ECOPROBE 5

Operator's Manual

CONTENTS

ECOPROBE 5

1. SPECIFICATIONS

Ecoprobe 5 introduces a new level of flexibility, convenience, and quality to in-situ detection and analysis of VOC's and other contaminant indicators. Cost effective, definitive soil contaminant surveys which provide an unprecedented breadth of high precision data result from its combination of **PID** and **IR** detectors complemented by temperature and pressure data. A new dimension in detection is provided by the simultaneous measurement of total soil gas / vapor concentration (PID detector) together with four channel selective analyses for methane, carbon dioxide, oxygen, and petroleum hydrocarbons (IR detector).

1.1 PID analyzer

Characteristics

- Detection limit 0.1 ppb (0.0001ppm)
- ppb resolution, 0.1 ppb zero stability
- calibration for quantitative vapour phase determination for over 200 compounds included zero response for methane (methane measured separately by IR unit)
- large dynamic range (0.1 ppb to 4000 ppm), fast response (0.5 sec)
- ion lamp 10.2 eV (other energy levels are optional)
- STANDARD mode with **ppm or mg/m3** output or HISENS mode with **ppb or mg/m3** output

PID unit measures **total concentration** of volatile organic compounds (VOC) and other toxic gases including chlorinated hydrocarbons, selectively excluding methane from the total sum.

Relative outputs

Ecoprobe 5 enables you to map a relative concentration cloud, identifies the contaminant sources, paths and the range of contaminated area. Measuring by means of Ecoprobe 5 is simple, fast and cheap and eliminates the principle of redundant and expensive analysis of the spectrally known and almost identical samples.

Absolute outputs

PID unit is calibrated only for one calibration gas –Isobuthylene. The instrument's responses to other compounds are different. Calibration procedure, however, automatically calibrates the instrument for about 200 specific compounds (see table of measured compounds in Figure 35).
This feature is used in cases when composition of the contaminant is known and absolute results of soil gas/vapour concentration are required. Choose the compound which is chemically equal or very close to the contaminant and select it in the System Configuration File of the locality (described later). Then the output can give quantitative concentration of vapour phase (For further details see Chapter 12.3).
Nevertheless, the operator should bear in mind that Ecoprobe 5 is neither a spectral analyzer nor a spectral-selective detector.

Spectral characteristic of Ecoprobe 5 analytical unit is equal to the characteristics of the laboratory gas chromatograph evaluating unit (if the lamp of equal energy is used). This means that spectral responses to all the spectral components of Ecooprobe 5 and laboratory gas chromatograph are equal which brings very close results between the in-situ total measurement and selective laboratory analysis of samples.

Photoionisation breakdown

Generally speaking, photoionisation process has its physical limit. For a concentration higher than certain value the ionization process will breakdown. Further increase of concentration may even lead to the decay of output. The average value of photoionisation breakdown limit is around 4000 ppm and varies for different spectral compounds.
To indicate this phenomenon by means of the inner instrument software is not entirely clear and it is not common for this type of instruments.

RS DYNAMICS worked on a technique of photoionization breakdown indication with following results: Ecoprobe 5 indicates the concentration exceeding breakdown limit by the message “over” displayed on the instrument screen but this message is not displayed in all cases. Depending on different conditions (particular compounds, the speed of photoionisation breakdown process, amount of concentration..) the output may also show a low “breakdown” value (hundreds of ppm) for concentration higher than photoionisation breakdown limit. Above mentioned facts must be considered in interpretation and are valid for **STANDARD mode**. (see Chapter 12 – The field survey).
In case of **HIGH SENSITIVE mode**, the measured limit is 100 ppm. Higher values of concentration are almost **always** indicated by the message “over” displayed on the instrument screen.

If **hydrocarbons** are presented in the contamination, consequent continuity between PID (in Standard mode) and IR unit outputs can be observed after photoionisation breakdown of the PID unit.
If the contamination consists of other compounds (no hydrocarbons), there is no response of IR unit.

1.2 IR analyzer

Infra-red analyzer provides **selective** detection of methane, petroleum hydrocarbons and carbon dioxide.

Characteristics

- Four independent channels features following ranges with ppm resolution:
- Methane 0 – 500 000 ppm, detection limit 20 ppm
- Petroleum Hydrocarbons 0- 500 000 ppm (**including Methane**), detection limit 20 ppm
- Carbon Dioxide 0 – 500 000 ppm, detection limit 20 ppm
- Reference channel
- ppm or mg/m3 output

1.3 Applications

With the very high sensitivity of the PID, this instrument has capability that reaches well beyond the standard soil vapour survey. Effectiveness in the detection and monitoring of contaminant spills and plume migration is substantially enhanced by the incorporation of ancillary data. The remarkable zero stability, combined with no response to methane, provides a detection capability undiminished by natural hydrocarbon occurrence, ensuring the application of optimum sensitivity levels. UST and pipeline leakage detection and localization are further extensions of the soil vapour applications, as is also the tracking of contamination from agricultural waste. Less obvious applications are to be found in the detection and monitoring of organic toxins in industrial applications. Minute traces of gas can be an indication of approaching breakdown of a shaft seal or packing in a process vessel with externally driven components. Real time continuous display mode makes localization of leakage with pinpoint accuracy a reality. Further applications incorporating the IR and temperature detection are found in the in-situ monitoring of bio-remediation, where bacteria will consume oxygen, and generate heat along with methane and carbon dioxide. Routine periodic repetition of sampling at fixed locations can track both the progress and health or effectiveness of the process, since the results provide a clear indication of bacterial activity as well as contaminant concentration.

Usefulness in brief:

- Detection, delineation & monitoring of hydrocarbon and other organic contamination of soils & water table from fuel spills; air pollution monitoring (PID)
- Waste dumps UST leakage
- Pipe-line leakage & agricultural waste
- Monitoring of plume migration
- Monitoring of in-situ bio-remediation processes
- Detection and monitoring of gaseous toxins in industrial plants and agricultural applications.

All the basic controls necessary for Ecoprobe 5's operations are described bellow. This user-friendly, easy-to-operate system allows the operator to select the optimal settings for data gathering. Maximum benefit is derived from Ecoprobe 5 by following the instructions systematically.

2. INSTRUMENT DESCRIPTION

2.1 BASIC CONTROLS

2.1.1 Display panel -- four keys arranged in two islands (Figure 1)

ESC	Terminates operations and returns to the Main Menu.
RUN	Starts a selected procedure.
ON/OFF	Switches the instrument on/off.
LIGHT	While holding down the key, ? /? is used to switch the screen back light on/off; ? /? is used to change the screen contrast.

2.1.2 Handle control -- four arrowed keys (Figure 1)

These are multi-functional switches and their actual operation or function depends on the specific menu displayed.

? /?	(Up/Down)	Moves the cursor up/down through a menu.
?	(Left)	Escapes from a current menu to return to the previous level and saves a selected option.
?	(Right)	Selects an option from a menu, or initiates a procedure/operation.

Figure 1: Display panel and handle controls

2.2 THE FRONT OF THE INSTRUMENT

(Figure 2)

(A)	Multifunctional connector for the charger, PC, GPS receiver, probe thermometer and alternative power sources like solar batteries or a car charging cable.
(B)	Gas inlet
(C)	Gas outlet

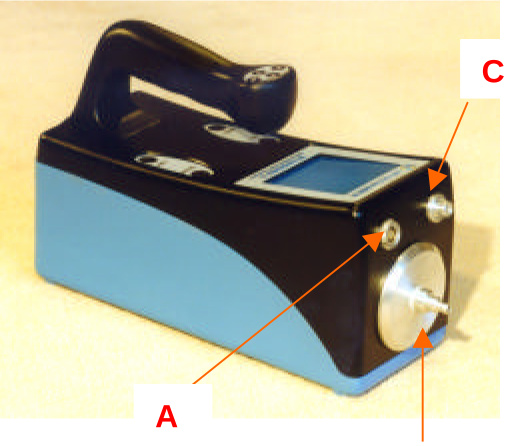
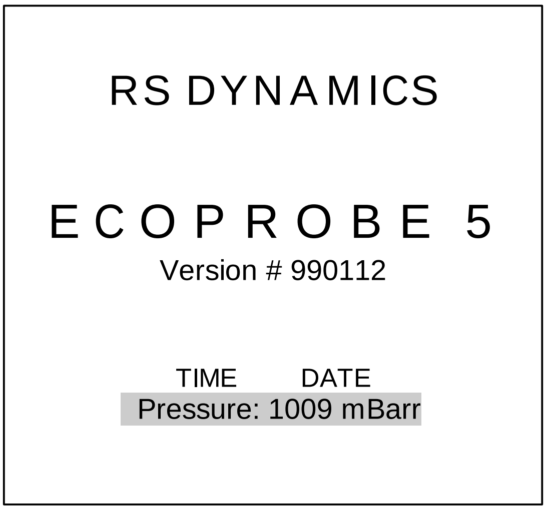


Figure 2: The front of the instrument

3. START ECOPROBE 5

By pressing the ON/OFF key on the display panel, the instrument will boot up in about two seconds and display the *Welcome Menu* (Figure 3).



RS DYNAMICS

ECOPROBE 5

Version # 990112

TIME DATE

Pressure: 1009 mBarr

Figure 3: Welcome Menu

Press any arrow on the handle control to open the **Main Menu**

4. MAIN MENU

Brief explanation

LOCALITY 1 (or 2) Measuring mode; starts measurement of the locality.

LOCALITY MANAGEMENT Configurates a new locality, already measured localities and monitoring stations and deletes localities.

CONTINUOUS MEASUREMENT Allows continuous operation without any data being logged.

MONITOR Enables automatic monitoring of contamination at a predetermined sampling rate.

COMMUNICATION Enables transferring data from Ecoprobe 5 to a PC or notebook. The user friendly communication software *Ecoprobe Plus* running under WINDOWS 95/98/2000 or Win NT 4.0, facilitates transfer of data and its graphic presentation (see *Ecoprobe Plus User Manual*)

```
************ MAIN MENU ***************


LOCALITY 1
LOCALITY 2
LOCALITY MANAGEMENT
CONTINUOUS MEASUREM.
MONITOR
COMMUNICATION
SYSTEM CONFIGURATION
CALIBRATION

*****************************************
```

Figure 4: Main Menu

SYSTEM CONFIGURATION Allows editing of the default values of the System Configuration File**.**

CALIBRATION With the appropriate calibration standards (optional items) an operator can calibrate both the PID and IR analytical systems in the field.

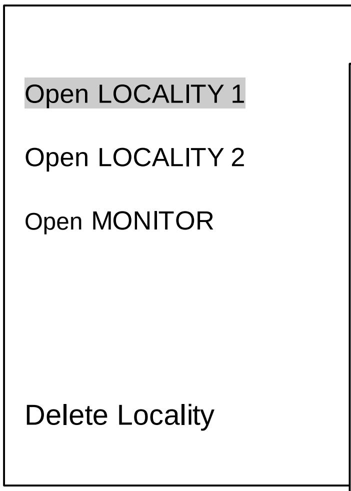
Each item of the Main Menu contains sub-menus.
Use ？ /？ to scroll through the menu, and ？ to access a selected item.

5. HOW TO ENTER A LOCALITY USING LOCALITY MANAGEMENT

Before starting a measurement it is necessary to enter a name and measuring parameters of a new locality or select an already existing locality.

5.1 Entering a new locality

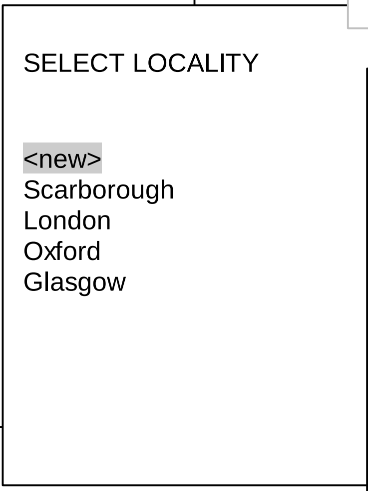
- First select *LOCALITY MANAGEMENT* from the Main Menu for entering a name and parameters of a new locality. Menu in Figure 5 will be displayed.
- Select either *Open LOCALITY 1* or *Open LOCALITY 2*. Both items offer the same menu – a list of existing (measured) localities and the option of a new locality (Figure 6*).*



Open LOCALITY 1
Open LOCALITY 2
Open MONITOR

Delete Locality

Figure 5: Locality Management Menu

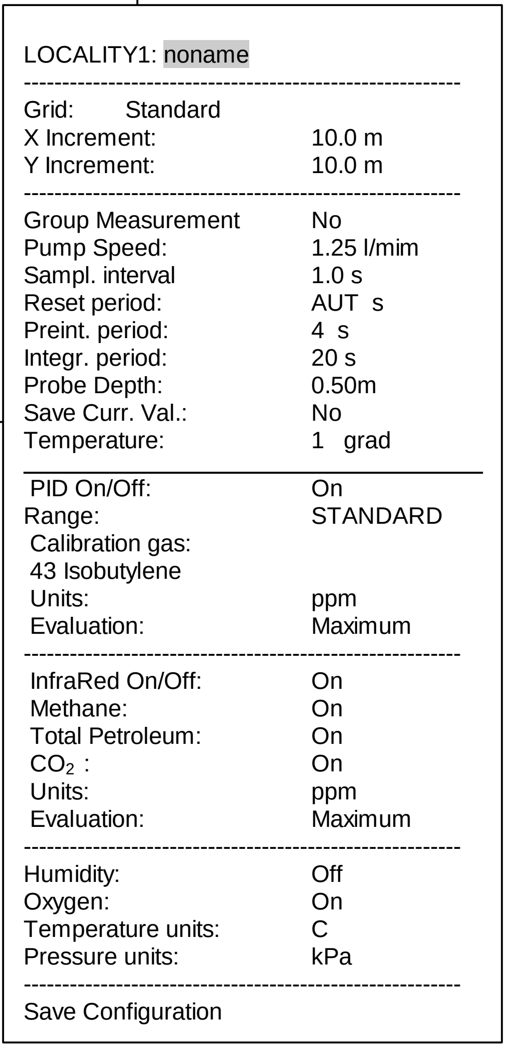


SELECT LOCALITY

<new>
Scarborough
London
Oxford
Glasgow

Figure 6: List of existing localities

Note: Item Open MONITOR will be described in Chapter MONITOR.



```
LOCALITY1: noname
--------------------------------------------------------
Grid:        Standard
X Increment:                    10.0 m
Y Increment:                    10.0 m
--------------------------------------------------------
Group Measurement               No
Pump Speed:                     1.25 l/mim
Sampl. interval                 1.0 s
Reset period:                   AUT  s
Preint. period:                 4  s
Integr. period:                 20 s
Probe Depth:                    0.50m
Save Curr. Val.:                No
Temperature:                    1   grad
________________________________________________________
 PID On/Off:                    On
Range:                          STANDARD
 Calibration gas:
 43 Isobutylene
 Units:                         ppm
 Evaluation:                    Maximum
--------------------------------------------------------
 InfraRed On/Off:               On
 Methane:                       On
 Total Petroleum:               On
 CO2 :                          On
 Units:                         ppm
 Evaluation:                    Maximum
--------------------------------------------------------
Humidity:                       Off
Oxygen:                         On
Temperature units:              C
Pressure units:                 kPa
--------------------------------------------------------
Save Configuration
```

Figure 7: System Configuration File

- Select the option < new >. *System Configuration File* with default settings will be opened (Figure 7). Default values for different measuring parameters in the System Configuration File, represent well-proven settings suitable for a general survey. Besides providing a guideline, these values facilitate setting up a new locality, and they should be used until the operator has sufficient experience to select an optimum combination for a given environment.
- Enter a name of a new locality in System Configuration File (see Chapter 5.3 -- System Configuration File)
- If you do not want to make any other changes, select the option *Save configuration* at the end of the System Configuration File or use the left arrow for saving changes and follow the instructions on the screen to return to the Main Menu.

If you entered the System Configuration File using the option *Open LOCALITY 1* (Figure 5), the new locality (for example DESIREE) is linked with LOCALITY 1. Name of this locality will be displayed after the option *LOCALITY 1* in the Main Menu (Figure 8).
If you entered System Configuration File using the option *Open LOCALITY 2,* the new locality is linked with LOCALITY 2. Name of the locality will be displayed after the option *LOCALITY 2* in the Main Menu.
In this way you can link one locality with *LOCALITY 1* and one locality with *LOCALITY 2.*

By selecting either *LOCALITY 1* or *LOCALITY 2* in the Main Menu it is easily possible to switch from one locality to another while working in the field. This procedure is particularly useful for measurement in 2 different depth levels in the same borehole. Measurement from one depth level can be associated with *LOCALITY 1*, from another depth level with *LOCALITY 2*.

```
*********** MAIN MENU **************


LOCALITY 1  DESIREE
LOCALITY 2
LOCALITY MANAGEMENT
CONTINUOUS MEASUREM.
MONITOR
COMMUNICATION
SYSTEM CONFIGURATION
CALIBRATION

*********************************
```

Figure 8: Main Menu after entering a new locality

By selecting *LOCALITY 1 DESIREE* in the Main Menu you will get directly to the Measuring Mode of the titled locality (see Chapter 6 – How to start measurement).

5.2 Selecting an already existing locality

- If the locality you want to measure is named after *LOCALITY 1 (or 2)* in the Main Menu, just select the option and the Measuring Mode will be opened.

- If you want to measure another locality, select *LOCALITY MANAGEMENT*, then *Open LOCALITY 1 (Open LOCALITY 2)* and in the list of localities select the locality you want to measure – for example Oxford (Figure 6). Its System Configuration File will be opened which can either be changed or you can return without making any changes to the Main Menu by pressing ? and following the instructions on the screen. The selected locality is associated with *LOCALITY 1 (LOCALITY 2)* and can be accessed by confirming *LOCALITY 1 OXFORD (LOCALITY 2 OXFORD)* in the Main Menu.

5.3 System Configuration File

This chapter describes all parameters of the System Configuration File (Figure 7) and provides instructions for entering new values and parameters.

> *Note: Communication software Ecoprobe Plus can be used to edit System Configuration File from a PC or Notebook.*

System Configuration File parameters

✓ **LOCALITY noname** Enables to enter a name of a locality.

- ? opens *Enter Character Menu* (Figure 9) to type the name:
- Scroll through the Menu with ? /?
- Select a character with ?
- Continue completing the locality title
- Use ? to navigate to the completed line
- Use ? to confirm/store the title and to return to the System Configuration File.

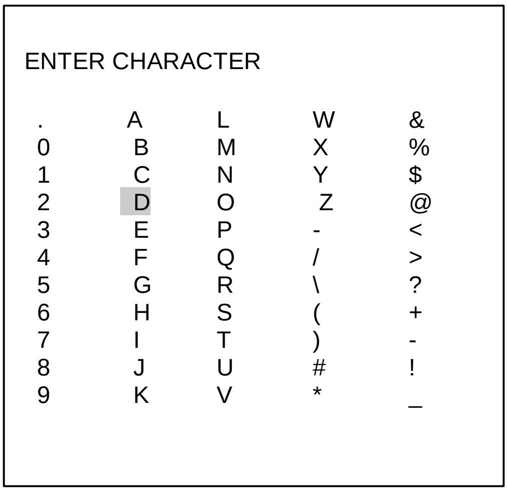
✓ **Grid:**

Standard This parameter allows automatic data logging according to the allocated X,Y coordinates, and X,Y increment, all of which can be set to the metric unit.

(Use ? to switch for the *Advanced* option).

X Increment use ? to open *Enter Number Menu* (Figure 10) to change the value of the increment. The number setting is similar to Enter Character Menu.

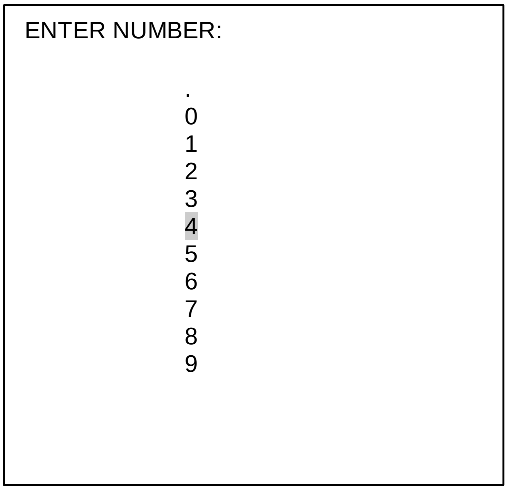
Y Increment as above



```
ENTER CHARACTER

.      A      L      W      &
0      B      M      X      %
1      C      N      Y      $
2      D      O      Z      @
3      E      P      -      <
4      F      Q      /      >
5      G      R      \      ?
6      H      S      (      +
7      I      T      )      -
8      J      U      #      !
9      K      V      *      _
```

Figure 9: Enter Character Menu



```
ENTER NUMBER:

        .
        0
        1
        2
        3
        4
        5
        6
        7
        8
        9
```

Figure 10: Enter Number Menu

GPS logging This option allows GPS coordinates to be introduced automatically. The coordinates of any location are obtained from an external GPS receiver.

? opens a menu with a selection of GPS receivers (Figure 11).

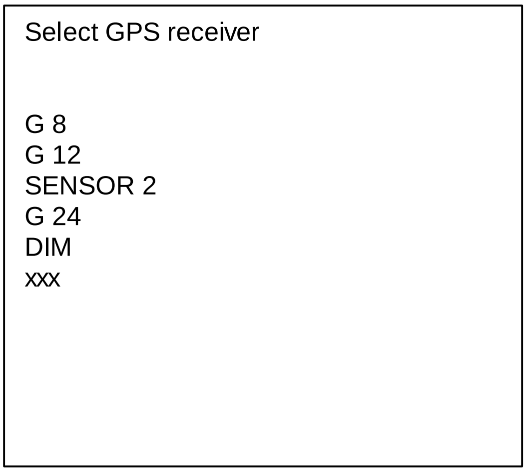


Figure 11: Selection of GPS receivers

? Confirms the selected receiver and returns to the System Configuration Menu.

✓ **Group measurement:**

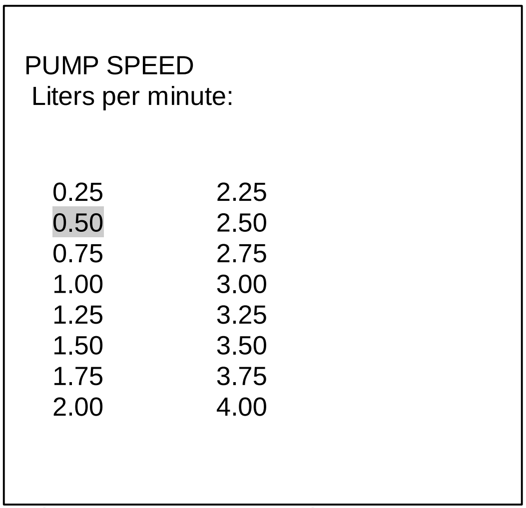
NO For a standard survey. Zeroing cycle is performed automatically before each measurement using ambient fresh air. This mode is suitable for most environments.

YES When measuring in a contaminated atmosphere (for example contaminated factory hall, where it is not possible to get fresh air for zeroing). Instrument performs zeroing cycle only once (outside in ambient fresh air or using special cylinder with fresh air) at the start of the operation. Following measurements are performed without zeroing thus avoiding the repetitive need for using cylinder with fresh air. This procedure speeds up measurement but degrades detection limit. This mode is used in areas requiring fast measurement where reading of very low values is not important and is also recommended for automatic monitoring of contamination (monitoring stations).

✓ **Pump speed:**

- ? opens a menu with a selection of pump speeds ranging from 0.25 to 4.0 l/min (Figure 12).
- Use ? /? to select a speed
- ? Confirms /stores the selected value and returns to the System Configuration Menu.

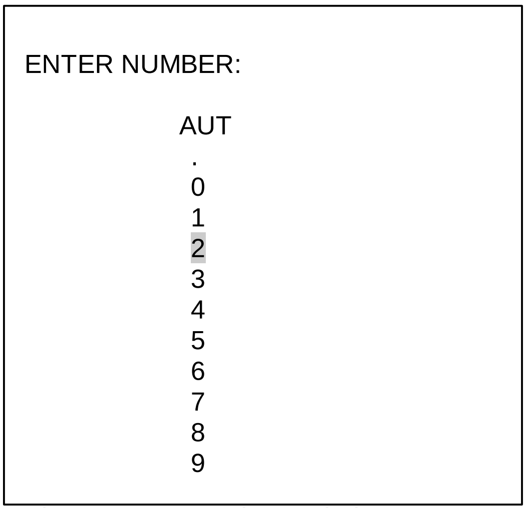
✓ **Sampling interval:** Default value is 1 second. It means that the instrument **stores** data repetitively at a rate of 1 measuring cycle per second during the integration period, **if the option *Save current values*** (see bellow) was selected. The value of the *Sampling interval* can be changed by opening *Enter Number Menu* (Figure 10) and ranges **from 0.1s** (that is 200 measuring cycles per default 20 second integration period) **to 1s**. Course of measurement at one station can be displayed on PC using *Ecoprobe Plus* communication software. If *Save current values* is selected for **general survey,** it is recommended not to use value of Sampling interval smaller than 1 second as such data uses a big part of the memory on the disc.



PUMP SPEED
Liters per minute:

0.25	2.25
0.50	2.50
0.75	2.75
1.00	3.00
1.25	3.25
1.50	3.50
1.75	3.75
2.00	4.00

Figure 12: Pump Speed Menu



ENTER NUMBER:

AUT
.
0
1
2
3
4
5
6
7
8
9

Figure 13: Resetting Period Menu

<u>Standard measuring process consists of three phases (Group measurement is set on “No”)</u>

1. <u>Resetting period (zeroing)</u> Ensures perfect cleaning of analytical units and perfect zero stability and accuracy of the measurement. Resetting interval is controlled by internal operating software. Analytical units may be contaminated by previously measured high contamination. Resetting time is directly dependant on the extent of the last measured concentration. The heavier the hydrocarbons, the longer the time for cleaning of the analytical units. Zeroing time may thus range from 3 to 30 seconds. Ambient fresh air is used for resetting for most of the environments. If ambient air is contaminated, it is recommended to use cylinder with fresh air for each zeroing cycle.

✓ **Resetting period : AUT** The instrument resets itself thus yielding the best results. Default value can be changed by opening and selecting from the Enter Number Menu (Figure 13).

2. <u>Pre-integration period</u> This initial pumping phase floods (conditions) the system with the vapour to be analysed. This procedure suppresses the tendency of the vapour to condense on internal surfaces in cold weather. This procedure also ensures perfect zero stability.

✓ **Pre-integration period:** Default value is 4 seconds and may be changed by opening and selecting from the Enter Number Menu.

3. <u>Integration period</u> Instrument processes output signal from analytical units at a default rate of 10 measuring cycles per second and displays course of measured values in four graphs. These graphs may be saved and used when working with *Ecoprobe Plus* communication software (see Save Current Values). At the end of the integration period the resulting values are displayed on the screen and saved on the disk.

✓ **Integration period:** Default value is 20 seconds and can be changed by accessing the *Enter Number Menu*.

✓ **Probe depth:** The depth of the hole into which the probe is inserted. Default value of 0.5 metres can be changed by accessing the *Enter Number Menu*.

✓ **Save Current Values:** Course of measurements (four graphs) at one station can be saved and displayed later on PC using *Ecoprobe Plus* communication software. Current values take up space on disk that should be considered while working with the instrument.

Default value is **NO** and can be switched to **YES** by pressing ? .

The possibility of recording the course of measurement provides a special advantage and represents real soil condition.

- ✓ **Temperature:** Enter the ambient air temperature for the record. Default value is 1 grad that means no value has been inserted.

Note: Next follows the setting of measuring channels. Those analytical channels (PID, IR methane, total petroleum and CO_2) that are actually needed for an investigation, should be selected (switched ON). Each channel uses current and thus reduces the instrument's effective operating time.

- ✓ **PID On/Off:** Switches the PID analytical mode ON/OFF.

- ✓ **Range:** enables you to select between two modes:

STANDARD results are displayed in **ppm** or **mg/m^3**
In most cases the concentration exceeding photoinisation breakdown limit is indicated by the message "over" displayed on the instrument screen and the longest possible line in the graph is associated with each measured concentration higher than this limit (Figure 36). This indication **is not always** valid. In a number of cases high concentration exceeding photoionisation breakdown limit may also show a low "breakdown" result value (Figure 37).

NEW !! **HISENS** very sensitive mode, results are displayed in **ppb** or m**g/m$^{3.}$**
The highest measured value in this mode is 100 ppm. If the measured value exceeds 100 ppm, a message "over" is displayed on the screen.

- ✓ **PID Calibration Gas** ? opens a window with a selection of around 200 different spectral compounds that can be used for the automatic calibration of the PID unit (see Table of Measured Compounds in Chapter 11).

  - Use ? /? to select a compound;
  - confirms/stores the selected item;
  - returns to System Configuration File.

Units: Resulting values can be displayed in ppm or mg/m^3 that can be switched by pressing ? .

- ✓ **Evaluation:** Resulting values can be displayed as Maximum or as Integral.

Maximum instrument will find maximum value, calculated as an average of three consecutive highest values.

Integral instrument will calculate numerical average of all measured values.

Default value is **Maximum** and can be switched by pressing ? .

- ✓ **IR** (and other selections): Self-explanatory.

6. HOW TO START MEASUREMENT USING LOCALITY 1, LOCALITY 2

6.1 STANDARD GRID

6.1.1 Measurement mode

If a name of a locality is displayed after *LOCALITY 1 (or 2)* in the Main Menu (for example DESIREE) and Standard Grid was selected in the System Configuration File, use ？ to select *LOCALITY 1 (or 2) DESIREE* to open its measurement mode (Figure 14).

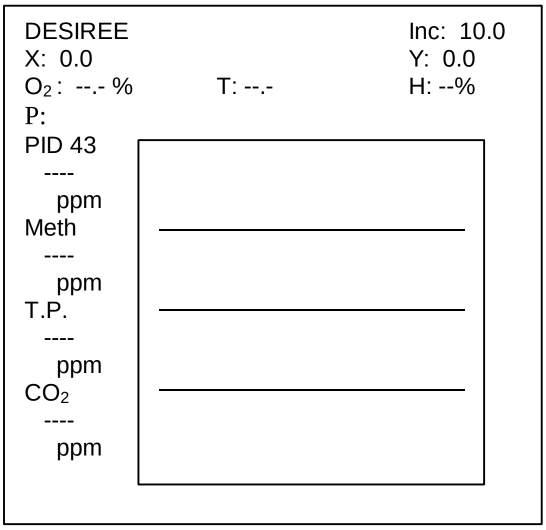

DESIREE Inc: 10.0
X: 0.0 Y: 0.0
O_2 : --.- % T: --.- H: --%
P:
PID 43
----
ppm
Meth
----
ppm
T.P.
----
ppm
CO_2
----
ppm

Figure 14 : Measurement Mode Menu

Description

First line:	The name of Locality and “Y” increment. Default setting is 10 metres.
Second line:	“X” coordinate, “Y” coordinate – default setting is 0.0 metres if *Standard grid* was selected in the System Configuration File.
Third line:	Oxygen concentration, Soil temperature, Humidity (there is no reading of humidity as humidity sensor is not implemented in this version).
Fourth line:	Absolute ambient pressure / vacuum during pumping

!

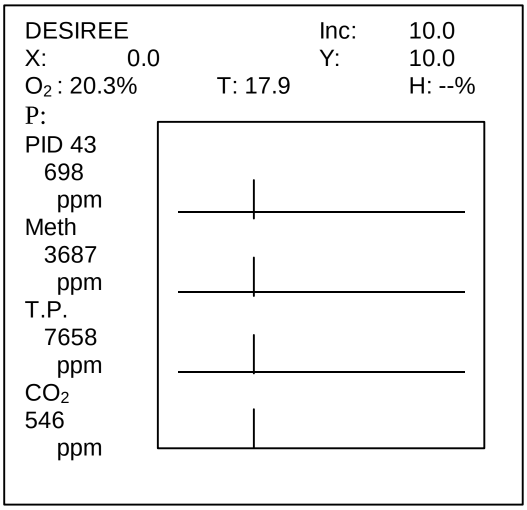
First graph:	PID calibration (in this case - 118 - Isobuthylen), result PID concentration, units -- **ppm** for **STANDARD** mode, **ppb** for **HI SENS** mode
Second graph:	the same for IR Methane channel
Third graph:	the same for IR Total Petroleum channel,
Fourth graph:	the same for IR CO_2 channel.

6.1.2 Measurement

- Use ？ to start measurement of the next point. **“Y” coordinate is increased by the increment**. The first measured station is then “X”=0; “Y”=10. If you want to measure the station with coordinates “X”=0.0; “Y”=0.0 it is necessary to set the starting point at ‘X”=0.0; “Y”= -10 (minus ten) using ？ to move one station back.

Measurement starts with resetting

- Use ？ when *Press ->* is displayed. Current values of concentration are displayed during the sampling interval in four graphs and resulting concentration is displayed at the end of the sampling interval on the-left hand side. (Figure 15)



DESIREE Inc: 10.0
X: 0.0 Y: 10.0
O_2 : 20.3% T: 17.9 H: --%
P:
PID 43 698 ppm
Meth 3687 ppm
T.P. 7658 ppm
CO_2 546 ppm

Figure 15: Measuring Mode Menu after measuring of the first station

- Use ? to start measurement of the next point (“X”=0, “Y”=20).

Use ? /? to review already measured data on the line. If the small cursor is located at the last measured point the measurement of the next point will start after pressing ? .

6.1.3 Finishing measuring

Use ESC button on the display panel to get back to the Main Menu. All data are saved.

- ❑ If you want to continue measuring locality DESIREE, select *LOCALITY 1 (or 2) DESIREE* in the Main Menu. This operation will take you to the last measured point of the locality.
- ❑ Use ON/OFF button if you want to switch the instrument OFF.

6.1.4 Repeating the last measured point

- Move the cursor one point left from the last measured point .
- Press “RUN”.
- Select *Measure* from the displayed menu (Figure 16). The measurement of the last point is repeated.

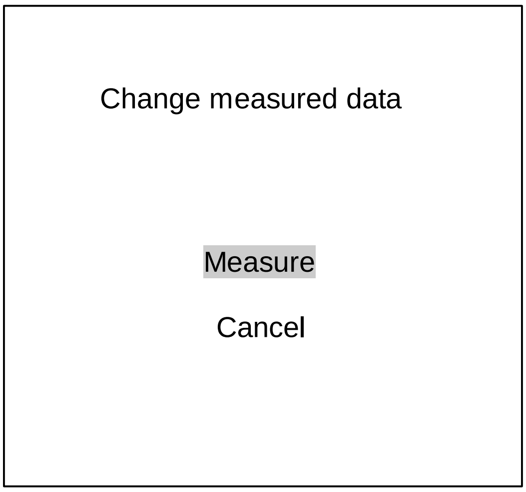


Figure 16: Repeating the last measured point

6.1.5 Data Logging – Standard Grid

Data logging is a powerful and versatile tool for network field measurement. Network is defined by number of "lines" (X) and number of "stations" (Y) on the line. Operator can freely move to any XY station just by changing "X" and "Y" coordinates. Changing "Y" and "X" increments enables you to proceed by the most suitable measuring interval and thus select an optimum network scheme for a given environment. Decimal and negative values can also be entered. Measured values are saved in an orderly manner in the network system.

✓ **Change "Y" coordinate**

- Use ? from the Measurement Mode Menu (Figure 15*)* to open the menu in Figure 17.
- Select *Enter Y*.
- *Enter Number Menu* is opened.
- Type in the Y coordinate.

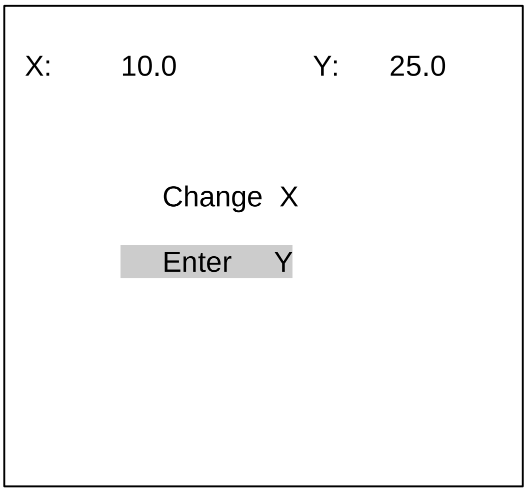


Figure 17: Change "Y" coordinate

✓ **Change "Y" increment**

- Use ? from Measurement Mode Menu to select the increment (Inc.) in the upper right-hand corner.
- ? / ? change the sign of the increment
- ? opens the *Enter Number Menu* to change the value of the increment.

✓ **Change "X" coordinate**

- Use ? from Measurement Mode Menu to open the menu in Figure 18.
- Select *Change X* and use ? to open the following menu (Figure 19).

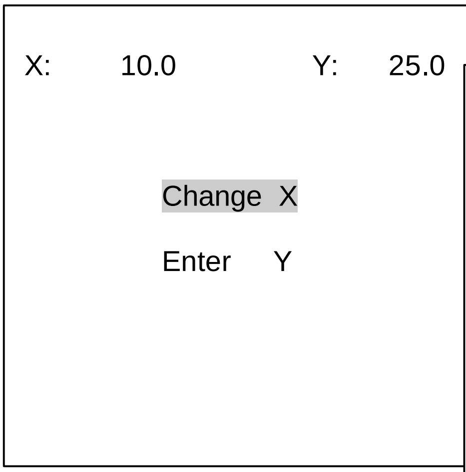


Figure 18: Change "X" coordinate

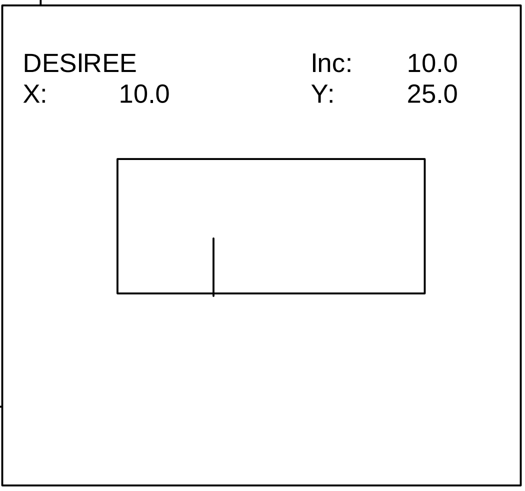
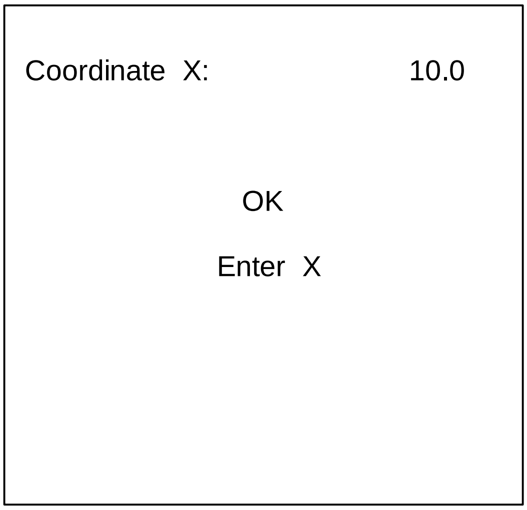


Figure 19: Selecting "X" coordinate

- ? /? change X coordinate by the displayed increment.
- Use ? to open a menu in Figure 20.



Coordinate X: 10.0

OK

Enter X

Figure 20

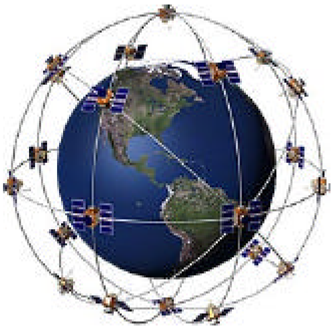
- Confirming the “X” coordinate **by pressing OK will take you back to Measuring Mode Menu**.

- For entering another value select *Enter X*. *Enter Number Menu* will be opened for typing in any “X” coordinate. Confirming the “X” coordinate by pressing *OK* in Figure 20 will take you back to Measuring Mode Menu.

✓ **Change “X” increment:**

- ? moves the cursor in Figure 19 to the “X increment” in the upper right-hand corner.
- ? changes the sign
- ? opens *Enter Number Menu* to change the value of the increment
- ? confirming the new value in *Enter Number Menu* will take you back to the menu in Figure 19.

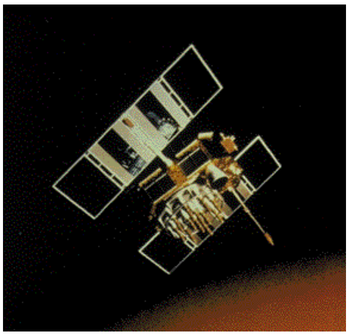
6.2 GPS LOGGING



6.2.1 About Global Positioning

GPS – The Global Positioning System, has changed the way people navigate the oceans, the skies and land. Commercial use of GPS has proven invaluable in many fields. It has revolutionized surveying. It can be used to track everything from migrating animal herds to the creep of the earth's crust.

GPS works on the principle of Triangulation. By knowing its distance from three or more satellites, the receiver can calculate its position by solving a set of equations. Information from three satellites is needed to calculate longitude and latitude at a known elevation; four satellites are needed to include altitude as well. Satellites orbit the earth twice a day at an altitude of 10,900 miles, repeatedly broadcasting their position and the time. The atomic clock aboard each satellite keeps time by atomic vibration and is accurate to one second in 30 years!



GPS under development by the U.S. Department of Defense for more than 20 years consists of 21 satellites, plus three back-up satellites in predictable orbits around the earth. The system provides 24-hour positioning information regardless of weather.

GPS satellite orbital information is referenced to WGS 84. WGS 84 is an earth - fixed global reference frame using latitude and longitude coordinate system to locate points on the Earth's surface.

Lines of longitude are circles that intersect both the North and the South Poles. Lines of longitudes are measured in half circles of 0º to 180º East and from 0º to 180º west from the Royal Greenwich Observatory in Greenwich, England.

Latitude is measured as an angle from the equator of the Earth (0º) to the North Pole (90º North) or to the South Pole (90ºSouth). Lines of latitude are made by circles that run parallel to the equator's plane, and grow progressively smaller as they get closer to the poles.

6.2.2 GPS and Ecoprobe 5

Ecoprobe 5 is the first geophysical instrument in the world to provide GPS positioning.
The GPS system in Ecoprobe 5 can be used if a specific software is activated and if a special RS Dynamics GPS receiver is available. Both of these items are optional. Ask your agent for further information.

GPS logging

GPS logging is a very effective data logging system with no need for concern about coordinates while measuring in the field. Coordinates are displayed / stored in the world geodetic format WGS 84
(latitude -GPS W, longitude - GPS L, altitude - GPS R) and also displayed in surface metres (X,Y,Z).

What do X,Y,Z coordinates mean?
Imagine a tangent plane made at the first measured station to the global elipsoid. The coordinates of the first measured station are X=0, Y=0. Coordinates of all other stations are related to the first station (X=0,Y=0). This system provides easier orientation in the field but reduces the accuracy of positioning (only on the instrument screen).

Measured data are stored according to time. Communication software *Ecoprobe Plus* enables you to display (and export to Excel) a data table with coordinates in the world geodetic format WDS 84 without affecting accuracy.

Depending upon accuracy requirements, users may select from GPS systems with

- Meter precision
- Decimeter precision
- Centimeter precision

1. Meter precision

Precision ranges from 3 to 10 meters using a single 8 channel receiver.

2. Decimeter precision

This GPS system uses "Differential GPS techniques". This involves two 12-channel GPS receivers. Base station is located at a known point and transmits data over a radio link to the Moving station. Moving station calculates precise position by using the signals from satellites, and the data it receives from the Base station.

3. Centimeter precision

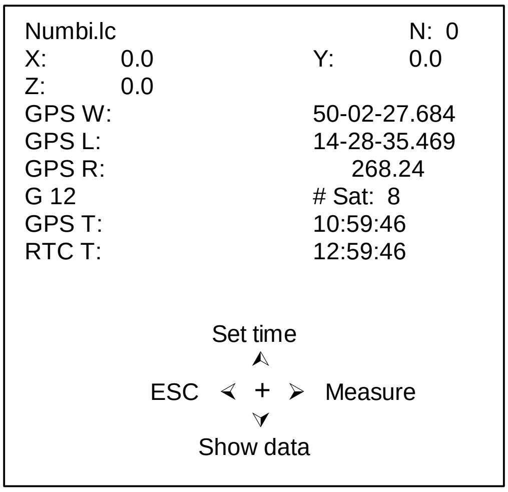
The same GPS system using "Differential GPS techniques" as above. To fix positions with centimeter accuracy "Post-processing procedure" is used by which the errors inherent to raw GPS data are removed after the field work has been completed.

Ecoprobe 5 system fully integrates all of the above options. In all categories RS Dynamics/Astech GPS receivers are required for which the system is especially configured.

For GPS logging connect GPS receiver to multifunctional connector in front of Ecoprobe 5 and select GPS logging in the System Configuration File.

6.2.3 Measurement mode

If a required name of a locality is displayed after *LOCALITY 1 (or 2)* in the Main Menu and GPS logging was selected in the System Configuration File, use ? to select the locality and to open the GPS welcome screen in Figure 21.

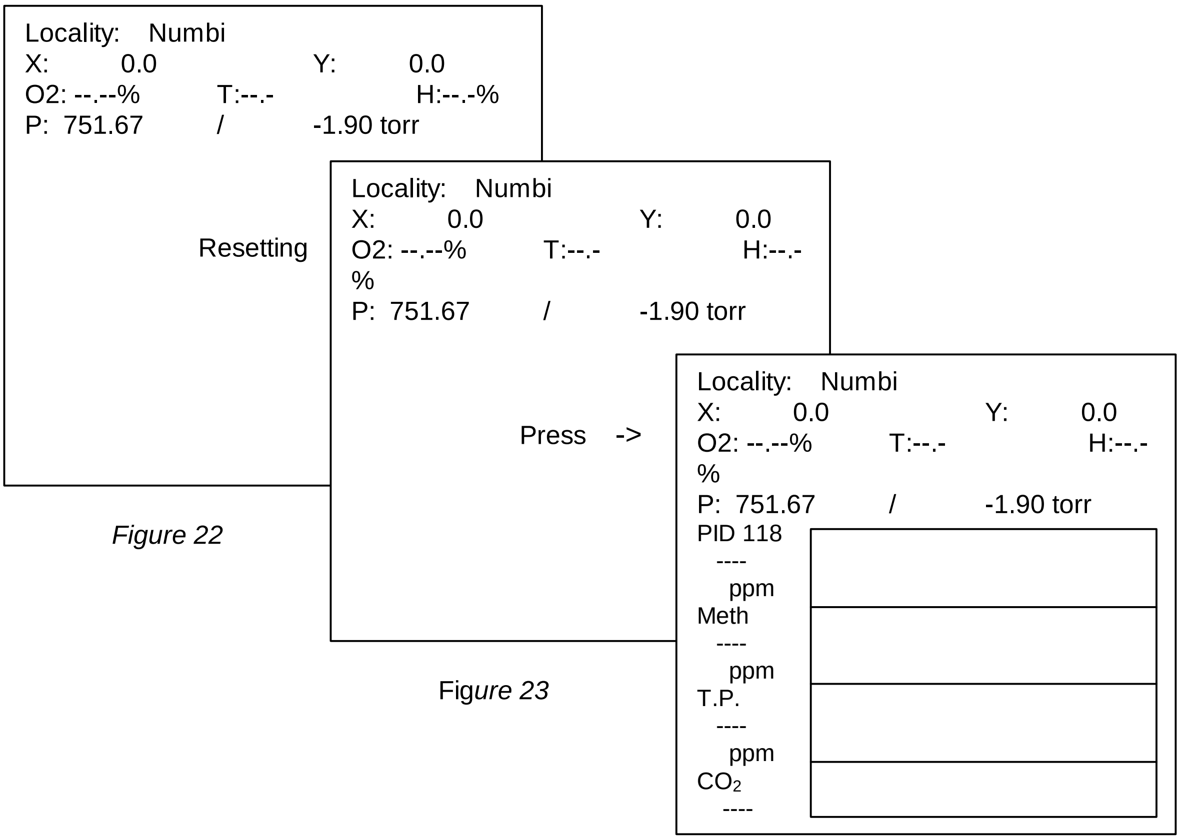


```
Numbi.lc                           N:  0
X:          0.0             Y:          0.0
Z:          0.0
GPS W:                      50-02-27.684
GPS L:                      14-28-35.469
GPS R:                            268.24
G 12                        # Sat:  8
GPS T:                      10:59:46
RTC T:                      12:59:46
```

Figure 21: GPS Menu

Description:

Numbi.lc	Name of the Locality
N	Number of measured stations
X	X coordinate related to the first measured station (X=0, Y=0)
Y	Y coordinate related to the first measured station (X=0, Y=0)
Z	altitude
GPS W	Latitude (WGS 84); degrees, minutes, seconds
GPS L	Longitude (WGS 84); degrees, minutes, seconds
GPS R	altitude
G12	Type of the GPS receiver
# Sat:	Number of satellites in use
GPS T	Absolute GPS time
RTC T	Local time
Set time	Use ? to open Enter Number Menu to set the local time shift from Absolute GPS time (Greenwich Mean Time). The setting is valid only if hours; minutes and seconds are identical.
ESC	? takes you back to the previous menu.
Show data	? enables you to review already measured data
Measure	? starts measurement of the next station. Following Menu will be displayed (Figure 22, 23, 24).



```
Locality:   Numbi
X:        0.0                Y:        0.0
O2: --.--%        T:--.-              H:--.-%
P:  751.67        /         -1.90 torr

                           Resetting
```

Figure 22

```
Locality:   Numbi
X:        0.0                Y:        0.0
O2: --.--%        T:--.-              H:--.-
%
P:  751.67        /         -1.90 torr

                          Press    ->
```

Figure 23

```
Locality:   Numbi
X:        0.0                Y:        0.0
O2: --.--%        T:--.-              H:--.-
%
P:  751.67        /         -1.90 torr
PID 118
   ----
     ppm
Meth
   ----
     ppm
T.P.
   ----
     ppm
CO2
   ----
```

Figure 24

The X,Y coordinates of the first measured station are set as X=0, Y=0. After measuring, the Measurement Mode Menu (Figure24) will disappear and Welcome GPS Menu (Figure 21) is displayed. Use the option “Show data” to review the measured values or “Measure” for measuring the next station.

If the receiver cannot get information from satellites (for instance while measuring among tall buildings), Ecoprobe 5 does not allow measurement to continue and the instrument starts beeping. Press any arrowed button to stop the beep and return to the Welcome GPS menu.

7. CONTINUOUS MEASUREMENT

Allows continuous operation without any data being logged.

- Select the item *CONTINUOUS MEASUREMENT* in the Main Menu
- Measuring mode will be opened (Figure 25) offering an option *START* and displaying System Configuration File that can be changed to the operator's specifications.
- Press *START* for resetting.
- Confirm *Press* -> when displayed with ？ .
- Continuous measurement will start after a short preintegration period.
- Press *ESC* to return to the Main Menu.

```
CONTINUOUS CONFIG.

               START

Group Measurement            No
Pump Speed:           1.25 l/min
Sampl. interval       1 s
Reset period:         AUT    s
Preint.period:        4 s
Integr. period:       20 s
Probe Depth:          0.50 m
Save Curr. Val.: No
Temperature:          99 grad
PID      On/Off:  On
Calibration gas:
```

Figure 25: Continuous Measurement Menu

After having the instrument switched off, IR unit needs to get stabilised. It is recommended to use CONTINUOUS MEASUREMENT mode for about 1 minute before starting the measurement. The operator can thus avoid the incorrect readings at the first measured station**.**

8. MONITOR

Ecoprobe 5 can be used to operate automatically as a monitoring station. You can just preset parameters in Monitoring Station Configuration File and leave the instrument anywhere needed. Ecoprobe 5 will work for you.

8.1 How to enter and measure a Monitoring station

- Use *LOCALITY MANAGEMENT* from the Main Menu to open the *Monitor Mode Menu* (Figure 26).
- Select *Open MONITOR LOC* to access a list of all localities and monitoring stations (Figure 27).
- For entering a **new** monitoring station select <*new*>*.* Monitoring Station Configuration File (Figure 28) will be opened. After entering a name and making possible changes return to Main Menu by pressing ? and following the instructions on the screen. Name of the new monitoring station will be displayed after *MONITOR* in the Main Menu.
- For entering an already existing monitoring station select the name of the monitoring station in the list of localities and monitoring stations (Figure 27). Its Monitoring Station Configuration File will be opened for possible changes. If you do not want to make any changes just return to the Main Menu by pressing ? and following the instructions on the screen. Name of the selected monitoring station will be displayed after *MONITOR* in the Main Menu.
- If there is a name of a monitoring station after *MONITOR* in the Main Menu, the instrument will start measurement of the titled station when this option is selected.

MONITOR MODE

Open MONITOR LOC

Delete Monitor

Figure 26: Monitor Mode Menu

SELECT MONITOR LOC

<new>
Scarborough
London
St Albans
Kimpton

Figure 27: A list of localities and monitoring stations

MONITOR: noname

Interval: 10.0 min

Group Measurement **No**
Pump Speed:1.25 l/mim
Sampl. interva 1.0 s
Reset period: AUT s
Preint. period: 4 s
Integr. period: 20s
Probe Depth: 0.50 m
Save Curr. Val.: No
Temperature: 1 grad

PID On/Off: On
Calibration gas:
43 Isobutylene
Units: ppm
Evaluation: Maximum

InfraRed On/Off: On
Methane: On
Total Petroleum: On
CO_2 : On
Units: ppm
Evaluation: Maximum

Humidity: Off
Oxygen: On
Temperature units:C
Pressure units: kPa

Save Configuration

Figure 28: Default Monitoring Station File

Monitoring Station Configuration File

✓ **MONITOR: noname**

Enter the name of a station (8 characters). It is recommended to put for example **M** or **MON** before or after the name of the station to ensure that you will access a **monitoring station** when working with the list of localities and monitoring stations. No **locality** can be accessed using the option *Open MONITOR* and “Error” message will be displayed on the screen.

In short:
Use *Open MONITOR* to enter a monitoring station
Use *Open LOCALITY 1 (2)* to enter a locality.

✓ **Interval: 10.0 min**

At the end of preset interval, instrument will repeat the measuring cycle. Default value (10 minutes) can be changed by pressing ？ . *Enter Number Value* will be opened for entering a new value.

✓ **Group measuremen**t
Operator can choose between already mentioned modes.
Group measurement (switched on **YES**) is recommended. This mode is easier and usually fulfils all requirements. Instrument performs zeroing cycle only once: at the start of the operation. Zeroing cycle can, however, be started anytime by pressing the RUN key on the display panel for longer than 1 sec.

In case maximal precision and sensitivity is required it is necessary to work in standard mode (Group measurement is switched on **NO**). Each measuring cycle is preceded by a zeroing interval. In this case a valve box with its own power supply is required to provide clean air to the instrument for zeroing. This item is available as an accessory from the manufacturer.

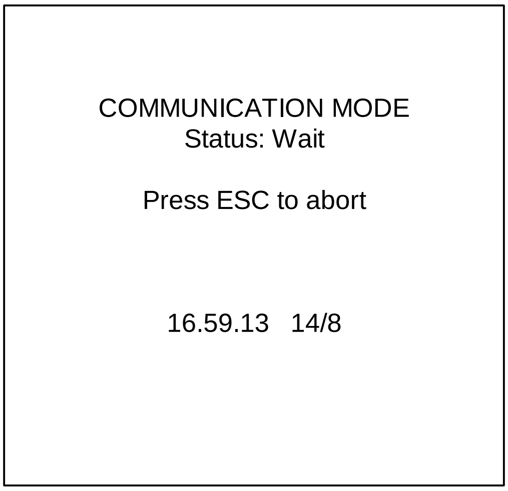
All other parameters of the Monitoring Station File are set as for the System Configuration File.

Electrical power needed for an extended operation is supplied either by the Ecoprobe 5 charger/power supply, or by a 6 to 24 volt, 0.5 ampere (minimum) DC source. Solar cells are another possibility, but the manufacturer should be consulted regarding detailed specifications and a special cable to connect to such power supplies.

9. COMMUNICATION

This mode is used for establishing communication between Ecoprobe 5 and PC.

- Connect Ecoprobe 5 with the appropriate cable to PC.
- Select *COMMUNICATION* in the Main Menu
- **?** Opens a menu in Figure 29.



COMMUNICATION MODE
Status: Wait

Press ESC to abort

16.59.13 14/8

Figure 29: Communication Mode

- All subsequent commands are issued from the computer (see *Ecoprobe Plus User Manual).*

This procedure enables transferring data from Ecoprobe 5 to a PC or notebook and will edit any System Configuration File inside Ecoprobe 5 from your PC.
The user friendly software *Ecoprobe Plus* running under WINDOWS 95/98/2000 or Win NT 4.0, facilitates rapid transfer of data and its graphic presentation.

Press ESC to return to the Main Menu.

10. SYSTEM CONFIGURATION

Enables you to change default setting of the System Configuration File, which is always offered when any new locality is opened.
In case of need, you can reconfigure this default System Configuration File to meet any definite requirement.
However, if you are not very experienced, it is advisable not to make any changes to the default setting.

<u>To make changes:</u>

- Select *SYSTEM CONFIGURATION* in the Main Menu
- **?** opens System Configuration File (Figure 30).
- Use the same procedure as in the case of configuring Locality or Monitor Configuration File.

<u>There are 2 ways of saving changes in the System Configuration File</u>

1. Select *Save Configuration* at the end of the file
2. Press ? to save changes and follow the instructions on the screen.

```
                SYSTEM CONFIGURATION
---------------------------------------------------
Grid:       Standard
X Increment:    10m
Y Increment:    10m
---------------------------------------------------
Group Measurement: No
Pump Speed: 1.25 l/mim
Sampl. Interval:  1.0 s
Reset period:  AUT  s
Preint. period:  4  s
Integr. period:  20 s
Probe Depth:    0.50m
Save Curr. Val.:  No
Temperature:   1  grad
________________________________________________________
PID On/Off:  On
Range:      STANDARD
 Calibration gas:
 43 Isobutylene
 Units:      ppm
 Evaluation: Maximum
---------------------------------------------------------
 InfraRed On/Off: On
 Methane:  On
 Total Petroleum: On
 CO2: On
 Units:      ppm
 Evaluation: Maximum
---------------------------------------------------
 Humidity: Off
 Oxygen: On
 Temperature units:C
 Pressure units: kPa
---------------------------------------------------
 Save Configuration
```

Figure 30: System Configuration File

11. CALIBRATION

Ecoprobe 5 measuring set comprises “Single gas” Calibration Kit for PID unit calibration. Calibration Kit provides everything you need for field calibration: Calibration interval depends upon absolute accuracy required and on dust condition of surveying terrain. If dusty gas is sucked into the instrument, PID unit may become dirty. It is highly recommended using a **dust filter** that is to be inserted between Ecoprobe 5 gas inlet and the sampling probe. The filter should be changed after 1 to 30 measurements depending upon the amount of dust and extent of contamination of the measuring environment. Dirty filters can be cleaned and used again. If heavily contaminated gas was let into the instrument, the filter should be changed and not used for a second time. Extra filters are included in the instrument set. As consumables they may be purchased for example at gas stations.

11.1 PID unit

Even though filters are used, the PID unit may become dusted and calibration procedure must be performed.

Calibration intervals:

From 1 to 6 months	if not working in dusty environment and using dust filters
Once a week	if working in dusty environments with dust filters
Every day	if precise quantitative values are required.

Calibration Kit consists of:

- LINDE plastic/metal bag and valve for inserting gas from the cylinder.

- Cylinder with calibration standard -- LINDE 100 ppm **Isobuthylene mixed into synthetic air (never nitrogen!).** Content of the cylinder (2l/150 atm) is enough for about 200 calibrations (if the operator does not waste the gas).
  Refills of the calibration gas may be purchased from any company providing calibration standard gases for gas chromatography (Air Products, SIAD, LINDE and others).

Ecoprobe 5 PID unit is calibrated only for one calibration gas – Isobuthylene. This procedure, however, automatically calibrates the instrument for all other compounds stored in the instrument memory. List of the compounds is printed in a table in Figure 35 for three different ionisation lamps (9.8 eV, 10.2 eV and 11.7 eV) **featuring the selective Methane suppression.** Ecoprobe 5 is equipped with 10.2 eV ionisation lamp. Other lamp options may be ordered with a specific spectral characteristic. The lamps may be switched directly in the field within several minutes since the instrument is precalibrated for all the lamps noted.

Table of compounds measured by means of PID unit

PID response to different spectral compounds is specified by Ionisation potential of a particular compound. Ionisation potentials (IP) are listed in the table of measured compounds (Figure 35). Constants in 3 other columns for different lamps express recalculated relative responses of individual compounds versus calibration gas Isobuthylene.

The constants are only for your convenience.

Ecoprobe 5 internal software processes all the data and displays definitive results.

11.2 IR unit

For IR Methane, IR Petroleum and IR CO_2 channels the same calibration procedure as for PID unit is valid. IR analytical unit requires calibration over a much longer interval as the unit has a reference channel capable of compensating for the dusting reading. The standard IR calibration interval ranges from 1 to 12 months depending on the dust conditions (12 months for $CO_{2.}$ channel).

For calibration of IR Methane and IR Total Petroleum channels use a cylinder with 10.000 ppm of Methane concentration **(mixture with synthetic air — never nitrogen!!)**

!

For calibration of CO_2 channel use a cylinder with 10.000 ppm concentration of CO_2 **(mixture with synthetic air — never nitrogen)**

Reserve one calibration bag for calibration of IR Methane and IR Total Petroleum channels and another calibration bag for calibration of CO_2 channel. Do not mistake them for each other as they may contain residue of calibration gases and thus cause inaccurate results.

11.3 Ecoprobe 5 calibration procedure

Calibration procedure is controlled by internal Ecoprobe 5 calibration program
It is easy and takes about 3 minutes in the field.

- Select *Calibration* from the Main Menu and use **?** to open *Calibration Menu* in Figure 31.
- Select PID for calibration of PID unit and use **?** to open *PID Calibration Menu* (Figure 32).
- Press **?** to change the concentration of the Calibration gas, if needed (concentration of calibration gas in the cylinder may not be exactly 100 ppm). Type in the value that is written on the cylinder – the value may vary within the interval +/-10 %).
- Go down to *Run Calibration* to start the calibration procedure. The cycle will start with a 60 second resetting interval. Menu in Figure 33 is opened.

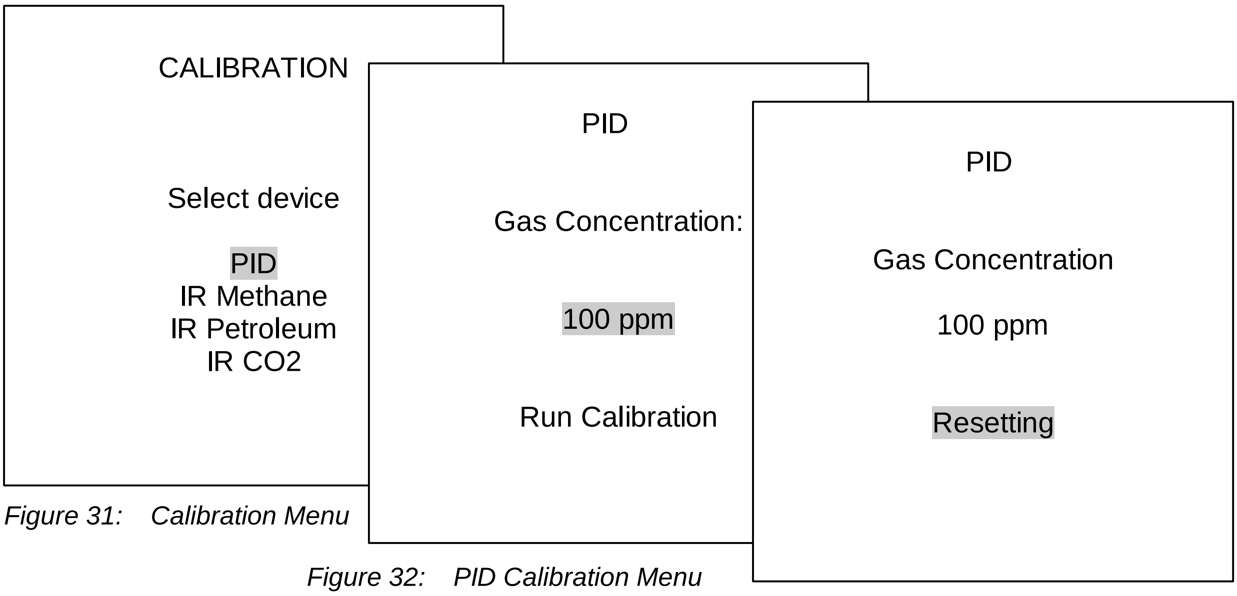


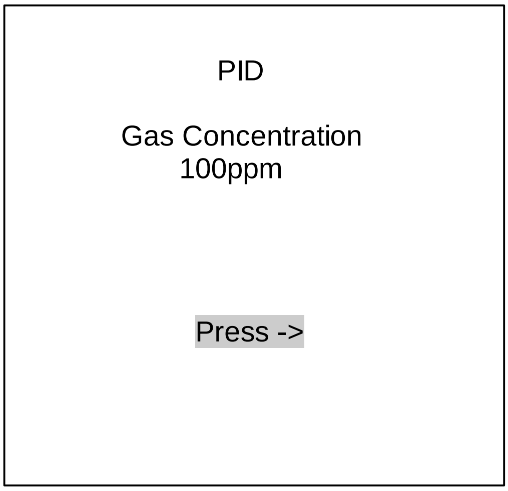
Figure 31: Calibration Menu

Figure 32: PID Calibration Menu

Figure 33: Run Calibration Menu

- Fill the calibration gas into the calibration bag from the gas cylinder and immediately close the valve on the bag. About 1 liter of gas is enough to complete the calibration.

- When the resetting interval is finished, menu in Figure 34 is displayed.



PID

Gas Concentration
100ppm

Press ->

Figure 34: Calibration Menu after resetting

- Connect the calibration bag by means of a plastic tube with the Ecoprobe 5 gas inlet in front of the instrument and confirm the option *Press->* on the display. Keep the bag connected till the instrument stops measuring and displays the result – Calibration coefficient. If the coefficient is within the allowed limits you are asked to confirm it and this completes the calibration.

The coefficient is always calculated from the initial condition set up (e.g. does not reflect the value of the previously set coefficient). According to its value you can thus estimate the condition of the analytical unit. If it tends to become dirty (dusted) the coefficient's value rises. If the value exceeds the limit, it is impossible to correct the process using software tools and the system **will not allow** completion of calibration.

You have three options for correction:

1. Incorrect value of the gas concentration was typed in (Figure 32). Correct the value and repeat the calibration procedure.

2. Internal parts of the PID unit is dirty (dusted) – **ask your agent for service (clean-out) !!**

3. The calibration gas is out of order. Ask for new refill.

Control of the Calibration procedure:

After the calibration is completed, check the result by switching to the locality mode and measuring one test station (you can create a locality linked with calibration procedures named for example CAL1).
Set the System Configuration File (of CAL1 Locality) as follows:

1. The reading MUST be switched to **ppm** values for all channels (select STANDARD mode and ppm units)
2. In PID channel the Calibration gas Isobuthylene # **118** (or equal **Isobutene**) must be selected. Do not mistake it for **Isobutane** which features much higher response !!!!

Due to absorption of the gas inside the calibration bag, gas temperature changes inside the bag (the gas is cooled due to rapid expansion after inserting it from the pressurized cylinder!!) and a number of other natural influences - the test result (in Locality CAL1) may be slightly different from the concentration you have typed in before calibration. In this case **two-step or three-step calibration is recommended**. Follow the next instruction:

Run the calibration again with the typed value of the calibration gas corrected as follows:

Example:

a) For the first time you have typed in the value 100 ppm. The test result shows 96 ppm. Difference is 4 ppm.
b) Type in the value 104 ppm and run the calibration again.
c) In the Locality mode (CAL1) run the test measurement. The value must be very close to 100 ppm. If not, or if you are not happy with the precision, run the third step of calibration.

You can apply the same procedure to calibration of all channels.
The common rule: If the result test value is lower than the value you typed in before the calibration, insert the value with added difference (higher); et vice versa.

NR means No Response to the particular compour

TABLE OF MEASURED COMPOUNDS

Compound Name	Formula	Lamp 9.8eV	Lamp 10.2eV	Lamp 11.7eV	IP [eV]
Acetaldehyde	C2H4O	NR	5.5	NR	10.23
Acetic Acid	C2H4O2	NR	22	2.6	10.66
Acetic Anhydride	C4H6O3	NR	6.1	2	10.14
Acetone	C3H6O	1.2	1.1	1.4	9.71
Acetonitrile	C2H3N	NR	NR	100	12.19
Acetylene	C2H2	NR	NR	2	11.4
Acrolein	C3H4O	42	3.9	1.4	10.1
Acrylic Acid	C3H4O2	NR	12	2	10.6
Acrylonitrile	C3H3N	NR	NR	1.2	10.91
Allyl alcohol	C3H6O	NR	2.4	1.7	9.67
Allyl chloride	C3H5Cl	NR	4.3	0.7	9.9
Ammonia	H3N	NR	9.7	5.7	10.16
Amyl alcohol	C5H12O	NR	5	NR	10
Aniline	C7H7N	0.5	0.5	0.5	7.72
Anisole	C7H8O	NR	0.8	NR	8.21
Benzaldehyde	C7H6O	NR	NR	1	9.49
Benzene	C6H6	0.55	0.5	0.6	9.25
Benzonitrile	C7H5N	NR	1.6	NR	9.62
Benzyl chloride	C7H7Cl	NR	2	0.7	
Bromobenzene	C6H5Br	NR	0.6	0.5	8.98
Bromoform	CHBr3	NR	2.5	0.5	10.48
Bromopropane,1-	C3H7Br	150	1.5	0.6	10.18
Butadiene	C4H6	NR	1	1.1	9.07
Butadiene diepoxide,1,3-	C4H6O2	25	3.5	1.2	~10
Butane	C4H10	NR	NR	1.2	10.53
Butanol, 1-	C4H10O	70	4.7	1.4	9.99
Butene, 1-	C4H8	NR	0.9	NR	9.58
Butoxyethanol, 2-	C6H14O2	1.8	1.2	0.6	<10
Butyl acetate, n-	C6H12O2	NR	2.6	NR	10
Butyl acrylate, n-	C7H12O2	NR	1.6	0.6	
Butylamine	C4H11N	NR	7	NR	8.71
Butyl cellosolve		NR	NR	NR	
Butyl mercaptan	C4H10S	NR	0.5	NR	9.14
Carbon disulfide	CS2	NR	1.2	0.3	10.07
Carbon tetrachloride	CCl4	NR	NR	1.7	11.47
Chlorine	Cl2	NR	NR	1	11.48
Chloro-1,3-butadiene, 2-	C4H5Cl	NR	3	NR	
Chlorobenzene	C6H5Cl	0.44	0.4	0.39	9.06
Chloro-1,1-difluoroethane, 1- (R-142B)	C2H3ClF2	NR	NR	NR	12
Chlorodifluoromethane	CHClF2	NR	NR	NR	12.2
Chloroethane	C2H5Cl	NR	NR	1.1	10.97
Chloroethanol	C2H5ClO	NR	NR	NR	10.52
Chloroethyl methyl ether, 2-	C3H7ClO	NR	3	NR	
Chloroform	CHCl3	NR	NR	3.5	11.37
Chlorotoluene, o-	C7H7Cl	NR	0.5	0.6	8.83
Chlorotoluene, p-	C7H7Cl	NR	NR	0.6	8.69
Crotonaldehyde	C4H6O	1.5	1.1	1	9.73
Cumene	C9H12	0.58	0.5	0.4	8.73
Cyanogen bromide	CNBr	NR	NR	NR	11.84
Cyanogen chloride	CNCl	NR	NR	NR	12.34
Cyclohexane	C6H12	NR	1.4	NR	9.86
Cyclohexanol	C6H12O	NR	NR	1.1	9.75
Cyclohexanone	C6H10O	1	0.9	0.7	9.14
Cyclohexene	C6H10	NR	0.8	NR	8.95

TABLE OF MEASURED COMPOUNDS

Cyclohexylamine	C6H13N	NR	1.2	NR	8.62
Cyclopentane	C5H10	NR	NR	0.6	10.51
Decane	C10H22	4	1.4	0.4	9.65
Diacetone alcohol	C6H12O2	NR	0.7	NR	
Dibromoethane, 1,2-	C2H4Br2	NR	1.7	0.6	10.37
Dichlorobenzene, o-	C6H4Cl2	0.54	0.47	0.38	9.08
Dichlorodifluoromethane	CCl2F2	NR	NR	NR	11.75
Dichloroethane, 1,1-	C2H4Cl2	NR	NR	NR	11.06
Dichloroethane, 1,2-	C2H4Cl2	NR	NR	0.6	11.04
Dichloroethene, 1,1-	C2H2Cl2	NR	0.9	NR	9.79
Dichloroethene, c-1,2-	C2H2Cl2	NR	0.8	NR	9.66
Dichloroethene, t-1,2-	C2H2Cl2	NR	0.5	0.3	9.65
Dichloro-1-fluoroethane, 1,1- (R-141B)	C2H3Cl2F	NR	NR	2	
Dichloropropane, 1,2-	C3H6Cl2	NR	NR	0.7	10.87
Dichloro-1-propene, 2,3-	C3H4Cl2	1.9	1.3	0.7	<10
Dichloro-1,1,1-trifluoroethane, 2,2- (R-123)	C2HCl2F3	NR	NR	10.1	11.5
Diesel Fuel #1	m.w. 226	NR	0.9	NR	
Diesel Fuel #2	m.w. 216	NR	0.7	0.4	
Diethylamine	C4H11N	NR	1	NR	8.01
Diethylaminopropylamine,3-	C7H18N2	NR	1.3	NR	
Diethylmaleate	C8H12O4	NR	4	NR	
Dimethylacetamide, N,N-	C4H9NO	0.87	0.8	0.8	8.81
Dimethylamine	C2H7N	NR	1.5	NR	8.23
Dimethyl disulfide	C2H6S2	0.2	0.2	0.2	7.4
Dimethylformamide, N,N-	C3H7NO	NR	0.8	NR	9.13
Dimethylhydrazine, 1,1-	C2H8N2	NR	0.8	0.8	7.28
Dimethyl sulfate	C2H6O4S	~23	~20	2.3	
Dioxane, 1,4-	C4H8O2	NR	1.1	NR	9.19
Epichlorohydrin	C2H5ClO	~200	8.5	1.4	10.2
Ethane	C2H6	NR	NR	15	11.52
Ethanol	C2H6O	NR	12	8	10.47
Ethanolamine (Not Recommended)	C2H7NO	NR	~4	~3	8.96
Ethene	C2H4	NR	10	3	10.51
Ethoxyethanol, 2-	C4H10O2	NR	3.5	NR	9.6
Ethyl acetate	C4H8O2	NR	4.6	NR	10.01
Ethyl acrylate	C5H8O2	NR	2.4	1	(<10.3)
Ethylamine	C2H7N	NR	0.8	NR	8.86
Ethylbenzene	C8H10	0.52	0.5	0.5	8.77
Ethylene glycol	C2H6O2	NR	16	6	10.16
Ethylene oxide	C2H4O	NR	19	3	10.57
Ethyl ether	C4H10O	NR	1.1	NR	9.51
Ethyl formate	C3H6O2	NR	NR	1.9	10.61
Ethyl hexyl acrylate, 2-	C11H20O2	NR	1.1	0.5	
Ethyl (S)-(-)-lactate	C5H10O3	13	3.2	1.6	~10
Ethyl mercaptan	C2H6S	NR	0.6	NR	9.29
Ethyl sulfide	C4H10S	NR	0.5	NR	8.43
Formaldehyde	CH2O	NR	NR	0.6	10.87
Furfural	C5H4O2	NR	0.9	0.8	9.21
Gasoline #1	m.w. 72	NR	0.9	NR	
Gasoline #2, 92 octane	m.w. 93	1.3	1	0.5	
Glutaraldehyde	C5H8O2	1.1	0.8	0.6	
Halothane	C2HBrClF3	NR	NR	0.6	11
Heptane, n-	C7H16	NR	2.6	0.5	9.92
Hexamethyldisilazane,1,1,1,3,3,3-	C6H19NSi2	NR	0.2	0.2	~8.6
Hexane, n-	C6H14	300	4.3	0.5	10.13
Hexene, 1-	C6H12	NR	0.8	NR	9.44
Hydrazine	H4N2	NR	2.6	2.1	8.1

Hydrogen	H2	NR	NR	NR	15.43
Hydrogen peroxide	H2O2	NR	NR	NR	10.54
Hydrogen sulfide	H2S	NR	3.3	1.5	10.45
Iodine	I2	0.1	0.1	0.1	9.4
Isobutane	C4H10	NR	100	1.2	10.57
Isobutanol	C4H10O	19	3.8	1.5	10.02
Isobutene	C4H8	1	1	1	9.24
Isobutyl acrylate	C7H12O2	NR	1.5	0.6	
Isoflurane		NR	NR	NR	
Isooctane	C8H18	NR	1.4	NR	9.86
Isopar G Solvent	m.w. 148	NR	0.8	NR	
Isopar M Solvent	m.w. 191	NR	0.7	0.4	
Isophorone	C9H14O	NR	NR	3	9.07
Isoprene	C5H8	0.69	0.6	0.6	8.85
Isopropanol	C3H8O	500	6	2.7	10.12
Isopropyl acetate	C5H10O2	NR	2.5	NR	9.99
Isopropyl ether	C6H14O	NR	0.8	NR	9.2
Jet fuel JP-4	m.w. 115	NR	1	0.4	
Jet fuel JP-5	m.w. 167	NR	0.6	0.5	
Jet fuel JP-8	m.w. 165	NR	0.6	0.3	
Kerosene		NR	NR	NR	
Mesitylene	C9H12	0.36	0.35	0.3	8.41
Methane	CH4	NR	NR	NR	12.51
Methanol	CH4O	NR	NR	2.5	10.85
Methoxyethanol, 2-	C3H8O2	4.8	2.4	1.4	10.1
Methoxyethoxyethanol, 2-	C7H16O3	2.3	1.2	0.9	<10
Methyl acetate	C3H6O2	NR	NR	1.6	10.27
Methyl acrylate	C4H6O2	NR	3.7	1.2	-9.9
Methylamine	CH5N	NR	1	NR	8.97
Methyl bromide	CH3Br	110	1.7	1.3	10.54
Methyl t-butyl ether	C5H12O	NR	0.9	NR	9.24
Methyl cellosolve		NR	NR	NR	
Methyl chloride	CH3Cl	NR	NR	0.7	11.22
Methylcyclohexane	C7H14	NR	1.1	NR	9.64
Methylene chloride	CH2Cl2	NR	NR	0.89	11.32
Methyl ethyl ketone	C4H8O	0.86	0.9	1.1	9.51
Methylhydrazine	C2H6N2	1.4	1.2	1.3	7.7
Methyl isobutyl ketone	C6H12O	NR	1.2	0.9	9.3
Methyl isocyanate	C2H3NO	NR	4.6	1.5	10.67
Methyl mercaptan	CH4S	NR	0.6	NR	9.44
Methyl methacrylate	C5H8O2	NR	1.4	1.4	9.7
Methyl propyl ketone	C5H12O	NR	0.9	0.8	9.38
Methyl-2-pyrrolidinone, N-	C5H9NO	1	0.8	0.9	9.17
Methyl salicylate	C8H8O3	NR	2	NR	
Methylstyrene, a-	C9H10	NR	0.5	NR	8.18
Mineral spirits		NR	0.7	0.39	
Naphthalene	C10H8	0.45	0.4	0.4	8.13
Nitric oxide	NO	NR	5.2	2.8	9.26
Nitrobenzene	C6H5NO2	2.6	1.9	1.6	9.81
Nitroethane	C2H5NO2	NR	NR	3	10.88
Nitrogen dioxide	NO2	NR	NR	NR	9.75
Nitromethane	CH3NO2	NR	NR	4	11.02
Nitropropane, 2-	C3H7NO2	NR	NR	2.6	10.71
Nonane	C9H20	NR	2	NR	9.72
Octane, n-	C8H18	13.2	1.8	NR	9.82
Pentane	C5H12	80	8.4	0.7	10.35
Peracetic acid	C2H4O3	NR	NR	2.3	

TABLE OF MEASURED COMPOUNDS

Peracetic/Acetic acid mix	C2H4O3	NR	50	2.5	
Perchloroethene	C2Cl4	0.69	0.57	0.31	9.32
PGME	C6H12O3	2.4	1.5	1.1	
PGMEA	C6H12O3	1.65	1	0.8	
Phenol	C6H6O	1	1	0.9	8.51
Phosphine in N2	PH3	NR	2	1.4	9.87
Photocopier Toner		NR	0.5	0.3	
Picoline, 3-	C6H7N	NR	0.9	NR	9.04
Pinene, a-	C10H16	NR	0.3	0.5	8.07
Pinene, b-	C10H16	0.38	0.4	0.4	~8
Piperylene, isomer mix	C5H8	0.76	0.7	0.6	8.6
Propane	C3H8	NR	NR	1.8	10.95
Propanol, n-	C3H8O	NR	6	1.7	10.22
Propene	C3H6	NR	1.7	NR	9.73
Propionaldehyde	C3H6O	NR	1.9	NR	9.95
Propyl acetate, n-	C5H10O2	NR	3.5	NR	10.04
Propylene oxide	C3H6O	NR	6.5	2	10.22
Propyleneimine	C3H7N	1.5	1.3	1	9
Pyridine	C5H5N	0.78	0.7	0.7	9.25
RR7300 (PGME/PGMEA)	C4H10O2/C6H12O3	NR	1.4	1	
Stoddard Solvent - see Mineral Spirits		NR	NR	NR	
Styrene	C8H8	0.45	0.4	0.4	8.43
Sulfur dioxide	SO2	NR	NR	NR	12.32
Tetrachloroethane, 1,1,1,2-	C2H2Cl4	NR	NR	1.3	~11.1
Tetrachloroethane, 1,1,2,2-	C2H2Cl4	NR	NR	0.6	~11.1
Tetraethyllead	C8H20Pb	0.4	0.3	0.2	~11.1
Tetraethyl orthosilicate	C8H20O4Si	NR	0.7	0.2	~9.8
Tetrafluoroethane, 1,1,1,2-	C2H2F4	NR	NR	NR	
Tetrafluoromethane	CF4	NR	NR	NR	>15.3
Tetrahydrofuran	C4H8O	1.9	1.7	1	9.41
Therminol		0.9	0.7	NR	
Toluene	C7H8	0.54	0.5	0.51	8.82
Tolylene-2,4-diisocyanate	C9H6N2O2	1.4	1.4	2	
Trichloroethane, 1,1,1-	C2H3Cl3	NR	NR	1	11
Trichloroethane, 1,1,2-	C2H3Cl3	NR	NR	0.9	11
Trichloroethene	C2HCl3	0.62	0.5	0.4	9.47
Trichlorotrifluoroethane, 1,1,2-	C2Cl3F3	NR	NR	NR	11.99
Triethylamine	C6H15N	NR	1.3	NR	7.5
Trifluoroethane, 1,1,2-	C2H3F3	NR	NR	34	12.9
Trimethylamine	C3H9N	NR	0.9	NR	7.82
Turpentine	C10H16	NR	0.4	NR	
Undecane	C11H24	NR	2	NR	9.56
Vinyl actetate	C4H6O2	NR	1.2	NR	9.19
Vinyl bromide	C2H3Br	NR	0.4	NR	9.8
Vinyl chloride in N2	C2H3Cl	NR	2	0.6	9.99
Vinyl-2-pyrrolidinone, 1-	C6H9NO	1	0.8	0.9	
Xylene, m-	C8H10	0.5	0.4	0.4	8.56
Xylene, o-	C8H10	0.57	0.6	0.7	8.56
Xylene, p-	C8H10	NR	0.5	0.6	8.44

Figure 35: Table of measured Compounds

12. THE FIELD SURVEY

12.1 General

Mapping the soil contaminant cloud using a regular network is the most common application of Ecoprobe 5. For this kind of survey it is recommended setting up a team of three (**operator**, **borer** and **probe carrier)** who cooperate as follows: the operator measures station number "n" while the borer is finishing boring the "n+1" borehole. At the same time the probe carrier removes the second probe from hole "n-1" and inserts it into hole "n+1", cleaning it by blowing it out while other work is going on. The probe must be inserted with minimum time-delay after the brace has been pulled out. Then the borer starts to make the "n+2" borehole. After finishing measuring the station, the operator starts **resetting** the instrument using fresh air. **The plastic tube with the dust filter has to be removed from the gas inlet of the instrument** and connected again after resetting at the next station.

- Before a full day of measurement it is necessary to fully charge the batteries. Charging is automatic and the apparatus cannot be overcharged. It is a good practice to perform this procedure overnight.

- Before starting the measurement of the locality, IR unit needs to get stabilised. Use CONTINUOUS MEASUREMENT mode for about 1 minute before switching into the measuring mode. The operator can thus avoid any incorrect readings at the first measured station.

- In spite of the fact that there is an **automatic water valve** on the probe top, **it is best to avoid inserting a sampling probe directly below water level.** If a probe is inadvertently inserted into underground water the reading will be close to zero or much lower than expected as the water valve does not allow the gas to be pumped in. The position of the sampling probe has to be vertical. It is not recommended to decline the probe since the water valve may stop the air supply and it is not designed to operate in a declined position. When surveying a potentially waterlogged terrain, use a stick to test each hole for seepage water.

- If a delicate measurement is required, the probe may not be used: only plastic tubes with a dust filter are possible. **In this case always ensure that there is no liquid in the site to be measured.**

Carefully avoid letting any liquid seep directly into the instrument's sampling aperture !! This causes serious damage to the analytical units and the warranty repair might be jeopardised. !

- Before measuring **each station, always check that air can be pumped** from the inserted sampling probe. This helps to avoid many problems in data interpretation.

- Ample time must be allowed before measurement after the sampling probe has been inserted into the sampling hole. This time interval **must be equal** for all stations of the locality. The recommended time interval is from 1 to 3 minutes, depending upon the soil structure. For very permeable soils this time interval may be shorter -- less than half a minute, for example. For semi-permeable soils and in windy weather when the hole is strongly aired, the time interval needs to be considerably longer (for example 3 minutes). In all cases the choice of the proper interval needs some field experience.

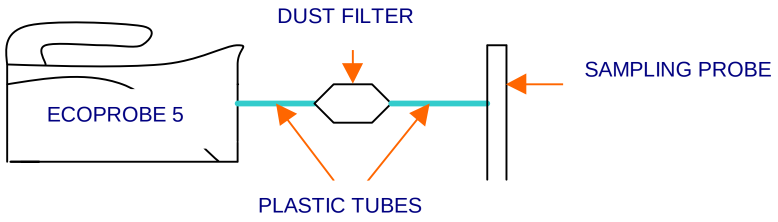
Never use the same boreholes for repeated measurement of the same station !

This can produce distorted results, especially in poorly permeable soils. The inserted probe **must allow easy pumping of the air.** If it is inserted into a tight borehole in claystones and soil sealed pumping perforation, air cannot be pumped in. The apparatus will record either no reading or a distorted value not representing the real contaminant concentration.

- If contaminants are especially designed not to create a vapour phase (for example transformer oils) or in wet claystones and other poorly penetrable soils, **measuring is very difficult**, **sometimes even impossible** and generally requires extensive experience

- Measuring below the freezing point can usually cause serious problems since the surface is covered by the frozen layer which causes homogenization of contaminant vapour concentration under the frozen "lid". This effect brings about loss of localization of contaminant sources and generally all the anomalies.

- Using dust filters considerably decreases the probability of failure of the units. Connect a piece of plastic tube to Ecoprobe 5 gas inlet. Connect the filter and then with another plastic tube connect the sampling probe.



Heavily contaminated soil vapour may leave a hydrocarbon residue in the entire system, and it is therefore advisable that the probe and its connecting tube receive special care while being cleaned.

Cleaning the probe

The sampling probe must be cleaned after measuring each station to remove all residual gas and condensation from the inside. This is usually the responsibility of the probe's carrier. Cleaning should be carried out using fresh, non-polluted air in a flow direction equal to the sampling. The higher the concentration and the heavier the hydrocarbons at the previous station, the higher will be the volume of air needed to be pumped in. The probe cleaning can be minimized in case of soil gas containing contaminants originally in gas phase (for instance methane). On the contrary soil gas containing intensive vapours of heavy oils demands greater volume of cleaning air, for instance 2 litres. Cleaning air can be blow through by means of a manual pumping device for rubber mattresses (do not blow **into** the sampling probe with your mouth as it may moisten it and thus cause incorrect outputs). Attention needs to be paid to the sampling apertures at the bottom of the sampling probe. From time to time these need to be cleaned of residual contaminated soil.
In contaminated localities there may be a certain layer of contaminant at the underground water level. If the sampling probe is inserted into such environment, it become very contaminated. In order to avoid false readings, clean out the pumping inlet immediately by means of a **strong** detergent for very dirty dishes (Fairy Ultra detergent is mostly used in Europe) and clean water for rinsing. Do not use organic based diluents as they causes residual outputs.

Connecting tubes

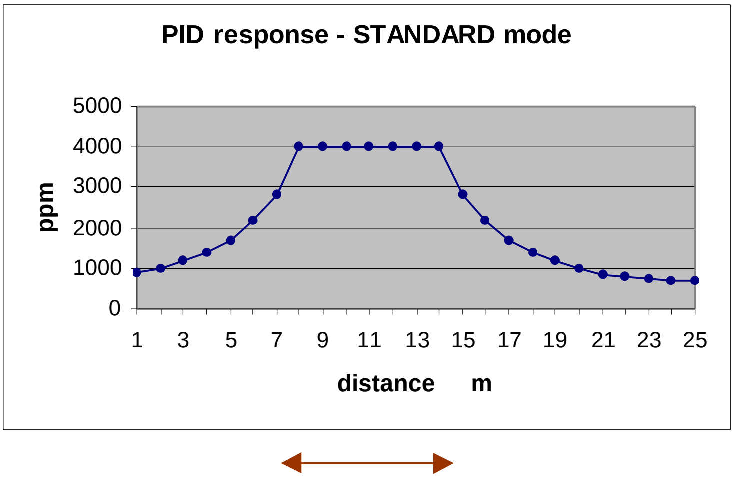
Special care is needed with the plastic connecting tubes between the probe and apparatus. There is an effect of diffusion of hydrocarbons into the mass of the plastic. The quality of the plastic materials varies. If the concentration at the previous measured station was higher than 10 000 ppm, there will be some tens or hundreds of ppm residue from the plastic tube of average quality on the next reading. The worst type, however, is the soft white silicon tube, while the best are transparent colourless or blue or slightly green plastic tubes intended for medical purposes (**Tygon** mark tubes are highly recommended). All black rubber tubes are to be avoided.
Careful cleaning of the tubes together with the sampling probe is recommended. When measuring a delicate locality with dramatic shifts between very high and very low concentrations from one station to another, the best solution is to use a set of tubes whose number is equal to the expected number of stations to be measured within one day. At each station a cleaned tube is to be applied. Used tubes usually self-clean if placed on a room heater overnight. The next day they are ready to use again.

Always clean the unit after a full day of measurement by starting CONTINUOUS MEASUREMENT with no tube connected to the gas inlet of the instrument.

12.2 How to interpret a photoionization breakdown phenomenon of the PID unit in the field:

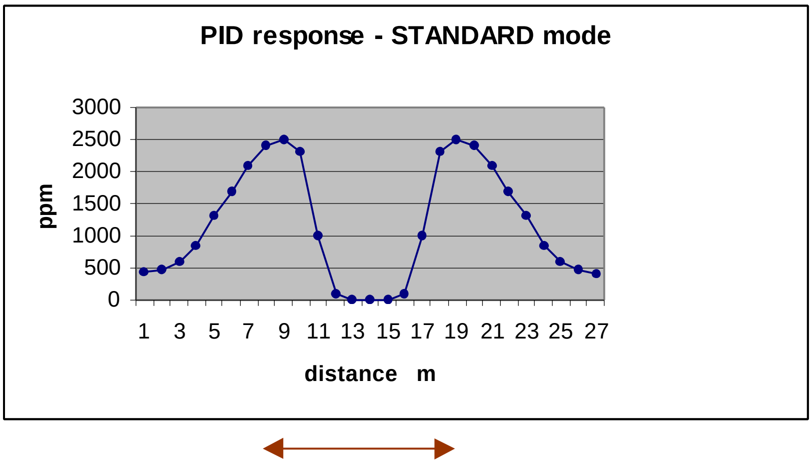
For a concentration higher than a given limit the ionization process will breakdown. Further increase of concentration may even lead to the decay of output. The average value of photoionisation breakdown limit is around 4000 ppm and this value varies for different spectral compounds.

STANDARD mode: In many cases the concentration exceeding photoinisation breakdown limit is indicated by the message “over” displayed on the instrument screen and the longest possible line in the graph is associated with each measured concentration higher than this limit (Figure 36). This indication **is not always** valid. Depending on different conditions (particular compounds, the speed of photoionisation breakdown process, amount of concentration) the output may also show a low “breakdown” value (hundreds of ppm) for concentration higher than photoionisation breakdown limit (Figure 37).



Localisation of the highest contaminant concentration

Figure 36: Response of PID unit to rising concentration of contaminant for STANDARD mode (valid for most contaminants)



Localisation of the highest contaminant concentration

Figure 37: Response of PID unit to rising concentration of contaminant for STANDARD mode (valid for some contaminants)

For **HISENS** mode the instrument measures up to 100 ppm and links this limit value with each measured concentration higher than this limit.
Example of a graph for HISENS mode is in Figure 38.

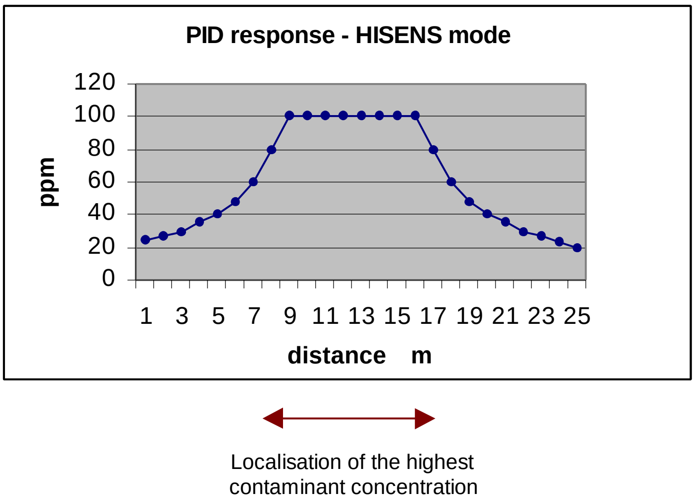


Figure 38: Response of PID unit to rising concentration of contaminant for HISENS mode

HISENS mode is extremely sensitive intended for precious measurements--for example of air pollution--where influence of other factors (moisture, tubing contaminant residuum etc.) is limited. It is recommended to use STANDARD mode for typical soil vapour survey.

12.3 Relative and absolute outputs of the PID unit

PID unit measures **total concentration** of volatile organic compounds (VOC) and other toxic gases including chlorinated hydrocarbons, selectively excluding methane from the total sum.

Relative outputs

Ecoprobe 5 enables you to map a relative concentration cloud, identifies the contaminant sources, paths and the range of contaminated area. Measuring by means of Ecoprobe 5 is simple, fast and cheap and eliminates the principle of redundant and expensive analysis of the spectrally known and almost identical samples.

Absolute outputs

PID unit is calibrated only for one calibration gas – isobuthylene. The instrument's responses to other compounds are different. Calibration procedure, however, automatically calibrates the instrument for about 200 specific compounds (see table of measured compounds in Figure 30). **This feature does not mean that Ecoprobe 5 is a spectral analyzer or a spectral-selective detector and always measures total concentration of all spectral components presented.**
The fact that Ecoprobe 5 is calibrated for many compounds can be utilized **in cases when composition of the contaminant is known**. If the contaminant consists of one **known** compound, select it (or similar compound which is chemically very close to the contaminant) in the list of measured compounds to get quantitative concentration of vapour phase.
Most contaminants consist of more spectral compounds. Typical soil vapour survey requires fast and reliable results. If the contaminant spectral characteristic and soil character is approximately equal over the given environment, results not far from quantitative values can be obtained by following next instructions: Compare several Ecoprobe 5 values with values of laboratory analyzed samples collected from the same site and set correlation coefficients for matching samples. If the correlation coefficient is approximately similar for all tested matching samples, it is possible to multiply the whole set of

Ecoprobe 5 values with the calculated coefficient to get approximately quantitative values for the given locality.
Diesel and gasoline fuels are the most common contaminants in the soil vapour survey. The list of measured compounds offers also frequent mixtures of diesel and gasoline fuels (see Table of measured compounds – Diesel fuel #1, Diesel fuel #2, Gasoline #1, Gasoline #2, Jet fuel JP-4, Jet fuel JP –5, Jet Fuel JP-8). Selecting the most suitable mixture enables you to get reliable quantitative results for the contaminated area.

For more precise quantitative results it is necessary to exactly know the weighted ratios of individual spectral components of contaminant to calculate their weighted contribution. Then choose dominant component from the contaminant spectrum and select it in the list of measured compounds in Ecoprobe 5. Concentration of all components may be later calculated for all measured values of the locality according to the weighted scheme to achieve the absolute concentration results. The spectral characteristic of contaminant must be homogenous over the whole locality, e.g. the ratio of volumes of individual spectral components is approximately equal and also the soil character of given environment must be of the same composition.

Note: Use Ecoprobe 5 as a sophisticated sampling device! Connect the absorbent cartridge to the instrument ***outlet****. You can preset pumping speed and observe other parameters on the instrument screen during the sampling interval.*

NEW !!

This instrument's new feature offers on-line data transfer from Ecoprobe 5 to the computer while measuring in any mode (standard measuring mode, monitoring station mode or continuous measurement mode).
For recording data in this way it is necessary to purchase an optional special software. The software enables you to overview measured data on the computer screen at a rate of one line per second. Each line contains the following information:

PID concentration	IR Methane concentration	IR Total Petroleum concentration	IR CO2 concentration

All data can be stored on the computer disc. More information is contained in the communication software manual.

For establishing communication for short distances (up to 40 meters), connect Ecoprobe 5 with the appropriate cable to the standard computer serial port RS 232.
For long-distance data transfer (up to 3 km) the manufacturer provides optional serial adapter RS 232 to RS 488.
For distances above 3 km, Ericsson or Siemens GSM Radio Communication Modul can be provided.

13. GENERAL

13.1 Power supply

Use system Ecoprobe 5 charger or any DC power source ranging from 4Volts/5 A to 24 Volts / 0.5 A to charge or continuously supply the unit. After charge the instrument will automatically switch to the supply mode. Continuous supply is utilized when the MONITOR mode is intended for consecutive use (for example monitoring station). You can also use solar batteries to charge/supply the unit. Using a car cigarette lighter socket for charging the instrument is also possible. Ask your agent for details.

When the battery is considerably weak, the message ATTENTION WEAK BATTERY will be displayed at the end of the resetting period. It is possible to measure about 10 more stations. The same message will appear at the end of each resetting period until the new message ATTENTION DEAD BATTERY is displayed. The instrument will not allowed measuring the next station. Press **?** to return to the Main Menu. Charge the battery by connecting the charger to the multifunctional connector in front of the instrument.

Charging time depends basically on the power capabilities of the DC source. System charger will charge the internal battery to the full condition within about 2-4 hours Charging mode is indicated by flashing of the red light. When charging is finished, the instrument will switch to the supply mode. The red light in the IR window lights continuously.

A fully charged battery pack can power Ecoprobe 5 for full day's soil vapour investigation. Boosting the battery over lunch or during an extended break is, however, advisable. An overnight charge will restore the battery to full capacity. Current consumption can be reduced by selecting only the necessary analytical systems. During extended storage, the battery should be charged every two to three weeks.

13.2 Warranty

Abuse and mishandling are excluded from the warranty that covers the instrument and original accessories for twelve (12) months against faulty workmanship and defective components Ecoprobe 5 **contains no operator serviceable units or parts**, and any unauthorised attempt to open the instrument will invalidate the warranty. Damages to the instrument caused by unqualified operation of the instrument or using the instrument for purposes not specified in the operator's manual without prior consultations with the manufacturer will also cancel the warranty.

13.3 Troubleshooting

If the system hangs and stops responding press three buttons on the display panel – ESC, LIGHT and RUN at the same time. Ecoprobe 5 will switch off. Press ON/OFF button to start again and reboot the instrument.

13.4 Important notes

- NEWER allow water or dust to be suck inside the unit !
- Use standard gas filters (consumables) sold at petrol stations while measuring.
- Using the IR unit ON, newer set the resetting interval shorter then 10 seconds. AUT zero mode or more then 20 seconds fixed zero interval is recommended time for proper operation
- Always clean the unit after the use by starting Continuous measurement with no gas inserted.
- Do not use the display backlight if not necessary. It noticeably discharges the instrument battery.
- Charge the instrument battery regularly even if not in use. Proper interval – 3 weeks.

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