

Heritage Geophysics

RESISTIVITY SOUNDING AND IMAGING SYSTEM



SYSCAL Pro resistivity & IP equipment

for SOUNDING, IMAGING and MONITORING

SYSCAL Pro Switch MAIN FEATURES

- The **SYSCAL Pro Switch** is a versatile electrical resistivitymeter which combines a transmitter, a receiver and a switching unit in one single casing. It is supplied by a 12V battery.
- The **measurements** are carried out automatically (output voltage, stacking number, quality factor) after selection of limit values by the operator, and are stored in the internal memory.
- The **output specifications** are 800V (switch mode), 1 000V (manual mode) for the voltage, 2.5A for the current and 250W for the power using the internal DC/DC converter and the battery.
- The **SYSCAL Pro Switch** uses multi-core cables for controlling a set of electrodes connected in a line or in several lines. The standard number of electrodes: 24, 48, 72, 96, 120, can be increased through Switch Pro units for 2D or 3D ground images.
- The **ten channels** of the system permit to carry out up to 10 readings at the same time for a high efficiency.
- The **Induced Polarisation chargeability (IP)** is also measured through 20 windows for a detailed analysis of the decaying curves displayed on the graphic LCD screen.
- The **SYSCAL Pro Switch unit** can be operated with cables in boreholes, or cables pulled on the ground by a vehicle or on the surface of the water by a boat for continuous acquisition surveys.
- The **SYSCAL** can be used for time lapse readings (monitoring)

1D, 2D, 3D, 4D RESISTIVITY INVESTIGATIONS

for characterizing underground structures:

- ENVIRONMENT
- CIVIL ENGINEERING
- GROUNDWATER
- ARCHAEOLOGY
- MINING EXPLORATION

TEN SIMULTANEOUS CHANNELS:

for high speed data acquisition, up to 1 000 rdgs/mn

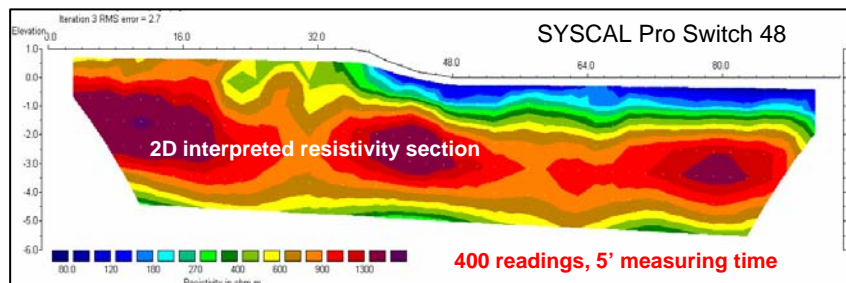
UP TO 800 - 1 000V, 2.5A OUTPUTS:
for penetration & data quality

AUTOMATIC SWITCHING CAPABILITY:
for 24, 48, 72, 96, 120, up to 1 300 electrodes

RESISTIVITY & INDUCED POLARIZATION:
twenty IP chargeability windows

PC SOFTWARE:

- **ELECTRE Pro:** sequence management
 - **PROSYS II:** data transfer, process, display
 - **COMSYSPro:** control of SYSCAL by PC
 - **SYSMAR:** continuous acquisition
 - **PROCESSING:** x2ipi (w/seq manag.)
 - **INTERPRETE:** ERTLab (w/seq manag.)
- Res2/3Dinv, IX1D, Winsev



SYSCAL Pro SPECIFICATIONS

TRANSMITTER

- Max voltage: 800V in switch mode
- Max voltage: 1 000V in manual mode
- Max current: 2.5A, typ. accuracy 0.2%
- Max power : 250W with internal DC/DC converter and 12V external battery; 1200W with external AC/DC and Motor Gene.
- Option 25mA max for readings on samples
- Pulse duration: 0.2s, 0.5s, 1s, 2s, 4s, 8s
- Internal 12V, 7Ah battery, plug for ext. batt.

RECEIVER

- Automatic ranging, 10 input channels
- Input impedance: 100 Mohm
- Max voltage channel 1: 15V
- Max voltage sum of channel 2 to 10: 15V
- Protection up to 1 000V
- Typ accuracy: 0.2%, resolution: 1 microV
- 50 to 60Hz power line frequency rejection
- Stacking process, SP linear drift correction
- Reading of current, voltage, standard dev., 20 IP windows (preset or selectable),
- Internal 12V, 7Ah battery

GENERAL

- Memory: 21 000 readings
- USB & SD card link
- GPS input for coordinates
- Fiber glass casing, weather proof
- Temperature range: -20 to +70°C
- SYSCAL Pro Switch 48: 31x23x36cm, Weight: 13kg, Cable w/ 24 take-out: 23kg

SYSCAL Pro Switch for resistivity imaging

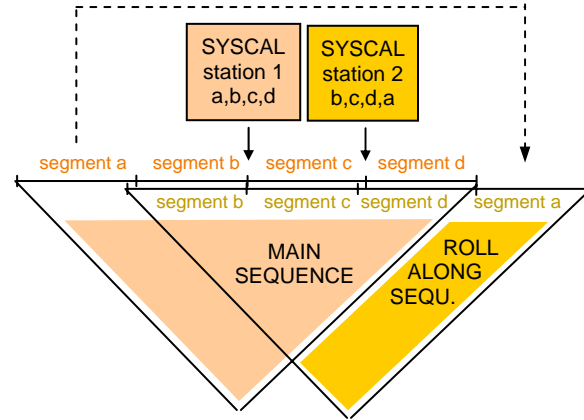
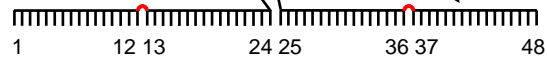


The **SYSCAL Pro Switch** units use segments (seg) of multi-core cable which are reversible and interchangeable.

For instance, the **SYSCAL Pro Switch 48** with 10m spacing has 4 segments of cable a, b, c, d, with 12 electrodes each, for a total line length of 480m. The SYSCAL is placed in the middle of the line, between segments b and c.

If the profile to measure is longer than the line length, a **ROLL ALONG** technique can be applied where, after a first set of readings with (a, b, c, d), segment a is placed after segment d to form a new (b, c, d, a) combination etc.

SYSCAL Pro Switch 48 multi-electrode equipment 10m spacing



SYSCAL Pro Switch	48	72	96	120
5m spacing	2 seg x 24 elect	4 seg x 18 elect	6 seg x 16 elect	12 seg x 10 elect
total line length	240m	360m	480m	600m
10m spacing	4 seg x 12 elect	8 seg x 9 elect	12 seg x 8 elect	24 seg x 5 elect
total line length	480m	720m	960m	1 200m

All the SYSCAL Pro Switch units (48, 72, 96, 120) can also be delivered with segments of cables of:

- 24 electrodes for the 5m spacing
- 12 electrodes for the 10m spacing

In this case, **extension cables** directly connect the external cable segments to the meter. Example: SYSCAL Pro Switch 48, 10m spacing:

RESISTIVITY IMAGING IN 4 STEPS

1 Choose & load a sequence ELECTRE Pro software	2 Take readings in the field SYSCAL Pro Switch	3 Transfer & process the data PROSYS software	4 Interpret the data INVERSION software
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ELECTRE Pro software for sequence management

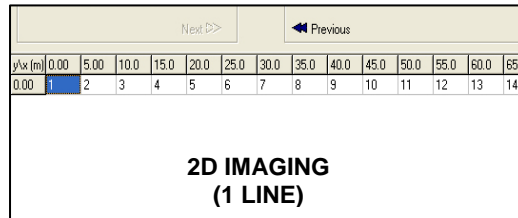
Introduction of parameters:

- type of electrode array (Wenner Schlumberger, dipole-dipole, pole-dipole)
- number of electrodes 'n'
- value of spacing 'a'
- depth to reach
- number of stacks to use &/or quality factor to reach

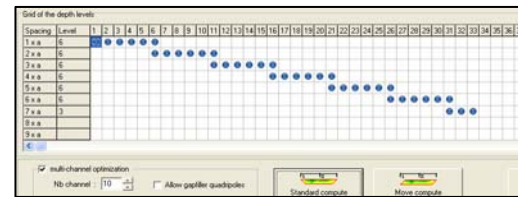
Creation of the sequence of readings with various multi-spacing levels, such as 'a', '2a', '3a', '5a', to increase the signal strength at a given depth. Visualization of the points

Transfer of the sequence file from the PC to the SYSCAL Pro Switch internal memory

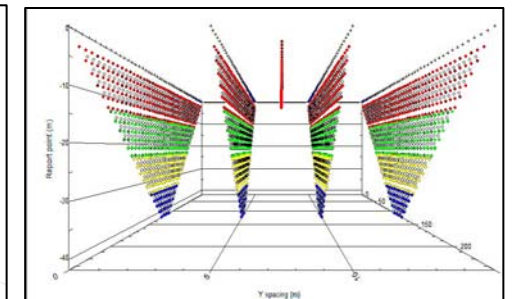
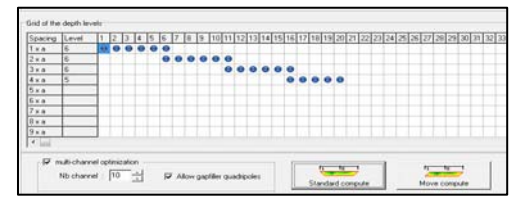
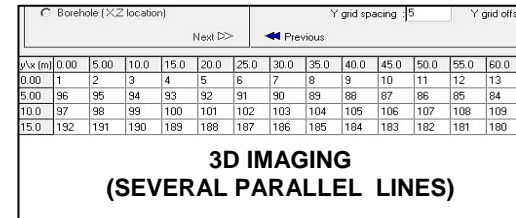
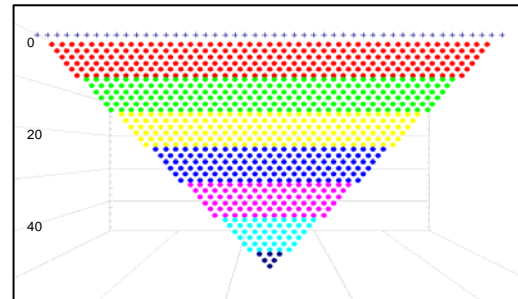
Automatic (or manual) numbering of electrodes



Automatic (or manual) generation of the sequence of readings



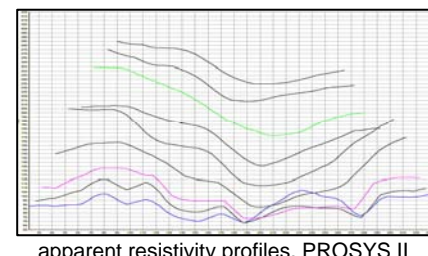
Visualization of the investigation points



ELECTRODE ARRAYS	depth / line length	signal strength	lateral resolution	field set up
Wenner Schlumb	20%	regular	regular	regular
Dipole Dipole	20%	weak	best	regular
Pole Dipole	35%	medium	good	medium
Pole Pole	90%	best	weak	weak

PROSYS II software for data processing

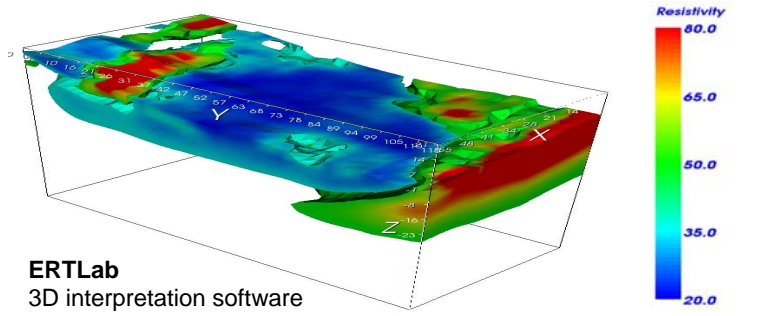
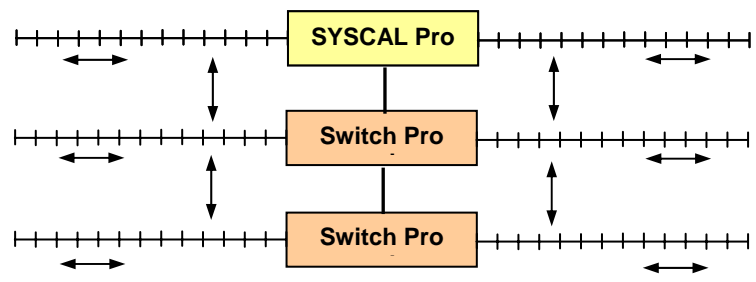
- data transfer from SYSCAL to PC
- data plotting in profile & section
- elimination of noisy data
- introduction of topography
- export to interpretation software





SWITCH Pro modules
 SYSCAL Pro (48, 72; 96, ...) units can be used to increase the number of electrodes controlled by the SYSCAL Pro Switch in a 3D survey for instance

ACQUISITION TIME for 1 000 READINGS	High speed mode 1 stack, 0.2s, ON time	Resistivity 5 stacks 0.5s ON time	Resistivity & IP 10 stacks, 2s ON/OFF time
ONE channel SYSCAL P1 Plus Sw	n/a	1 hour	8 hours
TEN channel SYSCAL Pro Switch	1 minute	8 minutes	1 hour



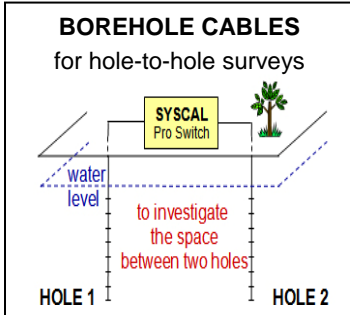
SYSCAL Pro options and accessories

'RECEIVER only' OPTION
 with this option, the SYSCAL Pro can be used as a separate receiver, the current being generated by external powerful transmitters such as VIPs (3000V, up to 10kW)

VENTILATION OPTION
 For high temperature surveys, the ventilated casing maintains the full power of the SYSCAL Pro Switch during the whole acquisition.



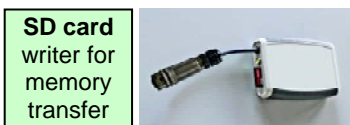
RESISTOR TEST BOX
 The resistor test box permits to run a sequence of readings on a set of resistors and check the good operation of the SYSCAL Pro Switch



STRIP unit
 Individual wires coming from the electrodes can be screwed on the front panel of a STRIP unit, itself connected to a Switch Pro module



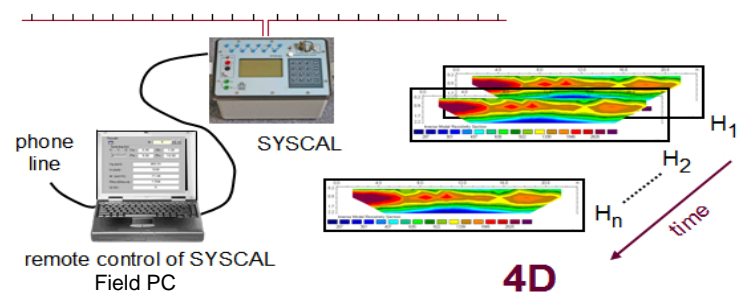
INSULATION TEST BOX
 The insulation test box detects short circuit and open line at 800V test voltage for multi-core cables and for testing internal relays of SYSCAL Pro Switch



12V BATTERY TESTER
 The battery tester gives the remaining time of acquisition available for 50, 100, 250W output power



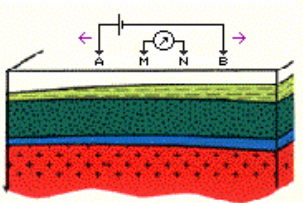
SYSCAL Pro Switch for resistivity monitoring



Remote control of the resistivity meter: COMSYS Pro software
 With **COMSYS Pro software**, the SYSCAL Pro Switch can be fully controlled by the PC during the measurements. In particular, the PC can repeat sequences at preset dates and hours (H₁, H₂, ...H_n) through the 'script' function of the software, for resistivity monitoring applications. Data can be sent after each new set of readings to an office PC by e-mail or consulted on a dedicated website.

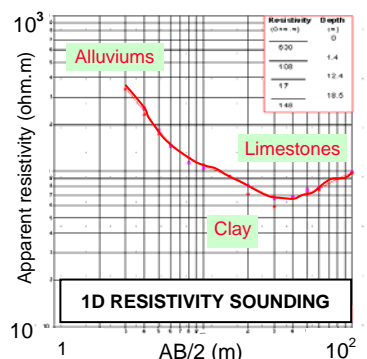
SYSCAL Pro for resistivity sounding

SYSCAL Pro (transmitter & receiver) and **SYSCAL Pro Switch** (transmitter, receiver & switcher) can be used for traditional vertical electrical sounding (VES), such as **Schlumberger Sounding**, to determine the depths and the resistivities of horizontal layers at the vertical of the centre of the array.
 - **individual wires** for A, B (current) and M, N (potential) electrodes are connected to the front panel of the unit.
 - in this manual mode, the maximum output voltage **V_{ab}** is **1 000V**.



$$\text{Rho} = \frac{K \times \text{Vmn}}{\text{Iab}}$$

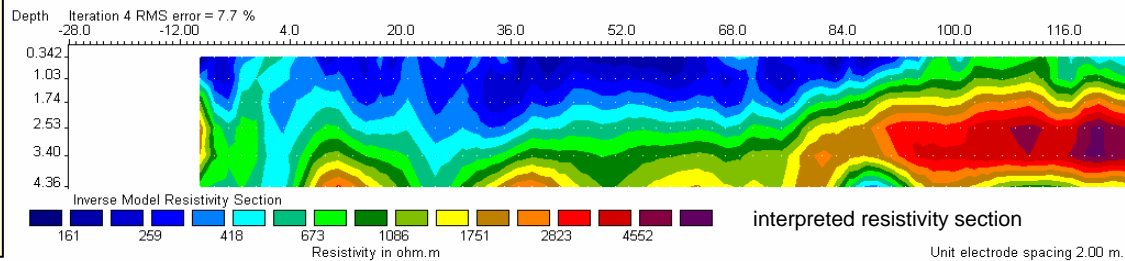
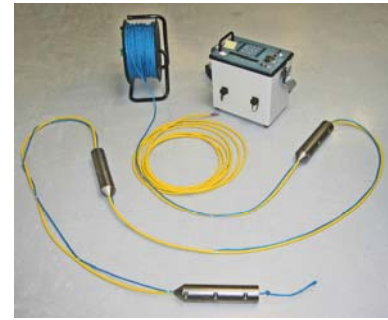
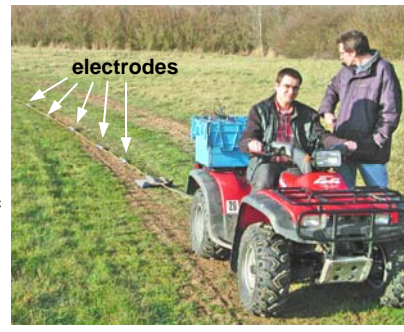
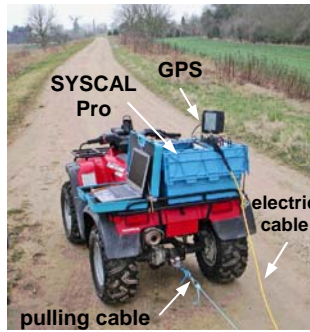
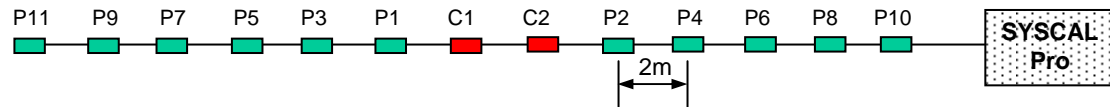
- **Rho**, apparent resistivity in ohm.m,
- **K**, geometrical coefficient in m
- **Vmn**, received potential in mV
- **Iab**, transmitted current in mA



SYSCAL Pro for continuous land survey

DYNAMIC ACQUISITION for LAND SURVEYS

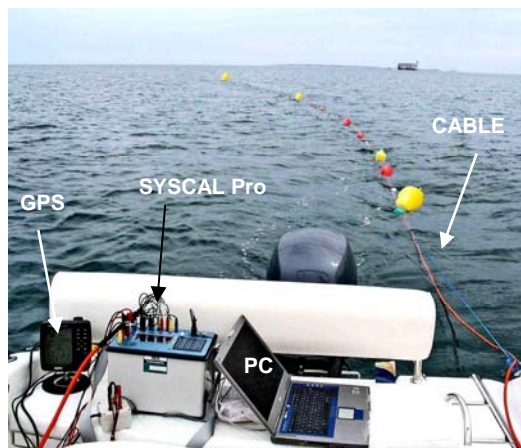
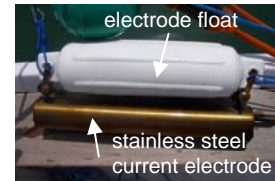
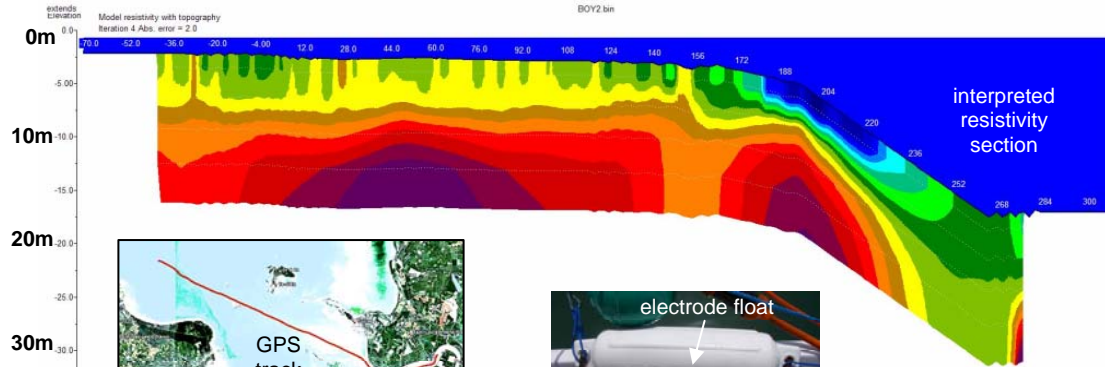
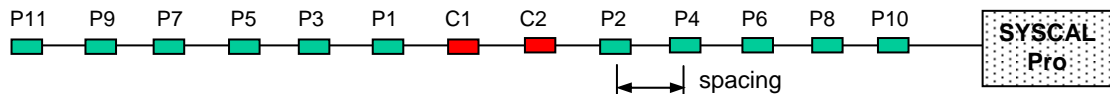
- The SYSCAL Pro can be used with a specific cable pulled on the ground by a light vehicle, for a continuous acquisition of resistivity readings.
- The cable features 13 cylindrical stainless steel electrodes (8cm diameter, 25cm length, 4.2kg) at 2m spacing:
 - 2 for transmitting the current,
 - 11 for simultaneously measuring ten potential channels.
- A PC continuously records the 10 resistivity values and the GPS data, displays profiles in real time
- Recommended electrode array: reciprocal Wenner Schlumberger
- Penetration depth: about 5m
- Best conditions: wet grounds
- Acquisition speed: typ. 3km/h



SYSCAL Pro for river and sea survey

DYNAMIC ACQUISITION for RIVER & SEA SURVEYS

- The SYSCAL Pro can be used with a specific cable pulled on the surface of water (lake, river or sea) by a light boat, for a continuous acquisition of resistivity readings.
- The cable features 13 cylindrical graphite electrodes (4cm diameter, 10cm length) at 5m spacing:
 - 2 for transmitting the current,
 - 11 for simultaneously measuring ten potential channels.
- A PC continuously records the 10 resistivity / IP values and the GPS data, displays profiles in real time
- GPS track visualisation on Google Earth
- Recommended electrode array: reciprocal Wenner Schlumberger
- Penetration depth: about 15m with a 100m total length cable
- Acquisition speed: typ. 3km/h



SYSCAL Pro Deep Marine is a SYSCAL Pro dedicated to measurement in sea water:

- with outputs of **50V, 50A, 2500W**
- for higher penetration
- for higher speed (up to 10km/h)
- with reciprocal Wenner-Schlumb & dip-dip

It uses the same graphite electrode cable as the SYSCAL Pro for the measurement of the potential, but stainless steel electrodes for the current (5cm diameter, 30cm length)

It can be used with a cable of 25m spacing between electrodes (total cable length 350m), for a depth of penetration of about 60m

cable with graphite electrodes

