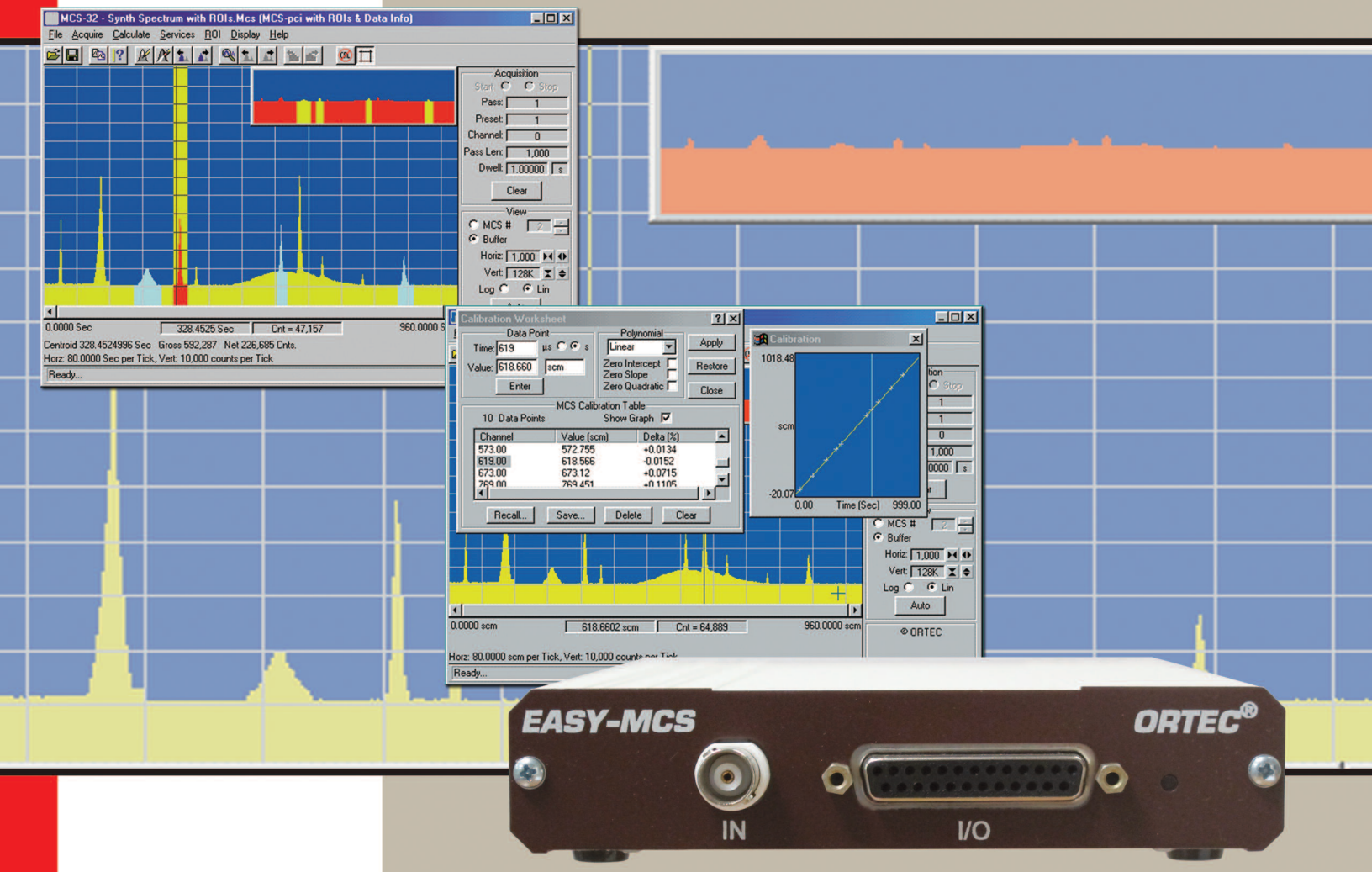
ORTEC®

EASY-MCS

Multichannel Scaler



"Profiling Counting Rates up to 150 MHz
with 15 ppm Time Resolution."

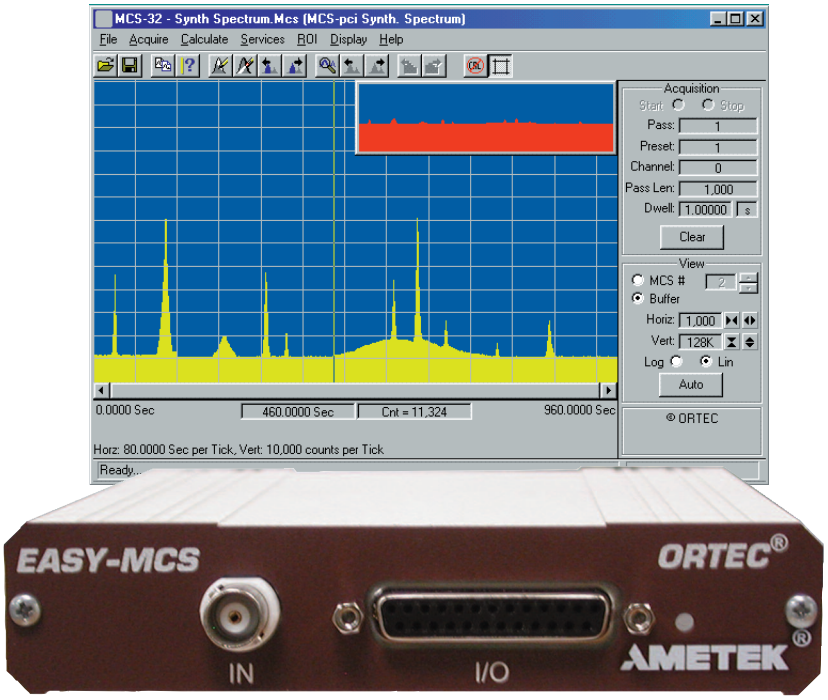
AMETEK®
ADVANCED MEASUREMENT TECHNOLOGY

EASY-MCS

The ideal solution for:

- **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 is a compact instrument with accompanying software, which when connected to your personal computer via USB 2.0 interface transforms it into a powerful and flexible Multi-Channel Scaler (MCS) or a multiple-stop time spectrometer. Powerful software operating under Windows, allows all controls and spectral manipulations to be implemented via on-screen displays. Resident memory provides access to the spectral data for display purposes, without interrupting data acquisition by the EASY-MCS. 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.



What is a Multichannel Scaler?

A Multi-Channel Scaler (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.

MAJOR FEATURES

Hardware

- 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 circumvents 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 operating, display and analysis software.
- 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 Programmer's Toolkit available for ActiveX™ programming under LabVIEW®, Visual Basic, or Visual C++.

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 ranging from 400 ns to 2.7 years can be selected.

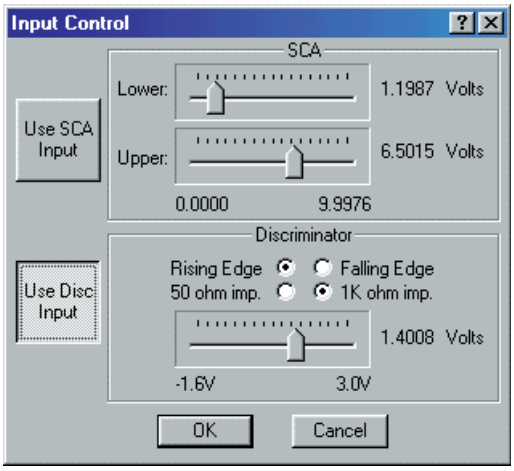
No Dead Time Between Channels, and Zero End-of-Pass Dead Time

EASY-MCS employs sophisticated digital circuits to eliminate the dead time between channels that is typically encountered in lower-performance multi-channel scalers. The result is absolutely no loss of counts and no double counting as the multichannel scaler 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

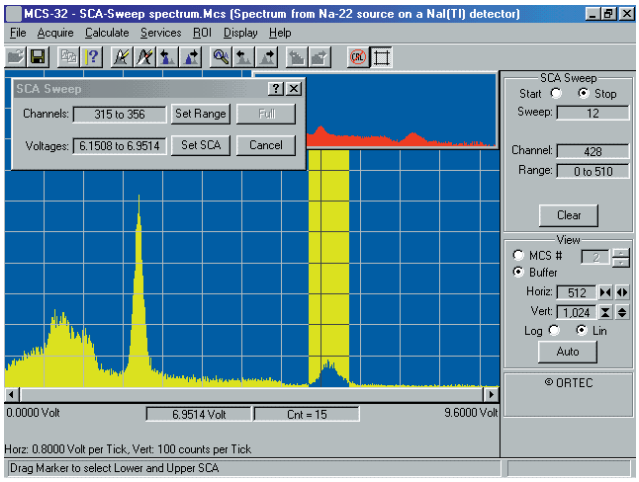
Two different types of counting inputs make the EASY-MCS adaptable to virtually any source of signals. The fast analog signal input (IN) accommodates both analog and digital signals with pulse widths >3.5 ns and counting rates up to 150 MHz. The input discriminator threshold is computer adjustable from –1.6 V to +3 V in steps of 1.5 mV (pulse must be >30 mV amplitude). 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 input. This "Single-Channel-Analyzer" input features two computer-controlled discriminators, whose thresholds can be set anywhere between 0 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 whose amplitudes are proportional to a measurement parameter, such as the number of photons in a pulse. Pulse widths from 0.5 to 100 µs can be readily accommodated.



The Power of the 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 to +10 V in 512 equal steps. In synchronism, the multichannel scaler 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 multichannel scaler 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 stops 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 is a 160-ns wide, positive TTL signal, 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.

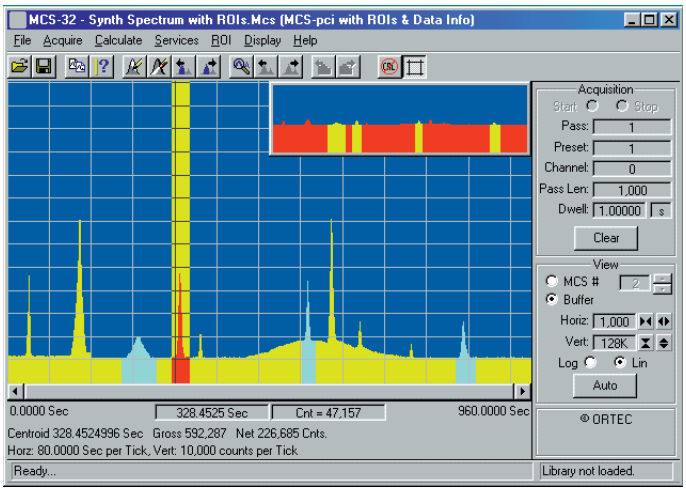
External Trigger Mode

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 (pulse must be >30 mV amplitude). 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.

Instrument Control at the Click of a Mouse

The EASY-MCS software operating under Windows, provides a powerful graphical user interface for spectral data display and for control of the instrument. All controls can be instantaneously activated on the computer display via the mouse. The most commonly used controls are always displayed alongside the spectrum. The less frequently used set-up parameters are easily accessed from drop-down menus. In addition to the quick action offered by the mouse, most controls can also be activated by keystrokes. For protection against power outages, all control settings are automatically stored on disk when the scan is started. In addition, settings can be saved in disk files, so that specific operating conditions can be recalled for later use.



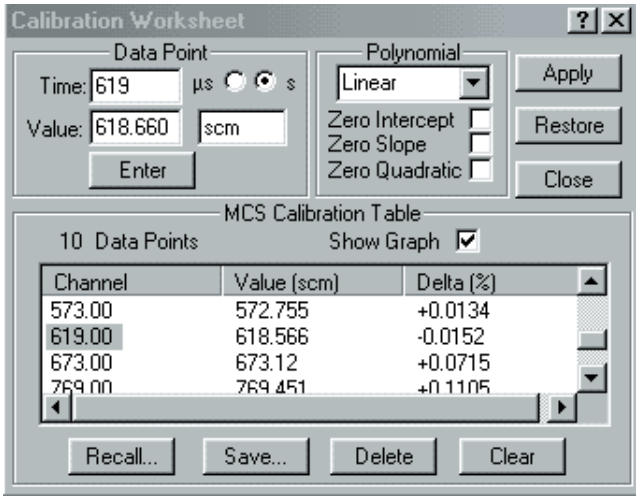
Quick Access to Multiple Spectra

An on-screen control allows the operator to view either the spectrum being acquired in the EASY-MCS dual-port memory, or a spectrum previously transferred to the buffer memory in the computer. 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 recall and examination later, or for further 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. By using the mouse pointer, a marker can be moved 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 calibration is accomplished, the operator can quickly toggle back and forth between the default and calibrated units.

The marker also serves to paint a "Region Of Interest" (ROI) on the spectrum. Typically, this is a colored region that marks the entire area under a peak in the spectrum. Single or multiple ROIs can be marked in a spectrum. Using the Data Info command under the Calculate menu, the marker can be positioned within an ROI to 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 peak.



More Options for Analysis

Further software features allow the operator 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 under the Services menu provides an easy way for the operator 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 Control.

Other software programs can activate the EASY-MCS for a specific operation by calling the EASY-MCS software with a Job file name specified on the command line. Alternatively, the A11 *CONNECTIONS* Programmer's Toolkit can be purchased and used to program the EASY-MCS at the command level. The use of ActiveX™ Controls in A11 makes programming orders-of-magnitude easier with LabVIEW®, Visual Basic, or Visual C++.

Specifications

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 (pulse must be >30 mV amplitude). 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 to +10 V with 12-bit resolution.

Dwell Time

Internal Clock Dwell time per channel is computer selectable from:
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.

Accuracy: within ±100 ppm over the operating temperature range.

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 32,768 with the ramp turned on, or up to 65,536 with the ramp turned off.

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 per 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

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.

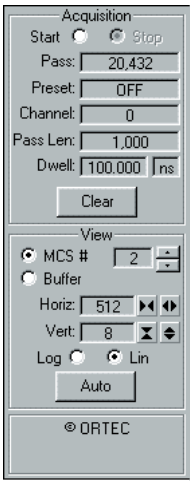
End-of-Pass Dead Time There is no dead time between passes during an acquisition.

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.

Computer Controls and Indicators

The following controls and indicators are provided as software-generated control panels or pull-down menus on the computer display. The functions are most conveniently selected and activated using a mouse, but are accessible via keystrokes.

Acquisition



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.

View

MCS# Selects the number of the MCS for viewing the spectrum in the card's memory, either during or after an acquisition. The software supports up to 8 units of the EASY-MCS. To simultaneously view multiple EASY-MCS units in a single PC the software must be opened multiple times.

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.

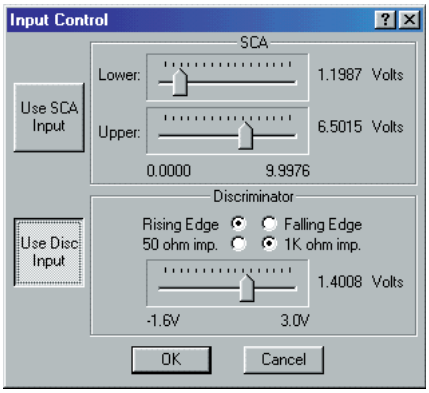
Log Displayed button selects a logarithmic vertical scale for the large, expanded display.

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 in any units selected during calibration of the horizontal scale. The marker can be used to mark regions-of-interest, and to read out peak centroids and gross or net peak areas within each region-of-interest.

Input Control



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

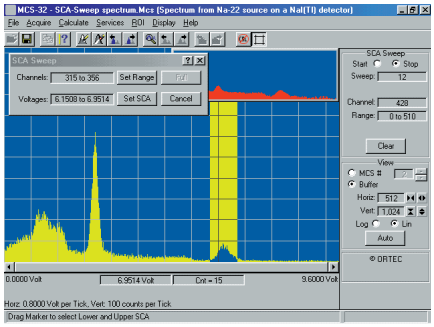
Use Disc Input Displayed button enables use of the fast discriminator input. See Discriminator and IN.

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.

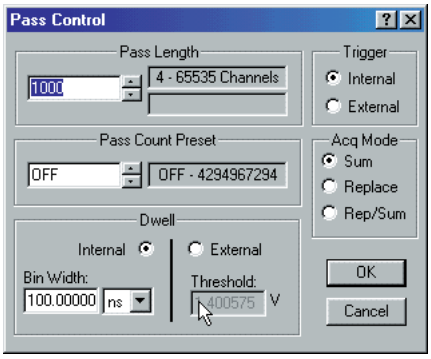
Discriminator Displayed slide bar selects the Discriminator threshold from –1.6 V to +3 V in 1.5-mV steps (pulse must be >30 mV amplitude) for the IN connector. Two displayed buttons select counting of the discriminator crossing on either the Rising Edge (positive slope) or the Falling Edge (negative slope). Two displayed buttons select input impedance: 50 Ω or 1 kΩ. See IN.

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.



Pass Control



Acq Mode: Sum, Replace, Rep/Sum The alternatives for data acquisition are selected via 3 displayed buttons. See Acquisition Modes under Performance.

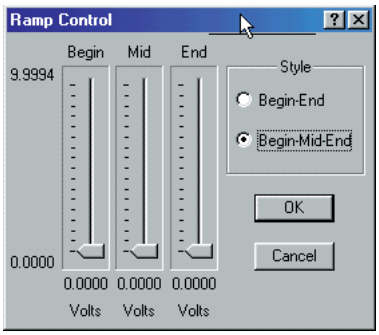
Trigger: Internal, External Two displayed buttons control whether the Start Output from the MCS will trigger the external instruments for the start of each scan (Internal Trigger), or a Start Input from the external instruments will start each scan (External Trigger).

Pass Length Data entry box, with up/down arrows for adjustment, selects the number of channels in a single pass (scan) from 4 to 32,768 (with ramp output active) or up to 65,536 (with ramp output 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 under Performance. A data entry box permits adjustment of the external channel advance input Threshold from –1.6 to +3 V in 1.5-mV steps (pulse must be >30 mV amplitude).

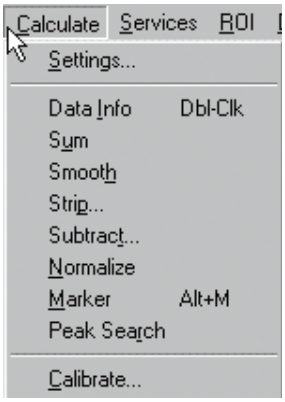
Ramp Control



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 to +10 V with 16-bit resolution.

Pull-Down Menus



Clicking the mouse on the menu titles at the top of the display generates pull-down menus that provide access to other displays and additional functions. Many of these functions are also accessible from the toolbar, the status sidebar, or by using the mouse directly on the display.

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 (ROI).

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. Selects uncalibrated versus calibrated marker readout. Displays or hides grid lines in the expanded display.

INPUTS

All inputs, except the fast analog IN are supplied on the 25-pin D connector. 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 (pulse must be >30 mV amplitude). Computer selection of either 50-Ω or 1000-Ω input impedance, dc-coupled. Minimum input pulse width is 3.5 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 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 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 0 to +2.5-V to 0 transition 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). Threshold is adjustable from –1.6 to +3 V in 1.5-mV steps (pulse must be >30 mV amplitude) via the computer. Minimum dwell time is 100 ns. Minimum pulse width is 10 ns. 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 a 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.

OUTPUTS

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

START OUT This TTL output 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 Input signal that occurs between the upper and lower discriminator thresholds. The output rises from <+0.4 V to >+2.4 V as the SCA Input 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 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.

Electrical and Mechanical

Power Requirements
The EASY-MCS is mains powered via an included power supply.

Voltage Current Power
+12 V, 250 mA, 2.5 W.

Operating Environment
Temperature: 0 to 50 °C.
Humidity: 0 to 80% non-condensing.

Dimensions
Width: 134 mm (5.25 in.)
Depth: 205 mm (8.1 in.). Includes 28.6 mm (1.13 in.) BNC connectors.
Height: 34.9 mm (1.38 in.)

Weight
Net 0.6 kg (1.3 lb.).
Shipping 2.3 kg (5 lb.).

Computer Prerequisites

IBM-compatible PC with:
One available USB port
At least 64 MB of memory
Hard drive
CD-ROM drive (software is supplied on CD)
Microsoft Windows XP/Vista (32-bit) and 7 (32- and 64-bit)

Optional and Related Equipment

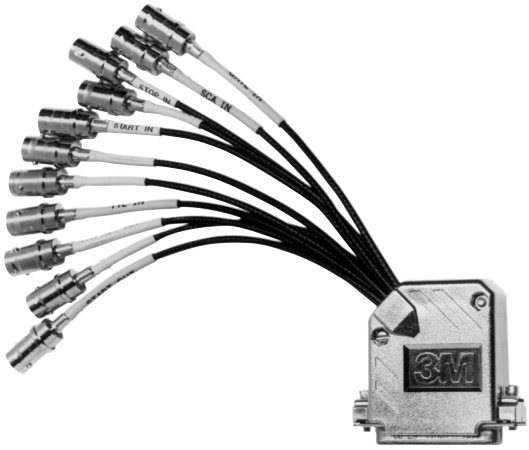
MCS-PCI-OPT2 Fan-Out Cable This cable converts the 25-pin D connector on the EASY-MCS into a separate BNC cable connection for each input and output signal. This option is strongly recommended.

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

Ordering Information

To order, specify:

Model Number	Description
EASY-MCS	EASY-MCS™ with software and documentation
MCS-PCI-OPT2	Fan-Out Cable



Specifications subject to change
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