

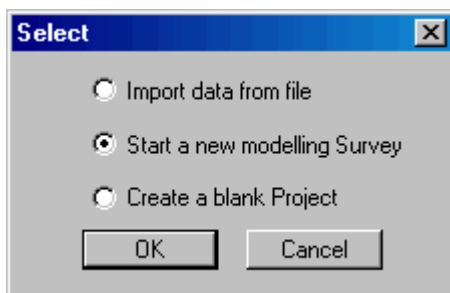
EMIGMA Modelling of TEM Data

Without Use of Imported Field Data:

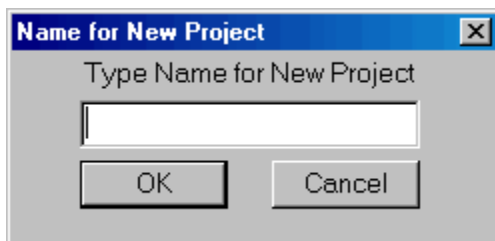
Forward Simulation - i.e. Building your model

Of course it is always easier to open a previously-created TEM dataset and adjust the model parameters. You will find several examples in the sample databases available on the downloads page of the Petros Eikon website(www.petroseikon.com).

- Click the **Create Project** button in the bottom left-hand section of the **Database** window. In the **Select** dialog to appear, select the **Start a New Modeling Survey** button:



- In the **Name for New Project** dialog to appear, type in the name of your project and click **OK**:



The **Property Pages** window to open contains four tabs allowing you to specify your system geometry, waveform, profile information and output.

Building a Profile

Property Pages

Profiles | Waveform | Tx-Rx | Output

#	Name	Stations #
1	LINE0	42
2	LINE1	37

Survey # 19
 Total number of Profiles 2
 Total number of stations 79
 Profile# 2
 Profile Name LINE1
 Station# 37

Enable Profile Reordering

S...	P...	X	Y	Z
1	2	-900	100	2
2	2	-850	100	2
3	2	-800	100	2
4	2	-750	100	2
5	2	-700	100	2
6	2	-650	100	2
7	2	-600	100	2
8	2	-550	100	2
9	2	-500	100	2
10	2	-450	100	2
11	2	-400	100	2
12	2	-350	100	2
13	2	-300	100	2
14	2	-250	100	2
15	2	-200	100	2

Retrieve Data

Modify Profile

Delete Every 2 Apply

Shift Z 0 Apply

All Profiles Current Profile

Join Profiles 0 Apply

Split Current Profile after Selected station 0 Apply

Change Name LINE1 Apply

Generate Stations with Constant Step

First Station Last Station

X -900 X 900 New Profile

Y 100 Y 100 Replace Profile

Z 2 Z 2

Station Increment 50 Num. of Stations 37

Add Single Station

Replace Insert

X 900

Y 100

Z 2

Add Loc

Delete Loc

OK Cancel Apply Help

On the profile page, Input the starting and ending X, Y and Z positions of the profile as well as the number of data points. Then click the **New Profile** button. This may be done for several profiles if so desired.

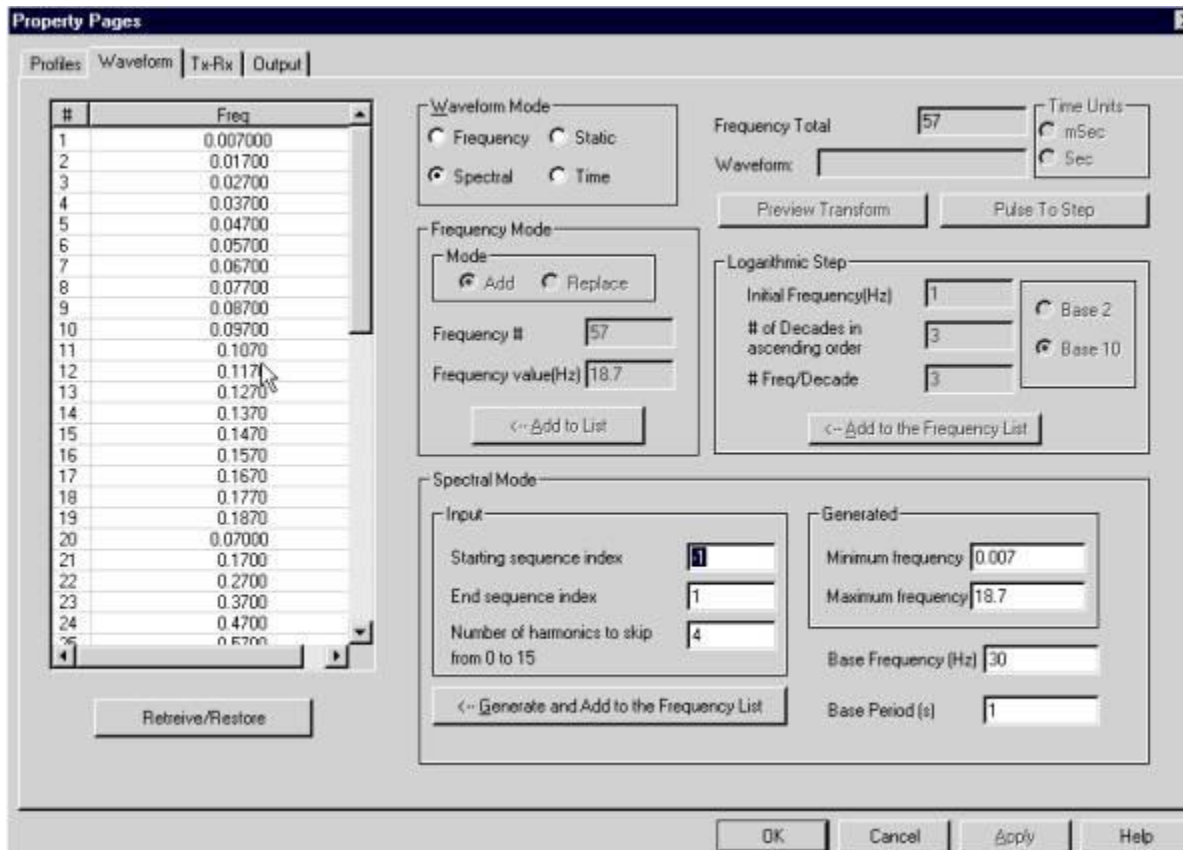
Note: For surface data, the profile must be placed above the surface interface e.g. at 0.01m

Enter the number of positions you would like to measure along the profile in the box labelled **Num. of stations**.

For a profile 1000 m long with sampling positions every 25 m you will need 41 positions.

[Sampling stations= length of profile/sampling spacing + 1]

Waveform Page



Waveform mode - Select “Spectral”, then specify a base frequency to generate a frequency list. To modify the default settings: in the **Spectral Mode** section, input a different starting sequence, end sequence and skip: e.g. 2,4,4

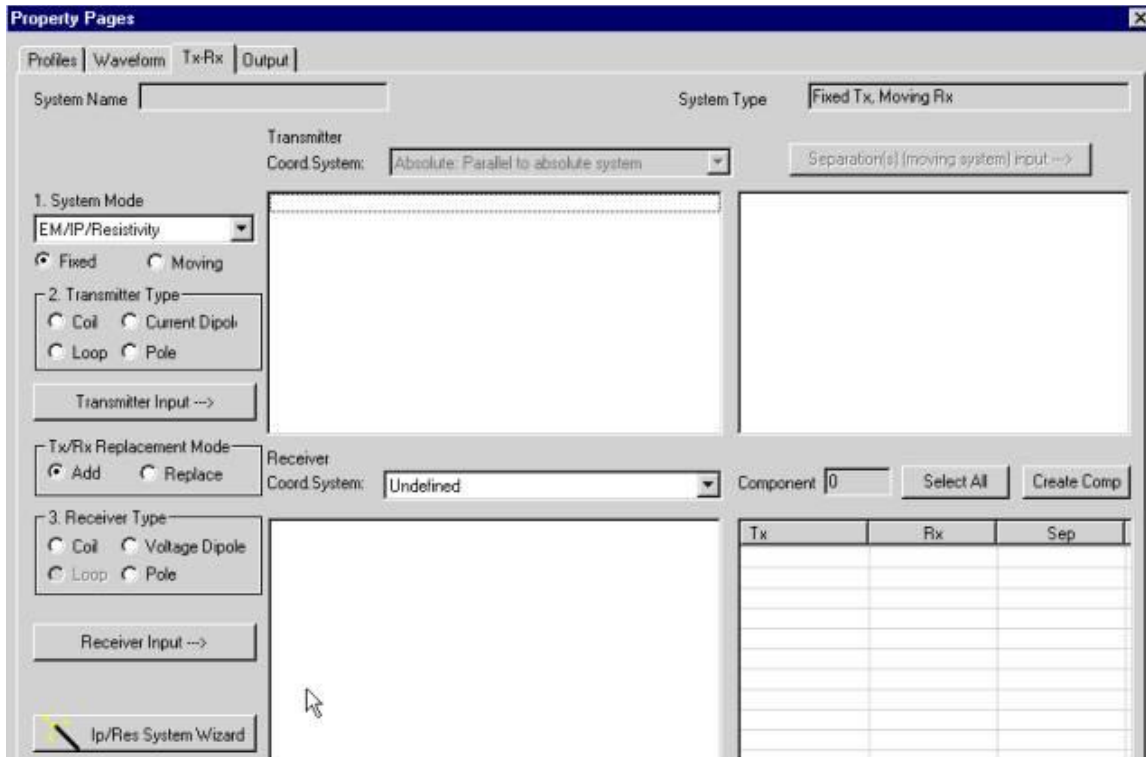
Click the **Generate and add to the frequency list** button.

Notes: the second frequency must be below the base frequency. Use a spectral sequence of 2 to 4 for crone surface data (base frequency of 30 Hz). Use a spectral sequence of 1-4 for borehole data (base frequency of 15 Hz). You may want to go as high as an end spectral range of 5. A skip rate of 4 is usually sufficient. Refer to your transform manual for more information on setting spectral ranges.

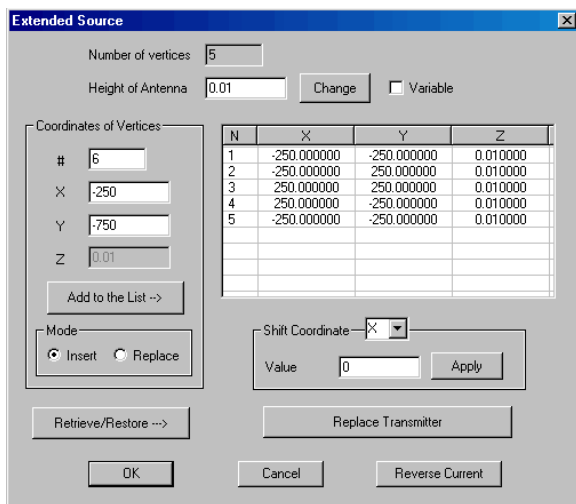
Note: In EMIGMAV7.x and up, the transform is automated for files that contain imported TEM data or for models that have been run through the transform once.

TX-RX Page:

This page encapsulates the capabilities of EMIGMA for a wide variety of geophysical systems. This example will illustrate one such system.



1. Transmitter Mode - select “Fixed” for fixed loop survey
2. Transmitter Type - select Loop
3. Click on “Transmitter input ->”.and accept the defaults in the Loop window to appear. *In this case, a 500m by 500m loop centred on 0,0.*



Set **Height of Antenna** to 0.01 in the following window and click **OK**.

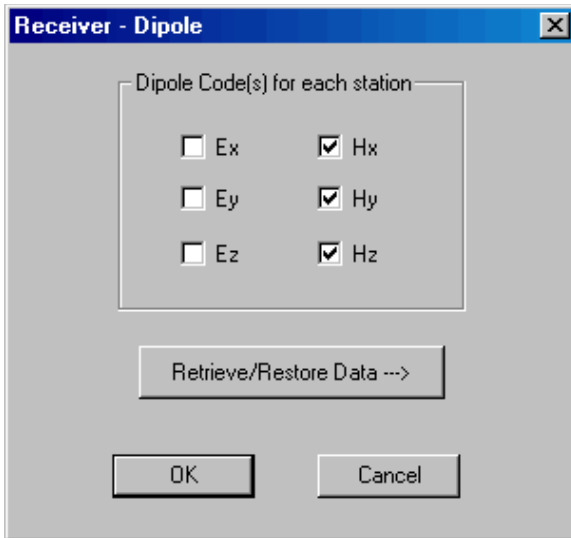
Note: You are not restricted to four cornered loops.

4. Receiver Coord. System

Select “Horizontal” as the coordinate system for surface systems

Select “Uhole” as the coordinate system for borehole systems

Refer to the main EMIGMA manual for details of the different coordinate systems



5. Receiver Type – “Dipole”

Receiver Input - Select components you wish to measure, i.e. Hx, Hy and Hz

6. Component

Click **Select All** to create a component for each transmitter receiver combination. To specify an individual component, select a single transmitter and receiver then click **Create Comp.**

Output Page

Normalization Convention should be set to Absolute for Time domain calculations

For Time Domain all normalizations are performed in the Transform module.

Now the data channels must be selected. For time-domain data select:

Fields: Scattered
Host
Freespace

The modules to be used later will be able to calculate the Total and Total-Freespace from the above.

Click **Apply** to specify the model properties.

Layers Page:

The screenshot shows the 'Model Configuration' dialog box with the 'Layers' tab selected. The dialog is divided into several sections:

- Table:** A table with columns 'N...', 'Permeability', 'Resistivity', 'Permittivity', and 'Thickness'. It contains three rows of data.
- Edit Mode:** A vertical stack of buttons: 'Insert Layer', 'Replace Layer', 'Delete Layer', 'Undo Delete', 'Restore', and '<< Import Layers'.
- Layer Parameters:** A section for editing a specific layer (Layer # 4) with input fields for 'Resistivity (Ohm.m)', 'Relative Permeability', 'Relative Permittivity', 'Thickness (m)', 'Susceptibility', and 'Density (g/cm³)'.
- Configuration:** Fields for 'Survey Name' (LN 12 prisms) and 'Model Name' (12 prisms).
- Depth:** Input fields for 'Top Depth' (-1e+030) and 'Bottom Depth' (-1e+008).
- Cole-Cole Polarization Mode Parameters:** A checkbox and input fields for 'C (exponent) parameter', 'M parameter (chargeability) dimensionless', and 'T (time constant) parameter seconds'.
- Resistivity & Susceptibility Grid Data Files:** A 'View' button, a checkbox for 'Extrapolate to Basement', and a 'Convert to GPSZ' button.
- Buttons:** 'OK', 'Cancel', 'Apply', and 'Help' at the bottom.

The first layer is set to air for you.

Air need not always be the first layer but must be included if part of the desired physical model.

Set the resistivity and thickness of your first layer ensuring that the insert mode is selected and “Add into the layer list”.

i.e. for conductive overburden you may chose 50 ohm-m for 50 m.

Continue adding layers until you have a representation of your host rock.
Set the thickness of the basement to something large, i.e. 1e8.

To edit layers once added, simply click on the layer in the top white box to select, make your correction to the resistivity and or thickness, then click Replace Layer.

To delete a layer click on the layer and click Delete Layer or use the delete key on your keyboard.

Prisms/Plates/Polyhedra Page:

This page allows access to the variety of simulation algorithms and interactions available in EMIGMA. In general, there are 3 basic modelling primitives - prisms, plates and polyhedra. These objects may have contrasts in either conductivity and/or permittivity from that of the background for EM applications and additionally contrasts in permeability (susceptibility) for Magnetics modelling. Multiple primitives may be considered by use of the “Prism Interactions”.

N...	Conductivity	Susceptibility	Permittivity	Algorithm ...	Anomaly N...	PolyFile Name
1	10	0.000000	1	LNPRISM	Plate1	

Model

Select Prism, EikPlate or Poly

Scattering Algorithm

- select LN for current channelling responses of prisms
- select ILN for current channelling and weak induction of prisms
- select VH for channelling and induction of a thin sheet
- select FS for induction of a thin sheet

If you are not sure whether the response is dominantly currently channelling or induction, or whether both are important in the response, you can run different algorithms to determine this. For example, if VH and FS give similar results, then the response is dominantly induction. Please refer to the main EMIGMA manual for a description of the different scattering algorithms.

Scale Factor:

Input the width (X), length (Y) and height (Z) of the body

These may be considered as the Strike, Dip Extent and Thickness of the object. Refer to the main EMIGMA manual under VHPLATE for help in this respect.

Centre/Top Location

Input the centre of mass or top position of the body:

Rotation (Prism/Plate)

Input the rotation/prisms (Euler Angles)

Refer to insert in the main manual on Euler Angles for instructions on rotation your body

For a Plate use strike and dip angles. *Refer to main manual*

Target Properties

Input the conductivity (or resistivity) of the body.

For VHPLATE, the conductance = the conductivity times the thickness of the target (Nominally 0.01m), thus for a plate with a conductance of 20S/m, use a conductivity of 2000S.

One may also indicate here a variation in permittivity.

For Magnetics modelling indicate either the permeability (here this is relative permeability) or the susceptibility

Note: The user is able to use variations in all material properties.

Internal Current Sampling

Input the number of sampling points you would like to calculate

VHPLATE defaults the number of sampling points to 441. You cannot change this.

LNPRISM defaults the number of sampling points to 100. Up to 600 may be used per prism

ILNPrism calculates 7 positions in a cluster around each sampling position. The default is set to 40 sampling points. Normally 20 sample points is sufficient. At this time, the maximum sample points is 85.

Cole-Cole Parameters:

At any time, whether for IP or EM, the user may specify the Cole-Cole parameters m,c,tau for any of the scattering objects.

Inserting an Anomaly:

Click **Insert Target**. Repeat process to add multiple bodies. Note that you can use more

than one algorithm in the same model and that you do not need to use the same sampling points for each body.

Prism Interactions - Available to clients who are licensed:

To model the response over multiple bodies, you can now choose the type of interaction. The default is set to near field (assumes electrical contact between the bodies). If you would like to change it to either far field (interaction of bodies not in contact) or superposition (simply addition of the response of two non interacting bodies) you can click on **Interactions** and select one of these.

Editing Prisms/Plates

To edit a prism or plate simply double click on the body in the top white box to select, make necessary changes and click the **Replace Target** button. To delete a prism click on the body and click **Delete** or use the delete key on your keyboard.

Click **Apply** to see the new data set in the main EMIGMA database window.

Confirm your model in the Visualizer before Calculations:

It is generally useful to view your model in the Visualizer prior to computing the model. In the visualizer you will be able to make modifications or more accurately specify your model.

With the data set of your model selected, open VisRD with the Viz button on the toolbar.

Using the hand and bottom left dial bars you can manipulate the view of your model in 3D space. The right bottom dial bar and slide bar are zoom controls.


You can toggle the viewing of the layers off and on with the use of the layers button on the visualizer toolbar.

Editing your model

With the arrow, click on your model once, right click, select edit, select properties page. You can now edit your model parameters in the same way as you did before.

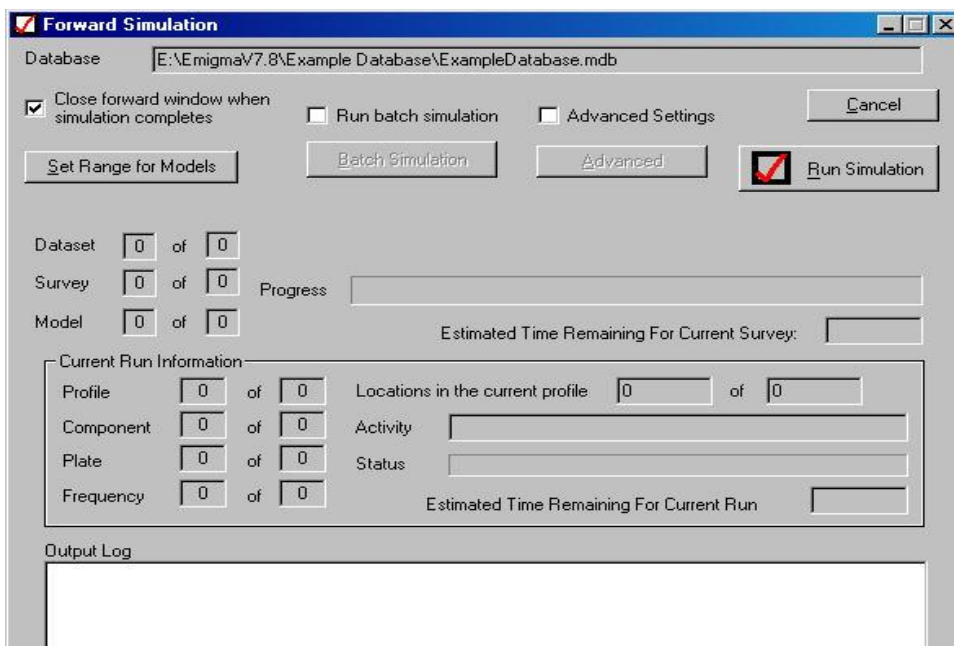
If you make changes to your model, click the **Save to Database** button.

Forward Simulation

Click the  button on the main EMIGMA toolbar.

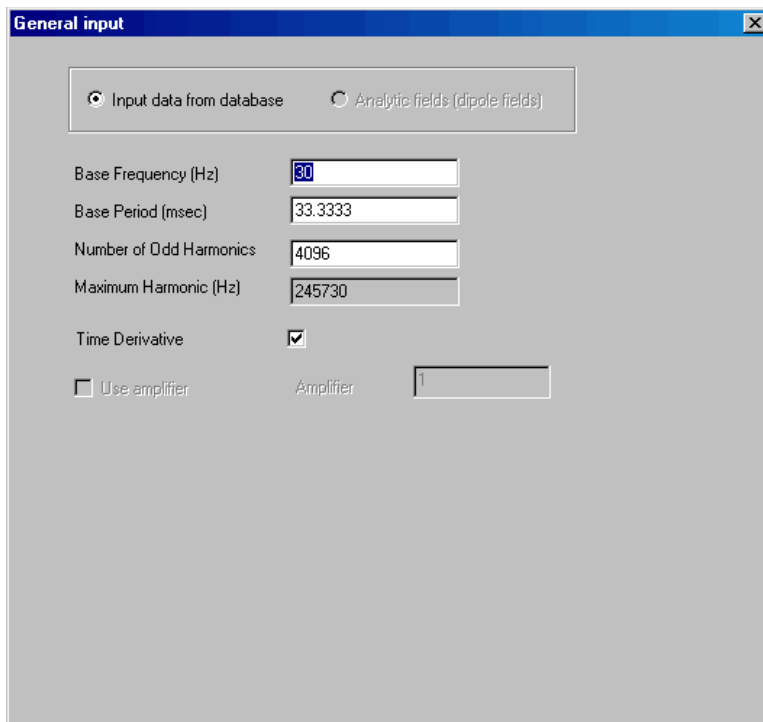
A page is displayed indicating progress through frequencies, components, and profiles.

Click **Run Simulation** to begin



FSEMTRS - Frequency to Time Domain Transform.

Select the time domain data set and start FSEMTRS with the  button on the main EMIGMA toolbar.



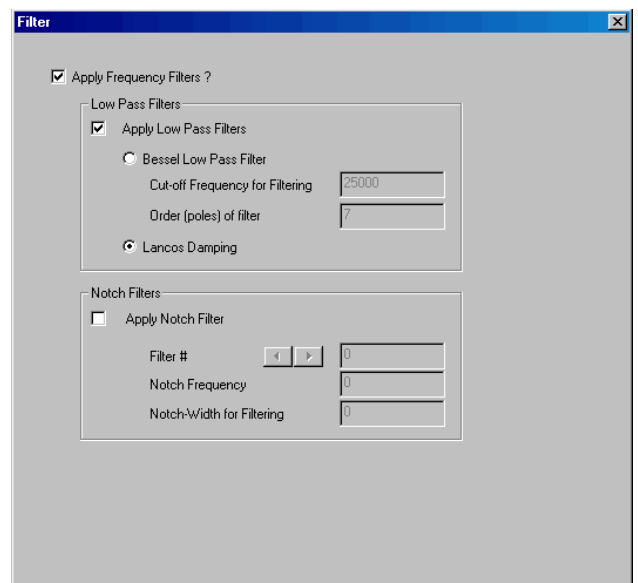
The 'General input' dialog box contains the following settings:

- Input data from database
- Analytic fields (dipole fields)
- Base Frequency (Hz): 30
- Base Period (msec): 33.3333
- Number of Odd Harmonics: 4096
- Maximum Harmonic (Hz): 245730
- Time Derivative:
- Use amplifier
- Amplifier: 1

The first page in the Wizard appears like this:

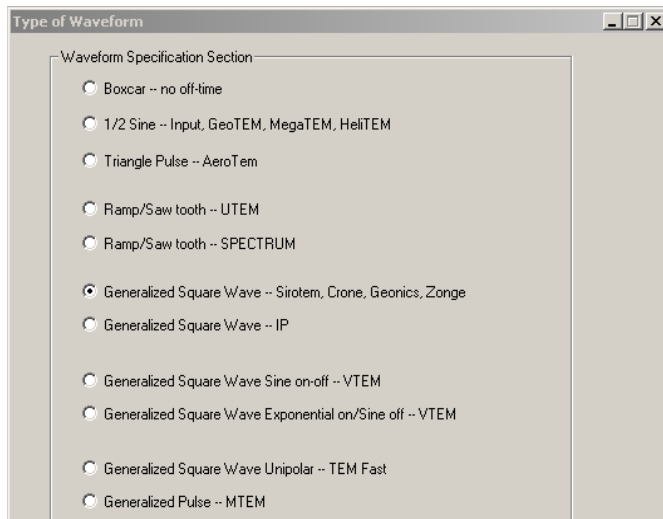
Input the base frequency for your system. Select **Next**.

Accept the defaults for low pass filters and click **Next**.



The 'Filter' dialog box contains the following settings:

- Apply Frequency Filters ?
- Low Pass Filters:
 - Apply Low Pass Filters
 - Bessel Low Pass Filter
 - Cut-off Frequency for Filtering: 25000
 - Order (poles) of filter: 7
 - Lancos Damping
- Notch Filters:
 - Apply Notch Filter
 - Filter #: 0
 - Notch Frequency: 0
 - Notch-Width for Filtering: 0

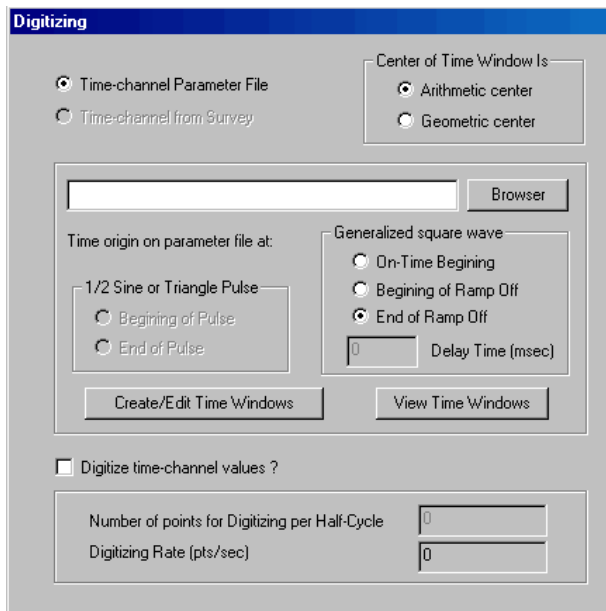
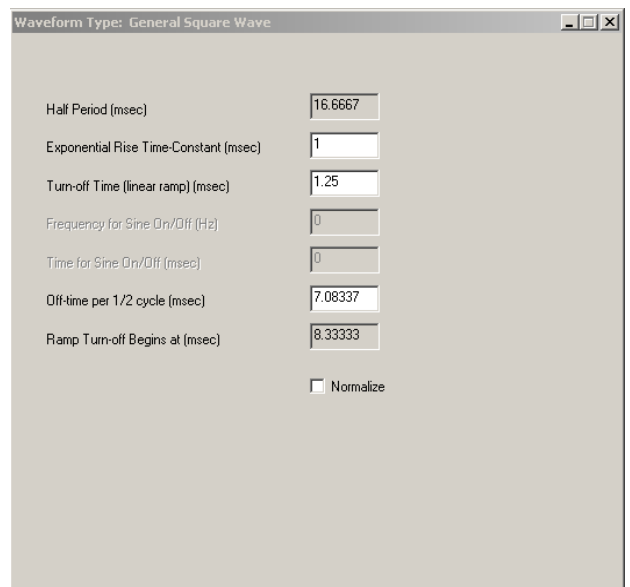


Choose Generalized square waveform for the Crone system and **Next**.

Input the rise time constant (1 msec is used as a rough approximation for the Crone system)

Input the linear ramp time: (1.25 msec)

Off-time: Off-time is calculated assuming ramp begins at a 1/4 cycle. If this is not correct then input a different Off-time.

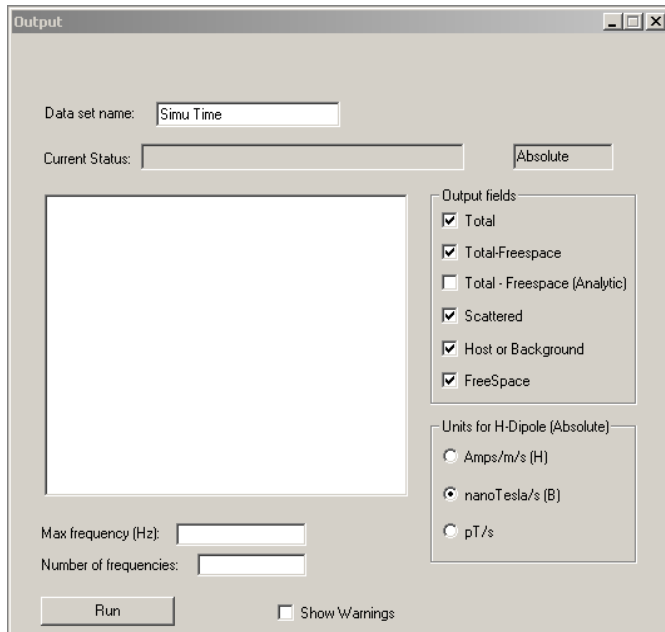


Browse for the parameter file `wcrone8_30Hz.par` in `..\TimeChannelFiles`
Use `wcrone20_15Hz.par` for a 15Hz base frequency system.

Note: You may view the time channels here using the Retrieve Data button. You may edit the time windows using the Create/Edit button.

Under Generalized Square Waveform, select end of ramp off as the start time for the channels, the primary pulse will be negative before this all time channels will be positive,

Click **Next**.



Select nanoTesla/sec (B) for the units.

Check the Data set name is as you wish.

Click **Run**.

Upon Successful completion you can click **Finish**.

You may then continue with plotting and displaying the results.

Plotting Measured and Simulated Data - EiKPlot

Start EiKPlot by clicking the button on the main EMIGMA toolbar.

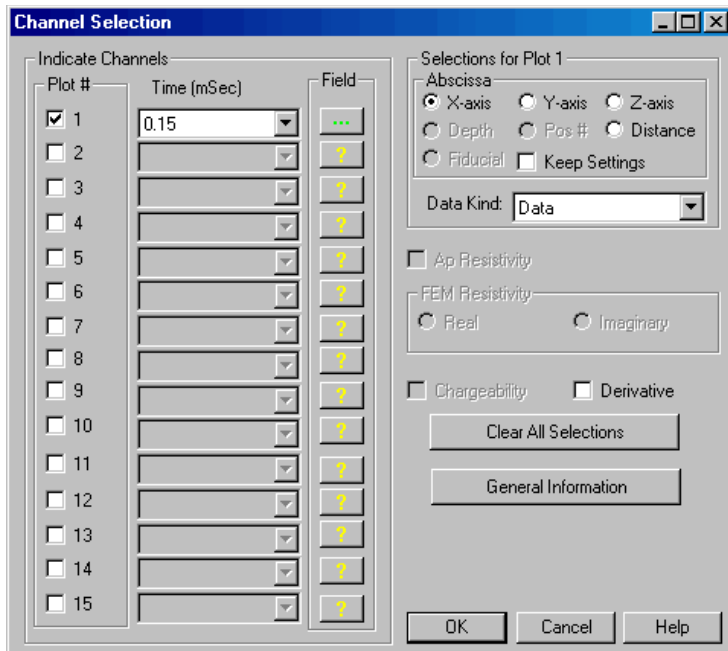
Configuring your plot

Survey - if you have more than one survey in the file choose the survey you wish to plot

Profile - if you have more than one profile in the file choose the profile you wish to plot.

Use profile name or the Axis which determines the profile line to see which profiles correspond with which numbers. For a profile running North South, the X axis will tell you the start X position of the profile which is usually the line name.

Domain - Use Profile to plot the data as a function of position.
- Use Decay to view the decay of the data as a function of time.



Channel - After channel selection under configuration or using the hot keys -

Click on the first white box under Plot #
- Select the time channel by clicking on the black triangle
- Click on the yellow question mark under field.

Select the fields, component and measured or simulated data. Use fields available to view data contained in the file.

Click **OK**

Additional Tools available in EiKPlot as buttons.

Hold your cursor over the centre of the button to read the tooltips.

Printing:

Printing is available as in any standard Windows application.