SYSCAL Pro
resistivity & IP
equipment
for SOUNING, IMAGING
and MONITORING

SYSCAL Pro Switch MAIN FEATURES

- The SYSCAL Pro Switch is a versatile electrical resistivity meter 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 (1 600V peak-to-peak) in switch mode, 1 000V (2 000V peak-to-peak) in manual mode, 2.5A, and 250W with the internal converter and a 12V 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).

PC SOFTWARE:
- ELECTRE Pro: sequence management
- PROSYS II: data transfer, process, display
- COMSYSPro: control of SYSCAL by PC
- SYSMAR: continuous acquisition
- PROCESSING: x2ip (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
- Digital rejection better than 120 db at power lines 50 and 60 Hz.
- Stacking process, SP linear drift correction
- Reading of current, voltage, standard dev., 20 IP windows (preset or selectable),

GENERAL
- Memory: 40 000 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

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
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.

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:

- Segment a
- Segment b
- Segment c
- Segment d

**SYSCAL Pro Switch**

<table>
<thead>
<tr>
<th>48</th>
<th>72</th>
<th>96</th>
<th>120</th>
</tr>
</thead>
<tbody>
<tr>
<td>5m spacing</td>
<td>2 seg x 24 elect</td>
<td>4 seg x 18 elect</td>
<td>6 seg x 16 elect</td>
</tr>
<tr>
<td>total line length</td>
<td>240m</td>
<td>360m</td>
<td>480m</td>
</tr>
<tr>
<td>10m spacing</td>
<td>4 seg x 12 elect</td>
<td>8 seg x 9 elect</td>
<td>12 seg x 8 elect</td>
</tr>
<tr>
<td>total line length</td>
<td>480m</td>
<td>720m</td>
<td>960m</td>
</tr>
</tbody>
</table>

**RESISTIVITY IMAGING IN 4 STEPS**

1. Choose & load a sequence
2. Take readings in the field
3. Transfer & process the data
4. Interpret the data

**ELECTRE Pro software**

**PROSYS software**

**INVERSION software**

**SYSCAL Pro Switch 48 multi-electrode equipment 10m spacing**

**ELECTRE Pro software**

**PROSYS software**

**INVERSION software**

**SYSCAL Automatic (or manual) numbering of electrodes**

**Automatic (or manual) generation of the sequence of readings**

**Visualization of the investigation points**

**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

**ELECTRE Pro software for sequence management**

**Introduction of parameters:**
- type of electrode array (Wenner Schlumberger, dipole-dipole, pole-pole)
- 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

**ELECTRODE ARRAYS**

- **Wenner Schlumb:** 20% regular regular regular
- **Dipole Dipole:** 20% weak best regular
- **Pole Dipole:** 35% medium good medium
- **Pole Pole:** 90% best weak weak

**2D IMAGING (1 LINE)**

**3D IMAGING (SEVERAL PARALLEL LINES)**

**apparent resistivity profiles, PROSYS II**
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

**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

**BOREHOLE CABLES**
for hole-to-hole surveys

**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

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

**RESISTANCE 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

**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

**ACQUISITION TIME**
for 1 000 READINGS

<table>
<thead>
<tr>
<th>ONE channel</th>
<th>TEN channel</th>
</tr>
</thead>
<tbody>
<tr>
<td>Switch Pro</td>
<td>Switch Pro</td>
</tr>
</tbody>
</table>

**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 \( (H_1, H_2, \ldots H_n) \) 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 \( \text{Vab} \) is 1 000V.

\[
\text{Rho} = \frac{K \times \text{Vmn}}{I_{ab}}
\]

- Rho, apparent resistivity in ohm,m,
- K, geometrical coefficient in m
- \( \text{Vmn} \), received potential in mV
- \( I_{ab} \), transmitted current in mA

**SYSCAL R1 Plus Sw**

**TEN channel**

**SD card writer for memory transfer**

**ERTLab**

3D interpretation software

\[
\begin{align*}
\text{Apparent resistivity (ohm.m)} & = 10^{2} \\
\text{Alluviums} & = 10^{-2} \\
\text{Clay} & = 10^{-1} \\
\text{Limestones} & = 10^{0}
\end{align*}
\]

1D RESISTIVITY SOUNDING
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

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
- Best conditions: suitably deep water
- 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-Schlumberger & 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