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 NaI scintillation detectors.
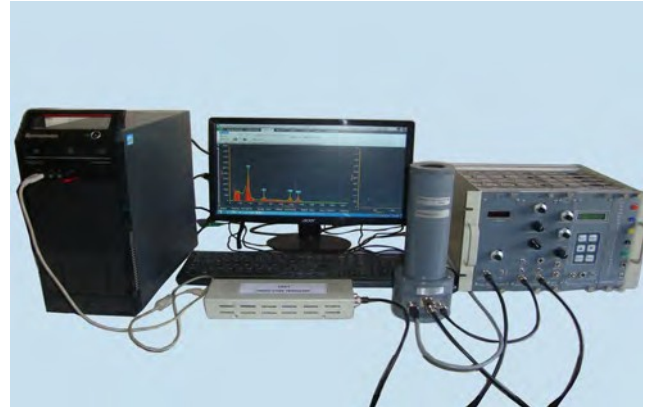
NaI Scintillation detector based gamma ray spectroscopy system with 8K/ 4K / 1K MCA consists of the following consistent units.

MINBIN with power supply (MB403) High Voltage (HV501) Spectroscopy Amplifier (SA524) or Linear Amplifier (LA520) 8K / 4K / 1K Multi channel Analyzer with processing software NaI Scintillation detector (2"x2" / 3"x3" Flat / Well type) Lead shielding (40mm) Personal computer system Gamma Reference Sources Set (optional)

Applications:

This system finds wide applications in Gamma Ray Spectroscopy measurements. Highly recommended for various Health Physics Labs of Nuclear Power Plants, Environmental survey labs for measurement of radioactivity in Environmental samples including Food, Vegetation, Soil and other samples. Additionally System is useful for basic & applied research purposes. Also it can be used in teaching labs of Nuclear Sciences & Engineering.

Introduction:

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 gigh 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 :

1. Mlinibin 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 warm-up at constant line, load & ambient temp.

2. High Voltage Unit (HV 501) :

a. Output voltage variable continuously from 0V to 1500 volts

b. Output current (max) 1mA

c. Load & Line regulations : Better than 0.005% of full Scale

d. Indefinite over load & short circuit protections and self recovery

e. Out ripple less than 20mv

f. Dimensions : Single / Two bit module.

3. Linear Amplifier (LA520):

Linear Amplifier LA 520 is a solid state pulse amplifier designed to shape and faithfully amplifies detector pre-amplifier output pulses to operable levels. Many of the Nuclear Detectors give small amplitude pulse outputs.

These output pulses cannot be directly counted or analysed by scalers, countrate meters and single channel analyser, without being first amplified. Featuring excellent non-overload characteristics, a high gain, low equivalent input noise and flexibility of pulse shaping, LA 520 is ideally suited for use with Nuclear Counting Systems such as Gamma ray Spectrometers and other similar units.

Input Polarity: Positive or Negative

Input Impedance: 93 ohms

Total Gain: Typical 600 +/-10% with 1 micro second time constant

Gain Adjustment:
Controlled by three gain controls Accuracy: +/-10%

a. Input attenuator: Attenuator factors x 2.5 & x 1

b. Coarse gain: 0.2, 0.5, 1,2,3,5 & 8 by rotary switch

c. Fine gain: About adjustable by a ten turn helipot and knob/ precision dial.

Pulse shaping: Differentiating and integration RC time constants variable from 0.1 micro second to 5 micro second in sequence of 0.5, 1, 2, 3, 6, 10 with a provision of switching integration IN/OUT.

Amplifier Rise Time: Better than 100 nano seconds with no integration and 0.1 micro second differentiation constant.
Output : 0 to 8V positive, 12V maximum unipolar.
Output Impedance : Approximately 93 ohms.
Amplifier noise : Equivalent input   noise 10 micro volts rms typical at maximum gain and 1 microsecond integration and differentiation
Linearity : The integral non-linearity is less than 0.15% from 200 mV to 8 mV at 1 micro sec time constant, integration IN.

OR

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4. 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 ±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.

5. 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. NaIPMT) to gigh 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 s including ADC conversion time of 5 s.

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, delection 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 smothing : 3,5,7,9 &11 point smothing functions have been provided

ROI Option : Insert, Delect, Hide Etc.,

Scale: X-axis can be choosen 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

6. 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 preamplifiers. 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.

Detector Types:

	SD 152F/SD152W.	SD 153 F/SD153W
1. Flat/Well type NaI crystal.		
2. Crystal Sizes.	2"x 2".	3"x 3"
3. Well Size (applicable for deep SD152 W & SD 153W only).	"0.656" dia x "1.546" deep.	0.656" x 1.546" deep
4. Photo multiplier.	EMI 9857 or 9266 or its equivalent.	EMI 9305 or 9266 or its equivalent
5. Resolution (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 than 50uV.	Less than 50 uV
9. Operating Voltage.	700 to 900 V.	750 to 900 V
10. Out put.	Positive Tail Pulse 90 ohms.	Positive Tail Pulse 90 ohms
11. Output impedance.		
12. Power Requirement (Typical).	-12V @12 mA.	-12V @12 mA

7. 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 dics 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 µci	273 Days
Ba-133	0.36 (Main)	2-5 µci	7.5 years
Cs-137	0.662	2-5 µci	30 years
Co - 60	1.17; 1.33	2-5 µci	5.3 years
Na-22	0.511;1,280	2-5 µci	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.

8. 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 Aluminum to minimize scattering. Thickness 40mm, accommodate 3" scintillation detector including sample of 3" overall size.

9. Personal Computer System With Printer :

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