

# **SPECTECH**

## **UCS-20**

Universal Computer  
Spectrometer

### **Operating Manual Macintosh Edition**

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## OVERVIEW

The UCS-20 is a fully integrated multichannel analyzer for nuclear spectroscopy and time related studies on the Macintosh computer. The instrument contains a high voltage supply, amplifier, multichannel scaling, a 2048 channel analog-to-digital converter and up to 2048 channels of data memory, capable of storing spectra and associated elapsed time.

### UCS-20 Software for Macintosh

Supplied software includes the following items:

**UCS20 for Mac version 1.0.0** - This is the MCA application program for the UCS-20 system.

**UCS20 Preferences.** This is a starting point for initial application conditions. This file is overwritten each time the application is closed.

**ucs20.hex.** This is the operating firmware for the UCS-20. It is downloaded to the UCS-20 when the program is launched if power was cycled since last loaded.

**UCS20 Notes.** A text file with latest additions and corrections.

**'OS Extensions' Folder.** This folder contains the USB drivers for communicating with the UCS-20. Files should be placed in the Extensions folder of computers running OS 8.6 and above (not OS-X compatible).

**'Sample Files' Folder.** This folder contains sample spectra acquired using the UCS-20 and saved to disk. Also contained are sample UCS Setup files holding high voltage, amplifier gain, presets, etc. These files may be opened and viewed within the UCS20 for Mac application.

### UCS 20 - Menus

#### File

**New** - Opens a blank window that is not associated with any hardware or opened file. This window may be used to hold a spectrum pasted from the clipboard.

**Open...** - Opens a UCS-20 spectrum file in its own window or a UCS setup file containing acquisition parameters and presets. Both file types will appear in the standard Open File dialog box. The spectrum files are represented by document style icons showing a miniature spectrum. Setup files are document style icons filled with simulated controls and indicators.

**Close** - Closes the current (front-most) spectrum data window.

**Save** - Standard data file saving.

**Save AS...** - Standard data file renaming or changes saving.

**Save UCS Settings...** - This selection will save UCS setup parameters including detector voltage, amplifier gains, presets, etc.

**Page Setup...** - Standard print out set up.

**Print Preferences...** - The check boxes select or deselect the print-out

features. The selection of the channel data will cause all channels between the first and last selections to be printed.

**Print** - Activates printing as defined in Print Preferences.

**Quit** - Exits the UCS-20 for Mac application.

## **Edit**

**Cut** - Erases spectrum in current window and copies data to clipboard in the same formats as the Copy selection.

**Copy** - This selection copies the currently selected spectrum into the clipboard. Spectrum data may be directly pasted into another spectrum data window from the clipboard. Clipboard data also exists in tab separated ASCII format for direct pasting into spreadsheets or documents.

**Paste** - Pastes spectrum data into the current window.

**Clear** - This selection erases the spectrum in the front window even if the window shows a spectrum loaded from disk. Note that this is not possible using the Erase control in the system control window.

**Copy Data Text Only** - This selection only copies to the clipboard the ASCII channel data with no header or column titles.

**Strip Clipboard Spectrum** - Allows the spectrum currently residing in the clipboard to be subtracted channel-by-channel from the spectrum in the current data window. This is done using live-time normalization.

**Add Clipboard Spectrum** - Allows the spectrum currently residing in the clipboard to be added channel-by-channel to the spectrum in the current data window.

**Overlay Clipboard Spectrum** - Allows the spectrum currently residing in the clipboard to be displayed as a channel-by-channel overlay with the spectrum in the current data window.

**Experiment Text...** - Allows entry of user information about the spectrum being collected to be tagged with the spectrum.

**Show Clipboard** - A simple clipboard text viewer. This is not a full-featured viewer. Only the first portion of the clipboard is displayed as an aid to see what is clipped. Pasting into a text editor or spreadsheet application is necessary to fully view or to edit the information.

## **Mode**

**Pulse Height Analysis** - Sets system into standard PHA mode (default).

**Multichannel Scaling** - Sets system into MCS mode where incoming events are counted for predetermined (Dwell) times and stored in sequential memory channels. This selection counts all events occurring between the upper and lower level discriminators. These are set using the sliders above the spectrum area in PHA mode.

**External Multichannel Scaling** - Same as above except that events are counted from rear panel *Ext MCS In* connector.

**Mössbauer** - Sets system into Mössbauer mode where incoming events are counted for predetermined (Dwell) times and stored in sequential memory channels. This selection counts all events occurring between the upper and

lower level discriminators. These are set using the sliders above the spectrum area in PHA mode. Acquisition continues to accumulate data for the number of passes specified in the Presets dialog.

**External Mössbauer** - Same as above except that events are counted from rear panel *Ext MCS In* connector.

### Calculations

**Energy Calibrate...** - This selection changes the system control window to energy calibration display to allow the system to read channels in energy units. Two (linear fit) or three (quadratic fit) points may be used do the calibration. This works by positioning the marker in a channel and clicking *Energy* to enter the energy for that channel. The radio buttons indicate which of the three points is being set. The energy units may also be set. When at least two points have been completed, clicking on *Calibrate* will initiate the calibration calculation and the marker and X axis can then be read in energy.

**Smooth Data** - This selection does a three point averaging of the data. The new data will be displayed. The actual data collected in the hardware will not be affected and may be retrieved by choosing *Raw Data* or continuing acquisition.

**Raw Data** - Retrieves the true spectrum data after a smooth selection.

### Tools

**IsoMatch...** - The IsoMatch feature places markers in the spectrum window showing the significant gamma ray emissions for many common isotopes. This feature requires a properly energy-calibrated spectrum so that the markers will not be misaligned. When this feature is selected a list box appears with the currently defined isotope list. Use the mouse to click on isotopes to be labeled. To select multiple isotopes, hold down the *Command* key while clicking on an isotope item.

The isotope list and the corresponding energies may be edited by the user using ResEdit on the UCS-20 application. Up to 128 isotopes may be added each with up to 9 energies. If editing the isotope table, always take care to safely back-up the application resources beforehand.

**Peak Summary** - If regions of interest (ROIs) are currently set, this selection changes the data display from spectral to text giving the summary information for each ROI.

### Settings

**View Settings...** - This selection displays a dialog box showing all the UCS hardware parameter settings. If the front window displays a spectrum loaded from disk, this dialog shows the parameters used to collect that data. The dialog may be exited with no action by clicking OK. If displayed as the result of *Opening* a Settings file, a button is provided for sending the settings to the connected UCS-20 hardware.

**Presets** - One of several acquisition presets may be set when in standard PHA

mode. When acquisition is started, it will stop automatically when an active preset is reached. Preset real- and live-times are available as well as preset peak counts and preset integral. When preset peak counts is selected , acquisition will stop when any channel reaches the count. Preset integral must be set while the marker resides in a region of interest. When the counts in that region reach the preset value acquisition will stop. To activate or deactivate a preset use the check boxes in this dialog. When in Mössbauer mode, the total number of passes to be acquired is as specified in this dialog.

**MCS Dwell Times** - In MCS or EMCS modes only this selects the time that events are counted in each channel. Times are selectable from a list ranging from 10 milliseconds to 600 seconds dwell per channel.

**Mössbauer Dwell Times** - In Mössbauer or External Mössbauer modes only this selects the time that events are counted in each channel. Times are selectable from a list ranging from 100 microseconds to 6 seconds dwell per channel.

**Amplifier/High Voltage...** - This opens a dialog which allows the coarse/fine gain and high voltage to be adjusted. The acquisition controls are also made available within this dialog for convenience.

**Conversion Gain** - Sets the ADC full scale conversion channel: 256, 512, 1024 or 2048.

**ROI Indicator** - Drag the mouse to the color/pattern of choice to make it the new active ROI type. Subsequent ROI settings will rotate through the color/pattern sequence.

**Spectrum Dot Size** - Choose size of dots used in drawing spectra: Small, Big or Huge.

## **Window**

**Stack** - Stacks vertically all open spectrum windows.

**Tile** - Tiles all open spectrum windows, scaling them such that they are fully and separately viewable.

**Window List** - Provides a means of selectively bringing any open window to the foreground .

## **Other Features and Controls**

### **Acquisition Controls**

Acquisition in any mode may be started by clicking the *Acquire* check box in the system control window. Small indicators will blink when acquisition is active. Clicking on the check box again will stop acquisition. To erase all acquired data click the Erase button. This does not clear any regions of interest that have been set or any current acquisition presets.

### **Regions of Interest (ROIs)**

Region of Interest selection provides instantaneous computation of peak gross and net counts. To set a region of interest click on the *Set* radio button in the system control window. The currently selected ROI color type will be

displayed to the right of the *Set* indicator. Move the mouse to the left edge of the spectrum area to be selected. Click and drag across the spectrum to the right until the right edge of the desired region is reached. Release the mouse button and the enclosed area will highlight as a region of interest. To clear a region click the *Clear* radio button and click and drag the cursor across a region. Release the mouse button and all channels marked as ROIs between the drag boundaries will be cleared. To quickly clear all ROIs select *ClearAll*. Only ROIs will be cleared. The data will remain. After setting or clearing ROIs the *Normal* button will be automatically reselected.

#### **Discriminators - ULD / LLD**

The upper and lower level discriminator settings are shown by the position of the sliders above the spectrum display area of a spectrum window. They may be changed by clicking and dragging these indicators. While discriminators are being set, a small box will show the current value of the setting. Setting is in increments of one percent of range.

### ***INSTALLATION***

Your UCS-20 Universal Computer Spectrometer is designed to interface with most Macintosh computers running System 8.6 and higher (not OS X). Communication is via a USB 1.1 compatible Bus. Support is not provided for OS X native-mode operation but will run in Classic Emulation.

It is recommended that you place all of the supplied application software into a folder of your choosing, such as '*SpecTech Applications*' where you can readily access them for regular use.

Before connecting the UCS-20 to the Macintosh, copy the contents of the 'OS Extensions' folder into the appropriate Extensions folder of your hard drive. Before turning on power to the UCS-20, and after the drivers are installed, reboot your computer.

#### ***WARNING - ELECTRICAL SHOCK HAZARD***

**TO AVOID ANY POSSIBILITY OF ELECTRICAL SHOCK, ALWAYS TURN OFF THE COMPUTER POWER BEFORE CONNECTING THE EXTERNAL CABLES. DANGEROUS HIGH VOLTAGE CAN EXIST ON THE THE EXTERNAL HV CONNECTOR WHEN THE UNIT IS OPERATING. NEVER REMOVE OR CONNECT CABLES WITH THE COMPUTER RUNNING.**

**SERVICE BY AUTHORIZED PERSONNEL ONLY.**



### Connecting the Detector

The UCS-20 is equipped with an internal Amplifier/Preamplifier allowing direct connection of a scintillation detector. If you plan to use this feature, connect the signal (anode) output of the detector tube base to the PREAMP IN connector on the rear of the instrument using a BNC cable and connect the high voltage to HIGH VOLTAGE with a MHV cable.

*These connectors appear similar with the MHV being slightly longer than the BNC*



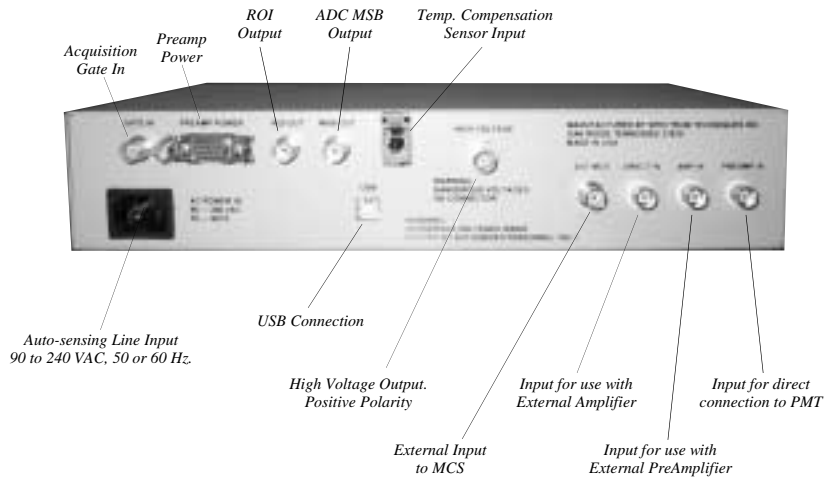
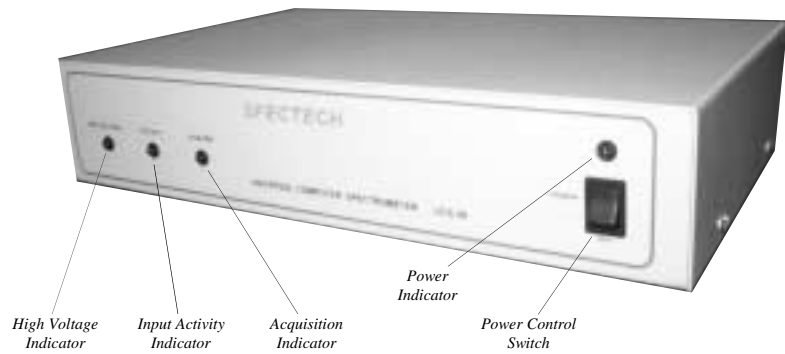
When using an external amplifier system, connect the amplifier unipolar or bipolar output to the *Direct In* connector.

### Software

The supplied software is detailed earlier in the Overview section. The software is not copy protected and making a backup copy is recommended prior to installing the programs on the Macintosh hard drive.

#### **- NOTICE -**

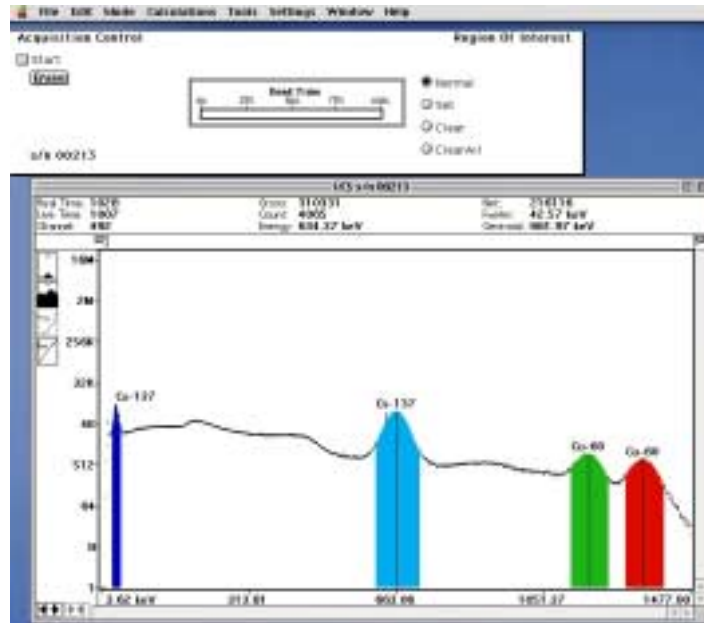
**When installing and running the software on systems booting OS X, the extensions must be placed in the Extensions folder for System 9. Some systems have demonstrated difficulty with properly identifying the hardware or starting the software in Classic Emulation. The condition is not unique to the UCS20 system. For this reason it may be advisable to run the *System Preferences - Classic - Advanced* control panel to *Rebuild Desktop* prior to launching the UCS20 software for the first time or subsequently at the first sign of startup trouble.**



## OPERATION

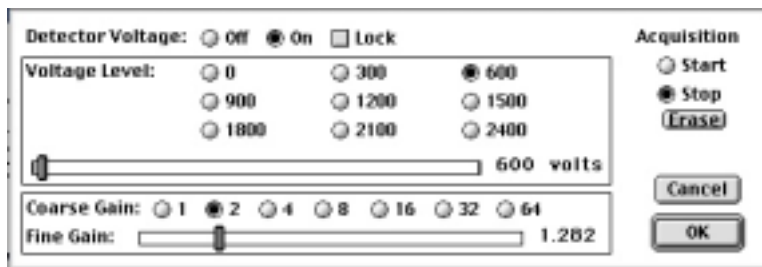
Once the program is running it will be necessary to configure the system parameters for correct operation and calibration.

Place a gamma emitting check source near the detector face. Cs-137 is a good choice for many applications but other isotopes or combinations may be used.



### High Voltage and Gain.

If you are using an integral NaI(Tl) detector with a voltage divider base such as the *SPECTECH* model GP-38, it will be necessary to set the high voltage and amplifier gain. From the menu bar select *Settings, High Voltage/Amplifier...* The following control box will appear.



Set the high voltage to the recommended operating value found on the

manufacturers data sheet (normally around 500v for the GP-38). Click the **ON** button to energize the *HV Out* .

Set the amplifier coarse gain to 8 as an initial starting value and start acquisition by clicking the **Start** button. The UCS-20 should begin collecting data and a spectrum of the calibration source will build on the screen. Using the course and fine gain controls align the peak(s) to the desired channel(s). If the 662 keV peak is set to channel 662 of a 1024 channel window, this will yield an approximate calibration of 1 keV per channel and a maximum energy range of 1.23 MeV which may not be sufficient for many experiments. Some measurements require an energy range of 2.8 MeV and the calibration should be set accordingly.

A more accurate energy calibration may be obtained using the **Energy Calibrate** feature described elsewhere in this manual.

#### **ADC Conversion Gain.**

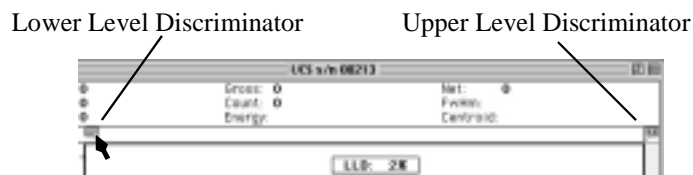
The default setting is 1024 channels. This is preferred for most scintillation detector applications and generally no adjustment is required. For certain uses such as alpha spectroscopy, it may be necessary to change this parameter to 2048, 512 or 256 channels.

From the menu bar select **Setting, Conversion Gain** to access the ADC conversion gain choices.

#### **LLD and ULD.**

At this stage it may be convenient to set the Lower and Upper discriminator levels to eliminate unwanted noise and high energy signals. If the LLD is set too low, detector noise may produce excessive system deadtime. Setting a counting window around a peak of interest can also be useful when performing decay studies using the MCS mode.

The upper and lower level discriminators are shown by the position of the sliders above the spectrum display area. They may be changed by clicking and dragging these indicators. While the adjustment is being set, a small window displays the level in percent of ADC range.



### ***Presets.***

Two preset time modes are available with the UCS-20.

**PRESET LIVE TIME** provides automatic correction for counting losses caused by the system deadtime. Events which occur during the pulse processing cycle are lost to the system so the timer is automatically updated to compensate for these losses. When operating at excessively high count-rates the deadtime meter will indicate a high value and the actual counting time may be more than doubled. Increasing the LLD setting can help reduce some high deadtime effects and is described elsewhere in this manual.

**PRESET REAL TIME** sets the counting timer to run for actual clocktime and makes no correction for losses due to deadtime effects.

Both the Live-Time and Real-Time values are recorded on the UCS-20 screen and saved in the file during data storage.

Two counting preset modes are also available in the UCS-20. These modes can be useful for acquiring spectra with the same counting statistics

**PRESET COUNT** provides for stopping acquisition when a specified count is reached in any channel.

**PRESET INTEGRAL** provides for stopping acquisition when the integrated counts in a selected region of interest reaches a specific total.

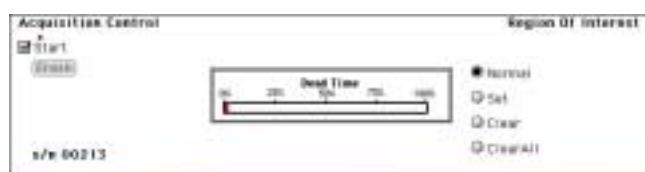
The screenshot shows a dialog box titled "Set Acquisition Presets". It contains the following elements:

- Preset Times:**
  - Preset Real Time: 60
  - Preset Live Time: 0
- Preset Counts:**
  - Preset Channel Count: 0
  - Preset Integral Count: 0
- Mossbauer Passes:** 0
- Buttons: Cancel, OK

From the menu bar select **Setting, Presets**. The following screen will appear. Check the box for the desired preset mode and enter the desired preset value. To turn off presets, uncheck all boxes. Only one Preset may be active at a time.

### ***Regions of Interest.***

Region of interest (ROI) selection is an advanced feature which provides instantaneous computation of peak gross and net counts. These values may be used along with isotope decay tables and detection efficiency to calculate absolute or relative isotopic activities. ROI's must not overlap and must be separated by at least one channel for correct area calculation. Up to 15 different groups of multiple ROI's are possible using the color selector. Normally, peaks from a single isotope are marked in one color with separate colors used to differentiate different isotopes. Regions may be setup and cleared using the mouse controls.



### **SETTING ROI's**

Click on the **Set** Button.

Move the marker to the left edge of the peak. Click and drag the mouse over the peak and release the button. This will color the channels covered. Move to the next peak and repeat the process. A different color from the **Settings** menu will be chosen automatically after each use.

After each ROI is set, the **Normal** button is automatically reselected.

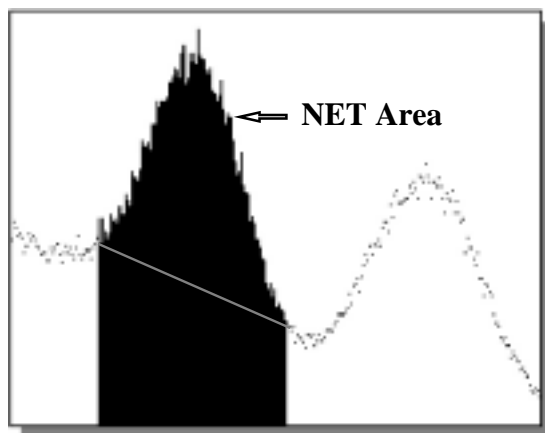
### **CLEARING ROI's**

To clear an individual ROI, place the marker in the desired ROI and Click on the **Clear** button. To clear all ROI's, click the **ClearAll** button. Only ROI's will be cleared, the data will remain. After each ROI operation, the **Normal** button is automatically reselected.

### ***Gross and Net Integrals.***

When the marker is positioned in a region of interest, the UCS-20 software automatically calculates the gross and net area of the region. In order to minimize statistical effects at the ROI endpoints, a 3-point averaging technique is applied. The contents of channels  $(n-1)$ ,  $(n)$ , and  $(n+1)$  are summed and averaged to derive the content of the endpoint channel for the net area computation. A linear interpolation is performed between these averaged endpoint values and counts below the Compton edge are subtracted to arrive at

the net area of the peak.



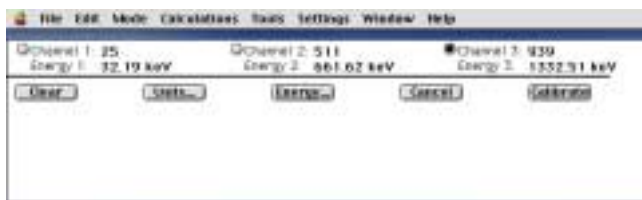
### CALCULATIONS.

The *Calculations* menu makes it possible to perform many advanced operations with the UCS-20.

#### *Energy Calibrate.*

The energy calibration feature allows the marker to read directly in energy units. Two calibration types are possible, a 2-point linear, or a 3-point quadratic fit. In order to perform an energy calibration, it is first necessary to acquire a spectrum using known isotopes. Cs-137 together with Co-60 works well for many applications, producing gamma lines at 32keV, 662keV, 1173keV and 1332.5keV.

Begin by Selecting the *Calculations - Energy Calibrate...* menu. Clear any residual data from the calibration screen by clicking the *Clear* Button.



Click the *Units* Button and select the units to be used.

Position the marker at the channel with the greatest counts of the first peak and

click the **Channel 1** button. Next click the **Energy** button and enter the peak energy value. Move the marker to the high point on the second peak to be used for the calibration and repeat the procedure. At this stage, if only a 2-point calibration is to be used, exit by clicking on the **Calibrate** button. If a 3-point calibration is required, continue by moving the marker to the peak channel of the third peak, enter its energy and click on **Calibrate**. The system will now be calibrated and the marker position will read directly in energy.

To return to the uncalibrated channel mode, restore the menu and click the **Clear** Button.

### ***Spectrum Smoothing***

Selecting this feature performs a 3-point smoothing on the spectrum. The smoothing function only works on the window currently being displayed and does not modify data stored in the UCS-20 memory. When executed, smoothing performs a 3-point averaging of the data using the algorithm

$$\frac{(n-1)+(n)+(n+1)}{3}$$

### ***Spectrum Stripping and Background Subtraction.***

Spectrum stripping is a method of subtracting one spectrum from another to show the residual. It is normally performed on a channel-by-channel basis using "Normalized Live-Time". If spectrum B has been accumulated for 1000 sec. and spectrum A is accumulated for 100 sec., when spectrum B is stripped from A only 10% of the channel content of B is subtracted from A.

This function can be useful for subtracting a background spectrum which has been accumulated over a long counting time from data accumulated over much shorter times.

Stripping only effects the data in the display window and never changes the contents of the UCS-20 memory. To strip a spectrum you must first transfer the spectrum that will be used for the stripping into the clipboard.

From the **Edit** menu copy the spectrum into the clipboard using **Edit, Copy**. Now select and display the spectrum to be stripped and from the **Edit** menu select **Strip Clipboard Spectrum**. The display window will now show the residual after the normalized spectra are subtracted channel-by-channel.

### ***MULTICHANNEL SCALING.***

Multichannel Scaling provides a means of recording time correlated data such as half-life decay or single photon counting. In this mode the ADC is bypassed and incoming events are routed directly into memory. The UCS-20 is factory configured to use its internal amplifier and



discriminators to process detector signals prior to routing to the MCS counter. This scheme presents a convenient method of counting the complete spectrum or a selected range such as a single photopeak.

First acquire a spectrum of the sample to be counted using the Pulse Height Analysis mode. While acquiring the spectrum, adjust the LLD and ULD to select the energy range of interest (For example, selecting only the 662keV peak from Cs-137 can eliminate unwanted background and produce a superior decay curve from the Cs-137/Ba-137 generator.)

From the *Mode* menu select *MCS*.

Select the *MCS Dwell Time* from the *Settings* menu for each memory location (channel). Remember the total pass time will be the dwell time times the conversion gain.

Erase any current memory data and click start. The UCS-20 will proceed to count incoming events for the selected dwell time, store the total in the first channel location, reset the counter and repeat the cycle storing each total in sequential channels.

If you wish to use an external pulse generation system such as a coincidence circuit, it will be necessary to bypass the on-board amplifier and discriminators. This mode may be selected from the *Settings, EMCS* menu. When set to the EXT position, the input BNC connector is routed directly to the MCS counter. When operating in this mode, the MCS input requires positive TTL signals (>2.5v, >150ns duration).

### ***MÖSSBAUER MODE***

Mössbauer mode acquisition is operationally similar to that of MCS mode. Multiple passes may be acquired and data for each channel summed into existing memory on each pass. The number of passes to overlay is determined by *Setting* the *Mössbauer Passes* Preset.

### ***PEAK SUMMARY***

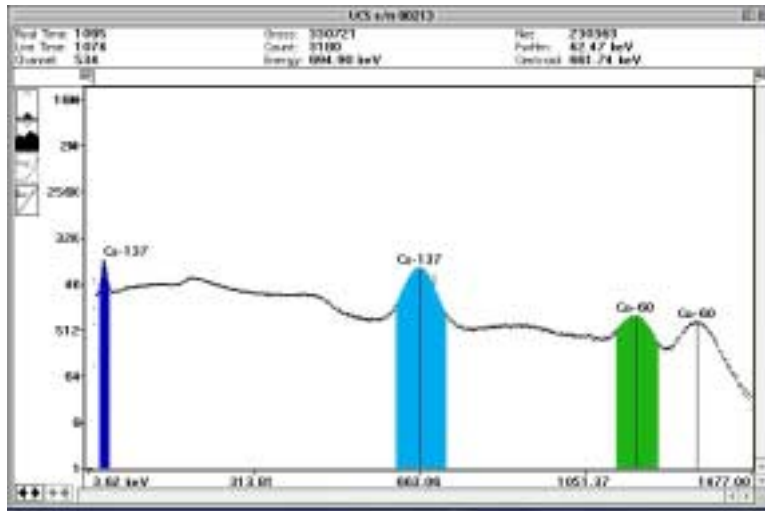
If regions of interest are currently set, a table of ROI data may be displayed by selecting the Peak Summary report.

From the *Tools* menu select *Peak Summary*.

The list of ROI data for the currently selected buffer will be displayed on the screen in place of the spectrum. Normal acquisition may be run while in this mode.

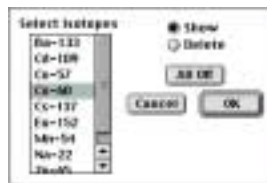
### ***ISOMATCH.***

The IsoMatch feature proves a convenient method of quickly identifying isotopic peaks in a spectrum relative to a master library. When the isotope is selected from the library, markers with the associated isotope label are superimposed on the spectrum at the appropriate energy positions. Prior to running IsoMatch, the UCS-20 must be accurately energy calibrated. Otherwise the peak markers will be misaligned.



To select IsoMatch, click ***Tools, IsoMatch.***

The IsoMatch library contains a listing of significant gamma ray emissions for many common isotopes.



Select the isotope of interest and click ***Show.*** Markers will be superimposed over the spectrum at the corresponding energies of gamma emissions for the selected isotope. Multiple isotopes may be displayed simultaneously by selecting and clicking ***Show.*** The IsoMatch library may be edited use a resource editor such as ResEdit.

### ***SAVING and PRINTING FILES***

Data files may be saved and restored in binary format from disk using the ***Save***, ***Save As***, and ***Open*** commands accessed from the ***File*** menu.

A ***Save UCS Settings*** command is also included which saves all current operating parameters such as high voltage, amplifier gain, ADC settings and presets. This feature can be very useful for saving and restoring specific setups and calibrations for different experiments. It also provides a convenient way of quickly restoring operating conditions after power has been removed from the UCS-20.

***Page Setup*** accesses the standard chosen printer setup function.

***Print Preferences*** provides a means of selecting portions of the available data to printing. The range of data channels may be specified if the entire spectrum is not required to be outputted.

***Print*** sends the selected data to the currently chosen printer.

### ***USING THE CLIPBOARD***

UCS-20 data may be pasted into another spectrum window or transferred in ASCII tab-delimited format to spreadsheets using the ***Clipboard*** function. Once in a spreadsheet, data may be manipulated and graphed for analysis and outputting to reports. Two copy commands are provided through the ***Edit*** menu.

***Copy***. This command transfers the entire spectrum and header data to the clipboard.

***Copy Data Text Only***. This command transfers only the spectrum channel data to the clipboard and is often preferred when moving data to mathematical analysis programs. Header information is not copied with this function.

*NOTES*



## SPECIFICATIONS

**Physical:** Fully shielded benchtop metal enclosure, 9x13x2.5 in.

**HV Output:** MHV (or optional SHV) connector supplies positive 0 - 2500 volt @ 1mA maximum current to power a scintillation detector. High voltage is fully regulated and computer controlled in 10 volt increments.

**Preamp In:** BNC connector for direct connection to PMT anode signal. Uses internal amplifier/preamplifier.

**Amp In:** BNC connector for signal connection to external preamplifier.

**Direct In:** BNC connector for connection to external amplifier. Bypasses internal amplifier and connects directly to ADC input. Accepts unipolar or bipolar signals 0-8 volt range.

**Ext MCS:** BNC connector to input positive MCS TTL pulses > 150 nsec. 5 MHz maximum rate.

**ROI Out:** BNC connector supplies a pulse out when data is acquired in a channel marked as a ROI. The pulse width is internally adjustable from 100  $\mu$ sec to 25 msec. The pulse amplitude is internally adjustable from 0 volt to 7.5 volts.

**Gate In:** BNC connector for connection to external coincidence unit. A positive TTL pulse of 50 nsec to 2  $\mu$ sec width must be present before the peak of the input Pulse.

**MSB Out:** (Optional) BNC connector to output the most significant MCS bit for Mössbauer Applications.

**T/Comp:** Modular connector for connection to temperature compensated tube base.

**USB:** Universal Serial Bus 1.1 connector for communication with computer.

**Preamp Power:** (Optional) DB-9 connector, supplies +/- 12v power for external preamp.

**Amplifier:** On-board combination preamp/amplifier for use with scintillation detectors and PMT's. Computer controlled coarse and fine gain from x1 to x160.

**ADC:** Wilkinson type with 80MHz clock and computer selected conversion gain of 2048, 1024, 512, or 256 channels. Direct input accepts pulse peaking times of 1 to 10  $\mu$ sec. Includes deadtime correction when used in Live-Time mode.

**LLD & ULD:** Independently computer controlled in 1% increments over entire input range. Operates prior to ADC for reduced system dead time.

**Modes:** MCA for pulse height analysis, MCS for half-life decay or other time related studies, or Mössbauer for Mössbauer

spectroscopy studies.

**Timers:** Real-Time or Live-Time operation, selectable in 1 sec increments, from 1 msec. to 60 sec. per channel in MCS mode and from 1  $\mu$ sec. to 6 sec. per channel in Mössbauer mode.

**Data Memory:** On-board dynamic RAM, 2048 channel x 24 bits for data, plus region-of-interest flag.

**Deadtime:** System dead-time is computed and displayed on screen during acquisition.

**Power:** AC line, 100-250VAC, 50/60Hz, autosensing internal power supply with Universal Power Cord input.

**Status Indicators:** High voltage, Acquire, Activity.

**System:** Operates under Macintosh System 8.6 - 9.2.2 with USB support; under OS X in Classic Emulation mode only.

**Display:** Color or monochrome monitor.

**Time Presets:** Preset live-time or real-time selection.

**Count Presets:** Preset count mode for selected channel or gross Region-of-Interest.

**Mössbauer Passes:** Number of overlapping passes can be specified from 1 to 99,999,999.

**ROI'S:** Multiple (up to 15 different) Regions-of-Interest using color coding.

**Integral:** When cursor is in ROI, computes gross area, net area with end point averaging, centroid and FWHM.

**Energy Cal:** 2-point linear or 3-point quadratic converts cursor position reading directly to energy units. (Time units in MCS and Mössbauer modes.)

**Subtract:** Subtracts channel-by-channel time normalized clipboard data from display data.

**Smooth:** 3-point smoothing of displayed data. Does not modify data in acquisition memory.

**Control:** Software control of High Voltage, Amplifier Gain, Lower and Upper level discriminators, and ADC Conversion Gain.

**File:** Save or load data file and header information in binary format. Save or Load instrument configuration settings.

**Clipboard:** Clips data and header information in spreadsheet compatible format for pasting into other applications.

**Isomatch:** Isotope library with peak markers and labeling for overlaying on spectrum. Provides quick isotope identification. Libraries may be edited and extended using Resource Editor.



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