

## Time Domain EM systems from Geonics

It is well known that there is a trade-off between depth of exploration and target definition in terms of conductivity, extent and orientation. Greatest depth is obtained with large fixed loop Turam-type systems which generate large half space responses and along with current gathering makes target detection difficult. Better spatial resolution is obtained with a moving transmitter configuration with a short intercoil spacing but is limited to a shallower depth of exploration. These variations in survey requirements make system flexibility an important design consideration.



**Protem Receiver**

Time Domain systems are also now routinely employed for general geological exploration such as for freshwater aquifers in bedrock fractures, and mapping groundwater contaminant plumes. Mapping to the shallow depths required in these applications requires a very wide bandwidth and many narrow sampling gates.

Recognition of these diverse requirements led GEONICS to develop the extremely flexible PROTEM time domain system. The digital, 3 channel receiver is used with any of the 3 TEM transmitters and choice of receiver coil to cover all applications. With its 23 bit resolution, system bandwidth of 500kHz, microsecond sampling gates and simultaneous XYZ component measurements, the PROTEM receiver provides the ultimate in time domain capability. Used with the GEONICS 3-component coil, mineral surveys are quickly completed with more data in either the fixed loop or Slingram mode. The three component measurement also allows a quick and accurate check on GeoElectrical sounding data for lateral variations in conductivity which could invalidate a layered-earth interpretation.

**Three interchangeable transmitters - TEM47, TEM57 and TEM37 - are used with the PROTEM receiver and the appropriate receiver coil to make up different PROTEM systems for various applications such as mineral exploration, structural mapping, resistivity sounding and contaminant plume mapping.**

## TEM47 Transmitter

The TEM47 is the smallest, lightest battery operated transmitter with a very fast turn-off time to enable the near surface response to be measured. The PROTEM 47 (PROTEM receiver and TEM47 transmitter) is most often used for shallow GeoElectrical sounding looking for conductive contaminant plumes, saline intrusion or general stratigraphy mapping. In this mode single turn transmitter loops from 5 m up to 100 m on a side with turn-off times as short as half a microsecond can be used to give maximum near surface resolution.

The maximum transmitter output of 3 A into a 100 m x 100 m loop gives a good response and resolution to depths down to 150 m making this the ideal instrument for resistivity sounding over a large area.

The TEM47 uses a reference cable to achieve the high synchronization accuracy required for shallow sounding. Regardless of application, the high frequency receiver coil is used in PROTEM 47 systems. This receiver coil has the bandwidth necessary to capture the earliest portion of the transient decay.

When the TEM47 is used in a PROTEM 47 system for profiling, it supplies 3 A to an 8-turn 5 x 5 m moving transmitter loop to provide a dipole moment of 600 ampere square metres. With base frequency of 75 Hz and 20 gates from 49 microseconds to 2.9 milliseconds this configuration is optimal for Slingram (horizontal loop) surveys for mineral exploration to shallow depths, and for groundwater exploration in bedrock fractures. Electrical sounding is performed simultaneously with the search for fault or dike-like targets.



## TEM57 TRANSMITTER

The TEM57 and PROTEM receiver are the principal components of PROTEM 57 systems. The design and performance of the PROTEM 57 make it a highly portable, powerful and versatile time domain system.

The TEM57 is powered by either a 600 W generator or by rechargeable batteries in a backpack. PROTEM 57 systems are synchronized by either a reference cable or quartz crystal, usually determined by the size of the loop and whether they are being used for large loop soundings or profiling.

The PROTEM 57 is used for a wide variety of applications. The system can sound the depth, thickness and conductivity of layers down to 300 m below surface, for applications such as mapping the thickness of aquifers, clay layers and assessing water quality. In coastal areas, the PROTEM 57 has defined the depth to saline intrusion as accurately as chemical samples from wells.

The PROTEM 57, with a short reference cable, portable transmitter and 3-D receiver coil can delineate complex ore bodies within 200 m of surface. Deeper conductors can be characterized by profiling with a crystal synchronized receiver and a large, fixed transmitter loop. Modelling provides conductivity thickness, dip and extent of the ore body.

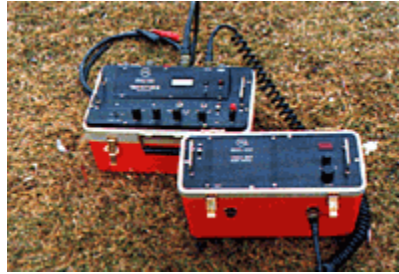


## **TEM67 TRANSMITTER**

The TEM67 is the most powerful PROTEM transmitter, replacing the TEM37. Not only is the TEM67 more powerful than the TEM37 (3,800 watts as compared to 2,800 watts for the TEM37), but the TEM67 offers a degree of flexibility not previously available in time domain transmitters; The TEM67 uses the TEM-57 Mk. 2 transmitter with a separate power module and larger generator (4,500 watts). This means that one can upgrade from the TEM-57 MK. 2 with the addition of a TEM67 power module and generator. Conversely, if the full power of the TEM67 is not required for a particular survey, much of the weight can be eliminated by using only the TEM-57 Mk. 2 portion.

The PROTEM 67 system with the 3D receiver coil is the ideal time domain system for profiling deeply buried conductive ore bodies, such as massive sulphides, to depths in excess of 500 metres, and with the 3-axis BH43-3 borehole probe for time domain logging to 2 kilometres.

The PROTEM 67 is also ideal for deep soundings in ground water exploration, saline intrusion mapping, geothermal exploration, and regional geological research where structures and layer information is required to depths of 1,000 metres or more.



## Specifications

### Protem Receiver

|                          |  |
|--------------------------|--|
| <b>Measured Quantity</b> | Rate of decay of induced magnetic field along 3 axes, in nV/m <sup>2</sup>                         |
| <b>EM Sensor</b>         | Air-cored coils  |
| <b>Channels</b>          | 1 channel used sequentially for 3 components, or 3 channels for 3 component simultaneous operation |
| <b>Time Gates</b>        | 20 gates covering 2 time decades or 30 gates covering 3 time decades                               |
| <b>Dynamic Range</b>     | 23 bits (132 dB)   |
| <b>Base Frequency</b>    | 0.3, 0.75, 3, 7.5, 30, 75 and 285 Hz or 0.25, 0.625, 2.5, 6.25, 25, 62.5 and 237.5 Hz              |
| <b>Integration Time</b>  | 0.5, 2, 4, 8, 15, 30, 60 or 120 s  |
| <b>Display</b>           | 240 x 64 dot graphic LCD   |
| <b>Data Handling</b>     | Solid-state memory for 3,300 data-sets, RS232 output   |
| <b>Synchronisation</b>   | Reference cable or, optionally, highly stable quartz crystal                                       |
| <b>Power Supply</b>      | 12 V rechargeable battery for 8 h continuous operation   |
| <b>Weight</b>            | 15 kg  |
| <b>Dimensions</b>        | 34 x 38 x 27 cm  |

## TEM-47 Transmitter

|                         |  |
|-------------------------|--|
| <b>Current Waveform</b> | Bipolar rectangular current with 50% duty cycle  |
| <b>Base Frequency</b>   | 30, 75 or 285 Hz where powerline frequency is 60 Hz<br>25, 62.5 or 237.5 Hz where powerline frequency is 50 Hz |
| <b>Turn-Off Time</b>    | 2.5 us at 3A into 40 x 40 m loop.<br>Faster into smaller loop  |
| <b>Transmitter Loop</b> | 5 x 5 to 100 x 100 m single turn loop or<br>5 x 5 m 8-turn loop  |
| <b>Output Voltage</b>   | 0.9 V, continuously variable   |
| <b>Power Supply</b>     | Internal 12 V rechargeable battery   |
| <b>Battery Life</b>     | 5 h continuous operation at 2A output  |
| <b>Weight</b>           | 5.3 kg   |
| <b>Dimensions</b>       | 10.5 x 24 x 32 cm  |

## TEM-57 Mk. 2 Transmitter

|                         |  |
|-------------------------|--|
| <b>Current Waveform</b> | Bipolar rectangular current with 50% duty cycle  |
| <b>Base Frequency</b>   | 3, 7.5 or 30 Hz where powerline frequency is 60 Hz<br>2.5, 6.25 or 25 Hz where powerline frequency is 50 Hz<br>Rates below 1 Hz available from Protem Receiver through reference cable |
| <b>Turn-Off Time</b>    | 20 to 115 us depending on size, current and number of turns in transmitter loop  |

|                               |  |
|-------------------------------|--|
| <b>Transmitter Loop</b>       | Single turn: any dimension; minimum resistance is 0.7 ohms, up to 300 x 600 m. 8-turn; 5 x 5 or 10 x 10 m. |
| <b>Output Current</b>         | 25 A maximum   |
| <b>Output Voltage</b>         | 18 V to 60 V continuous control with motor generator, up to 160 V (3,800 W)                                |
| <b>Synchronization</b>        | Reference cable or, optionally, quartz crystal   |
| <b>Power Supply</b>           | 1,800 W, 110/220 V, 50/60 Hz single-phase motor generator or, optionally multiple 12 V batteries           |
| <b>Transmitter Protection</b> | Electronic and electromechanical protection short circuit  |
| <b>Transmitter Weight</b>     | 15 kg  |
| <b>Transmitter Dimensions</b> | 43 x 25 x 25 cm  |

## TEM-67 Transmitter

|                               |  |
|-------------------------------|--|
| <b>Current Waveform</b>       | Bipolar rectangular current with 50% duty cycle  |
| <b>Base Frequency</b>         | 0.3, 0.75, 3, 7.5 or 30 Hz where powerline frequency is 60 Hz<br>0.25, 0.625, 2.5 or 25 Hz where powerline frequency is 50 Hz<br>Rates below 1 Hz available from Protem Receiver through reference cable |
| <b>Turn-Off Time</b>          | 20 to 750 us depending on transmitter loop size, current and number of turns.  |
| <b>Transmitter Loop</b>       | Up to 2,000 x 2,000 m minimum  |
| <b>Output Current</b>         | 25 A maximum   |
| <b>Output Voltage</b>         | 18 to 150 V continuously adjustable  |
| <b>Synchronization</b>        | Reference cable or, optionally, quartz crystal   |
| <b>Power Supply</b>           | 4,500 W, 115 or 110/220 V, 50/60 Hz single-phase with 8 h continuous operation motor generator   |
| <b>Transmitter Protection</b> | Electronic and electromechanical protection short circuit  |

|                                   |   |
|-----------------------------------|---|
| <b>Transmitter Weight</b>         | 15 kg (TEM-57 MK. 2); 12 kg (TEM-67 power module)                     |
| <b>Transmitter Dimensions</b>     | 43 x 25 x 25 cm (TEM-57 Mk. 2); 42 x 20 x 31 cm (TEM-67 power module) |
| <b>Motor Generator Weight</b>     | 62 kg   |
| <b>Motor Generator Dimensions</b> | 60 x 50 x 49 cm   |



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