TREWMAC SYSTEMS Pty Ltd

TREWMAC

RF Vector Analysers

SOFTWARE GUIDE

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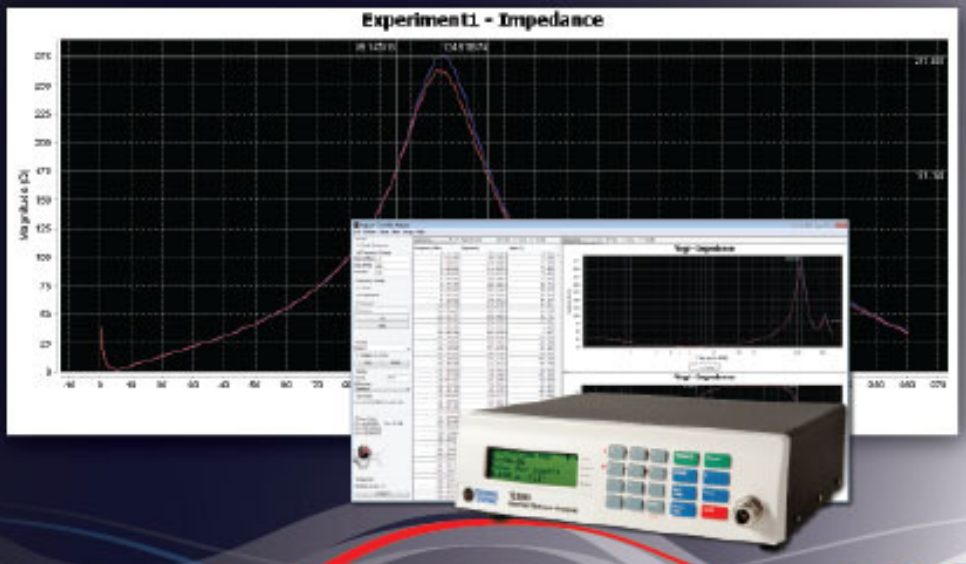
Version 17.1



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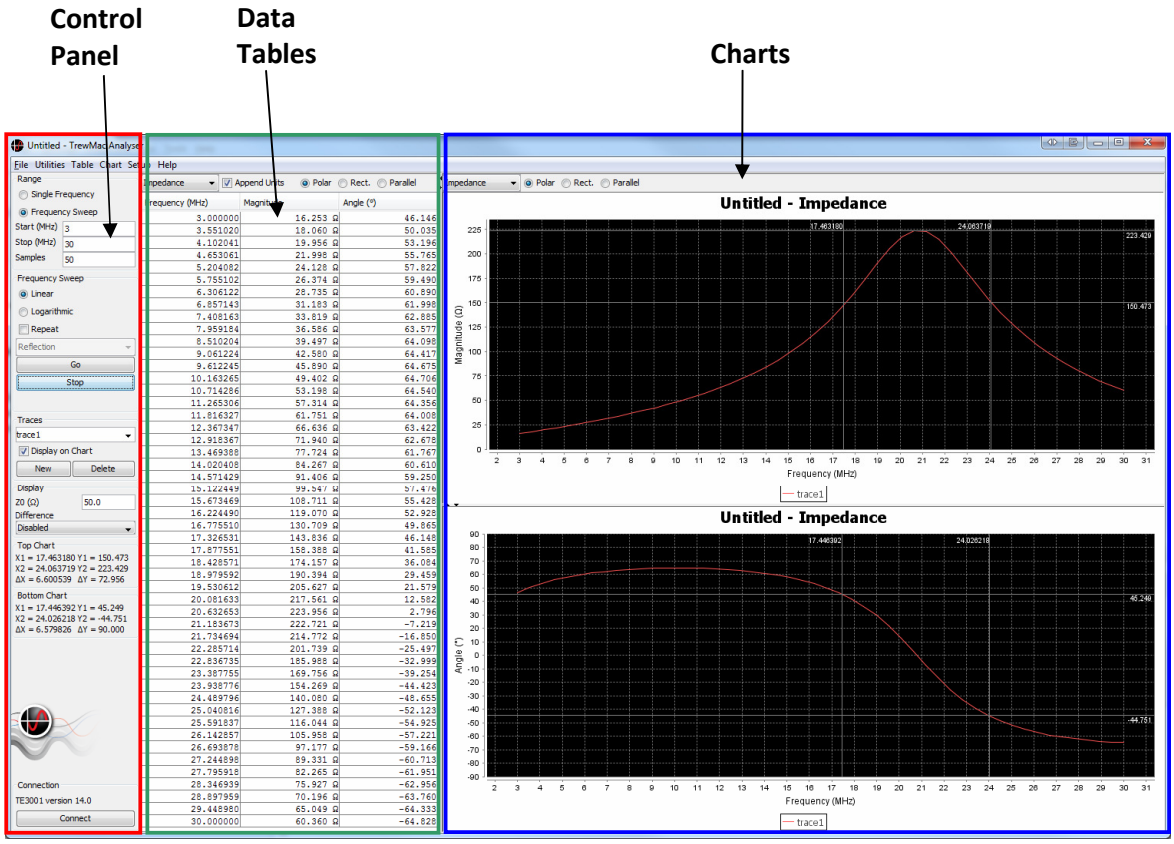
TREWMAC SYSTEMS

Section Page

Overview

The TrewMac Analyser Software is an advanced user interface for the TE1000, TE3000, TE3001 and TE3002 analysers. It connects to the unit via USB or RS232 and provides a host of features to display analyse and process data in an intuitive and powerful way. Tables and charts can be independently controlled to display data in a range of formats. It can hold unlimited data traces, each of which can be independently shown, hidden, deleted or updated at any time. The charts provide X and Y Markers with range and bandwidth information. They feature real time zooming using the mouse scroll wheel, and allow complete control of the range and domain parameters for the advanced user. A difference function allows any trace to be plotted as the difference from another.
Time domain reflectometry functions provide a powerful analysis tool for the impulse characterisation of a linear network, or to locate faults along a transmission line. Transmission line utilities let you characterise networks quickly and confidently.
Files can be saved and printed and are compatible with excel.

The main window is divided into 3 areas; Control Panel, Data Tables, and Charts. These areas are discussed in more details in the following chapters of this manual.



System requirements

The analyser software is written in Java and can be run successfully on a range of computers and platforms. Particular effort has been made to ensure it works on XP and Windows7, 32 and 64 bit machines.

The Java 6 (or later) run time environment is required for the application to run. The installer will prompt you to install this if it is not detected. In this case, the user must install Java from the website: http://www.java.com/en/download/index.jsp before continuing to install the analyser software.

Several comm. port and USB drivers will also be automatically installed for communication with the unit. See the Installation section of this manual for more details.

The minimum hardware requirements are detailed below:

Memory: 1GB

CPU: Intel Celeron 1.6GHz or greater

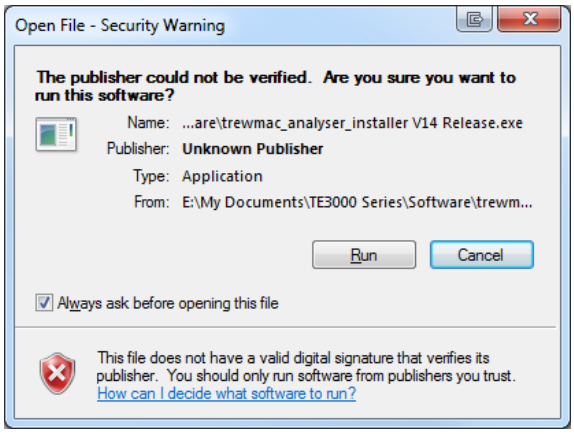
1 USB or Serial Port

3 MB disk space
(+100MB for jre 7)
(+70MB for jre 6)

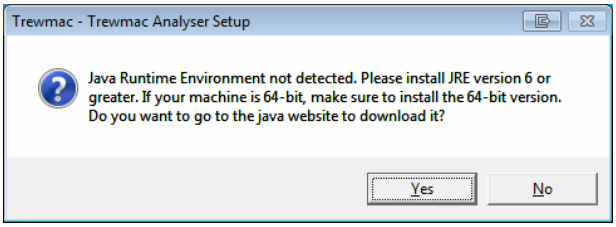
Installation Instructions

1. Insert the software CD and the installer should automatically run.
   If installation does not begin automatically please try the following steps:
   1. Open "My Computer" (Windows XP) or "Computer" (Windows 7/8) (either from the desktop or start menu)
   2. Open "Trewmac Analyser" CD
   3. Double click on the install file (TrewMac_Analyser_Installer_Vxx.exe)

2. A security warning may be displayed asking if you are sure you want to run this software: Click Run.



3. If the required Java run time environment is not detected on your machine, a window will prompt you to install it from the Java website. If you do have Java go to step 9.

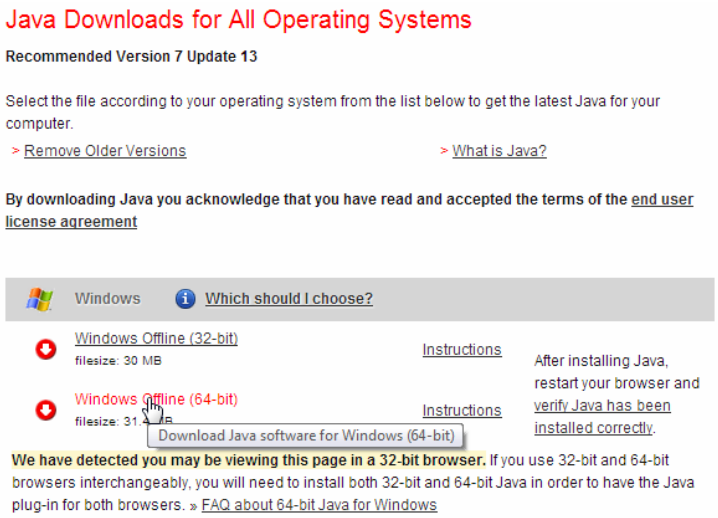


   If you don't have Java, click yes to go to the Java website.
   The current install will close and have to be run again once Java is installed.

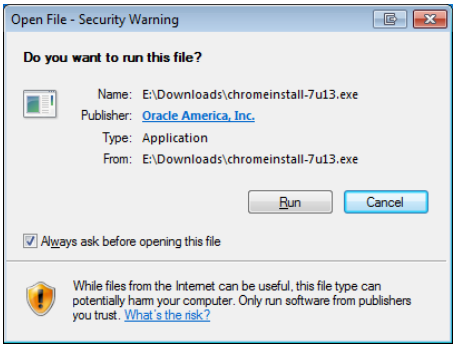
   Alternately, check if the software disc contains the required java installation package.

4. ***Do not install the default file*** from the Java website as this is often incorrect for your machine. Click the 'See all Java downloads' link instead.

5. If your machine is 64 bit, choose the 64 bit version to install. This is because the TrewMac TE Analyser software uses 64 bit communication libraries for 64 bit machines. If you are unsure whether your machine is 32bit or 64bit:
    1. Right click on "My Computer" (Windows XP)
       or "Computer" (Windows 7/8)
    2. Click "properties"
    3. Your system type (32 or 64) should be listed under system type



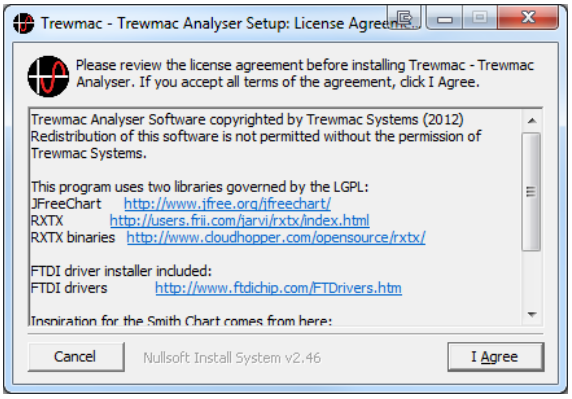
6. Download and run the Java installation file. Window users may get a security warning.



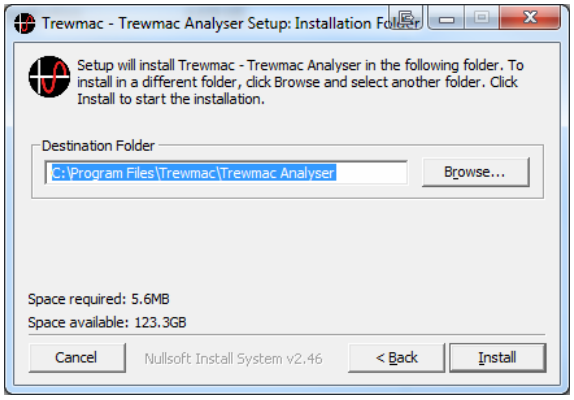
7. Follow the prompts until Java is installed successfully.

8. When Java is successfully installed, restart the TrewMac Analyser software installer.

9. Read the licensing agreement and, if you agree, click "I agree".



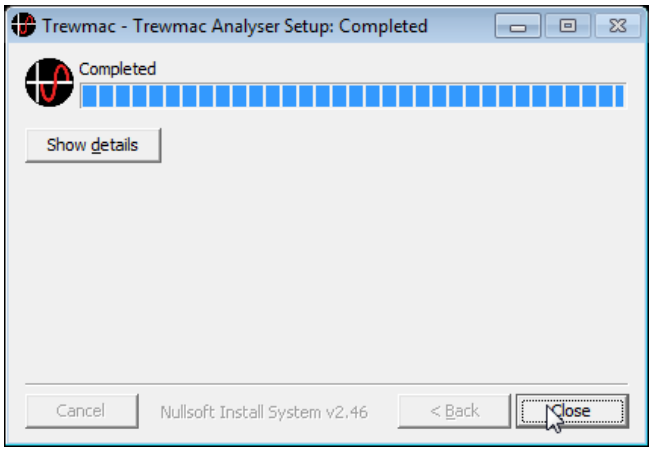
10. Set the install destination folder for the TE analyser software and click Install.



During normal installation, several windows may open and close as the serial port and USB drivers are installed on your computer.

The installer will also create a desktop icon.

When completed, click Close, and the TrewMac Analyser application will start.



If the USB driver does not install

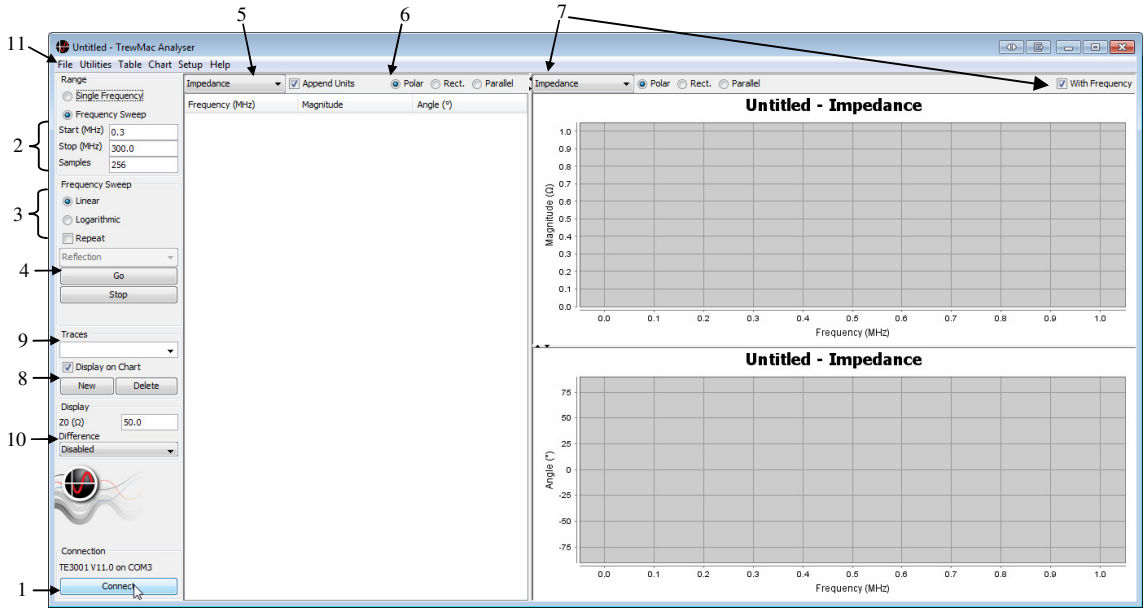
If the USB driver does not install successfully first time, run the installation again. If still unsuccessful, try downloading the appropriate driver for your operating system, and following the OEM installation guide for the USB virtual comm. port driver (VCP) from the FTD232 website: http://www.ftdichip.com/Drivers/VCP.htm

1 Quick Start

After successfully installing the software, connect the analyser to the computer with the serial cable or USB cable provided.

Launch the application by double clicking the desktop icon, or by finding the TrewMac Analyser application in the start menu/TrewMac folder.

Starting the analyser application will open the main window and scan the available serial ports for the presence of a TE analyser.



If an analyser is found, the type and port number will be displayed in the connection area at the bottom of the control panel (1). If no analyser is detected, check the connection to the PC and press the **Connect** button in the connection area (1). For issues with the USB connection, see the Installation section of this manual.

Set up a sweep
In the control panel, set the start and end frequency to the desired values (2), set the number of points to be taken, and the type of sweep (3). Now press the **Go** button to initiate a sweep (4).

Perform a sweep
By clicking the **Go** button, the application will send the relevant commands to the TE analyser and the results of the sweep will start to be displayed on the table and chart area simultaneously.

Table display
The display format of the table and chart areas is set individually by the controls at the top of each panel. To display rectangular reflection coefficient in the data table, select **Reflection Coefficient** from the drop down list (5). Then select the **Rectangular** radio button (6).

Chart Display
Now set the chart display to **Smith Chart** by un-checking the *With Frequency* check box and choosing *impd. Smith Chart* from the drop list (7).

Zooming
It is possible to zoom in on specific detail by positioning the mouse over the area of interest and using the scroll wheel. Alternately, click and drag a rectangle to the right, around the area of interest to box zoom.
To reset the zoom, simply click and drag to the left.

Panning
Panning is achievable by using a combination of the mouse pointer location and the scroll wheel. For example, to pan left scroll out with the pointer located on the right of the chart and in with the pointer located on the left.

Other chart options
Right click the chart area to add Annotations, Markers, Copy, Print, Save or change the chart properties.

Add a new trace
Click the New button (8) to add a new trace and name it in the traces list (9).
Click the Go button to get the new trace from the analyser.

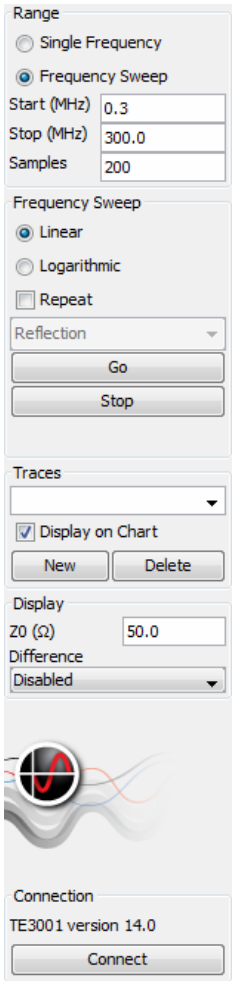
This new trace may be displayed as the difference from the original by selecting 'trace1' from the Difference drop list (10).

Disable the difference function by selecting 'Disable' from the difference list.

Saving data
Select 'save' from the file menu to save this file to disc (11). The file will be saved in .csv format and may be opened in excel.

This is the end of the Quick Start guide. For a more detailed explanation of features and functions see the following sections of this manual.

2 The Control Panel



Range parameters

Sweep options

Scan Controls

Trace management

Display options

Connection management

2.1 Range Parameters

The range group sets the parameters for a sweep.

Single Frequency will return the number of samples specified in the samples box at the frequency specified in the start box.

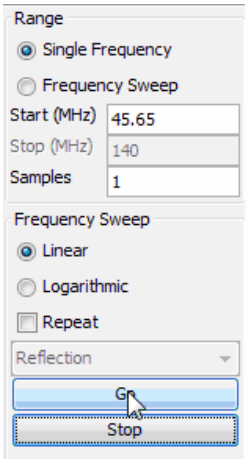
Frequency Sweep will return the number of samples in the samples box starting at the start frequency and ending at the stop frequency.

The **Start** box contains the first frequency in a sweep (or the single frequency for single frequency mode).
The **Stop** box contains the last frequency in a sweep.
The **Samples** box contains number of frequency points in a sweep.

Some examples:

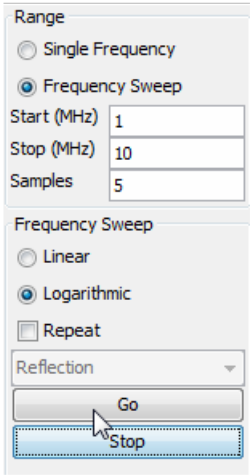
To perform a single frequency sweep at 45.65 MHz:

1. Check the **Single Frequency** radio button.
2. Enter '45.65' in the **Start** box.
3. Press **Go**



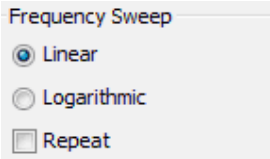
To perform a linear frequency sweep from 1 to 10 MHz with 5 samples:

1. Check the **Frequency Sweep** radio button.
2. Enter '1' in the **Start** box.
3. Enter '10' in the **Stop** box.
4. Enter '5' in the **Samples** box.
5. Click to **Logarithmic** radio button.
6. Press **Go**



2.2 Sweep Options

The sweep group specifies the scale for the frequency axis.
Changing these values affects both the chart display and the next frequency sweep points.



To explain the way the points in the sweep are calculated, certain parameters need to be defined as per the Range dialogue boxes in the preceding section;

Start=Start Frequency
Stop=Stop Frequency
Span=*Stop*–*Start*
Points=Total number of frequency points
Point=current point index (0,1,2….*Points*-1)

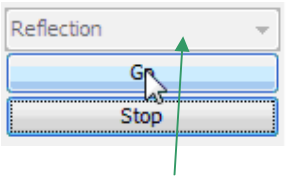
Linear will divide the frequency range into even steps:

$$Frequency = Start + Span\frac{Point}{Points - 1}$$

Logarithmic will scale the range into logarithmic steps:

$$Frequency = Start\left(\frac{Start}{Stop}\right)^{\left(\frac{Point}{Points-1}\right)}$$

Repeat will cause the sweep to loop continuously until the Stop button is pressed.



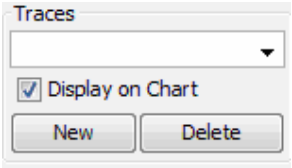
The Sweep **Mode** drop box (lowest position in the sweep group) is for 2 port operations and is locked to Reflection for single port usage. When using the TE3002 use this drop box to select between S11 reflection mode and S21 transmission mode.

2.3 Scan Controls

The scan group sends commands to the TE Analyser to initiate a sweep.

The **Go** button initiates the sweep.
The **Stop** button terminates a sweep.
The progress bar indicates progress.

2.4 Trace Management



This area controls data traces.
Individual traces can be named, deleted, showed or hidden on a chart.
Functions such as distance to fault, and interference scan create their own traces and these will be named automatically upon creation. Traces can be renamed at any time.

The **Trace** drop list contains all recorded traces for the current session.
The current trace is displayed in the drop list box.
Click the arrow on the right to select a particular trace from the list.
To rename a trace, type in the box and press enter to save the new name.

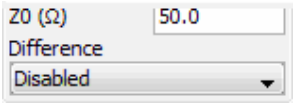
The **Display on chart** checkbox will show or hide the current trace on the current chart.

The **New** button will create a new trace of the currently selected mode (S11 or S21) which is automatically named trace X. (Where X is the next trace number available) If a TE3002 is connected, the type of the trace is automatically appended to the trace name upon creation. This is to prevent confusion between trace types, but may be removed at any time.

To create a new trace, click the **New** button and then name the new trace in the trace drop box. Be sure to press enter after renaming the trace.

The **Delete** button will delete the current trace.
Data cannot be retrieved after deleting.

2.5 Display Options



This group includes Zo and the difference plotting function.

Zo is the characteristic system impedance used to calculate the reflection coefficient and VSWR. It can be any real number – usually 50 or 75 Ohms. Note that this value is independent from the Zo used on the TE unit.

The **Difference** drop list provides a difference plotting function whereby all traces displayed on the chart are plotted as the difference from a selected reference trace.

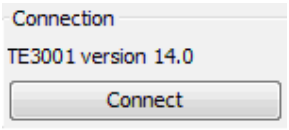
For example, if trace2 is selected as the reference trace, then plotting trace1 will result in a plot of trace1- trace2.

Note that this function does not alter the actual data in the traces. It only affects the way they are plotted.

This function is useful for removing repeatable errors or detecting changes in a setup.

See the Difference Plotting section of this manual for more details.

2.6 Connection



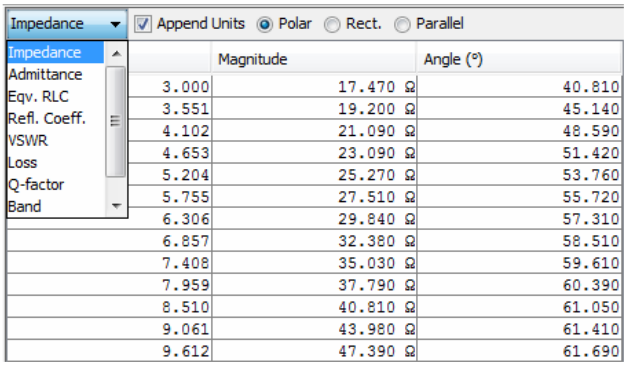
The connection group contains information and functions to connect to a TE unit. Pressing the Connect button will initiate a scan of all available comm. ports for the presence of a TE unit. When detected, the hardware model and version number is displayed on the connection status label.

Use the Serial Configuration window from the Setup menu to directly control which port and what baud rate to use for the analyser connection.

3 The Data Table Area

The table area displays the current data trace in the format specified by the format options at the top of the area. A range of formats are available and symbols can be included or excluded from the results. The display format of the data table area is independent of the chart area display format and highlighting a particular data set will result in a cross hair being shown at the corresponding location on the chart. Data may be copied from the table area and pasted directly into excel.

3.1 Selecting display format



	Magnitude	Angle (°)
3.000	17.470 Ω	40.810
3.551	19.200 Ω	45.140
4.102	21.090 Ω	48.590
4.653	23.090 Ω	51.420
5.204	25.270 Ω	53.760
5.755	27.510 Ω	55.720
6.306	29.840 Ω	57.310
6.857	32.380 Ω	58.510
7.408	35.030 Ω	59.610
7.959	37.790 Ω	60.390
8.510	40.810 Ω	61.050
9.061	43.980 Ω	61.410
9.612	47.390 Ω	61.690

Select the parameter to be viewed from the drop list of options.
Note that Interference and Impulse traces will only display data if the relevant function calls have been performed.

Where appropriate, radio buttons will appear to specify the format of the parameter selected. For example, Impedance may be viewed as polar, rectangular or equivalent parallel. Click the radio button to select each format.

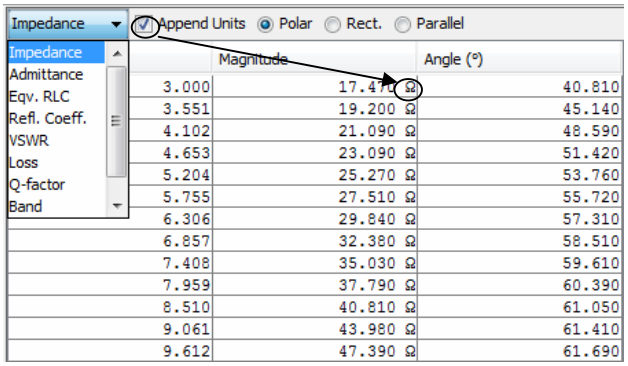
Some parameters like **VSWR** have no format options, and some will use the system **Zo** in the display option area of the control panel to generate their value.

Zo dependant parameters include:

VSWR
Reflection Coefficient
Return Loss
Mismatch Loss

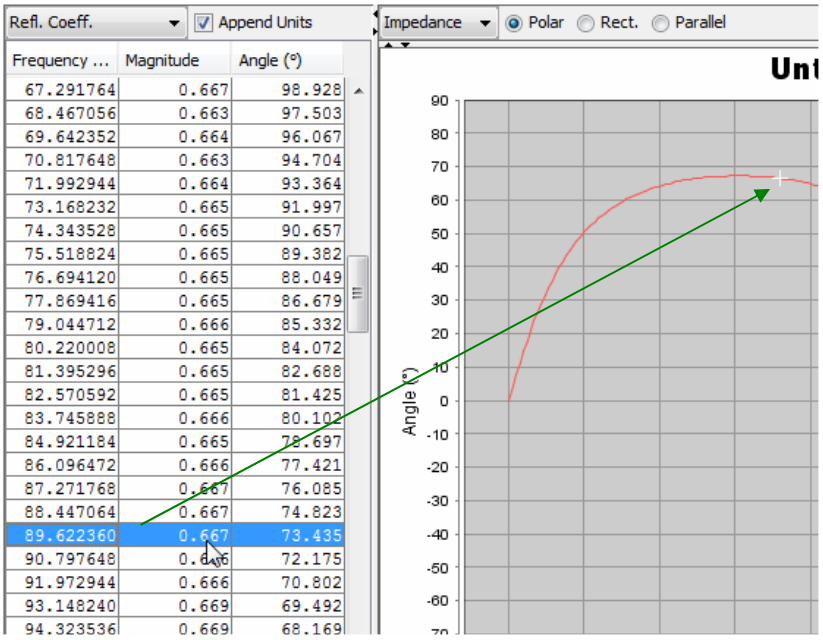
3.2 Appending units

Append the unit symbols or not by checking or un-checking the **Append Units** check box. This is useful for copying and pasting data into other applications.



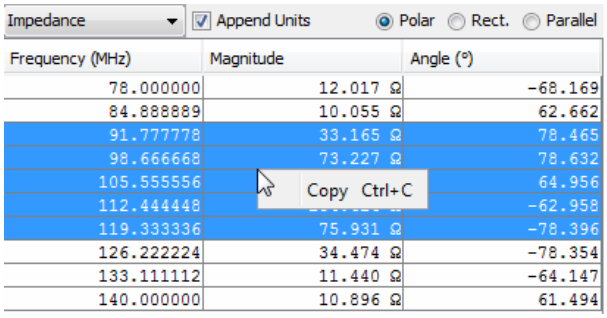
3.3 Highlighting a data point

The data table display format is independent of the chart display format so it is possible to view different parameters on the table and chart. Selecting a row of data in the data table will cause a cross hair to appear on the chart at the selected point:



3.4 Saving Data

Select the data cells to be saved, right click the mouse and choose **Copy** from the menu. This will copy the selected data to the local clipboard where it can be pasted into other applications.



Alternately, select the data and press Control-C to copy.

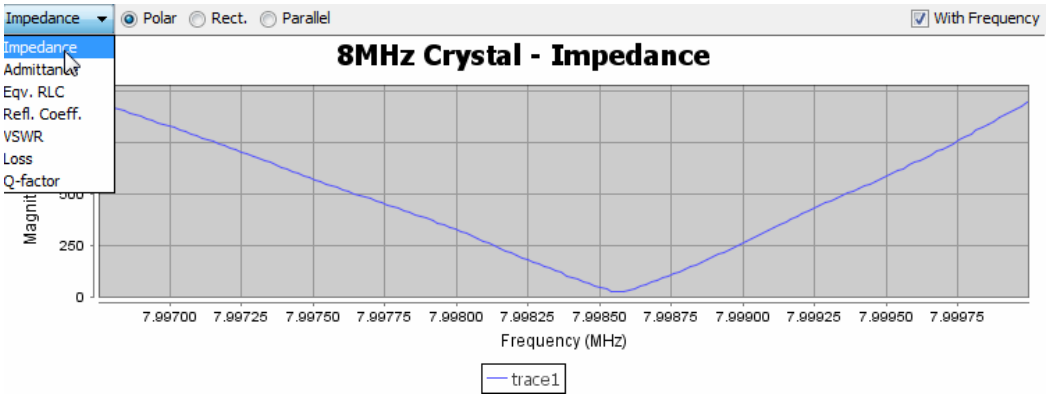
Of course, the file may be saved by selecting **Save** in the **File** menu.
See the File Menu chapter for details.

4 The Chart Area

The chart area provides a complete set of graphing facilities to plot and analyse data. Facilities available include real time scroll zoom, box zoom, multi-trace plotting, annotations and Markers.

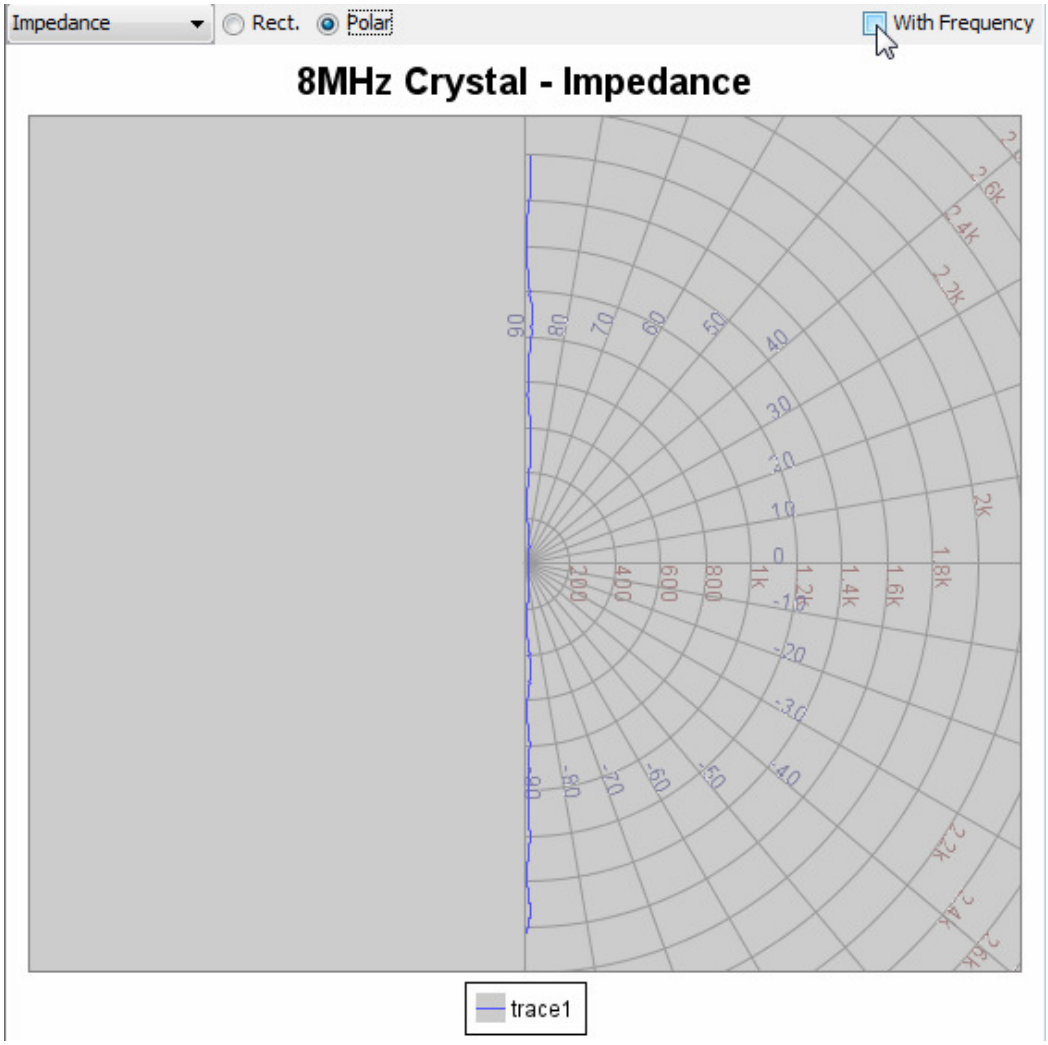
4.1 Selecting Display Format

Chart display format is selected from the drop list of options just like the data table. Note that the chart format is independent of the data table format. When a format is selected, the chart is displayed with the auto ranging function turned on. This means that all captured data will be visible.



In the example above, **Impedance** is chosen from the drop list and the **Polar** radio button is selected. So this is a plot of Polar Impedance vs Frequency.

In the far right hand top corner of the chart window is the **With Frequency** checkbox. Clicking on this will change the chart format from a frequency sweep to a complex plot of the chosen display format.



The chart now shows a complex plot of **Polar Impedance**. i.e. Magnitude vs Angle.

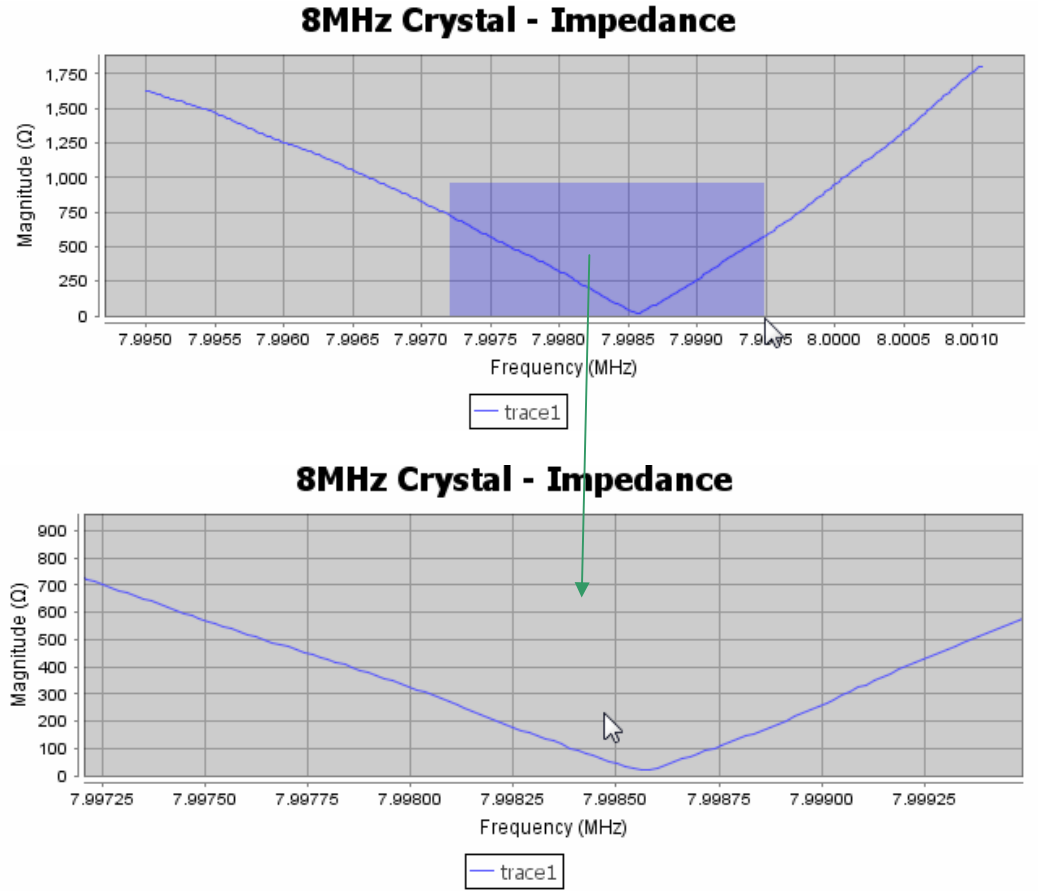
Placing the mouse pointer over the trace shows frequency information.

Note that certain display formats such as **Return Loss** are scalar numbers and therefore do not have a complex plot option, so the **With Frequency** checkbox is disabled.

4.2 Chart Zooming

To zoom in on a selected area do one of the following:

Using the mouse, drag a rectangle from left to right over the desired area



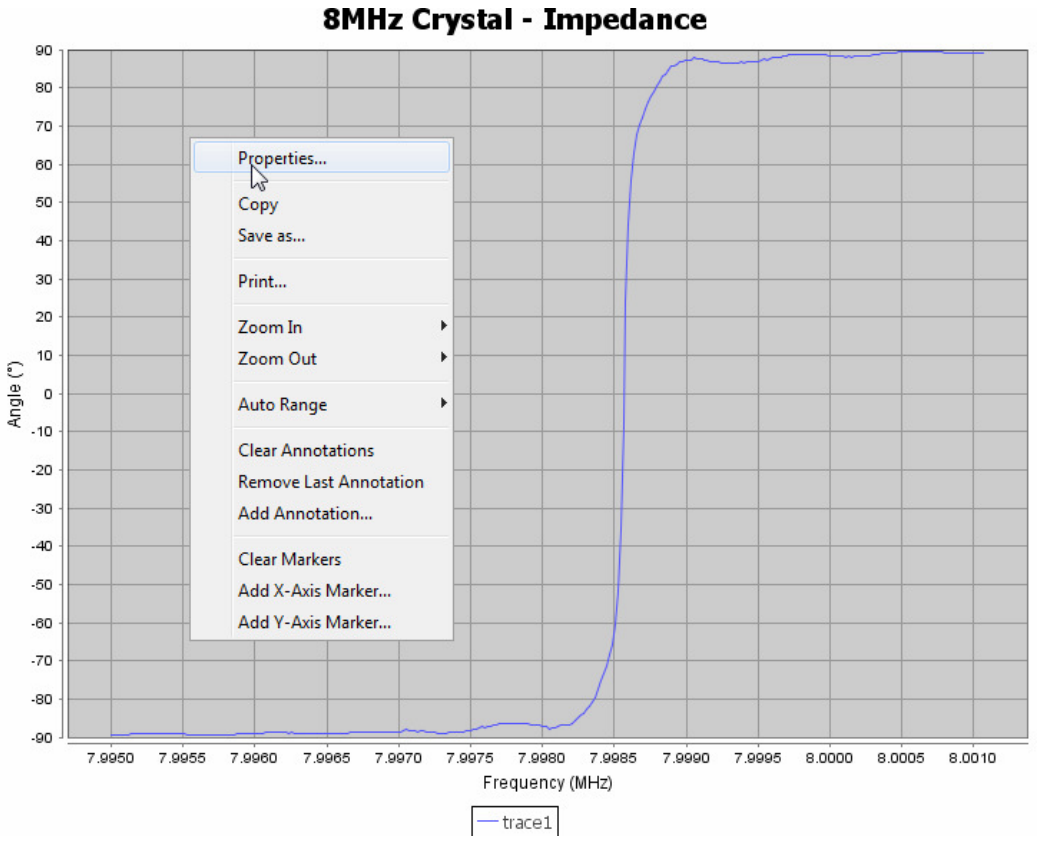
Or

Position the mouse pointer over the selected area and use the scroll wheel.

To reset both axes, drag a rectangle from right to left anywhere on the chart.

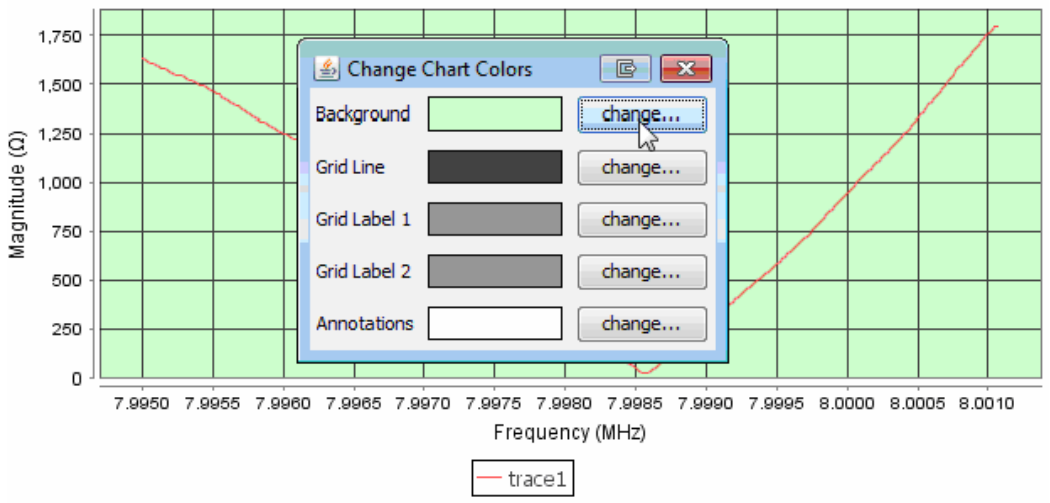
4.3 Chart Properties and functions

Right clicking on a chart displays a list of chart functions and parameters. From here you can add Annotations, create X or Y Markers, Zoom in or out and control all the properties available for the chart.



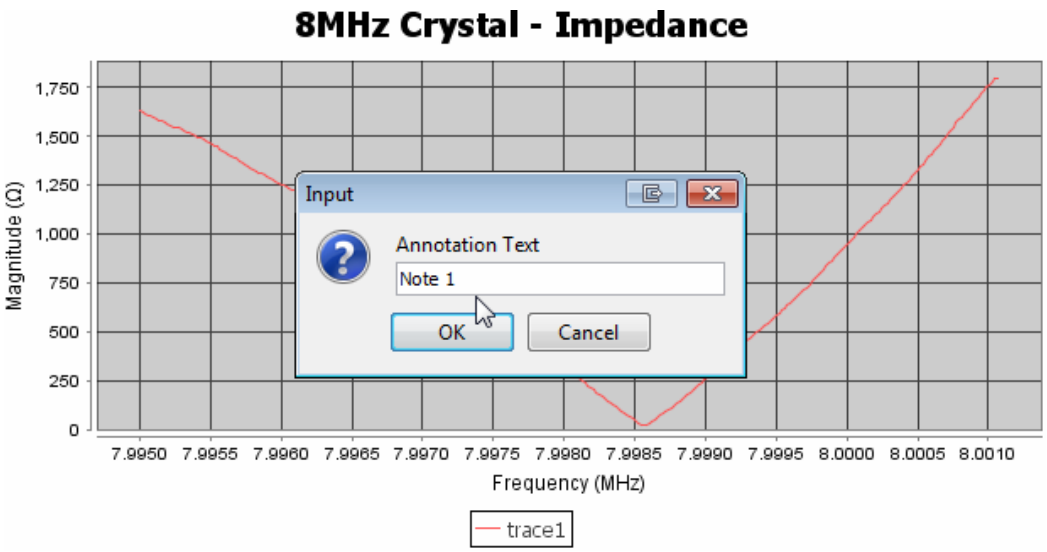
4.4 Setting chart colours

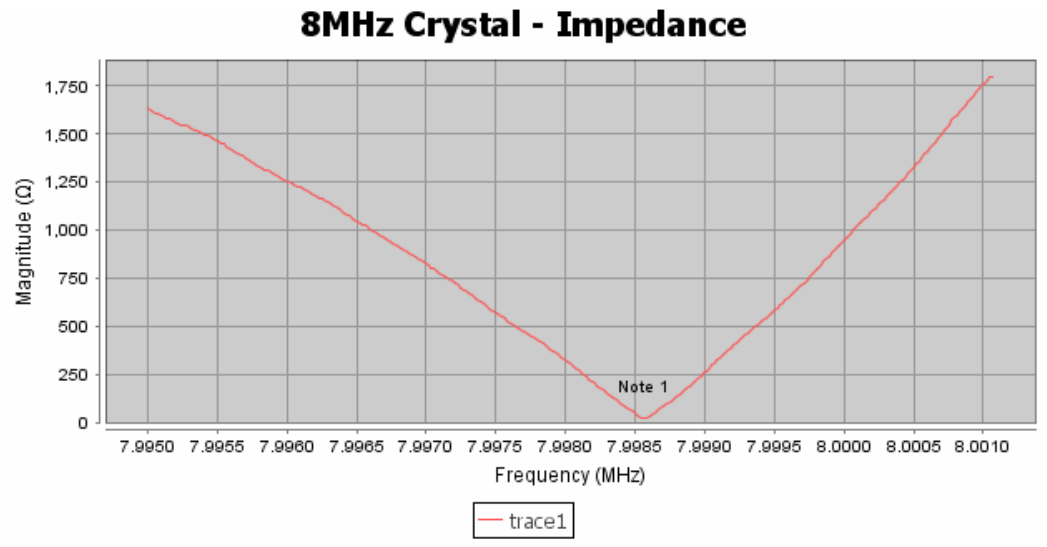
Select **Properties** from the chart area right click menu. This will display the chart colours dialogue box. From here you can manually set the chart colour scheme:



4.5 Annotations

Annotations can be added to a chart by choosing **Add Annotation** from the right click menu. The annotation entered will be placed to the right of the mouse position when the right mouse button was clicked.

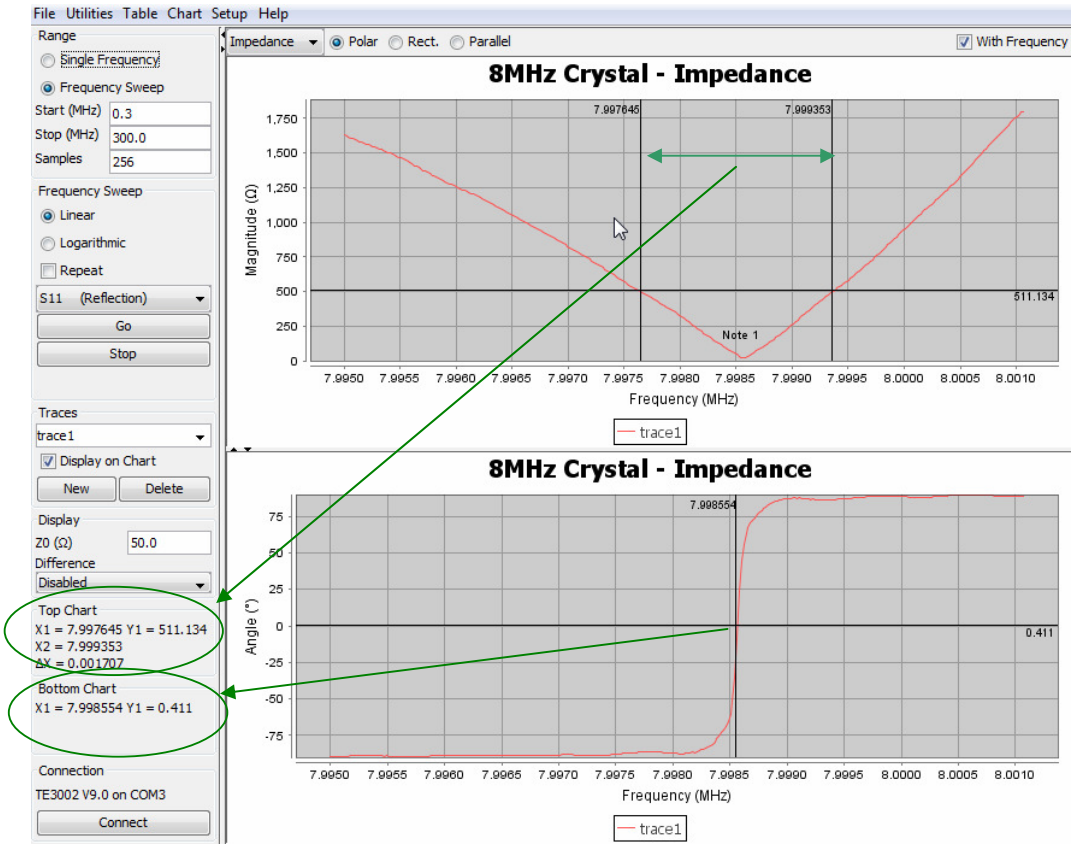




Annotations can be cleared any time with the **Remove Last Annotation** and **Clear Annotations** options. Annotations persist with zooming and will be saved and retrieved together with the file.

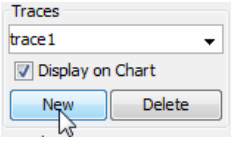
4.6 XY Markers

X and Y Markers may be added using the appropriate option from the right click menu.
The marker position is listed in the control panel area just under display options.
If two X or two Y Markers are present, the difference information will also be displayed in the control area.

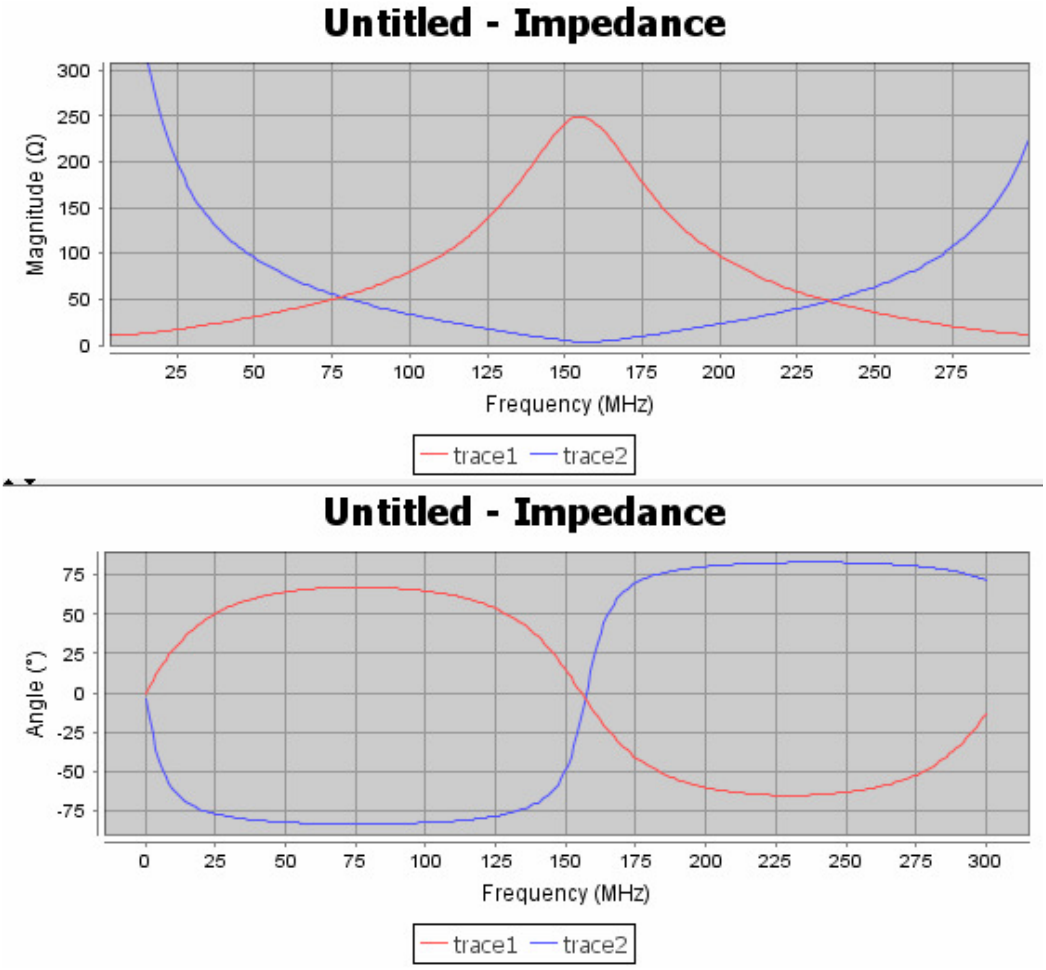


4.7 Multiple Traces

An unlimited number of traces can be added to a session. Click on the **New** button in the traces group on the control panel to add a new trace. A new trace will appear in the traces drop box called 'traceX' where X is the next available number in the series. This new trace remains in memory until the session is terminated or saved, and can be selected/deleted/renamed at any time.



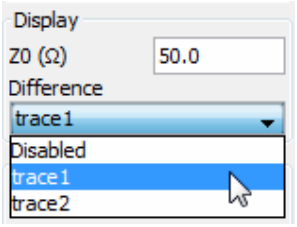
After adding the new trace, click **Go** to perform a new sweep.

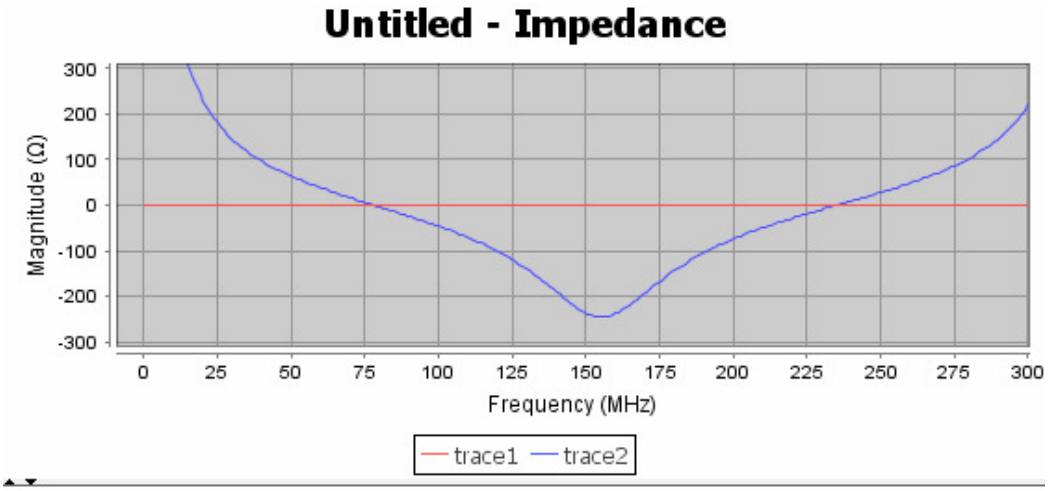


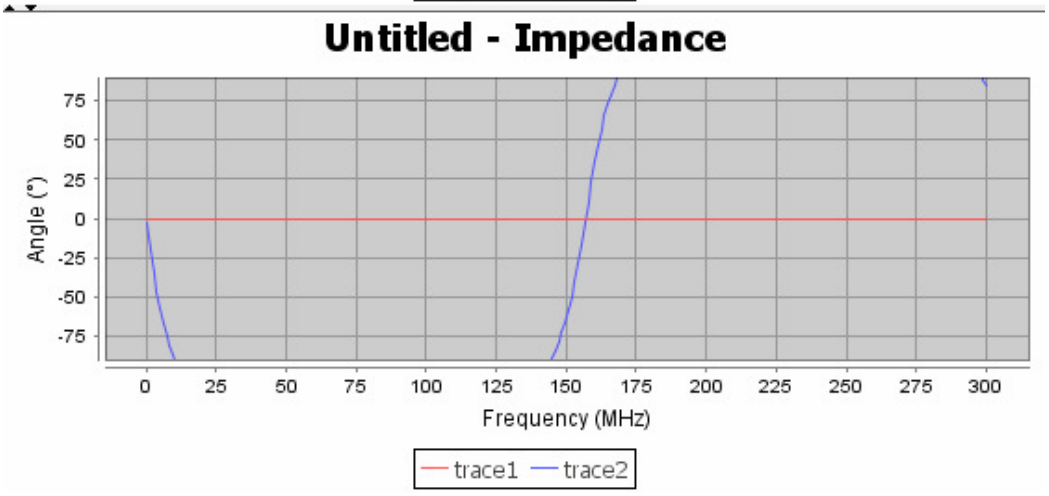
The new trace will be plotted in the same chart as the original and a legend will indicate the colour of each trace. Individual traces may be displayed or hidden on the chart area by checking or un-checking the **Display on Chart** checkbox in the control panel trace group.

4.8 Difference plotting

Each trace may be plotted on Cartesian charts as the difference from a particular reference trace. This function is useful for highlighting changes in a setup from a previous reference. Select the reference trace from the **Difference** drop list in the Display options group of the control panel. All displayed traces will now be plotted as the difference from the selected reference trace.



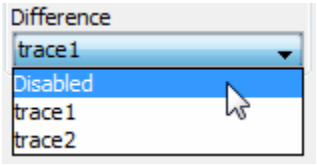




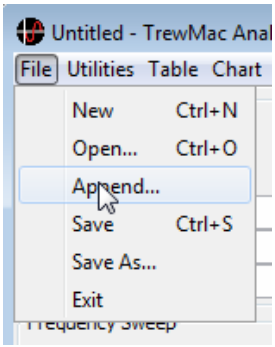
Of course, if trace1 is selected as the reference for the difference function, the plot for trace1 will appear as a flat zero. It could be hidden by un-checking the **Display on Chart** checkbox in the Trace group of the control panel.

Note that this function does not alter the actual data in the traces. It only affects the way they are plotted.

To disable the difference function, select **Disabled** from the **Difference** drop list.



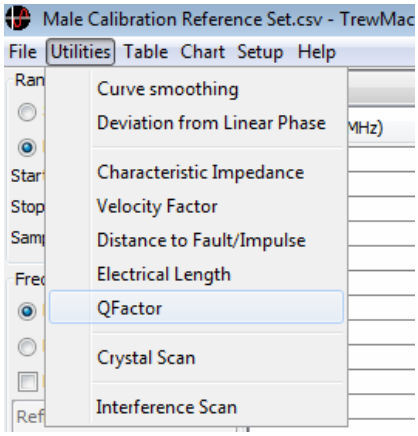
5 File Menu



The file menu provides the regular file options.
To open a file it must be in a recognisable format with a .csv extension.
Use the **Append** function to combine the traces from separate files into one.

6 Utilities

The utilities menu contains functions for processing data and characterising networks. It includes curve smoothing, a velocity factor function, a characteristic impedance function, time domain reflectometry, and interference spectrum scanning.



6.1 Curve Smoothing

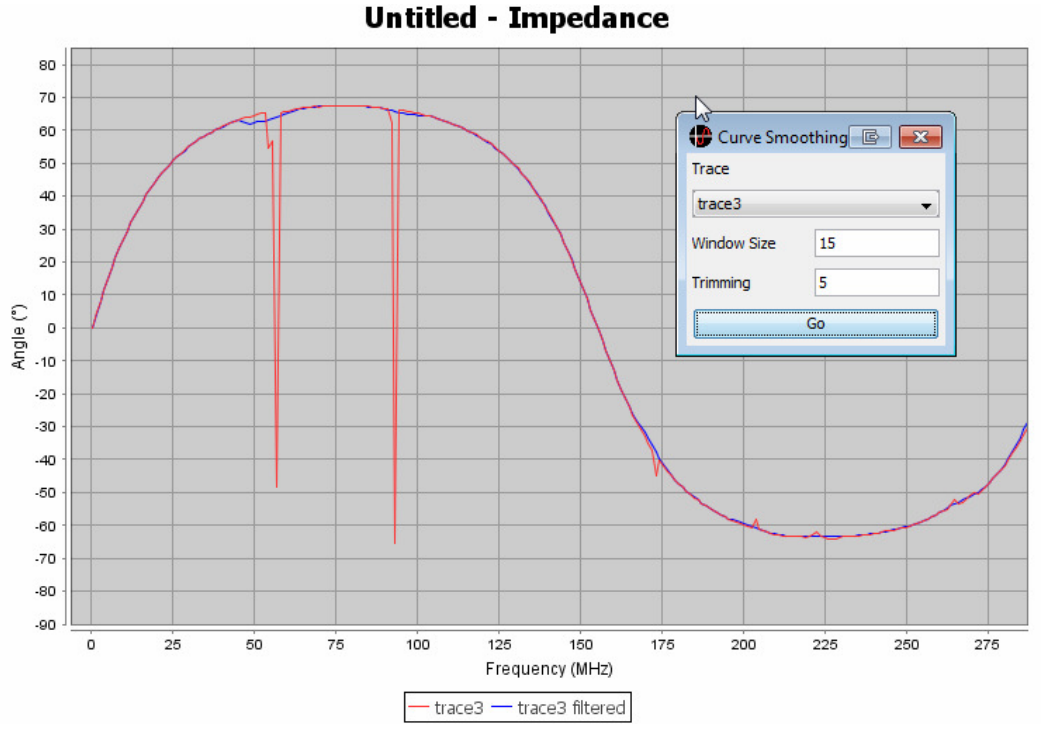
An alpha trimmed mean filter is provided for curve smoothing. Be aware that smoothing data can lead to the corruption of results, and should only be used to improve the 'look' of a trace - not to improve accuracy.

The alpha trimmed mean filter is a simple moving window filter that sorts the windowed data by magnitude, discards some of the highest and lowest values and averages the rest. This type of filter is good at removing random (Gaussian) noise and impulse (Laplacian) noise and is simple to configure.

Procedure

- Select **Curve Smoothing** from the **Utilities** menu
- Choose the trace to filter from the drop down box
- Enter the window size – it must be an odd number
  (a larger filter size will result in a higher degree of averaging)
- Enter the amount of trimming – it must be less than half the window size
  (trimming dictates the degree of impulse error rejection)
- Press **Go**

A new trace is generated named ‘Trace X filtered’ where ‘Trace X’ is the name of the original unfiltered trace. Changing the filter parameter values and pressing Go will re-generate the filtered trace. This new trace remains in memory until the session is terminated or saved, and can be selected/deleted/renamed/plotted or tabled at any time.



Close the filter utility by clicking the close button at the top right hand corner of the dialogue box.

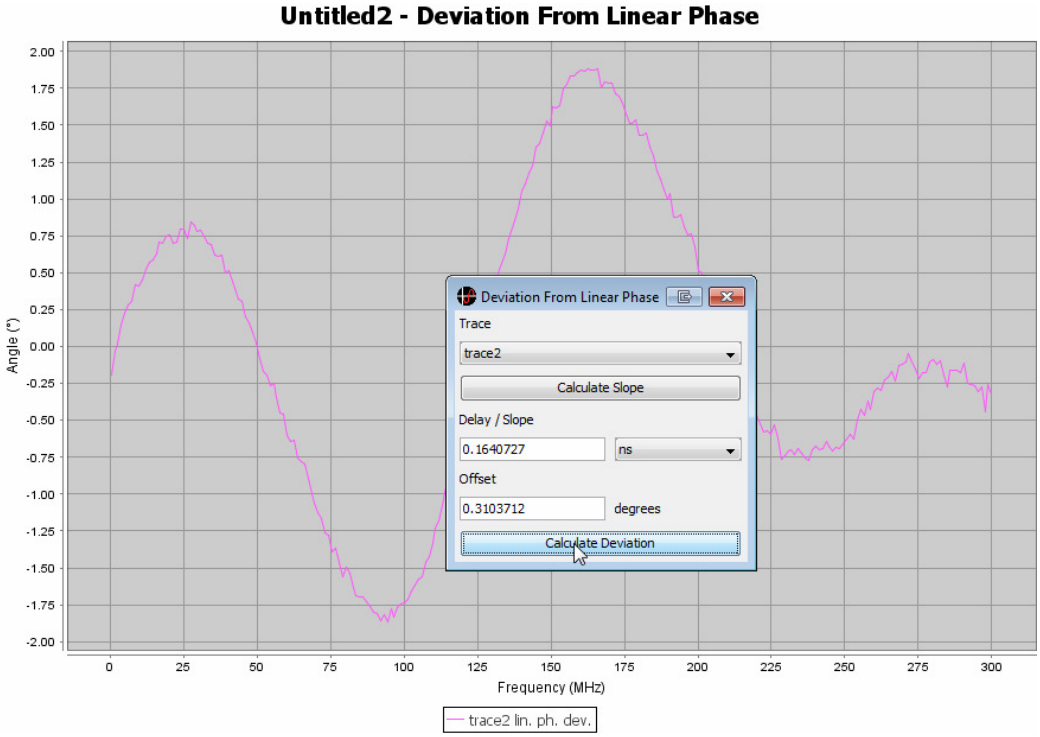
6.2 Deviation from Linear Phase

The deviation from linear phase function calculates the ‘average’ slope of the phase of a particular trace using the method of least squares. It is usually used for transmission traces but is also available for reflection traces. This value of slope is displayed on the dialogue box in the frequency or time domain and is subtracted from the selected trace to generate a new deviation from linear phase trace.

Procedure

- Select **Deviation from Linear Phase** from the **Utilities** menu
- Choose the trace to use from the Trace drop down box
- Click **Calculate Slope**
- The slope and offset is displayed in either frequency or time domain format according to the suffix drop list
- Click **Calculate Deviation** to generate a new trace

The new trace is named 'Trace X lin. Phs. Dev.' where 'Trace X' is the name of the original trace. This may be renamed at any time by clicking in the Traces list.



Close the utility by clicking the close button at the top right hand corner of the dialogue box.

6.3 Characteristic Impedance Zo

This function calculates the characteristic impedance of a transmission line at the frequency of the first impedance null or peak. The null or peak is detected by the zero crossing of phase, and indicates that the transmission line is acting as a quarter wave transformer. At this point, the characteristic impedance Zo is found as $Zo = \sqrt{ZlZt}$ where Zl is the terminating load and Zt is the transformed load as seen through the quarter wave transmission line.

The Analyser must be in calibration for the results of this utility to be meaningful.

Procedure

- Select **Characteristic Impedance** from the **Utilities** menu
- Terminate the cable to be measured with a load of approximately half suspected Zo
- Connect the other end of the terminated cable to the analyser and click **Measure Terminated Cable**
- Now connect the termination directly to the analyser (without the cable) and click **Measure Termination**
- The measured Zo is displayed on the dialogue box in Ohms

Pressing the **Stop** button on the control panel will terminate the current sweep.

Notes on Termination

The best terminations for this function are purely resistive loads with a value of around ½ the suspected Zo or alternately, 2x the suspected Zo. The worst terminations are Zo itself, a Short or an Open.

This is because:

> Zo will tend to transform to itself and so the phase may fluctuate above and below zero, making the quarter wave point impossible to locate.
>
> An Open will transform to a Short generating $Zo = \sqrt{\infty * 0}$?
>
> The same goes for a Short; it's transformed to an Open.

Therefore use a resistive termination significantly different from Zo but not close to a Short or Open.

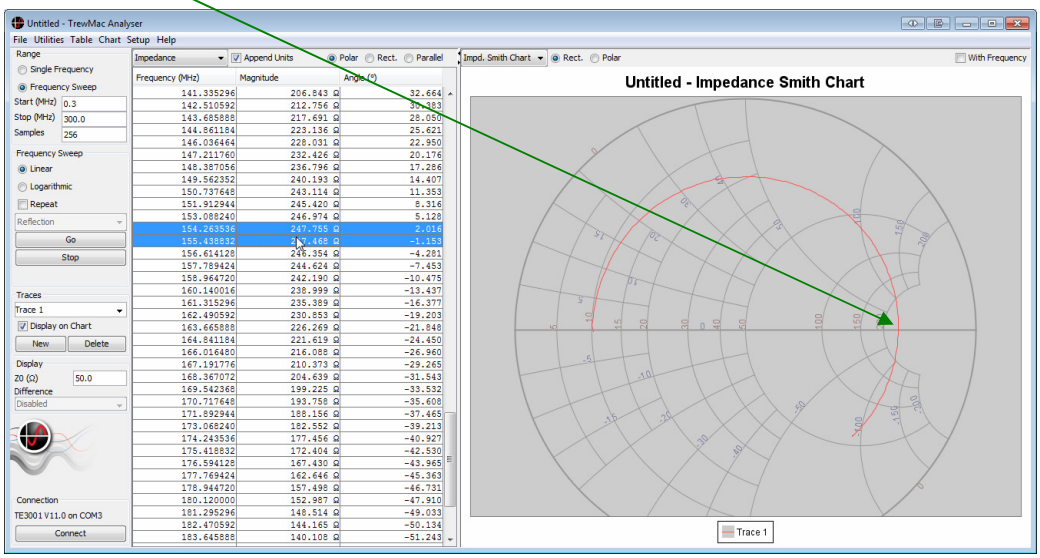
Notes on Minimum required length

One more factor to consider is the minimum length of the transmission line.
In order to use this function, the transmission line must be at least ¼ wavelengths long at the highest frequency the analyser can do. Assuming the VF of the cable is at best 80%, this means the cable must be at least C/F/4*0.8 or

300/300/4*0.8 = 20cm long for TE3000/1/2, and 40cm long for TE1000

Manual Option

To perform this procedure manually, connect the terminated cable and select the smith chart view. Look for the first crossing of the X axis to locate the ¼ wavelength point.



Record the impedance magnitude at the zero crossing point. This is Zt.
Now connect the termination directly and record the impedance magnitude at the zero crossing frequency. This is Zl.

The characteristic impedance Zo is found as $Zo = \sqrt{ZlZt}$

6.4 Velocity Factor Function

This function calculates the velocity factor of a transmission line at the frequency of the first impedance null. The null is detected as the zero crossing of phase, and indicates that the transmission line is acting as a quarter wave transformer, and hence its electrical length is known to be ¼ the wavelength of the null frequency.

The transmission line must be 'Open' terminated for this utility to function correctly, as an open is transformed to the null that this function searches for.

The analyser must be in calibration for the results of this utility to be meaningful.

Procedure

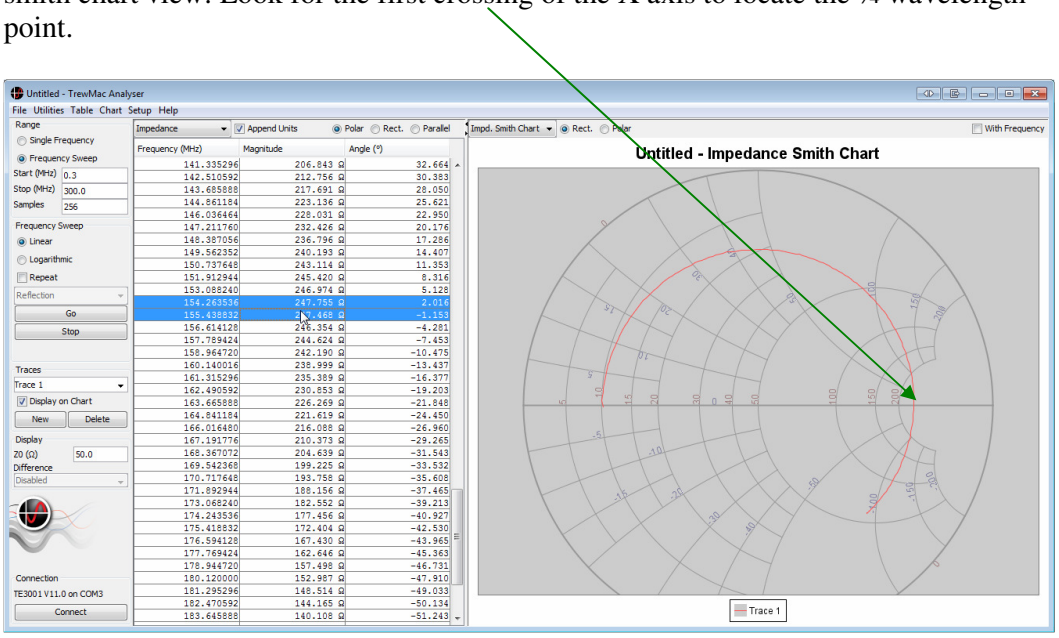
- Select **Velocity Factor** from the **Utilities** menu.
- Connect an open terminated transmission line.
- Enter the measured length of the cable in meters and press **Go**.

The analyser will search for the null point, and then the velocity factor is returned as a percentage of the speed of light.

Pressing the **Stop** button on the control panel will terminate the current sweep.

Manual Option

To perform this procedure manually, connect the open terminated cable and select the smith chart view. Look for the first crossing of the X axis to locate the ¼ wavelength point.



The Velocity Factor $VF = \frac{mf}{4C}$ where m is the length in meters, f is the zero crossing frequency (quarter wave frequency) and C is the speed of light in a vacuum.

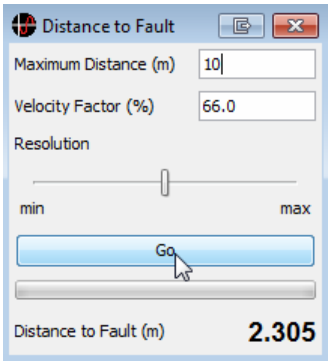
6.5 Distance to Fault / Impulse Response

This utility detects the peak of the time domain reflection impulse response to compute the one way distance down a transmission line to a fault. The impulse response is derived from the inverse Fourier transform of a reflection coefficient sweep. Some windowing is employed to compensate for the upper and lower frequency limits.

The analyser must be in calibration for the results of this utility to be meaningful.

Procedure

- Select **Distance to Fault\Impulse** from the **Utilities** menu
- Enter the maximum distance to scan down the line
  (larger distances require more frequency samples)
- Enter the velocity factor of the transmission line.
  (If the velocity factor of the cable is unknown, it could be measured with the VF utility. Alternatively, the VF for most cables is freely available on the internet.)
- Select the resolution of the scan (higher resolution requires more memory)
- Press **Go**

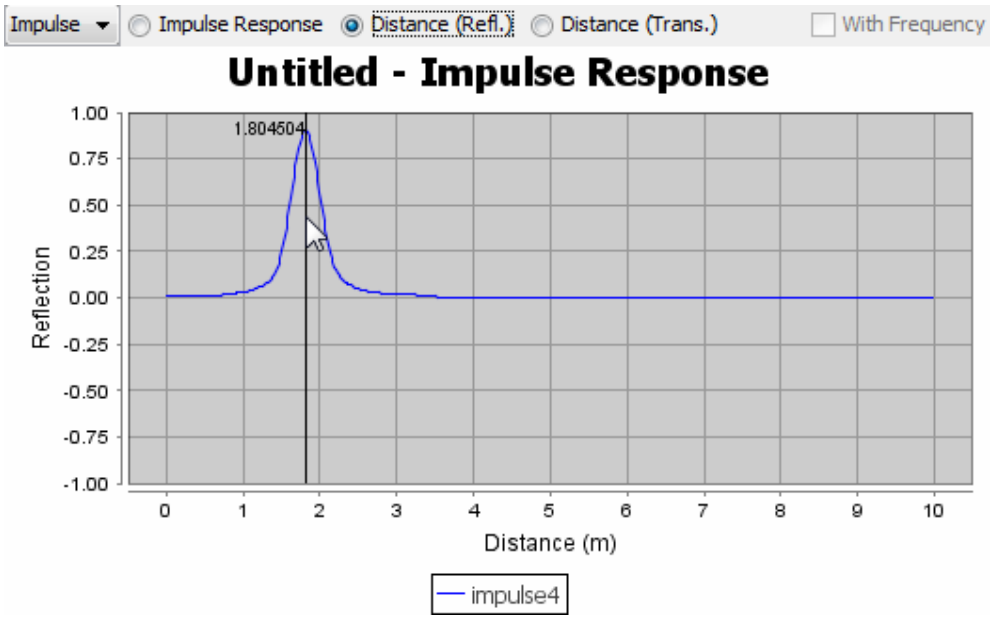


The unit will conduct a sweep with the required number of points, compute the inverse Fourier transform, and generate an Impulse data trace. The Distance to Fault is determined as the location of the highest peak in the new impulse trace and is displayed in the dialogue box.

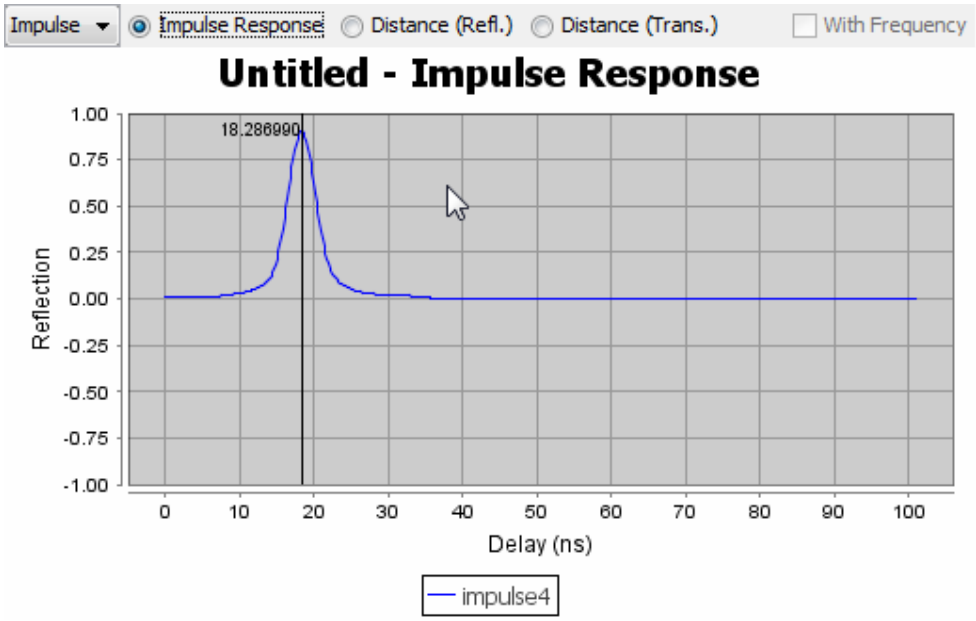
The Impulse trace can be view in the distance or time domain in the table and chart areas. It remains in memory until the session is terminated or saved, and can be selected/deleted/renamed at any time.

Pressing the **Stop** button on the control panel will terminate the current sweep.

With the **Distance** radio button checked the X axis of the Impulse trace can literately be read as the distance to a feature. Be aware that the distance is calculated using the velocity factor entered in by the user.



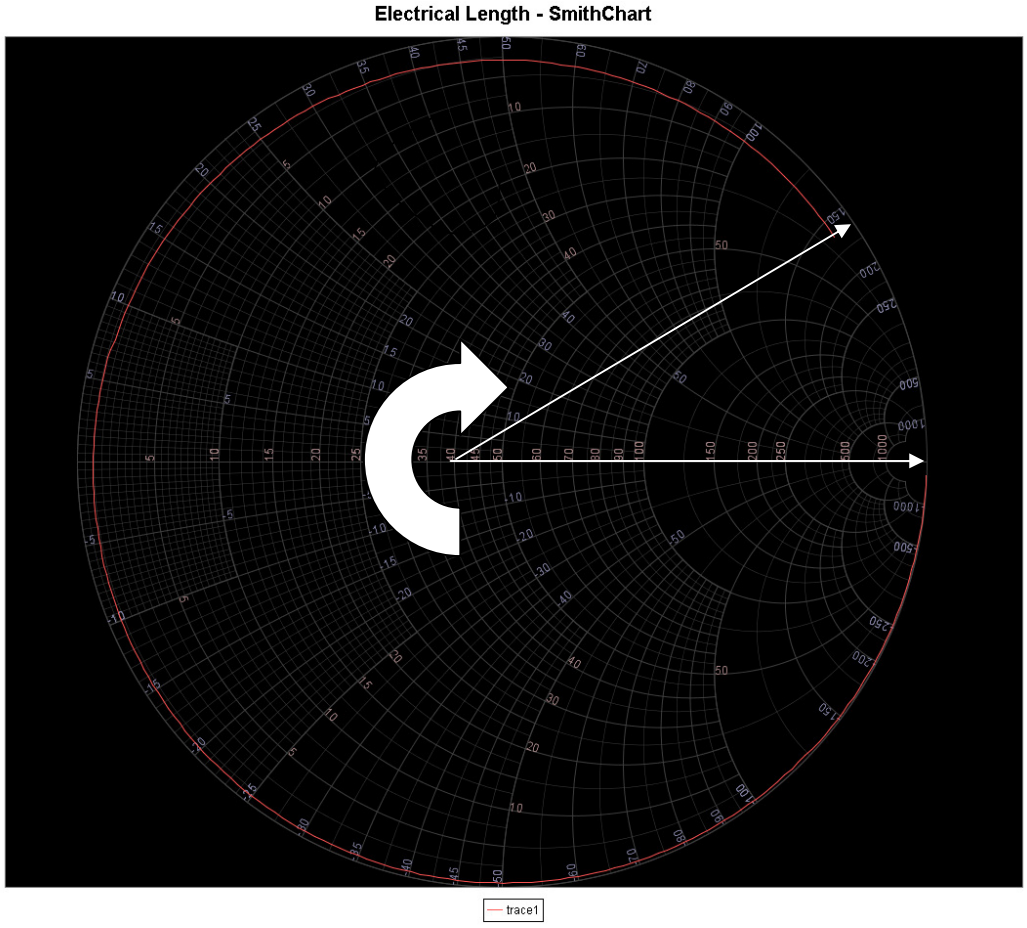
When the **Impulse Response** radio button is checked, the X axis is should be read as the time taken for the impulse to travel down the line and back again.



Any deviation from the normal characteristic impedance of the transmission line will generate a reflection. For example, a pinch in a length of 50 Ohm coaxial line may reduce the impedance at the pinch. This in turn will cause a negative going reflection (because it's less than Zo) at this point. A severed coaxial line will appear as an Open termination, resulting in a positive going reflection.

6.6 Electrical length

This utility measures the total electrical length of a transmission line attached to the analyser at one particular frequency. It does this by measuring the total reflection coefficient angle for a sweep of the transmission line up to the frequency of interest. This angle is halved to obtain the total electrical length.

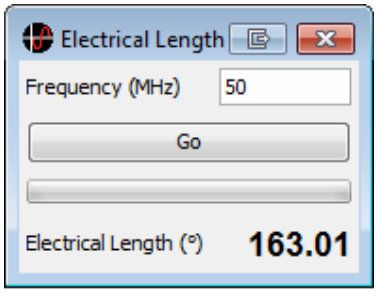


Be sure to use the correct calibration type according to the measurement setup. For example, if the transmission line to be measured is a coaxial cable connected to the N type connector on the fascia of the TE3001, use STD cal.

Note that this utility functions differently to the on board 'Electrical Length' display format of the TE3000 series. This utility calculates the total electrical length. The on board display format wraps around at 180˚ and cannot distinguish between (for example) 10˚ and 190˚.

Procedure

- Select **Electrical Length** from the **Utilities** menu
- Enter the frequency of interest
- Press **Go**



The utility will scan the transmission line and return the total electrical length.

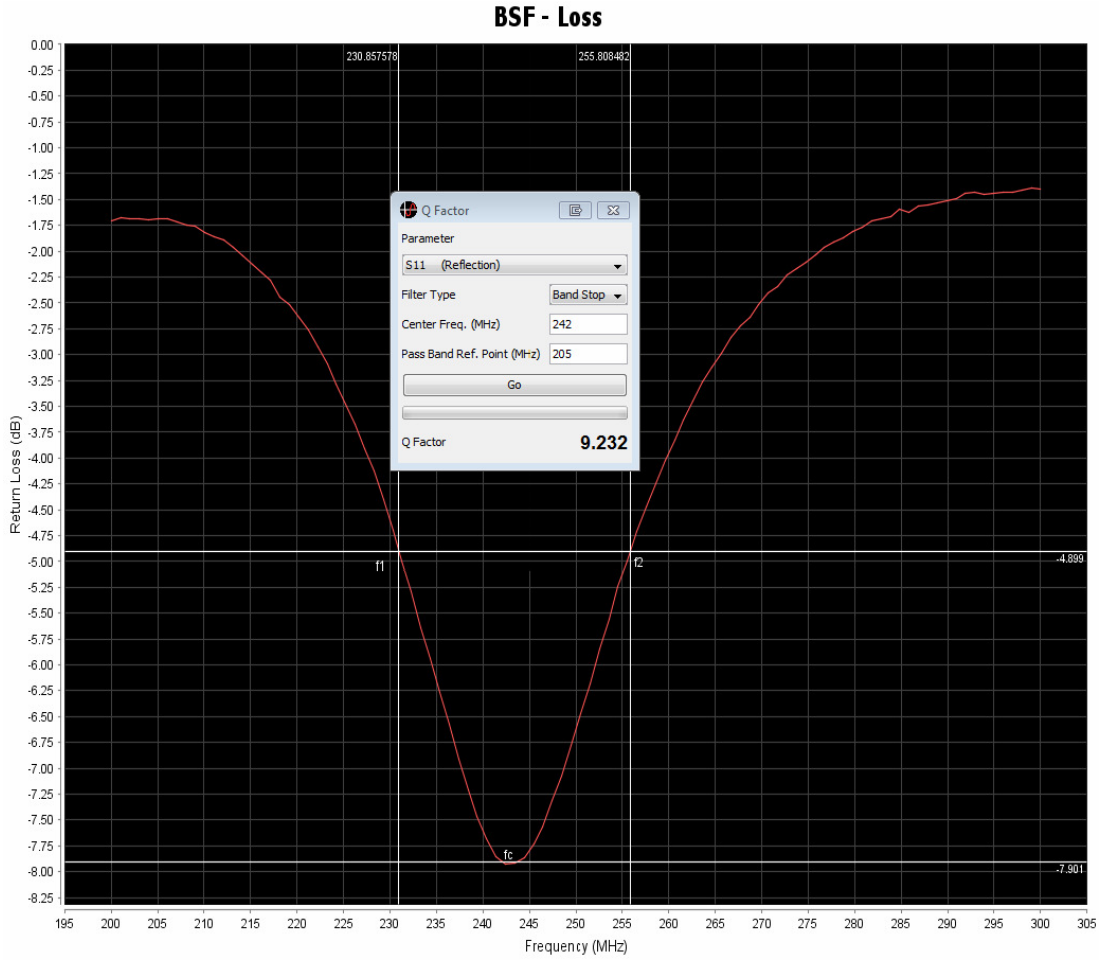
This utility will function for both Open and Short terminated cables.

Limitations
Maximum cable length is 100m and subject to attenuation.
For example, a long poor quality cable may attenuate the signal to the point where there is no reflected signal to measure.

6.7 Q factor

This utility provides automated Band Stop and Band Pass filter characterisation. The algorithm searches for the upper and lower half power (3dB) points and calculates the value of Q as $\frac{fc}{f_2 - f_1}$

Where fc is the centre frequency and f_2, f_1 are the upper and lower half power points.

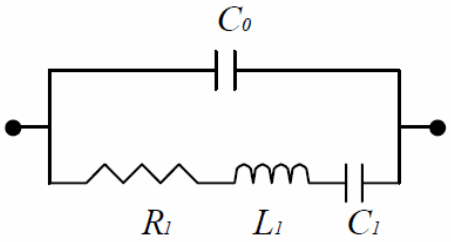


Procedure

- Select **Q Factor** from the **Utilities** menu
- Select Band Pass or Band Stop
- Enter the centre frequency
- For Band Stop filters, enter a frequency that you consider to be in the pass band region on the lower side
- Press **Go**

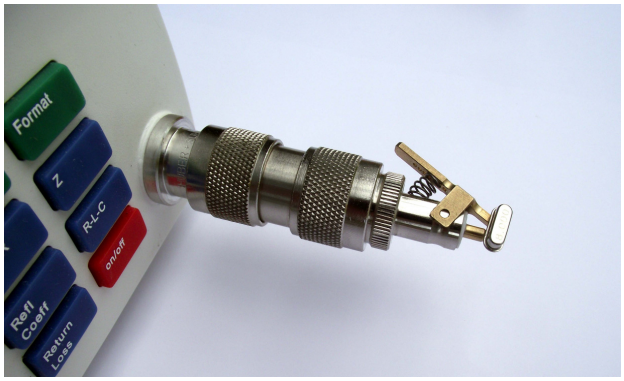
6.8 Crystal Scan

This utility provides automated Quartz crystal characterisation. The algorithm searches for series and parallel resonant points, then measures or calculates the value of each element in the 4 parameter crystal model shown below.



Electrical model of Quartz Crystal

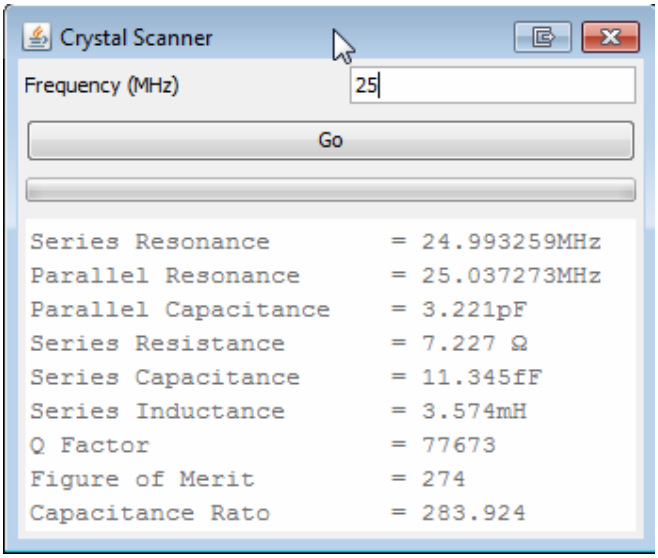
The TM5200 tweezer attachment is the easiest way to hold and measure a regular quartz crystal. Before accurate measurements can be obtained, the effect of this fixture must be calibrated out. This is easily achieved using the custom cal routine and the TM5174 SMD cal kit.



Once the measurement fixture is calibrated out, the crystal scan function can be used to measure the crystal parameters.

Procedure

- Select **Crystal Scan** from the **Utilities** menu
- Enter the crystal frequency
- Press **Go**



All parameters are measured or calculated and displayed on the screen. These values are automatically copied to the clipboard for pasting into other application.

See the website for articles containing more information about quartz crystal behaviour and analysis.

6.9 Interference Scan (excludes TE1000)

This utility scans the specified frequency range for interfering signals.
It achieves this by monitoring input voltage activity with the output switched off.
To ensure the capture of all possible sources of interference, the frequency step must be limited to half the IF of the unit, and is necessarily small. For fastest results, narrow the frequency range to the region of interest.

This utility is not intended to provide a high degree of accuracy for the absolute amplitudes of the interfering signals, but it does provide clues as to where and how large the interference signals might be.

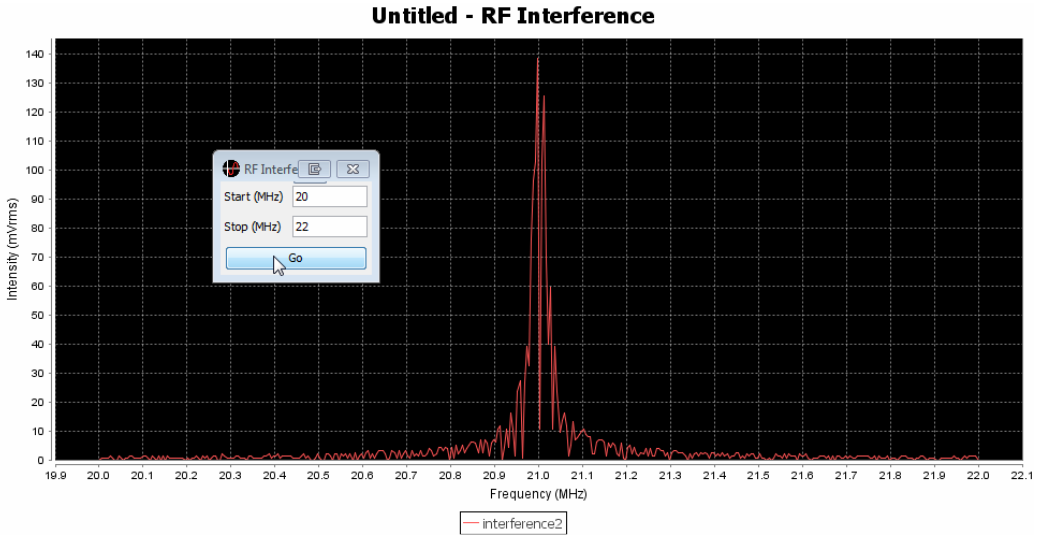
Procedure

- Connect the antenna to Port 1
- Select **Interference Scan** from the **Utilities** menu
- Enter the start and stop frequencies over which to scan
- Press **Go**

The analyser will scan the specified frequency range in the required number of steps and return the measured value of RF interference on the input.

Pressing the **Stop** button on the control panel will terminate the current sweep.

Running this utility creates a new trace called 'Interference' suffixed by the next available number in the series. This new trace remains in memory until the session is terminated or saved, and can be selected/deleted/renamed/plotted or tabled at any time.



The image above shows an interference scan from 20-22MHz.
A signal generator generates -10dBm sinusoidal interference at 21MHz.

Input limitations

TE3000

The input to the TE3000 analyser is very sensitive, and can effectively detect ~300mVrms to ~300µVrms over the available frequency range.
Above these limits the input becomes saturated and will not display any increase.
Below these limits the signal will be lost in background noise.

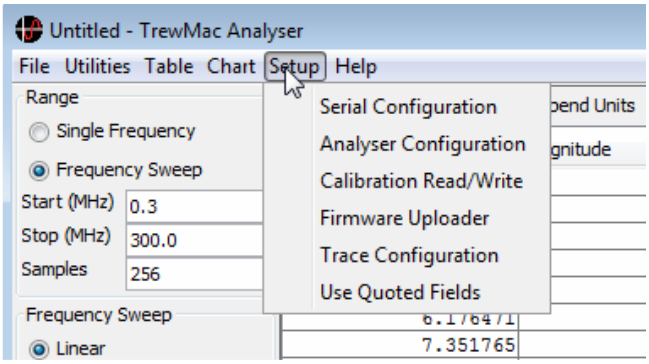
Interference signals larger than 300mVrms can be analysed using a 20dB in line attenuator.

TE3001/TE3002

The input to the TE3001/TE3002 analyser input is significantly more robust, and can effectively detect ~1.7Vrms to ~1.7mVrms over the available frequency range.
Above these limits the input becomes saturated and will not display any increase.
Below these limits the signal will be lost in background noise.

Interference signals larger than 1.7Vrms can be analysed using a 20dB in line attenuator.

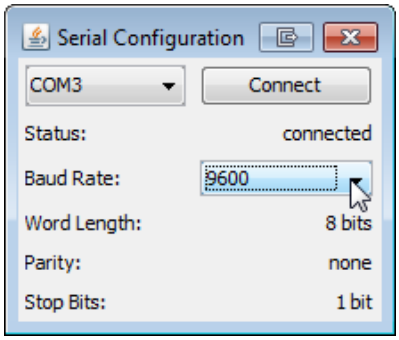
7 Setup Menu



The setup menu provides control over various aspects of the software and analyser behaviour.

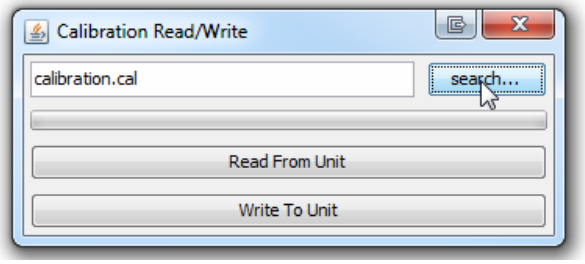
7.1 Serial Configuration

The serial configuration parameters are fixed for TE analyser communications, but can be viewed in the serial configuration window. The drop list will display all available serial ports on the computer and will allow selection of an alternative port.
Two baud rates are possible: 9600 and 115200.
Only analysers with firmware V9.0 or later can use the high baud rate.
Select the desired baud rate from the drop list and the analyser will change automatically.

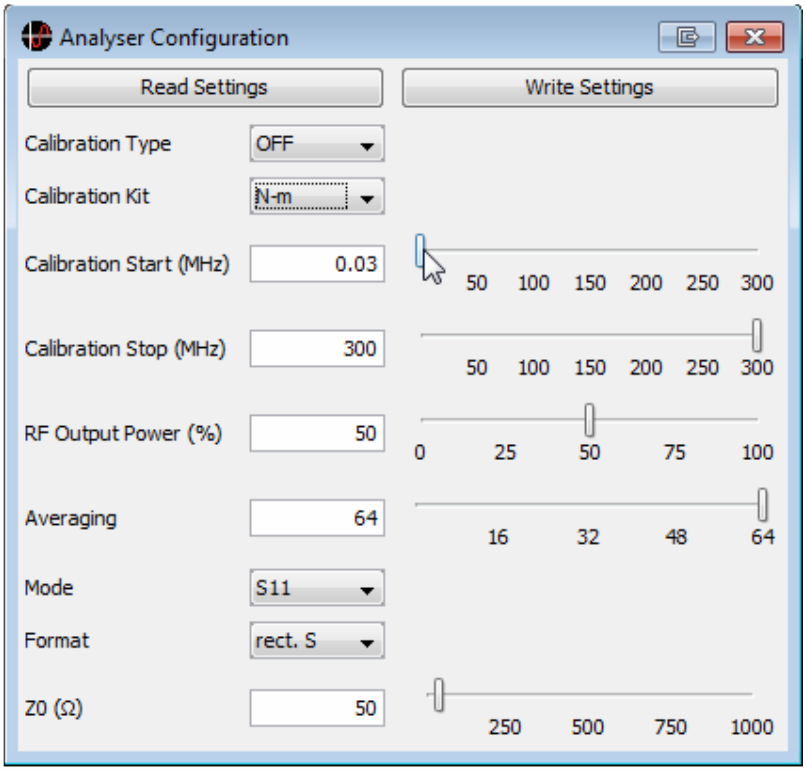


7.2 Calibration Files (TE300X Only not available for TE1000)

The TE3000 series of analysers use a set of error tables stored in the analyser memory to achieve error correction. This set of tables can be uploaded or downloaded to the device via the cal file utility. It is sometimes desirable to save a known calibration setup, either for reference or to save time for a frequently repeated test. From the utilities menu, choose cal file, locate the file to be transferred or saved and click the appropriate button.



7.3 Analyser Configuration



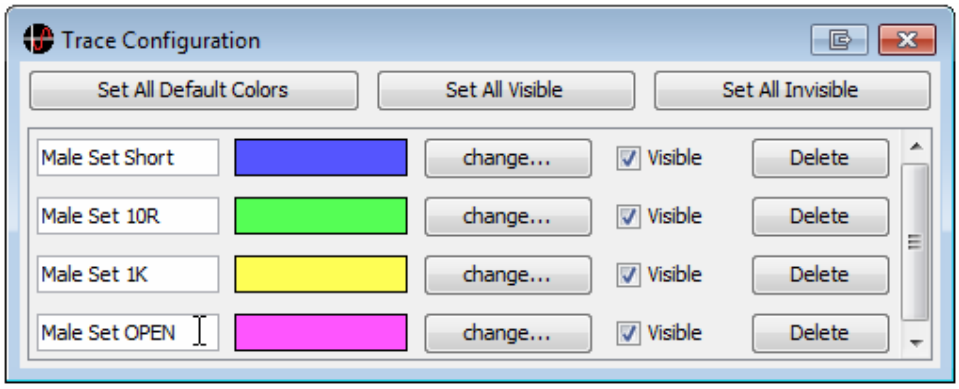
The analyser configuration window provides read/write access to the analyser's system parameters. All of these parameters are available on the analyser itself by pressing the **System Zo** or **Cal** key.

Note that the **Format** option above sets the RS232 communication format of measured data; it does not control the LCD display format.

7.4 Firmware Uploader

The firmware uploader utility allows more recent firmware to be downloaded from our website and uploaded to the analyser. New firmware will change the way the analyser operates. See the Firmware Update section of the hardware manual for details. Be aware that recent firmware may not suit old machines. Check the file description before use.

7.5 Trace Configuration



This window provides control over how the traces in the charts are plotted. The visibility, colour, and name of each trace may be set individually. Alternately the **Set All Visible/Invisible** buttons provides group control. Traces may be deleted but may not be restored after deletion.

7.6 Use Quoted Fields

This option allows European users to store quoted comma separated variable files. This option is required if the number format of the host computer is set to use a comma as the decimal separator.

8 Saving and retrieving Data

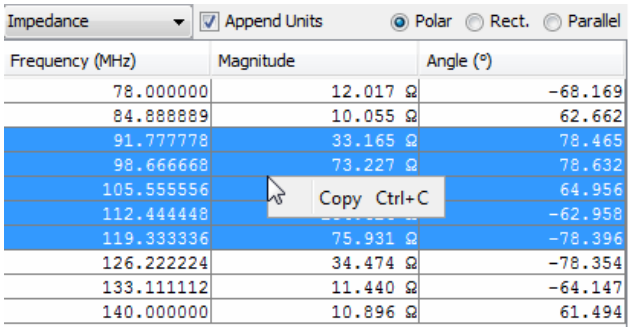
Data can be saved or retrieved using the file menu commands.
These commands open the standard operating system dialogue boxes.
The file type for the TE analyser series is quoted comma separated variables (.csv).
This type of file may be opened easily with excel and other spreadsheet applications.
Data can be manipulated within a spreadsheet and loaded back on to the TE Analyser Software for display however **care must be taken to ensure that the .csv format is preserved.**

Below is a typical file format for a two trace file named “File1.csv”
Commands are preceded by a #: and comments by a # only.

# All data is saved in rectangular format	*(Comment)*
# Each line has the form {frequency/time},data	
#: characteristic_impedance = 50.000000	*(Setting Zo)*
#: velocity_factor = NaN	*(Setting VF)*
#: new_trace = trace1	*(Setting Trace1 Name)*
#: trace_color = 0xff5555	*(Setting Trace1 Colour)*
#: data_type = Reflection	*(Setting Data Type)*
23.000000,-0.777743,-0.402642	*(MHz,R,I)*
29.111111,-0.840125,0.198203	
35.222222,-0.507092,0.690389	
41.333334,0.057239,0.850088	
47.444444,0.585855,0.618724	
53.555558,0.844880,0.100455	
59.666668,0.710273,-0.466254	
65.777780,0.244809,-0.815025	
71.888888,-0.341141,-0.776022	
78.000000,-0.762121,-0.359990	
#: new_trace = trace2	*(Setting Trace2 Name)*
#: trace_color = 0x5555ff	*(Setting Trace2 Colour))*
#: data_type = Reflection	*(Setting Data Type)*
78.000000,-0.762018,-0.360854	*(MHz,R,I)*
84.888889,-0.783230,0.291614	
91.777778,-0.328424,0.762242	
98.666668,0.307573,0.771473	
105.555556,0.763315,0.330041	
112.444448,0.770334,-0.306343	
119.333336,0.333458,-0.759528	
126.222224,-0.299139,-0.770107	
133.111112,-0.756973,-0.328944	
140.000000,-0.758680,0.305052	
#: selected_table = WithFrequency.Impedance	*(Setting table view)*
#: selected_chart = WithFrequency.Impedance	*(Setting chart view)*
#: selected_trace = trace2	*(Setting selected trace)*

The user is free to manipulate these files to display alternate data within the displayable limits of the software.

To save formatted trace data, highlight the data in the table area to be saved using the mouse. Right click, then copy. This action copies the selected data to the local clipboard so it can be pasted into other programs.



Use the “append units” check box and the other format options to format the data as desired.

9 Support

For help with the Analyser or the software please contact the help desk via email:

help@trewmac.com