SYSCAL KID
&
SYSCAL KID *SWITCH-24*

Compact resistivity-meters
Multi-Electrode switching system (Switch-24 model)

Operating manual

June 2001

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I. GENERALITIES

The Syscal KID is an equipment designed for environment applications. Lightweight (3 kg), totally automatic and cost effective, it's a exploration tool particularly adapted for shallow electrical surveys (archaeological, geological mapping and civil engineering applications).

Its outputs characteristics are the following ones:

- **200 V maximum output voltage**
- **25 W maximum output power**
- **500 mA maximum output current**

The output voltage is chosen automatically in relation with the level of the measured signal.

I.1. Front panel

The front panel of the Syscal KID is composed of:

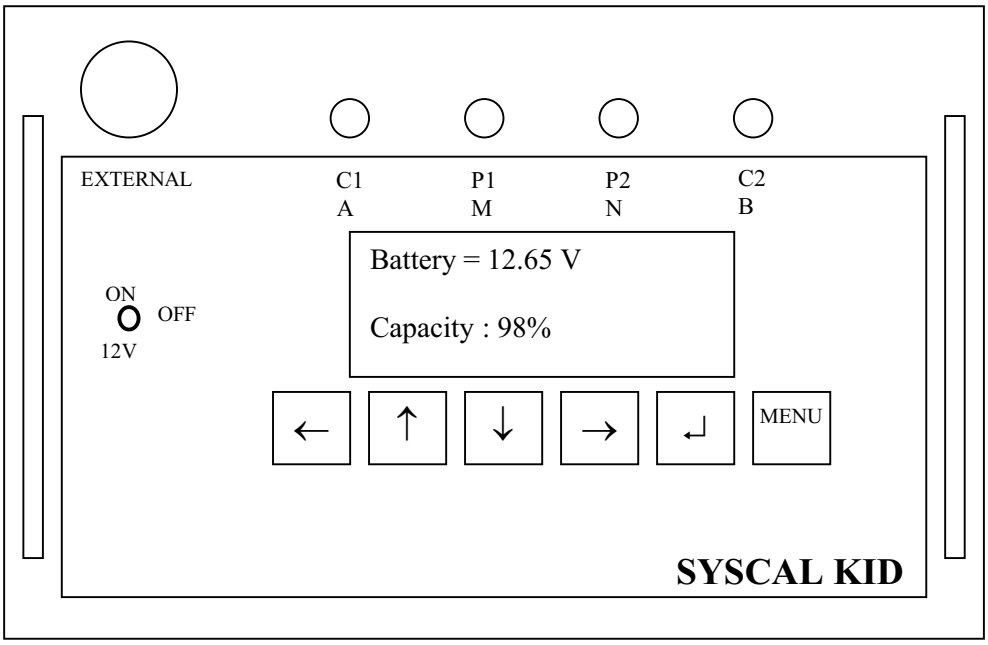
- A very simplify keyboard (6 function keys) and a LCD screen of 4 lines of 20 characters.

- 4 plugs to connect the cables coming from the electrodes, in standard mode.

- A 7 socket connector providing three functions:
  - Supply the resistivity meter by an external 12V battery
  - Transfer the data to a PC
  - Recharge the internal battery

- A switch allowing to turn on the unit (ON), to turn it off (OFF) or to set the instrument in the external supply mode (12V).

- The Syscal KID *Switch-24* has more on the backside two connectors for the electrode strings connection to work in Multi-Electrode mode (Cf. Annex. 3).



I.2. Keys definition

←	: to move in an option towards the left : to erase some numerical inputs
↑	: to go up in a menu : to go up in ranges (numeric and alpha)
↓	: to go down in the menu : to go down in ranges (numeric and alpha)
→	: to move in a option towards the right
↵	: to validate an input or a selected option : to stop a measurement
MENU	: to come back whenever you want to the main menu

I.3. Supplying

The Syscal KID has an internal rechargeable Ni-Cd battery.
Its characteristics are 12 V – 2 Ah (autonomy of 1000 readings typ.).
This battery has to be charged with the charger supplied, which has to be connected to the "EXTERNAL" connector of the front panel.

It can also be supplied by an external standard car type battery (12V – 40 Ah) if you need to carry out some intensive measurements.

I.4. Technical characteristics

- Input voltage:
  - Range: -2.5 V to +2.5 V
  - Protection up to 200V
- Input impedance: 22MΩ
- Resistivity:
  - Range: 10^{-3} Ωm to 10^{5} Ωm
  - Accuracy: 1% typ.
- SP compensation including linear drift
- Quality control on the measurement through standard deviation and number of stacks
- Display and storage (1828 measuring points) of measured voltage, intensity of current, apparent resistivity and self potential
- Temperature range: -10 °C to 50 °C

II. OPERATING

<u>Notes about the serial link</u>:
- You mustn't connect the serial link cable during a measurement.
- The Syscal KID has to be switched on before connecting the serial link cable for data transfer.

When you switch on the unit, the resistivity meter will show the value either of the internal battery or of the external one (relative to the one that is being used):

```
Battery = 12.65 V

Capacity : 98%
```

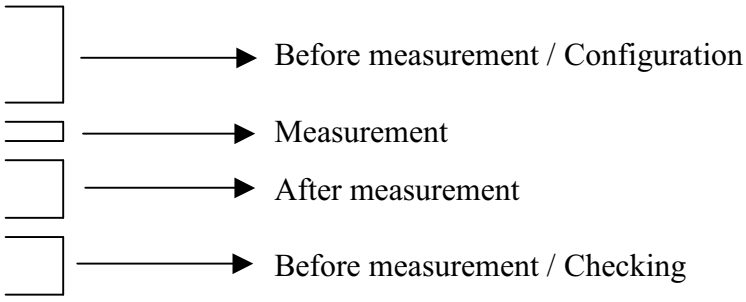
After a while, the following display will be:

```
* - Menu  - - -  V2.2a   - *
   El. Array              ▸
→ Spacing…
   Start
```

The Syscal KID shows then the options of the main menu that can be visualized thanks to the (↑) and (↓) keys.

This main menu owns 8 functions:

- Set-up…
- El. Array
- Spacing…
- Start
- Result
- Memory
- Monitor
- Clock…



<u>Note</u>:
At the "El. Array" and "Memory" lines, a small prompt (▸) is present to indicate that to this option will be associated another menu.

II.1. Before measurement

II.1.1. "Set-up" function

This function allows to introduce the parameters of the recording.

The first display is the following one (for the *Switch-24* model*)*:

```
* ------ Time ------ *
    Short
→   Standard
    IP Mode
```

This menu allows to select the injection time.

- **Short**: Pulse: about 1 second (injection cycle: about 2 second). Mode to use in good field conditions (good contact between the metallic stakes and the ground – stable values – no Sp variations,…).
- Standard: Pulse: about 2 seconds (injection cycle: about 4 seconds).
Mode generally used for resistivity measurement (its a good compromise between the quality of the data and the acquisition time).
- **IP mode**: Pulse: about 2 seconds (injection cycle: about 8 seconds).
This mode requires a long injection time in order to give to the measuring circuit a time sufficiently long to measure precisely the relaxation curve (Chargeability / Cf. Annex. 2).

Note:
For the SET-UP menu of the Syscal KID model, the display will be successively the following ones:
*- **Raw value**: Choose "Yes" to display both the instantaneous and the average values ("No" to display only average values)*
*- **Manual HT**: Choose "No" if you want the unit selects automatically the injection voltage range (defined in regards to the Vmn signal level measured)*
*- **Long time HT**: Choose "Yes" for a 2 seconds injection cycle ("No" for 1 second)*
*- **Mode PP**: Choose "Yes" to measure both the resistivity and the chargeability (Induced polarization) ("No" for only resistivity measurements)*

Then, press the (↵) key:

```
stack max  # :   10
stack min  # :   3
q max : 3
```

These parameters will allow to control the quality of the data:
- **Stack max**: maximal number of stacking per quadripole
- **Stack min**: minimal number of stacking per quadripole
- **q max**: quality factor (standard deviation of V/I), in %

Explanation:
The minimum stacking number per quadripole is: Stack min
When the Stack min is reached:
- if q ≤ q max then, the stacking process stops.
- if q ≥ q max then, the stacking process goes on until q ≤ q max or until the maximum number of stacks is reached (Stack max).

For each parameter to define, follow the procedure described above:

- Press one of the four directional keys
- Introduce the first digit thanks to the (↑) and (↓) keys: You'll have here only access to the numerical inputs.
- Press the (→) key if you wish to introduce a second digit and use in the same way that previously the (↑) and (↓) keys.
- At the end, validate with the (↵) key

II.1.2. "El. Array" function

After having selected the set-up parameters, the electrode array has to be specified.
The "**El. Array**" function will allow to choose an array among the following ones:

✓ Dipole Dipole
✓ Pole Pole
✓ Pole Dipole
✓ Grad. RCTGL
✓ Schlum. VES
✓ Schlum. PRF
✓ Wenner VES
✓ Wenner PRF
✓ Hole surf.
✓ Dip. dip. switch
✓ Pole dipole switch
✓ Pole pole switch
✓ Wenner PRF switch
✓ Other

Multi-Electrode sequences / Only for the *Switch-24*

Some of them will generate some measurements in standard mode and some others, in Multi-Electrode mode.
Please refer to the Annex 1 for the various electrode arrays definition.

Once you selected an electrode array, you'll have to define the geometrical parameters (Cf. § II.1.2).

II.1.3. "Spacing" function

This function allows to introduce the geometrical parameters corresponding to the electrode array previously chosen.

For each parameter to define, follow the procedure described above:

- Press one of the four directional keys
- Introduce the first digit thanks to the (↑) and (↓) keys: You'll have here only access to the numerical inputs.
- Press the (→) key if you wish to introduce a second digit and use in the same way that previously the (↑) and (↓) keys.
- To validate each number introduced, use the (↵) key: you'll have access then to the following geometrical parameter, and so on…

After having defined the whole parameters required, you'll automatically go back to the main menu.

Please refer to the Annex 1 for the "Parameters / Electrode array" correspondence and the Annex 3 if you want to work in one of the Multi-Electrode switching modes.

II.1.4. "Clock" function

Before running a measurement and so realize some data storage, it's advised for practise, to check the internal clock of your Syscal KID.
You'll have here the possibility to introduce the correct date/time. This will be recalled in the display of the "**Result**" function.

```
Clock
      14 June 1999
         13 : 35
```

If you want to introduce some modifications, press one of the four directional keys.

• The program offers then to enter the current year.
Procedure to follow:
- Press again one of the four directional keys to set your cursor under the first digit
- Press the (↑) and (↓) keys to go up and down in the numeric range
- Press the (→) key if you wish to introduce the second digit and use in the same way that previously the (↑) and (↓) keys.
- And so on…
- At the end, validate by the (↵) key

• Then, enter the current month and validate by the (↵) key
• At last, enter the current day and validate by the (↵) key

A new screen will appear:
Then, enter the current time (hour/minutes) and validate by the (↵) key.

Now, the internal clock of your Syscal KID is on time and you automatically go back to the main menu.

II.1.5. "Monitor" function

Finally, after having configured the measurement, you have the possibility, thanks to the "**Monitor**" function, to control the instantaneous "ambient noise" measured by the voltage circuitry (between the electrodes M,N). This is an advised checking before running a measurement. The display is the following one:

```
Processing
V      =     0.29 mV
Offset   :   <↵ >
```

This value is continually updated and permits to check the noise level and the spontaneous polarization (Sp) variations. By pressing the (↵) key, the relative value (Offset) will be displayed, that is to say the difference between the observed voltage and the reference value.

Press the (MENU) key to come back to the main menu.

II.2. Measurement / "Start" function

This function has to be used to run the measurement.

Warning:
If no data are present in the memory, after the Start function validation, the program will ask you automatically to enter a filename.

However, if some directories are already present in the memory, don't forget to create, before running an acquisition, a new directory (Cf. § II.3.2.2) in which the next data will be stored (if not, they will be stored in the latest directory): this can be useful particularly in Multi-Electrode mode (Switch-24).

In the ***Multi-Electrode switching*** *mode (Switch-24)*:
Just after having selected the "**Start**" function, if the spacing parameters are not coherent, a warning message will appear: "Error(s) in spacing".
Pressing the Enter (↵) key at this stage will give you access automatically to the spacing parameters (Cf. Annex 3 for the spacing parameters signification in Multi-Electrode mode).

Then, if the spacing parameters are correct, the selection of the "**Start**" function will recall the configuration you are using and pressing the Enter key one more time a resistance checking of the stakes will be run automatically. The resistance between each consecutive dipole (1-2, 2-3,…) will be tested automatically. The first display will be:

```
Check Line
1  ⇔  2
```

And so on…

Note:
If, during the process, the resistance value measured between two stakes in not correct, a warning message will appear: "Bad contact".
In that case, check the connections of the corresponding stakes and try to improve the contact between the stakes and the ground (pour some salt water if necessary).
The resistance measurement is made continuously. So, as soon as the contact has became correct, the test will go automatically on the next dipole.
If the "Bad contact" message stays on, you'll be able manually to go on the process by the Enter (↵) key.

Then, in Multi-Electrode mode, once the test has been finished, the measuring process is automatically initiated.

The resistivity meter will display then, after the voltage battery indicator, the following display (during a while):

```
Processing
Sp = 1.6
   - - -
Vcc : 0-200V
```

With

Sp : self potential before the current injection
- - - : the three first pulses before the first display of the average value of v, i and R
Vcc : injected voltage between the current electrodes (A,B)

And, after the three first pulses, the measurements will be displayed in real time:

```
V  = 105.65      v = 104.12
I  =   6.43      i =   6.43
R  = 412.73      q =   0.2
M  =   8.10            # 1
```

With

V : average measured voltage between the potential electrodes (M,N) in mV
v : instantaneous (raw) voltage measured between the potential electrodes (M,N), in mV
I : average injected current between the current electrodes (A,B), in mA
i : instantaneous (raw) current measured between the current electrodes (A,B), in mA
R : computed resistivity, in Ohm.m (see Annex 1 for the resistivity definition)
q : quality factor (standard deviation of V/I), in %
M : global chargeability, in $mV.V^{-1}$
\# : running stacks number

Note:
- If you are not working in IP mode (Cf. § II.1.1), the global chargeability (denoted M) won't obviously be displayed (Cf. Annex 2 for the chargeability definition).
- If you are working in Multi-Electrode switching mode (*Switch-24*), between each quadripole of measurement, before displaying the measurement in real time, it will appear another display (during a while):

```
Quadripole 1/60
A1 B2 M3 N4

XC = 1.0        XP = 2.0
```

And so, at the end of the measuring process (number of stacks reached), the display will be:

```
V  = 104.66        v = 105.55
I  =    6.43       i =    6.43
R  = 409.05        q =    0.2
Save Yes : ↵     No : MENU
```

So, at this stage, press the (↵) key to save the previous measurement or the (MENU) key to come back to the original menu without saving the data.
Choosing "Yes", the next display will be:

```
 Data   stored   at
    14 June 1999      15 : 35
```

Note:
In Multi-Electrode switching mode (*Switch-24*):
- The data are automatically stored in the memory.
- If you stop the measurement before the end of the sequence, the program will offer to save the measurements. In that case, after having stored them, the program will automatically re-start the sequence on the next quadripole.

II.3. After measurement

II.3.1. "Result" function

Option not available in Multi-Electrode mode (*Switch-24*).
This option allows to visualize the results (and the geometrical parameters) of the latest measuring point (even if it hasn't been stored in the memory):

```
SP   =     1.6  mV
Vpp  =   104.66  mV
Icc  =     6.43  mA
M    =     8.10  mV/V  ▸
```

(↵) key:

```
Dipole Dipole
Rho   =   409.05  ohm.m
q     =       0.2  %
                    ▸
```

(↵) key:

```
XC   =  1.00  m
XP   =  2.00  m
D    =  1.00  m
Line =  1.00  m
```

Pressing the Enter key one more time, you'll go back to the original menu.

II.3.2. "Memory" function

The choice of this function will give access to another menu having 6 options:

- Directory
- New…
- Read…
- Transfer…
- Delete…
- Format…

Note:
At the "Transfer" line, a small prompt (▸) is present to indicate that to this option will be associated another menu.

II.3.2.1. "Directory" option

Option allowing to see the number of directories (sets of measuring points) present in the memory.
The free memory size is also indicated (1828 measuring points max).

```
File :   5
Free memory :
1234 / 1828
```

The (↵) key will allow to visualize the name, the size (number of measuring points) and the creation date of the first directory and so on:

```
File :  test
Size :  12
Date
14 June 1999
```

Size: number of measuring points in the corresponding data file.

II.3.2.2. “New” option

Option allowing to create a directory in which the next measuring points will be stored.
If you select the "**Start**" function without creating a new directory between some measuring points, all of them will be stored in the same data file (directory).

<u>Note</u>:
Between different survey lines, don’t forget to use this function between each of them if you want to create one data file per survey (if not, all the measuring points will be stored in the same data file (directory)).

```
Enter    filename  ?
```

To introduce a number, follow the procedure described in § II.1.1.

II.3.2.3. “Read” option

Option allowing to read a data file with its various measuring points:

```
Enter    filename  ?
```

To introduce a number, follow the procedure described in § II.1.1.
After having introduced a directory number, the display will be:

```
storage : 1
     dated
14 June 1999        11 : 45
```

The (↵) key allows to have access to the same displays that the ones shown in the "**Result**" function (Cf. § II.3.1). If several storage (measuring points) are present, you will be able to read them successively (thanks to the (↵) key).

II.3.2.4. “Transfer” option

Note:
Before connecting the serial link cable between the Syscal KID and the PC, the resistivity meter has to be switched on.
This option allows to transfer the data files to your PC:

```
Enter    filename  ?
```

Once a data file present in the directory has been introduced, the display will be:

```
* * * * * * * * * * * * * * *
*          Transfer         *
*       in progress …       *
* * * * * * * * * * * * * * *
```

Please refer to the § III. for the PC transfer software procedure.

II.3.2.5. “Delete” option

Option allowing to erase a directory to specify:

```
Enter    filename  ?
```

After having introduce its name, validate by the (↵) key.

II.3.2.6. “Format” option

This option has to be used if you need to re-initialize the Syscal KID. Be careful, the memory will be totally erased.

III. DATA TRANSFER AND MANAGING PROGRAM

For the Syscal KID and for the Syscal KID *Switch-24*, the PC software required for data transfer is PROSYS. This software allows to transfer, process and export the data acquired in the field. It has been developed under 32 bits version (Windows® 95/98/Me/NT).

The program is supplied on a CD-ROM. To install it, you have just to insert the CD in your PC and then run the "PROSYS" installation.

The program will offer then to install the software in a default directory (which can be modified):
[C:\Program Files\Iris Instruments\Prosys]

Once the installation process has been finished, run the program clicking on the "Prosys.exe" file or on the icon.
The master window of the program will appears then with the following menu bar:

This Program owns an Help file that will support in your various tasks.

To transfer the data from the Syscal KID or the Syscal KID Switch-24, follow the procedure:

☛ Choose first in the program the communication port in the "**Communication|Communication port**" option.

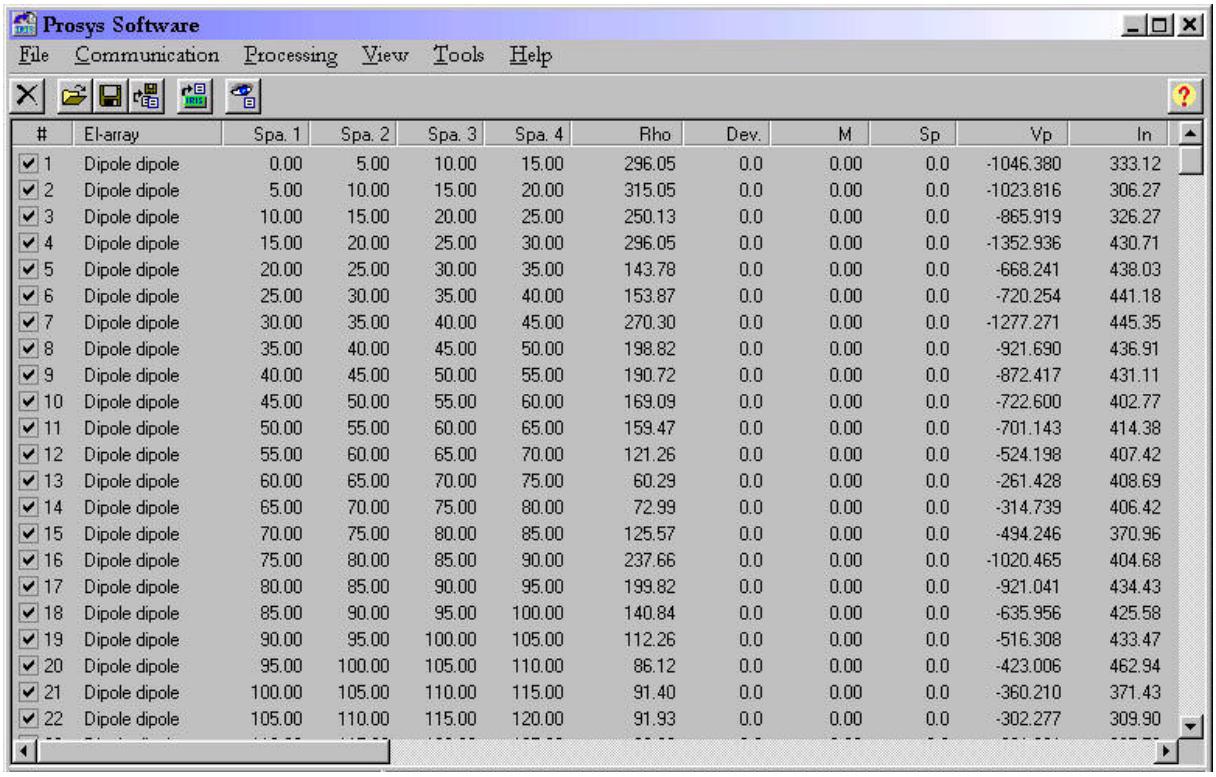
☛ Select then the "**Communication|Data download|Syscal KID**" option or the "**Communication|Data download|Syscal KID Switch**" option**.**

☛ Then, follow the indications given by the program.

During the transfer, a bar graph in PROSYS and a message on the Syscal will indicate the progress.

Once the transfer has been finished, the programs asks then to introduce a data file name in which the data will be stored. This file will have the ".bin" extension.

Then, after validation, the data will be directly displayed in the master window of the program (the next window shows an example of such a file).



Prosys Software

File Communication Processing View Tools Help

#	El-array	Spa. 1	Spa. 2	Spa. 3	Spa. 4	Rho	Dev.	M	Sp	Vp	In
1	Dipole dipole	0.00	5.00	10.00	15.00	296.05	0.0	0.00	0.0	-1046.380	333.12
2	Dipole dipole	5.00	10.00	15.00	20.00	315.05	0.0	0.00	0.0	-1023.816	306.27
3	Dipole dipole	10.00	15.00	20.00	25.00	250.13	0.0	0.00	0.0	-865.919	326.27
4	Dipole dipole	15.00	20.00	25.00	30.00	296.05	0.0	0.00	0.0	-1352.936	430.71
5	Dipole dipole	20.00	25.00	30.00	35.00	143.78	0.0	0.00	0.0	-668.241	438.03
6	Dipole dipole	25.00	30.00	35.00	40.00	153.87	0.0	0.00	0.0	-720.254	441.18
7	Dipole dipole	30.00	35.00	40.00	45.00	270.30	0.0	0.00	0.0	-1277.271	445.35
8	Dipole dipole	35.00	40.00	45.00	50.00	198.82	0.0	0.00	0.0	-921.690	436.91
9	Dipole dipole	40.00	45.00	50.00	55.00	190.72	0.0	0.00	0.0	-872.417	431.11
10	Dipole dipole	45.00	50.00	55.00	60.00	169.09	0.0	0.00	0.0	-722.600	402.77
11	Dipole dipole	50.00	55.00	60.00	65.00	159.47	0.0	0.00	0.0	-701.143	414.38
12	Dipole dipole	55.00	60.00	65.00	70.00	121.26	0.0	0.00	0.0	-524.198	407.42
13	Dipole dipole	60.00	65.00	70.00	75.00	60.29	0.0	0.00	0.0	-261.428	408.69
14	Dipole dipole	65.00	70.00	75.00	80.00	72.99	0.0	0.00	0.0	-314.739	406.42
15	Dipole dipole	70.00	75.00	80.00	85.00	125.57	0.0	0.00	0.0	-494.246	370.96
16	Dipole dipole	75.00	80.00	85.00	90.00	237.66	0.0	0.00	0.0	-1020.465	404.68
17	Dipole dipole	80.00	85.00	90.00	95.00	199.82	0.0	0.00	0.0	-921.041	434.43
18	Dipole dipole	85.00	90.00	95.00	100.00	140.84	0.0	0.00	0.0	-635.956	425.58
19	Dipole dipole	90.00	95.00	100.00	105.00	112.26	0.0	0.00	0.0	-516.308	433.47
20	Dipole dipole	95.00	100.00	105.00	110.00	86.12	0.0	0.00	0.0	-423.006	462.94
21	Dipole dipole	100.00	105.00	110.00	115.00	91.40	0.0	0.00	0.0	-360.210	371.43
22	Dipole dipole	105.00	110.00	115.00	120.00	91.93	0.0	0.00	0.0	-302.277	309.90

Once a transfer has been made, you'll be able to manage the data, under the software, with the main following possibilities:

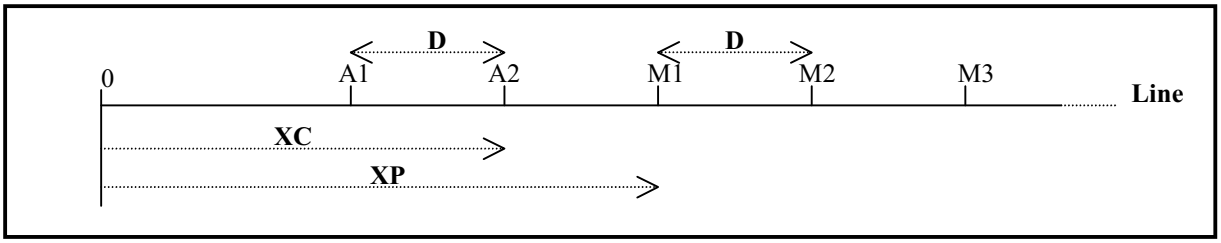
- Data filtering
- Topography insertion
- Data printing
- Data export in various format ("text" file for further spreadsheet presentation – "data" file for the standard interpretation software).

Note:
Please consult the Help file of the program for further details.

ANNEX 1: ELECTRODE ARRAYS

Note:
The Dipole-Dipole, Pole-dipole and Pole-Pole arrays are described in the Multi-Electrode switching mode (AiMi instead of ABMN in standard mode).

→ Dip. Dip.

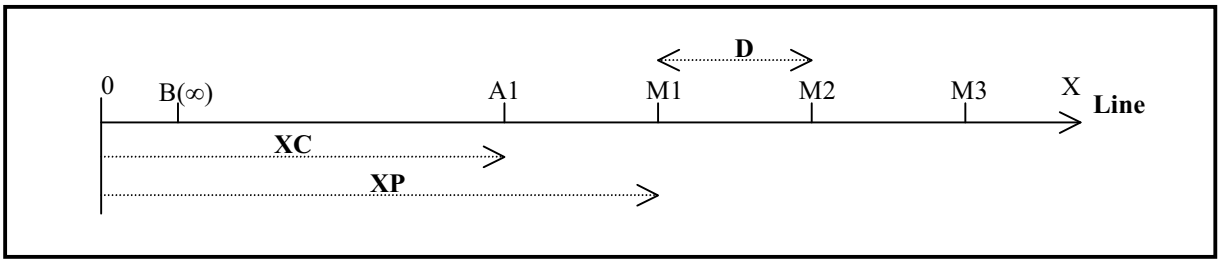


- **XC** : abscissa of the nearest current electrode from the M1M2 dipole
- **XP** : abscissa of the nearest potential electrode from the A1A2 dipole
- **D** : length of dipoles (current and potential):
  |D| = |A1A2| = |M1M2| = |MiMi+1|
  : shift of the array
- **Line** : number allowing a distinction between different survey lines

By setting n_i.D as the distance between the midpoints of the dipoles A1A2 and MiMi+1, one obtains:

$K_i = \pi.n_i.D.(n_i^2-1)$

→ Pole-Dipole



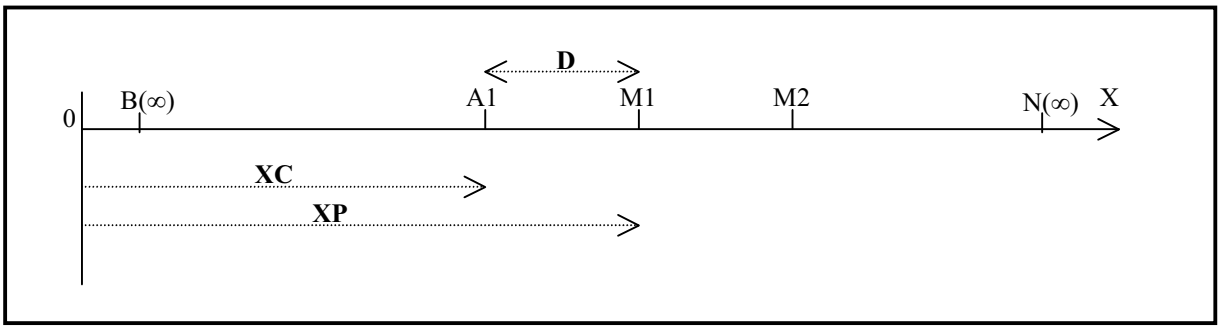
The current electrode B has to be placed sufficiently far from the other electrodes to be able to ignore $(BM1)^{-1}$:

- **XC** : abscissa of the nearest current electrode from the M1M2 dipole
- **XP** : abscissa of the nearest potential electrode from the A1 electrode
- **D** : length of potential dipoles:
  |D| = |M1M2| = |MiMi+1|
  : shift of the array
- **Line** : number allowing a distinction between different survey lines

$K_i = 2\pi/((A1Mi)^{-1}-(A1Mi+1)^{-1})$

→ **Pole-Pole**

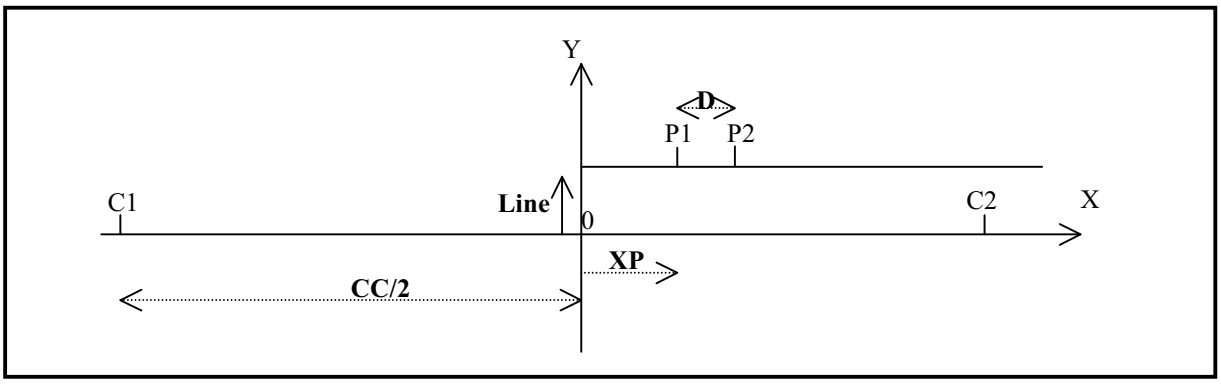
The electrodes B and N have to be placed sufficiently far from A1 and M1 to be able to ignore $(A1B)^{-1}$,$(BM1)^{-1}$ and $(A1N)^{-1}$.



- **XC** : abscissa of the nearest current electrode from the M1 electrode
- **XP** : abscissa of the nearest potential electrode from the A1 electrode
- **D** : distance between the electrodes:
  |D| = |A1M1| = |M1M2| = |MiMi+1|
  : shift of the array
- **Line** : number allowing a distinction between different survey lines

$K_i = 2\pi/((A1Mi)^{-1})$

→ **Grad. RCTGL** (Gradient rectangle)



In this array, the C1C2 electrodes are fixed and the potential electrodes are moved parallel to the C1C2 line inside a zone located in the central part of C1C2. This array serves to observe variations in resistivity on a surface for a relatively high investigation depth without the need to move the current electrodes.

- **XP** : abscissa of M, the origin 0 being the middle of C1C2 and the abscissa axis 0X being the C1C2 line
- **Line** : ordinate of the potential electrodes
- **D** : length of the potential dipoles:
  |D| = |P1P2|
- **CC/2** : half-distance between the current electrodes

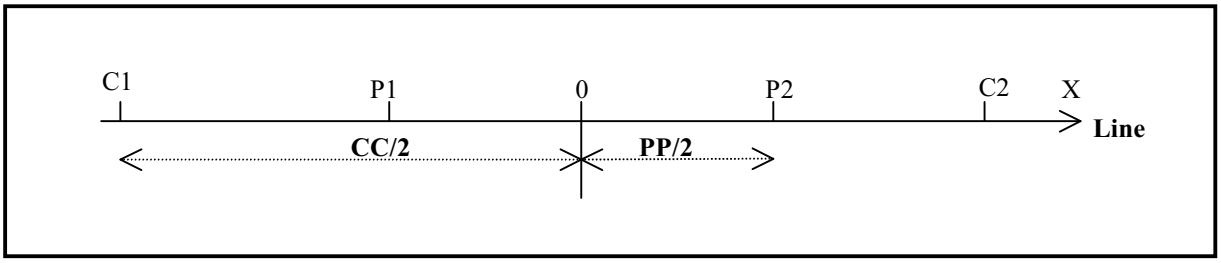
$K = 2\pi/|(AM)^{-1}-(AN)^{-1}-(BM)^{-1}+(BN)^{-1}|$

with

$C1P1 = [(XP+a)^2+Line^2]^{½}$	C1 (-a, 0)
$C1P2 = [(XP+a + D)^2+Line^2]^{½}$	C2 (+a, 0)
$C2P1 = [(XP-a)^2 +Line^2]^{½}$	P1 (XP, Line)
$C2P2 = [(XP-a+D)^2+Line^2]^{½}$	P2 (XP+D, Line)

<u>Remark</u>:
The term "Gradient" is reserved for the case in which the investigation is only performed along the C1C2 line.

→ **Schlum. VES** (Schlumberger sounding)

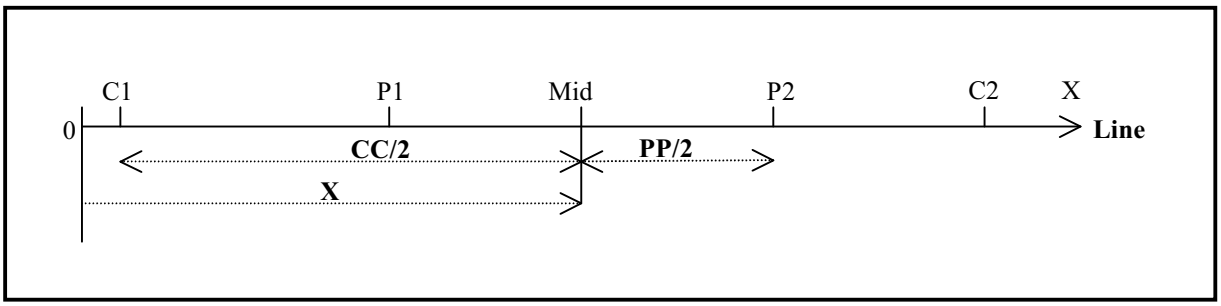


The potential electrodes P1P2 are placed symmetrically at the centre of C1C2 and the origin 0 is their common mid point.
At each measurement, the current electrodes (C1,C2) are moved of PP/2 from 0.

- **CC/2** : half-distance between the current electrodes
- **PP/2** : half-distance between the potential electrodes
- **Line** : number allowing a distinction between different survey lines
- **Opt1** : optional number

K then assumes a simplified expression:
If CC/2 > PP/2: $K = \pi.((C1P1)^{-1}-(C1P2)^{-1})$ (symmetrical array)
So, if CC/2 = a and PP/2 = b:
$K = \pi.(a^2-b^2)/2b$

→ **Schlum. PRF** (Schlumberger profiling)



The electrodes keep constant relative positions (identical to those of Schlum. VES).

- **X** : abscissa of the centre of P1P2 (Mid) (the direction being C1C2)
- **CC/2** : half-distance between the current electrodes
- **PP/2** : half-distance between the potential electrodes
- **Line** : number allowing a distinction between different survey lines

If CC/2 = a and PP/2 = b:
$K = \pi.(a^2-b^2)/2b$ (if CC/2 > PP/2).

→ **Wenner VES** (Wenner sounding)

Wenner sounding is a restriction of the Schlumberger sounding: PP = CC/3

- **CC/3** : a third of the distance between the current electrodes
- **Line** : number allowing a distinction between different survey lines
- **Opt1** : optional number
- **Opt2** : optional number

$K = 2\pi.CC/3$

→ **Wenner PRF** (Wenner profiling)

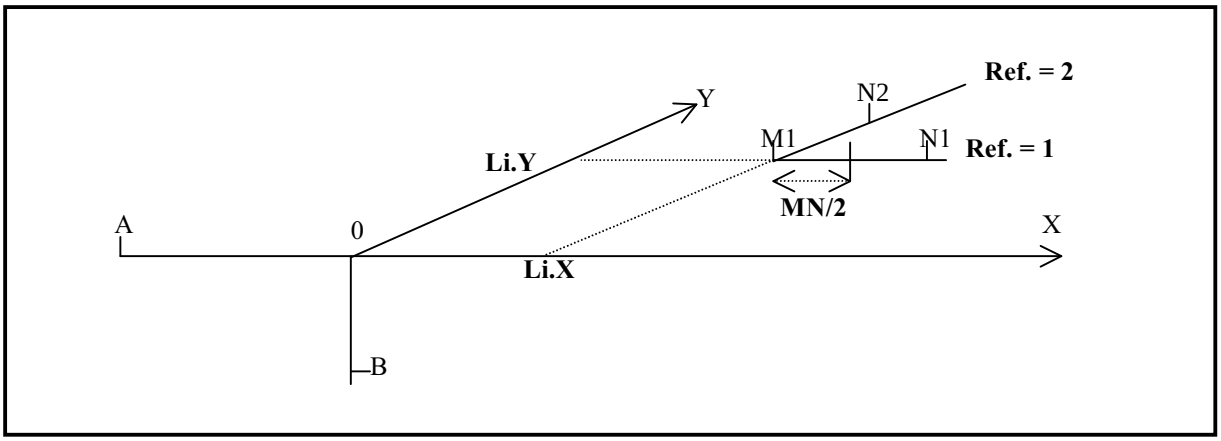
Wenner profiling is a restriction of the Schlumberger profiling: PP = CC/3

- **X** : abscissa of the centre of P1P2 (Mid) (the direction being C1C2)
- **CC/3** : a third of the distance between the current electrodes
- **Line** : number allowing a distinction between different survey lines
- **Opt1** : optional number

$K = 2\pi.CC/3$

→ **Hole surf.** (buried electrode)

Array used to determine the directions of extensions of polarizable zones.
With the electrode B lowered in a borehole and the electrode A set to infinity the potential is measured on two perpendicular dipoles with coordinates X and Y (0 being the borehole top).



- **MN/2** : half-distance between the potential electrodes
- **Ref.** : this array uses two perpendicular potential dipoles (M1N1 and M1N2) ; this parameter allows to distinguish between these ones during a storage
- **Li.X** : number in the X axis direction allowing to parameter the common point M1 of the potential dipoles M1N1 and M1N2
- **Li.Y** : number in the Y axis direction allowing to parameter the common point M1 of the potential dipoles M1N1 and M1N2

In this configuration the value of K is taken arbitrarily at 1000.

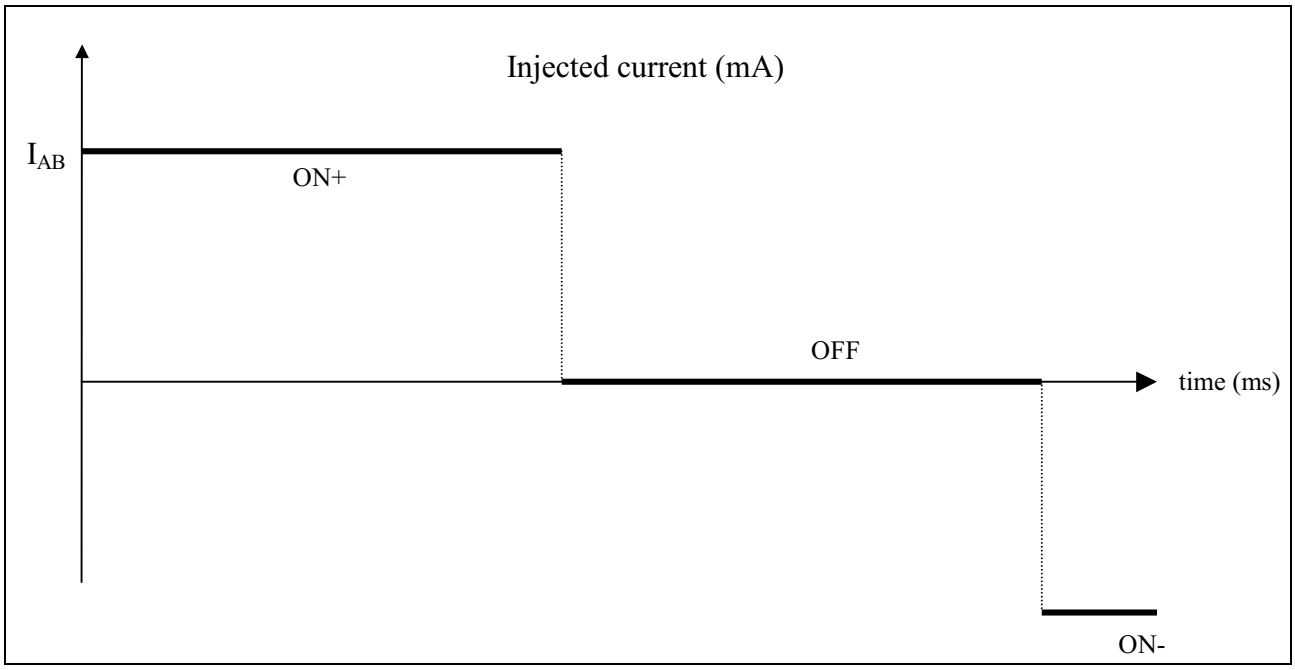
→ **Other**

This array has to be chosen to define a user specific configuration.
- **K** : geometrical parameter to define
- **Opt1** : optional number
- **Opt2** : optional number
- **Opt3** : optional number

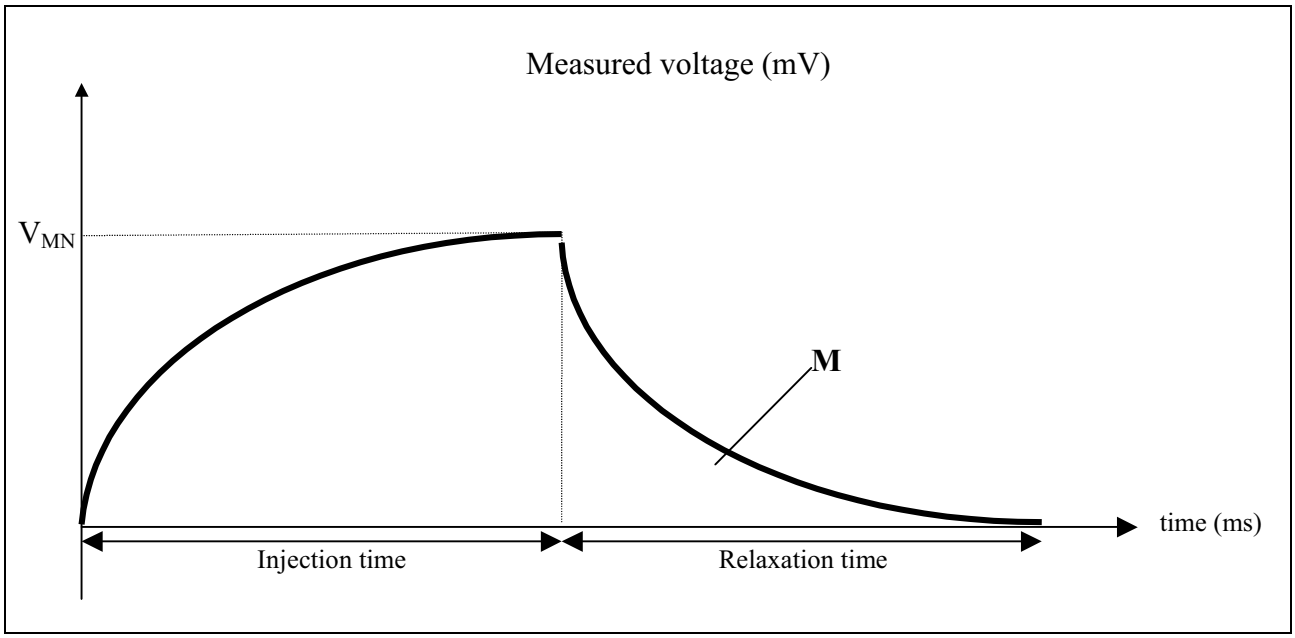
ANNEX 2: IP PARAMETER

The global chargeability measurement (M) give us information regarding the ability of the ground to charge itself due to a current flow.

- The waveform of the current injection is: ON+, OFF, ON-, OFF, ON+,…



- The discharge phenomena observed during the relaxation time can be described according to the following curve:



The resistivity is computed during the ON time thanks to the measured primary voltage V_{MN} established during the current sending whereas the chargeability (area under the relaxation curve) is measured during the OFF time (unity in mV/V).

ANNEX 3: MULTI-ELECTRODE MODE – *Switch-24* model

A specific Multi-Electrode switching system has been designed for the Syscal KID resistivity meter (Syscal KID *Switch-24*). This one allows to carry out very quickly some automatic measurements thanks to an internal switching board driving a network of electrodes (nodes).

The Syscal KID *switch-24* has two outputs located on the backside to allow the connection of two electrode strings.

To work in the Multi-Electrode mode, you have to follow the procedure:

☛ Connect the electrode string(s) to the Syscal KID outputs

☛ Make contact between each take out to of the string(s) to a metallic stake (thanks to a small clip cable)

☛ Select the configuration parameters in the **Configuration** menu

☛ Select one of the two following arrays in the **El. array** menu:
- Dip. dip. switch
- Pole Dipole switch
- Pole Pole switch
- Wenner PRF switch

☛ Choose the geometrical parameters relative to the chosen electrode array

- For the *Dip. dip. switch* Array:
  - D : dipoles length
  - #Lvl : maximum depth level (≤ 9)
  - Node : number of electrodes used [4 – 24]
  - Line : number allowing a distinction between different survey lines

- For the *Pole Dipole switch* Array:
  - D : AM and MN dipoles length
  - #Lvl : maximum depth level (≤ 9)
  - Node : number of electrodes used [4 – 24]
  - Line : number allowing a distinction between different survey lines

- For the *Pole Pole switch* Array:
  - D : AM dipole length
  - #Lvl : maximum depth level (≤ 9)
  - Node : number of electrodes used [4 – 24]
  - Line : number allowing a distinction between different survey lines

- For the *Wenner PRF switch.* Array:
  - CC/3 : a third of the distance between the current electrodes
  - #Lvl : maximum depth level (≤ 7)
  - Node : number of electrodes used [4 – 24]
  - Line : number allowing a distinction between different survey lines

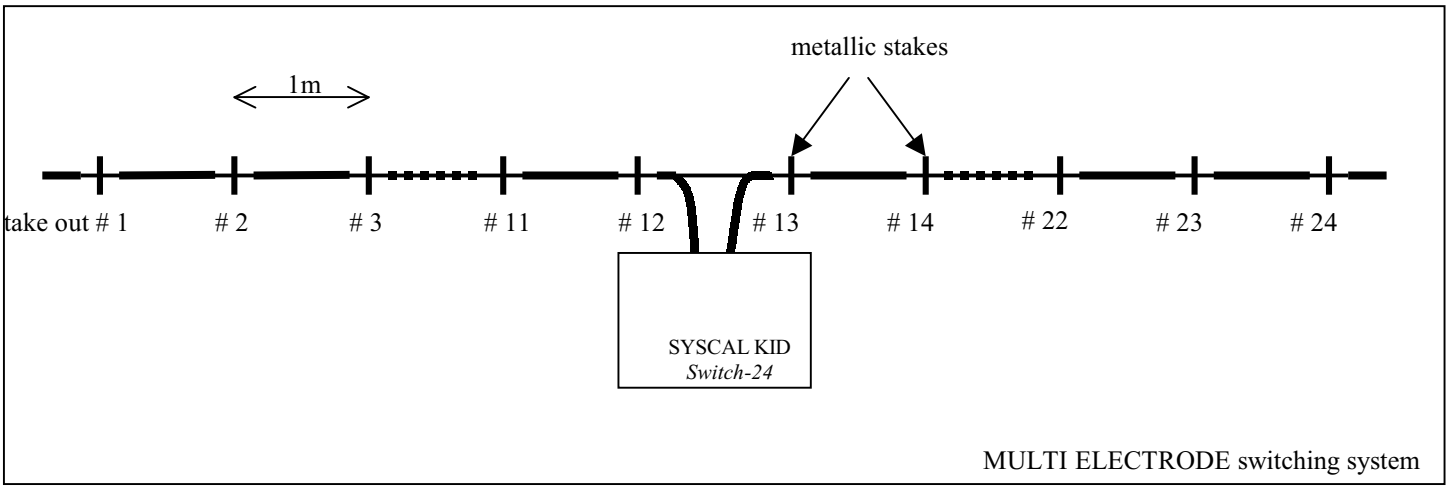
☛ Select the "**Start**" function

If you didn't create a new file before, the program will ask you then to introduce a number. Then, the automatic measurement is running.

The full system is composed of:

- Syscal KID resistivity meter with an internal switching board (Syscal KID *Switch-24*)
- 2 string(s) of 12 electrodes each
- Metallic stakes where each take-out of the string is put in contact by a small clip cable

The following scheme shows the implementation of the switching system (example: 24 take-out - 1 meter spacing):



ANNEX 4: ROLL ALONG PROCESS – *Switch-24* model

The Syscal KID *Switch-24* resistivity-meter allows to implement automatically some Roll along surveys, due to its reverse cables.
This procedure can only be implemented in the Multi-Electrode mode.

Exemple of a Multi-Electrode switching system with the following parameters:

- Configuration: Dipole Dipole
- Nodes: 24
- # lvl: 9
- Roll along: 12 nodes

Each sequence of measurements is realised by 2 electrode strings of 12 take-out each.

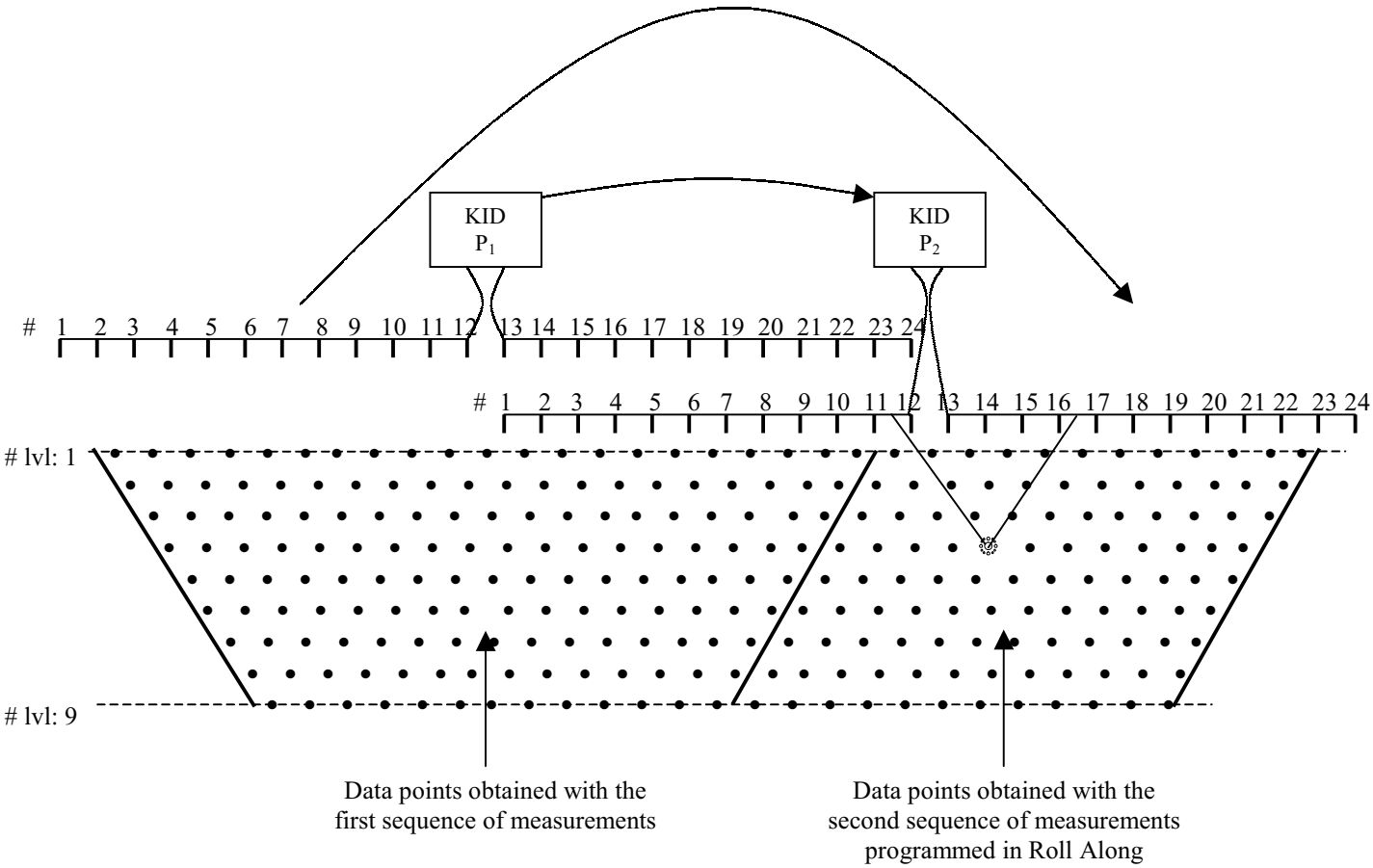
The order of the first sequence of measurement is made in order to get free the first electrode string as quicker as possible. At this stage, during the measurement, a message indicates: "First segment free". Then, you'll be able to disconnect and move the first string on the other part of the second electrode string.
As soon as the first sequence of measurement has been finished, move the Syscal KID to the center of the new configuration ($P_1 \Rightarrow P_2$ - (Cf. the scheme below)).

You'll be now ready to start the second sequence of measurements (in Roll along), and so on if you wish to carry out several Roll along measurements.

The following array sums up the way whose the sequences are configured (according to the previous parameters):

# 1 SEQUENCE OF MEASUREMENTS		**# 2 SEQUENCE OF MEASUREMENTS**	
Quadripole # 1	A1 – B2 – M3 – N4	Quadripole # 1	A8 – B9 – M12 – N13
Quadripole # 2	A1 – B2 – M4 – N5	Quadripole # 2	A9 – B10 – M12 – N13
Quadripole # 3	A1 – B2 – M5 – N6	Quadripole # 3	A9 – B10 – M13 – N14
.	.	.	.
.	.	.	.
.	.	.	.
.	.	Quadripole # 96	A21 – B22 – M23 – N24
Quadripole # 140	A21 – B22 – M23 – N24		

The following scheme shows the various data points that will be got according to the sequences previously described.



Example:
The data point marked on the previous scheme has been obtained by the quadripole [11-12-16-17] of the second sequence of measurement.

Notes:
- The Roll along procedure consists in setting the first electrode string [1-12] at the end of the second one [13-24], after the first sequence of acquisition, in order to go on the measurement judiciously.
- **The Roll along is only offered in the case of 24 nodes are used.**

In that case, at the end of a first sequence of acquisition, after having pressed the "Start function", the Syscal KID *Switch*-24 will display:

```
* - - - - - - - Start : - - - - - - *
→ New acquisition
  Roll along
```

Selecting Roll along, you'll have the possibility to introduce a specific number of nodes between [1-12]. If "12" is chosen, you'll be able to process a roll along more at the end of the second sequence, and so on…