ORTEC®

Easy-MCS™

with the MCS-32 (A73-B32) Software for Microsoft® Windows® 7 and Windows XP® SP3

Hardware and Software User's Manual
Software Version 2.2

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Manual Revision C

Advanced Measurement Technology, Inc.

a/k/a/ ORTEC®, a subsidiary of AMETEK®, Inc.

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Before being approved for shipment, each ORTEC instrument must pass a stringent set of quality control tests designed to expose any flaws in materials or workmanship. Permanent records of these tests are maintained for use in warranty repair and as a source of statistical information for design improvements.

Repair Service

If it becomes necessary to return this instrument for repair, it is essential that Customer Services be contacted in advance of its return so that a Return Authorization Number can be assigned to the unit. Also, ORTEC must be informed, either in writing, by telephone [(865) 482-4411] or by facsimile transmission [(865) 483-2133], of the nature of the fault of the instrument being returned and of the model, serial, and revision ("Rev" on rear panel) numbers. Failure to do so may cause unnecessary delays in getting the unit repaired. The ORTEC standard procedure requires that instruments returned for repair pass the same quality control tests that are used for new-production instruments. Instruments that are returned should be packed so that they will withstand normal transit handling and must be shipped PREPAID via Air Parcel Post or United Parcel Service to the designated ORTEC repair center. The address label and the package should include the Return Authorization Number assigned. Instruments being returned that are damaged in transit due to inadequate packing will be repaired at the sender's expense, and it will be the sender's responsibility to make claim with the shipper. Instruments not in warranty should follow the same procedure and ORTEC will provide a quotation.

Damage in Transit

Shipments should be examined immediately upon receipt for evidence of external or concealed damage. The carrier making delivery should be notified immediately of any such damage, since the carrier is normally liable for damage in shipment. Packing materials, waybills, and other such documentation should be preserved in order to establish claims. After such notification to the carrier, please notify ORTEC of the circumstances so that assistance can be provided in making damage claims and in providing replacement equipment, if necessary.

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Safety Instructions and Symbols

This manual contains up to three levels of safety instructions that must be observed in order to avoid personal injury and/or damage to equipment or other property. These are:

DANGER	Indicates a hazard that could result in death or serious bodily harm if the safety instruction is not observed.
WARNING	Indicates a hazard that could result in bodily harm if the safety instruction is not observed.
CAUTION	Indicates a hazard that could result in property damage if the safety instruction is not observed.

Please read all safety instructions carefully and make sure you understand them fully before attempting to use this product.

Cleaning Instructions

DANGER	Opening the cover of this instrument is likely to expose dangerous voltages. Disconnect the instrument from all voltage sources while it is being opened.

WARNING	Using this instrument in a manner not specified by the manufacturer may impair the protection provided by the instrument.

Cleaning Instructions

To clean the instrument exterior:

- Remove loose dust on the outside of the instrument with a lint-free cloth.
- Remove remaining dirt with a lint-free cloth dampened in a general-purpose detergent and water solution.
- Do not use abrasive cleaners.

CAUTION	To keep moisture out of the instrument during external cleaning, use only enough liquid to dampen the cloth or applicator.

NOTE!

We assume throughout this manual that you are thoroughly familiar with Microsoft Windows usage and terminology.

The convention used in this manual to represent actual keys pressed is to enclose the key label within angle brackets; for example, **<F1>**. For key combinations, the key labels are joined by a + within the angle brackets; for example, **<Alt + 2>**.


EASY-MCS
ORTEC®
IN
I/O

1. INTRODUCTION

The ORTEC® Easy-MCS™ converts your computer into a powerful multichannel scaler (MCS) or multiple-stop-time spectrometer. With dwell times from 100 ns to 1300 s, a memory length of 65,536 channels, and input counting rates up to 150 MHz, the Easy-MCS has the flexibility to handle a wide variety of counting and timing applications, including:

- Time-resolved single-photon counting
- Phosphorescence lifetime spectrometry
- Atmospheric and satellite LIDAR
- Laser-induced chemical reactions
- Scanning mass spectrometers
- Time-of-flight spectrometry
- Scanning X-ray diffractometers
- Mössbauer experiments

The Easy-MCS connects to your computer via a high-speed USB 2.0 interface, and one computer can control up to eight units.

The accompanying MCS-32 software allows you to manipulate all controls and spectral data from your computer or across a network. Multiple Easy-MCS units can be run at the same time with corresponding multiple instances of the MCS-32 program.

1.1. Easy-MCS Features

Hardware

- Small-footprint instrument connects to the host computer via high-speed USB.
- Dwell time selectable from 100 ns to 1,300 seconds per channel.
- Number of channels per scan selectable from 4 to 65,536.
- Accepts counting rates up to 150 MHz at the fast analog input.
- 1-MHz single-channel analyzer input with computer-controlled upper- and lower-level discriminators independently adjustable from 0 to +10 V.
- Computer adjustable discriminator thresholds on the fast analog input and the external channel advance input.
- Zero dead time between channels: absolutely no lost counts and no double counting at channel boundaries.
- No end-of-pass dead time.
- *Sum* mode for signal averaging; *Replace* mode for single-scan data; *Replace-then-Sum* mode to circumvent reset dead time between acquisitions.
- Up to 1,073,741,823 counts per channel in single or multiple passes.
- Automatic termination of data acquisition after a preset number of passes (up to 4 billion).

- The start of the scan can trigger the experiment, or the experiment can trigger the start of the scan.
- Includes a ramp output with computer-adjustable sawtooth and triangular waveforms.

Software

- Complete with MCS-32 operating, display, and analysis software for Windows 7 and XP SP3.
- All functions are computer-controlled.
- SCA Sweep mode for recording pulse-height spectra and selecting accurate SCA windows.
- Spectra and instrument settings can be saved on disk and recalled for further processing.
- Software features include smooth, sum, strip, compare, and normalize spectra; peak-search, report, and user-defined job streams.
- Horizontal scale calibration by least squares fitting to user-defined units.
- A11-B32 Programmer's Toolkit available separately for ActiveX® programming under National Instruments LabVIEW®, and Microsoft Visual Basic or Visual C++.

NOTE The MCS-32 software does not support our legacy ACE®-MCS or MCS-PLUS®.

1.2. Host Computer and Software Requirements

The Easy-MCS is completely computer-controlled and can be operated with any suitable version of the MCS-32 software, communicating via CONNECTIONS v7.1 or higher. The Easy-MCS connects via a USB port and can be used on any computer running runs on any computer running under Windows 7 and XP SP3.

1.3. What is a Multichannel Scaler?

An MCS records the counting rate of events as a function of time. When a scan is started, the MCS begins counting input events in the first channel of its digital memory. At the end of the preselected dwell time, the MCS advances to the next channel of memory to count the events. This dwell and advance process is repeated until the MCS has scanned through all the channels in its memory. A display of the contents of the memory shows the counting rate of the input events versus time. In repetitive measurements, where the start of the scan can be synchronized with the start of the events, multiple scans can be summed to diminish the statistical scatter in the recorded pattern.

The MCS can also function as a multiple-stop-time spectrometer. In a typical LIDAR application, the MCS scan is started when a laser emits a brief flash of light. The light photons are reflected back to the detector located near the laser as they encounter objects at various distances in the line of sight. The resulting “stop” pulses generated in the detector are counted as input events by the MCS. Thus, a spectrum of the number of photons versus their round-trip flight times is recorded in the MCS memory. By design, the MCS can accept multiple stop pulses in each scan. The channel numbers in memory can be calibrated to read in terms of round-trip flight time, or in distance to the reflecting object. Summing the spectra from multiple laser flashes improves the signal-to-noise ratio.

1.4. A Closer Look at the Easy-MCS

An Abundant Choice of Time Ranges

The Easy-MCS employs a crystal-controlled clock with 100 ppm accuracy and high-speed digital electronics to achieve a wide range of accurate operating parameters. With the dwell time per channel selectable from 100 ns to 1300 seconds, and a scan length variable from 4 to 65,536 channels, time scans can be selected ranging from 400 ns to 2.7 years.

No Dead Time Between Channels, and Zero End-of-Pass Dead Time

Easy-MCS employs sophisticated digital circuits to eliminate the dead time between channels that is typically encountered in lower-performance MCSs. The result is absolutely no loss of counts and no double counting as the MCS advances from one time channel to the next. Fast digital processing also ensures that there is no end-of-pass dead time before starting a new scan.

Versatile Counting Inputs

Two different types of counting inputs make the Easy-MCS adaptable to virtually any source of signals. The fast analog signal input (IN) accommodates both analog and digital signals with pulse widths >3.5 ns and counting rates up to 150 MHz. The input discriminator threshold is computer adjustable from −1.6 V to +3 V in steps of 1.5 mV. This facilitates the preferential selection of larger pulses for counting and the rejection of noise. Triggering can be selected for either positive or negative slope to match pulses of either polarity.

For counting rates up to 1 MHz with positive analog signals, Easy-MCS offers the pulse-amplitude selectivity of the SCA (single-channel-analyzer) input. This input features two computer-controlled discriminators whose thresholds can be set anywhere between 0 V and +10 V with 12-bit resolution. Easy-MCS counts only the analog pulses that rise above the lower-level threshold without exceeding the upper-level threshold. This input is ideal for analog signals with amplitudes proportional to a measurement parameter, such as the number of photons in a pulse. Pulse widths from 0.5 μs to 100 μs can be readily accommodated.

SCA Sweep Mode

The SCA Sweep mode makes the setting of the SCA thresholds quick, easy, and accurate. In this mode the window width between the lower and upper SCA thresholds is held constant (at 1/512 of 10 V) while the computer repeatedly sweeps the position of the window from 0 V to +10 V in 512 equal steps. In synchronism, the MCS repeatedly scans from channel

0 to 511 while counting the SCA output. The result is a display of the pulse-amplitude spectrum present at the SCA input. The mouse can be used to mark the lower and upper limits of a spectral feature in this display for selective counting in a subsequent MCS mode. Once these limits are marked, clicking the mouse on the **Set SCA** button in the display locks the lower and upper thresholds of the SCA into the exact settings that bracket the feature.

Improved Precision by Signal Averaging

For any selected dwell time and memory length, the data collected in each scan can either replace the data stored in memory, or can be added to the data in memory. The latter mode is useful for reducing statistical scatter. Effectively, it improves the signal-to-noise ratio by signal averaging. For random noise (noise that is not correlated with the Start trigger or the dwell-time clock), the signal-to-noise ratio improves in proportion to the square root of the number of scans added together. Selection of a "preset pass count" programs the instrument to collect data for the desired number of scans (or passes) and then automatically stop data acquisition. Once data acquisition commences, the computer is free to run other software programs. To permit repetitive data addition to high precision, the preset pass count can be set to any value from 1 to 4,294,967,295, with a memory capacity of 1,073,741,823 counts per channel.

Versatile Scan Synchronization

Easy-MCS offers two methods for synchronizing the scans with the start of the events to be counted. Either the start of a scan in the Easy-MCS can provide the trigger for the events (internal trigger mode), or an external trigger for the events can start the scan (external trigger mode).

- **Internal Trigger Mode** The Start Output signal is 160 ns wide, positive TTL, produced in synchronization with the start of a scan. This output can be used to trigger the external events. For example, this signal can trigger a laser, whose output light pulse is used to excite phosphorescence in a sample. The decaying counting rate of photons emitted by the sample after each laser pulse is counted by the Easy-MCS.

  For measurements requiring analog control of a parameter (e.g., Mössbauer experiments), Easy-MCS provides a Ramp Output voltage proportional to the channel number in the scan. The ramp can be operated with either a sawtooth pattern or a triangular waveform. In the sawtooth mode, the ramp voltage varies linearly from the beginning voltage to the ending voltage as the scan progresses. At the end of the scan the voltage abruptly changes back to the beginning voltage. With the triangular pattern, the ramp voltage changes linearly from the beginning voltage to the mid-point voltage during the first half of the scan. During the second half of the scan, it makes another linear transition from the mid-point voltage to the ending voltage. All three voltages (Begin, Mid, and End) are adjustable via the computer from 0 to +10 V in 65,536 steps. For precise repeatability, the ramp profile is stored as a digital image in half the memory. This limits the memory length available for counting events to 32,768 channels when the ramp is active.

- **External Trigger Mode** In the external trigger mode, a positive TTL logic pulse delivered to the Start Input will initiate the scan in the Easy-MCS. The scan can proceed based on the internal dwell-time clock in the Easy-MCS, or the channel advance can be implemented by supplying pulses to the Channel Advance Input.

  Using the internal dwell time, the scan starts on the first edge of the internal 50-MHz clock following the rising edge of the Start Input pulse. When the external channel advance is used, the scan starts as the rising edge of the first channel advance input pulse crosses its discriminator threshold, subsequent to the rising edge of the Start Input. The external channel advance input includes a computer-controlled discriminator threshold selectable from –1.6 V to +3 V in 1.5-mV steps. This discriminator permits adaptation to a variety of signal sources at the external channel advance input. The minimum interval between external channel advance pulses is 100 ns.

Quick Access to Multiple Spectra

The MCS-32 software allows you to view either the spectrum being acquired in the Easy-MCS memory (*MCS mode*) or you can transfer the contents of the MCS memory to the MCS-32 software's buffer window (*buffer mode*). The full power to display and manipulate can be applied to the spectra in either of these memories. Spectra can also be saved as disk files for later recall (into the buffer window) and processing.

Full and Expanded Displays Reveal Quantitative Details

Two views of the selected spectrum are displayed. The box in the upper, right-hand corner always shows the full spectrum. A region selected and marked on this small display is expanded in the larger display for better resolution of details. Using the mouse, you can move a marker through the spectrum to a feature of interest. Simultaneously, the computer displays the horizontal coordinate for the channel designated by the marker position, and the number of counts recorded in that channel. By default, the horizontal coordinate is displayed as the channel number in the external dwell-time mode. In the internal dwell-time mode, the default horizontal coordinate corresponds to the selected dwell time. The horizontal scale can be easily calibrated in user-defined units through least-squares fitting to a linear, quadratic, or cubic function. In that case, the marker position reads out in the calibrated units. Once the system is calibrated, you can quickly toggle back and forth between the default and calibrated units.

The marker also serves to paint regions of interest (ROIs) on the spectrum. Commands under the Calculate menu then trigger the computer to display the centroid of the ROI, the gross (total) counts in the ROI, and the net counts above background in the region.

More Analysis Options

Further software features allow you to compare two spectra, subtract or add two spectra, normalize the vertical scale, subtract a flat background, or smooth statistical fluctuations. Also available is a routine that automatically finds each peak in a spectrum and marks it with an ROI. The centroids, gross counts, and net counts from all the ROIs in a spectrum can be printed, either with or without library matching. If the computer has been asked for a match to a user-defined library of peak locations, the library information will be printed along with the matching ROI data. In addition to the standard `.MCS` file format, spectra can be imported and exported as ASCII text.

Programmed Data Acquisition

Some measurements require changes in the data acquisition conditions as different spectra are acquired. The **Start JOB** command gives you an easy way to define a stream of "job commands" that varies the instrument settings and controls acquisition of multiple spectra. The job stream can be simple or sophisticated. Once the job stream is defined and implemented, data acquisition proceeds automatically under the job's control. If you wish, you can set up a job as an icon on your Windows desktop, and run it with one click of the mouse.

Other software programs can activate the Easy-MCS for a specific operation by calling the MCS-32 software with a .JOB file name specified on the command line. Alternatively, the CONNECTIONS Programmer's Toolkit (A11-B32) can be purchased and used to program the Easy-MCS at the command level. The use of ActiveX controls in A11-B32 makes programming orders of magnitude easier with National Instruments LabVIEW, Microsoft Visual Basic, or Microsoft Visual C++.

Inbit FullShot™ Screen Capture and Graphics Printing

The Easy-MCS package includes the Inbit FullShot Image Capture and Printing Utility. With FullShot, you can capture a whole screen, a window, or a portion of a window and save it in a variety of graphics file formats or send it directly to the printer. See the accompanying FullShot user manual.

2. THE EASY-MCS

Figure 1 shows the Easy-MCS front and rear panels.

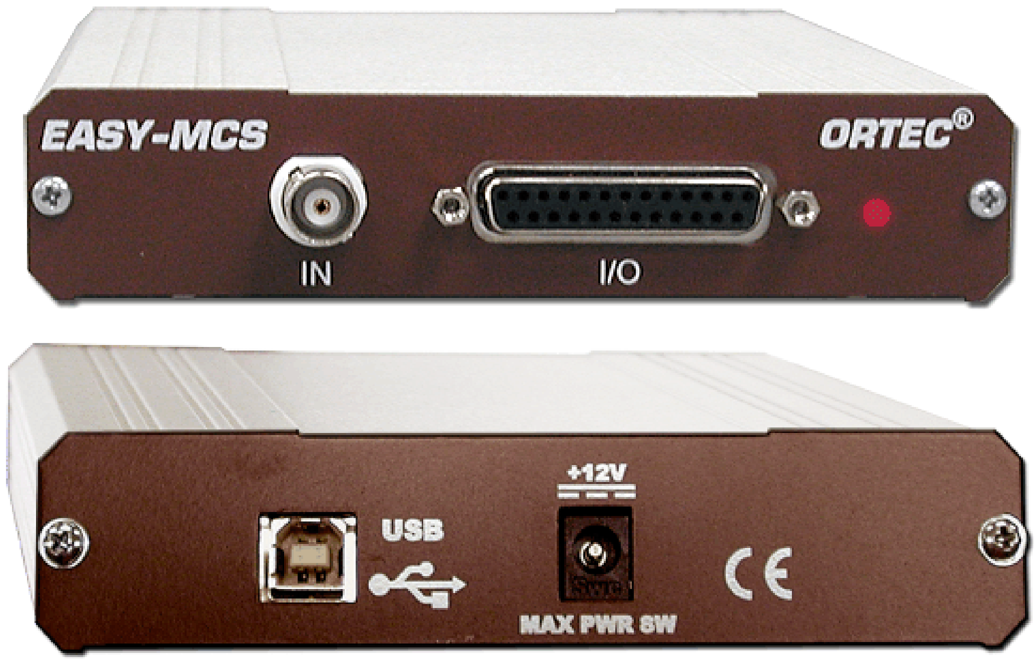

Fig. 1. The Easy-MCS.

2.1. Front Panel

2.1.1. Inputs

All inputs except the fast analog IN are supplied on the 25-pin D connector on the rear panel. The MCS-PCI-OPT2 option offers convenient BNC connections to the D connector.

IN Fast analog signal input accepts analog or digital pulses up to ±5 V in amplitude on a rear-panel BNC connector. Pulses are counted as they cross the discriminator threshold. Computer selection of triggering on either positive or negative slope. Threshold is computer adjustable from −1.6 V to +3 V in steps of 1.5 mV (minimum pulse amplitude 30 mV). Computer selection of either 50-Ω or 1000-Ω input impedance, dc-coupled. Minimum input pulse width is 3 ns at the discriminator threshold. Maximum counting rate is 150 MHz.

SCA IN 1-MHz window discriminator (single-channel analyzer) accepts linear signals from 0 V to +12 V for counting. SCA input is dc-coupled with a 1000-Ω input impedance. Minimum input pulse width is 500 ns. The upper- and lower-level thresholds are independently adjustable from 0 V to +10 V in 4096 steps via the computer. A signal that rises above the lower-level threshold without exceeding the upper-level threshold will be counted as it falls below the lower-level threshold.

START IN Accepts a TTL signal to start the scan on the next clock edge after the falling edge of the transition from +2.5 V to 0 V is detected on the START IN. In the Internal Dwell mode the next clock edge is obtained from the 50-MHz internal time base. For the External Dwell mode, the next clock edge is obtained from the External Channel Advance Input. The START IN edge is ignored during a scan or when disabled by the Start Enable Input. Input impedance is 1000 Ω to ground. Minimum pulse width is 10 ns.

STOP IN Accepts an external TTL input rising from 0 to +2.5 V to stop scanning at the end of the current scan. Minimum pulse width is 10 ns. Input impedance is 5000 Ω to ground.

CHN ADV IN (Channel Advance Input) Accepts an analog or digital pulse to cause a channel advance when the signal crosses the threshold with a positive slope (provided **External Dwell** has been selected in the MCS-32 software). Threshold is adjustable from −1.6 to +3 V in 1.5 mV steps via the computer. Minimum dwell time is 100 ns. Minimum pulse width is 10 ns. Minimum pulse amplitude is 30 mV. Input impedance is 1000 Ω to ground.

GATE IN Accepts a TTL input to prevent counting of the signals at the IN and SCA IN connectors. When the GATE IN is <0.8 V, counting is inhibited. Counting is enabled when the GATE IN level is >2 V, or when the GATE IN is not connected to signal source. Input impedance is 1000 Ω to +5 V.

TTL (START ENABLE INPUT) Accepts a TTL input to enable/disable response to a START IN trigger. When the START ENABLE INPUT is <0.8 V, triggering is inhibited. Triggering is enabled when the START ENABLE INPUT level is >2 V, or when the START ENABLE INPUT is not connected to a signal source. Input impedance is 5000 Ω to +5 V. START ENABLE INPUT must be at the desired level when the rising edge of the START IN arrives.

2.1.2. Outputs

All outputs are supplied on the 25-pin D connector on the rear panel. The MCS-PCI-OPT2 option offers convenient BNC connections to the D connector.

START OUT This TTL ouput rises from <+0.4 V to >+2.4 V when a scan starts, and returns to <+0.4 V after 160 ns. Useful for synchronizing external instruments with the start of the scan. The output is short-circuit protected and can drive impedances ≥50 Ω.

CHN ADV OUT (Channel Advance Output) This TTL output rises from <+0.4 V to >+2.4 V when the Easy-MCS advances from one channel to the next. The pulse width is approximately 20 ns. The output is short-circuit protected and can drive impedances ≥50 Ω.

SCA OUT A TTL output pulse for every SCA IN signal that occurs between the upper and lower discriminator thresholds. The output rises from <+0.4 V to >+2.4 V as the SCA IN signal falls through the lower discriminator threshold. The pulse width is nominally 250 ns. The output is short-circuit protected and can drive impedances ≥50 Ω.

MIDPASS OUT This TTL output rises from <+0.4 V to >+2.4 V after half the channels in a pass have been scanned. It returns to <+0.4 V at the end of the pass. If the number of channels in a pass is odd, the MIDPASS OUT remains low for one more channel than it stays high. The output is short-circuit protected and can drive impedances ≥50 Ω.

RAMP OUT Provides an analog voltage ramp from a digital-to-analog converter to drive external devices. See **Ramp Control** for a description. The output voltage range is computer adjustable from 0 V to +10 V with 16-bit resolution. Minimum voltage step size is approximately 0.15 mV for any range. Settling time is 2 μs. The output impedance is 100 Ω, short-circuit protected.

2.2. Rear Panel

POWER INPUT The EASY-MCA uses an ac/dc adapter that connects to the instrument's **+12 V DC** connector.

USB High-speed USB connector connects to the computer.

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3. HARDWARE AND SOFTWARE INSTALLATION

Installing the Easy-MCS and the MCS-32 software takes just four easy steps. You must have Windows administrator access to install ORTEC software.

1) Install the accompanying CONNECTIONS Driver Update Kit (Part No. 797230), being sure to select the **USB-based instruments** family on the install wizard's Instrument Setup page.
2) Install the MCS-32 software (v2.2 or higher).
3) Connect the Easy-MCS to the computer.
4) Run the MCS Configuration program to build the list of available ORTEC MCSs.

3.1. Install the CONNECTIONS Driver Update

The first step is to install the accompanying CONNECTIONS Driver Update Kit (Part No. 797230) according to its instruction sheet (p/n 932721). *Be sure to read the update kit's instructions thoroughly*. They explain how to install CONNECTIONS, enable/disable the drivers for your ORTEC instrument(s), use the MCS Configuration program's optional command line arguments, and share ORTEC instruments across a network.

On the install wizard's Instrument Setup page, *be sure to select the* **USB-based instruments** *family*. ***Otherwise the Easy-MCS will not be able to communicate with the computer and MCS-32 software.*** At the end of installation, you will be directed to restart the computer. After restart, return here to continue software and hardware installation.

3.2. Install the MCS-32 Software

Insert the MCS-32 CD, navigate to the CD drive, and open `Setup.exe`. If one or more security dialogs ask if you wish to continue installation, select the "install anyway" option to start the installation wizard. Click **Next** and follow the wizard prompts.

Existing instruments (i.e., units configured before this upgrade) do not have to be powered on during this part of the installation procedure, but must be powered on before running the MCS Configuration program discussed in Section 3.4.

NOTE You can enable other device drivers later, as described in the CONNECTIONS update instructions.

3.3. Connect the Easy-MCS to the Computer

With the computer powered on, connect the Easy-MCS to a high-speed USB port on the computer or to a powered hub attached to the computer. A series of "found new hardware" messages will be displayed. When this operation is complete, you are ready to run the MCS Configuration program so the MCS-32 software can communicate with the Easy-MCS.

3.4. Run the MCS Configuration Program to Build the List of Available MCS Units

From the Windows Start menu, enter **mcs** in the "search programs and files" box, then click the **MCS Configuration** search result; or open the Windows Start menu and click **MCS-32**, then **MCS Configuration**.

The MCS Configuration program will locate all (powered on) ORTEC MCSs attached to the local computer and to any (powered-on) network computers, display the list of MCSs found, allow you to enter customized instrument numbers and descriptions, and optionally write this configuration to those other network PCs, as described in the next section.

3.4.1. Customizing the Master MCS List

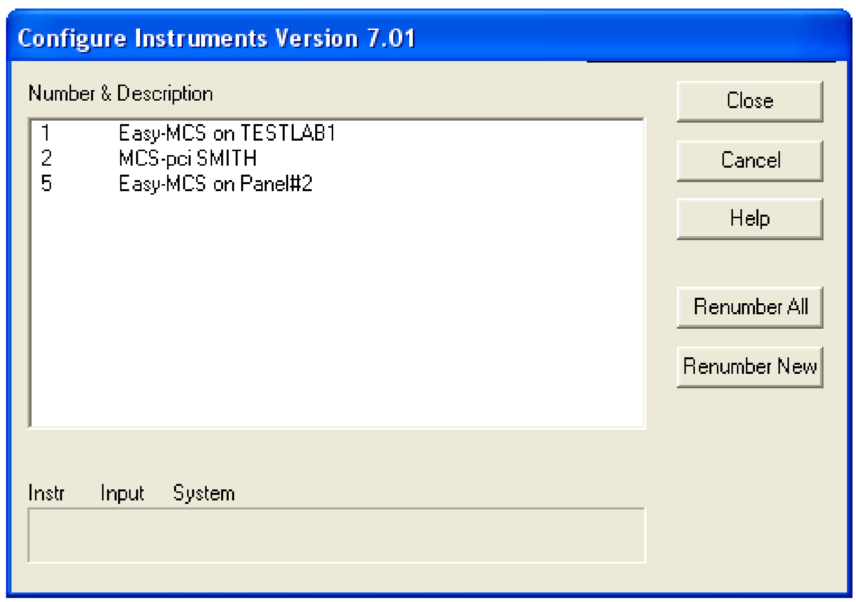

Fig. 2. MCS Numbering and Descriptions.

When MCS Configuration runs, it searches the computer and the network (if any) for MCSs, then displays a master list of the instruments found (Fig. 2).[1]

You can change the instrument numbers and descriptions by double-clicking an instrument entry in the list. This opens the Change Description or ID dialog (Fig. 3). It shows the physical detector location (read-only) and allows you to change the **ID** and **Description**. When you close the dialog, any changes you have made to an ID number or description will be written back to the corresponding MCS. *Complete details on assigning MCS numbers and descriptions are in the* CONNECTIONS *Driver Update Kit instructions.*

[1]MCS Configuration will also locate and display any ORTEC spectroscopy units in your system. To see only the list of MCS units in your system, use the **Select MCS** command discussed in Section 6.6.2.

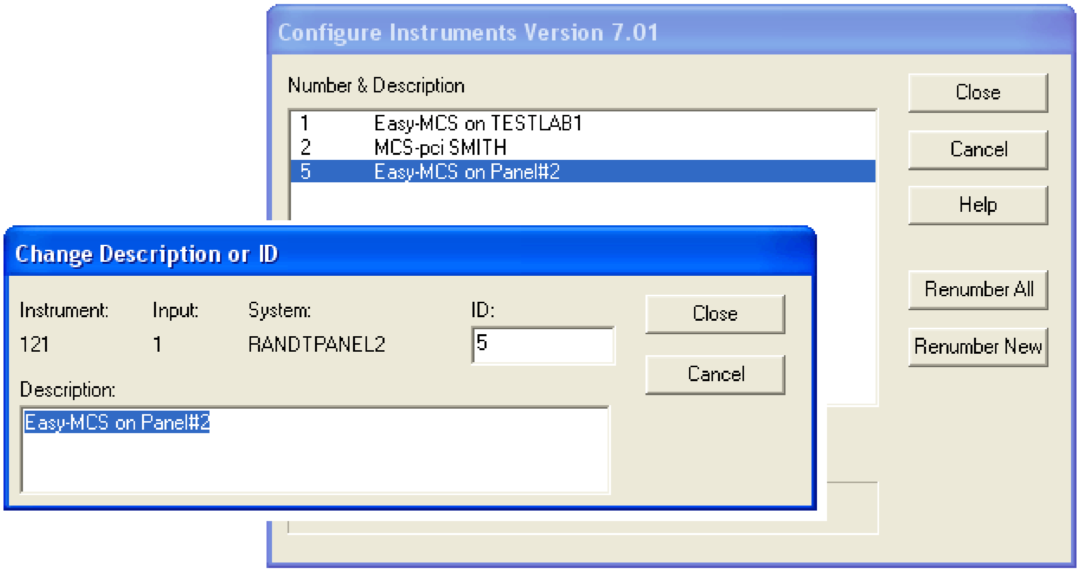

Fig. 3. Change MCB Number or Description.

NOTE Remember that some applications use the instrument number to refer to a specific MCS or device (e.g., the .JOB file command SET_DETECTOR 5). Therefore, you may wish to avoid changing an instrument's number so all defined processes will still operate.

You are now ready to run one instance of the MCS-32 software for each Easy-MCS connected to your computer (to a limit of 8), as described in the remainder of the manual.

3.5. Attaching More Than One Easy-MCS to the Computer

Once the driver for one Easy-MCS has been installed, simply attach the new unit(s) to a USB port or powered hub on the computer. You can attach as many as eight (8) Easy-MCSs to a single computer.

REMINDER Be sure to run MCB Configuration every time you add new Easy-MCSs (or other ORTEC instruments) to your system.

3.5.1. Connecting to and Disconnecting from the Computer

The USB connection allows you to connect Easy-MCSs to and disconnect them from a USB port without shutting down the computer or USB hub. If you disconnect the Easy-MCS while the MCS-32 program is running, simply close and reopen the MCS-32 program to re-detect the instrument.

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4. GETTING STARTED — MCS-32 TUTORIAL

This chapter is a short tutorial to help first-time users. It tells you how to:

- Set up an acquisition
- Collect data
- Store spectra to and retrieve them from disk.
- Abort a data acquisition

This tutorial assumes that your Easy-MCS and MCS-32 software have been installed as described in Chapter 3.

4.1. Preparing To Acquire Data

The first step is to start MCS-32 and prepare the hardware for acquisition.

1) **Start MCS-32**

From the Windows Start menu, type **mcs** in the "search programs and files" box, then click the **MCS-32** search result; or open the Windows Start menu and click **MCS-32**, then **MCS-32** (Fig. 4).

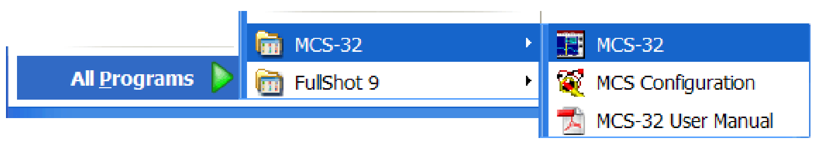


Fig. 4. Starting MCS-32.

The startup screen for MCS-32 will look similar to Fig. 5. Note that the program starts in *MCS mode* (i.e., live monitoring of an MCS instrument) by default. See Section 5.2 for a discussion of the horizontal and vertical scaling.

2) **Stop any current acquisition and clear the data**

- Check the **Stop** radio button in the upper section of the sidebar on the right of the screen. If it is not marked with a black dot, the MCS is collecting data. Click the **Stop** button until it is marked (this shouldn't take more than two clicks.

- Next, click the **Clear** button near the middle of the sidebar. This clears any data in the MCS that may have been left over from a previous experiment.

You are now ready to get started with your first acquisition. However, before starting an acquisition, you must set the pass and input control parameters.

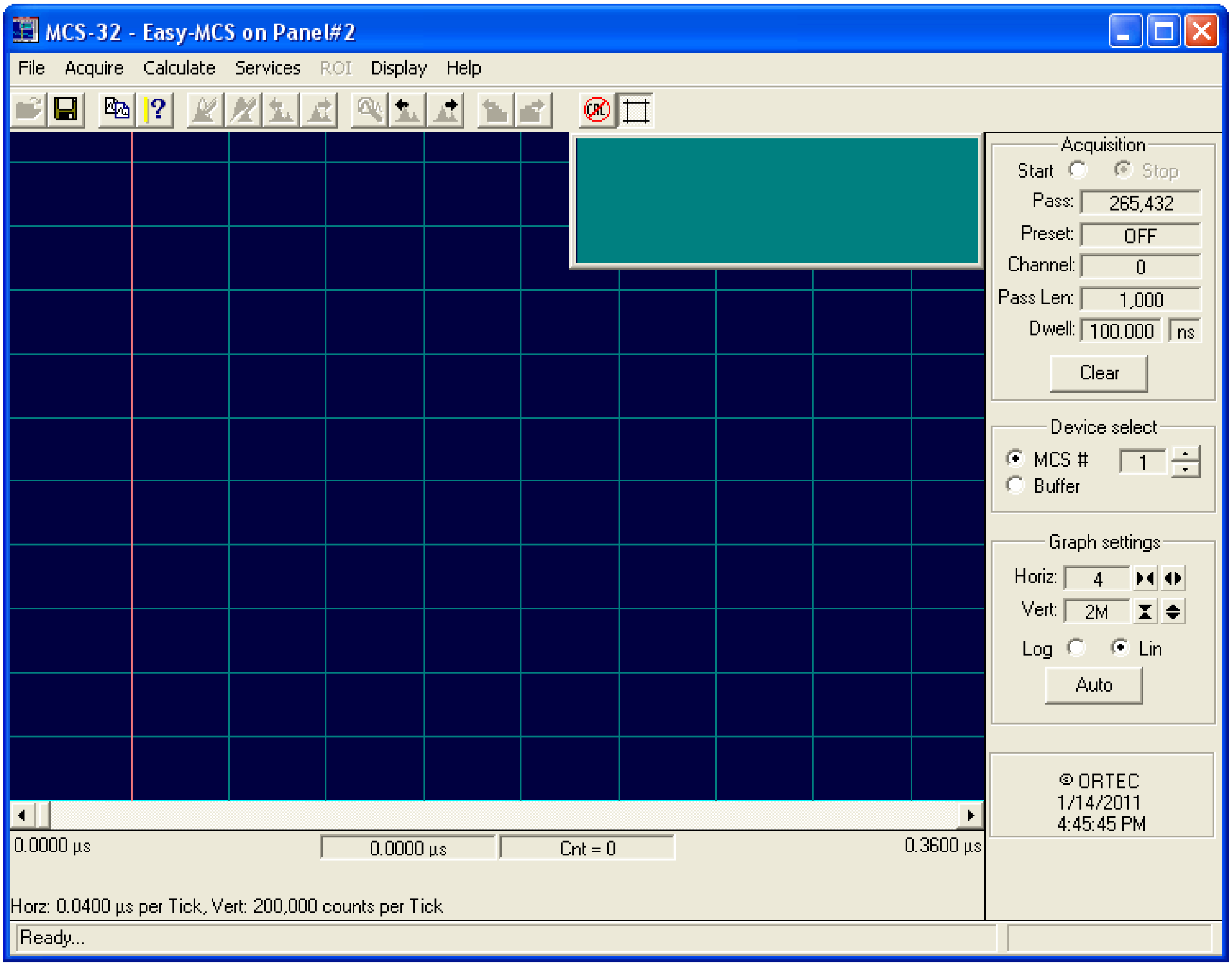


Fig. 5. The MCS-32 Screen.

1) Select Pass Control... from the Acquire menu

To set the pass control parameters, click the **Acquire** menu at the top of the screen, and select **Pass Control...**. This will open the Pass Control dialog shown in Fig. 6.

2) Set the Pass Length to 1000

Assume that 1000 channels of data are required. To set the **Pass Length** to 1000, double-click the current value to highlight it (or click and drag across it until it is highlighted). Type 1000 (this will overwrite the previous value), but don't click **OK** yet.

3) Set The Pass Count Preset to 1

Use the same procedure as was used for **Pass Length**. Double-click the current value and type 1 (which will overwrite the preceding value), but don't yet click **OK**.

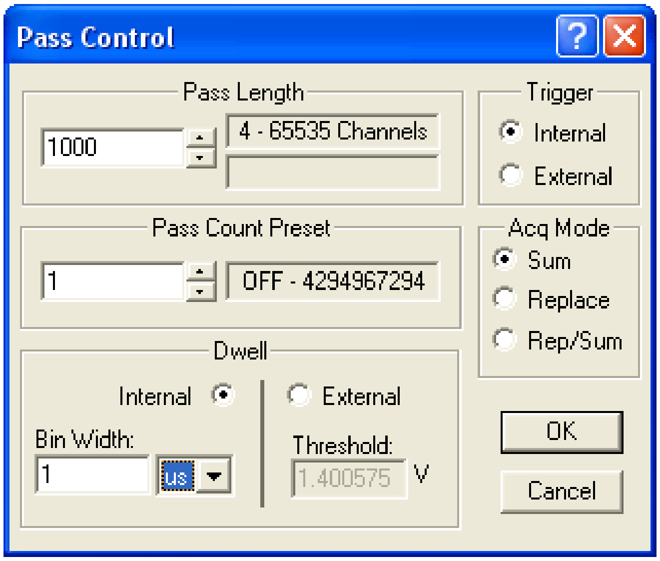


Fig. 6. Pass Control Dialog.

4) Set the Dwell Time to 1 µs

Click the **Internal** dwell radio button. Next, set the value in the box to 1. Finally, select the time units from the list beside the **Bin width** field. Click the down-arrow to open the list and select **uS** to set the range to microseconds. Don't click **OK** yet.

5) Set the Acq Mode (acquire mode) to Sum

If the **Sum** button is not already marked with a dot, click it to mark it.

6) Set the Trigger to Internal

If the radio button labeled **Internal** is not already marked with a black dot, click it to mark it.

7) Click OK to accept these settings

If you've entered all of the fields correctly, the Pass Control dialog will look exactly like Fig. 6. If everything is correct, click the **OK** button to accept the settings.

4.2. Collecting Data

At this point, you have set the pass parameters for the acquisition. You are now ready to start data acquisition and see what happens.

1) Start data acquisition

- The **Start** button is at the top of the sidebar. Click it to start the acquisition.

- Note that several things happened after you clicked on **Start**:

  (a) The **Start** button was highlighted for an instant, indicating that acquisition was taking place. Since the dwell time was 1 µs and the pass length was 1000, the acquisition lasted 1 µs × 1000, or only 0.001 second.

  (b) The **Pass Count** changed from 0 to 1 on the sidebar.

  (c) No data were collected because there was no input. (You may have acquired a few counts if anything is connected to your instrument's DISC or SCA inputs.)

- If you want to see it happen again, click the **Clear** button. Note that the **Pass** value changes from 1 to 0. Click **Start** again.

2) The next step: Select Input Control... from the Acquire Menu

Click the **Acquire** menu and select **Input Control...**. This will open the dialog shown in Fig. 7.

3) Choose which input to use

The Easy-MCS has two different inputs: a fast discriminator and a single-channel analyzer (SCA). In general, the fast discriminator is used to count pulses with fast edges (<100 ns), while the SCA is used to count slow-positive pulses (pulse widths from 0.5 µs to 100 µs). For this tutorial, connect the Channel Advance output to the discriminator input so the discriminator will be used.

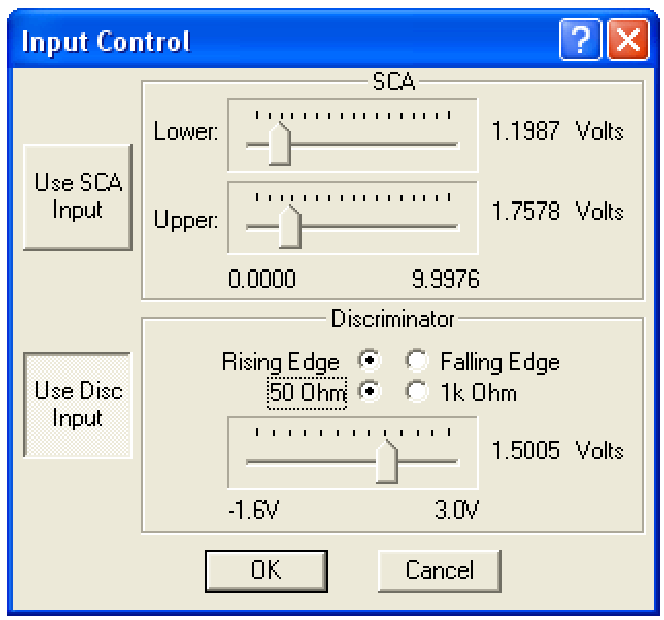


Fig. 7. Input Control Dialog.

4) Connect the CHANNEL ADVANCE Output to the DISC input

With a 50-Ω coaxial cable, connect the BNC labeled Channel Advance Output to the BNC on the MCS-PCI-OPT2 Fan-Out Cable that you installed on the Easy-MCS. Note that there is also a Channel Advance Input, so be careful to connect to the correct BNC. If you do not have a fan-out cable, you will need to make a wired connection between the appropriate two pins on the 25-pin D connector illustrated in Fig. 60 (page 92).

5) Select the Discriminator

If the **Use Disc Input** button does not look "pushed in" or highlighted, click it.

6) Set the Discriminator to Rising-Edge-Triggered

The discriminator can trigger on rising or falling edges. To select Rising-Edge-Triggered, click the **Rising Edge** radio button until it is marked with a dot.

7) Set the Discriminator Voltage to 1.5 V

- Since the Channel Advance Output signal goes from a low value of 0.8 V (max) to a high value of 2 V (min), use the **Discriminator** slide bar to set the threshold to 1.5 V.

- Click and drag the slider button toward the 1.5-V setting. Note how much the voltage readout (located to the right of the slide bar) changes as you move the slider.

- To make fine adjustments to the voltage, click to the immediate right or left of the slide button. To make super-fine adjustments, click the slide bar once to activate it, then use the <←> and <→> keys.

- When the discriminator is set to 1.5 V, click the **OK** button to close the dialog.

You are now ready to run another experiment.

8) Clear the data and start another acquisition

- Click the **Clear** button followed by **Start**. This time you should get some data.

- Look at the Marker counts at the bottom center of the screen. There should be 1 count in the marker channel.

- Click the **Auto** button in the lower section of the sidebar. This changes the vertical scale to 16, so you should be able to see exactly 1 count in every channel. This makes sense because you are counting the edge that indicates we are moving from one channel to the next.

It's now time to collect more data by acquiring more than one pass.

9) Select Pass Control... from the Acquire menu

- Click the **Acquire** menu and select **Pass Control...**. This will open the dialog shown in Fig. 6.

- Set the **Pass Count Preset** to 1000, then click **OK**.

10) Clear and start

- Click **Clear**, then **Start**.

- This time the pass count should go to 1000, and there should be 1000 counts in every channel. Click the **Auto** button to scale the data in the Expanded Display Window.

11) Reduce the horizontal scale to 62

- In the sidebar, click the down arrow beside the **Horiz** field until the value is 62. This zooms in on the data so that there are only 62 data points displayed across the screen.

- Notice that the full display in the corner still displays the entire spectrum. The part of the full display visible in the expanded display has the same color background as the expanded display, while the rest of the spectrum has a different color background.

12) Point and Click in the Full Display Window and click

This causes the expanded display to move to the area pointed to in the full display. Note that the marker channel changes at the bottom of the screen. Try it a few times.

13) Point and Click in the Expanded View and click

This moves the marker channel in the expanded display and changes the marker information at the bottom of the screen.

14) Highlight a range of channels

- Click somewhere in the expanded display.

- Click and drag to the left or right across the spectrum. Note that the marker width increases as you continue dragging the mouse across the screen.

- When you release the mouse button, this set of channels stays highlighted. You can now manipulate this block of channels, such as marking them as a *region of interest* (ROI); or calculating their centroid, gross area and net area.

15) Use the Data Info command from the Calculate menu

- Click the **Calculate** menu and select **Data Info**.

- Notice that the Marker Information Line at the bottom of the screen is now reporting a centroid, gross area, and net area for the set of channels you just highlighted. (Since the spectrum is flat, the centroid and net area aren’t very exciting.)

You have now been introduced to the major aspects of acquiring, viewing, and analyzing data. The next step is to save the data to disk.

4.3. Saving and Retrieving Your Data

1) Save the spectrum to disk

- Select **Save Data As...** from the **File** menu. This will open the dialog shown in Fig. 8.

- Name the file TUT1. To do this, type TUT1 in the **File name** field, then click the **Save** button. Your file, TUT1.MCS, will be saved in the default directory. First, though, the Sample Description dialog will open so you can describe what's stored in the file. You'll see this description again when you retrieve the spectrum.

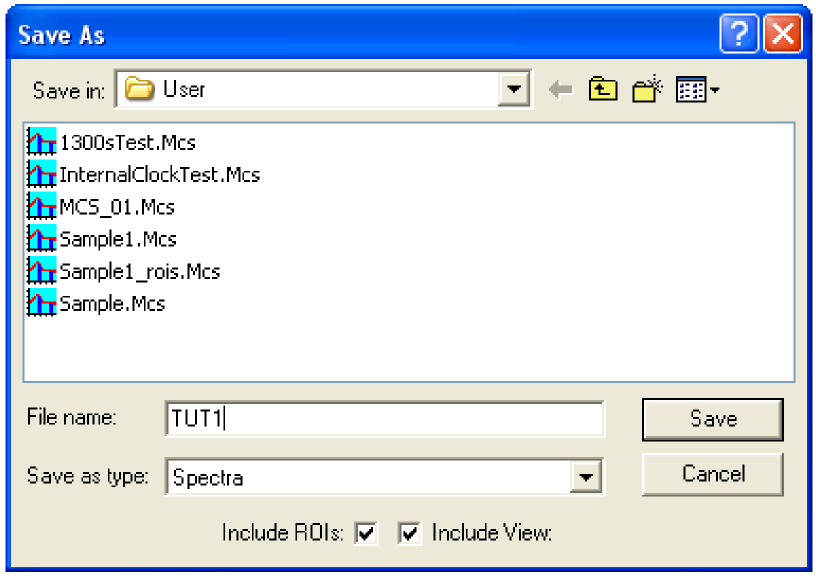


Fig. 8. Save File TUT1.MCS.

- Enter Tutorial Data as the sample description.

Now it's time to retrieve your file.

2) Switch to buffer mode

- The buffer is simply a place where you can work with your data without tying up the MCS. For example, you can be running a long acquisition on the MCS and, at the same time, be analyzing old data in the buffer. The buffer is completely separate, and will retain any data you put there until you clear it, overwrite it, or exit the software.

- Click the **Buffer** radio button in the lower section of the sidebar. The screen should change so that only 16 channels are displayed and all the data points are zero.

3) Load TUT1.MCS into the buffer

- To recall your spectrum file into the buffer, select **Recall Data...** from the **File** menu. This will open the dialog shown in Fig. 9.

- The main section of this dialog is a list-of-files box. One of the files in the list should be TUT1.MCS. Click the filename to highlight it. Now notice that the sample description you just entered, Tutorial Data, is displayed in the bottom section of the dialog.

- Click the **Open** button to load the file. The data saved from the MCS will appear in the full and expanded displays.

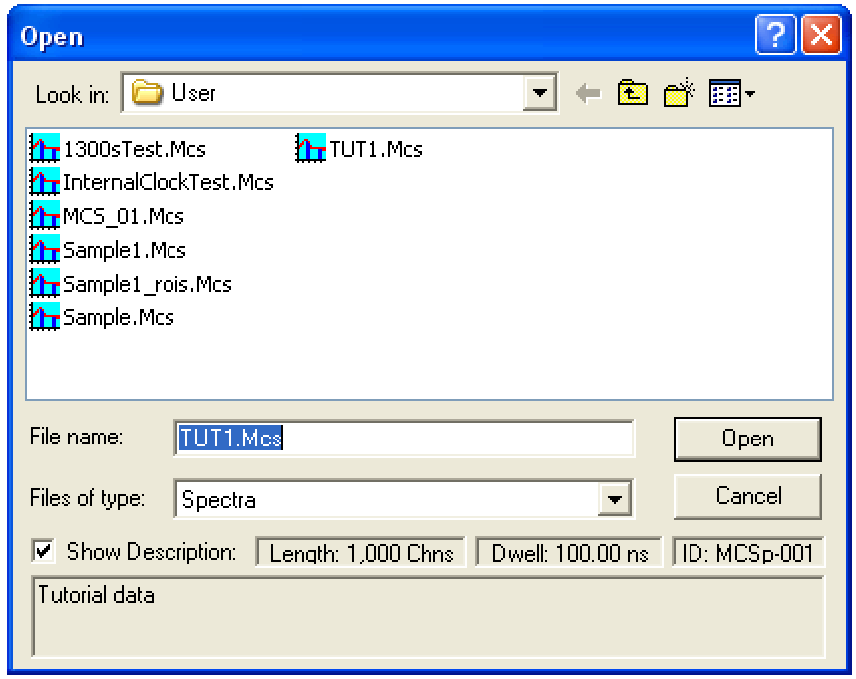


Fig. 9. Recall (retrieve) File TUT1.MCS.

- This was a very round-about way to load the MCS data into the buffer (it was a quick way to demonstrate the **Save Data As...** and **Recall Data...** commands). The faster and more direct way to do it is to use the **MCS > Buffer** command on the **Acquire** menu. During normal operation (as opposed to a tutorial), you don't have to save the data to a file unless you wish to.

4) Use the MCS > Buffer Command to transfer data from the MCS to the buffer

- Clear the data in the buffer by clicking the **Clear** button just as you would do to clear the data in the MCS.

- Switch back to MCS mode by clicking the **MCS#** radio button in the lower section of the sidebar.

- Select **MCS > Buffer** from the **Acquire** menu.

- Return to buffer mode by clicking the **Buffer** radio button. Notice that the data has been transferred.

It's now time to return to the MCS and do a few more acquisitions to explore the ways to abort an MCS-32 data acquisition.

4.4. Aborting Data Acquisition in MCS-32

1) **Enter a new round of data acquisition presets**

- Click the **MCS#** radio button to return to MCS mode.
- Select **Pass Control...** from the **Acquire** menu.
- Set the **Pass Length** to 20.
- Set the **Pass Count** preset to 1000.
- In the **Dwell Time** section, set **Bin Width** to 1 second (the time unit from the list will be seconds, **s**).
- Click **OK** to close the dialog.

2) **Clear the data and start an acquisition**

- Now the sidebar display is changing more slowly because the time unit is 1 second instead of 1 microsecond. Notice that the current channel, displayed in the **Channel** field on the sidebar, is incrementing slowly (once per second). Also, each time the **Channel** value reaches 19, it returns to zero and the pass count increments.
- Click the **Auto** button to scale the data. You should be able to see individual points move as the MCS advances from one channel to the next. You are collecting exactly 1 count per channel.
- You will notice that the **Start** radio button stays highlighted. It will remain highlighted until the acquisition is completed. With the current settings, this will take 20,000 seconds (1000 passes × 20 channels/pass × 1 second/channel).
- Since this exercise was introduced as a *short* tutorial, it's time to abort the acquisition and move on to explore yet another aspect of the MCS-32 software.

3) **Abort the acquisition**

- Wait until the current channel is less than 10, then click the **Stop** button. You will notice that the current channel keeps incrementing, and the **Stop** button starts *flashing*.
- If you now wait (without clicking **Stop** again) for the channel to reach zero again, you'll see the mark in the **Start** button clear, while at the same time, the **Stop** button will stop flashing and will now display the mark (dot).

- Here's what's taking place: when you click **Stop** *once*, this tells the MCS that you want to stop *at the end of the current pass*. While this pass is finishing, the **Stop** button blinks so you'll know the command was accepted. When the MCS finishes this final pass, **Stop** is marked, indicating that acquisition has ended.

  If you don't want to wait for the last pass to finish (that is, if you want to quit immediately):

4) Abort the acquisition *immediately*

- Click the **Start** button to restart the acquisition.

- Click the **Stop** button once; notice that it starts flashing.

- Click **Stop** again. Now acquisition has come to a complete stop. Notice that there is a step in the data where the pass was stopped.

This concludes the MCS-32 tutorial. It has introduced you to just a few of the important features of the MCS-32 program. You may wish to go to Chapter 6, which discusses all of the menu commands in detail.

5. DISPLAY FEATURES

This chapter explains the MCS-32 software's display features, discusses the role of the mouse and keyboard, covers the use of the Toolbar and sidebars, discusses how to change to different disk drives and folders, and shows how to use additional features such as Help.

5.1. Screen Features

Figure 10 shows the major screen features of MCS-32:

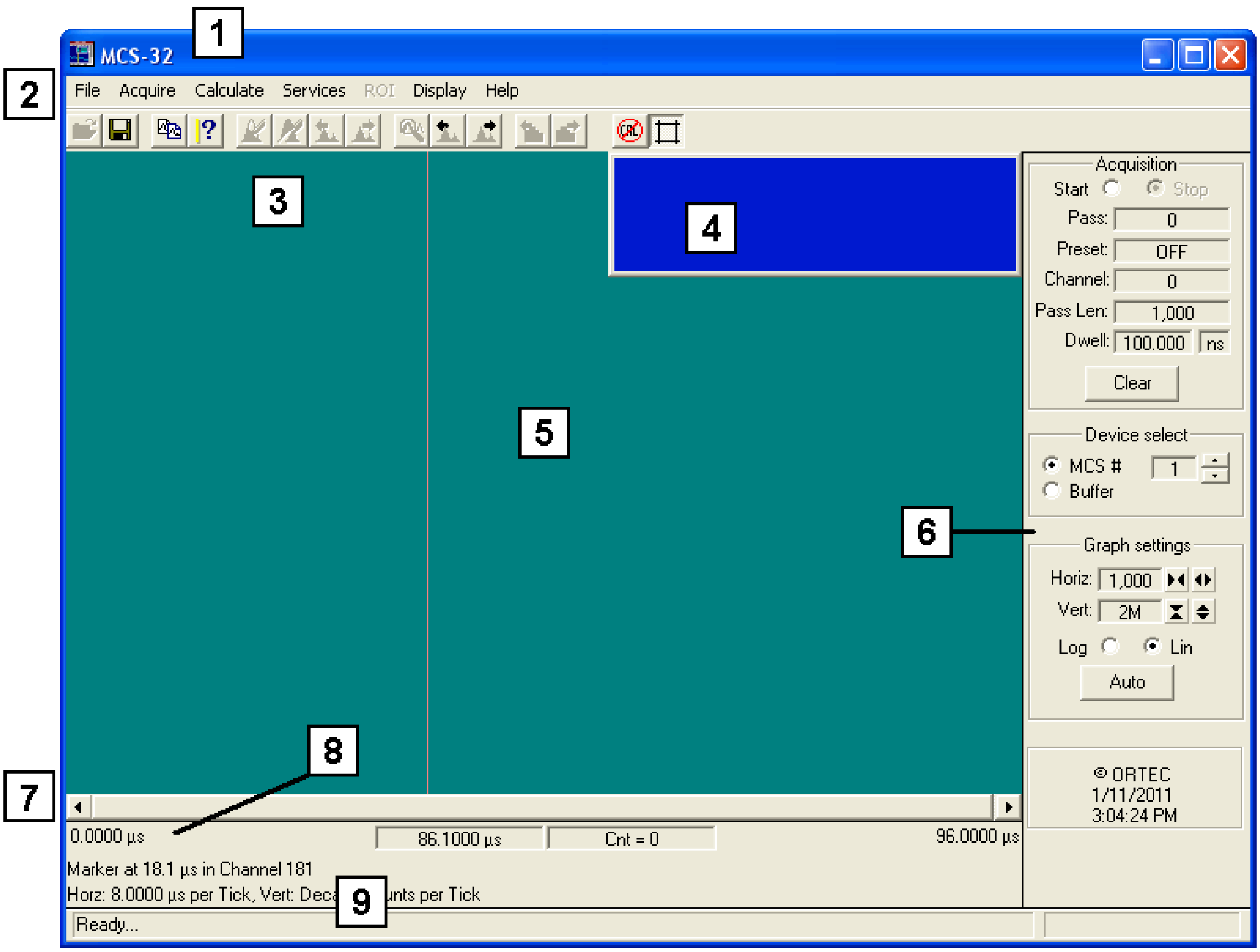


Fig. 10. Main MCS-32 Screen Features.

1) **Title bar**, showing the source of the currently displayed spectrum. This is either the MCS description; the word "Buffer" if the buffer is selected; or a file name, if a file has been saved or recalled and not yet modified (if a sample description has been entered for the file, it will accompany the file name). On the far right are the Minimize, Maximize, and Close buttons.

2) **Menu Bar**, showing the menu commands (which can be selected with either the mouse or keyboard); these functions are discussed in detail in Chapter 6.

3) **Toolbar**, beneath the Menu Bar, contains buttons for 15 of the most commonly used MCS-32 commands.

4) **Full Display Window**, showing the complete histogram from the MCS memory, buffer, or file, and indicating which part of the spectrum is now displayed in the Expanded Display Window. The vertical scale is always logarithmic. The expanded part of the spectrum is highlighted in a different color than the rest of the spectrum. Clicking any part of the spectrum in this window will display that part of the spectrum in the expanded window; the expanded window will be centered on the channel where the mouse was clicked. The Full Display Window can be moved and sized (see Section 5.4.2).

5) **Expanded Display Window**, showing all or part of the complete histogram. In this window, you can change the vertical and horizontal scaling, and perform a number of analytical operations such as calculating peak information, marking ROIs, locating library peaks, or calibrating the spectrum. This window also contains a vertical line called a *marker* that highlights a particular position in the spectrum.

6) **Sidebar**, on the right side of the screen, providing information on the current MCS presets and counting times, the time and date, MCS vs. buffer mode, and vertical and horizontal scale. The **MCS#** and **Buffer** radio buttons allow you to switch between modes. The pairs of arrow buttons next to the vertical- and horizontal-scale readings are used to adjust the scaling. The **Auto** button automatically sets the vertical scale of the expanded display.

7) **Horizontal Scroll Bar**, directly beneath the expanded display, lets you scroll through the expanded display at any horizontal and vertical scale.

8) **Marker Information Line**, beneath the scroll bar, showing the channel in which the marker is currently positioned, and its calibration and contents. The **Display** menu and Toolbar contain a toggle that lets you switch between calibrated units and time units when running in internal dwell mode.

9) **Supplementary Information Line**, below the Marker Information Line, used to show results of certain calculations, display warning messages, or post instructions during certain procedures.

5.2. Two Spectrum Displays

The Full and Expanded Display Windows show, respectively, a complete histogram of the current spectrum (whether from an MCS or the buffer) and an expanded view of all or part of the spectrum. These two windows are the central features of the MCS-32 screen. All other windows and most functions relate to the spectrum windows. The Full Display Window shows the entire data memory of the MCS as defined in the configuration. In addition, it has a marker box showing which portion of the spectrum is displayed in the Expanded Display Window.

The Expanded Display Window contains a reverse-color marker line at the horizontal position of the pixel representing the marker channel. This marker can be moved with the mouse pointer, as described in Section 5.4.1, and with the **<←>/<→>** and **<PgUp>/<PgDn>** keys.

Note that in both spectrum windows the actual spectrum is scaled to fit in its window as it appears on the display. Also, since both windows can be resized, it follows that the scaling is not always by powers of two, nor even integral multiples. Therefore, MCS-32 uses algorithms to scale the window properly and maintain the correct peak shapes regardless of the actual size of the window. The vertical scale in the Full Display Window is always logarithmic. In the Expanded Display Window, use the menus, right-mouse-button menu, accelerator keys, and Toolbar to choose between logarithmic and linear scales, change the horizontal or vertical axes, and select which region of the spectrum to view.

Depending on the expansion or overall size of the spectrum, all or part of the selected spectrum can be shown in the expanded window. Therefore, the number of channels may be larger than the horizontal size of the window, as measured in pixels. In this case, where the number of channels shown exceeds the window size, all of the channels cannot be represented by exactly one pixel dot. Instead, the channels are grouped together, and the vertical displacement corresponding to the maximum channel in each group is displayed. This maintains a meaningful representation of the relative peak heights in the spectrum. For a more precise representation of the peak shapes displaying all available data (i.e., where each pixel corresponds to exactly one channel), the scale should be expanded until the number of channels is less than or equal to the size of the window.

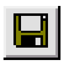
NOTE The marker can be moved by no less than one pixel or one channel (whichever is greater) at a time. In the scenario described above, where there are many more memory channels being represented on the display than there are pixels horizontally in the window, the marker will move by more than one memory channel at a time, even with the smallest possible change as performed with the <→> and <←> keys. If true single-channel motions are required, the display must be expanded, as described above.

In addition to changing the scaling of the spectrum, you can change the colors of the various spectrum features (e.g., background, spectrum, ROIs) using the **Display** menu commands.

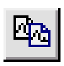
5.3. The Toolbar

The row of buttons below the Menu Bar provides convenient shortcuts to some of the most commonly used MCS-32 commands.

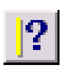
The **Recall** button reads an existing spectrum file into the buffer; MCS-32 must first be in buffer mode. This command is the equivalent of selecting **File/Recall Data...** from the menu.



Save Spectrum copies the currently displayed spectrum to disk. It duplicates the menu functions **File/Save Data As...**.



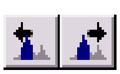
MCS > Buffer copies the currently displayed instrument's spectrum data to the buffer. This duplicates **Acquire/MCS > Buffer**. To then view the buffer contents, click the **Buffer** radio button on the Sidebar, press **<F4>** or **<Alt + 6>**, or use the **Display/MCS/Buffer** menu command.



Show Marker Information reports the current marker position on the Supplementary Information Line. This duplicates **Calculate/Marker** and **<Alt + M>**.

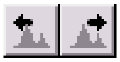
Mark ROI marks the highlighted block of channels at the marker position as an ROI. This duplicates **ROI/Mark Peak**, and the **<Insert>** and **Keypad<Ins>** keys. This command is available in buffer mode only.

Clear ROI removes the ROI mark from the channels of the peak currently selected with the marker. This duplicates **ROI/Unmark ROI**, and the **<Delete>** and **Keypad<Del>** keys. This command is available in buffer mode only.

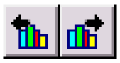


Find Previous ROI and **Find Next ROI** move the marker backward or forward through the spectrum to the next closest ROI. They duplicate **<Ctrl + ←>** and **<Ctrl + →>**, respectively, and are available in buffer mode only.

Execute Peak Search performs the peak search described in Section 6.3.9, and marks the resulting peaks as ROIs. This command is available in buffer mode only. This duplicates **Calculate/Peak Search**.

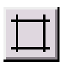


Find Previous Peak and **Find Next Peak** move the marker backward or forward, respectively, through the spectrum to the next closest peak. These functions use the **Calculate/Peak Search** algorithm (Section 6.3.9).



Find Previous Library Entry and **Find Next Library Entry** move the marker backward or forward, respectively, through the peak-identification library to the next closest library entry. Any available peak data are displayed on the Marker Information Line. The library entry is identified at the bottom of the screen, beneath the Sidebar. These commands duplicate **<Alt + ←>** and **<Alt + →>**, respectively.

Toggle Calibration switches the expanded display between calibrated units and time units in internal dwell mode, and between calibrated units and channels in external dwell mode. This has the same function as **Display/Time Units** (Section 6.6.3).



Toggle Graticules displays or hides the grid marks for the Expanded Display Window. This duplicates **Display/Preferences/Graticules** (Section 6.6.9.4).

Finally, note that as you pause the mouse pointer over the center of a Toolbar button, a pop-up *tool tip* box opens, describing the button's function (Fig. 11).

Fig. 11. Tool Tip.

5.4. Using the Mouse

The mouse can be used to access the menus, Toolbar, and sidebars; adjust spectrum scaling; mark and unmark ROIs; locate spectrum, library, and ROI peaks; select MCSs; work in the dialogs — every function in MCS-32 except text entry.

5.4.1. Moving the Marker with the Mouse

To position the marker with the mouse, move the pointer to the desired channel in the Expanded Display Window and click the left mouse button once. This will move the marker to the mouse position. This is generally a much easier way to move the marker around in the spectrum than using the arrow keys and other accelerators, although you may still prefer some keyboard functions for specific motions.

5.4.2. Sizing and Moving the Full Display Window

To resize the Full Display Window, click and drag the sides, corners, or bottom edge. To move it, click the top edge and drag.

5.4.3. The Expanded View (Right-Mouse-Button) Menu

Figure 12 shows the right-mouse-button menu. To open it, position the mouse pointer in the spectrum display and click the right mouse button. When the menu opens, use the left mouse button to select from the list of commands.

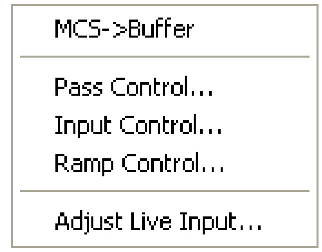


Fig. 12. Expanded View Menu.

All five commands are available in MCS mode; **Ramp Control...** and **Adjust Live Input...** are not available in buffer mode. These functions belong to the **Acquire** menu, and are discussed in detail in Section 6.2.

5.5. Buttons and Checkboxes

This section describes the MCS-32 radio buttons, arrow buttons, and checkboxes. To activate a button or checkbox, just click it.

Radio buttons (Fig. 13) allow you to select only one of the choices. The **arrow buttons** in the lower section of the Sidebar are for scrolling through the list of available MCS instruments, and adjusting the expanded display's horizontal and vertical scaling. **Checkboxes** (Fig. 14) allow you to choose one or more of the options at the same time.

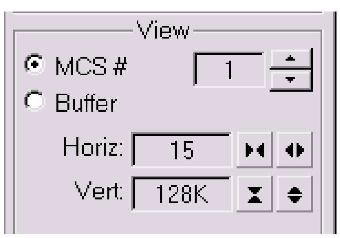


Fig. 13. Arrow Buttons.

Fig. 14. Checkboxes.

5.6. The Sidebar

Figure 15 shows the Sidebar.

5.6.1. Acquisition Section

The **Acquisition** (top) section of the Sidebar is activated when MCS-32 is in MCS mode, and displays the pass, pass count preset, channel, pass length, and dwell time settings for the selected MCS. In buffer mode, the **Acquisition** fields show the presets for the current buffer or MCS contents, and except for the **Clear** button, are inactive or read-only.

The **Start** and **Stop** radio buttons provide controls for the data acquisition functions, as well as status information.

To start acquisition in the selected MCS, click the **Start** button. **Start** will then turn gray, indicating that it is now inactive.

Click the **Stop** button to end data acquisition. When you click **Stop**, acquisition stops at the *end* of the current pass. While this final pass is collected, the **Stop** button flashes. Once the final pass is completed, the **Stop** button stops flashing.

You can abort the acquisition without finishing the current pass by clicking **Stop** a second time. When the selected MCS is not acquiring data, **Stop** is gray (inactive).

The **Start** and **Stop** buttons have the same function as **Acquire/Start** and **Acquire/Stop** (see Section 6.2), and are duplicated by the **<Alt + 1>** and **<Alt + 2>** accelerators, respectively.

The **Clear** button clears the spectrum data and pass count from the buffer or the selected MCS. To clear an inactive MCS, click once on **Clear**. During acquisition, the **Clear** button is gray (inactive).

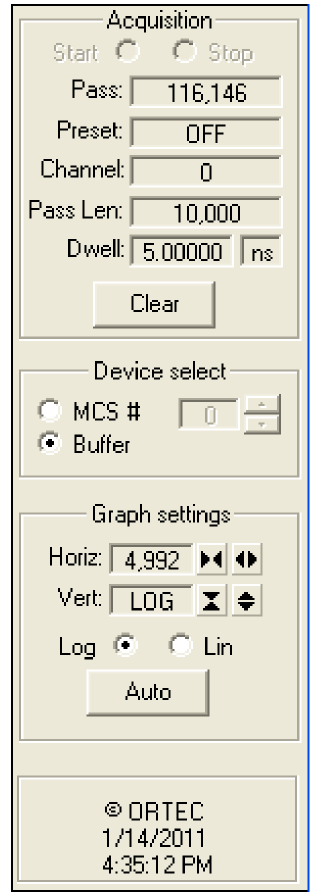


Fig. 15. Sidebar.

The **Clear** button has the same functions as **Acquire/Clear** (Section 6.2.3) and the **<Alt + 3>** accelerator.

5.6.2. View Section

The controls in the **View** (lower) section of the sidebar are active in both MCS and buffer mode.

The **Horiz** and **Vert** arrow buttons are for scaling the expanded display up and down by factors of two. These buttons duplicate, respectively, the **Narrower/Wider** and **Shorter/Taller** commands on the **Display** menu (see Section 6.6), and their accelerator keys, **<F7>/<F8>** and **<F5>/<F6>**.

The **Log** and **Lin** radio buttons switch the expanded display between logarithmic and linear scaling. These buttons duplicate the function of the **Logarithmic** toggle on the **Display** menu (see Section 6.6), and the **Keypad</>** key.

The **Auto** button switches the Expanded Display Window from a logarithmic vertical scale to a linear scale that is automatically adjusted so the largest peak in the current display is at its maximum height without overflowing the display. In addition, it centers the marker in the expanded display. **Auto** also toggles the vertical scale of the spectrum display between the automatic and manual modes. This function is duplicated by **Display/Automatic** and **Keypad<*>**.

5.7. About MCS-32

Figure 16 shows the **About MCS-32** dialog under the **Help** menu. The information on this dialog will be useful should you need customer support.

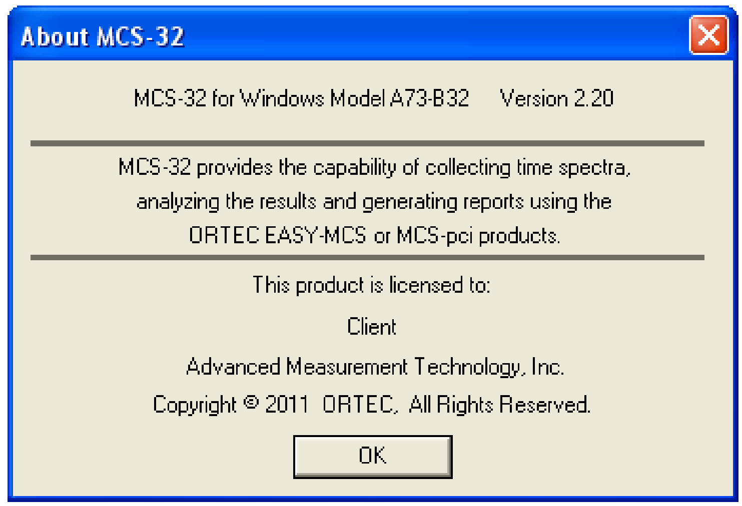


Fig. 16. About MCS-32.

6. MENU COMMANDS

This chapter describes the MCS-32 menu commands and their associated dialogs. The accelerator(s), if any, are listed on the menus to the right of the command they duplicate. Also, the underlined letter in the menu item indicates a key that can be used together with the **<Alt>** key for quick access in the menu. (So, for example, the **Select MCS...** dialog under **Display** can be reached with the key sequence **<Alt + S>**, **<Alt + D>**.) The ellipsis (**...**) following a menu selection indicates that a dialog is displayed to complete the function. Finally, a small arrow ("▸") following a menu selection means this item has a submenu.

File

Recall Data...	
Save Data As...	
Print Data...	
Report...	
Compare Data...	
Recall Settings...	
Save Settings As...	
Import ASCII...	
Export ASCII...	
Exit	

Acquire

Start	Alt + 1
Stop	Alt + 2
Clear	Alt + 3
MCS > Buffer	Alt + 5
Pass Control...	Alt + P
Input Control...	Alt + I
Ramp Control...	Alt + R
Adjust Live Input...	
SCA Sweep...	

Calculate

Settings...	
Data Info	Dbl-Clk
Sum	
Smooth	
Strip...	
Subtract...	
Normalize	
Marker	Alt + M
Peak Search	
Calibrate...	

Services

- Start JOB...
- Library...
- Sample Description...

ROI

Recall ROI...	
Save ROI As...	
Mark ROI	Insert
Unmark ROI	Delete
Unmark All ROIs	

Display

MCS/Buffer	F4 or Alt + 6
Select MCS...	Ctrl + Fn
Time Units	
Taller	F6 or Up-Arrow
Shorter	F5 or Dn-Arrow
Automatic	Keypad<*>
Logarithmic	Keypad</>
Narrower	F7 or Keypad<−>
Wider	Keypad<+>
Center	Keypad<5>
Preferences ►	

- Points
- Fill ROI
- Fill All
- Wrap Mode
- Full View
- Graticules
- Toolbar
- Colors...

Help

Help Topics	F1
How To Use Help	
About MCS-32...	

Expanded View (Right-Mouse-Button) Menu

- MCS > Buffer
- Pass Control...
- Input Control...
- Ramp Control...
- Adjust Live Input...

6.1. File

The **File** menu is shown in Fig. 17. These commands are available for both the MCS and the buffer with the exception of **Recall Data...**, which is only available in buffer mode.

Fig. 17. File Menu.

6.1.1. Recall Data...

Switch to buffer mode before using **Recall Data....** This function read a spectrum file created by the MCS-32 **Save Data As...** command into the buffer. The buffer must be selected first. The buffer is sized to conform to the pass length of the recalled spectrum.

If the buffer contains data that have not been saved, a warning dialog opens first, asking if the data should be saved. Click **Yes** to perform a **Save As**, **No** to continue with **Recall...**, and **Cancel** to return to the main display with no action.

The Open dialog (Fig. 18) shows the list of available `.MCS` files in the current directory.

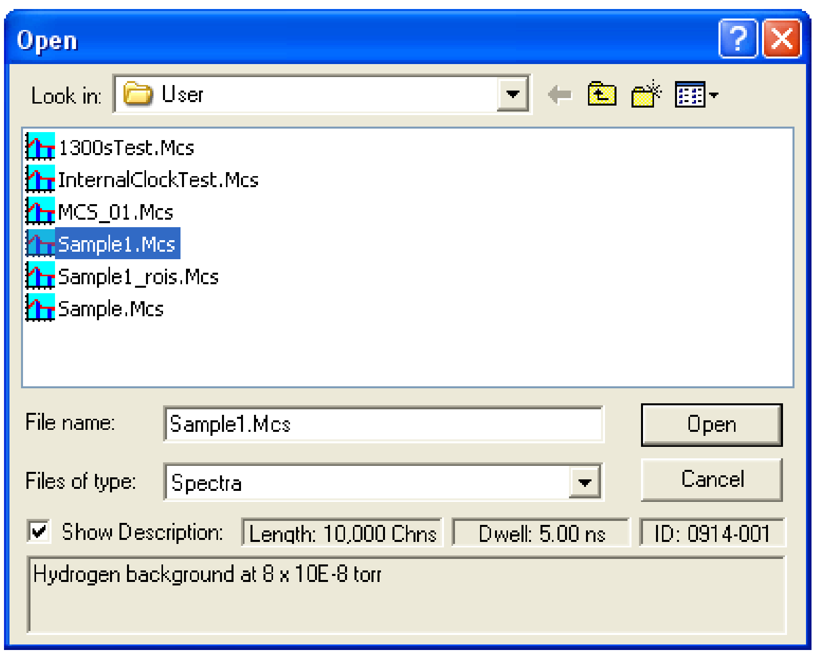


Fig. 18. Recall Spectrum Dialog.

Note the **Show Description:** checkbox on the lower left of the dialog. Use this to display the sample description, format, and spectrum size of each file without having to open it.

When the spectrum has been read successfully by this function, the descriptors (pass count, dwell time, etc.) are obtained from the file for the buffer, and the filename is displayed in the Title Bar. If the spectrum file has calibration information, this is used to set the calibration for the buffer.

This command is duplicated by the **Recall Data** button on the Toolbar.

6.1.2. Save Data As...

This command writes the displayed spectrum to disk. The **Save Spectrum File** dialog (Fig. 19) opens when **Save As...** is selected. Enter any valid location and filename in the **File name:** field. The file extension is .MCS.

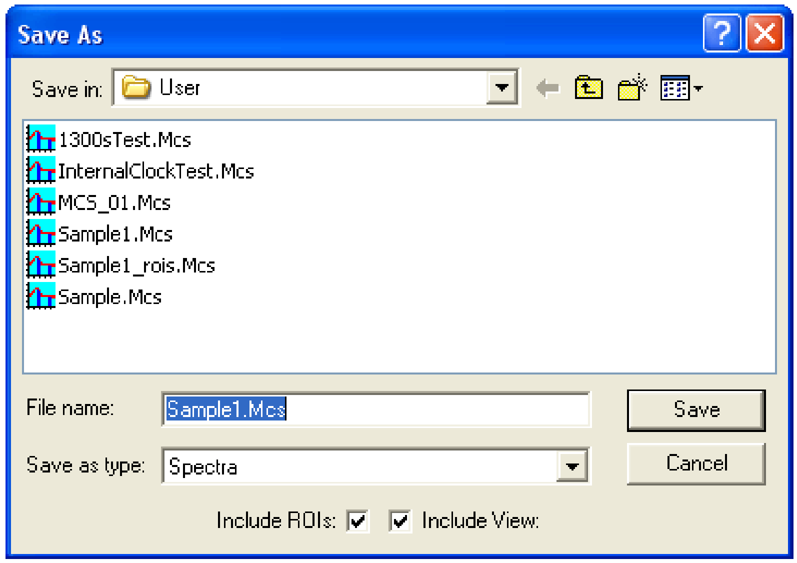


Fig. 19. Save Spectrum File Dialog.

The following are stored in the .MCS file with the data: pass count, dwell time, pass length, pass count preset, input control settings, acquisition start time, hardware and sample descriptions, acquisition mode, and calibration (if any). The .MCS file structure is detailed in Appendix C.

The check boxes labeled **Include View** and **Include ROIs** determine whether or not the scaling and/or ROI information will be saved in the file.

Click **Save**. If the file already exists, a message box opens asking you to verify the entry or cancel the operation. Click **OK** to overwrite the existing file, or click **Cancel**.

When you click **Save**, a Sample Description dialog will open in which you can enter a short description of the file contents. (This is the sample description displayed at the bottom of the **Recall Data...** dialog when a file is selected.)

After the file has been written, its filename is displayed on the Title Bar if MCS-32 is in buffer mode.

This command is duplicated by the **Save Data As** button on the Toolbar.

6.1.3. Print Data...

This command prints, to the printer or a text (ASCII) file, the contents of the channels currently selected with the marker. The data are formatted at seven channels per line with the channel number on the left. To select the channels to be printed, highlight the region by clicking and dragging the mouse from one edge of the region to the other edge.

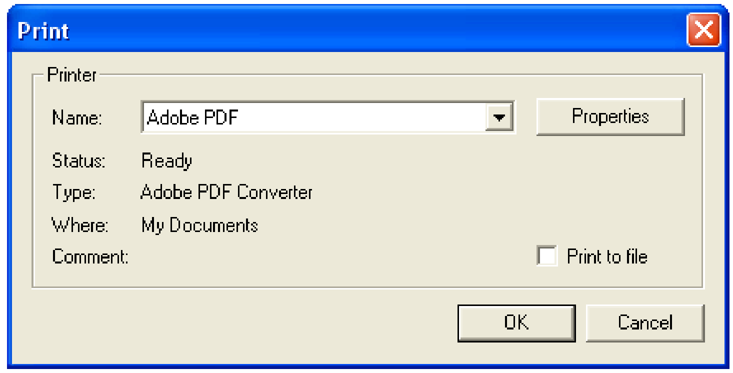


Fig. 20. Print Spectrum.

Use the **Print** dialog (Fig. 20) to print the output or save it in a disk file (click **Print to file** to mark it).

6.1.4. Report...

The **Report...** function creates a report describing acquisition conditions and contents of all ROIs, and sends this to a text file and/or the printer, in one of two output formats, **Paragraph** or **Column**.

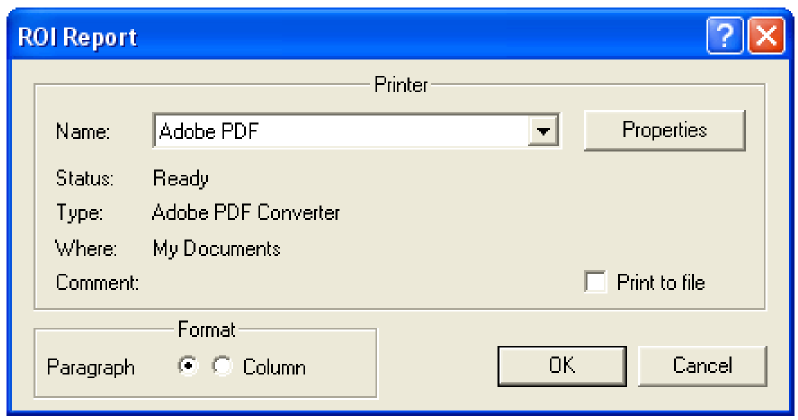


Fig. 21. ROI Report Dialog.

The **ROI Report** dialog, shown in Fig. 21, opens first. If you check **Print to file**, a file-save dialog opens, prompting for a filename. Enter a name and click **OK**.

Examples of the **Paragraph**- and **Column**-style reports are shown in Figs. 22 and 23, respectively. Both report formats supply the same information.

If the spectrum is not calibrated, the following are reported for each ROI:

- ROI number (1 is lowest).
- Start channel of the ROI.
- Stop channel of the ROI.
- Gross area of the peak.
- Net area of the peak, as calculated in **Calculate/Data Info**.
- Centroid channel of peak, as calculated in **Calculate/Data Info**.

If the spectrum is calibrated, both calibrated and channel values are given for 1–6 above, and in addition the following is also included:

- The best match from the library.
- Corrected net area of the peak, using the factor supplied in the library.

```
MCS   1 ACQ 01-20-88 at 11:52:12, 10 mS Dwell, 10 Pass(es)
        Mass Spectrometer  SN 123
        MENNE01.MCS with calibration and library

ROI   1 Range: 121 (241.408 amu) to 135 (269.414 amu)
        Gross: 534209, Net: 127924
        Centroid: 129.150 (257.711 amu)
        ID: XYZ-138 at 258.411 amu, Adjusted Net: 406107.5

ROI   2 Range: 200 (399.44 amu) to 212 (423.444 amu)
        Gross: 493232, Net: 118381.3
        Centroid: 206.129 (411.7 amu)
        ID: ABC-198 at 411.8044 amu, Adjusted Net: 123945.3

ROI   3 Range: 300 (599.479 amu) to 311 (621.483 amu)
        Gross: 498328, Net: 117078
        Centroid: 305.325 (610.13 amu)
        ID: RST-103 at 610.33 amu, Adjusted Net: 2075851

ROI   4 Range: 354 (707.5 amu) to 366 (731.505 amu)
        Gross: 535655, Net: 127914.3
        Centroid: 360.453 (720.409 amu)
        ID: ABX-126 at 720.5 amu, Adjusted Net: 237754.4
```

Fig. 22. Example Spectrum Report (Paragraph Format).

```
MCS   1 ACQ 01-20-88 at 11:52:12, 10 mS Dwell, 10 Pass(es)
       Mass Spectrometer SN 123
       MENNE01.MCS with calibration and library

ROI   From           To                    Gross       Net        Centroid     Library                       Adj Net
  1   241.408 amu    269.414 amu           534209        127924   257.711 amu  XYZ-138     258.411 amu       406107.5
  2   399.440 amu    423.444 amu           493232      118381.3   411.700 amu  ABC-198     411.804 amu       123945.3
  3   599.479 amu    621.483 amu           498328        117078   610.130 amu  RST-103     610.330 amu        2075851
  4   707.500 amu    731.505 amu           535655      127914.3   720.409 amu  ABX-126     720.500 amu       237754.4
```

Fig. 23. Example Spectrum Report (Column Format).

6.1.5. Compare Data...

This function displays a disk spectrum along with the spectrum in the buffer so that the two can be visually compared. When **Compare Data...** is selected, a standard file-open dialog opens, allowing you to select the desired spectrum file. Once the Compare file is opened, the Expanded Display Window shows both spectra, as illustrated in Fig. 24.

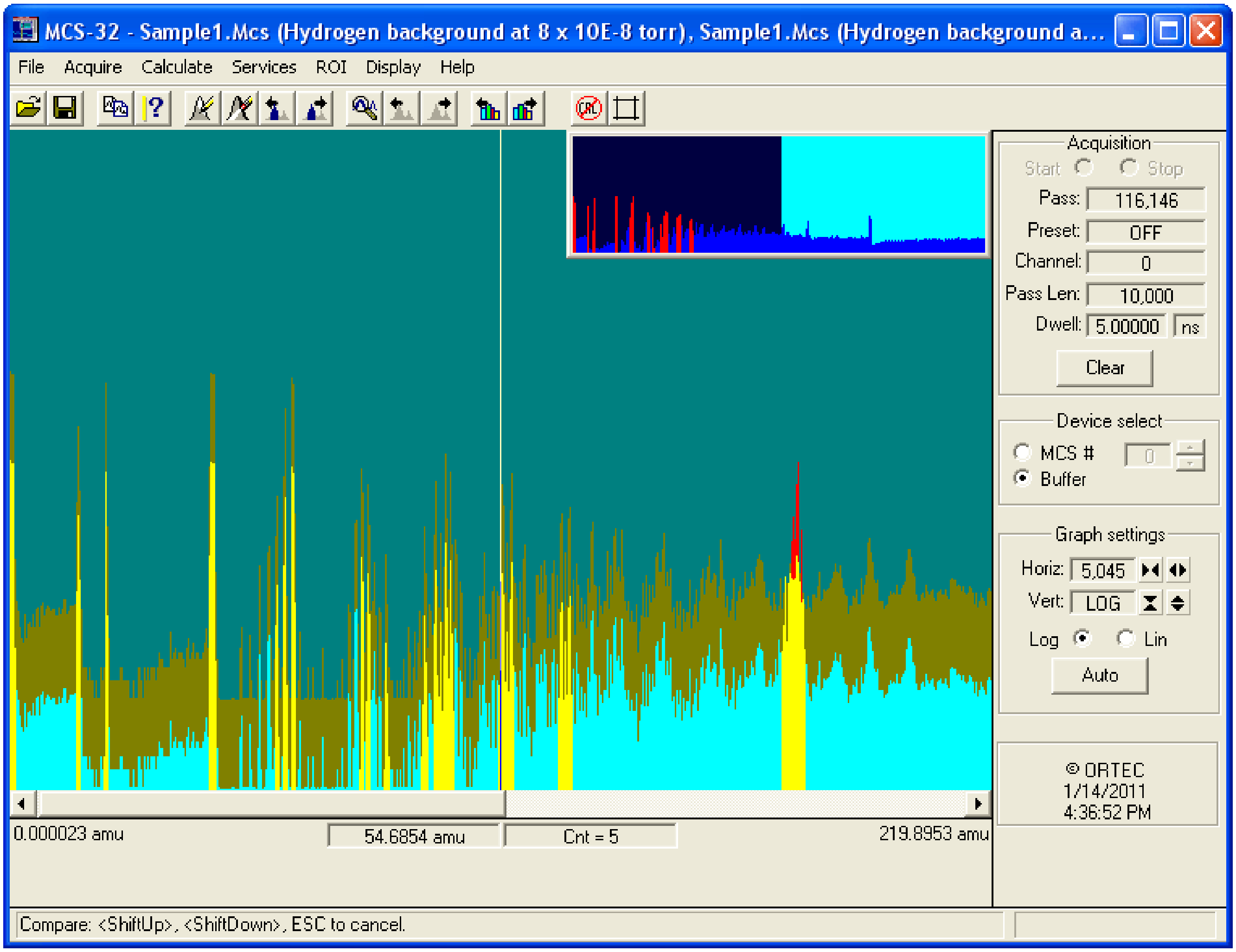


Fig. 24. Compare Mode Screen.

Note that the spectra in this illustration are displayed in Fill All mode, in which all of the area under the peaks is filled with a color different from the background (see **Display/Preferences/ Fill All**, Section 6.6.9.1).

The Compare spectrum is offset from the starting spectrum, and can be moved up and down incrementally with the <**Shift** + ↑> and <**Shift** + ↓> accelerators. In addition, the vertical scale of both spectra can be simultaneously changed with <↑>/<↓>. Note that the Compare spectrum's ROIs (if any were saved with the file) are not marked in this mode.

Figure 25 is taken from Fig. 24. In this illustration, the starting spectrum is displayed in color **(1)**, the Compare spectrum is shown in color **(2)**, the starting spectrum's ROIs are marked in color **(3)**, and the portion of the starting spectrum that exceeds the Compare spectrum is indicated by color **(4)**. These colors — called **Foreground**, **Compare**, **ROI**, and **Combine**, respectively — are chosen on the **Colors** dialog discussed in Section 6.6.9.6.

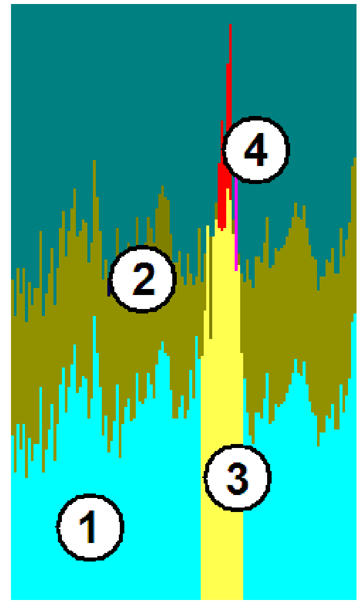


Fig. 25. Spectrum Colors in Compare Mode.

Press <**Esc**> to leave Compare mode.

6.1.6. Recall Settings...

This function restores settings saved by the **Save Settings As...** function. When the **Recall Settings...** function is selected, a standard file-open dialog opens (Fig. 26). The recalled settings apply to the current MCS or buffer depending on which is selected at the time **Recall Settings...** is performed.

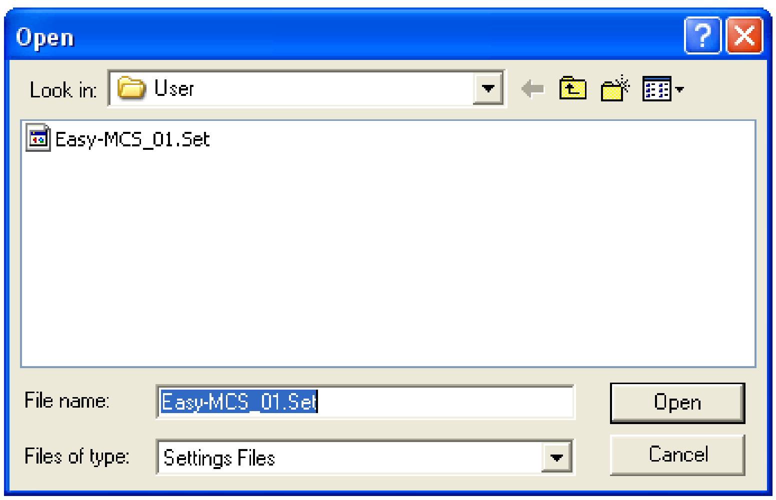


Fig. 26. Recall Settings Dialog.

6.1.7. Save Settings As...

This command saves the settings of the current MCS or buffer, depending on which is selected. The dialog (Fig. 27) has several checkboxes that determine the information saved in the settings file.

- If the **Colors** box is marked, the current screen colors are saved in the file.
- If the **Display** box is marked, the current settings of the **Fill All**, **Fill ROI**, **Full View**, and **Wrap Mode** commands on the **Display** menu are saved.

- If the **Hardware** box is marked, the Pass Length, Pass Count Preset, Dwell Time, Sum/Replace Mode, Internal/External Trigger, Discrim-nator, SCA, and Ramp Settings are saved.

- If the **Calibration** box is marked, the current calibration is saved.

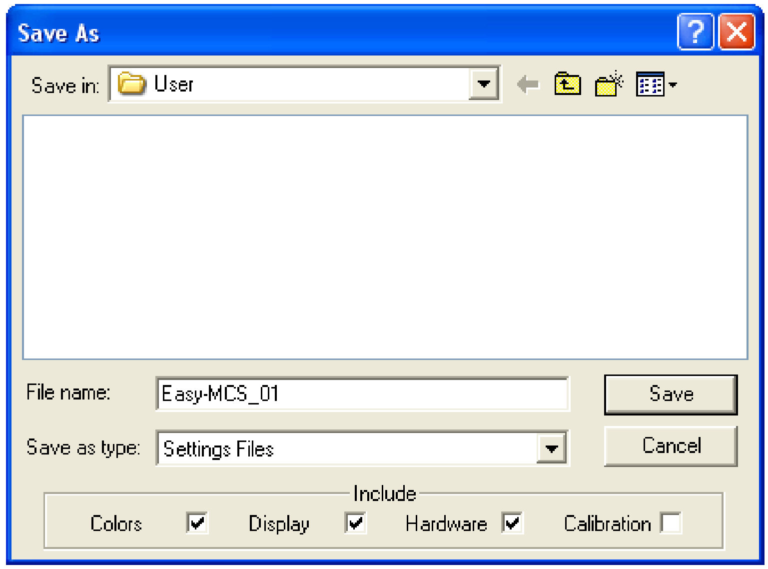


Fig. 27. Save Settings on Disk.

Any or all checkboxes can be marked to control what is stored in the settings file. The default and recommended extension for a settings file is .SET.

6.1.8. Import ASCII...

This command reads into the buffer an ASCII, histogram data file created by the **Export ASCII...** command. MCS-32 must be in buffer mode before the command is executed.

The data format for the text file consists of a list of two-element lines. Each line is composed of the calibrated value (floating point) and the counts (integer) separated by spaces, tabs, commas, or semicolons; see the example in Fig. 28. The number of channels read into the buffer is equal to the number of lines in the text file.

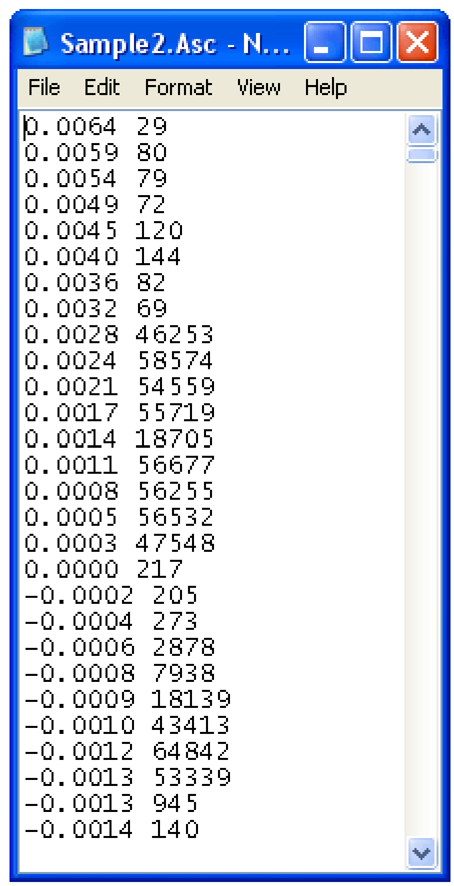


Fig. 28. Format of Exported ASCII File.

If the buffer contains data that have not been saved, a warning message opens. Click **Yes** to execute the **Save Data As...** command, **No** to continue the import operation, and **Cancel** to return to the main display with no action.

A standard file-open dialog opens, displaying a list of ASCII text files. Select a file and click on **Open.** A progress indicator at the bottom of the screen will track the progress of the importation.

When the text file has been read successfully, the descriptors (Pass, Dwell Time, etc.) will be set to default values for the buffer (since descriptors are not saved by the **Export ASCII...** command). The **Acquisition** fields on the Sidebar are grayed to indicate that the values did not come from an actual acquisition. The calibration curve is fitted as a linear, quadratic, or cubic fit depending on the number of channels in the file. The calibration units are set to "???" to indicate that the units did not come from the file. In addition, an MCS calibration table (.MCT) file is also generated which shows the calibration points selected during the import process.

6.1.9. Export ASCII...

The **Export ASCII...** command writes the displayed data to an ASCII text file with the default extension .ASC. When this command is selected, a standard file-save dialog opens. Enter a valid filename (consisting of an optional drive and directory, a filename, and an optional extension) and click **Save**. If the specified file already exists, a message box opens asking you to verify the entry or cancel the operation. Click **Yes** to overwrite the existing file. A progress indicator at the bottom of the screen will track the duration of the save.

The entire spectrum is saved to disk. The data format for the text file consists of a list of two-element lines. Each line is composed of the calibrated value (floating point) and the counts (integer) separated by spaces. This is also the format read by the **Import ASCII...** command. Figure 28 shows the layout of an exported ASCII file.

6.1.10. Exit

This exits MCS-32 and returns to Windows. If the buffer contains a spectrum that has not been saved, a warning message is displayed to allow you to save. Any JOBs are terminated. If data acquisition is in progress, acquisition will continue — the hardware can continue data collection even if the software is not active.

6.2. Acquire

The **Acquire** menu is shown in Fig. 29. The **Start**, **Stop**, and **MCS > Buffer** commands are active only in MCS mode.

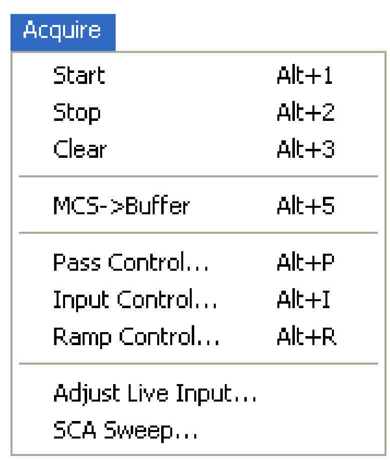


Fig. 29. Acquire Menu.

6.2.1. Start

The **Start** command initiates data collection in the selected MCS. You can also start the MCS with the **<Alt + 1>** accelerator, or by clicking the **Start** button on the Sidebar. See **Pass Control...** (Section 6.2.5) for information on what takes place when you select **Start**.

6.2.2. Stop

Stop terminates data collection in the selected MCS. The MCS can also be stopped with the **<Alt + 2>** accelerator or by clicking the **Stop** button on the Sidebar.

If the MCS is not collecting data, the **Stop** command is ignored. If the MCS is collecting data, the **Stop** command will stop acquisition after the current pass is completed. The **Stop** button on the Sidebar flashes while this final sweep is completed. If you then issue **Stop** a second time, the current pass will terminate before completion.

6.2.3. Clear

Clear erases the spectral data and pass count. This command will not operate on an active MCS. You can also execute the **Clear** command with **<Alt + 3>** or by clicking the **Clear** button on the Sidebar.

6.2.4. MCS > Buffer

This command transfers data and all pertinent information (pass count, pass length, dwell time, etc.), from the selected MCS to the buffer. The **MCS** > **Buffer** function can also be performed by pressing **<Alt + 5>**.

6.2.5. Pass Control...

This command opens the dialog shown in Fig. 30 appears. This function is available in both buffer and MCS modes, even if the MCS is acquiring data. However, for the buffer and for MCSs acquiring data, the current settings can't be changed.

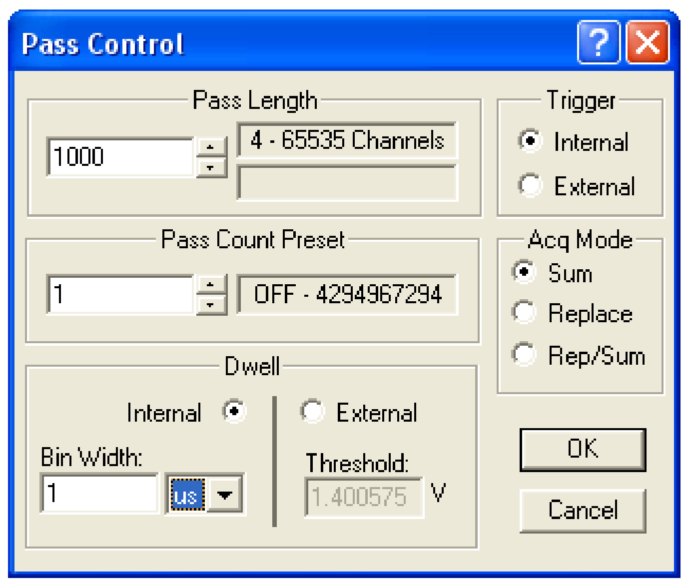


Fig. 30. Pass Control Dialog.

Enter the number of channels to use for MCS acquisition in the **Pass Length** field. The minimum pass length is 4 and the maximum is 65536.

The **Pass Count Preset** entry field is used to enter the number of passes to collect. With this preset condition, the MCS stops counting when the pass count reaches this value. To turnoff this preset, enter 0 (zero) or the word "off"; the MCS will then collect data until the **Stop** command is issued.

In the **Dwell** section, select either **Internal** or **External**. For internal dwell, enter the dwell time in the **Bin Width** field, then open the adjacent drop-down list and select the time units. If you select external dwell, the Channel Advance input on the MCS is used to provide the signal that causes the MCS to move from one channel to the next. Set the dwell threshold voltage to a value between −1.6 V to +3.0 V (inclusive). Typically, the threshold voltage should be set halfway between the upper and lower amplitude limits of the signal provided to the Channel Advance input.

The **Acq Mode** radio buttons determine how new data is collected.

- **Sum** — The current pass data are added to data from previous passes.
- **Replace** — The current pass data replace the data from previous passes.
- **Rep/Sum** — The first pass replaces any current data, then the remaining passes are summed.

The **Trigger** radio buttons determine how passes are started.

- **Internal** — The first pass begins immediately when the **Start** command is issued. When a pass completes, the next pass starts immediately with no dead time.

- **External** — A pass does not start until the appropriate signal is applied to the START input on the front panel of the MCS. After a pass completes, the MCS unit stops and waits until another start signal occurs on the START input before beginning the next pass. See Section 2.1.1 for timing details.

In general, the **External** trigger is used to synchronize the MCS to the external hardware, while the external hardware is synchronized to the MCS by selecting the **Internal** trigger. See Sections 2.1.1 and 2.1.2.

The current **Pass Count Preset** and **Dwell Time** for the selected MCS are shown on the Sidebar. These values are not affected while you enter the values into the dialog or **Cancel** the dialog. They do change, however, as soon as you click **OK**.

6.2.6. Input Control...

Selecting **Input Control...** opens the dialog shown in Fig. 31. This command is available in both buffer and MCS mode, even if the MCS is acquiring data. However, for the MCSs that are acquiring data and in buffer mode, the settings can’t be changed.

The **Use SCA Input** and **Use Disc Input** buttons determine which input is used. When **Use SCA Input** is “on” (highlighted), the SCA input is activated. When the **Use Disc Input** button is highlighted, the fast discriminator is activated for the BNC connector labeled IN.

The SCA input accepts pulses that fall between two levels. For the signal to be accepted, the signal must start at a voltage less than the lower level, rise to a voltage that is between the lower and upper levels, then return to a voltage less than the lower level. The lower and upper levels are set with the **Lower** and **Upper** slide bars in the **SCA** section of the dialog. The nominal voltage of the levels is displayed to the right of each slide bar. To change the voltage, point at the slide button, click and hold the left mouse button, and drag the mouse to the voltage you want. To make small adjustments, click the slide bar to the left or right of the button. To make super-fine adjustments, click the slide bar to activate it, then use the <↑>/<↓> keys.

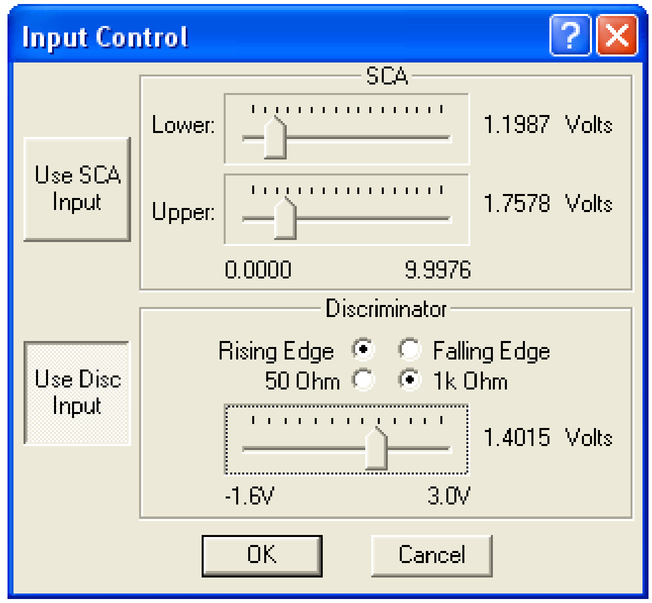


Fig. 31. Input Control Dialog.

The **Discriminator** input (the BNC connector labeled IN) accepts pulses that cross the Dis criminator Voltage. When the **Rising Edge** radio button is marked, the discriminator triggers when the input crosses the discriminator voltage with a *positive slope*. When the **Falling Edge** radio button is marked, the discriminator triggers when the input crosses the discriminator voltage with a *negative slope*. The discriminator voltage is set with the slide bar. The nominal voltage of the discriminator level is displayed to the right of the slide bar. To change the voltage, drag the slide button left or right. To make fine adjustments, click the slide bar to the left or right of the slide button. To make super-fine adjustments, click the slide bar to activate it, then use the <↑>/<↓> keys. Use the discriminator threshold to reject noise and smaller-amplitude pulses while counting larger-amplitude pulses.

6.2.7. Ramp Control...

Ramp control provides an analog waveform synchronized with the MCS sweep. Use the **Ramp Control...** command (Fig. 32) to set up the type of waveform that will be used.

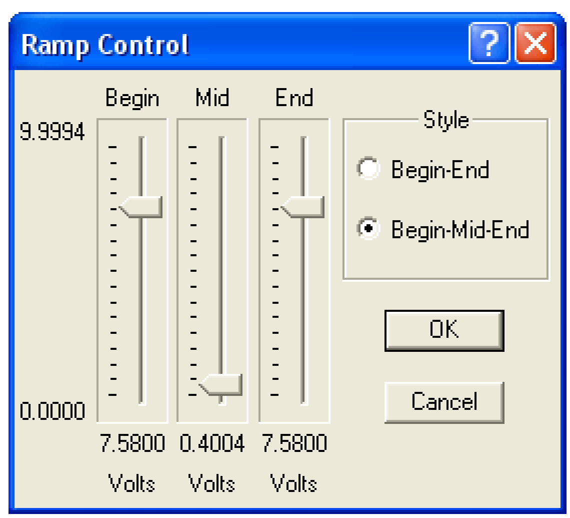


Fig. 32. Ramp Control Dialog.

The **Style** radio buttons determine the type of waveform. The **Begin-End** style generates a "sawtooth" waveform, while the **Begin-Mid-End** button generates a "triangle" waveform.

Several examples of **Begin-End** and **Begin-Mid-End** waveforms are illustrated in Fig. 33.

When the **Begin-End Style** is selected, you must specify two voltages: the voltage at channel 0 and the voltage at the last channel in the sweep. The dialog displays two slide bars for setting

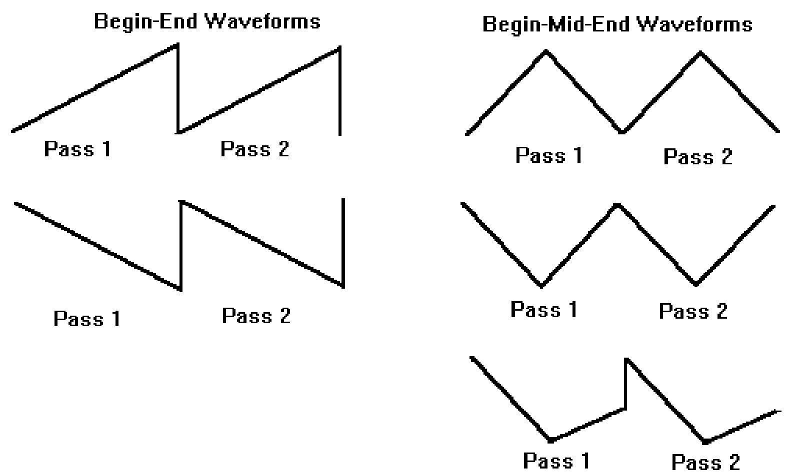


Fig. 33. Example Ramp Waveforms.

these voltages. To change a voltage, click the slide button and drag the mouse up or down to the setting you want. To make small adjustments, click the slide bar above or below the slide button. To make super-fine adjustments, click once on the slide bar to activate it, then use the <↑>/<↓> keys. The nominal voltage is displayed below the bar.

When the **Begin-Mid-End Style** is selected, the voltage at the middle channel in the pass must be specified. A third slide bar is displayed to specify this voltage. A straight line will be drawn between the specified voltages; however, since the voltage is generated by a digital-to-analog convertor, the waveforms will have a discrete appearance ("stair steps").

6.2.8. Adjust Live Input...

This command opens a small dialog (Fig. 34) that allows you to adjust the discriminator or SCA levels while data collection is in progress. This feature is useful in setting up the thresholds since the data responds immediately as the threshold is adjusted. In contrast, if you use the **Input Control...** dialog to adjust the thresholds, you must close that dialog before the adjustment takes effect.

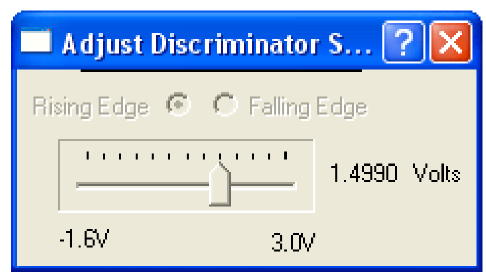


Fig. 34. Adjust Input Levels During Data Acquisition.

6.2.9. SCA Sweep...

This command opens a dialog and sidebar that allow you to efficiently choose the optimum SCA settings. An SCA window (with a width of 19.5 mV between the upper and lower levels) is swept from 0 to +10 V in 512 steps. The Easy-MCS records the number of counts that arrive during each setting. The resulting histogram displays the pulse-height spectrum presented at the SCA input.

If the buffer contains unsaved data when you issue the **SCA Sweep** command, a warning dialog (Fig. 35) opens. To cancel the sweep without losing the buffer contents, click **No**.

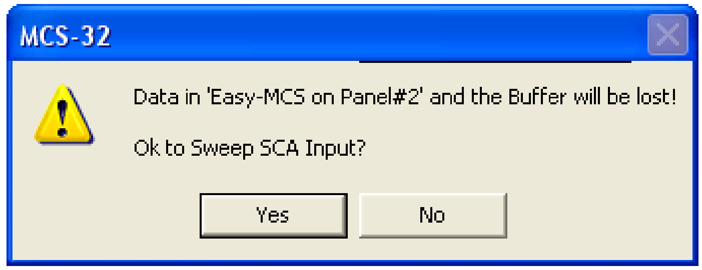


Fig. 35. Warning that Buffer Contents Will Be Lost.

Once the SCA Sweep dialog and sidebar open (Fig. 36), the Easy-MCS continuously sweeps the SCA discriminator voltage to create the histogram. Each sweep takes 5 to 20 seconds depending on the speed of the computer. Click the **Stop** button to stop the SCA sweep when enough data have been collected to adequately define the pulse-height spectrum.

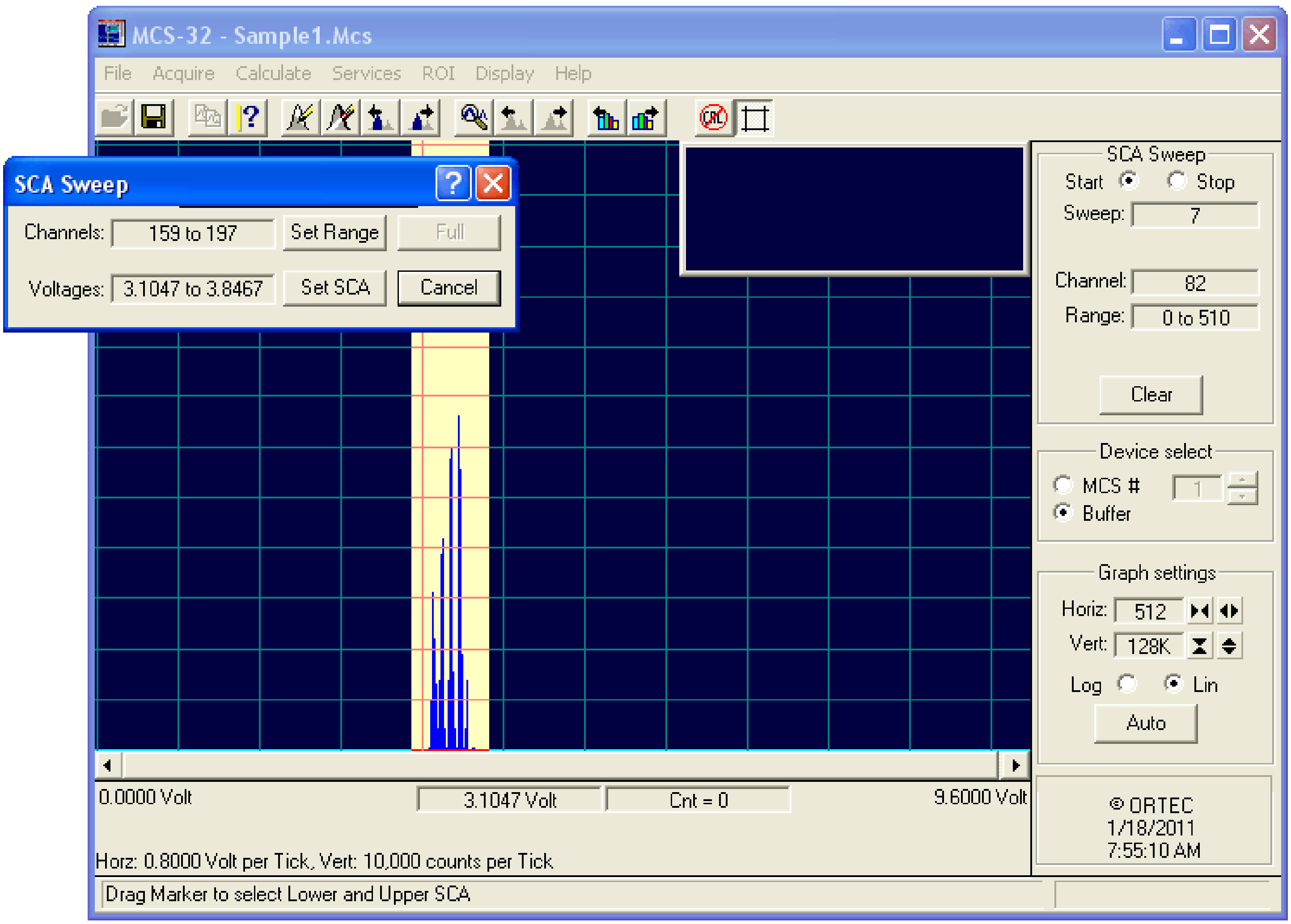


Fig. 36. SCA Sweep Display (voltage range set by clicking and dragging marker with mouse).

In Fig. 36, a signal with an amplitude of approximately 5 V has been fed into the SCA input. The spectrum peak collected has been marked in reverse video by clicking and dragging the mouse from one side of the peak to the other. The voltage range of this marked region is reflected in the **Voltages** field in the dialog (note that the **Channels** and **Voltages** fields in the SCA Sweep dialog will update in real time as you click and drag the mouse). These SCA voltages correspond to the upper and lower limits of the region marked on the peak. To set the SCA levels to these voltages, click the **Set SCA** button. The SCA sweep will run faster if the range of sweep voltages is limited. To do this, click and drag the marker over the range of channels to be swept and click the **Set Range** button.

The **Full** Button returns the range to 10 V. The **Stop** Button stops acquisition. The **Start** Button restarts the acquisition and **Clear Data** clears the data. The **Cancel** Button can be used to exit the SCA sweep mode and return the SCA settings to their original values.

6.3. Calculate

The **Calculate** menu is shown in Fig. 37. These commands functions are available in both MCS and buffer mode.

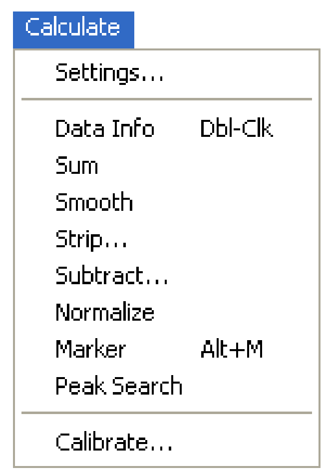


Fig. 37. Calculate Menu.

6.3.1. Settings...

Settings... opens the dialog shown in Fig. 38, which allows you to set the sensitivity of the algorithm used in **Peak Search**. Duringa peak search, suspected peaks in a spectrum must pass a sensitivity test to be accepted. This test compares the magnitude of the smoothed second difference with the weighted error to be accepted. The peak search sensitivity is a multiplicative factor in the weighting factor.

Use the **Peak Search Sensitivity** slider to set the sensitivity to a value between 1 and 200. A value of 1 is the most sensitive (i.e., finds more peaks), and 200 is the least sensitive (i.e., fewer peaks will be found). Click and drag the slider to the setting you want. To make finer adjustments, click the slider bar to activate it, then use the <↑>/<↓> keys.

Click **OK** to activate the new settings.

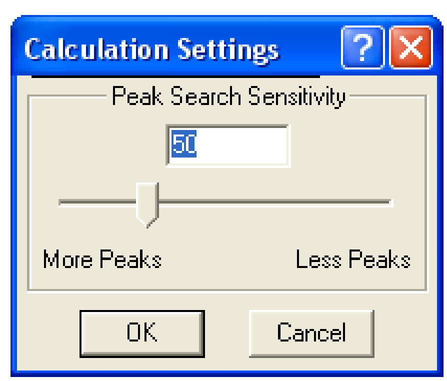


Fig. 38. Set the Peak Search Sensitivity.

6.3.2. Data Info

This command calculates a centroid, gross area, and net area for the region selected with the marker. To select a region, click and drag the mouse across the desired set of channels in the expanded display.

Alternatively, this calculation can be performed on an ROI by double-clicking the ROI. This automatically selects the region marked by the ROI and performs the **Data Info** calculation.

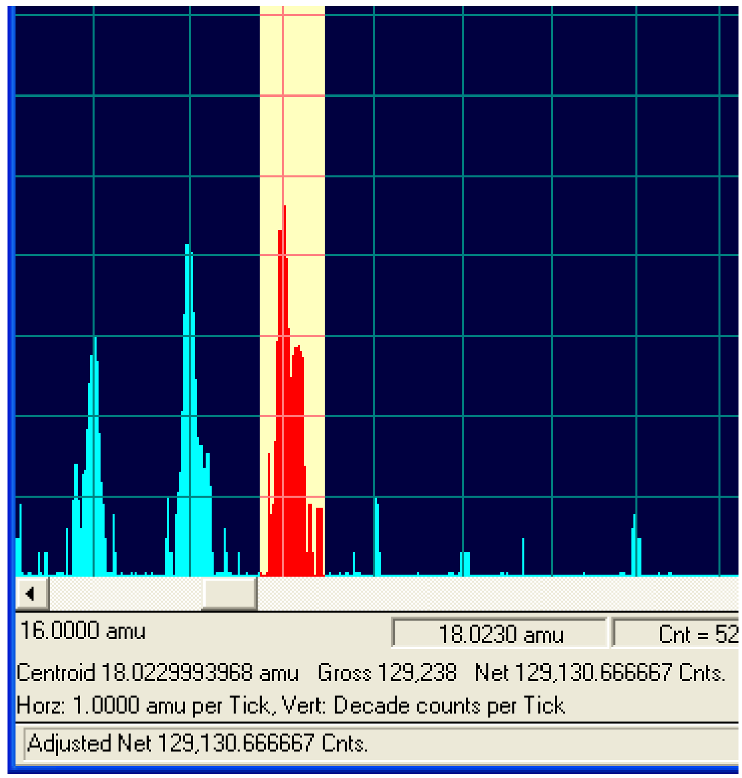


Fig. 39. Data Info Results.

Figure 39 shows how the results of the **Data Info** command are displayed on the Marker Information Line. The marker value changes to the centroid, and a gross and net count are displayed. If the spec-trum is calibrated, the centroid is reported in calibration units. If the spectrum is not calibrated, the centroid is reported in either time (internal dwell time mode) or channels (external channel advance mode). Also, if a library file has been specified (see Section 6.4.2), MCS-32 searches the library for the value that most closely matches the calculated centroid, and reports the name associated with that value on the bottom line of the screen.

The centroid is calculated by taking the first moment of the selected data after a linear background is subtracted from the data. The background is calculated by averaging the last three channels of the region on each side of the region as end points of a straight-line fit. The background is calculated from the mid-point of the three points used in the average. If the region is less than 6 channels wide or the net counts is zero, the calculated centroid will be the first moment of the selected data without subtracting the background.

6.3.3. Sum

This command sums all of the data values in the spectrum and reports the value on the Supplementary Information Line. If the MCS is acquiring data at the time the **Sum** command is issued, an approximate sum is reported.

6.3.4. Smooth

The **Smooth** function transforms the data in the buffer according to a five-point, area-preserving, binomial smoothing algorithm. That is, the existing data are replaced, channel-by-channel, with the smoothed data as follows:

$$S_i = (O_{i-2} + 4O_{i-1} + 6O_i + 4O_{i+1} + O_{i+2}) / 16$$

where

S_i = the smoothed data in channel i

O_i = the original data in channel i

After S_i is calculated, it is rounded off to the closest integer.

6.3.5. Strip...

When **Strip...** is selected, the dialog shown in Fig. 40 opens, prompting you for a filename and **Stripping Factor**. The strip file should be a valid .MCS file containing the same number of channels as the buffer. Once you select a file and click **OK**, MCS-32 strips the specified disk spectrum from the spectrum in the buffer and stores the result in the buffer.

The **Stripping Factor** is a real number that is multiplied, channel by channel, by the disk spectrum before being subtracted from the buffer. This factor can be negative, in which case the spectra are added.

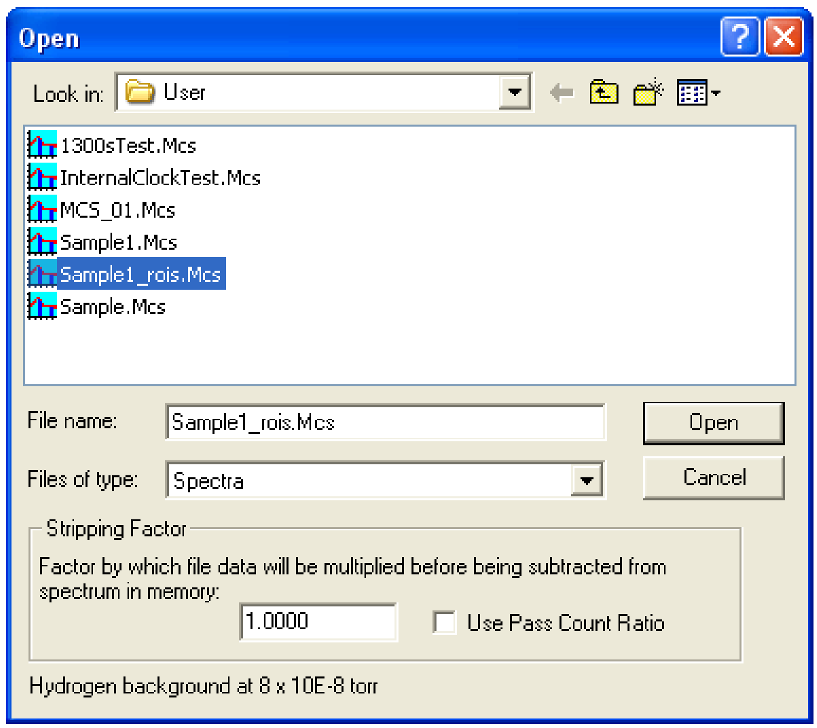


Fig. 40. Choose a Stripping File and Stripping Factor.

If the **Use Pass Count Ratio box** in the file-recall dialog is marked, the strip factor is calculated as the ratio of the pass count of the buffer spectrum to the pass count of the disk spectrum. The pass count is not changed by any strip operation.

6.3.6. Subtract...

The **Subtract** function (Fig. 41) subtracts a constant from each channel in the buffer. This function is useful if small peaks are present on a large, constant background. The background can be subtracted off to get a better look at the peaks.

6.3.7. Normalize

The **Normalize** function transforms the data in the buffer by dividing the data in each channel by the pass count and rounding that value off to the closest integer (see Fig. 42). This command changes the pass count to 1.

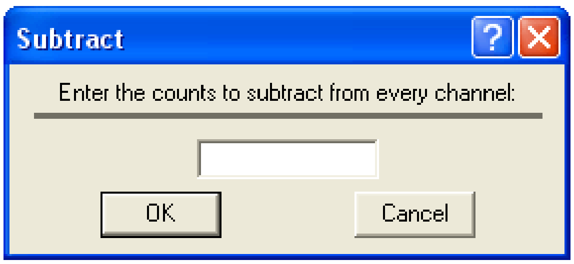


Fig. 41. Enter the Subtraction Constant.

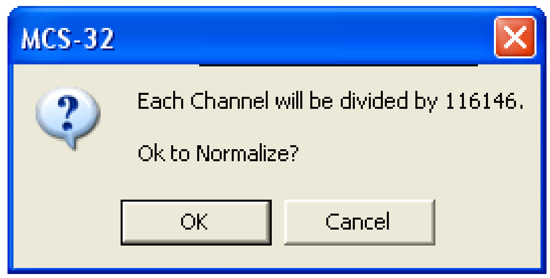


Fig. 42. Normalize?

6.3.8. Marker

Marker reports the current marker position on the Supplementary Information Line near the bottom of the display (see Fig. 43).

By default, the marker is reported at the center of the channel. The marker position is displayed at a much higher precision than on the Marker Information Line.

In the external dwell time mode, the marker position is displayed in channels. In the internal dwell time mode it is displayed in time. If the spectrum is calibrated, the marker position is also displayed in calibrated units. In all three cases, the closest channel number is also included on the Supplementary Information Line.

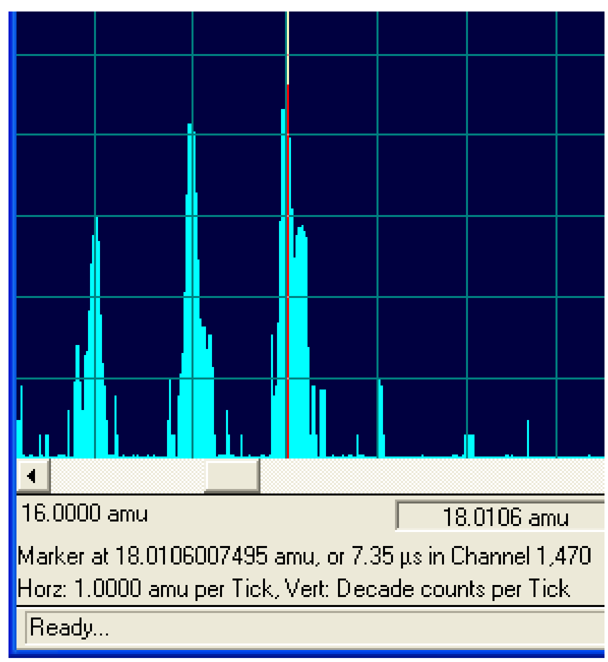


Fig. 43. Results of Marker Command.

If a region is selected with the marker, the width of the region is displayed, in time or calibrated units, instead of the single marker position.

This command is duplicated by the **<Alt + M>** accelerator and the **Marker** button on the Toolbar.

6.3.9. Peak Search

This function initiates a Mariscotti[2]-type peak search on the spectrum in the buffer. This smoothed-second-derivative peak-search algorithm is useful for peak widths in the range of 2–20 channels (full width at half maximum [FWHM]). The peak-search sensitivity is set in **Calculate/Settings...**. Each peak found is marked as an ROI. Overlapping or close peaks may have contiguous ROIs. Existing ROIs are cleared before the command executes.

This command is duplicated by the **Peak Search** button on the Toolbar.

The **Report** command (see Section 6.1.4) can be used with **Peak Search** to produce a semi-quantitative peak list for the spectrum.

6.3.10. Calibrate...

The **Calibrate** command is used to establish a calibration for or remove a calibration from the spectrum such that channel numbers and peak parameters are reported in the specified units as well as time.

The calibration is stored with the spectrum when the **Save Spectrum As...** command is executed. The calibration values are also saved in the default configuration settings that are loaded when MCS-32 is started, so the calibration is automatically restored.

To calibrate a spectrum:

1) Select **Calibration...**. This will open the **Calibration Worksheet** dialog shown in Fig. 44. This dialog provides a place for entering up to 64 time or channel values, and the calibration values that correspond to the times or channels. By default, time values are entered when the dwell is internal. For external dwell, you must enter channel numbers. The Marker Information Line is updated to display the marker position and display limits in the selected time units when the calibration dialog is displayed.

2) Enter **Time** (**Channel**) values by typing the appropriate value into the **Data Point** section of the worksheet, or by clicking the desired time or channel in the expanded display. The channel number entered does not have to be an integer. If you mark a set of channels and select

[2]M.A. Mariscotti, "A Method for Automatic Identification of Peaks in the Presence of Background and its Application to Spectrum Analysis," *Nuclear Instruments and Methods* **50**, 309–320 (1967).

the **Data Info** command (see Section 6.3.2), the calculated centroid will be entered in the calibration channel field.

3) Once this value is displayed in the **Time** (**Channel**) field, enter the calibration **Value** and units.

4) Click the **Enter** button to add this calibration point to the **MCS Calibration Table** at the bottom of the **Calibration Worksheet**.

5) Repeat this procedure for each calibration point.

The **Polynomial** group determines the calibration equation; specify a **Linear**, **Quadratic**, or **Cubic** polynomial. Two or more points are required for a linear fit, a minimum of three points for a quadratic fit, and four or more points for a cubic fit.

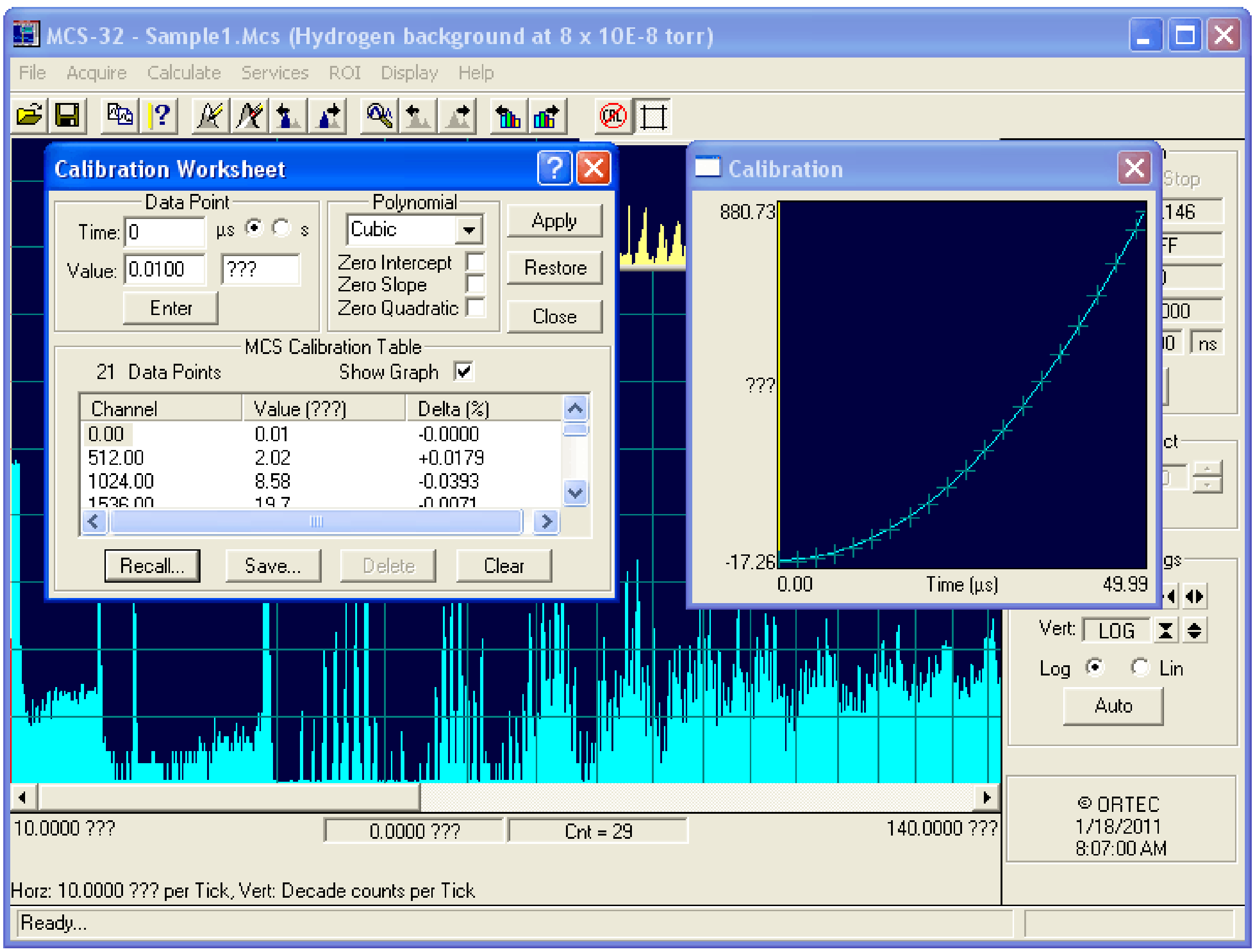


Fig. 44. The Calibration Worksheet and Graph.

In addition, you can force the intercept, slope, or quadratic terms of the polynomial to zero by marking the appropriate checkboxes.

The **MCS Calibration Table** shows the list of calibration points entered. If MCS-32 successfully performs the polynomial fit with the calibration points in the **MCS Calibration Table**, the **Delta(%)** field of the table shows the goodness of fit. This value is calculated as:

$$Delta\ Value\ =\ 100.0 * (Desired\ Value - Calculated\ Value)\ /\ Desired\ Value$$

MCS calibration tables can be saved to or recalled from disk. The default extension for these files is .MCT. The **Recall** button displays a standard file-recall dialog from which you can open a previously stored table. The **Save** button displays a standard file-save dialog.

To undo the calibration and start over, click the **Restore** button. Click **Clear** to clear the calibration, and use **Apply** to apply the calibration to the displayed spectrum.

To end the calibration procedure, click **Close**.

Note that once a spectrum is calibrated, the **Toggle Calibration** Toolbar button and **Display/Time Units** command (Section 6.6.3) switch the expanded display between calibrated units and either time units (for internal dwell) or channels (for external dwell). For example, in internal dwell mode, if the dwell time is 1 second and the pass length is 100 channels, it will take 100 seconds for a single sweep; each channel still represents one second.

6.4. Services

Figure 45 shows the **Services** menu.

Fig. 45. The Services Menu.

6.4.1. Start JOB...

Most of the functions under the various MCS-32 menus can be automated by writing a *JOB*, which consists of one or more commands written in ASCII text (see Chapter 8 for an in-depth discussion and catalog of the commands). JOBs allow you to easily perform repetitive tasks and/or define initial conditions at MCS startup. These files are given a filename extension of .JOB. To start a JOB or edit a .JOB file, select **Services/Start JOB...** to display the dialog shown in Fig. 46. You can also edit .JOB files in Windows Notepad or any other ASCII text editor.

To display the contents of a .JOB file at the bottom of the dialog, click once to highlight the file, then click the **Show Contents** checkbox.

To run a JOB, select a .JOB filename and click **Open**. Once a JOB is started, most menu functions will be disabled (grayed) to prevent interference with JOB as it runs. The .JOB filename will be displayed on the Title Bar. In addition, a JOB control dialog in the upper left corner of the display window will show the current status (current line number) of the JOB. This dialog includes a **Cancel** button so the JOB can be aborted.

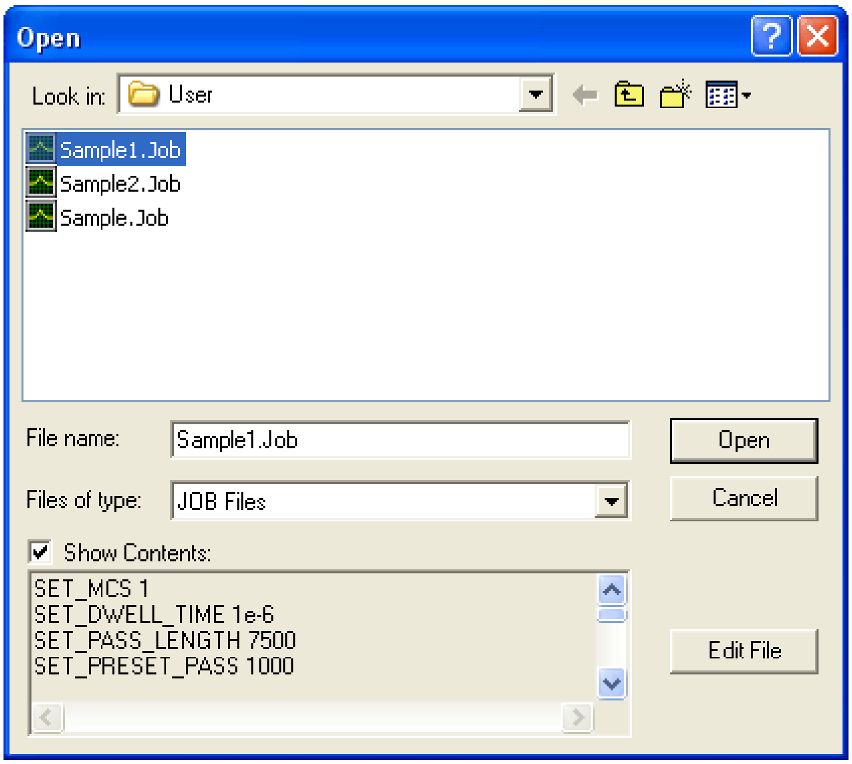


Fig. 46. .JOB File Selection and Execution.

If an error is encountered in a .JOB file, an error message will indicate that an error has occurred, and will display the offending line of the .JOB file.

6.4.1.1. Editing .JOB Files

To edit a .JOB file from the Start JOB dialog (whether or not **Show Contents** is activated), select a file from the list and click the **Edit File** button. This will open Windows Notepad with the .JOB file loaded.

NOTE When editing is complete, the file *must* be saved in Notepad (select **Save** or **Save As** under the **File** menu) for the changes to be effective. When Notepad is closed (**File/ Exit**), the newly edited file will be shown in the Start JOB dialog's **Show Contents** list box.

6.4.2. Library...

A *library* stays resident in memory after it has been loaded, and is used in such functions as **Calculate/Data Info** and **File/Report...** for identifying spectral components according to calibrated peak channel value. Refer to Chapter 9 for information on creating custom libraries that can be loaded with this command.

The **Library**... function opens the file-recall dialog shown in Fig. 47. The default library file extension is .LBR.

When the library file has loaded, MCS-32 displays a status message on the Supplemental Information Line, as shown in Fig. 48.

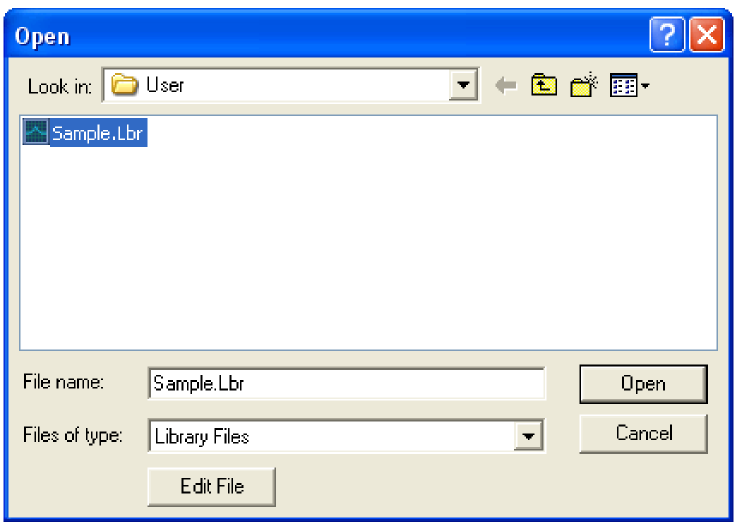


Fig. 47. Load a Library File.

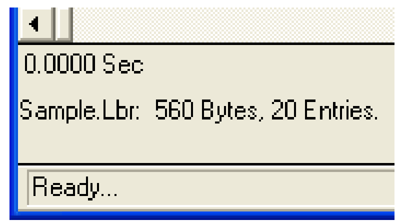


Fig. 48. Status Message Confirms Library File has Loaded.

To edit an existing library file, click a filename to highlight it, then click the **Edit File** button at the bottom of the dialog. This will open Windows Notepad with the library file loaded (see the example in Fig. 49). Remember to save the edited file before exiting Notepad, or the changes will be lost.

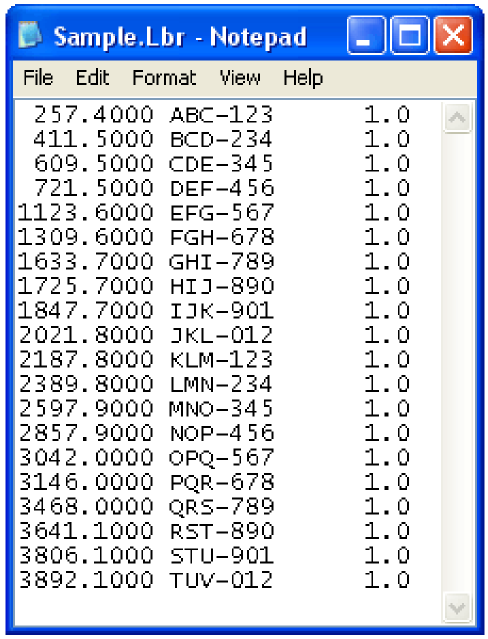


Fig. 49. Editing a Library File in Windows Notepad.

6.4.3. Sample Description...

Use this command to read, edit, or enter a sample description for the displayed spectrum (Fig. 50). The description can be up to 128 characters in length, and automatically accompanies the spectrum when it is subsequently copied or saved to a file. The description also appears in the Title Bar when the spectrum file is opened.

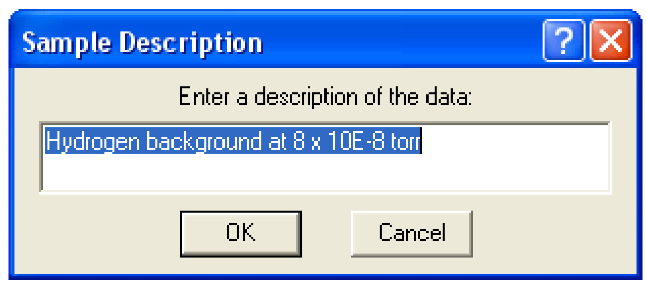


Fig. 50. Sample Description Entry.

6.5. ROI

A *region of interest* (ROI) is a way to denote channels or groups of channels as having special meaning. Channels marked as ROI channels are displayed graphically in a different color than the unmarked channels. ***ROIs are only available in buffer mode***, so the **ROI** menu is gray (inactive) when MCS mode is selected. ROIs are typically used to integrate the area under a spectrum peak. The **ROI** menu is shown in Fig. 51.

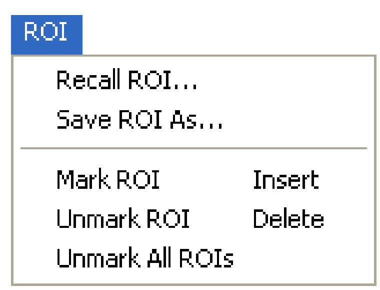


Fig. 51. ROI Menu.

6.5.1. Recall ROI...

Recall ROI... opens the dialog shown in Fig. 52. Select the desired file and click on **Open**.

This command sets the ROIs in the buffer to conform to the table in the file created by **Save ROI As...**. The data contents of the buffer are not changed by this operation, only the ROI bits. If the **Unmark All** checkbox on the dialog is marked, the previous ROIs in the buffer are cleared.

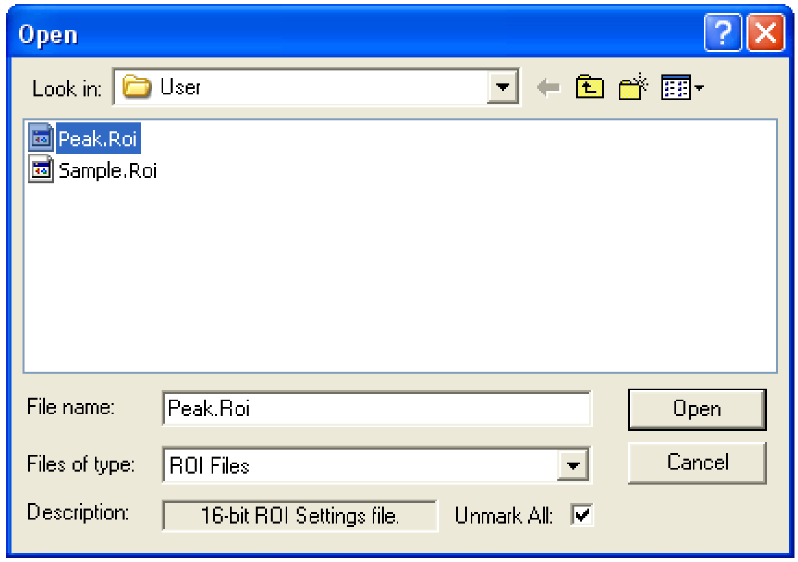


Fig. 52. Load ROI Information from .ROI File.

6.5.2. Save ROI As...

This command opens a standard file-save dialog so you can save the ROI information in the current spectrum. The contents of the spectrum are not changed. The default and recommended file extension is `.ROI`.

6.5.3. Mark ROI

Mark ROI sets an ROI in the region currently selected by the marker. To select a region, click and hold on one edge of the region, drag the mouse to the other edge of the region, and release the left button.

This command is duplicated by the **<Insert>** and **Keypad<Ins>** keys, and by the **Mark ROI** button on the Toolbar.

6.5.4. Unmark ROI

Unmark ROI clears all ROIs in the region currently selected by the marker. This command is duplicated by the **<Delete>** and **Keypad<Del>** keys, and by the **Clear ROI** button on the Toolbar.

6.5.5. Unmark All ROIs

Unmark All ROIs unmarks all the ROIs in the spectrum. The spectral data are not affected.

6.6. Display

Figure 53 shows the **Display** menu. These commands are available in both buffer and MCS mode.

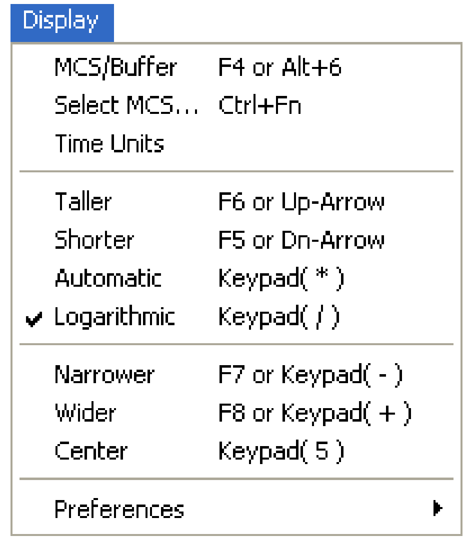


Fig. 53. Display Menu.

6.6.1. MCS/Buffer

This function switches the source of the spectrum and Status Sidebar display between the MCS and buffer. The source of the displayed spectrum (MCS or buffer) is shown by the radio buttons on the Sidebar. The sidebar also shows the corresponding descriptors and presets. The horizontal and vertical scales remain the same in both views. This function is duplicated by the **<Alt + 6>** and **<F4>** accelerators, and the **MCS > Buffer** button on the Toolbar.

6.6.2. Select MCS...

Use this dialog (Fig. 54) to select an MCS from the current configuration for display. Click the appropriate MCS, then click **OK**.

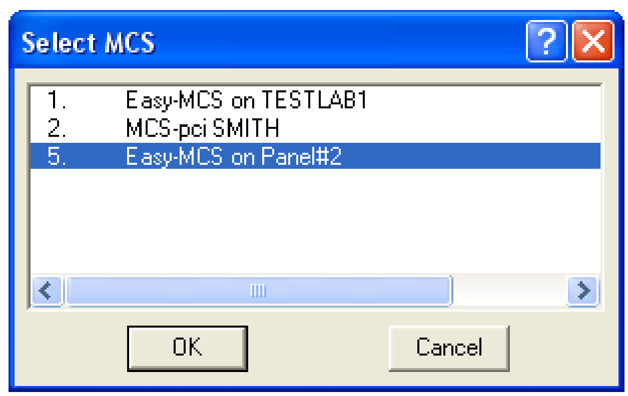


Fig. 54. MCS Pick List.

You can also select an MCS with **<Ctrl + F1>** for MCS #1, **<Ctrl + F2>** for MCS #2, and so on, through **<Ctrl + F8>**; or by clicking the **MCS #** radio button on the Sidebar, then clicking the up/ down buttons beside it.

Note that although the instrument configuration program locates all ORTEC CONNECTIONS-compatible instruments, the Select MCS dialog shows only Easy-MCS and legacy ORTEC MCS instruments.

6.6.3. Time Units

This command switches the expanded display between calibrated units and time units if the dwell time is known (e.g., when running in internal dwell mode). For external dwell times, it switches between calibrated units and channels. For example, in internal dwell mode, if the dwell time is 1 second and the pass length is 100 channels, it will take 100 seconds for a single sweep; each channel represents one second.

If the spectrum is calibrated, switching off the time units shows the display in calibrated units. If the spectrum is uncalibrated, switching off the time (internal dwell) or channel (external dwell) units does nothing, since an uncalibrated spectrum is shown in time (internal dwell) or channels (external dwell).

6.6.4. Shorter/Taller

Shorter and **Taller** switch the spectrum display to a linear vertical scale and, respectively, increase or decrease the full-scale value by a power of two. In either case, the current vertical full-scale value is shown in the **Vert** field on the Sidebar. **Shorter** and **Taller** are duplicated by the **<F5>**/**<F6>** and <↓>/<↑> keys.

6.6.5. Automatic

Automatic is used to switch the spectrum window from a logarithmic vertical scale to a linear scale that is automatically adjusted until the largest peak shown is at its maximum height without overflowing the display. It also toggles the vertical scale of the spectrum display between the automatic and manual modes. This function is duplicated by **Keypad<*>** and the **Auto** button on the Sidebar.

6.6.6. Logarithmic

Logarithmic toggles the vertical scale of the expanded display between the logarithmic and linear modes. This function is duplicated by **Keypad</>** and the **Log** radio button on the Sidebar. To switch out of automatic vertical scaling mode, click the **Automatic**, **Taller**, or **Shorter** menu command, or the **Auto** button or **Lin** radio button on the sidebar.

6.6.7. Narrower/Wider

Narrower and **Wider** increase and decrease the horizontal full scale of the Expanded Display Window by a factor of two so that the peaks appear respectively narrower and wider. The number of channels in the expanded display is shown in the **Horz** field on the Sidebar. These functions are duplicated by the **<F7>**/**<F8>** and **Keypad<−>**/**Keypad<+>** keys, and the arrow buttons beside the **Horz** field.

6.6.8. Center

This function forces the marker to the center of the screen by shifting the spectrum without moving the marker from its current channel. This function is only required when moving the marker with the mouse. The keyboard functions for moving the marker automatically shift the spectrum to center the marker when the marker travels past the end of the current expanded display. **Center** is duplicated by **Keypad<5>**.

6.6.9. Preferences...

This displays the options available for selecting the screen colors and spectrum display options. The submenu is shown in Fig. 55.

Fig. 55. Display Preferences.

6.6.9.1. Points/Fill ROI/Fill All

Use these functions to select the histogram display mode for both spectrum windows.

In **Points** mode, the data are displayed as points or pixels on the screen, in the colors chosen for **Foreground** and **ROI** under **Display**/**Preferences**/ **Spectrum Colors...** (see Section 6.6.9.6).

In **Fill ROI** mode, the unmarked regions of the spectrum are displayed as points, while the ROIs are filled from the baseline to the data point with the **ROI** spectrum color.

In **Fill All** mode, all the data points are filled from the baseline to the data point with the **Foreground** and **ROI** spectrum colors.

Figure 56 shows a comparison of the three display modes. Note that the point/pixel size in the **Point**- and **Fill ROI**-mode illustrations has been exaggerated to make them easier to see.

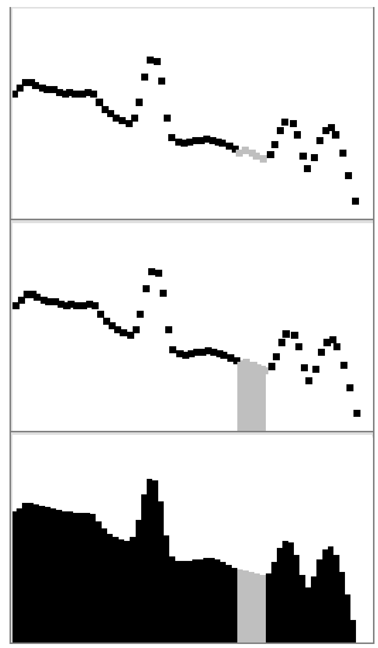


Fig. 56. Comparison of the Points, Fill ROI, and Fill All Display Modes.

6.6.9.2. Wrap Mode

When **Wrap Mode** is selected, data that exceeds the vertical scale are displayed as if the data value is the remainder when that value is divided by the vertical scale. For example, if the channel value is 1030 and the vertical scale is 1024, the data point is displayed as if 6 is the data value. If **Wrap Mode** is not selected, data points which exceed the vertical scale are displayed at the top of the screen.

6.6.9.3. Full View

This function displays or hides the Full Display Window. When the Full Display Window is off, more of the Expanded Display Window is visible and the screen updates more quickly. However, the ability to rapidly move from one part of the spectrum to another without increasing the number of channels in the horizontal scale (using **Narrower**) is lost.

6.6.9.4. Graticules

This command displays or hides the grid marks for the Expanded Display Window. When the graticules are displayed, a check-mark appears beside the menu item. This command is duplicated by the **Graticules** button on the Toolbar. While the graticules are displayed, their spacing is defined at the bottom of the screen as "spacing per tick" (see Fig. 57). The spacing units can be counts on the vertical scale; and time, channels, or calibrated units on the horizontal scale.

Fig. 57. Graticule Spacing Information.

6.6.9.5. Toolbar

This displays and hides the Toolbar. When the Toolbar is hidden, the spectrum windows are larger, but the controls the bar provides are not available (except for those duplicated on the menus and Sidebar).

6.6.9.6. Colors...

Use this dialog (see Fig. 58) to select colors for various features in the two spectrum windows. Each scroll bar controls the color of a different feature. The vertical colored stripes behind the scroll bars show the available colors.

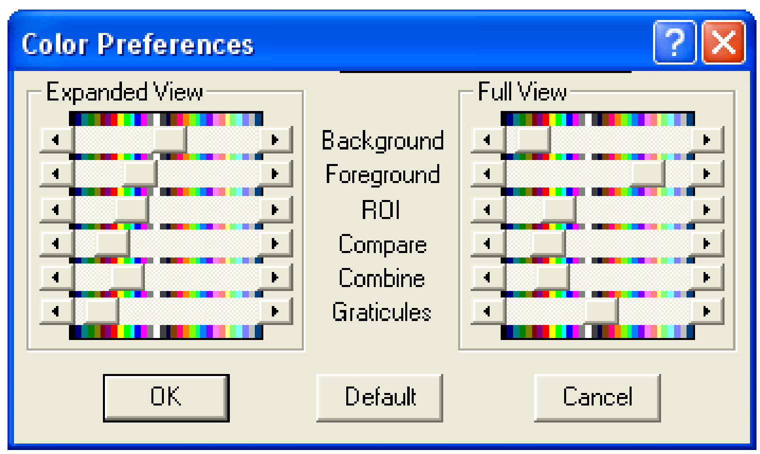


Fig. 58. Display Color Selections.

The **Background** scroll bar controls the background color of the spectrum window, **Foreground** determines the color of the spectrum points or fill, **ROI** governs the color of the ROI points or fill. The points/fill of a compared spectrum (**File/Compare...**) use the **Compare** color, unless they overlap with the original spectrum, in which case the **Combine** color is used. The grid that can be superimposed on the expanded display uses the **Graticules** color.

- To change a color, click the scroll bar button and drag it slowly across the different colors. The expanded and full displays will change color in real time as you drag the mouse. When the desired color is displayed on the screen, release the mouse button.

- To accept the color changes, click **OK**, then answer **Yes** to the pop-up dialog.

- To cancel a color change, return the slider button to its starting color, or close the Color Preferences palette by clicking **Cancel** or pressing **<Esc>**.

- To reset the color values to the original MCS-32 colors, click **Default**.

NOTE The colors on this palette affect only the Expanded and Full Display Windows. The colors of the remaining features on the screen must be changed using the Windows Control Panel (which will also, of course, affect the appearance of all other Windows applications on this computer).

7. KEYBOARD FUNCTIONS

This chapter describes the MCS-32 accelerator keys. The keys described in this section are grouped primarily according to location on the keyboard and secondarily by related function.

7.1. Introduction

Table 1 provides a quick reference to all of the MCS-32 keyboard and keypad functions. These accelerators are also illustrated in Fig. 59, and discussed in more detail in the remainder of the chapter.

The accelerators are available only in the MCS-32 window. The Title Bar must be highlighted with the active title bar color (as set up in Windows Control Panel). In addition, the active cursor — or input *focus* — must be in the spectrum window. Similar to other Windows applications, the input focus can be switched between MCS-32 and other applications by clicking the Windows Taskbar, pressing **<Alt + Tab>**, or, if the inactive window is visible, pointing with the mouse at some spot in the inactive window and clicking.

The multi-key functions, such as **<Alt + 1>** or **<Shift + →>**, are executed by holding down the first key (e.g., **<Alt>**, **<Shift>**, or **<Ctrl>**) while pressing the key that follows the “+” sign in the brackets, then releasing both keys simultaneously. Functions that use the keypad keys begin with the word **Keypad**, e.g., **Keypad<5>**.

As usual for any Windows application, the menus are accessed by clicking them with the mouse, or by using the **Alt** key plus the key that matches the underlined letter in the menu item name. For example, the multi-key combination to activate the **File** menu is **<Alt + F>**.

Note that the MCS-32 accelerator keys do not interfere with Windows menu operations or task switching. For example, when a menu is active (i.e., pulled down), the <←>/<→> and <↑>/<↓> keys revert to their normal Windows functions of moving across the menu bar and scrolling up/down within a menu, respectively. As soon as the menu is closed, they behave as MCS-32 accelerators again.

7.2. Marker and Display Function Keys

7.2.1. Next/Previous Channel <→>/<←>

The right and left arrow keys move the marker by one displayed pixel in the corresponding direction. This may represent a jump of more than one spectral data memory channel, especially if the horizontal scale in channels is larger than the width in pixels of the window (see the discussion in Section 5.2).

Table 1. Quick Reference to MCS-32 Keyboard Commands.

Key	Function
<↓> or <F5>	Increase the vertical scale so peaks appear smaller.
<↑> or <F6>	Decrease the vertical scale so peaks appear larger.
<→>	Move marker to higher channel.
<←>	Move marker to lower channel.
<Ctrl + →>	Jump to next higher ROI.
<Ctrl + ←>	Jump to next lower ROI.
<Shift + →>	Highlight channels to the right.
<Shift + ←>	Highlight channels to the left.
<Alt + →>	Jump to next library entry.
<Alt + ←>	Jump to previous library entry.
<PageUp>	Jump to higher channel number in 1/64th-screen-width increments.
<PageDown>	Jump to lower channel number in 1/64th-screen-width increments.
<Home>	Jump to first channel of the full display.
<End>	Jump to last channel of the full display.
<Ctrl + Fi>	Select MCS i (i = 1 to 12, in pick list order).
<F4> or <Alt + 6>	Switch between displaying selected MCS and buffer.
<F5> or <↓>	Increase the vertical scale so that peaks appear smaller.
<F6> or <↑>	Decrease the vertical scale so that peaks appear larger.
<F7> or Keypad<−>	Increase the horizontal scale so peaks appear narrower.
<F8> or Keypad<+>	Decrease the horizontal scale so peaks appear wider.
Keypad<−> or <F7>	Increase the horizontal scale so peaks appear narrower.
Keypad<+> or <F8>	Decrease the horizontal scale so peaks appear wider.
Keypad<5>	Center Expanded Display Window on cursor.
Keypad</>	Switch to logarithmic vertical scale.
Keypad<*>	Switch to auto vertical scale.
Insert or <Ins>	Mark the highlighted area as an ROI.
Delete or <Del>	Clear the ROI.
<Shift + ↑>	Shift the **Compare** spectrum upwards.
<Shift + ↓>	Shift the **Compare** spectrum downwards.
<Alt + 1>	Start acquisition in selected MCS.
<Alt + 2>	Stop acquisition in selected MCS.
<Alt + 3>	Clear data and descriptors for the selected MCS.
<Alt + 5>	Copy data in the selected MCS to the buffer.
<Alt + 6> or <F4>	Switch between displaying selected MCS and buffer.
<PrintScreen>	Capture screen to Windows Clipboard.

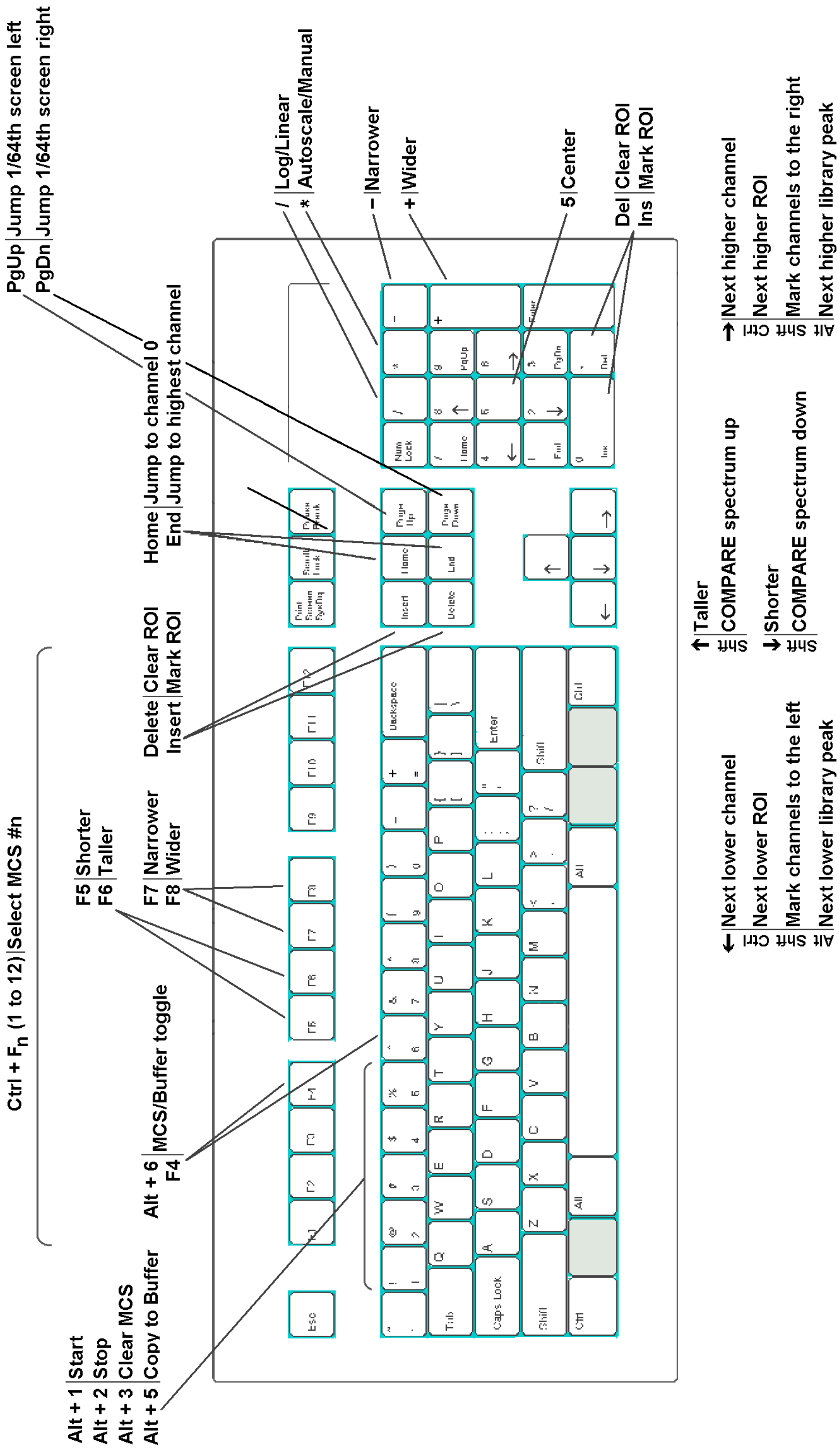


Fig. 59. MCS-32 Keyboard and Keypad Accelerators.

If the horizontal scale is expanded, when the marker reaches the edge of the spectrum window, the next key press past the edge shifts the window to the next block of channels in that direction such that the marker is now in the center of the display.

7.2.2. Next/Previous ROI <Ctrl + →>/<Ctrl + ←>

The **<Ctrl + →>** and **<Ctrl + ←>** move the marker to the beginning of the next higher channel ROI, and the end of the preceding ROI, respectively, of the displayed spectrum. These functions are duplicated by the **Find Previous ROI** and **Find Next ROI** buttons on the Toolbar.

7.2.3. Highlight Channels Left/Right <Shift + →>/<Shift + ←>

The **<Shift + →>** and **<Shift + ←>** keys allow you to highlight a block of channels from the current marker position to the left or right, respectively. This is the keyboard equivalent of highlighting a block of channels by clicking and dragging with the mouse. You can then perform such operations as marking the highlighted region as an ROI and calculating the centroid of the region.

7.2.4. Next/Previous Library Entry <Alt + →>/<Alt + ←>

These keys move forward or backward through the peak-identification library to the next closest library entry. Each button press advances to the next library entry and moves the marker to the corresponding energy. Also, instead of indexing from a previously identified peak, the marker can be positioned anywhere in the spectrum and these keys used to locate the entries closest to that point. If a warning beep sounds, it means that all library entries have been exhausted in that direction, or that the spectrum is not properly calibrated for reaching further entries with the marker. In any case, if an appropriate peak is available at the location of the marker, data on the peak are displayed on the Marker Information Line. These functions are duplicated by the **Library** indexing buttons on the Sidebar.

7.2.5. First/Last Channel <Home>/<End>

These keys move the marker to the first or last channel of the spectrum.

7.2.6. Jump 1/64 Screen Width <PageDown>/<PageUp>

<PageDown> and **<PageUp>** jump the marker position to the left (to lower channel numbers) or right (to higher channel numbers), respectively, 1/64 of the window width, regardless of the horizontal scale. The status of the ROI bit is not altered when the marker is moved with these keys, that is, the mark/unmark state is ignored. The marker channel contents and Marker Information Line are continuously updated as the marker jumps, so when the jump is complete, the marker information is up-to-date for the current channel.

7.2.7. Insert ROI <Insert> or Keypad<Ins>

These keys mark a selected set of spectrum channels as an ROI. To select the channels to be marked, highlight the region by clicking and dragging the mouse from one edge of the region to the other edge. These accelerators duplicate the function of the **Mark ROI** Toolbar button and the **ROI/Mark ROI** command (see Section 6.5.3).

7.2.8. Unmark ROI <Delete> or Keypad<Del>

<Delete> and **Keypad<Del>** clear the ROI bits of all ROI channels contiguous to the channel containing the marker. These accelerators duplicate the function of the **Clear ROI** button on the Toolbar and the **ROI/Unmark ROI** command (see Section 6.5.4).

7.2.9. Taller/Shorter <↑>/<↓>

The <↑> and <↓> keys decrease or increase the vertical full scale of the displayed spectrum so the peaks appear taller or shorter, respectively. The minimum is 16 counts-full-scale; the maximum is 1024 million counts. Each successive key press doubles or halves the full scale until the maximum or minimum is reached. Whenever the maximum full-scale value is reached, the next <↑> key press switches to logarithmic scale. If the display is already in logarithmic scale, the display switches to linear scale. In either case, the vertical full-scale value is always shown on the Sidebar. Note that if the number of counts exceeds the full-scale value, the data points will be displayed at the full-scale value unless **Wrap Mode** has been selected (see Section 6.6.9.2). These keys duplicate the **<F6>**/**<F5>** keys.

7.2.10. Shift Compare Spectrum <Shift+↑>/<Shift+↓>

In **Compare** mode, the **<Shift + ↑>** or **<Shift + ↓>** keys decrease or increase the vertical separation between the two spectra. Each successive key press increases or decreases the separation by moving the spectrum read from disk. The spectrum from disk can be moved below the first spectrum if it has fewer counts.

7.2.11. Wider/Narrower Keypad<+>/<−>

Keypad<+> decreases the horizontal scale of the Expanded Display Window so the peaks appear wider, while **Keypad<−>** increases the horizontal scale, making the peaks look narrower. The horizontal and vertical scale values are displayed on the Sidebar. These functions are duplicated by **<F7>**/**<F8>**.

7.2.12. Screen Capture <PrintScreen>

The **<PrintScreen>** key captures the entire monitor display to the Windows Clipboard, where it is available for use in other applications such as word processors, Windows Paint, etc.

A typical usage would be to set up the display as desired for the snapshot (you may wish to use **Display**/**Preferences**/**Spectrum Colors...** to select black or white for all areas rather than colors, since they produce clearer printouts), then press **<PrintScreen>**. Start the desired graphics or word processing application. Copy the image from the Clipboard with **<Ctrl + V>** or **Edit**/**Paste** (refer to the documentation for the graphics or word processing program). See the accompanying FullShot manual for other screen-capture and screen-printing methods.

7.3. Keyboard Number Combinations

NOTE Only the key*board* numbers will function in the following combinations. The key*pad* number keys will *not* perform these functions.

7.3.1. Start <Alt + 1>

<Alt + 1> starts the acquisition in the selected MCS. Any presets desired must be entered before starting acquisition. This accelerator duplicates the **Start** Toolbar button, the **Start** command on the right-mouse-button menu, and **Acquire**/**Start**, discussed in Section 6.2.1.

7.3.2. Stop <Alt + 2>

<Alt + 2> stops acquisition in the selected MCS. This duplicates the **Stop** Toolbar button, the **Stop** command on the right-mouse-button menu, and **Acquire**/**Stop**, discussed in Section 6.2.2. Acquisition stops at the end of the current pass. To stop before the end of the pass, issue the **Stop** command twice.

7.3.3. Clear <Alt + 3>

<Alt + 3> clears the displayed instrument's histogram data and its descriptors (real time, live time, etc.). This accelerator duplicates the **Clear Spectrum** Toolbar button, the **Clear** command on the right-mouse-button menu, and **Acquire**/**Clear**, discussed in Section 6.2.3. Stop acquisition before executing the **Clear** command.

7.3.4. MCS > Buffer <Alt + 5>

<Alt + 5> copies the histogram data from the selected MCS to the buffer, along with its descriptors (e.g., live time, real time), and displays the spectrum in a new window. This duplicates the **MCS** > **Buffer** Toolbar button and **Acquire/MCS** > **Buffer**, discussed in Section 6.2.4.

7.3.5. MCS/Buffer <Alt + 6>

<Alt + 6> switches the display between the histogram of the spectrum in the selected MCS and the spectrum in the buffer. The buffer will have the memory size of the spectrum that was last transferred from MCS or disk file. The Sidebar indicates whether the buffer or a particular MCS is currently displayed, and shows the presets for the displayed data. This duplicates **<F4>** and **Display**/**MCS/Buffer**; see Section 4.6.2.

7.4. Function Keys

7.4.1. MCS/Buffer <F4>

The **<F4>** key switches between the display of the data in the MCS and the data in the buffer. It duplicates the function of **<Alt + 6>** and **Display/MCS/Buffer**; see Section 7.3.5.

7.4.2. Taller/Shorter <F5>/<F6>

These keys decrease or increase the vertical full scale of the displayed spectrum so the peaks appear taller or shorter, respectively. They duplicate the function of the <↑> and <↓> keys. The vertical scale value is always shown on the Sidebar.

7.4.3. Narrower/Wider <F7>/<F8>

F7 increases the horizontal scale of the Expanded Display Window so the peaks appear narrower, while **F8** decreases the horizontal scale, making the peaks look wider. The horizontal and vertical scale values are displayed on the Sidebar. These functions are duplicated by **<F7>**/**<F8>**.

7.4.4. Select MCS <Ctrl + F1> through <Ctrl + F8>

These keys open a new window and display the spectrum for the specified MCS **n** (where **n** = 1 to 8, corresponding to **<Ctrl + Fn>**, in the order that the instruments are defined in the MCS pick list). The selected instrument name (or the buffer) is shown on the Sidebar.

These keys duplicate the function of the MCS pick list on the Sidebar, and the **Select MCS...** command under the **Display** menu. However, be aware of which instrument numbers are available when using the function keys. An error message will appear if the selected instrument is invalid. In systems with more than eight instruments, use **Display/Select MCS...** or the MCS pick list on the Sidebar.

7.5. Keypad Keys

7.5.1. Log/Linear Keypad</>

Keypad</> toggles the active spectrum window between logarithmic and linear vertical display. This is duplicated by the **Log** and **Lin** radio buttons on the Sidebar. The vertical scale can also be controlled with the **Taller/Shorter** commands, **Keypad**<+>/<−>, the <↑> and <↓> keys, and **<F7/F8>**.

7.5.2. Auto/Manual Keypad<*>

Keypad<*> switches the spectrum window between automatic and manual vertical full scale (see the discussion in Section 6.6.5). This is duplicated by the **Auto** button on the Sidebar, and **Display/Automatic**.

7.5.3. Center Keypad<5>

Keypad<5> forces the marker to the center of the screen by shifting the spectrum without moving the marker from its current channel. This is duplicated by **Display/Center.** For more information, see Section 6.6.8.

7.5.4. Wider/Narrower Keypad<+>/<−>

Keypad<+> decreases the horizontal scale of the Expanded Display Window so the peaks appear wider, while **Keypad**<−> increases the horizontal scale, making the peaks look narrower. The horizontal and vertical scale values are displayed on the Sidebar. These functions are duplicated by **<F7>**/**<F8>**.

8. JOB FILES

An MCS-32 .JOB file consists of one or more lines of ASCII text representing a series of commands that can automate most of the functions described earlier in this manual. This chapter gives the details of the commands including required syntax. A .JOB file can be executed with the **Services**/**Start JOB...** dialog, or by including the name of the .JOB file on the command line when MCS-32 is first started (e.g., MCS32 -JDEMO.JOB).

.JOB files are used for the following types of functions:

1) Performing a repetitive task, such as running a sequence of experiments without user intervention.

2) Defining initial conditions at startup (this is useful for preloading presets for a specific experiment, although a settings [.SET] file can serve the same function; see Section 6.1.7).

MCS-32 can run repetitive loops. Furthermore, the current loop count can be included as a variable in any string, including filenames, program parameters, and text. Data can thus be stored with unique filenames and labeled with unique descriptions.

If an error occurs in running a .JOB file, file execution stops and control returns to MCS-32. An error code appears in the **Start JOB...** dialog, as described in Section 6.4.1.

8.1. JOB Programming Example

A common operation that is ideal for a .JOB file is the collection of many consecutive sample spectra without user intervention. This process can be described as follows:

1) Set the MCS parameters, such as dwell time
2) Start the acquisition
3) Wait for acquisition to stop
4) Integrate a spectrum peak
5) Record the peak area
6) Repeat this for the required number of samples

By looking at the list of steps above and the explanations below, the necessary commands can be determined.

The first step in the process is to set the MCS parameters and clear the data:

```
SET_MCS 1
SET_DWELL_TIME 1e-6
SET_PASS_LENGTH 7500
```

```
SET_PRESET_PASS 1000
CLEAR
```

Note that only the Dwell Time, Pass Length, and Pass Preset were set. We will assume that the other parameters (Disc Voltage, Acq Mode, etc.) were set before the JOB was started. Now start the acquisition and wait for completion of the pass preset.

```
START
WAIT
```

During this time, the display-manipulation keys and mouse are active so the spectrum can be studied while data collection takes place.

Now move the spectrum from the MCS to the buffer, and select the buffer for the computational step.

```
FILL_BUFFER
SET_MCS 0
```

In the next step, the peak of interest is being marked by reading in an .ROI file. This .ROI file has been previously defined by looking at the spectrum and marking the peak (or the region around the peak). These ROI data are saved on the disk under the name PEAK.ROI. This .JOB file will work on different peaks just by changing the ROI file.

```
RECALL_ROI "PEAK.ROI"
```

The peak areas of the marked peak or peaks is printed on the printer by this command.

```
REPORT "PRN"
```

This gives a list of the peak areas for the marked peak. If the library (LIB.MCS) has a peak near this peak, the peak identity will also be printed.

The set of instructions, as written so far, will only collect data and report once. There are two ways to make the process repeat itself for a series of samples. The first and hardest is to write one set of the above instructions for every sample in the series. A much more efficient way is to use the LOOP command. To use this, put LOOP before CLEAR and END_LOOP after REPORT. The whole .JOB file now looks like this:

```
SET_MCS 1
SET_DWELL_TIME 1e-6
SET_PASS_LENGTH 7500
```

```
SET_PRESET_PASS 1000
LOOP 10
    CLEAR
    START
    WAIT
    FILL_BUFFER
    SET_MCS 0
    RECALL_ROI "PEAK.ROI"
    REPORT "PRN"
    SET_MCS 1
END_LOOP
```

Note that an additional SET_MCS 1 has been inserted after REPORT, *so the loop will operate on the desired MCS*.

This file is included on the MCS-32 CD-ROM under the name SAMPLE.JOB. If a typical installation was performed, this file will be located in c:\User.

Now select **Services**/**Job Control**. Click once on an existing .JOB filename then click the **Edit File** button. This will display the contents of that file in Windows Notepad. You could *overwrite* the existing instructions with the above set of commands by saving the above commands to the .JOB filename you just selected in the dialog. Instead, though, save these new instructions to a new file named SAMPDATA.JOB using the **File**/**Save As** function (do not use **Save** or the original file will be lost).

This new .JOB file can then be executed in MCS-32 from the **Services** menu by selecting **Job Control...** to display the **Run JOB File** dialog. Select SAMPDATA.JOB from the list of files and click **Open**.

8.1.1. Improving the JOB

This .JOB file can be improved by adding a save step for each spectrum collected. This is done by inserting the SAVE command in the .JOB file. The spectrum sample description is also entered here. This sample description is saved with the spectrum and is printed by the REPORT command. Note that the loop counter (the ??? in the .JOB file text) is used in the SAVE and DESCRIBE_SAMPLE commands.

The new SAMPDATA.JOB file is:

```
SET_MCS 1
SET_DWELL_TIME 1e-6
SET_PASS_LENGTH 7500
SET_PRESET_PASS 1000
```

```
LOOP 10
        CLEAR
        START
        WAIT
        FILL_BUFFER
        SET_MCS 0
        DESCRIBE_SAMPLE "This is sample ???."
        SAVE "PEAK???.MCS"
        RECALL_ROI "PEAK.ROI"
        REPORT "PRN"
        SET_MCS 1
END_LOOP
```

Spooling the report may take some time. To overlap the data collection with the analysis, the logic of the .JOB file needs to be modified to restart the acquisition after the data have been moved to the buffer.

NOTE All of the analysis is performed on the buffer spectrum so the MCS spectrum can be erased and the next one started.

Insert CLEAR and START after FILL_BUFFER, as shown here:

```
SET_MCS 1
SET_DWELL_TIME 1e-6
SET_PASS_LENGTH 7500
SET_PRESET_PASS 1000
CLEAR
START
        LOOP 10
        WAIT
        FILL_BUFFER
        CLEAR
        START
        SET_MCS 0
        DESCRIBE_SAMPLE "This is sample ???"
        SAVE "PEAK???.MCS"
        RECALL_ROI "PEAK.ROI"
        REPORT "PRN"
        SET_MCS 1
END_LOOP
```

8.1.2. The RUN Command

The RUN command can be used to execute other programs. For example, if the system consists of a computer-controlled filter changer and an Easy-MCS, you can write a program that triggers the filter changer to change the filter. Following is an example of this type of JOB:

```
SET_MCS 1
SET_DWELL_TIME 2e-6
SET_PASS_LENGTH 7500
SET_PRESET_PASS 1000
CLEAR
START
LOOP 10
WAIT
        FILL_BUFFER
        CLEAR
        RUN "MOVEFILT.EXE"
        START
        SET_MCS 0
        DESCRIBE_SAMPLE "This is filter ???"
        SAVE "PEAK???.MCS"
        RECALL_ROI "PEAK.ROI"
        REPORT "PRN"
        SET_MCS 1
END_LOOP
```

Now the filter is changed before each acquisition.

Note that when an EXE program is run, the program starts but returns to the JOB before it exits. This is usually undesirable. For instance, in the preceding example, the Easy-MCS will start the acquisition *before* the filter is changed. The way around this is to add a WAIT command immediately after the RUN command:

```
RUN "MOVEFILT.EXE"
WAIT "MOVEFILT.EXE"
```

The .JOB file will now suspend execution until MOVEFILT.EXE exits.

8.1.3. Controlling MCS-32 from Other Programs

In the preceding example, MCS-32 ran another executable to control the system. A different method of operation is to run MCS-32 from another control program. In this situation, a user-written program would set up the hardware for the acquisition, then run MCS-32 with a command line that immediately starts a JOB to perform the acquisition. Using the QUIT command as the last line of the JOB would cause MCS-32 to exit at the end of the acquisition and return to the control program. For example, if you use the MAESTRO® MCA Emulator software, you might write a JOB that runs MCS-32, then returns to MAESTRO after the acquisition. See Section B.1 for information on the MCS-32 command line.

8.2. Job Commands

In the following descriptions, a variable filename or text is enclosed in "**...**" and a variable number is enclosed in <**...**>; anything enclosed in square brackets [**...**] is optional.

BEEP [<freq>, <duration>] or [<ID>] or [<String>]

This command functions for computers without a sound card (typically, legacy PCs).

Format 1: **BEEP** <freq>, <duration>

This format produces an audible tone at a pitch of <freq> Hertz, lasting for <duration> milliseconds.

Format 2: **BEEP** <ID>

This format produces a sound based on a system event. See the following table:

ID	**Event**
0	PC Speaker Beep
1	Default Windows Beep
2	Start Windows
3	Asterisk
4	Exclamation
5	Critical Stop
6	Question
7	Exit Windows

Format 3: **BEEP** <String>

This format plays a `.WAV` file or any event defined in the Windows Registry. For example, **BEEP TADA.WAV** plays the `TADA.WAV` file, and BEEP Question plays the sound associated with Question.

CLEAR

Clears (erases) the data and the pass count for the selected MCS. The presets are not changed. This command has the same function as the **Clear** function under the **Acquire** menu. The command would logically be preceded by the SET_MCS command as follows:

```
.
.
SET_MCS 1
CLEAR
.
```

CLEAR_ROI

Erases the ROIs in the buffer. The command is only valid when the buffer is selected.

DESCRIBE_HARDWARE "description"

This command accepts a 63-character description of the system. This description is saved with the spectrum using the SAVE command function, and is included in the REPORT printout. This command is only applicable in the buffer.

The loop count value can be included in any text by typing three question marks in the text where the loop count is to be inserted. The loop count replaces "???" wherever they appear.

DESCRIBE_SAMPLE "description"

Accepts a 63-character description of the sample being analyzed. This description is saved with the spectrum using the SAVE command function, and is included in the REPORT printout.

The loop count value can be included in any text by typing three question marks in the text where the loop count is to be inserted. The loop count replaces "???" wherever it appears.

ENABLE_AUTOCLR

Enables the AutoClr function of the Easy-MCS for sum-then-replace mode (see Section 6.2.5). When enabled (i.e., in sum-then-replace mode), the first pass replaces the data in memory, then additional passes are summed with the data in memory, as in sum mode.

ENABLE_DISCRIMINATOR

Enables the Discriminator Input on the MCS and disables the SCA Input. This command performs the same function as clicking "Use Disc" in the Input Control dialog box. This command fails if the buffer is selected.

ENABLE_SCA

Enables the SCA Input on the MCS and disables the Discriminator Input. This command performs the same function as clicking "Use SCA" in the Input Control dialog box. This command fails if the buffer is selected.

EXPORT "[D:\Path\]File[.Asc]"

Exports the viewed spectrum to an ASCII text file. It is valid both for the MCS and buffer. Any valid filename, including the drive and subdirectory, can be used. If the drive and subdirectory are omitted, the last subdirectory used for exporting data is used as the default. If a file extension is not provided, the default extension .Asc is appended to File. This command is identical to the **Export ASCII...** command on the **File** menu.

FILL_BUFFER

Transfers the MCS data to the buffer. This command has the same function as **MCS > Buffer** under **Acquire**. This command fails if the buffer is selected.

IMPORT "[D:\Path\]File[.Asc]"

Imports the ASCII text file into the buffer. Any valid filename, including the drive and subdirectory, can be used. If the drive and subdirectory are omitted, the last directory used for importing data is used as the default. If a file extension is not provided, the default extension .Asc is appended to File. This command is identical to the **Import ASCII...** command on the **File** menu. This command fails if the buffer is selected.

LOAD_LIBRARY "lib.lbr"

Loads the specified library, and duplicates the function of **Library...** under the **Services** menu.

LOOP <repetitions> **... END_LOOP**

This command pair executes multiple times all the commands between LOOP and END_LOOP. The number of execution times is specified by <repetitions>. Each command must be given on a separate line. A value of zero or a LOOP with no END_LOOP statement executes once.

The loop count value can be included in any text by typing three question marks in the text where the loop count is to be inserted. The loop count replaces "???" the first time the question marks appear. Spaces should be included only in the text and not in the filename. Filenames with spaces cannot easily be used by DOS commands.

The following is an example:

```
SET_MCS 1
SET_PRESET_PASS 20
LOOP 3
    SET_MCS 1
    CLEAR
    START
    WAIT
    FILL_BUFFER
    SET_MCS 0
    SAVE "TEST???.MCS"
END_LOOP
```

The above commands run three 20-pass acquisitions and store the data on a disk in TEST001.MCS, TEST002.MCS and TEST003.MCS.

NORMALIZE

Normalizes the data in the buffer by dividing the data in each channel by the pass count. If the buffer is not selected, this command fails. This command has the same function as **Normalize** in the **Calculate** menu.

PRINT_DATA “[D:\Path\]File[.Rpt]” or “PRN” [0/1]

Executes the **Print...** command under the **File** menu. The output can be printed to the printer (PRN) or saved to a disk file, which can be used by other programs or printed later. Any valid filename, including the drive and subdirectory, can be used. If the drive and subdirectory are omitted, the last subdirectory used for report files is the default. If a file extension is not provided, the default extension .Rpt is appended to File.

The loop count value may be used in the file name by typing three question marks “???” in the text where the loop count is to be inserted. The loop count replaces the “???” in the file name.

An optional argument is provided to enable or disable the Data Only feature of the command. If absent, a standard report is generated. If equal to “1", the Data Only format of the command is generated. If equal to “0", the standard format is generated.

QUIT

Unconditionally terminates MCS-32 and returns control to Windows.

RECALL “file.mcs”

Reads a disk filename to the buffer. The disk file must be in the format created by SAVE. Any valid filename, including the drive and subdirectory, can be used. If the file has calibration information, the calibration parameters are used to set the calibration for the buffer. This command has the same function as **Recall File...** under the **File** menu. If the buffer is not selected, this command fails.

The loop count value can be included in the above filename, as in any text, by typing three question marks in the text where the loop count is to be inserted. The loop count replaces “???” wherever they appear.

RECALL_CALIBRATION “file.mcs” or “file.set”

Loads the calibration parameters from the calibration data stored with a spectrum if an “.mcs” file is supplied, or the calibration from the settings file if a “.set” file is specified.

This command can be used in generating reports that include library peak identification. See the RECALL_ROI command for an example of such a `.JOB` file.

RECALL_ROI "file.roi"

Marks the ROI channels in the buffer to conform to the table in the disk file, created by SAVE_ROI or **Save ROI As...** under the **ROI** menu. The data contents of the buffer are not changed by this operation. The previous ROIs are cleared.

This command has the same function as **Recall ROI...** under **ROI**. This command fails if the buffer is not selected.

This command can be used in generating reports that look for specific peaks. For example, a calibration spectrum containing known peaks is run, the spectrum is calibrated, and the peaks are marked with ROIs. The calibration is saved as spectrum file STANDARD.MCS and as ROI file STANDARD.ROI. The command sequence is:

```
.
.
RECALL_CALIBRATION "STANDARD.MCS"
RECALL_ROI "STANDARD.ROI"
REPORT "STANDARD.RPT"
.
.
```

These commands report the values only for the peaks that were marked in the calibration spectrum.

As usual, the loop count value can be included in any text by typing three question marks in the text where the loop count is to be inserted.

RECALL_SETTINGS "file.set"

Reads the settings from a disk filename and applies them to the selected MCS or buffer. The disk file must be in the format created by **File/Save Settings As...**. Any valid filename, including the drive and subdirectory, can be used.

This command has the same function as **File/Recall Settings**.

The loop count value can be included in the above filename, as in any text, by typing three question marks in the text where the loop count is to be inserted. The loop count replaces "???" wherever they appear.

REM [Text]

This line is a comment (remark), and is ignored during command processing. The REM command allows you to enter descriptive comments into .JOB files or temporarily disable commands while testing a .JOB file.

REPORT "filename"

Generates a paragraph-style report in the selected file. This command has the same function as **File/Report...**. See Section 6.1.4 for a description of the report format.

The output can be printed on the printer (PRN), or sent to a disk file, which can be used by other programs or printed later. The loop count value can be included in the filename by typing three question marks in the text where the loop count is to be inserted. The loop count replaces "???" in the filename.

RUN "program"

Executes an application named "program". This is typically an `.EXE` filename. Note that the program will not run to completion before returning to MCS-32 unless it is run at higher priority or the WAIT "program" command is used (see also the discussion of WAIT "program" on p. 77).

RUN_MINIMIZED "program [arguments]"

This command executes an application named "program" in a minimized window. This is typically an `.EXE` or `.PIF` filename. Note that the program will not run to completion before returning to the MCS-32 program unless it is run at higher priority or the WAIT "program" command is used.

SAVE "[d:][\path\]file[.mcs]"

This command, which has the same function as **Save As...** under the **File** menu, saves the MCS or buffer to a disk file. The disk filename (in quotation marks) can be any valid filename; the drive [d:], path [\path\] and extension [.mcs] are optional. If an extension is not supplied, the default extension is automatically `.MCS`. Also, the current drive and directory are used by default when the optional path specification is not supplied. The loop count value can be included in the filename by typing three question marks in the text where the loop count is to be inserted. The loop count replaces "???" wherever it appears.

SAVE_ROI "[d:][\path\]file[.roi]"

This command, which has the same function as **Save ROI...** under the **ROI** menu, saves in a disk file, a table of channel numbers that have the ROI set for the buffer. The contents of the spectrum are not altered by this operation. The disk filename (in quotation marks) can be any valid filename, with optional elements as described for the SAVE command. The default extension is `.ROI`. The loop count value can be included in the filename by typing three question marks in the text where the loop count is to be inserted. The loop count replaces "???" wherever it appears. This command fails if the buffer is not selected.

SEND_MESSAGE “command”

This command is used to send NIM-488 commands to the MCS. It can be used to perform any desired MCS operations. The text must be in the syntax expected by the MCS. If the response from the MCS does not end with a command-accepted message, this command will exit with error. Specific MCS commands and syntax are described in Appendix D.

Following is an example of using this command to set the date in the Easy-MCS to March 3, 2000:

```
.
.
SET_MCS 1
STOP
SEND_MESSAGE “SET_DATE 3,3,00"
.
.
```

SET_DISCRIMINATOR_EDGE <n>

If <n> is 0, the discriminator is set to rising-edge triggered. If <n> is not zero, the discriminator is set to falling-edge triggered. This command performs the same function as the **Rising/Falling** radio buttons on the Input Control dialog (**Acquire/Input Control...**). This command fails if the buffer is selected.

SET_DISCRIMINATOR <f>

Sets the discriminator level to <f> volts. The value of <f> may be a floating-point number between −1.6 V and +3.0 V. This command performs the same function as the **Discriminator** slide bar on the Input Control dialog (**Acquire/Input Control...**). This command fails if the buffer is selected.

SET_DWELL_ETHLD <f >

Sets the external dwell threshold. F can be a floating-point number between −1.6 V and 3.0 V.

SET_DWELL_EXTERNAL

Sets the dwell time to external. The SET_DWELL_TIME command switches the MCS from external to internal dwell. This command is only valid when an MCS is selected and is not acquiring data.

SET_DWELL_TIME <f>

Sets the dwell time to <f> seconds and selects internal dwell time. The value of <f> is a floating-point number that may take on any value from 5×10^{-9} to 65535. If an invalid dwell time is specified, the MCS will roundoff the value to the closest legal value. This command fails if the buffer is selected or the MCS is acquiring data.

SET_INPED <number>

Sets the input impedance. The value of <number> has only 2 valid possibilities, zero and 1. Zero sets the input impedance to 50 Ω; 1 sets the input impedance to 1 kΩ.

SET_MCS <number>

This command selects the active MCS or the buffer. The MCS number can be 1 to 8 according to the MCS configuration, or 0 for the buffer. SET_MCS without an argument is used to switch to the previously selected MCS . If an MCS that does not exist is selected, no change is made.

This command (for values 1 to 8) has the same function as **<Ctrl + F1>** through **<Ctrl + F8>**. For value 0 or no argument, this command duplicates the buffer-selection capabilities of the **MCS/Buffer** toggle under the **Display** menu, **<F4>**, **<Alt + 6>**, and the **MCS#** and **Buffer** radio buttons on the Sidebar.

SET_MODE_ACQUIRE <n>

Sets the acquire mode to Sum if <n> is 0, or to Replace if <n> is not 0. Performs the same function as the **Acq Mode** radio buttons in the Pass Control dialog (**Acquire/Pass Control...**). Valid pass lengths with ramp control enabled are 4–65536. This command fails if the buffer is selected or the MCS is acquiring data.

SET_PASS_LENGTH <n>

Sets the pass length to <n> channels. <n> can be any value from 4 to 65536. This command performs the same function as the **Pass Length** field in the Pass Control dialog (**Acquire/Pass Control...**). This command fails if the buffer is selected or the MCS is acquiring data.

SET_PRESET_PASS <n>

Sets the pass preset to <n> passes. <n> can be any value from 0 to 4,294,967,295. If 0 is specified, there is no preset. Performs the same function as the **Pass Count Preset** field in the Pass Control dialog (**Acquire/Pass Control...**). This command fails if the buffer is selected or the MCS is acquiring data.

SET_RAMP <f1>,<f2>[,<f3>]

Sets the ramp parameters. If all three values are specified, a “triangle” ramp is selected (Begin-Mid-End). The three values then specify the ramp voltage in channel 0 (<f1>), the middle channel of the pass (<f2>), and the last channel (<f3>). If <f3> is omitted, a “sawtooth” ramp is selected (Begin-End). In that case, <f1> is the voltage at channel 0 and <f2> is the voltage in the last channel. See the Ramp Control dialog box (**Acquire/Ramp Control...**) for more information. This command fails if the buffer is selected or the MCS is acquiring data.

SET_SCA_LOWER <f>

Sets the SCA lower-level discriminator voltage to <f> volts. <f> is a floating-point number that may take on values from 0 to 10. If an invalid value is specified, the MCS rounds off to the nearest legal value. This command performs the same function as the **Lower** slide bar on the Input Control dialog (**Acquire/Input Control...**). This command fails if the buffer is selected.

SET_SCA_UPPER <f>

Sets the SCA upper-level discriminator voltage to <f> volts. <f> is a floating-point number that may take on values from 0 to 10. If an invalid value is specified, the MCS rounds off to the nearest legal value. This command performs the same function as the **Upper** SCA slide bar on the Input Control dialog (**Acquire/Input Control...**). This command fails if the buffer is selected.

SET_TRIGGER <n>

Sets the trigger to Internal if <n> is 0, and to External if <n> is not 0. This command fails if the buffer is selected, or the MCS is acquiring data.

SMOOTH

Smooths the data in the buffer using a five-point, area-preserving, binomial smoothing algorithm. Its function is the same as **Smooth** under the **Calculate** menu. The original contents of the buffer are lost. This command fails if the buffer is not selected.

START

Initiates data collection in the selected MCS. This function is the same as **Start** under the **Acquire** menu. This command fails if the buffer is selected.

STOP

Stops data collection in the selected MCS at the end of the current pass. To stop before the end of the current pass, issue this command twice. If the MCS has already been stopped, STOP has no effect. This command has the same function as **Stop** under the **Acquire** menu. It fails if the buffer is selected.

STRIP <factor>,"file.mcs"

Strips the disk spectrum from the spectrum in the buffer, and stores the results in the buffer. The disk and buffer spectra must be the same size. The disk spectrum can be scaled up or down by <factor> (a constant) or, if <factor> is zero, by the ratio of the pass counts of the two spectra. This command fails if the buffer is not selected.

WAIT [<seconds>]

Suspends execution of the JOB to wait until either the active MCS stops counting (in the case where the <seconds> argument is not included), or for a fixed number of seconds (which can be fractional). Note that the “wait for end of acquisition” form of the command (i.e., no argument) suspends the JOB indefinitely if there is no pass preset that can be satisfied (i.e., if acquisition proceeds indefinitely).

WAIT “program”

Suspends execution of the JOB to wait until the named program stops execution. If the program does not stop, the JOB does not continue.

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9. LIBRARY FILES

Library files are used to provide names for specific features (usually peaks) in the spectra. Library files have a very simple format consisting of a series of text lines, terminated by carriage returns, specifying one peak per line in the following format:

<Calibrated Value> <Name> <Factor>

where **<Calibrated Value>** is the location of the peak in the appropriate calibration units, **<Name>** is the name of the peak (it must be no more than 8 characters), and **<Factor>** is a real number used to obtain a corrected net area in the Report function (use a Factor of 1.0 for no correction).

All fields on each line are separated by spaces or tabs. Extra spaces and tabs are ignored. Since spaces are used to separate the items, spaces are not allowed in the Name; however, all other characters are legal. An underscore (_) is a good substitute for a space.

The text file can be created by any programming text (i.e., ASCII) editor that does not put special codes in the text (for example, Windows Notepad). The following is an example of a short library file:

```
  14.4100 ABC-123    1.0
  31.8171 BCD-234    1.0
  32.1936 CDE-345    1.0
  36.4000 DEF-456    1.0
 122.0630 EFG-567    1.0
 136.4760 FGH-678    1.0
 661.6600 GHI-789    1.0
 802.0000 HIJ-890    1.0
1173.2370 IJK-901    1.0
1332.5010 JKL-012    1.0
2616.0000 KLM-123    1.0
```

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APPENDIX A. SPECIFICATIONS

A.1. Performance

Maximum Counting Rate 150 MHz at the IN connector; 1 MHz at the SCA IN connector.

Discriminator Thresholds (IN and CHN ADV IN) Software controlled and variable from −1.6 V to +3 V in 1.5 mV steps (minimum pulse amplitude 30 mV). Triggering selectable for either positive or negative slopes on the fast analog signal IN connector. The external channel advance input triggers only on a positive slope.

SCA IN Thresholds Upper and lower thresholds independently selectable via the computer from 0 V to +10 V with 12-bit resolution.

Dwell Time

- **Internal Clock** Dwell time per channel is computer selectable from the following ranges, with accuracy within ±100 ppm over the operating temperature range:
  100 ns to 1.3 ms in 20 ns steps
  1.3 ms to 1.3 s in 20 μs steps
  1.3 s to 1300 s in 20 ms steps

- **External Clock Input** The external channel advance input (CHN ADV IN) determines the dwell time. The minimum external dwell time is 100 ns per channel.

Channel-Width Uniformity Systematic dwell-time variations over the entire pass length are <0.1% for the worst case of 100 ns dwell time.

Pass Length The number of time bins (channels) in a single pass is computer selectable from 4 to 65,536.

Pass Preset The instrument can be programmed to stop data acquisition after a preset number of scans. The Pass Preset can be selected from 1 to 4,294,967,295, or turned OFF.

Memory Capacity 1,073,741,823 counts/channel (30 bits).

Acquisition Modes

- **Sum** The data set from each pass is added to the sum of the data sets from the previous passes.

- **Replace** The data set from the current pass replaces the data set from the previous pass.

- **Replace/Sum** Data acquisition operates in the Replace mode on the first pass, and then switches to the Sum mode for subsequent passes. This eliminates the need to clear memory between acquisitions, and reduces the end-of-acquisition dead time when alternating data acquisition between two units of the Easy-MCS.

Maximum Counts/Channel in a Single Pass 1,073,741,823 counts.

Dead Time Between Channels There is no dead time between channels, i.e., no counts are lost at the time of channel advance. The event is always counted in exactly one of the two adjacent channels.

End-of-Pass Dead Time There is no dead time between passes during an acquisition.

Ramp Output Linear ramps with “begin”, “mid”, and “end-of-pass” voltages computer selectable from 0 to +10 V with 16-bit resolution, and a 2 μs settling time.

A.2. Inputs and Outputs

All inputs and outputs except the fast negative analog NIM IN re supplied on the 25-pin D connector on the front panel. Detailed information on the inputs and outputs are supplied in Sections 2.1.1 and 2.1.2, respectively.

We strongly recommend you use an MCS-PCI-OPT2 Fan-Out Cable to convert this connector into BNC connectors. However, for those special applications that require a custom cable, the connector pin outs are shown in Fig. 60.

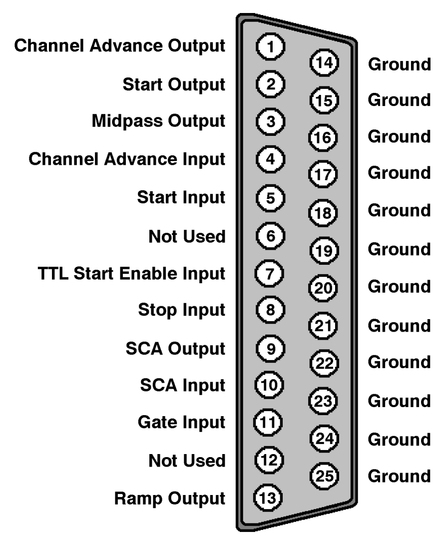

Fig. 60. Pin Outs.

A.3. Electrical and Mechanical

Dimensions 3.5 cm H × 13.4 cm W × 20.5 cm D (1.4 in. × 5.3 in. × 8.1 in.)

Weight 0.52 kg (1.13 lb).

Operating Temperature 0°C to 50°C (32°F to 122°F); 10% to 90% relative humidity, non-condensing.

CE Conforms to CE standards for radiated and conducted emissions, susceptibility, and low-voltage power directives.

A.4. Computer Controls and Indicators

The following controls and indicators are provided by the MCS-32 operating software.

A.4.1. Sidebar Controls

The Sidebar (feature 6 in Fig. 10) contains controls for data acquisition and spectrum viewing.

Data Acquisition Controls

- **Start** Displayed button starts data acquisition in synchronization with the next internal clock pulse.
- **Stop** A single click on the displayed button stops data acquisition at the end of the current pass. A second click stops data acquisition immediately.
- **Clear** Displayed button clears the data and the pass count for the spectrum currently being viewed (Buffer or MCS memory).
- **Pass** Displays the number of the current pass or scan (1 to 4,294,967,295)
- **Preset** Displays the preset pass number that will terminate data acquisition.
- **Channel** Displays the channel number into which counts are currently accumulating, starting with channel 0.
- **Pass Length** Displays the number of channels selected for the pass length.
- **Dwell** Displays the selected dwell time per channel.

Spectrum Display Controls

- **MCS#** Selects the number of the MCS for viewing the spectrum in that unit's memory, either during or after an acquisition. The software supports up to 8 units of the Easy-MCS in one computer.
- **Buffer** Displayed button selects the buffer memory in the computer for viewing the previous spectrum while the MCS is collecting the next spectrum.

- **Horiz** Indicates the number of channels viewed in the larger, expanded spectrum, and the width of the window in the small full-scale spectrum display. Displayed arrow buttons permit expansion or contraction.

- **Vert** Indicates the maximum number of counts in the vertical scale currently selected for the large, expanded spectrum. Displayed arrow buttons permit scale changes.

- **Log** Displayed button selects a logarithmic vertical scale for the large, expanded display.

- **Lin** Displayed button selects a linear vertical scale for the large, expanded display.

- **Auto** Displayed button automatically adjusts the vertical scale and centers the window around the marker in the large display for optimum viewing of the spectrum.

- **Marker** The vertical line can be dragged left or right in the display by the mouse. The vertical coordinate of the data (counts) at the marker position is displayed to the right of center under the large spectrum. The horizontal coordinate is displayed to the left of center under the spectrum. The horizontal scale is expressed in time, channel number (Chan), or any units selected during calibration of the horizontal scale. The marker can be used to mark regions of interest (ROIs), and to read out peak centroids and gross or net peak areas within each ROI.

A.4.2. Input Control

Use SCA Input Displayed button enables use of the SCA input. See SCA and SCA IN.

Use Disc Input Displayed button enables use of the fast discriminator input. See Discriminator and IN.

SCA: Lower, Upper Two displayed slide bars permit independent selection of the SCA lower- and upper-level thresholds from 0 to +10 V in 4096 steps. See SCA IN.

Discriminator Displayed slide bar selects the Discriminator threshold from −1.6 V to +3 V in 1.5 mV steps for the IN connector. Two displayed buttons select counting of the discriminator crossing on either the Rising Edge (positive slope) or the Falling Edge (negative slope). Two displayed buttons select input impedance: 50 Ω or 1 kΩ. See IN.

A.4.3. SCA Sweep Control

This control provides an efficient method for choosing the optimum SCA settings without resorting to an oscilloscope. An SCA window (with a width of 19.5 mV between upper and lower levels) is swept from 0 to +10 V as the MCS scans through a pass length of 512 channels. The resulting histogram displays the pulse-height spectrum presented at the SCA Input. By using the cursor to mark a region over the feature of interest in the spectrum and clicking the mouse on the Set SCA button, the SCA levels are automatically set at the upper and lower limits of the selected region. This is a quick and accurate method for setting up the SCA for a conventional MCS scan. A single pulse height scan lasts 5 to 20 seconds, depending on the speed of the computer. To improve the counting statistics in the histogram, scans are automatically repeated until the acquisition is stopped, or the SCA levels are set.

A.4.4. Pass Control

Acq Mode: Sum, Replace, Rep/Sum The alternatives for data acquisition are selected via three displayed buttons. See *Acquisition Modes* in Section A.1.

Trigger: Internal, External Two displayed buttons control whether the Start Output from the MCS will trigger the external instruments for the start of each scan (Internal Trigger), or a Start Input from the external instruments will start each scan (External Trigger).

Pass Length Data entry box, with up/down arrows for adjustment, selects the number of channels in a single pass (scan) from 4 to 65,536 with ramp output active or inactive.

Pass Count Preset Data entry box, with up/down arrows for adjustment, selects the number of passes that will be executed before data acquisition automatically stops. Selectable from 1 to 4,294,967,295 passes. or OFF to disable.

Dwell Two displayed buttons permit selection of the **Internal** dwell-time clock or an **External** channel advance input. The **Bin Width** data entry box provides selection of a range of internal dwell times. See *Dwell Time* in Section A.1. A data entry box permits adjustment of the external channel advance input **Threshold** from –1.6 to +3 V in 1.5 mV steps (minimum pulse amplitude 30 mV).

A.4.5. Ramp Control

Style: Begin-End, Begin-Mid-End Two displayed buttons select either a single-segment ramp or a two-segment ramp. The single-segment ramp moves linearly from the specified starting voltage at the beginning of each pass to the specified ending voltage at the completion of each pass. The two-segment ramp makes a linear transition from the specified starting voltage at the beginning of the pass to a specified Mid voltage at the mid-point of the pass. It makes another linear transition from the mid-point voltage to the specified ending voltage at the completion of the pass.

Begin, Mid, End Three displayed slide bars select the begin-, mid-, and end-point ramp voltages from 0 V to +10 V with 16-bit resolution.

A.4.6. MCS-32 Menus

Many of these functions are also accessible from the toolbar, the Sidebar, and the spectrum window context menu.

File Allows saving and recalling of spectrum data files to/from the computer disk. Permits comparison of a spectrum on disk with a spectrum in the Buffer memory. Allows saving and recalling the instrument settings. Selects regions of the spectrum for printing. Creates reports describing acquisition conditions and the contents of all ROIs for printing or filing on disk. Includes the functions for exporting or importing the data in ASCII format.

Acquire Offers menu selection of the Start, Stop, and Clear controls, live adjustment of the thresholds, and selection of the MCS or Buffer memory. Provides access to the SCA Sweep mode and the display panels for Pass Control, Input Control, and Ramp Control.

Calculate Includes an automated peak search, and offers calculation of the centroid, gross area, and net area of a peak within boundaries selected by the marker. Provides Sum, Smooth, Strip, and Normalize operations on the spectrum. Implements linear, quadratic, or cubic calibration of the horizontal scale in user-defined units via least-squares fitting. Allows subtraction of a flat background to extract small peaks from a high background.

Services Provides menu access to user-defined Job programs, the Library Files for peak identification, and the Sample Description.

ROI Provides menu access to recalling, saving, marking, and unmarking regions of interest (ROIs).

Display Offers menu selection of all the functions listed under **View**. Allows coloring of the ROI areas and/or the entire spectrum. Provides selection of the colors used for the various features in the displays. Toggles marker information display between calibrated units and time units (in internal dwell mode) or channels (in external dwell mode). Displays or hides grid lines in the expanded display.

A.5. Optional and Related Equipment

MCS-PCI-OPT2 Fan-Out Cable This cable converts the 25-pin D connector on the Easy-MCS into a separate BNC cable connection for each input and output signal. This option is strongly recommended.

A11-B32 CONNECTIONS Programmer's Toolkit with ActiveX® Controls Write you own special software to control the Easy-MCS from LabVIEW, Visual C++, or Visual Basic.

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APPENDIX B. MCS-32 COMMAND LINE STARTUP

From the Windows Start menu, type **mcs** in the "search programs and files" box, then click the **MCS-32** search result; or open the Windows Start menu and click **MCS-32**, then **MCS-32** (Fig. 61).

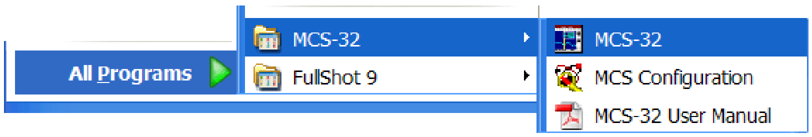

Fig. 61. Starting MCS-32.

However, you can also run it in command-line mode, with or without the arguments described below. In Windows 7, enter the command line and any arguments in the "search programs and files" box. In XP, use the **Run** dialog on the Start menu.

B.1. Command Line Options

The form of the command line for invoking MCS-32 is:

MCS32.EXE -S file.set -L file.lbr -J file.job -M m

All of the arguments are optional. When the arguments are omitted certain defaults apply for the initial configuration and library, as described below.

-S file.set	Uses file.set for the initial settings. This can include a path specification. Settings (.SET) files can be created with the **Save Settings As...** command under the **File** menu.
-L file.lbr	Pre-loads the library file.lib. This can include a path specification.
-J file.job	Begins execution of the job file.job immediately. This can include a path specification.
-M m	Selects MCS m. m can be an integer from 0 to 8. If m is 0, the buffer is selected, otherwise the MCS number which corresponds to m is selected. The default MCS is the lowest MCS present.

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APPENDIX C. FILE FORMATS

This appendix describes the file structure for the .MCS spectrum data files and the .ROI data files.

C.1. .MCS Spectral Data Files

.MCS files contain the channel-by-channel contents of the MCS in 32-bit integer format. The header is 256 bytes long and contains the following:

Byte offset	Descriptor length	Use
0	2	Must be −4
2	1	0 = Internal Trigger, otherwise External Trigger
3	1	0 = Internal Dwell, otherwise External Dwell
4	1	Dwell units (0 = µs, 1 = ms, 2 = sec, 3 = ns)
5	1	Acq Mode (0 = Replace, 1 = Sum, 2 = Replace then Sum)
6	4	913 Format Dwell (integer number of µs). Provided for compatibility with ACE-MCS (unrelated to Byte 4)
10	2	Pass Length in channels (integer, 4–65535)
12	4	Pass Count in passes (integer, 0–4294967295)
16	4	Pass Count Preset (integer, 0 = OFF; maximum = 4294967295)
20	8	Start Time (8 characters, “13:59:59")
28	8	Start Date (8 characters, “01311992")
36	2	Marker Channel (integer, 0 to Pass Length−1)
38	1	MCS number (0–255)
39	1	Calibration Type (0 = None, 1 or 2 = linear, 3 = quadratic, 4 = cubic)
40	4	Calibration units (4 characters, “amu”)
44	4	Calib. Coeff 0 — Constant term (floating point)
48	4	Calib. Coeff 1 — linear term (floating point)
52	4	External dwell threshold voltage
56	4	Reserved
60	1	Reserved
61	1	Replace-then-sum mode supported (1 = supported, 0 = not supported)
62	1	Identification Byte (Always AA Hex)
63	1	Programmable dwell threshold voltage
64	1	Detector Description Length (0–63)
65	63	Detector Description (up to 63 characters)
128	1	Sample Description Length (0–63)
129	63	Sample Description (up to 63 characters)

Byte offset	Descriptor length	Use
192	1	Linear Display Flag (0=Log, else Linear)
193	1	Linear Scale (4=16 counts, 5=32, ...,30 = 1024M)
194	2	Display Start Channel (0 to Pass Length−5)
196	2	Display Number of Channels (4 to Pass Length)
198	10	Reserved
208	1	Discriminator Select (0 = SCA, otherwise Disc)
209	1	Discriminator Edge (0 = Falling, else Rising)
210	4	Discriminator Voltage (Floating Point in Volts)
214	4	SCA Upper Level Voltage (Float. Pt. in Volts)
218	4	SCA Lower Level Voltage (Float. Pt. in Volts)
222	4	Dwell Time (Floating Point, relative to Dwell Units in Byte 4)
226	1	Settings Consistent Flag (non-zero = consistent; 0 = settings were changed between start of acquisition and saving of data)
227	13	Reserved
240	4	Calibration coefficient 2 — quadratic term (floating point)
244	4	Calibration coefficient 3 — cubic term (floating point)
248	8	MCS ID string (8 characters, “0914-001") from SHOW_VERSION command of MCS unit.

The next part of the file contains the spectrum stored as 32-bit integers. The number of integers is the pass length in channels (See byte 10 in the header). The data are written to the disk in groups of 512 channels. Therefore, the file may contain up to 2044 bytes of meaningless data at the end. If the pass length is a multiple of 512, there will be no extra data at the end of the data records.

If ROI information is saved with the data, an ROI record will be present immediately after the last block of spectral data (after the meaningless data if the pass length is not a multiple of 512). The ROI record is identical to the `.ROI` file described in the following section.

C.2. .ROI Files

This file is created by the **Save ROI As...** command, and contains a list of the start and stop channels for the ROIs in the display. The file contents are as follows:

Byte Offset	Byte Length	Use
0	2	Must be −2
2	2	Start channel number of first ROI
4	2	Stop channel number of first ROI
...		Continue for all ROIs in the display
n	2	Start channel = −1 is end of data

The Start channel number of an ROI is the first channel (starting with 0) that has the ROI set. The Stop channel number is the first channel that does not have the ROI set.

[Intentionally blank]

APPENDIX D. FIRMWARE COMMANDS AND RESPONSES

Communication with the Easy-MCS consists of sending commands to receiving responses from the MCS through the CONNECTIONS software layer. CONNECTIONS is used by all ORTEC software and is available for other software development with our CONNECTIONS Programmer's Toolkit with Microsoft® ActiveX® Controls (A11-B32). Use the DLL interface call MIOComm or the ActiveX control UCONN's Comm method to send commands to instruments and receive responses.

D.1. Command Format

The commands consist of a command header that may be followed by numeric parameter values. The header consists of a verb; a verb and noun; or a verb, noun, and modifier; each separated by underscores.

Commands consist of a command header, which may be followed by numeric parameter values. The header consists of a verb, a verb and noun, separated by an underscore; or a verb, noun, and modifier, each separated by underscores. When composing commands, the first four letters of any word are always sufficient to uniquely identify the word. For example, **ENABLE_DISCRIMINATOR** can be abbreviated to **ENAB_DISC**.

Numeric parameters are either unsigned integers or signed floating-point numbers, and follow the command header separated by one or more spaces. Some commands require multiple parameters, separated by commas, to specify numeric quantities such as pass length or dwell time. For example, the command **SET_RAMP 0,10,0** has three parameters, 0, 10 and 0, which set the ramp to a full-scale triangle.

Some parameters listed in the command dictionary are optional and are distinguished from mandatory parameters by being surrounded by brackets (e.g., **SHOW_INTEGRAL [start,length]**). Commands with optional parameters can be sent to the MCB without the optional parameters, in which case the instrument behavior is explained in the command description.

D.2. Error Codes

Upon each completion of a command, the MCB returns a macro error code and micro error code. The macro error code represents the general class of error with 0 meaning no error, and the micro error code represents the sub-class of error with 0 meaning no error. In case of error condition, you can use MIOGetLastError (DLL interface) or GetErrMajor, GetErrMinor (ActiveX control interface).

Macro error codes:

0	Success
1	Power-up just occurred
2	Battery-backed data lost
129	Command syntax error
131	Command execution error
132	Invalid Command

For macro code 129 (syntax error) or 131 (execution error), the following apply:

1	Invalid Verb
2	Invalid Noun
4	Invalid Modifier
128	Invalid first parameter
129	Invalid second parameter
130	Invalid third parameter
131	Invalid fourth parameter
132	Invalid number of parameters
133	Invalid command
134	Response buffer too small
135	Not applicable while active
136	Invalid command in this mode
137	Hardware error
138	Requested data not found

Micro error codes:

0	Success
1	Input already started/stopped
2	Preset already exceeded
4	Input not started/stopped
64	Parameter was rounded (for decimal numbers)
128	No sample data available

D.3. Dollar Response Records

SHOW commands respond with a dollar response record. The valid dollar response records for each command are discussed in the command catalog. The following list provides the general form of each dollar response record for the MCB API. In this list, lower case letters represent numeric values. The letters “ccc” always represent an 8-bit unsigned checksum of all characters on the record up to but not including the checksum characters, and <CR> represents the ASCII carriage return character.

Response	Description
$Axxxccc<CR>	**xxx** is an 8-bit unsigned number
$Cxxxxxccc<CR>	**xxxxxx** is a 16-bit unsigned number
$Dxxxxxyyyyyccc<CR>	**xxxxx** and **yyyyy** are 16-bit unsigned numbers
$Exxxxxccc<CR>	**xxxxx** is a 16-bit alarm mask
$Fssss...<CR>	**ssss...** is a variable length ASCII character sequence (no checksum is sent with this record)
$Gxxxxxxxxxxccc<CR>	**xxxxxxxxxx** is a 32-bit number
$IT<CR>	True response to a SHOW command (no checksum)
$IF<CR>	False response to a SHOW command (no checksum)
$Jxxxxxyyyyy...ccc<CR>	Response to SHOW_CONFIG command.
$Mxxxxxxxxxx...ccc<CR>	Response to SHOW_STATUS command.
$Nxxxyyyzzzccc<CR>	**xxx**, **yyy**, and **zzz** are 8-bit unsigned numbers.

D.4. Command Catalog

This section lists each Easy-MCS command with a description of its operation. The descriptions include a list of any unusual responses that may result. Though syntax and communication error responses may result from any command, in practice, these error responses rarely occur on systems with reliable communication hardware running debugged software.

The commands are listed in alphabetical order, each starting with a command prototype line. Uppercase letters, numeric digits, blank space, and special symbols such as the underscore “_” and comma 13 “,” in the prototype line are literal text to be sent to the MCB exactly as it appears. Lowercase letters in the prototype line represent numeric values as described in the accompanying text, and should not be sent literally to the MCB but should be replaced by an appropriate numeric value. In this section, the term **<CR>** represents the ASCII carriage return character, decimal value 13, and the character “**_**” represents the ASCII underscore character, decimal value 95.

CLEAR
The channels of spectral data are set to zero. The pass count is also set to zero. This command is equivalent to the combination of CLEAR_COUNTER and CLEAR_DATA commands.

CLEAR_ALL
This command is equivalent to the combination of CLEAR_COUNTER, CLEAR_DATA, and CLEAR_PRESETS commands.

CLEAR_COUNTERS
The pass count counter, and the start time and date are set to zero.

CLEAR_DATA
The channels of spectral data are set to zero.

CLEAR_PRESET
The pass count preset is set to zero (disabled).

DISABLE_ACLEAR
Disables the AutoClr function of the Easy-MCS. When disabled, the acquisition mode is set to Sum mode. See also ENABLE_ACLEAR, SHOW_ACLEAR, and ENABLE_SUMMATION.

DISABLE_DISCRIMINATOR
Disables Discriminator input and enables the SCA input. See also ENABLE_DISCRIMINATOR and SHOW_DISCRIMINATOR.

DISABLE_DWELL_EXTERNAL
Disables External Channel Advance signal and enables the internal dwell-time clock. Dwell time is set to the value it held before the ENAB_DWELL_EXT command was issued. See also ENABLE_ DWELL_EXTERNAL and SHOW_DWELL_EXTERNAL. This command is invalid when acquisition is in progress.

DISABLE_SUMMATION
Places the MCS in replace mode. In replace mode new data replaces the old data when a scan is made. In sum mode, new data is added to the old data when a new scan is made. See also SHOW_ SUMMATION and ENABLE_SUMMATION.

DISABLE_TRIGGER
Disables External Start signal and enables internal starting of passes. See also ENABLE_TRIGGER and SHOW_TRIGGER. This command is invalid when acquisition is in progress.

ENABLE_ACLEAR

Enables the AutoClr function of the Easy-MCS. When enabled, any data in memory is replaced with the new data on the first pass, then additional passes are summed as in sum mode. This is the replace-then-sum mode. See also ENABLE_ACLEAR, SHOW_ACLEAR, and ENABLE_SUMMATION.

ENABLE_DISCRIMINATOR

Enables Discriminator input and disables the SCA input. See also DISABLE_DISCRIMINATOR and SHOW_DISCRIMINATOR.

ENABLE_DWELL_EXTERNAL

Enables External Channel Advance signal and disables the internal dwell time clock. See also DISABLE_DWELL_EXTERNAL and SHOW_DWELL. This command is invalid when acquisition is in progress.

ENABLE_SUMMATION

Places the MCS in sum mode. In sum mode new data is summed with the old data when a scan is made. In replace mode, new data replaces the old data when a new scan is made. See also SHOW_SUMMATION, DISABLE_SUMMATION, DISABLE_ACLEAR, and ENABLE_ACLEAR.

ENABLE_TRIGGER

Enables External Start signal and disables internal starting of passes. See also DISABLE_TRIGGER and SHOW_TRIGGER. This command is invalid when acquisition is in progress.

INITIALIZE

Simulates a power-down/power-up cycle with loss of battery-backed-up memory. Sets the MCS as though the following commands had been issued, and also resets all internal hardware.

STOP
CLEAR_DATA
CLEAR_COUNTERS
DISABLE_DWELL_EXTERNAL
DISABLE_TRIGGER
ENABLE_DISCRIMINATOR
ENABLE_SUMMATION
ENABLE_ACLEAR
SET_DISCRIMINATOR 1.4
SET_DISCRIMINATOR_LEADING
SET_DWELL_ETHLD 1.4
SET_DWELL 1E−7

SET_LLSCA 1.2
SET_PASS_LENGTH 1000
SET_PASS_PRES 0
SET_ULSCA 6.5

RESET
Resets the MCS to the state just after power is applied.

SET_DISCRIMINATOR voltage
Sets the input discriminator threshold to the specified voltage. Voltage has a maximum value of +3.0 and a minimum value of −1.6. Legal values between +3.0 and −1.6 occur nominally every 0.0015256 volts. When an invalid value is specified, the value is rounded off to the closest legal value and a warning message is returned. See also SHOW_DISCRIMINATOR.

SET_DISCRIMINATOR_LEADING
Makes the input discriminator leading (rising) edge sensitive. After this command is issued, the counters will increment when the input crosses the threshold with a positive slope. See also SHOW_DISC_EDGE and SET_DISCRIMINATOR_TRAILING.

SET_DISCRIMINATOR_TRAILING
Makes the input discriminator trailing (falling) edge sensitive. After this command is issued, the counters will increment when the input crosses the threshold with a negative slope. See also SHOW_DISC_EDGE and SET_DISCRIMINATOR_LEADING.

SET_DWELL dwell
Sets the dwell time to the specified value. Dwell is in units of seconds and exponential notation is permitted. Dwell has a maximum value of 65535 and a minimum value of 5×10^{-9}. Legal values between the minimum and maximum values may be determined by using the VERIFY_DWELL command. The value can then be set with SET_DWELL. If an invalid value is specified, the value is rounded to the closest legal value and a warning message is returned. See also SHOW_DWELL, ENAB_DWELL_EXT and DISA_DWELL_EXT.

SET_DWELL_ETHLD voltage
Sets the external dwell threshold. The value of voltage can be a floating-point number between –1.6 V and +3.0 V. Legal values occur between these limits nominally every 0.0015256 volts. When an invalid value is specified, the value is rounded off to the closest legal value. See also SHOW_DWELL_ETHLD.

SET_INPED number
Sets the input impedance. Number has only 2 valid values, zero and 1. Zero sets the input impedance to 50 Ω; 1 sets the input impedance to 1 kΩ. See also SHOW_INPED.

SET_LLSCA voltage

Sets lower-level threshold on the SCA to the specified voltage. Voltage has a maximum value of +10 and a minimum value of 0. Legal values between +10 and 0 occur every 0.002442 volts. Use VERIFY_LLSCA to find the closest legal value to the desired voltage and then set the value with SET_LLSCA. If an invalid value is specified, the value is rounded to the closest legal value and a warning message is returned. See also SHOW_LLSCA. The LLSCA voltage should not be set above the ULSCA voltage for proper operation of the SCA.

SET_PASS value

Sets the pass count counter to the specified value. This command is invalid during acquisition.

SET_PASS_LENGTH channels

Sets the pass length to the specified number of channels. The pass length must be >3 and ≤65536. This command is invalid during acquisition.

SET_PASS_PRESET value

Sets the pass count preset to the specified value. This command is invalid during acquisition.

SET_RAMP start,[mid,]end

Programs the shape of the ramp signal that comes from the ramp option. “start”, “mid” and “end” are in units of volts. Legal values are between 0 and 10 with a step size of 0.6104 mV. Legal values can be found by using the VERIFY_RAMP command. If an invalid value is specified, it is rounded off to the closest legal value. “start” specifies the output voltage of the ramp during the first time bin, “mid” specifies the output voltage at the middle channel of the ramp, and “end” specifies the ramp voltage during the last channel of the ramp. If the pass length is even, “mid” specifies the voltage at the lower channel number closest to the middle of the pass. A straight line is drawn between the specified values to determine the settings between the start, mid, and end channels. If the pass length is even and the slope of the ramp changes sign at the middle channel, then the “mid” value occurs at both channels closest to the middle of the pass. Ramp step size will vary from channel to channel if the difference between start and mid is not a multiple of the number of channels in a half pass. A similar constraint holds between mid and end. If the “mid” parameter is omitted, then a single line is drawn from the first channel to the last channel in the pass. See also SHOW_RAMP and VERIFY_RAMP. The SET_RAMP command can be successfully executed independent of the pass length.

SET_ULSCA voltage

Sets upper-level threshold on the SCA to the specified voltage. Voltage has a maximum value of +10 and a minimum value of 0. Legal values between +10 and 0 occur every 0.002442 V. Use VERIFY_ULSCA to find the closest legal value to the desired voltage and then set the value with SET_ULSCA. If an invalid value is specified, the value is rounded to the closest legal value and a warning message is returned. See also SHOW_ULSCA. The ULSCA voltage should always be greater than the LLSCA voltage for proper operation of the SCA.

SHOW_ACTIVE

Returns a 1 if acquisition is active, or 0 if it is not active.

Responses:

$C00000087<CR>	Acquisition is not active.
$C00001088<CR>	Acquisition is active.

SHOW_ACTIVE_DEVICES

This command is provided for compatibility with existing ORTEC MCBs. In the Easy-MCS, it is identical to the SHOW_ACTIVE command.

Responses:

$C00000087<CR>	Acquisition is not active.
$C00001088<CR>	Acquisition is active.

SHOW_CHANNEL

Returns a response that indicates in which channel data are currently being acquired. The command is only valid when acquisition is started.

Responses:

$C00001088<CR>	Collecting data in channel 1.
$C01762103<CR>	Collecting data in channel 1762.

SHOW_CONFIGURATION

Returns a record that indicates the hardware configuration of the unit. The record contains information about the memory size, and the number of segments (always 1 for the Easy-MCS).

$Jaaaaabbbbbddddd00000[65 zeros here for total of 75 zeros]00000ccc

where **aaaaa** represents the number of channels in the MCS (always 65536 for the Easy-MCS), **bbbbb** is the number of segments (always 1 for the Easy-MCS), **ddddd** is the current pass length, and **ccc** represents the record checksum.

SHOW_DEVICE

There is only 1 device in the Easy-MCS, so the command always returns 1.

Responses:

$A001246<CR>	Device 1 selected.

SHOW_DISCRIMINATOR

Returns the input discriminator threshold and the status of the discriminator. If the discriminator is enabled, the header on the response will be DISC_ENA. If the discriminator is disabled, the header will be DISC_DIS. The threshold is returned as a signed, 13-digit, floating point number. See also SET_DISCRIMINATOR, and VERIFY_DISCRIMINATOR.

Responses:

DISC_ENA -0000000001.6<CR>	Disc Enabled, Threshold = −1.6 V
DISC_ENA -0001.5987793<CR>	Enabled, Threshold = −1.598779 V
...	
DISC_ENA 00002.9987793<CR>	Enabled, Threshold = 2.998779 V
DISC_ENA 00000000003.0<CR>	Enabled, Threshold = 3.0 V
DISC_DIS -0000000001.6<CR>	Disc Disabled, Threshold = −1.6 V
DISC_DIS -0002.4987793<CR>	Disabled, Threshold = −2.49878 V
...	
DISC_DIS 00002.9987793<CR>	Disabled, Threshold = 2.998779 V
DISC_DIS 00000000003.0<CR>	Disabled, Threshold = 3.0 V

SHOW_DISCRIMINATOR_EDGE

Returns the discriminator edge (leading or trailing) that is counted. See also SET_DISCRIMINATOR_TRAILING and SET_DISCRIMINATOR_LEADING.

Responses:

$FLEAD<CR>	Discriminator is leading- (rising-) edge sensitive.
$FTRAI<CR>	Discriminator is trailing- (falling-) edge sensitive.

SHOW_DWELL

Returns current dwell time setting as a 13-digit, floating point number. See also SET_DWELL, and VERIFY_DWELL.

Responses:

DWELL 0000000000000<CR>	External dwell time enabled.
DWELL 00000001e-007<CR>	Dwell time reported as 100 ns.
DWELL 00000002e-007<CR>	Dwell time reported as 200 ns.
DWELL 000002.4e-007<CR>	Dwell time reported as 240 ns.
...	
DWELL 00009.960e-006<CR>	Dwell time reported as 9.960 μs.
DWELL 00000001e-005<CR>	Dwell time reported as 10 μs.
DWELL 00001.02e-005<CR>	Dwell time reported as 10.2 μs.
...	
DWELL 00000.0099800<CR>	Dwell time reported as 9.9800 ms.
DWELL 0000000000.01<CR>	Dwell time reported as 10 ms.
DWELL 00000000.0101<CR>	Dwell time reported as 10.1 ms.
...	
DWELL 0000000004.98<CR>	Dwell time reported as 4.98 s.
DWELL 0000000000005<CR>	Dwell time reported as 5 s.

DWELL 0000000005.04<CR>	Dwell time reported as 5.04 s.
...	
DWELL 0000000002480<CR>	Dwell time reported as 2480 s.
DWELL 0000000002500<CR>	Dwell time reported as 2500 s.
DWELL 0000000002501<CR>	Dwell time reported as 2501 s.

SHOW_DWELL_ETHLD

Returns the current value of the external dwell threshold in voltage. See also SET_DWELL_ETHLD.

Responses:

ETHLD 000001.400575	External dwell threshold is currently set to 1.400575 V.

SHOW_INPED

Returns the current input impedance value. See also SET_INPED.

Responses:

$F50<CR>	Input impedance is currently set to 50 Ω.
$F1000<CR>	Input impedance is currently set to 1000 Ω.

SHOW_INTEGRAL [start_chan,number_of_chans]

Reports the sum of the specified group of spectral data channels for the currently selected device. If start_chan and number_of_chans is not provided, SHOW_INTEGRAL reports the sum of all channels.

Responses:

$G0000000000075<CR>	Integral reported as 0.
...	**...**
$G4294967294131<CR>	Integral reported as 4,294,967,294.
$G4294967295132<CR>	Integral reported at least 4,294,967,295 (maximum reportable value).

SHOW_LLSCA

Returns the lower-level threshold setting on the SCA. See also SHOW_LLSCA, and VERIFY_LLSCA.

Responses:

LLSCA 0000000000000<CR>	Lower-level report as 0 V.
LLSCA 00000.0024414<CR>	Lower-level report as 2.441 mV.
...	
LLSCA 00009.9975586<CR>	Lower-level report as 9.997559 V.
LLSCA 0000000000010<CR>	Lower-level report as 10 V.

SHOW_MODE

Responds with a record that indicates what type of acquisition the unit performs. The Easy-MCS always responds with $EZMS.

SHOW_PASS

Returns the number of passes (scans) completed in the current acquisition. See also SET_PASS and CLEAR_COUNTER. When the pass count reaches 4294967295, the counter rolls over and starts back at zero.

Responses:

$G0000000000075<CR>	Pass count reported as 0.
...	**...**
$G4294967294131<CR>	Pass count reported as 4,294,967,294.
$G4294967295132<CR>	Pass count reported as 4,294,967,295 (maximum reportable value).

SHOW_PASS_LENGTH

Returns the number of channels in the scan. See also SET_PASS_LENGTH.

Responses:

$C00004091<CR>	Pass length is 4 channels (minimum).
$C00005092<CR>	Pass length is 5 channels.
...	**...**
$C65535109<CR>	Pass length is 65535 channels (maximum).

SHOW_PASS_PRESET

Returns pass count preset setting. If the returned value is zero, then there is no pass preset. See Also SET_PASS_PRESET and CLEAR_PRESETS.

Responses:

$G0000000000075<CR>	Pass count preset reported as 0 (no preset).
...	**...**
$G4294967294131<CR>	Pass count reported as 4,294,967,294.
$G4294967295132<CR>	Pass count reported as 4,294,967,295 (maximum value).

SHOW_PEAK [start_chan,number_of_chans]

This command returns the contents of the channel within the specified range with the largest number of counts. The maximum possible value is 1,073,741,824, which is the maximum number of counts that can be stored in a 30-bit channel. If the range is omitted, the entire spectrum is searched.

Responses:

$G0000000000075<CR>	Maximum count in a channel is zero.
$G0000000001076<CR>	Maximum count in a channel is 1.
...	**...**

$G1073741824110<CR>	Maximum count is 1,073,741,824.
$G1073741824111<CR>	Maximum count is 1,073,741,824.

SHOW_PEAK_CHANNEL [start_chan,number_of_chans]

This command returns the number of the channel within the specified range with the largest number of counts. The lowest number channel with the largest count is reported if more than one channel contains the largest number of counts. Channel 65536 is the highest numbered channel. If the range is omitted, the entire spectrum is searched.

Responses:

$C00000087<CR>	Maximum count was found in channel 0.
$C00001088<CR>	Maximum count was found in channel 1.
...	**...**
$C65534107<CR>	Maximum count was found in channel 65534.
$C65535108<CR>	Maximum count was found in channel 65535.

SHOW_RAMP

This command reports the current ramp option setting. The commands responds with a data record containing an ASCII header and two or three floating point values. The header specifies whether the ramp is in two-point or three-point mode. When in two-point mode, only two floating point values are returned, while three floating point values are returned in three-point mode. In three-point mode, the first floating point value specifies the ramp voltage at channel 0, the second value specifies the ramp voltage at the middle channel of the pass (the lower-middle channel for even pass lengths), and the third value specifies the ramp voltage at the final channel of the pass. A straight line is drawn between channel 0 and the middle channel, and the middle channel and the ending channel. There are a maximum of 65,536 unique settings for the ramp. In two-point mode, values are returned for the first and last channel in the pass, and a straight line is drawn between them. If the custom ramp mode is selected, no data record is returned.

Example Responses:

RAMP_3 000000000000 00009.9993896 000000000000<CR>

Ramp starts at 0 V, peaks at the middle channel at 9.99939 V, ends at 0 V.

RAMP_3 00009.9993896 000000000000 00009.9993896<CR>

Ramp starts at 9.9939 V, reaches a minimum of 0 V at the middle channel, returns to 9.9939 V in last channel.

RAMP_2 000000000000 00009.9993896<CR>

Ramp starts at 0 V, and peaks at the last channel at 9.99939 V.

SHOW_SEGMENT

Always returns 1 on an Easy-MCS.

Responses:

$A001246<CR>	Segment 1 selected.

SHOW_SNUM

Returns the serial number of the Easy-MCS.

Responses:

$F0022	The serial number of the current device is 22.

SHOW_STATUS

Returns system status information in the following format:

$Mxxxxxxxxxxyyyyyyyyyyzzzzzwwwwwccc

where **xxxxxxxxxx** is the pass count as returned by SHOW_PASS command; **yyyyyyyyyy** is the current channel as returned by SHOW_CHANNEL; **zzzzz** is the active device mask as returned by SHOW_ACTIVE; **wwwww** is a status word with the following bits definitions: 0 = Acquisition is stopping at end of pass due to STOP, and 1 = Settings are consistent with data; and **ccc** is the checksum.

SHOW_SUMMATION

Indicates whether the unit is in sum mode or replace mode. If in sum mode, new data are summed with the old data when a scan is made. If in replace mode, new data replaces the old data when a new scan is made. See also ENAB_SUMMATION and DISABLE_SUMMATION.

Responses:

$FSUM<CR>	New data is summed with old data.
$FREP<CR>	New data replaces old data.

SHOW_TRIGGER

Reports if the external start signal is enabled or disabled. See also ENABLE_TRIGGER and DISABLE_TRIGGER.

Responses:

$IF<CR>	External start is disabled.
$IT<CR>	External start is enabled.

SHOW_ULSCA

Returns the upper-level threshold setting on the SCA. See also SHOW_LLSCA, and VERIFY_ULSCA.

Responses:

ULSCA 000000000000<CR>	Upper-level report as 0 V.
ULSCA 00000.002441<CR>	Upper-level report as 2.441 mV.
...	

ULSCA 00009.997559<CR>	Upper-level report as 9.997559 V.
ULSCA 000000000010<CR>	Upper-level report as 10 V.

SHOW_VERSION

Reports the Easy-MCS firmware version number in the form:

Fmmmmm-vvv<CR>

where mmmmm is a 4-character model designator and vvv is a 3-character version designator.

Example Responses:

$EZMS-002CR>	Easy-MCS firmware version 2.

START [seg-mask]

Starts the acquisition of data. The optional segment mask may be any value from 0 to 65535 but is ignored. If external start is enabled (see ENABLE_TRIGGER), the first scan will start on the first external start input after the START command is issued (see Section 2.1.1 for hardware details). If external start is disabled, the first scan starts immediately after the start command is issued.

STOP [seg-mask]

Stops the acquisition of data at the end of the current pass. The optional segment mask may be any value from 0 to 65535 but is ignored. When the STOP command is issued, the acquisition will not stop until the end of the current scan. Use the SHOW_ACTIVE command to determine when the acquisition actually stops. If you wish to stop the acquisition without completing the current scan, use the STOP command twice.

VERIFY_DWELL value[,step]

Used to determine the valid dwell-time setting closest to a specific value. The VERIFY commands allow you to test for the closest valid setting without changing the setting. The software remembers the actual setting prior to the VERIFY test and resets that original value after the test.

Example:

Command:	**VER_DWELL 230e-9**	
Response:	**DWELL 000002.4e-007<CR>**	Closest legal value to 230 ns is 240 ns.

VERIFY_LLSCA value[,step]

This command is used to determine the valid SCA lower-level setting close to a specific value. For the use and operation of a verify command, see VERIFY_DWELL.

Examples:

Command:	**VER_LLSCA 6**	
Response:	**LLSCA 00006.0009766<CR>**	Closest legal value to 6 is 6.0009766.
Command:	**VER_LLSCA -1**	
Response:	**LLSCA 000000000000<CR>**	Closest legal value to −1 is 0.

VERIFY_RAMP value[,step]

This command is used to determine the valid RAMP settings. For the use and operation of a verify command, see VERIFY_DWELL.

Examples:

Command:	**VER_RAMP 6**	
Response:	**RAMP 00005.9997558<CR>**	Closest value to 6 is 5.999756.
Command:	**VER_RAMP 11**	
Response:	**RAMP 00009.9993896<CR>**	Closest legal value to 11 is 9.99939.

VERIFY_ULSCA value[,step]

This command is used to determine the valid SCA upper-level setting close to a specific value. For the use and operation of a verify command, see VERIFY_DWELL.

Examples:

Command:	**VER_ULSCA 6**	
Response:	**ULSCA 00006.0009766<CR>**	Closest legal value to 6 is 6.000977.
Command:	**VER_ULSCA 11**	
Response:	**ULSCA 0000000000010<CR>**	Closest legal value to 11 is 10.

[Intentionally blank]

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