

Model ST-260 Ratemeter



Figure 1 ST260

The **ST260 Ratemeter** combines many features into a single, inexpensive instrument. A large analog meter displays Counts per Minute (CPM) and Counts per Second (CPS), as well as the High Voltage set point for the Geiger-Mueller detector. The **ST260** may be interfaced to a computer via USB and displays information using the included Spectrum Techniques **STX** software on both PC and Macintosh OSX computers.

The ratemeter function is ideal for laboratory contamination survey work. Classroom demonstrations and nuclear experiments can be viewed directly from either an IBM-PC compatible computer running Microsoft Windows or Macintosh computer using a USB interface. The provided software renders all of the **ST260's** information visible from the PC and allows real-time data transfer to the computer. This data can be stored in spreadsheet compatible files allowing data analysis and graphical presentation using many common spreadsheet programs, such as

Microsoft Excel or Open Office Spreadsheet.

The preset **Time**, **Pause Time**, and **Number of Runs** functions are available when connected to a computer and enable the user to acquire radioactive events for a predetermined number of seconds. This is useful for accurately comparing radioactive sources and teaching plateaus in GM counters. Plotting GM detector plateaus may be done if the high voltage is manually incremented.

The **ST260** has a BNC connector and a precision high voltage supply that is adjustable from 0 to +1200 volts. This supply provides 0.2mA at 1200 volts, making it suitable for many types of GM tubes. The ST260 operates on internal, rechargeable NiMH batteries and also includes a 9-volt AC power supply. The unit may be used and the batteries recharged while operating on the AC power supply.

Specifications

GM Input: BNC connector; Accepts standard Geiger-Mueller tubes.

High voltage: 0 to +1200 volts @ 0.2mA, continuously variable by front panel **HV ADJUST** control.

Display: 4 1/2" analog meter display, **CPS**, **CPM** and **HIGH VOLTAGE**.

Modes: **Counts per Second (CPS)**, **Counts per Minute (CPM)** and **HIGH VOLTAGE** front panel display. When connected to a computer, the **ST260** offers: **Scaler Counts**; **Digital Count Rate**, **Analog Count Rate**, **Preset Time**, **Pause Time**, **Elapsed Time**; **Runs Remaining**; **High Voltage**.

Audio: **VOLUME ADJUST** by front panel control; Audible indication of radiation events.

Interface: USB, for both PC and Macintosh computers.

Power: 9 volt DC, at 500mA* and internal, rechargeable NiMH batteries.

Dimensions: 10" W, x 8" D, x 4.25" H

Software: **STX** software for Windows and Macintosh OSX both on CD

Caution: Use only the AC adapter included with the **ST260** if you are not operating on internal battery power. Using a different adapter can damage the unit and void the warranty. You may operate the unit and simultaneously charge the batteries by using the AC adapter.

Controls & Indicators

Below is a brief description of the **ST260** controls and indicators.

FRONT PANEL

OFF, HV, X1, X10, X100, X1000 Control

Turning the **ST260** to the **HV** position allows adjustment of the High Voltage bias to the Geiger-Mueller detector. (Adjustment is by means of the **HV ADJUST** control, below.) **X1** through **X1000** switch positions scale the count rate by a factor of 1 through 1000 depending upon which switch position is selected.

HV ADJUST Control

Allows adjustment of the High Voltage bias to the Geiger-Mueller detector to be from zero to +1200 volts. This bias voltage is indicated on the panel meter and also on the computer screen if the instrument is connected via the USB.

VOLUME ADJUST Control

Speaker volume is adjusted between **MIN** and **MAX** with this control.

BATTERY Indicator

Tri-color LED shows **GREEN**, **YELLOW** or **RED** depending upon rechargeable NiMH battery conditions. A bar graph and percent charge remaining readout is present at the top of the computer screen if the **ST260** is connected via USB.



Figure 2 ST260 Rear Panel

REAR PANEL

GM INPUT

BNC connector accepts standard BNC to BNC cables. Provides power to and accepts signals from GM detectors.

+9V

AC Power input connector; accepts +9 volts from AC transformer, 115/220 volts ac input.

USB

Standard Female A connector; accepts Male A connector to Male B connector cable that connects the **ST260** to computer.

Operating Modes

Below is a description of each mode. The standalone-operating mode is probably the most common and it will be discussed first.

RATEMETER Mode

The **ST260** may be used as a standalone ratemeter, displaying counts as both counts per second (CPS) and counts per minute (CPM). Front panel controls and adjustments include High Voltage and speaker Volume Adjust. A BATTERY level indicator glows GREEN, YELLOW or RED to indicate relative level of battery function remaining.

HIGH VOLTAGE Mode

This mode is for displaying, or setting, the high voltage level. The high voltage is continuously variable and can be set to any value between 0 and 1200 volts.

In the computer-operating mode, there are many more options available. These include the following:

SCALER COUNTS Mode

The *SCALER COUNTS* mode is for displaying the number of radioactive events, or *counts*. During data acquisition, the display will increment in real time.

DIGITAL COUNT RATE Mode

In the *DIGITAL COUNT RATE* Mode, a small, independent window appears on screen that indicates the number of radioactive events in either CPS or CPM, depending upon which is selected.

ANALOG COUNT RATE Mode

In the *ANALOG COUNT RATE* Mode, a small, independent window appears on screen with an analog meter that indicates the number of radioactive events in either **CPS** or **CPM**, depending upon which is selected. The scale factor may be selected as **X1**, **X10**, **X100**, **X1000** or **Auto Scale**.

PRESET Mode

The PRESET Mode allows the user to preset **Time**, **Pause Time** and **Number of Runs**. The *Preset Time* function will allow the user to automatically count radiation events for a predetermined amount of time. To engage the Preset Time function, select the *TIME* Preset from the drop down menu. Set the value desired from the resulting menu. The Preset Time is always visible in the upper right-hand corner of the main window. After counting for this time value, counting will automatically stop. To stop the *Preset Time* function, set the preset time to zero.

The **Pause Time** is also selected from the PRESET drop down menu. This feature pauses the ST260 counting for the selected number of seconds to allow adjustment of high voltage, recording counts for later use, or other desirable pauses. Setting is similar to Preset Time, using the Set Pause Time, type the number of seconds you desire to pause counting in the box and click OK.

The **Number of Runs** sets the number of times the **ST260** will count for the preset **Time**, pause for the selected **Pause Time** and repeat this cycle. The **Number of Runs** function is useful for determining the GM plateau by automatically repeating counting cycles, allowing the user to increment the High Voltage during the Pause Time, as chosen above.

ST260 Software Installation and Operation Microsoft Windows Version

Introduction

NOTE: The STX software should be installed BEFORE connecting the instrument to the computer!

The supplied **STX** software provides full readout of the **ST260** information from an IBM compatible PC or Macintosh computer. It allows the user to save data to the PC and to use the features described in the *Operation* section below. The latest **STX** software revisions are available on our web site at www.spectrumtechniques.com.

Installation

Place the installation CD into the CD-ROM drive or download the **STX** software from the web site. In the case of the CD, the window, below, should appear. If it should not appear, open Window's Explorer, open the CD to inspect its contents and double click on the "Software" folder. Follow the instructions as below. **This menu will not appear if the software has been downloaded from the Spectrum Techniques web site.**

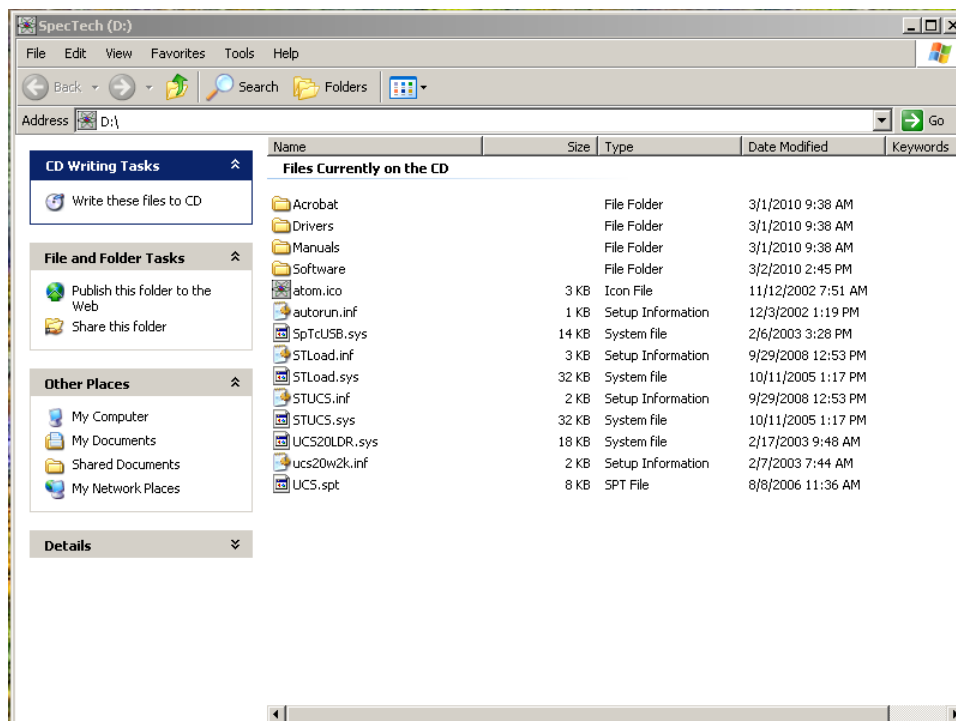


Figure 3 SpecTech CD menu after insertion

After double clicking the Software folder, you should get the following screen.

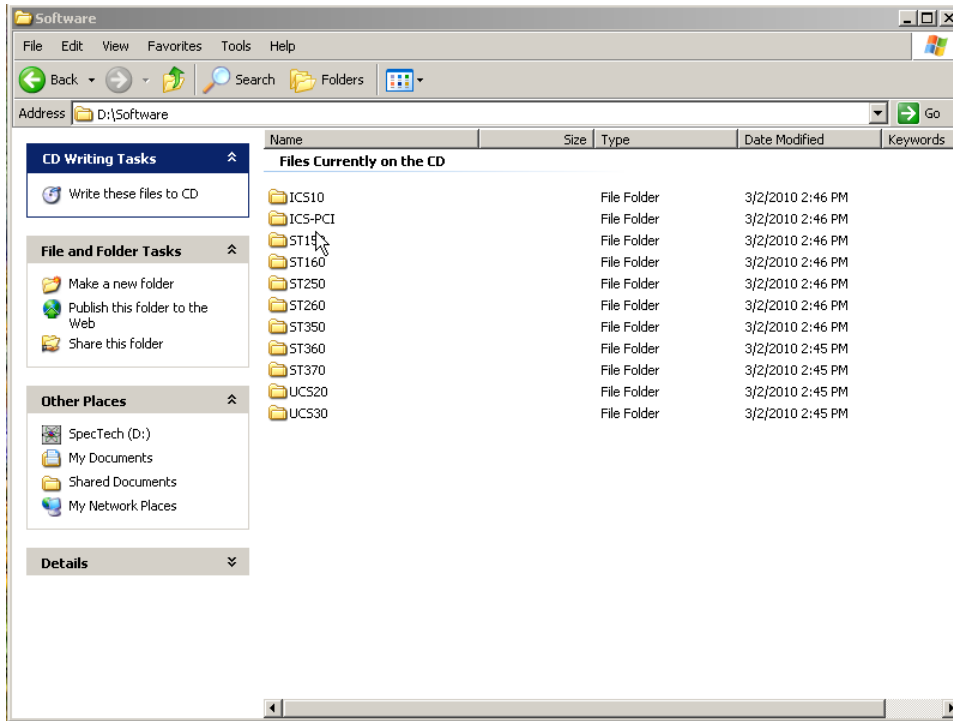


Figure 4 View after opening the "Software" folder

Double click the ST260 folder and you will see the following screen.

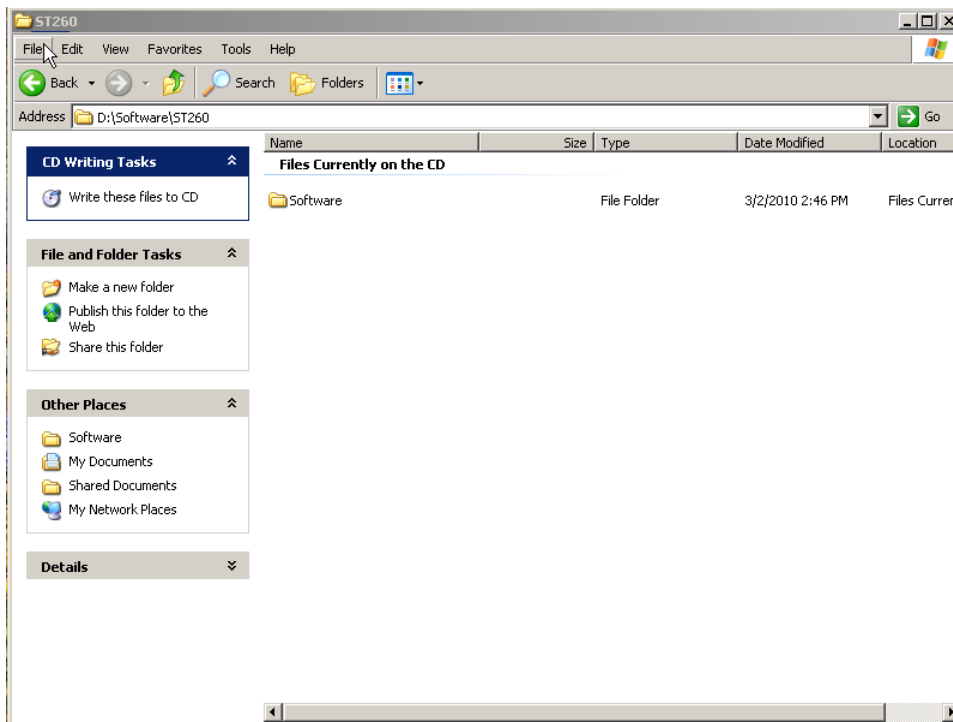


Figure 5 After opening the ST260 folder

Double click the Software folder and verify you see the following screen. If you have downloaded the **STX** software from the Spectrum Techniques web site instead of installing it from the CD, you will see the following message. If so, click "OK" to continue Installation.

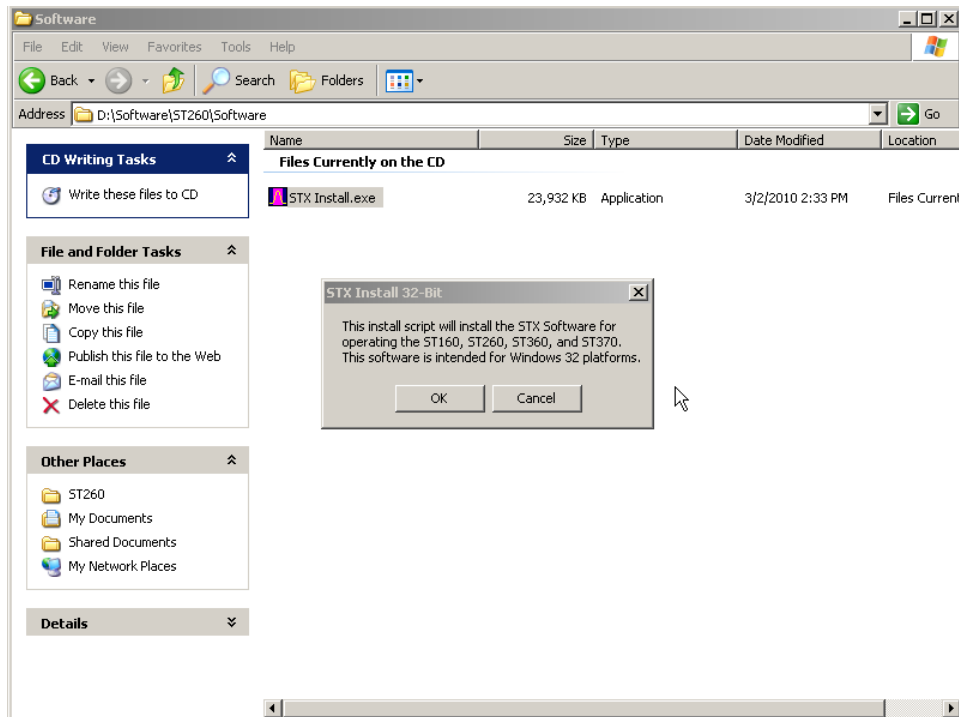


Figure 6 Contents of "Software" folder

Select *Run*. The Wizard will proceed to the next display.

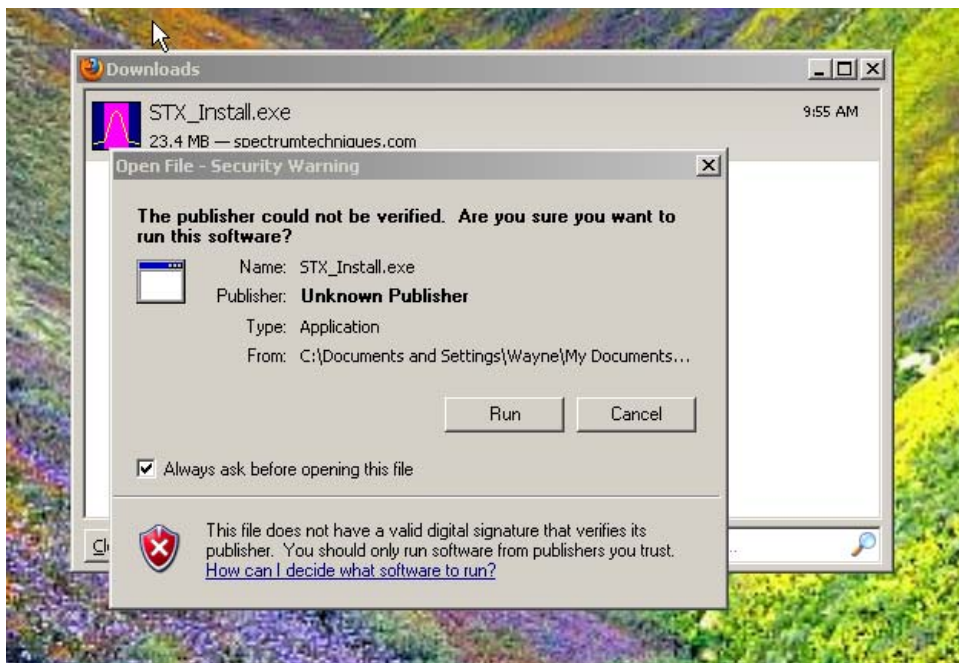


Figure 7 Security warning

You will have the opportunity to install Java. If it is already installed on your computer, you may cancel Java install; otherwise, click *Setup*.

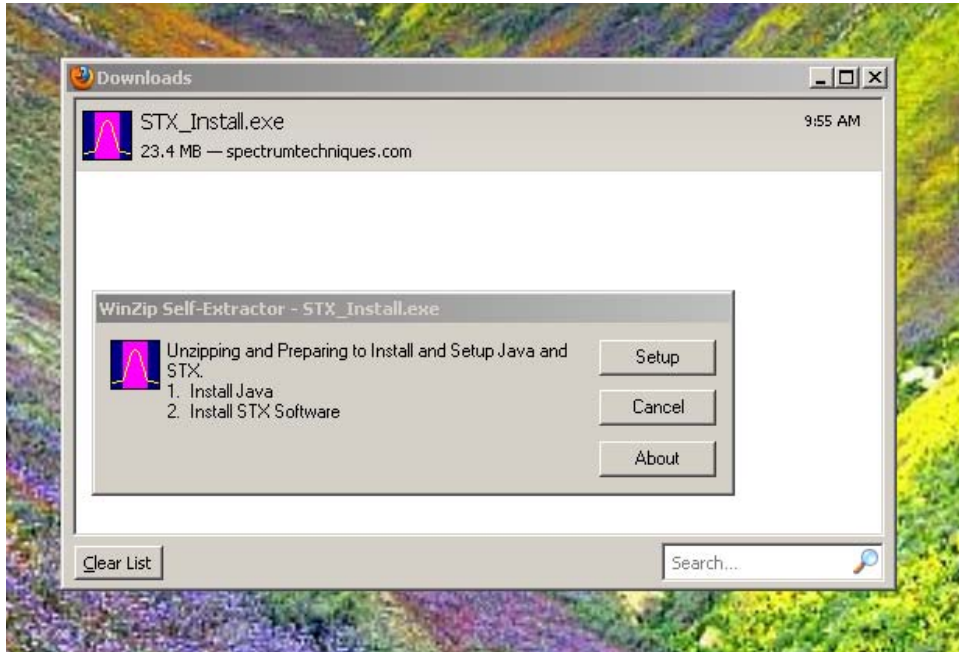


Figure 8 Java and STX Software Setup

Java Installation screen:

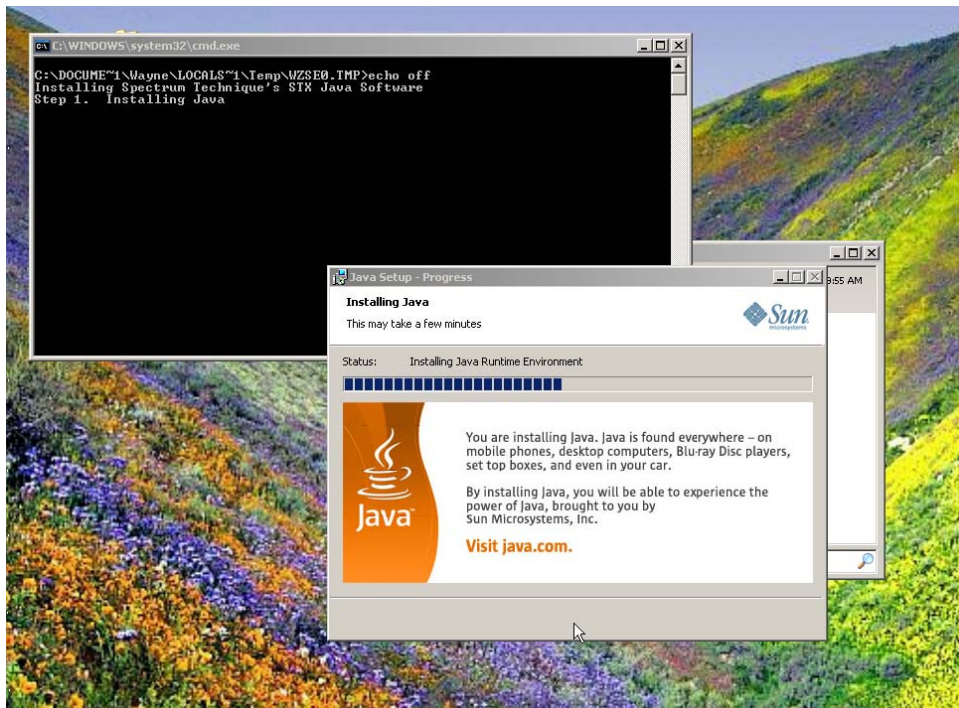


Figure 9 Java Installation Screen

STX software Installation screen. Just follow the prompts until the software installation is complete.

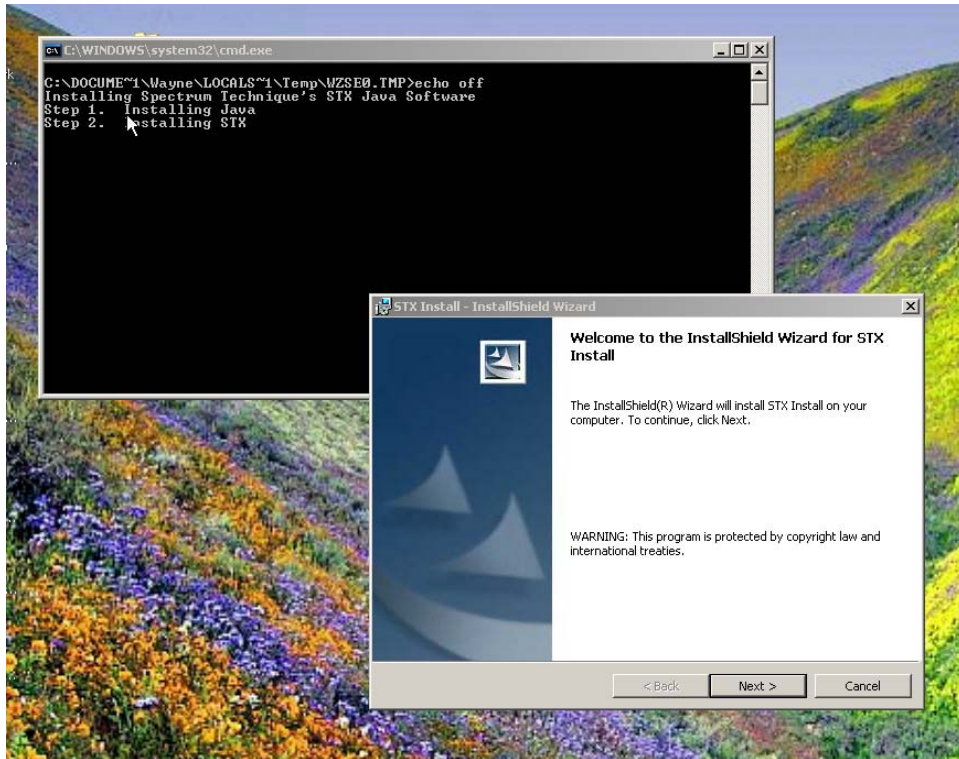


Figure 10 STX Software install

When you first connect the **ST260**, or any of the **STxxx** series of instruments to the computer after you have installed the **STX** software, you will get the following "**Found New Hardware**" Wizard. The following screens are taken of a **ST360** installation and the **ST260** procedure will be the same.



Figure 11 Add New Hardware

Select *Search for the best driver for your device*, and *Next*. The Wizard will proceed to the next display.



Figure 12 Add New Hardware, Step #2

Select *CD-ROM drive* and *Specify a location*. Verify that the text box is displaying the correct path to the CD-ROM drive and select *Next*. (NOTE: In this example the CD-ROM drive is shown as "E". However, it may be a different letter depending on the configuration of the user's PC). The following display will appear when Windows has found the correct driver on the installation CD.



Figure 13 Add New Hardware, Step #3

Select *Next*. The Wizard will proceed to the next display, indicating that driver installation is complete.



Figure 14 Finish

Select *Finish* to end installation. Run the **ST260** software by double-clicking on the desktop icon.

Operation

When the **ST260** program opens, it defaults to the *Scaler* view, with the title bar reading **ST260 USB - -[Data Window]** or **ST260 Serial - -[Data Window]**.

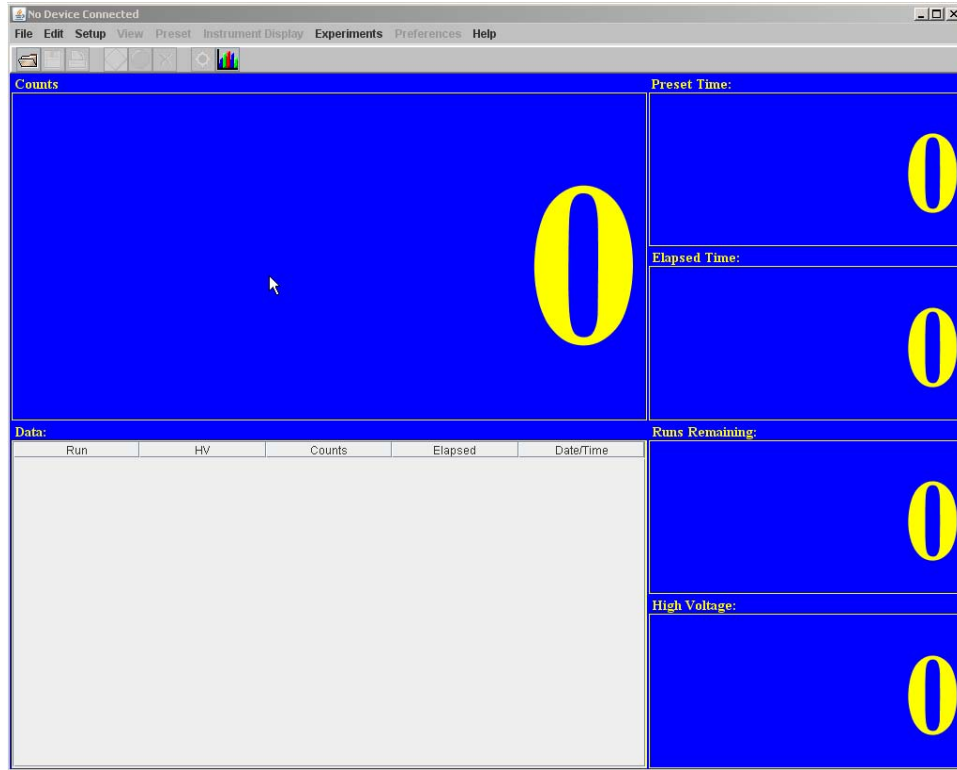


Figure 15 Default STX Counting Screen

In the upper part of the main display are the menu headings. From left to right, they are: **File**, **Edit**, **Setup**, **View**, **Preset**, **Experiments**, and **Help**. Menu selection is either by using the mouse or by holding the *Alt* key and pressing the key corresponding to the underlined letter in the title's name. Note that grayed out menu headings do not apply to the **ST260**.

Below the menu titles are icons for running commands. From left to right, they are **File Open**, **File Save**, **Print**, **Start**, **Stop**, and **Erase**.

Under the icon row are sections displaying various data and settings. The sections include **Counts**, **Data**, **Preset Time**, **Elapsed Time**, **Runs Remaining**, and **High Voltage**.

Menus

This section describes the menus and their contents. The menus are **File**, **Edit**, **Setup**, **View**, **Preset**, **Experiments**, and **Help**.

File

The File menu contains **Open**, **Save**, **Save As**, **Print**, **Print Setup**, and **Exit**.

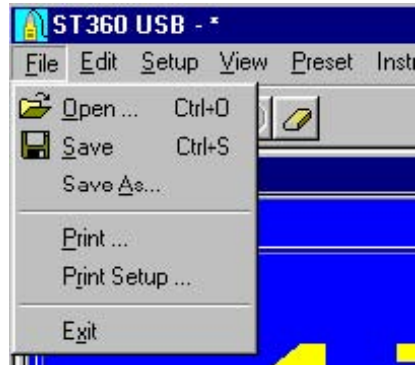


Figure 16 The File menu options

Open

Open allows the user to open a previously saved file with the **.tsv** extension and display it in the Data section of the main display. Once a file has been opened, any additional data acquired will automatically append itself to the end of the list.

Save / Save As

Save allows the user to save the current data displayed in the Data Section. If the data has been previously saved, it will be saved with the same file name. If the data has not been previously saved, it will prompt the user for a file name and allow selection of a different directory. *Save As* always asks for a file name, whether or not the file has been previously saved. The file is always saved in the **.tsv** version that can be opened in database spreadsheets such as Microsoft Excel.

Print / Print Setup

Print opens the standard Windows printer dialog box allowing the user to select the printer properties, printing range, and the number of copies. Selecting *OK* will print the description, number of runs, preset time, pause time, alarm level, high voltage setting, counts, date, and time. *Print Setup* will open the standard Windows dialog box, allowing printer configuration.

Exit

Selecting *Exit* will close the program.

Edit

The *Edit* menu contains the *Copy* selection.



Figure 17 Edit option

Copy

Copy is the only selection in the *Edit* menu. It allows the user to copy the description, number of runs, preset time, pause time, alarm level, high voltage setting, counts, date, and time to the Windows clipboard. Afterwards, the user can paste the data into another application.

Setup

The *Setup* menu contains *ReSync* and it is only available when communication is established via the USB.

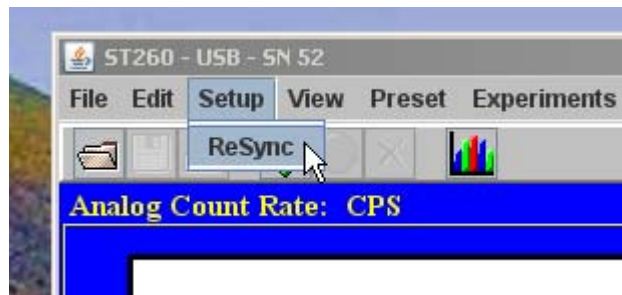


Figure 18 Setup option

ReSync

If communication is lost between the **ST260** and the PC, click on *ReSync* to re-establish it.

View

The *View* menu contains the two main views of the **ST260**: *Digital Rate Meter*, and *Analog Rate Meter*. It also gives the option of displaying **CPS** or **CPM** and **Scaler Counts**, **Digital Count Rate** and **Analog Count Rate**.

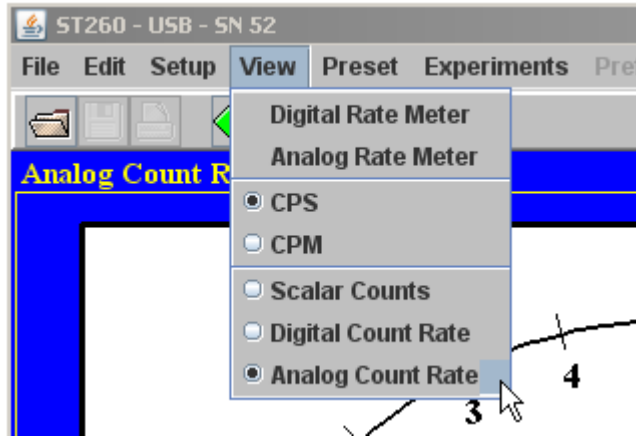


Figure 19 View Options of ST260

Digital Rate Meter

Selecting the *Digital Rate Meter* opens a small, independent *Digital Rate Meter* window that displays either *CPS* or *CPM*, depending upon what is selected.

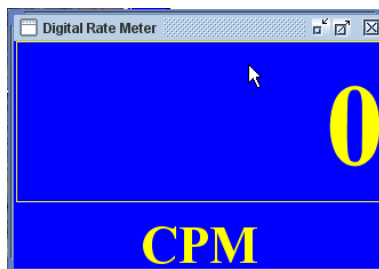


Figure 20 Digital Rate Meter Option

Analog Rate Meter

The *Analog Rate Meter* view simulates an analog meter by displaying a meter and a moving needle. Users accustomed to analog meters will find this view helpful. The meter range is selectable and also features an auto-ranging scale. As with the *Digital Rate Meter* view, the *Analog Rate Meter* view displays the count rate in counts-per-second or in counts-per-minute.

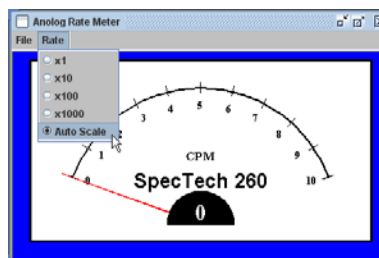


Figure 21 Analog Rate Meter Option

The figure below shows all three views displayed simultaneously.

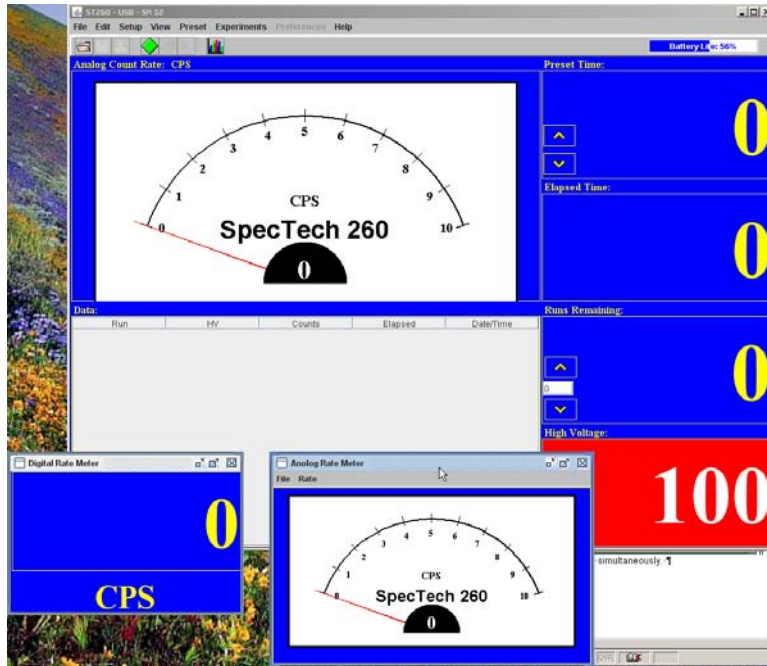


Figure 22 Main ST260 Window with Digital and Analog Rate Meter showing

Preset

The Preset menu allows certain parameters to be set before counting takes place.

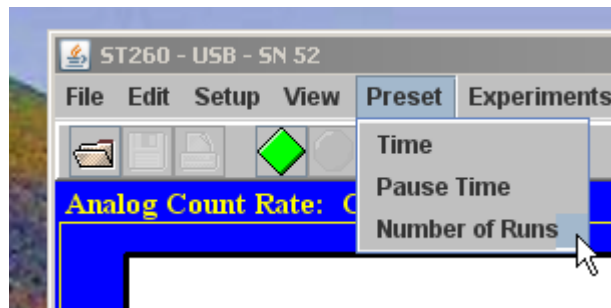


Figure 23 Preset Options

Preset Time

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

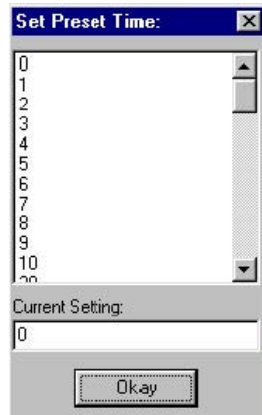


Figure 24 Preset Time Setting

The Preset Time is always visible in the upper right-hand corner of the main window.



Figure 25 Preset Time from right-hand-corner of main window

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, the following box appears. Enter the time in seconds.

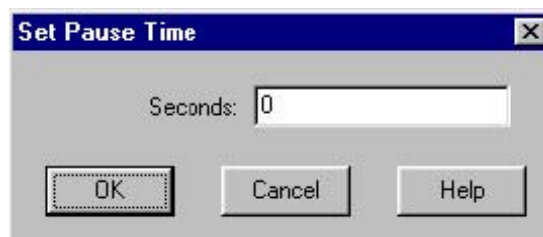


Figure 26 Pause Time Setting

Runs

When *Runs* is selected, the following box appears.



Figure 27 Set Number of Runs

Enter the number of runs and click OK. When used in conjunction with Preset Time, this feature causes counting to automatically repeat after the unit counts for the preset time. Once all the runs have been executed, the counting will stop. During this operation, the Runs Remaining section of the main view displays the remaining runs.

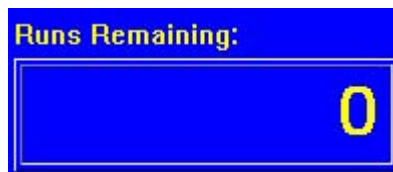


Figure 28 Runs Remaining from main window

Experiments

The *Experiments* menu allows the user to create a graph from the **ST260**'s counts, such as demonstrating a GM plateau with counts vs. bias voltage.

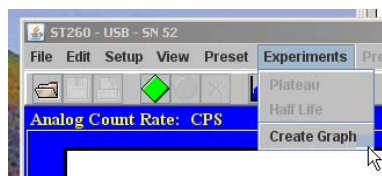


Figure 29 Experiments Menu

Help

The *Help* menu provides immediate help for the user. To utilize the help feature, select Help and the topic you wish to view.

Command Icons

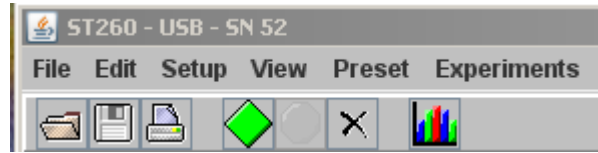


Figure 30 Command Icons

File Open, File Save, and File Print

The first group of icons from the left is the *File Open*, *File Save*, and the *File Print* icons. The *File Open* icon functions exactly like the *Open* command in the *File* menu. The *File Save* icon functions exactly like the *Save* command in the *File* menu. The *File Print* icon functions exactly like the *Print* command in the *File* menu.

Count, Stop, and Erase

The second group of icons consists of the *Count*, *Stop*, and *Erase* icons. The *Count* icon starts counting on the **ST260**. The *Stop* icon functions stops counting. The *Erase* icon erases all the data in the data section. However, as a safety precaution it will prompt the user to save the current data before deleting it.

Graph

The Graph function icon allows the user to create a Graph based upon either Counts and Voltage, such as a GM plateau or Counts and Runs. See menu, below.

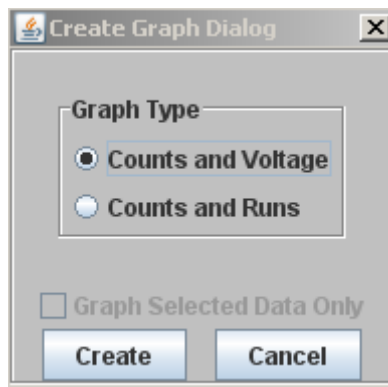


Figure 31 Create Graph Options

Note: If any of the icons are *grayed out*, it means they are not available at that particular time. In the example below, the *File Save*, *File Print*, and *Stop* icons are grayed out. This is because the *Data* section contains no data to save or print, and the **ST260** is already in *STOP* mode.



Figure 32 Showing Icons grayed out

Information Display Sections:

As the illustration below shows, the main display has 7 sections for displaying information: *Counts*, *Data*, *Preset Time*, *Elapsed Time*, *Runs Remaining*, *HV*, and *Step*. (Note that the Step function is not available in the **ST260** and the option will not display on the screen.)

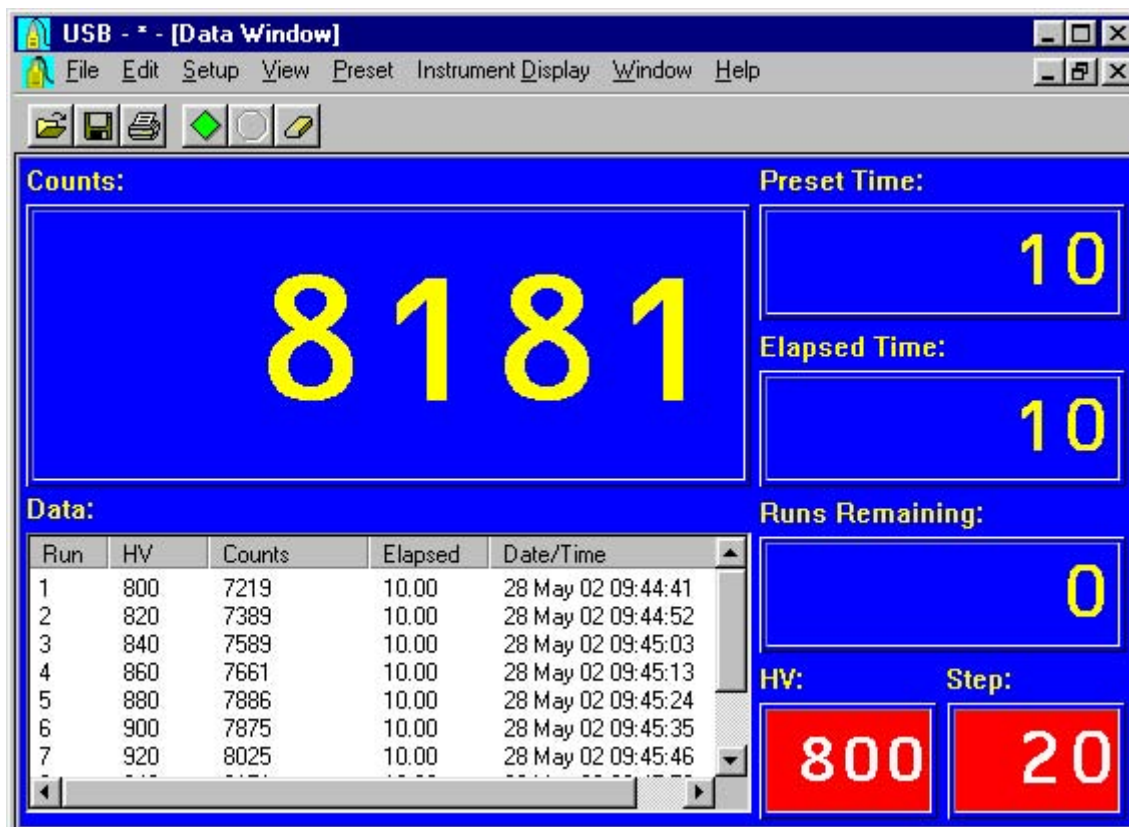


Figure 33 Typical Data Window

Counts Section

The *Counts* section displays the total number of counts.

Data Section

The *Data* section displays information for each data acquisition. This information includes *Run*, *HV* (high voltage setting), *Counts*, *Elapsed* (time in seconds), *Date*, and *Time*. This is the actual data that is stored when using the *Save* command.

Preset Time Section

The *Preset Time* section displays the current *Preset Time* setting.

Elapsed Time Section

The *Elapsed Time* section displays the time elapsed during counting. The elapsed time will reset to 0 when either the data is erased or when counting is re-started after the end of a preset time. If the preset time is not set, or counting is interrupted with the *Stop* command, the elapsed time will not reset and will resume running when *Count* is selected again.

Runs Section

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

HV Section

The *HV* section displays the current high voltage setting.

Step Section

The *Step* window displays the high voltage step size and is only visible when the step voltage function is available and set.

System Operation

Basic GM Tube Setup and Operation

Warning!

Dangerous voltages can exist at the GM connector. Ensure that the high voltage is set to zero or that the instrument is OFF before connecting or disconnecting a detector.

1. Connect the **ST260** to its AC adapter.
2. Connect a GM tube to the **GM INPUT** connector via a BNC cable.
3. Set the HIGH VOLTAGE to the recommended value for the GM tube by the front panel **HV ADJUST** control.
4. Place the radioactive source close to the GM tube's window.
5. Using the Operating Mode information described above, set the unit up to perform the desired function.
6. Click the **COUNT** icon to start data acquisition, the **STOP** icon to halt data acquisition (providing Preset Time is not being used), and the **RESET** icon to clear the data and reset the time and data to zero.

GM Tubes

Geiger-Mueller tubes produce electrical pulses when ionizing radiation events occur within their sensitive volume. 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 (see below). To improve sensitivity to alpha and beta particle radiation, many GM tubes have extremely thin entrance windows made of mica or other materials, which require considerable care in handling. Do not remove protective caps unless necessary and never touch the window.

GM Tube Plateau

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 using a constant preset time to count a source for several *runs*, while increasing the high voltage by some constant amount after each *run*. This process is described in detail in the next section, *Creating a Plateau Chart*.

Creating a Plateau Chart

Running the unit as stand-alone

1. Place the radioactive source in a fixed position close to the GM window.
2. Turn on the **ST260** and slowly increase the high voltage until you observe a count rate increase from the **ST260**.
3. Increase the voltage by 20 volts and count data again.
4. Repeat step 3 until the high voltage reaches its upper limit (this is determined by the upper operating voltage limit of the detector).
5. Create an X-Y graph of the data, with "Y" being the Counts, and "X" being the voltage, and plot the chart.

Using the ST260 Software

1. Place the radioactive source in a fixed position close to the GM window.
2. Turn on the **ST260** and slowly increase the high voltage until the meter indicates an increased count rate. This is the *starting* voltage.
3. Determine the upper operating voltage limit of the detector. This is the *ending* voltage.
4. Subtract the *starting* voltage from the *ending* voltage. Divide the result by the high voltage step size that you want to use (20 volts in this case). This will yield the number of *runs*.
5. Select *High Voltage Setting* in the *Setup* menu and set the High Voltage to the *starting* voltage.
6. Select *Preset Time* in the *Preset* menu and set it to 10 seconds. Set the *Pause Time* to 5 or 10 seconds, or whatever delay you will need to write down the counts and high voltage and then **manually** increase the voltage by the step size you selected in step 4.
7. Select *Runs* in the *Preset* menu and set it to the number calculated in step 4.
8. Start data acquisition. Manually increase the High Voltage during the *Pause Times* to the next level. Record results. After counting has begun, it will automatically stop when *runs* equals zero.
9. Save the data to a file. Before saving, a description of the data may be entered into the *Description* box.
10. Open the saved file version with a **.tsv** extension into a spreadsheet program such as *Microsoft Excel*.

The following illustration shows a typical detector plateau.

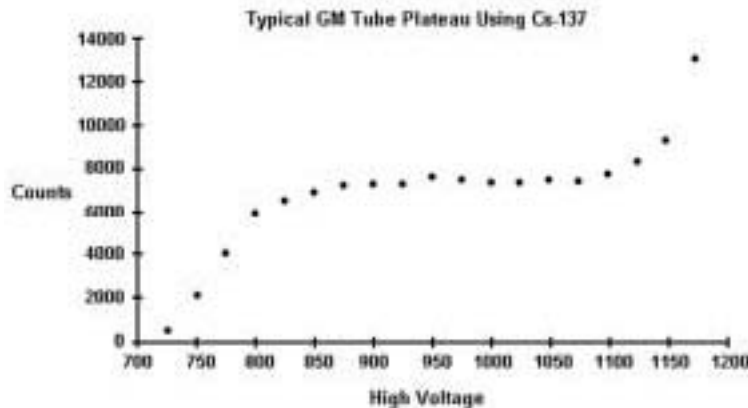


Figure 34 Typical GM Plateau

Notice that the counts form a relatively flat place on the graph between 850 and 1100 volts. The center of this area, at approximately 1000 volts, is the recommended operating voltage for the 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:

$$n = m / (1 - mt)$$

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 # **RSS2**) is available for making the measurement, but good results may be obtained by careful positioning of two standard check sources. Perform the following steps to calculate the resolving time:

1. Turn on the ST260.
2. 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 CPM.
3. Record the count rate as $R_{(a+b)}$.
4. Remove source (**b**) and record the count rate as $R_{(a)}$.
5. Carefully replace source (**b**) to its original position, remove source (**a**) and record the count rate of source (**b**) as $R_{(b)}$.

Solve for the resolving time using this equation

$$T = [R_{(a)} + R_{(b)} - R_{(a+b)}] / [2R_{(a)} * R_{(b)}]$$

The resolving time of the **ST260** RATEMETER is very short and is not a significant factor compared to that of the GM tube.

Warranty and Repair Information

Spectrum Techniques warrants products of our manufacture against defects in workmanship or material for a period of one year from 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 or return authorization, contact customer service at:

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