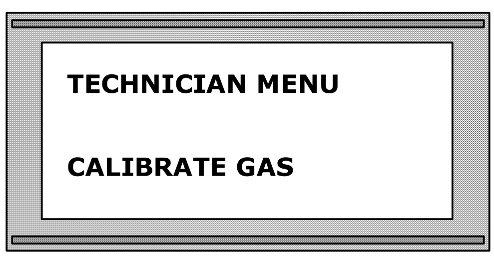

Figure 3-38 Calibrate

.

3.8.4 Technician Menu - Set Sensor Range

This part of the Technician Menu will allow the range of the sensor to be changed. The default range is factory set at 2000 ppm.

This is already factory set and should not be attempted by anyone other than TQ personnel.

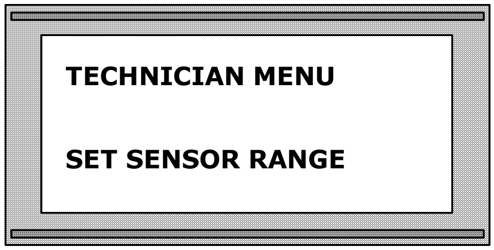

Figure 3-39 Set Sensor Range

3.8.5 Technician Menu – Exit Menu

From here the user can exit from the technical menu back into the main. To exit the Technical menu, the user must use the *UP* and *DOWN* keys to display the **EXIT MENU** option as shown in Figure 3-40 below:

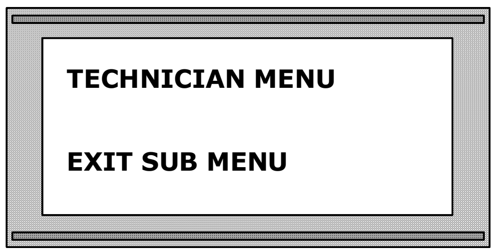

Figure 3-40 Exit Menu

The user must press the *SELECT* key to invoke this function and return to the Main Menu.

3.9 Menu - Exit Menu

This option is used to exit the Main Menu Mode. To exit the main menu, the user must use the *UP* and *DOWN* keys to display the **EXIT MENU** option as shown in Figure 3-41 below:

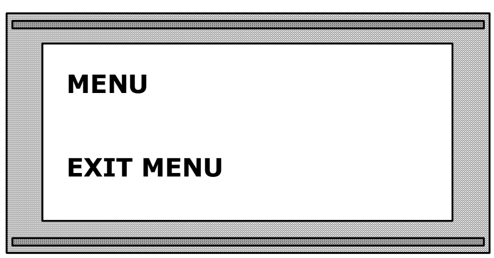

Figure 3-41 Menu Exit Option

The user must press the *SELECT* key to invoke this function and return to the Normal Operating Mode to continue scanning the zone locations.

4.0 OPERATION

This section explains the TQ4200 main functions and gives an overview of how to deal with the alarms.

4.1 System warm-up

When the ***TQ4200*** is powered up, the system enters a warm-up period. This warm-up period typically takes about five minutes to complete. During this time the liquid crystal display will indicate that the system is in the warm-up period as shown in Figure 4-2 below:

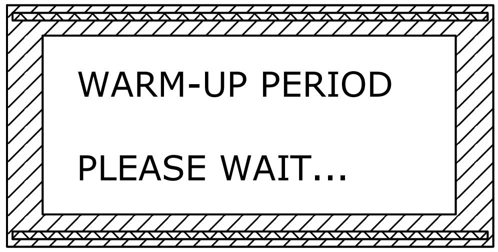

Figure 4-2 Warm-up period

4.2 Normal Operating Mode

After the warm-up period is complete, the system enters the Normal Operating Mode. This mode is indicated by the display shown in Figure 4-3 below:

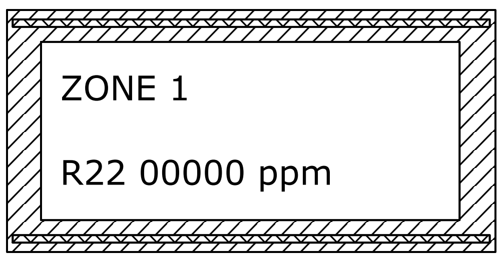

Figure 4-3 Normal Operating Mode

The first line of the display indicates the current zone location. On the second line of the display, the left hand side indicates the sampled gas type and the right hand side indicates the sampled gas concentration in parts per million (ppm).

In Normal Operating Mode, the system will cycle through each zone location performing alarm checks at the end of each zone cycle. The following section describes the alarms.

4.3 Alarms

The system will generate an alarm under two main conditions.

4.3.1 System Fault

The first of these conditions generates an alarm if the warm-up period has not been completed within 45 minutes of power-on. This will be displayed as a system fault as indicated by Figure 4-4 shown below:

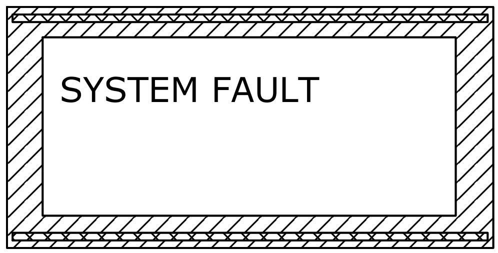

Figure 4-4 System Fault

The fault alarm will be activated under this condition.

4.3.2 Gas Level Alarms

The second condition generates an alarm if the sampled gas level exceeds the set alarm point for either Alarm 1 to Alarm 3. When an alarm is generated the ***TQ4200*** displays the zone location, the alarm number, and the alarm status. This is shown in Figure 4-5 below:

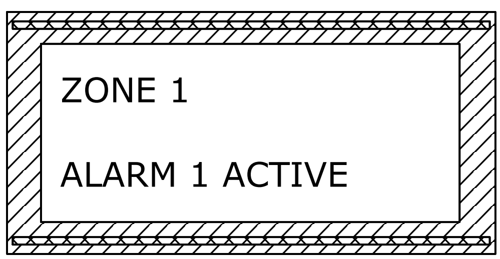

Figure 4-5 Alarm Status

The ***TQ4200*** then continues to sample normally. The ***TQ4200*** will continue to display the status of the alarm until the user acknowledges the alarm or alarms.

If a second alarm is activated while the first alarm is still active, the ***TQ4200*** will store the zone location, alarm number, and alarm status of the second alarm and place this into a queuing system. Further alarms will continue to be stored up to a maximum value of 20 alarms.

To perform any action on a zone that is in alarm, the user must enter a password. To enter the password the user must first press the *MENU* button. The user is then prompted to enter the password as shown in Figure 4-6 below:

Figure 4-6 Password Prompt

To enter the password the user must press the *UP* button and/or *DOWN* button to change the number. When the required number is displayed the user must press the *SELECT* button to accept the choice. This is repeated for all four password digits. Once the password has been accepted the user enters the menu mode and the required function may be selected by pressing the *UP* button and/or *DOWN* button followed by the *SELECT* button when the required function is displayed. (System default password is 6197).

4.3.2.1 Mute Alarms

Select the mute alarms menu to mute the most recent alarm. When this function is invoked, the alarm relay will be de-activated and the display will show that the alarm has been acknowledged as shown in Figure 4-7 below:

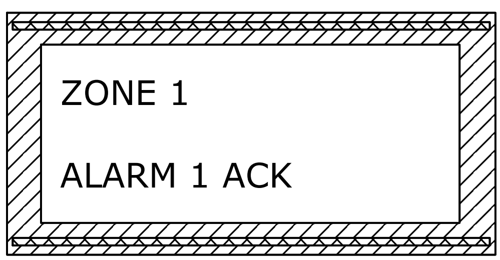

Figure 4-7 Alarm Acknowledged

If no other alarms are active, the system will resume normal operation and continue scanning the zone locations sequentially. However, if an alarm is pending after the mute function has been selected, this alarm will become the active alarm. To mute this alarm the user must repeat the procedure detailed above. When the zones cycle back to a muted alarm the alarm indication LED's will flash indicating this alarm has not been reset.

4.3.2.2 Reset Alarms

Select the ***'Reset Alarms'*** menu to reset the most recent alarm. This option may be performed on a muted alarm or an active alarm producing the same effect. When ***'Reset Alarms'*** is selected on the main menu, the system will de-activate the most recent alarm relay and display for a period of approximately 5 seconds that the alarm has been acknowledged. The system will then resume normal system operation. However, if more than one alarm has been activated, the above procedure will need to be repeated until all active alarms have been reset.

5.0 DRAWINGS

DRAWING NO.	DESCRIPTION
Figure 1	PANEL OUTLINE
Figure 2	GLAND PLATE OUTLINE
Figure 3	INTERNAL LAYOUT
Figure 4	PNEUMATIC SCHEMATIC
Figure 5	ELECTRICAL TERMINATION

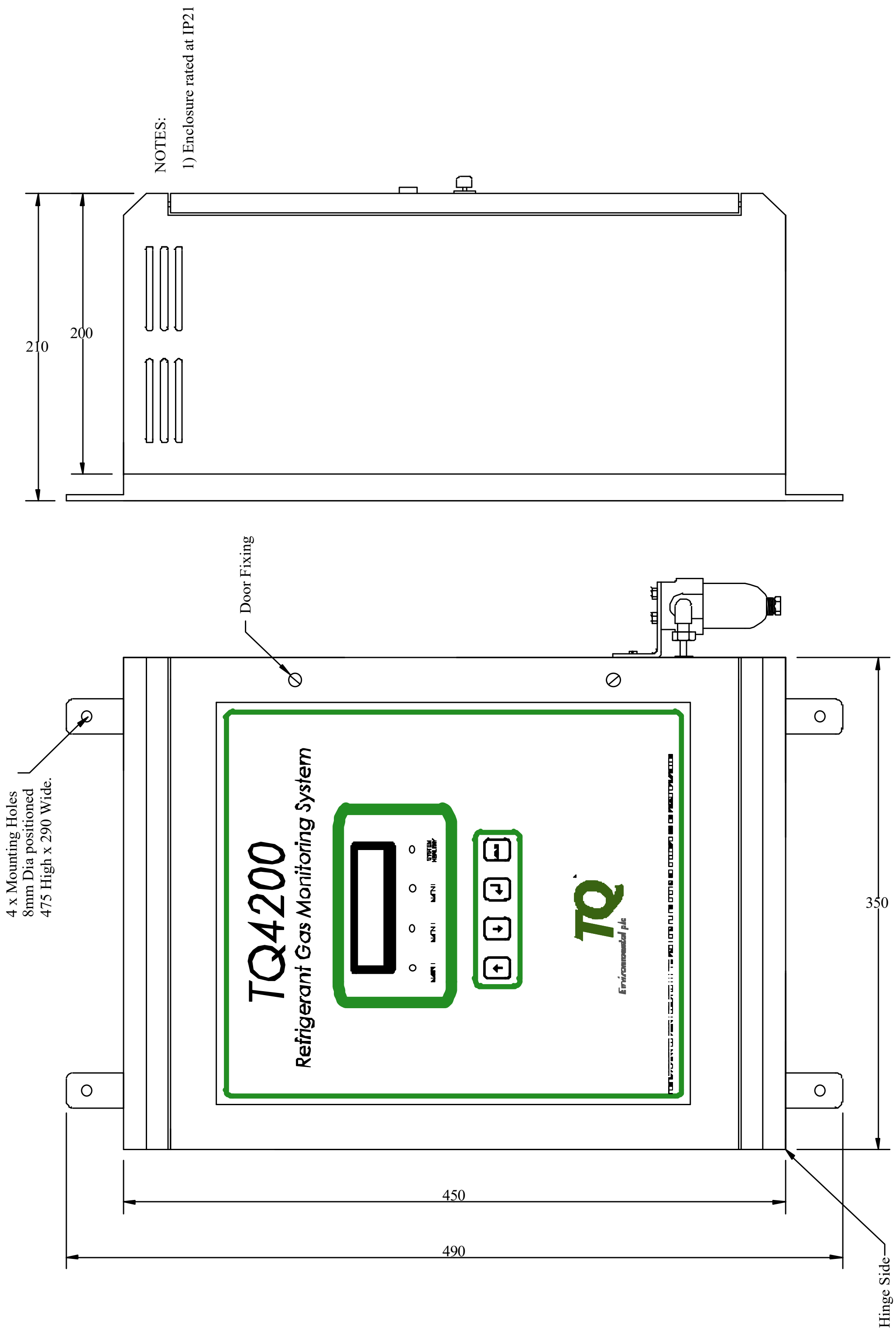
NOTES:
1) Enclosure rated at IP21
210
200
Door Fixing
4 x Mounting Holes
8mm Dia positioned
475 High x 290 Wide.
TQ4200
Refrigerant Gas Monitoring System
350
450
490
Hinge Side

Figure 1

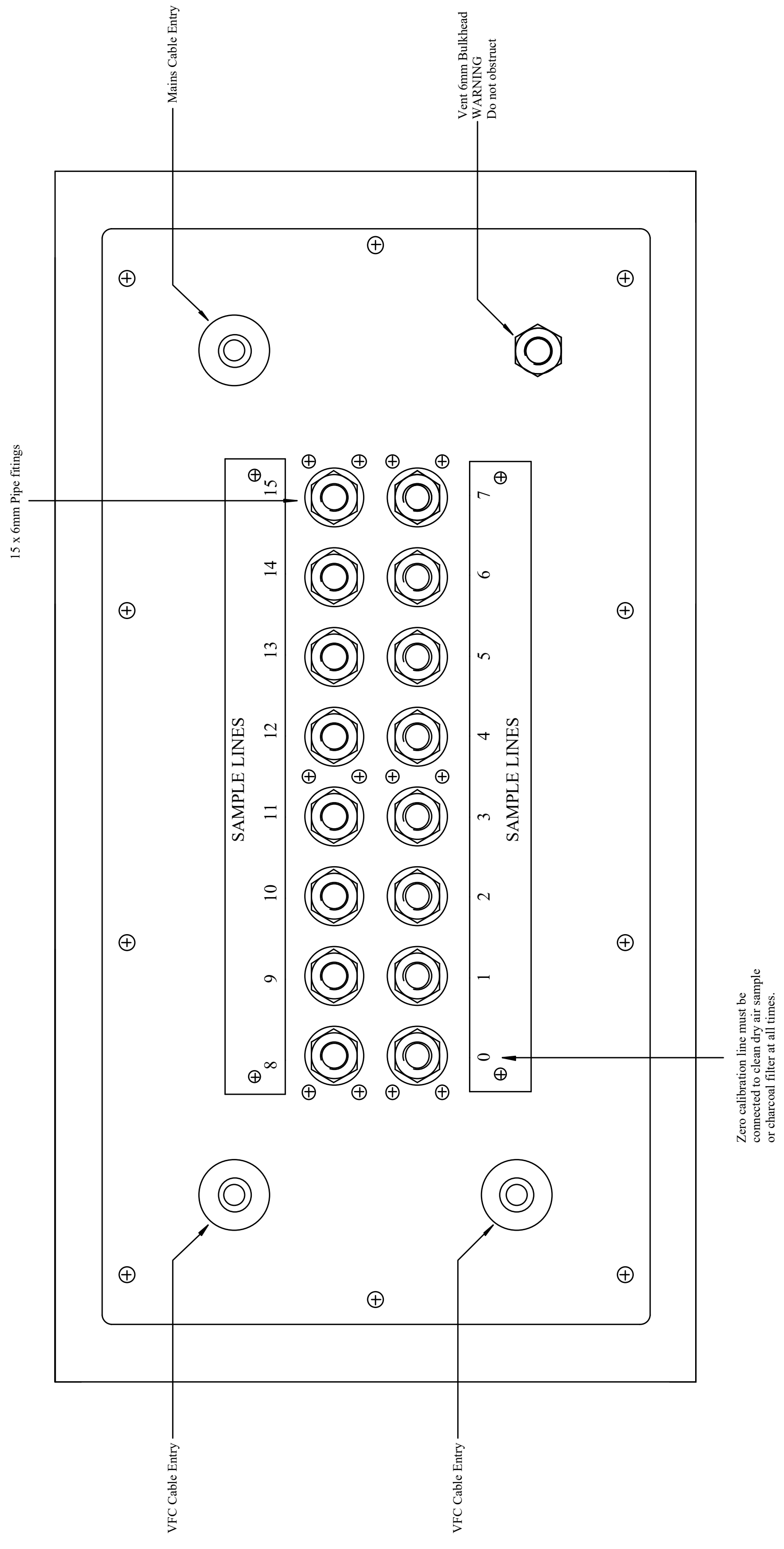
Mains Cable Entry
Vent 6mm Bulkhead
WARNING
Do not obstruct
15 x 6mm Pipe fittings
SAMPLE LINES
15
14
13
12
11
10
9
8
SAMPLE LINES
7
6
5
4
3
2
1
0
Zero calibration line must be
connected to clean dry air sample
or charcoal filter at all times.
VFC Cable Entry
VFC Cable Entry

Figure 2

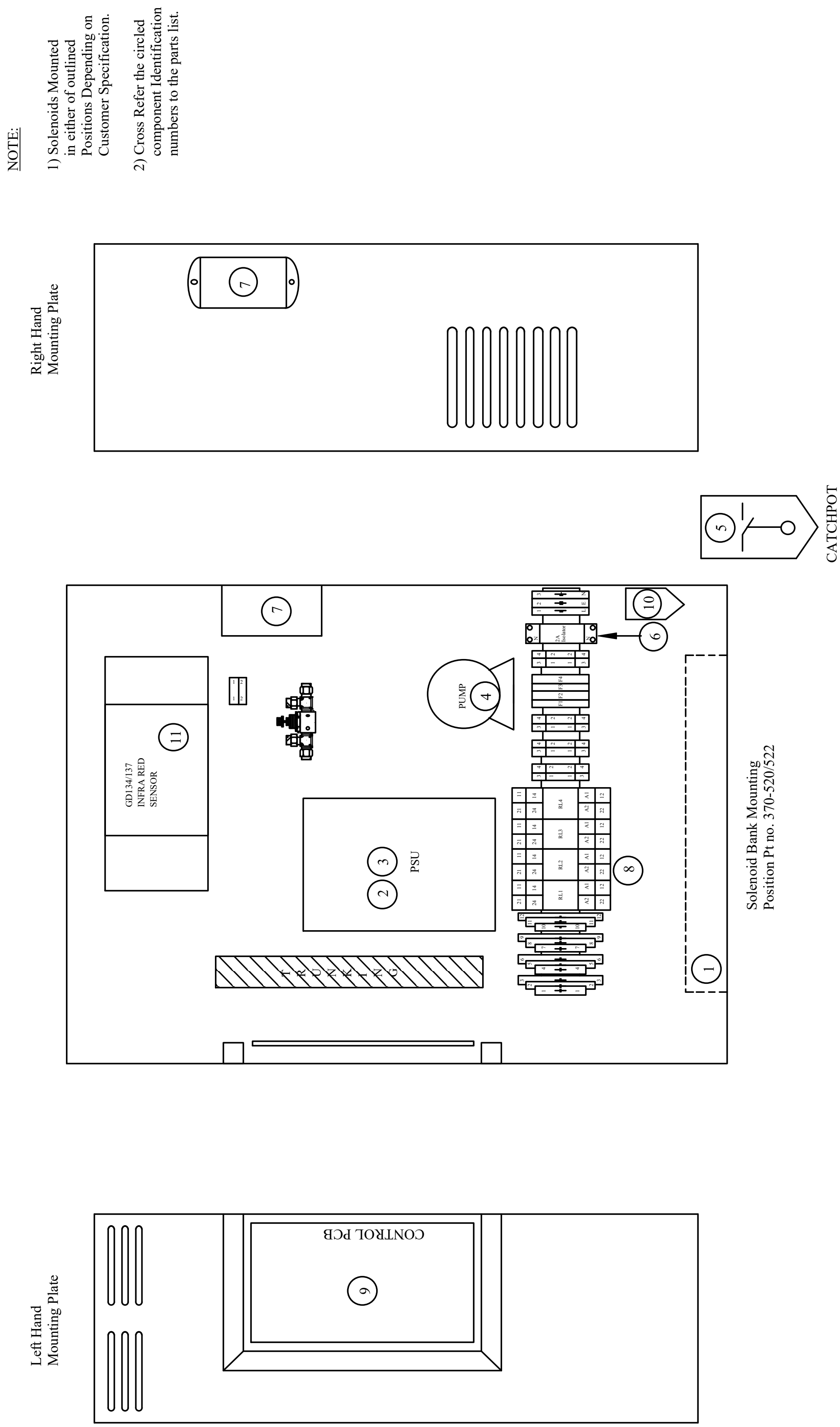
NOTE:
1) Solenoids Mounted in either of outlined Positions Depending on Customer Specification.
2) Cross Refer the circled component Identification numbers to the parts list.
Right Hand Mounting Plate
CATCHPOT
GD134/137 INFRA RED SENSOR
PUMP
PSU
TRUNKING
Solenoid Bank Mounting Position Pt no. 370-520/522
Left Hand Mounting Plate
CONTROL PCB

Figure 3

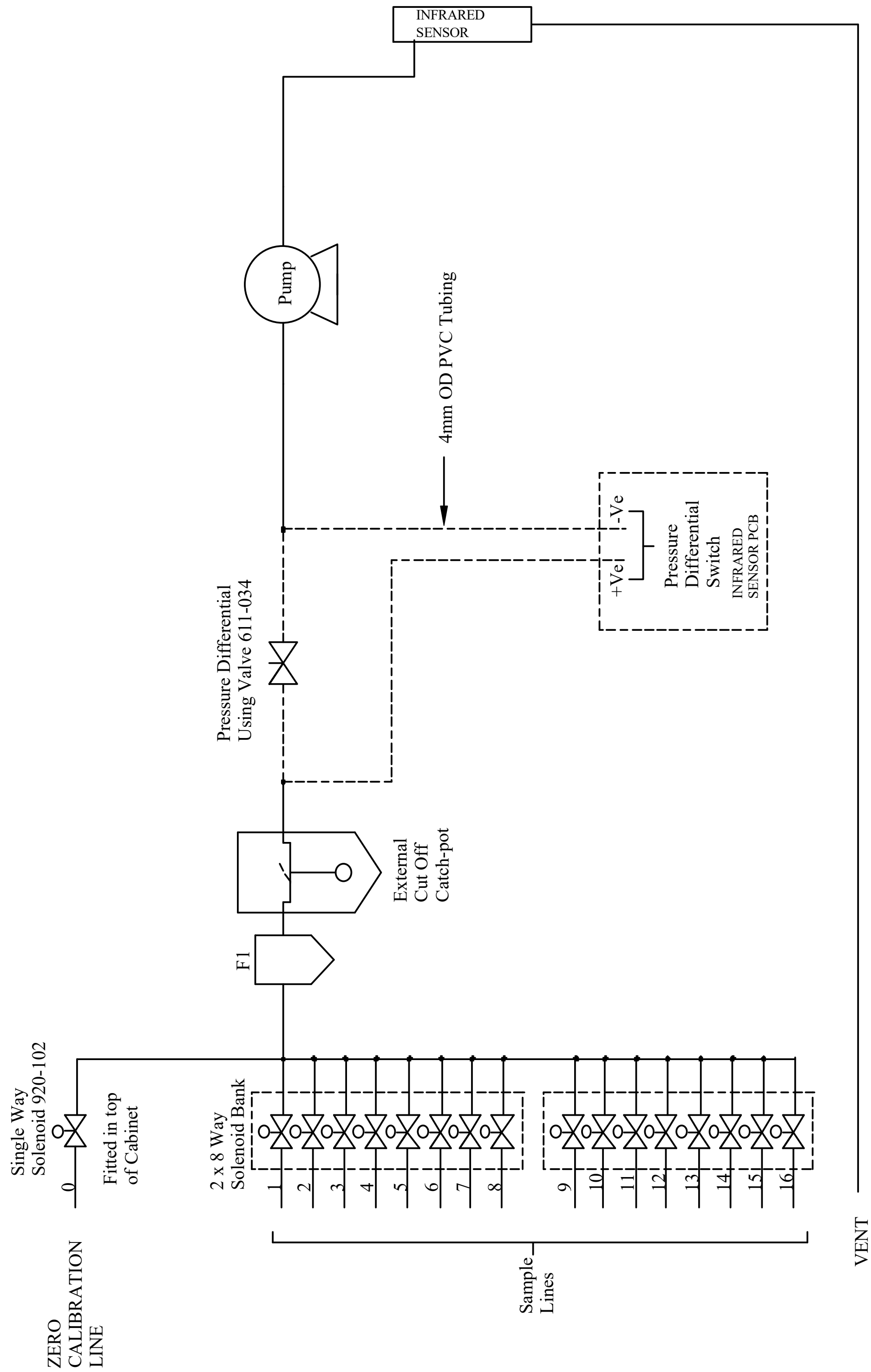
INFRARED SENSOR
Pump
4mm OD PVC Tubing
-Ve
+Ve
Pressure Differential Switch
INFRARED SENSOR PCB
Pressure Differential Using Valve 611-034
External Cut Off Catch-pot
F1
Single Way Solenoid 920-102
Fitted in top of Cabinet
2 x 8 Way Solenoid Bank
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
16
ZERO CALIBRATION LINE
Sample Lines
VENT

Figure 4

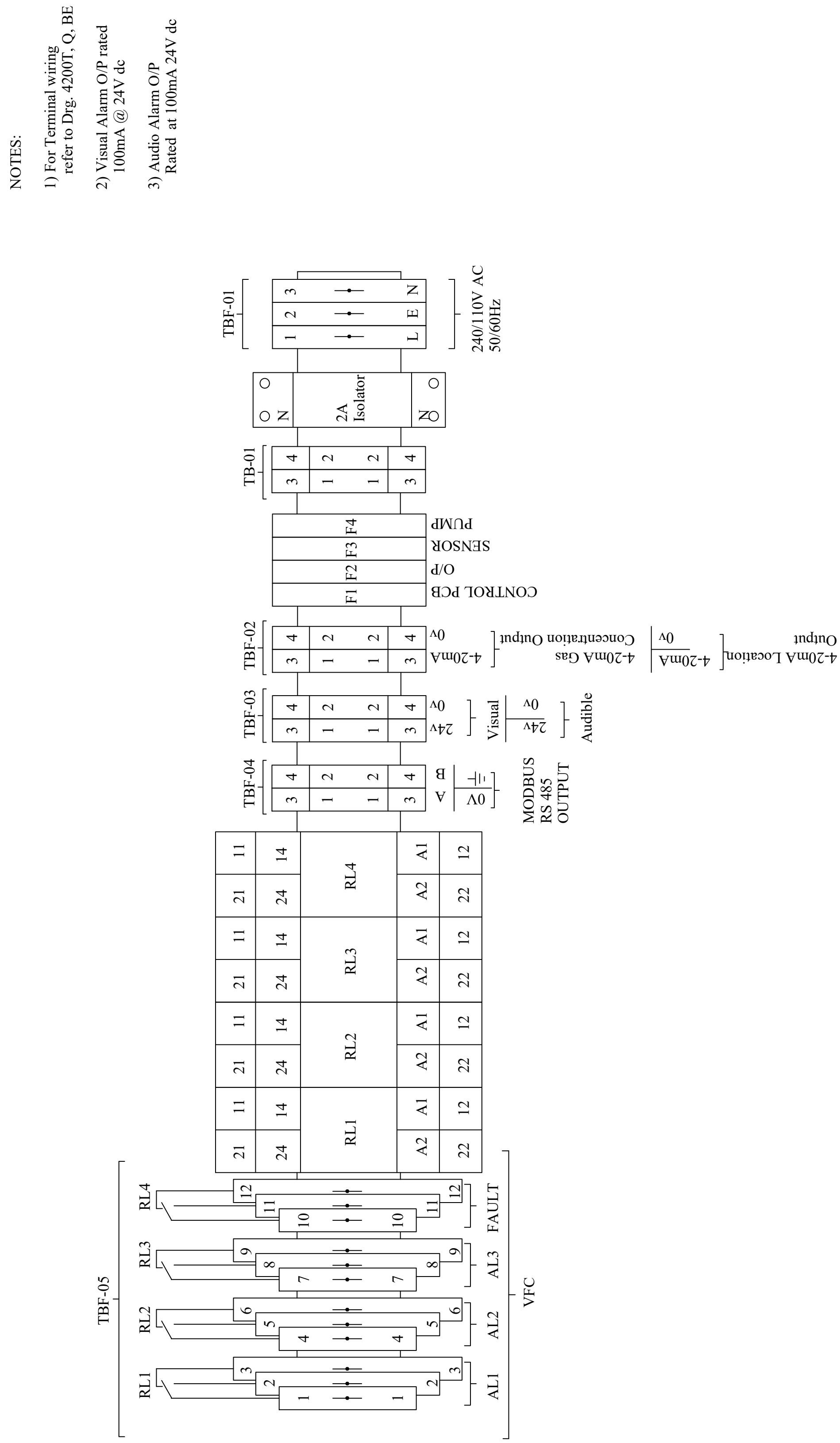
NOTES:
1) For Terminal wiring refer to Drg. 4200T, Q, BE
2) Visual Alarm O/P rated 100mA @ 24V dc
3) Audio Alarm O/P Rated at 100mA 24V dc
TBF-01
240/110V AC 50/60Hz
2A Isolator
TB-01
PUMP
SENSOR
O/P
CONTROL PCB
F1 F2 F3 F4
TBF-02
4-20mA Gas Concentration Output
4-20mA Location Output
TBF-03
Visual
Audible
TBF-04
MODBUS RS 485 OUTPUT
RL1
RL2
RL3
RL4
TBF-05
AL1
AL2
AL3
FAULT
VFC

Figure 5

6.0 MAINTENANCE

Preventative maintenance requirements on the system have been designed to be minimal and limited. The details of this maintenance plan are as follows:-

6.1 Weekly

Check external 'catchpot' located on the right hand side of the ***TQ4200*** enclosure for water ingress. (See Figure 1).

To drain off water turn the bleed screw on the bottom of the bowl anti-clockwise as you look at the bottom of the catchpot. Ensure that the bleed screw is turned full clockwise on completion of draining.

6.2 Annually

6.2.1 Replace the particulate filter (Part No. 420-026).
Power down. Locate filter 'F1' loose in the lower right hand side of the cabinet, refer to figure 3, Note the direction of flow arrow on the body. Remove pipe from each side change filter and refit in the reverse of above.

6.2.2 Replace the end of line filters (Part No. 420-006).
Locate filters at the sample points, unscrew the end cap and change filter element, and refit end cap.

6.2.3 Replace the charcoal filter (Part No. 420-004) fitted to the calibration line on sample inlet 'O'.
Locate the filter fitted to the calibration line and remove by undoing the compression nut. Remove the nut from the old filter and place over the new filter port. Place the new brass 1/4" ferrule set supplied, over the same port with the cone front ferrule pointing towards the bulkhead fitting. Push new filter port into the bulkhead fitting and screw on compression nut until finger tight. Mark the nut and bulkhead fitting and tighten the compression nut ¾ to 1.0 turn.

6.2.4 Replace the pump diaphragm and seals (Part No. 920-031).
Locate the sample pump, refer figure 3, remove the four screws securing the square pump housing cover plate. Remove the two seals and diaphragm, fit the new items and refit cover plate.

6.3 **3 Yearly**

6.3.1 Replace sample pump Pt No 920-030.

N.B However, it may be more feasible to adopt a ‘breakdown only’ approach to maintaining the system as the repairs are relatively simple and the system will always fail safe. The expected failures will be water ingress to external catchpot as above, filter blockages and pump failure all of which will generate alarms

7.0 PARTS LIST

The following pages contain the parts list for the ***TQ4200*** and cross refer to figure 3

ITEM	*PART NO*	*DESCRIPTION*	*QTY*	*NAME*
1.	920-019	8 Way Solenoid Bank	2	
2.	710-028	PSU	1	
3.	710-028A	PSU Cover	1	
4.	920-030	Sample Pump	1	
5.	100-038-001	Catchpot	1	
6.	905-011	Isolator	1	
7.	100-041	EMC Suppresser	1	
8.	910-018	Relay	4	
9.	370-351	4200 Controller PCB	1	
10.	420-026	Disposable Filter	1	
11.	137-002	GD 137 Infrared Sensor	1	TARGET GAS TO BE SPECIFIED ON ORDER

Figure 12

8.0 FAULT FINDING

The ***TQ 4200*** has built in fault diagnostics which constantly monitor the operation of the unit and in the event of detecting a fault will indicate a **'Fault'** followed by:

- ANALYSER NVRAM FAIL
- 4200 NVRAM FAIL
- SENSOR COMMS FAIL
- 4200 COMMS FAIL
- ZERO FILTER BLOCKED
- FLOW FAIL
- NO PRESSURE
- SENSOR DRIFT
- SENSOR FAULT

Please note that all fault alarms are latched and require an alarm reset as per section 4.3.2.2. **'Fault'** will remain displayed until all faults have been cleared.

8.1 Analyser NVRAM Fault

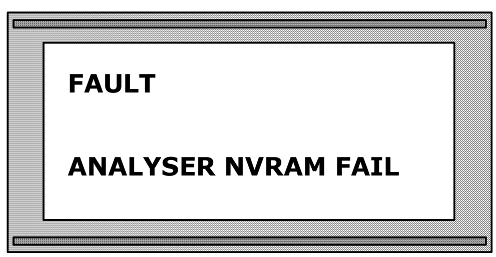

Figure 8.1 Faults – Analyser NVRAM Fail

'Analyser NVRAM Fail' will be displayed when the gas analyser board has failed to write or read the correct values to or from its' non-volatile RAM.

8.2 4200 NVRAM Fault

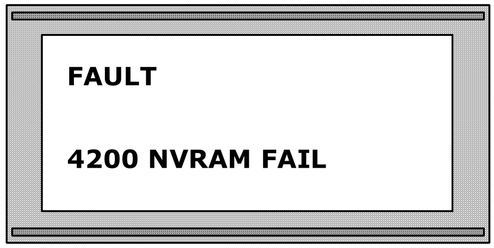

Figure 8.2 Faults – OMNICA NVRAM Fail

'4200 NVRAM Fail' will be displayed when the ***TQ 4200*** has failed to write or read the correct values to or from its' non-volatile RAM.

8.3 Sensor Communications Fault

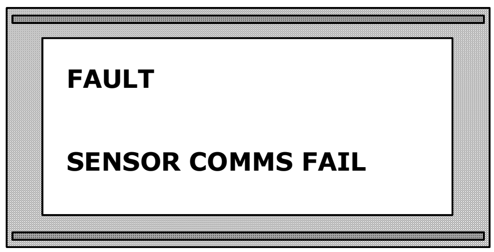

Figure 8.3 Faults – Sensor Communications Fail

'Sensor Comms Fail' will be displayed when there is a communications failure between the infrared sensor and the analyser board.

8.4 4200 Communications Fault

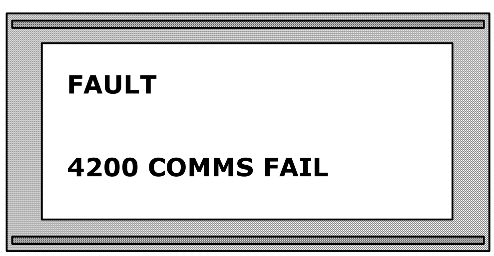

Figure 8.4 Faults – OMNICA Communications Fail

'4200 Comms Fail' will be displayed when there is a communications failure between the ***TQ 4200*** and the gas analyser board.

8.5 Zero Filter Blocked Fault

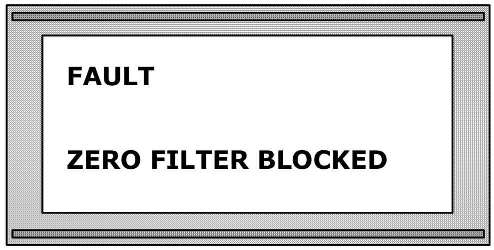

Figure 8.5 Faults – Zero Filter Blocked

'Zero Filter Blocked' will be displayed when the differential pressure sensor on the gas analyser PCB is not sensing its' correct air pressures when the Zero line solenoid is activated.

Rectification:

- Check pump operation.
- Check solenoid valve operation.
- Check for security and integrity of all ***TQ 4200*** internal pipe work and fittings.
- Disconnect the 'Zero line' from inlet to ***TQ 4200***.

If 'Zero Filter Blocked' clears after an alarm reset, check and replace charcoal filter, if necessary. Please note that the 'Zero Filter Blocked' alarm requires an alarm reset as it is a latched alarm.

8.6 Flow Fail Fault

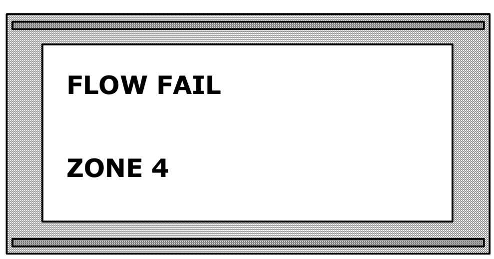

Figure 8.6 Faults – Flow Fail

'Flow Fail' will be displayed when the differential pressure sensor on the gas analyser PCB is not sensing its' correct air pressures. The zone location where the flow fail happened is displayed and the System

Healthy LED will extinguish. The system will continue to sample normally but if a gas alarm occurs while still in flow fail, the gas alarm will take precedence over the flow fail alarm, displaying the gas alarm and zone location. The system Healthy LED will however, remain extinguished until a reset has been performed.

Rectification:

- Check pump operation.
- Check solenoid valve operation.
- Check for security and integrity of all ***TQ 4200*** internal pipe work and fittings.
- Disconnect selected 'sample line' from inlet to ***TQ 4200***.

  If 'flow fail' clears after an alarm reset, check sample line for blockages.

Please note that the 'flow alarm' requires an alarm reset as it is a latched alarm.

8.7 No Pressure Fault

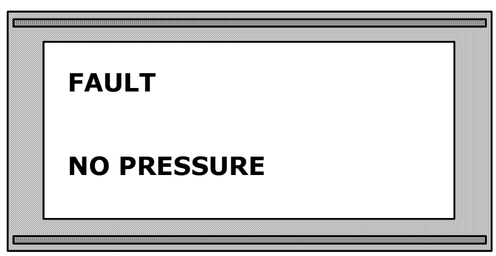

Figure 8.7 Faults – No Pressure

'No Pressure' will be displayed when the ***TQ 4200*** has failed its' 24 hour pressure test. This indicates a leak within the system.

Rectification - Check ***TQ 4200*** internal pipe work for integrity and security of all pipe work and fittings.

8.8 Sensor Drift Fault

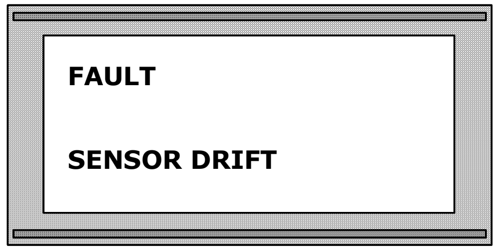

Figure 8.8 Faults – Sensor Drift

'Sensor Drift' will be displayed if the sensor's base zero level has changed more than a pre-defined percentage change when performing an auto-zero.

8.9 Sensor Fault

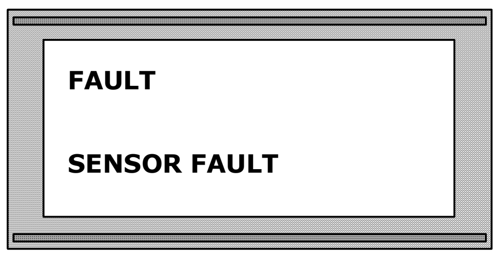

Figure 8.9 Faults – Sensor Fault

'Sensor Fault' will be displayed when the digital output of the sensor falls below a pre-determined value. This value corresponds to a 2mA output.