

GEOQUIP



WORLDWIDE

The Leader in Perimeter Protection Solutions

PSICON 11 SYSTEM OPERATION MANUAL

PSICON System Overview

The PSICON signal analysis system is a complex signal processing system designed to analyse signals from geophone sensors and to classify these signals by comparing them with patterns or signatures of various events which have been previously stored within the system.

Geophone sensors detect the vibrations caused by human activity adjacent to the sensors. The geophones convert these vibrations into electrical signals which are fed directly into the PSICON analyser.

Since the PSICON system relies on being trained to recognise and respond to hostile, or alarm activities, and to recognise and ignore non-hostile, or benign activities, it is important that careful attention is given to the process of identifying and simulating the activities that the system must respond to. Simulation of the activities that the system must respond to is only valid if the simulation procedure very accurately reflects the activities that will occur under operational conditions.

For example, if it is necessary to classify cutting a metal fence with a hacksaw as a alarm activity, it will be necessary to actually use a hacksaw on the fence to simulate this activity. Pseudo-simulations such as impact tests or other non-destructive simulations will not produce accurate representations of the signal likely to be generated in response to the actual activity that may occur under operational conditions.

Unless this process is clearly understood and carefully executed, it is unlikely that the system will perform satisfactorily.

Each simulation carried out during the training process will result in the generation of a pattern that may be entered into the PSICON analyser memory for subsequent use as a reference when the system placed into the operational mode. Any pattern entered into the system may be allocated either an alarm (hostile) or a benign (non-hostile) classification. In total, up to 32 patterns may be stored, although in practice, far fewer than this will be required.

The checklist below outlines the major considerations that need to be addressed during system training.

1. Identify all types of alarm activity that the system is required to respond to and decide how these activities may be accurately simulated.
2. Identify the conditions under which the alarm activities may occur and ensure that the system is trained under the same conditions.
3. Identify all benign activities likely to affect the system and ensure that, if necessary, the system can be exposed to these activities so that the training process can take these activities into account as benign events.

PSICON System Overview (cont'd)

The following precautions need to be considered when adding new patterns or modifying old ones.

1. Addition of any pattern representative of a benign activity will mean that the detection capability of the system must be re-checked to ensure that detection has not been compromised by the new pattern appearing similar to any alarm activities that the system must respond to. The more benign patterns that are entered in the system, the greater the possibility that a benign classification may occur in response to an alarm activity.
2. Great care must be taken to ensure that, during a simulation, only activity that is truly representative of the event is allowed to contribute to the formation of the pattern. If for example an alarm activity is simulated while, at the same time, a vehicle is driving past, the resulting pattern generated will be representative of a combination of both events. This means that if the alarm activity subsequently occurs when no vehicle is present, detection of the activity is likely to be poor.

The following list details the component parts of the PSICON II system and the relevant order codes used to define these components. Not all of these components may be necessary to configure an operational system.

Component Description	Geoquip Order Code
PSICON II Analyser Unit Internal Mounting Only - IP55 Mild Steel Case Fitted with 1 PSI-IM1 Interface Module	PSI-102
PSICON II Analyser Unit Internal/External Mounting - IP65 Stainless Steel Case Fitted with 1 PS1-IM1 Interface Module	PSI-202
8 Channel Geophone Interface Module	PSI-IM1
Psicon Analysis Program	PSI-AP1
Psicon Serial Lead Assembly	PSI-SL1
Geophone Sensor Assembly (Horizontal Axis Sensors) Duct Installed Configuration	GSA-001 *
Geophone Sensor Assembly (Horizontal Axis Sensors) Wall/Railing Configuration	GSA-002 *
Geophone Sensor Assembly (Vertical Axis Sensors) Wall/Railing Configuration	GSA-003 *

* Geophone sensor assemblies are factory produced items and require detailed information regarding sensor spacing and tail cable lengths. Recommendations are given in the Geophone Sensor Installation Manual. Each geophone assembly will incorporate, as standard, an end of line termination device to provide tamper monitoring of the geophone sensor assembly.

Definitions

In the descriptions and explanations in this manual, certain terminology will be used

which is defined at this point for clarity.

Data Pattern

A data pattern is defined as a pattern produced by the PSICON analyser in response to signals produced by the geophone sensors connected to the analyser. The data pattern produced will therefore change as the signals detected by the geophones change. The PSICON analyser will only ever produce one data pattern at a time and this pattern is updated every two seconds.

Reference Pattern

A reference pattern is defined as a fixed pattern produced as a result of the PSICON training process. Such patterns are incorporated into the PSICON analyser to be used as a references so that data patterns may be compared with these reference patterns to enable the identification of the activity that produced the data pattern. Up to 32 reference patterns may be incorporated within a PSICON analyser.

Analysis PC

An IBM compatible PC running the Psicon Analysis Program PSI-AP1 to facilitate parameter adjustment and training of the PSICON analyser.

Benign Activity

Activity detected by the geophone sensors that is considered non-hostile and is not related to intruder activity. Under normal conditions, the PSICON analyser would be trained to ignore such activities.

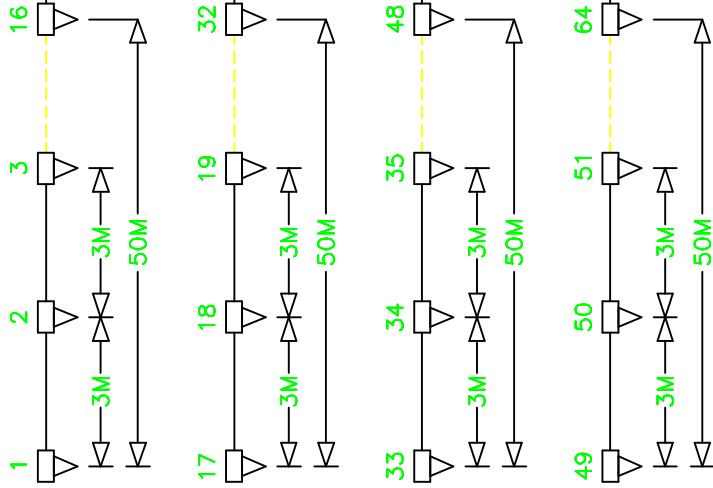
Alarm Activity

Activity detected by the geophone sensors that is considered hostile and results from actual or simulated intrusion activities. The PSICON analyser would normally register an alarm condition on detection of such activities.

PSICON II System - Hardware Configuration

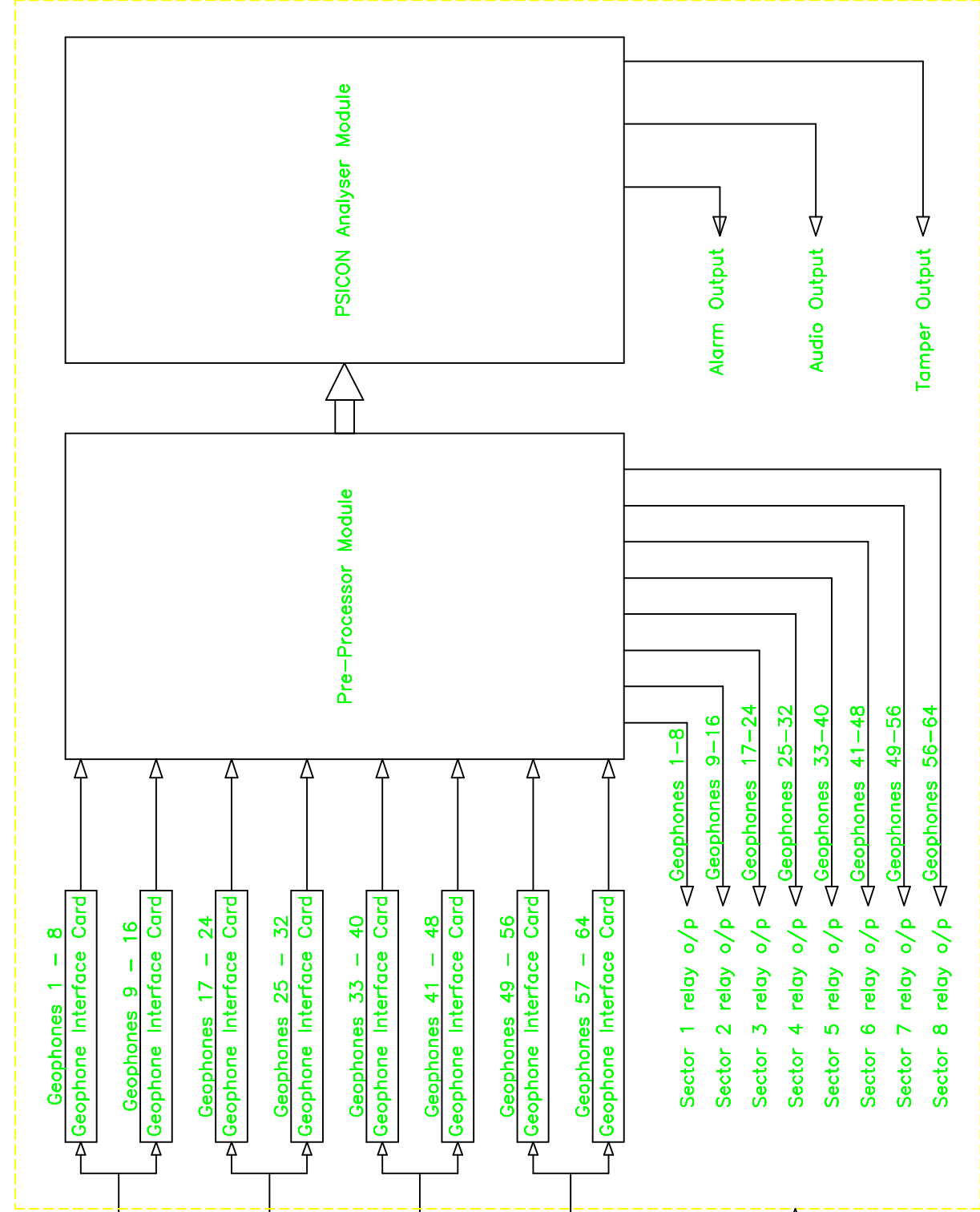
Figure 1 shows the general configuration.

Geophone Sensor Arrays



Maximum coverage = 200 Metres

AC Power



The PSICON II system comprises a signal analyser module, a pre-processor module, geophone interface units, geophone sensors elements, and a power supply module.

Geophone sensors are connected to the system via a multi-pair cable, with each geophone separately connected to a channel on a geophone interface unit. Geophone sensors are wired into groups of typically 16 geophones, with a maximum group size of 19 geophones.

The pre-processor module in the PSICON II system can accept up to 8 geophone interface units with 8 channels on each unit providing a maximum capability of 64 channels. Each PSICON II system can therefore cater for a maximum of 64 geophone sensors, typically configured as 4 groups of 16. Each geophone channel has individual sensitivity adjustments for maximum flexibility.

The PSICON II system provides alarm and tamper relays to signal to external alarm panels or other annunciation equipment. An audio output is also available for situations in which audio monitoring is required.

The PSICON II system also provides up to 8 sector relays which are relays operated by intruder activity to indicate which group of geophones detected the intruder. This feature provides the user with a method of locating the source of intruder activity within the overall zone of protection. A serial data port on the pre-processor module provides additional location information and can be used to drive a mimic panel to display intruder location within the protected zone.

The analyser module provides a serial data interface to a PC for the purposes of setting the system parameters and storing the patterns representative of the activities that are to be detected by the system. The PSICON II system also provides an audio output signal which may be used in applications where a manned control room is present.

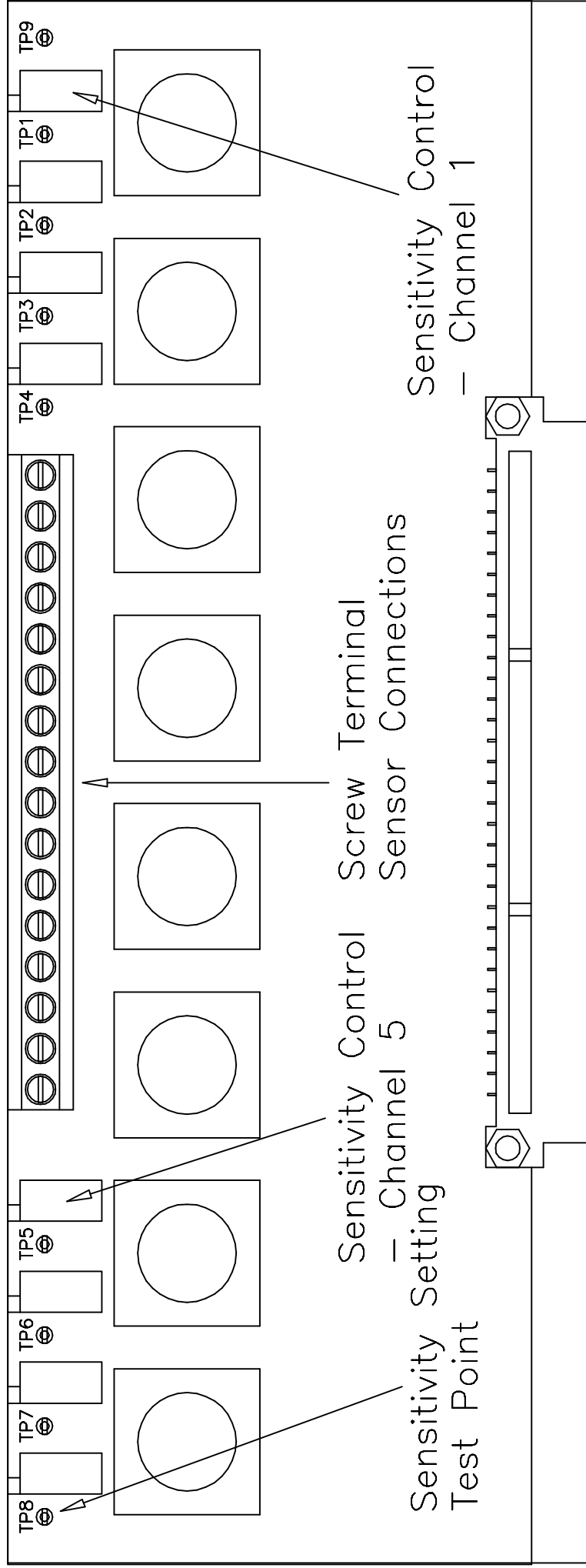
The PC is a tool which is used to adjust the system parameters and generate new reference patterns to be entered into the analyser for use when in operational mode. Once this process is complete, the PC is disconnected and the analyser will operate in a stand-alone mode as a perimeter intrusion detection system. The PC is therefore not required once the system is commissioned.

PSICON II Hardware Description

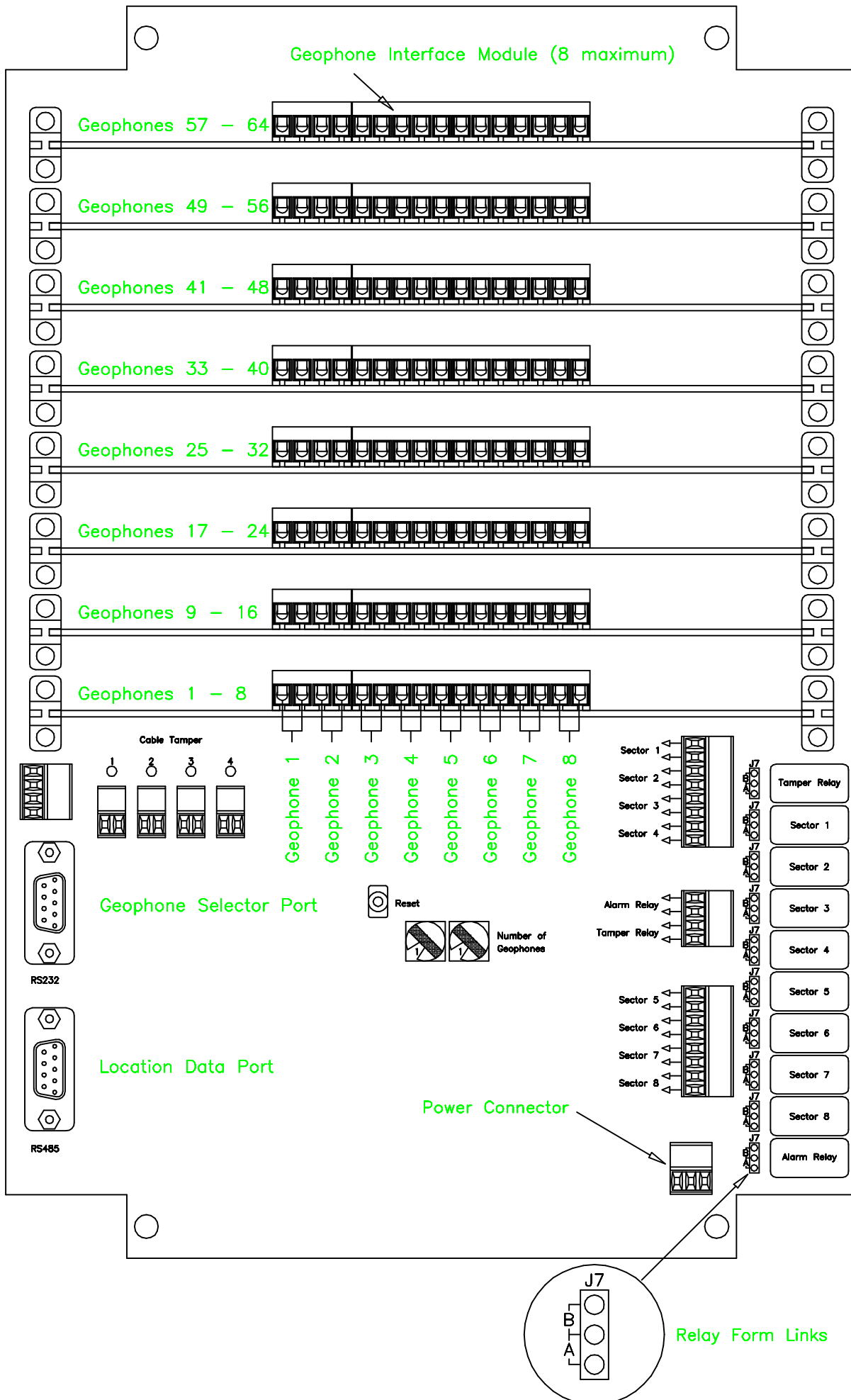
Geophone Interface Module (Revision 3 or greater)

Refer to Figure 2

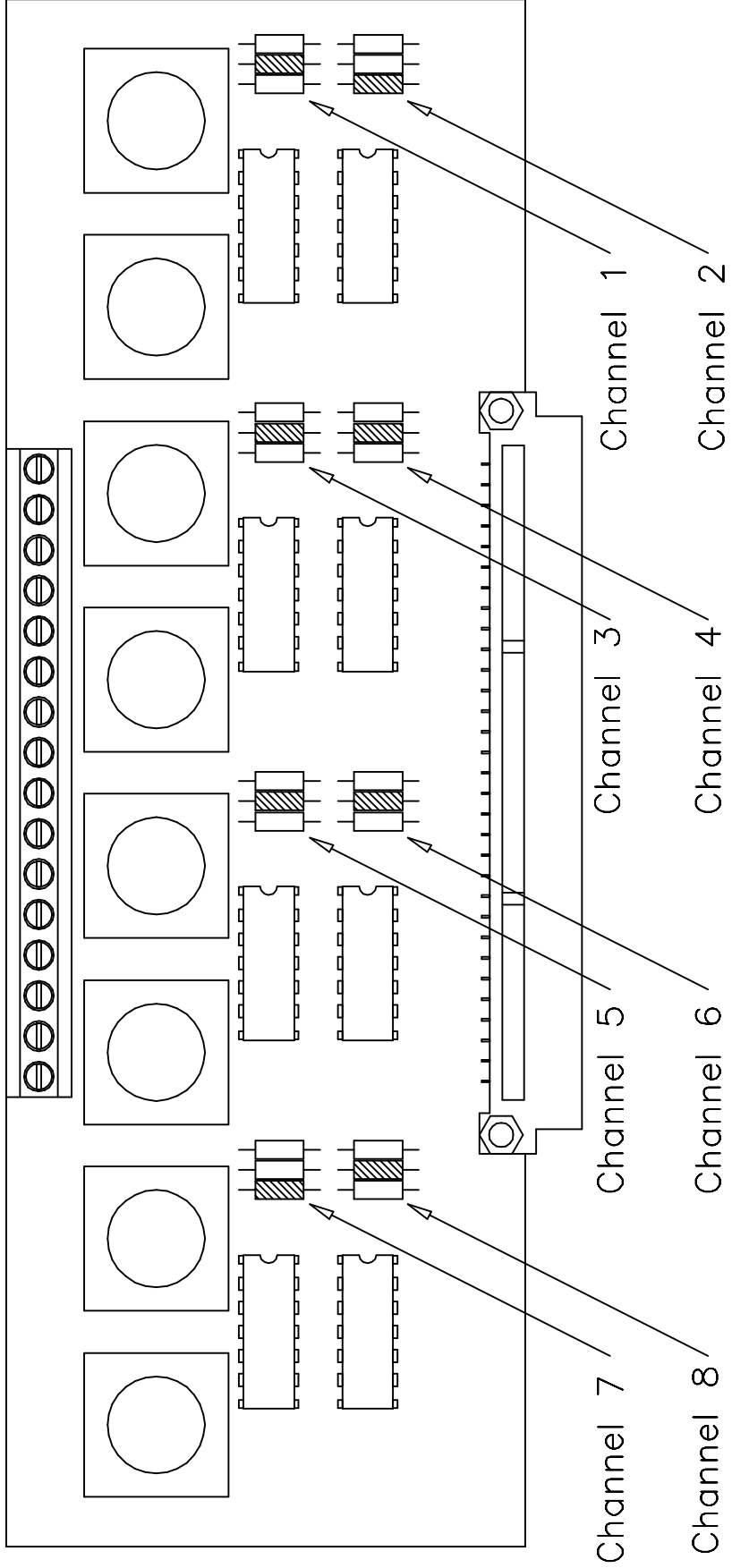
PSICON II Geophone Interface Unit



PSICON II Pre-Processor Module



PSICON II Geophone Interface Module



Sensitivity Adjustment Resistor Locations

Applicable to revision 2 units or lower

The geophone interface module processes the signals from the geophone sensors and feeds these signals into the pre-processor module. The module is designed as a 'plug-in' device and up to 8 of these modules may be used with a PSICON II pre-processor unit.

The geophone interface module provides a sensitivity adjustment for each geophone and is the only user adjustment on this module. The diagram shows the location and identification of the sensitivity controls while Figure 4 shows how each module installed relates to geophone numbers greater than 8.

Each geophone sensor is connected to the interface module by a single twisted pair of wires and these wires are connected via screw terminals as shown on the diagram.

Geophone Interface Module (Revision 2 or less)

Refer to Figure 3

The geophone interface module processes the signals from the geophone sensors and feeds these signals into the pre-processor module. The module is designed as a 'plug-in' device and up to 8 of these modules may be used with a PSICON II pre-processor unit.

The geophone interface module allows sensitivity adjustment for each geophone by means of resistor value change. The diagram shows the location and identification of the resistors while Figure 4 shows how each module installed relates to geophone numbers greater than 8.

Each geophone sensor is connected to the interface module by a single twisted pair of wires and these wires are connected via screw terminals as shown on the diagram.

Pre-Processor Module

Refer to Figure 4

The pre-processor module examines the individual geophone signals and routes these signals to the analyser module if certain conditions are met. At any given time, signals from only one geophone are routed through the pre-processor to the analyser unit.

There are a number of features on the pre-processor card which the user needs to be aware of and these are described in the following text.

PSICON II Hardware Description (cont'd)

Pre-Processor Module (cont'd)

Geophone Number Switches

This pair of rotary switches is provided to program the number of geophones connected to the PSICON II system. The pre-processor module requires this information to carry out the signal processing effectively. In all cases, the number set on the switches must equal the number of geophone sensors connected to the system. The permitted range of adjustment of the switches is from 04 - 64.

Geophone Interface Unit

As described previously, up to 8 geophone interface units may be 'plugged-in' to the pre-processor module.

Cable Tamper LED's

An LED is provided which monitors the integrity of each multi-pair cable connected to the pre-processor module. 4 LED's are provided and these are normally 'OFF' when the cable is intact and undamaged. Should a geophone cable be cut, the LED for that cable will turn on and the TAMPER relay will operate.

Each geophone cable is monitored by an end-of-line resistor connected to an unused pair within the cable. The resistor is always placed at the end of the geophone sensor array.

Power Connector

The power connector routes DC power on to the pre-processor module and is normally pre-wired to the power supply unit within the PSICON II system.

Relay Output Connectors

A group of 3 connectors is provided to access pre-processor relay outputs. Identification of these outputs is provided on the diagram. The relay output connectors are detachable screw terminal types to facilitate external wiring.

Relay Form Links

A removeable jumper link is provided for each relay output to allow the user to select the type of relay contact output. The configuration of these links depends on the revision number of the modules and this number can be found printed on the top right hand side of the PCB surface.

PSICON II Hardware Description (cont'd)

Pre-Processor Module (cont'd)

Relay Form Links (cont'd)

Revision 0 Modules

In position 'A', the relay output will be open under normal operational conditions and will close when an alarm condition is detected. In position 'B', the relay output will be closed under normal operational conditions and will open when an alarm condition is detected. The default setting of these links is position 'B'.

Revision 1 (& greater) Modules

In position 'A', the relay output will be closed under normal operational conditions and will open when an alarm condition is detected. In position 'B', the relay output will be open under normal operational conditions and will close when an alarm condition is detected. The default setting of these links is position 'A'.

Reset Button

A reset button is provided to reset the pre-processor module if any diagnostic routines are invoked during commissioning of the system. Normally, this button will never be used and is provided primarily as an engineering feature.

Geophone Selector Port

This port is an RS232 format port which will interface to a simple 'dumb' terminal and is used to manually route any chosen geophone sensor signal through the pre-processor module to the analyser module. This feature is provided as a commissioning aid and is used only during the commissioning process. A safety feature built into this function is to force all the alarm relay outputs to the active state so that the pre-processor module will not be inadvertently left with only one geophone sensor routed to the analyser module. The connection and operation of the terminal unit is dealt with later in this manual.

Location Data Port

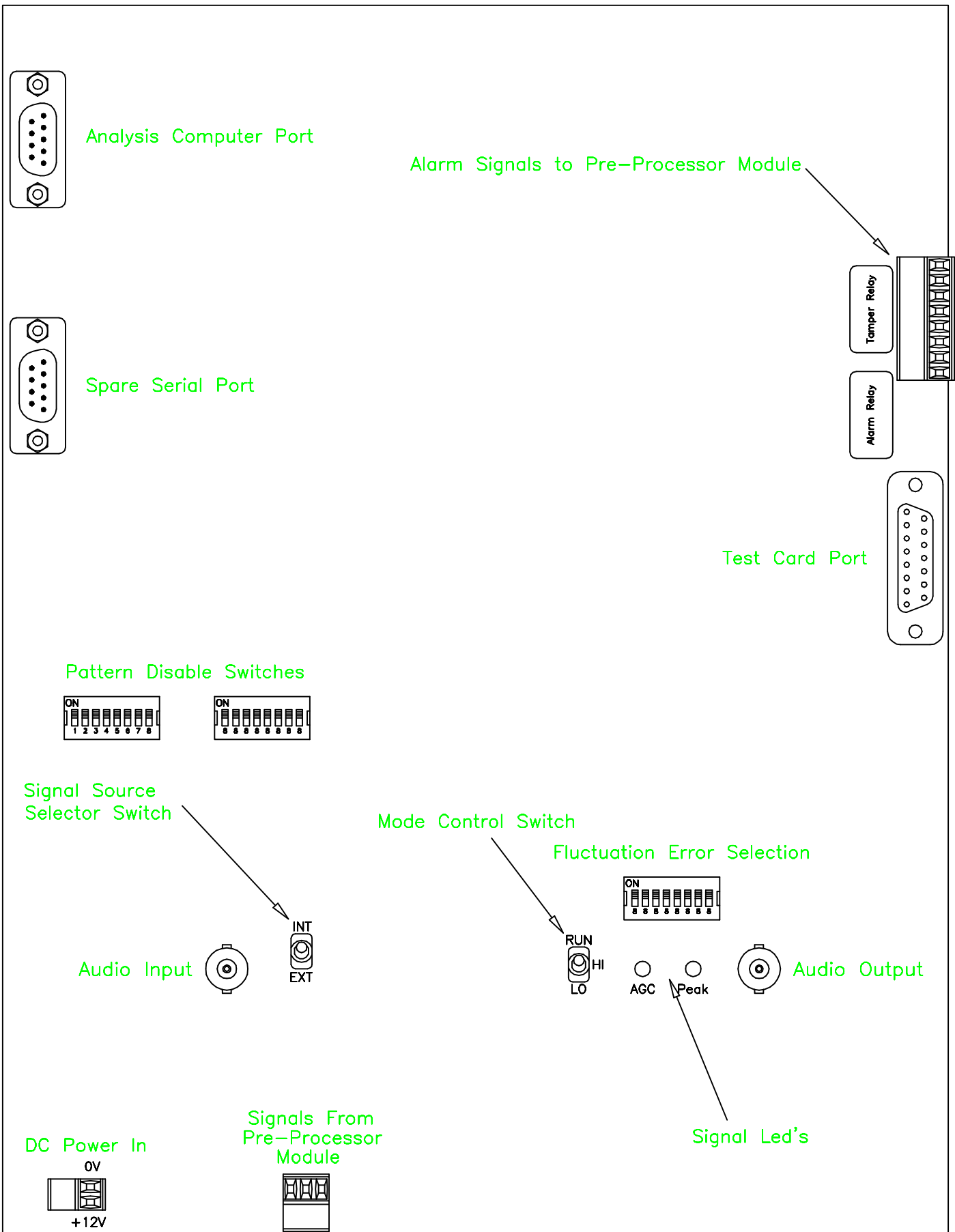
This port is an RS485 format port and can provide status information to external control equipment via a serial data link. The information provided comprises geophone number (location information) and alarm information.

PSICON II Hardware Description (cont'd)

Analyser Module

The layout of the Psicon analyser card assembly is shown in Figure 5. The major

PSICON II Analyser Module



features of the Psicon analyser card are described below.

Reference Pattern Disable Switches

A group of 16 DIL (dual in-line) switches are provided to allow the user to selectively enable or disable any of the first 16 reference patterns which may be stored within the system.

To enable the patterns, the switches should be placed in the 'ON' position. This is the normal mode of operation. In this condition, the Psicon analyser will include all the stored reference patterns in the decision making process which occurs within the analyser unit.

Any switch placed in the 'OFF' position will exclude the corresponding pattern from this process.

Analysis Computer Port

A standard 9-way D-type connector is provided for the communications link between the Psicon analyser card and the analysis PC used to set up and adjust the operational parameters of the system. This link uses a serial data cable (stock code PSI-SL1) between the analysis PC and the Psicon analyser card.

Alarm Signal Connector

This connector accesses the relay outputs from the Psicon analyser. These relay outputs are pre-wired into the pre-processor module and are not accessible to the user. The anti-tamper switch on the lid of the PSICON II housing is connected via this connector to the tamper detect circuitry on the pre-processor module. User accessible alarm relay outputs are provided on the pre-processor module.

Pre-Processor Signal Connector

This connector is the point at which the signals from the pre-processor module are routed to the PSICON II analyser card. This is pre-wired during construction of the PSICON II analyser system.

PSICON II Hardware Description (cont'd)

DC Power Connector

DC power is supplied to the PSICON analyser card via this connector. This is pre-wired to the power supply unit fitted within the enclosure.

Mode Control Switch

This is a 3 position switch used when the system is first commissioned to allow manual selection of the sensitivity ranges of the analyser. The normal position of the switch under operational conditions is the 'RUN' position. In this position, the system automatically determines the optimum sensitivity range for the prevailing conditions.

When switched to the 'HI' setting, the system is permanently forced into the high sensitivity range. When switched to the 'LO' setting, the system is permanently forced into the low sensitivity range.

Signal LED's

There are two LED's on the analyser card which indicate the signal levels fed into the analyser from the pre-processor module.

The LED marked 'PEAK' is provided to indicate when the signal level from the geophone array is too high. Under such conditions, this LED will flash on and off in accordance with the signal level changes. This LED may be used to help adjust the system sensitivity by indicating when the sensitivity is too high.

Excessive signal levels will prevent the system from operating correctly.

The LED marked 'AGC' is provided as a diagnostic aid only and indicates when the system gain is automatically reduced under high signal level conditions.

Signal Source Selector Switch

This switch is normally placed in the 'INT' position and will route the signals from the pre-processor module to the analyser circuitry. If the switch is placed in the 'EXT' position, signals for analysis must be routed into the analyser via the 'Audio I/O' BNC connector adjacent to the switch.

PSICON II Hardware Description (cont'd)

Audio I/O Connector

A BNC connector is provided which can act as an output or an input depending on the position of the Signal Source Selector Switch described previously. When the Signal Source Selector Switch is placed in the 'INT'

position, the Audio I/O connector is configured as an **output** and is used as a convenient point from which audio recordings of the unprocessed geophone signals may be taken. The signal level at this point is normally adjusted to approximately 2 volts peak-to-peak.

When the Signal Source Selector Switch is placed in the 'EXT' position, the Audio Input/Output connector is configured as an **input** and allows the connection of an external source of audio signals to be routed to the PSICON analyser for analysis. This configuration is normally used in conjunction with a tape recorder to replay pre-recorded signals into the analyser. The expected signal level at this point should be 2 volts peak-to-peak.

Audio Output Connector

A BNC connector is provided to monitor the AC signal from the geophone sensors. This can be used during commissioning to ensure the signal levels from the geophones are correct, or it can be used to provide an audio signal as an additional feature of the system operation. This output will only be active when the pre-processor module routes a geophone sensor signal through to the analyser module.

Other connectors or controls shown on the Psicon analyser are used only for engineering functions and are not used under normal operating conditions.

Analysis PC Connection and Setup

Prior to adjustment and commissioning of the PSICON analyser unit, it is necessary to connect a PC to the Analysis Computer Port on the PSICON analyser board. This PC must be equipped with the Psicon Analysis Program software package to access the control settings on the PSICON analyser board.

The following procedure should be adopted for the setup and configuration of the PC

to run the supplied software package most efficiently.

To carry out these instructions, it will be necessary to have a floppy disk containing the necessary software to install on the PC. This disk may be obtained by specifying Geoquip stock code PSI-AP1. This program is copy protected by a software key or 'dongle' supplied with the program.

To connect the PSICON analyser to the PC, it will be necessary to use a serial data cable which can be obtained from Geoquip by specifying the stock code PSI-SL1.

Analysis PC Requirements

IBM compatible PC running Windows 3.1 or Windows for Workgroups 3.11.
At least 5 Mb of free hard disk space.
At least 4 Mb of memory
A spare serial port on the PC (COM1 or COM2)
Colour display

Analysis PC Setup Procedure

1. Switch on the PC and wait until the C:\ prompt is showing. If the PC goes directly to Windows, use the ALT & F key combination to select the 'File' menu and type X to exit from Windows. Press ENTER to confirm that you wish to exit from Windows. This will return the user to the C:\ prompt.
2. Insert the software installation disk into the A: drive and type the following command: a:\install (return)
3. The installation program will make an appropriate directory on the hard disk of the PC and copy the various files from the installation disk to the PC.

The message !!!!Installation Complete!!!! will appear on completion.

4. Start the Windows program (usually by typing 'win' from the C:\ prompt) and install the software key for the analysis program on the parallel (printer) port of the computer.
6. Choose the 'WINDOW' menu and select the 'Psicon Analysis' option to switch to that window.

Analysis PC Connection and Setup (cont'd)

Analysis PC Setup Procedure (cont'd)

Selecting the Serial Port on the PC

The Psicon Analysis Program software package needs to access a serial port on the PC for the purposes of transmitting data to the PSICON analyser, or to

receive data from the PSICON analyser.

The analysis program can be configured to use either COM1 or COM2, depending on which of these ports are available on the PC. Under normal circumstances, there is a mouse connected to COM1, so the normal configuration is to select COM2 for use by the analysis program. This is the default setting supplied with the Psicon Analysis Program software package.

If it is necessary to change the port settings, the instructions given below should be followed.

1. Click once on the icon entitled 'Psicon Analysis' to highlight the icon.
2. Select the 'FILE' menu and choose the 'Properties' option from the menu.
3. In the 'Command Line' box, the text 'analysis.exe 2' should be displayed. The number at the end of the text specifies the 'COM' port that will be accessed by the program, in this case being the 'COM2' port. To change it to access the 'COM1' port, edit the text to change the number 2 to a 1, making sure there is a space between the number and the last text letter.
4. Click on OK to complete the operation.
5. When the program is now started, the new COM port setting will be used.

Psicon Group Window Description

There will be a number of icons present in the new window and these are described below.

1. **Psicon Analysis** This is the icon which will start the analysis program running. The analysis program is a DOS program and will run in a full-screen window. Once this program is started, the key combination of ALT-TAB will return the user to the Psicon

Analysis window.

3. Training File This icon allows access to a text based file which contains the parameters and patterns that are received from the PSICON analyser via the serial port on the PC.
4. New Pattern File This icon allows access to a text based file containing new pattern information generated as a result of the training process.
5. Alarm File This icon allows access to a text based file containing information relating to the alarm activations stored within the alarm log in the PSICON analyser.
6. MSDOS Prompt This icon is provided as a means of returning the PC to DOS operation for any file manipulation operations that may be necessary when setting the PSICON analyser up.

To access any of the text-based files described above, it is necessary only to double-click on the appropriate icon to open the file using the DOS based text editor program 'EDIT'. Once the file is opened, it can be edited, copied, and deleted in accordance with normal file manipulation rules.

To start the PSICON analysis program, it is necessary only to double-click on the Psicon Analysis icon. This will result in a full-screen operation of the program. To return to the Psicon Analysis group window, simply use the ALT & TAB key combination. This will switch between any windows currently opened.

When the PSICON analysis program is started, it will automatically generate a file called 'analysis.log' within the C:\analysis directory created by the installation program. This log file is typically 3.5 Mb in size.

To return to MSDOS mode of operation, it is only necessary to double-click on the MSDOS icon. To return to Windows mode operation, type 'EXIT' (return) from the DOS prompt.

The Psicon Analysis Program

Overview

The Psicon Analysis Program is a software tool which allows the user to communicate with the PSICON analyser and alter or adjust the operational characteristics of the analyser. It is required only for setup and adjustment of the PSICON analyser, and once this process is completed, the PSICON analyser can continue to operate in 'stand-alone' mode without the need to have the Analysis PC connected.

The Psicon Analysis program makes use of various data files to control the operation of the PSICON analyser unit. These files, their locations, and how they are accessed by the function keys which control them are illustrated graphically in Figure 7. The function keys shown correspond to the function keys in the main menu of the Psicon Analysis Program described below.

This illustration shows a PC connected to a PSICON analyser and the flow of data between the two units. All data passing between the PSICON analyser and the PC travels along the serial data cable described previously.

Starting the Program

From the Psicon Analysis group window, double-click on the Psicon Analysis icon to start the analysis program. Once the program has started, the following screen of information will appear:

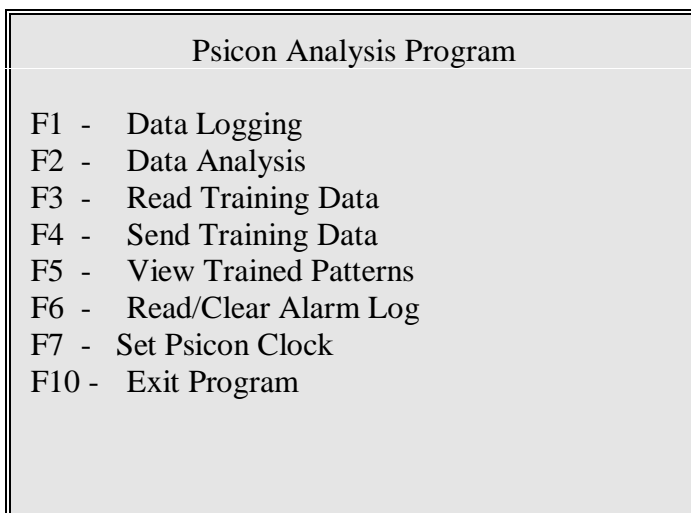


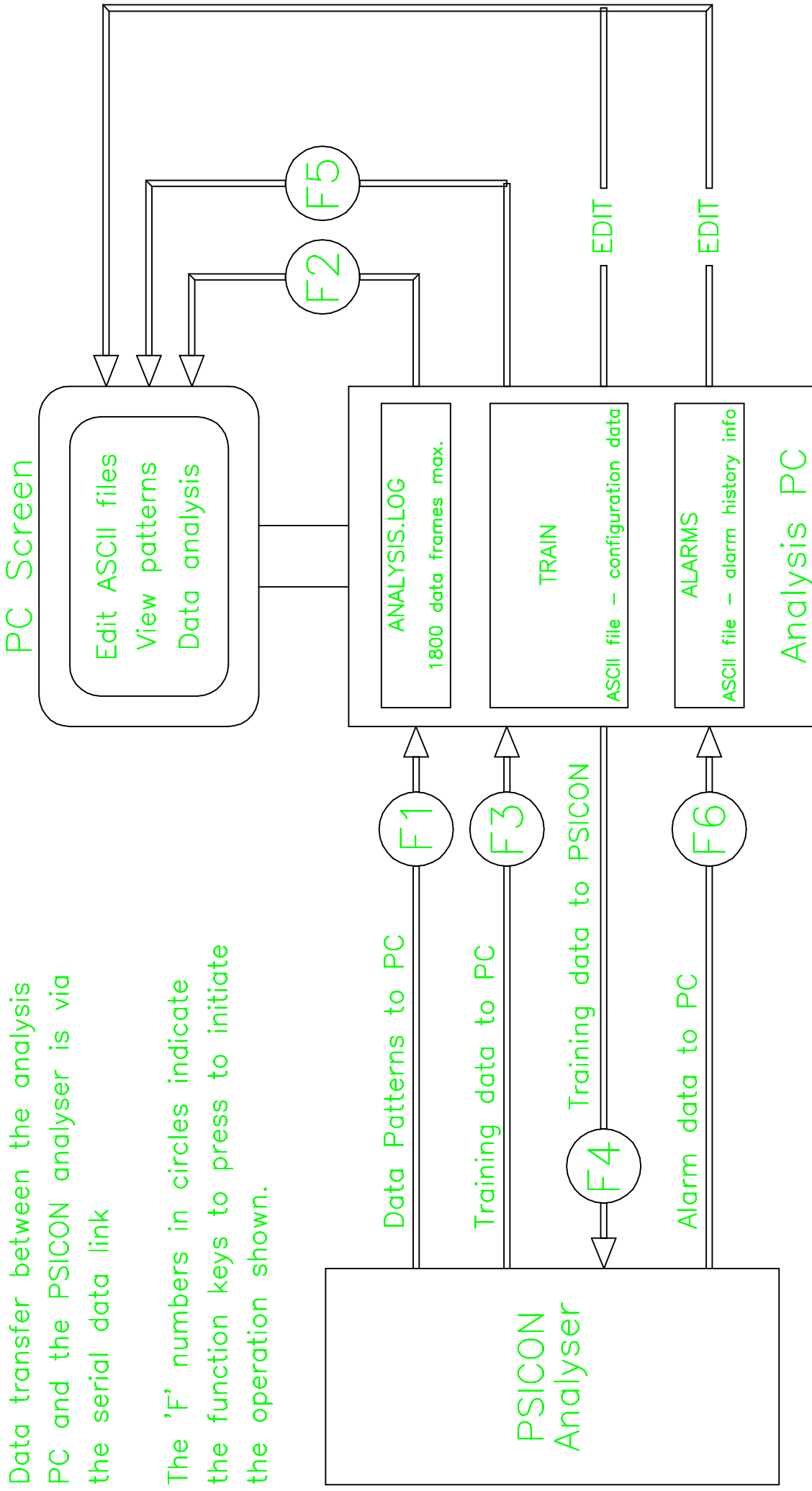
Figure 6

Operation of the function keys F1 through F10 shown on this screen will cause the program to enter the mode shown against the function key. These modes are described in detail in the following text.

The Psicon Analysis Program (cont'd)

Data transfer between the analysis PC and the PSICON analyser is via the serial data link

The 'F' numbers in circles indicate the function keys to press to initiate the operation shown.



F1 - Data Logging Mode

To enter Data Logging mode, the F1 key is pressed.

When in data logging mode, the PSICON analyser processes 'live' signals from the geophone sensors and generates data patterns from these signals. A new data pattern is produced every two seconds by the PSICON analyser and the sequence of these patterns can be viewed on the screen of the analysis PC. In addition to viewing these patterns, the patterns can be stored on the hard disk of the analysis PC in a file called analysis.log.

Analysis Log File

When the Psicon Analysis program is first started, it automatically generates a file called 'analysis.log' which is used subsequently to store the data patterns that the PSICON analyser unit generates in response to the signals from the geophone sensors. The file 'analysis.log' is stored in the working directory c:\analysis which was created previously.

The log file is capable of storing up to a maximum of 1800 data patterns which can subsequently be accessed for the purposes of producing new patterns to be stored within the PSICON analyser unit. Since the log file is updated every two seconds, the total length of time over which data can be stored is $1800 \times 2 \text{ seconds} = 1 \text{ hour}$. After this point, the first data patterns will be overwritten as the log file continues to update.

The PC will only store this data when it is in Data Logging mode and connected to the PSICON analyser by means of the serial lead.

Data Logging Screen Display

When Data Logging mode is selected, the screen display illustrated in Figure 8 is shown.

The screen display appears as 5 separate areas, each of which will be described in the following text.

Pattern Display Area (Upper Left Box)

This area forms the core of the PSICON analysis process and is a display area with 841 separate elements arranged in a square box with each side comprising 29 elements. The view of the display area is as though the user is looking down on to a flat surface. Each element may rise above the surface of this plane by some value determined by the PSICON coding process within the analyser. The effect is to generate a 3 dimensional pattern which the user sees from above as a 2 dimensional display.

The Psicon Analysis Program - Data Logging Screen Display (cont'd)

DATA LOGGING MODE

LEVEL

PATTERN NUMBER 0

PATTERN DURATION 8s

TIME STAMP 11:3:36 07:03:97

0000

ST-0000
NF-0000

Signal Level Indicator

- F1 - PATTERN DISPLAY MODE
- F10 - RETURN TO MAIN MENU
- Z - ZERO COUNTS
- T - DISPLAY ELEMENT FILTER

Pattern Profile Display

Pattern Display Area

Pattern Colour Key

Comparison Scores

Pattern Activity No:

901-65535
701-900
501-700
361-500
261-360
181-260
121-180
81-120
51-80
31-50
21-30
16-20
11-15
6-10
1-5
0

V	SCORES / COUNTS
01	00017 000
02	00018 000
03	00019 000
04	00020 000
05	00021 000
06	00022 000
07	00023 000
08	00024 000
09	00025 000
10	00026 000
11	00027 000
12	00028 000
13	00029 000
14	00030 000
15	00031 000
16	00032 000

DATA PATTERN CONTENTS	ELEMENTS 0000												FILTER OFF		
	01	02	03	04	05	06	07	08	09	10	11	12	10	11	12
01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

USE CURSOR KEYS TO SCROLL THIS AREA

Pattern Ident No:

Pattern Display Area (Upper Left Box) (cont'd)

Signals detected by the geophone sensors are encoded in such a way as to cause elements to appear in the data pattern display. The data pattern display is updated every two seconds and the display pattern will change according to changes in the characteristics of the geophone signals.

The position of each element in the display area is controlled by the PSICON coding process and each position reflects certain characteristics of the signal detected by the geophone sensors. The location of each element is therefore a measure of certain features within the geophone signals.

Additionally, each element in the data pattern has a number associated with it. This number reflects the number of times that the feature in the geophone signal occurred with the pattern duration time. The number associated with each element also governs the colour of the display element. The relationship between the colour of the element and the numeric value of the element is controlled by the Pattern Colour Key in the lower left hand box of the display screen. A cursor comprising a square box with blue dotted line is provided in the pattern display area. This box may be moved around the pattern display area using the cursor keys on the PC keyboard. The area enclosed within the box will be reflected in the Data Pattern Contents area in the lower right box on the PC screen. From this box, the numbers associated with each pattern element can be readily established.

This numeric value can be thought of as the third dimension of the data pattern since it controls the 'height' of each element above the plane of the data pattern display area.

It is the patterns which occur in this display area that are compared with fixed patterns stored in the PSICON analyser. In Data Logging mode, the patterns shown in the pattern display area are indicative of real-time signals detected by the geophone sensors.

Data patterns are constructed of data collected over fixed lengths of time. The length of time that data may be collected over depends on a parameter contained within the TRAIN file used to configure the PSICON analyser. This can be from 2 seconds to 16 seconds in steps of 2 seconds. If an 8 second pattern duration is displayed, any data entering the pattern display area of the screen will remain in there for 8 seconds, after which time it will be discarded. The pattern in the pattern display area is updated every two seconds by adding new 2 second 'block' of data, and discarding the oldest 2 second data 'block'. The pattern is therefore dynamic and changes every two seconds to reflect the changes in the characteristics of the signals detected by the geophone sensors.

The Psicon Analysis Program - Data Logging Screen Display (cont'd)

Pattern Display Area (Upper Left Box) (cont'd)

Each data pattern that is generated in the pattern display area is stored on the hard disk of the PC and can be retrieved at a later date for the purposes of constructing reference patterns which can be used to identify different types of activity impinging on the geophone sensors. Each data pattern is allocated a pattern number when it is stored on the hard disk, along with date and time information taken from the PC clock.

Signal Level Indicator Area (Upper Right Box)

This area includes a bar type level display which shows the signal level detected by the geophone sensors. The bar display is updated every 2 seconds and reflects the peak signal value detected by the sensors within the previous 2 seconds. A numeric display is included in the box below the bar display which shows the absolute signal level. The range of the bar display is from 0 - 2048.

Threshold Level Display

Associated with the bar display are 3 threshold levels which are set in the TRAIN file during system setup. The analysis program reads the TRAIN file to be able to display these values. The box at the right hand side of the bar display shows the numeric settings of the threshold values and the relative position of these thresholds is indicated on the bar display by coloured cursors which identify each threshold level.

Text Information

In the same area as the Signal Level Indicator, there is also textual information available describing certain features of the data logging mode screen. Explanatory notes on this text is given below.

Pattern Number

The pattern number indicates the identity of every pattern logged by the system when in Data Logging mode. This number can range from 1 - 1800. Once the limit of 1800 patterns (1 hour) is logged, the first patterns are overwritten as new ones are generated.

Pattern Duration

The pattern duration indicates the time over which data is collected to construct a data pattern within the data pattern display area of the screen.

The Psicon Analysis Program - Data Logging Screen Display (cont'd)

Signal Level Indicator Area (Upper Right Box) (cont'd)

Time Stamp

The time stamp information is a block of data stored along with each pattern of data and identified the time and date when the pattern was acquired. The time and date information is automatically taken from the clock within the analysis PC itself, so for accurate time/date logging of the data patterns, the PC clock should be checked for correct settings.

F1 - Pattern Display Mode

The F1 function key on the computer can be used to 'toggle' the pattern display mode to show either absolute values associated with each pattern element, or to show these values relative to the largest element in the display area. It will be seen that the Pattern Colour Key area changes in response to the operation of the F1 key. Relative mode is useful for displaying the position of the largest element in the pattern display area. Absolute mode is useful for showing every element associated with any data pattern.

Z - Zero Counts

The 'Z' key on the PC keyboard may be used to reset or 'zero' the number of times that any particular pattern is identified by the PSICON analyser. In the 'Comparison Scores' area of the PC display, it can be seen that there is a table comprising two columns and 16 rows. This means that there are 32 locations in the PSICON analyser into which reference patterns can be loaded. Associated with each location is a two digit identity number (01 - 32), and a 3 digit 'COUNTS' number which can assume values from 0 - 255.

Every time a data pattern is matched to a reference pattern, the 'COUNTS' number against that pattern is incremented by 1. It is possible therefore to see which reference patterns were selected most often by the analyser as being the closest match to the data patterns generated in response to the geophone signals.

This value may be reset to zero by pressing the 'Z' key on the PC.

Element Filter

Operating the 'T' key on the computer keyboard while in data monitoring mode will restrict the content of the data pattern display to only the 60 largest elements in the display, i.e. the 60 elements that have the largest numerical values associated with them.

This is useful for diagnostic purposes since the PSICON analyser will only use the 60 largest elements in a data pattern display when producing a reference pattern for storage within the system.

The Psicon Analysis Program - Data Logging Screen Display (cont'd)

Signal Level Indicator Area (Upper Right Box) (cont'd)

Element Filter (cont'd)

The status of the Display Element Filter is shown in the top line of the 'Data

Pattern Contents' display area as either 'Filter Off' or 'Filter On'. 'Filter Off' means that every event in the data pattern display is shown while 'Filter On' means that only the 60 largest elements are displayed.

Pattern Profile Display Area (Lower Right Box)

The lower right hand box on the PC screen shows a grid of boxes with numbers inside the boxes. This area of the screen represents a 'window' into the pattern display area. This 'window' represents a section of the pattern display area and is provided so that the numerical values associated with the elements of the pattern display area can be readily observed.

The position of the 'window' may be altered by using the cursor control keys on the PC keyboard and the position of the window is reflected on the pattern display area by a square box outlined with a blue dotted line.

Both edges of the grid are annotated by numbers ranging from 01 - 29. These numbers relate to the grid in the pattern display area and are provided so that the numerical values in the boxes can be readily associated with particular elements in the pattern display area. These numbers will change as the window is moved around within the limits of the pattern display area.

The space above the grid contains information relating to the pattern display area, and hence to the contents of this area. These are described as follows:

Elements 0000

The number associated with the legend 'Elements' is the total number of elements in the pattern display area at that time. The number will change as the data pattern changes and this can be used during the training process to set a minimum number of elements that need to be present within the pattern display area in order to allow the PSICON analyser to perform the pattern comparison process and identify the nature of the activity detected by the geophone sensors.

There is a parameter within the 'TRAIN' file named 'Pattern Elements' which specifies the minimum number of pattern elements which need to be present before the PSICON analyser will allow the pattern comparison process to take place. The number used to control this part of the process is the number shown in this display.

The Psicon Analysis Program - Data Logging Mode (cont'd)

Pattern Profile Display Area (Lower Right Box) (cont'd)

Filter OFF

This legend indicates the status of the Pattern Element Filter process which is controlled by operation of the 'T' key on the PC keyboard. The operation of

this key has been described in detail earlier in this section.

Comparison Scores Box (Centre box - Bottom Row)

This area of the screen display shows a table comprising two columns and 16 rows. This corresponds to 32 locations in the PSICON analyser into which reference patterns can be loaded. Associated with each location is a fixed two digit identity number (01 - 32), and a 3 digit 'COUNTS' number which can assume values from 0 - 255.

Between the identity number and the 3 digit 'COUNT' value, a space is left in which an additional number will appear under certain conditions. This number can assume any value between 0 and 100, and is a measure of how closely the data pattern in the pattern display area matches the reference pattern associated with the location in the comparison scores box.

The number is expressed as a percentage and if a data pattern produces a numerical value of 100% against any reference pattern stored within the PSICON analyser, it means that the data pattern exactly matches the reference pattern in every way. If the data pattern produces a numerical value of 0%, it means that the data pattern is completely different to the reference pattern stored at that location.

The numbers which appear in these boxes are referred to as 'comparison scores' and a comparison score will appear against every reference pattern that is stored in the PSICON analyser.

Within the 'TRAIN' file used to configure the PSICON analyser are two parameters which determine whether the PSICON analyser will allow the comparison process to take place.

These are: i) Signal Threshold
& ii) Pattern Elements

For the pattern comparison process to occur, the 'Signal Threshold' setting must be exceeded and the number of elements in the pattern display area must also exceed the number set against the 'Pattern Elements' parameter.

Also within the 'TRAIN' file is a parameter entitled 'Pattern Comparison'. This parameter can be set from any value between 0 and 100 and is a percentage level corresponding to the calculated comparison score.

The Psicon Analysis Program - Data Logging Mode (cont'd)

Comparison Scores Box (Centre box - Bottom Row)(cont'd)

If there are a number of reference patterns stored within the PSICON analyser, a comparison score is calculated for every reference pattern. Each score level is likely to be slightly different depending on the degree of variability in the stored patterns. Before the PSICON analyser 'decides' which reference pattern most closely matches the current data pattern, the comparison score must

exceed the parameter setting. If more than one comparison score exceeds the parameter setting, the highest score is chosen as the pattern most likely to match to the data pattern at that time.

Pattern Colour Key Box (Lower Left Corner)

The pattern colour key box gives an indication of the numeric value associated with each pattern element by allocating a colour code to each pattern element. There are two mode of operation of this box controlled by the F1 function key on the analysis computer keyboard.

Absolute Mode

In this mode, each colour covers a band of numbers so that any element which has numeric value falling within that band will show up as that colour.

Relative Mode

In this mode, the colours are allocated to pattern elements to indicate the percentage difference that each element shows relative to the highest or largest element value. This means that the largest element value can easily be located as it will always show up as white.

This concludes the description of the screen display shown while in Data Logging mode of the Psicon Analysis Program.

The Psicon Analysis Program (cont'd)

F2 - Data Analysis Mode

When in Data Analysis mode, the file 'analysis.log' is accessible so that data patterns of interest can be selected to form stored patterns to be used by the PSICON analyser as references when analysing data from the geophone sensors. In Data Analysis mode, the log file containing the data patterns is no longer updated every two seconds as is the case when in Data Logging mode.

Pattern Display Area

LEVEL	
	0000

Signal Level Indicator

ST-0000
NF-0000

Comparison Scores

Pattern Identity Number

Pattern Colour Key

901-65535	
701-900	
501-700	
361-500	
261-360	
181-260	
121-180	
81-120	
51-80	
31-50	
21-30	
16-20	
11-15	
6-10	
1-5	
0	

SCORES / COUNTS
01 00017 000
02 00018 000
03 00019 000
04 00020 000
05 00021 000
06 00022 000
07 00023 000
08 00024 000
09 00025 000
10 00026 000
11 00027 000
12 00028 000
13 00029 000
14 00030 000
15 00031 000
16 00032 000

DATA ANALYSIS MODE

PATTERN NUMBER 0
 PATTERN DURATION 8s
 TIME STAMP 11:3:36 07:03:97

F1 - PATTERN DISPLAY MODE
 F2 - STEP TO START F7 - STEP TO END
 F3 - STEP BACK 10 F6 - STEP FWD 10
 F4 - STEP BACK 1 F5 - STEP FWD 1
 SHIFT F2-F7 = INCLUDE PATTERNS
 CTRL F2-F7 = EXCLUDE PATTERNS
 F10 - RETURN TO MAIN MENU

Z - ZERO COUNTS
 T - DISPLAY ELEMENT FILTER
 E - EXCLUDE/INCLUDE PATTERN
 A - SUM PATTERNS
 1 - SINGLE PATTERN
 G - GENERATE NEW PATTERN FILE

DATA PATTERN CONTENTS		ELEMENTS 0000										FILTER OFF		
		01	02	03	04	05	06	07	08	09	10	11	12	
01		0	0	0	0	0	0	0	0	0	0	0	0	
02		0	0	0	0	0	0	0	0	0	0	0	0	
03		0	0	0	0	0	0	0	0	0	0	0	0	
04		0	0	0	0	0	0	0	0	0	0	0	0	
05		0	0	0	0	0	0	0	0	0	0	0	0	
06		0	0	0	0	0	0	0	0	0	0	0	0	
07		0	0	0	0	0	0	0	0	0	0	0	0	
08		0	0	0	0	0	0	0	0	0	0	0	0	
09		0	0	0	0	0	0	0	0	0	0	0	0	
10		0	0	0	0	0	0	0	0	0	0	0	0	
11		0	0	0	0	0	0	0	0	0	0	0	0	
12		0	0	0	0	0	0	0	0	0	0	0	0	

USE CURSOR KEYS TO SCROLL THIS AREA

Pattern Activity Number Pattern Profile Display

In this mode, any or all of the data patterns stored in the analysis.log file are easily accessible using the procedures described in the following text. The primary function of Data Analysis mode is to allow the user to select data patterns produced in response to known activities while in Data Logging mode for the purposes of producing reference patterns. These reference patterns are used by the PSICON analyser to identify these activities once the system is placed in monitoring mode on completion of the commissioning process.

To enter Data Analysis mode, the F2 key is pressed and the Data Analysis screen shown in Figure 9 is displayed.

The screen display is very similar to the screen display used in Data Logging mode with the exception of the Signal Level Indicator display area and the associated text. The differences in this area are described below.

Data Analysis Screen Display

Signal Level Indicator Display Area

The function of the bar display showing the signal levels associated with any particular data pattern is identical to the description given under the Data Logging mode text given previously. The bar display shows the peak signal level associated with the data pattern on the screen at that time.

Text Description

Text shown in this area of the display screen differs from that shown in the Data Logging screen since additional controls have been added to permit the user to step through the log file to access particular frames of interest.

To avoid duplication of explanations, the following text will only describe the features that differ from the Data Logging screen. Descriptions of features or functions on the screen display that are not addressed in the following text may be found in the the section dealing with Data Logging mode.

Function Keys F2 - F7

These key function are provided as a means of stepping through all the data patterns held in the analysis.log file. On entry to Data Analysis mode, the user is placed at the beginning of the log file.

The Psicon Analysis Program - Data Analysis Screen Display (cont'd)

Function Keys F2 - F7 (cont'd)

The log file comprises a maximum of 1800 patterns of data. If more than 1800 data patterns are logged in Data Logging mode, the oldest data pattern is overwritten and the new pattern will become data pattern number 1. The most recent data pattern recorded while in Data Logging mode is therefore referred to as the **end** of the file. The **start** of the file is therefore the data pattern that is positioned 1800 patterns behind the most recent data pattern.

This is where the user is placed on entry to Data Analysis mode.

To step directly to the **end** of the file, and the most recent data patterns logged, function key F7 is pressed. To return to the **start** of the file, function key F2 is pressed.

From either position, the user has the option to step forward or backwards in single steps (Function keys F4 & F5), or in steps of 10 (Function keys F3 and F6). In this way any frame in the log file may be quickly located and displayed on the screen.

Pattern Selection

Pattern selection is the process of selecting specific data patterns from the log file which represent known activities detected by the geophone sensors.

For example, if a pattern representative of a person walking near the geophone sensors is required as a reference pattern, the activity is simulated and note is taken of the data patterns generated while in Data Logging mode.

On completion of the simulation, Data Analysis mode is selected and the noted patterns are selected and combined to produce a reference pattern.

To do this, some means of selecting only the data patterns representative of the walk simulation from the possible maximum 1800 patterns stored in the analysis.log file is required. This is done by 'marking' or 'tagging' each data pattern as either 'included' or 'excluded'. Patterns marked as being 'included' will be used to generate a reference pattern while those marked as 'excluded' will be ignored during the reference pattern generation process.

On entry to Data Analysis mode, it is wise to ensure all patterns in the log file are marked as 'excluded'. This is done by pressing the key combination 'CTRL- F7'. All patterns in the analysis.log file will then be marked as 'excluded' patterns and the user will be placed at the end of the file.

The function keys F2 - F7 may now be used to locate the data patterns known to be produced as a result of the simulation. These patterns can be 'included' singly by pressing the 'E' key on the PC keyboard, or as a block by using the function keys in combination with the SHIFT key.

The Psicon Analysis Program - Data Analysis Screen Display (cont'd)

Pattern Selection (cont'd)

As shown on the text display of the Data Analysis mode screen, a function key operation combined with the SHIFT key will 'include' data patterns while a function key combined with the CTRL key will 'exclude' data patterns.

The marked or tagged data patterns can be scrolled to check whether they are 'included' or 'excluded' by observing the legend adjacent to the Pattern No: legend at the top of the text display area.

‘A’ Key Operation - Sum Patterns

Once a series of data patterns is marked for inclusion in a reference pattern, the ‘A’ key on the PC keyboard is pressed. This will add all the marked data patterns together into a single data pattern which combines the features of the sum of all the individual patterns.

At this point, a comparison score is calculated between this summed group of data frames, and any other existing reference patterns within the PSICON analyser.

This feature is provided so that the user does not inadvertently produce a new pattern which is similar to any existing reference patterns. It is important to avoid this for two reasons.

- i) If the new pattern is to be allocated a ‘non-hostile’ status, it is important that the pattern should not be too similar to any existing patterns that are allocated a ‘hostile’ status. Unless this is observed, it is possible that a hostile activity may be wrongly classified as a non-hostile activity because of the similarity between reference patterns with different status allocations.
- ii) Addition of patterns which are closely matched serves no useful purpose since one pattern should be sufficient to perform the function of a group of similar patterns.

‘1’ key - Single Pattern

It will be noticed that once a group of data patterns are combined into one summed pattern, the function keys used to select the data patterns become inoperative. This is because a group of patterns is combined into one and cannot be stepped through again singly as before. If the comparison score calculated for the new group of data frames shows that it may be unsuitable for use as a reference pattern, the data frames may be separated again into single patterns by pressing the ‘1’ key on the PC keyboard. The pattern selection process may then be repeated to produce a more suitable reference pattern.

The Psicon Analysis Program - Data Analysis Screen Display (cont’d)

‘G’ - Generate New Pattern File

If the result of the summing process is satisfactory, a new pattern file may be generated by pressing the ‘G’ key.

This will create a file containing a single pattern in the correct format for placing into the TRAIN file to be sent to the PSICON analyser for updating with the new reference pattern.

Pressing the ‘G’ key will cause the word ‘done’ to flash briefly beside the text to show that the file generation was successful.

The process of incorporating this new file in the TRAIN file is described later in this manual.

The Psicon Analysis Program (cont'd)

F3 - Read Training Data

When this mode is entered by pressing the F3 key, the training, or configuration data stored within the PSICON analyser is retrieved by the analysis PC into a file called 'TRAIN'. Prior to retrieval of the file, a warning message is displayed so that the user is aware that the existing training file within the PC will be overwritten. An example of this screen display is shown below.

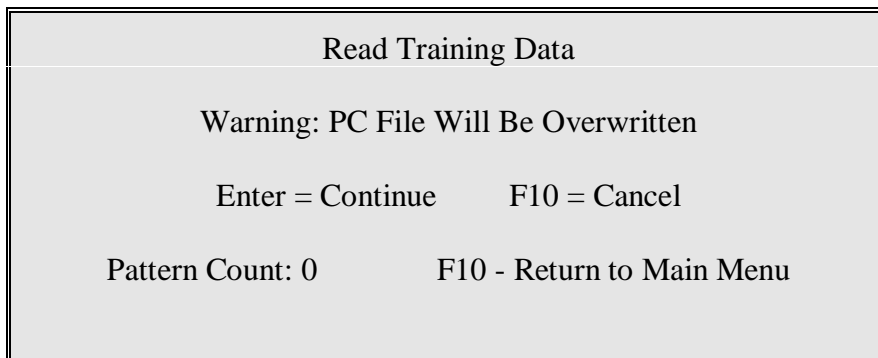


Figure 10

If the existing file on the PC represents data that needs to be saved, from another analyser for example, the file 'TRAIN' can be saved using a different filename. The file 'TRAIN' is an ASCII text file and can be viewed and edited using the MSDOS program 'EDIT' which is available on every IBM compatible PC. All file manipulation descriptions that follow in this manual will use this 'EDIT' program.

There is a 'TRAIN' file associated with every PSICON analyser which holds the reference patterns that the analyser uses, along with the settings needed to configure the analyser for each application. A full description of this file and the associated parameters follows later in this manual.

F4 - Send Training Data

When this mode is entered, the file 'TRAIN' is sent to the PSICON analyser to update the analyser with any alterations made by editing the file. A warning message is displayed prior to updating so that the user is aware that the existing training data within the analyser will be overwritten. An example of this screen is shown below.

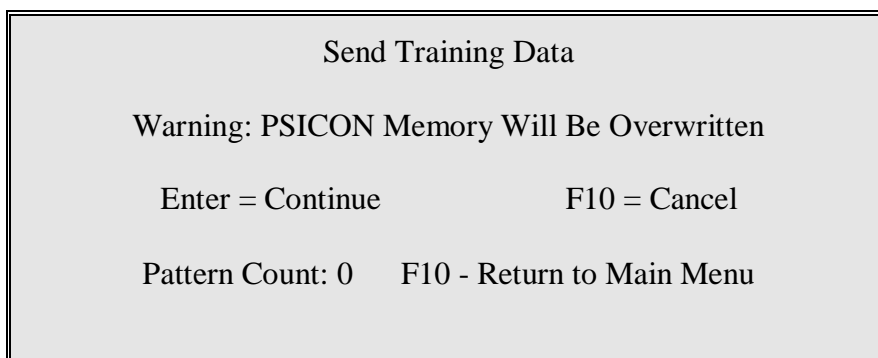


Figure 11

The Psicon Analysis

Program (cont'd)

F5 - View Reference Patterns

Entering this mode allows the user to view the reference patterns held in the 'TRAIN' file described previously. This mode is entered by pressing the F5 key. The user is then prompted for the number of the pattern to be viewed and on entering this number, the corresponding reference pattern is displayed on the screen of the PC.

Pattern Display Area

VIEW REFERENCE PATTERNS

PATTERN NUMBER 1

F1 - PATTERN DISPLAY MODE
F10 - RETURN TO MAIN MENU

Pattern Profile Display

	901-65535
	701-900
	501-700
	361-500
	261-360
	181-260
	121-180
	81-120
	51-80
	31-50
	21-30
	16-20
	11-15
	6-10
	1-5
	0

Pattern Colour Key

DATA	PATTERN CONTENTS												ELEMENTS 0000												FILTER OFF			
	01	02	03	04	05	06	07	08	09	10	11	12	01	02	03	04	05	06	07	08	09	10	11	12	01	11	12	
01	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
02	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
03	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
04	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
05	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
06	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
07	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
08	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
09	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

USE CURSOR KEYS TO SCROLL THIS AREA

An example of this screen display is shown in Figure 12.

The Psicon Analysis Program (cont'd)

F6 - Read/Clear Alarm Log

The PSICON analyser maintains an internal alarm log which shows the date and time for each occurrence of a hostile event detected by the analyser. The log is held in non-volatile memory on the PSICON analyser card and will store up to 1000 events.

This information can be read into the analysis PC for inspection by pressing the F6 key. An example of the screen display is shown below.

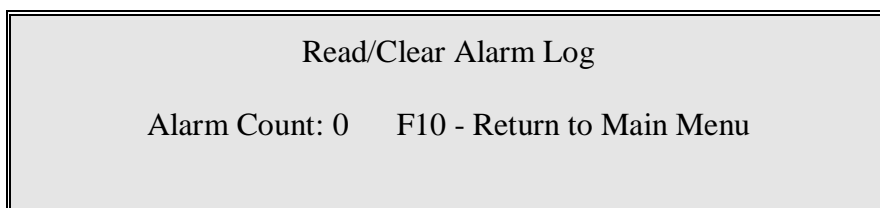


Figure 13

On pressing the F6 key, the alarm information stored in the PSICON analyser is retrieved and stored on the PC in a file called 'ALARMS'. This file may be inspected and edited using the MSDOS EDIT program. When the alarm data is transferred to the PC, the memory within the PSICON analyser is cleared.

F7 - Set Psicon Clock

The PSICON analyser maintains an internal clock which keeps track of date and time so that significant events can be logged in the alarm log against specific dates and times. The clock within the Psicon analyser is updated by reading the clock in the analysis PC. The clock is set by selecting the F7 function key from the main menu of the Psicon Analysis Program.

If the PC clock and Psicon analyser clock settings are the same, the following screen is displayed:

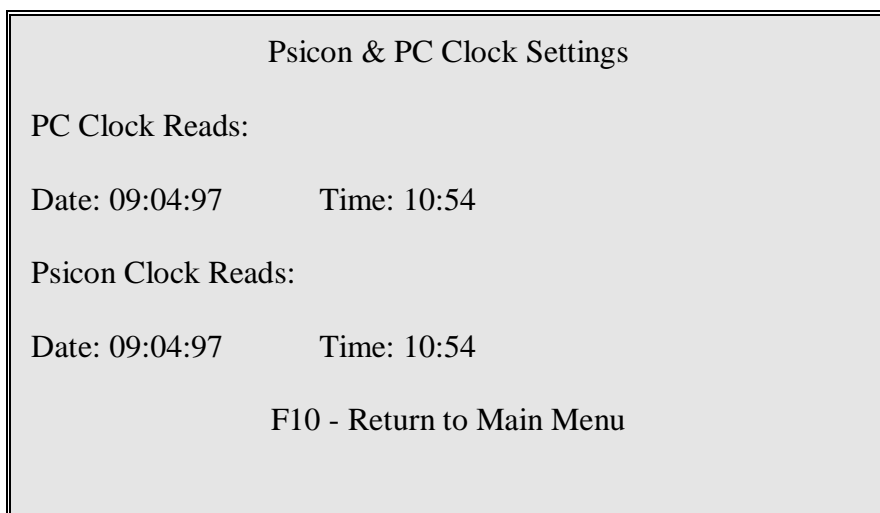


Figure 14

The Psicon Analysis Program (cont'd)

F7 - Set Psicon Clock (cont'd)

If the clocks in the analysis PC and the Psicon analyser are different, the following screen will be displayed.

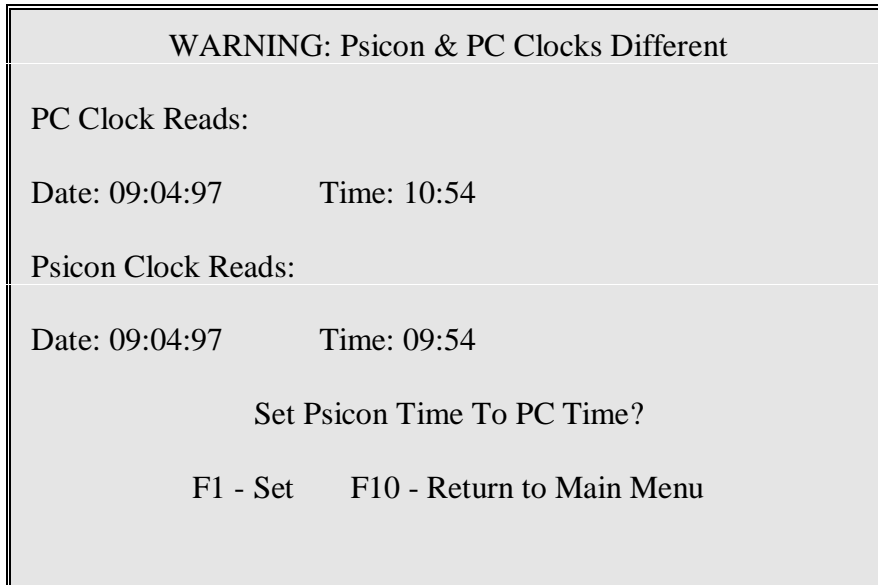


Figure 15

Pressing the F1 function key will synchronise the clocks in the analysis PC and the Psicon analyser. Obviously, before this is done, it will be necessary to ensure that the PC clock is set correctly.

F10 - Exit Program

Operation of this key will exit from the Psicon Analysis Program and return the user to Windows.

The PSICON Analyser 'TRAIN' File

Training the PSICON analyser means adjusting the system to best deal with the site conditions, and then adding reference patterns to the system representative, primarily of alarm related activities, so that the system is able to identify these activities when they occur.

All of the adjustments to the system, with the exception of the system sensitivity, are accomplished by changing parameters in the TRAIN file which is held in memory in the PSICON analyser. The TRAIN file is sent to and retrieved from the PSICON analyser as described in the section entitled 'Psicon Analysis Program'.

To be able to adjust the PSICON analyser and form reference data patterns for the system to work with, it is necessary to understand the format of the TRAIN file, and the function of the parameters available for adjustment by editing this file. The following text describes these parameters in detail. The process of adjusting these parameters during commissioning is covered at a later point in this manual.

Reference should be made to Figure 16 which shows the layout of the system parameters. The range of adjustment for each parameter, and where applicable, the units of the parameter are shown. These explanatory notes are not part of the TRAIN file format.

rem	The top 5 lines of the training file are used to enter comments or a header		rem
	so that information about the site can be appended to the file. This		rem
	information provides useful data to any user or engineer who has not been		rem
	involved in the initial set-up of the analyser. Unused lines in this header must		
rem	have the letters 'rem' (remark) at the start of each line.		

Pattern Duration	: 2, 4, 6, 8, 10, 12, 14, 16	(seconds)	
Pattern Threshold	: 1 - 2047	(signal size)	
Pattern Position	: 100 - 10,000	(frequency)	

Pattern Comparison	: 1 - 100	(percentage)	
Signal Threshold	: 1 - 2047	(signal size)	
Pattern Elements	: 1 - 60	(no.of pixels)	
Pattern Separation	: 1 - 100	(percentage)	
Pk/Av Ratio	: 0 - 100	(see text)	

Alarm Pattern Count	: 1 - 5	(event count)	
Alarm Relay Time	: 2, 4, 6, 8, -- 32	(seconds)	

Figure 16

Note that the reference pattern structure is not shown in this diagram. This will be described later in this manual.

The PSICON Analyser 'TRAIN' File - Parameter Description

Header Text

The first 5 lines of the TRAIN file are set aside to allow the user to insert a textual description which will be held as part of the TRAIN file. This text is useful for incorporating notes about any site specific problems or adjustments carried out during commissioning. The text description is important as an aide-memoire for service engineers returning to the site at some later date and making further adjustments. Date and times of adjustments or last visits can be incorporated in the text header. Any unused lines must incorporate some text such as 'rem' (remark) to signal to the PSICON analyser that valid information is held in these lines. **ONLY** alphanumeric (numbers or letters) characters are permitted in these lines. Symbolic characters such as punctuation marks, mathematical symbols etc. are **NOT** allowed.

Pattern Duration

This parameter determines the time over which data is collected to contribute to the overall data pattern within the PSICON analyser. The parameter can be set from 2 seconds to 16 seconds in steps of 2 seconds.

The value set for this parameter depends on the length of time it is likely to take for a typical intrusion activity to take place so that signals generated by the activity are added in as part of overall data pattern built up in response to this activity.

The default setting of this parameter is 8 which means that data from activity detected by the geophone sensors will be collected over a period of 8 seconds. Data is added to the pattern display every 2 seconds and after a period of 8 seconds has elapsed, the oldest two second 'block' of data entered into the

pattern is discarded.

Care must be exercised when setting this parameter to short durations such as 2 or 4 seconds since the accuracy of the classification of short duration patterns is more difficult to guarantee. This is because there will be more variability in data collected over a short duration whereas if the data is collected over a longer period, the data, and hence the resulting pattern generated is more likely to be consistent in content.

The PSICON Analyser 'TRAIN' File - Parameter Description (cont'd)

Pattern Threshold

This parameter operates by setting a threshold which controls the entry of pattern data into the pattern display area on the PC screen. The threshold is related to the amplitude or magnitude of the signals detected by the geophone sensors. Signal levels which fall below this threshold will not be allowed to contribute to the pattern formed in the pattern display area on the Data Logging PC screen. Signals which exceed this threshold are converted into pattern elements and are allowed to enter the pattern display area.

The function of the noise floor threshold parameter is to screen out any low level background signals detected by the geophone sensors. Such low level signals are usually random in nature and therefore impossible to categorise or classify as specific events.

The parameter value is adjustable between 1 and 2047, with the lowest figure representing the lowest threshold which allows virtually every signal to contribute to the matrix pattern. Setting the value higher than 1 will progressively screen out more and more signals.

Setting the pattern threshold is an important aspect of commissioning the system and care should be exercised to ensure that it is done correctly.

Pattern Position

The sampling frequency controls the position of the data pattern within the data pattern display area and is a fundamental parameter which needs to be set carefully to optimise the system performance. The range of adjustment of this parameter is from 100 - 10,000.

Increasing the sampling frequency will have the effect of moving the position of the data pattern towards the bottom right hand corner of the pattern display area. Decreasing the sampling frequency will move the data pattern towards

the top left hand corner of the display.

Irrespective of whether the sampling frequency is increased or decreased, the data pattern will always move along the diagonal of the data pattern display area which runs from the top left hand corner of the display area to the bottom right hand corner of the display area.

The PSICON Analyser 'TRAIN' File - Parameter Description (cont'd)

Pattern Position (cont'd)

For most applications, it is recommended that this parameter is adjusted so that the pattern element with the highest numerical value is positioned at location 12, 12 in the pattern display area. This process will be described in detail later in this manual.

The three parameters described above must be set correctly before the system can be trained with any reference patterns. Any reference patterns entered into the system will be invalidated if these parameters are changed after generating the reference patterns.

All of the following patterns parameters may be changed at any time without affecting any reference patterns within the system.

Pattern Comparison

This is a percentage value which can be set at any value between 1 and 100. When the PSICON analyser performs a comparison between a data pattern generated in response to signals detected by the geophone sensors, and a reference pattern stored within the PSICON analyser, a comparison score is calculated which is a measure of how similar the two patterns are.

This parameter is used to set a threshold on this comparison which must be exceeded before the system will accept the comparison as being valid.

A typical default setting would be 50% which allows the system to accept a reasonable degree of variability in the data patterns generated by the system.

Signal Threshold

This parameter operates in a similar way to the Pattern Threshold described previously. The parameter sets a threshold applicable to the amplitude or magnitude of the signals from the geophone sensors. If the signal levels exceed the threshold, the pattern comparison procedure within the PSICON analyser is enabled. If the signal levels from the geophone sensors fall below this threshold, the pattern comparison procedure is disabled.

The pattern comparison procedure is a process within the PSICON analyser that compares the data pattern generated by the signals from the sensors with reference patterns previously stored in the analyser. If this process is enabled continuously, the data pattern in the pattern display area of the Data Logging PC screen will be compared every two seconds with all of the reference patterns stored within the PSICON analyser.

The PSICON Analyser 'TRAIN' File - Parameter Description (cont'd)

Signal Threshold (cont'd)

The silence threshold parameter is provided to limit the pattern comparison process to patterns generated in response to signal levels that are representative of intrusion activities so that the system is prevented from comparing patterns produced from much lower level signals than would be representative of actual alarm related activities.

As with the noise floor threshold, the range of adjustment is from 1 - 2048, with 1 representing the lowest threshold which will allow the pattern comparison process to continue without being restricted by signal level considerations.

Pattern Elements

This parameter is of interest when the PSICON analyser and the analysis PC are connected and running in the Data Logging mode. Under these conditions, data patterns will appear in the pattern display area on the Data Logging screen in response to activity detected by the geophone sensors. These patterns comprise a number of elements, whose position in the pattern display area depends on the type of signal the sensors have detected.

The parameter specifies the **number** of pattern elements that must appear in the pattern display area of the analysis PC screen before the PSICON analyser comparison procedure is enabled. This parameter may be set to any value between 1 and 60. The number of pattern elements in the data pattern at any given time is indicated by the number against the legend 'ELEMENTS' in the top line of the Data Contents Display when the Psicon Analysis Program is in either Data Logging mode, or Data Analysis mode.

This parameter is provided to prevent the PSICON analyser making pattern comparisons on data patterns which comprise less than a representative number of elements.

Pattern Separation

This parameter is adjustable between 0 and 100 and specifies a minimum difference that must exist between the comparison of a data pattern in the pattern display area and any alarm and benign reference patterns stored within the system.

For example, if a data pattern generated by the PSICON analyser in response to some activity detected by the geophone sensors is compared against the alarm and benign reference patterns previously stored in the system, the system will normally select the reference pattern that shows the closest similarity between itself and the data pattern created in response to these signals.

The PSICON Analyser ‘TRAIN’ File - Parameter Description (cont’d)

Pattern Separation (cont’d)

The degree of similarity between data patterns and the stored reference patterns is calculated by the analyser and results in a percentage ‘score’ value. A score of 100% indicates that the data pattern exactly matches a stored reference pattern, while a score of 0% indicates that the data pattern is totally different to the reference pattern.

Pk/Av Ratio

This parameter is not used at present and should be ignored for the purposes of this description.

Alarm Pattern Count

This parameter sets the number of times that an alarm, or hostile event is detected before the alarm relay on the analyser card is activated. The parameter can be set to a minimum of 1 event and up to a maximum of 5 events. If the parameter is set to a value greater than 1, this value must be reached within 16 seconds of the first event. If for example, the value is set to 3, all 3 events must occur within 16 seconds of the first one in order to operate the alarm relay output. If only two events are recorded and then the 16 second time period elapses, one of the events is discarded, meaning that the system must log another two events in the next 16 seconds for the alarm relay to be operated.

Alarm Relay Time

This parameter controls the length of time that the alarm relay on the analyser card will remain open for once an alarm condition has been detected and is adjustable in steps of 2 seconds from a minimum of 2 seconds up to a maximum of 32 seconds.

This concludes the description of the training file parameters and their respective functions.

The following section will describe the reference pattern format and parameters associated with these patterns. The reference patterns used by the PSICON analyser are loaded into the ‘TRAIN’ file during the training process and then used to update the analyser by sending the ‘TRAIN’ file to the analyser using the ‘Send Training Data’ option in the Psicon Analysis Program as described previously.

The PSICON Analyser 'TRAIN' File

Reference Pattern Format

Figure 17 illustrates the reference pattern locations of the 'TRAIN' file prior to training. Only two pattern locations are shown for clarity. The parameters shown in these locations are explained in the following text.

```
Industrial chemical site wall protection system. 14 geophones installed on single skin
brick wall. System installed 01/02/97. Train file saved as BPCHEM1 for future ref.
System sensitivity set to detect scramble climb.
rem
rem
*****
Pattern Duration           : 8
Pattern Threshold         : 65
Pattern Position          : 2800
*****
Pattern Comparison        : 50
Signal Threshold          : 350
Pattern Elements          : 25
Pattern Separation        : 0
Pk/Av Ratio               : 1
*****
Alarm Pattern Count       : 2
Alarm Relay Time          : 6
*****
Pattern Number            :1
-----
Status                    : 0 = Empty
Type                      : 2 = Ambient
Name                      : Pattern 01
Significant Events        : 0
-----
Pattern Number            :32
-----
Status                    : 0 = Empty
Type                      : 2 = Ambient
Name                      : Pattern 32
Significant Events        : 0
```

Figure 17

The PSICON Analyser 'TRAIN' File - Reference Pattern Format (cont'd)

Pattern Number

The PSICON analyser can store up to 32 reference patterns. Each pattern is identified within the 'TRAIN' file using a Pattern Number. This number is shown on the first line of the data following the system parameters. For brevity, only pattern numbers 1 and 32 are shown in the example. In practice, all 32 pattern locations are always present, whether there is a pattern stored at that location or not.

Status

This line is used only by the PSICON analyser to determine the status of any pattern stored at that location. The information associated with this line is automatically updated by the analyser and needs no user intervention.

Type

The PSICON analyser can use two types of reference pattern for decision making purposes. The type of reference pattern is determined by the user according to the activity which created that pattern during the training process. Pattern types are allocated by assigning a particular number to this parameter at this location in the file. The pattern type may be changed at any time.

Setting the parameter TYPE to 0=Alarm will register the reference pattern as an alarm type so that if it is selected by the PSICON analyser during a comparison, the system will register an alarm activation. This allocation would be applied to patterns generated in response to intrusion activity.

Setting the parameter TYPE to 1=Benign will register the reference pattern as a non-alarm type. If such a pattern is selected by the PSICON analyser during a comparison process, the system will recognise this as an event for which no action need be taken. This allocation would be applied to patterns generated in response to non-hostile activities detected by the geophone sensors and might include weather-related activities, vehicular traffic noise, or other spurious signals occurring in the vicinity of the geophone sensors.

The system will automatically set any unused or empty pattern locations to have the TYPE 2=Ambient. This allocation applies only to empty pattern locations.

Name

Each pattern location allows the user to enter a text name of up to 32 characters to describe the activity that created the pattern. Unused pattern locations will automatically have the names as shown in Figure 17.

The PSICON Analyser 'TRAIN' File - Reference Pattern Format (cont'd)

Training Count

This is a system parameter and is allocated automatically by the system. The user must not alter this parameter.

Duration

This is a system parameter and is allocated automatically by the system. The user must not alter this parameter. It does not relate to the Pattern Duration parameter described earlier in this section.

Checksum

This is a system parameter and is allocated automatically by the system. The user must not alter this parameter.

Sum of Squares

This is a system parameter and is allocated automatically by the system. The user must not alter this parameter.

Significant Events

This is a system parameter and is allocated automatically by the system. The user must not alter this parameter. This number indicates the number of separate elements that are used to construct the reference pattern. The maximum number of elements used by the system is 60 and under normal conditions, the reference patterns will use all 60 elements.

This concludes the description of the parameters associated with any reference patterns that may be stored within the system.

The PSICON Analyser 'TRAIN' File - Reference Pattern Format (cont'd)

Figure 18 shows the same file with the addition of one reference pattern.

Industrial chemical site wall protection system. 14 geophones installed on single skin brick wall. System installed 01/02/97. Train file saved as BPCHEM1 for future ref. System sensitivity set to detect scramble climb.

rem

rem

Pattern Duration : 8
Pattern Threshold : 65
Pattern Position : 2800

Pattern Comparison : 50
Signal Threshold : 350
Pattern Elements : 25
Pattern Separation : 0
Pk/Av Ratio : 1

Alarm Pattern Count : 2
Alarm Relay Time : 6

Pattern Number : 1

Status : 2 = Fully Trained
Type : 0 = Alarm
Name : Scramble climb
Significant Events : 60

[12][12] = 0x003F
[20][20] = 0x0033
[10][8] = 0x0032
[12][10] = 0x002C
[8][8] = 0x002B
[15][15] = 0x002A
[8][10] = 0x0027
[12][8] = 0x0025
[8][12] = 0x0025
[10][10] = 0x0025
[10][12} = 0x0020
[10][8] = 0x001A

Figure 18

The PSICON Analyser 'TRAIN' File - Reference Pattern Format (cont'd)

Not all the pattern elements are shown since there would normally be 60 lines used. Each line relates to a pattern element and the numbers shown in the square brackets are the locations of these elements. The number after the 'equals' symbol represent the number of time that pattern element occurred during the activity that resulted in the pattern.

Commissioning the Psicon II System

The PSICON II system is commissioned in accordance with the instructions in this section of this manual. It is important that the sequence of operations is followed closely to ensure optimum results from the system.

Before embarking on this procedure, it is necessary to confirm that installation of the geophone sensors is complete and that the PSICON II analyser unit is installed and connected as shown diagrammatically in Figure 1.

Sensitivity Adjustment

The first step in commissioning the PSICON II system is to set the sensitivity to cater for the range of activities likely to be detected by the geophone sensors.

The PSICON II system allows the sensitivity of each geophone connected to the system to be altered to optimise the system performance. These adjustments are made on the geophone interface modules shown in Figures 2 & 3. A slightly different

procedure is required depending on the version of geophone interface module fitted to the pre-processor module. These procedures are detailed below.

Setting the system sensitivity correctly is vital in ensuring the best performance of the system. Sensitivity settings that are too high will cause a loss of performance as the signal waveform will be distorted and will lose many of the features that the PSICON II system uses to enable it to 'recognise' particular signal patterns. Sensitivity settings that are too low will result in poor detection capabilities.

The steps detailed below should be followed:

- i) Ensure that the PSICON II system is supplied with power.
- ii) Ensure that all the cable tamper LED indicators on the pre-processor module are OFF.
- iii) Ensure that the Signal Source Selector Switch on the analyser module is in the 'INT' position.
- iv) Ensure that a PC running the Psicon Analysis Program is connected to the Analysis Computer Port on the analyser module.
- v) Test the communications link between the PSICON analyser and the analysis PC by reading the training file from the PSICON analyser using the F3 function key from the Psicon Analysis Program main menu. The training file should be read into the analysis PC in a few seconds if the communications link is functional.
- vi) Select Data Logging mode (F1) from the main menu on the analysis PC.

Commissioning the Psicon II System (cont'd)

Sensitivity Adjustment (cont'd)

- vii) Place the Mode Control Switch on the PSICON analyser module into the 'LO' position.
- viii) Following the procedure described in the section entitled 'Manual Geophone Selection', select a geophone to act as a signal source that is representative of the other geophones in the installation. By this, it is meant that the selected geophone should be installed in the same way as all the others, and would be likely to produce signals with similar characteristics as all the others when exposed to the same types of intrusion activity.
- viii) Have an assistant simulate a typical intrusion activity in the immediate vicinity of the selected geophone while observing the Signal Level Indicator on the Data Logging screen of the analysis PC. The Signal Level indicator will show the peak level of signal applied to the PSICON analyser every two seconds. The assistant should simulate the activity repetitively so that a representative set of readings is obtained

on the signal level indicator.

Geophone Interface Modules - Revision 2 or lower.

Refer to Figure 3.

- ix) The sensitivity of the selected geophone channel is altered by changing the resistor which corresponds to that channel. To increase the sensitivity, the resistor value is **reduced**, while to decrease the sensitivity, the resistor value is **increased**. The permissible range is from 0 (maximum sensitivity) to 5k ohms (minimum sensitivity).
- x) Select an appropriate resistor value so that the signal level indicator shows a level of typically 50 - 75% of the total range of the bar display.

Geophone Interface Modules - Revision 3 or greater.

Refer to Figure 2.

- ix) Adjust the sensitivity control for the selected geophone so that the signal level indicator shows a level of typically 50 - 75% of the total range of the bar display.

Commissioning the Psicon II System (cont'd)

Sensitivity Adjustment (cont'd)

Once the sensitivity is set correctly for the selected geophone, it is necessary to set the sensitivity controls for all the remaining geophones to the same level. This is done by following the instructions detailed below.

Geophone Interface Modules - Revision 2 or lower.

Replace all remaining resistors on the geophone interface modules with resistors of the same value as selected for the geophone channel on which the simulations were carried out.

Geophone Interface Modules - Revision 3 or greater.

A digital multimeter capable of reading resistance values will be required to carry out this procedure.

Refer to Figure 2.

Each geophone interface card has a set of test points marked TP1 - TP9 which are provided to assist the commissioning engineer to set the sensitivity levels

for each geophone.

Once the geophone channel selected by manual means as described previously has been correctly adjusted for sensitivity, the resistance value set for this channel may be transferred to all the other channels which have geophone sensors connected. This procedure is described below.

- i) Switch the power to the PSICON II system off and identify the geophone interface card which incorporates the channel selected manually during the sensitivity adjustment process described previously.
- ii) Set the digital multimeter to read resistance (select the 20k range) and place one of the probes on TP9, and the other probe on the test point corresponding to the geophone channel which was manually selected during the sensitivity adjustment process. Figure 2 shows the correspondence between the test points and the sensitivity controls.
- iii) Note the resistance reading shown on the digital multimeter. The resistance value should be within the range 0 - 5k ohms.
- iv) Leave the digital meter probe on test point TP9 and remove the other probe from the test point corresponding to the manually selected geophone channel.

Commissioning the Psicon II System (cont'd)

Sensitivity Adjustment (cont'd)

- v) Place the free meter probe on to any of the other test points and note the resistance reading obtained. Adjust the sensitivity control corresponding to the test point chosen so that the reading obtained is identical to the reading obtained when the manually selected geophone channel was measured as described earlier in this section.
- vi) Repeat this process until all the geophone channels have had the corresponding sensitivity controls adjusted to be the same as the channel chosen to monitor the simulated intrusion activity.
- vii) On completion of the process, the system can be returned to the normal mode of operation by placing the Mode Control Switch into the 'RUN' position.

This concludes the sensitivity adjustment process.

Note that this process assumes that all geophones are installed similarly and are equally exposed to intrusion activity. Should any geophone(s) be installed differently, or are likely to be more or less exposed to intrusion activity, then it is important that simulations are carried out on these channels to ensure that the system sensitivity is optimised for these channels.

Commissioning the Psicon II System (cont'd)

Manual Geophone Selection

Under normal operating conditions, the pre-processor module determines which geophone is selected and routed to the analyser module so that the signals from that geophone may be processed and analysed.

A feature is also provided so that any single geophone connected to the pre-processor module may be manually selected so that the signals from that geophone are routed through the pre-processor module and into the PSICON analyser module. This facility is useful for making sensitivity adjustments and for system training.

The process of manually selecting a geophone is done by connecting a 'dumb' terminal to the serial port on the pre-processor module entitled 'Geophone Selector Port', and entering appropriate commands via the terminal.

The analysis PC used to adjust and configure the PSICON analyser module can also be configured as a 'dumb' terminal using the Windows program 'Terminal' and can therefore be used to manually select individual geophones. The procedure to do this is detailed below.

Terminal Program Operation

Ensure the analysis PC is running the Psicon Analysis Program and that the 'Psicon Analysis group window is displayed.

Remove the serial lead (PS1-SL1) from the PSICON analyser module and connect it to the Geophone Selector Port on the pre-processor module.

Highlight the 'Terminal' icon and press ENTER. This will open an empty window headed 'Terminal - untitled'.

Use the ALT & F key combination to select the FILE menu and press O to open a file. This will show a list of terminal setup programs in a box below the file name entry box.

Press the TAB key to move the cursor to the list of setup programs and use the cursor control keys to select the program named 'PSICON.TRM'.

Press the SPACE bar to highlight this program and then press ENTER to start the program. The window heading will now show 'Terminal - PSICON.TRM'.

Press ENTER once more to send a command to the pre-processor module. The following information will be sent from the pre-processor module to the analysis PC and will appear in the 'Terminal - PSICON.TRM' window:

Commissioning the Psicon II System (cont'd)

Manual Geophone Selection (cont'd)

Psicon Geophone Selector Version 1.00 23-May-96 Operational

To select a geophone enter 01 to 64 >

This prompts the user to enter a number corresponding to the geophone to be selected. For the purposes of illustration only, it will be assumed that the number 05 is entered to select geophone number 5. On entry of this number, the following text display will be sent to the 'Terminal - PSICON.TRM' window:

**Psicon Geophone Selector Version 1.00 23-May-96
Geophone 05 Selected**

00 to 64>For normal operation select 00

To alter selection enter

The geophone selection is 'echoed' to the window display along with additional text to describe other options.

To return the system to automatic mode where geophone selection is controlled by the pre-processor module, the number 00 would be entered. To change the geophone selection, another two digit number may be entered.

When a geophone is manually selected, all the sector relays are forced to an alarm condition to warn the user that the normal (automatic) mode of operation has been overridden. When the system is returned to normal operation by entering 00, the relays will return to a 'secure' condition.

Returning to the Psicon Analysis Program

Once a geophone is manually selected, the user may return to the Psicon Analysis Program to carry out simulations or to gather data patterns prior to training the system. The procedure to do this is as follows:

From within the windows 'Terminal - PSICON.TRM', type the key combination ALT & F to select the FILE menu. Type X to exit from the program and return to the Psicon Analysis Group Window. The geophone selected while in the 'Terminal' program will still be selected.

Remove the serial data lead from the 'Geophone Selector Port' on the pre-processor module and connect it to the 'Analysis PC Port' on the analyser module.

Commissioning the Psicon II System (cont'd)

Manual Geophone Selection (cont'd)

Use the key combination ALT & TAB to switch to the Psicon Analysis Program window.

On completion of the operations within the Psicon Analysis Program, the pre-processor module must be returned to automatic geophone selection mode by re-starting the terminal program and entering the number 00 to select operational mode as described above.

Alternatively, the pre-processor module may be returned to automatic geophone selection mode by simply pressing the 'reset' button mounted on the pre-processor module PCB. Return to automatic mode will be indicated by the sector and alarm relay outputs returning to the 'secure' condition.

Notes on Simulated Activities

It is important at this stage to decide on a simulation activity that can be repeated easily so that a reasonable number of these simulations can be carried out while adjusting the system. For example, if the geophone sensors are buried in the ground, it is easy to simulate a person walking close to the sensors by simply walking near the sensors. This represents a repetitive activity that will make the adjustment of the system relatively simple.

Another example might be if the sensors are protecting a brick wall, and it is required to set the system to detect a person climbing over the wall. This is not an easy activity to simulate and certainly not an easy activity to repeat 10 or 15 times. In such cases, it may be necessary to analyse the activity and select a particular feature that may be considered representative of the activity as a whole. In this case, an unaided climb of a brick wall will almost certainly result in the feet of the intruder skidding across the surface of the wall. If this is a valid premise, then this activity can be used to represent at least approximately, the actions of an intruder as the wall is scaled. This has the advantage that the action of a foot scraping across the wall surface is relatively easily simulated and can be repeated easily 10 or 15 times to enable the system

sensitivity to be set.

The activity simulated should also be representative of a reasonably intense activity since this procedure will set the system sensitivity to cater for the **largest** signals likely to be encountered.

This requires some careful consideration since, for example, if a buried system was to be set up to detect a running person, it would not be realistic to run directly over the top of the sensors themselves. If the system sensitivity were to be set to cater for such large signal levels, it would almost certainly be too insensitive for other intrusion activities such as walking or crawling.

Commissioning the Psicon Analyser - Sensitivity Adjustment (cont'd)

Notes on Simulated Activities (cont'd)

A running person would generate high levels of signals and because of this, detection would occur at a relatively large distance from the sensors themselves. A compromise therefore would be to set the sensitivity to detect a person walking normally at about 1 metre from the sensors.

Commissioning the PSICON Analyser (cont'd)

PSICON System Parameter Adjustment

It is assumed that, before proceeding with the instructions listed below, the system is connected to an analysis PC and setup in the same way as detailed under the sub-heading entitled '**Sensitivity Adjustment**' earlier in this section.

All of the parameter adjustments described in this section require the 'TRAIN' file to be modified and sent to the PSICON analyser to update the settings within the analyser. This applies whichever parameter(s) is/(are) altered and the procedure to accomplish this is described below. This procedure should be followed for any modifications to the 'TRAIN' file.

Updating the PSICON Analyser

The process of updating the PSICON analyser with any modifications to the system parameters comprises of 5 steps, namely:

1. Reading the 'TRAIN' data from the PSICON analyser
2. Opening the 'TRAIN' file.
3. Editing the 'TRAIN' file.
4. Saving the 'TRAIN' file.
5. Sending the modified 'TRAIN' data to the PSICON analyser
6. Verifying the changes made.

These steps are described as follows:

Reading the 'TRAIN' File From the PSICON Analyser

To read the training data from the PSICON analyser, ensure that the PC screen is displaying the main menu of the Psicon Analysis Program and that the PC is connected to the PSICON analyser by means of the serial data transfer lead.

- i) Press the function key F3 (Read Training Data).

A message warning the user that the existing 'TRAIN' file on the PC will be overwritten. If this is acceptable, press the 'ENTER' key to proceed.

If the existing 'TRAIN' file contains information that needs to be saved for future reference, exit from this screen by pressing function key F10 and refer to the instructions given in step 4 below.

Commissioning the PSICON Analyser - Parameter Adjustment (cont'd)

Updating the PSICON Analyser (cont'd)

- ii) Press the function key F10 when prompted on completion of the data transfer. This will return the user to the Main Menu.

The file 'TRAIN' on the PC is now updated with the data from the PSICON analyser.

This process is also described in the section entitled 'Psicon Analysis Program' earlier in this manual.

Opening the 'TRAIN' File

- i) From the main menu of the Psicon Analysis Program, use the ALT-TAB key combination to switch to the Psicon Analysis Window of the Windows Program Manager. This involves holding down the 'ALT' key on the keyboard and then pushing the 'TAB' key. Continue to do this until the small window displayed in the screen centre shows the 'Psicon Analysis' window. Release the keys at this point to switch to this window.
- ii) Using the cursor control keys, move the cursor until the icon marked 'Training File' is highlighted.
- iii) Press the 'ENTER' key.

This will open the file 'TRAIN' using the MSDOS text editor available on virtually all PC's.

Editing the 'TRAIN' File

Refer to Figure 17 for the layout of the 'TRAIN' file.

- i) Using the cursor control keys, move the cursor to the parameter to be altered. This will be the number immediately after the colon (:) marker and delete the existing number.
- ii) Type in the new number in the same position as the old one.
- iii) Make any other changes to the file required at this time, ensuring that the format of the file is not altered.

Saving the 'TRAIN' File

- i) Once the alterations to the 'TRAIN' file are completed, press the key combination 'ALT' and 'F'. This will 'pull-down' the File menu of the EDIT program.

Commissioning the PSICON Analyser - Parameter Adjustment (cont'd)

Updating the PSICON Analyser (cont'd)

- ii) Choose the 'SAVE' option, either by using up/down cursor keys to highlight this option, or by typing the letter 'S'. The modified file will be saved with the same name 'TRAIN'.

N.B.

If it is necessary to save the file 'TRAIN' under a different name to prevent it being overwritten the next time the data is read from the PSICON analyser, the 'SAVE AS' option from the file menu should be chosen. A dialogue box will be displayed with the filename 'TRAIN' as the existing filename. Use the 'BACKSPACE' key to delete the filename 'TRAIN' and enter a new filename for the file. Press 'ENTER' to save the file under this new filename. To access this file using an icon from the Psicon Analyser Group Window, refer to the description entitled 'New Files and Icons' ?? in the Windows configuration procedure earlier in this manual.

- iii) Exit from the file by selecting the File menu again and choose the Exit option using either the up/down cursor keys or by typing the letter 'X'. This will return you to the Psicon Analyser Group Window.

Sending the 'TRAIN' File to the PSICON Analyser

- i) From the Psicon Analyser Group Window, use the ALT-TAB key combination to return to the Psicon Analysis Program Main Menu.
- ii) Press the F4 function key (Send Training Data) to transmit the 'TRAIN' file to the PSICON analyser.
- iii) A message will be displayed warning the user that the existing data within the PSICON analyser will be overwritten. If this is acceptable, press 'ENTER' to proceed. Any errors in the file format will be reported during the transfer and will almost certainly be due to inadvertent modification of the file format. This must be corrected and the file re-transmitted to ensure that the changes have been acknowledged by the PSICON analyser.
- iv) On completion of the data transfer, press F10 to return to the Main Menu.

Verifying 'TRAIN' file modifications

To ensure that any modifications made to the parameters within the PSICON analyser have actually been accepted by the analyser, it is prudent to perform the following verification procedure.

- i) From the main menu of the PSICON Analysis Program, choose the F3 option to re-read the training data from the analyser.

Commissioning the PSICON Analyser - Parameter Adjustment (cont'd)

Updating the PSICON Analyser (cont'd)

- ii) Open the 'TRAIN' file as described previously and verify that the parameter changes are reflected in the 'TRAIN' file. Parameters shown in this file reflect exactly the settings that the PSICON analyser will be using.

The following text describes the function of the parameters and how they are adjusted.

Pattern Duration

The Pattern Duration parameter governs the length of time over which data is collected by the PSICON analyser to construct the data pattern within the pattern display area. This can be set from any value from 2 seconds to 16 seconds in steps of 2 seconds. The default setting for this parameter is 8 seconds.

Data is collected from the geophone sensors and is added to the data pattern every 2 seconds, provided that the data is valid and meets the requirements of the various threshold settings in the system.

After the time set by the Pattern Duration parameter has elapsed, new data entering the data display area will displace the earliest data that contributed to the pattern. The data pattern therefore updates every 2 seconds and reflects the pattern resulting from geophone signals occurring in the previous time period set by this parameter.

Short time periods will result in larger variations in the data pattern while longer time periods will result in a more stable display. Longer duration periods also mean however that any spurious interfering signals that may degrade the detection process will be held in the pattern display for a longer period.

The Pattern Duration parameter should therefore be set to the minimum duration consistent with capturing all the signals associated with the intrusion activity.

The parameter is set by editing the 'TRAIN' file in accordance with the instructions in the previous section entitled 'Updating The PSICON Analyser.'

Pattern Threshold

The Pattern Threshold is a parameter which controls the entry of data into the data pattern display area and is related to the amplitude of the signals produced by the geophone sensors. The default value for this parameter is 50.

This parameter is set to screen out low level noise detected by the geophone sensors when the level of activity in the vicinity of the sensors is low. It is important to understand that geophone sensors are extremely sensitive and are capable of detecting vibrations from activities quite a long distance from the sensors themselves.

Commissioning the PSICON Analyser - Parameter Adjustment (cont'd)

Pattern Threshold (cont'd)

It may not be possible therefore to identify the cause of any low level signals detected by the system. It is signals such as these that this threshold is designed to remove. It is not intended that this parameter be adjusted to remove signals caused as a result of identifiable activities such as vehicle movement and weather related activity.

To set the parameter, ensure that there is no obvious activity within the vicinity of the geophone sensors and observe the level of signal shown on the bar display of the signal level indicator. It may be necessary to choose a known quiet time of day to enable this to be done accurately.

Note the signal level shown on the numerical display at the bottom of the bar display and multiply this value by 1.5 to cater for any variations likely to affect this reading. The calculated value is the value that will be entered into the 'TRAIN' file to be sent to the PSICON analyser. Update the PSICON analyser as described previously.

Any changes to this parameter will invalidate any reference patterns that may have been produced using this setting.

Pattern Position

This parameter controls the position of the data pattern in the data pattern display shown while in Data Logging mode.

As described earlier, the data pattern display comprises a square containing 841 display elements. Each side therefore comprises 29 elements. Each element in the data pattern display can be located by specifying the distance along one side followed by the distance along the other side, similar to the grid reference on a map. For example, the centre of either edge of the display would be either element number 15,0 or element number 0,15 which means 15 elements along the edge, and 0 elements towards the other edge. The geometric centre of the display is therefore element number 15,15.

The setting of the Pattern Position parameter is chosen so that the largest element in the display is centred on element number 12,12. Since the display is not arranged as a linear distribution of elements across the whole area, the location 12,12 in the display is closer to the actual centre of the display as far as the distribution of pattern elements is concerned.

The largest element in the display is the element which occurs most frequently for any given activity and can be identified in the pattern display as the element with the largest number associated with it. The numbers associated with each pattern element are displayed in the Data Contents area of the Data Logging screen.

Commissioning the PSICON Analyser - Parameter Adjustment (cont'd)

Pattern Position (cont'd)

An instant indication of the position of the largest element in the Data Pattern area can be shown by using the F1 key to switch the display mode to relative.

In this mode, the colours of the display elements are displayed according to the colour key and are related to a percentage of the largest element which is always shown in white. The white element therefore, will always be the largest element in the display.

To set the Pattern Position parameter, it is necessary to carry out a simulation of a typical intrusion while in Data Logging mode and observe the position of the largest element in the display area. Some care is necessary in doing this, since it is likely that the position of the largest element in the display may change position depending on variations in the simulated activity. The object is to arrive at a setting that results in the largest display element remaining in position 12,12 for the longest possible time during the simulation of the intrusion activity.

Typical ranges of settings for this parameter for different applications are listed below. These are intended as a general guide and are not definitive. Some applications may require radically different settings to those listed below.

Buried Geophone Applications

Soft Ground, Turf, Uncompacted Soil,	1000 - 2000
Sandy Surfaces,	2000 - 3000
Loose Gravel Surfaces	2500 - 4000
Hard Ground, Tarmac, Concrete,	2500 - 3500

Rigid Fence Applications 2000 - 5000

Wall Applications 3000 - 5000

Changes to the Pattern Position parameter will result in the position of the data pattern moving across the diagonal of the pattern display area which runs from the top left corner to the bottom right corner. Increasing the value of the parameter will move the pattern position towards the lower right hand corner of the display while decreasing the parameter will move the pattern towards the top right hand corner.

A typical procedure for setting this parameter is detailed as follows:

- i) Read the training data from the PSICON analyser using the F3 function on the main menu of the Psicon Analysis Program.

Commissioning the PSICON Analyser - Parameter Adjustment (cont'd)

Pattern Position (cont'd)

- ii) Open the 'TRAIN' file and locate the parameter 'Pattern Position' in the file. Verify that the setting falls within the ranges shown in the table above for the application. Edit the file if necessary and update the PSICON analyser as described earlier in this section.
- iii) Select Data Logging mode from the main menu of the Psicon Analysis Program. Use the F1 function key to select the relative or 'floating' display mode. The colour key chart on the screen will switch to a range of percentage indications in this mode.
- iv) Have an assistant simulate a typical intrusion activity and observe the data pattern generated. Ensure that no other activity is present at the same time. Note the position of the largest display element in the display.
- v) Adjust the Pattern Position parameter by editing and updating the Psicon analyser as described previously until the largest element falls in the location 12,12 in the data pattern display. This may require a number of repetitions of this step and the previous step.

The Pattern Position parameter is now set. Any changes to this parameter will invalidate any reference patterns that may have been produced using this setting.

The preceding parameters must be set before training of the system can take place. The remaining parameters are best set after completion of the training process which will be described in the following text. Adjustment of the remaining parameters in the 'TRAIN' file will be described on completion of the description of how the system is trained.

Psicon Analyser Training

The process of training the PSICON analyser involves simulation of intrusion activities and capture of the data patterns that these activities generate. These patterns

are then combined into reference patterns to be stored within the PSICON analyser memory.

Before commencement of the training process, the parameters Pattern Duration, Pattern Threshold, and Pattern Position need to be set in accordance with the instructions given previously in this section.

It is important that the training process be carried out **ONLY** while activities truly representative of the events that the system must respond to are occurring. It is highly likely that poor performance will result if reference patterns generated as a result of the training process include elements related to spurious activity not connected to the events that must be recognised.

The procedure for generating a reference pattern can be broken down into a number of steps as listed below:

1. Place the Psicon Analysis Program into Data Logging mode.
2. Ensure that no activity is being logged by the analysis PC prior to commencement of the training activity.
3. Note the Data Pattern number currently shown in the Data Pattern display area on the analysis PC connected to the PSICON analyser. Refer to the section entitled Psicon Analysis Program for the location of this number.
4. Simulate the activity for which a reference pattern is required, keeping in mind the guidelines outlined previously on activity simulation.
5. Continue the simulation until at least 20 data patterns resulting from that activity are produced, noting the pattern numbers produced in response to this activity.
6. Exit from Data Logging mode and select Data Analysis mode within the Psicon Analysis Program.
7. Locate and 'include' the data patterns generated using the procedures outlined in the section dealing with Data Analysis mode of operation of the Psicon Analysis Program explanation. The sub-section dealing with Pattern Selection covers this topic in detail.
8. Once the patterns are located and marked as being 'included', sum all these patterns into one reference pattern by pressing the 'A' key. Follow the recommendations outlined under the paragraph dealing with 'A' Key Operation in the same section of the Psicon Analysis Program description.

Psicon Analyser Training (cont'd)

9. If the reference pattern produced in response to pressing the 'A' key above is satisfactory, press the 'G' key to generate the new pattern file.

Once the 'G' key has been pressed, a file is generated which contains only the new reference pattern. This pattern must now be incorporated within the 'TRAIN' file and subsequently sent to the PSICON analyser to update the analyser. This incorporation process is described below.

TRAIN File - New Pattern Incorporation

This procedure assumes that the user is starting from the point at which the 'G' key was pressed to generate the reference pattern file.

1. Exit from the Data Analysis screen display by pressing the F10 key to return to the main menu.

```
Pattern Number      :1
-----
Status              : 2 = Fully Trained
Type                : 1 = Benign
Name                : Pattern 01
Significant Events  : 60
[12][12]           = 0x003F
[20][20]           = 0x0033
[10][ 8]           = 0x0032
[12][10]           = 0x002C
[ 8][ 8] = 0x002B
[15][15]           = 0x002A
[ 8][10]           = 0x0027
[12][ 8]           = 0x0025
[ 8][12]           = 0x0025
[10][10]           = 0x0025
```

2. Use the ALT-TAB key combination to select the Psicon Analysis Group Window from the Program Manager.

3. Use the cursor control keys to highlight the icon in this window entitle 'New Pattern File'. Press 'ENTER' to open this file. The format of this file is shown in Figure 19.

It will be seen that the format of the New Pattern file is almost identical to the reference pattern section of the 'TRAIN' file described earlier. Refer to this description for information regarding the format and function of the file.

The New Pattern file represents pattern information that will be inserted into the 'TRAIN' file so that the PSICON analyser may be updated with this new information.

4. Place the cursor at the beginning of the file and 'select' or 'block' the entire

file by holding down the SHIFT key along with the cursor 'DOWN' key. Hold down the key combination until all the text in the file is selected.

Psicon Analyser Training - New Pattern Incorporation (cont'd)

5. Use the key combination ALT & E to select the Edit menu. Type C to copy the selected text. This text is copied to a temporary store known as the Clipboard and will be retrieved later.
6. Use the ALT & F key combination to select the File menu. Type O to access the File Open dialogue box. In the dialogue box, delete any existing file name and enter TRAIN to open the TRAIN file.
7. When the TRAIN file is opened, move the cursor to the location that the new pattern is to be placed in. This may be an empty location or a location with an existing pattern. In either case, it is necessary to delete the existing information at that location, since the new pattern information will replace it. Note the number of the pattern location.

NB

For clarity, it is recommended that any reference patterns that are to be allocated an 'ALARM' type are placed in locations 1 - 16. Any patterns that are to be allocated a 'BENIGN' type should be placed in locations 17 - 32. This will avoid confusion when observing the comparison scores against these patterns when in Data Logging mode.

8. Delete the existing text at the chosen location by placing the cursor at the start of the line with the Pattern Number text on it. Select all the text in that location by using the SHIFT key in conjunction with the DOWN arrow key. If the location is empty, the last line that will be selected is entitled 'Significant Events'. If the location contains a pattern that is to be discarded, the last line to be selected will be the last element of the pattern. When the text is selected, press the DEL (delete) key to remove the selected text.
9. Use the ALT & E key combination to select the Edit menu. Press the P key to 'paste' the new pattern information from the Clipboard into the selected location.
10. Use the cursor keys to scroll to the top and bottom of the location to ensure that there is a blank line separating the new pattern information from the previous and following locations in the TRAIN file.
11. Edit the Pattern Number of the new pattern to be the same as the number of the pattern that was deleted to make room for this new pattern.
12. Edit the number against the TYPE to set the pattern to be either an ALARM pattern or a BENIGN pattern.

13. Edit the NAME field to briefly describe the type of activity the pattern represents. Only text and number characters are allowed.

Psicon Analyser Training - New Pattern Incorporation (cont'd)

14. Use the ALT & F key combination to select the File menu. Press S to save the file with the new pattern and then exit by selecting the File menu again followed by pressing the X key. This will return the user to the Psicon Analysis group window.
15. Use the ALT & TAB key combination to switch the screen to the Psicon Analysis Program main menu.
16. Update the PSICON analyser by pressing the F4 function key.

This completes the process for incorporating a new reference pattern in the PSICON analyser.

Whenever any reference pattern is added to a PSICON analyser, it is necessary to verify the effectiveness of that pattern by repeating the activity which was used to generate the activity originally. To do this, the analysis PC should be placed in Data Logging mode and the comparison score against the location of this reference pattern observed while the activity is repeated. Typically, the score against the activity should exceed 75% most of the time if the training process has been carried out correctly.

Once the required reference patterns have been entered into the PSICON analyser, the remaining parameters in the TRAIN file may be set. These are set as described below.

Pattern Comparison

This parameter is used to specify how similar a data pattern needs to be to a stored reference pattern for the PSICON analyser to attribute the data pattern to the activity associated with that reference pattern. This similarity is referred to a 'score' and a 'score' value is calculated for the similarity between the data pattern and all the reference patterns within the analyser.

The number associated with this parameter is expressed as a percentage value with a value of 100 requiring that the data pattern and the reference pattern be identical for the comparison to be valid. The parameter is therefore a threshold which any comparison score must exceed in order to be considered valid.

The default value for this parameter is 50. Increasing the value will mean that the data pattern must be more closely matched to the reference pattern to be valid, while decreasing the value will allow more generalised data patterns to be attributed to the reference patterns. The parameter value applies to all reference patterns within the system and if a data pattern produces comparison scores for the reference patterns which exceed the Pattern Comparison threshold, the reference pattern which yielded the highest score would be attributed to the activity which caused the data pattern.

Setting the parameter can only be done after completion of the training process and involves simulating the intrusion activities used to train the system and

choosing a value for this parameter which will ensure that the occurrence of this activity results in a comparison score for that activity which exceeds the parameter setting.

Psicon Analyser Training - Final Parameter Adjustments (cont'd)

Signal Threshold

This parameter places an amplitude threshold on the signals generated by the geophones and will only allow the pattern comparison process to take place within the PSICON analyser if this signal threshold is exceeded.

To set this parameter, place the analysis PC into Data Logging mode and simulate the intrusion activities that the system is to respond to. Note the typical peak signal levels on the bar display of the signal level indicator while the intrusion activity is taking place.

The parameter setting should be chosen so that the intrusion activity always exceeds this threshold, and to cater for variations in the site conditions and methods of intrusion, a useful rule is to set the parameter to between one quarter and one half of the level indicated on the signal level indicator display.

Pattern Elements

To set this parameter, the user must observe the number of elements in the data pattern display area while the intrusion activities are being simulated or carried out.

The number of elements is shown by the figure next to the legend 'ELEMENTS' in the top line of the Data Contents display area while the analysis PC is in Data Logging mode.

As with the signal threshold, the figure should be set so that the number of elements present during an intrusion activity always exceeds this setting. Again, a useful rule is to set the parameter half the number of elements shown when the intrusion activities are simulated.

Pattern Separation

This parameter is only used if there are both 'ALARM' and 'BENIGN' types of reference patterns present in the PSICON analyser at the same time.

It is possible that, under certain conditions, it may be necessary to generate reference patterns that are representative of benign activities that may be similar to some or all of the 'ALARM' reference patterns within the system.

Such reference patterns are required to prevent the system reacting to those benign activities and wrongly attributing them to alarm activities. In cases where there is activity that shows a close correspondence with both alarm and benign events, incorrect classification of the event may occur due to the natural variability in the signals generated by the geophone sensors. When this occurs, there is the possibility that the system may make an incorrect

classification of the cause of the signals.

Psicon Analyser Training - Final Parameter Adjustments (cont'd)

Pattern Separation (cont'd)

To try to minimise these incorrect classifications, the parameter 'Pattern Separation' is included in the TRAIN file. This parameter sets a difference in the comparison scores between 'ALARM' and 'BENIGN' reference patterns that must be exceeded before an alarm classification is made.

A typical setting for this parameter would be typically 10. Care must be exercised in setting this parameter since setting a large separation value may mean that the system never detects a hostile event if there is a pattern for a benign event present that is closely related to the hostile event pattern. As always, tests should be carried out to verify the detection after all the adjustments to the system are made.

Pk/Av Ratio

This parameter is not used at the present time and is provided as an expansion parameter to be implemented at some point in future developments of the PSICON analyser.

Alarm Pattern Count

This parameter specifies the number of times any 'ALARM' type pattern within the system is selected following a comparison procedure before the alarm relay on the PSICON analyser is activated. Typically, this parameter would be set to 2.

Alarm Relay Time

The alarm relay time is set to ensure that the annunciation equipment to which the analyser is connected reliably logs the operation of the alarm relay on the PSICON analyser. Typically this parameter would be set to 10 seconds. Note that during the alarm relay time period, the PSICON analysis process is suspended until the relay time period has elapsed.