Time Domain Electro-Magnetics

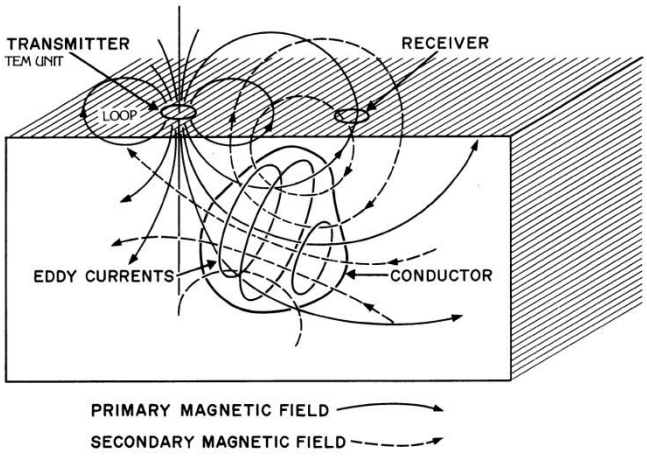
Introduction

This brochure provides information on the geophysical technique known as Transient Electro-magnetics or TEM for short.

Australia has been in the forefront of TEM development due to the existence of a highly conductive overburden which requires high transmitter power and late time recording to penetrate. SIROTEM was developed locally to provide these capabilities and subsequently was sold in many other countries. To replace the ageing Sirotem technology, while retaining its particular advantages, the much more advanced terraTEM has been developed by Monash Geoscope and distributed world-wide by Alpha Geoscience.

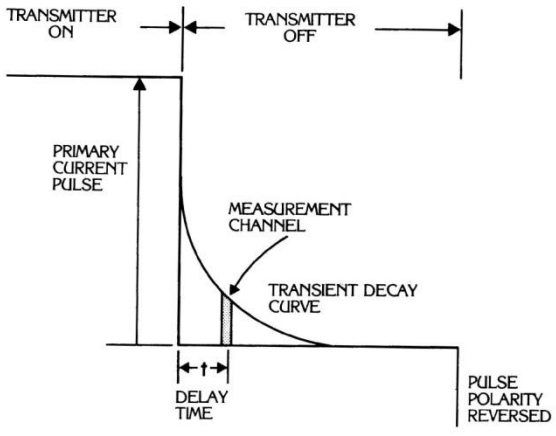
Transient EM (TEM)

The principle of the TEM method of geophysical prospecting is very simply, that current flowing in a transmitter loop sets up a magnetic field which when switched off induces eddy currents to flow in any good electrical conductor in the ground. These eddy currents set up a secondary magnetic field which can be detected by a receiver loop as a time-dependant decaying voltage.



TEM Uses

The recording of the 'transients' is a means of detecting conductors in the ground. The decaying transient can be described by a number of measurement channels recording the voltage at various delay times (see figure below) during the "quiet time" between current pulses.



Schematic diagram of TEM operation

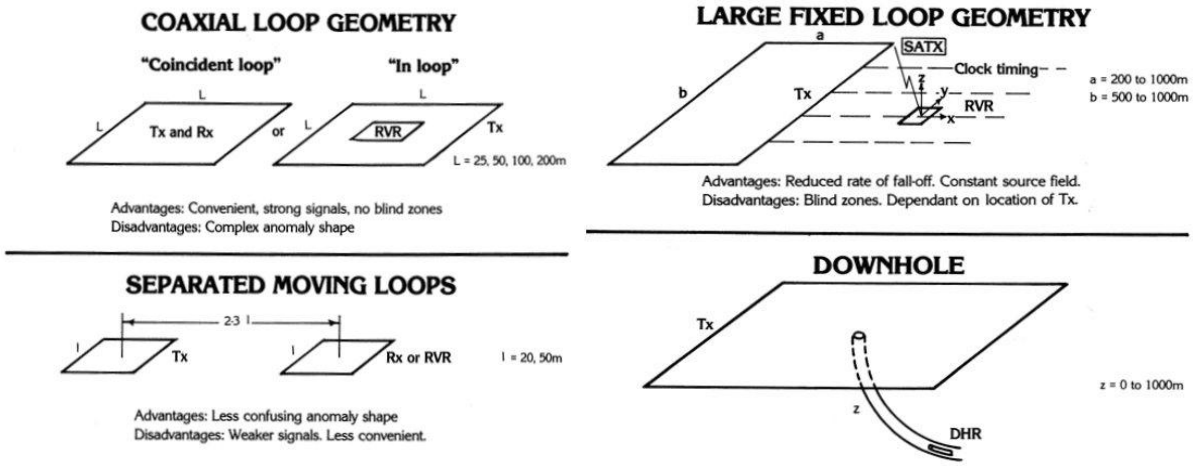
The character of this decay (duration, amplitude, etc.) depends on the conductivity, shape and size, and depth and attitude of the conductor and its position with respect to the receiver loop and can be used to provide information on all this factors.

A particular advantage of transient EM systems over continuous waves systems is the fact that the measurements are taken when the transmitted fields are switched off. This means that the sensitivity of the receiver can be a maximum to record the

transient voltages only without having to cope with the much greater signal strength of the transmission field. It also means that a greater variety of loop configurations can be used including having the receiver loop in the same place as the transmitter loop for maximum signal reception.

Typical Common Loop Configurations

There are a number of different loop configurations that can be used with TEM. The terraTEM is capable of operating with all the configurations mentioned. Having a Transmitter (Tx) and Receiver (Rx) in one unit makes to ease of data collection and logistics very much easier.



Coincident Loop – where the Tx and Rx loop is one cable (no need for two cables).

In-Loop – using a Roving Vector Receiver as the Rx, Transmit into the larger loop and receive on profiles through the Tx loop.

Separate Moving Loops – in this configuration, both the Tx and Rx loops are moved simultaneously along the survey line with a spacing between them of between 2 and 3 times the length of the sides of the Tx loop.

Larger Fixed Loop Geometry - this geometry is similar to the in-loop however the fixed loop is considerably larger that the in-loop, a large Tx is used on the fixed loop and the RVR is clock synchronised to the Tx.

DownHole / Surface Loop – a downhole probe with a surface loop can be used to better define conductive bodies in the sub-surface.

terraTEM System

The terraTEM is a new transient electromagnetic survey system designed and constructed in Australia. It incorporates a 10 Amp transmitter and a true simultaneous 500 kHz 3-component receiver. The unit is powered by an external 24 V battery pack system allowing 6-8 hours of continuous operation. An inbuilt GPS is mounted on the front panel, allowing location information to be

automatically recorded with soundings. All connectors are external to the case allowing easy transportation without having to shutdown between sites.

The user interface comprises a 15″ colour LCD panel and a touch-screen. Menus are designed to allow intuitive and rapid transition between critical acquisition parameters and data display. Spectral analysis, combined with DSP options, allows the user to design specific filters to suit local site conditions. A diagnostic menu provides access to a spectrum analyser as well as time-domain views of the input signal for rapid troubleshooting or optimisation of acquisition parameters to ambient site conditions.

Data is stored in an expandable 1 GByte solid-state memory, this provides the user with essentially unlimited storage space (up to 500,000 soundings), making the terraTEM system ideal for rapid, high-resolution surveys. System parameters are stored automatically with each sounding for post-survey quality assurance. Data is transferred using a USB flash memory stick. The terraTEM is packaged with data reduction and processing software and can generate on-site standard profile and decay plots, apparent conductivity pseudo-sections, and contour plan maps. Images can be saved as bitmaps and inserted directly into reports. All data in this brochure was derived from the internal terraTEM software. Synchronisation with an external transmitter is optional.

The terraTEM has been developed and manufactured by Monash Geoscope and distributed worldwide by Alpha GeoScience.

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