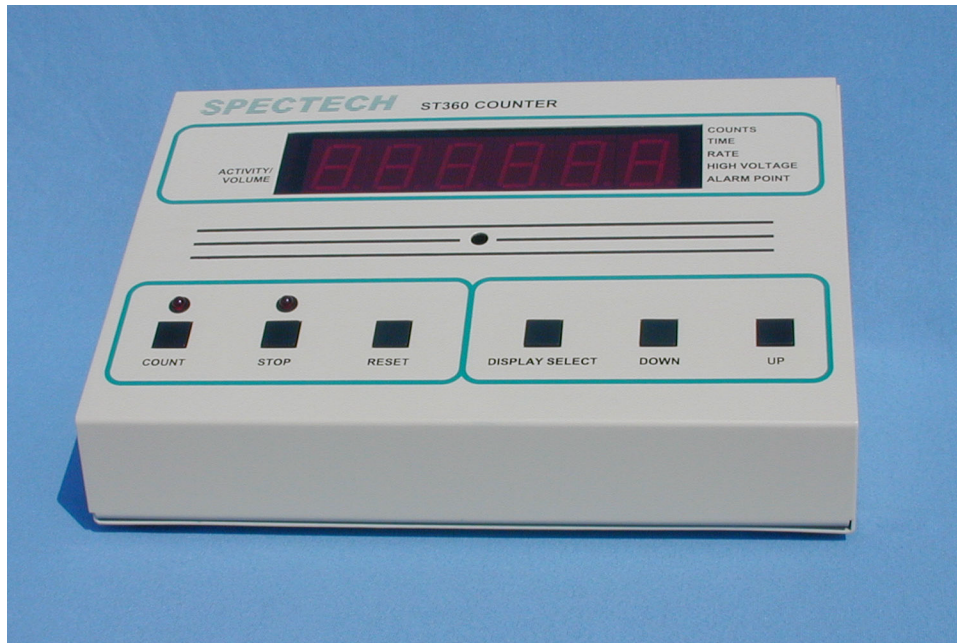


# Model ST360 Radiation Counter



The ST360 Radiation Counter combines many features into a single inexpensive instrument. The classic nuclear scaler design has been expanded to include a preset time function, a digital rate-meter with alarm, a digitally controlled high voltage supply, and computer interfacing via RS232 serial or USB formats.

The ST360 includes BNC and MHV connectors, and a precision high voltage supply that is adjustable from zero to +1200 volts. This supply provides 0.5mA at 1200 volts making it suitable for scintillation detectors as well as GM tubes.

The preset time function enables the user to acquire radioactive events for a predetermined number of seconds. This is useful for accurately comparing radioactive sources.

The rate-meter function is ideal for contamination survey work because it instantaneously displays the counts-per-second. An audio alarm can be programmed to sound when the count rate exceeds a *set* level, warning of high activity.

Extra large LED's provide a digital display that is clear and visible, even under bright ambient light. A 5-segment bargraph LED visually indicates the activity level and speaker volume.

Classroom demonstrations and nuclear experiments can be run directly from a Macintosh computer running using either a serial or USB interface. The provided software renders all of the ST360's controls accessible from the Mac and allows real-time data transfer to the computer. This data can be stored for data analysis and graphical presentation.

The software also includes automated features, one of which recycles counting after reaching a preset time, which is useful for studying radioactive decay. Another feature automatically increments the high voltage after each cycle, which is useful for plotting detector plateaus.

# Specifications

**Inputs:** BNC connector - Accepts standard Geiger tubes.  
MHV connector - Accepts scintillation detectors.

**High voltage:** 0 to +1200 volts @ 0.5mA.

**Display:** 6-decade LED, 1 in. numerals; 5-segment bargraph LEDs

**Modes:** Counts; Elapsed Time; Preset Time; Count Rate (counts per second); High Voltage Level; Alarm Level; Speaker Volume.

**Audio:** Includes an audio indication of radiation events and a programmable audio alarm.

**Interface:** USB and RS-232 serial ports for both PC and Macintosh

**Power:** 9 volt DC, at 500mA\*

**Dimensions:** 10 inches W, x 7 inches D, x 4.5 inches H

**Software:** Windows and Macintosh versions

**\*Caution:** Use only the AC adapter included with the ST360. Using a different adapter can damage the unit and void the warranty.



## Controls

Below is a brief description of the ST360's controls. A detailed explanation of the controls is in the following *Operating Modes* section.

### ***COUNT Control***

The *COUNT* button starts the timer and event data acquisition. The corresponding LED indicates when the unit is counting.

### ***STOP Control***

The *STOP* button stops the timer and event data acquisition. The corresponding LED indicates when the unit has stopped counting.

### ***RESET Control***

Pressing the *RESET* button when counting is stopped, resets the time and counts to zero.

### ***DISPLAY SELECT Control.***

Pressing *DISPLAY SELECT* button cycles through each mode in the following order: *COUNTS*, *TIME*, *RATE*, *HIGH VOLTAGE*, *ALARM POINT*, *SPEAKER VOLUME*, then back to *COUNTS*, etc. On the right side of the display, a corresponding LED will indicate the selected mode unless the unit is in *SPEAKER VOLUME* mode for which there is no indication LED.

### ***DOWN and UP Controls***

The *DOWN* and *UP* buttons are used for setting the preset time, high voltage, alarm point and speaker volume.

## Operating Modes

Below is a description of each mode. As described above, the *DISPLAY SELECT* button cycles through the modes. Modes can be changed at any time, even if the unit is counting, without affecting the data or interrupting the count.

### **COUNTS Mode.**

The *COUNT* mode is for displaying the number of radioactive events, or counts. In this mode, the display will indicate the number of counts in real time.

### **TIME Mode**

The *TIME* mode is used for either displaying the elapsed acquisition time or for setting the *Preset Time*. When viewing acquisition time, the display shows the time elapsed during the most recent data acquisition. If counting is interrupted with the *STOP* button, and the *RESET* button is not pressed, the elapsed time will begin counting at the point where it stopped. If the *RESET* button is pressed, the elapsed time will reset to zero.

When in *TIME* mode, the *Preset Time* function allows radioactive events to be automatically counted for a predetermined amount of time. To engage the *Preset Time* function, select the *TIME* mode and enter a value using the *UP/DOWN* buttons. Once counting begins, it will continue for the duration of the preset time value and then automatically stop. Pressing *COUNT* a second time will reset the counts and elapsed time to zero and count again for the preset time. Pressing the *STOP* button will interrupt counting without losing current data or resetting the time elapsed. Pressing *COUNT* again will continue data acquisition for the remaining preset time. To stop the *Preset Time* function, set it to zero.

### **RATE Mode**

When the *DISPLAY SELECT* is set to *RATE* mode, it provides an instantaneous display of the count rate in counts-per-second. This is useful for survey applications, and can be used in conjunction with the *ALARM* feature.

### **HIGH VOLTAGE Mode**

This mode is for either displaying, or setting the high voltage level. The high voltage can be set to any value between 0 and 1200 volts in 25-volt increments using the *UP/DOWN* buttons. The *COUNT*, *STOP*, or *RESET* buttons do not affect the high voltage setting.

### **ALARM POINT Mode.**

This mode is for setting a number that causes an alarm to sound when it is exceeded by the count rate. To set the *Alarm Point* number, select this mode and use the *UP/DOWN* buttons. The *COUNT*, *STOP*, or *RESET* buttons do not affect the alarm point setting.

### **SPEAKER VOLUME Mode**

This mode is for displaying or setting the speaker volume and has no associated LED indication. The *UP/DOWN* buttons set the speaker volume. When in this mode, the *ACTIVITY/VOLUME* bargraph LED becomes a speaker volume indicator.

### **The ACTIVITY Indicator**

When the unit is counting, the *ACTIVITY* bargraph on the left side of the display indicates the activity in 200cps (counts-per-second) increments. That is, one segment indicates a count rate between 200cps and 400cps, two segments indicate a count rate between 400cps and 600cps, three segments indicate a count rate between 600cps and 800cps, four segments indicate a count rate between 800cps and 1000cps, and five segments indicate a count rate exceeding 1000cps. The *ACTIVITY* bargraph is not visible when the display is set to *SPEAKER VOLUME* mode.

# ST360 Software Installation and Operation

## Macintosh Version

### Introduction

The ST360 software will run on both PowerPC and 68K Macintosh computers. It provides full control of the ST360 from the Macintosh and allows the user to save the data. It also enables the features described below in the Software Operation section. The latest software revisions are available on our web site at [www.spectrumtechniques.com](http://www.spectrumtechniques.com).

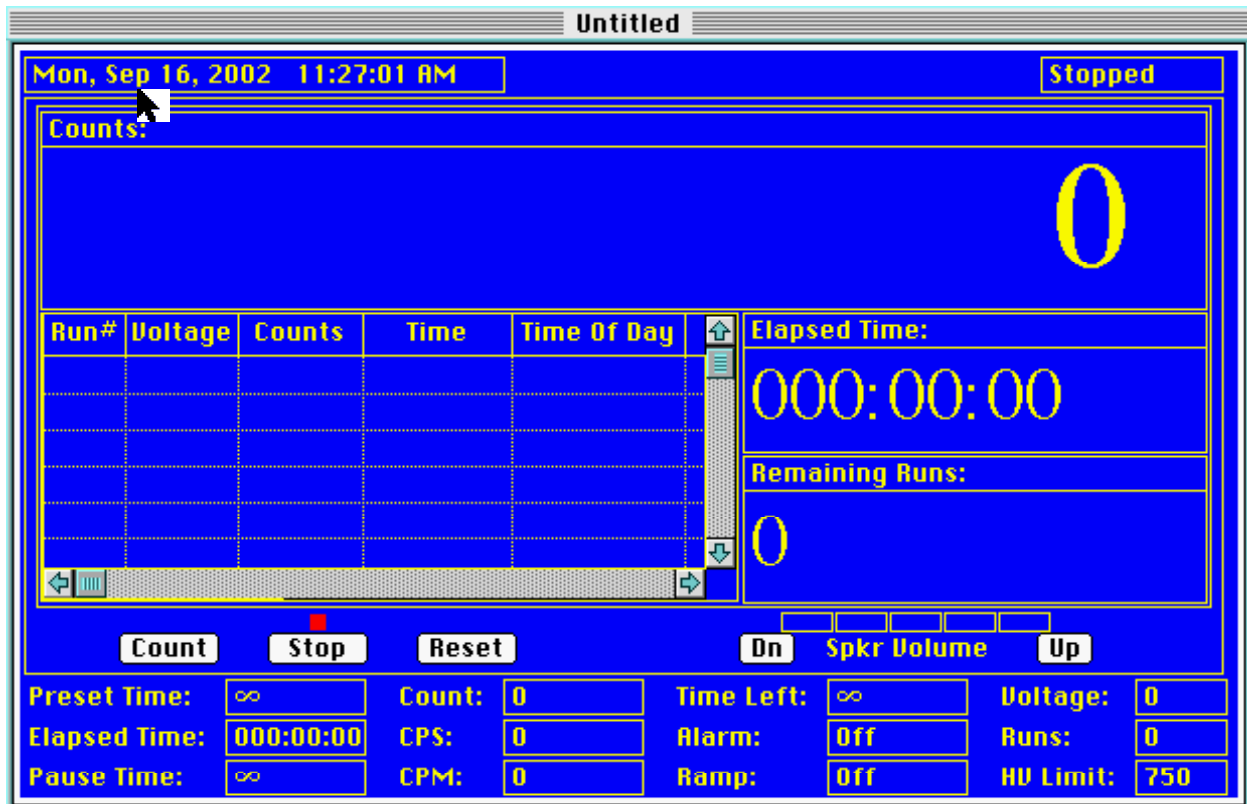
Communication using the 9-pin serial port is supported on MAC OS versions 7.1 thru 9.2.2 and on the OSX in the Classic Emulation environment. The USB operation is only supported on MAC OS versions 8.6 - 9.2.2.

### Software Installation and Hardware Interface

The software disk contains the application program, *LabLink 360 v #.#.#*, a folder named *ST360 Notes*, and a folder named *USBDriver for Extensions Folder*. The *ST360 Notes* folder contains a condensed version of the software installation and operating instructions. The *USBDriver for Extensions Folder* holds the USB driver *USB360*, which is required to operate the ST360 when communicating via the USB port. Copy the ST360 application file to the Mac's Desktop and the *USB360* file to the *System Extensions* folder.

Connect the Macintosh to the ST360 using either a RS-232 or USB cable. The RS-232 cable will connect from either the printer or modem port of the Mac to the RS-232 Mac connector on the 360's rear panel.

Connect the ST360 to a power source, turn it *ON*, and open the *LabLink 360* application. An introductory window will appear with the software version information. Click *OK* to complete initialization and proceed to the main display shown below.



The software will automatically determine which port the ST360 is connected to and perform the necessary initializations. A small box in the upper right corner will display the status of communications with the ST360. It will read *Relinking* until communication is established and then read *Stopped*.

If communication is not established, a message will appear warning that no ST-360 responded. Clicking *OK* will close the message and the status box will then read *I/O Error*. In the event that this happens, check to see if the ST360 is turned *ON* and is properly connected.

If an error occurs using the RS232 serial connection, verify that the software is set to either the modem port or the printer port, depending on the connection used. Normally, the software will set this automatically, but it can be set manually by selecting *Serial Port* under the *Options* menu. Once the problem has been corrected, select *Serial Relink* under *Options* to re-establish communication.

The USB interface is not dependent on any other setting.

## Software Operation

Once the software is executed, it defaults to the *Scaler* view shown above. Above the ST360 program window are the main menu headings. From left to right they are *File*, *Edit*, *View*, *Presets*, *Display*, *Options*, and *Font*.

When in *Scaler* view, the top half of the ST360 program window displays information in four different sections. These are *Counts*, *Data Table*, *Elapsed Time*, and *Remaining Runs*.

In *Digital Rate Meter View*, only the counts are displayed in this upper section. The *Analog Rate Meter View* simulates an analog meter by displaying a meter and a moving needle in this upper section.

Immediately below the upper section of the program window are push-button icons, which represent the *Count*, *Stop*, and *Reset* buttons on the ST360. There are LED representations above the *Count* and *Stop* buttons to indicate their status.

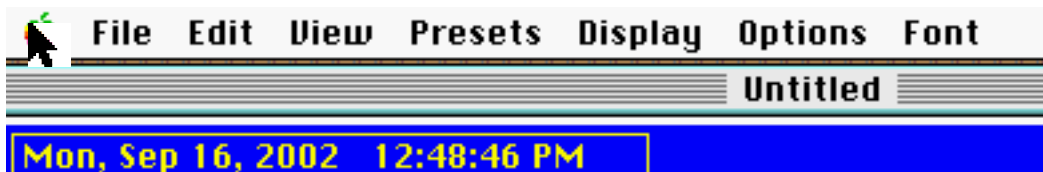
To the right of these push buttons is the speaker volume control, which can be adjusted via the *Dn* (Down) and *Up* buttons. Between the *Dn* and *Up* buttons is a representation of the ST360's speaker volume bar-graph LEDs.

In the lower portion of the software window 12 types of information can be viewed simultaneously. These are: *Preset Time*, *Elapsed Time*, *Pause Time*, *Count*, *CPS*, *CPM*, *Time Left*, *Alarm*, *Ramp*, *Voltage*, *Runs*, and *HV Limit*.

**Note:** When connected to a Macintosh and running the application software, the ST360's controls will NOT function, allowing it to only be controlled from the Mac. However, once the ST360 program is closed or the unit is disconnected from the Mac, the user will regain use of the ST360's controls.

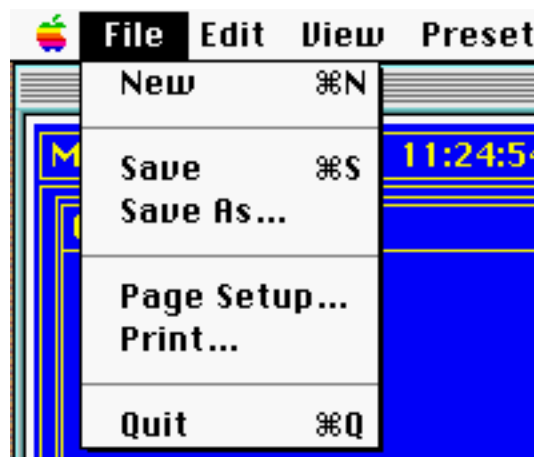
### Menus

This section describes the menus and their contents. The menus are *File*, *Edit*, *View*, *Presets*, *Display*, *Options*, and *Font*.



#### File Menu

The *File* menu contains *New*, *Save*, *Save As*, *Page Setup*, *Print*, and *Quit*.



#### New

Selecting *New* will reset the *Data Table* section of the display deleting all of the data. If this section contains data that has not been saved, a box appears asking if changes are to be saved. Selecting *Yes* allows the data to be saved before it is deleted. Selecting *No* will delete the data without saving it.

### Save / Save As

*Save* allows the user to save the data contained in the *Data Table* section. If the data has been saved previously it will use the same file name. If the data has not been saved, it will prompt the user for a file name and allow a location to be selected. *Save As* always ask for a file name, whether or not the file has been previously saved.

### Page Setup / Print

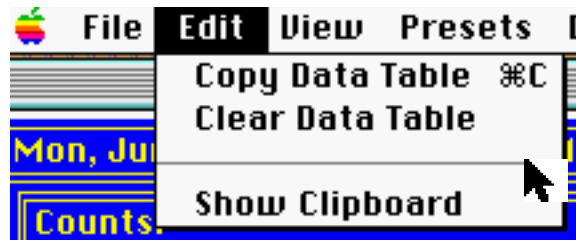
*Page Setup* opens the standard Macintosh page setup box allowing the user to select the page size, scaling, and the orientation. *Print* opens the standard Macintosh page setup box allowing the user to configure the printing properties. Selecting OK will print a text representation of the data displayed in the *Data Table*.

### Quit

Selecting *Quit* will close the program and return control back to the ST360's hardware controls.

### Edit Menu

The *Edit* menu contains the *Copy Data Table*, *Clear Data Table*, and *Show Clipboard* selections.



### Copy Data Table

Selecting *Copy Data Table* copies the Data Table's contents to the clipboard.

### Clear Data Table

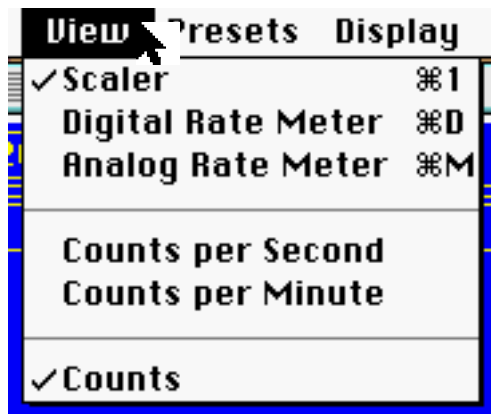
Selecting *Clear Data Table* erases the Data Table. Information copied to the clipboard is not affected when the Data Table is erased.

### Show Clipboard

This displays the contents of the clipboard.

### View Menu

The *View* menu contains the three main views of the ST360 program: *Scaler*, *Digital Rate Meter*, and *Analog Rate Meter*. The *View* menu also enables selection of *Counts per Second*, *Counts per Minute* and *Counts*.



### Scaler

When the ST360 program first runs, it defaults to the *Scaler* view. When in this view, the top half of the ST360 program window displays the *Counts*, *Data Table*, *Elapsed Time*, and *Remaining Runs* sections. When *Scaler* and *Counts* are selected in the *View* menu, the *Counts* section displays the current number of radioactive events captured in the most recent data acquisition. When *Scaler* and *Counts per Second* are selected, the *Counts* section displays the count rate in counts per second. When *Scaler* and *Counts per Minute* are selected, the *Counts* section displays the count rate in counts per minute.

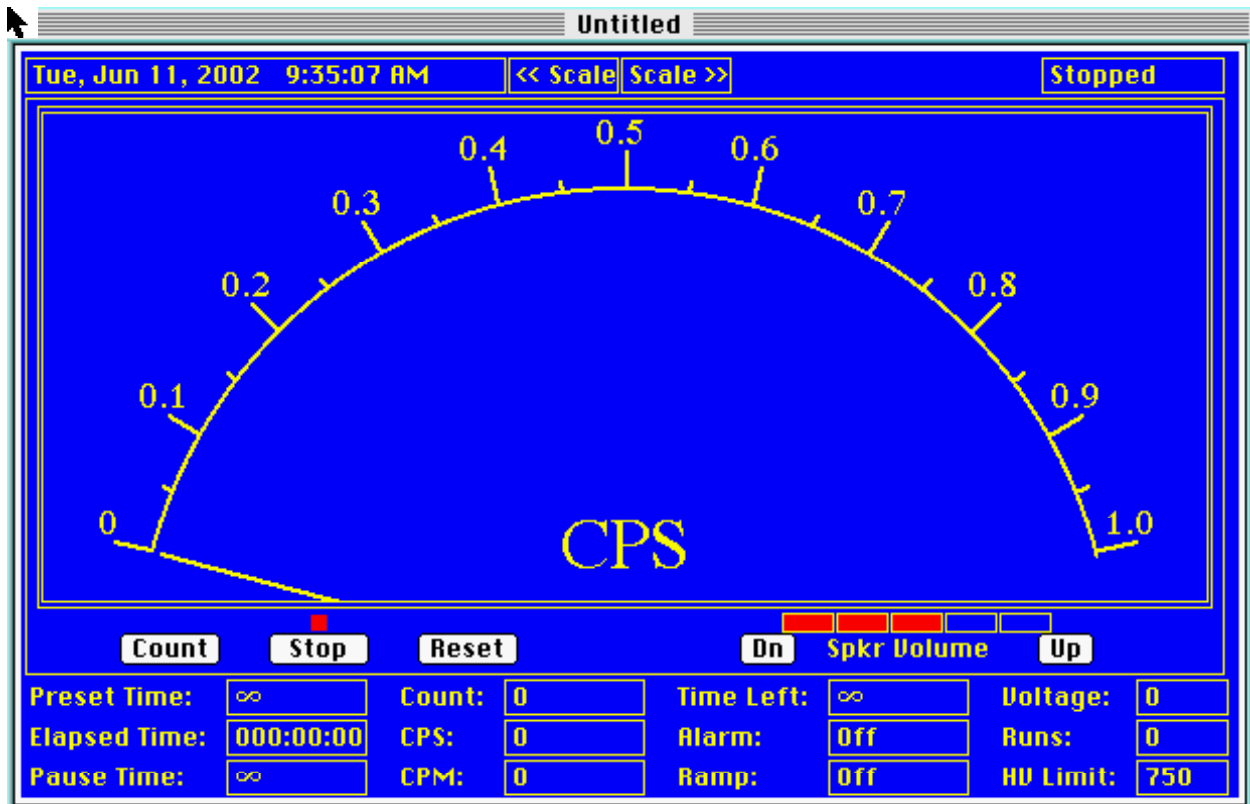


### Digital Rate Meter

The *Digital Rate Meter* view displays the counts in counts-per-second or in counts-per-minute. However, unlike when in *Scaler* view, the *Digital Rate Meter* view does not show the *Data Table*, *Elapsed Time*, or *Remaining Runs* sections. The *Counts per Second* view is identical to the ST360's display when it is in *Rate* mode. The *Counts per Minute* display is only available using the ST360 software.

### Analog Rate Meter

The *Analog Rate Meter* view simulates an analog meter by displaying a meter and a moving needle. The meter is also auto-ranging and automatically sets itself to the correct scale, regardless of the count rate. As with the *Digital Rate Meter* view, the *Analog Rate Meter* view can show the count rate in *Counts per Second* or in *Counts per Minute*.



### Presets Menu

The *Presets* menu allows the *Preset Time*, *Preset Runs*, *Pause Time*, *High Voltage*, and *Rate Alarm* to be set before counting takes place.



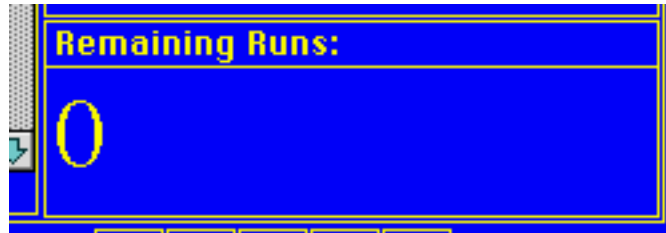
### Preset Time

*Preset Time* opens a box that displays the available preset time settings in seconds. The setting range is in decades from 0 to 900,000 with zero being *OFF*. To change the setting, click on a number. When the setting is reached, the counting will stop automatically.

### **Preset Runs**

*Preset Runs* opens a box that displays the available preset run settings with zero being *OFF*. To change the setting, click on a number.

*Preset Runs* is used in conjunction with *Preset Time*. The *Preset Runs* setting determines the number of times a count cycle is automatically repeated. Once all the runs have executed, counting will automatically stop. During this operation, the *Remaining Runs* section of the main view displays the remaining runs.



When used with the *Step Voltage* feature, *Runs* allows the user to automatically graph a detector's plateau. This is explained in the section "Creating a Plateau Chart".

### **Pause Time**

*Pause Time* is used in conjunction with *Preset Time* and *Runs*. It causes the counting to pause for a predetermined number of seconds between runs. When *Pause Time* is selected, a box appears allowing the *Pause Time* to be selected.

### **High Voltage**

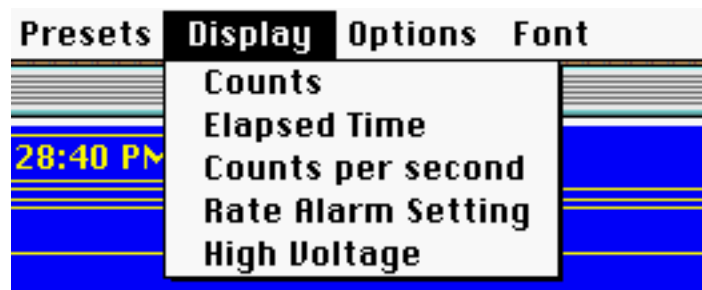
*High Voltage* opens a box that displays the available high voltage settings in 25-volt increments with zero being *OFF*. Clicking on a number will immediately turn the high voltage *On* and set it to the selected value.

### **Rate Alarm**

*Rate Alarm* opens a box that displays the available alarm rate settings with zero being *OFF*. The settings are given in counts per second. When the count rate exceeds this limit, an audio warning will sound until the count rate falls below the limit.

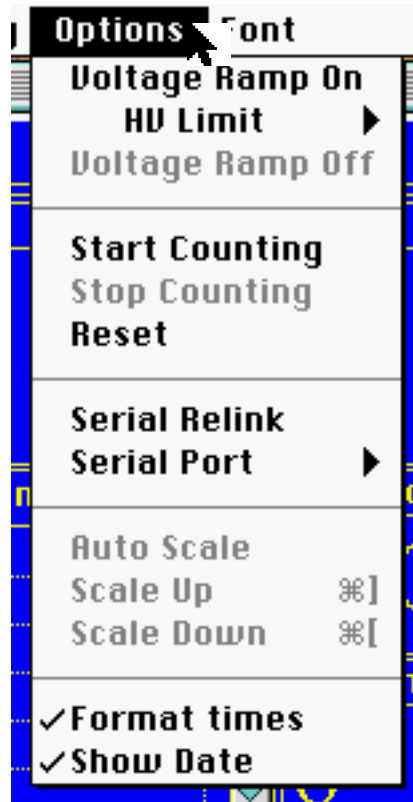
### **Display Menu**

The *Display* menu enables the Macintosh to change the ST360's hardware display. For example, if *Counts* is selected from the *Display* menu, the ST360's display will switch to the *Counts* mode



## Options Menu

The *Options* menu consist of *Voltage Ramp On*, *Voltage Ramp Off*, *HV Limit*, *Start Counting*, *Stop Counting*, *Reset*, *Serial Relink*, *Serial Port*, *Scale Up*, *Scale Down*, *Format Times* and *Show Date*.



### Voltage Ramp On

Causes the high voltage to automatically increment in steps of 25 volts from the current setting to the *HV Limit* setting during a cycle of *Runs*.

### HV Limit

Selects the upper voltage limit for the *Voltage Ramp*.

### Voltage Ramp Off

Disables the *Voltage Ramp* feature.

### Start Counting

Functions the same as the *Count* button.

### Stop Counting

Functions the same as the *Stop* button.

### Reset

Functions the same as the *Reset* button.

### Serial Relink

Causes a re-initialization of the serial connection link. This Command is only used when a serial connection has been inadvertently broken and an *I/O Error* is reported in the Status field.

### Serial Port

Allows either the *Modem Port* or the *Printer Port* to be manually selected for serial communications. Otherwise, the port is selected automatically from all available ports when the application is started.

### Auto Scale

Enable/disable automatic scaling of the *Analog Rate Meter* display.

### Scale Up

If not in *Auto Scale* mode, this command will adjust the meter scaling *Up* to the next range. The *>> Scale* icon located at the top of the display may be used to perform the same function.

### Scale Down

If not in *Auto Scale* mode, this command will adjust the meter scaling *Down* to the next range. The << *Scale* icon located at the top of the display may be used to perform the same function.

### Format Times

This changes the preset and elapsed time formats from *seconds* to *hours:minutes:seconds*.

### Show Date

Enable/disable showing of the date along with time in the upper most right corner of the software display.

### Font

This menu displays the available printer fonts for your computer. The default font used is 'Times'. Font changes are limited to the *Scaler* and *Rate Meter* software selected displays.



### Command Button Icons:

The *Command Button Icons* consists of the *Count*, *Stop*, and *Reset* icons and function the same as the hardware buttons on the ST360.



Selecting the *Count* icon begins counting.

Selecting the *Stop* icon stops counting.

Selecting the *Reset* icon erases accumulated counts, elapsed time and remaining run values. The *Data Table* is not affected by this function.

### Speaker Volume

The *Dn* (down) and *Up* buttons provide control of the ST360's speaker volume. Clicking on *Dn* lowers the speaker volume and clicking on *Up* raises it. In addition, the bargraph display represents the speaker volume setting just like its hard ware counter-part on the ST360.



## Information Display Sections:

As shown below, the Scaler view has four sections for displaying information: *Counts*, *Run Data*, *Elapsed Time*, and *Remaining Runs*.

The screenshot shows a software interface with a blue background and yellow text. At the top, the 'Counts' section displays the number '321'. Below this is a table with five columns: 'Run#', 'Voltage', 'Counts', 'Time', and 'Time Of Day'. The table contains five rows of data. To the right of the table, the 'Elapsed Time' section displays '000:00:10' and the 'Remaining Runs' section displays '0'. The interface includes a vertical scrollbar and navigation arrows at the bottom.

Run#	Voltage	Counts	Time	Time Of Day
1	950	355	000:00:10	2:54:39 PM
2	950	339	000:00:10	2:54:49 PM
3	950	315	000:00:10	2:54:59 PM
4	950	306	000:00:10	2:55:10 PM
5	950	321	000:00:10	2:55:20 PM

### Counts Section

The *Counts* section displays either the current number of counts or the count rate, depending on how it is set. As stated earlier, this setting can be changed by going to the *View* menu and selecting *Counts Per Second*, *Counts Per Minute* or *Counts*.

Another way of changing views is by "clicking" the area with the mouse. When the cursor is placed over this section, it changes shape and the word *SET* appears below it. When this area is clicked once, it changes to display the rate in counts per second. When this area is clicked a second time, it displays the rate in counts per minute. When it is clicked a third time, the display changes back to *Counts*.

### Data Table Section

The *Data Table* section displays information for each data acquisition. This information includes *Run*, *HV* (high voltage setting), *Counts*, *Time* (elapsed time in seconds), and the *Time Of Day* and *Date* the data was acquired.

### Elapsed Time Section

The *Elapsed Time* section displays the time elapsed during counting. The elapsed time will reset to zero when either the *Reset* button is pressed or when counting is re-started after the end of a preset time. If a preset time is not set, or counting is interrupted with the *Stop* command, the elapsed time will not reset and will continue running when *Count* is selected again.

As described earlier, the *Time* format can be changed by selecting *Format times* under the *Options* menu. Another way of changing the time format is by "clicking" the *Elapsed Time* area with the mouse. When the cursor is placed over this section, it changes shape and the letters *FMT* appears below it. When this area is clicked, the time format will toggle between *seconds* and *hours:minutes:seconds*.

### Remaining Runs Section

The *Runs Remaining* section displays the remaining number of runs set by the *Preset Runs* function.

### ***Lower Display Section:***

The lower display section is shown below.

<b>Preset Time:</b>	000:00:01	<b>Count:</b>	208	<b>Time Left:</b>	∞	<b>Voltage:</b>	900
<b>Elapsed Time:</b>	000:00:01	<b>CPS:</b>	208	<b>Alarm:</b>	Off	<b>Runs:</b>	3
<b>Pause Time:</b>	∞	<b>CPM:</b>	12480	<b>Ramp:</b>	Off	<b>HV Limit:</b>	750

It displays a summary of various data and presets. These are *Preset Time*, *Elapsed Time*, *Pause Time*, *Count*, *CPS* (counts per second), *CPM* (count per minute), *Time Left* (remaining *Preset Time*), *Alarm* (OFF or ON), *Ramp* (OFF or ON), *Voltage* (*High Voltage* setting), *Runs*, and *HV Limit*.

If the mouse pointer is clicked over the *Preset Time*, *Elapsed Time*, *Pause Time*, or *Time Left*, the time format will toggle between *seconds* and *hours:minutes:seconds*.

Clicking the mouse pointer over *Ramp*, toggles it between OFF and ON.

# System Operation

## **Warning!**

Dangerous voltages can exist at the GM and SCINT connectors. Do not connect or disconnect a detector unless the high voltage is set to *zero* or the instrument is turned *OFF*.

## **Caution:**

The ST360 was designed and calibrated to work with either a GM tube or a scintillation detector, but not both at the same time. Simultaneously connecting both to the ST360 will result in erroneous data.

## Basic GM Tube Setup and Operation

1. Connect the ST360 to its AC adapter.
2. Connect a GM tube to the GM connector using a BNC cable.
3. Select the *HIGH VOLTAGE* mode and set it to the recommended value for the GM tube.
4. Place the radioactive source under the GM tube's window.
5. Using the information described in the section *Operating Modes and Software Operation*, configure the ST360 and its software to perform the desired operation.

## GM Tubes

Geiger-Mueller tubes produce electrical pulses when ionizing radiation events occur within their sensitive volume. To improve sensitivity to alpha and beta particle radiation, GM tubes have extremely thin entrance windows, which require careful handling. Keep the protective caps in place when the tube is not in its stand and never touch the window. For proper operation, only run these detectors at the manufacturer's specified voltage. If this voltage is not known, then it must be derived empirically by plotting a plateau, which is explained in the next section.

## Creating a GM Tube Plateau Chart

The correct operating voltage for the Geiger-Mueller tube may be determined experimentally using a radioactive source such as Cs-137 or Co-60. A properly functioning tube will exhibit a "plateau" effect, where the counting rate remains nearly constant while the high voltage is increasing linearly. A plateau chart is obtained by counting a source for several runs using a constant preset time, while increasing the high voltage by a constant amount with each run.

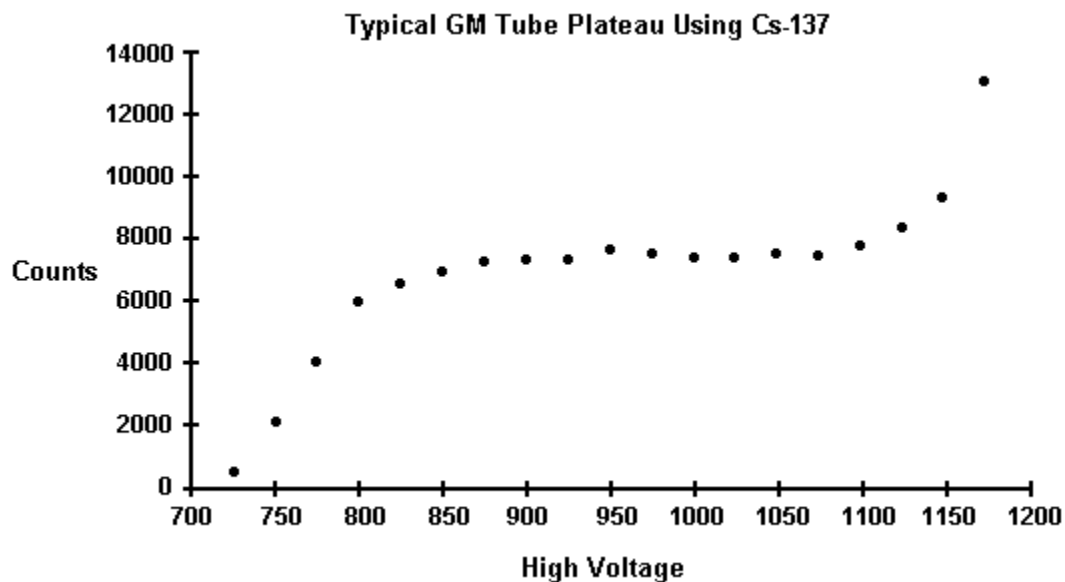
### ***Creating a Chart Manually***

1. Place the radioactive source in a fixed position close to the window of the GM tube.
2. Put the ST360 into *COUNT* mode and increase the high voltage until the first bar of the *ACTIVITY* bargraph lights. Press *STOP* and *RESET*.
3. Set the *Preset Time* to 10 seconds and press *COUNT* again.
4. When the *Preset Time* expires, record the counts and the voltage setting.
5. Increase the high voltage 20 volts and press *COUNT* again.
6. Repeat steps 4 and 5 until the high voltage reaches its upper limit (this is determined by the upper operating voltage limit of the detector).
7. Create an X-Y graph of the data, with "Y" being the Counts, and "X" being the voltage.

## Using the ST360 Software

1. Place the radioactive source in a fixed position close to the window of the GM tube.
2. Put the ST360 into *Count* mode and increase the high voltage until the first bar of the *ACTIVITY* bargraph lights. This is the starting voltage.
3. Select *High Voltage* in the *Presets* menu and set it to the starting voltage. Under the *Options* menu, select *Voltage Ramp On*.
4. Determine the upper operating voltage limit of the detector. Under the *Options* menu, select *HV Limit* and set it just below the detector's upper voltage limit.
6. Select *Preset Time* in the *Presets* menu and set it to 10 seconds.
7. Begin counting. The program will count for 10 seconds, record the value, and increment the high voltage. This process will automatically repeat itself until the upper voltage limit is reached.
8. After data is acquired, save it to a file. Use the file to create an X-Y graph of the data, with "Y" being the Counts, and "X" being the voltage.

The following illustration shows a typical GM tube plateau:



Notice that the counts form a relatively flat place on the graph between 850 and 1100 volts. The center of this area is at approximately 1000 volts and is the recommended operating voltage for this detector. However, any voltage in this flat region would be acceptable. Also, notice that the counts increase rapidly as the high voltage nears its upper limit. This indicates that the tube is entering its breakdown region. Do not continue to operate the tube in this region.



## Resolving Time

Geiger-Mueller tubes exhibit dead time effects due to the recombination time of internal gas ions after an ionizing event occurs. The actual dead time depends on several factors including the active volume and shape of the detector. Dead time can range from a few microseconds for miniature tubes, to over 1000 microseconds for large volume devices.

When making absolute measurements it is important to compensate for dead time losses at higher counting rates. If the resolving time of the detector is known, the true counting rate may be calculated from the measured rate using the following expression:

$$n = \frac{m}{1 - mt}$$

where  $n$  is the true counting rate,  $m$  the measured rate, and  $t$  the detector resolving time.

If the detector resolving time is unknown, it may be determined experimentally using two radioactive sources. Maintaining constant counting geometry is important throughout the experiment. A special source split into two halves (Spectrum Techniques part # RSS-2) is available for making the measurement, but nominal results may be obtained by careful positioning of two standard check sources. Perform the following steps to calculate the resolving time:

1. Set the high voltage to the GM tube's correct operating voltage.
2. Set the *Preset Time* to 60 seconds.
3. Position the two sources (a+b) side-by-side and close enough to the GM tube's window to obtain a count rate of at least 10,000 counts per minute.
4. Press *COUNT*. When counting stops, record the number of counts as  $R(a+b)$ .
5. Remove source (b) and Press *COUNT*. When counting stops, record the number of counts as  $R(a)$ .
6. Carefully replace source (b) to its original position and remove source (a). Press *COUNT*. When counting stops, record the number of counts as  $R(b)$ .
7. Solve for the resolving time using this equation:

$$t = \left[ \frac{R_{(a)} + R_{(b)} - R_{(a+b)}}{2R_{(a)} \cdot R_{(b)}} \right] \cdot 60$$

The resolving time of the ST360 Radiation Counter is very short and is not a significant factor compared to that of the GM tube.

# The Wipe Test System

The ST360 Radiation Counter will also operate with a NaI(Tl) scintillation tube for detecting low-level gamma and X-ray emission from a variety of samples. The Wipe-Test system includes a well detector, base, cable, and lead shield for measuring wipes or tube samples.

This system will detect gamma and X-rays ranging in energy from 20 keV to several meV. Each system is factory calibrated and should not require further adjustment unless a different detector or tube base is used. A Cs-137 calibration source is included for routine checking of overall system performance and quality assurance. Details of the system's setup, operation, and calibration are covered in the following sections.

## Scintillation Detector Setup

The *Wipe Test* system should be set up in the following manner:

1. Install the scintillation detector into the socket of the tube base/stand. Note that the base of the detector is keyed and will only locate in one position of the socket.
2. Place the lead shield over the top of the detector allowing it to rest on the vertical metal support tube.
3. Insert the plastic liner into the well.

**Caution:** This liner provides protection from mechanical damage and contamination. The aluminum wall inside the well is very thin and can be damaged if a tube or rod is inadvertently dropped into the well without the liner in place.

4. Connect the coaxial cable from the detector assembly to the input labeled *SCINT* on the rear panel of the ST360.
5. Turn the ST360 *ON*. Using either the ST360 program or the front panel controls set the high voltage to the value marked on the detector assembly.
6. Set the *Preset Time* to the desired number of seconds and begin counting.

## Checking the System Calibration

Use the supplied calibrated Cs-137 source to check the counting efficiency and overall system performance. This source has its activity marked in counts per minute (cpm) and the date of manufacture. Over time, the source decays with a half-life of 30.1 years and it will be necessary to periodically correct the activity.

1. Place the calibrated Cs-137 source into the plastic well liner and into the well of the detector.
2. Set the *Preset Time* to 60 seconds and begin counting
3. After counting is finished, the reading should correspond within  $\pm 10\%$  of the activity in cpm recorded on the source. For better accuracy, use the average of three separate readings.

## Taking a Background Reading

Wipe tests are inherently low-level measurements and it is necessary to perform background subtraction on all samples to generate accurate activity data. Because the background reading is low, it should be counted for a longer period to improve the statistics.

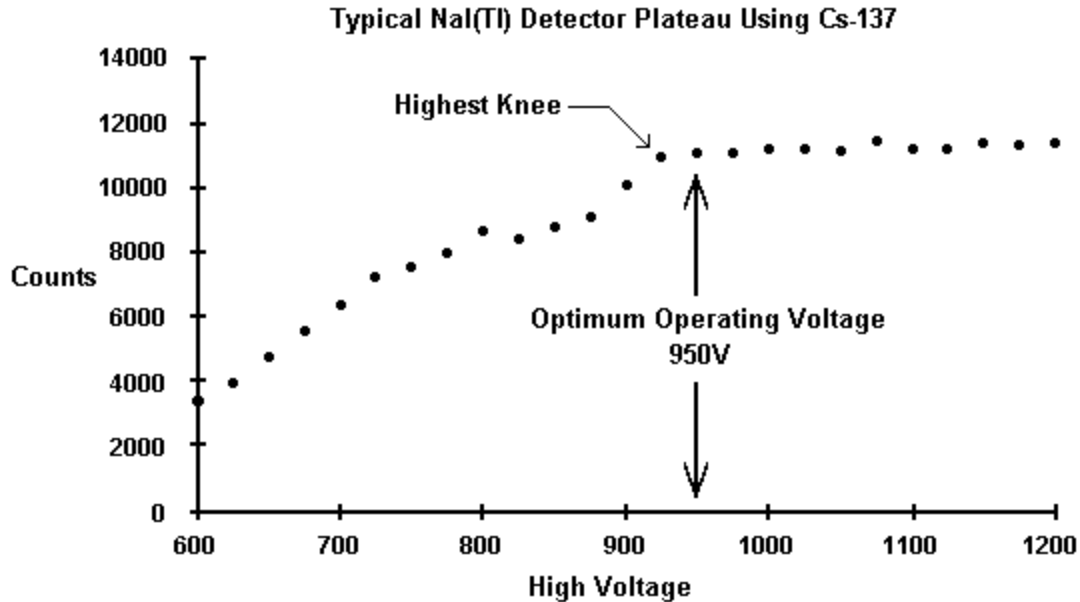
1. Remove all radioactive material from the vicinity of the detector.
2. Set the *Preset Time* to 600 seconds and begin counting.
3. When counting is complete, record the value and divide it by 10 to derive the background counts-per-minute.

## Measuring Wipes

1. Using the well-liner, position the sample into the well of the detector.
2. Set the *Preset Time* to 60 seconds and begin counting.
3. When counting is complete, record the count.
4. Subtract the background counts-per-minute and record the value. This is the correct counts/minute for the sample.

## System Re-calibration

The system is calibrated at the factory. Under normal circumstances, recalibration should not be required. However, in the event that the detector or tube base is replaced, it will be necessary to re-determine the correct operating voltage for the system. To do this, repeat the section *Scintillation Detector Setup* using the new detector or tube base. Using the Cs-137 source supplied with the system, refer to the section *Creating a Plateau Chart* to obtain a chart like the one shown below. The operating voltage is found by selecting the point just to the right of the highest knee. In the example below, the operating voltage would be 950V.



## Warranty and Repair Information

Spectrum Techniques warrants products of our manufacture against defects in workmanship or material for a period of one year from the date of shipment. We will repair or replace, at our option, any instrument that is deemed defective during this time. This warranty covers all replacement parts and labor. The instrument must be returned to our factory prepaid and we in turn will pay the cost of the return shipping.

The warranty does not cover damage caused by mishandling or misuse. GM tubes with broken windows are specifically excluded from this warranty. Accessory items not manufactured by Spectrum Techniques but supplied as part of our systems will be subject to the original manufacturer's warranty.

For warranty repair information and return authorization, contact customer service at:

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