FEATURES

- 16k data channels.
- Stores up to 128 spectra.
- Conversion time <5 µs (>200,000 cps).
- Two stage input analog pipeline.
- Sliding-scale linearization.
- Differential nonlinearity <±0.6%.
- Integral nonlinearity <±0.02%.
- Two peak detection modes: first peak after the threshold (nuclear spectroscopy) or absolute peak after the threshold (particle counter calibration in clean rooms).
- Two TTL compatible gates for coincidence and anticoincidence.
- Stand-alone data acquisition.
- Date-time stamp.
- Stored spectra protection via software security and serial ID number.
- High speed 115.2 kbps serial interface.
- Compatible with USB to RS232 adapters
- Battery life: 24 hours of continuous data acquisition from two 1.5V AA batteries.
- Dimensions: 6.5 x 2.8 x 0.8 in / 165 x 71 x 20 mm.
- Weight (including batteries): <300 g.
- Free PC software supports ROI, energy calibration, peak information, MCA configuration, and file management.

WORLD'S BEST MCA

Pocket MCA
MCA 8000A

FITS IN A SHIRT POCKET!!

The MCA8000A is a full featured, low power multichannel analyzer intended to be used with a wide variety of detector systems.

RUNS FOR 24 HOURS ON 2 AA BATTERIES

The Amptek **MCA8000A 'POCKET MCA'** is a state-of-the-art, compact, low power Multichannel Analyzer (MCA) with the high performance typically found only in much larger systems. Building on 20 years of experience in producing scientific spacecraft instrumentation, Amptek has developed specialized, high density circuitry that gives the MCA8000A a significant advantage in size and power over other MCAs. All that is needed to operate the MCA8000A is a computer with a standard RS232 serial interface or USB to RS232 adapter.

Superior performance results from a sophisticated low-power peak hold circuit (Amptek PH300) followed by a 16 bit analog to digital converter with sliding scale linearization. Spectra are accumulated in nonvolatile memory and read out by a microcontroller. Advanced power management techniques maximize battery life.

The POCKET MCA gives the performance necessary for semiconductor detectors such as HPGe, Si and CZT. At the same time, it provides the portability needed in the field. The user friendly software included with the MCA8000A allows the acquisition, display, calibration and manipulation of spectra.

Compromising nothing in performance, the MCA8000A is a low power, light weight instrument which is exceptionally versatile and easy to use. Ideal for laboratory work, OEM applications, and portable instrumentation.

PERFORMANCE CHARACTERISTICS

Pulse-Height Digitizer	Successive-approximation ADC with two stage input analog pipeline and sliding-scale linearization. Software selectable resolution: 16k, 8k, 4k, 2k, 1k, 0.5k and 0.25k channels. The sliding-scale linearization technique reduces the top end of the ADC scale by 1/32.
Pulse Processing Times	Minimum pulse peaking time is 250 ns. Acquisition time of the analog pipeline ≤ 2 µs. ADC conversion time ≤ 5 µs.

Peak Detection Modes *(See Figure 1)*	*First Peak After Threshold (V1)*	Standard to nuclear instrumentation MCAs.
	Absolute Peak Above Threshold (V2)	Typically used in airborne particle sizing analyzers, in environmental air monitoring systems and in aerosol research.

Differential Nonlinearity	$<\pm 0.6\%$ from 15 mV to full scale.
Integral Nonlinearity	$<\pm 0.02\%$ over full scale.
Gain Stability	Gain $<\pm 10$ ppm/°C.; Zero drift $<\pm 3$ ppm/°C.
Low Level Discriminator	Software selectable threshold, in increments of one channel, up to half of full range. Threshold accuracy $<\pm 0.5\%$ of full range.
Memory	Nonvolatile, 10 years data retention. The memory is segmented and can store up to 128 different spectra. The number of groups available for spectral storage depends on the ADC resolution and is given as: 32k/[ADC RESOLUTION].
Counts per Channel	Maxium $= 4.29 \times 10^9$ counts (4 bytes).
Real and Live Timers	Data acquisition real or live time preset in multiples of one second. Maximum preset time 16777215 (2^{24} - 1) seconds. Shorter or non-integer accumulation times can be achieved by gating the input signal with Gate 1 or Gate 2. Every time a data acquisition is started a start time-date stamp is stored in the current memory group.
Interface	RS232 serial, high speed 115.2 kbps. Compatible with USB to RS232 adapters. Units with SN#3660 and higher include this capability. Serial numbers below 3660 can be upgraded. Software selectable baud rate selection: 4.8 kbps, 9.6 kbps, 19.2 kbps, 38.4 kbps, 57.6 kbps, 115.2 kbps.
Security	Each MCA8000A unit is assigned a unique serial ID number that is embedded internally and is accessible through the computer software. A five digit MCA lock number can be used to lock data in the internal memory. Zero lock number disables the security feature.
Operating Temperature	0 - 70°C.

CONTROLS AND INDICATORS

ON/OFF Button	Toggles the MCA8000A power between ON and OFF.
Status Light	Steady red light: power is ON and no data acquisition in progress. Flashing red light: data acquisition mode.
Input Range Switch	Switch sets the dynamic range of analog input pulses at 0 to +5 V or 0 to +10 V.

POWER

Power is turned on either via computer using ADMCA software or with the ON/OFF button. When operating on battery power, the automatic power-off function turns the power off whenever the MCA is not acquiring data or exchanging data with a computer. If the MCA is powered via an external power adapter or the data acquisition is active while on battery power, the automatic power-off function is disabled.

Operating Power	<300 mW in data acquisition mode with active serial interface, <250 mW in data acquisition mode with inactive serial interface (stand-alone mode).
Power Sources	Two AA batteries or 9 V (200mA) AC adapter (included) 3.5 mm x 1.3 mm Female Barrel, center positive. When operating on external power via the adapter, there is no drain on or recharging of the internal batteries.
Monitor	Battery discharge monitor for alkaline and NiCad batteries.
Protection	Built-in against incorrect battery polarity.
Battery types	Any type of AA battery, including: alkaline, Lithium, rechargeable NiCad or NIMH, or any battery set with appropriate capacity and voltage range from 2 to 7 V.
Battery life (typical)	From a set of two alkaline batteries - 24 hours in stand-alone acquisition mode with inactive serial port, 16 hours in acquisition mode with active serial port.

CONNECTIONS

Input	The analog input accepts positive unipolar or bipolar semigaussian type pulses of shaping time constants ≥ 100 ns or peaking time ≥ 250 ns. The dynamic range is 0 to +5 V ($Z_{in} = 200$ kΩ) or 0 to +10 V ($Z_{in} = 2$ kΩ), selectable by the Input Range Switch. The input has overload protection up to ± 15 V. The DC level of the input signal must be zero. The minimum input signal for the specified nonlinearity is 15 mV.
Gate 1	Active HIGH TTL compatible logic gate. When this input is HIGH, the analog input pulses are gated off and the live clock is stopped. The active state of this signal must occur at or prior to the peak of the analog pulse and must extend for at least 1 µs after the peak. When not connected, this input is held inactive by an internal pull-down resistor.
Gate 2	Active LOW TTL compatible logic gate. When this input is LOW, the analog input pulses are gated off and the live clock is stopped. The active state of Gate 2 must occur at or prior to the peak of the analog pulse and must extend for at least 1 µs after the peak. When not connected, this input is kept inactive by an internal pull-up resistor.

INPUT, GATE 1, and *GATE 2* connectors are LEMO, S series receptacle, style 00, female.

Interface (I/O)	DB-9 male RS232 connector. This connector requires a null modem cable (included) to connect to a computer. See Interface under Performance Characteristics.
Power	The MCA8000A power connector mates to a center positive, 3.5 mm x 1.3 mm female barrel connector.

Note: Input must be a positive going unipolar or bipolar shaped pulse of peaking time greater than 250 ns. See Figure 4.

MECHANICAL

Weight	<300 g (including set of alkaline batteries).
Dimensions	6.5 x 2.8 x 0.8 in (165 x 71 x 20 mm).

OPERATING NOTES

HOST COMPUTER INTERFACE

The MCA8000A connects to any host computer (min. Pentium 200) via an RS232 serial interface. The baud rate is software selectable and set by the computer. Display software is included. The data exchange protocol is available to facilitate custom connections to other computer platforms.

Many new laptop/notebook computers do not have RS-232 ports. In these cases, Amptek recommends either the use of a PCMCIA RS-232 card or the use of a compatible USB to RS232 converter. The USB converter must be able to handle a full RS232 translation as the MCA8000A protocol utilizes almost all the RS232 control lines. One example of a PCMCIA card is the SSP-100 manufactured by Quatech. Amptek has verified that the Hawking H-UC232S, USB Gear USBCOM-2 (D), CableMax Transfer Series (D) USB to RS232 converters, and most Prolific chipset based converters are compatible. Amptek ships the UMC-2111 USB to RS232 converter based on the Prolific chipset.

Note: MCA8000A units SN#3660 and higher are RS232 to USB converter compatible. Serial numbers below 3660 can be upgraded.

DATA ACQUISITION

CONFIGURATION

Key parameters in the MCA8000A data acquisition configuration are the low level threshold and the data acquisition time. The low level threshold is digitally set and stored in the nonvolatile memory.

The acquisition time can be preset as either live or real, since the MCA8000A has both real and live time clocks. The live time clock adjusts for deadtime by turning off the clock whenever: a) the input signal exceeds the low level threshold, b) the analog pipeline is holding a pulse to be processed by the ADC, or c) if one or both of the MCA gates are active.

CONVERSION

The successive approximation ADC digitizes the pulse amplitude in less than 5 µs. If a second pulse arrives while another pulse is being processed, it is held by the internal peak-hold detector. The second pulse is processed after the ADC has completed digitizing the first pulse. Because of this two stage storage, the dead time following a single pulse can be as short as 2 µs. The use of the sliding scale technique maintains differential nonlinearity to better than ±0.6% over full scale.

STAND-ALONE MODE

The MCA8000A can operate in a stand-alone mode, not connected to any host computer. The MCA enters this mode after data acquisition is activated via the host computer and then the host computer is either turned off or disconnected from the MCA8000A. In this stand-alone mode, the MCA will acquire data until the preset acquisition time (real or live) is reached.

Once the spectrum is acquired, the MCA waits approximately 2 minutes for a connection with the host computer. If there is no connection attempt from the host computer, the MCA powers down with the spectrum stored in memory.

MCA8000A can store spectra in up to 128 different memory groups. Each group also stores the data acquisition parameters and the date-time stamp. All spectra can be held in the MCA8000A memory for up to 10 years. This capability is provided by low power memory backed by an internal Lithium battery.

Upon reconnecting to the host computer, the spectrum in the most recently accessed group is transferred and displayed. As a result, the MCA8000A provides easy and reliable transport of spectral data from one place to another - all that is required is a serial connection to a computer.

DISPLAY AND ACQUISITION SOFTWARE (ADMCA)

The ADMCA Software allows for data acquisition and display on any PC compatible computer, including desktops, notebooks, and palmtops. This Software supports region of interest (ROI), energy calibration, peak search, peak information, MCA8000A configuration, multiple spectra, and mathematical operations.

The ADMCA Software acquires and displays all data transmitted by the MCA8000A: spectral data; elapsed real and live time; and status parameters and flags, including battery status.

Among the primary tools in ADMCA Software is an automatic peak search routine which marks the identified peaks as ROIs. Peak counts and FWHM are automatically calculated and displayed in either channels or user-defined calibration units.

The ADMCA Software includes an isotope library and listing of atomic x-ray emission lines. The peak information panel automatically suggests the isotope or x-ray line closest to the peak. Multiple spectra can be displayed at the same time and mathematical operations can be performed on the spectra. Examples of the Windows Software are shown in Figures 2 and 3.

In order to accommodate custom applications, a complete Application Programming Interface (API) performing the functions of the MCA8000A is included. These libraries (.dll and .lib) will link directly with customer-written code to control the MCA8000A.

OPTIONAL SOFTWARE

XRF-FP Quantitative Analysis Software for X-ray Fluorescence applications. Please see our web site: http://www.amptek.com/fp.html.

OPTION PA FOR PARTICLE COUNTING

The Option PA package has been developed to facilitate the use of the MCA8000A for particle counting in airborne (Size Calibration) and liquid suspended[1] (Number Calibration) particle applications. The unit is calibrated and certified traceable to the National Institute of Standards and Technology (NIST).

The Option PA package is capable of detecting pulses of less than 5 mV to 10 V. The MCA8000A is typically connected to the output of a particle sensor. It detects and displays a spectrum of pulse heights allowing the user to determine if a given particle size is producing the correct voltage.

The software included with the MCA provides information on the peak center (centroid and mean calculation) making it easy to determine if the peak is in the correct position. The supplied calibration curves convert the MCA channel scale to a mV scale. The calibration curves can be set to load automatically when the software opens.

[1]Sommer, H.T. "IMPLEMENTING PARTICLE COUNTER CALIBRATION PER ISO 11171-1999. "; TEAM Service, Inc., P.O. Box 220, Merlin, OR 97532, (541)476-4744. HolgerTSo@aol.com; Copyright Society of Automotive Engineers
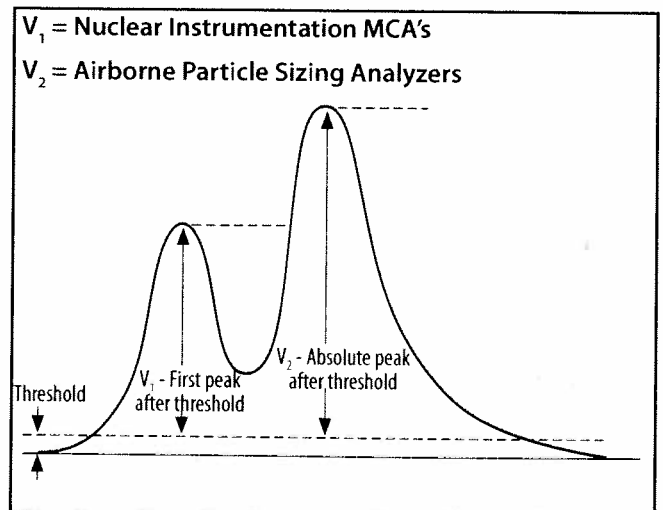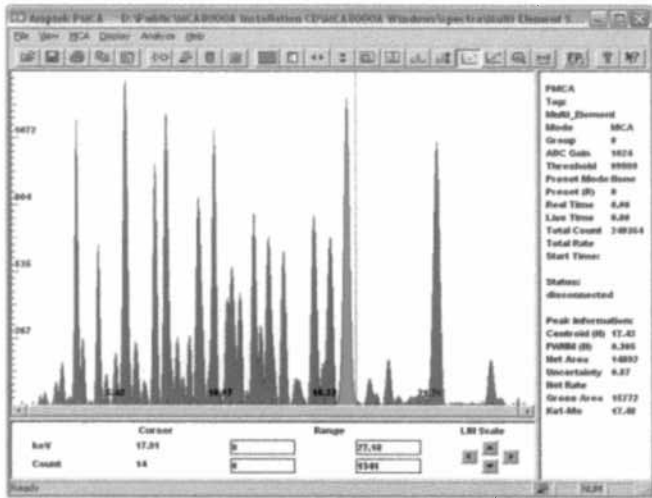

Figure 1. MCA8000A Peak Detection Modes
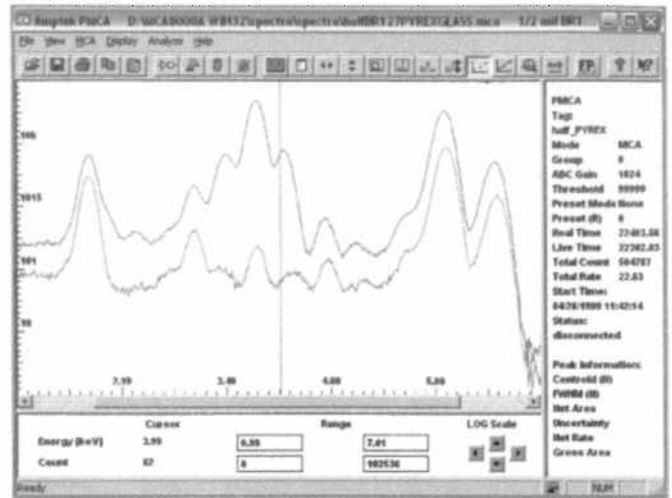
Figure 2. Example of ADMCA Software for MCA8000A

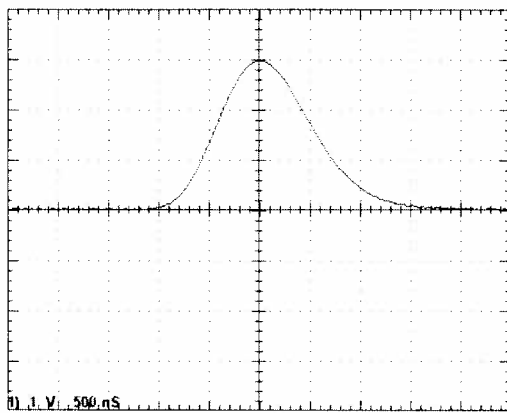*Figure 3. Example of ADMCA Software showing multiple spectra capability*

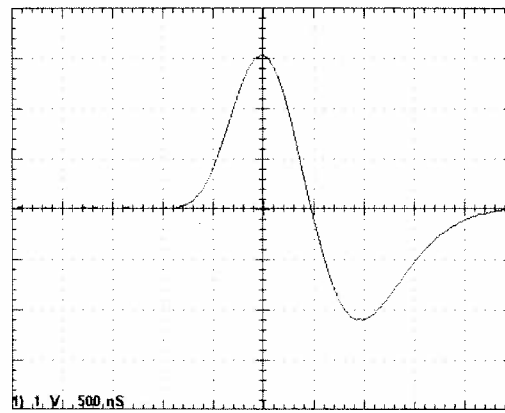*Figure 4. Example of unipolar input pulse.*

Figure 5. Example of bipolar input pulse.

MCA8000A Ordering Information

The MCA8000A is now comaptible with USB to RS232 adapters. MCA8000A units with SN# 3660 and higher include the upgrade. Units before 3660 can be upgraded. Contact Amptek for return instructions.

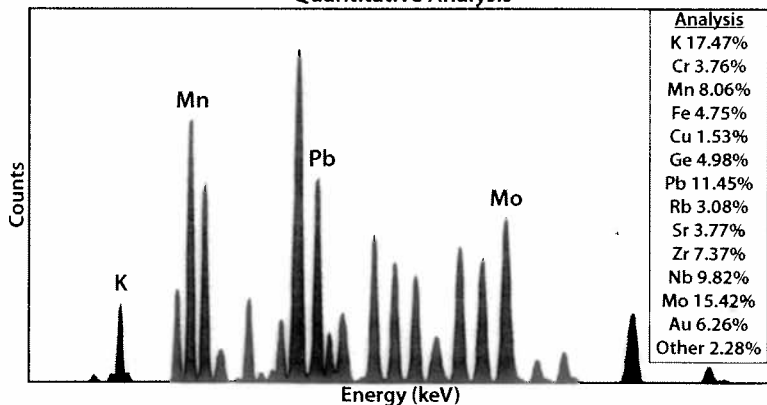### MCA8000A Basic Package - for Nuclear Instrumentation

- MCA8000A
- One AC adapter for MCA8000A
- Two Lemo to BNC signal cables (1 meter length)
- One Null Modem cable (2 meter length)
- ADMCA Display Software installation disk
- USB to RS232 converter

MCA8000A PA Package - for Airborne Particle Sizing

- MCA8000A Basic Package, plus modification to facilitate airborne particle sizing
- NIST traceable calibration
- Certificate of Calibration
- Three voltages scales: 0-0.5 V, 0-5 V, 0-10 V

XRF-FP Quantitative Analysis Software - Optional

Quantitative Analysis

Analysis
K 17.47%
Cr 3.76%
Mn 8.06%
Fe 4.75%
Cu 1.53%
Ge 4.98%
Pb 11.45%
Rb 3.08%
Sr 3.77%
Zr 7.37%
Nb 9.82%
Mo 15.42%
Au 6.26%
Other 2.28%

FEATURES

Fundamental Parameter (FP) Calculations
Analysis with or without standards
General bulk and thin-film analysis
Analyze up to 40 elements
Automode for continuous or repeated analyses
Spectrum Processing
- Spectrum calibration
- Background removal and blank subtraction
- Escape peak and sum peak removal
- Smoothing
- Deconvolution: Intensity extraction
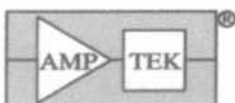
AMP TEK INC.   14 DeAngelo Drive, Bedford, MA 01730-2204 U.S.A.
Tel: +1 (781) 275-2242   *Fax:* +1 (781) 275-3470   *email:* sales@amptek.com   http://www.amptek.com
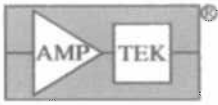
MCA8000A Software Installation Procedure

Insert the CD into your computer. Locate the ADMCA directory on the CD and copy it to your local drive (e.g. C:\ADMCA). Browse to the ADMCA directory on your drive and create a shortcut for the ADMCA.exe file (right-click and select create shortcut) and copy it to your desktop. Click on this shortcut to open the ADMCA application. If you wish to use the USB to RS232 converter you must install the driver for the converter before plugging in the adapter into your computer. The USB to RS232 converter has its own software installation disk and is also included on the Amptek CD. Put in the CD and locate the driver for your operating system. Once the driver has been installed, plug in the USB adapter. Windows will now locate and install the driver. The USB adapter acts like a virtual RS232 port. To find the Port number go to Start -> Control Panel -> System -> Device manager -> Hardware tab -> Device Manager. Locate and expand the Ports section. Remember the port assigned to the USB adapter. You will need to input this number in ADMCA.

Quick Start Guide

Open the ADMCA software. The 'Starting ADMCA' dialog will appear. Select MCA8000A from the Device Type menu. To open a file select Open a File. To Connect to the MCA8000A select Connect. If the MCA is not on, the software will turn it on within 3 seconds and then connect. If you are using the MCA8000A on a COM Port other than COM 1, you must change the default setting in the View menu, Preferences, MCA tab. If you are using the USB to RS232 adapter you must enter in the correct port number that you found in Device Manager.
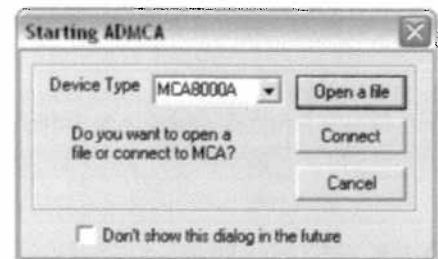
All the MCA8000A acquisition parameters are in the 'Set Acquisition Mode' dialog. This dialog is accessible from the toolbar ▣, the MCA pull down menu under Acquisition Setup, or by pressing <F9> on the keyboard. Click the Defaults button on the bottom and then OK. For more information about the specific acquisition parameters see the Help File (F1).

Press the Start/Stop button ▣ on the toolbar. The MCA begins its acquisition and the red light flashes on the front panel of the unit. You will see the screen updating with the spectrum. To stop acquisition, press the Start / Stop button on the toolbar. The Space Bar is the keyboard shortcut for starting and stopping data acquisition. For a list of keyboard shortcuts, go to the Help menu and select Keyboard Map.

Info Pane

The Info Pane displays the current status of the MCA and Peak Information if a Region of Interest (ROI) has been set. To set an ROI click on the Edit ROI button on the toolbar. The mouse cursor has now changed to ↕. To set an ROI left-click and drag the mouse over the desired region. An ROI has now been set. Additional ROIs can be set by the same left-click and drag. To exit the Edit ROI cursor mode click the Edit ROI button on the toolbar. The cursor has now changed back to the normal cursor. If the cursor is clicked in an ROI the Info Pane will display the Peak Information for that ROI. You can also set an ROI with the keyboard shortcuts U and Y.

Select Pane

The Select Pane displays cursor information (channel location and counts in that channel), x and y-axis range settings, and the scale of the spectrum (linear, square root, and log). At the right end of the Select Pane there are four arrows. The up and down arrows are the same as the up and down arrows on the keyboard and change the y-axis range. The left and right arrows change the x-axis range. The left and right arrows on the keyboard move the cursor through the spectrum channel by channel.
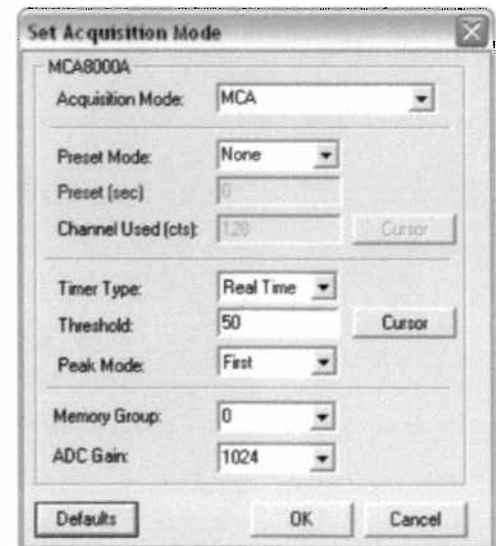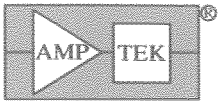
MCA8000A Software

ADMCA
This application is the main display and acquisition software for the MCA8000A. It is compatible with Windows 98SE/ME/NT/2000/XP/VISTA. Before running the software for the first time read the MCA8000A Quick Start Guide on the other side of this sheet. The Help File (press F1) is the primary resource, there is no paper manual. For specifications see the web site at http://www.amptek.com/mca8000a.html. Keep in mind that the ADMCA software controls all Amptek devices. Some functionality may only be applicable to the other devices.

MCA8000A APPLICATION PROGRAMMING INTERFACE (API):
The API libraries are compatible with Windows 95/98/ME/NT/2000/XP/VISTA. The libraries, with their supporting files, examples, and documentation, are in the MCA8000A API directory on the CD. These libraries are used to write custom code to control the MCA8000A.

OTHER PLATFORMS:
Go to the Amptek website at http://www.amptek.com/mcasoft.html for information on other platforms. There are no Amptek applications that support the MAC or Unix related operating systems.

XRF-FP Quantitative Analysis Software

The XRF-FP Quantitative Analysis Software is an additional purchase from Amptek. To install the software, browse the CD to the Quantitative Analysis (XRF-FP) directory and launch the setup.exe file. Once installed the security plug must be used in order to run the software. Install the XRF-FP software into the same directory as the ADMCA application.

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