SIGNAL STACKING RESISTIVITY METER
MODEL-SSR-MP-AT-ME

RESISTIVITY METER SSR-MP-AT-ME:

The IGIS Signal Stacking Resistivity Meter Model SSR-MP-AT-ME is a high quality - data acquisition system incorporating several innovative features. This equipment is a Resistivity Imaging System and can be employed for resistivity profiling as well as resistivity scanning of the subsurface.

In the presence of random (non-coherent) earth noises, the signal to noise ratio can be enhanced by $\sqrt{N}$ where N is the number of stacked readings. SSR-MP-AT-ME is a microprocessor-based signal stacking Resistivity Meter, in which running averages of measurements [1, (1+2)/2, (1+2+3)/3, ...(1+2+....+16)/16] up to the chosen stacks are displayed and the final average is stored automatically in memory utilizing the principle of stacking to achieve the benefit of high signal to noise ratio. Hence SSR-MP-AT-ME can be used for resistivity investigations up to about 600 m depth under favourable geological conditions.

The SSR-MP-AT-ME is programmable through user-friendly menu for its operation and entry of survey parameters like Survey No., Electrode Separations etc. The special feature in SSR-MP-AT-ME Resistivity Meter is that it can store the data in its nonvolatile memory up to 1500 measurements and has provision to down load the data directly to the computer through RS232 port for further analysis. It has also provision to view the data through 16x2 alphanumeric liquid crystal display. The SSR-MP-AT-ME resistivity meter directly gives the Resistance (ratio of ΔV and current) with a resolution up to 10^{-5} ohms at 1 A input current.

Applications:

* Ground Water Exploration
* Bedrock Investigations
* Delineation of Geological Structures
* Sand and Gravel Deposit Identification

Description of the system:

The Multi-Electrode Resistivity Meter system comprises

1) The main measuring unit (Resistivity Meter)
2) G-Unit (Power supply unit to inject current into the ground)
3) Control Unit (for connecting desired electrodes to the measuring unit)
4) 10-core cable sets with 10 take-outs at every 10 meters
5) 50 stainless steel electrodes
6) Interconnecting cables

2.3.1 Measuring Unit (M-Unit):

A photograph of the instrument is shown Fig. 1. Various controls and other functional switches are enumerated below:

1.	C_1 & C_2	Terminal for connecting current electrodes.
2.	P_1 & P_2	Terminal for potential electrode connection.
3.	Display	Alphanumeric display to show the menu and measured values.
4.	Power ON	ON-OFF Power switch
5.	Measure	Sets the measuring unit from standby mode to measurement mode.
6.	Ref 1	Ref 1 to be connected to Ref 1 of G-Unit
7.	Key pad	Key pad to interact with the system and entry of spacing values, no. of stacks etc.
8.	To PC	Facilitates connection to the computer for data transfer through data transfer cable
9.	Ref 2	Ref 2 to be connected to Ref 2 of G-Unit

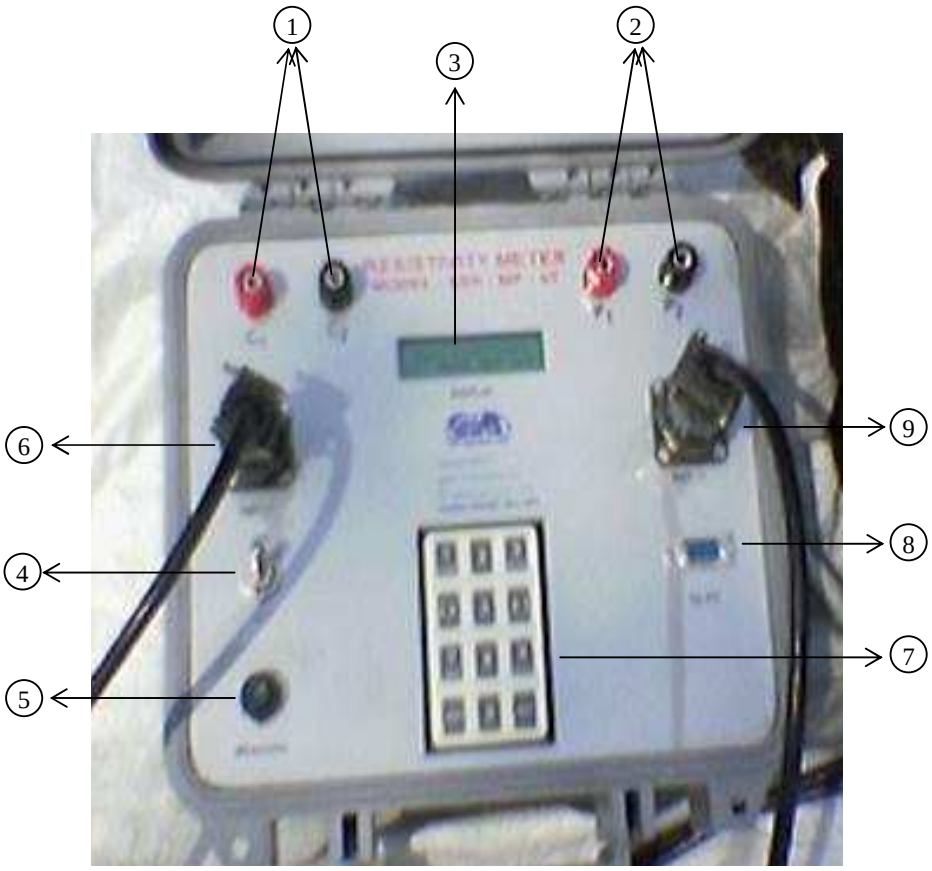

Fig. 1

G-Unit:

A photograph of the G-Unit (Power supply) is shown Fig. 2. Various controls and other functional switches are enumerated below:

1	Bat. Check	Switch to check the battery level on the VU meter.
2	Fuse	To protect the circuit in case of overload. If there is no display when all connections are made, check the fuse and change it, if necessary.
3	Charge	Connector to facilitate charging of the built-in battery.Connect the charger to this 3-pin connector to charge (2 X 12V) batteries, which are housed in the bottom compartment of the G-unit.
4	VU Meter	Meter to show the condition of the battery when the Bat.Check switch is pressed.
5	Ref. 1	To be connected to Ref.1 of the Measuring Unit.
6	Ref. 2	To be connected to Ref.2 of the Measuring Unit.

Control Unit:

A photograph of the Control Unit is shown Fig. 3. Various controls and other functional switches are enumerated below

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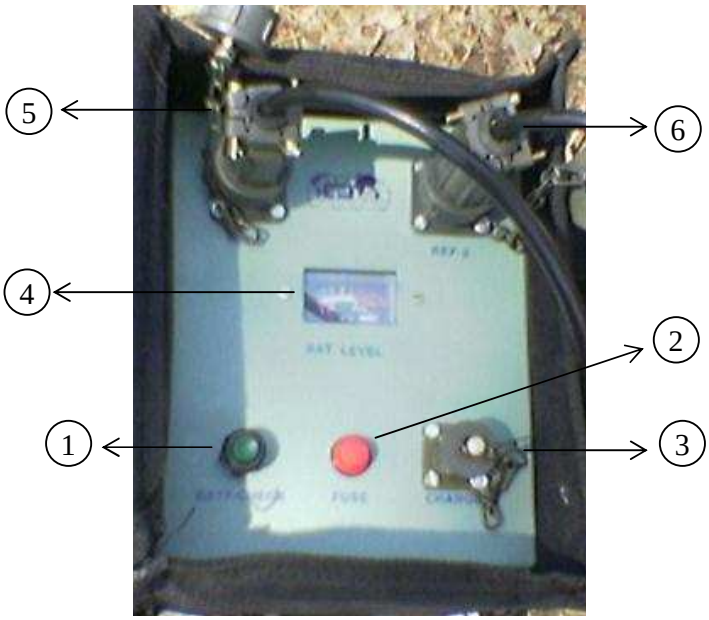

Fig. 2

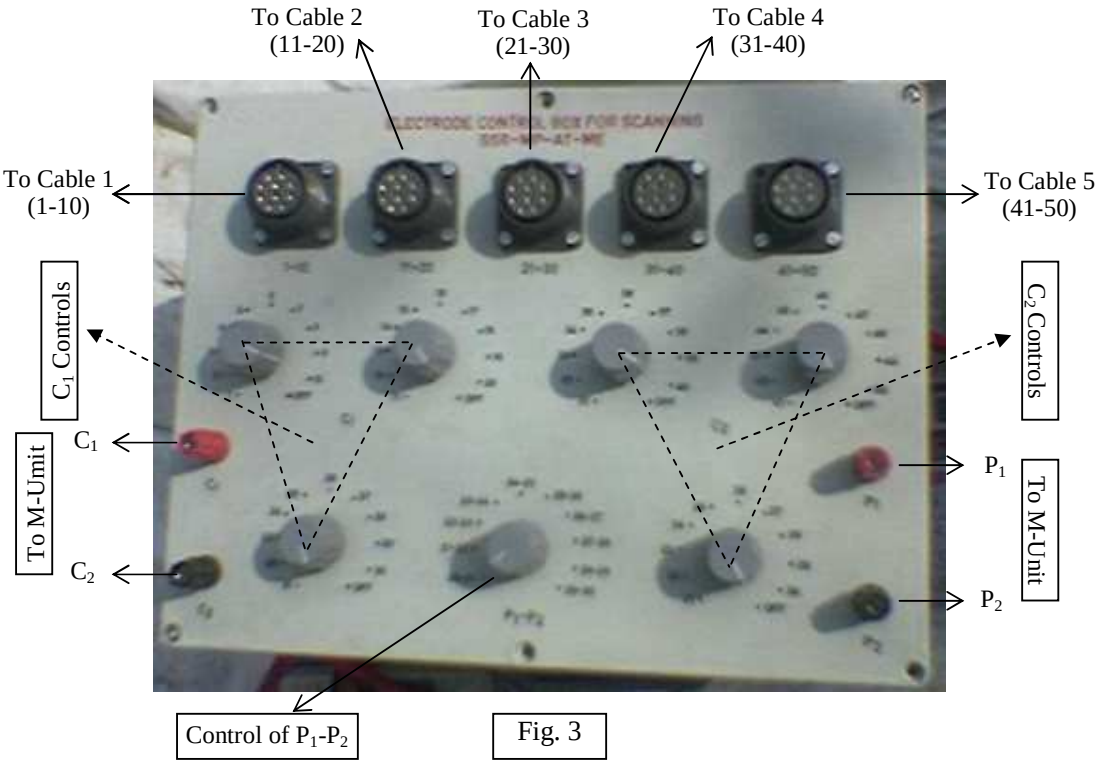

Fig. 3

Principle of Measurement:

The SSR-MP-AT-ME contains mainly three units viz., Current unit and Microprocessor-based Measuring Unit and Control Unit. The current unit sends bipolar signals into the ground at a frequency of about 0.5 Hz. The receiver has a 4½ digit dual-slope analog to digital converter (ADC) unit, which can measure the ground potentials and current with resolution up to 100 μV and 100 μA respectively. The microprocessor controls the current unit, determines the attenuation level for potential measurements, computes the resistance values, averages the measured values, keeps the data in memory, displays and transfers the data to PC.

Current Unit: This unit sends bipolar current into the ground. This unit has three voltage settings 50V, 150V and 350V, which are controlled by the microprocessor of the measuring unit. This unit is powered by 2 x 12 V rechargeable batteries.

Measuring (Microprocessor) Unit: This is the main unit, which measures the current and potential values, calculates the resistance and apparent resistivity, stores in the memory and gives the output through the display. This unit is to be programmed. For programming kindly refer Programming (Menu) chart. This unit is powered by the same batteries meant for current unit.

This is a versatile multi-electrode resistivity system can be used for Resistivity Scanning besides normal sounding and profiling. Each 10-core cable assembly is of 100 m length and with 5 such cable assemblies connected in series. A maximum current electrode spacing of 500 m can be covered with this cable assembly. The full-length resistivity scanning is done for the central 1/5 portion of the profile, that is, 100 m of the 3rd cable assembly, when 10 m inter-electrode spacing is chosen.

Field layout for Scanning:

After finalizing the target area for scanning, the other parameters to be considered are (i) depth to be investigated (ii) depth resolution and (iii) direction of the required section. Fixing of electrode separation depends on the depth of investigation and resolution. However, there will be a trade-off between the depth of investigation and resolution. The SSR-MP-AT-ME is provided with cables having maximum 10 m inter-electrode spacing. Hence any inter-electrode spacing upto 10 m can be chosen for the survey and the maximum depth of investigation is achieved with 10 m inter-electrode separation. The scanning is the process of taking progressive Vertical Electrical Soundings at regular intervals (depending upon the inter-electrode spacing) along a profile direction. Hence it is a combination of profiling and sounding.

The sketch diagram of the cable assembly is shown in figure 4. Each cable assembly has 10 take-outs.

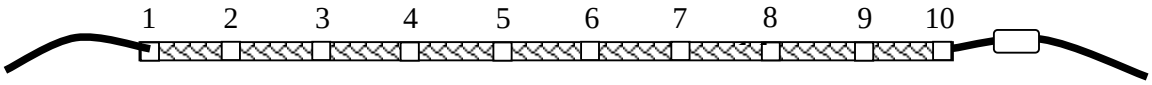

Fig. 4

For getting a 2-D scan the traverse is to be laid along the line of interest. Stainless steel electrodes are driven at regular intervals of inter-electrode spacing chosen as shown in fig. 5. Please note that the electrodes are to be driven deep enough to get good galvanic contact with the ground; if necessary, wetting the ground at the electrodes is recommended.

Fig. 5

Each take-out of the cable is connected to the corresponding electrode with the help of inter-connecting cables. Each inter-connecting cable has a small clip and a large clip on either end. The small clip is attached to the cable take-out as shown in fig. 6a and the large clip to the current electrode as shown in fig. 6b.

Fig. 6a

Fig. 6b

Normal scanning:

For normal scanning purpose, we use 5 cable assemblies and 50 electrodes. The scanning is performed between 21 and 30 electrodes (Central cable assembly) i.e., over a maximum stretch of 100 m and up to a depth of 150 m.

All the five cables are laid in a line as shown in figure 7a and connected to the Control Unit. Take-outs 1-10 of the first cable are connected 1-10 of the current electrodes, take-out 11-20 of the second cable to the electrodes 11-20 and so on.

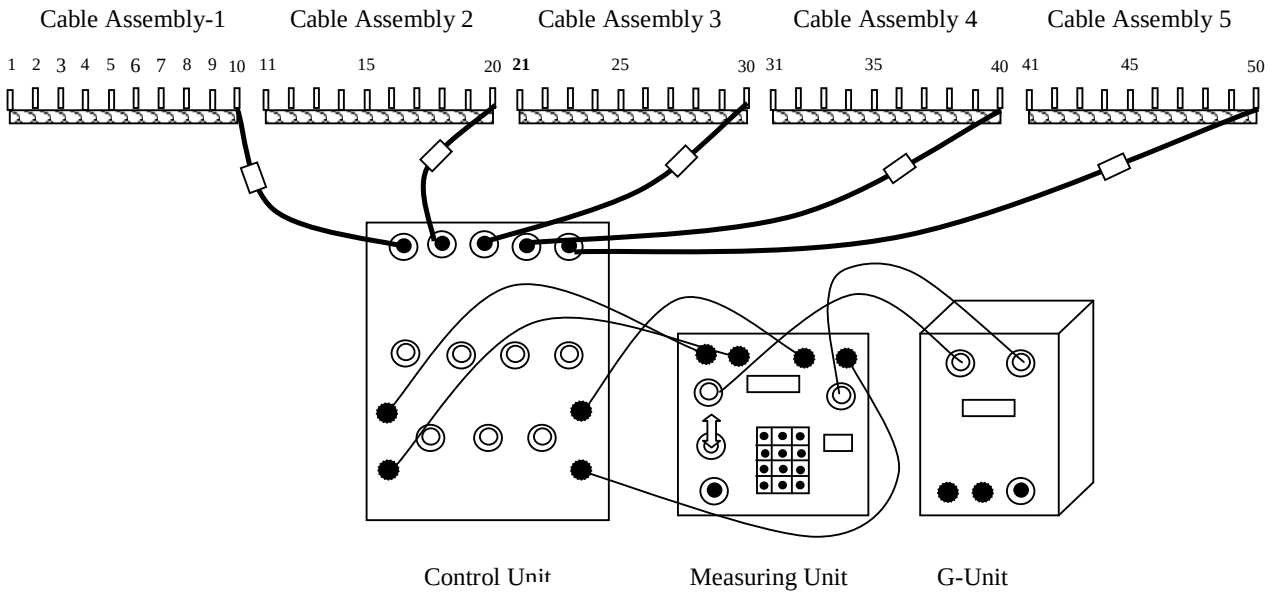

Fig. 7a

To start with, the electrodes 20 and 21 are used as potential electrodes (measurement station refers to the mid-point of 20-21) through the selecting knob on the Control unit. Electrodes 19 and 22 are selected as current electrodes through the selecting knobs on the Control Unit (please see fig. 3). The measurements are taken as per the procedure mentioned below. After the desired parameters are measured, the current electrode positions are shifted to 18-23 for the same station. The measurements are continued till the current electrode C_1 reaches the last position i.e., 1 or C_2 reaches 50^{th} electrode. Thus there will be 19 measurements for each sounding. Then the sounding point is shifted to 21-22. The first measurement for this sounding will be made with current electrode positions 20-23. The soundings are measured at all the ten points on the central cable assembly. The maximum current electrode spacing (C_1-C_2) for each sounding will be 40 times the inter electrode separation, which is related to the depth investigated. The user can choose the measurements according to the lateral and vertical information required. The scanning can be continued in any direction along the original traverse by shifting the entire electrodes en-block along with the cable assemblies by 100 m (or 10 times the station interval) to get the scan for the next stretch.

The field setup of SSR-MP-AT-ME equipment is shown in fig. 8.

To save time, it is advisable to have one more set of cable assembly and 10 more electrodes as spare. These spare electrodes have to be planted in continuation with the original traverse in advance. The spare cable assembly has to be connected to the electrodes and left near the Control Unit ready for the next scan. After completing the original scanning with the five cable assemblies, disconnect the first cable assembly from the Control Unit and remove the corresponding electrodes. For continuing the scanning stretch, connect the Cable-2 to socket-1, cable-3 to socket-2 …… and the spare cable to socket-5 of the Control Unit (see fig. 3). Now continue the process of measurements. This roll-over assembly of electrodes and spare cable can be continued depending upon the stretch to be scanned.

Shallow and rapid Scanning:

For getting information to shallow levels, we use only 3 cable assemblies and 30 electrodes at a time to scan upto a maximum depth of about 50 m. In this case, we will not be using current electrode sockets 1 and 5 on the Control Unit, which control the electrodes 1-10, and 41-50. The electrodes numbers will be from 11-40. Here also the scanning stretch is between the electrodes 21-30 , i.e., cable-3.

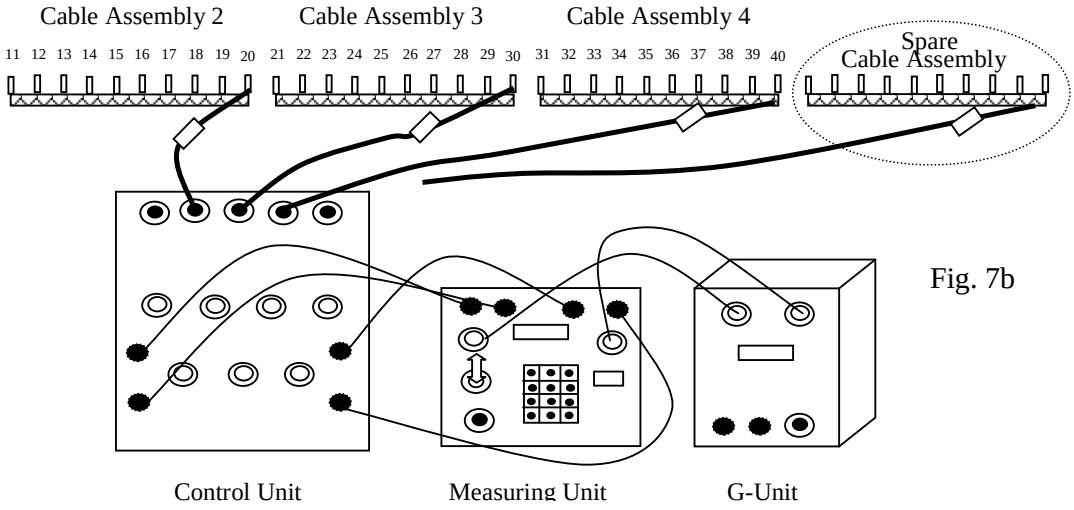

Fig. 7b

We get only 9 measurements for each sounding with this 3-cable assembly set-up. Thus the number of measurements controls the depth.

Caution: Please note that all the current electrode selection knobs for C_1 and C_2 on the Control Unit should be in OFF position, except the knobs of electrodes in use at the time of measurement.

The strip-resistivities obtained in these soundings for various electrode separations at various sounding points are used to prepare a 2-D scan section of the subsurface below the central cable assembly. The section can be prepared either manually or using the software developed by IGIS.

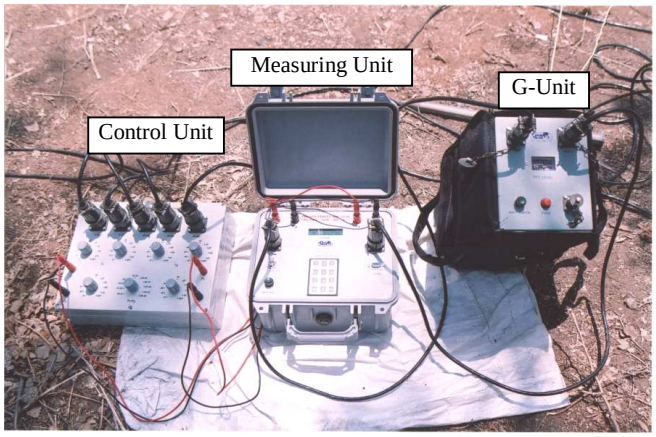

Fig. 8

Salient features of SSR-MP-AT-ME

1. The SSR MP-AT-ME has provision to stack up to 16 values and get the running average value. While taking measurements the display shows the input current in mille amperes and running average value of resistance in ohms. From these current values it is possible to assess the reliability of the resistance measurements referring to the graph.1.
2. After completing all the measurements the display finally shows average resistance and apparent resistivity value. This apparent resistivity value can be utilized for data processing by conventional methods.
3. If you press **ENT** the display shows apparent resistivity and strip (true) resistivity values. The strip resistivity is the resistivity of a strip of earth between two depths corresponding to the present and previous electrode spacings (for details refer lecture notes)