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A - About Chamber

The Chamber Task measures the Pulse Polarization response and Small Signal Capacitance of a Pyroelectric material that is being heated and/or cooled within a thermal chamber, on a hot chuck or in a furnace. From these measurements the Spontaneous Polarization $P_r(\theta)$ and the Dielectric Constant $\varepsilon_r(\theta)$ are computed. These are then combined to determine the Electrical Displacement $D(\theta)$ as a function of the temperature θ. This is known as the *Pyroelectric Coefficient* and is given by:

$$D(\theta) = \varepsilon_0 \varepsilon_r(\theta) * \vec{\mathbf{E}} + PR(\theta) \quad \text{(A.1)}$$

Where

- ε_0= Free Space Permittivity = 8.85 x 10^{-12}.
- $\vec{\mathbf{E}}$ = DC Bias Field = Bias Volts/Sample Thickness

The Dielectric Constant, the Spontaneous Polarization, the Displacement, the small signal capacitance and all pulse polarization measurements may be plotted in any combination. These may be plotted as a functions of the temperature θ or the change in temperature from sample point to sample point. The derivatives of $P_r(\theta)$ and $\varepsilon_r(\theta)$ may also be plotted with respect to the change in temperature. All data may be printed or exported to a Text or Excel file.

The Chamber Task can control thermal chambers from the following manufacturers:

Delta Model 9000 Series with 9010 or 9015 Temperature Controller
Signatone Quietemp Hot Chuck
Sigma Systems Corporation, Model 170S
Thermonics Model T-2500 Temperature Forcing System
Nippon Tesco Corp Model NT 1700RSGP
Nippon Tesco Corp Model NT 2000
Sun Systems
MDC Hot Chuck
Linkam TMS 94 Hot Chuck
INSTEC Hot Chuck
Eurotherm 2404 Thermal Controller
Blue-M Furnace
REX Fxxx Thermal Controller

Custom versions can also be produced provided the customer provide a complete manual for the desired thermal chamber. This must include the GPIB command set. The user must also provide the temperature tolerant chuck that will hold the sample under test and cabling between the Precision tester and the chuck. The GPIB cable is provided with the Precision unit.

NOTE - Several late changes have been made to accompany the release of Version 4.0.0 of the Chamber Task. These are not completely documented in these pages although they are summarized here and in the discussions of the appropriate configuration tabs.

- **The Vision Data File selection flag is now passed from the Sample Configuration dialog tab to all other configuration tabs (Temperature, Measurement, GPIB and Plot). If the Task is configured to read information from a Vision Data File, all controls and all labels are disabled in these tabs. This is because the values that are configured in them are to be input from the file. When the Task has executed and is recalled from the DataSet Archive, the labels and text controls will be enabled to show the configuration values read from the file. Text controls will be set to read-only.**
- **The Internal/High-Voltage Amplifier selection is now passed from the Sample Configuration dialog tab to the Measurement configuration tab. The PUND/SSAC selection buttons in the Measurement configuration tab have been replaced by a *Measurement Type* list box control. This control lists "PUND" only in high-voltage mode. In low-voltage mode, the control lists "PUND", "SSAC" or "Both". Both measurements may be made in a single execution of the Task in low-voltage mode. In High-Voltage mode, all SSAC and Sensor configuration controls and labels are disabled.**
- **The selected Measurement Type is passed from the Measurement Configuration dialog to the Plot Configuration dialog. The values listed in the Y Values list box will depend on the measurement type selected. Only PUND values are selectable if the type is "PUND". Only Small Signal values are available if the type is "SSAC". All values are available if the type is "Both".**
- **An error condition exists if the user takes the following steps:**
  - **Select High-Voltage in the Sample Configuration tab.**
  - **Set a PUND voltage of absolute value greater that 100.0 Volts in the Measurement Configuration tab.**
  - **Select Low-Voltage in the Sample Configuration tab.**
- **An internal reference ferroelectric sample has been added to the Precision Premier II tester and is planned in the Precision LC II tester. The ferroelectric test element includes two switchable capacitors in a single package inserted into a user-accessible connector. A variety of capacitors are available from Radiant Technologies, Inc. and this test element may be easily changed to adjust the type or to replace fatigued samples. Just as with the internal reference capacitor and resistor, the ferroelectric test sample may be**

switched into the test signal path in parallel with any externally-connected test sample and/or the internal reference capacitor and/or resistor. More information is available in the Version 4.0.0 What's New document, section E.1.8.

In this case, the high-voltage *PUND (Start Volts)* value will be reset to the default value of 5.0 Volts.

B - Hardware Configuration

The simplest hardware setup for using the Chamber Task is shown in **Figure B.1**. The figure shows the Precision tester, the Thermal Chamber and a Chamber Controller. Although the Chamber Controller is shown separately, normally it is an integral part of the chamber. The controller is used to set and maintain specific temperatures within the chamber. Also shown is an LN_2 tank. Liquid nitrogen is used to provide cooling between a higher set point and a lower point. With the liquid nitrogen, temperatures of –200 °C may be obtained. Without LN_2, the experimental thermal profile must be continually increasing or delays between test points using only ambient cooling will be prohibitive.

The connections shown in **Figure B.1** include the Precision Drive and Return Signals attached to opposite sample electrodes. The sample itself is shown placed in the chamber. These signal cables are connected to the front or rear of the Precision tester using BNC connectors. Attachment to the sample is at the user's discretion. Any high-temperature cabling, sample test chucks, etc. are to be provided by the user. The GPIB cable shown is connected from the rear of the Precision tester to the Chamber Controller. (In the case of the Precision Premier and Workstation testers, the GPIB communication cable connects directly to the tester. For the Precision LC family, the host computer must be equipped with a National Instruments GPIB board for communications with the thermal device to occur.) This connection is used to allow the software to automatically control the temperature of the sample during Task execution. This is an optional connection. Chamber may be run in either Manual or Automatic Mode. In Automatic Mode, the software will control the entire experiment including the sequencing through the Thermal Profile. In Manual Mode, a dialog will appear and the program will pause each time the temperature is to be changed. An operator must first set the temperature manually, then acknowledge the dialog. Clearly the need for human attention makes this a less efficient option.

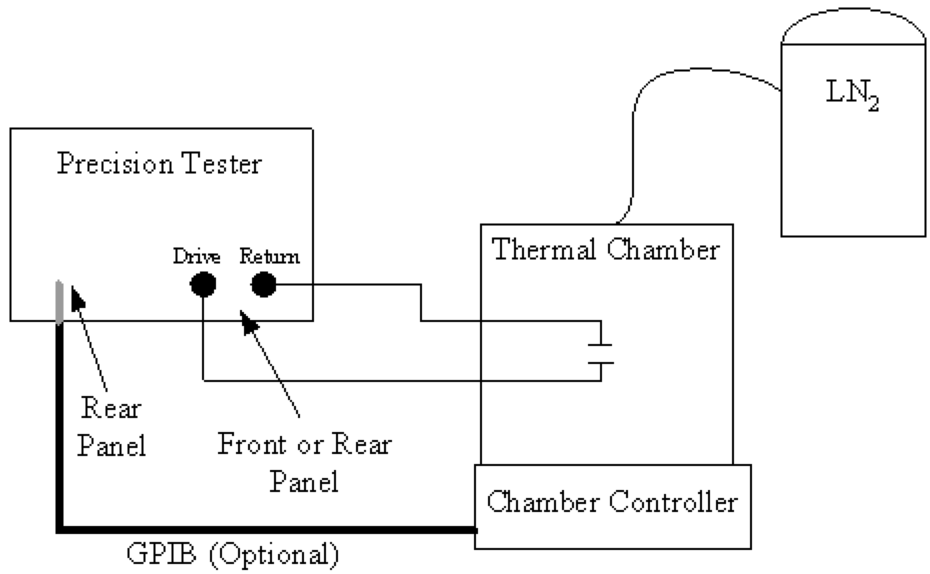


Figure B.1 - Simple Hardware Configuration for the Chamber Task.

A more elaborate hardware configuration includes the connection of an accessory 48-Channel Multiplexer provided by Radiant Technologies, Inc. As shown in **Figure B.2**, this accessory allows the Tester to be connected to multiple samples simultaneously, normally by connecting the Multiplexer to a probe card. The probe card is normally connected to the sample at a probe station. In this case, Chamber would normally use the probe station's hot chuck to control the experimental temperature. During any given execution of the Chamber Task only a single sample can be addressed through the Multiplexer. However, the Chamber Task can be repeatedly executed in a Branch Loop and programmed to automatically sequence through up to fifteen Multiplexer channels, one per Branch Loop iteration.

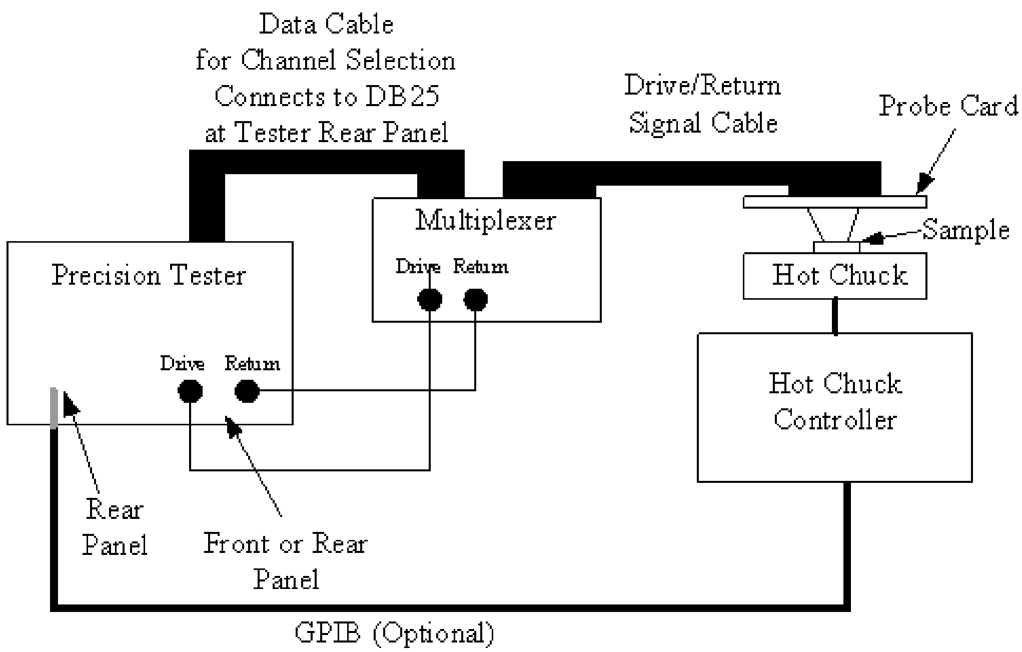


Figure B.2 - Hardware Configuration for the Chamber Task Using the 48-Channel Accessory Multiplexer.

A third configuration is used for bulk samples that require high voltages. Internal voltages of up to ±100 Volts (±10.0 Volts in some models) can be generated by the Precision tester. For higher voltages an external High Voltage Amplifier (HVA) must be connected to the Precision Tester through a High Voltage Interface (HVI). Both the HVI and the HVA are provided as accessories by Radiant Technologies, Inc. Amplifiers are available at up to ±10,000 Volts. With the release of Vision Version 3.1.0 any amplifier may be connected so that the experiment may use an existing amplifier. In this case, Radiant Technologies must be informed of the amplifier specifications so that a logic unit for the amplifier can be provided. A logic unit (ID Module) will allow the HVI to recognize the amplifier. A high-voltage configuration is shown in **Figure B.3**. A five-channel High Voltage Multiplexer is also available that combines the High Voltage feature with the advantages of multi-sample testing.

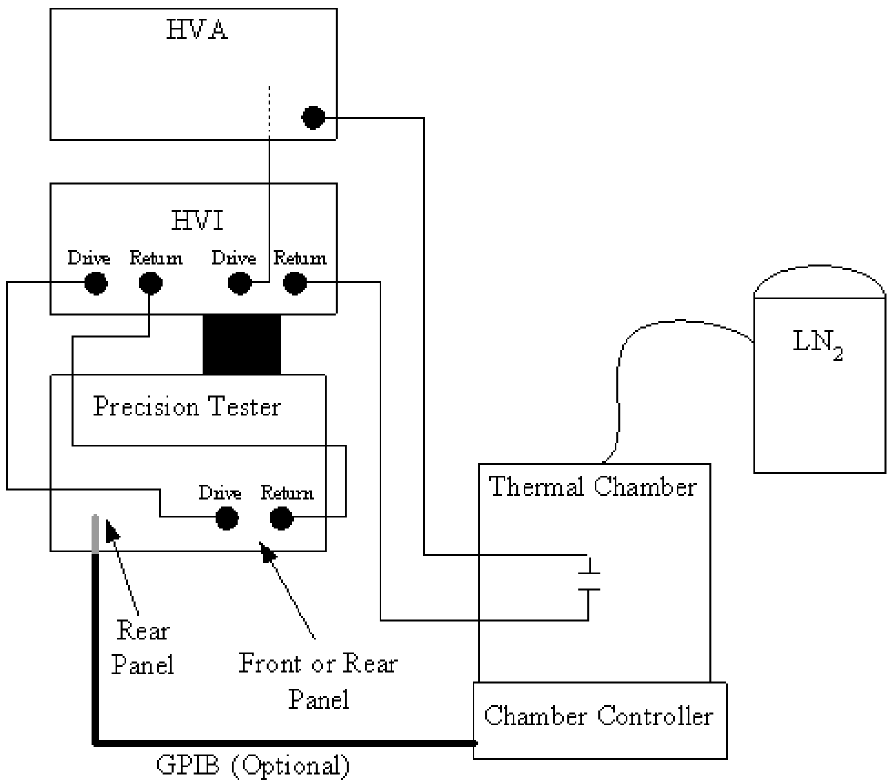


Figure B.3 - High Voltage Hardware Configuration for the Chamber Task.

C - Measurements

The Chamber Task performs one of two basic measurements – the standard PUND Pulse Measurement and the Small Signal Capacitance measurement. Significant measured parameters are further derived using both the values obtained by these measurements and certain key measurement and sample configuration parameters. Both measurements and all measured and computed parameters are presented in detail in this chapter.

Note that the user must choose the measurement to be made. For full characterization, Chamber should be executed twice to allow both measurements to be made and then combined. The reason that the measurements are separated is that the Task is often applied to high-voltage samples. PUND measurements are acceptable at high voltage, but (as described below) the small signal measurement relies on small perturbations. Furthermore, at higher temperatures samples become more conductive. The rapid application of the small signal perturbation at high voltage and high temperature can lead to sample breakdown. To correct for this problem, the measurements are made separately and the Small Signal Capacitance measurement should be made a low voltage.

C.1 PUND Measurement

The PUND (Positive Up Negative Down) measurement is a standard ferroelectric measurement well known to users of the Radiant Technologies, Inc. Charge program. The test consists of five pulses as shown in **Figure C.1.1**. The first pulse presets the sample to a known Polarization state, but makes no measurement. Each of the next four pulses is used to measure two PUND parameters, one at the maximum applied voltage and one at zero volts after the pulse. These pulses alternately switch the sample (P* measurements), then repeat without switching (P^ measurements). The two final pulses are of opposite signs to fully characterize the sample in both polarization states. The profile can be easily constructed out of three configuration parameters…

1. **Test Voltage** - This defines the absolute value of the maximum voltage of each pulse. The non-zero polarization measurement is made at this voltage. The sign of this value determines the polarity of the preset pulse and the pulse sequence. A negative test voltage will invert the profile of **Figure C.1.1**.
2. **Pulse Delay** – This is the delay time between each pulse. In RT6000 and RT66A test systems this time was fixed at 1 second. In Vision it is programmable in milliseconds. The extended time is important to let any Non-Remanent Polarization settle out before beginning the next measurement.
3. **Pulse Width** – The time between the start of the rise of the pulse and the measurement. It is also the time at which the pulse begins to fall back to zero volts. In

RT6000 and RT66A systems this period could be switched from "Fast" to "Standard" to "Slow". In the Precision system this is continuously variable in milliseconds.

Table C.1.1 shows the relationship between the pulse, its voltage and the parameters measured. **Figure C.1.2** shows a detailed close up of the first measurement pulse (test voltage positive).

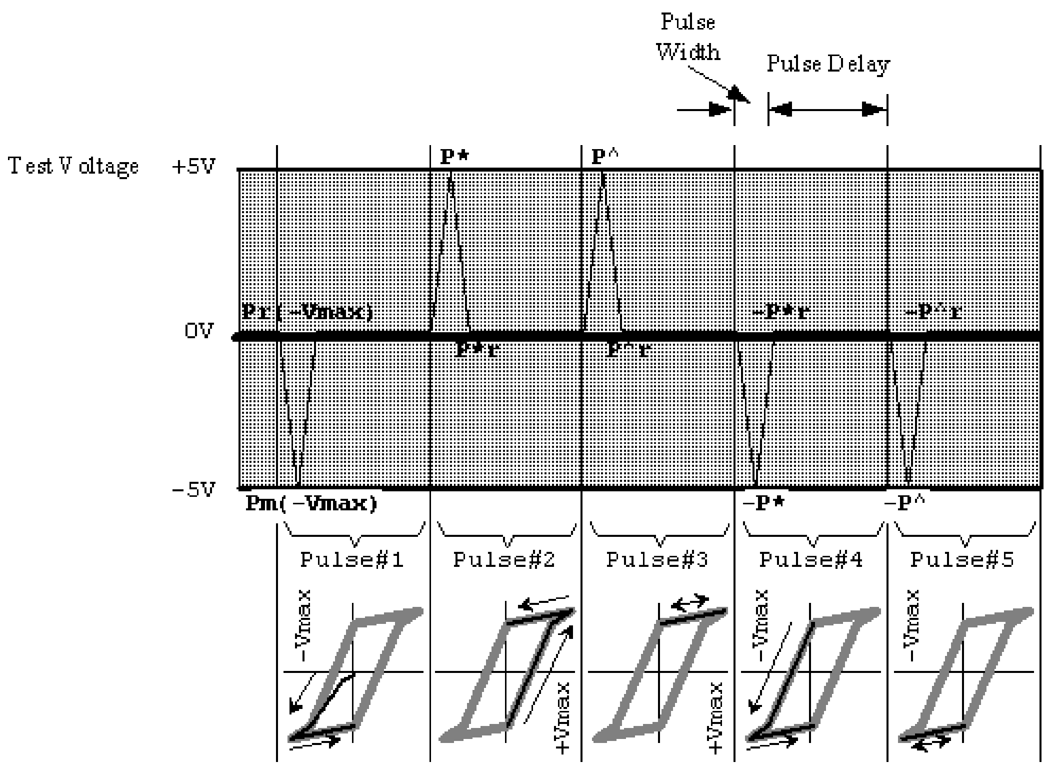


Figure C.1.1 - PUND Pulse Voltage Profile.

Pulse #	Voltage Applied	Parameter Measured
1	-Vmax	-
1	0	-
2	Vmax	P*
2	0	P*r
3	Vmax	P^
3	0	P^r
4	-Vmax	-P*
4	0	-P*r
5	-Vmax	-P^
5	0	-P^r

Table C.1.1 - PUND Pulse Voltages and Parameters.

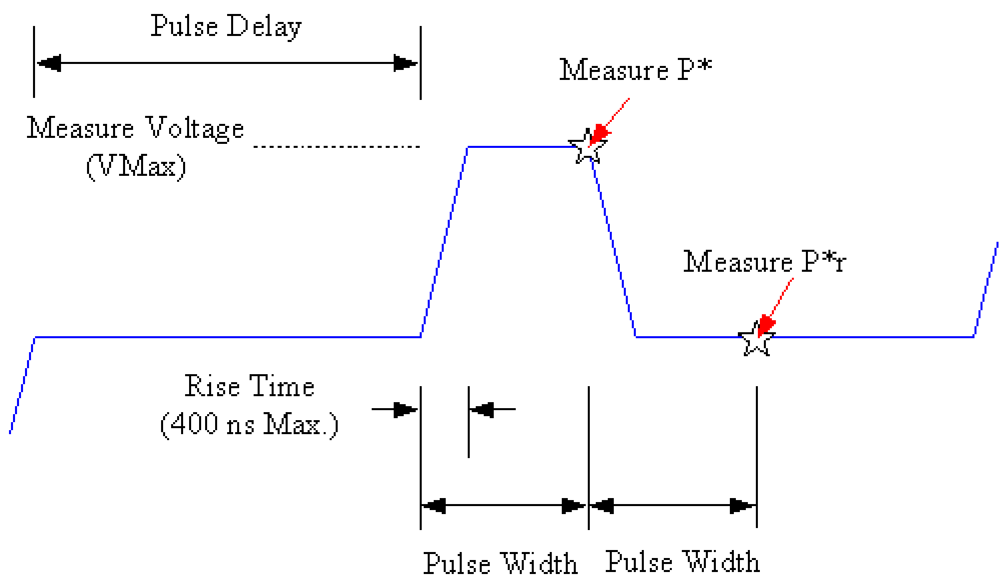


Figure C.1.2 - PUND Single Pulse Detail.

Definitions:

- $P_r(X)$ = Remanent Polarization state at zero volts after the application of X volts.
- $P_m(X)$ = the polarization state at X volts.

In the PUND measurement, the switching (P*) measurements contain both Remanent and Non-Remanent polarization values. The non-switching (P^) measurements contain only Non-Remanent polarization. The desired remanent property can therefore be derived by subtracting the non-switching values from the switching. In an ideal ferroelectric sample, identical non-remanent values should be calculated regardless of the parameters used to derive them, so that:

$$abs(P^* - P^\wedge) = abs(P^*_r - P^\wedge_r) = abs(-P^* - (-P^\wedge)) = abs(-P^* - (-P^\wedge_r)) \quad \text{(C.1.1)}$$

Each of these terms are computed and recorded in Chamber…

$$dP = P^* - P^\wedge$$
$$dP_r = P^*_r - P^\wedge_r$$
$$-dP = -P^* - (-P^\wedge)$$
$$-dP_r = -P^*_r - (-P^\wedge_r) \quad \text{(C.1.2)}$$

Combining these comparisons and scaling by ½ to account for full switching of states from negative to positive, gives the averaged equation:

$$PR(\theta) = \frac{abs(P^* - P^\wedge) + abs(P^*_r - P^\wedge_r) + abs(-P^* - (-P^\wedge)) + abs(-P^*_r - (-P^\wedge_r))}{8}$$
$$= \frac{abs(dP) + abs(dP_r) + abs(-dP) + abs(-dP_r)}{8} \quad \text{(C.1.3)}$$

Table C.1.2 summarizes all PUND measured parameters. All parameters are given in μC/cm^2.

P*	P_m(Vmax) - P_r(-Vmax): The polarization transferred out of the capacitor traversing from zero to Vmax volts when the capacitor starts at P_r(-Vmax).
P*r	P_r(Vmax) - P_r(-Vmax): The polarization remaining out of the sample capacitor after going to zero volts from P*.
P^	P_m(Vmax) - P_r(Vmax): The polarization transferred out of the capacitor traversing from zero to Vmax volts when the capacitor starts at P_r(Vmax).
P^r	P_r(Vmax)-P_r(Vmax): The polarization remaining out of the sample capacitor after going to zero volts from P^.
-P*, -P*r,-P^,-P^r	These are the negative equivalent of the previous four measurements but tested with negative instead of positive pulses, i.e. zero to -Vmax instead of zero to +Vmax.
dP, dPr,-dP,-dPr	Various representations of the derived Remanent Polarization.
PR(θ)	Spontaneous Polarization computed from ±P*, ±P^, ±P*r and ±P^r.

Table C.1.2 - PUND Measured Parameters.

C.2 Small Signal Capacitance Measurement

A small signal capacitance measurement is used to determine the sample capacitance from which the dielectric constant is calculated. The measurement is made by holding the sample at a constant DC voltage. (This voltage is used to calculate the bias field $\vec{\mathbf{E}}$ in the defining equation for $D(\theta)$). The bias voltage is then perturbed by a very small 'tickle' voltage. The resultant current is integrated to give the accumulated charge, $q(\theta)$. The charge can then be divided by the tickle voltage to produce the capacitance through the relationship:

$$C(\theta) = \frac{q(\theta)}{V} \quad \text{(C.2.1)}$$

Since the very small voltages and currents involved in the analysis can result in significant noise measurement, the process is repeated 30 times per measurement, and the noise is averaged out. The result is a measurement of fairly long duration. The capacitance *C(θ)* is then used to compute the dielectric constant *ε(θ)* using the relationship:

$$\epsilon_r(\theta) = \frac{C(\theta) * d}{A * \epsilon_o} \quad \text{(C.2.2)}$$

With *d* being the sample thickness in μm, *A* the area in cm^2 and ε_o the permittivity constant of free space.

PR(θ) (C.1..3) can then be combined with $\varepsilon_r(\theta)$ to produce the overall Pyroelectric effect, displacement, given as *D(θ)* through the relationship (repeated here):

$$D(\theta) = \varepsilon_0 \varepsilon_r(\theta) * \vec{\mathbf{E}} + PR(\theta) \quad \text{(C.2.3)}$$

Figure C.2.1 shows a single instance of the small signal capacitance measurement, including all configuration parameters. The bias voltage applied during the measurement is $\vec{\mathbf{E}}$ in (1.1). Clearly, if this value is held at 0.0 Volts, the dielectric constant term falls out of (1.1) and…

$$D(\theta) = PR(\theta), \vec{\mathbf{E}} = 0.0 \quad \text{(C.2.4)}$$

The Pre-Measure Bias Soak parameter is a delay period, for each iteration of the Small Signal Capacitance measurement, during which the sample is simply held at the bias voltage before the tickle voltage is applied and the capacitance is read. The main purpose of this delay is to allow any current that results from switching the sample from zero to $\vec{\mathbf{E}}$ volts to settle so that only current induced by the application of the Tickle Voltage will be integrated into the measurement. It is important that this delay be large enough to account for the fact that the voltage switches from zero to the bias value each iteration of the measurement. The Tickle Delay is the duration, in milliseconds of the application of the Tickle voltage at each iteration.

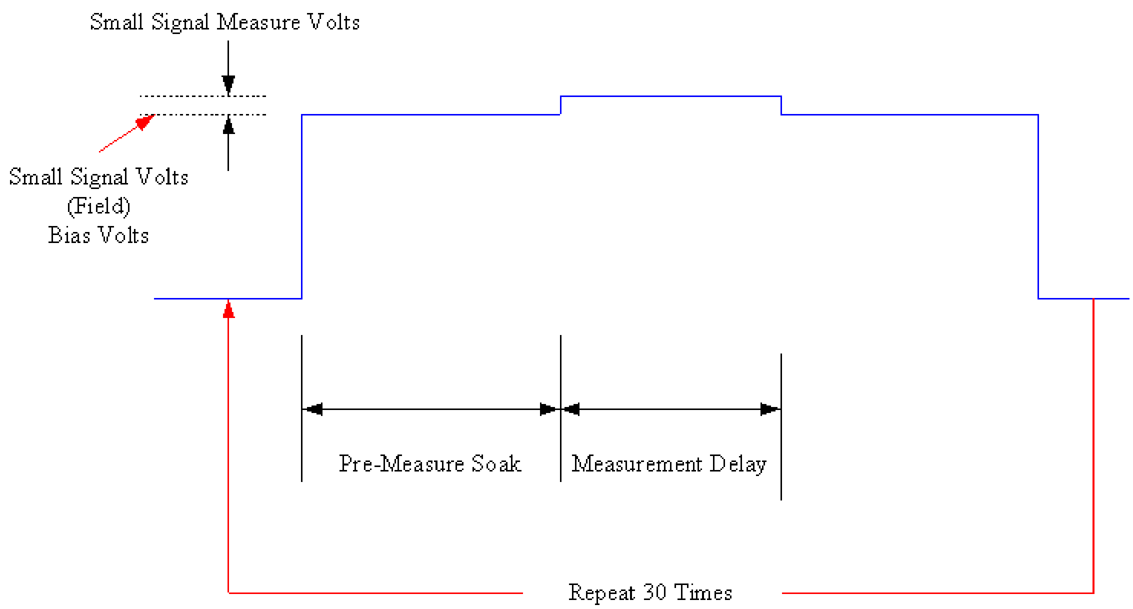


Figure C.2.1 - Small Signal Capacitance Measurement Detail.

D - Execution Sequence

Chamber Task execution proceeds as shown in **Figure D.1**. Elements of the sequence are discussed in detail below the Figure.

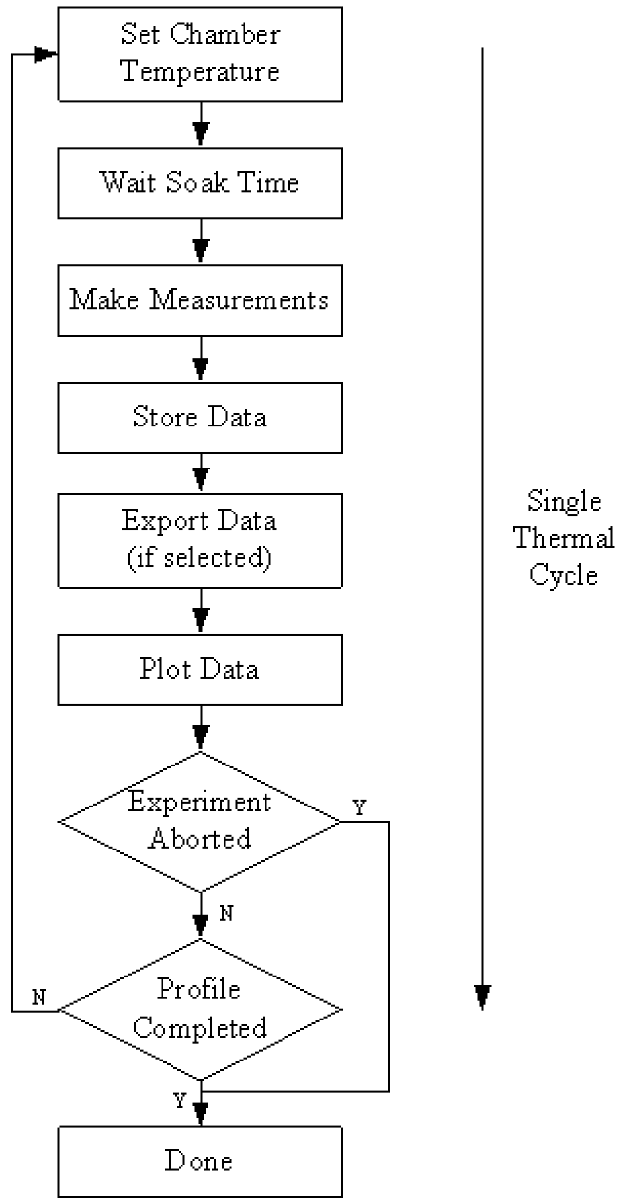


Figure D.1 - Chamber Task Execution Sequence.

D.1. Set Chamber Temperature

In this step the next temperature in the Thermal Profile is set. The temperature may be set either manually or automatically. Automatic temperature profiling is preferable because it allows the program to run completely automatically without human interaction once the experiment is started. This mode requires the Precision Tester to be connected to one of the thermal control devices listed in About Chamber, using the GPIB IEEE-488 cable provided with the tester or purchased for use with the LC host computer. (Many hot chucks have only RS-232 serial communications. In this case the GPIB signals are routed to the hot chuck through and RS-232-GPIB converter. The converter may be purchased through Radiant Technologies or may be obtained independently.) In automatic mode all temperatures are specified in °C. Temperatures are specified with an accuracy of 0.1 °C. Higher precision temperatures are truncated to the 1/10 degree. The chamber is first assigned a set point of the desired temperature. Then, as the temperature is adjusted, the current temperature is continuously read and compared to the set temperature. When the current temperature is within ±tolerance °C (programmed by the user) of the set temperature, the program proceeds. No attempt is made by the Chamber Task to achieve stability at the set temperature. (See Section D.2.)

In manual mode, the user will be prompted by a dialog (**Figure D.1.1**) to set the temperature manually at the appropriate time. The temperature must be set before the dialog is responded to, since program sequencing will continue immediately when the dialog is acknowledged.

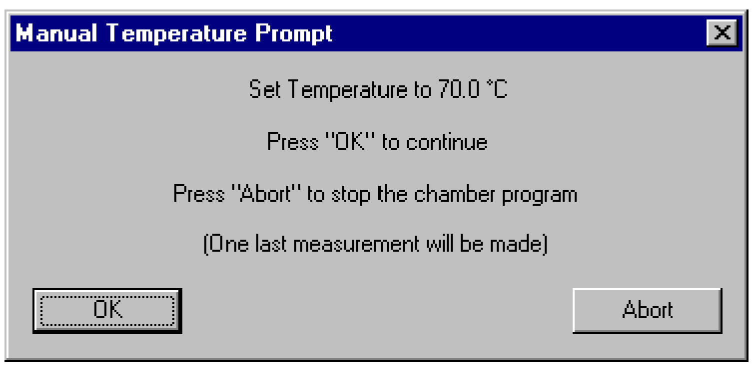


Figure D.1.1 - Manual Mode Temperature Setting Dialog.

The Thermal Profile may be established in one of three ways…

1. **Auto Increment –** In this method, the Thermal Profile is set by establishing two temperature parameters: the initial temperature and a temperature increment. Both are given in °C with a 0.1 °C precision. The number of Thermal Cycles is also set

by the user. The first program cycle will set the temperature to the initial value and test. Subsequent cycles will adjust the temperature by adding the thermal increment to the previous temperature. The result is a linear, evenly-stepped Thermal Profile. The temperature increment may be set negative so that the experiment progresses over a continuously decreasing temperature profile. No programmatic limits exist to number of Thermal Cycles. However, care must be taken that the combination of initial temperature, temperature increment and Thermal Cycles does not result in a temperature that eventually exceeds the upper or lower limit of the thermal chamber.

2. **Custom Profile –** This method allows the user to randomly specify each of the temperatures to be set at each Thermal Cycle. Each temperature is completely independent of all other temperatures. Temperatures are given in °C with a 0.1 °C precision. No programmatic limit to the value of a temperature is given, but no temperature should exceed the capability of the thermal chamber. A limit of 36 Thermal Cycles is programmed for this method. The custom profile set in this method may be saved to file for reuse without reprogramming.
3. **Custom File –** This method is identical to the **Custom Profile** method except that the profile is read from a file that was earlier created in the Custom Profile method. This obviates the need for recreating identical experiments. Small changes to such standard file profiles can be made by first reading the file, then switching to Custom Profile mode and making the changes.

A Temperature Progress dialog has been added as of Version 3.1.0. This dialog is displayed during temperature adjustment and shows target temperature, current temperature and elapsed time. *Help* is available from the dialog. A *Cancel* button will immediately abort the temperature sampling by the Task and cause the Chamber Task to make a final measurement and terminate. The chamber will continue to adjust to the target temperature for that iteration.

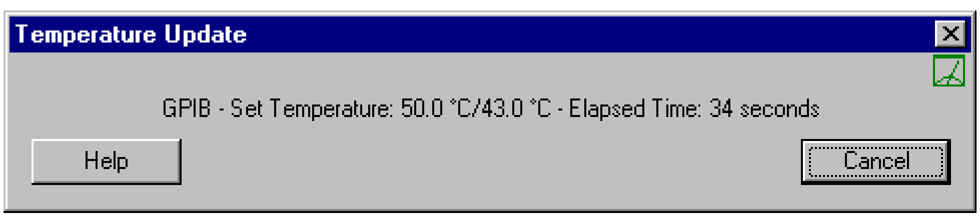


Figure D.1.2 - Sample Temperature Progress Dialog.

D.2. Wait Soak Time

Once the set temperature is reached, either manually or automatically, the program first delays a user-specified period of time. During this period a progress dialog is shown as in

Figure D.2.1. The purpose of this delay is two-fold…

1. Allow the sample to stabilize at the set temperature. The delay allows the sample to "soak" at the established temperature until it reaches steady state. This is particularly important for bulk samples.
2. Allow the chamber to stabilize at the set temperature. No attempt is made by the Chamber Task to stabilize the actual chamber temperature. Once the actual temperature is within 0.3 °C of the set temperature, the software will assume the temperature is set and will move into the Soak Time delay. Normally the temperature will fluctuate dramatically when it initially reaches the set point, with the fluctuation damping over time. A lengthy Soak Time will allow the chamber to naturally stabilize for a more accurate measurement.

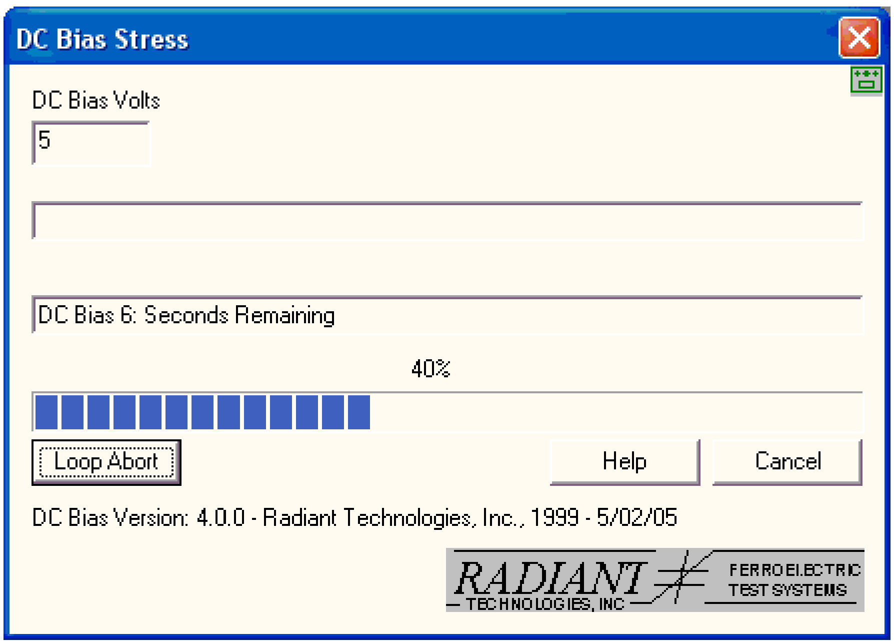


Figure D.2.1 - "Soak Time" Delay Progress Dialog.

D.3. Make Measurements

Two measurements are made at the set temperature after the Soak Time has elapsed. The ferroelectric measurements are discussed in detail in Chapter 4. The two measurements are…

1. **Actual Temperature –** The current chamber temperature is read as the measurements are being made, if automatic (GPIB) temperature mode is programmed.

With a long Soak Time, this value should be close to the desired set temperature. The temperature is recorded in place of the set temperature for data analysis and presentation. The value is specified in °C, with a precision of 0.1 °C.

2. **PUND Pulse Measurement** (Go To Description) OR **Small Signal Capacitance** (Go To Description)

D.4. Store Data

Once acquired, data are stored as usual within the DataSet, with the Task being stored as an icon in the Executed Test Definition (ETD). Data are stored repeatedly, with the database being updated each time data are acquired. Data are also terminated in such a way that an "incomplete" set of data, resulting from an early experiment abort (see Section D.7) or catastrophic failure, can still be recalled from the DataSet for review, regraphing and analysis.

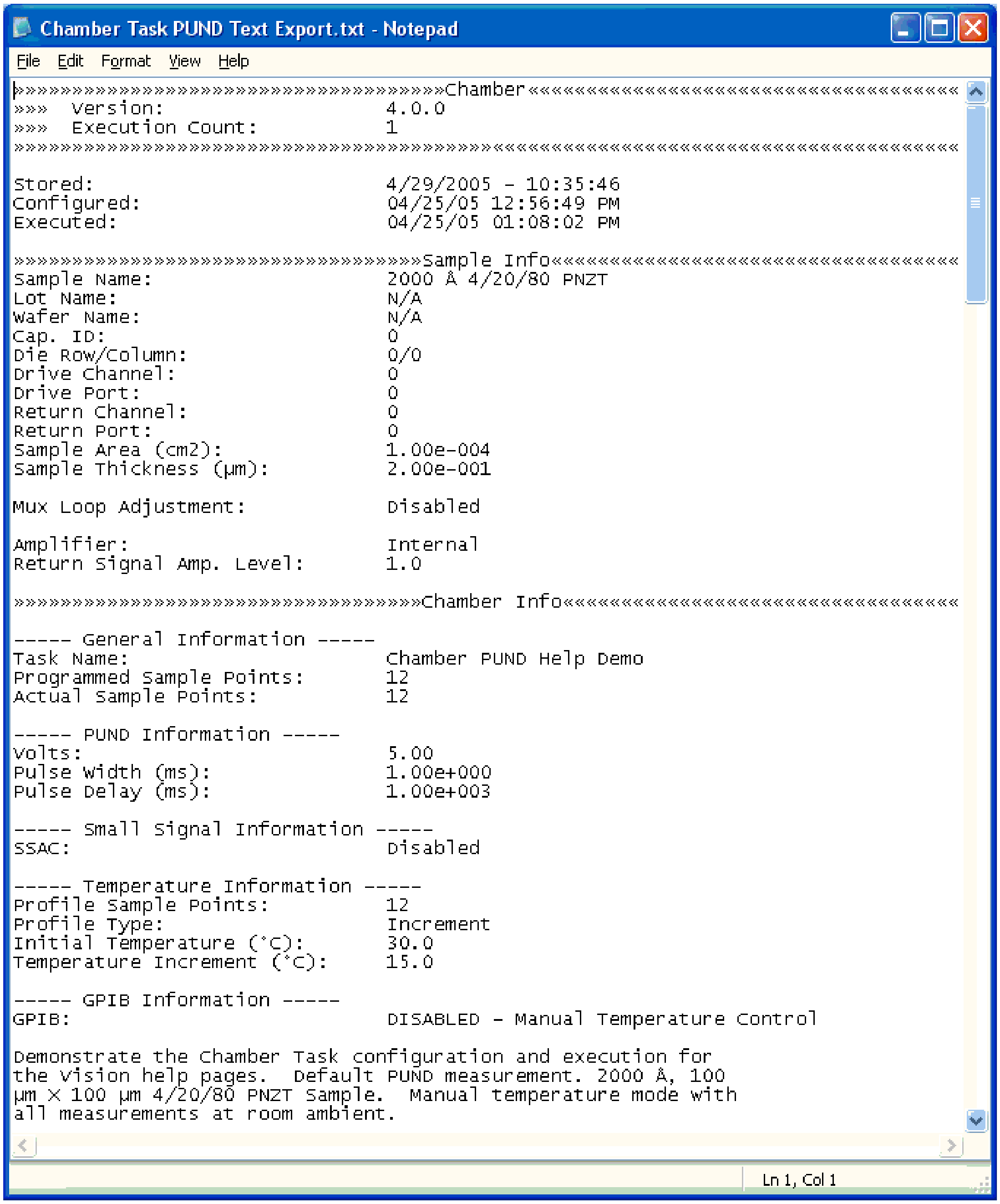
D.5. Export Data (if selected)

Because the Chamber Task is a long-duration experiment in which execution of the Current Test Definition (CTD) remains fixed within the single Task for an extended period, data may be exported by the Task during execution without the need for appending a Print/Export Filter in the Test Definition. As with all Tasks, data may also be exported as they are recovered from the DataSet Archive. A detailed description of export configuration is given in the Sample Dialog description.

Data may be exported to one of four targets during execution. These are…

1. **Printer –** A formatted output of the Chamber Task data is sent to the printer. If the Thermal Cycle is in its first iteration, a header page will be printed that shows all configuration parameters. Each thermal cycle prints a new data page that shows the current measurement appended to all previous measurements from earlier Thermal Cycles. The printout will be sent to the default printer using the default configuration. The printer and configuration can be selected/altered before Task execution from within Vision by selecting "File>Print Setup…" or from Windows NT 4.0 by choosing "Start>Printers", then selecting the desired printer and "File>Properties".
2. **Text File –** A formatted output is written to a file whose name and path are specified by the user during Task configuration (see **Section 5.1**). All Thermal Cycles and all subsequent executions of the Chamber Task will write to the same specified file. The file may exist when it is selected during configuration. On execution, if the file does not exist it is created. If it does exist, it is opened and new text is appended to the existing older text. No previously written data are lost. **Figures**

D.5.1 and **D.5.2** show a typical output. Note that data represented in this document are purely synthetic and do not represent valid measured values.



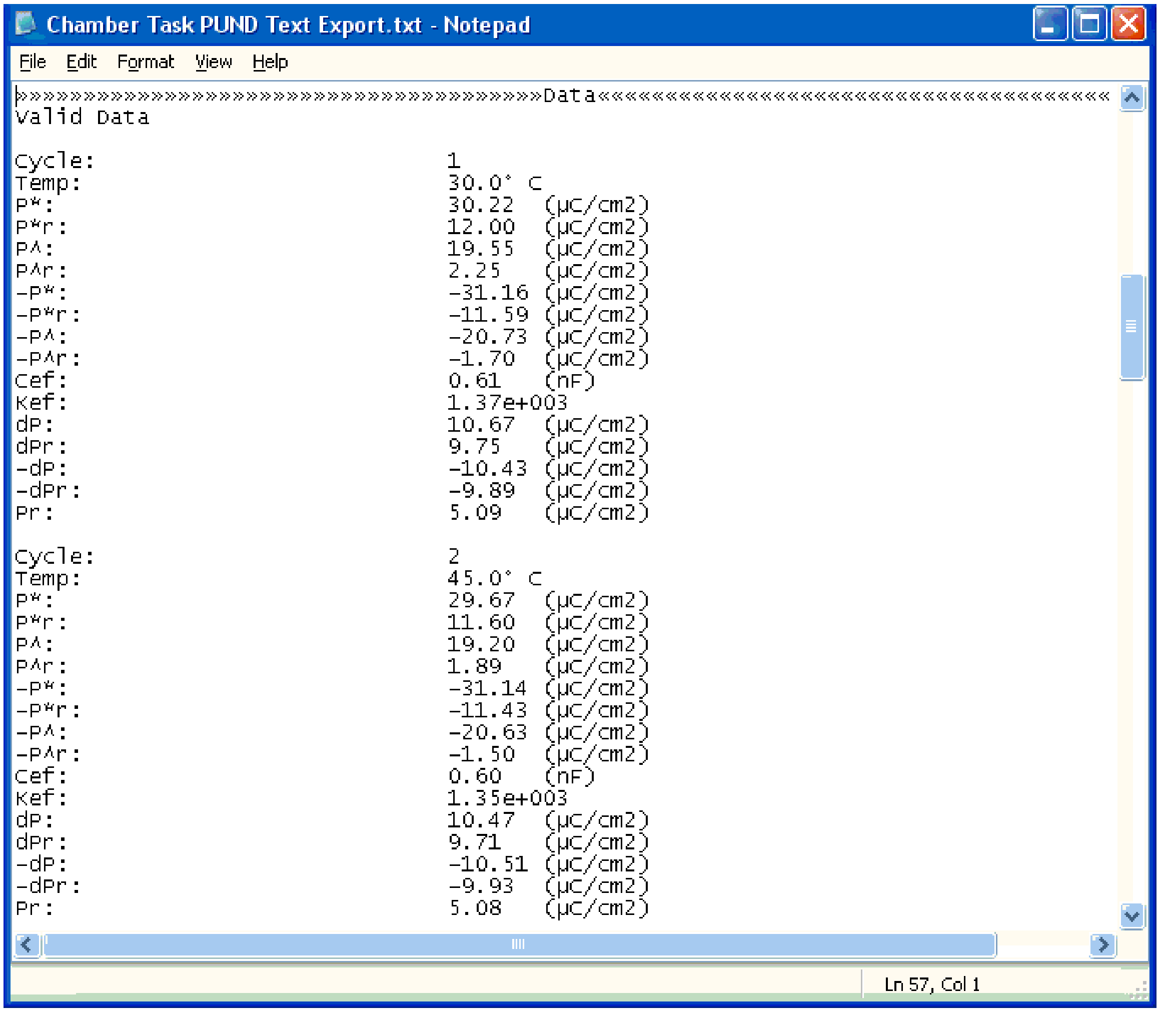
Chamber Task PUND Text Export.txt - Notepad

File Edit Format View Help

```
»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»Chamber«««««««««««««««««««««««««««««««««««««
»»»   Version:                      4.0.0
»»»   Execution Count:              1
»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»««««««««««««««««««««««««««««««««««««««««

Stored:                             4/29/2005 - 10:35:46
Configured:                         04/25/05 12:56:49 PM
Executed:                           04/25/05 01:08:02 PM

»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»Sample Info««««««««««««««««««««««««««««««««««««
Sample Name:                        2000 Å 4/20/80 PNZT
Lot Name:                           N/A
Wafer Name:                         N/A
Cap. ID:                            0
Die Row/Column:                     0/0
Drive Channel:                      0
Drive Port:                         0
Return Channel:                     0
Return Port:                        0
Sample Area (cm2):                  1.00e-004
Sample Thickness (µm):              2.00e-001

Mux Loop Adjustment:                Disabled

Amplifier:                          Internal
Return Signal Amp. Level:           1.0

»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»Chamber Info«««««««««««««««««««««««««««««««««««

----- General Information -----
Task Name:                          Chamber PUND Help Demo
Programmed Sample Points:           12
Actual Sample Points:               12

----- PUND Information -----
Volts:                              5.00
Pulse Width (ms):                   1.00e+000
Pulse Delay (ms):                   1.00e+003

----- Small Signal Information -----
SSAC:                               Disabled

----- Temperature Information -----
Profile Sample Points:              12
Profile Type:                       Increment
Initial Temperature (°C):           30.0
Temperature Increment (°C):         15.0

----- GPIB Information -----
GPIB:                               DISABLED - Manual Temperature Control

Demonstrate the Chamber Task configuration and execution for
the Vision help pages.  Default PUND measurement. 2000 Å, 100
µm × 100 µm 4/20/80 PNZT Sample.  Manual temperature mode with
all measurements at room ambient.
```

Ln 1, Col 1

Figure D.5.1 - Chamber Task Sample Text Export File. Upper Portion.


Chamber Task PUND Text Export.txt - Notepad

File Edit Format View Help

```
>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>>Data<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<<
Valid Data

Cycle:                          1
Temp:                           30.0° C
P*:                             30.22  (µC/cm2)
P*r:                            12.00  (µC/cm2)
P^:                             19.55  (µC/cm2)
P^r:                            2.25   (µC/cm2)
-P*:                            -31.16 (µC/cm2)
-P*r:                           -11.59 (µC/cm2)
-P^:                            -20.73 (µC/cm2)
-P^r:                           -1.70  (µC/cm2)
Cef:                            0.61   (nF)
Kef:                            1.37e+003
dP:                             10.67  (µC/cm2)
dPr:                            9.75   (µC/cm2)
-dP:                            -10.43 (µC/cm2)
-dPr:                           -9.89  (µC/cm2)
Pr:                             5.09   (µC/cm2)

Cycle:                          2
Temp:                           45.0° C
P*:                             29.67  (µC/cm2)
P*r:                            11.60  (µC/cm2)
P^:                             19.20  (µC/cm2)
P^r:                            1.89   (µC/cm2)
-P*:                            -31.14 (µC/cm2)
-P*r:                           -11.43 (µC/cm2)
-P^:                            -20.63 (µC/cm2)
-P^r:                           -1.50  (µC/cm2)
Cef:                            0.60   (nF)
Kef:                            1.35e+003
dP:                             10.47  (µC/cm2)
dPr:                            9.71   (µC/cm2)
-dP:                            -10.51 (µC/cm2)
-dPr:                           -9.93  (µC/cm2)
Pr:                             5.08   (µC/cm2)
```

Ln 57, Col 1

Figure D.5.2 - Chamber Task Sample Text Export File. Lower Portion.

3. **Excel File –** This option sends Chamber data directly into an Excel file where it can be manipulated, plotted, analyzed and reviewed using all of the tools provided by Excel. This is likely the most useful of the exporting options. A path and base file name are provided by the user. Each new Thermal Cycle produces a new Excel file containing configuration parameters and a history of all measured data from the initial Thermal Cycle through the current measurement. Since multiple files are produced, the files are rendered unique by appending an index for the execution count of the Task (if it is located within a Branch Loop) and a second index for the current Thermal Cycle. Reexecutions of the same CTD will produce identical file names resulting in the continual display of overwrite dialogs. To

avoid this, before reexecution, either a) rename all *.xls files, b) remove all *.xls files to a separate directory or c) reconfigure the Task and specify a new file name/path. A typical output sample is shown in **Figures 6** and **7**. Note that **Figure 7** does not extend far enough to the right to show all data. **Note that Office '97 or later must be installed on the Precision Tester for the Excel export to work. Office is not provided as a standard installation by Radiant Technologies, Inc, though it is quoted as an option. Output to an Office 2000 format is not yet supported.**

Microsoft Excel - Chamber Help Excel Export Example.xls

	A	B
1	**Chamber**	
2	Version	4.0.0
3		
4	Execution Count	1
5	Excel Date	6/20/2005 - 10:17:14
6	Configuration Date	4/25/2005 12:56
7	Execution Date	4/25/2005 13:08
8		
9	**Sample Information**	
10	Sample Name	2000 Å 4/20/80 PNZT
11	Lot Name	N/A
12	Wafer Name	N/A
13	Die Row/Column	0/0
14	Capacitor ID	0
15	Area (cm^2)	0.0001
16	Thickness (µm)	0.2
17		
18	Mux Adjust	Disabled
19		
20	Amplifier	Internal
21	Return Signal Amp. Level	1
22		
23	**Chamber Information**	
24	*General Information*	
25	Task Name	Chamber PUND Help Demo
26	Programmed Sample Points	12
27	Actual Sample Points	12
28		
29	*PUND Information*	
30	Volts	5
31	Pulse Width (ms)	1
32	Pulse Delay (ms)	1000
33		
34	*Small Signal Information*	
35	Small Signal	Disabled
36		
37	*Temperature Information*	
38	Profile Type	Increment
39	Initial Temperature (°C)	30
40	Temperature Increment (°C)	15
41		
42	*GPIB Information*	
43	GPIB DISABLED	Manual Temperature Control

Figure D.5.3 - Chamber Task Sample Excel Export Output. Upper Portion.

45	**Data**										
46	Sample	Temperature (°C)	P* (μC/cm^2)	P*r (μC/cm^2)	P^ (μC/cm^2)	P^r (μC/cm^2)	-P* (μC/cm^2)	-P*r (μC/cm^2)	-P^ (μC/cm^2)	-P^r (μC/cm^2)	Cef
47	1	30	30.22338867	12.00140381	19.54925537	2.254760742	-31.15887451	-11.58563232	-20.73260498	-1.695068359	0.607284768
48	2	45	29.67169189	11.60162354	19.19744873	1.886962891	-31.1428833	-11.43371582	-20.62866211	-1.503173828	0.59818014
49	3	60	29.63970947	11.62561035	19.11749268	1.934936523	-31.48669434	-11.66558838	-20.9085083	-1.679077148	0.596214856
50	4	75	29.57574463	11.57763672	19.22143555	1.822998047	-31.41473389	-11.6975708	-20.79656982	-1.471191406	0.595147384
51	5	90	29.51177979	11.59362793	19.19744873	1.751037598	-31.24682617	-11.76153564	-20.83654785	-1.631103516	0.595176022
52	6	105	29.43182373	11.5536499	19.12548828	1.79901123	-31.23083496	-11.5536499	-20.98046875	-1.639099121	0.591162192
53	7	120	29.35186768	11.6975708	19.03753662	1.767028809	-31.33477783	-11.51367188	-20.95648193	-1.551147461	0.591514145
54	8	135	29.37585449	11.52166748	18.98956299	1.87097168	-31.32678223	-11.64160156	-20.9085083	-1.551147461	0.591125031
55	9	150	29.33587646	11.53765869	18.99755859	2.046875	-31.32678223	-11.62561035	-20.87652588	-1.647094727	0.590103131
56	10	165	29.41583252	11.59362793	19.11749268	1.894958496	-31.35076904	-11.67358398	-20.87652588	-1.687072754	0.592147684
57	11	180	29.27990723	11.56964111	19.07751465	1.663085938	-31.25482178	-11.58563232	-20.88452148	-1.511169434	0.589846305
58	12	195	29.30389404	11.32977295	19.03753662	1.990905762	-31.39074707	-11.36975098	-20.88452148	-1.687072754	0.590547355
59											
60	Valid Data										
61											
62	Demonstrate the Chamber Task configuration and execution for										
63	the Vision help pages. Default PUND measurement. 2000 Å, 100										
64	μm X 100 μm 4/20/80 PNZT Sample. Manual temperature mode with										

Figure D.5.4 - Chamber Task Sample Excel Export Output. Lower Portion.

4. **Word File –** The Word export option is not available during Task execution.

D.6. Plot Data

As with exporting, the Chamber Task departs from the standard Task limitations in that data can be plotted by the Task during execution without the need to append a plotting Filter Task. Again the reason is that the Test Definition execution remains within the Task for an extended period and the user must be able to review the history of the experiment in real time. Any number of measured parameters may be plotted simultaneously as a function of either the test temperature or the change in temperature from the previous Thermal Cycle. In the latter case, the first cycle is always plotted against a change in temperature of 0.0 °C. The plot is accompanied by a window that shows a text display of experiment configuration and measured results. **Figure D.6.1** shows a typical plot. Note that manual temperature mode was used and no actual thermal device was present, so that the represented temperature is synthetic and the actual temperature was room ambient.

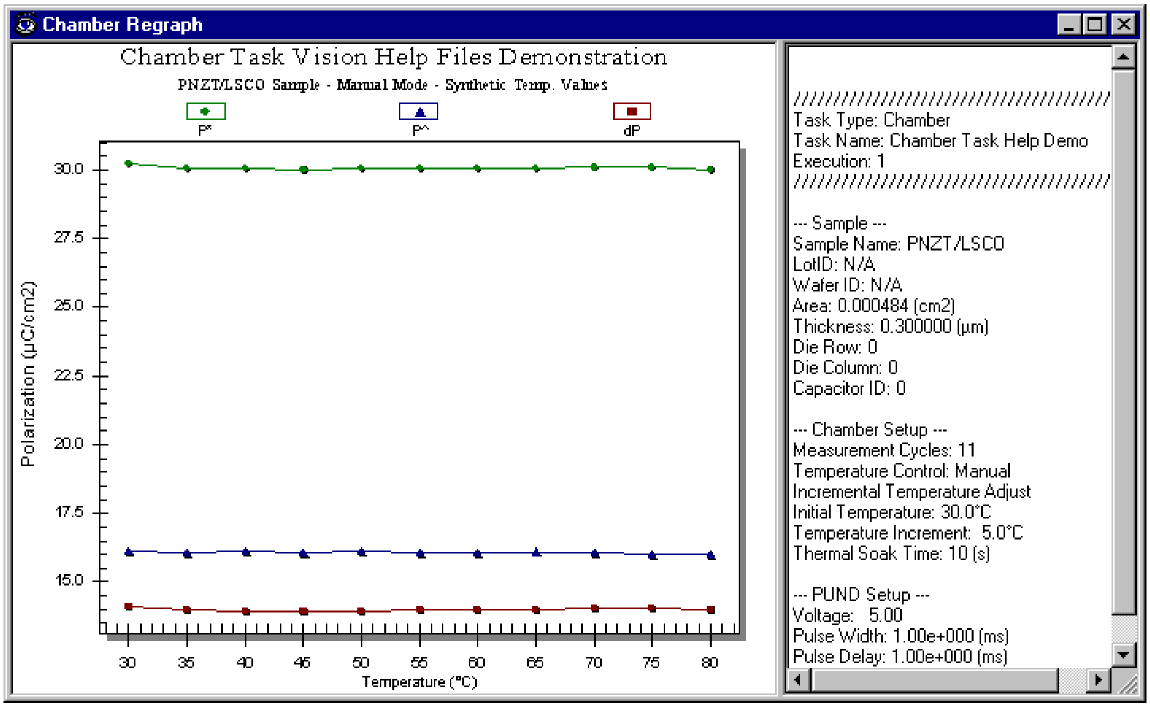


Figure D.6.1. Values Plotted During Chamber Execution. Temperature Values are Synthetic.

D.7. Aborted?

The Chamber Task may be prematurely terminated by the user without interrupting Test Definition execution or prohibiting normal DataSet Archive access after the test. There are two ways to terminate the Task (**Figure D.7.1**)…

1. If the temperature is being set in manual mode (see **Section D.1**) the Task can be aborted by clicking the *Abort* button rather than *OK*. The next soak period an measurement will proceed, but the Task will then terminate with no further cycling.
2. In any operation mode, the *Abort* button of the Soak Time progress dialog can be clicked. This immediately terminates the Soak Time. A measurement is made and plotted, then the Task terminates. If the Task is programmed into a Branch Loop in the Test Definition, this button will also set the Branch Abort flag. In this case, the Test Definition will continue executing Tasks up to the Branch Task, but the Branch Task will not return execution to its Branch Target (will not loop) regardless of the Branch Logic Condition. The situation is shown in **Figure D.7.2**.

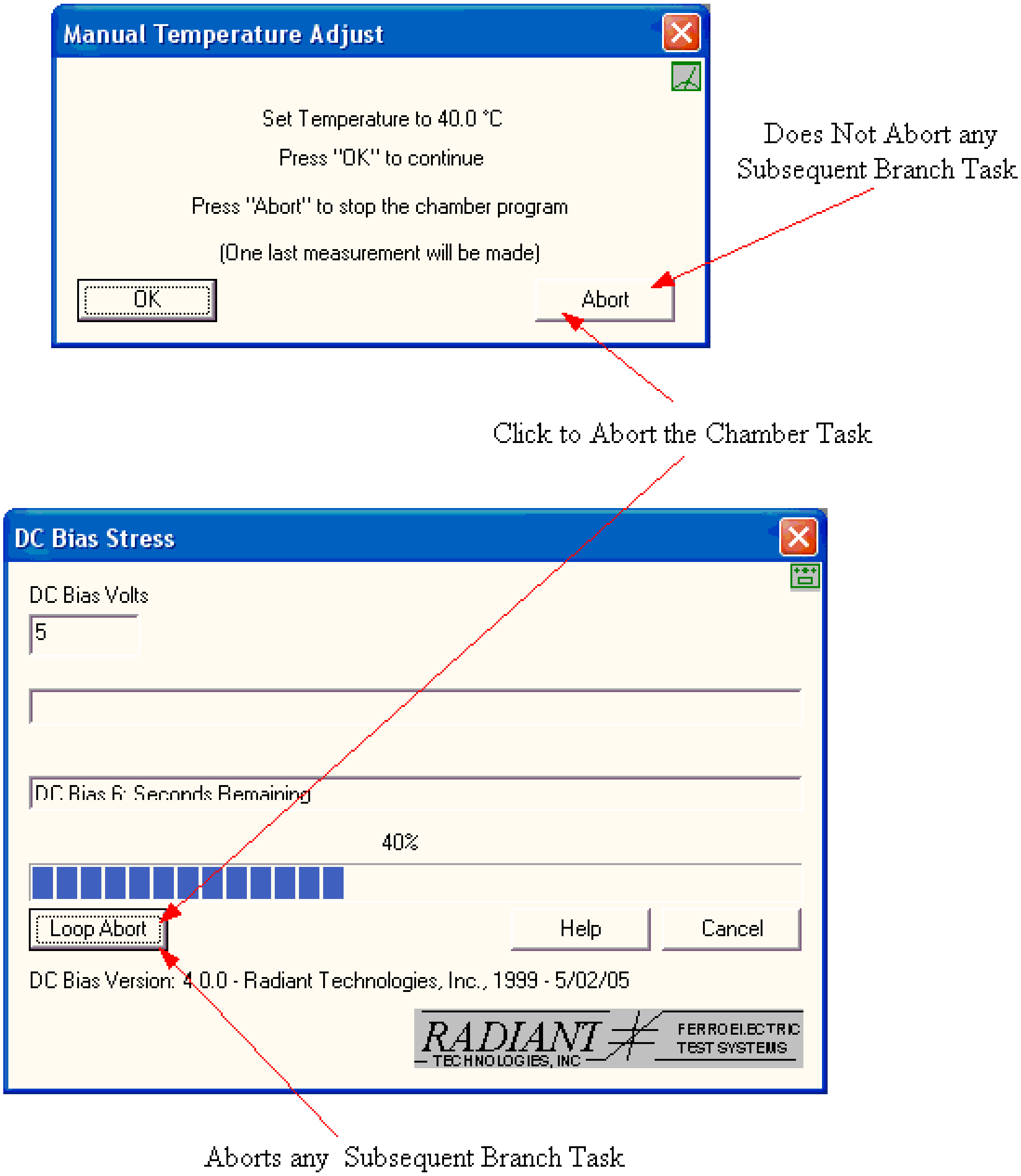


Figure D.7.1. Two Ways to Terminate Chamber Execution.

Regardless of the method of Task termination, the Task will continue to execute normally through the measurement, data storage, exporting and data plotting portions of the Thermal Cycle. No new Thermal Cycle will be executed.

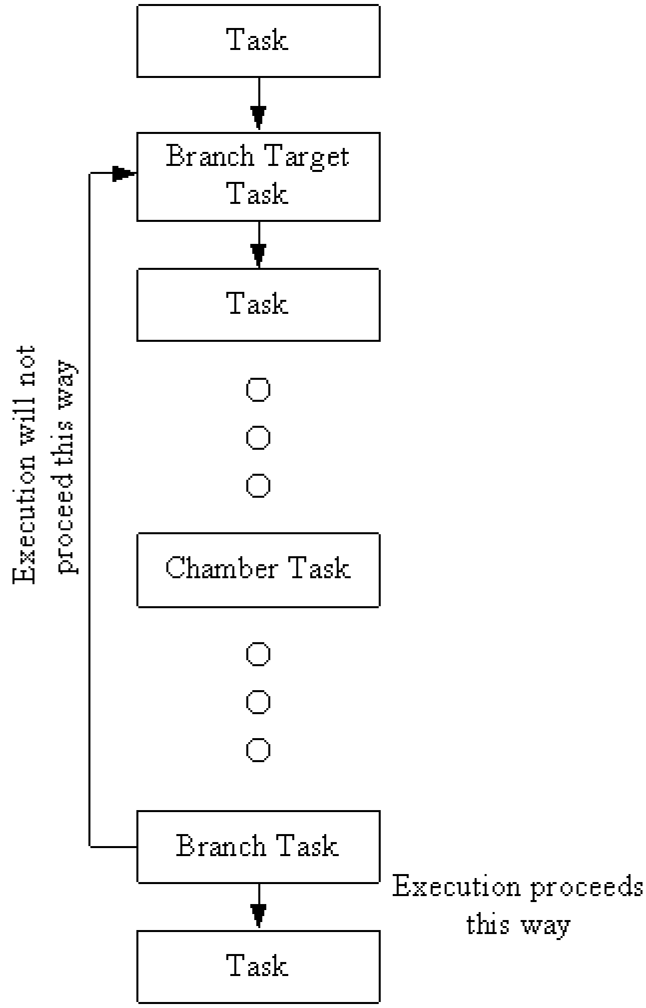


Figure D.7.2. Branch Loop Abort Resulting from Chamber Task Abort.

E - Sample Dialog

Task Name: Chamber
Version: 4.0.0
Last Task Update: 9 June 2007
In QuikLook Menu: No
Folder: Hardware
Subfolder: Measurement
Subsubfolder: Long Duration
Window Name: Chamber Setup - Sample Setup
Change Record: **Go to Change Record**
Known Bugs: None
User Variables Added: Go to List

E.1 - Setup Dialog

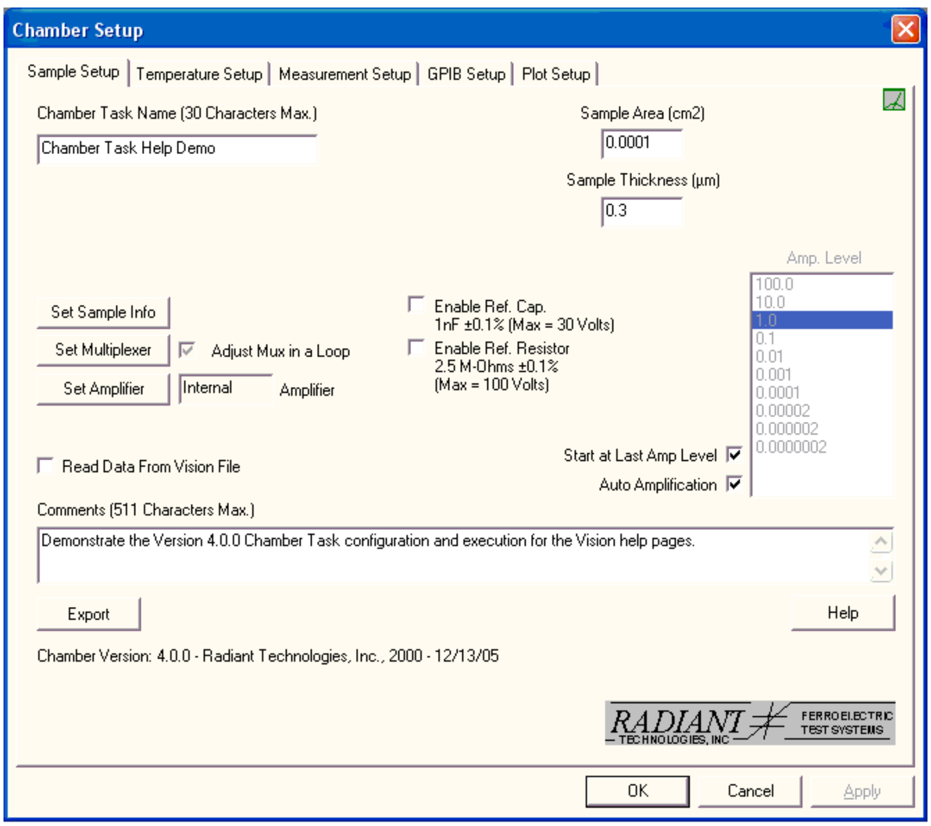


Figure E.1.1 - Chamber Task Sample Configuration Dialog Tab.

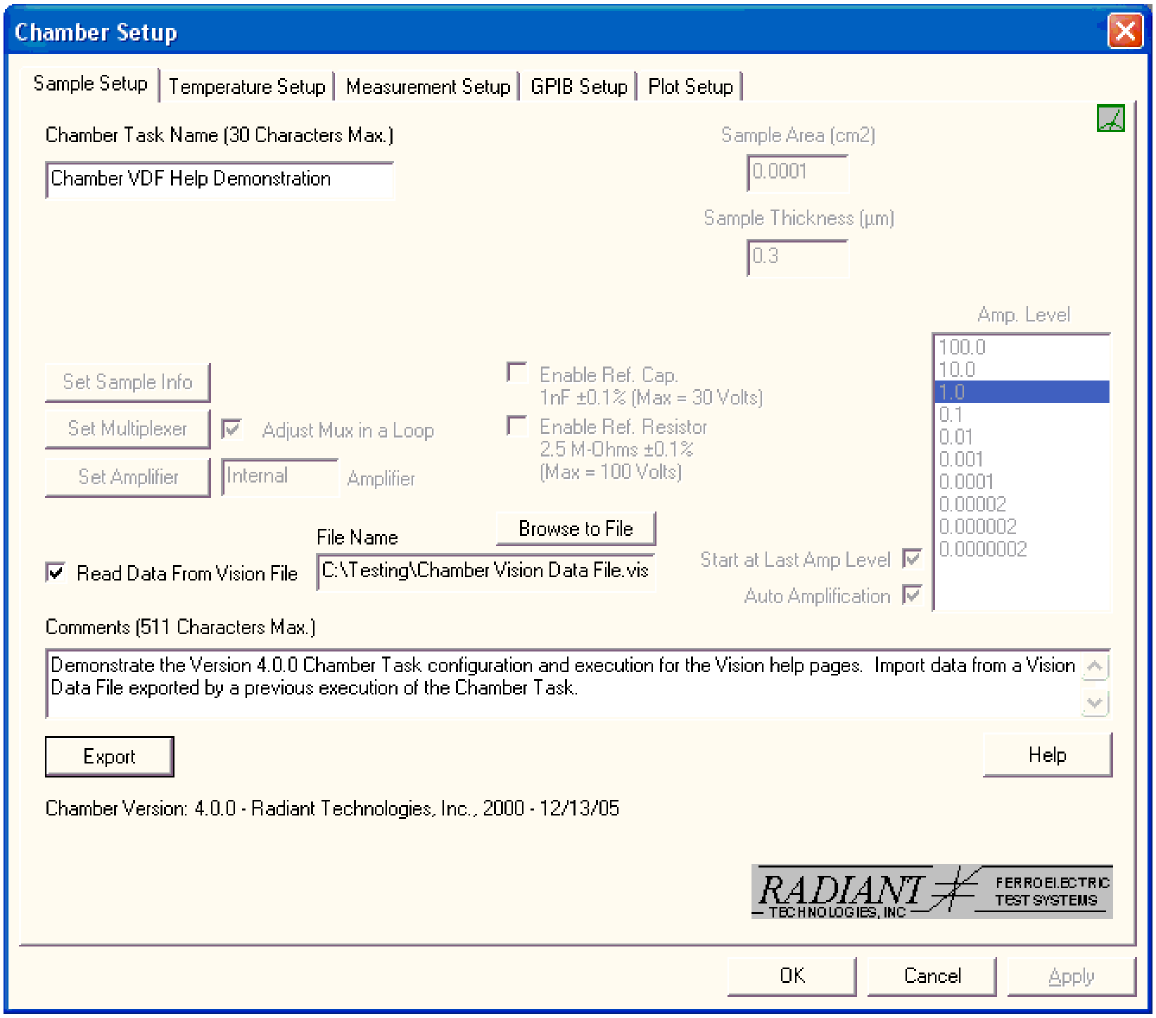


Figure E.1.2 - Chamber Task Configured to Import Data from a Vision Data File.

E.2 - Description

The Sample Setup dialog is the first dialog to appear in configuring the Chamber Task. It is used to provide information and program control parameters of a general nature. The parameters configured are those that are common to most or all Hardware and Measurement Tasks. The dialog differs from other Measurement Tasks in that controls that are specific to the Chamber Task are absent. These have been moved off to other tabs in the configuration dialog.

Two new controls have been added in Version 3.1.0.

- *Custom Amplifier* - This radio button has been added to the *External Amplifier* list. This control allows the user to attach an existing amplifier (not provided by Radiant Technologies) to the experiment. The user must provide RTI the amplifier specifications such as voltage range, gain factor and maximum rise time. RTI will then provide the user with an identifying module that will allow the amplifier to be connected to the HVI.
- *Sensor Impedance* - This is added to the suite of Sensor controls. This control specifies an integer output impedance of the instrument attached to the Sensor port. The sensor output impedance in series with the Precision input impedance (currently about 4 k-Ω) make a voltage divider that distorts the measured voltage by:

  Measured = Actual x 4k / (4k + Sensor Impedance).

  If the sensor output impedance is large with respect to the 4k input impedance, the distortion will be significant. This control accepts a value that is used to correct this distortion.

- *Start at Last Amp Value* - When *Auto Amplification* is checked, the system will begin to search for the correct amplification level by using the value specified in the Amp Level control, even though the control is disabled. Checking this new control will force the search to start at the amplification level that was established by the last executed Measurement Task.

In Version 4.0.0 controls to set sample information and to select and configure the amplifier to use have been moved to subdialogs accessed through button controls. These displaced controls are controls that are usually either uncommonly used or set once in a Test Definition and not reset. Moving them to subdialogs reduces the clutter and confusing appearance of the Chamber Sample configuration dialog. Multiplexer Branch Loop adjustment configuration is now also accessed through a button rather than by clumsily switching a check box. The check box remains to indicate if the adjustment is enabled

With the release of Version 4.0.0, a new exporting option has been introduced. Once a Chamber Task has been executed it can have its configuration parameters and data exported to a Vision Data File. Subsequent Chamber Tasks can be configured to read from the data file in lieu of making a new measurement. This feature allows data taken from diverse places including QuikLook and multiple DataSets to be imported into other DataSets, where Filters can then be applied as though the Task were taking new data. Configuration of the Chamber Task to import Vision Data File data is shown in **Figure E.1.2**, above. For details, see the exporting tutorial. Note that selecting Vision Data File importing will disable all standard controls except *Chamber Task Name*, *Comments* and *Help*. Parameters established in other controls will be imported from the file on execution. Enabling this option does cause the *File Name* and *Browse to File* controls to appear. Ideally, selecting the Vision Data File import option would disable controls in other dialog tabs. However, there is no mechanism for transmitting the information that this option is selected to the other tabs.

Version 4.0.0 also has extended *Comments* length to 511 characters.

An internal reference ferroelectri) sample has been added to the Precision Premier II tester and is planned in the Precision LC II tester. The ferroelectric test element includes two switchable capacitors in a single package inserted into a user-accessible connector. A variety of capacitors are available from Radiant Technologies, Inc. and this test element may be easily changed to adjust the type or to replace fatigued samples. Two Capacitors are available for switching, labeled Cap A and Cap B. The capacitors may be switched individually or in parallel. *Cap A Enable* and *Cap B Enable* controls are activated when the internal ferroelectric capacitor is enabled. Just as with the internal reference capacitor and resistor, the ferroelectric test sample may be switched into the test signal path in parallel with any externally-connected test sample and/or the internal reference capacitor and/or resistor. More information is available in the Version 4.0.0 What's New page. Note that the control is not shown in the Figures above.

E.3 - Controls

Control	Type	Default	Description
Chamber Task Name	Text	"Chamber-#"	32-Character Maximum. A description of the Task to be configured. Used as a base name in the DataSet Archive
Sample Area (cm2)	Real	0.0001	In cm^2. The surface area of the sample electrode.
Sample Thickness (µm)	Real	0.3	In µm. The thickness of the ferroelectric material.
Set Sample Info	Button	Unpressed	Clicking this button opens a subdialog in which sample identifying information can be entered.
Set Multiplexer	Button	Unpressed	Clicking this button opens a subdialog that allows Drive and Return signal multiplexer channels and ports to be specified for one or two attached 48-channel multiplexers. This is discussed in detail below. If Branch Loop adjustment is enabled in the subdialog, *Adjust Mux in a Loop* will be checked when the dialog is closed. Otherwise it will be unchecked.
Adjust Mux in a Loop	Check Box	Unchecked	Read-only. This control indicates that the Task has been configured to switch Drive and Return signals between multiplexer ports and channels, from iteration-to-iteration, if the Task is programmed into a Branch Loop and if one or two 48-channel accessory multiplexers is/are connected to the tester. The status of this control is adjusted using *Adjust Mux*.
Set Amplifier	Button	Unpressed	Clicking this button opens a subdialog in which the Task can be set either to generate its drive signal from the internal ±100.0-Volt (±10.0-Volt, in some systems) amplifier or from an external High

			Voltage Amplifier (HVA) connect to the system through and accessory High Voltage Interface (HVI). If an HVA is selected, the tester port and HVI channel are specified. The subdialog is described in detail below.
Amplifier	Text	"Internal"	Read-Only. Indicates if the measurement is to be made using the internal (low-voltage) amplifier ("Internal") or an external High Voltage Amplifier (HVA) connect to the system through and accessory High Voltage Interface (HVI) ("High Voltage"). The text in this control is adjusted using *Set Amplifier*.
Enable Ref. Cap *Enable Ref. Resistor*	Check Box	Unchecked	These controls switch the three high precision internal reference elements into or out of the Precision signal path. Selecting multiple elements places them into the signal path in parallel. The elements are also in parallel with any externally connected sample.
Enable Ref. Ferroelectric (Not Shown in the Figures Above)	Check Box	Unchecked	A third internal reference (ferroelectric) sample has been added to the Precision Premier II tester and is planned in the Precision LC II tester. The ferroelectric test element includes two switchable capacitors in a single package inserted into a user-accessible connector. A variety of capacitors are available from Radiant Technologies, Inc. and this test element may be easily changed to adjust the type or to replace fatigued samples. Just as with the internal reference capacitor and resistor, the ferroelectric test sample may be switched into the test signal path in parallel with any externally-connected test sample and/or the internal reference capacitor and/or resistor. More information is available in the Version 4.0.0 What's New page. Checking this control enables *Cap A Enable* and *Cap B Enable*. Otherwise those controls are disabled.
Cap A Enable *Cap B Enable (Not Yet Shown in The Figures Above)*	Boolean	Unchecked	When the internal reference ferroelectric is selected, these controls are activated to allow the user to select the capacitor to be measured. Cap A, Cap B or both may be selected. When both are selected, the capacitors are measured in parallel. Both may also be disabled, though this has little practical value.
Auto Amplification	Check Box	Enabled	This control enables or disables the automatic software adjustment of the amplification level. See the discussion above in this section. Disabling this control enables the *Amp. Level* control.
Start at Last Amp Level	Check Box	Enabled	See the discussion under Description above. This control was added as of Version 3.1.0.
Read Data From Vision File	Check Box	Unchecked	Checking this box instructs the Chamber Task to read its data in from a file specified in File Name rather than making a measurement. The file is a binary Vision Data File in Chamber-specific format. If this control is unchecked, *File Name* and *Browse to File* are hidden. If the control is checked, *File Name* and *Browse to File* are shown and all controls except *Task Name* and *Comments* are disabled. That is because the controlled values will be read in from the input file. If the control is checked, *Browse to File* must be used to locate and identify an Chamber-formatted Vision Data File.
File Name	Text	""	Read-only. This control shows the file path and file name of the Chamber-formatted Vision Data File to be read for measured data and configuration parameters on Task execution. The control is updated using Browse to File. This control is hidden if *Read Data From Vision File* is unchecked.

Browse to File	Button	Unpressed	Clicking on this button opens a standard Windows browser dialog that must be used to locate and identify a Chamber-formatted Vision Data File. By default, the browser filters for *.vis files, although the file may have any name and extension. Once identified, the file path and file name are displayed in *File Name*. This control is hidden if *Read Data From Vision File* is unchecked.
Amp. Level	List Box	1.0	If *Auto Amplification* is disabled, this control is enabled to allow the manual selection of the amplification level. This control is disabled if *Auto Amplification* is enabled.
Comments	Text	""	255-Characters Maximum. This control allows the user to provide some detailed discussion of the experiment.
Export	Button	Unpressed	Enable and configure the Task self-exporting option as discussed in **Section 5.2**. This control is normally disabled. It is enabled when the dialog appears during data recall from a DataSet Archive.
Help	Button	Unpressed	Open these HTML Help pages.

E.4 - 48-Channel Multiplexer Configuration

With the release of Version 4.0.0, the 48-channel multiplexer *Drive* and *Return Port* and *Channel* controls have been moved to a subdialog to reduce clutter and confusion on the main dialog. The subdialog is accessed through the *Set Multiplexer* button on the main dialog. A *Set Mux Adjust* button on the subdialog opens a subsubdialog to configure the adjustment of *Drive* and *Return Port* and *Channels* settings in a Branch Loop as described in the next section. The status of Branch Loop adjustment is reflected in the read-only *Adjust Mux in a Branch Loop* check box on the subdialog.

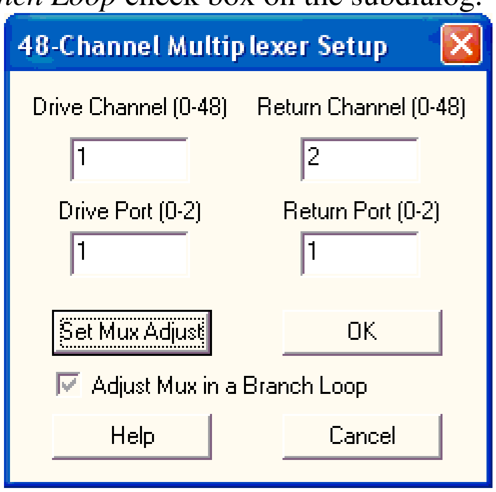


Figure E.4.1 - 48-Channel Multiplexer Configuration Subdialog.

E.5 - Controls

Name	Type	Default	Description

Drive/Return Channel	Integer	0/0	0-48. One or two 48-channel mulitplexers may be connected to the Precision tester using DB-25 connectors on the rear of the unit (limit one for the Precision LC). These accessories allow up to 95 samples (with a single common return) to be connected to the tester. These controls designate the channel to apply the drive signal to and to receive the return signal from. Values of 0 through 48 may be entered. A value of 0 indicates that no multiplexer is present or that it should not be selected. In this case, the signal will be routed through the normal BNC connector on the tester front panel. Setting a non-zero value in *Drive Channel* and/or *Return Channel* enables *Drive Port* and/or *Return Port* and sets the value in the control(s) to a default of '1'. Setting '0' in *Drive Channel* and/or *Return Channel* disables *Drive Port* and/or *Return Port* and sets the value in the control(s) to a default of '0'.
Drive/Return Port	Integer	0/0	0-2 (0-1 for the Precision LC tester). The DB-25 connector on the rear of the Precision Tester to which is connected the multiplexer to be used for the Drive/Return Signal. These controls are disabled and forced to a value of '0' if the *Drive/Return Channel* controls are set to '0'. Otherwise they will be enabled and initially set to a default value of '1'. A value of '0' in this control indicates that no multiplexer is to be used.
Adjust Mux	Button	Unpressed	Clicking this button opens a subdialog that allows Drive and Return signal multiplexer channels and ports to be specified for each iteration, up to fifteen iterations, in a Branch Loop. This is discussed in detail below. If Branch Loop adjustment is enabled, *Adjust Mux in a Loop* will be checked when the dialog is closed. Otherwise it will be unchecked.
Adjust Mux in a Loop	Check Box	Unchecked	This control is disabled and used solely to indicate if the Task is configured to adjust multiplexer signal channels and ports in a Branch Loop.
Help	Button	Unpressed	Read this Help page.
OK	Button	Unpressed	Accept the configured 48-channel multiplexer configuration.
Cancel	Button	Unpressed	Close the dialog. Make no changes to the 48-channel multiplexer configuration.

E.6 - Loop Multiplexer Adjustment

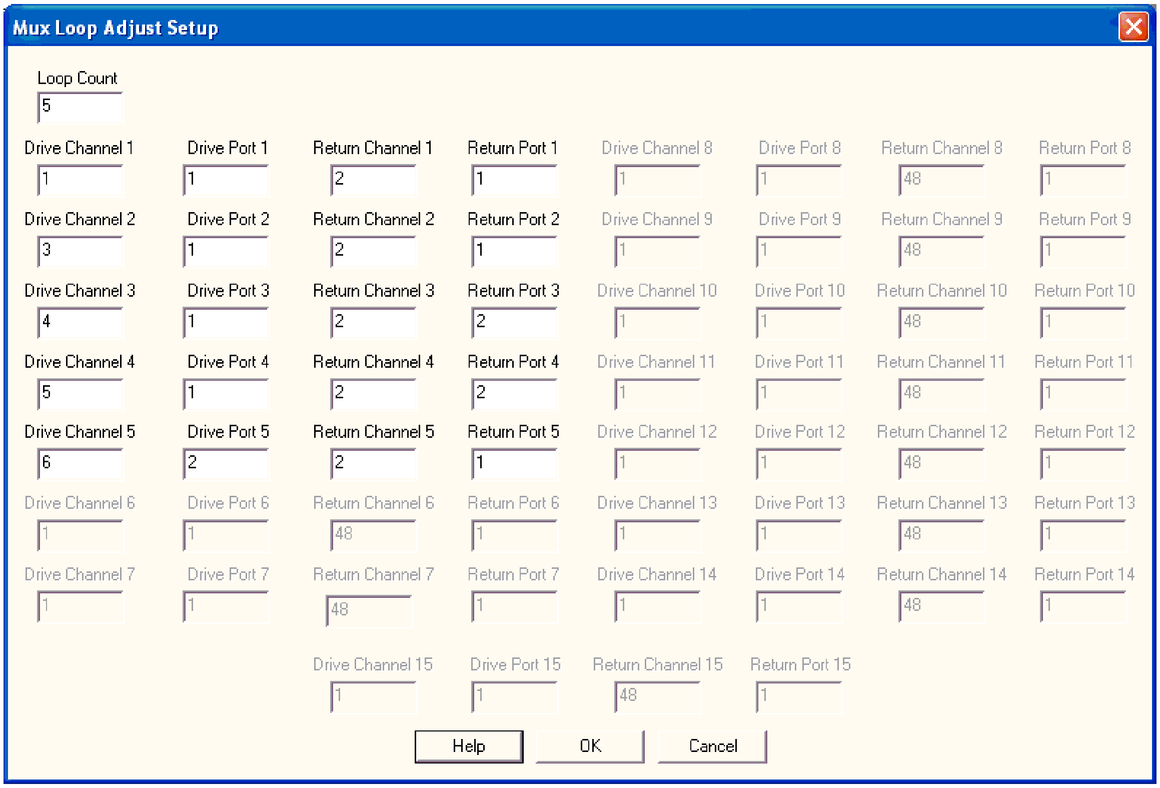


Figure E.6.1 - Branch Loop Multiplexer Adjustment Dialog.

E.7 - Description

Checking the *Adjust Mux in a Loop* control allows the Chamber Task to change the Multiplexer drive and return channels and ports during Branch Looping provided it is programmed into a Branch Loop. This, in turn, allows multiple capacitors to be fully measured automatically without reconfiguring the program or adjusting hardware. When the control is checked, the dialog in **Figure E.6.1** appears. This option allows up to fifteen loop cycles to be independently programmed. (Loop cycles exceeding fifteen will repeat the channel sequencing.). In the example samples 1 through 4 have their Drive Signal Connected to a common HVI attached to DB-25 port 1. Sample 5 is connected to a separate HVI attached to Port 2. Return signals for samples 1, 2 and 5 are common and connected to the same channel (2) of the HVI at port 1. Samples 3 and 4 also have common return signals connected to channel 2 of the second HVI at port 2.

E.8 - Loop Mux Adjust Controls

Name	Type	Default	Description
Loop Count	Integer	0	0-15. Indicates the number of unique Drive and Return Channel and Port sequences to be iterated. The value entered here enables or disables the

			Drive Channel *n*, Drive Port *n*, Return Channel *n* and Return Port *n* controls depending on *n* and the Loop Count selected.
Drive Channel *n*	Integer	0	The Drive Channel on the multiplexer to be enabled when the Branch Loop iteration mod *n* = 0. This control is disabled unless Loop Count >= *n*.
Drive Port *n*	Integer	0	The DB-25 connector on the rear of the Precision tester to which the multiplexer is connected whose channel is to be attached to the Drive Signal when the Branch Loop iteration mod *n* = 0. This control is disabled unless Loop Count >= *n*.
Return Channel *n*	Integer	0	The Return Channel on the multiplexer to be enabled when the Branch Loop iteration mod *n* = 0. This control is disabled unless Loop Count >= *n*.
Return Port *n*	Integer	0	The DB-25 connector on the rear of the Precision tester to which the multiplexer is connected whose channel is to be attached to the Return Signal when the Branch Loop iteration mod *n* = 0. This control is disabled unless Loop Count >= *n*.
Help	Button	Unpressed	Call up a dialog-specific help page.
Okay	Button	Unpressed	Accept the programmed values and enable the Branch Loop update.
Cancel	Button	Unpressed	Close the dialog and disable the Branch Loop update.

E.9 - Amplifier Selection

Selecting either the internal ±100 Volt amplifier (±10 Volts for some Precision LC models) or an external High Voltage Amplifier (HVA) connected to the tester through a High Voltage Interface (HVI) is accomplished by clicking *Set Amplifier*, opening the subdialog of **Figure E.9.1**. The "Internal" amplifier is set by default. In Version 4.0.0 High Voltage configuration has been simplified by allowing only two amplifier selections - "Internal Amplifier" or "External Amplifier". "Internal Amplifier" refers to the ±100.0-Volt amplifier (±10.0 Volts in some LC models) that the Precision Tester can produce with no externally-attached accessories. "External Amplifier" refers to any amplifier connected to the Precision Tester through an HVI. The type of external amplifier is no longer specified. The software recognizes the type of amplifier through the ID module that accompanies the delivery of the High Voltage accessories. With an "External Amplifier" specified, the user must choose an *HVI Comm Port* ('1' or '2' for the Precision Premier or Workstation, '1' for the Precision LC) and an *HVI Channel* ('1' or '2' for the 10 kV HVI, '1' for the 4 kV unit).

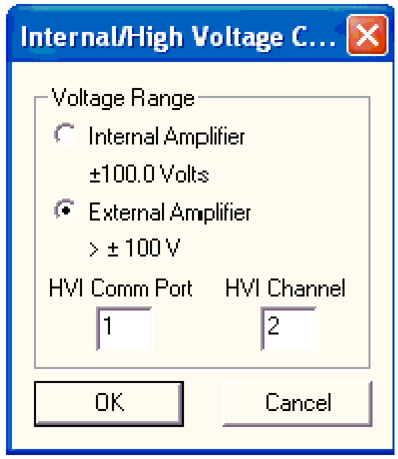


Figure E.9.1 - Internal Amplifier Selection or External Amplifier Configuration.

Name	Type	Default	Description
Internal Amplifier	Radio Button	Selected	Selecting this control instructs Vision to use the Tester's internal amplifier to generate a signal of up to ±100.0 Volts. *HVI Comm Port* and *HVI Channel* will be forced to values of '0' and disabled.
External Amplifier	Radio Button	Unselected	Selecting this control instructs Vision to use an external High Voltage Amplifier (HVA), connected to the tester through a High Voltage Interface (HVI). Voltages of up to ±10,000 Volts can be switched to the sample *HVI Comm Port* and *HVI Channel* will be set to default values of '1' and enabled.
HVI Comm Port	Integer	0/1	0, 1 or 2. This is the DB-25 connector at the rear of the tester to which the external HVI is connected. For Precision Workstations and Premiers, this may take a value of '1' or '2', allowing two HVIs to be connected and switched in software. Precision LCs have only a single comm port, selected by '1'. A '0' indicates that the signal is to be taken from the Tester's internal amplifier. If *Internal Amplifier* is selected, this control is forced to '0' and disabled. If *External Amplifier* is selected, this control is set to '1' by default and enabled.
HVI Channel	Integer	0/1	0, 1 or 2. This is the channel at the rear of the HVI to which the HVAs connected. For 10 kV HVIs, this may take a value of '1' or '2', allowing two HVAs to be connected and switched in software. 4 kV HVIs have only a single channel, selected by '1'. A '0' indicates that the signal is to be taken from the Tester's internal amplifier. If *Internal Amplifier* is selected, this control is forced to '0' and disabled. If *External Amplifier* is selected, this control is set to '1' by default and enabled.

E.10 - Sample Identifying Information

Clicking *Set Sample Info* opens a subdialog in which several sample identifying parameters may be configured. The purpose is strictly for documentation and most identifiers are not generic enough to apply to all cases.

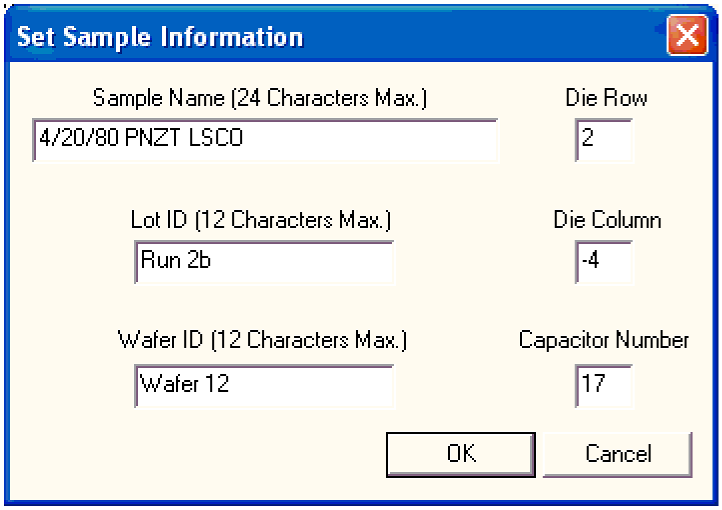


Figure E.10.1 - Sample Documentation Subdialog.

E.11 - Controls

Name	Type	Default	Description
Sample Name	Text	""	24 Characters Maximum. A unique description of the sample being measured
Lot ID	Text	""	12 Characters Maximum. A unique description of the the lot from which the sample under test is taken.
Wafer ID	Text	""	12 Characters Maximum. A unique description of the the wafer from which the sample under test is taken.
Die Row	Integer	0	The vertical location on the wafer of the sample under test. May be negative.
Die Column	Integer	0	The horizontal location on the wafer of the sample under test. May be negative.
Capacitor Number	Integer	0	Serial identifier of the capacitor being tested.
OK	Button	Unpressed	Accept the entered values.
Cancel	Button	Unpressed	Close the dialog. Do not adjust the sample information.

F - Temperature Dialog

Task Name: Chamber
Version: 4.0.0
Last Task Update: 9 June 2007
In QuikLook Menu: No
Folder: Hardware
Subfolder: Measurement
Subsubfolder: Long Duration
Window Name: Chamber Setup - Temperature Setup
Change Record: **Go to Change Record**
Known Bugs: None
User Variables Added: Go to List

F.1 - Setup Dialog

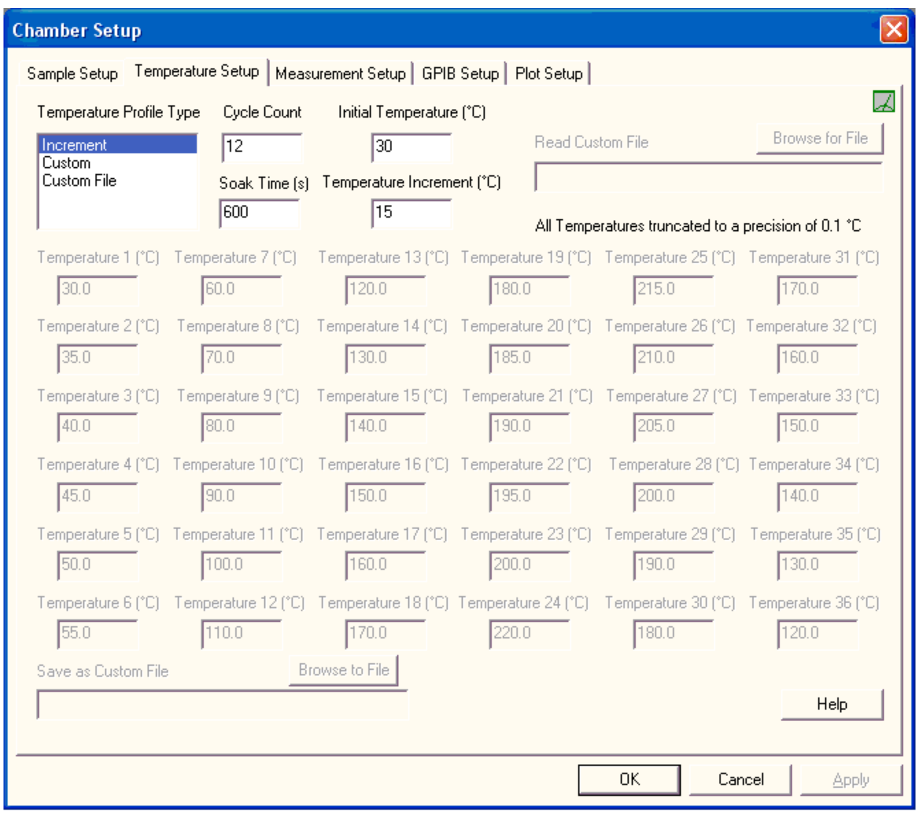


Figure F.1.1 - Chamber Task Temperature Profile Configuration Tab. Incremental Temperature Adjustment.

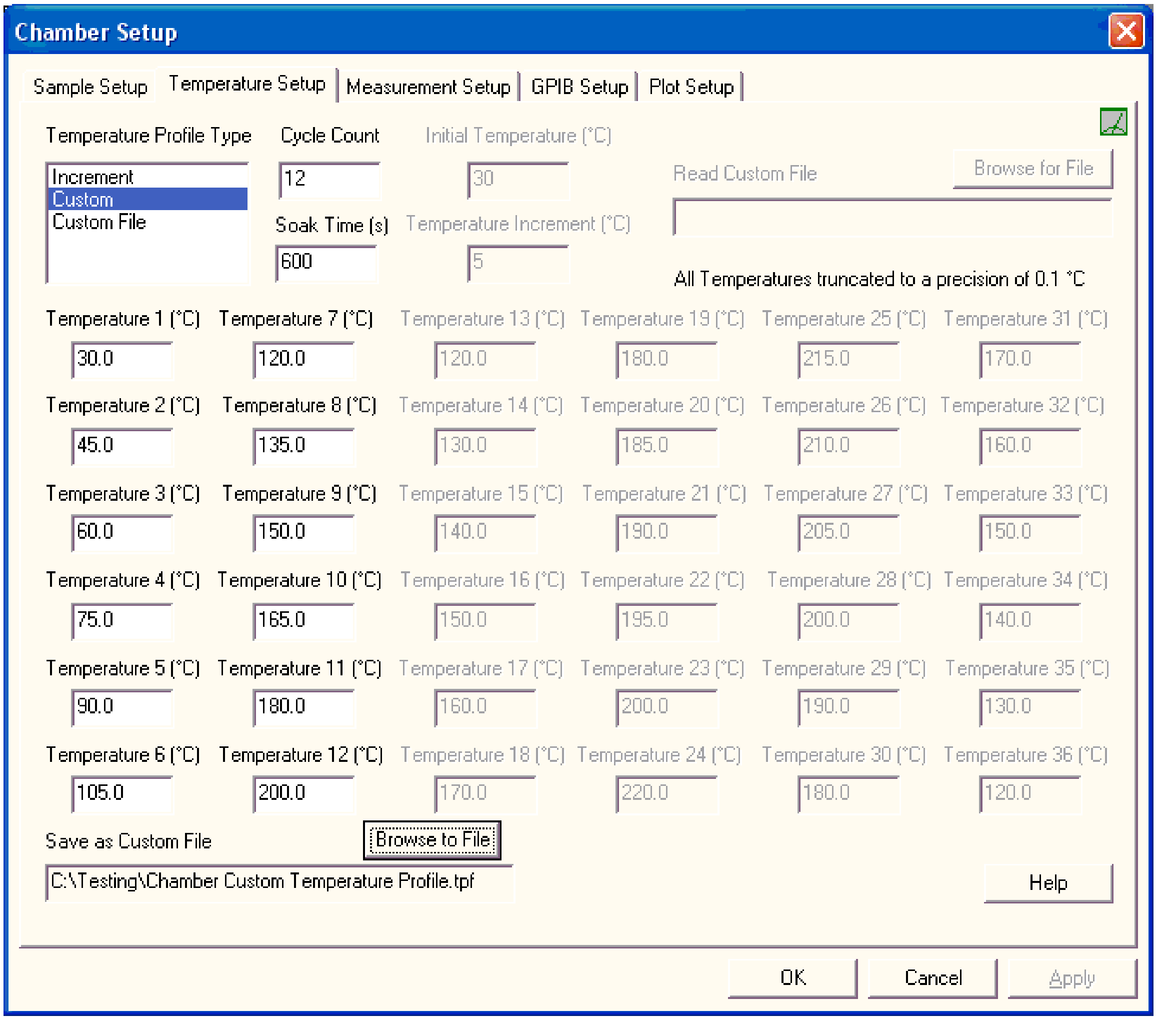


Figure F.1.2 - Chamber Task Temperature Profile Configuration Tab. Custom Temperature Adjustment.

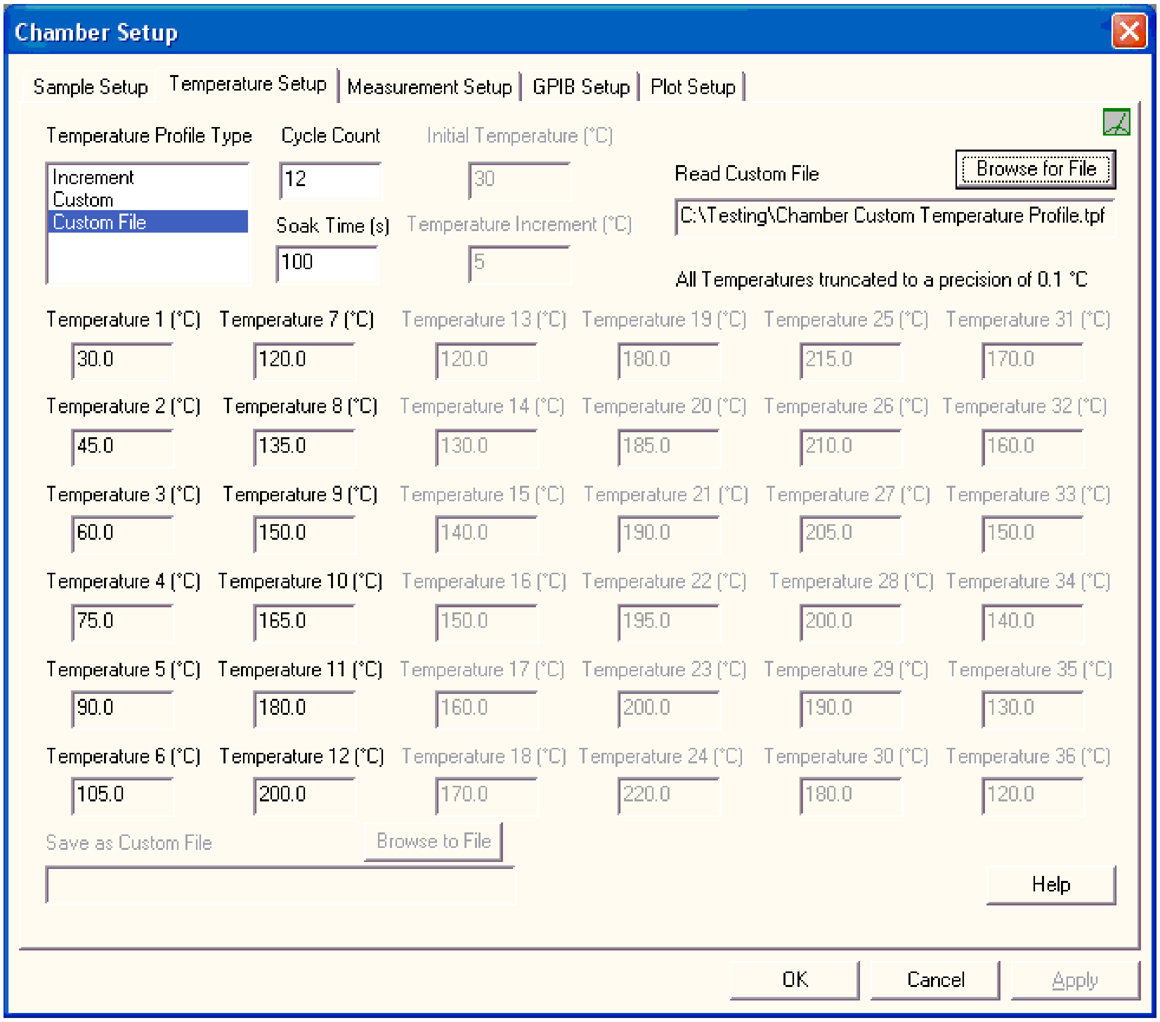


Figure F.1.3 - Chamber Task Temperature Profile Configuration Tab. Custom Temperature Adjustment Recalled from a File.

F.2 - Description

The "Temperature Setup" page is used to completely define the Thermal Profile and Thermal Cycling. A the upper left, the type of Thermal Profile is selected. Three types are available, including Increment, Custom and Custom File, as discussed in detail in **Section D.1**. Other controls are enabled or disabled in this dialog based on the Thermal Profile Type selected. Two controls that do not depend on the Thermal Profile are the *Cycle Count* and the *Soak Time*. The Cycle Count specifies the number of Thermal Cycles to perform. This control is set automatically in Custom File mode when the file is read, but remains enabled so that the count can be adjusted. The Soak Time is the length of the delay the Task performs when the temperature reaches the set temperature in the Thermal Cycle. For reasons discussed in **Section D.2** this value should be of a significant duration.

Initial Temperature and *Temperature Increment* controls are only enabled when the Increment Thermal Profile Type is selected. The Initial Temperature provides a start point for the first Thermal Cycle from which the temperature of all subsequent Thermal Cycles will derive. Each subsequent Thermal Cycle will have a set temperature of the previous set temperature plus the increment. The result is a linear temperature profile with uniform temperature steps. The increment may be negative so that the profile is continuously decreasing in temperature. Normally a decreasing profile would only be used if an LN_2 tank is attached to the system. Ambient cooling would be too slow and would set a lower limit of the room temperature. No programmatic limit to the number of Thermal Cycles exists, but a practical limit is reached when the combination of Cycle Count, Initial Temperature and Increment creates a profile that will exceed the upper or lower chamber temperature limit.

Read Custom Profile text control and browser are enabled when the Custom File Thermal Profile Type is selected. The browser can be used to select a stored custom profile. The file name control is strictly for display of the file path and file name. The browser must be used to select the file.

The main portion of the dialog is taken up by 36 identical real-value input controls. These are used to specify up to 36 independent custom temperatures when the Custom Thermal Profile Type is selected. A particular control is enabled when the Custom type is selected AND when the Cycle Count equals or exceeds the number of the control. Selecting the Custom Profile also enables the *Save as Custom File* text control and browser. The browser can be used to specify a file path and filename into which will be written the custom file created, including the Cycle Count and all custom temperatures. The file can then be recalled for later use by selecting the Custom File Profile. Note that the text control is used strictly to display the file path and filename. The browser must be used to create the file. Although these controls remain disabled in Custom File mode, their values are updated from the file.

Note that the custom profile of **Figure F.1.2** produces the same temperature sequence as the incremental configuration of **Figure F.1.1** except the final temperature is set to 200° C while the incremental configuration will produce a final temperature of 195° C.

The *Help* button opens these HTML help pages.

NOTE - Several late changes have been made to accompany the release of Version

4.0.0 of the Chamber Task. These are not completely documented in these pages although they are summarized here.

- **The Vision Data File selection flag is now passed in from the Sample Configuration dialog tab. If the Task is configured to read information from a Vision Data File, all controls and all labels are disabled. This is because the values that are configured in them are to be input from the file. When the Task has executed and is recalled from the DataSet Archive, the labels and text controls will be enabled to show the configuration values read from the file. Text controls will be set to read-only.**

F.3 - Controls

Control	Type	Default	Description
Temperature Profile Type	List Box	Increment	Select the type of Thermal Profile. The selection enables/disables controls as follows: • Increment – Enables *Initial Temperature* and *Temperature Increment*. Disables *Read Custom File*, *Custom File Browser*, *Temperature n (°C)*, *Save as Custom File* and *Save as Custom File Browser*. • Custom – Enables *Temperature n (°C)*, *Save as Custom File* and *Save as Custom File Browser*. Disables *Initial Temperature*, *Temperature Increment*, *Read Custom File* and *Custom File Browser*. • Custom File – Enables *Read Custom File* and *Custom File Browser*. Disables *Initial Temperature*, *Temperature Increment*, *Temperature n (°C)*, *Save as Custom File* and *Save as Custom File Browser*.
Cycle Count	Integer	1	Specifies the number of Thermal Cycles in the experiment. The control is used to enable Custom Temperatures 1 through *n*, where *n* is the Cycle Count, if Custom Profile mode is selected. This control is unlimited in Increment mode, but cannot exceed 36 in Custom or Custom File mode.
Soak Time (s)	Integer	100	Specifies the delay time at the set temperature before any measurement is made. See **Section 3.2** for a detailed discussion of this control.
Initial Temperature (°C)	Real	30.0	This control is enabled if the Profile Type is Increment, otherwise it is disabled. This control is used to specify the initial base temperature of the first Thermal Cycle from which all subsequent temperatures are derived. Temperatures are real valued, truncated to a precision of 0.1 °C.
Temperature Increment (°C)	Real	5.0	This control is enabled if the Profile Type is Increment, otherwise it is disabled. This control is used to specify the incremental temperature that is to be added to the previous Thermal Cycle temperature to arrive at the current set temperature in Increment Profile mode. Temperatures are real valued, truncated to a precision of 0.1 °C.
Read Custom File	Text	""	This control is enabled if the Profile Type is Custom File, otherwise it is disabled. The control reports the file path and name of the file

			that contains the custom profile that has been read. This control is an indicator only. The Custom File Browse Button must be used to browse to select the path and filename.
Browse for File	Button	Unpressed	This control is enabled if the Profile Type is Custom File, otherwise it is disabled. This control invokes a standard browser dialog similar to the one in Figure 5.4. The browser is used to locate and open a file that contains a list of custom temperatures. The file also indicates the number of Thermal Cycles to be executed. When the file is read the *Read Custom File* control is updated with the path and filename. The *Cycle Count* control is update with the appropriate count and the specified number of *Temperature n (°C)* controls are also updated. The *Cycle Count* control remains active so that the number of cycles can be adjusted.
Temperature n (°C)	Real	30.0	These controls are enabled if the Profile Type is Custom AND if the Cycle Count equals or exceeds *n*, otherwise they are disabled. These controls are used to enter the independent temperature values for all the Thermal Cycles in a Custom Profile mode. Temperatures are real valued, truncated to a precision of 0.1 °C.
Save as Custom File	Text	Enabled	This control is enabled if the Profile Type is Custom, otherwise it is disabled. This control indicates the path and filename into which the current Custom Profile has been written. This control is an indicator only and cannot be used to specify the path and/or filename. The *Save as Custom File Browser* control must be used to define the path and filename.
Browse to File	Button	Disabled	This control is enabled if the Profile Type is Custom, otherwise it is disabled. This control invokes a standard browser dialog similar to the one in Figure 5.4. The browser is used to locate and open a file to which to write the list of custom temperatures. The file also indicates the number of Thermal Cycles to be executed. When the file is opened the *Save as Custom File* control is updated with the path and filename.
Help	Button	Unpressed	Open these HTML Help pages.

G - Measurement Dialog

Task Name: Chamber
Version: 4.0.0
Last Task Update: 9 June 2007
In QuikLook Menu: No
Folder: Hardware
Subfolder: Measurement
Subsubfolder: Long Duration
Window Name: Chamber Setup - Measurement Setup
Change Record: **Go to Change Record**
Known Bugs: None
User Variables Added: Go to List

G.1 - Setup Dialog

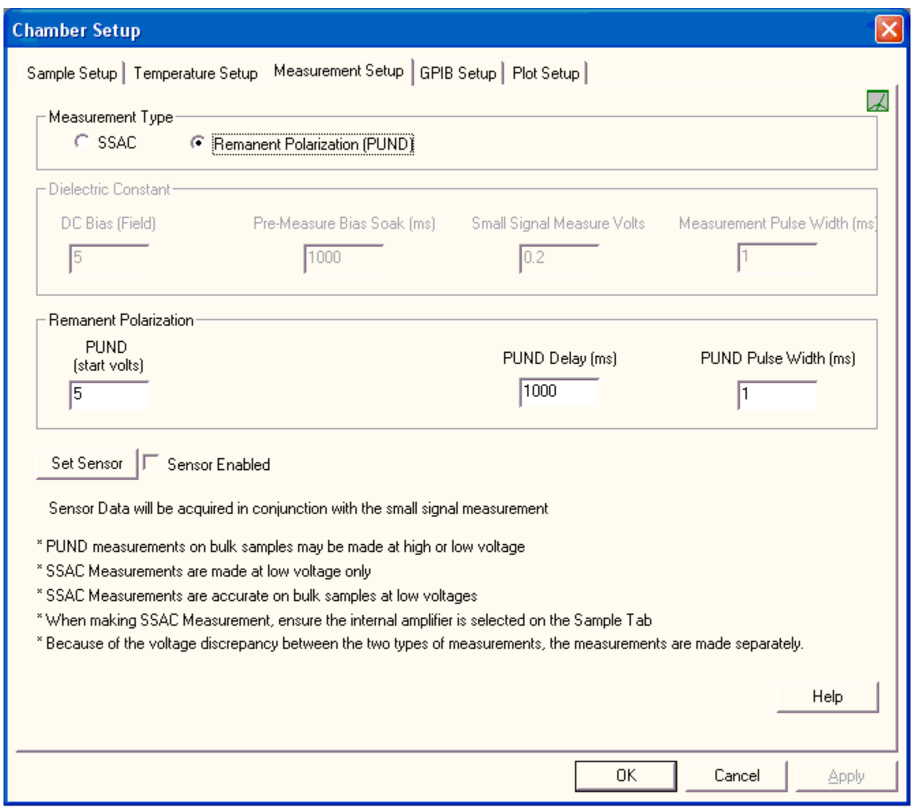


Figure G.1.1 - Chamber Task Measurement Configuration Tab with Default Settings.

G.2 - Description

The "Measurement Setup" page is used to configure both the PUND and Small Signal Capacitance measurements. External Sensor measurements can also be configured and will be made simultaneously with the Small Signal Capacitance measurement. However, you cannot run PUND and SSAC in a single Chamber Task execution.

The upper row of the dialog contains four controls devoted to the Small Signal Capacitance measurement. **Section C.2** gives a detailed description of the parameters set by these controls. *DC Bias (Field)* is the bias field that is applied throughout the Small Signal measurement. *Small Signal Measure Volts* is the small 'tickle' voltage applied to induce the current that is integrated to derive the capacitance. This value must be kept small enough to prohibit any actual ferroelectric switching that will induce large currents. *Pre-Measure Bias Soak* is the delay between the setting of the bias field and the application of the tickle voltage. It is also the delay before any measurement begins. This time allows the sample to "soak" at the bias voltage and should be large enough to allow the sample to reach a steady state, with no remaining current induced by switching polarization as the bias field was set. Finally, *Measurement Pulse Width Delay* is the length of the application of the tickle voltage and the length of the measurement.

The second row of dialog controls sets the PUND values. These can be reviewed in more detail by referring to **Section C.1**. *PUND Volts* refers to the maximum absolute voltage to be applied during the PUND measurement. *PUND Delay* refers to the zero-volt delay between each of the PUND pulses. This value should be of sufficient duration to allow all ferroelectric switching from the previous pulse to settle. A 1-second value was used as the default in the RT66A and RT6000 families of testers. *PUND Pulse Width* refers to the actual pulse time. It is the time between the start of the rise of the pulse and the measurement at the top of the pulse. It is the time that the pulse begins to return to zero volts. Finally, it is also the time between the measurement at the top of the pulse and the measurement at zero volts.

The bottom row of controls refers to the acquisition of Sensor data. Sensor data are external voltage data, connected to the sensor port at the rear of the Precision tester, that can be read simultaneously with internally measured data. This is a general purpose port whose use is at the user's discretion. One application would be to sample an external metering instrument that responds to the Drive Signal stimulus and provides a voltage output. It is assumed that the voltage input is linearly related to a meaningful measurement value. The Sensor voltage can be automatically converted to that value by applying the Sensor Scale, Sensor Offset and Sensor Impedance as in:

Sensor Data =
Sensed Voltage * ((Input Impedance+Sensor Impedance)/Input Impedance) * Scale + Offset

Where Input Impedance = 4 kΩ for Precision Testers released before March 2002

A single Sensor value is read and converted at each Thermal Cycle. The measurement is made simultaneously with the Small Signal Capacitance Measurement. A Sensor Label control is provided to allow a name to be specified to label the sensor trace on the plotted data.

A new control has been added in Version 3.1.0.

- *Sensor Impedance* - This is added to the suite of Sensor controls. This control specifies an integer output impedance of the instrument attached to the Sensor port. The sensor output impedance in series with the Precision input impedance (currently about 4 k-Ω) make a voltage divider that distorts the measured voltage by:

  Measured = Actual x 4k / (4k + Sensor Impedance).

  If the sensor output impedance is large with respect to the 4k input impedance, the distortion will be significant. This control accepts a value that is used to correct this distortion.

With the release of Version 4.0.0, the sensor configuration has been moved to a subdialog accesses through the Set Sensor button. This reduces the clutter on the dialog caused by seldom-used controls. The subdialog is discussed in detail below.

NOTE - Several late changes have been made to accompany the release of Version 4.0.0 of the Chamber Task. These are not completely documented in these pages although they are summarized here.

- **The Vision Data File selection flag is now passed in from the Sample Configuration dialog tab. If the Task is configured to read information from a Vision Data File, all controls and all labels are disabled. This is because the values that are configured in them are to be input from the file. When the Task has executed and is recalled from the DataSet Archive, the labels and text controls will be enabled to show the configuration values read from the file. Text controls will be set to read-only.**
- **The Internal/High-Voltage Amplifier selection is now passed in from the Sample Configuration dialog tab. The PUND/SSAC selection buttons in the Measurement configuration tab have been replaced by a *Measurement Type* list box control. This control lists "PUND" only in high-voltage mode. In low-voltage mode, the control lists "PUND", "SSAC" or "Both". Both measure-**

ments may be made in a single execution of the Task in low-voltage mode. In High-Voltage mode, all SSAC and Sensor configuration controls and labels are disabled.

- **An error condition exists if the user takes the following steps:**
  - **Select High-Voltage in the Sample Configuration tab.**
  - **Set a PUND voltage of absolute value greater that 100.0 Volts in the Measurement Configuration tab.**
  - **Select Low-Voltage in the Sample Configuration tab.**

In this case, the high-voltage *PUND (Start Volts)* value will be reset to the default value of 5.0 Volts.

G.3 - Controls

Control	Type	Default	Description
Small Signal Volts	Real	5.0	-10,000.0 – 10,000.0. The Bias Field voltage to apply to the Small Signal Capacitance throughout the measurement. This is also used to compute $\vec{\mathbf{E}}$ in (1.1).
Pre-Measure Bias Soak (ms)	Real	1000.0	1e-6 – 30,000. In a Small Signal Capacitance measurement, this is the period at which the sample is held at the DC Bias Field after the field is switched and before the tickle voltage is applied or any measurement made. The period should be of sufficient duration to allow any ferroelectric polarization switching, induced by the application of the Bias Field, to settle.
Small Signal Measure Volts	Real	0.05	-10,000.0 – 10,000.0. The small perturbation voltage to apply to the sample that has "soaked" at the Bias Field during the Small Signal Capacitance measurement. The voltage induces a small current that can be integrated to determine the sample capacitance. The voltage should be kept small to avoid inducing any ferroelectric polarization switching.
Measurement Pulse Width (ms)	Real	1.0	1e-6 – 30,000. In a Small Signal Capacitance measurement, this is the duration of the tickle voltage and the time over which the measurement is made.
PUND Volts	Real	5.0	-10,000.0 – 10,000.0. The maximum absolute voltage applied during the PUND pulses and the voltage at which the pulse top measurements are made. This is also referred to as VMax.
PUND Delay (ms)	Real	1.0	1e-6 – 30,000. This is the time that the PUND measurement delays at zero volts between each pulse. The delay should be sufficient to allow any ferroelectric polarization switching induce by the pulse, or by the return to zero volts, to settle.
PUND Pulse Width (ms)	Real	1.0	1e-6 – 30,000. This is the time between the beginning of the rise of a PUND measurement pulse and the measurement at the top of the pulse. It is the delay between the beginning of the rise of the pulse and the beginning of the fall of the pulse to zero volts. It is also the delay between the measurement at the top of the pulse and the accompanying measurement at zero volts.
Set Sensor	Button	Unpressed.	This button opens a subdialog in which the signal-capture of the

			Sensor port can be enabled and configured or disabled. The status of the Sensor port is reflected in the *Sensor Enable* control.
Sensor Enabled	Check Box	Unchecked	Boolean - This control is disabled and is an indicator only - Indicates if the capture of the Sensor port signal is enabled (control is checked) or disabled (control is unchecked).
Help	Button	Unpressed	Open these HTML Help pages.

G.4 - Sensor Configuration

Clicking Set Sensor opens a subdialog that allows voltages at the external SENSOR port to be acquired along with the measured data. The SENSOR data can be linearly scaled and offset to convert them from a voltage to a meaningful value. Inputting the known output impedance of the device attached to the sensor helps correct for small errors in the measured value. The sensor data can be labeled for identification. As shown on the dialog, the derived sensor value is given by:

Sensor Data =
Sensed Voltage x *Sensor Scale* (*Tester Input Impedance* + *Sensor Impedance*) / *Tester Input Impedance* + *Offset* (2)

The results of enabling or disabling the Sensor data will be displayed in the *Sensor Enabled* control on the main dialog when the subdialog is closed.

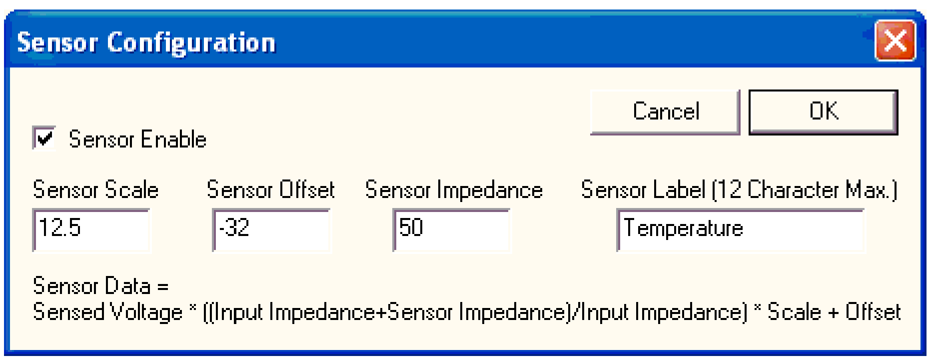


Figure G.4.1 - Sensor Configuration Subdialog.

Name	Type	Default	Description
Sensor Enable	Check Box	Unchecked	Checking this control tells the software to capture the voltage signal attached to the SENSOR port simultaneously with the measured data. The signal will be scaled and offset using equation (2). Checking this box enables *Sensor Scale*, *Sensor Offset*, *Sensor Impedance* and *Sensor Label*.
Sensor Scale	Real	1.0	Checking *Sensor Enable* enables this control. Otherwise it is disabled. The value in this control will be used as a scale factor to linearly convert the measured sensor signal to a physical value in accordance with

			equation (2).
Sensor Offset	Real	0.0	Checking *Sensor Enable* enables this control. Otherwise it is disabled. The value in this control will be used as an offset value to linearly convert the measured sensor signal to a physical value in accordance with equation (2).
Sensor Impedance	Integer	50	Checking *Sensor Enable* enables this control. Otherwise it is disabled. The value in this control will be used as a corrective term to adjust the measured voltage in accordance with equation (2).
Sensor Label	Text Box	""	Checking *Sensor Enable* enables this control. Otherwise it is disabled. This value is used to identify the converted SENSOR signal when the sensor data are displayed.
Cancel	Button	Unpressed	Close the dialog. Discard any changes made in the Sensor configuration.
OK	Button	Unpressed	Close the dialog. Make the indicated changes in the Sensor configuration.

H - GPIB Dialog

Task Name:	Chamber
Version:	4.0.0
Last Task Update:	9 June 2007
In QuikLook Menu:	No
Folder:	Hardware
Subfolder:	Measurement
Subsubfolder:	Long Duration
Window Name:	Chamber Setup - GPIB Setup
Change Record:	**Go to Change Record**
Known Bugs:	None
User Variables Added:	Go to List

H.1 - Setup Dialog

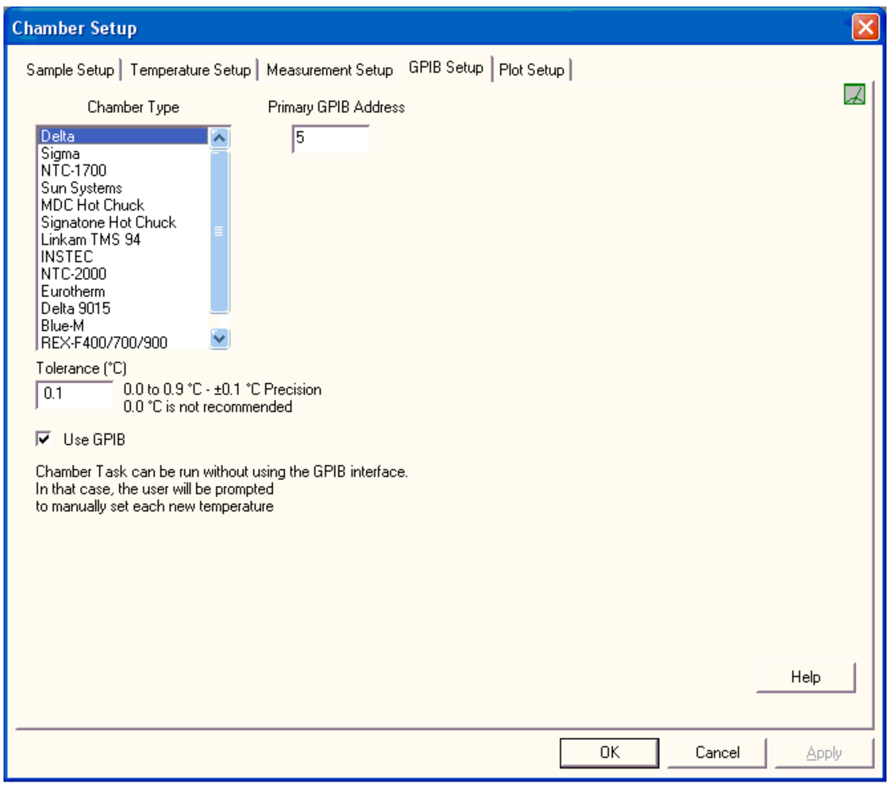


Figure H.1.1 - Chamber Task GPIB Configuration Tab - Delta Chamber.

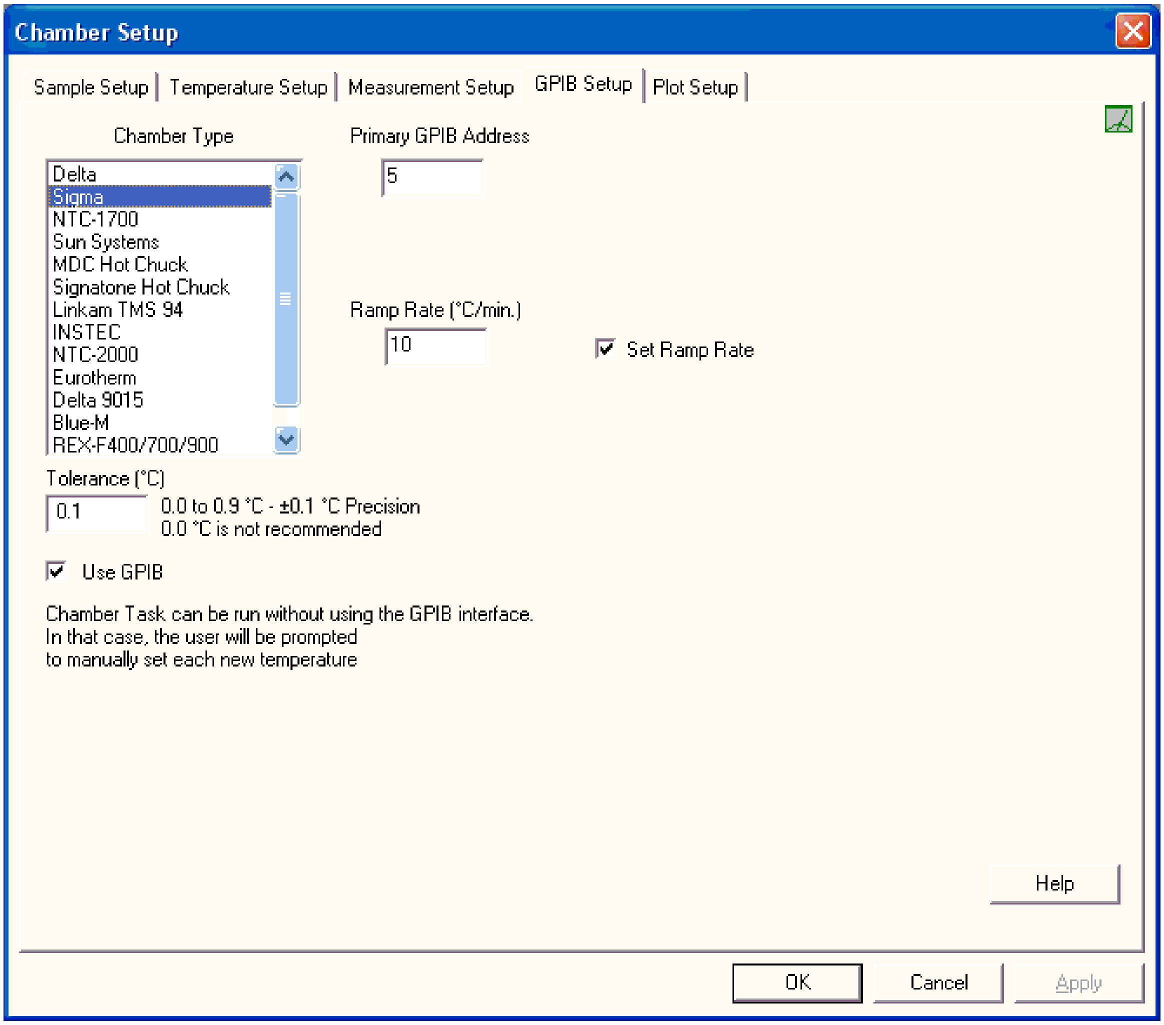


Figure H.1.2 - Chamber Task GPIB Configuration Tab - Sigma Chamber. Rate Adjustment Available.

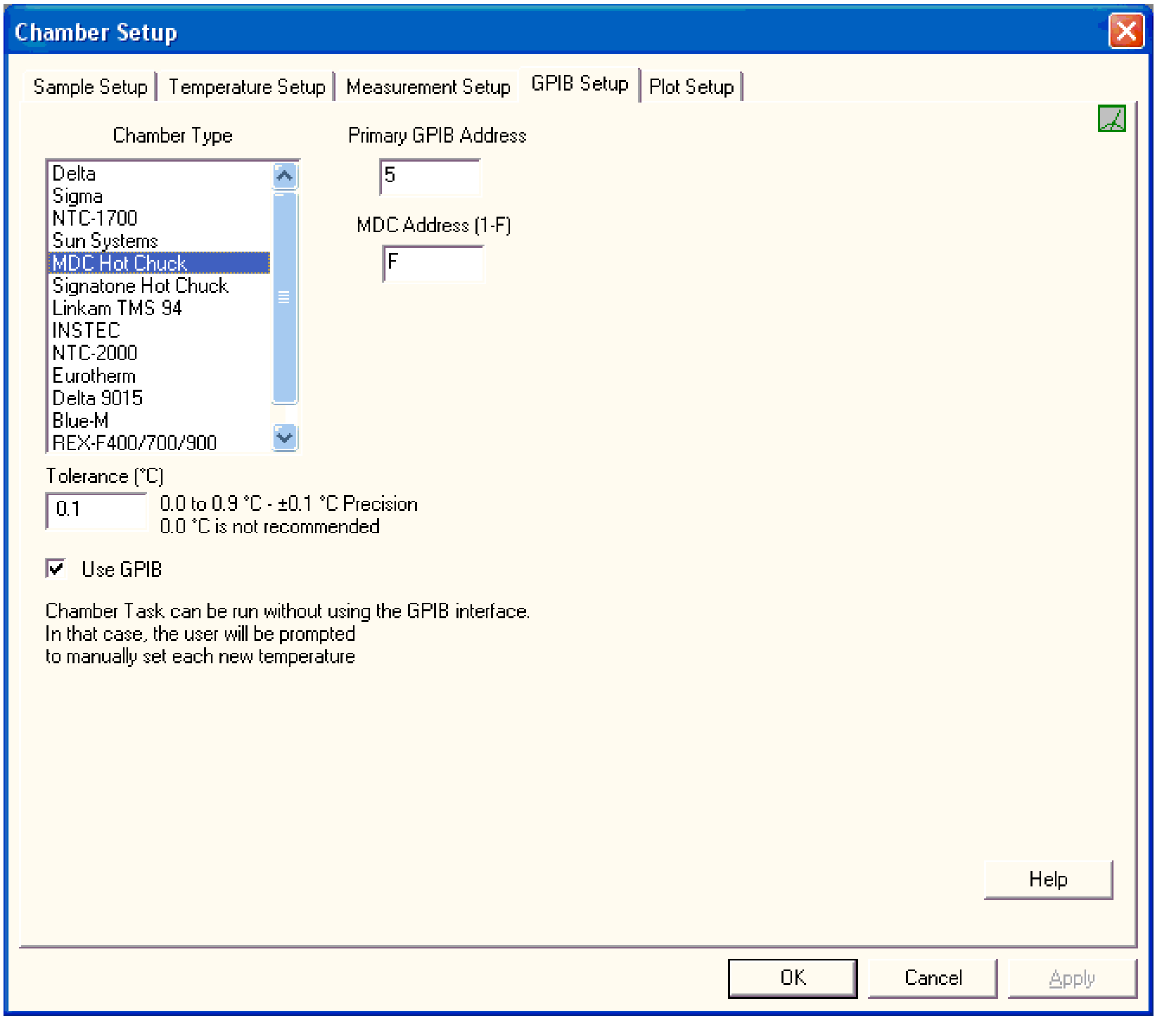


Figure H.1.3 - Chamber Task GPIB Configuration Tab - MDC Hot Chuck.

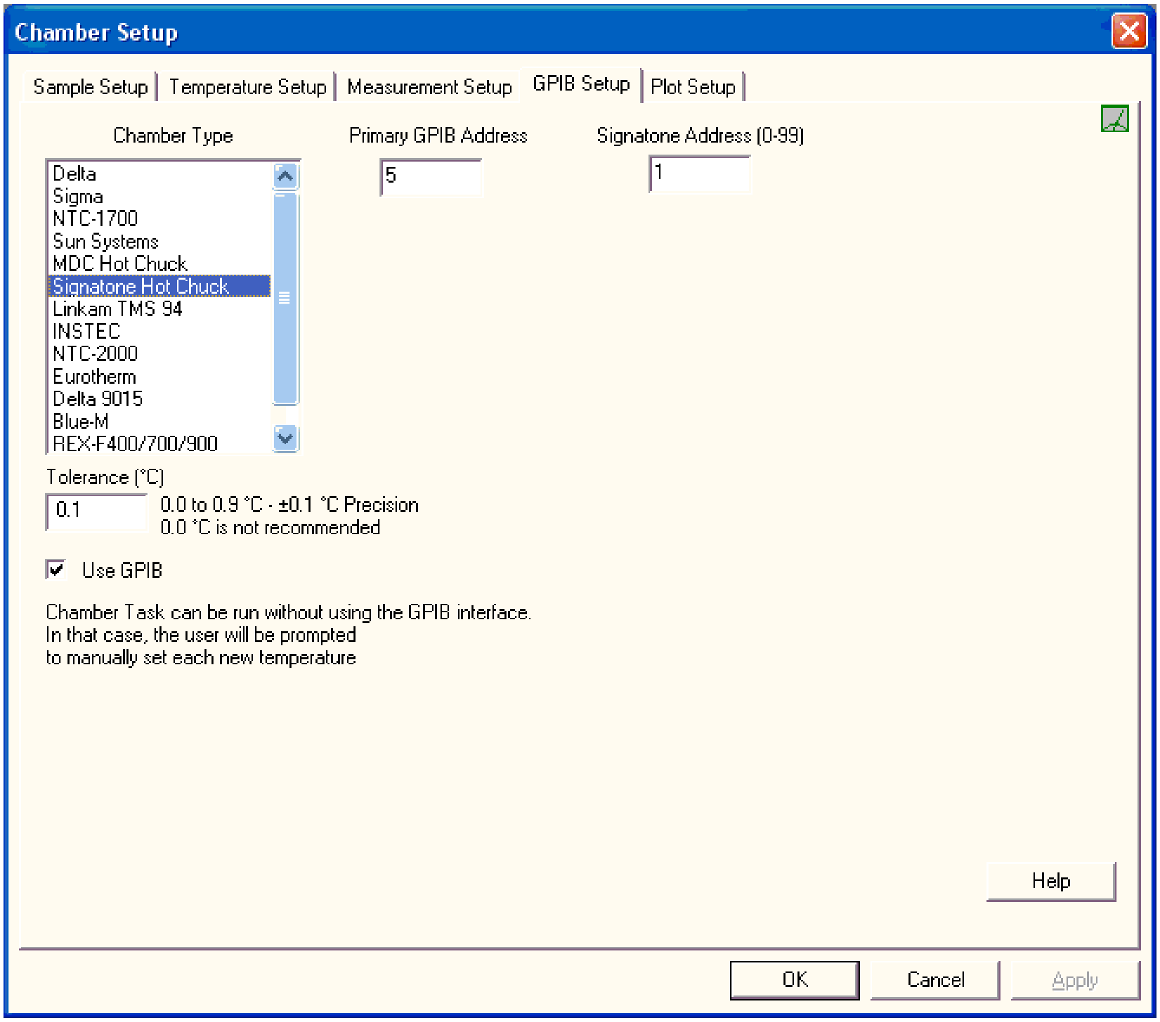


Figure H.1.4 - Chamber Task GPIB Configuration Tab - Signatone Hot Chuck.

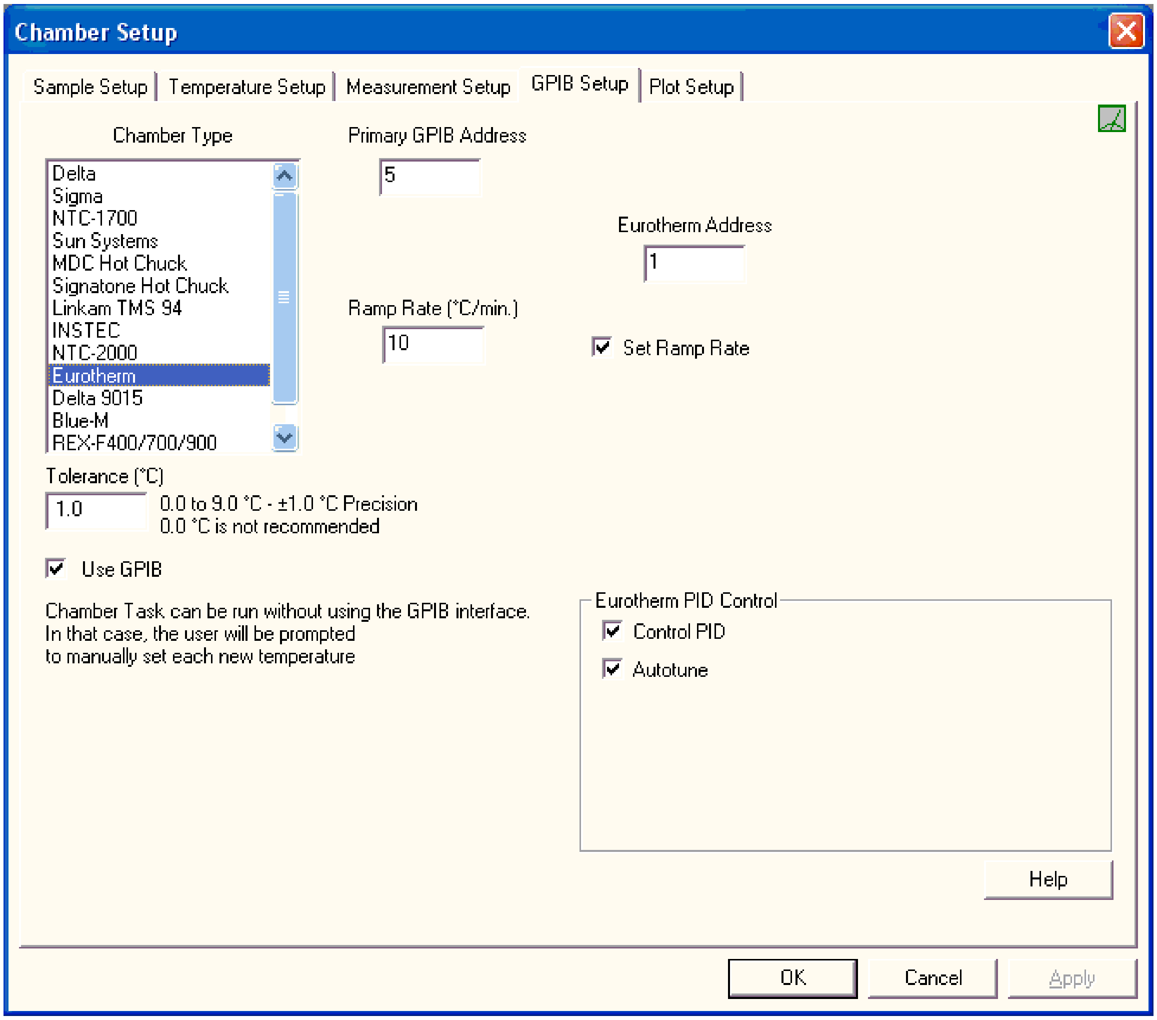


Figure H.1.5 - Chamber Task GPIB Configuration Tab - Eurotherm Furnace Control. Ramp Rate and PID Adjust Available.

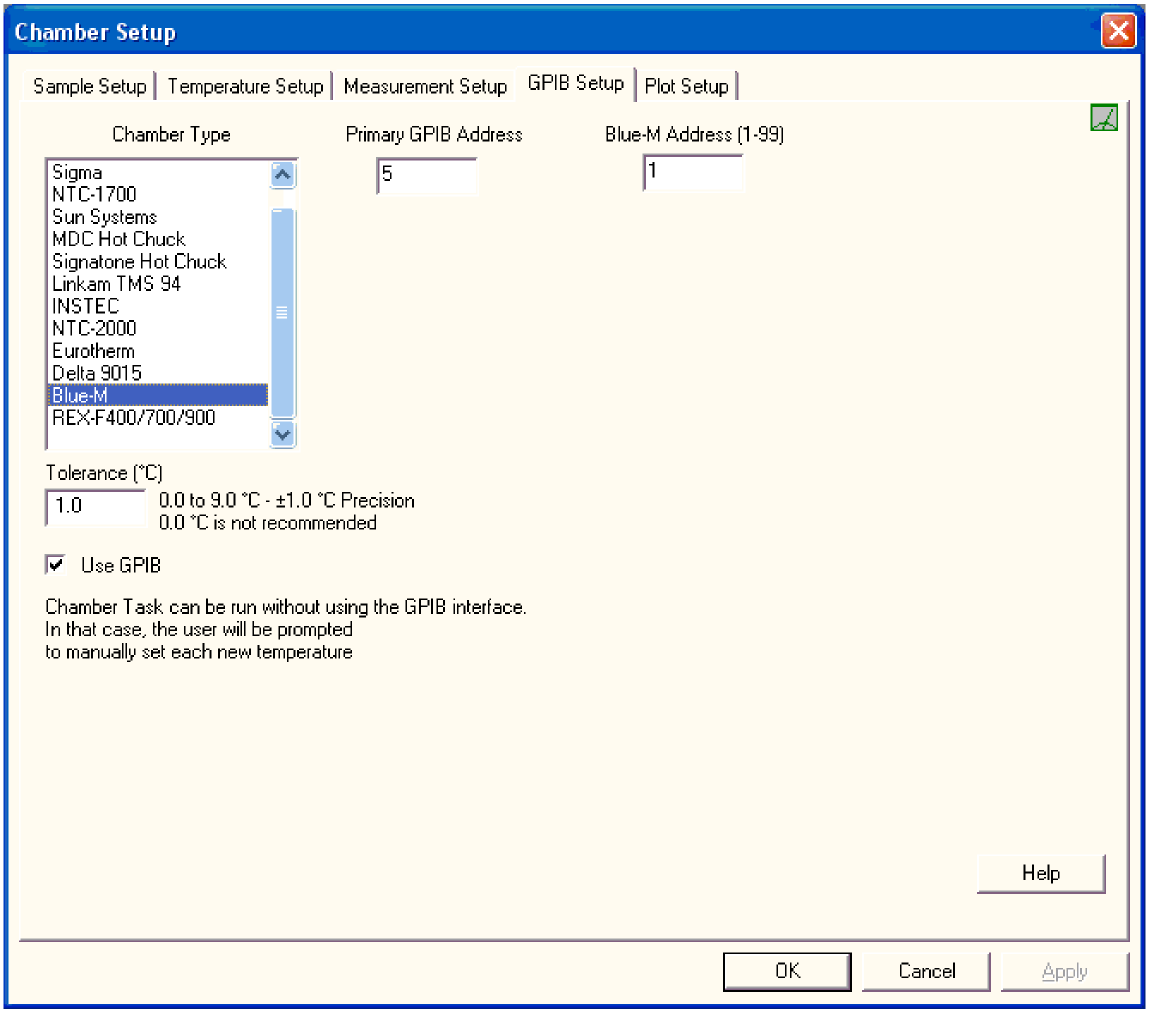


Figure H.1.6 - Chamber Task GPIB Configuration Tab - Blue-M Furnace.

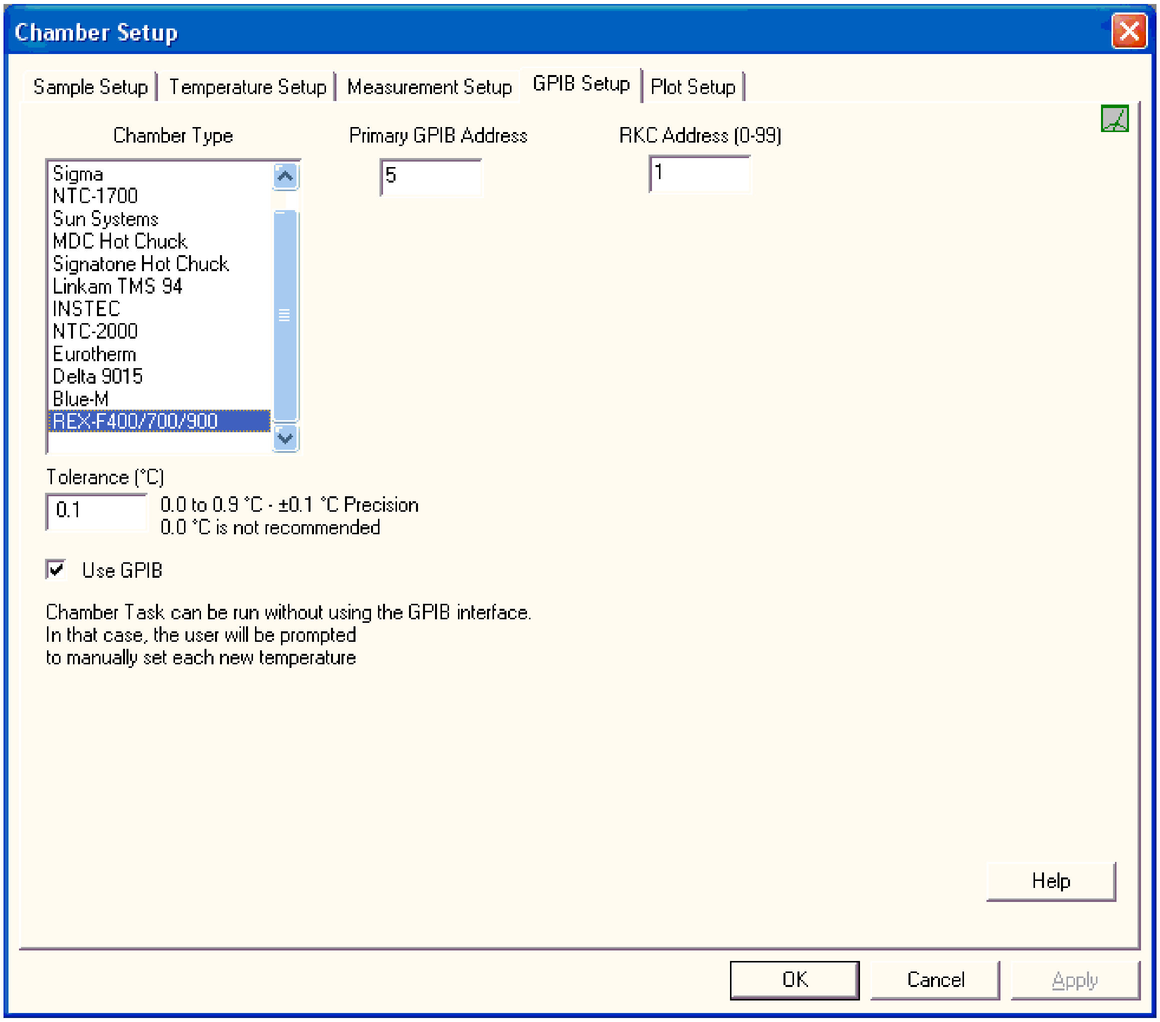


Figure H.1.7 - Chamber Task GPIB Configuration Tab - REX Series Controllers.

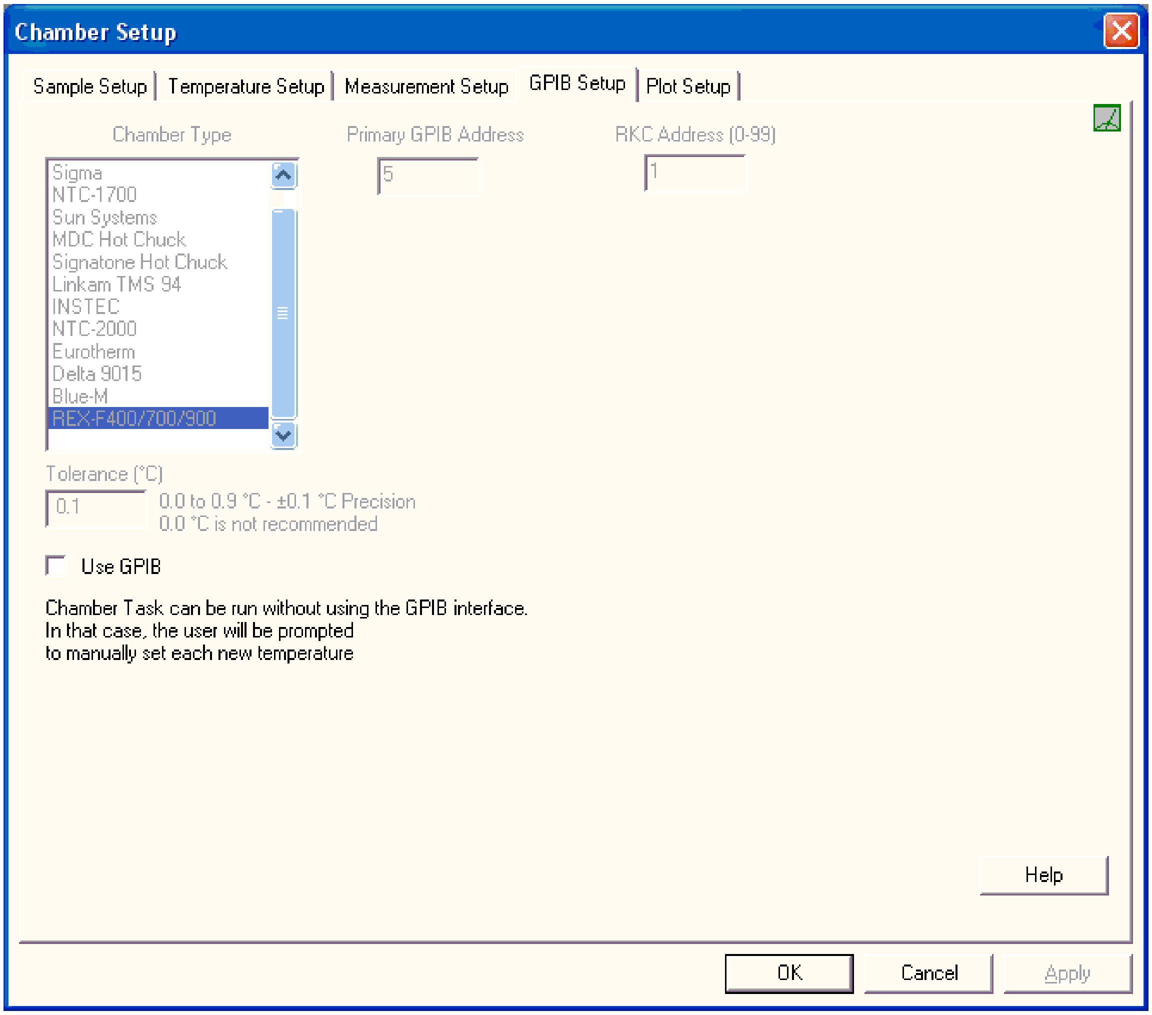


Figure H.1.8 - Chamber Task GPIB Configuration Tab. Manual Temperature Setting is Selected.

H.2 - Discussion

The "GPIB Setup" page is used to set up the GPIB connection to the thermal chamber for automatic temperature control. Automatic control is optional. The program will operate in manual mode by prompting the operator to manually set the required temperature at each new Thermal Cycle. GPIB is enabled or disabled through the GPIB setup dialog. If enabled, the user selects the appropriate chamber type and sets the GPIB primary and secondary addresses. (Normally the secondary address is unused and left to the default value of 0). The default primary address is set to 5, but may be adjusted from 1 to 31 by the user. Chambers that are shipped through Radiant Technologies, Inc. have their GPIB address set to 5. Note that if other instruments are connected to the GPIB bus, their addresses must not conflict.

Two controls appear only when their associated Hot Chuck type is selected in Chamber Type. Both the MDC and the Signatone hot chucks can be chained together. For this reason, they require additional addressing within the GPIB commands. *MDC Address (1-F)* and *Signatone Address (0-99)* only appear when the hot chuck is selected. Note that, except for the INSTEC product, all hot chucks require a duplex RS-232-to-GPIB converter.

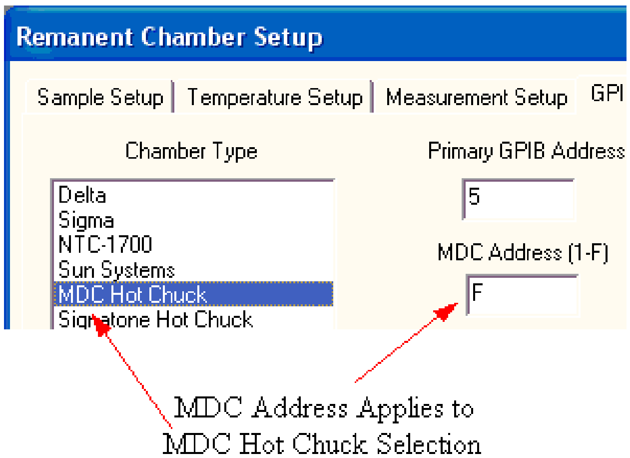


Figure H.2.1 - *MDC Address* Control Appears when "MDC Hot Chuck" is Selected.

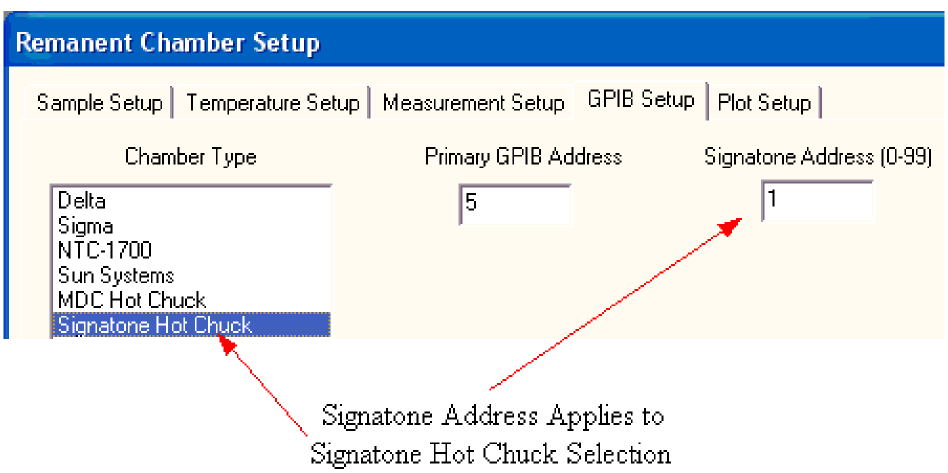


Figure H.2.2 - *Signatone Address* Control Appears when "Signatone Hot Chuck" is Selected.

If the Sigma chamber type is selected, the user has the option of setting a ramp rate in °C/min. If set, the time of ramping from one set temperature to the next will be ordered at the chamber. Ramp time will be in integer minutes and computed by

Absolute(Current Temperature (°C) - Set Temperature (°C)) / Ramp Rate (°C/min.).

The computed value will be rounded to the nearest minute. If ramp time is less than 1 minute, it will be set to 1 minute. This option will be extended to other thermal controllers over time.

The *Tolerance* control has been added to allow the user to control the precision with which the the actual thermal controller temperature approaches the set temperature before the soak period is started. If the difference between actual an set temperature is greater than the *Tolerance* value, the Task will continue to wait for the temperature to change as it samples the current temperature. If the difference is less than or equal to the tolerance, the temperature sampling will cease and the soak period will begin. *Tolerance* is specified between 0.0 and 0.9 °C. A large tolerance value will cause the soak period to start with the temperature significantly different from the set temperature. In this case, the soak period should be lengthened to ensure stability. Too small a sample may mean that the actual temperature will pass through the set temperature, ±tolerance, without being sampled. In this case, the program will continue sampling until the thermal controller returns to a value that is within the tolerance of the set temperature. Note that 0.0 °C is permitted, but is not recommended.

The *Secondary GPIB Address* control has been eliminated and the value set to zero, indicating that the instrument under control has no secondary GPIB address. This control had the potential to lead to confusion and create difficulties in managing GPIB communications.

With Version 4.0.0, several new controllers have been added to the list. Many of these require addresses to be set and some allow Ramp Rate adjustment. The Eurotherm controller also allows the user to set PID values at the request of one customer. PID control is discussed below. The various configuration are shown in Figures 1 through 8. Several controllers share the same control for setting the address. As controllers are switched in *Chamber Type*, address controls are shown or hidden and, when shown, have their labels adjust to reflect the selected controller and the available range of values.

NOTE - Several late changes have been made to accompany the release of Version 4.0.0 of the Chamber Task. These are not completely documented in these pages although they are summarized here.

- **The Vision Data File selection flag is now passed in from the Sample Configuration dialog tab. If the Task is configured to read information from a Vision Data File, all controls and all labels are disabled. This is because the values that are configured in them are to be input from the file. When the Task has executed and is recalled from the DataSet Archive, the labels and text controls will be enabled to show the configuration values read from the file. Text controls will be set to read-only.**

H.3 - Controls

Control	Type	Default	Description
Chamber Type	List Box	Delta	Select the Chamber type to be controlled. If the desired Chamber does not appear on this list, the manual mode must be used by disabling the GPIB. Any GPIB-compatible chamber that does not appear on this list can be added if the user provides a complete chamber manual to Radiant Technologies, Inc. This control is enabled if the *Use GPIB* control is enabled. Otherwise it is disabled.
Primary GPIB Address	Integer	5	0-31. This is the GPIB address of the thermal chamber. If the chamber was purchased through RTI, it will have a value of 5. Up to 15 instruments may be connected to the GPIB bus. No two instruments on the bus may have the same address. 0 is normally reserved for the Precision tester. Advanced GPIB users can adjust the Precision address, chamber address and/or addresses of other instruments to clear conflicts. The address entered here must agree with the address of the thermal chamber. This control is enabled if the *Use GPIB* control is enabled. Otherwise it is disabled.
MDC Address	Character	F	'1'-'F'. The MDC address of the particular hot chuck being addressed for adjustment.
Signatone Address	Integer	0	0 - 99. The Signatone address of the particular hot chuck being addressed for adjustment.
Eurotherm Address	Integer	1	The address of the particular Eurotherm controller being addressed for adjustment. This control is enabled if *Chamber Type* is set to "Eurotherm".
Blue-M Address	Integer	1	1-99. The address of the particular Blue-M thermal controller being addressed for adjustment. This control is enabled if *Chamber Type* is set to "Blue-M". This control piggy-backs with the *Signatone Address* control with the label and limits appropriately set.
RKC Address	Integer	1	0-99. The address of the particular REX Fx00-Series controller being addressed for adjustment. This control is enabled if *Chamber Type* is set to "REX-F400/F700/F900". This control piggy-backs with the *Signatone Address* control with the label and limits appropriately set.
Set Ramp Rate	Check Box	Unchecked	Indicates that the time between the current temperature and the set temperature is to be adjusted to a value in integer minutes that represents the rate of change in temperature set in Ramp Rate (°C/min.). This control is hidden if Chamber Type is not set to Sigma. This control is disabled if *Use GPIB* is not checked. Checking *Set Ramp Rate* enables *Ramp Rate (°C/min.).*
Ramp Rate (°C/min.)	Integer	10	The rate of temperature change to be used to set each temperature. This control is hidden if *Chamber Type* is not set to Sigma. This con-

			trol is disabled if *Use GPIB* is not checked. Checking *Set Ramp Rate* enables *Ramp Rate (°C/min.)*.
Tolerance	Real	0.1	0.0 to 0.9 in °C. The comparative difference between the thermal controller set temperature and the actual current thermal controller temperature used to control the termination of the Task. If the difference is greater than this value the Task will continue sampling the thermal controller current temperature. If the difference is less that or equal to this value the Task will terminate. This control is disabled if *Use GPIB* is not checked. A tolerance of 0.0 °C is permitted but not recommended.
Control PID	Check Box	Checked	Shown only if *Chamber Type* is Set to "Eurotherm". See the detailed discussion below.
Autotune	Check Box	Checked	Shown only if *Chamber Type* is Set to "Eurotherm". See the detailed discussion below.
Pb	Integer	5	Shown only if *Chamber Type* is Set to "Eurotherm" and *Autotune* is disabled. See the detailed discussion below.
Ti	Integer	300	Shown only if *Chamber Type* is Set to "Eurotherm" and *Autotune* is disabled. See the detailed discussion below.
Ti	Integer	600	Shown only if *Chamber Type* is Set to "Eurotherm" and *Autotune* is disabled. See the detailed discussion below.
Hcb	Integer	0	Shown only if *Chamber Type* is Set to "Eurotherm" and *Autotune* is disabled. See the detailed discussion below.
Lcb	Integer	0	Shown only if *Chamber Type* is Set to "Eurotherm" and *Autotune* is disabled. See the detailed discussion below.
Rel. C	Integer	100	Shown only if *Chamber Type* is Set to "Eurotherm" and *Autotune* is disabled. See the detailed discussion below.
Use GPIB	Check Box	Disabled	Checking this box places the Chamber Task into automatic mode and enables *Chamber Type*, *Primary GPIB Address* and *Secondary GPIB Address*. Unchecking the box sets the manual temperature adjust mode and disables the listed controls.
Help	Button	Unpressed	Open these HTML Help pages.

H.4 - PID Adjustment

The Eurotherm 2404 controller, if selected, allows the PID (Proportional-Integral-Differential) parameters of the controller to be adjusted. These parameters are coefficients into the controller functions that examine target temperature, current temperature, set ramp rate, measured ramp rate, power applied to the heating coils, etc. to control the rise (fall) to temperature to minimize overshoot and accelerate stability. These parameters are normally tuned for the instrument under control and should not be adjusted by anyone who does not have complete understanding of PID operations.

With "Eurotherm" selected in *Chamber Type* the *Eurotherm PID Controls* controls suite appears as in **Figure H.4.1**. Here the PID parameters may be set or *Autotune* selected. With *Autotune* checked, the parameters are adjusted by the controller, so the parameter controls are hidden as in **Figure H.4.2**.

Note that the adjustments performed apply only to PID 1.

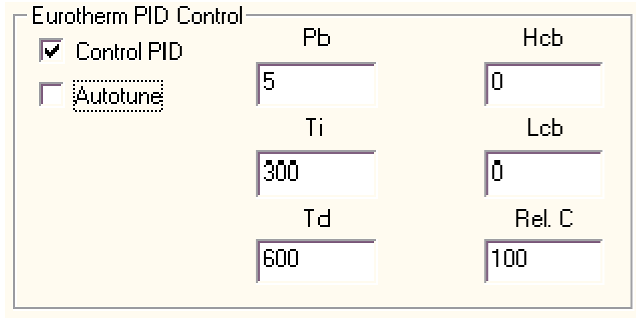


Figure H.4.1 - Eurotherm PID Parameter Adjustment Dialog.

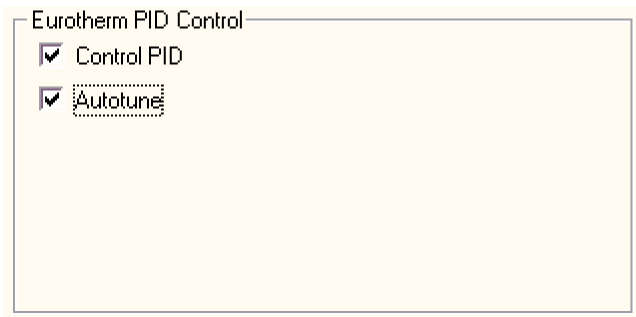


Figure H.4.2 - Eurotherm PID Parameter Adjustment Dialog in Autotune mode.

H.5 - Controls

Name	Type	Default	Description
Control PID	Check Box	Un-checked	Enable or disable PID adjustment. If checked *Autotune* is enabled. If *Autotune* is checked, checking this control enables *Pb*, *Ti*, *Lcb*, *Hcb*, *Td* and *Rel. C*. Otherwise these controls are disabled.
Autotune	Check Box	Checked	If the PID is to be controlled, selecting *Autotune* will cause the Eurotherm 2404 controller to self-adjust the PID parameters. BE SURE TO REVIEW THE OPERATING MANUAL FOR THE PROPER PROCEDURE. With this control enabled, *Pb*, *Ti*, *Lcb*, *Hcb*, *Td* and *Rel. C* are hidden. Otherwise, they are shown.
Pb	Integer	5	Proportional Band. Please see the controller documentation and/or general PID literature for a more detailed description. This control is hidden of *Autotune* is enabled. This control is disabled if *Control PID* is unchecked.
Ti	Integer	300	Integral Time. Please see the controller documentation and/or general PID literature for a more detailed description. This control is hidden of *Autotune* is enabled. This control is disabled if *Control PID* is unchecked.
Lcb	Integer	0	Low Cutback. Please see the controller documentation and/or general PID

			literature for a more detailed description. This control is hidden of *Autotune* is enabled. This control is disabled if *Control PID* is unchecked.
Hcb	Integer	0	High Cutback. Please see the controller documentation and/or general PID literature for a more detailed description. This control is hidden of *Autotune* is enabled. This control is disabled if *Control PID* is unchecked.
Td	Integer	600	Derivative Time. Please see the controller documentation and/or general PID literature for a more detailed description. This control is hidden of *Autotune* is enabled. This control is disabled if *Control PID* is unchecked.
Rel. C	Integer	100	Relative Cool Gain. Please see the controller documentation and/or general PID literature for a more detailed description. This control is hidden of *Autotune* is enabled. This control is disabled if *Control PID* is unchecked.
OK	Button	Unpressed	Accept the PID adjustment configuration.
Cancel	Button	Unpressed	Close the dialog. Make no changes to previous PID settings.

I - Plot Dialog

Task Name:	Chamber
Version:	4.0.0
Last Task Update:	9 June 2007
In QuikLook Menu:	No
Folder:	Hardware
Subfolder:	Measurement
Subsubfolder:	Long Duration
Window Name:	Chamber Setup - Plot Setup
Change Record:	**Go to Change Record**
Known Bugs:	None
User Variables Added:	Go to List

I.1 - Setup Dialog

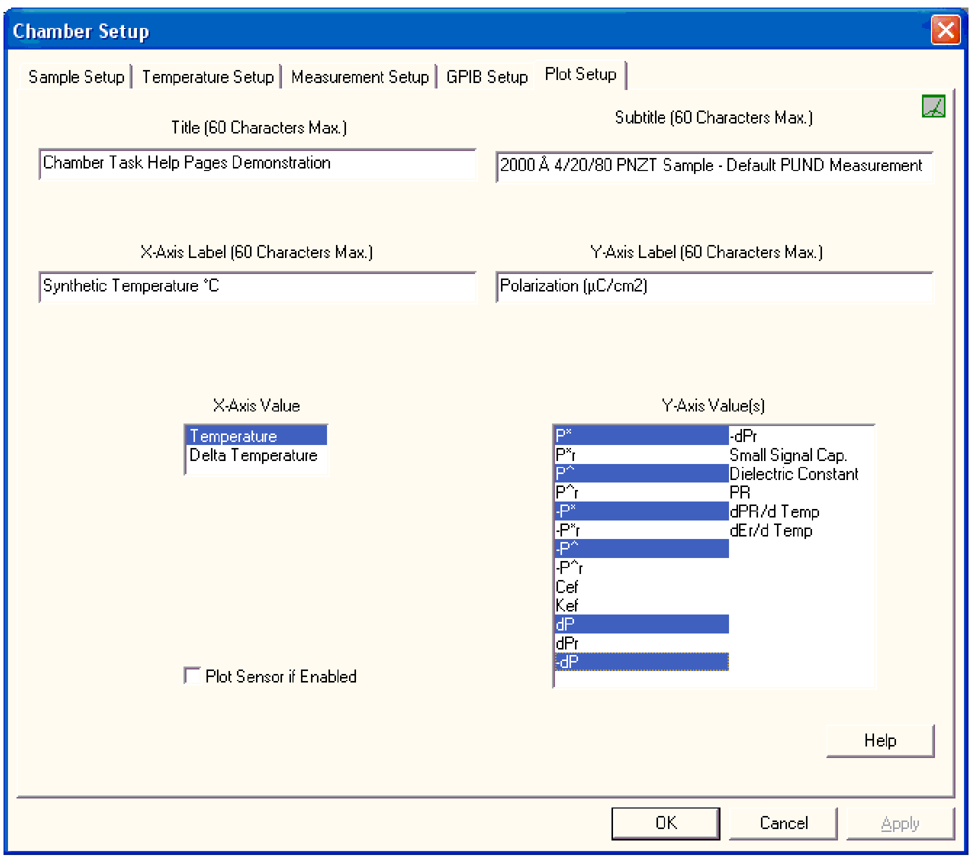


Figure I.1.1 - Chamber Task Plot Configuration Tab.

I.2 - Description

Unlike most Tasks, since the Chamber Task runs over a long period of time, it is able to plot its own data during execution without the need to append a Filter Task. The "Plot Setup" page is used to configure the plot by specifying the various labels and selecting the plotted parameters. Multiple measured and derived parameters may be plotted in any combination. Values may be plotted as a function of either the actual measurement temperature, or against the change in temperature from Thermal Cycle to Thermal Cycle. In the latter case, the initial value will be plotted as a function of 0.0 °C change in temperature.

$$dP = P* - P\wedge$$
$$dP_r = P*_r - P\wedge_r$$
$$-dP = -P* - (-P\wedge)$$
$$-dP_r = -P*_r - (-P\wedge_r)$$

Unlike most dialogs, this dialog is active when the Chamber Task is recalled from an Executed Test Definition. This allows the recalled data to be regraphed in any format, not just the format that was configured before execution. Plot titles and labels may be changed, along with the values that will be plotted.

NOTE - Several late changes have been made to accompany the release of Version 4.0.0 of the Chamber Task. These are not completely documented in these pages although they are summarized here.

- **The Vision Data File selection flag is now passed in from the Sample Configuration dialog tab. If the Task is configured to read information from a Vision Data File, all controls and all labels are disabled. This is because the values that are configured in them are to be input from the file. When the Task has executed and is recalled from the DataSet Archive, the labels and text controls will be enabled to show the configuration values read from the file. Text controls will be set to read-only.**
- **The selected Measurement Type is passed in from the Measurement Configuration dialog. The values listed in the *Y-Axis Values* list box will depend on the measurement type selected. Only PUND values are selectable if the type is "PUND". Only Small Signal values are available if the type is "SSAC". All values are available if the type is "Both".**

I.3 - Controls

Control	Type	Default	Description
Title	Text	""	60-Character maximum. A user-defined label for the plot
Subtitle	Text	""	60-Character maximum. A secondary user label for the plot
X Axis Label	Text	"Temperature (°C)"	The label for the independent X variable. Care should be taken to ensure this value reflects the selected X Axis value.
Y Axis Label	Text	""	The label for the dependent measured and/or derived Y values. Care should be taken to ensure that this value reflects the selected Y Axis value(s). Any number of Y values may be selected and their labels need not necessarily correspond.
X Axis Value	List Box	Temperature	Select either Actual Measure Temperature or the change in temperature between Thermal Cycles as the independent X Value.
Y Axis Value(s)	List Box	Displacement	Select any number of measured and/or derived Chamber response parameters to be plotted. **See Note * Below.**
Plot Sensor if Enabled	Check Box	Disabled	Checking this box will cause the measured Sensor values to be placed on the plot as a trace, labeled with the Sensor Label, provided the Sensor data measurement is enabled.
Help	Button	Unpressed	Open these HTML Help pages.

* dPR/D Temp and dEr/D Temp refer to two derivative plot options that can be shown simultaneously with any other options. Using dEr/D Temp** as an example, a sample point is plotted as:

$$Y_x = \begin{Bmatrix} 0 & \mid x = 0 \\ \dfrac{\varepsilon_r(\theta_x) - \varepsilon_r(\theta_{x-1})}{\theta_x - \theta_{x-1}} & \mid x > 0, \theta_x \neq \theta_{x-1} \\ 0 & \mid x > 0, \theta_x = \theta_{x-1} \end{Bmatrix} \text{ Vs } \theta_x \text{ for Thermal Cycle } x$$

** The Chamber Task is unable to display general Greek symbols or subscripts or superscripts. A 'µ' may be entered into text controls by pressing the <Alt> key and typing '0181'.

J - Archive Regraph and Exporting

The data shown in the figures in this section were measured on a 2000 Å, 100 µm X 100 µm 4/20/80 PNZT Sample. Measured values are accurate. However, the Task was run in manual temperature mode with no actual temperature change. All measurements are made at room ambient temperature.

J.1. Archive Regraph

As with any Task, once the Chamber Task has completed execution it is stored into a DataSet Archive. It can be recalled from the Archive to review both the Task configuration and the measured and derived data. To recall the Chamber Task, open the desired DataSet and its Archive. Open the desired Executed Test Definition (ETD) and the "Experiment Data" Folder and double-click on the desired Chamber Task.

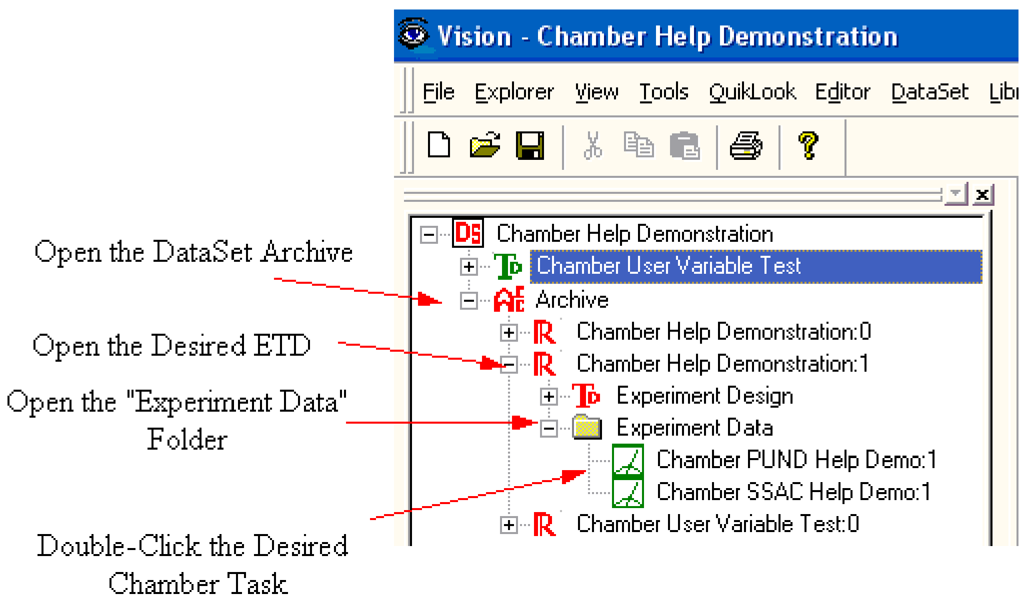


Figure J.1.1 - Recall the Chamber Task from the DataSet Archive.

The configuration dialog will open. Most controls are disabled and for configuration review only. *Set Sample Info*, *Adjust Mux* and *Set Amplifier* buttons to allow their subdialogs to open for review. The subdialogs will have their controls disabled. *Export* is available to allow Chamber configuration parameters and data to be written to a source outside of Vision as described below. *Help* is available. *OK* and *Cancel* both close the dialog an follow it by a presentation of the plotted data. All tabs are accessible for configuration review. The "Plot Setup" tab is completely enabled to allow the data to be replotted in any possible combination and configuration. This keeps data that were not originally plotted during execution accessible for review. Note that for any Task configured to read data from a Chamber Vision Data File controls are also enabled and controls previously grayed are now set to read-only. That is because the dialog now reflects the actual configuration of the Task that took the data

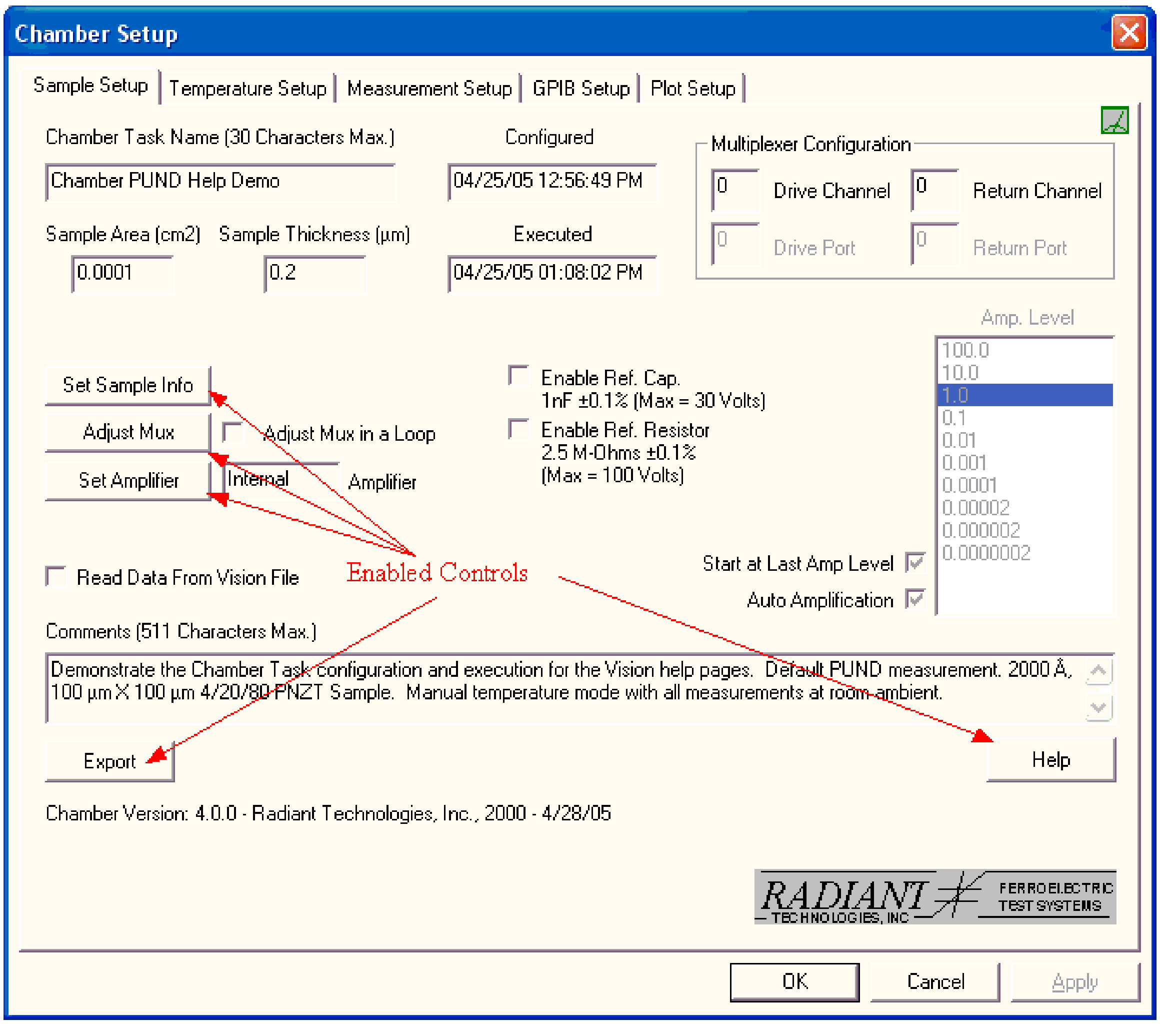


Figure J.1.2 - Chamber Task Sample Dialog Tab Recalled from a DataSet Archive.

When the dialog is closed, the data will appear in a plot window. Titles and selected data will be those configured in the "Plot Setup" tab after the dialog was recalled from the DataSet Archive. If no changes are made to the "Plot Setup" tab, the plot will be the same as configured for Chamber Task execution.

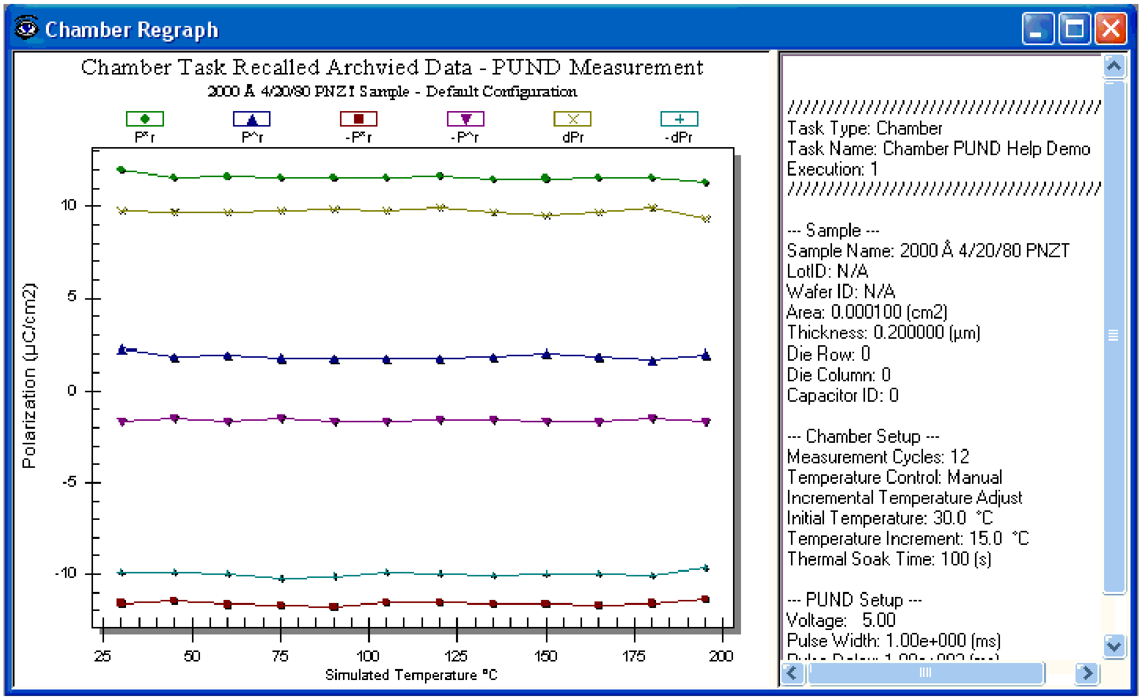


Figure J.1.3 - Chamber Task Data Recalled from a DataSet Archive. Cef is Plotted. Temperatures are Synthetic.

J.2. Exporting Data

All Tasks can have their data exported to one of five targets outside of Vision when recalled from a DataSet Archive after the execution of a the Test Definition in which they are programmed. In order to perform the exporting during the execution of the Test Definition, most Tasks must be associated with a Print/Export Filter and cannot directly export their data. Chamber, along with other long-duration Measurement Tasks such as Fatigue or Resist, has the exceptional ability to directly export data during execution as well as during Archive Regraph. Some minor restrictions do apply to that export and these are noted below under the discussions of the export targets. Targets are:

- **Printer** - This is the default selection. Pre-formatted text is sent to the printer attached to the Precision Tester (Workstation and Premier testers) or the tester host computer (all others) when the configuration dialog is closed. As of version 4.0.0, *Line Spacing*, *Left Margin* and *Tab Spacing* controls are shown on the dialog when "Print" is selected in Select Option. These allow text horizontal and vertical placement to be adjusted, through trial-and-error, for the particular printer. A *Header Only* option restricts the output to Task configuration information, eliminating extensive lists of measured data and reducing the output length. Before output begins, the appropriate Window printer configuration dialog will appear as in **Figure J.2.2**.

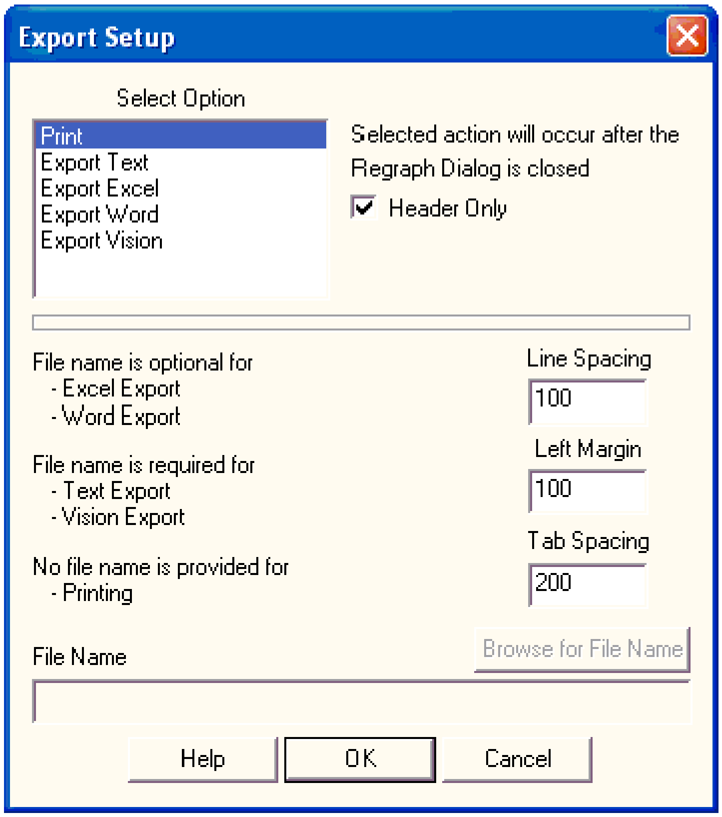


Figure J.2.1 - Export Dialog with Printer Configuration Selected.

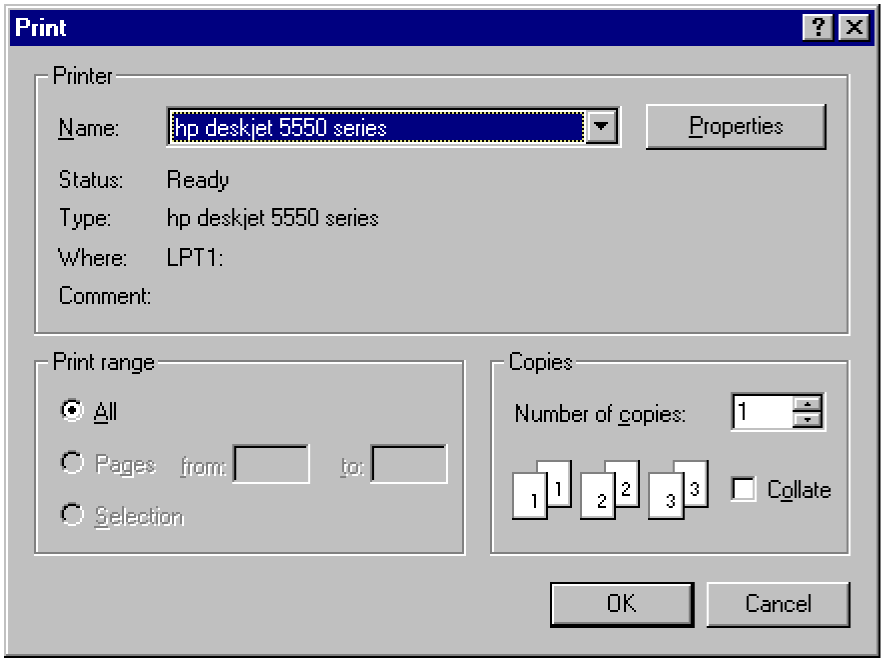


Figure J.2.2 - Standard Windows Printer Configuration Dialog.

- **Text File** - Selecting this option enables the *Browse for File Name* button. Clicking this button will open a standard browser dialog in which a file name and path must be selected. If the file already exists, the output will be appended to existing text. An output file name must be specified for this export. The figures show a partial sample of the text export from a file generated using the data shown in **Figure J.1.3**.

  Execution-Time Exporting - When the text export is performed during Task execution, the first iteration of the Set Temperature/Measure cycling will generate the file and write a full Task configuration description. Each new Temperature/Measurement cycle will append only the measured data to the file. If the Task is located in a Branch Loop the output of each full execution of the Task will be appended to the same file.

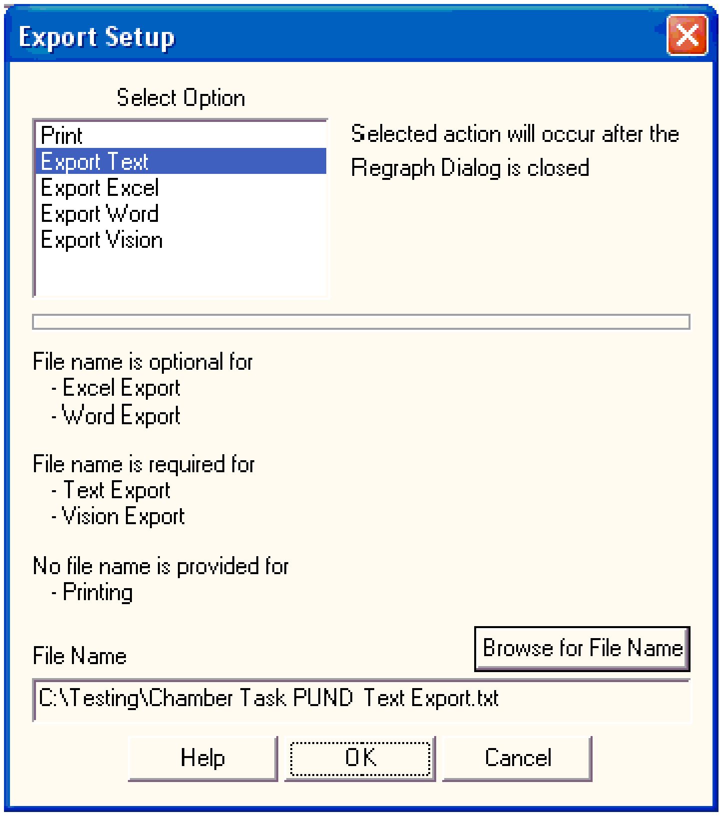
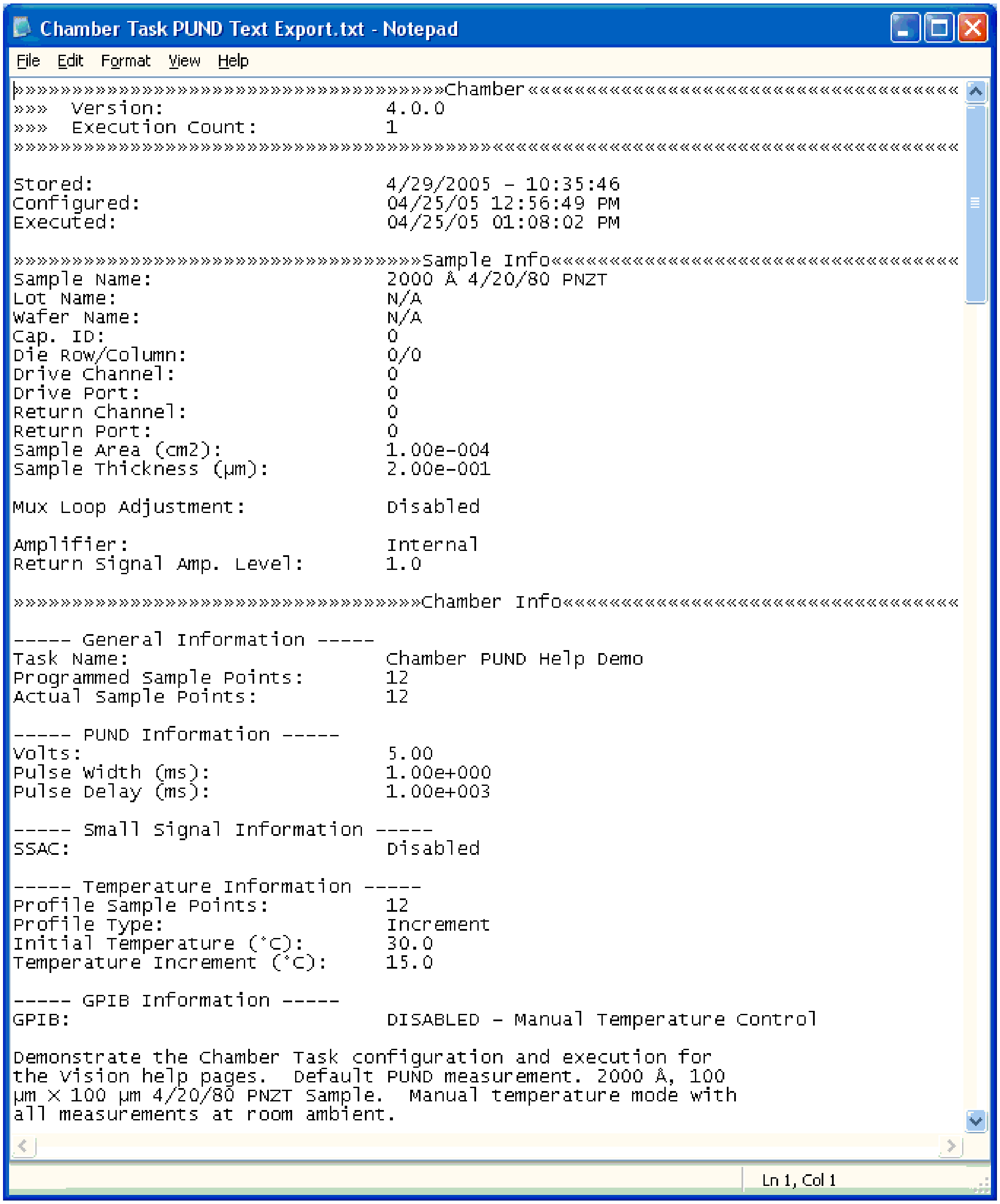


Figure J.2.3 - Export Dialog with Text Configuration Selected.



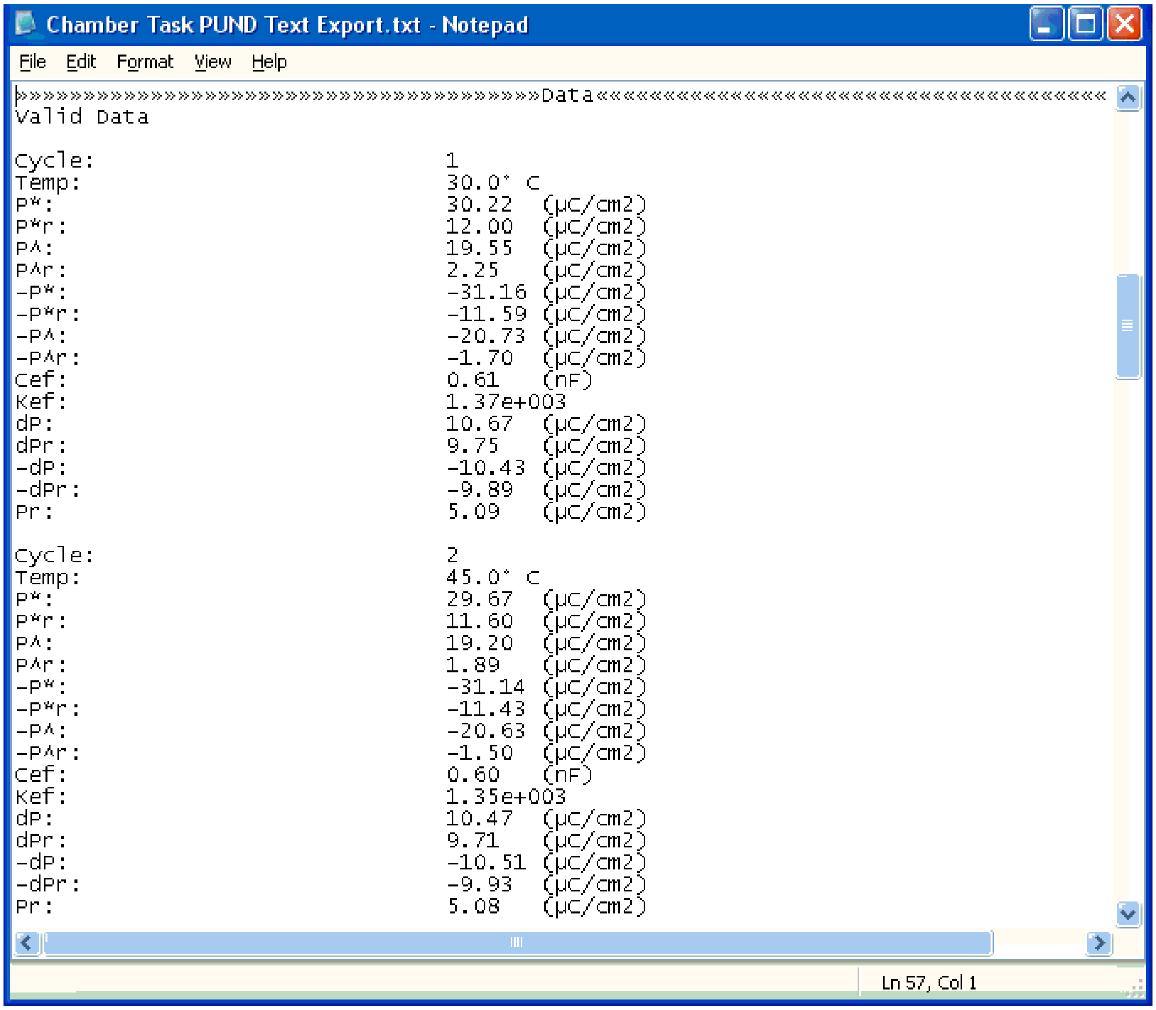
Chamber Task PUND Text Export.txt - Notepad

File Edit Format View Help

```
»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»Chamber«««««««««««««««««««««««««««««««««««««
»»»  Version:                       4.0.0
»»»  Execution Count:               1
»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»««««««««««««««««««««««««««««««««««««««««««

Stored:                             4/29/2005 - 10:35:46
Configured:                         04/25/05 12:56:49 PM
Executed:                           04/25/05 01:08:02 PM

»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»Sample Info««««««««««««««««««««««««««««««««««««
Sample Name:                        2000 Å 4/20/80 PNZT
Lot Name:                           N/A
Wafer Name:                         N/A
Cap. ID:                            0
Die Row/Column:                     0/0
Drive Channel:                      0
Drive Port:                         0
Return Channel:                     0
Return Port:                        0
Sample Area (cm2):                  1.00e-004
Sample Thickness (µm):              2.00e-001

Mux Loop Adjustment:                Disabled

Amplifier:                          Internal
Return Signal Amp. Level:           1.0

»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»Chamber Info«««««««««««««««««««««««««««««««««««

----- General Information -----
Task Name:                          Chamber PUND Help Demo
Programmed Sample Points:           12
Actual Sample Points:               12

----- PUND Information -----
Volts:                              5.00
Pulse Width (ms):                   1.00e+000
Pulse Delay (ms):                   1.00e+003

----- Small Signal Information -----
SSAC:                               Disabled

----- Temperature Information -----
Profile Sample Points:              12
Profile Type:                       Increment
Initial Temperature (°C):           30.0
Temperature Increment (°C):         15.0

----- GPIB Information -----
GPIB:                               DISABLED - Manual Temperature Control

Demonstrate the Chamber Task configuration and execution for
the Vision help pages.  Default PUND measurement. 2000 Å, 100
µm x 100 µm 4/20/80 PNZT Sample.  Manual temperature mode with
all measurements at room ambient.
```

Ln 1, Col 1

Figure J.2.4- Chamber Task Sample Text Export File. Upper Portion.

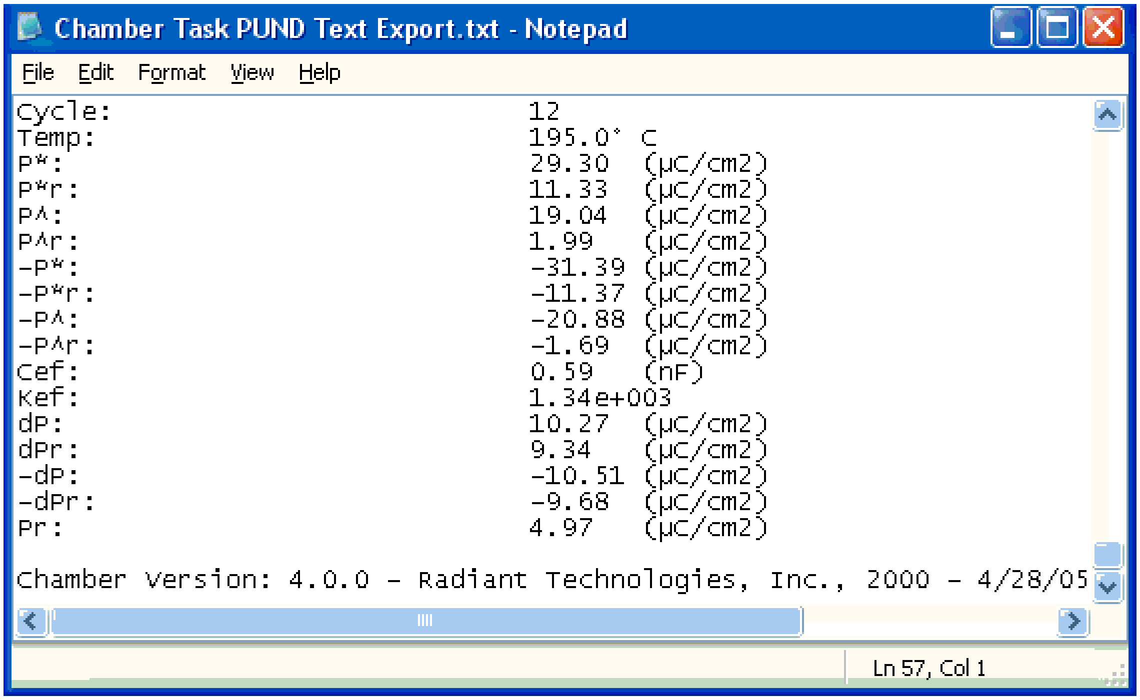

Chamber Task PUND Text Export.txt - Notepad

File Edit Format View Help

```
»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»Data««««««««««««««««««««««««««««««««««««««««
Valid Data

Cycle:                          1
Temp:                           30.0° C
P*:                             30.22   (µC/cm2)
P*r:                            12.00   (µC/cm2)
P^:                             19.55   (µC/cm2)
P^r:                            2.25    (µC/cm2)
-P*:                            -31.16  (µC/cm2)
-P*r:                           -11.59  (µC/cm2)
-P^:                            -20.73  (µC/cm2)
-P^r:                           -1.70   (µC/cm2)
Cef:                            0.61    (nF)
Kef:                            1.37e+003
dP:                             10.67   (µC/cm2)
dPr:                            9.75    (µC/cm2)
-dP:                            -10.43  (µC/cm2)
-dPr:                           -9.89   (µC/cm2)
Pr:                             5.09    (µC/cm2)

Cycle:                          2
Temp:                           45.0° C
P*:                             29.67   (µC/cm2)
P*r:                            11.60   (µC/cm2)
P^:                             19.20   (µC/cm2)
P^r:                            1.89    (µC/cm2)
-P*:                            -31.14  (µC/cm2)
-P*r:                           -11.43  (µC/cm2)
-P^:                            -20.63  (µC/cm2)
-P^r:                           -1.50   (µC/cm2)
Cef:                            0.60    (nF)
Kef:                            1.35e+003
dP:                             10.47   (µC/cm2)
dPr:                            9.71    (µC/cm2)
-dP:                            -10.51  (µC/cm2)
-dPr:                           -9.93   (µC/cm2)
Pr:                             5.08    (µC/cm2)
```

Ln 57, Col 1

Figure J.2.5 - Chamber Task Sample Text Export File. Central Portion.



Chamber Task PUND Text Export.txt - Notepad

File Edit Format View Help

Cycle:	12
Temp:	195.0° C
P*:	29.30 (µC/cm2)
P*r:	11.33 (µC/cm2)
P^:	19.04 (µC/cm2)
P^r:	1.99 (µC/cm2)
-P*:	-31.39 (µC/cm2)
-P*r:	-11.37 (µC/cm2)
-P^:	-20.88 (µC/cm2)
-P^r:	-1.69 (µC/cm2)
Cef:	0.59 (nF)
Kef:	1.34e+003
dP:	10.27 (µC/cm2)
dPr:	9.34 (µC/cm2)
-dP:	-10.51 (µC/cm2)
-dPr:	-9.68 (µC/cm2)
Pr:	4.97 (µC/cm2)

Chamber Version: 4.0.0 - Radiant Technologies, Inc., 2000 - 4/28/05

Ln 57, Col 1

Figure J.2.6 - Chamber Task Sample Text Export File. Lower Portion.

- **Excel** - Selecting this option enables the *Browse for File Name* button. Clicking this button will open a standard browser dialog in which a file name and path may be selected. Specifying a file name is optional when the Task is recalled from a DataSet Archive. However, if specified, a unique file name/file path must be created or an overwrite situation will occur. Data are not appended to existing files. When the configuration dialog is closed, the Excel program will be started and a spread sheet created. When Excel is closed, the data will be written to the specified file name, or the user will be prompted to save if the file is not specified. Programmatic techniques for producing Excel '97 files were provided by Lacoude and Ketema[2]**. Office '97 or Office 2000 must be loaded for this option**. Office is not provided as standard with the tester or Vision software. Utilities to write to Office 2003 or Office XP are not yet available. The figures show a sample of the Excel export file. Office 2000 exporting has been added as of Version 4.0.0.

  Execution-Time Exporting - When configuring the Task for export to Excel during execution, a file name <u>must</u> be specified. Excel will not appear during execution, but the Task will create, write and close the file on each Set Temperature/Measure cycle. Each cycle produces a new file that includes all configuration information and all measured data up to that point. The programmed file name serves as a base name for a family of files generated by the Task on execution. Furthermore, if the Task is located in a Branch Loop, a new series of files will be generated with each Branch Loop execution of the Task. To distinguish the files, the name takes the form:

file name.x.y.xls

Where *file name* is the user-programmed basis text, *x* is the serialized iteration count of the Set Temperature/Measure cycle being saved and *y* is the Branch Loop iteration count and xls is the standard Excel file extension.

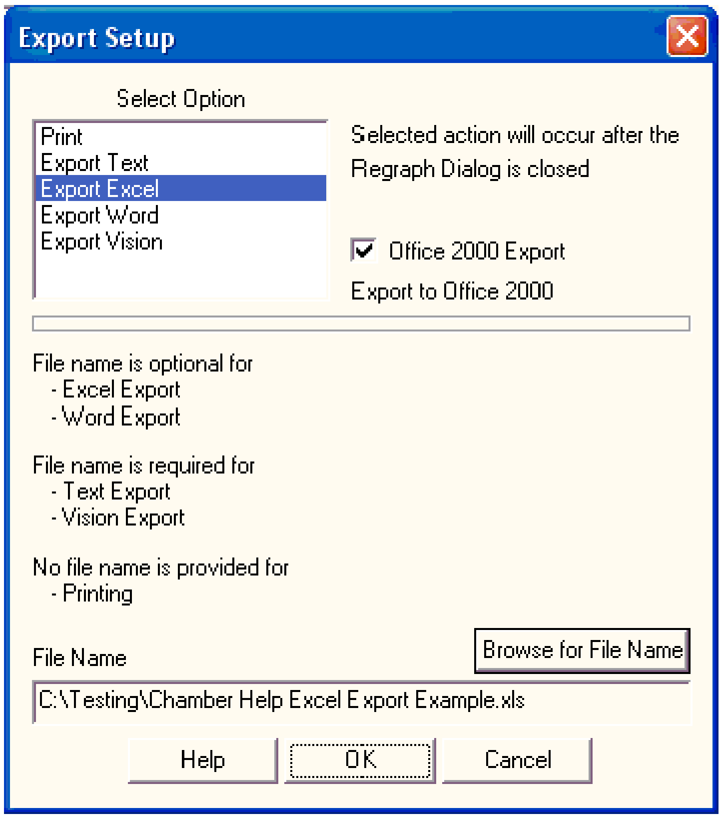


Figure J.2.7 - Export Dialog with Excel Configuration Selected.

Microsoft Excel - Chamber Help Excel Export Example.xls

	A	B
1	**Chamber**	
2	Version	4.0.0
3		
4	Execution Count	1
5	Excel Date	6/20/2005 - 10:17:14
6	Configuration Date	4/25/2005 12:56
7	Execution Date	4/25/2005 13:08
8		
9	**Sample Information**	
10	Sample Name	2000 Å 4/20/80 PNZT
11	Lot Name	N/A
12	Wafer Name	N/A
13	Die Row/Column	0/0
14	Capacitor ID	0
15	Area (cm^2)	0.0001
16	Thickness (µm)	0.2
17		
18	Mux Adjust	Disabled
19		
20	Amplifier	Internal
21	Return Signal Amp. Level	1
22		
23	**Chamber Information**	
24	*General Information*	
25	Task Name	Chamber PUND Help Demo
26	Programmed Sample Points	12
27	Actual Sample Points	12
28		
29	*PUND Information*	
30	Volts	5
31	Pulse Width (ms)	1
32	Pulse Delay (ms)	1000
33		
34	*Small Signal Information*	
35	Small Signal	Disabled
36		
37	*Temperature Information*	
38	Profile Type	Increment
39	Initial Temperature (°C)	30
40	Temperature Increment (°C)	15
41		
42	*GPIB Information*	
43	GPIB DISABLED	Manual Temperature Control

Figure J.2.8 - Chamber Task Sample Excel Export Output. Upper Portion.

45	**Data**										
46	Sample	Temperature (°C)	P* (µC/cm²)	P*r (µC/cm²)	P^ (µC/cm²)	P^r (µC/cm²)	-P* (µC/cm²)	-P*r (µC/cm²)	-P^ (µC/cm²)	-P^r (µC/cm²)	Cef
47	1	30	30.22338867	12.00140381	19.54925537	2.254760742	-31.15887451	-11.58563232	-20.73260498	-1.695068359	0.607284768
48	2	45	29.67169189	11.60162354	19.19744873	1.886962891	-31.1428833	-11.43371582	-20.62866211	-1.503173828	0.59818014
49	3	60	29.63970947	11.62561035	19.11749268	1.934936523	-31.48669434	-11.66558838	-20.9085083	-1.679077148	0.596214856
50	4	75	29.57574463	11.57763672	19.22143555	1.822998047	-31.41473389	-11.6975708	-20.79656982	-1.471191406	0.595147384
51	5	90	29.51177979	11.59362793	19.19744873	1.751037598	-31.24682617	-11.76153564	-20.83654785	-1.631103516	0.595176022
52	6	105	29.43182373	11.5536499	19.12548828	1.79901123	-31.23083496	-11.5536499	-20.98046875	-1.639099121	0.591162192
53	7	120	29.35186768	11.6975708	19.03753662	1.767028809	-31.33477783	-11.51367188	-20.95648193	-1.551147461	0.591514145
54	8	135	29.37585449	11.52166748	18.98956299	1.87097168	-31.32678223	-11.64160156	-20.9085083	-1.551147461	0.591125031
55	9	150	29.33587646	11.53765869	18.99755859	2.046875	-31.32678223	-11.62561035	-20.87652588	-1.647094727	0.590103131
56	10	165	29.41583252	11.59362793	19.11749268	1.894958496	-31.35076904	-11.67358398	-20.87652588	-1.687072754	0.592147684
57	11	180	29.27990723	11.56964111	19.07751465	1.663085938	-31.25482178	-11.58563232	-20.88452148	-1.511169434	0.589846305
58	12	195	29.30389404	11.32977295	19.03753662	1.990905762	-31.39074707	-11.36975098	-20.88452148	-1.687072754	0.590547355
59											
60	Valid Data										
61											
62	Demonstrate the Chamber Task configuration and execution for										
63	the Vision help pages. Default PUND measurement. 2000 Å, 100										
64	µm X 100 µm 4/20/80 PNZT Sample. Manual temperature mode with										

Figure J.2.9 - Chamber Task Sample Excel Export Output. Lower Portion.

- **Word** - Selecting this option enables the *Browse for File Name* button. Clicking this button will open a standard browser dialog in which a file name and path may be selected. Specifying a file name is optional. The Word program will be opened and written when the regraph dialogs have been closed. If a new file name is specified, the document will be saved immediately. Word export to Office '97 depends on two template files - "Template.doc" and "Template2.doc"- located in "D:\DataSets" (C:\DataSets for the Precision LC tester family.). These are blank Word files. Template.doc is in portrait orientation with tabs at 1", 2.5", and 4". Template2.doc is in landscape orientation with tabs at 1", 2.5", 4" and 6". Both pages are set to Times New Roman 12 pt font. Word export output is formatted to align properly with these settings. Care must be taken not to overwrite the templates. If no file name is specified, the user will be prompted to save the documents when closed. If the documents are saved, the template file will be overwritten. In this event, the file should be renamed appropriately and a new template file created with the specifications given above. Exporting to Word 2000 does not depend on the template files. **Office '97 or Office 2000 must be loaded for this option**. Office is not provided with the tester or Vision software. Utilities to write to Office 2003 or Office XP are not yet available. **The Word export option has been added as of Version 3.1.0. Office 2000 exporting is available as of Version 4.0.0**. The *Header Only* option appears when Word selected. Checking this control (default) suppresses the point-by-point output of measured data. This eliminates many pages of document that simply reflect columns of numbers, greatly reducing document size and clutter. The sample figures show the output with *Header Only* unchecked.

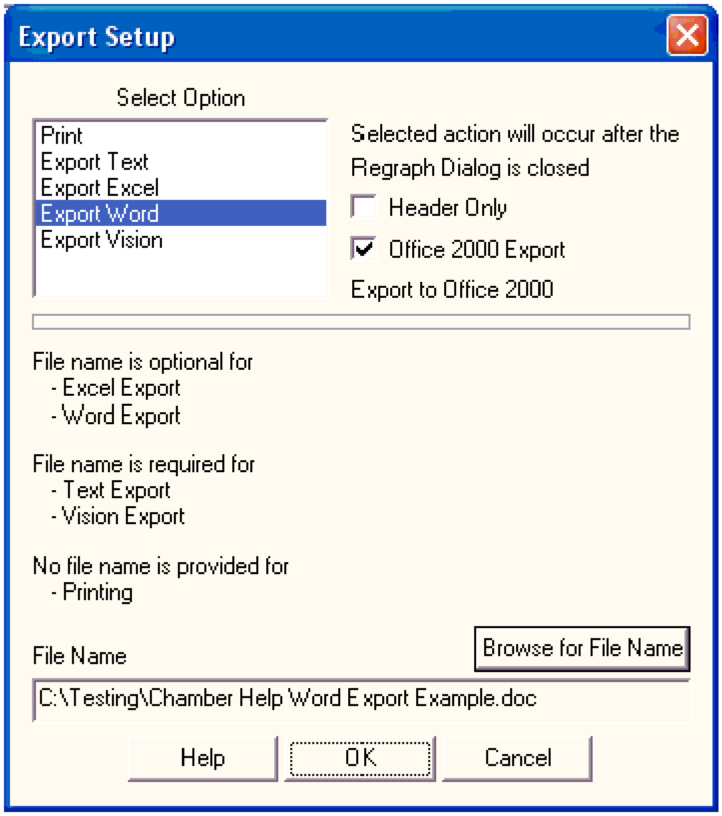


Figure J.2.10 - Export Dialog with Word Configuration Selected.

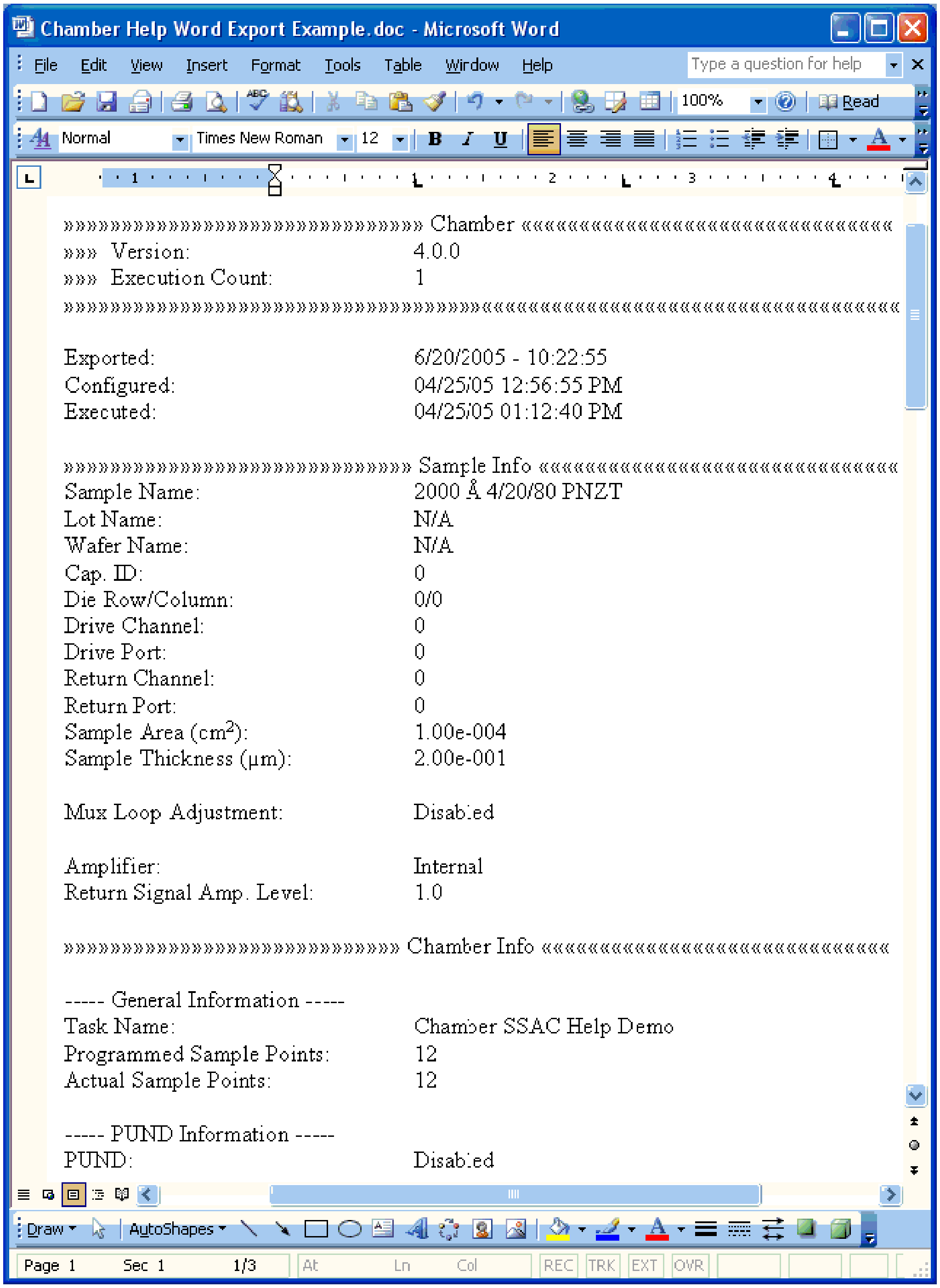
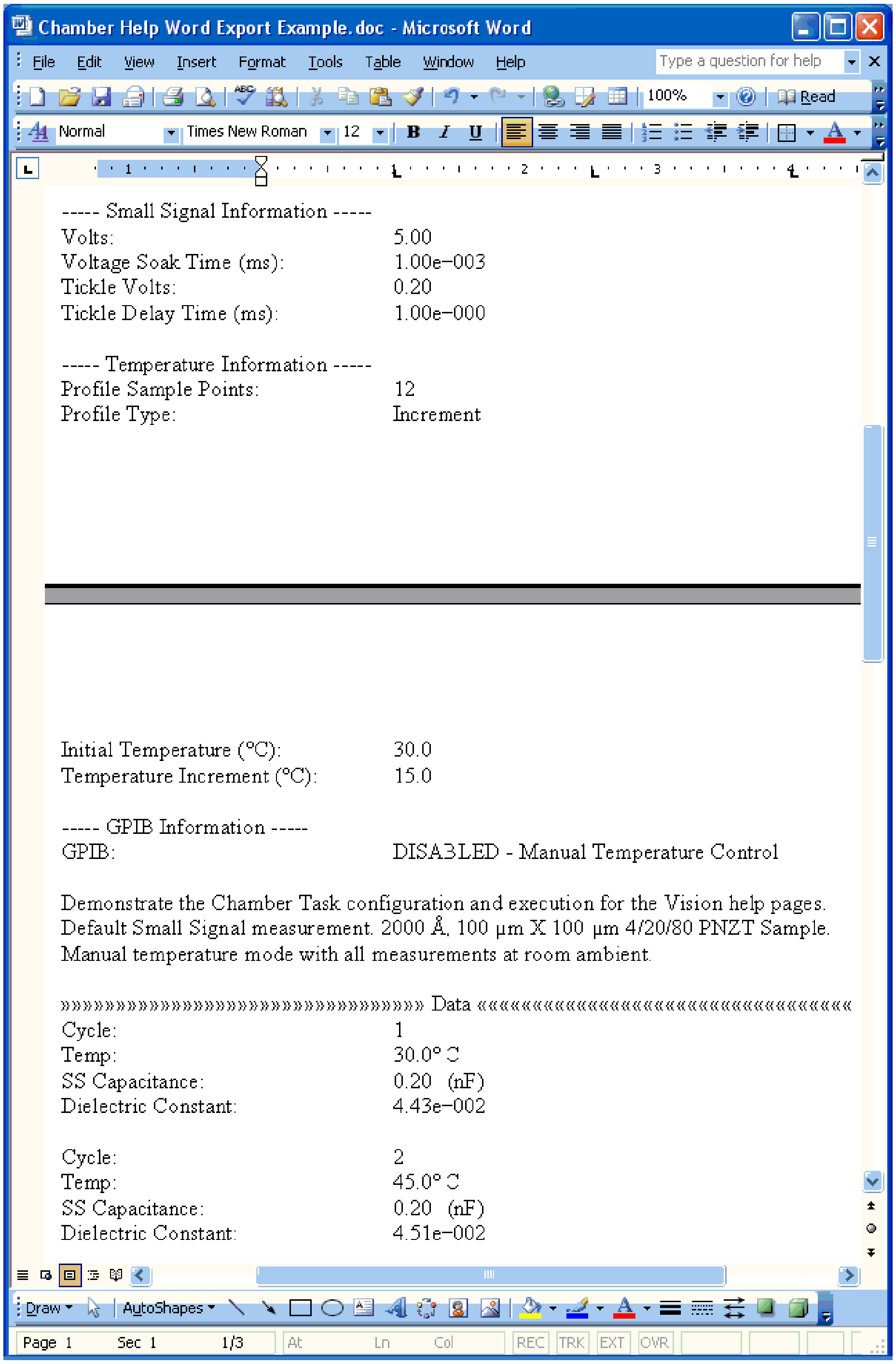


Figure J.2.11 - Chamber Task Sample Word Export Output. Upper Portion.



----- Small Signal Information -----
Volts: 5.00
Voltage Soak Time (ms): 1.00e-003
Tickle Volts: 0.20
Tickle Delay Time (ms): 1.00e-000

----- Temperature Information -----
Profile Sample Points: 12
Profile Type: Increment

Initial Temperature (°C): 30.0
Temperature Increment (°C): 15.0

----- GPIB Information -----
GPIB: DISABLED - Manual Temperature Control

Demonstrate the Chamber Task configuration and execution for the Vision help pages.
Default Small Signal measurement. 2000 Å, 100 µm X 100 µm 4/20/80 PNZT Sample.
Manual temperature mode with all measurements at room ambient.

»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»»» Data ««««««««««««««««««««««««««««««««««
Cycle: 1
Temp: 30.0° C
SS Capacitance: 0.20 (nF)
Dielectric Constant: 4.43e-002

Cycle: 2
Temp: 45.0° C
SS Capacitance: 0.20 (nF)
Dielectric Constant: 4.51e-002

Figure J.2.12 - Chamber Task Sample Word Export Output. Central Portion.

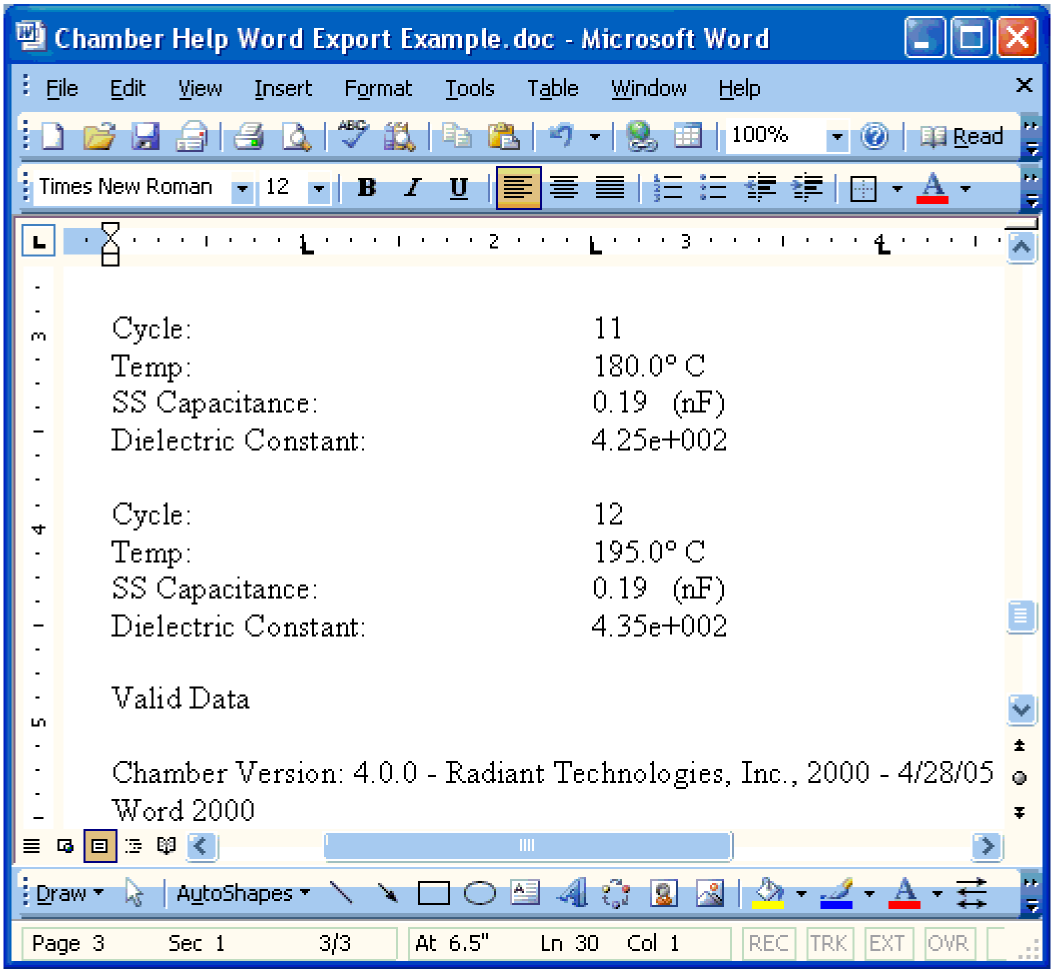


Figure J.2.13 - Chamber Task Sample Word Export Output. Lower Portion.

- **Vision Data File -** In this option, added as of Version 4.0.0., the Task configuration parameters and measured data are written to a formatted binary file. Subsequent instances of the Simple Pulse Task can be configured to import the data from the file, on execution, rather than making a new measurement. In this way, data can be moved from one DataSet to another where they can be grouped with other data and filtered. This utility is demonstrated in **Figure J.2.14**. Selecting this option enables the *Browse for File Name* button. Clicking this button will open a standard browser dialog in which a file name and path may be selected. Specifying a file name is required.

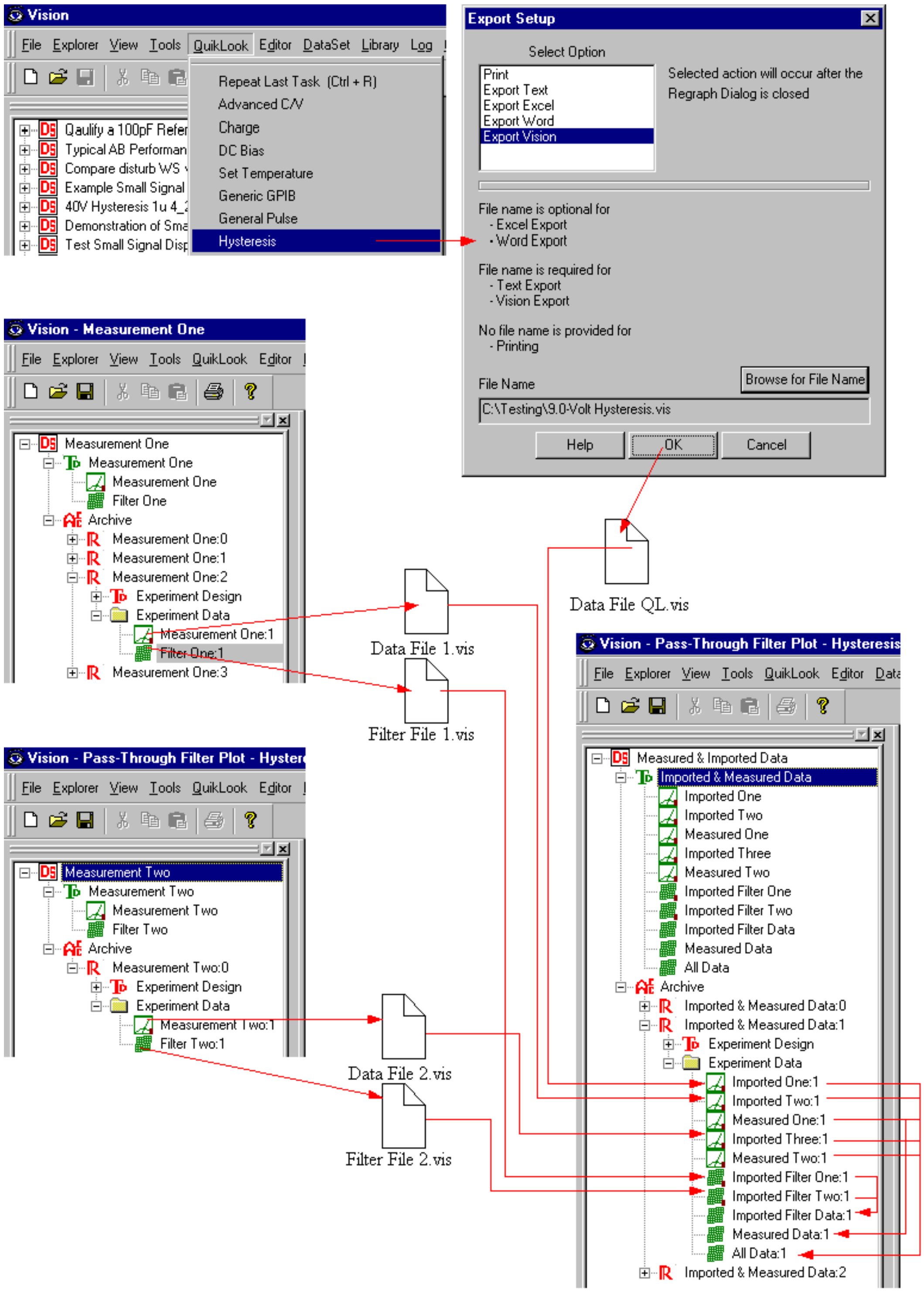


Figure J.2.15 - Utility of Vision Data File Exporting.

J.3 - Export Setup

Name	Type	Default	Description
Select Option	List Box	"Print"	Select between the "Print", "Export Text", "Export Word", "Export Excel" and "Export Vision" options. This control enables the *Browse for File Name* button for all selections except the "Print" option.
Header Only	Check Box	Checked	This control appears when *Select Option* is set to "Print" or "Export Word". Otherwise it is hidden. When checked, the output of the point-by-point drive voltage and measured data is suppressed. This shortens the document and eliminates what is likely to be superfluous data.
Line Spacing	Integer	100	This control appears when *Select Option* is set to "Print". Otherwise it is hidden. Increasing or decreasing this value will increase or decrease the vertical spacing of lines on the printed page. Experimentation will fix the value for any given printer.
Left Margin	Integer	100	This control appears when *Select Option* is set to "Print". Otherwise it is hidden. Increasing or decreasing this value will increase or decrease the left start point of text on the printed page. Experimentation will fix the value for any given printer.
Tab Spacing	Integer	200	This control appears when *Select Option* is set to "Print". Otherwise it is hidden. Increasing or decreasing this value will increase or decrease the horizontal spacing of tabbed sections of text on the printed page. Experimentation will fix the value for any given printer.
Browse for File Name	Button	Unpressed	This control is enabled for all export options except "Print". For the remaining options, this control must be selected. The browser dialog will appear where a path and filename must be specified for the export output.
File Name	Text	""	This control is always disabled and cannot be used to specify the file name or path for Text, Word or Excel export. Once the browser is used to selected a path and file name, those will be displayed in this control for review. Note that a path and file name MUST be specified for the "Text" and "Vision" export options and may be specified for "Excel" or "Word".
Help	Button	Unpressed	Open this help document for review.
OK	Button	Unpressed	Accept the configured export and close the dialog. Exporting will occur when the main data regraph dialog is closed.
Cancel	Button	Unpressed	Close the export dialog. Do not export.

K - Change and Version Record

Version 2.1.1 - 9 October 2000

1. Updated the Task version number to 2.1.1 for the second Vision software release **- 9 October 2000 - SPC**
2. Corrected plotting so that each plot update will show the most recent measured value. **SPC - 14 November 2000.**
3. Corrected plotting so that each plot update will show the most recent measured value. **SPC - 14 November 2000.**
4. Made the Plot Configuration dialog active for Archive Regraph. This allows the plot to be reconfigured when it is recalled from the DataSet. **SPC - 16 November 2000**

Version 2.1.3 - 30 August 2001

1. Added the Linkam TMS 94 Hot Chuck controller. Task Version 2.1.3. **30 August 2001. SPC.**
2. Updated the export functions, especially the formatting. **30 August 2001. SPC.**
3. Made the plot type Points Plus Line. **31 August 2001. SPC.**
4. Added *Custom Amplifier*, *Sensor Impedance* and *Start at Last Amp Level* controls and code to make use of them. **23 November 2001. SPC.**

Version 3.0.0 - 23 November 2001

1. Updated the Task to Version 3.0.0 for development for the next release. **23 November 2001. SPC.**
2. Made the Drive/Return Channel/Port controls dynamically update as Adjust Mux in a Loop is enabled or disabled. **5 December 2001. SPC.**
3. Eliminated several User Variables to reduce clutter in the list as noted in the next Table. Functionality is not lost. **10 December 2001. SPC.**
4. Moved the Task into the "Long Duration" subsubdirectory. **15 January 2002. SPC.**
5. Added the Instec STC200 Hot Chuck controller to the list of GPIB devices controlled by the Task. **31 January 2002. SPC.**

Version 3.1.0 - 14 March 2002

1. Set to Version 3.1.0 for release. **14 March 2002 - SPC.**
2. Added selection of the NT-2000 Chamber and control code for the NT-1700 and 2000 chambers. **SPC - 20 March 2002.**
3. Initial Word Export feature was added. **29 March 2002 - SPC.**
4. Added the ramp rate option to the Sigma chamber selection. **18 April 2002. SPC.**
5. Added the Tolerance control. **18 April 2002. SPC.**
6. Eliminated the GPIB Secondary Address control. This value is now forced to

zero, indicating that the instrument under control has no secondary GPIB address. **29 April 2002. SPC.**

7. Added Configured and Executed date/time controls to the configuration dialog. Controls are hidden during configuration, but visible when the Task is recalled from the DataSet Archive. **29 April 2002. SPC.**
8. Added a temperature progress dialog to be displayed during temperature adjustment. The Dialog displays target temperature, current temperature and elapsed time. **14 May 2002. SPC.**
9. Added Eurotherm 2400 series controller. **27 September 2002. SPC.**
10. Added Eurotherm PID and Ramp Rate control. **2 October 2002. SPC.**

Version 3.1.1 - 4 October 2002

1. Set to Version 3.1.1 for Task update. **4 October 2002 - SPC.**
2. Deleted the Eyecon image from the dialogs. **4 October 2002 - SPC.**
3. Adjusted the text control size in the plot dialog to match possible text length. **4 October 2002 - SPC.**
4. Moved configuration of Sensor, amplifier and Sample Information to subdialogs accessed by push button. **13 October 2002 - SPC.**
5. Added Tool Tips. **22 November 2002 - SPC.**
6. Added the Delta 9015 controller. **24 December 2002 - SPC.**
7. Added Office 2000 exporting. **12 February 2003 - SPC.**
8. Added the Blue-M Furnace. **13 March 2003 - SPC.**

Version 3.2.0 - 30 April 2003

1. Set to Version 3.2.0 to develop next release. **30 April 2003 - SPC.**
2. Added custom text spacing to print export. **31 July 2003 - SPC.**
3. Added generic-only (External) HVA selection. **7 November 2003 - SPC.**
4. Added the header-only option to Word exporting and printing. **7 May 2004 - SPC.**

Version 4.0.0 - 3 June 2004

1. Set to Version 4.0.0 for next release. **3 June 2004 - SPC.**
2. Added Ramp Rate control to the INSTEC selection. **23 August 2004 - SPC.**
3. Added Vision Data File I/O. **23 August 2004 - SPC.**
4. Added the REX Fxxx family of thermal controllers. **2 March 2005 - SPC.**
5. Added the ESPEC controllers. **13 December 2005 - SPC.**
6. Moved Multiplexer channel and port configuration controls into a subdialog. Mux loop adjustment is now configured by a subsubdialog accessed through the Mux channel subdialog**. 28 December 2005 - SPC.**
7. Passed the Vision Data File selection switch to the Temperature, Measurement, GPIB and Plot configuration tabs. Disable all controls and labels in the tabs if Vision Data File is enabled because the setup values are read from the file. Labels

and text controls are enabled when the Task is recalled from the DataSet Archive, because they represent configuration parameters read from the file. **23 January 2006 - SPC**.

8. Passed the Internal/High-Voltage selection from the sample configuration dialog to the Measurement dialog. Made the control limits dependent on the selected amplification type. **23 January 2006 - SPC**.
9. Added a "Both" selection to the Measurement Type control in the measurement configuration tab. Both types of measurement may be made if the Task is configured in low-voltage mode. This control lists only PUND if the Task is configured in high-voltage mode. In High-Voltage mode, the Measurement Type control lists "PUND" only and Small Signal and Sensor configuration controls are disabled. **23 January 2006 - SPC**.
10. Passed the measurement type from the measurement configuration tab to the plot configuration tab. Made the list of values available for selection in the Y-Axis Values control dependent on the type of measurement to be made. **23 January 2006 - SPC**.
11. Adjusted data plotting to respond to the selected Y-Axis values appropriately based on the measurement type. **23 January 2006 - SPC**.
12. Made the Task configuration respond correctly if high voltage is first enabled, then a voltage assigned that is greater than 100.0 volts, then high voltage is disabled. In this case, the configured voltage is reset to the default. **23 January 2006 - SPC**.
13. Inserted the checkbox to enable the internal reference ferroelectric**. 12 May 2007 - SPC**.