

SYSCAL Pro

Standard & Switch (48 - 72 - 96 - 120) Version

10 channels Resistivity-meter for
Resistivity and IP measurements

User's manual

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IRIS INSTRUMENTS - 1, avenue Buffon, B.P. 6007 - 45060 Orléans Cedex 2, France
Phone: +33 (0)2 38 63 81 00 - Fax: +33 (0)2 38 63 81 82
E-mail: support@iris-instruments.com - Web site: www.iris-instruments.com

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I. OVERVIEW

I.1. GENERALITIES

The SYSCAL Pro unit is a resistivity-meter designed for high productivity survey.

This all in one unit (containing transmitter – receiver and booster) is a very practical in-the-field tool ; an external DC converter for an higher power can be added.

This unit allows to measure primary voltage and decay voltage curve values, giving thus resistivity and chargeability (IP) data.

The main technical characteristics of this unit are the following ones:

- 10 reception dipoles available to carry out some measurements with high productivity in the field
- 20 chargeability slices (automatic or user defined) able to measure the discharge phenomena with an high accuracy
- a 1 μ V resolution on the primary voltage allowing to obtain very accurate measurements
- a large graphic LCD screen allowing to visualize the data in real time either numerically or graphically

The SYSCAL Pro unit can be also used in automatic switching mode (thanks to internal switching board(s) or external *Switch* Pro box(es)) for intensive measurements in 2D / 3D and boreholes.

I.2. DESCRIPTION

I.2.1. Front panel

The front panel shows the following features:

- Graphic LCD (128x140 dots) made of 16 lines by 40 characters
- Two plugs for current electrodes connection ("A" and "B") in **Standard** and **Continuous survey** mode (in **Manual switch** - **Manual sequence** - **Automatic sequence** and **High speed sequence** mode, the electrodes are connected to switch cables plugged to the unit ; in that modes, the ("A" or "B") plugs can be used only for remote injection electrode, (like in a Pole-Pole or Pole-Dipole sequence)).

-
- Eleven plugs for potential electrodes connection ("1" to "10" dipoles) in **Standard** and **Continuous survey** mode (in **Manual switch** - **Manual sequence** - **Automatic sequence** - and **High speed sequence** mode, the electrodes are connected to switch cables plugged to the unit ; in that modes, the potential plugs can be used only for remote injection electrodes (Pole-Pole or Pole-Dipole sequence))
 - Two plugs for internal battery chargers connection ("Charger" for Rx and Tx)
 - Ventilation screw for possible going out of gas of the internal batteries during charge process
 - "+" and "-" plugs for external battery connection
 - "Batt int / Ext" switch for Tx part.
 - Three pins plug (RS232 standard port) for the serial or USB link cable connection ("Com 1")
 - Keyboard with 16 keys
 - Switch On/Off

I.2.2. Backside

At the backside of the unit, the SYSCAL Pro has the following plugs:

- 1 serial link plug ("**Com 2**") for external PC connection (useful in **Continuous survey** acquisition where the "**Com 1**" is used for a GPS connection) or for *Switch* Pro box connection
- 1 plug for a connection of a 1200 W AC/DC converter
- 1 plug for a connection of a external controlled DC converter

For the *Switch* version, some more plugs are present (2 in standard) for multi-conductor cables connection.

I.2.3. Keyboard

The keyboard of the SYSCAL Pro features some keys designed to be used either in the **numeric** or in the **function** mode ; no confusion can be done between these modes, as the device knows at any step of the use, in which mode it has to set itself.

The main functions of the SYSCAL Pro are reached either from these keys or from options of the master menu.

- In the numeric mode, the meaning of the keys is obvious.

Each time one has to enter a numeric value, the available range for this value will be indicated in the left bottom part of the screen

- In the function mode, the next table shows the description of these keys:



to transfer the data to the PC



to check the voltage level of the batteries



to check the reception voltage value without injection (ambient noise + Sp)



to select the operating mode and the injection parameters



to select the electrode array and the number of measuring channels



to check, before running a measurement, the grounding resistance value of the electrodes



to visualize the results channel per channel (during and after measurement)



- to scroll up in a menu
- to go up in a range
- to change the result display



to visualize the results of the whole channels (during and after measurement)



- to move to the left in the menu bar
- to move to the left in the alphanumeric bar
- to move in the channel range



- to scroll down in a menu
- to go down in a range
- to change the result display



- to move to the right in the menu bar
- to move to the right in the alphanumeric bar
- to move in the channel range



- to stop the acquisition
- to reach the menu bar (at any step of the process)



to start the acquisition



- to stop the Rs check process
- to rub some letters or numbers
- to go out of any blocked function and go back to the menu bar



- to validate an input or a selected function

I.2.4. Power supply

The electronic of the unit is supplied by an internal rechargeable battery (12 V – 7.2 Ah).

To generate the current, one can use the internal rechargeable battery (12 V – 7.2 Ah) or an external 12 V battery (standard car battery) ; so, put the "Int / Ext" switch of the Tx area in correct position.

In switching process (sequence mode), you'll have to use for the transmitter an external 12V fully charged battery (plugs "+" and "-" of Tx) and put the Tx switch in "Ext" position.

If you need to change the Tx switch position during measurement, we recommend to pause the measurement before doing the operation.

In any case, the battery used for the current injection should not drop below 8 V during transmitting. If not, erroneous values will appear (a warning message will appear at 9 V).

Please refer to the Annex 5 to have a view of the behaviour of a battery becoming weak.

- The internal batteries are located at the bottom part of the instrument. In case of the device wouldn't be used for a long time, it would be better to take out the battery in order to prevent any possible leakage of this battery that could damage the casing.

Two specific chargers are supplied with the unit ; they have to be connected to the "Charger" plugs of the front panel.


Important note:

For security reasons, a ventilation screw is located on the front panel of the unit ; this component allows to release a possible going out of gas of the internal batteries during the charge process in case of defective or damaged batteries.

So, during the charge of the battery, the operator has to unscrew the ventilation screw, up to release the small radial hole on the screw ; a retaining ring prevents the screw be totally removed of the front panel.

The ventilation screw has to be locked while in-the-field using to ensure the watertightness.

- The external battery has to be connected to the "+" and "-" plugs of the front panel, using the power cables provided with the instrument.

Before using the SYSCAL Pro in the field, the first operation to do is to check the voltage level of the batteries by the "**Tools | Battery**" menu or by the  key (cf. II.2.2.).

The indicator located at the lower right part of the screen allows also to check the level of the two batteries. This indicator is divided in two parts: the upper part is relative to the Tx (transmitter) and the lower to the Rx (Receiver).

If an external battery is used for the current transmission, the battery level displayed will be relative to the battery having the higher voltage value as the battery used will be always the one having the highest level.

I.2.5. Overheating

In case of large sequence of measurements, it's possible that overheating condition appears in the unit.

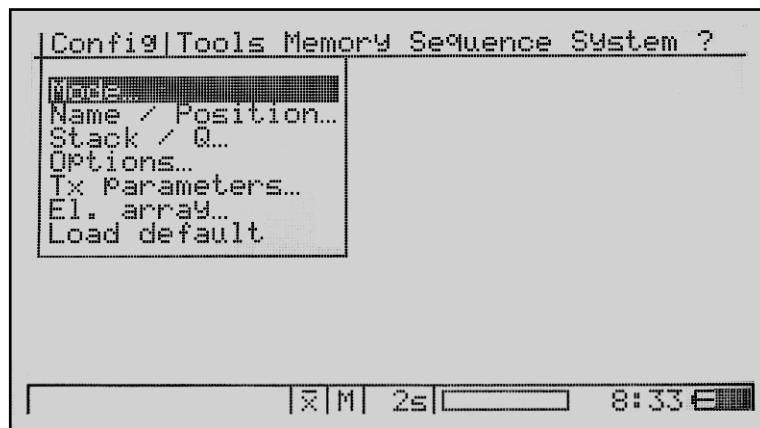
Above 50 °C, an automatic process reducing the output power is automatically run ; the injected voltage will be limited but without cutting totally the injection ; this will avoid internal damages and won't have any effect on the resistivity measurement.

As soon as the temperature has went down sufficiently, the unit will recover the original power.

II. IN-THE-FIELD

II.1. SET-UP

To switch on the equipment, use the On/Off switch: the unit will briefly display the type of the instrument, the version of the firmware and then, the following screen will appear, with the menu bar:



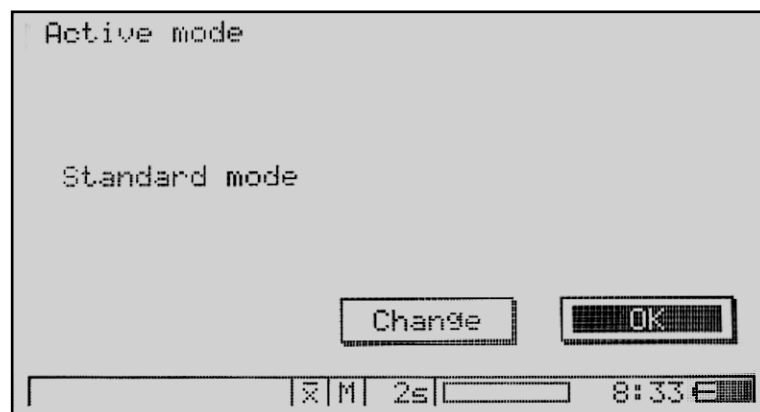
Before performing an acquisition, one has first to introduce the set-up parameters ; all the options relative to this set-up can be reached from the "**Config**" menu and some of them, directly from the keyboard.

In case of using a sequence of measurement (*Switch* version), the setup parameters will be entered while the creation of the sequence (cf. II.3.4)..

II.1.1. Mode

The SYSCAL Pro unit allows to work in various operating modes.

The selection of the "**Config|Mode**" menu will show the following screen:




From that window, one can see the current mode and one has the possibility to change it by the "Change" button: the following screen will be displayed:



- **Standard mode:** standard use of the unit (step by step acquisition): this mode requires to move the electrodes and enter the new positions between each location.

- **Automatic sequence:** automatic switching of electrodes according to a preset sequence of measurement: this mode requires the use of a switching process.

- **Manual sequence :** this mode is equivalent to the previous mode excepted than in that case the sequence will be run in a manual way (necessity to press regularly the  key to continue the sequence).

This mode is useful for the SYSCAL Pro units having the "Rx-Only" option in case of sequences where injection electrodes need to be moved regularly.

- **Manual switch:** test mode allowing to switch manually a set of specific electrodes ; this mode requires the use of a switching process.

Remark: this mode can be run in case of doubt with specific electrodes

- **High speed sequence:** quick mode (pulse duration: about 200 ms / 1 positive pulse and 1 negative pulse) ; this mode requires the use of a switching process.

Remark: this mode can be run for example to get a first idea of the resistivity values of the area.

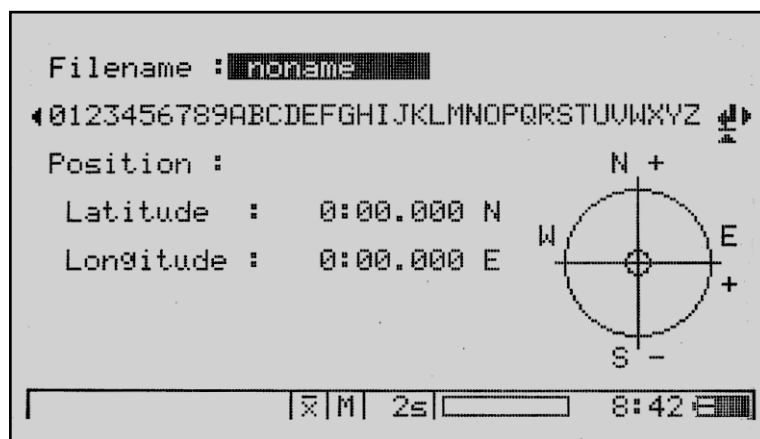
Note:

In **Standard mode** or in **Manual switch** mode, the set up parameters have to be chosen from the options of the "Config" menu.

For the other modes requiring a sequence of measurement, the set up parameters have to be specified while the sequence creation (cf. II.3.4.) but can be nevertheless modified from the options of the "**Config**" menu before running the sequence.

II.1.2. Name / Position

The selection of the "**Config | Name/Position**" menu will display the following screen:






So, specify a filename in which the data will be stored (until one enter a new name, all the next data will be stored with this filename).

One can specify also the location of the profile in longitude and latitude positions.

Note:


If you need to perform several profiles (using one of the sequence modes), it can be very useful to enter a filename for each profile, as after the download of the full memory to PROSYS II software, one will have the opportunity to split the file in several files according to the various filenames.


Procedure:

- For **Filename**, use the  and  keys to move left and right the cursor in the alphanumeric bar and press the  key each time the cursor is located below the letter you wish to enter.


Then, locate the cursor below the "↵" letter to validate the filename.

Automatically, the line **New latitude** will be created and highlighted at the bottom of the screen

- Use the numeric keys to enter the **New latitude** number and validate by the  key ; the **Latitude position** will so be updated and the line **New longitude** will be automatically created and highlighted

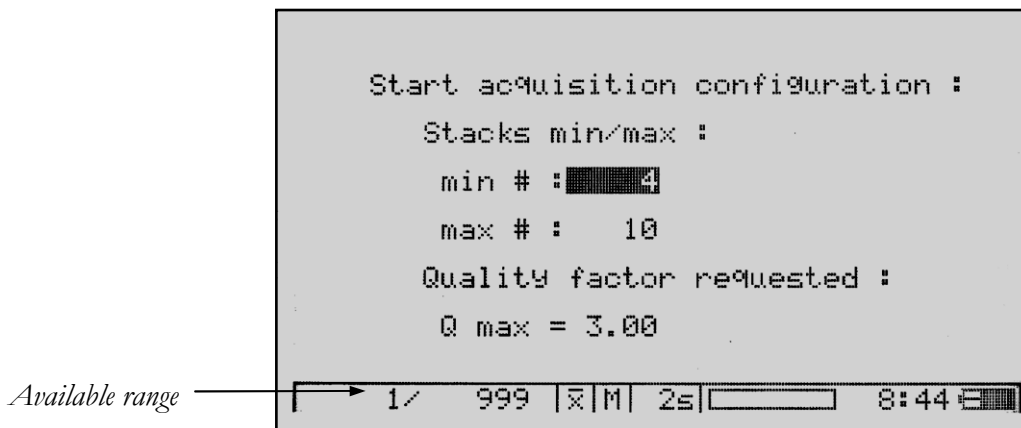
Use the numeric keys to enter the **New longitude** number and validate by the  key: the **longitude position** will so be updated.

Note:

if a GPS is connected to the unit, instead of entering numerically the value, you'll be able to press the  key for a direct introduction of GPS data when **New latitude** and **New longitude** are highlighted (any type of GPS using the *NMEA 0183* norm can be used (cf. Annex 10 for details)).

II.1.3. Stacking parameters

The selection of the "**Config|Stack/Q**" menu will display the following screen:



So, enter a value for each parameter (the available range is indicated for each parameter in the bottom left part of the screen):




- **Stack min:** minimum number of stacks (cycles) to do
- **Stack max:** maximum number of stacks (cycles) to do
- **Q max:** quality factor requested (standard deviation in %).

As long as the quality factor is greater than the introduced value, the measurement will run up to the specified stack max. If not, it will stop to the stack min.

The quality factor is computed for each channel but is checked relatively to the results obtained on the triggering channel.

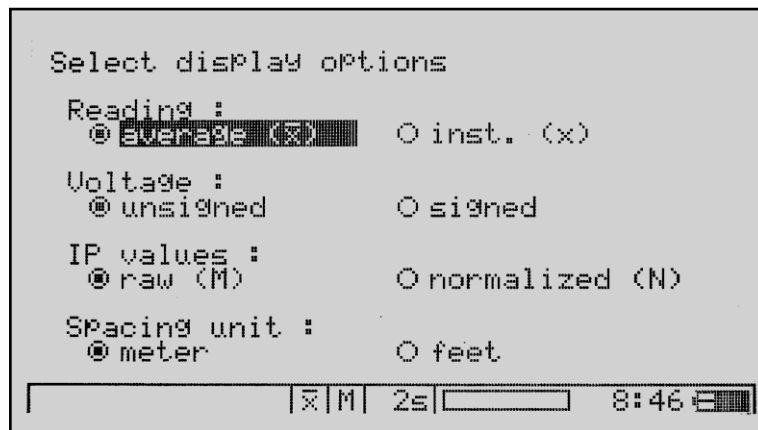
Note that in IP mode, the computation of this factor is made on the global chargeability.

Procedure:

- Use the numeric keys to enter the **min #** number and validate by the  key
- Use the numeric keys to enter the **max #** number and validate by the  key
- Use the numeric keys to enter the **Q max** number and validate by the  key

II.1.4. Display options

The selection of the "Config/Options" menu will show the following screen:



So, choose the various options relative to the display:

- **Reading:**

Average (\bar{X}): the displayed values will be the average values of the pulses from the beginning of the measurement.

Inst. (X): the displayed values will be the average values of the three latest pulses (standard)

- **Voltage:**

Unsigned: the displayed average values of voltage will be absolute values (standard)

Signed: the voltage values will have a sign, which depends on the polarity of the measured dipole voltage with respect to the first dipole voltage. Consequently, the resistivity values will be also signed.

- **IP values:**

Raw: the displayed values will be the true partial chargeability values observed on the decay curve (standard)




Normalized: the displayed values will be values normalized in regards to a reference decay curve (not available for the Cole-Cole and Programmable modes) (cf. Annex 3 for more information)

- **Spacing unit:**


Meter: the spacing values will be given in meters (standard)

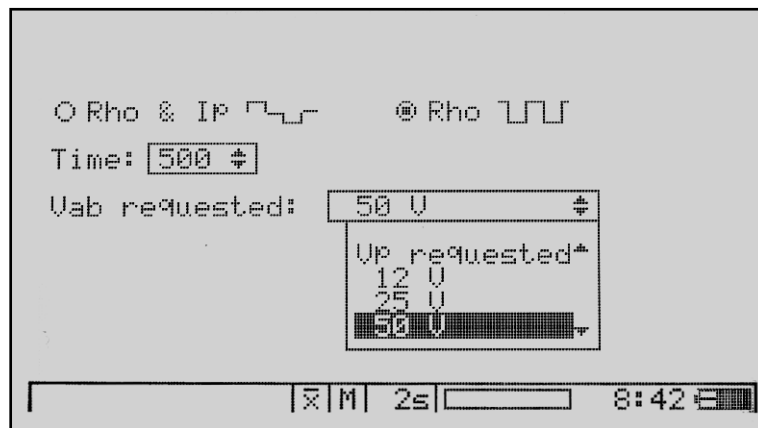
Feet: the spacing values will be given in feet

Procedure:

Use for each option the  and  keys to move left and right the cursor and the  key to validate the option you wish

II.1.5. Tx parameters

The selection of the "**Config|Tx parameters**" menu or the  key will display the following screen:



- **Rho & Ip** (resistivity and chargeability) or **Rho** (resistivity only) measurement
- **Time:** select the injection pulse duration: 250 ms - 500 ms - 1 s - 2 s - 4 s - 8 s.
- **Mode** (if **Rho & Ip**): choose the sampling of the partial chargeability slices (Cf. Annex 3 for more information).

Arithmetic: arithmetic sampling with 3 to 20 partial chargeability slices

Semi logarithmic: semi logarithmic sampling with 3 to 20 partial chargeability slices

Logarithmic: logarithmic sampling with 2 to 6 partial chargeability slices

Cole-Cole: specific sampling used to compute the Cole-Cole parameters ; the computation will be done by PROSYS II software.

Programmable: 20 fully programmable slices

• **Vp requested or Vab requested**: choose either:

- a constant injection value (**Vab requested**) and then select the value among [12V - 25V - 50V - 100V - 200V - 400V - 800V - Vab Maximum - External DC].

If you select "Vab Maximum", you'll have to define the value, in V, of the maximum voltage the unit will inject.

- a constant reception value (**Vp requested**) and then select the value among [Save energy (20 mV) - 50mV - 200mV - 800mV - Max (3V)].

Then, you'll have to define the value, in V, of the maximum voltage the unit will inject if you want to limit the injection level (this can be useful to limit the power of the unit, so consequently, the consumption of the battery, and also for security reasons, if it's preferable (for a demonstration) or necessary (for a compatibility with a local norm) not to overcome a limit).

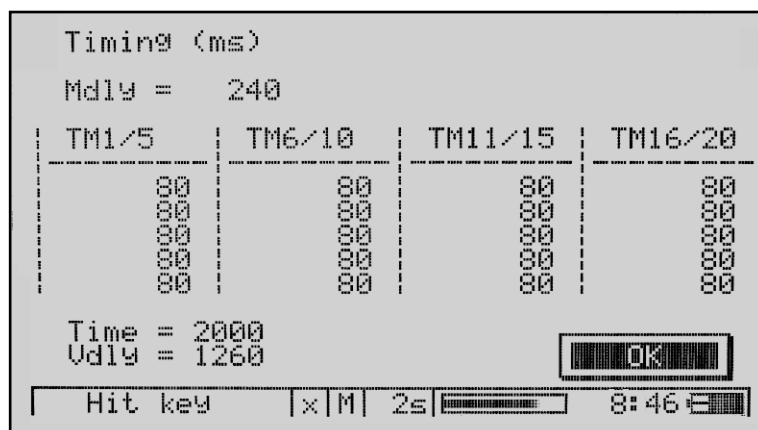
Notes:

• The Vp value will be requested for the channel recording the lowest reception signal. If the Vp value requested induces some overvoltage on the first channels, the new channel for the Vp requested will be the previous one, and so on until there's no more overvoltage on channel 1.

The "triggering channel" will be assigned of the character "*" in the results and acquisition displays in front of the corresponding line ; it can change during a sequence, due to the organization of the quadripoles in the sequence and to the reception levels measured.

• In switching process, due to the use of multi-conductor switch cables, the Vab max will be 800V, even if the user has selected an higher injection voltage value.

if **Rho & Ip** has been chosen, then, one will reach the **IP parameters** screen allowing to visualize or to modify the values (in regards to the chosen IP mode):



Vdly: delay time (in ms) from which the samples (sampling rate: 10ms) will be taken into account after injection, both for intensity and voltage measurements:

This delay time permits to be sure that all transient effects like IP and EM responses will be vanished and so, won't disturb the measurement.

Mdly: delay time (in ms) from which the voltage samples (sampling: 10ms) will be taken into account after the current cut off.

Note:

The number of chargeability slices depends on the injection pulse duration previously chosen (cf. Annex 3 for more information).

General note about the Rx-Only acquisition mode:

In case of the SYSCAL Pro has the "Rx-only" option, the **Tx parameters** window will be slightly different than the one shown page 14.

Indeed, in that case, we'll have the choice between the two types of acquisition:

- **Tx-Rx** : means the unit is used as a transmitter and a receiver: this is the classical configuration to which we refer in that manual.


- **Rx-only**: means that the unit is used as a receiver.

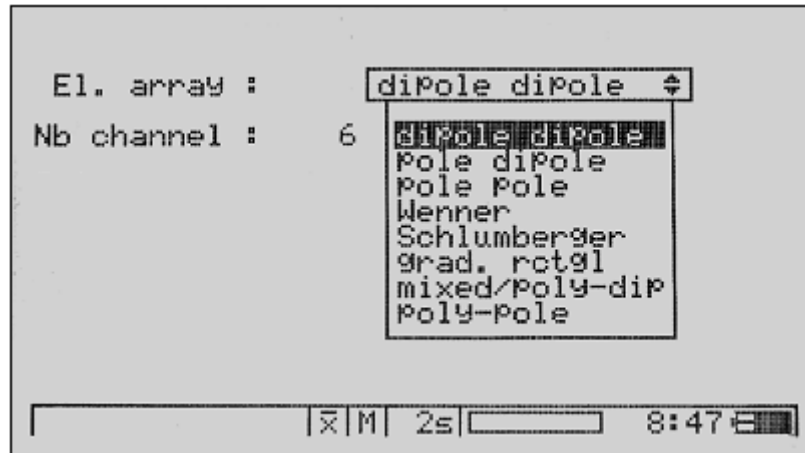
For the transmitter, in that case, it's necessary to use an external unit, like a VIP transmitter.

In that configuration, the SYSCAL Pro unit doesn't drive the transmitter part: the current will be set by the grounding resistances of the electrodes connected to the transmitter, the configuration and the capabilities of this transmitter.

In that measuring mode, which allows to run IP acquisition with an high resolution, only the **"Rho & Ip"** mode will be available.




II.1.6. Electrode array

The selection of the **"Config | E. array"** menu or the  key will display the following screen:



So, first, choose the electrode array you wish to use (cf. Annex. 2 for more information).
Then enter the number of channels to be used.

Procedure:

For **El. array**: use the  and  keys to move up and down the cursor in the list and the  key to select the array you wish

For **Nb channel**: use the numeric keys and validate by the  key.

Note (cf Annex 2 for more information):

The maximum number of channels allowed is 10 except for the following arrays (1 channel max):
Pole-Pole - Wenner - Schlumberger.

So for these arrays, by default **Nb channel**: 1.

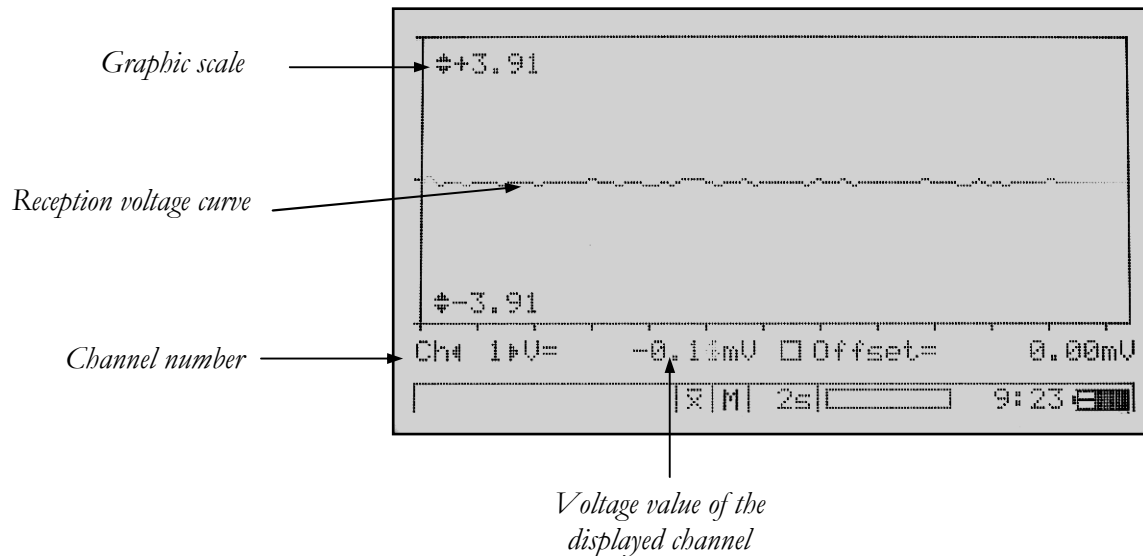
In case of using a mode requiring a sequence of measurement, and if the sequence loaded by ELECTRE Pro (cf. II.3.4.) is a non standard sequence, the electrode type displayed in the previous screen will be: Mixed/Poly-Dip.

II.2. BEFORE ACQUISITION





Before running the acquisition, some tests have to be done to be sure that the measurement will be performed in the best conditions:


II.2.1. Monitor

The selection of the  key (or the "**Tools | Monitor**" menu) will show the following screen:




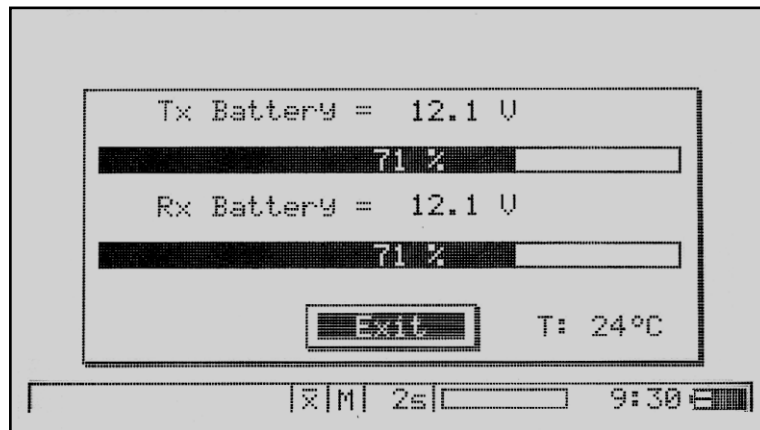
This function allows to visualize in real time the reception voltage value and the corresponding curve, channel per channel ; this is just a monitoring of the reception voltages without injection (Sp + ambient noise monitoring)

At this stage, you can change the graphic scale using the  and  keys and the channel to be visualized by the  and  keys.

Press the  key to see the DC offset value (SP + noise): automatically, the **Offset** box will be crossed and the voltage value will be indicated.

II.2.2. Battery

The voltage level of the batteries can be displayed by the  key or by the "**Tools | Battery**" menu ; the following screen will appear:




So, one can see the battery voltage value in V and the capacity (10 V means 0 % of capacity) for the Tx (transmission) and the Rx (Reception) part.

Press a key to skip this function.

Note:

From the master screen, the indicator located at the lower right part allows also to have continuously a view of the batteries level.

If one of the battery levels become too low (10 V for the Rx and 9 V for the Tx), a warning message will appear after having pressed the  key or during acquisition.

II.3. ACQUISITION

II.3.1. In-the-field implementation

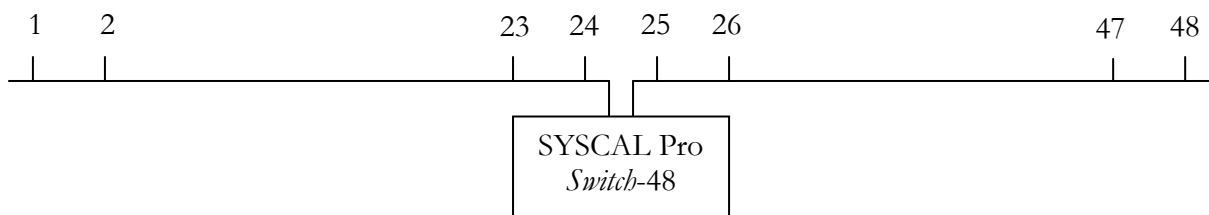
The SYSCAL Pro can be used in various operating modes (cf. II.1.1.)

In regards to that mode, some actions have to be done before running the measurement.

The **Standard** (cf. II.3.2.) and the **Continuous survey** (cf. II.3.5.) modes, requires the electrodes directly connected to the front panel of the unit.

The **Manual switch** (cf. II.3.3.) - **Manual sequence** (cf. II.4.1.) - **Automatic sequence** (cf. II.3.4.2.) and **High speed sequence** (cf. II.3.4.3.)) modes, requires the use of a switching system ; the standard switch cables supplied by *IRIS Instruments* are double ended, and so can be reversed for a full flexibility (useful for the Roll along implementation).

In that configuration, the SYSCAL Pro *Switch* unit is located at the centre of the configuration (example given for the SYSCAL Pro *Switch-48* unit):



The switch cables are supplied in several cable sections, in regards to the electrode spacing and the number of electrodes, to keep a reasonable weight per reel.

II.3.2. Standard mode





Preliminary note:


The screens described below are relative to a Dipole-Dipole array with 5 meters between electrodes and 6 channels of reception.

To run an acquisition in that mode, select the "**Config|Mode**" menu ; a screen indicating the current mode will appear: if **Standard mode** is displayed, press "**OK**".

If not, press **"Change"** ; then the screen showing the available modes will appear ; then, select **Standard mode**.

Procedure:

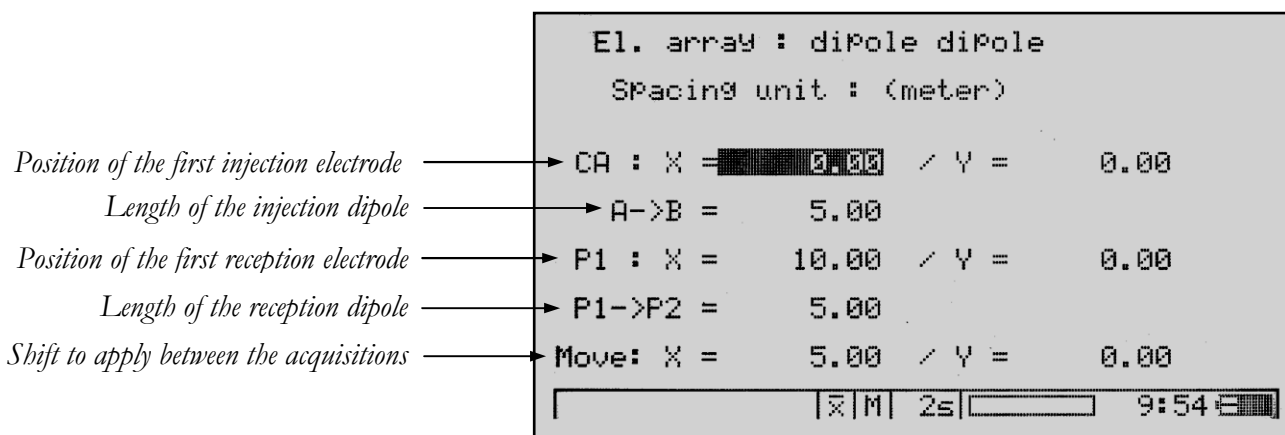
Use the  and  keys to move up and down the cursor in the list and the  key to select **Standard mode**, then press the  key

Then press the  key or select the **"Tools | Start"** menu

At this stage, the program will display the batteries screen if one of the voltage levels is low.


So, in that case, press the **"Continue"** button if you think that it will be sufficient or **"Stop"** button if you want to recharge the batteries or connect an external 12V battery.

Then, the first screen displayed will be the following one:

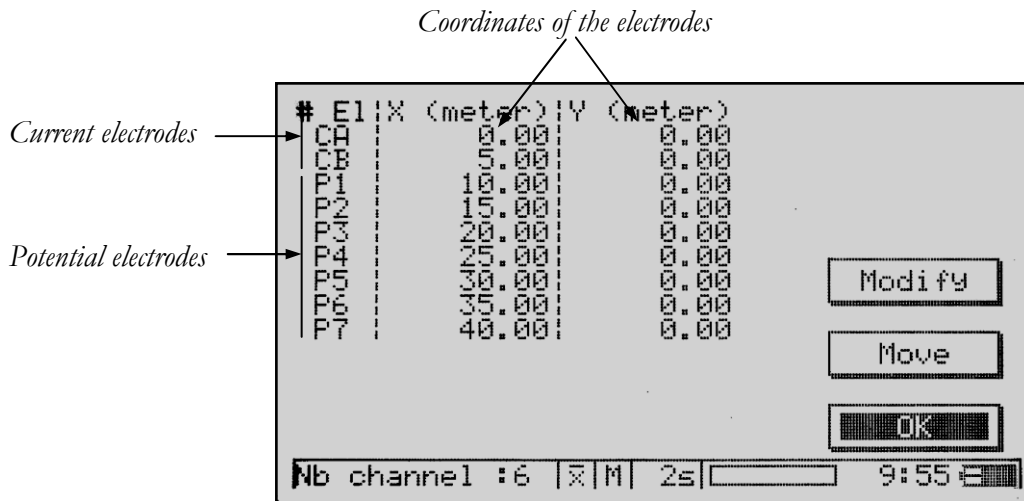


So, enter the spacing parameters (the spacing parameters are relative to the electrode array you previously selected - cf. Annex 2 for more information):

Procedure:

For each spacing: use the numeric keys and validate each input by the  key

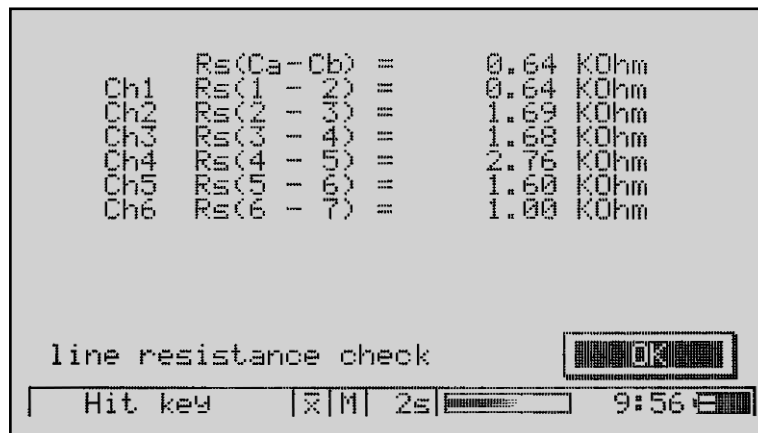
Then, the following screen will appear:



Then, press the  key to run the acquisition.


The next screen is relative to the resistance measurement of the whole dipoles ; this allows to check that all the electrodes are correctly connected ; if not, check the wires and try to improve the contact with the ground.

The following example is given for an SYSCAL Pro used with 6 channels:



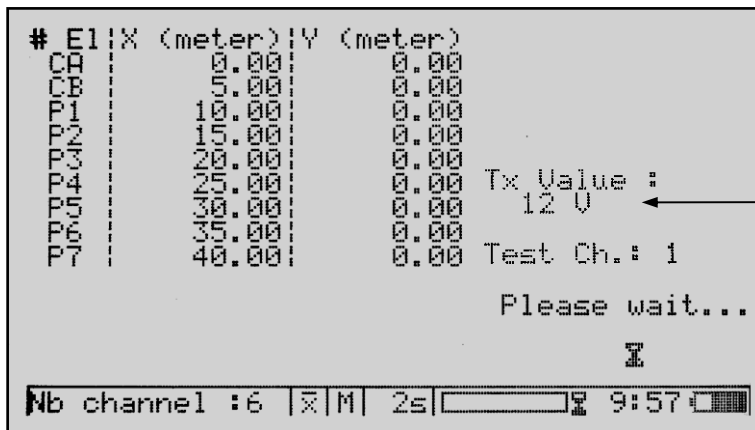
Note:

The value of the grounding resistance is displayed in kOhm.

If the line is open (electrode not correctly connected), the displayed value will be "999.999" kOhm and the line will be highlighted ; one can press the  key to skip this value and to check the next dipoles.

So, at the end of the test, press "OK" button if the resistance values are correct ; until you don't press "OK", the Rs check test will be continuously performed ; so, if necessary, you can try in the meantime to improve the grounding resistances.

Then, the measurement will start automatically with first, a filtering process:



Theoretical injected voltage value

Note:

In the previous screen, the **Tx value** displayed is a theoretical value which can be sometimes different from the actual value as a power or voltage limitation can occur in regards to the grounding resistance value.

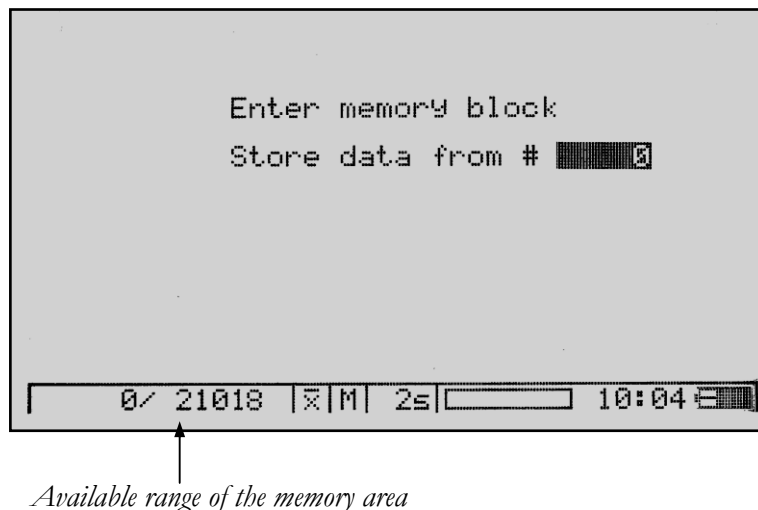
Then, the results will be displayed in the following screen:

Ch	Rho Ohm.m	Up mV	MP mV/U	Q
1*	100.711	854.859	29.292	0.04
2	120.488	213.241	21.294	0.04
3	180.540	85.341	24.287	0.05
4	162.242	42.544	29.249	0.13
5	155.523	24.621	20.259	0.07
6	190.325	15.207	20.345	0.03

#3 M 2s 9:58


During the measurement, one has the opportunity to see various results and various type of screens: cf § II.3.6. for more information.


At the end of the measurement, for the first acquisition, the program offers automatically to save the data in the first memory area ("0"):



Note that if you want to store the data from a specific memory area, use the numeric keys.

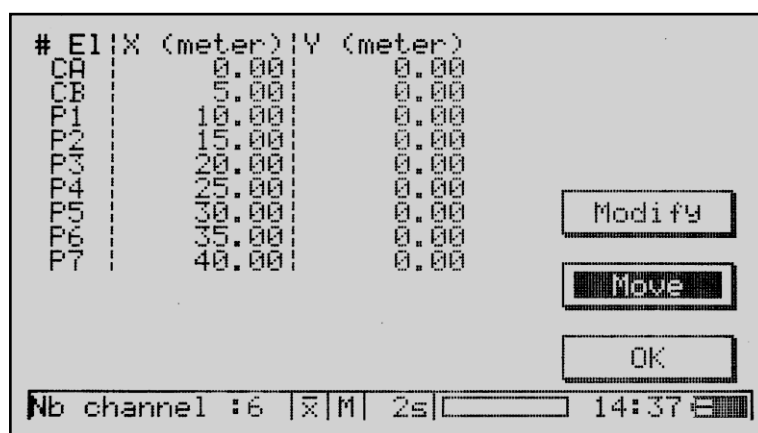
Then, press the  key to confirm.

If you don't want to save the data (to check the results beforehand for example), press the  key ; you'll have the possibility in a second time to store them, thanks to the "**Memory | Store**" menu.

Then to go on the profile, move your electrodes in the field, of the specified **Move** parameter (5 meters in our case) and so, press the  key.

If the data previously acquired has not been saved, a warning message will be displayed ; you'll have so the choice to go on the measurement ("**Continue**" button) or to stop it to store the previous data ("**Stop**" button).

Then the next screen will be automatically displayed:




Then, from this window, choose the "**Move**" button.

The following screen will be then displayed:

# E1	X (meter)	Y (meter)	
CA	5.00	0.00	
CB	10.00	0.00	
P1	15.00	0.00	
P2	20.00	0.00	
P3	25.00	0.00	
P4	30.00	0.00	
P5	35.00	0.00	Modify
P6	40.00	0.00	Move
P7	45.00	0.00	OK

Nb channel : 6 | X | M | 2s | 14:37

Note that all the electrodes have been shifted of 5 meters.

Then, press the  key to run the acquisition: the measurement will start automatically with the same screen as previously.


Then, after acquisition of this second data set, the program offers for saving the data from the next memory area ("6" in that case as the previously data have been stored in memory area from "0" to "5"):

Enter memory block
Store data from # 6

0 / 21018 | X | M | 2s | 14:44

Note that if you want to store the data from a specific memory area, use the numeric keys.

So, press the  key to confirm.


If you don't want to save the data to check the results beforehand, press the  key ; you'll have the possibility in a second time to store them, thanks to the "**Memory** | **Store**" menu.

Note:

If you want to store the data from a full memory area, the following warning message will be displayed:



So, press **"Yes"** to confirm, and **"Abort"** to skip this function without overwriting the data.





If you press **"No"**, the program will check automatically the first free memory area and will offer to save the data from this one ; then, press  to validate.


II.3.3. Manual switch

To run an acquisition in that mode, select the **"Config|Mode"** menu ; a screen indicating the current mode will appear: if **Manual switch** is displayed, press **"OK"**.

If not, press **"Change"** ; then the screen showing the available modes will appear ; then, select **Manual switch**.

Procedure:

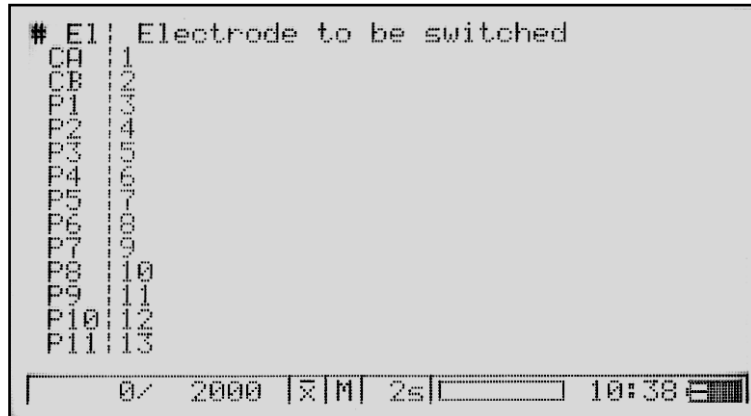
use the  and  keys to move up and down the cursor in the list and the  key to select **Manual switch**, then press the  key


Then press the  key or select the **"Tools|Start"** menu

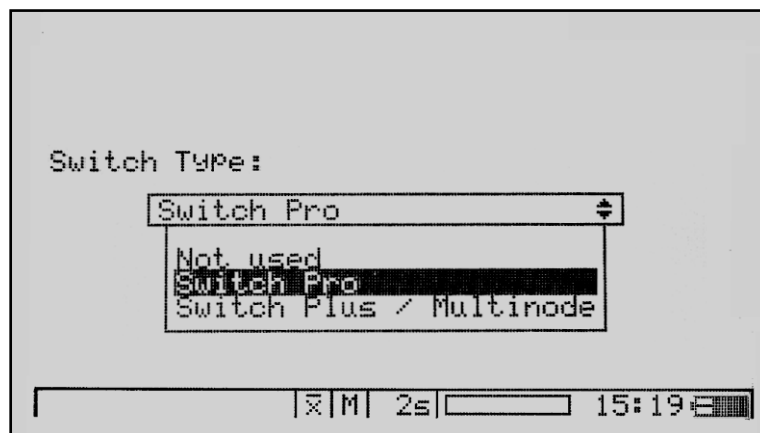
At this stage, the program will display the batteries screen if one of the voltage levels is low.

So, in that case, press the **"Continue"** button if you think that it will be sufficient or **"Stop"** button if you want to recharge the batteries or connect an external 12V battery.

Then, the first screen displayed will be the following one after having entered the electrodes to be switched:




Then, press  key to validate: the following screen will appear:



Then, specify the configuration of the system:

- **Not used** (no switching capability: 10 channels standard using): no meaning in that mode.
- **Switch Pro** (internal or external 10 channels switching capability)
- **Switch Plus / Multinode** (external 1 channel switching capability)

Then press the  key or select the "**Tools | Start**" menu.

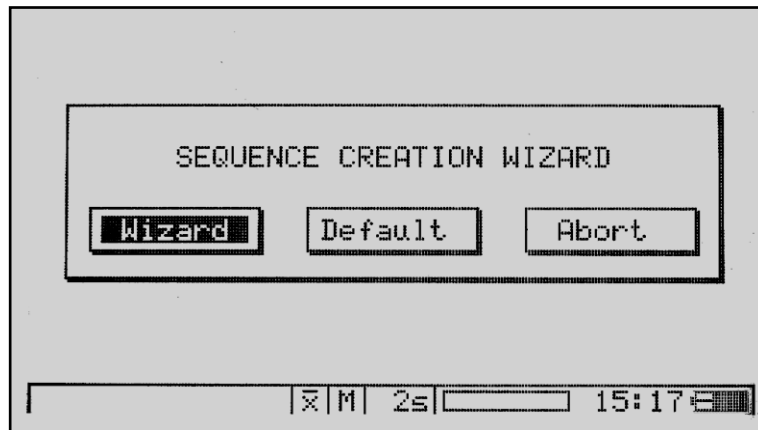
Then, one will reach exactly the same screens than in **Standard mode** (cf. II.3.2.), from which one will have to specify the coordinates of the electrodes.

Note:

No Rs check process and no data storage will be done in the **Manual switch** mode.

II.3.4. Sequence creation

For the other modes of measurement (**Manual sequence** - **Automatic sequence** and **High speed sequence**), before running the acquisition, one has first to create a sequence of measurement (i.e. a list of quadripoles with the definition of the geometrical parameters) ; this can be done by the "**Sequence | Creation**" menu ; the following screen will appear:



Then, from this window, you have the opportunity to press the "**Wizard**" button if you want to create the sequence step-by-step, from the beginning.

If the set up parameters have been defined from the "**Config**" menu, you can press directly the "**Default**" button.

Press "**Abort**" button to skip this function and reach the master menu

From the **Wizard** creation, you'll reach successively the screen of the following **Config** parameters:

- Name / Position (cf. II.1.2.)
- Tx parameters (cf. II.1.5.)
- Stacking parameters (cf. II.1.3.)
- Electrode array (cf. II.1.6.)

Note:

In "Vp requested" mode, we advise to choose a number of channels in relation with the number of depth levels of the sequence.

For example, if 16 depth levels are programmed, a number of channels of 8 will allow to optimize the measurement. Indeed, In that case, the unit will perform a first set of measurements of 8 channels and then another set of 8 channels: so, this will allow to get higher voltage levels in

reception than in the 10 channels configuration, as in that case a first set of measurements of 10 channels would be performed followed by a set of measurements of 6 channels).

Then, one will reach the *geometry parameters* screen:

```

Geometry Parameters
min. spacing (a)= 5.00
Depth level (lvl)# 10
Nb of electrodes : 24
First electrode # 1
X = 0.00 / Y = 0.00
X|M| 2s| 15:19

```

From the "Default" button of the *Sequence creation* screen, you'll have only access to the *Filename* screen and then you'll reach directly the *geometry parameters* screen:

Then, enter the following parameters:

- **min. spacing (a):** minimum spacing between the electrodes (in meters)
- **Depth level (lvl):** number of levels of investigation (max:16)
- **Nb of electrodes:** total number of electrodes (linked to the length of the profile you wish to explore and the spacing between electrodes)
- **First electrode:** first electrode to be used
- Position of the first electrode in **X, Y** coordinates

Then, the following screen will appear:

```

Type of sequence to create

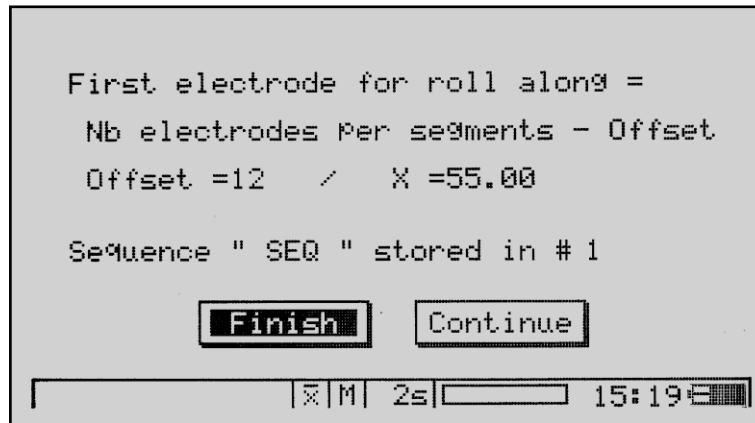
Regular sequence 1 x Run
Roll along seq. 1 x Run
X|M| 2s| 15:19

```

Choose **Regular sequence** to run a standard sequence and the **Roll along seq.** to run a roll along sequence.

The selection of the **Roll along seq.** requires that you have previously entered the correct spacing for the first electrode ; this spacing is given at the end of the creation of the regular sequence (for the first roll along).

Indeed, at the end of the creation of a regular sequence, one will reach the following screen:

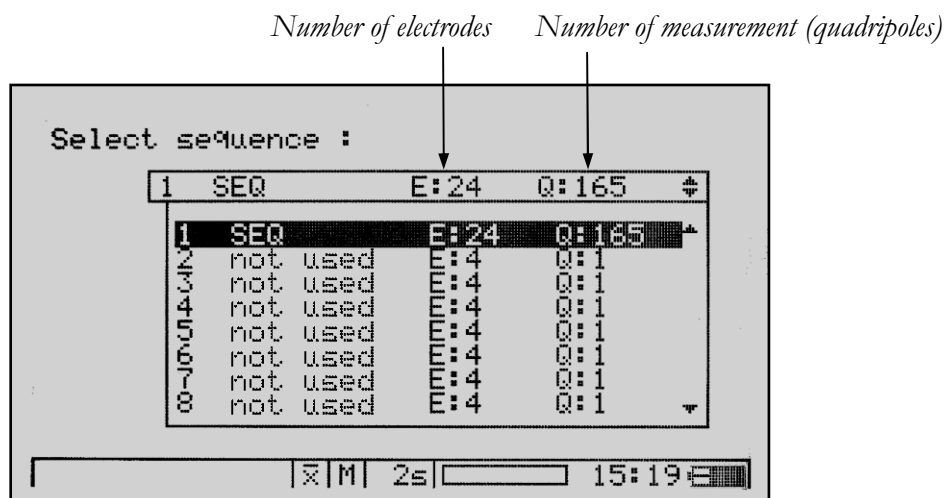


So, press "**Finish**" to validate the sequence creation or "**Continue**" if you want to modify the sequence.

Notes:

- After creation of the sequence, the modification of the parameters from the options of the "**Config**" menu will be taken into account.
- Up to 12 sequences can be stored into the SYSCAL Pro memory

Once the sequence has been created, it's possible to visualize it from the "**Sequence | View**" menu: the list of sequences present in the memory will so be displayed:




So choose from this list, by the  and  keys, the sequence you wish to visualize and validate by the  key: the following screen will appear:





List of the quadripoles of measurement →

#	Ca	Cb	Pm	Pn
1	1	2	3	4
2	1	2	3	4
3	1	2	3	4
4	1	2	3	4
5	1	2	3	4
6	1	2	3	4
7	1	2	3	4
8	1	2	3	4
9	1	2	3	4
10	1	2	3	4
11	1	2	3	4
12	1	2	3	4
13	1	2	3	4

of the A electrode # of the B electrode # of the M electrode # of the N electrode

View : Electrode

 M 2s 15:19

From this window, use the  and  keys to scroll up and down in the list and the  and  keys to visualize the set up parameters of the sequence.

Note:

It's also possible to use some sequences created by the ELECTRE Pro software, in case of the sequences generated internally wouldn't match your requirement (cf. IV.4.1.).

In such a sequence:

- The number of measuring has not been defined ; by default, the number of channel is "10" ; you can change it just before starting the sequence from the "Config|E. array" menu (cf. II.1.6.).

- No "Vab maximum" value has been entered : by default, this will be the highest one ("800 V") ; you can change it just before starting the sequence from the "Config|TX parameters" menu (cf. II.1.5.).

II.3.4.1. Manual sequence

This mode is useful for the units having the "Rx-only" option.





Indeed, in configuration where it's necessary to move regularly the A-B electrodes, (like dipole-dipole), this type of acquisition allows to work in multi-electrodes using a sequence, but that is run manually (to permit the user in the field to move physically the A-B electrodes).

In that process, after having created a sequence (cf. II.3.4.), one has to specify that the acquisition has to be performed in **Manual sequence** mode.

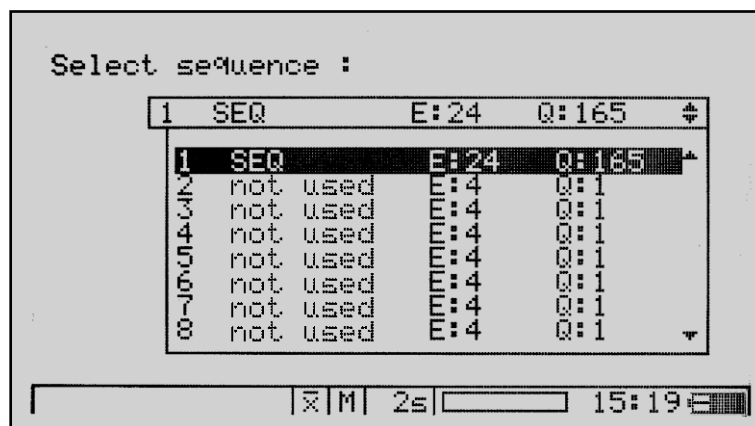
Then select the "**Config|Mode**" menu ; a screen indicating the current mode will appear ; so if **Manual sequence** mode is selected, then press "**OK**".

If not, press "**Change**": the screen showing the available modes will appear ; so, select the **Manual sequence** mode.

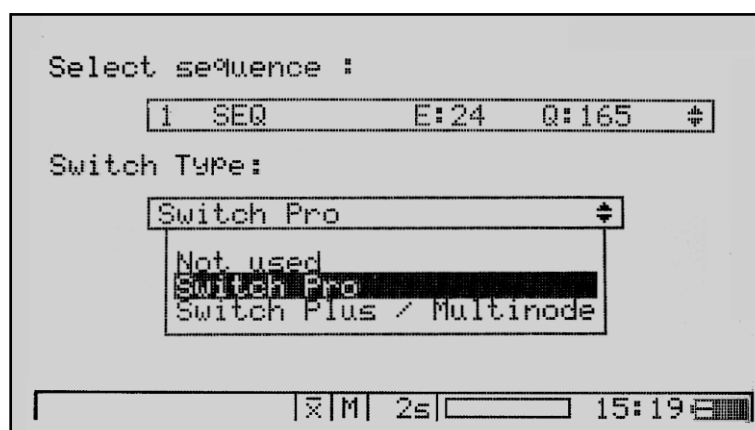
Procedure:

use the  and  keys to move up and down the cursor in the list and the  key to select **Manual sequence**, then press the  key

The list of sequences present in the memory will so be displayed:



So choose from this list, by the  and  keys, the sequence you wish to run and validate by the  key: the following screen will appear:





Then, specify the configuration of the system:

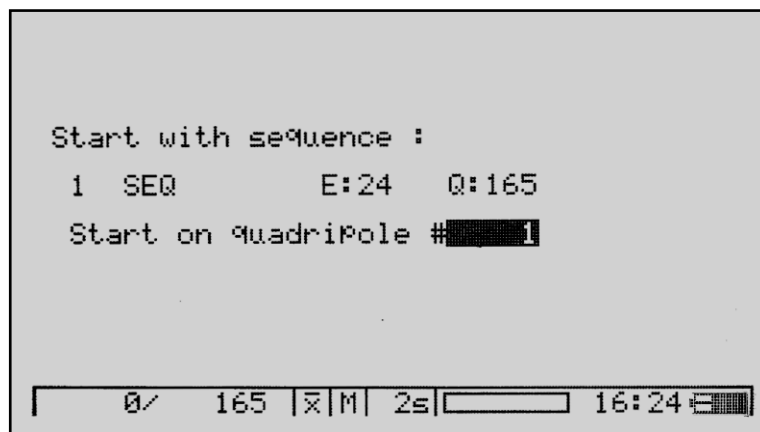
- **Not used** (no switching capability: 10 channels standard using): no meaning in that mode.
- **Switch Pro** (internal or external 10 channels switching capability)
- **Switch Plus / Multinode** (external 1 channel switching capability)


Note:

As one can see from the previous screen, one has the possibility to work in that mode with switch boards, but the main advantage is of course for a SYSCAL Pro standard version (no switch boards).

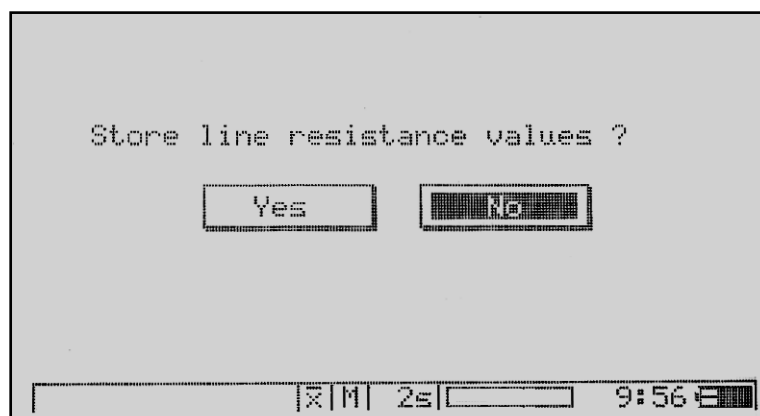
Then press the  key or select the "**Tools | Start**" menu.

The first screen will be relative to the filename, which you can change at this stage ; then press the  key: the following screen will appear:



So, to start the measurement at the first quadripole, then press the  key (if you want to start the measurement from another quadripole, enter its number and validate):

Then, the program will offer to store the resistance values of the dipoles:



So, if you choose **"Yes"**, the Rs check process will be run first displaying the resistance of the dipoles in the cable; and then, between each set of measurements, the Rs check on the next measuring dipoles will be run and the resistance value of these dipoles will be stored.

Note:

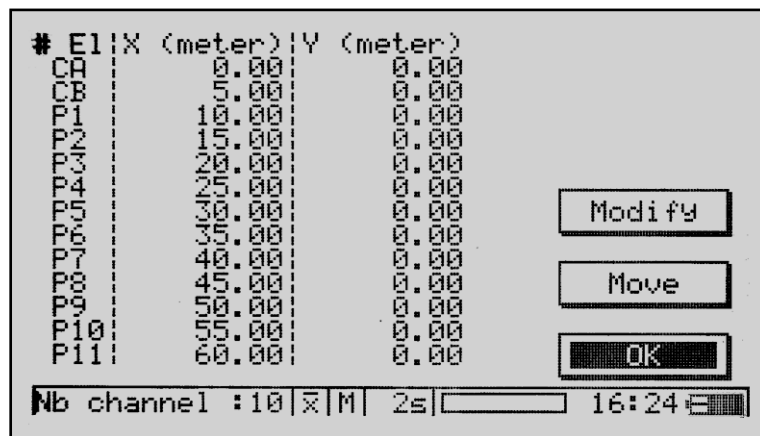
Keep in mind that this option is time consuming (acquisition time will be multiplied about by 2)

If **"No"** has been selected, the Rs check process will be run but values wont be stored.



Then, if you selected previously **"Yes"**, a screen with the **"Rs check"** message in the lower left part of the screen, will appear briefly.

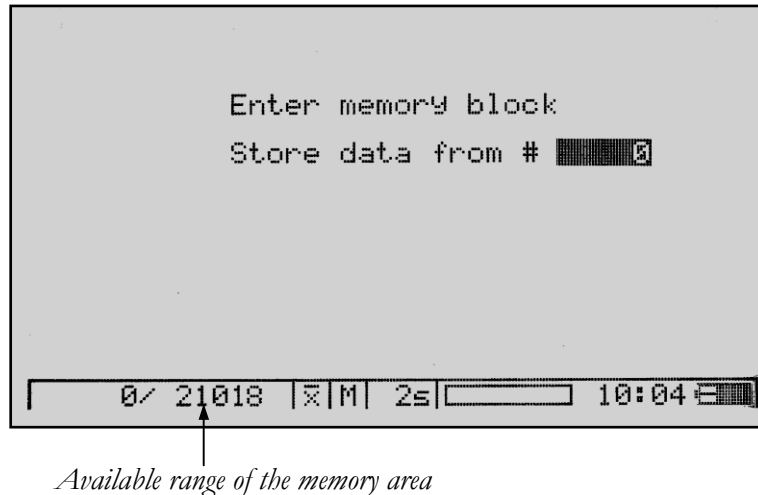
Then, the next display will be:



Then, press the  key to run the acquisition.


During the measurement, one has the opportunity to see various results and various type of screens: cf § II.3.6. for more information.

At the end the measurement, for the first acquisition, the program offers automatically to save the data from the first memory area ("0"):



Note that if you want to store the data from a specific memory area, use the numeric keys.

Then, press the  key to confirm.

If you don't want to save the data (to check the results beforehand for example), press the  key ; you'll have the possibility in a second time to store them, thanks to the **"Memory | Store"** menu.

Then the next screen will be automatically displayed:


#	E1	X (meter)	Y (meter)	
CA		5.00	0.00	
CB		10.00	0.00	
P1		15.00	0.00	
P2		20.00	0.00	
P3		25.00	0.00	
P4		30.00	0.00	
P5		35.00	0.00	
P6		40.00	0.00	
P7		45.00	0.00	
P8		50.00	0.00	
P9		55.00	0.00	
P10		60.00	0.00	
P11		65.00	0.00	

Modify

Move

OK

Nb channel : 10 | X | M | 2s | 16:26


Note that all the electrode positions have been shifted of 5 meters (as the min. spacing parameter defined in the sequence is "5" (cf. II.3.4.)). In **Manual sequence** mode, the unit computes automatically the new spacing parameters ; so, you don't have to use the **"Move"** or the **"Modify"** button between the acquisitions: then, one has just to move the electrodes and press the  key to continue the sequence.

Then, after acquisition of this second data set, the program offers for saving the data from the next memory area ("10" in that case as the previously data have been stored in memory area from "0" to "9"):



Note that if you want to store the data from a specific memory area, use the numeric keys.

So, press the  key to confirm.


If you don't want to save the data to check the results beforehand, press the  key ; you'll have the possibility in a second time to store them, thanks to the "**Memory|Store**" menu.

Note:

If you want to store the data from a full memory area, the following warning message will be displayed:



So, press "**Yes**" to confirm, and "**Abort**" to skip this function without overwriting the data.

If you press "**No**", the program will check automatically the first free memory area and will offer to save the data from this one ; then, press  to validate.





II.3.4.2. Automatic sequence

In that process, after having created a sequence (cf. II.3.4.), one has to specify that the acquisition has to be performed in **Automatic sequence** mode.

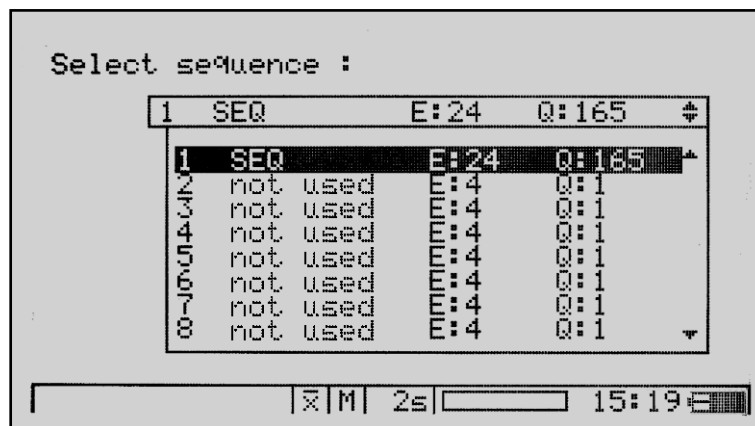
Then select the "**Config|Mode**" menu ; a screen indicating the current mode will appear ; so if **Automatic sequence** mode is selected, then press "**OK**".




If not, press "**Change**": the screen showing the available modes will appear ; so, select the **Automatic sequence** mode.

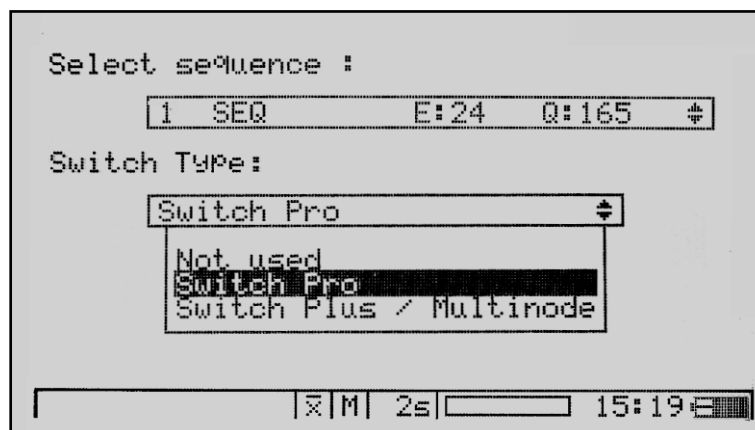
Procedure:

use the  and  keys to move up and down the cursor in the list and the  key to select **Automatic sequence**, then press the  key

The list of sequences present in the memory will so be displayed:




So choose from this list, by the  and  keys, the sequence you wish to run and validate by the  key: the following screen appear:




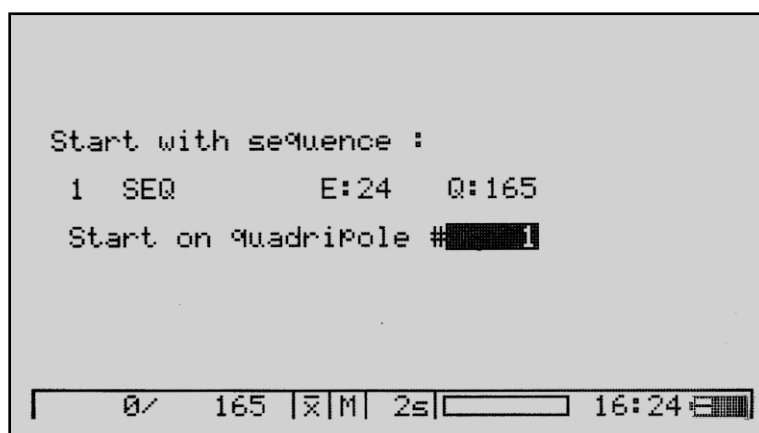
Then, specify the configuration of the system:


- **Not used** (no switching capability: 10 channels standard using): no meaning in that mode.
- **Switch Pro** (internal or external 10 channels switching capability)
- **Switch Plus / Multinode** (external 1 channel switching capability)

Press  to validate

Then press the  key or select the "Tools|Start" menu.

The first screen will be relative to the filename, which you can change at this stage ; then press the  key: the following screen will appear:



So, to start the measurement at the first quadripole, then press the  key (if you want to start the measurement from another quadripole, enter its number and validate):

Before running the measurement, for the first acquisition, the program offers automatically to save the data from the first memory area ("0"):



Available range of the memory area

Note that if you want to store the data from a specific memory area, use the numeric keys.


Then, press the  key to confirm.

Note:

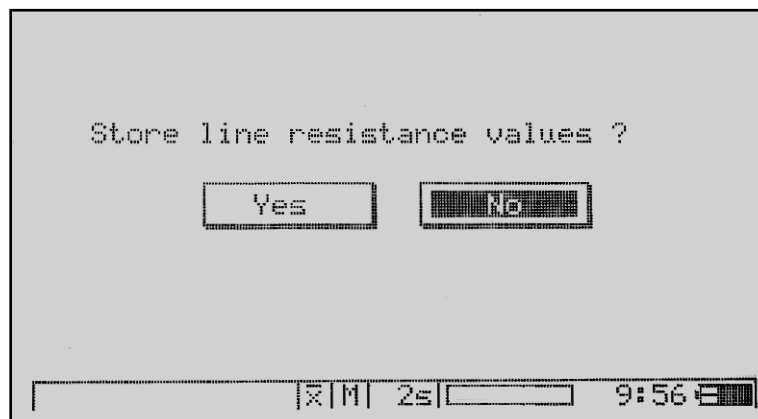
If you want to store the data from a full memory area, the following warning message will be displayed:



So, press **"Yes"** to confirm, and **"Abort"** to skip this function without overwriting the data.

If you press **"No"**, the program will check automatically the first free memory area and will offer to save the data from this one ; then, press  to validate.

Then, after selection of the memory area, the program will offer to store the resistance values of the dipoles:

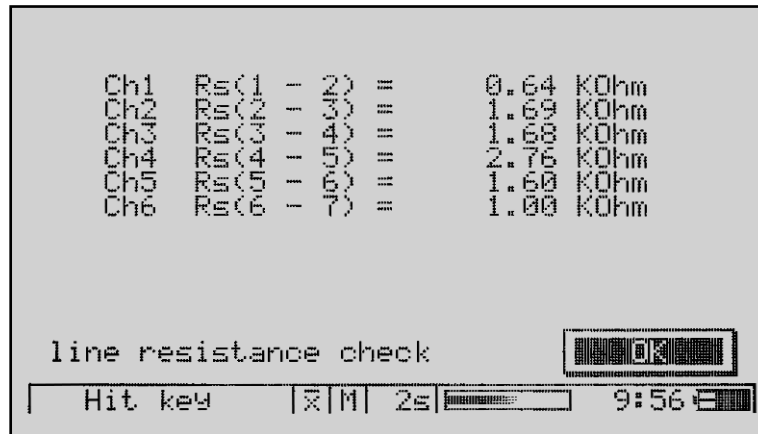


So, if you choose **"Yes"**, the Rs check process will be run first before each set of measurements, displaying the resistance of the dipoles in the cable ; then, between each set of measurements, the Rs check on the next measuring dipoles will be run and the resistance value of these dipoles will be stored

Note:

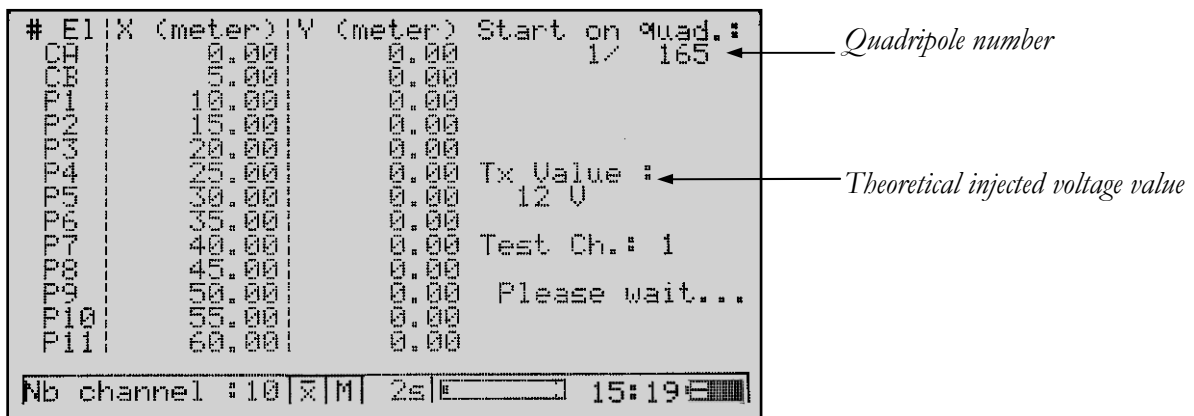
Keep in mind that this option is time consuming (acquisition time will be multiplied about by 2)

If "**No**" has been selected, the Rs check process will be run but values won't be stored.



Then, if you selected previously "**Yes**", during a while, a screen with the "**Rs check**" message in the lower left part of the screen, will appear during a time required for the measurement.

Then, the next display will be:

**Note:**


On that screen, the **Tx value** displayed is a theoretical value which can be sometimes different from the actual value as a power or voltage limitation can occur, depending on the grounding resistance values and temperature conditions.

The measurements will be then displayed.

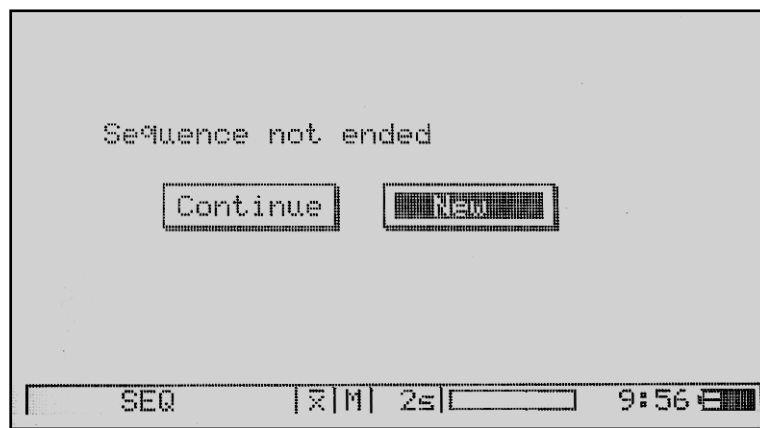
The previous screen will appear between each set of measurements.

Note that during the measurement, one has the opportunity to see various results and various type of screens (cf § II.3.6. for more information).

Notes:

- The estimated time left will be also displayed (in the upper right corner of the screen) after the first set of measurements and between each set of measurements.
- To stop a sequence, press the  button ; if a sequence has not been stopped before the end, a message (**Sequence not ended...**) will be displayed in the master screen

Then, if a start on the same sequence is run, the following screen will be displayed:



Then, press "**Continue**" to continue the acquisition or press "**New**" to run a new acquisition.





II.3.4.3. High speed sequence

In that process, after having created a sequence (cf. II.3.4.), one has to specify that the acquisition has to be performed in **High speed sequence** mode.

Then select the "**Config|Mode**" menu ; a screen indicating the current mode will appear ; so if **High speed sequence** mode is selected, then press "**OK**".

If not, press "**Change**": the screen showing the available modes will appear ; so, select the **High speed sequence** mode.

Procedure:

use the  and  keys to move up and down the cursor in the list and the  key to select **High speed sequence**, then press the  key

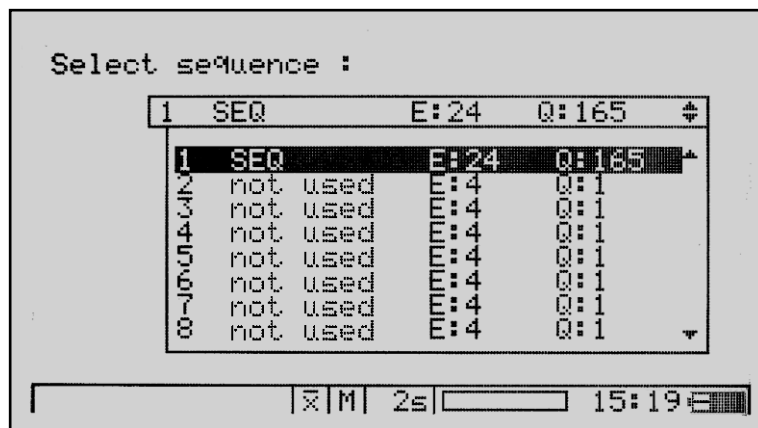
Important note:




This mode uses by default the following parameters:

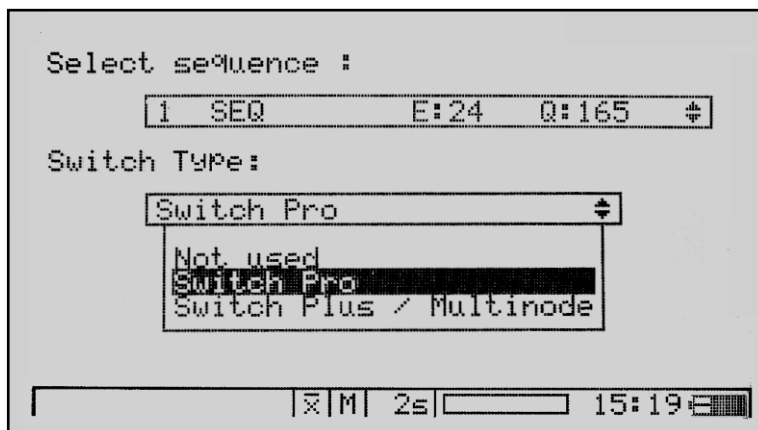
- Pulse duration: about 200 ms
- Positive pulse followed by a negative pulse (In that mode, no IP measurements can be done).

Moreover, this mode requires to work with a constant value of injection. So, the sequence has to be created with a Vab requested value or this can be modified from the Tx parameters (cf. II.1.5.) before running the sequence.

After validation of the mode, the list of sequences present in the memory will so be displayed:




So choose from this list, by the  and  keys, the sequence you wish to run and validate by the  key: the following screen appear:

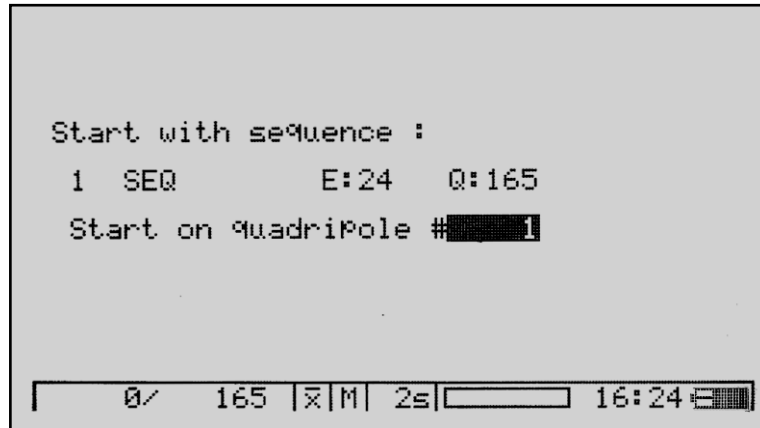



Then, specify the configuration of the system:

- **Not used** (no switching capability: 10 channels standard using): no meaning in that mode.
- **Switch Pro** (internal or external 10 channels switching capability)
- **Switch Plus / Multinode** (external 1 channel switching capability)

Then press the  key or select the "**Tools | Start**" menu.

The first screen will be relative to the filename, which you can change at this stage ; then press the  key: the following screen will appear:



So, to start the measurement at the first quadrupole, then press the  key (if you want to start the measurement from another quadrupole, enter its number and validate):

Note:

After validation, if the type of injection is not based on a constant Vab value ("**Vab requested**" mode), an error message will appear in a window. In that case, choose "**New**" from this window to reach directly the "**Tx Parameters**" screen to modify the type of voltage requested (cf. II.I.5.).

Before running the measurement, for the first acquisition, the program offers automatically to save the data from the first memory area ("0"):



Available range of the memory area

Note that if you want to store the data from a specific memory area, use the numeric keys.


Then, press the  key to confirm.

Note:

If you want to store the data from a full memory area, the following warning message will be displayed:



So, press **"Yes"** to confirm, and **"Abort"** to skip this function without overwriting the data.

If you press **"No"**, the program will check automatically the first free memory area and will offer to save the data from this one ; then, press  to validate.

Then, the following screen will appear directly (no Rs check is performed in that mode):



At the end of the sequence, we'll reach automatically the master screen.

II.3.5. Continuous survey

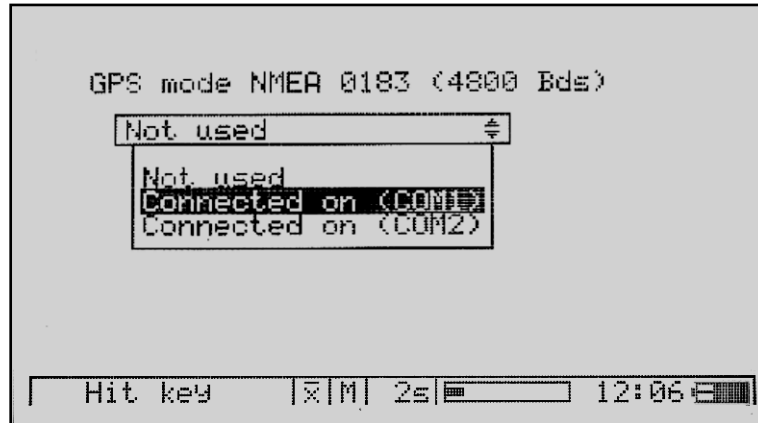
This type of acquisition can be reached from the **"Tools | Continuous survey"** menu.

This is a dynamic mode designed for marine acquisition.

In that mode, the SYSCAL Pro is in the **standard mode** configuration ; it means than we can use simultaneously up to 10 reception channels (the marine cable being connected to the A-B-P1...P11 plugs of the unit by a specific connector) ; this corresponds to 10 levels of investigation.

In that mode, only resistivity measurements will be performed

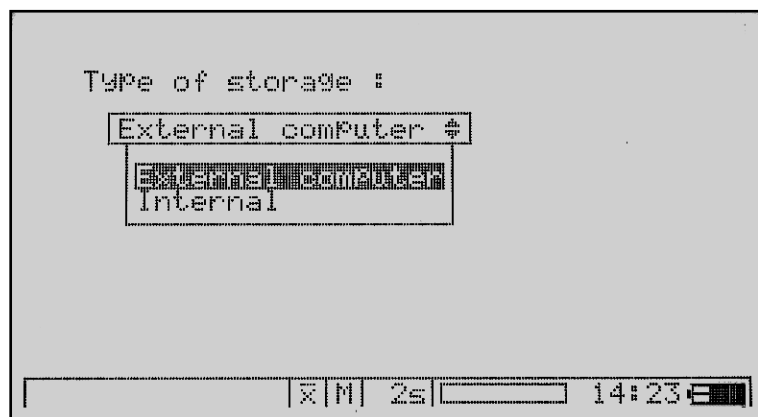
After selection of that mode, one can specify if a GPS is connected to the unit:



Then, after validation, the following screen will appear:



Then, press "OK": a waiting message ("**Remote control**") will appear then. If no GPS is used, the following screen will appear before the display of the waiting message:

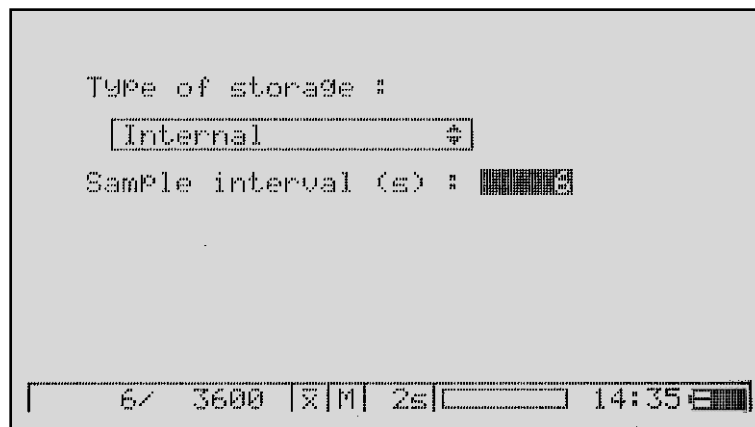


- In case of "**External computer**" is selected, a waiting message ("**Remote control**") will appear ; then, from a specific PC software, SYSMAR, one has to define the position of the electrodes, the pulse duration and the voltage value to inject ; then the measurement can be run.

- In case of the internal memory of the unit is used, one has first to define the setup parameters from the options of the "**Config**" menu:

Note that from the "**Config|Tx parameters**" option (cf. II.1.5.), one has to specify a "Vab" requested value.


Then after selection of "**Internal**", the following window will be displayed:



Then, specify the interval between measurements, in second, in the range [6 – 3600] ; in case of no GPS is connected, the minimum value of the sample interval is: 1 s

This value corresponds to the minimum step of measurement ; then validate: one will have then to specify the first memory area from which the data will be stored ; after validation, if the type of injection is not based on a constant Vab value (Vab requested), an error message will appear. In that case, apply the modification from the "**Config|Tx parameters**" menu and do anew the procedure.

Then, specify the first memory area to store data and then, the measurement will be run: no values will be displayed in that mode:

The acquisition will have to be stopped by the  key.

In case of a GPS is connected, the minimum acquisition value is about 2 s ; the measurements are stored automatically in the PC. The GPS data are also continuously recorded and stored for a precise location of the profile.

A GPS with a sounder can be also used for a continuous water depth recording.

Please refer to the on-line help file of SYSMAR software for more information.

Note:



In standard configuration:


- The cable (specific cable with a DB9 female output) has to be connected to the "Com 2" of the unit (serial link of the backside).
- The GPS has to be connected to the "Com 1" of the unit (serial link of the front panel) by the cable with a DB9 male output supplied ; then a Rs232 cable, allowing to connect your own GPS to that DB9 male plug will have to be used.

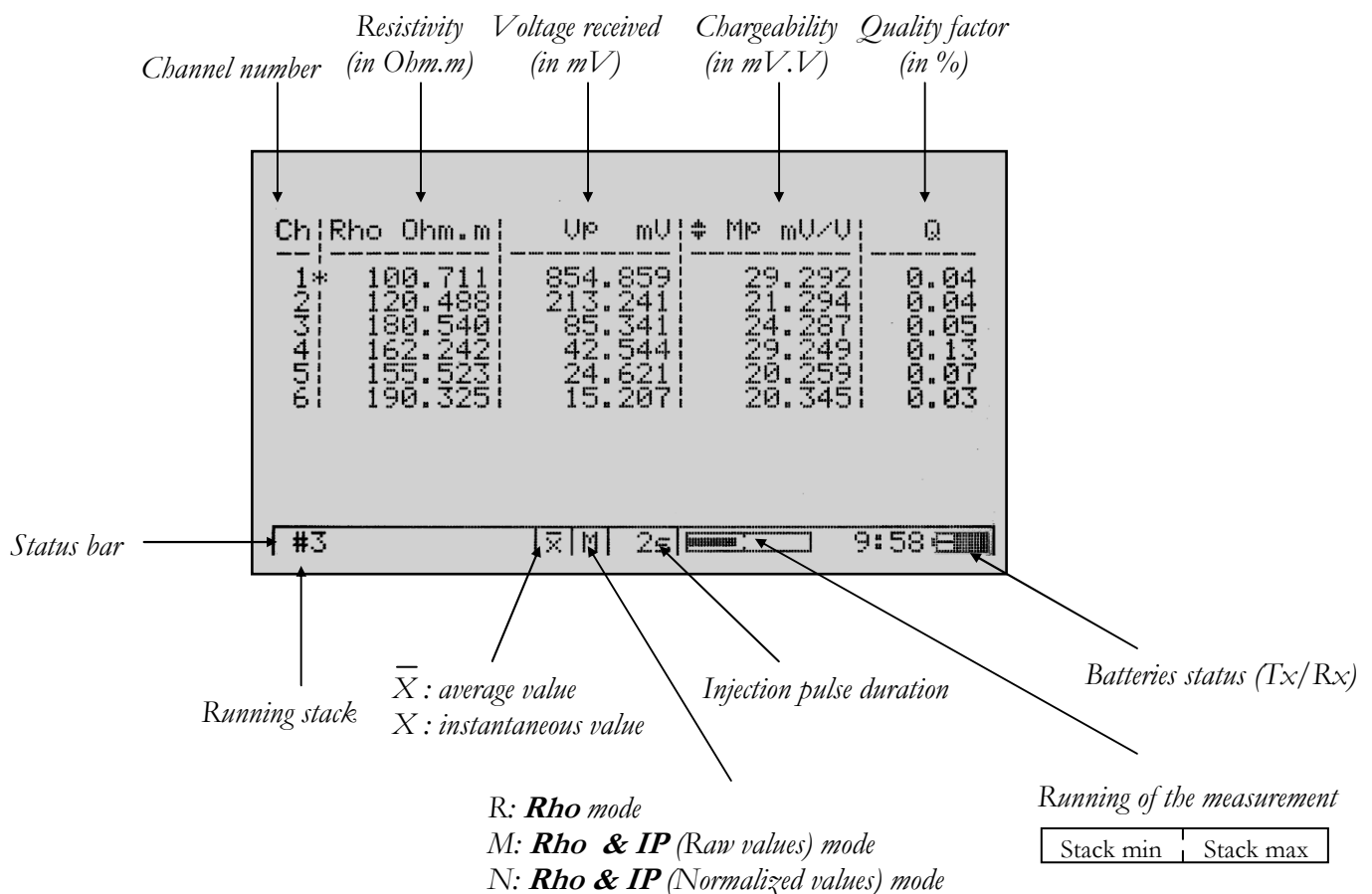
If a GPS is used, you have first set your GPS in NMEA mode (cf. Annex 10 for details)).

II.3.6. Results during measurement




Whatever the operating mode (except for the **High speed sequence** mode), the screens showing the results will be the same:

The  key will show the results of the measurement, channel per channel whereas the  key will show the results of the measurement, for the whole channels.

- So, from the  key:




During the measurement, one can use the  and  keys to change the displays:


- Pressing the  key will allow to see the **current** value (in mA) instead of the chargeability (**Mp**) value.
- Pressing the  key one more time will allow to see the **Sp** value (Self potential in mV) instead of the **current** value.
- Pressing the  key one more time will allow to check if there are some **overload** in reception


The overload thresholds are the following ones:

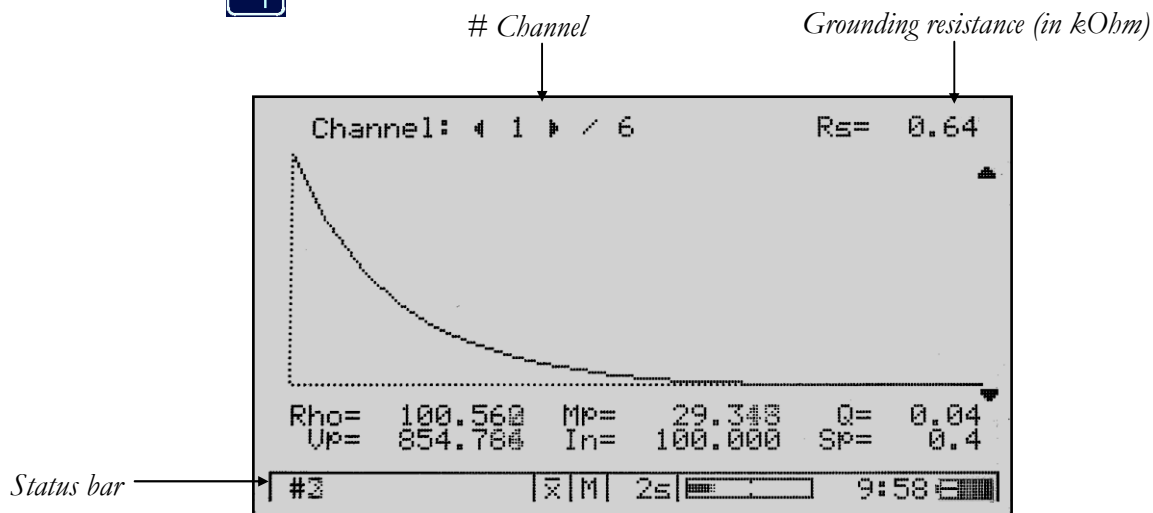
V_{P1-P2} : 15 V and



$\sum V_{P2 \text{ to } P11}$: 15 V


- And then, pressing the  key one more will allow to see the **decay curves** for the whole channels of measurement.


- Press the  one more time to come back to the first screen.



- And from the  key:



During the measurement, one can use the  and  keys to see the results channel per channel.

At this stage, you can use also the  key to visualize the partial chargeability values of the current channel.

- Pressing the  key one more time will allow to visualize the spacing parameters



- Press the  key one more time to visualize the location of the profile (longitude and latitude position)
- Press the  key one more time to come back to the first screen.


Note:

The parameters displayed during the acquisition depend on the injection pulse duration selected. Indeed, if a low injection time has been selected (250 ms for example), only some of the parameters will be displayed.

II.4. AFTER ACQUISITION

II.4.1. Result

Once a measurement has been performed, the results can be visualized in the same way than during the measurement, by the  or by the  key.

The  key will show the results of the previous measurement, channel per channel.

This function can also be reached from the "**Tools | Result**" menu.

The  key will show the results of the previous measurement, for the whole channels.

The screens will be exactly the same that the ones shown during the measurement and you'll have the same functions offered (cf. II.3.6.).

Note:

This function is mainly useful for the Standard mode. Indeed, in the modes where a sequence of measurement has been run, we'll only have a view of the last measurement.

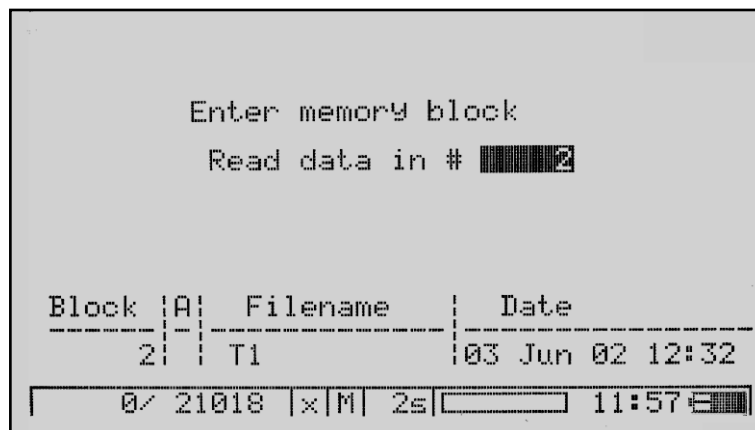
II.4.2. Memory

The memory size of the unit is 20241 data points.

One has the opportunity to recall a data point previously stored into the memory of the unit.


Each data point is stored in a memory area.

To do that, select the "**Memory | Recall**" menu: the following screen will appear:



Then select the memory area you wish.

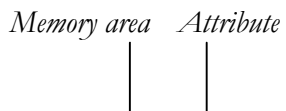
Procedure:

Use the numeric keys and validate by the  key


The screens will be exactly the same that the ones shown during the measurement and the same functions will be offered.

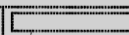

You can also visualize the whole data files stored in the memory by the "**Memory|Explore**" menu: the following screen will appear:

Memory area *Attribute*



Block	A	Filename	Date
0	T1		03 Jun 02 12:32
1	T1		03 Jun 02 12:32
2	T1		03 Jun 02 12:32
3	T1		03 Jun 02 12:32
4	T1		03 Jun 02 12:32
5	T1		03 Jun 02 12:32
6	T1		03 Jun 02 12:32
7	T1		03 Jun 02 12:32
8	T1		03 Jun 02 12:32
9	T1		03 Jun 02 12:32

List #  10

0/ 21018 | x | M | 2s |  11:58 


This option allows only to visualize the name of the data files with the storage date:

You can enter the memory area number you wish (**List #** area) in order to scroll up and down in the list.

The attribute (**A**) of the memory area can be the following one:

- " ": if a data is currently stored in that memory area
- "D": if the corresponding data has been deleted

Procedure:

Use the numeric keys and validate by the  key

III. DATA MANAGEMENT

Once the measurement has been performed and the data stored in the internal memory of the unit, one can download the data to the PC, connected to the "**Com**" plug.

This has to be done by the PROSYS II software.

PROSYS II software is the data visualization, processing and export software for all the SYSCAL / ELREC type units of *IRIS Instruments*.

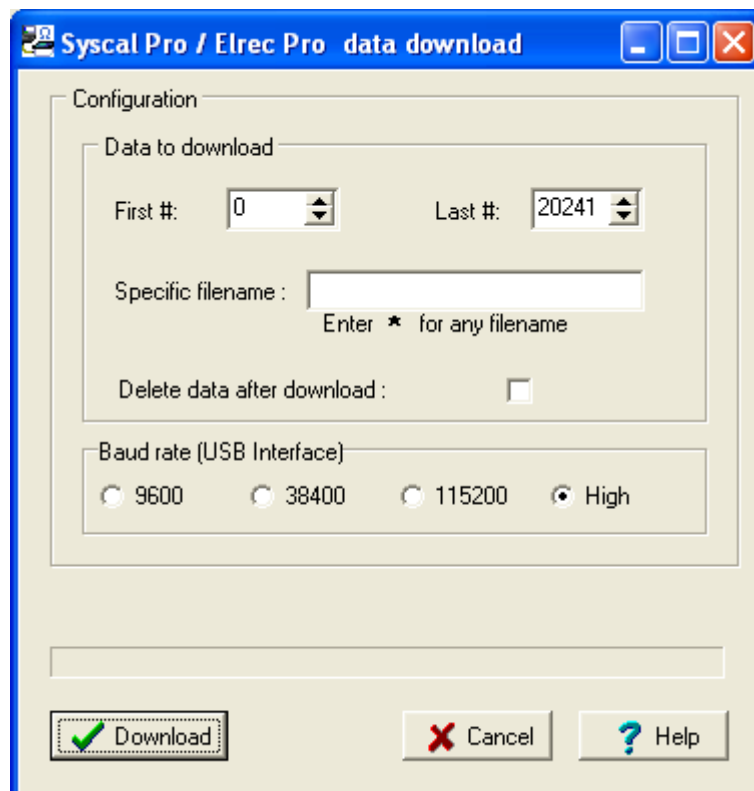
So, after having installed PROSYS II software in the PC (by the "IRIS Instruments" CD-ROM supplied with the unit), run the "ProsylsII.exe" file from the installation directory.

Note:

PROSYS II software has an on-line help file, which will help you in the various tasks.

III.1. DATA DOWNLOAD

From PROSYS II software, select first the "**Communication|Communication port**" menu (USB (IRIS USB device required) or Serial link) then, the "**Communication|Data download|SYSCAL Pro/ELREC Pro**" menu ; the following screen will appear:




So, you'll have the choice to select either the first and last data points to transfer ("**First #**" and "**Last #**") or to enter the name of a file to download the whole data stored with this file name ("**Specific filename**" area) ; note that you can enter a "*" to download the whole memory.

Notes:

- In regards to the PC capabilities, the baud rate for download can be chosen.
- You can choose also to delete data after download crossing the appropriate box

Then, click on the "**Download**" button: the following screen will appear:



Then, press the  key (or select the "**Memory | Data download**" menu) from the SYSCAL Pro.

Then, click on "Ok" on the computer and the data transfer will begin ; a bar graph showing the transfer progress will appear in the PROSYS II window.

After data transfer, PROSYS II offers to save the data with a filename ; the extension of the file is ".bin".

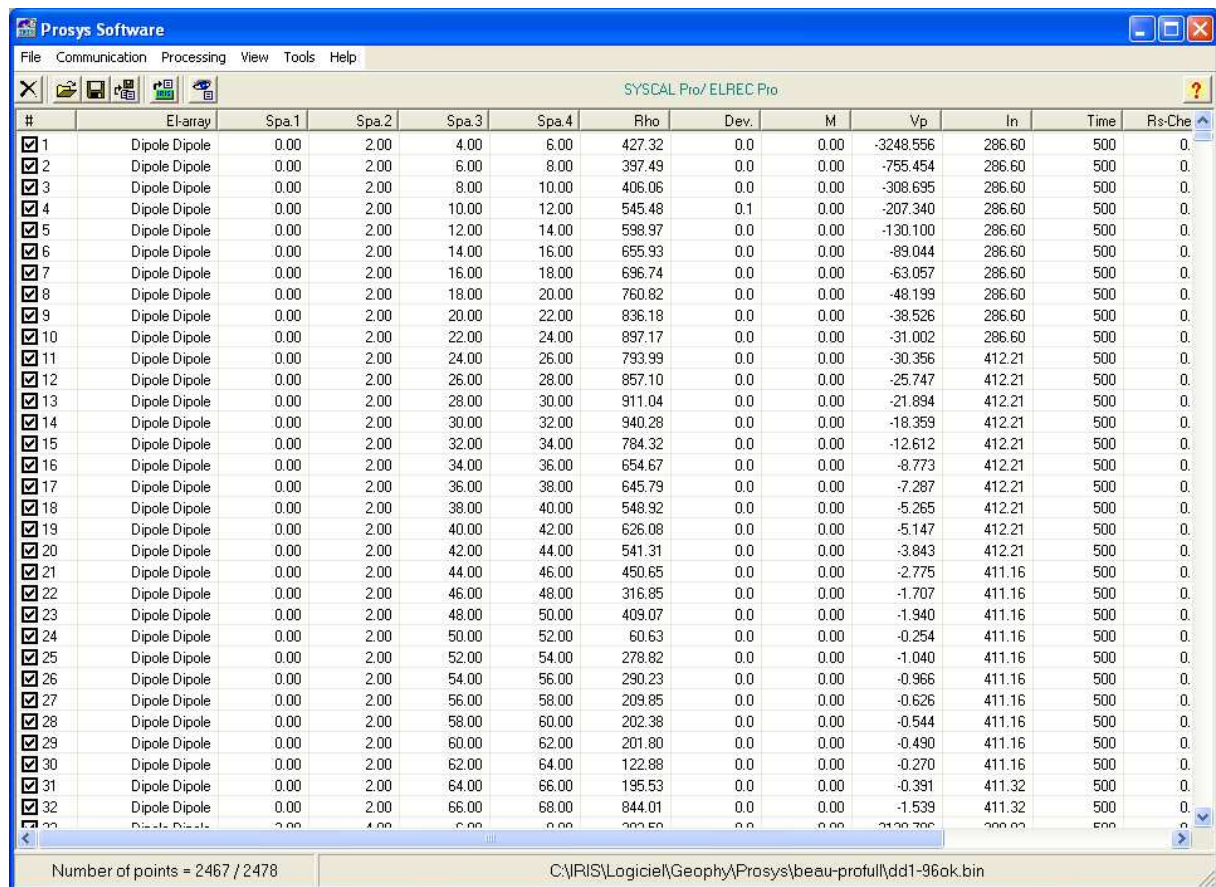
Note that data can be also downloaded to the IRIS SD reader: in that case, select the "**Memory | SD card download**" menu.

For more information, please refer to the Annex 11.

III.2. DATA VISUALIZATION

Once a data file has been transferred, one can visualize it thanks to the **"File | Open"** menu.

Then select the ".bin" file you wish to open ; the following screen will appear:



#	El-array	Spa.1	Spa.2	Spa.3	Spa.4	Rho	Dev.	M	Vp	In	Time	Rs-Che
1	Dipole Dipole	0.00	2.00	4.00	6.00	427.32	0.0	0.00	-3248.556	286.60	500	0.
2	Dipole Dipole	0.00	2.00	6.00	8.00	397.49	0.0	0.00	-755.454	286.60	500	0.
3	Dipole Dipole	0.00	2.00	8.00	10.00	406.06	0.0	0.00	-308.695	286.60	500	0.
4	Dipole Dipole	0.00	2.00	10.00	12.00	545.48	0.1	0.00	-207.340	286.60	500	0.
5	Dipole Dipole	0.00	2.00	12.00	14.00	598.97	0.0	0.00	-130.100	286.60	500	0.
6	Dipole Dipole	0.00	2.00	14.00	16.00	655.93	0.0	0.00	-89.044	286.60	500	0.
7	Dipole Dipole	0.00	2.00	16.00	18.00	696.74	0.0	0.00	-63.057	286.60	500	0.
8	Dipole Dipole	0.00	2.00	18.00	20.00	760.82	0.0	0.00	-48.199	286.60	500	0.
9	Dipole Dipole	0.00	2.00	20.00	22.00	836.18	0.0	0.00	-38.526	286.60	500	0.
10	Dipole Dipole	0.00	2.00	22.00	24.00	897.17	0.0	0.00	-31.002	286.60	500	0.
11	Dipole Dipole	0.00	2.00	24.00	26.00	793.99	0.0	0.00	-30.356	412.21	500	0.
12	Dipole Dipole	0.00	2.00	26.00	28.00	857.10	0.0	0.00	-25.747	412.21	500	0.
13	Dipole Dipole	0.00	2.00	28.00	30.00	911.04	0.0	0.00	-21.894	412.21	500	0.
14	Dipole Dipole	0.00	2.00	30.00	32.00	940.28	0.0	0.00	-18.359	412.21	500	0.
15	Dipole Dipole	0.00	2.00	32.00	34.00	784.32	0.0	0.00	-12.612	412.21	500	0.
16	Dipole Dipole	0.00	2.00	34.00	36.00	654.67	0.0	0.00	-8.773	412.21	500	0.
17	Dipole Dipole	0.00	2.00	36.00	38.00	645.79	0.0	0.00	-7.287	412.21	500	0.
18	Dipole Dipole	0.00	2.00	38.00	40.00	548.92	0.0	0.00	-5.265	412.21	500	0.
19	Dipole Dipole	0.00	2.00	40.00	42.00	626.08	0.0	0.00	-5.147	412.21	500	0.
20	Dipole Dipole	0.00	2.00	42.00	44.00	541.31	0.0	0.00	-3.843	412.21	500	0.
21	Dipole Dipole	0.00	2.00	44.00	46.00	450.65	0.0	0.00	-2.775	411.16	500	0.
22	Dipole Dipole	0.00	2.00	46.00	48.00	316.85	0.0	0.00	-1.707	411.16	500	0.
23	Dipole Dipole	0.00	2.00	48.00	50.00	409.07	0.0	0.00	-1.940	411.16	500	0.
24	Dipole Dipole	0.00	2.00	50.00	52.00	60.63	0.0	0.00	-0.254	411.16	500	0.
25	Dipole Dipole	0.00	2.00	52.00	54.00	278.82	0.0	0.00	-1.040	411.16	500	0.
26	Dipole Dipole	0.00	2.00	54.00	56.00	290.23	0.0	0.00	-0.966	411.16	500	0.
27	Dipole Dipole	0.00	2.00	56.00	58.00	209.85	0.0	0.00	-0.626	411.16	500	0.
28	Dipole Dipole	0.00	2.00	58.00	60.00	202.38	0.0	0.00	-0.544	411.16	500	0.
29	Dipole Dipole	0.00	2.00	60.00	62.00	201.80	0.0	0.00	-0.490	411.16	500	0.
30	Dipole Dipole	0.00	2.00	62.00	64.00	122.88	0.0	0.00	-0.270	411.16	500	0.
31	Dipole Dipole	0.00	2.00	64.00	66.00	195.53	0.0	0.00	-0.391	411.32	500	0.
32	Dipole Dipole	0.00	2.00	66.00	68.00	844.01	0.0	0.00	-1.539	411.32	500	0.

Number of points = 2467 / 2478

C:\IRIS\Logiciel\Geophy\Prosys\beau-protull\dd1-96ok.bin

Then, from the master menu, you'll be able to visualize graphically the results, process (filtering - topography insertion,...) the data and create some export files for the commonly used interpretation software.

For more information, please refer to the on-line help file of PROSYS II software.

IV. OTHER FUNCTIONS

IV.1. FROM CONFIG MENU

The **Load default** option allows to load the default set-up parameters.

IV.2. FROM TOOLS MENU


IV.2.1. Rs Check option

The **Rs Check** option allows to run a grounding resistance measurement for the dipoles.

The screen is the same that the first one appearing after having pressed the  key:

In that process, the consecutive dipoles are tested and the resistance value is displayed in kOhm.

Notes:

- In **High speed sequence** mode, this option is particularly useful as no Rs check process is performed before running the measurement
- In **Manual sequence - Automatic sequence** and **High speed sequence** modes, the Rs check process can be stopped by the  button.

IV.2.2. Remote option

This option allows to use the system in the following ways:

- Connect a modem to the "**Com 1**" of the unit to be able, remotely, to upload a sequence from the ELECTRE Pro software and download the data from the PROSYS II software.

For more information, please refer to the on-line help file of ELECTRE Pro and PROSYS II software.

- Or, connect a PC directly to the unit ("**Com 1**") to drive it from a specific PC software (COMSYS Pro software)

IV.3. FROM MEMORY MENU

IV.3.1. Store option

After a measurement, one has the choice to store the data directly or not.

If you choose not to store the data (to check them beforehand for example), you'll have in a second time the opportunity to store them thanks to the "**Memory | Store**" menu.

IV.3.2. Store index option

This option allows to select a memory area from which the next measurements will be stored.

This option is useful if you programmed a wake up of the unit (thanks to the "**Alarm**" options of the "**System**" menu (cf. IV.5.5.)).

IV.3.3. Delete data option

This option allows to delete some data from the internal memory ; one has just to specify the block to erase (first and last data point to erase) ; a message will ask you to confirm the delete.

IV.3.4. Undelete data option

This option allows to undelete 1 datum point that have been previously deleted. So, this means that if some data have been deleted, you'll have the opportunity to retrieve these data. To do that, you'll have to enter the area number of the data point ; a message will indicate if the undelete process was successful or not.

Note:

This can be done only if you didn't write into this memory location in the meantime.

IV.4. FROM SEQUENCE MENU

IV.4.1. Upload (from Pc or SD card) option

The "**Upload | From PC**" menu allows to load a sequence from ELECTRE Pro software.

The "**Upload | From SD card**" menu allows to load a sequence from the SD reader.

Selecting this option, a waiting message will appear on the screen ; then, upload the sequence from the software.

By ELECTRE Pro software, you can create any type of sequence (directly created by the software, or via Excel).

- Optimized sequences for multi-channel reception
- 2D - 3D or borehole sequences.

For more information, please refer to the on-line help file of ELECTRE Pro software.

IV.4.2. Modify Config option

This option allows to modify some parameters of a sequence:

So, first select in the list the sequence you wish to modify and then, you'll have access to the following parameters:

- Tx parameters (cf. II.1.5)
- Electrode array (cf. II.1.6)

IV.4.3. Delete option

This option allows to delete one ("**One**" button) or the whole sequences ("**All**" button) stored in the SYSCAL Pro memory.

If you choose "**One**", you'll have then to select from the list the sequence you wish to erase.

If you choose "**All**", a message will ask you to confirm the delete.

Press "**Abort**" to skip this function and reach the master menu

IV.4.4. Undelete option

This option allows to undelete a sequence previously deleted. So, this means that if some sequences have been deleted, you'll have the opportunity to retrieve these sequences. To do that, you'll have to enter the # of the deleted sequence ; a message will indicate if the undelete process was successful or not.

Note:

This can be done only if you didn't create any sequence in the meantime.

IV.5. FROM SYSTEM MENU

IV.5.1. Clock

This option allows to program the internal clock of the unit ; the date/time are stored into the memory.

IV.5.2. Check Switch option

In that option, one has the possibility to test 1 specific electrode or several electrodes.

- Check 1 electrode:

In that option, one has just to specify the electrode to be switched and create a short circuit between this electrode and the P2 plug of the front panel : a resistance measurement (in kOhm) will be performed ; this test allows to check the open line condition on a specific electrode.

- Check all electrodes:

In that option, one has to specify the electrodes to be tested: specify the first and the last electrode number: in that case, all the dipoles combinations will be tested ; a resistance measurement (in kOhm) for each dipole will be performed ; this test allows to check the short circuit condition in a cable.

IV.5.3. Calibration option

This option allows to run the calibration of the whole channels.

This has to be done after firmware upgrade and also if you have a doubt about the received voltage levels.

This operation has to be performed without connected dipoles.

After having chosen this option, the following screen will appear:

Ch	Sc < 1.00	Of < 2.30	
1	H 0.09	L 0.10	
2	H 0.07	H 0.17	
3	H 0.10	L 0.12	
4	H 0.09	L 0.10	
5	H 0.09	L 0.19	
6	H 0.06	L 0.10	
7	H 0.09	H 0.14	
8	H 0.35	H 0.09	New
9	H 0.46	L 0.08	
10	H 0.56	H 0.09	Exit
U+ = 16.6 / U- = -16.1			
x M 2s 16:19			

The result of the latest calibration is so displayed ; to perform a new one, press "**New**" button.

The results have to be the following ones:

Sc < 1.00 and **Of < 2.30** for the whole channels.

Press the "**Exit**" button to skip this option.

IV.5.4. Format option

This option will re-initialize the unit ; so, all the data and sequences will be lost if you perform this operation ; a message will ask you to confirm the format.

IV.5.5. Alarm options

This option has to be used to program a wake up of the unit.

This allows to specify the time (hour/minutes) of the wake up (2 wake up can be programmed in the unit ("**Set Alarm 1**" - "**Set Alarm 2**" options)).

After that, the "**Start Alarm**" option has to be used: the following screen will appear:



Then, make you selection by the arrow keys and validate by the  key.

V. FIRMWARE UPGRADE

The SYSCAL Pro unit is programmed in flash ROM.

To upgrade it, an "**e-Flash**" programmer is supplied with the unit.

This programmer has to be used to upgrade the firmware of the reception (Rx) and the transmitter (Tx) boards.

A specific PC software, called E-FLASH, has to be used to perform this process.

Note:

Before performing the upgrade, transfer the whole measurements to a PC.

Indeed, depending of the upgrade version, the memory will be totally erased.

So, after having installed E-FLASH software in the computer (thanks to the "IRIS Instruments" CD-ROM supplied with the unit), run the "eFlash.exe" file from the installation directory.

For more information, please refer to the on-line help file of E-FLASH software.

After firmware upgrading, we advise to run a calibration of the system (by the "**System| Calibration**" menu (cf. IV.5.3.).

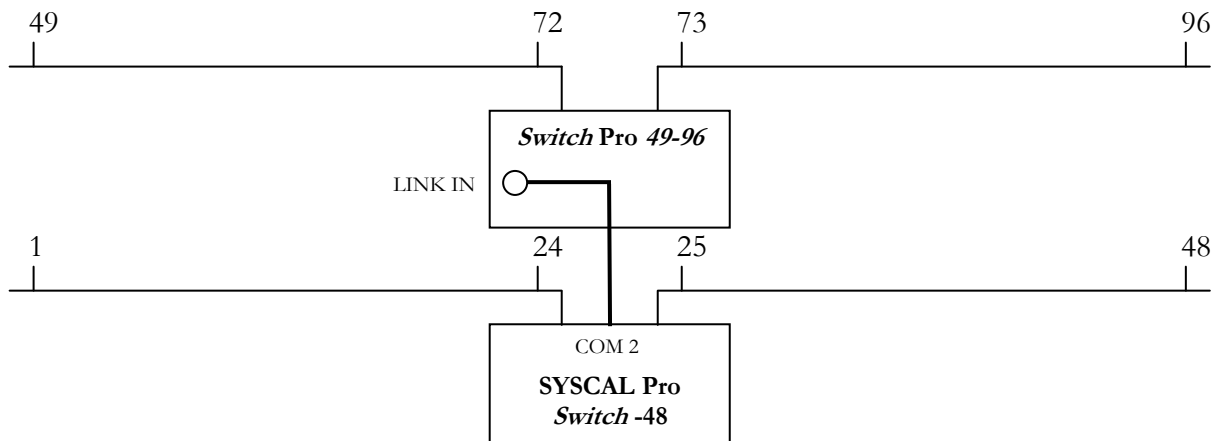
ANNEX 1: EXTERNAL SWITCH PRO BOX

To perform 3D acquisition keeping the capability to use 10 reception channels in switching mode, an external switching box, called *Switch Pro* has been developed.

This external box can be connected to the SYSCAL Pro unit (Standard or *Switch* version), by a specific cable connected between the "**Extension link**" plug of the SYSCAL Pro and the "**Link in**" plug of the *Switch Pro*).

This switching box exists in different versions from 24 to 192 electrodes ; to extend the number of electrodes several boxes can be connected by specific cables connected between the "**Link out**" plug of the previous *Switch Pro* box to the "**Link in**" plug of the next *Switch Pro* box.

The following scheme shows the in-the-field configuration of the electrodes of a SYSCAL Pro *Switch*-48 unit with a *Switch*-48 Pro box:



On the *Switch Pro* box, a display with two keys ("**MENU**" - "**CHANGE**") allows to choose the numbering of the electrodes to make it compatible with your SYSCAL Pro unit.

The "**MENU**" key allows to reach the "increment node function": then by the "**CHANGE**" button, choose the numbering. Press the "**MENU**" key to reach the "decrement node function". Then, press anew the "**MENU**" key to see the type of *Switch* box (Pro in standard) ; you can change it by a *Switch Plus* box (1 channel switching) to be compatible with a SYSCAL *Switch* unit.

Note:

The *Switch Pro* box has an internal rechargeable 12V – 7 Ah battery. As for the SYSCAL Pro, for security reasons, a ventilation screw is located on the front panel of the *Switch Pro* box (cf. I.2.4.).

An external 12V standard car battery can be connected to the front panel ("+" and "-" plugs (Input 12 V)). If the battery level becomes insufficient (lower then 10 V), a "**Low Batt**" message will appear on the screen and a "**Switch Error**" message will appear on the SYSCAL Pro.


ANNEX 2: GEOMETRICAL PARAMETERS AND RESISTIVITY

The methods for measuring the subsurface resistivity by DC current injection are all based on the same principle:

- a current is sent in the ground through two electrodes (A, B - electrodes connected to the transmitter).
- the current creates an equipotential distribution making it possible to measure a potential difference between two other electrodes, which are potential ones (some arrays allowing to drive simultaneously up to ten potential dipoles (P1, P2...P10,P11)).
- an apparent resistivity is then defined by: $R_o = K.V/I$ where K (geometric factor) only depends on the geometric array of the electrodes in the field and is expressed by:

For the dipole i: $K_i = 2\pi / |1/A_{Pi} - 1/A_{Pi+1} - 1/B_{Pi} + 1/B_{Pi+1}|$

The various configurations only differ by the position of the electrodes with K assuming a more specific expression.

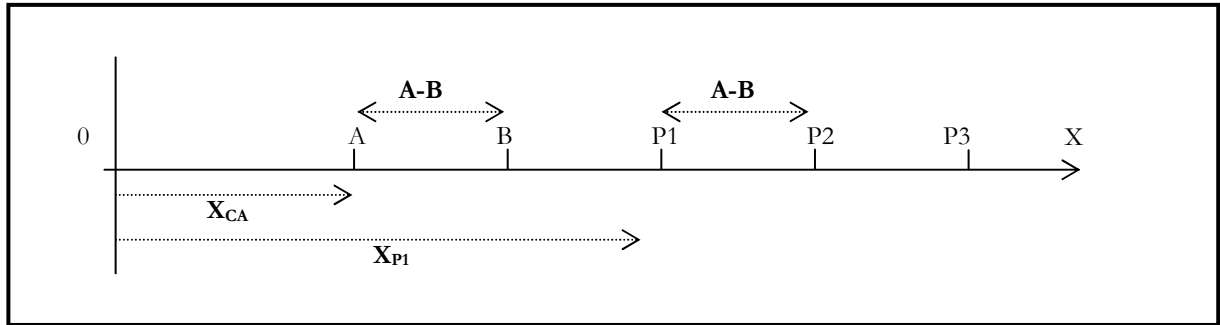
In regards to the chosen electrode array (, one will have several specific parameters to enter:

Electrode array	Geometrical parameters to specify				Max. number of dipoles
Dipole-Dipole	X _{CA}	A-B	X _{P1}		10
Pole-Dipole	X _{CA}	X _{P1}	P1-P2		10
Pole-Pole	X _{CA}	X _{P1}			1
Wenner	Mid	AB/3			1
Schlum	Mid	AB/2	MN/2		1
Grad. rctgl	X _{CA}	A-B	X _{P1}	P1-P2	10
Mixed/Poly-Dip	X _{CA}	A-B	X _{P1}	P1-P2	10
Poly-Pole	X _{CA}	X _{P1}	P1-P2		10

Remark:

In the following pictures, the X axis is defined as the AB axis, the Y axis is directly perpendicular to AB and the origin 0 is taken as any arbitrary point.

• Dipole-Dipole



- X_{CA} : abscissa of the first current electrode

- X_{P1} : abscissa of the nearest potential electrode from the AB dipole

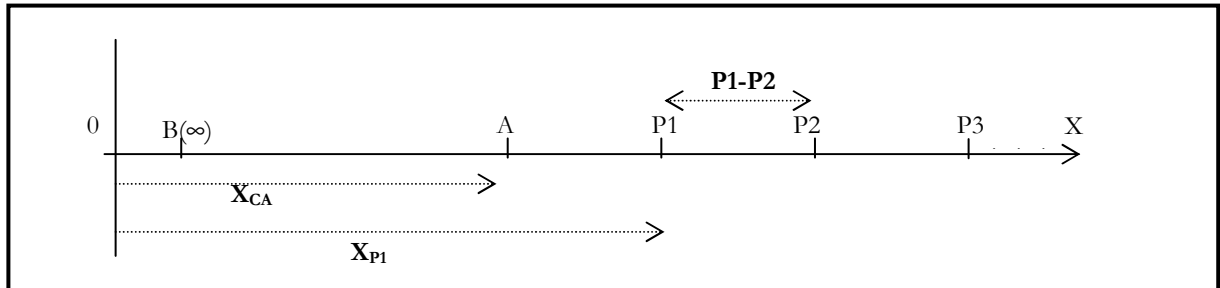
- **A-B**: length of dipoles (current and potential):

$$|AB| = |P1 P2| = \dots = |P10 P11|$$

By setting $n_i D$ as the distance between the midpoints of the dipoles AB and $P_i P_{i+1}$, we have:

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

• Pole-Dipole



The current electrode B has to be placed sufficiently far from the other electrodes to be able to ignore $1/BP_i$ (generally 5 times the maximum distance between A and P)

- X_{CA} : abscissa of the first current electrode

- X_{P1} : abscissa of the nearest potential electrode from the AB dipole

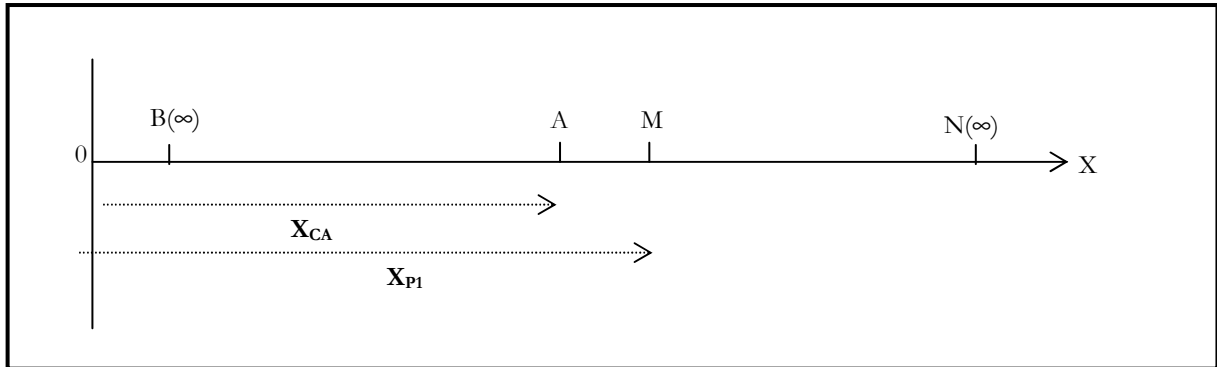
- **P1-P2**: length of the potential dipoles:

$$|P1 P2| = \dots = |P10 P11|$$

$$K_i = 2\pi / (1/AP_i - 1/AP_{i+1})$$

• Pole-Pole

In this array, the electrodes B and N have to be set sufficiently far from the A and M to be able to ignore $1/BM$, $1/BN$ and $1/AN$ (about 10 times the maximum distance between A and M)

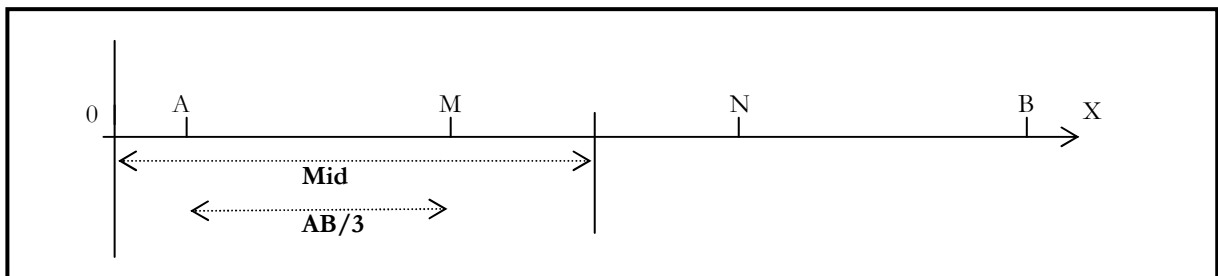


- X_{CA} : abscissa of the current electrode

- X_{P1} : abscissa of the potential electrode

$$K = 2\pi / (1/AM)$$

• Wenner

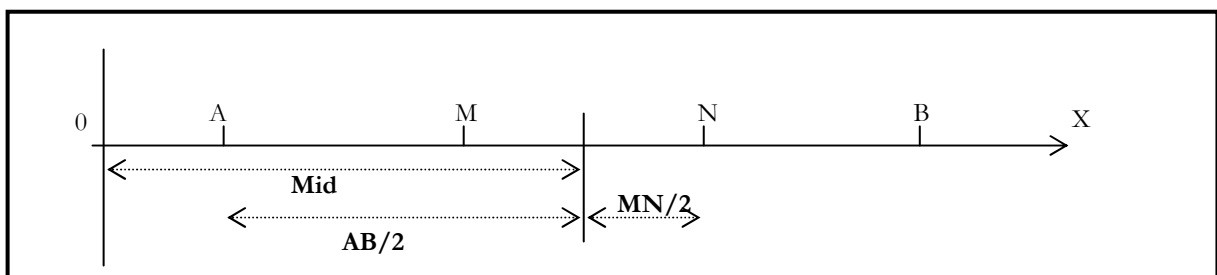


- **Mid**: abscissa of the centre of MN

- **AB/3**: a third of the distance between the current electrodes

So K remains constant all along the profile axis.

• Schlumberger



The electrodes keep constant relative positions.

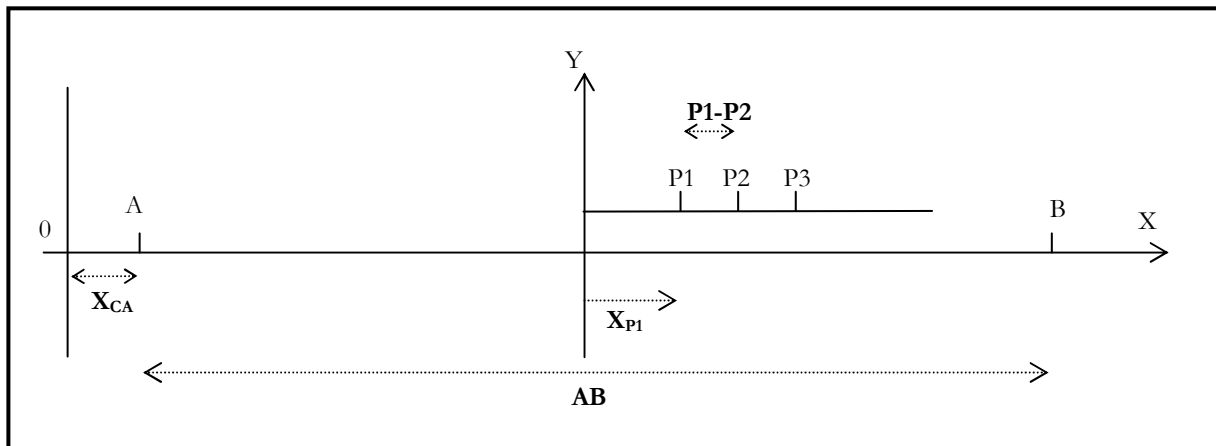
- **Mid**: abscissa of the centre of MN
- **AB/2**: half-distance between the current electrodes.
- **MN/2**: half-distance between the potential electrodes.

K is a constant of the profile:

If $AB/2 = a$ and $MN/2 = b$

$$K = \pi (a^2 - b^2) / 2b \quad (\text{if } AB/2 > MN/2).$$

• **Grad. rctgl (Gradient rectangle)**



In this array, the AB electrodes are fixed and the P_i electrodes are moved parallel to AB inside a zone located in the central part of AB. 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.

- **X_{CA}** : abscissa of the first current electrode
- **X_{P1}** : abscissa of the first potential electrode
- **A-B**: length of the current dipole
- **P1-P2**: length of the potential dipoles

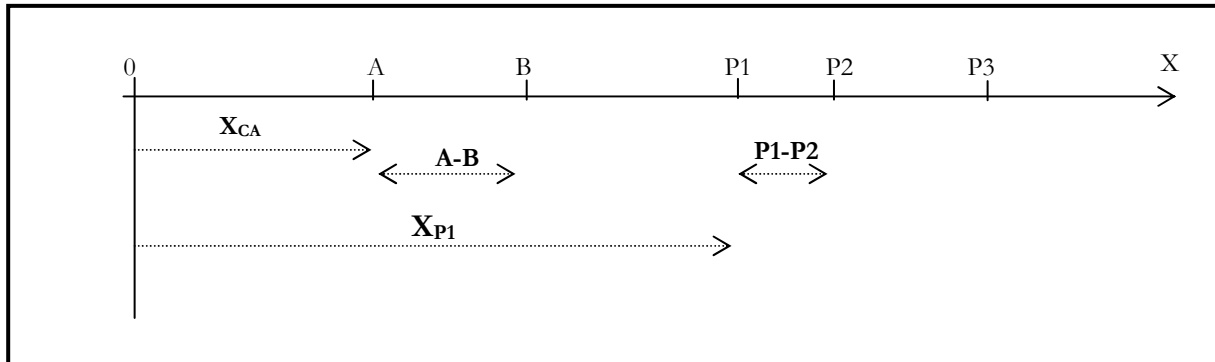
$$|P1\ P2| = \dots = |P10\ P11|$$

Note:

In that configuration, the Y coordinate of the reception electrodes (P_i) can be introduced directly from the SYSCAL Pro.

• Mixed/Poly-Dip

This array is similar to the Dipole-Dipole one with potential dipoles lengths that can be user specified.

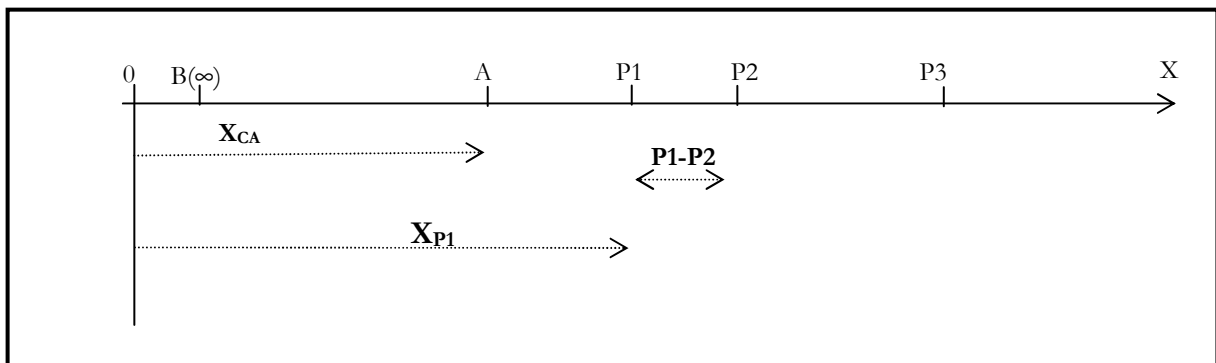


- X_{CA} : abscissa of the first current electrode
- X_{P1} : abscissa of the nearest potential electrode from the AB dipole
- $A-B$: length of the current dipole
- $P1-P2$: length of the potential dipoles

Note:

And, in a second step, you can modify the position of each potential electrode, selecting the "Move" button after having introduced these spacing parameters.

• Poly-Pole



This array is similar to the Pole-Dipole one with potential dipoles lengths that can be user specified.

The current electrode B has to be placed sufficiently far to be able to ignore $1/BP_i$

- **X_{CA}**: abscissa of the current electrode
- **X_{P1}**: abscissa of the nearest potential electrode from the AB dipole
- **P1-P2**: length of the potential dipoles

Note:

And, in a second time, you can modify the position of each potential electrode, selecting the "**Move**" button after having introduced these spacing parameters.

$$K_i = 2\pi / (1/AP_i - 1/AP_{i+1})$$

ANNEX 3: IP PARAMETERS AND CHARGEABILITY

The partial chargeabilities measurements (M_i) and the average global one deduced (M_g) give some information regarding the ability of the soil to charge itself due to a current flow.

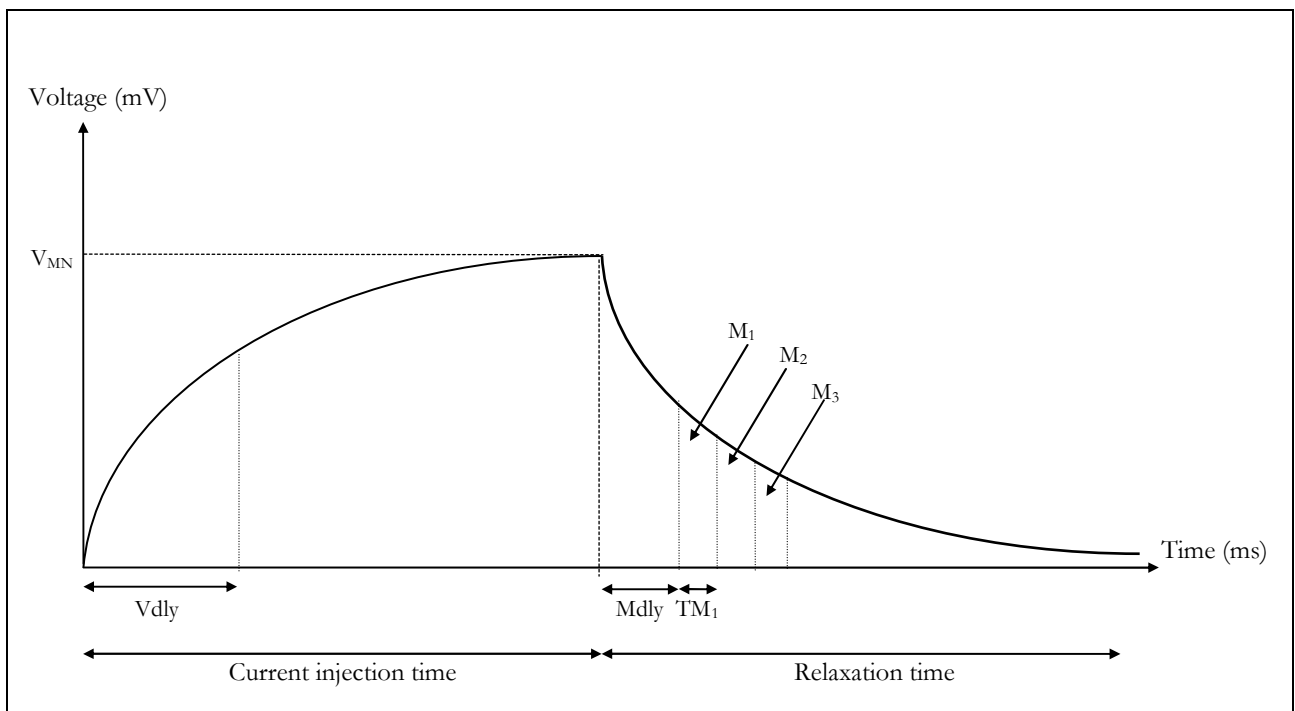
The partial chargeability of the window "i" is measured thanks to the following formula:

$$M_i = \int_{TM_i} V dt / TM_i \cdot V_{MN}$$

And the global chargeability is computed thanks to the following formula:

$$M_g = \frac{\sum_{i=1}^n (M_i \cdot TM_i)}{\sum_{i=1}^n TM_i} \quad (n: \text{number of IP windows})$$

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



With the SYSCAL Pro, up to 20 IP windows can be used to define the decay curve.

The number of IP windows available for the measurement depends on the type of IP mode and on the current injection time:

⇒ **Current injection times** available (cf. II.1.5): 500 ms - 1 s - 2 s - 4 s - 8 s

⇒ Types of **IP mode** available (cf. II.1.5): Arithmetic – Semi logarithmic – Logarithmic
Cole-Cole - Programmable

For a given current injection time and IP mode, the program will choose automatically the IP parameters (Mdly, Vdly, TM_i) that will be used for the measurement.

Note:

The programmable mode is a mode where 20 fully programmable windows are available. The operator has to select the delay time (Mdly) with a minimum of 20 ms and the width of each partial window (TM_i) with a minimum of 10 ms. Vdly is automatically determined by the injection time chosen.

In the following tables, the preset TM_i values are given for each IP mode (1 means TM₁ ...):

• **Time = 500 ms**

Mode	Vdly	Mdly	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Arith.	280	60	40	40	40	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Semi	280	40	40	80	160	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Log.	280	160	80	180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cole	280	160	80	180	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

• **Time = 1000 ms**

Mode	Vdly	Mdly	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Arith.	580	120	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40	40
Semi	580	40	20	20	20	20	20	20	20	20	40	40	40	40	40	40	80	80	80	80	80	80
Log.	580	160	120	220	420	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cole	580	20	10	20	20	20	20	20	30	30	30	40	40	40	50	50	50	60	60	70	80	90

• **Time = 2000 ms**

Mode	Vdly	Mdly	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Arith.	1260	240	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80	80
Semi	1260	40	40	40	40	40	40	40	80	80	80	80	80	80	80	160	160	160	160	160	160	160
Log.	1260	160	120	220	420	820	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cole	1260	20	20	30	30	30	40	40	50	60	70	80	90	100	110	120	130	140	150	160	180	200

• **Time = 4000 ms**

Mode	Vdly	Mdly	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Arith.	2620	480	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160	160
Semi	2620	160	80	80	80	80	80	80	80	80	160	160	160	160	160	160	320	320	320	320	320	320
Log.	2620	160	120	220	420	820	1620	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cole	2620	20	40	50	60	70	80	90	100	110	120	140	160	180	200	220	250	280	320	380	450	530

• **Time = 8000 ms**

Mode	Vdly	Mdly	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Arith.	5340	960	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320	320
Semi	5340	320	160	160	160	160	160	160	160	160	320	320	320	320	320	320	640	640	640	640	640	640
Log.	5340	160	120	220	420	820	1620	3220	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Cole	5340	20	40	60	80	100	120	150	180	220	250	280	320	360	400	450	500	580	700	850	1010	1180

About the **IP values type**, note that the changing "raw (R) \Leftrightarrow normalised (N)" can be realised after the acquisition.

The normalization allows to homogenize the data that have been obtained with various injection and integration times. This is made with respect to a standard decay curve, which is the one obtained with the following parameters:

Mode: *Logarithmic*

Injection time: *2000 ms*

Vdly: *1260 ms*

Mdly: *160 ms*

TM₁: *120 ms*

TM₂: *220 ms*

TM₃: *420 ms*

TM₄: *820 ms*

The coefficients to multiply, allowing to go from a type to the other one, are indicated in the following tables:

500 ms								
Arithmetic			Semi logarithmic			Logarithmic		
	R \rightarrow N	N \rightarrow R		R \rightarrow N	N \rightarrow R		R \rightarrow N	N \rightarrow R
M _g	0.72	1.39	M _g	0.94	1.06	M _g	1.32	0.76
M ₁	0.60	1.67	M ₁	0.55	1.81	M ₁	1.06	0.94
M ₂	0.75	1.33	M ₂	0.82	1.22	M ₂	1.47	0.68
M ₃	0.88	1.13	M ₃	1.25	0.80			

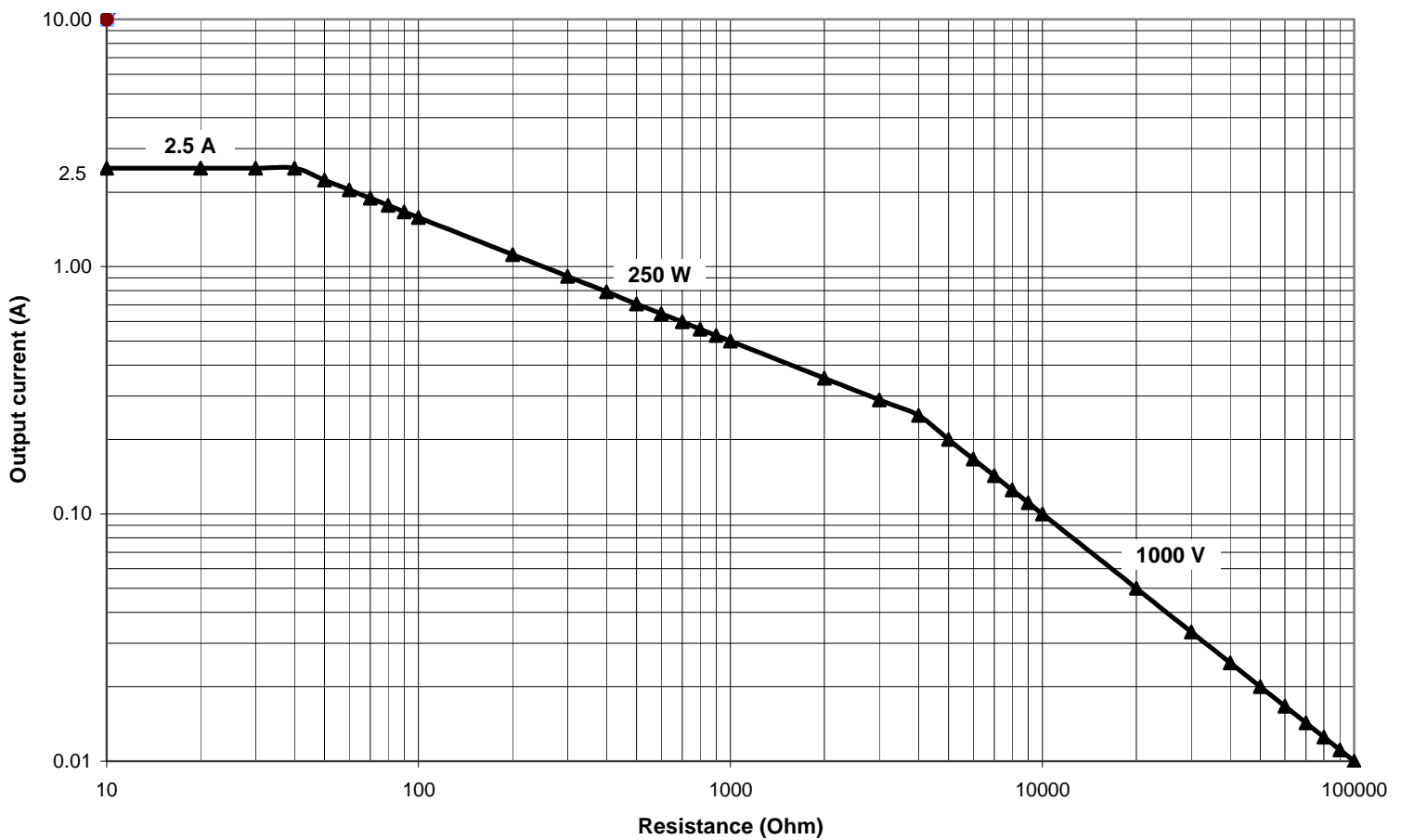
1000 - 2000 - 4000 - 8000 ms					
Arithmetic			Semi logarithmic		
	$R \rightarrow N$	$N \rightarrow R$		$R \rightarrow N$	$N \rightarrow R$
M_g	1.08	0.93	M_g	0.96	1.04
M_1	0.56	1.79	M_1	0.38	2.63
M_2	0.64	1.56	M_2	0.42	2.38
M_3	0.72	1.39	M_3	0.46	2.17
M_4	0.78	1.28	M_4	0.51	1.96
M_5	0.85	1.18	M_5	0.55	1.82
M_6	0.91	1.10	M_6	0.59	1.69
M_7	0.97	1.03	M_7	0.62	1.61
M_8	1.03	0.97	M_8	0.66	1.51
M_9	1.10	0.90	M_9	0.72	1.39
M_{10}	1.16	0.86	M_{10}	0.80	1.25
M_{11}	1.23	0.81	M_{11}	0.86	1.16
M_{12}	1.29	0.77	M_{12}	0.93	1.07
M_{13}	1.35	0.74	M_{13}	0.99	1.01
M_{14}	1.41	0.71	M_{14}	1.05	0.95
M_{15}	1.47	0.68	M_{15}	1.14	0.88
M_{16}	1.54	0.65	M_{16}	1.26	0.79
M_{17}	1.60	0.62	M_{17}	1.39	0.72
M_{18}	1.66	0.60	M_{18}	1.52	0.66
M_{19}	1.72	0.58	M_{19}	1.65	0.61
M_{20}	1.78	0.56	M_{20}	1.78	0.56

Logarithmic								
	1000 ms		2000 ms		4000 ms		8000 ms	
	$R \rightarrow N$	$N \rightarrow R$	$R \rightarrow N$	$N \rightarrow R$	$R \rightarrow N$	$N \rightarrow R$	$R \rightarrow N$	$N \rightarrow R$
M_g	1.16	0.86	1.00	1.00	0.90	1.11	0.79	1.27
M_1	0.72	1.39	0.51	1.95	0.39	2.56	0.29	3.45
M_2	1.02	0.98	0.67	1.50	0.47	2.13	0.35	2.86
M_3	1.53	0.65	0.95	1.05	0.62	1.61	0.43	2.33
M_4			1.43	0.70	0.87	1.15	0.56	1.79
M_5					1.37	0.73	0.79	1.27
M_6							1.28	0.78

ANNEX 4: OUTPUT CURRENT AND VOLTAGE SPECIFICATIONS

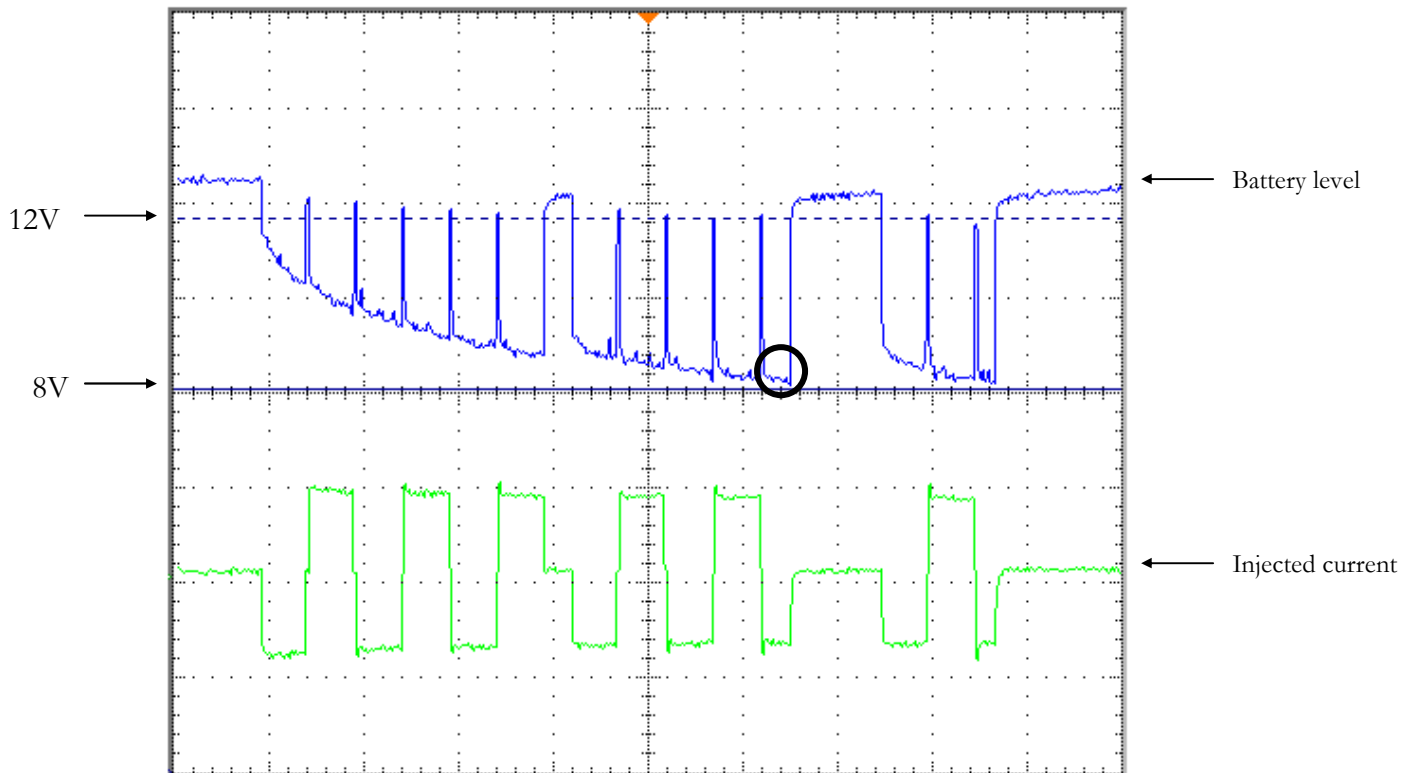
The following diagram shows the output current curve (in A), versus the grounding resistance (in Ohm).

One can note the limit of the output characteristics of the unit, in terms of current (2.5 A) - power (250 W) and voltage (1000V), in regards to the resistance value.



ANNEX 5: BEHAVIOUR OF A BATTERY WITH TIME

The following diagram shows the behaviour of a battery becoming weak with time.



One can note that, before injection, the voltage value is about 13 V.

Then, one can point out that this level decreases regularly with the number of injection realized.

The peaks going up means that just after the injection, the voltage battery increases quickly due to an instantaneous recharge phenomenon.

When the battery becomes low (9 V), a warning message will appear ; you can continue the acquisition, but note that if the battery level drops to 8 V (black circle in the diagram), the unit won't inject any current ; however, during this time, as the battery has not been used, the recharge allows to inject the next stack, and so on...

Of course, if the battery is not recharged, after a while no more injection will be done.

By default, whatever the mode used (excepted for the **High speed** mode) and whatever the number of stacks selected, the unit will inject by default three pulses:

- If the battery level becomes too low during the three first pulses, the current value will be erroneous ("9999.00 mA")

- If that situation appears after the three first pulses, the injected current and reception voltage values stored will be erroneous but the ratio, so the resistivity, will be correct as the computation of the resistivity will be done with the current and voltage values obtained when the transmitter injected properly.

Note that in **High speed** mode or in **Continuous survey** mode, as there's not the three first pulses, the current value will be "9999.00 mA" if the situation appears during the first pulse (positive pulse).

If the situation appears during the second pulse (negative pulse), the current value will be:

$$I = (I \text{ (first pulse)} + 9999.00) / 2$$

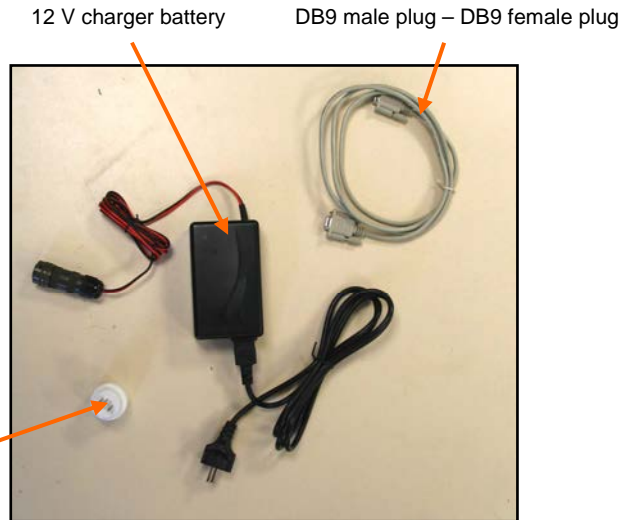
Conclusion:

One has to keep in mind that even if a battery has a good voltage value before injection, one has to be sure of the level during current transmission. So, one can advise to check this value regularly during injection, with a voltmeter.

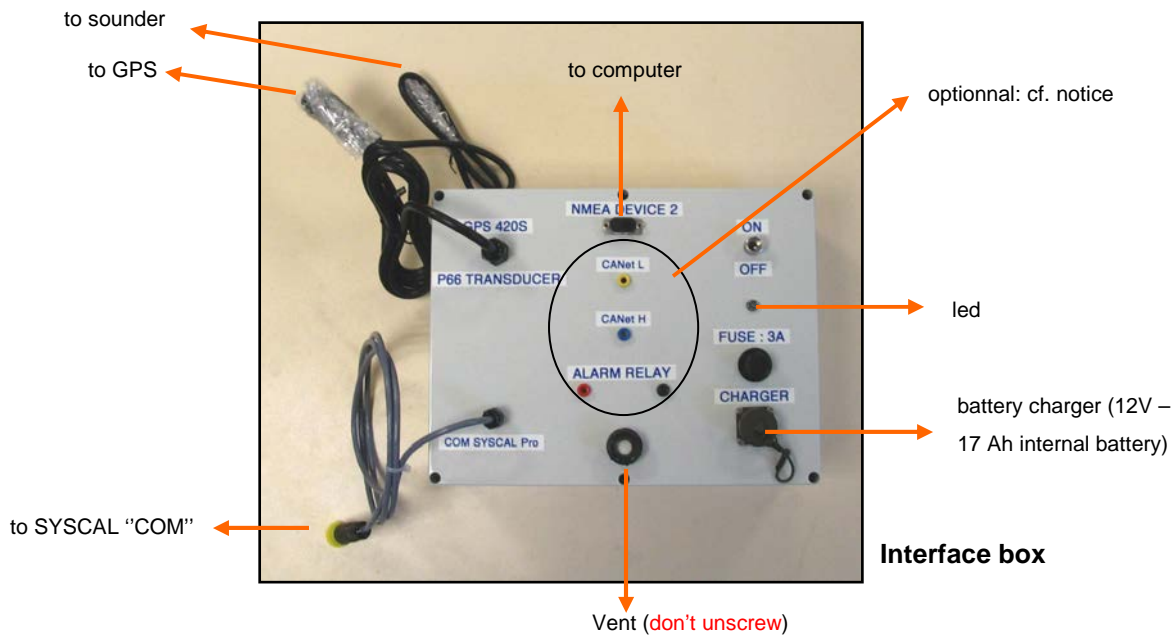
ANNEX 6: SYSMAR OPTION (for the GARMIN GPS 420) – ITEMS REQUIRED



SYSCAL Pro rear side



Accessories



Interface box

DB9 female plug – "COM2" plug

USB plug – "COM2" plug



to Pc serial port
(Sysmar Software)

to SYSCAL
"Extension link"
(COM2)



to Pc USB port
(Sysmar Software)

to SYSCAL
"Extension link"
(COM2)

Remark:

The LED is:

- green above 11.3 V
- green / red winking from 9.8 to 11.3 V
- red below 9.7 V (recharge the internal battery)

ANNEX 7: COMSYS PRO OPTION – ITEMS REQUIRED

The USB Comsys module is an accessory of the Comsys Pro utility package.

This package contains also a set of communication cables, a 12V battery and a charger.

This module has to be used for real-time communication between a SYSCAL Pro unit and a computer running with the Comsys Pro software.

This module allows an electrical isolation about the PC connected to the mains.

Note:

The module has to be supplied by its own 12V separate battery ; neither use the external battery supplying the Tx part of the SYSCAL Pro ; this would induce some high disturbances on the measurement).

to 3 pins plug of
Syscal Pro ("Com")

to 12V separate
battery



Rear side of the module with
plugs for battery connection



Pc USB cable plug

Comsys module

PC – Comsys module USB cable

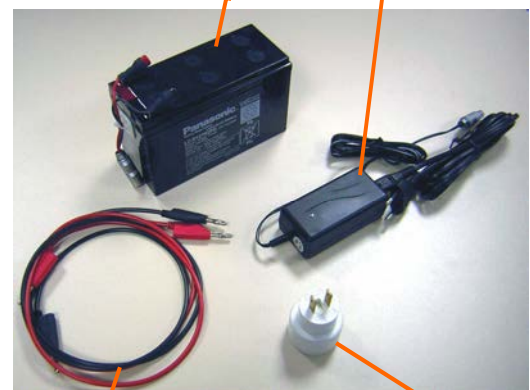


to USB port of PC

to Comsys module

12 V battery

12 V charger battery



supplying cables

Supplying pack

US plug adapter

ANNEX 8: INITIALIZATION TROUBLE
--

If, after a switch on of the unit, the introduction of the serial number is requested, it means that the unit has been re-initialized.

Then, enter the serial number written on the sticker of the unit, and after validation, the following message will appear:

"Format... Please confirm. **Yes** or **No**"

Then, in that case press "No" (if not the data stored will be automatically deleted).

ANNEX 9: WIRING DIAGRAM OF SWITCH CABLES

Keep always the plugs of the cables and the bases of the connecting box and Syscal unit perfectly dry (no contact with the ground and closed with their cap) to avoid arcing between pins while high voltage injection, which would damage them.

If necessary, use a humidity remover (WD40 type) for a deep drying of the plugs and bases.

3 m

5 m

#1 #2 #3

#22 #23 #24 #25 #26 #27

#46 #47 #48

26 pins male plug

SYSCAL Pro Switch
SWITCH Pro

plug ref.:
6 P PG 50

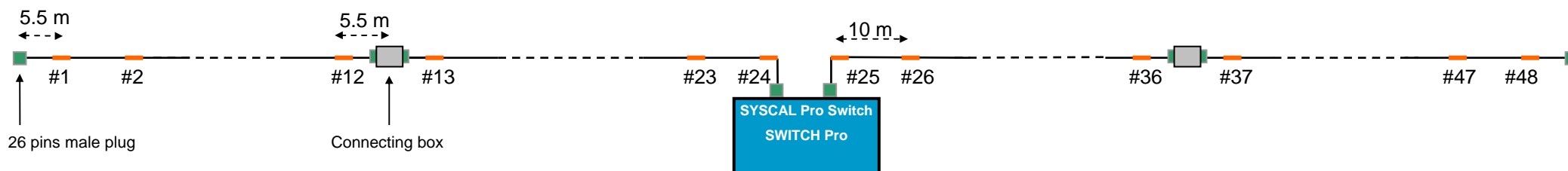
base ref.:
6 S S 50

26 pins male plug

26 pins male plug

SWITCH CABLE OF A MULTI-ELECTRODE SYSTEM UNIT 48 ELECTRODES – 10 METERS SPACING BETWEEN TAKEOUT

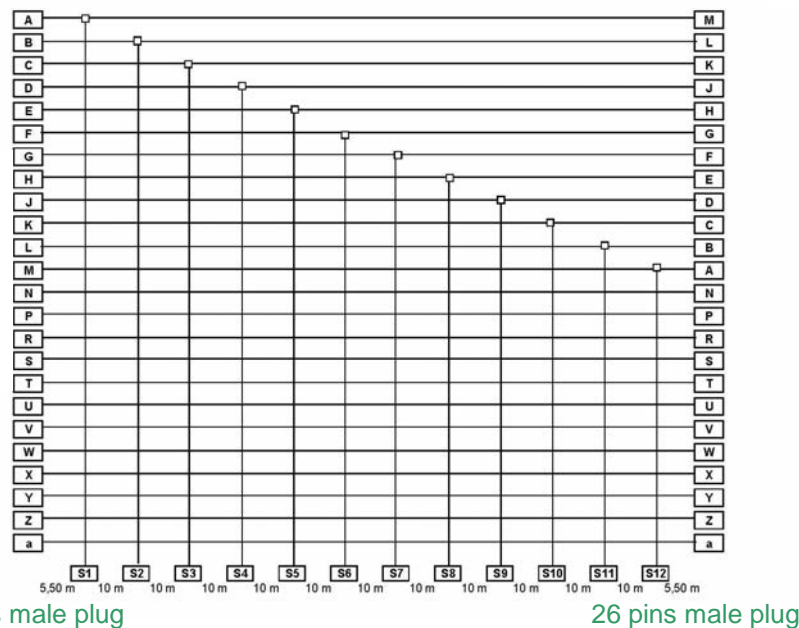
In the field configuration (4 cables with 12 takeout – 2 connecting boxes)



Wiring diagram of a switch cable (12 electrodes)

26 pins male plug ref.:
851 06A 16 26 P PG 50
Cap ref.:
BF N PT 16

26 pins female base ref.:
851 02 E 16 - 26 S 50
Cap ref.:
BECN 16



Wiring diagram of a connecting box

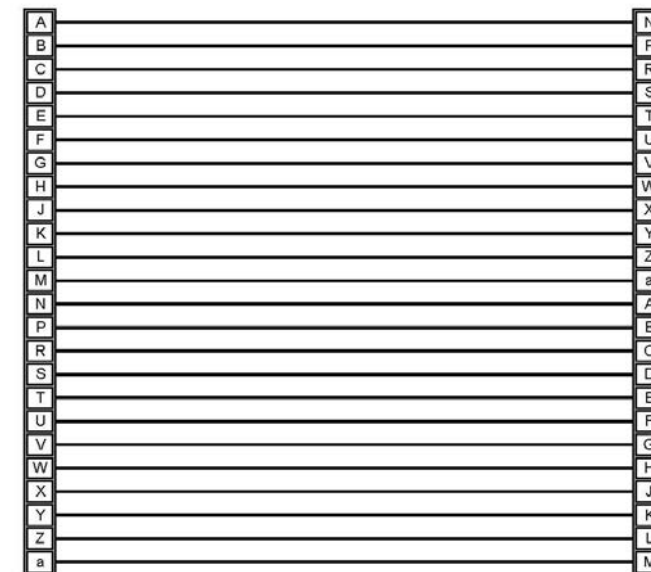


Diagram illustrating the network topology for the SYSCAL Pro Switch. The topology shows a linear arrangement of nodes connected by links. The nodes are labeled #1, #2, #18, #19, #35, #36, #37, #38, #54, #55, #71, and #72. The distance between #1 and #2 is 3 m. The distance between #18 and #19 is 3 m. The distance between #37 and #38 is 5 m. The nodes #1, #18, #36, #37, #54, and #72 are marked with green squares, indicating they are part of the SYSCAL Pro Switch. The nodes #2, #19, #35, #38, #55, #71, and #72 are marked with orange rectangles, indicating they are part of the network. The SYSCAL Pro Switch is a blue box labeled "SYSCAL Pro Switch" and "SWITCH Pro".

Figure 1 is a plot showing the first 26 eigenvalues of the Laplacian operator on the Sierpinski triangle. The x-axis is labeled with indices from 1 to 26, and the y-axis is labeled with eigenvalue values from 0 to 1. The eigenvalues are labeled with letters A through Z. The plot shows a decreasing sequence of eigenvalues, with some values being zero (e.g., A, B, C, D, E, F, G, H, I, J, K, L, M, N, O, P, Q, R, S, T, U, V, W, X, Y, Z).

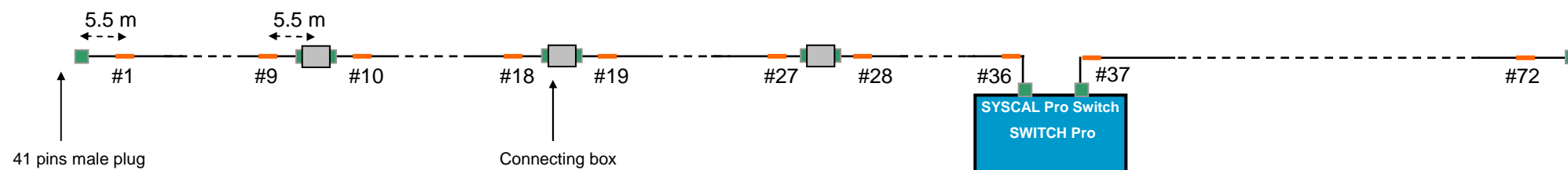
41 pins male plug

A		a
B		b
C		c
D		d
E		e
F		f
G		g
H		h
I		i
J		j
K		k
L		l
M		m
N		n
O		
P		
Q		
R		
S		
T		
U		
V		
W		
X		
Y		
Z		
a		
b		
c		
d		
e		
f		
g		
h		
i		
j		
k		
l		
m		
n		

41 pins female base

SWITCH CABLE OF A MULTI-ELECTRODE SYSTEM 72 ELECTRODES – 10 METERS SPACING BETWEEN TAKEOUT

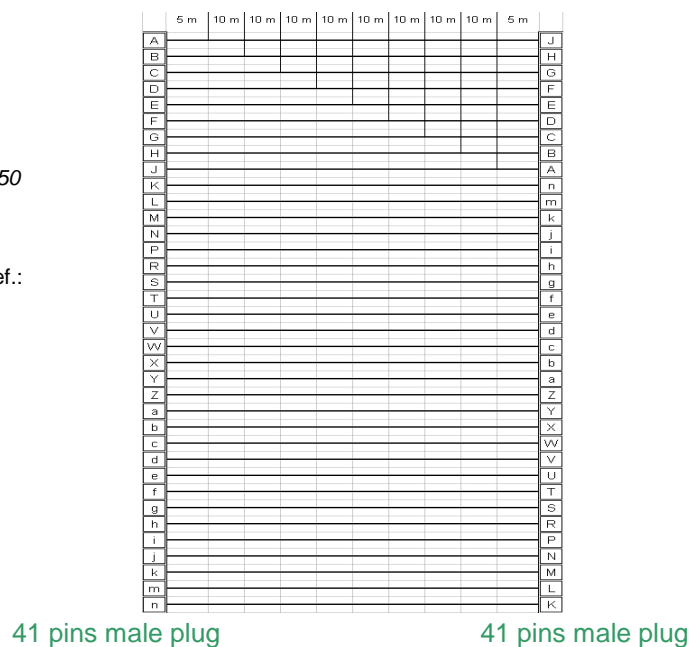
In the field configuration (8 cables with 9 takeout – 6 connecting boxes)



Wiring diagram of a switch cable (9 electrodes)

41 pins male plug ref.:
851 06A 20 41 P PG 50
Cap ref.:
BF N PT 20

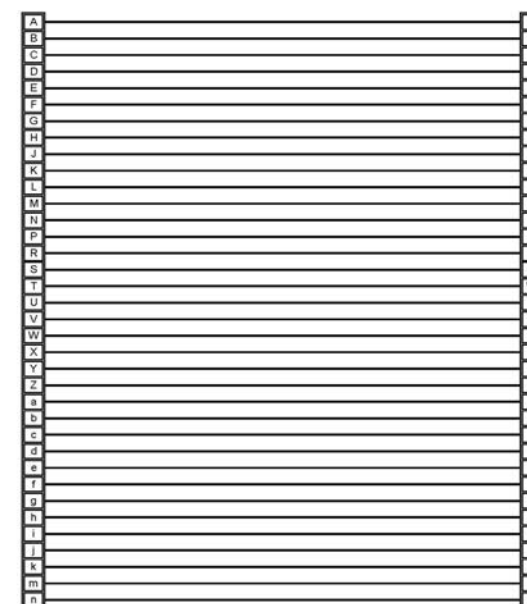
41 pins female base ref.:
851 02 E 20 - 41 S 50
Cap ref.:
BECN 20



41 pins male plug

41 pins male plug

Wiring diagram of a connecting box

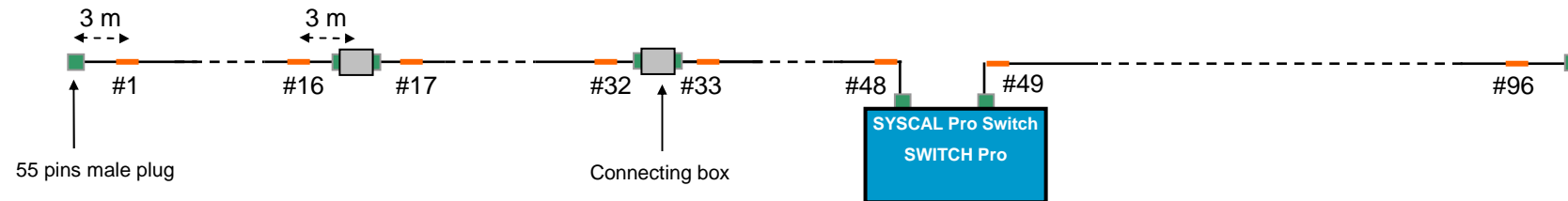


41 pins female base

41 pins female base

SWITCH CABLE OF A MULTI-ELECTRODE SYSTEM UNIT 96 ELECTRODES – 5 METERS SPACING BETWEEN TAKEOUT

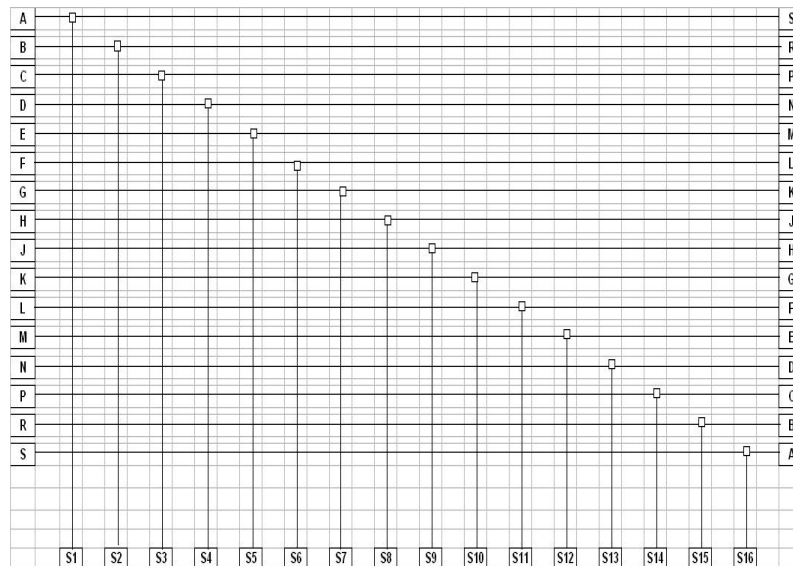
In the field configuration (6 cables with 16 takeout – 4 connecting boxes)



Wiring diagram of a switch cable (16 electrodes)

55 pins male plug ref.:
851 06A 22 55 P PG 50
Cap ref.:
BF N PT 22

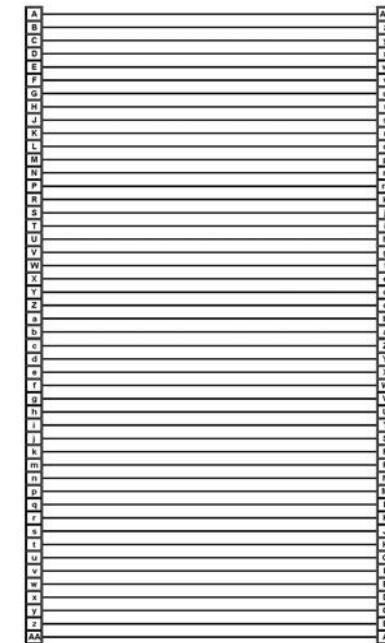
55 pins female base ref.:
851 02 E 22 - 55 S 50
Cap ref.:
BECN 22



55 pins male plug

55 pins male plug

Wiring diagram of a connecting box

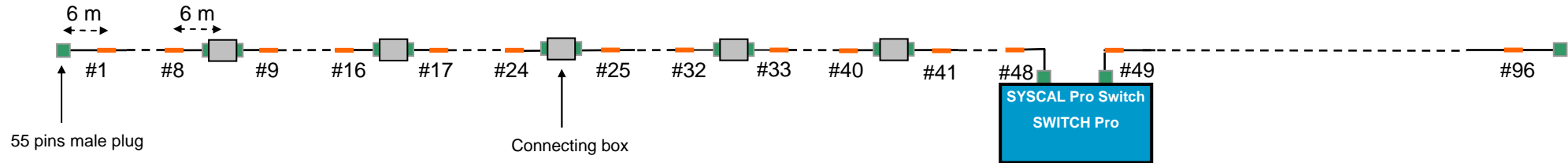


55 pins female base

55 pins female base

SWITCH CABLE OF A MULTI-ELECTRODE SYSTEM UNIT 96 ELECTRODES – 10 METERS SPACING BETWEEN TAKEOUT

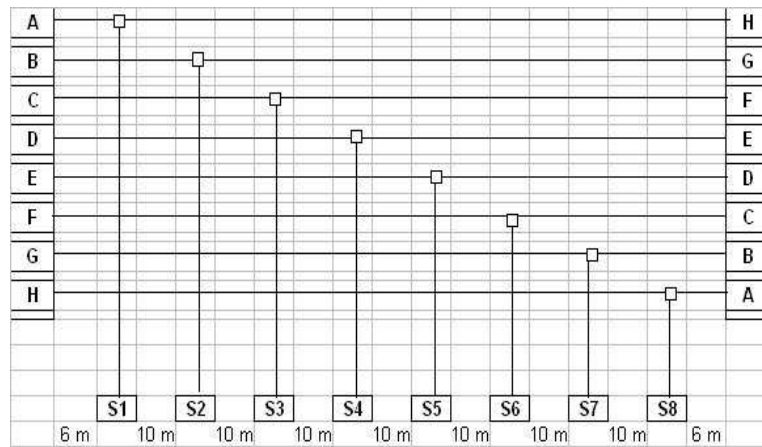
In the field configuration (12 cables with 8 takeout – 10 connecting boxes)



Wiring diagram of a switch cable (8 electrodes)

55 pins male plug ref.:
851 06A 22 55 P PG 50
Cap ref.:
BF N PT 22

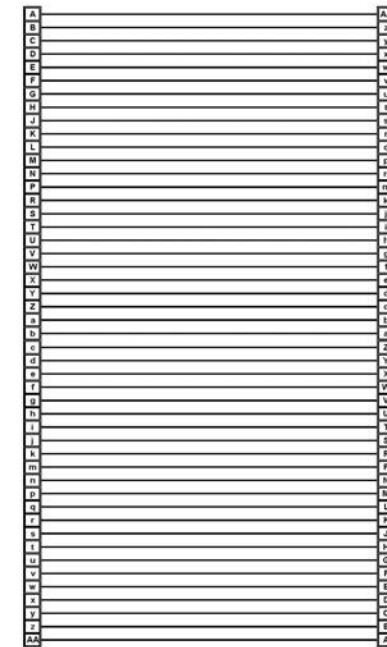
55 pins female base ref.:
851 02 E 22 - 55 S 50
Cap ref.:
BECN 22



55 pins male plug

55 pins male plug

Wiring diagram of a connecting box

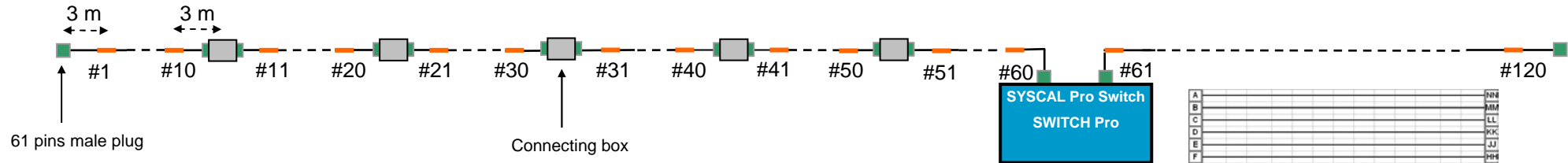


55 pins female base

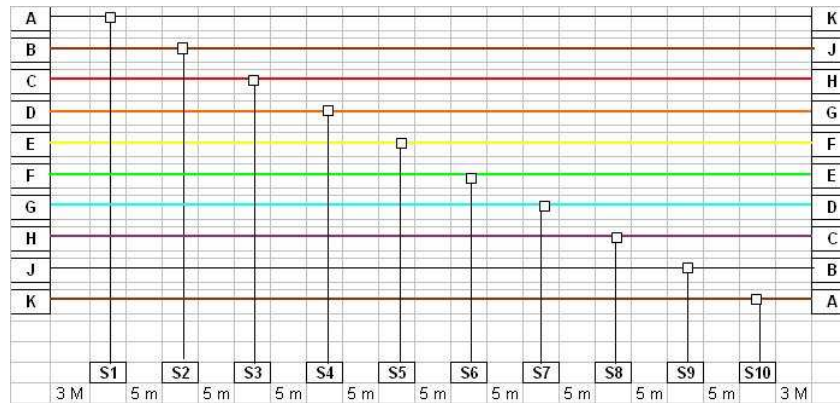
55 pins female base

SWITCH CABLE OF A MULTI-ELECTRODE SYSTEM UNIT 120 ELECTRODES – 5 METERS SPACING BETWEEN TAKEOUT

In the field configuration (12 cables with 10 takeout – 10 connecting boxes)



Wiring diagram of a switch cable (10 electrodes)

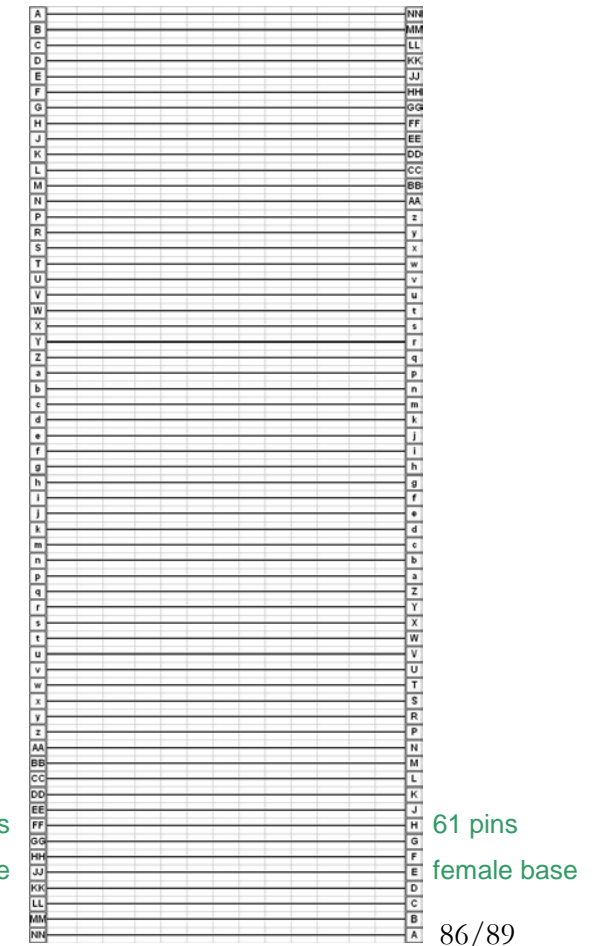


61 pins male plug

61 pins male plug

Wiring diagram of a connecting box

61 pins
female base



ANNEX 10: GPS DATA FORMAT - NMEA 0183

NMEA is a standard protocol, used by GPS receivers to transmit data.

NMEA output is RS-232 compatible (4800 bps - 8 data bits - no parity and one stop bit).

NMEA 0183 sentences are all ASCII ; each sentence begins with a dollarsign (\$)

and ends with a carriage return linefeed (<CR><LF>) and data is comma delimited (all commas must be included as they act as markers).

Following the \$ is the address field acccc. aa is the device id. GP is used to identify GPS data.

Transmission of the device ID is usually optional. ccc is the sentence formatter, otherwise known as the sentence name

Sentence :

\$GPGGA,hhmmss.ss,llll.ll,a,yyyy.yy,a,x,xx,x.x,x.x,M,x.x,M,x.x,xxxx*hh

- 1 = UTC of Position
- 2 = Latitude
- 3 = N or S
- 4 = Longitude
- 5 = E or W
- 6 = GPS quality indicator (0=invalid ; 1=GPS fix ; 2=Diff. GPS fix)
- 7 = Number of satellites in use [not those in view]
- 8 = Horizontal dilution of position
- 9 = Antenna altitude above/below mean sea level (geoid)
- 10 = Meters (Antenna height unit)
- 11 = Geoidal separation (Diff. between WGS-84 earth ellipsoid and mean sea level. - = geoid is below WGS-84 ellipsoid)
- 12 = Meters (Units of geoidal separation)
- 13 = Age in seconds since last update from diff. reference station
- 14 = Diff. reference station ID#
- 15 = Checksum

ANNEX 11: SD CARD Reader

A SD CARD reader developed by IRIS can be connected to the serial port ("com1") of the Syscal Pro so as to load sequences and download data without using the computer in the field. The reader is supplied with 2 R6 cells.

When connected to the PC, by the USB port, the IRIS SD CARD reader is recognized as an external device – so, files can be copied easily in the explorer window.



Here is the meaning of the led colors of the SD reader:

Status	Meaning
Steady Green (>3s)	Ready: waiting for transfer
Steady Red (>3s)	Error (SD Card missing or full, low battery, communication error)
Orange	Initializing SD card before transfer
Red/Green Flashing	Initializing SD card, browsing card, getting free space (if the card has just been formatted, it can take tens of second)
Fast Green Flashing	Transferring data
Fast Red Flashing	Writing data on SD Card
Slow Green Flashing	Transfer terminated, user can disconnect the SD reader

For the Syscal pro, the IRIS SD card reader is able to read the following extension files:

- . **pro**: data downloaded from a Syscal Pro
- . **sqz** : sequence created by Electre Pro
- . **sds** : sequence created by Electre Pro and converted to the "sds" format

20 characters is the maximum number for the file names in the SD reader.

Note:

If the SD card contains "sds" and "sqz" files, they will be both displayed – but, as soon as one "sds" file has been transferred, the "sqz" files won't appear anymore (because, with time, the "sds" format is the one that will become the standard format for the Syscal Units) - (it contains all the information of the sequence whereas the "sqz" contains a part of the information).

Remarks about the version numbers:

Electre Pro software (from V.1.6) can generate sequences with the "sds" format

Prosyst II software (from V. 2.29) can read the dataset extension ("pro").

Syscal Pro (from V. 4.3.0 for the Rx) can upload sequences from the IRIS SD reader or can download data files to the IRIS SD reader.