Introduction to Vision

Vision is a revolutionary software package that provides exceptional freedom to design, conduct and review all procedures associated with any material experiment. The Vision test environment will collect all of the data acquired in a test sequence and organize it in archived data structures along with the test sequence definitions and data analysis tools, so that the experiment can always be recalled or reproduced. Data and test conditions can be shared over the Internet to allow collaborative research. The program is freely distributed with the testers and is available for download (http://www.ferrodevices.com/vision4update.html) for evaluation purposes.

Vision's Agents - Tasks

Vision is a framework that loads a variable series of independent agents known as Tasks. Tasks are configurable objects that perform the procedures of an experiment and collect and analyze any measured data. Such an experiment is called a Test Definition.

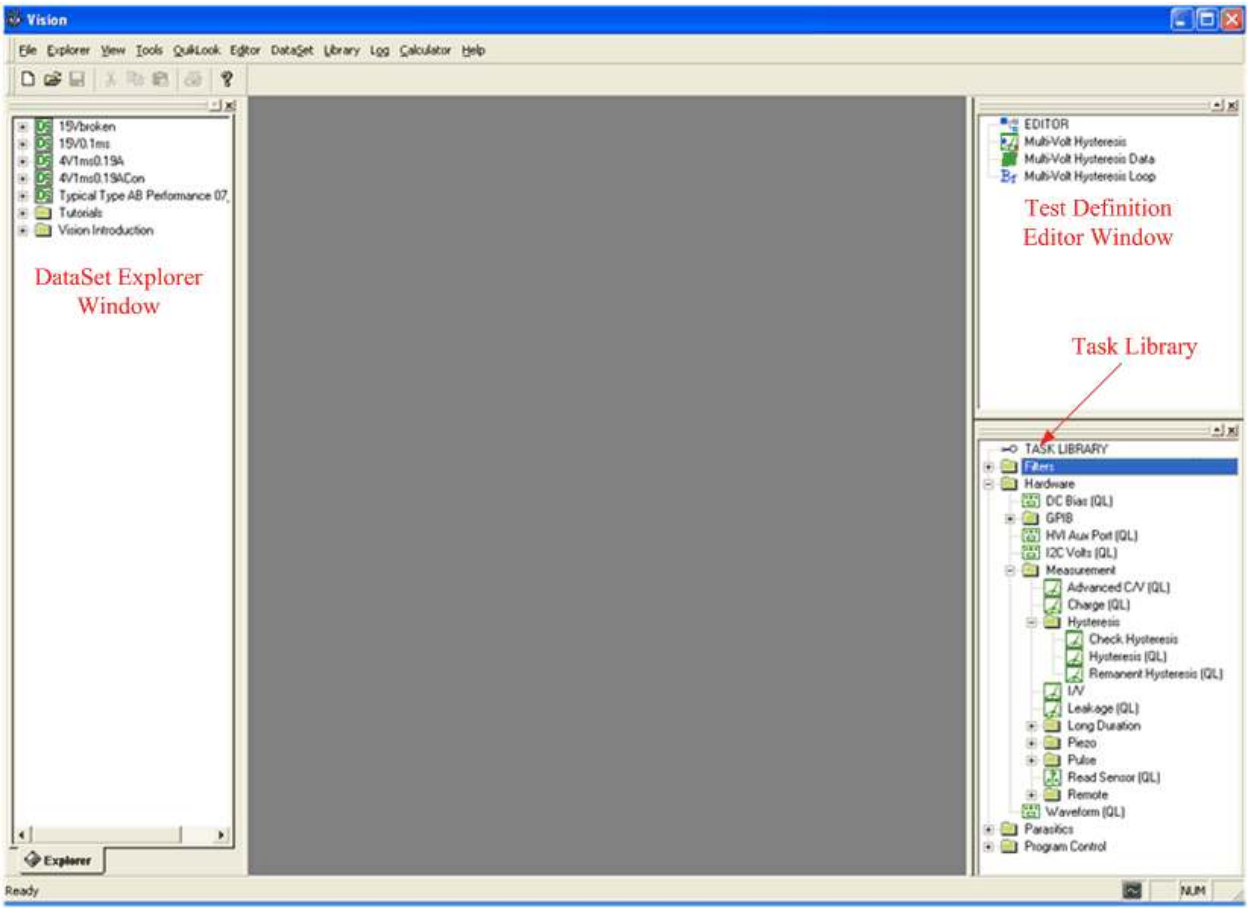

Figure 1 – Vision Program Window.

Categories of Tasks Include:

- **Hardware Tasks –** These are Tasks that send signals to a tester through the driver. These also may communicate with other instruments attached to the tester or to the host computer. Hardware Tasks normally apply a voltage profile to the sample. Testers may apply voltages of up to ±10.0 Volts, ±100.0 Volts or ±200.0 Volts, depending on tester model. Voltages of up to ±10,000.0 Volts may be applied with the addition of an accessory High-Voltage Interface (HVI) and High Voltage Amplifier (HVA). Hardware Tasks include:

    - Waveform – The Task applies a sine, square, triangle or user-defined voltage waveform to stress the sample. No data are acquired. The waveform is of user-defined voltage, frequency and duration.

    - DC Bias – The Task applies a constant user-defined voltage to the sample for a user-defined duration

- **Measurement Tasks –** These are Hardware Tasks that receive data from the tester. Measurement Tasks include, but are not limited to:

    - Hysteresis – A standard ferroelectric characterization measurement. This Task measures sample polarization ($\mu C/cm^2$) response to a Task-applied voltage profile. The profile is of user-specified maximum voltage and period (ms). (Period = 1000/frequency.) Profiles are normally standard bipolar (triangular) but may be monopolar, sinusoidal or user-specified.

    - Small Signal Capacitance – This measurement captures the samples capacitance as a function of voltage. It measures the capacitance at each voltage step using a very small stimulus signal to eliminate polarization switching components of the sample response.

    - PUND – A standard five-pulse ferroelectric sample characterization measurement that captures both switching (remanent + nonremanent) and non-switching (non-remanent) polarization ($\mu C/cm^2$). Pulse width and voltage are under user control.

    - Leakage – This Task captures the current through a sample induced by a steady-state, DC Bias voltage. Voltage and measurement duration are user-defined.

    - Fatigue – This Task performs a series of stress/measure sequences. In the stress sequence the sample is submitted to a switching waveform. At the end of the

waveform period, a PUND measurement is made to capture the sample's polarization response. Each subsequent stress period may have its duration increased to better serve a logarithmic analysis.

- Piezo-electric – This Task captures a sample's displacement as a function of voltage profile along with the sample's polarization response. An external displacement measurement instrument must be attached to the tester to make this measurement. This Task is purchase separately.

- Pyro-electric – This Task sets the sample to a series of temperature by performing GPIB control of an external thermal device. At each temperature it captures the sample's polarization response and/or small-signal capacitance. These are combined to calculate the pyroelectric coefficient.

- **GPIB Tasks –** These are Hardware Tasks that communicate with remote instruments through a GPIB bus.

- **Filters –** These are Tasks that collect, operate on, store and plot data from one or more Measurement Tasks or other Filters. Filter categories include:

  - Simple data collection and plotting.

  - Mathematical Analysis – Combine two measured data vectors into one through addition, subtraction, multiplication or division or perform single vector manipulation on one or more input data vectors. Single vector operations include linear scaling and offset, integration and differentiation. FFT analysis is planned for release, soon.

  - Averaging – Average multiple data vectors together to form a single vector, average one or more single vectors with itself over multiple iterations in a Branch Loop or perform statistical analysis on one or more single vectors. Statistical analysis includes maximum, minimum, mean and standard deviation.

- **Program Control –** These are Tasks that document and/or control the progress of an experiment.

Vision's Shortcut - QuikLook

Although primary experiments are conducted in Test Definitions, Vision also allows some Tasks to be configured and executed independently from a menu called QuikLook. QuikLook provides a handy one-shot measurement. It is not intended to store data for later review. That capability resides in Test Definition execution. The figures below show a QuikLook configuration and execution of a Hysteresis Task on a 4/20/80 PNZT sample.

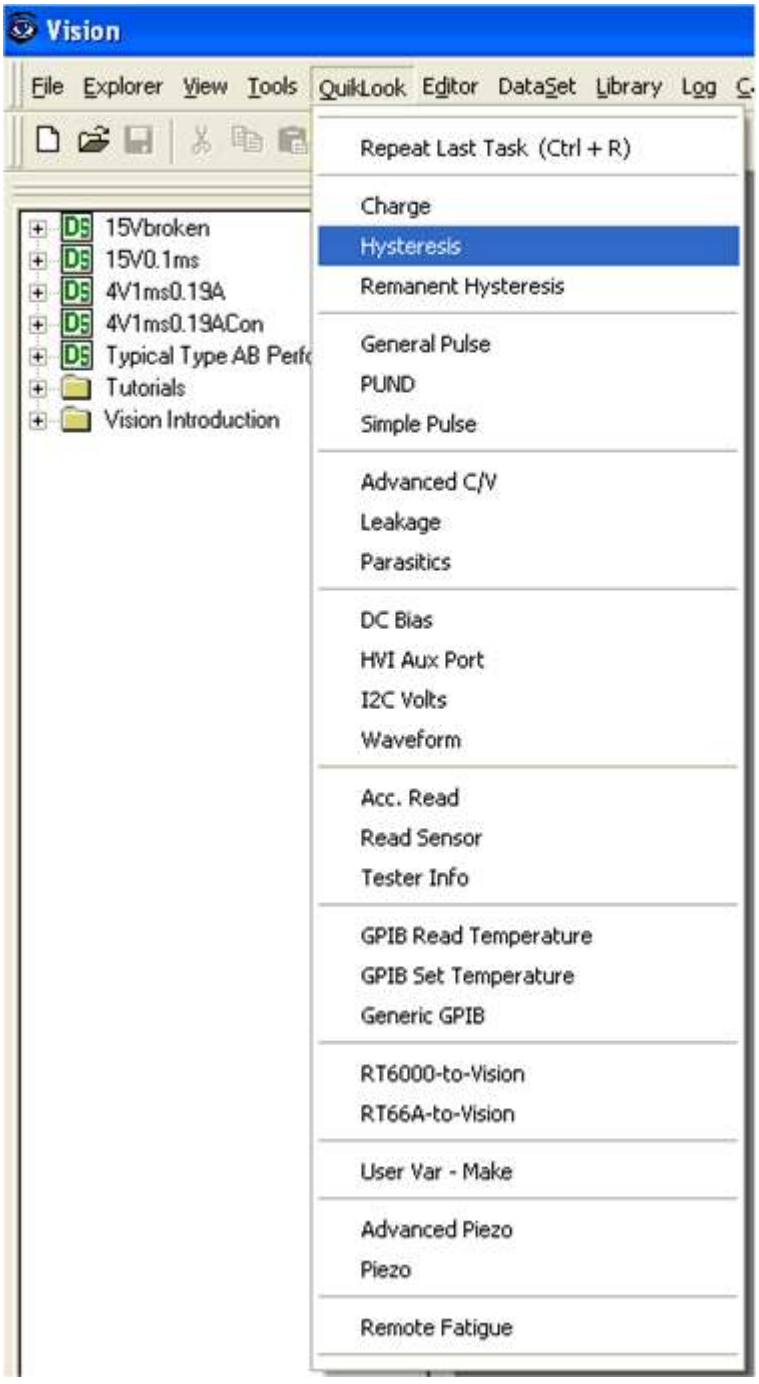

Figure 2 – QuikLook Menu.

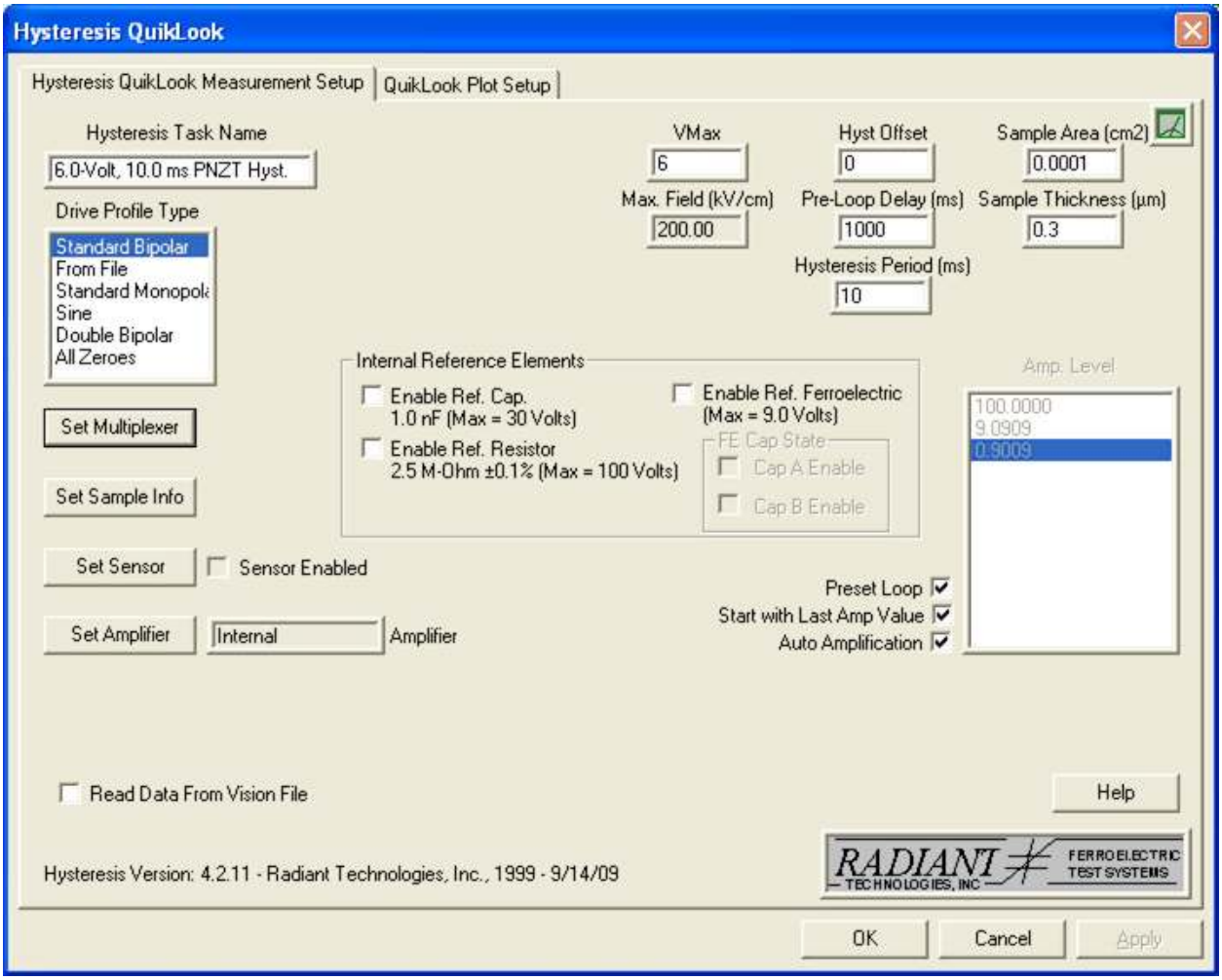

Figure 3a – Main Hysteresis QuikLook Configuration Tab.

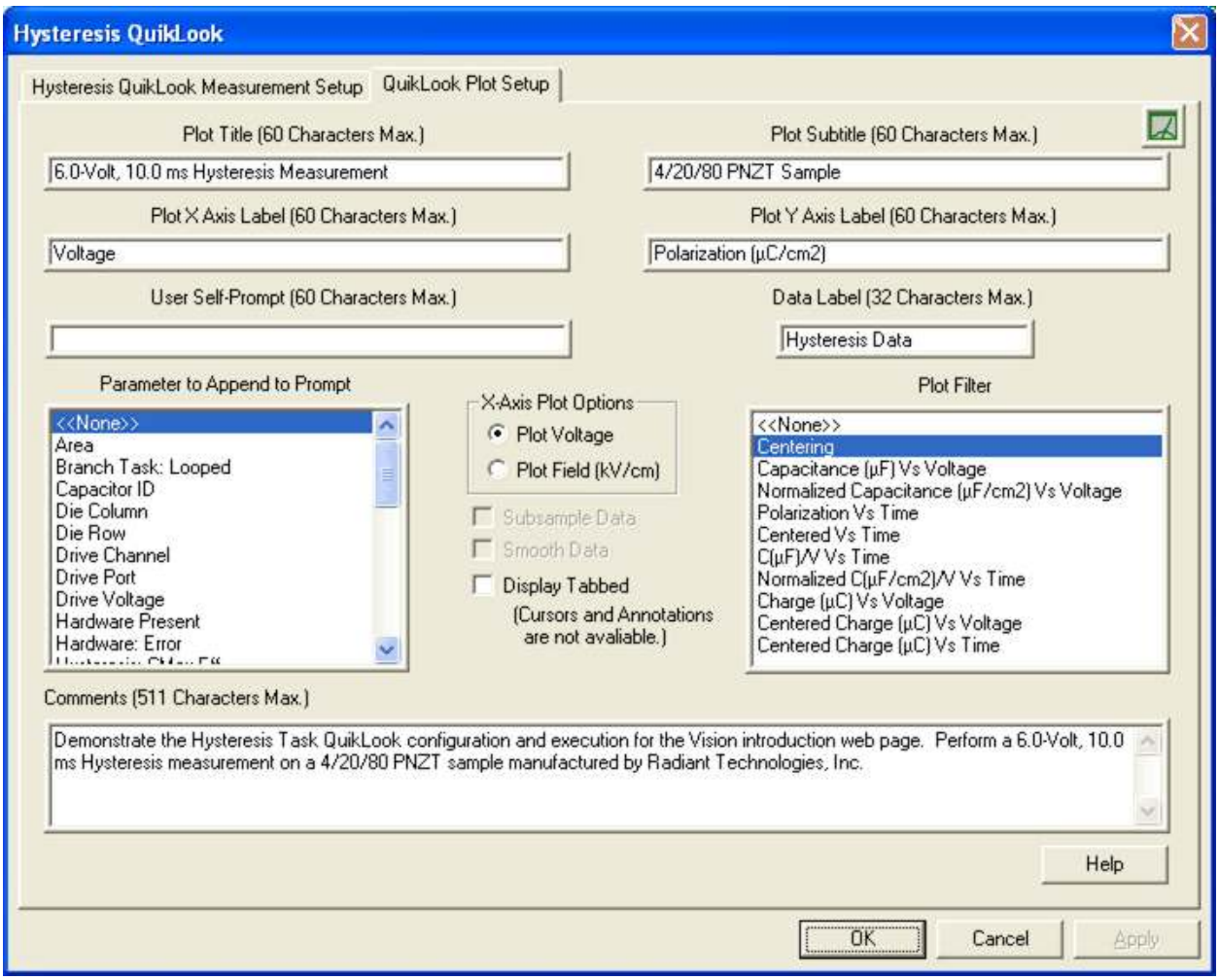

Figure 3b – Hysteresis QuikLook Plot Configuration Tab.

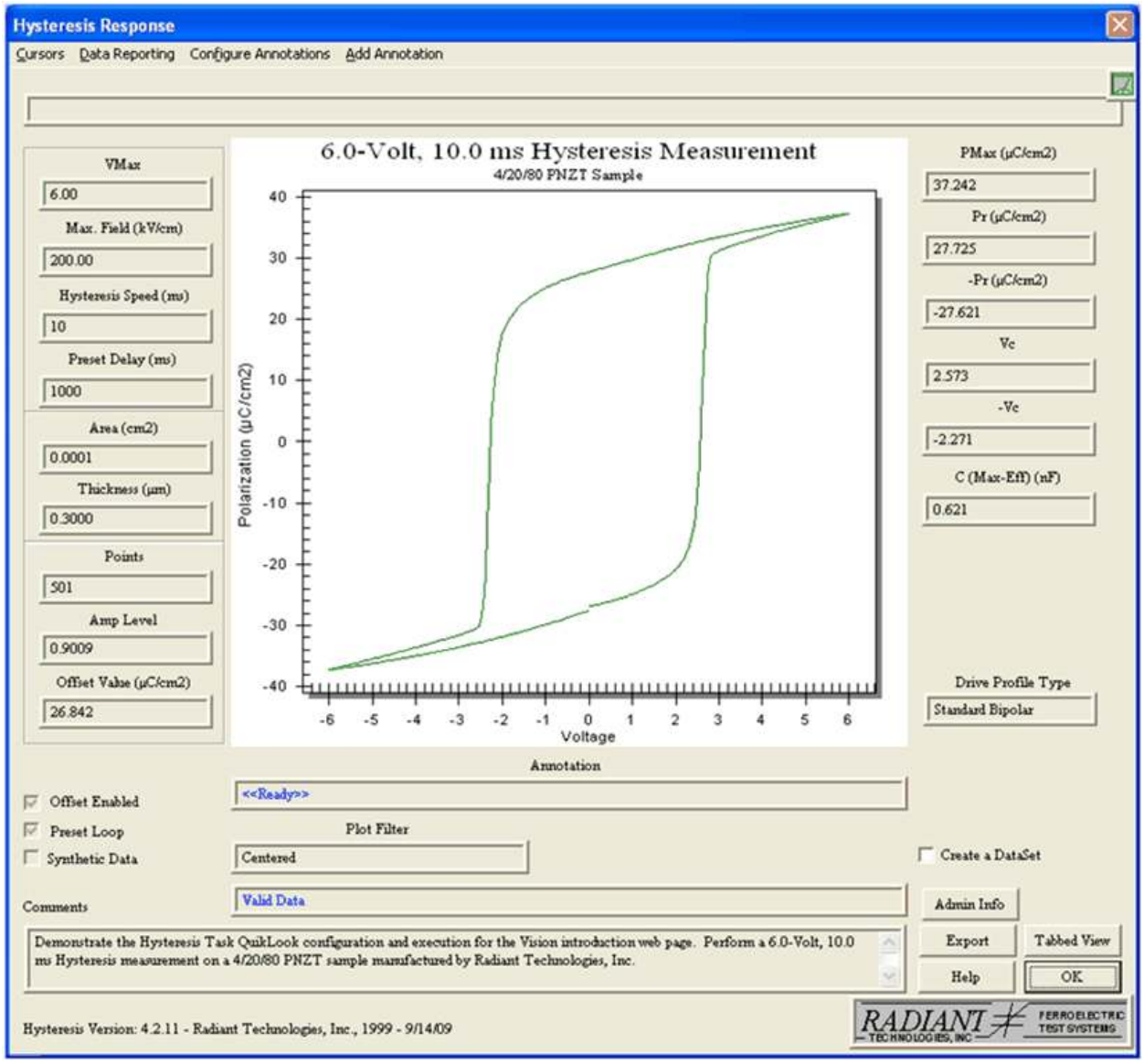

Figure 3c – Hysteresis QuikLook Results.

The Power of Vision - Test Definitions and DataSets

The true power of Vision is in grouping Tasks together in Test Definitions to form custom experiments. This is not done in QuikLook, but is accomplished by moving Tasks from the Library into the Editor window in a linear sequence (Test Definition) in the order which the Tasks are to be executed. The Test Definition may consist of any number of Measurement Tasks. The Measurement Tasks may be associated with Filter Tasks to collect, manipulate, store and plot the Task data. Program control Tasks may be added to document the Test Definition and to provide Test Definition operation tools.

A very powerful Program Control Task is the Branch Task. This Task allows the user to program a logical condition. If the condition is met, the Branch Task returns Test Definition execution to some user-selected previous Task and the Task sequence between that target Task and the Branch Task will reiterate. This forms a Branch Loop. The process will continue until the logic condition is not met.

An important thing to note is that all Tasks include a *Help* button on their configuration (and data presentation) dialogs. Clicking *Help* opens an HTML project that provides a complete and detailed description of the Task. The description will include Task theory, where appropriate, a complete and detailed discussion of every control on the configuration dialog, a detailed discussion of the Task execution and a history of changes to the Task.

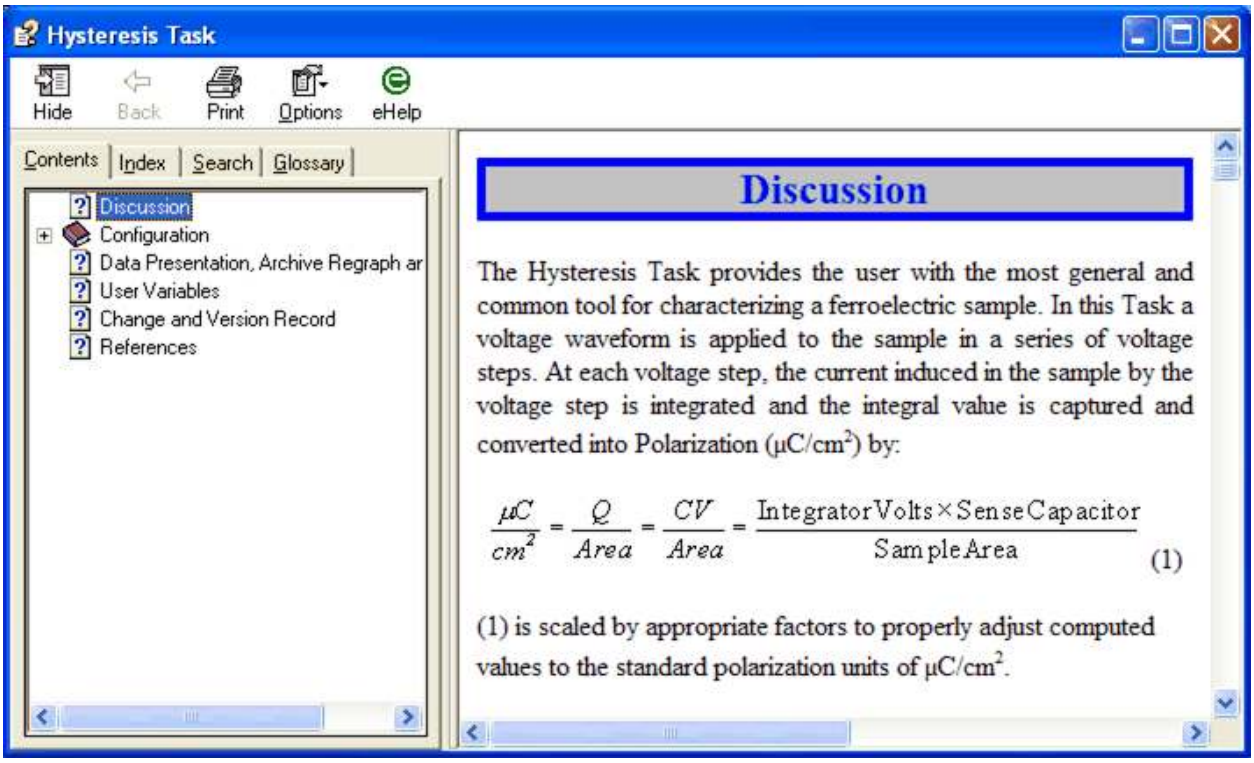

Figure 4 – Hysteresis Task HTML Help Project.

Vision's Vault - DataSets

Test Definitions are executed and archived in a Vision object called a DataSet. A DataSet consists of a single Test Definition that is ready to execute – the Current Test Definition (CTD). It also consists of an archive of all Test Definitions that have been executed within it – the Executed Test Definitions (ETDs). Any Task that has been executed in a Test Definition in the DataSet is stored in its ETD. All Tasks may be recalled from the ETD simply by locating them and double-clicking their icon. The Task will then present its original configuration dialog for

review. For Tasks that collect data (Measurement Tasks and Filters) the configuration dialog is followed by a data display window in which the archived data are plotted. Note that the data of **Figure 7** were taken by a single Hysteresis Task programmed in a Branch Loop and configured to increment the maximum profile voltage by 1.0 Volts at each Branch Loop increment.

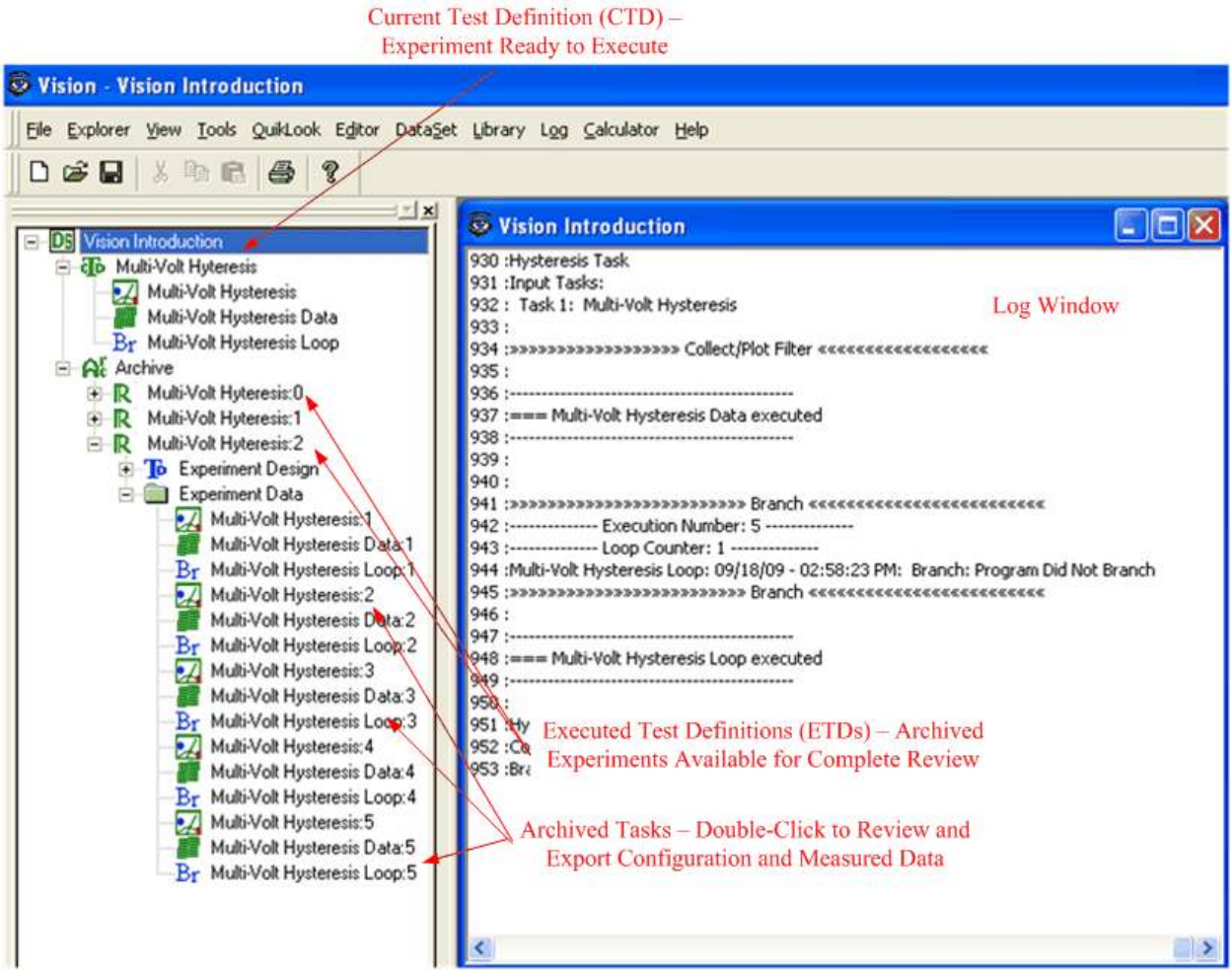

Figure 5 – DataSet Open in DataSet Explorer.

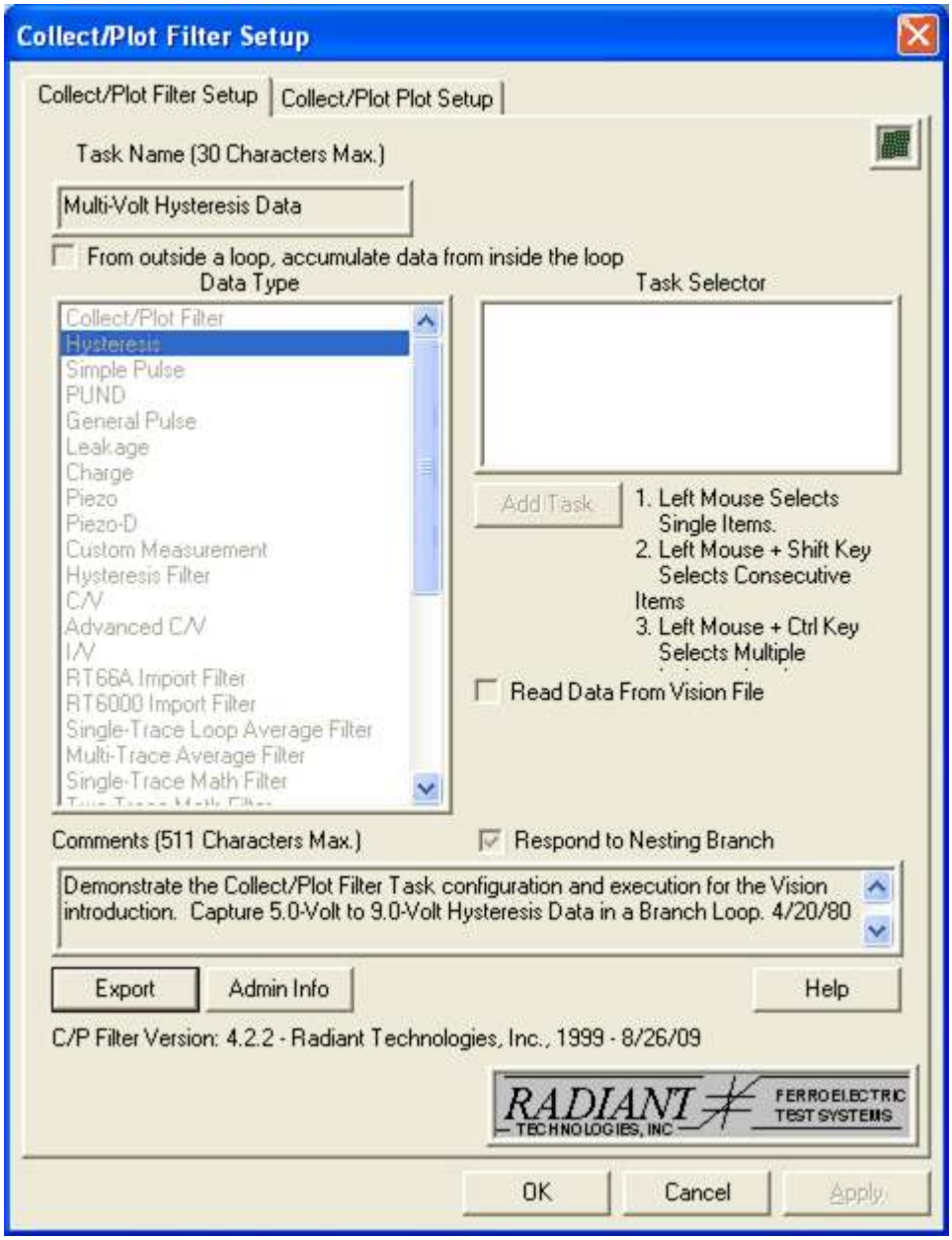

Figure 6 – Collect/Plot Filter Task Configuration Recalled from the DataSet Archive.

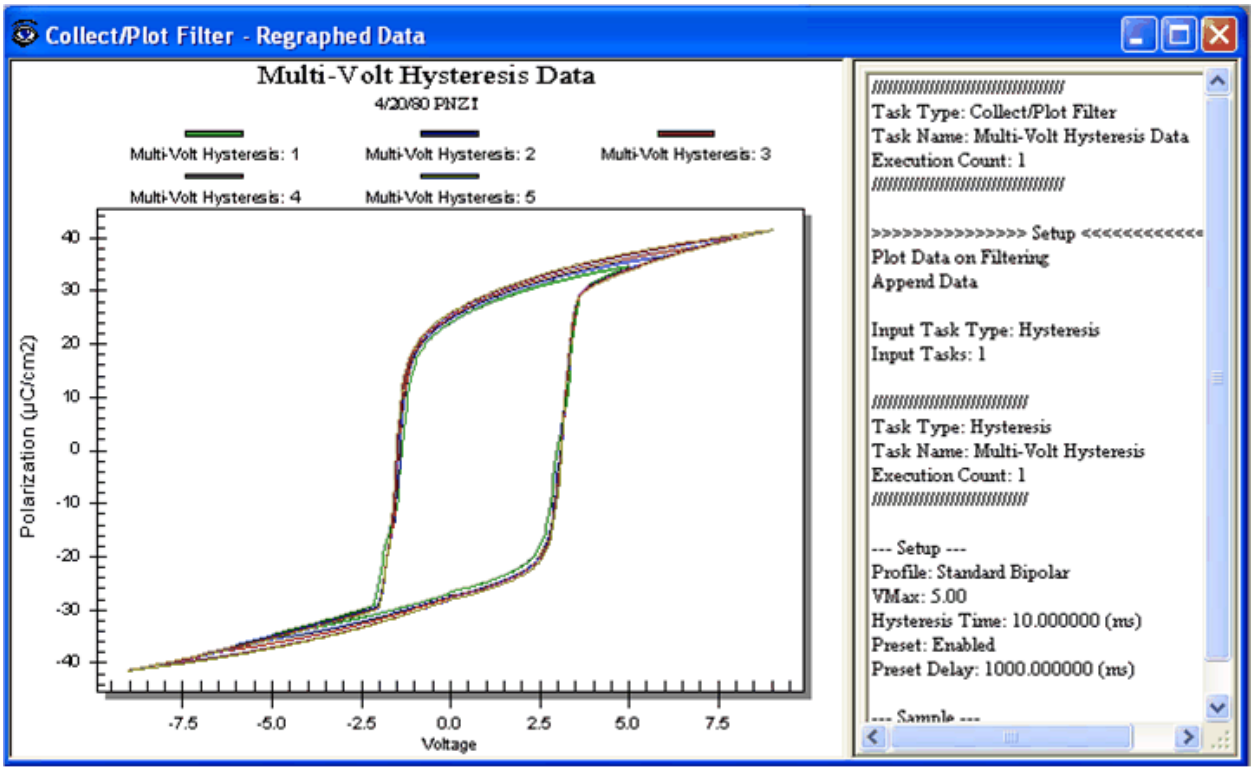

Figure 7 – Collect/Plot Filter Data – Multi-Volt Hysteresis Loops.

All Tasks that are recalled from a DataSet Archive – and all QuikLook measurements – may have their data exported to targets outside of Vision. The targets include a printer, a text file, an Excel window or a Word window. Each export format includes a complete description of the Task configuration and, where appropriate, all measured data.

Try Vision for Yourself

Radiant prides itself in being the innovators of the world's first ferroelectric test systems. The Vision virtual tester is the result of twenty years experience in characterizing nonlinear materials. It provides researchers with extensive and time-saving tools that allow large-scale experiments to be quickly developed and conducted. Radiant Technologies, Inc. invites you to experiment with Vision downloading at http://www.ferrodevices.com/vision4update.html. Please enter "No Tester" in the "Model" field of the form that appears. Vision is freely distributed for unlimited installations for unlimited time. Once you have tried Vision, please share with us comments and question about the experience.

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