

MULTICHANNEL ANALYZER 'POCKET MCA'

MCA8000A

FEATURES

- 16k data channels.
- Stores up to 128 spectra.
- Conversion time $<5 \mu\text{s}$ ($>200,000$ cps).
- Two stage input analog pipeline.
- Differential nonlinearity $<\pm 0.6\%$.
Integral nonlinearity $<\pm 0.02\%$.
Sliding-scale linearization.
- 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 RS-232 serial interface.
- 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 SMALLEST MCA



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 ePOCKET 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 RS-232 serial interface.

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.

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SPECIFICATIONS

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 $\leq 2 \mu\text{s}$. ADC conversion time $\leq 5 \mu\text{s}$.

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 $< \pm 10 \text{ ppm}/^\circ\text{C}$; zero drift $< \pm 3 \text{ ppm}/^\circ\text{C}$.

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: $32k/[\text{ADC RESOLUTION}]$.

MAXIMUM COUNTS PER CHANNEL: 4.29×10^9 counts (4 bytes).

TIMERS: 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: RS-232 serial, high speed 115.2 kbps. 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.

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.

Power Consumption: $< 300 \text{ mW}$ in data acquisition mode with active serial interface, $< 250 \text{ mW}$ in data acquisition

mode with inactive serial interface (stand-alone mode).

Power sources: Two AA batteries or 9 to 12 V DC from an AC adapter (included). When operating on external power via the adapter, there is no drain on or recharging of the internal batteries.

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.

Protection: Built-in protection against incorrect battery polarity.

Power monitor: Battery discharge monitor for alkaline and NiCad batteries.

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.

CONTROLS AND INDICATORS

ON/OFF BUTTON: Toggles the MCA8000A power between ON and OFF.

STATUS LIGHT: Steady red light indicates that the MCA power is ON and no data acquisition in progress. Flashing red light indicates MCA is in 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.

CONNECTIONS

INPUT: The analog input accepts positive unipolar or bipolar semigaussian type pulses of shaping time constants $\geq 100 \text{ ns}$ or peaking time $\geq 250 \text{ ns}$. The dynamic range is 0 to +5 V ($Z_{in} = 200 \text{ k}\Omega$) or 0 to +10 V ($Z_{in} = 2 \text{ k}\Omega$), selectable by the Input Range Switch. The input has overload protection up to $\pm 15 \text{ V}$. 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 $1 \mu\text{s}$ 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 $1 \mu\text{s}$ 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 RS-232 connector; requires a null modem cable (included) to connect to a computer.

POWER: The MCA8000A power connector mates to a center positive, 3.5 mm x 1.3 mm female barrel connector.

MECHANICAL

WEIGHT: $< 300 \text{ g}$ (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 via an RS-232 serial interface. The baud rate is software selectable and set via the computer using ADMCA software. The data exchange protocol is available to the user to facilitate custom software development.

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 μ s. 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 μ s. The use of the sliding scale technique maintains differential nonlinearity to better than $\pm 0.6\%$ 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 reconnection 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.

POCKET MCA DISPLAY SOFTWARE (ADMCA)

The ADMCA Software allows for data acquisition and display on any PC compatible computers running on Windows 98SE or later. This Software supports region of interest (ROI), energy calibration, peak search, peak information, MCA8000A configuration and file management.

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. An example of the ADMCA Software is shown in *Figure 2*.

The ADMCA Software includes an isotope library and listing of atomic x-ray emission lines. The peak information window automatically suggests the isotope or x-ray line closest to the peak after the user has selected the desired library.

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

OPTIONAL SOFTWARE

XRF-FP Quantitative Analysis Software for X-ray Fluorescence applications.

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 suspended¹ (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.

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

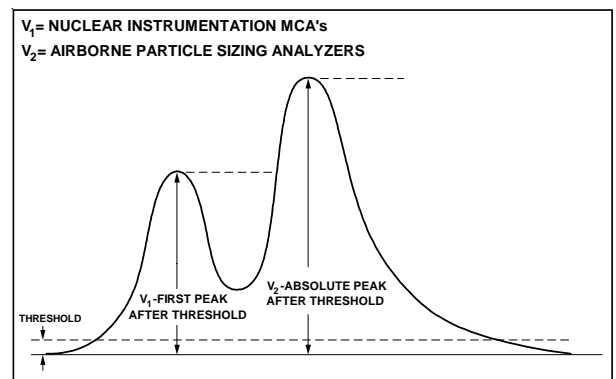


Figure 1. MCA8000A Peak Detection Modes

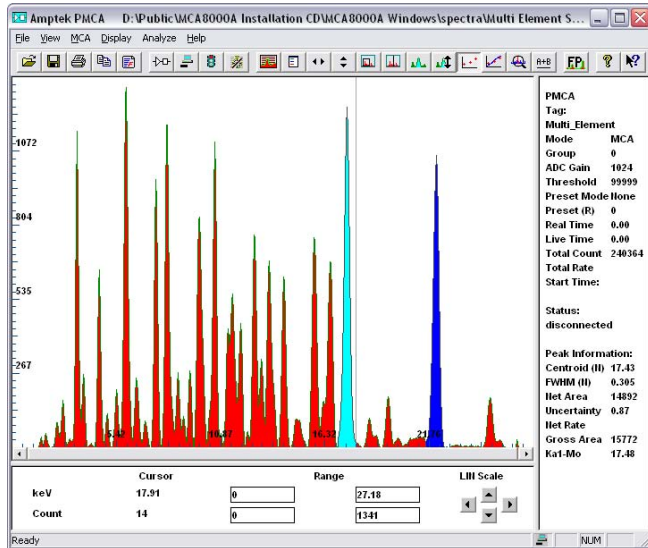


Figure 2. Example of ADMCA Software for MCA8000A

MCA8000A ORDERING INFORMATION

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

Optional Software

- XRF-FP Quantitative Analysis Software for X-ray Fluorescence Applications

MCA8000A PA Package - for Airborne Particle Sizing

- MCA8000A Basic Package, plus modification to facilitate airborne particle sizing
- NIST traceable calibration and certificate

Homeland Security Applications

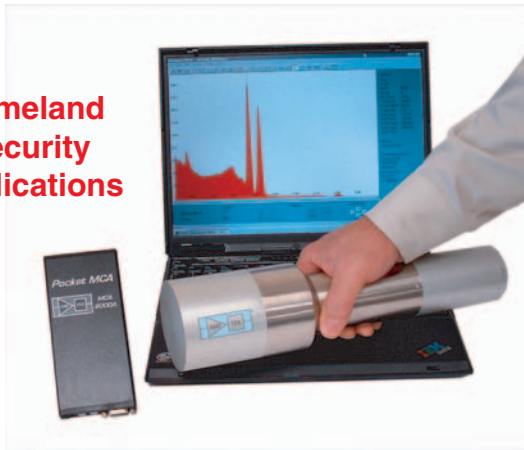


Figure 3. MCA8000A Shown With Scintillation Detector and laptop computer

Amptek's Portable XRF System

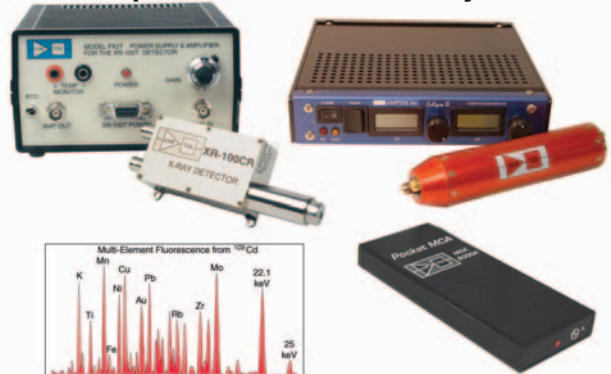
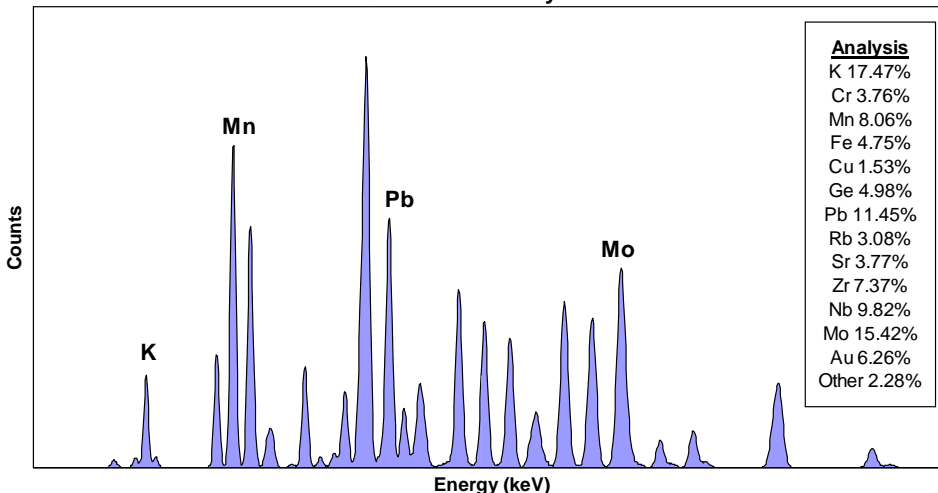


Figure 4. Clockwise from top: Amptek XR-100CR X-Ray Detector System, Amptek ECLIPSE-II X-Ray Tube System, 'Pocket MCA' and sample spectrum using Amptek's XRF-FP Quantitative Analysis Software.

XRF-FP Quantitative Analysis Software

Quantitative Analysis



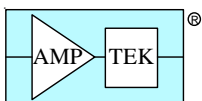
FEATURES

Spectrum Processing

- Spectrum calibration
- Background removal
- Escape peak and sum peak removal
- Smoothing
- Intensity extraction

Fundamental Parameter (FP) Calculations

- Elemental and compound flexibility
- Analysis with or without standards
- General bulk and thin-film analysis
- Use with various excitation sources and detectors
- Specify complete system geometry



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