



Thermal Transient Test

Installation and Operating Manual

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Installation

Hardware Installation

1. Connect a high quality shielded serial interface cable to the 9-pin SERIAL PORT connector on the back of the Thermal Transient Test System. Connect the other end to a serial port on the computer.
2. Connect the test chamber cable to the CURRENT OUT/MEASURE IN connector on the Thermal Transient Tester. This is a 15 pin 'D' connector.
3. Connect the other end of the test chamber cable to the test chamber. This is typically a pair of dual banana plugs. Note that the side of the banana plug with the tab is the negative side and should be connected to the black banana jack.
4. Connect the test chamber door interlock switch cable (banana plug) to the INTERLOCK connector on the Thermal Transient Test System. When the chamber door is open the Thermal Transient Test System is electrically disconnected from the chamber. An LED is visible inside the rear of the Thermal Transient enclosure to indicate when the chamber door is closed.
5. Connect the operator switch (banana plugs, when used) to the REMOTE SWITCH connector on the Thermal Transient Tester. You may also start the test by clicking on the test button of the measurement screen in the thermal transient software application. *These buttons are only active when the test chamber door is closed.*
6. Verify that the mains voltage is proper (as shown in a small window on the modular AC inlet) and connect the power cord to the modular AC inlet and plug it into an AC outlet.
7. If the optional external multimeter is used (Agilent 34401A), connect it to an available serial port (such as COM2) using the Agilent-supplied serial cable. Configure the multimeter for use with serial interface (typically the default factory setting is GPIB). Please refer to the multimeter owner's manual for further details.

This completes the hardware installation.

Software Installation

This program may be installed on Microsoft XP Professional or Vista. To install the Thermal Transient application, your computer must have the following resources:

- A Pentium 4 2.4GHz or faster processor (2.8GHz recommended).
- A minimum of 256 Megabytes of RAM (512MB recommended).
- 20 Megabytes of free disk space for installation.
- 100 Megabytes of free disk space for data storage.
- XGA (1024x768) or higher resolution video board (1280x1024 recommended).
- A free high-speed serial port (16550 UART).
- An optional second serial port for the multimeter connection.
- The monitor display must be set to a resolution of 1024 by 768 or higher.
- You must have Administrative privileges for the installation and updates.

IMPORTANT

If you are updating an earlier installation of the Thermal Transient software, you *must* uninstall the previous version before starting the following install procedure. The default program directory for 32-bit operating systems is **C:\Program Files\Thermal4**. For 64-bit operating systems the default directory is C:\Program Files (x86)\thermal4. Use the Windows Add/Remove Programs application in the Control Panel to uninstall the older thermal application.

1. Insert the Thermal Transient install CD into the CD drive or download the proper files over your network to a unique location on the hard disk.
2. To install the Thermal Response 2010 application please follow these steps, *in the order noted*:
3. Install the Thermal Response release 4 software by running setup.exe. Double click on the file setup.exe. Depending on your version of Windows an error may be displayed relating to "Simpdata.Tib" but the application should install successfully.
4. Follow the instructions that appear on the display.

This completes the program installation. Next you should install or create and, if necessary, edit the test parameter file; testparameters.ini. This file contains the test parameters referenced by part number and is unique to the individual initiators tested. The testparameters.ini file is normally located in **C:\Program Files\Thermal4**. You may start the program without this file and the thermal application will automatically create it. Without properly configured part numbers in this file you must manually enter the test current and test time for the parts you test.

The test parameter file uses similar formats to the testparameters.ini file used on all Santa Barbara Automation Final Electrical Test equipment. A responsible supervisor or engineer who is knowledgeable and understands testing parameters should maintain the Testparameters.ini file.

CAUTION

The settings in the testparameters.ini file provide a consistent means of testing and allow the operator to identify initiators by part number. Incorrect settings, such as higher current or longer pulse width, may detonate parts. Proper maintenance of this file and the data within are critical to the safe use of the Thermal Transient Test System. *Do not allow untrained operators access to this file or data.*

Desktop Icon

To create a desktop icon for Thermal Transient:

1. Start the Windows Explorer.
2. Navigate to the **C:\Program Files\Thermal4** directory. If you installed the program to a different directory, navigate to that directory.
3. Right-click on **Thermal.exe** and select **Create Shortcut**.
4. The new entry, **Shortcut to ThermalTransient.exe** will appear in the directory. Right-click this new entry and select **Rename**. Type in the new name **Thermal Transient** and press the Enter key.
5. Drag this shortcut to the desktop and drop it. Right-click in a blank area on the desktop and select **Arrange Icons** then select the choice you want.

This completes the desktop icon creation.

Start Up

To start the Thermal Transient Tester and the Thermal Transient program:

1. Verify that no initiators are within the test chamber.
2. Turn on the power switch on the front of the Thermal Transient Tester and confirm that the POWER light is lit on the front panel.
3. Double-click the Thermal2010 icon on the Windows desktop.



Figure 1: Desktop icon

The Thermal transient software may operate in either online or offline modes. In the offline mode the user may view, print and analyze previously acquired waveforms; in the online mode parts may be tested and new data may be acquired. The Thermal Transient software may be run on any computer in the offline mode – no hardware connection is required.

If the Thermal Transient Test System is connected to COM1 and no external multimeter is used, select the “Go Online” option. If a different serial port is used or an external multimeter is connected select “Go Offline” and verify that the communication settings are configured properly (see below for details). If the software will always be used in Offline mode then select “Always Stay Offline” to disable the dialog box.

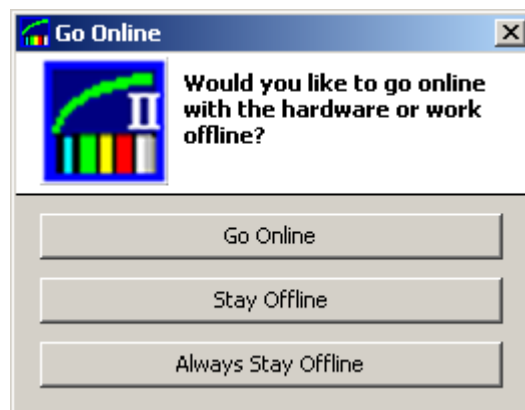


Figure 2: Online/Offline selection

4. If you connected the serial interface cable to a port other than COM1, you will receive a message either saying the port cannot be opened or the Thermal Transient Test System could not be initialized. To change the serial port, click the Com settings button for Thermal or Multimeter on the menu bar while offline, then select the serial port where the interface cable is connected and select the proper communication characteristics. Then click the *Ok* button.

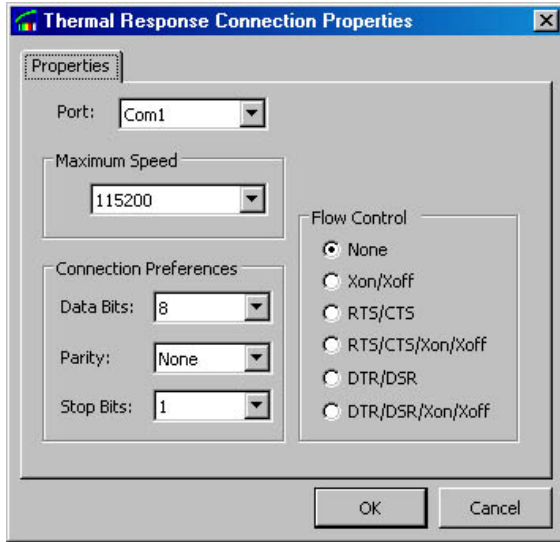


Figure 3: Communication Setup for Thermal Response

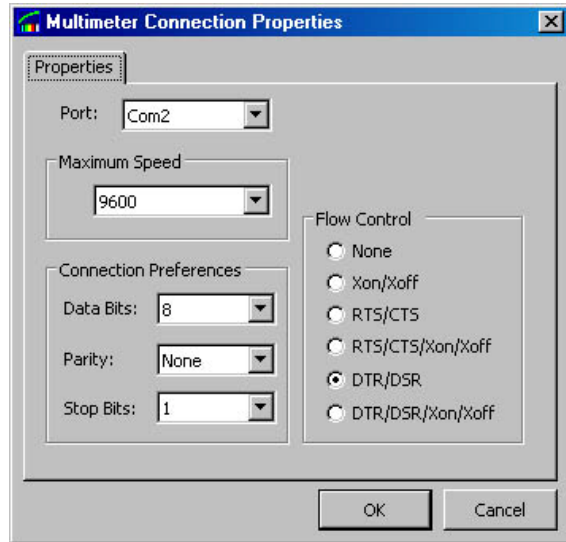


Figure 4: Communication Setup for multimeter

Alternately, the thermal and multimeter communications dialog may also be selected from Options on the menu bar as shown below.

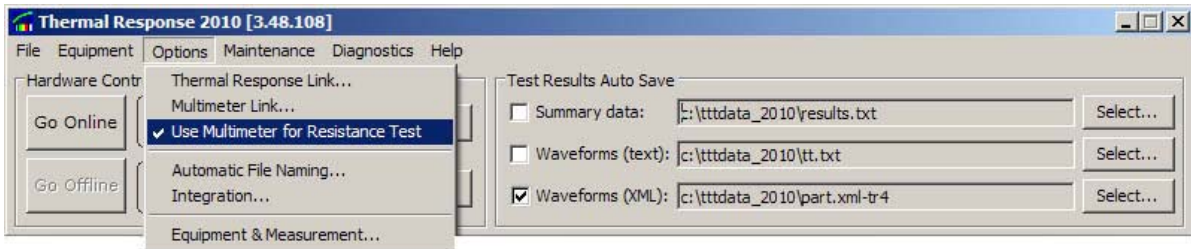


Figure 5: Menu for Multimeter use

- If the optional external multimeter (Agilent 34401A) is used, click Options on the menu bar and select Use Multimeter for Resistance Test. The application will remember this setting and will attempt to initialize the multimeter each time the application is placed online. To change the settings you must be offline.

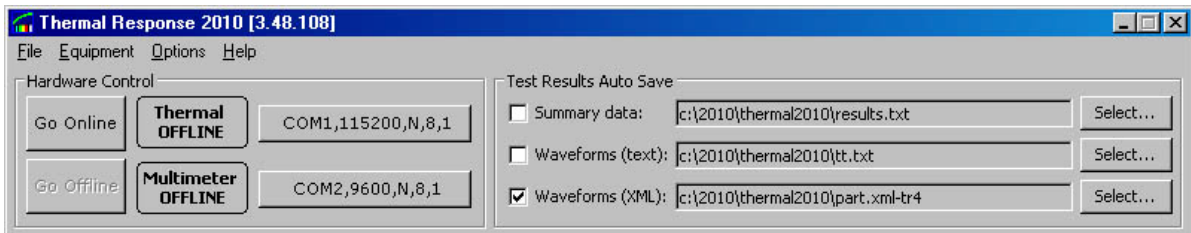


Figure 6: Thermal and Multimeter offline/online selection and file save options

Once the COM port and multimeter are configured, select “Go Online” on the menu bar. This will initiate communications with the Thermal System.

- When the initialization is successful, the *Thermal Response Board status display* will change to **ONLINE** with a green background.

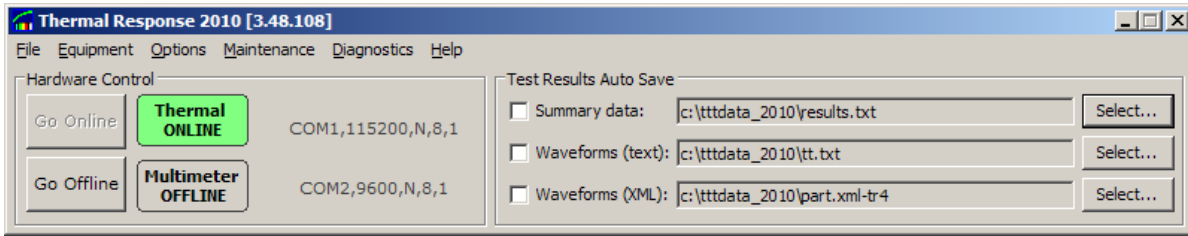


Figure 7: Thermal Transient System online indicator

If an external multimeter is connected, the Multimeter status display will also change to ONLINE with a green background:

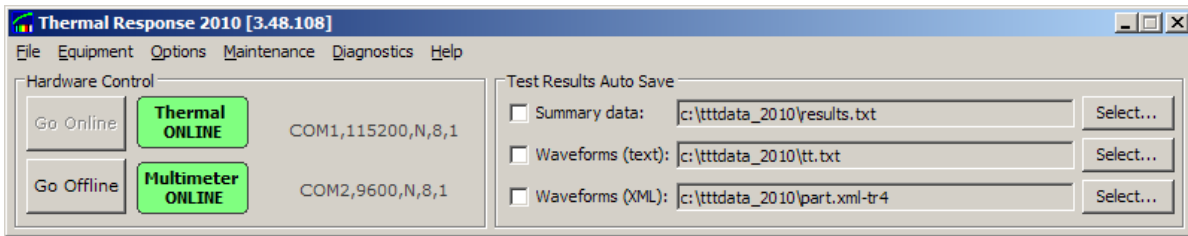


Figure 8: Thermal Transient and Multimeter online indicators

7. With power applied to the Thermal Transient Test System and the software application *online*, the **TRANS** and **REC** lights on the Test System front panel should be blinking and the **TEST ON** light should not be lit.
8. Open and close the door on the test chamber. Confirm that the door (interlock) status is displayed correctly in the *Measurement window*.
9. Select the output data destination folders, if necessary, under the *Test Results Auto Save* section on the main window by clicking on the selection buttons. Additional configuration settings can be found in *Automatic File Naming* under the *Options* menu and under the *Equipment* menu.

Note that an extension of xml-tr4 will automatically associate saved waveform files with the Thermal Transient program and is recommended. Waveform files with xml or xml-tr4 are compatible with the Thermal application but xml-tr4 is preferred.

10. The Thermal application may also operate without the main window in the viewer mode. Select this option under **Equipment** to turn on or turn off the main (top) window of the Thermal application.

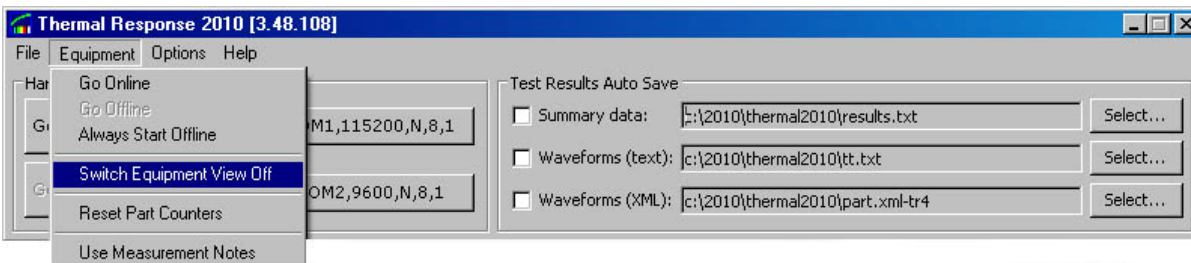


Figure 9: Equipment view on/off selection

This completes the installation and startup.

Testing Limits and Options

The maximum current applied during a Thermal Transient test may be limited to a safe value regardless of the user entered test current. To enable a limit on the test current:

1. Click *Options* on the menu bar then select *Equipment and Measurement*.
2. In the *Equipment and Measurement Options* menu under the Thermal Response tab select the box marked *Enable Test Current Limit*.

Enter the maximum safe test current (milliamps), typically slightly higher than the test current used. If the selected test current exceeds the set limit a warning will be displayed and the test aborted.

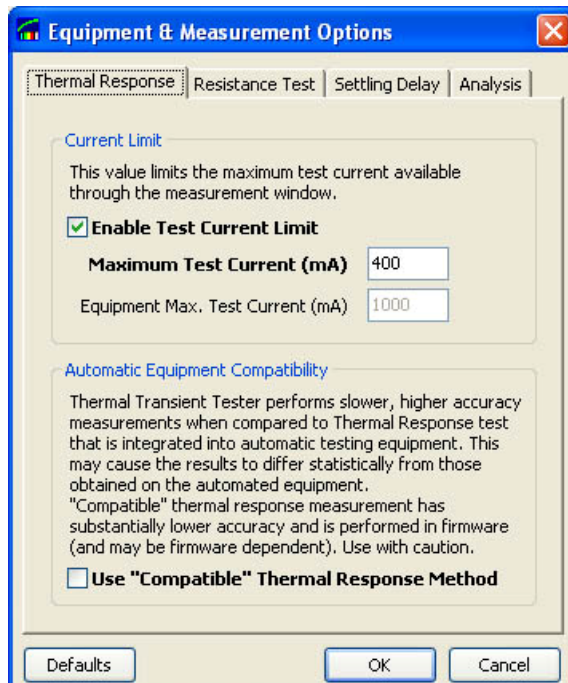


Figure 10: Test current limit selection

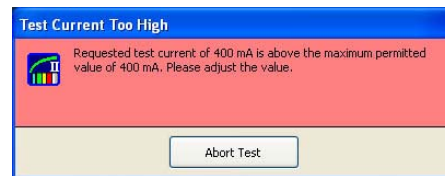


Figure 11: Test current limit exceeded

3. When an external multimeter is not used for resistance test, select the test current to be used by the Thermal Transient board – typically always 10mA. This selection box is found in the Resistance Test tab in the *Equipment and Measurement Options* menu.
4. Also in the *Equipment and Measurement Options* menu select the settling delay tab and enter the time in milliseconds to wait between resistance test and thermal test. When the Thermal Transient board is used for both tests sufficient time must be allowed for internal reference voltages to stabilize. Values from 2000ms to 5000ms are typical. This entry is also used when a new value of test current is selected. In this case the first test with the new value will be longer.
5. Also in the *Equipment and Measurement Options* menu select the criteria to be used for analysis (the Analysis tab).

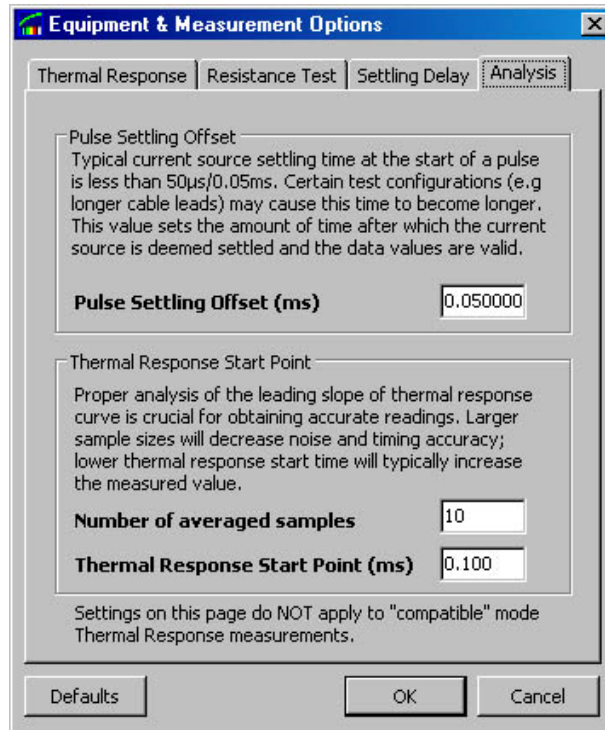


Figure 12: Analysis options

The Pulse Settling Time is the time after the start of current before the waveform is considered stable and may be used for Thermal Transient calculations. Installations with longer test leads and some initiator types may require longer settling times. Values of 0.050ms to 0.060ms are normal.

The number of averaged samples may be used to allow the user to compensate for certain initiator types and environmental conditions. These include initiators with very low thermal transient test results, those that display high electrical noise that may be caused by bridgewire movement during testing and those with residual process defects. A linear regression fit is used that reduces noise and provides highly accurate detection of the voltage and current values at 100us. Normal values for averaged samples are 6 to 12, with 10 the most common.

The industry standard for thermal transient test is the difference in voltage measured between 100 microseconds after test start and the end of the thermal transient pulse. Pulse widths of 10ms are common, although 40ms and 80ms have also been used. The Thermal Response Start Point (ms) should be set to 0.100ms.

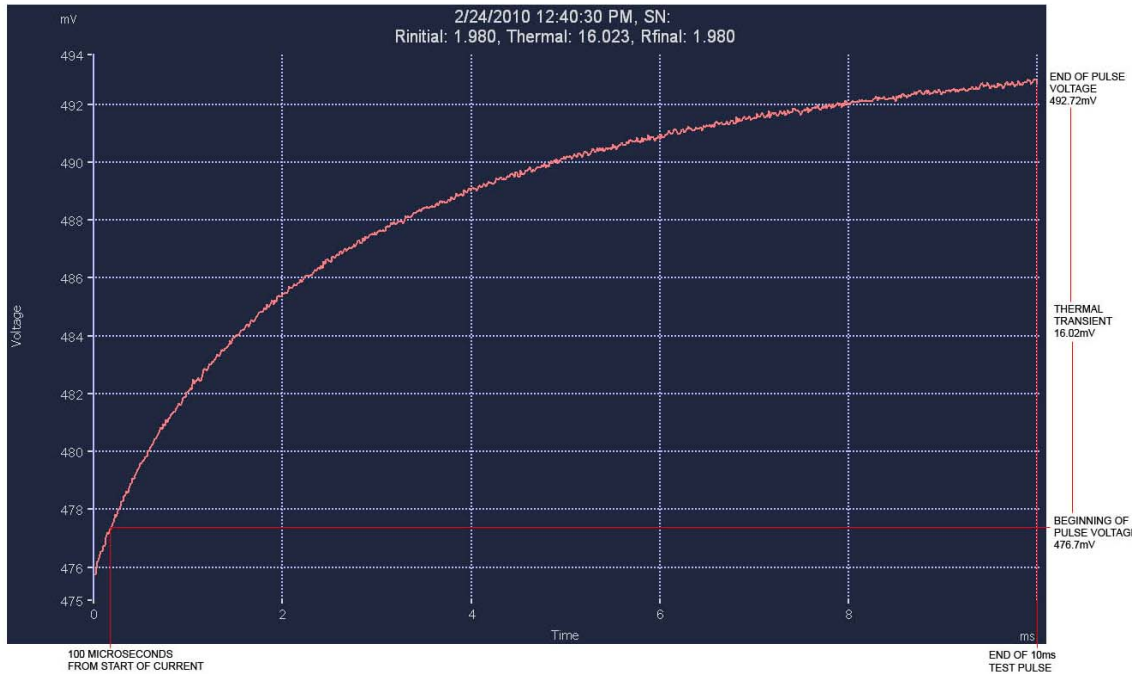


Figure 12: Thermal Transient Measurement

The waveform above represents the heating curve and resistance change resulting from a test current of 240mA. Note that the initial portion of the curve (between 0 and 1 milliseconds) reflects a much faster rate of rise than later portions of the curve. Accurate measurement of the 100us voltage and current is critical to measurement of thermal transient values.

- 6. Select the file naming features found under the menu bar Options selection.

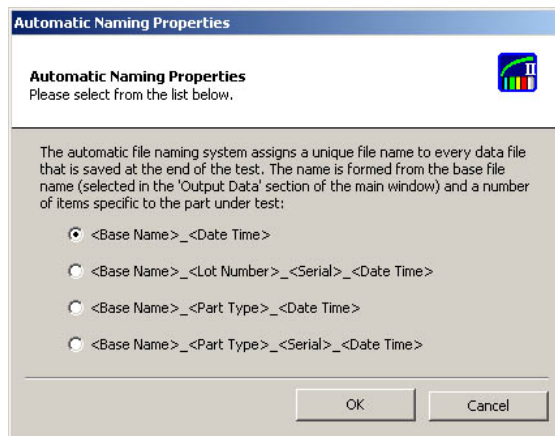


Figure 13: Automatic Naming Properties



Figure 14: Main window with path, base name, date, time and extension

Testing Parts

Please note that the Thermal Transient application must be **online** in order to run a test and **offline** to change settings such as use of the multimeter. To run a thermal transient test:

Either: a) Select a part type from testparameters.ini (if configured) by clicking on the box next to the **Part type** on the **Measurement Window**, or b) Configure the test parameters (test current and duration) directly. The part number and testing parameters listed in the Part Number drop down menu must be present and properly configured in the Testparameters.ini file to appear in the menu.

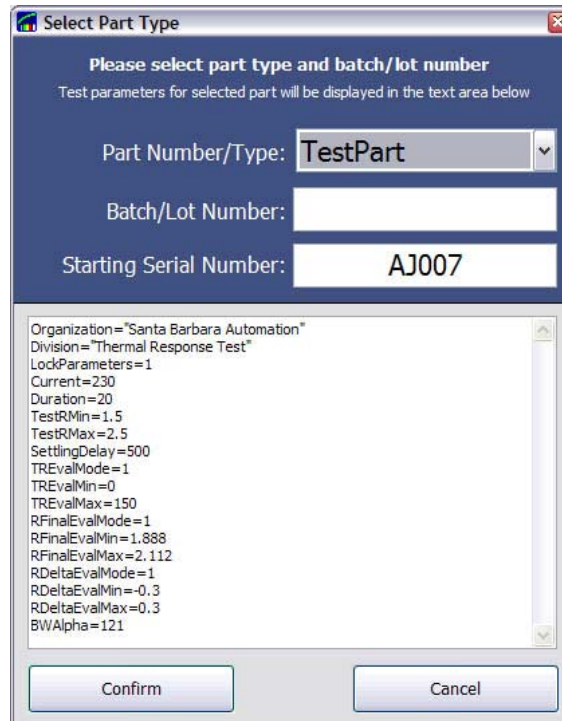


Figure 15: Select Testing Parameters

1. Decide how and where you want the test results to be saved under **Test Results Auto Save**.
2. Connect the initiator to the test connector and close the test chamber door.
3. Either press the operator switch or click the program's **Start Test** button.

CAUTION

Wait until the test is completed before opening the test chamber door. The test will stop automatically if the chamber door is opened. Never attempt to bypass the interlock switch as this is an unsafe condition.

Test Results

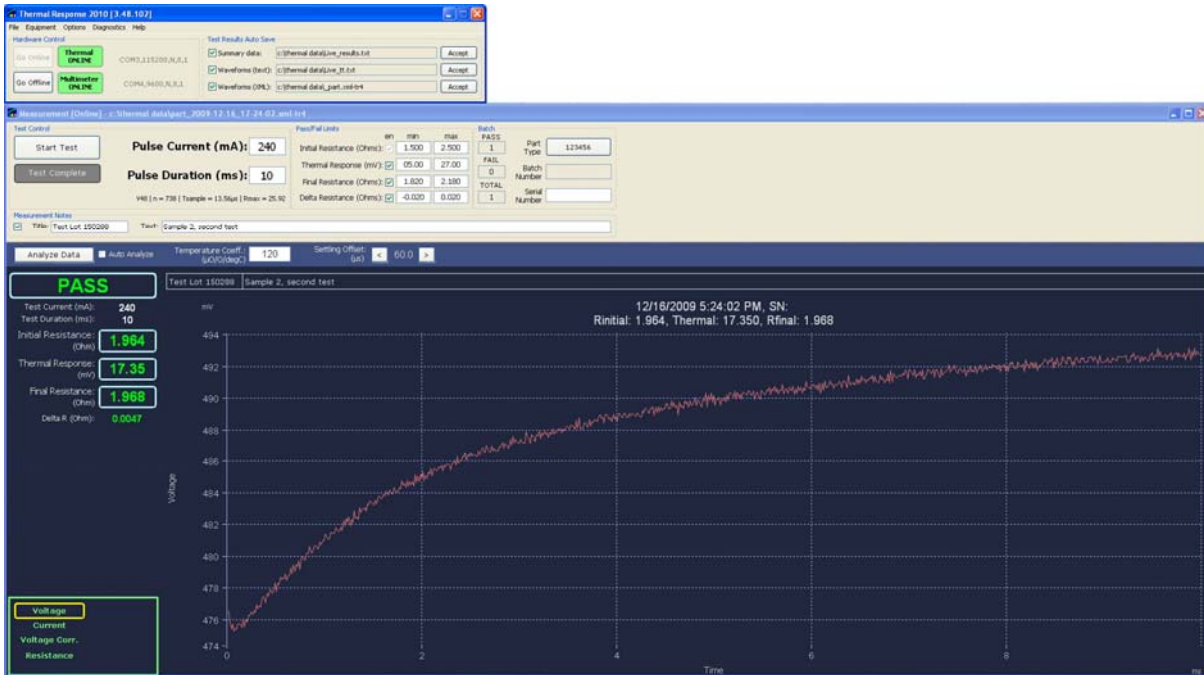


Figure 16: Graph of Thermal Transient test results

The primary display of the Thermal Transient test is a graphical window as shown above. The vertical axis shown in this display is the voltage across the bridgewire and the horizontal axis is test time. A numerical display of the test results is provided on the left side of the screen.

The Thermal Transient test is conducted in three parts;

1. The initial bridgewire resistance is measured.
2. The Thermal Transient test is conducted.
3. The final bridgewire resistance is measured.

When the test has been successfully completed the test results are uploaded over the serial cable to the host computer and displayed on the screen. You may select several viewing options, including:

1. The voltage across the bridgewire.
2. The constant current through the bridgewire during the test.
3. The voltage across the bridgewire as corrected for the actual, measured current.
4. The bridgewire resistance during the test.

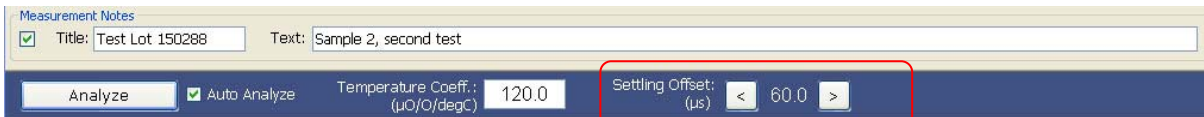


Figure 17: Analysis and Measurement Notes selection

To allow measurement notes to be saved with the test and for automatic thermodynamic analysis, check the appropriate boxes as shown above and enter the title and text. Enter the temperature coefficient of the bridgewire in microohms/ohm/°C to allow accurate temperature calculation. For manual analysis click on the Analyze button. After the test a new set of graph options will appear along with another set of numerical results for the part just tested. Different measurements may be selected for the x and y axis with the buttons on the left side of the screen. Note that the Settling Offset in microseconds (red box above) is only used for temperature analysis.

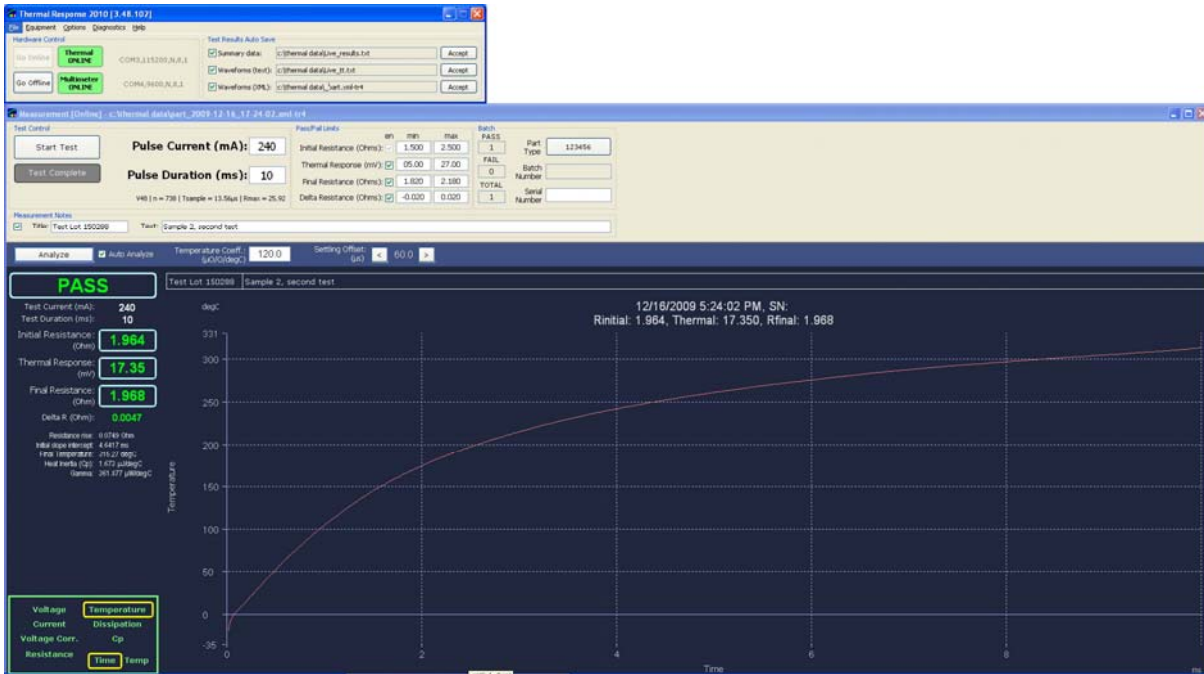


Figure 18: Analysis Screen

When viewing the graphical display on the Thermal Transient software application the following key shortcuts may be used for adjusting the viewing area of the graph (click on the graph to enable these):

Keyboard Entry	Action
A	Autoscale
B	Bimap mode on/off
C	Cursor on/off
Tab	Second cursor/toggle cursor
Left/Right arrow key	Move cursor on selected curve
Shift + Left/Right arrow key	Fast move cursor on selected curve
Up/down arrow key	Next/previous curve
f	Cursors floating/locked
Control + arrow key	Scroll and pan
Control + shift + arrow key	Fast scroll and pan
Control + left mouse button held down	Define start of zoom window, move to define window
Control + left mouse button up	Zoom to defined window
Control + left mouse button up	Abort zoom operation
i	Copy bitmap to the clipboard
l	Legend on/off
o	Original scale
p	Open properties dialog
t	Zoom out one step
y	Toggle active y-axis
z	Start keyboard zoom
Arrow key	Move zoom rectangle
Alt + arrow key	Size zoom rectangle
Enter	Zoom
Esc	Abort zoom operation

Figure 19: Graph Navigation

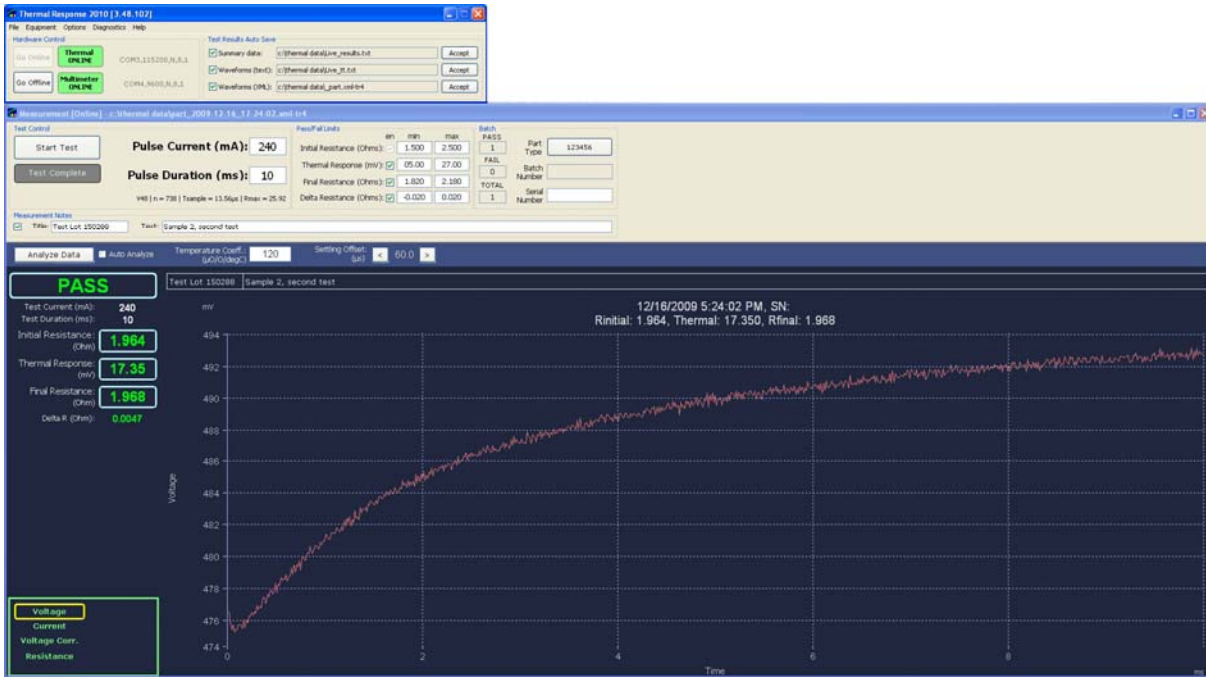


Figure 20: Good Test Results Screen

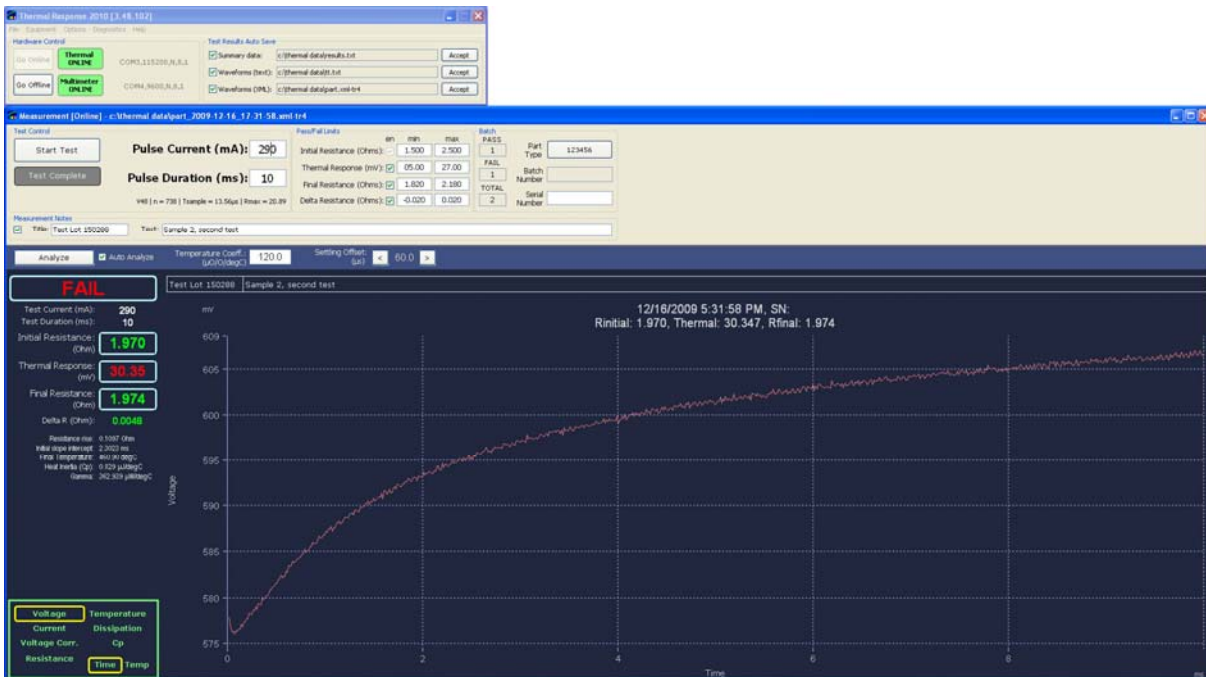


Figure 21: Failing Test Results with Analysis Active

Test results are archived in as many as three different formats:

1. **Text Summary:** The *Text Summary* file presents a listing of test results in a form suitable for statistical analysis of lot data. The data is stored one test per line in comma separated values (CSV) format. For example (presented here in 2 lines due to page width limitations):

Date, Time, Serial, PartType, LotNumber, TestCurrent, PartEvaluation, InitialR, InitialREval,

2009-11-16, 20-25-44, Sample2, 180.00, FAIL, 2.00140, PASS,

Thermal, ThermalEval, FinalR, FinalREval,DeltaR, DeltaREval

6.13486, FAIL, 2.00203, PASS, 0.00063, PASS

Select the “Save test results only” checkbox to enable the *Text Summary* output.

2. **Text Waveform:** The *Text Waveform* file contains all waveform data along with the test results and test settings in a comma separated format. It is suitable for further data analysis in MS Excel or a similar program.

Note: It is not necessary to save all the test data in the *Text Waveform format* at the time of acquisition since any *XML Waveform* file can be converted to a text waveform by loading it in into the application and then clicking *Export Analysis Data As Text* under the *File* menu.

3. **XML Waveform:** The *XML Waveform* file contains all the settings, test results, waveforms and any other information associated with a measurement. When selected, the *XML Waveform* files may be generated automatically after every measurement. You may also view the test results offline for analysis, troubleshooting and comparison to other waveforms. Using the XML-TR4 extension will automatically associate the waveform files with the thermal application and is the recommended archival format for the waveform data. Most early versions of Thermal XML files may be opened from within the new application. Files saved with a plain XML extension under the new application may be opened from within the program, or using drag and drop, but not by double-clicking.

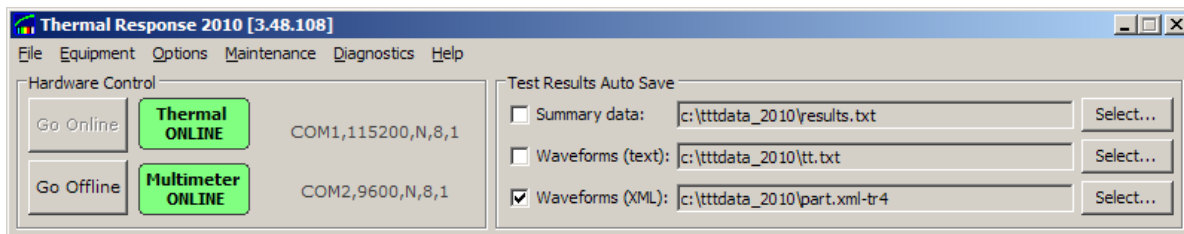


Figure 22: Output data save selection screen

Select the type and location of the data you wish to save prior to running a test. Choose file names that will allow the series of tests and data to be easily identified at a later date. Since large groups of data may be useful for determining production equipment performance we suggest periodically archiving the data. This also serves to reduce the number of files in the save location and improve performance.