INSTRUCTION MANUAL

FOR

MODEL IPR-7

NEWMONT-TYPE
INDUCED POLARIZATION RECEIVER

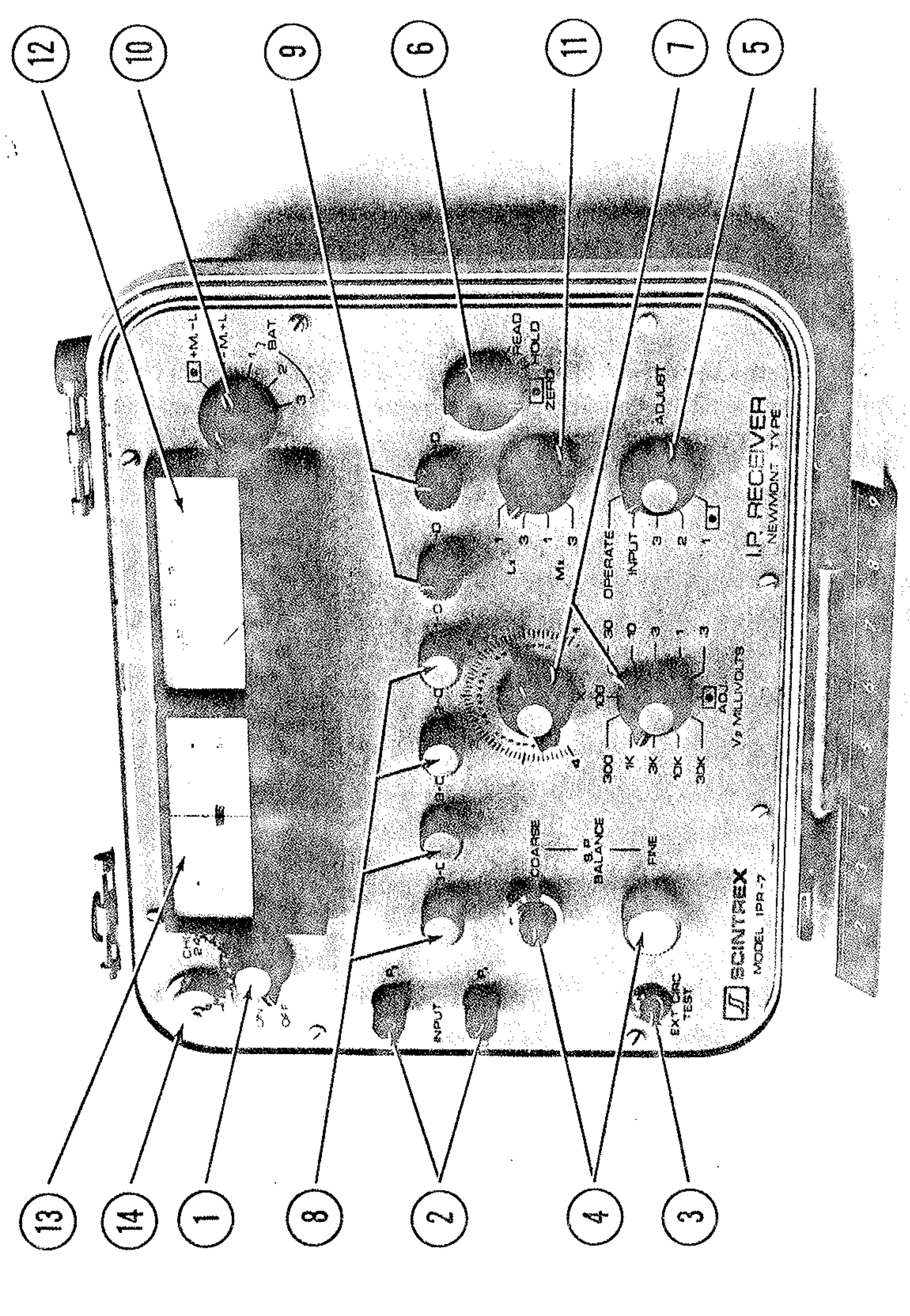

FIG.5. IPR-7 FRONT PANEL

SWITCH POSITION	CONTROLS	REMARKS
10.		Switch the power on at the transmitter
11. Adjust Switch (5) at Input	Primary voltage coarse and fine (7)	Advance primary voltage coarse switch step by step, maintaining balance and adjust primary voltage fine control until signal produces 80% meter swing, this is from 0 to red dot at the right, back to 0 and to red dot at the left, etc. Record input level from coarse and fine positions, e.g. 300mV x 2.55 = 765mV
12. (a) Adjust switch (5) at operate (b) M or L Selector (10) at M-L (c) Scale Sensitivity (11) at MxL (d) Zero-Hold-Read (6) at zero		Zero the right meter (integrator)
13. Zero-Hold-Read (6)	0 (red)	Correct meter drift to correct zero shift, return briefly to zero
14.		Repeat 12
15. Zero-Hold-Read (6)		Switch during a transmitter "on" period (this is left meter needle at red dot) to read. Count even amount of pulses, e.g. 4 or 10. Switch during the next corresponding transmitter "on" to hold. Record M reading and divide by number of pulses to obtain chargeability value in milliseconds.

SWITCH POSITION	CONTROLS	REMARKS
16. Zero-Hold-Read (6) at Zero.		Cancel integrator
17. All switches at green dot.		

NOTE:

1. For negative M readings step 12 (b) should be executed with M or L selector at -M+L.

2. For positive L readings step 12 (b), (c) should be executed with M or L selector at -M+L and scale sensitivity at L x 1.

3. For negative L readings step 12 (b), (c) should be executed with M or L selection at M-L and scale sensitivity at L x 1.

4. For "high" positive/or negative M or L readings step 12 should be executed with the scale sensitivity at M x 3 or L x 3.

   e.g. 10 pulses reads 75 chargeability is $\frac{75 \times 3}{10} = 22.5$ milliseconds.

5. M to L selector switch may be changed only during a transmitter "on" period and zero-hold-read at Zero.

6. Normally, batteries are turned "off" after each reading.

   Exception: Leave ON for 15 minutes after charging or if temperature variations cause excessive drift of settings.

CALIBRATION & FUNCTION CHECKING PROCEDURES

A simulating network (Figure 6) is provided with each receiver. This network consists of capacitors and resistors designed to provide a transient polarization voltage decay curve similar to that provided by the ground. It is used to check the teneral functioning of the receiver.

To check the receiver:

1. Insert the metal prongs of the simulator into the high voltage output terminals of the IP transmitter unit and connect the potential terminals of the simulator (black to black, red to red) to the input of the receiver (Figure 6).

2. Turn the simulating network switch to the "on" position. This puts the evergy storage portion of the simulator into the circuit.

3. Set the "high voltage selector" switch of the IP transmitter to approximately 1000V.

4. Turn the high voltage "on" and pulse. Allow at least four pulses to go by before integrating.

5. Read M and L with the Receiver Selector Switch set on both the 10 mV and 1000 mV terminals for linearity check. The range of values of the integrations for M and L are specified on the simulator network.

The above procedure provides a check to verify (a) that the instrument is working properly and (b) that the receiver calibration is correct. If the observed calibration values of the M and L* differ by more than 10% from those on the simulating network then, to a first approximation, a correction can be made to the M and L values by multiplication by the ratio of specified value. If the apparent calibration has changed by more than 25%, however, and the receiver is not being subjected to extremely high or low operating temperatures, the instrument should be thoroughly lab tested to check for the source of the malfunction.

To check the electronic noise in the receiver and to verify that the transmitter programmer is functioning properly:

6. Turn the simulating network switch to the "off" position.

7. Repeat procedures 3, 4, and 5.

There should now be no storage of energy and no integration on M or L.

Note: * The M and L values shown on the simulator case are for the sum of two consecutive pulses not for a single pulse.

BATTERY CHARGING

The nickel-cadium batteries in the receiver must be recharged after each full day of use in the field. (Charge 1-1½ times as long as the unit was used.) A small charger working on 115V 50-400 Hz supply and producing 24 V.D.C. is supplied with the receiver. This should be plugged into a 115V outlet and connected to the "battery charger" plug on the receiver (battery switch "OFF"). Alternatively, the other charging leads supplied with the unit can be connected to a 24V DC supply such as two car batteries in series - red to positive and black to negative terminals. Overcharging will damage the batteries.

USE OF IPR-7 AS A SELF-POTENTIAL METER

The Scintrex IPR-7 receiver can be used to make self-potential measurements as well as chargeability and resistivity measurements.

Using standard S.P. techniques follow the operational procedures given below:

1. Turn the IPR-7 "on".

2. With all switches at green dots zero the three amplifier stages (sequence 1-6, Page 9).

3. Put the adjust switch to the "input" position.

4. Connect the S.P. electrode cables to the IPR-7 input terminals.

5. Short the input terminals and zero the primary voltage meter using the coarse and fine S.P. helipot controls.

6. Take short off and adjust the primary voltage gain controls in order to bring needle on primary voltage meter to red mark.

7. Read coarse and fine primary voltage gain controls. This value will be equal to the self-potential voltage in millivolts.

8. Note polarity of reading with respect to the polarity input.

TROUBLE SHOOTING

The IPR-7 can be checked for possible faults very rapidly by following the procedure outlined below. The numbers in brackets refer to Figure 5.

(a) To check the batteries, turn the Integrate Function Switch (10) to "BAT" positions "1, 2 and 3". The integrating needle should fall within the green section on the integrating meter (12).

(b) With the VP switch (7) in the "Adj." position, turn the Adjust Switch (5) to 1, then to 2, then to 3. If the VP meter (13) needle moves when the Amplifier Zeroing Pots 1-0, 2-0 and 3-0 (8) are turned then the amplifiers are functioning. (Move 1-0 with Adjust Switch to 1, 2-0 with Adjust Switch to 2, etc.).

(c) To check the VP Meter (13) short out the Input Terminals (2). Put Primary Voltage Coarse Control Switch (7) to the 1K position and Adjust Switch (5) to "Input" position. Turn the Coarse SP Helipot (4). The VP meter (13) needle should move.

(d) Using the simulator network (Fig. 6) check the integrating meter (12) and the VP meter (13).

If an integration cannot be measured adjust the VP meter (13) needle to swing from red mark to red mark on the VP meter. Using a voltmeter check the voltage between (negative) ground and the single ended side of the polarity need of Relay No. 4 (see Schematics). The meter should read +3V, off, +3V, off, +3V, off +3V, off for whatever length of time the pulse duration switch on the control unit is set at. If the voltmeter reads +3V, off, etc. and there is still no chargeability reading, check the three internal batteries inside the instrument. In series, these batteries should show a minimum of 3.6 Volt. If the battery voltage is satisfactory remove the protective covering on the Program IC (see Schematics) and change it -- note carefully the position of the slot marker on the IC case.

(e) Unsteady Integrate readings may be caused by fatigued reed switches. To replace a single reed unit, cut off the leads as close to the relay as possible. Using these leads as supports, solder in new switches.

(f) Before taking a reading, all instrument controls should be carefully adjusted according to the Operating Instructions above. High resistivity and low chargeability areas necessitate working on the lower scales. Drift becomes more of a problem as the sensitivity is increased.

(g) Electrodes such as porous pots must be correctly prepared. In high resistance areas, steel probes should be moistened using salt water. For better ground constant more than one current probe should be utilized.

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INTRODUCTION

The basic equipment required for an Induced Polarization survey consists of a transmitter, a receiver, wire and electrodes. Power can be derived from a motor-generator set or batteries. A block diagram showing the basic IP system is presented in Figure 1.

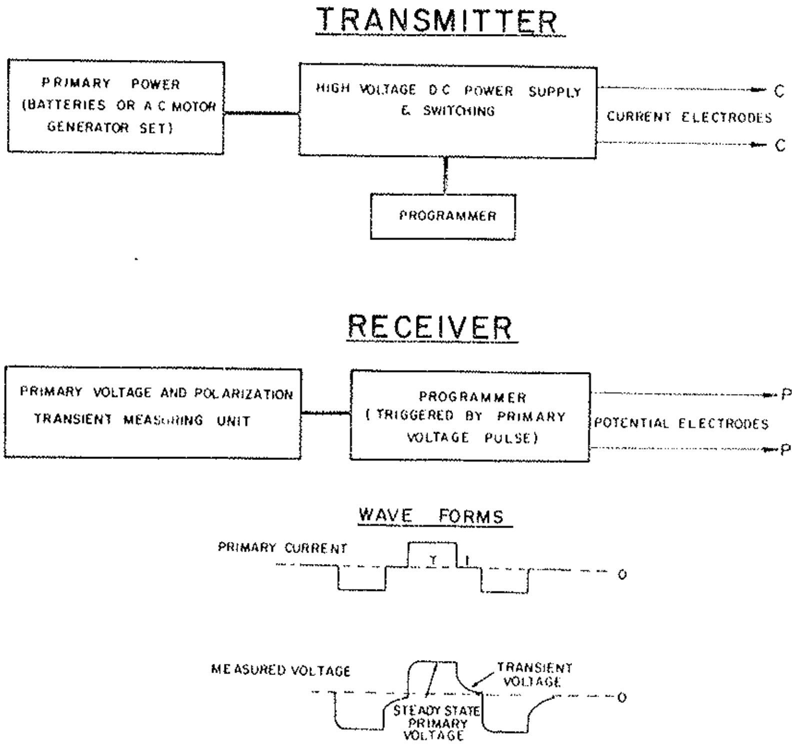


FIG. 1 Block Diagram Showing Basic Time Domain I. P. System

The Scintrex measuring unit is the IPR-7 Newmont-type remote-controlled ground-pulse triggering receiver used for time-domain IP operations. This manual describes in some detail, the operation and field maintenance of the IPR-7.

As shown in Figure 2 (Block Diagram of IPR-7) the unit consists of an automatic self-potential buck-out circuit, an A.C. filter, a three step amplifier, a programmer to operate 4 relays, an integrator circuit and two meters. These are enclosed in a portable light-weight fibreglass case.

The IPR-7 receiver is designed specifically for use with the following IP transmitters manufactured by Scintrex Limited:

(1) IPC-7 25W Transmitter

--a battery powered, solid-state, light weight, unit designed for rapid reconnaissance coverage over areas of shallow overburden.

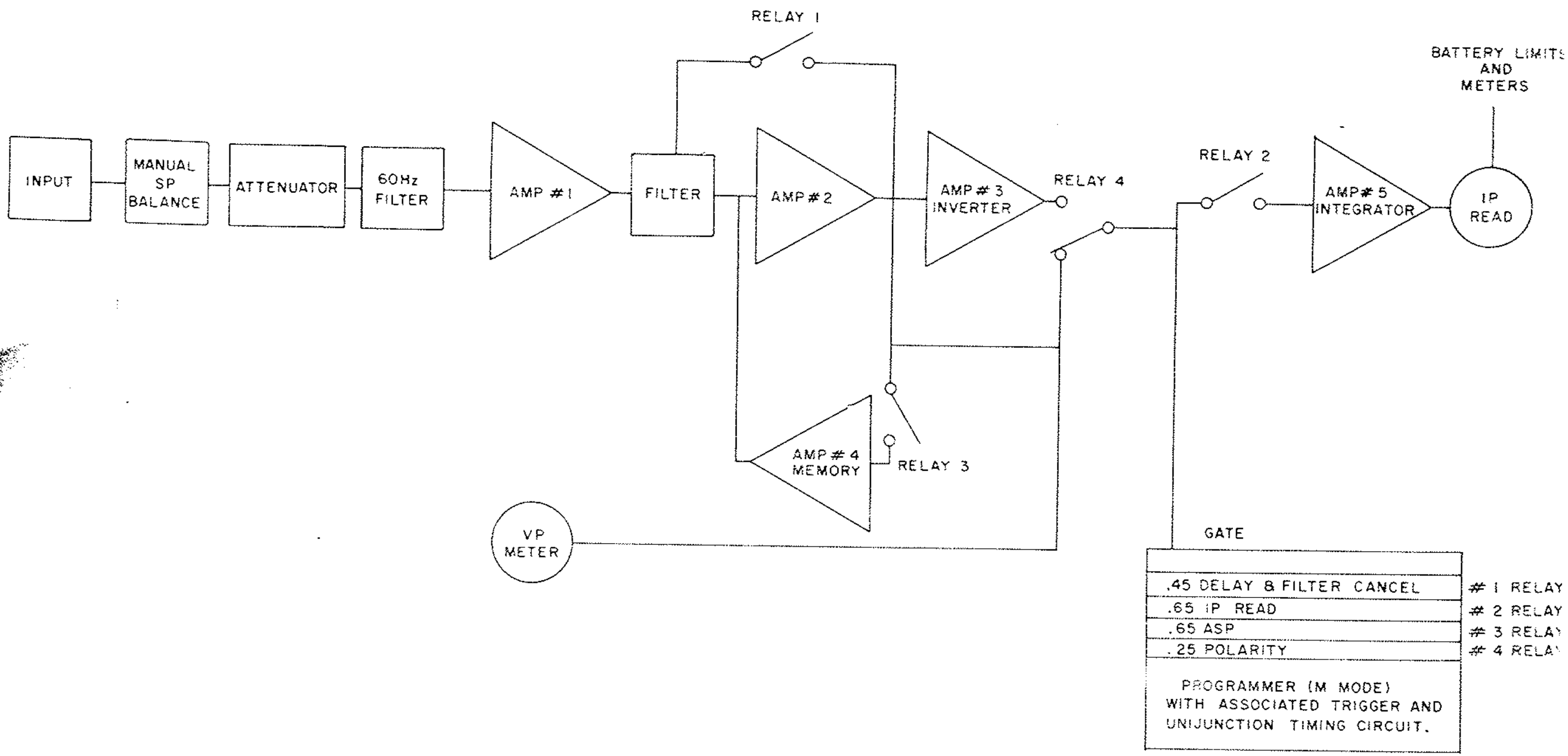
(2) IPC-7 2.5 kW Transmitter

--powered by a 7 hp Briggs and Stratton motor-generator set. This unit is medium weight, portable, compact and completely solid-state. It lends itself to application in most geological and geographical environments.

(3) IPC-7 15 kW Transmitter

--powered by a 36 hp Volkswagen (industrial) engine and designed for use in areas of highly conducting overburden and for very deep penetration.

Each of these transmitting units are described in the appropriate Operator's Instruction Manual.



(FIG. 2) BLOCK DIAGRAM OF THE IPR-7 RECEIVER

RECEIVER SPECIFICATIONS

Electrical:

Primary Voltage Range	300 microvolts to 30V Accuracy ± 3%
Input Impedance	300 K ohms
Chargeability (M) Reading Range	0 -100 and 0 - 3-- milliseconds Accuracy ± 5%
Curve Factor (L) Reading Range	0 - 100 and 0 - 300 milliseconds Accuracy ± 5%
Delay Time Before Integration	0.45 seconds
SP and VLF Noise Compensation	Manual: ± 1.5 millivolts Automatic: lmV range ± mV total 30 mV range ± lV total
Power Supply	Internal rechargeable nickel cadmium batteries. Rated life 45 hours/charge.
Temperature Range	-20° to 130° F (-29° C to $+55^{\circ}$ C)
Humidity Range	to 100% non-condensing

NOTE: A time reference signal is remotely obtained from the received primary signal to give coherent detection.

Automatic SP corrections are applied during each reading period using a memory circuit.

Mechanical:

Weight	13½ lbs. (6.1 kg) including batteries
Dimensions	14" x 11" x 6½" (35.5 cm x 28 cm x 16.5 cm)

QUANTITIES MEASURED BY THE IPR-7 RECEIVER

Figure 3 shows the quantities measured by the IPR-7 receiver. In this receiver, one sets the gain of certain amplifiers common to both the primary voltage Vp and transient voltage Vt measurements so that these voltages are essentially normalized. The usual amplitude measurement performed by the receiver consists of an integration of the area under the transient curve over a specified interval (0.45 seconds to 1.1 seconds) after the interruption of the primary current and is designated by the letter "M" -- the "chargeability" in milliseconds. The 0.45 second delay time allows most EM transients, switching transients and interline coupling effects to disappear prior to making a measurement. Differing measuring intervals may be employed under specific conditions.

In addition to "M", the instrument is equipped to measure a quantity "L" which is defined as the time integral of the area over the transient curve, for a specified time interval, taking as reference voltage the transient voltage value at the beginning of the time interval. In practice, the interval selected is 0.45 seconds to 1.75 seconds, as shown in Figure 3, although different intervals may be employed under certain conditions.

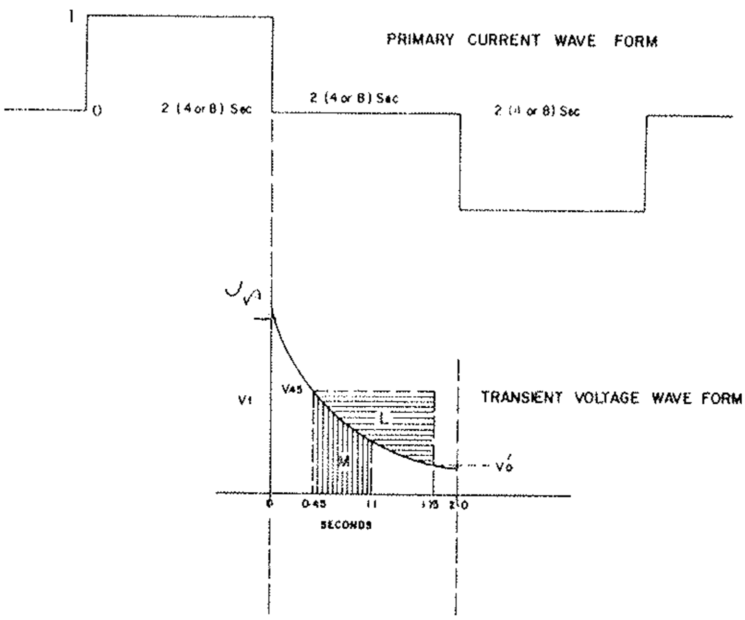


FIGURE 3. TIME-DOMAIN WAVE FORMS AND QUANTITIES MEASURED.

The ratio of L/M is taken as a sensitive indication of transient curve shape. It has been well established that the L/M measurements in non-metallically-mineralized areas, for a given current wave form, are constant within better than 20%. Significant departures from these ratios usually imply an abnormal condition -- either an anomalous metallic polarization response or electromagnetic or interline coupling.

Figure 4 shows a range of transient curves and their possible cause. For each case the "normal" transient curve is also shown. These cases illustrate the sensitivity of the L/M ratio to the transient time constant. A significant increase in L/M implies an abnormally short time constant (Case A) reflecting either positive EM effects or small particle size. This should, in either case, normally be accompanied by an increase in apparent chargeability "M".

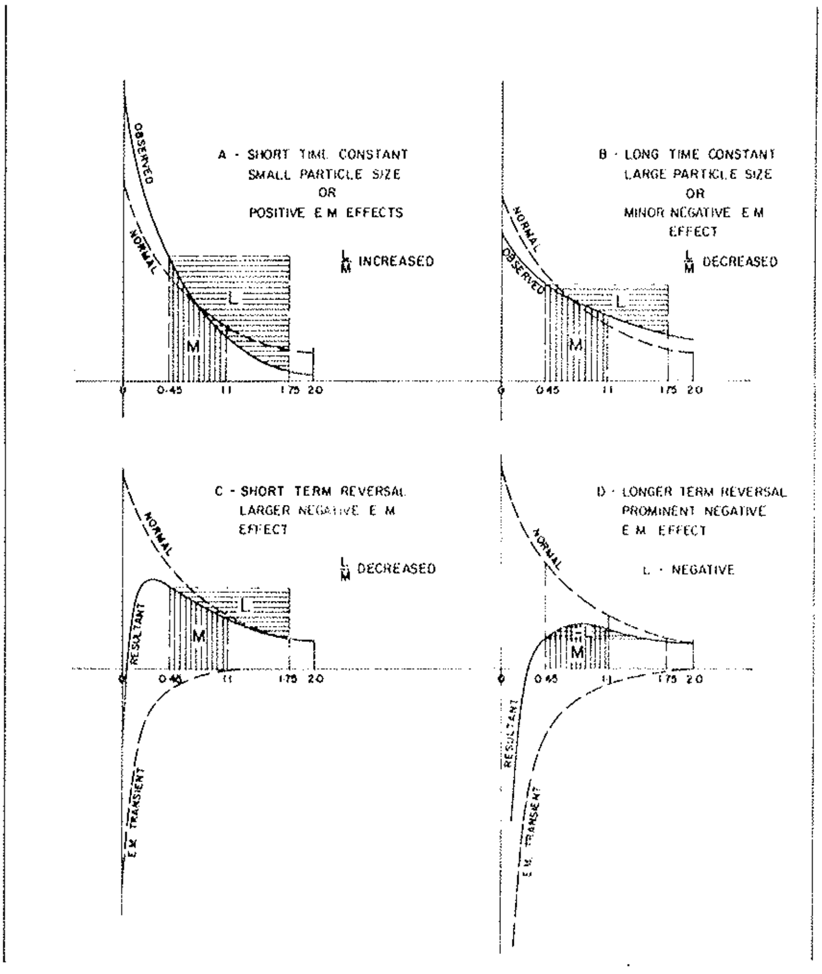


FIGURE 4. THE SIGNIFICANCE OF L/M RATIOS.

A modest increase in L/M ratio, reflecting an increase in time constant (Case B) may reflect either the presence of large particle size metallic conductors, in which event an increase in "m" should also be noted, or a minor negative EM transient. In the latter event, "M" may or may not be appreciably reduced.

Cases C and D show the effect of reversed polarity EM transients of increasing amplitude. In Case C there is a short term Vt reversal and although "M" is only slightly reduced, L/M is considerably reduced. In Case D, which is considerably more extreme, Vt is still rising at 0.45 seconds, so that L and thus L/M are, in fact, negative. M is considerably reduced from its normal value in this case, but a warning to this effect is clearly indicated by the L measurement.

FRONT PANEL DESCRIPTION

The following is a description of the functions of the IPR-7 front panel controls and meters as illustrated in Figure 5.

1. The POWER SWITCH is used to turn the receiver "on" and "off".

2. The INPUT TERMINALS (P_1 and P_2) are used to connect the electrode cables to the receiver.

3. The EXTERNAL CIRCUIT TEST buttonis used to check the contact resistance across the electrodes. The contact resistance values can be read in kilohms on the top scale of the integrating meter (11).

4. The SELF POTENTIAL COARSE and FINE HELIPOTS are used to manually balance out the self-potential prior to setting the instrument on automatic and taking a reading.

5. The ADJUST switch is used to turn on the various amplifier zeroing pots, to allow the external signal to enter the receiver and to turn the unit to the operate position.

6. The INTEGRATE FUNCTION switch is used to control the receiver's integrating network.

7. The PRIMARY VOLTAGE COARSE and FINE CONTROL switches are used to adjust the swing of the needle in the VP meter (12) and to measure the magnitude of the primary voltage.

8. The AMPHFIER ZEROING POTS 1-0, 2-0 and 3-0 refer to the 1st, 2nd and 3rd amplifier stages. D-0 connects for amplifier drift.

9. The INTEGRATE ZEROING POTS

O refers to the amplifier in the integrating network

D corrects for drift in the integrating network

10. The INTEGRATE FUNCTION SWITCH is used to put the receiver in the M and L mode of operation and to check the batteries.

11. The M and L MODE RANGE SWITCH is used to bring the M and L readings within the range of the integrating meter (12).

12. The INTEGRATING METER used to measure the magnitude of M and L in milliseconds, to check the battery voltage and to read the contact resistance of the external circuit.

13. The PRIMARY VOLTAGE (Vp) METER is used to measure the value in milliseconds of the primary voltage.

14. The CHARGING PLUG used for connecting the battery charger to the receiver.

OPERATING PROCEDURES

The following is the recommended sequence of operations performed in taking measurements using the IPR-7 receiver. The numbers in parenthesis refer to the labels in Figure 5.

SWITCH POSITION	CONTROLS	REMARKS
1. All switches at green dots		
2. Main Switch (1)		Turn to ON
3. Adjust Switch (5) at 1	1-0 (blue)	Zero left meter (first amplifier stage)
4. Adjust Switch (5) at 2	2-0 (blue)	Zero left meter (second amplifier stage)
5. Adjust Switch (5) at 3	3-0 (blue)	Zero left meter (third amplifier stage
6. Adjust Switch (5)	3 D (blue)	If necessary, correct meter drift by turning the 3-D pot opposite to drift, till drift stops. (due to drift zero may be permanently shifted) Cancel the offset by switching "Adjust Switch" (5) to pos. 2
7. Potential Electrode Test		Push red button (3) and watch the resistance meter. Resistance should be less than 30K ohms.
8. Adjust Switch (5) at 3 - 2 - 3		Re-check steps 4 and 5
9. Adjust Switch (5) at input	SP-Balance coarse and fine (4)	Balance the SP on the left hand meter