Chapter 4: Probe Settings and Calibration

Single Probe Mode

In the *Menu Bar* under the options *File, New* there are at least four modes of operation listed. The first is called single probe mode. In the single probe mode it is implied that you have the probe hooked directly to the TDR unit, no multiplexers are in-between. If you have questions about the controls in this chapter please refer to Chapter 2 “The WinTDR Interface” for descriptions and explanations of each control.

Setting the Probe Controls

This is an ongoing process. From the time the probe is created until that probe is no longer used, the values in the *probe controls* are subject to change. The more you use the program though, the less often you will have to change the values. The purpose of this step is to ideally contain the points of inflection within the area defined by the *graph window*.

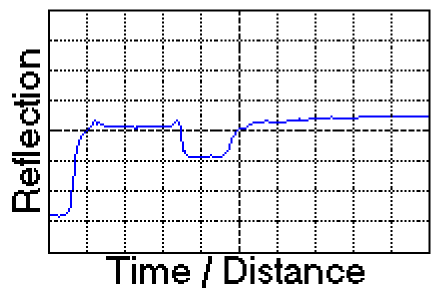

Figure 1: An example of a trace that is not ideally contained. Although the trace is wholly contained.

What is meant by ideal is open to question. For the most part ideal can be defined as follows:

One, the cursor position is slightly before the rise to the peak position. The point, which contains the first slope maximum found after the section reflection, is before the last grid section. As the solution in which the probe is placed changes the second reflection will move; hence you may have to change some values to still get accurate results.

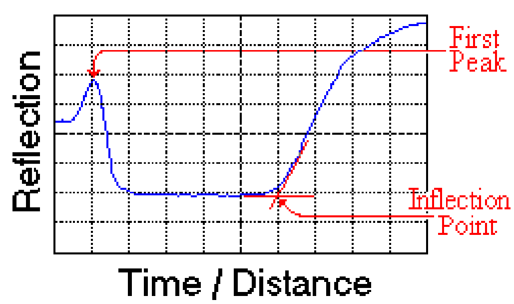

Figure 2: An example of a trace that could be considered ideally contained. Note how little excess data is included.

Another definition of ideal could be this: Almost the same as above with the exception that the resolution is undercut enough so that you never need make future changes. Values that should remain fairly constant are the impedance, the length, the cursor position, and the peak position. These are determined by the impedance of the coaxial cable, the length of the prongs, and the length of the coaxial cable used. As these are constants, the corresponding values should be also.

The value that will change is the **dist/div,** which is a resolution value controlling data accuracy and is subject to the environment. As you get a feel for the program, you will know where to set this value *ideally* for your needs. The only way to understand how this whole process works is to play around with the system a bit.

Finding and Setting the Cursor Position

To find and set the cursor position is rather simple. You want a value that will have the start of the waveform to appear as an ideal waveform described above. You can get a rough estimate for this length by measuring the length of the coaxial cable from the start to the beginning of the probes prongs. From this you should be able to see some part of a waveform and can make specific adjustments accordingly.

Another way to do it is to set the distance per division high, say around 5 or more meters, and sweep a waveform. From this waveform you should be able to see where the reflections are located. Now move your mouse over the graph to about where the waveform begins to increase to the peak position. In the status bar should be a value in meters. This value should be a good estimate to begin with as the cursor position.

Once you have a beginning value, place it in the *Cursor Position* text box. Now you can refine that value without sweeping a waveform by changing the *Distance per Division* to a smaller value and moving your mouse over the graph again. This allows you to "zoom" in on pieces of the waveform. Using this 'zooming' effect can also help setup an ideal waveform in just one sweep. **NOTE:** As zooming increases the waveform well appear "choppy". This is due to the fact we are still only displaying the waveform values we retrieved from the TDR but with stretching or shrinking.

When you think you have things setup correctly, sweep again to make sure everything is still satisfactory with your needs. Sweeping again will get a more accurate representation of the waveform at the current position and distance per division.

Finding and Setting the Peak Position

To set the peak at any time, simply double click in the display analysis window. Or you can adjust the peak position by "dragging" it to the desired position. The peak is necessary for all calibration and analyzing of the waveform. If you do not set the peak position yourself before analysis WinTDR will attempt to find it for you.

NOTE: When zooming it will appear that the peak is not always on the highest point. To ensure that it is, move your mouse over the graph by the peak position and note the Rho values associated with the peak position and the highest point. They should be the same. The peak appears to be off because the peak is drawn at the first pixel the highest Rho value appears. This is an example of the "choppy" effect described in the previous section on cursor position.

Calibration of Probe Length and Impedance

- First of all, this is something you only need do once for a set of similar probes. If you constructed your probes identically, their length and impedance should be approximately the same.
- Obtain the following items:
    - A large container of non-saline water. (De-ionized water seems best).

- 4 or 5 probes from the set of similar probes. (This is to establish an average).

When you compute the length and impedance you will want to have the probe as close to the center of the de-ionized water in the container as possible. We have found that probes on the edge, or in small containers, are influenced by the container and the air outside of the container. For information regarding the algorithms we use for these calculations, see Chapter 11.

NOTE: We calibrate the effective length of the probe, not the physical length.

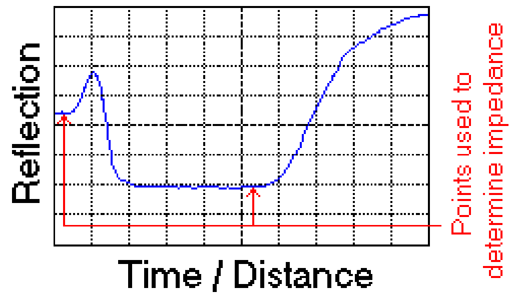

Figure 3: The points used to determine the impedance by the program.

Calibrating Probe Length

- Find and ideal trace of the waveform and click Calibrate Length either from the menu or the Probe window.
- It should then display the **Length Calibration Options** window. If it does not display this window see the note below.
- The **Length Calibration Options** window allows you to specify the medium the waveform was retrieved from. If you are using De-ionized water, you can specify the temperature and the expected Kb will be set automatically. If you are not using water, you can specify the expected Kb of the solution by un-checking the "Calculate Kb from Water Temp." and then specifying the Kb in the text box.
- Click OK when you are done.
- A new value will be presented. If you accept, the *Length* box will reflect the new value; else the old value will remain.
- Repeat two or three times, sweeping a new waveform each time. Take and average of these values.
- This average is the effective length of the probe.

NOTE: The **Length Calibration Options** window will appear each time you calibrate the length only when the check box at the bottom is checked. If you are using the same solution (at the same temperature) for all probe calibrations, setting this once is enough. The Length Calibration Options windows is described later in this chapter.

Calibrating Impedance

- For a probe find the trace as if you were going to analyze for water content.
- Select **Probe**, **Calibration, Characteristic Impedance** from the menu bar. Or click the button labeled Calibrate Imped. from the setup window.
- A new value will be presented. If you accept, the *Imped. box* will reflect the new value; otherwise the old value will remain.
- Repeat two or three times, sweeping a new waveform each time, then take the average.
- This average is the impedance for the probe.

Length Calibration Options 

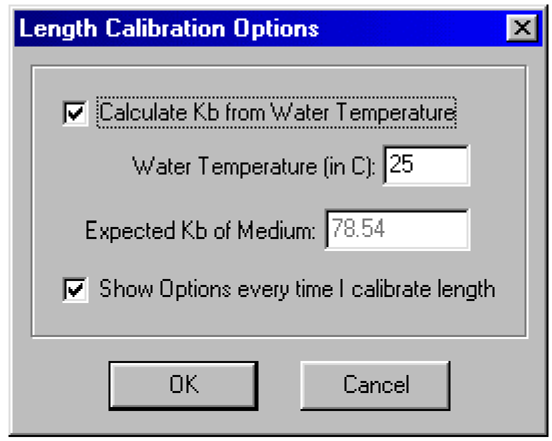

Figure 4: The Length Calibration Options Window.

The Length Calibration Options windows allows the user to fine tune what expected Kb is for the probe.

Calculate Kb from Water Temperature

This is useful if you are calibrating the probe length in de-ionized water and you know the temperature of that water. Input the temperature in the *Water Temperature* box and the Expected Kb is calculated automatically.

Expected Kb of Medium

When you know the expected Kb of the medium you are using to calibrate the probe length in, uncheck the Calculate Kb from Water Temperature and then enter the expected Kb in this edit box. NOTE: The you can not change this box if Calculate Kb from Water Temperature is checked.

Show Options every time I calibrate length

If checked, this window will be displayed every time you calibrate the length of a probe allowing you to adjust temperature or expected Kb for each probe you calibrate. If you uncheck this box, you can always change the settings by selecting **Options | Length Calibration** from the menu bar.