

Nal Scintillation detector based gamma ray spectroscopy system with 8K MCA

Technical Data

Nal Scintillation detector based gamma ray spectroscopy system with 8K/ 4K / 1K mca consists of the following consistent units.

MINBIN with power supply (MB403)

High Voltage (HV501)

Spectroscopy Amplifier (SA524) or Linear Amplifier (LA520)

8K / 4K / 1K Multi channel Analyzer with processing software

Nal Scintillation detector (2"x2" / 3"x3" Flat / Well type) Lead shielding (40mm)

Personal computer system

Gamma Reference Sources Set (optional)

This system finds wide applications in Gamma Ray Spectroscopy measurements. Highly recommended for various Health Physics Labs of Nuclear Power Plants, Environmental survey labs & other labs for basic & applied research purposes. System also can be used in teaching labs of Nuclear Sciences & Engineering.

Multi-Channel Analyzer (MCA) is an important part of nuclear spectroscopy system. The major requirement of MCA is for nuclear pulse height analysis in energy spectroscopy. The USB-MCA presented here, incorporates state of art technologies like FPGA,USB bus interface and precision analog electronics to meet the stringent system requirements in nuclear pulse spectroscopy. The resolution supported by the USB-MCA ranges from 256 channels to 8K channels selectable via software, making it suitable for all spectroscopy applications from low resolution (e.g. Nal-PMT) to high resolution (e.g.HP-Ge) systems. The USB bus interface of the MCA provides an excellent connectivity with most of the new PCs and lap-top computers. The PHAST application software provided with the USB-MCA, seamlessly integrates with the hardware, featuring a range of standard functions required for analysis and acquisition.

Features

- Excellent MCA performance in terms of DNL: +/- 1% ; INL : +/- 0.05% of F.S.resolution etc.
- Supports both PHA & MCS modes of operation.
- Universal connectivity to a wide range of PCs and notebook computers.
- Gamma Ray Spectroscopy System uses Spectroscopy Amplifier, HV module and Scintillator Detector including instrumentation BIN & power supply.
- Excellent processing software features.
- System can be used with different sizes of Nal scintillation detectors.



Specifications

1. MINIBIN AND POWER SUPPLY (MB 403)

Mini bin : Accommodates SIX / EIGHT single bit modules or combination of multiple widths with Amphenol connectors. Minibin is primarily designed with the objective of conserving bench space and to achieve significant saving in cost of the Minibin based systems. Bussed wiring is provided to the power connectors to distribute +/- 12V and +/- 24V. A control panel with ON/OFF switch, low voltage test sockets is provided on the right extreme side of the bin.

Minibin Dimensions : 11.75"width X 11.00 depth (upto connectors) X 8.75" height.

Power supply : This is either two and half bit module or a compact box type enclosure fitted at the back of this bin, which generates highly regulated D.C voltages.

Input : (230V + 10%) a.c, 50Hz.

D.C Output : +12V @ 1A, -12V @ 1A, +24V @ 0.5A, -24V @ 0.5A 48 watts maximum.

Regulation : Better than +/- 0.1%

Noise & Ripple : Less than 3 mv

Stability : +/- 0.5% after a 24 hr warmup at constant line, load & ambient temp.



2. HIGH VOLTAGE UNIT (HV 501) :

- Output voltage variable continuously from 0V to 1500 volts
- Output current (max) 1mA
- Load & Line regulations : Better than 0.005% of full scale
- Indefinite over load & short circuit protections and self recovery
- Output ripple less than 20mv.
- Dimensions : Single / Two bit module



3. SPECTROSCOPY AMPLIFIER (SA524) :

Spectroscopy Amplifier is a high performance nuclear pulse shaping amplifier, ideally suited for use with all types of detectors such as germanium, silicon surface barrier and Si(Li) detectors. This is a single width NIM module with pile-up rejector (PUR), gated baseline restorer (BLR), auto threshold, diode limited unipolar output, BUSY and count-rate output as some of the key features designed into it. Some of the main applications of spectroscopy amplifier involve nuclear pulse height spectroscopy, nuclear timing spectroscopy, Counting Systems etc.

The input to SA524 can be either positive or negative signal from a detector preamplifier. The output pulses, 0 to 10V for unipolar pulse and $\pm 10V$ for bipolar pulse.

A. PERFORMANCE

Gain Range : Continuously variable from X4 to X1500.

Pulse Shaping : Quasi-gaussian and quasi-triangular.

Shaping time : 0.5, 1, 2, 3, 6 and 10 msec

Input Noise : 5 mv r.m.s with 3 ms shaping time

Overload : Recovers to within 2% of baseline in 15x shaping time from x200 overload.

Integral Non-Linearity : < 0.05% from 0 to 10V.



B. CONTROLS

FINE GAIN : Front panel 10 turns precision potentiometer provides a continuously adjustable, gain factor from 0.5 to 1.5.

COARSE GAIN : Front panel six-position switch selects gain factors of X20, X50, X100, X200, X500 and X1000.

PZ : Screwdriver adjustment of the PZ cancellation using 20-turn potentiometer on the front panel.

POS/NEG : Front panel toggle switch for selecting either positive or negative input signals.

ATN : A front panel toggle switch selects an input attenuation factor of X1 or X2.5

SHAPING : Front panel six position switch for selecting shaping times of 0.5, 1, 2, 3, 6 and 10 msec.

4. Multi-Channel Analyzer (8k MCA) : Multi-Channel Analyzer (MCA) is an important part of nuclear spectroscopy system. The major requirement of MCA is for nuclear pulse height analysis in energy spectroscopy. The USB-MCA presented here, incorporates state of art technologies like FPGA, USB bus interface and precision analog electronics to meet the stringent system requirements in nuclear pulse spectroscopy. The resolution supported by the USB-MCA ranges from 256 channels to 8K channels selectable via software, making it suitable for all spectroscopy applications from low resolution (e.g. NaI-PMT) to high resolution (e.g. HP-Ge) systems.

The USB bus interface of the MCA provides an excellent connectivity with most of the new PCs and lap-top computers. The PHAST application software provided with the USB-MCA, seamlessly integrates with the hardware, featuring a range of standard functions required for analysis and acquisition.

SPECIFICATIONS :

Hardware features:

MCA resolution: 256, 512, 1K, 2K, 4K and 8K channels.

Spectrum memory : 128K bytes single port SRAM.

Max counts / channel: 31 bit (2 Giga counts).

Pulse processing time : 7 ms including ADC conversion time of 5 ms.

Pile up rejection: Active high TTL input from spectroscopy amplifier

DNL: +/- 1%

INL : +/- 0.05% F.S.

MCA Input: Single channel, 0 to +10 volts

Power requirement: 5V, ~500 mA through USB cable directly (No external power supply required)

Software features:

Important software features include * spectrum display in two windows * marker selection (two) for ROI Detection & bracketing the peaks of interest, multiple ROI selection, deletion of ROIs etc.,

File Handling: Involves storing, loading of complete spectrum.

Print: Print of Total graph, selective graph, peak report

Acquisition: With pause option

Erase: Erasing spectrum from memory

Spectrum Analysis: Find peak, Shape calibration, Energy calibration, Approx Calib, Efficiency Calibration, Activity Calculation, etc.,

Spectrum smothering: 3,5,7,9 & 11 point smothering functions have been provided



USB MCA Module



USB MCA Module open form

ROI Option: Insert, Delect, Hide Etc.,

Scale: X-axis can be chosen as Channel number (or) Energy axis (in Kev) & Y - axis has range from 256 to 64M in binary steps with auto scaling option. Y-scale can be linear or log LLD, ULD & base line are soft selectable In built Isotope library for isotope selection & matching.

5. SCINTILLATION DETECTORS :

Nucleonix Systems offers wide range of NaI Scintillation Detectors of different sizes both with flat & well type crystals, to meet the requirements of wide range of users for Gamma ray spectrometry measurements.

Scintillation detectors offered include 2"x2" & 3"x3" NaI integral assemblies with built-in pre-amplifiers. These detector assemblies give excellent stability, superior performance & good resolution in the range of 8.0 to 9.5% for Cs-137. Scintillation detectors of other sizes can be offered against user specific requirements also.



Important Specifications	Detector Type	
1. Flat/Well type NaI crystal SD		
2. Crystal Sizes		
3. Well Size (applicable for SD 152 W & Sd 153 W only)	152/Sd 152 W 2" x 2" 0.656" dia x 1.546" deep	SD 153/ SD 153W 3" x 3" 0.656" x 1.546" deep
4. Photo multiplier EMI 9857 or	EMI 9857 or 9266 or its equivalent	EMI 9305 or its equivalent
5. Resulation (Better than)	8.5 %	9.5%
6. Pre-amplifier	Built - in	Built - in
7. Gain (Approx.)	25	25
8. Noise (RMS. referred to input)	Less tha 50uV	Less than 50 uV
9. Operating Voltage	700 to 900V	750 to 900V
10. Out put	Positive Tail Pulse	Positive Tail Pulse
11. Output impedance	90 Ohms	90 Ohms
12. Power Requirement (Typical)	-12V @ 12mA	-12 V @ 12mA

6. GAMMA REFERENCE STANDARD SET (GS290) :

Gamma Reference Standard Set Type: GS290 consists of a set of FIVE Gamma sources evaporated & sealed on 25mm dia x 5mm plastic disc covering SIX photopeak energies in the range of 3 to 5 micro curie. A reference chart for this is given below. The accuracy of these sources is in the range of +/-10%. All these discs sources are enclosed in a box made of acrylic sheet and supplied.



Gamma Isotope	Energy Mev	Nominal Activity	Half life
Co-57	0.123	2-5 μ ci	273
Ba-133	0.36 (Main)	2-5 μ ci	Days
Cs-137	0.662	2-5 μ ci	7.5
Co - 60	1.17; 1.33	2-5 μ ci	years
Na-22	0.511;1,280	2-5 μ ci	30
			years
			5.3
			years
			2.6
			years

Note : BRIT is not able to supply this Mn-54 at present. In view of this we are able to give only 5 sources in the Gamma Reference set.

7. LEAD SHIELD : This Lead Shield is designed to shield 2"x2" or 3"x3" NaI detector Scintillation Detectors of NUCLEONIX make. It is built-up of interlocking rings with bottom and top plates. The bottom ring is provided with a small opening so that the cables from the Scintillation Detector Pre-amplifier base could be taken out for connecting to the Gamma ray spectrometer counting system.

The inside of the lead shield is lined with Aluminium to minimise scattering.

Thickness 40mm, accommodate 3" scintillation detector including sample of 3" overall size.

8. Personal computer system with printer :

Any standard pentium IV computer configuration with printer is adequate to run MCA software.