RESEARCH INTERNATIONAL

NUCLEAR RADIATION DETECTORS AND SPECTROMETERS

- NUCLEAR RADIATION DETECTORS
- MODULAR NUCLEAR ELECTRONICS
- NUCLEAR RADIATION SPECTROMETERS
- RADIOACTIVE AND NUCLEAR MATERIAL INSPECTION SYSTEMS
- DEDICATED EQUIPMENT

DEVELOPMENT AND PRODUCTION OF RADIATION CONTROL EQUIPMENT

CONTENTS

NUCLEAR RADIATION DETECTORS

MODULAR NUCLEAR ELECTRONICS

NUCLEAR RADIATION SPECTROMETERS

RADIOACTIVE AND NUCLEAR MATERIAL INSPECTION SYSTEMS

DEDICATED EQUIPMENT

Research International, Inc. is an exclusive distributor for Aspect products.
Contact:
Research International, Inc.
17161 Beaton Road SE
Monroe, Washington 98272
1-800-927-7831
www.resrchintl.com

BDS-G
Scintillation gamma detectors

PURPOSE
Detection of gamma-radiation and conversion of its energy into electric signals of corresponding amplitudes so that they can be later processed.

APPLICATION
- Construction of spectrometric systems for laboratory and industrial purposes
- Detectors of the BDS-G type can be used in various scientific and economic fields for qualitative and quantitative analysis of gamma-emitting radionuclide samples

COMPONENTS
Detection units are based on a cintillation crystal – PMT" design approved and consist of:
- A pre-amplifier, a driver-amplifier with parameters of output pulses that allows their direct transmission to the input of the amplitude-to-digital converter (multi-channel analyzer)
- High-voltage power supply
- A system for stabilization of the measurement channel based on a special LED that provides temperature compensation for the converter characteristic

TECHNICAL DATA AND CHARACTERISTICS

Detector type	BDS-G63x63	BDS-G100x100	BDS-G150x100
Scintillator size, mm	63x63	100x100	150x100
Relative energy resolution for the 662-keV line (Cs-	8	9.5	10.5
Detectable energies, MeV*	0.03 – 3		
Integral nonlinearity,%	1		
Temperature instability, %/°C	0.1		
Additional instability of the conversion characteristic at the change of the load from background to 50000 s-1,	1		
Time instability over a 24-hour period of continuous operation, %	1		
Maximum undistorted amplitude of output spectrometric signals, V	4.8		
Operating temperatures,°C**	10… 35		
Power supply voltage, V	6 – 15		
Power consumption, W	1.5		
Weight, kg	1.4	6.5	9.3
Overall dimensions, mm***	Ø88x315	Ø125x375	Ø180x387

Notes:
*On request, the range of detectable energies can be changed
** On request, the range of operating temperatures can be extended from -20°C to +50°C
***The size of the BDS-G 63x63 detection part allows the use of Marinelli vessels with a capacity of one liter

Research International, Inc. • 17161 Beaton Road SE, Monroe, Washington 98272-1034 USA
Toll Free: 1-800-927-7831 • Email: info@resrchintl.com

UDS-G
SCINTILLATION GAMMA DETECTING DEVICE

PURPOSE

Detection of gamma-radiation and conversion of its energy into electric signals of proportional amplitude; statistical distribution of the amplitude as a function of energy (spectrum); transmission of spectra through standard data transmission channels for their visualization and processing.

APPLICATION

The device is used to construct technological and laboratory spectrometric systems intended for determination of specific activity of radioactive and noble gases, radioactive iodine and aerosols, as well as a submerged detector for monitoring of technological water environments at NPP and at nuclear facilities.

COMPONENTS

- NaI(Tl) scintillator: 40x40 or 63x63*
- PMT
- Spectrometric amplifier
- Thermocompensation LED peak stabilization system
- High-voltage power supply for the PMT
- Spectrometric ADC
- Buffer memory and RS232/485 or USB interface controller

TECHNICAL DATA

Detectable energies, MeV	0.05 – 3
Relative energy resolution for the 662-keV line (Cs-137) for crystal Ø40x40, %	8
Integral nonlinearity, %	1
Number of ADC channels	992
ADC conversion time, µs	3
Differential nonlinearity of ADC, %	1
LLD adjustment range, of full scale, %	0.4 – 96
LLD adjustment step, of full scale, %	0.04
Accumulated spectrum channel capacity	2^{32} - 1
Maximum input statistical intensity, pulses/s	10^5
Relative displacement of the 662-keV (Cs-137) peak at the maximum intensity, %	1.5
Additional conversion characteristic instability due to temperature variation, %/°C	0.1
Time instability over 24 hours of continuous operation, %	1
Rate of transmission through the serial channel, Kbit/s	9.6 – 115.2
Power supply voltage (for RS 232/485), V	9 – 18
Power consumption, W	1.3
Dust and moisture protection	IP54
Operating temperatures, °C**	5 ... 50

NOTES
*On request, detecting devices with scintillation crystals of other types and dimensions can be manufactured
** On request, detecting devices for application in an extended temperature range can be manufactured

DESIGN MODIFICATIONS

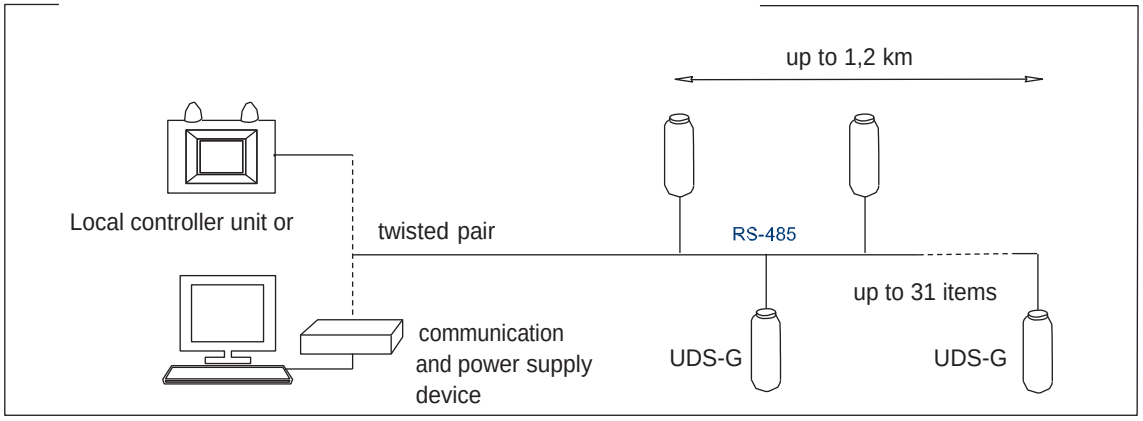
UDS-G-40x40-RS-232 UDS-G-40x40-RS-485 UDS-G-40x40-USB	UDS-G-63x63-RS-232 UDS-G-63x63-RS-485 UDS-G-63x63-USB

OVERALL DIMENSIONS

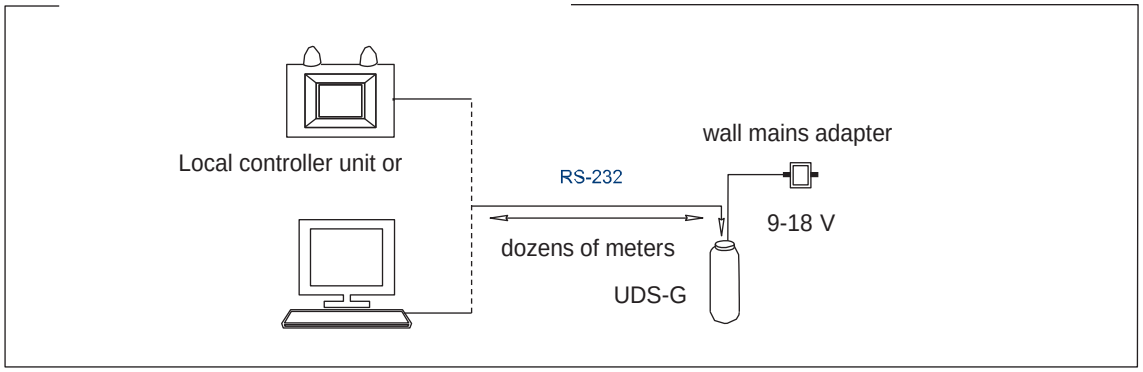
	Crystal Ø40x40	Crystal Ø63x63
Diameter, mm	66	88
Length, mm	278	315
Weight, kg	1.1	1.4

Research International, Inc. • 17161 Beaton Road SE, Monroe, Washington 98272-1034 USA
Toll Free: 1-800-927-7831 • Email: info@resrchintl.com

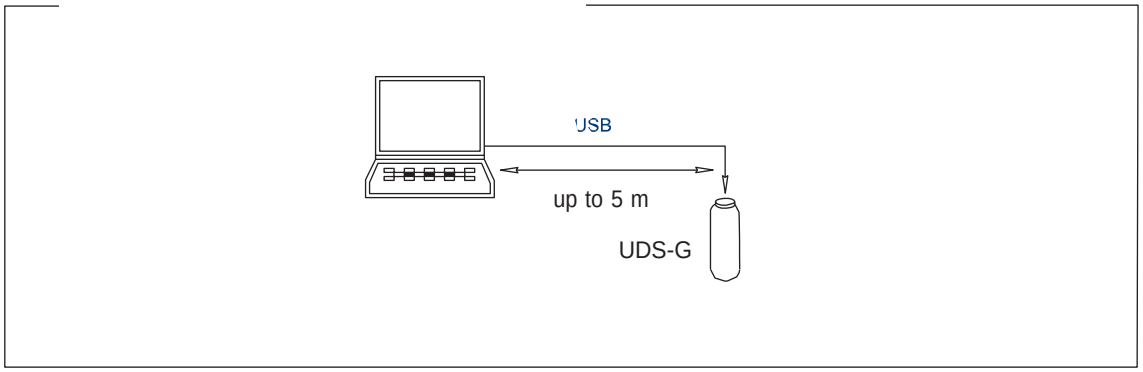
UDS-G-based distributed spectrometric system with RS-485 interface



UDS-G-based spectrometer with RS-232 interface



UDS-G-based spectrometer with USB interface



UDS-GA
STAND-ALONE SCINTILLATION GAMMA SPECTROMETER

PURPOSE
Detection of gamma radiation; collection of recorded data as statistic energy (spectrum) distribution both under the control of the external computer and independently in accordance with a preset cyclic program; and transmission of spectra to a computer for their visualization and processing

APPLICATION
The device is used to construct spectrometric systems for independent radiation monitoring with periodic access and maintenance

COMPONENTS
- NaI(Tl) scintillator: 63x400 mm*
- PMT
- Amplifier and spectrometric ADC
- Processors, memory and RS232/485 interface controller

TECHNICAL DATA

Main range of detected energies, MeV		0.05 – 3
Additional range of detected energies, MeV		0.15 - 9
Relative energy resolution for the 662-keV line (Cs-137) for various location of radiation sources, %	from the end face	9
	from the side face	12
Integral nonlinearity during irradiation from the side face, %		1
Additional conversion characteristic instability due to temperature variation, %/°C		0.1
Temporary instability over 24 hours of continuous operation, %,		1
Maximum input statistical intensity, pulses/s		50000
Relative change of resolution for the 662-keV line (Cs-137) for crystal Ø40x40, %		15
Relative displacement of the 662-keV (Cs-137) peak at the maximum intensity, %,		1
Range of gamma-radiation EDR measurement, µSv/h		0.001 - 5
Error of gamma-radiation EDR determination in the range 0.1 – 5 µSv/h, %		30
Number of ADC channels		992
Preset communication line interface		RS-485
Number of spectrometers connected to one RS-485 bus		15
Rate of transmission through the serial channel, Kbit/s		9.6 – 115.2
External power supply voltage, V		9 - 18
Storage battery voltage, V		7.0 – 8.4
Dust and moisture protection		IP65

*NOTES *On request, independent spectrometers with scintillation crystals of other dimensions can be manufactured*

Research International, Inc. • 17161 Beaton Road SE, Monroe, Washington 98272-1034 USA
Toll Free: 1-800-927-7831 • Email: info@resrchintl.com

BDS-B, BDS-B-150
SCINTILLATION BETA-DETECTORS

PURPOSE
Detection of beta particles and conversion of their energy into electric signals of proportional amplitude for subsequent processing.

APPLICATION
- Construction of spectrometric systems for laboratory and industrial purposes
- Qualitative and quantitative analysis of beta-emitting radionuclide samples in various fields of science and economy.
- Parts of the Beta-1S and Beta-1S-150 spectrometers

COMPONENTS
Detectors are produced on the basis of the “plastic scintillator – PMT” approach and consist of:
- A pre-amplifier, driver-amplifier with output pulses allowing their direct transmission to an A/D. This system provides:
- A converter input (multi-channel analyzer);
- A high-voltage power supply;
- A system for stabilization of the measurement channel based on a special LED used for temperature compensation of the converter characteristic

TECHNICAL DATA
OVERALL DIMENSIONS OF THE SCINTILLATOR

BDS-B, mm	⌀ 70x7
BDS-B-150, mm	⌀ 150x7

Detectable energies, MeV		0.2–3
Energy resolution for the Cs-137 conversion electron peak,	BDS-B	15
	BDS-B-150	20
Temperature instability, %/°C		0.1
Time instability over a 24-hour period of continuous operation, %		1
Maximum undistorted pulse height of output spectrometric signals, V		4.8
Operating temperatures, °C		10 … 35
Power supply voltage, V		6 – 15
Power consumption, W		1.1

OVERALL DIMENSIONS AND WEIGHT OF DETECTORS:

	BDS-B	BDS-B-150
Weight, kg	1.3	4.8
Dimensions, mm	90x250	185x281

NOTE: On request, detection units with plastic scintillators of various dimensions can be manufactured. BDS-B, BDS-B- 150 detection units can be manufactured as UDS-B and UDS-B-150 (with built-in ADC and serial interface controller RS-232/485 or USB)

Research International, Inc. • 17161 Beaton Road SE, Monroe, Washington 98272-1034 USA
Toll Free: 1-800-927-7831 • Email: info@resrchintl.com

BDS-R5
SCINTILLATION X-RAY DETECTOR

PURPOSE

Detection and determination of the spectral composition of X-ray radiation in the 2 – 30 keV range.

APPLICATION

The detector is a stand-alone device and can be included in a spectrometric system for laboratory or industrial purposes.

COMPONENTS

The BDS-R5 is an X-ray radiation detection unit consisting of:

- Crismatec type N32x3/Al scintillation NaI (Tl) detector
- PMT
- Amplifier
- High-voltage power supply and low voltage converters, accommodated in a single case

TECHNICAL DATA

Detectable energies, keV	2 - 30
Relative energy resolution for the Fe-55 line, %	50
Amplitude of output analogue signal corresponding to Fe-55 line, V	1±0.1
Diameter of operating window, mm	32
Thickness of protective aluminum scintillator coat, mm	0.05
Constant component at detector output, mV	10
Integral nonlinearity of conversion characteristic, %	1
Temperature instability, %/°C	0.1
Temporary instability over a 24-hour period of continuous operation, %	1
Additional instability of conversion characteristic at the change of the loading from the background to 50000 s-1, %	1
Time to get ready for operation, min	30
Power supply voltage, V	6 – 16
Power consumption, W	1.3
Weight, kg	0.8
Overall dimensions, mm	76x76x260
Length of connecting cable, m	2

Research International, Inc. • 17161 Beaton Road SE, Monroe, Washington 98272-1034 USA
Toll Free: 1-800-927-7831 • Email: info@resrchintl.com

ADC
AMPLITUDE-TO-DIGITAL CONVERTERS

PURPOSE

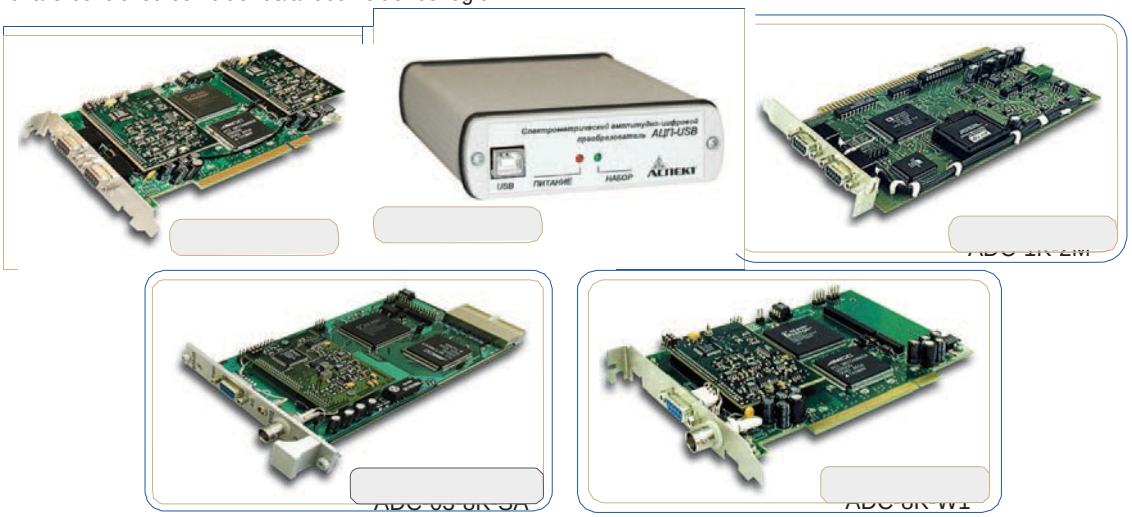
Spectrometric ADCs are intended for measuring amplitudes of pulsed input signals by analog-to-digital conversion and storing the data in the form of statistical distributions (spectra) in the internal buffer memory. An ADC with a connected computer and corresponding software makes up a multichannel amplitude analyzer.
The family of developed ADCs allows a wide range of multi-channel analyzers to be built for use in spectrometric systems based on various nuclear radiation detectors or other sources of statistically distributed pulse signals.
A selection of ADCs with ISA, PCI, Compact PCI, USB and RS 232/485 interfaces allows a measurement system to be made with computers of the corresponding configuration.
As ADCs come with various numbers of inputs (1, 2, 8), it is possible to use one device to make systems with one or several measurement channels.
ADCs are designed as PC cards, Euromechanics and NIM modules, and stand-alone devices.

FEATURES

- Highly accurate ADCs with conversion by Wilkinson's method
- ADCs with constant time of conversion by successive approximations
- One or two independent conversion channels
- One, two, or eight analogue inputs
- Storage of spectra from all inputs in the internal memory (except ADC-4K-LT and ADC-4K-mPC)
- Channel width adjusted by software with a step of 5 µV
- Coincidence/anticoincidence logic
- Built-in rate meters
- Live-time or real-time exposures
- Multi-counter mode (ADC-USB)

Spectrometric ADCs with the PCI, Compact PCI, USB and RS232/485 bus interfaces

- Single mezzanine architecture
  - A motherboard with mezzanine circuit cards connected to it
  - The motherboard comprises a bus interface, a processor with a memory to store spectra, timers, ratemeters, and connectors to connect one or two mezzanines
  - The spectrometric ADC proper is located on the mezzanine circuit card
- Two connected mezzanine circuit cards make up two independent channels
- Various types of ADC mezzanine circuit cards
  - Highly accurate, with Wilkinson conversion and channel width adjusted by software with a step of 5 µV
  - With constant conversion time
  - With an 8-input multiplexer (only with PCI interface)
- Plug-and-Play mode support
- Automatic identification of the mezzanine circuit card connected to the motherboard
- Software-controlled coincidence/anticoincidence logic



Research International, Inc. • 17161 Beaton Road SE, Monroe, Washington 98272-1034 USA
Toll Free: 1-800-927-7831 • Email: info@resrchintl.com

BASIC CONFIGURATION

Type of ADC	Design	Interface	Conversion method	Conversion frequency, (time)	Number of inputs	Number of converters	Resolution	Maximum input signal amplitude
ADC-1K-2M	PC circuit card	ISA (16-bit)	Wilkinson	100 MHz	2	1	1K	10 V
ADC-8K-2M							1K - 8K	
ADC-4K-LT	PC circuit	ISA (8-bit)	Wilkinson	50 MHz	1	1	1K - 4K	10 V
ADC-4K-mPC	Industrial computer							
ADC-1K-W1	PC circuit card	PCI	Wilkinson	100 MHz	1	1	1K - 4K	10 V
ADC-1K-W2					2	2	1K - 4K	
ADC-8K-W1					1	1	2K - 8K	
ADC-8K-W2					2	2	2K - 8K	
ADC-1K-W8					8	1	1K	
ADC-8K-SA1	PC circuit card		Successive approximations	(3.5 µs)	1	1	1K, 2K, 4K, 8K	5 V
ADC-8K-SA2					2	2		
BPA-03-8K-W	Euromech a- nics	Compact PCI	Wilkinson	100 MHz	1	1	2K - 8K	10 V
BPA-03-8K-SA			Successive approximations	(3.5 µs)			1K, 2K, 4K, 8K	5 V
BPA-02	Euromechani cs NIM	RS- 232/485	Wilkinson	100	1	1	1K - 8K	10 V
BPA-02N								
ADC-USB-8K-W	Stand-alone	USB	Wilkinson	100 MHz	1	1	2K – 8K	10
ADC-USB-8K- SA	Stand-alone	USB	Successive approximations	(3.5 µs)	1	1	1K, 2K, 4K, 8K	5 V
ADC-RS-8K-W	Stand-alone	RS232/485	Wilkinson	100	1	1	1K – 8K	10
ADC-RS-8K-SA			Successive approximations	(3.5 µs)			1K, 2K, 4K, 8K	5 V

- The number of spectra accumulated in the memory is equal to the number of inputs
- DB9 connectors allow connection of detector units to ADC-1K-W1/2 and ADC-8K-W1 (these connectors receive an analogue signal and output +12V power supply)

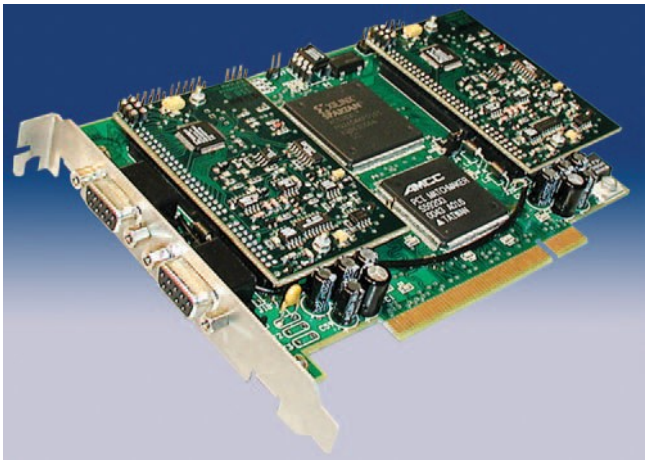
RESOLUTION AND NON-LINEARITY

Type	Channel width	Resolution (number of channels)	Differential non-linearity
			Maximum
ADC-1K-W1/2	10 mV – 2,5 mV	1K – 4K	0.5 %
ADC-8K-W1/2	5 mV – 1,25mV	2K – 8K	1 %
ADC-1K-W8	10 mV	1K	0.6 %
ADC-RS-8K-W	5mV – 1.25 mV	2 K – 8 K	1 %
ADC-B5-8K-SA	5 mV – 0.625 mV	1K – 8K	1 %
ADC-USB-SK-W	5mV – 1.25 mV	2K – 8K	1 %
ADC-USB-8K-SA	5 mV – 0.625 mV	1K – 8K	1 %

Spectrometric ADCs with Wilkinson conversion
(USB, RS, PCI bus interfaces)

BASIC CHARACTERISTICS

		ADC-USB-8K-W	ADC-RS-8K-W	ADC-1K-W1(-W2, -W8) ADC-8K-W1(-W2)
Conversion method		Wilkinson		
Conversion clock frequency		100 MHz		
Analogue input signal	Polarity	Positive		
	Amplitude	50 mV – 10 V		
	Rise time	0.25 µs		
	Decay time	100 µs		
Input resistance		2 kΩ		
Differential non-linearity (DNL)		1 %		
Integral non-linearity (INL)		0.04 %		
Adjustable channel width with step		5µV		
Channel width setting accuracy		5%		
Temperature instability of channel width less than		0.01 %		
Channel memory capacity		2^{24}-1		
Real/live time setting accuracy		5 ms		
Lower-level discriminator threshold range		30 mV – 10 V (50 mV – 5 V for ADC-1K-W8)		
Upper-level discriminator threshold range		100 mV – 10 V		
"Ratemeter" input - logic signal with frequency				
"Inhibit" input with programmable polarity		✓		
Multichannel count mode:		✓		
Number of channels:		From 32 to 8192	—	
Minimum time of channel accumulation		1ms	—	
Maximum time of channel accumulation		2^{32} – 1 ms	—	
Number of cycles		from 1 to 65535	—	
Maximum frequency of logic signals, MHz		1	—	
Time of logic signals, ns		50	—	
Bus interface		USB	RS	PCI
Dimensions		215x105x33 mm		180 x 110 mm

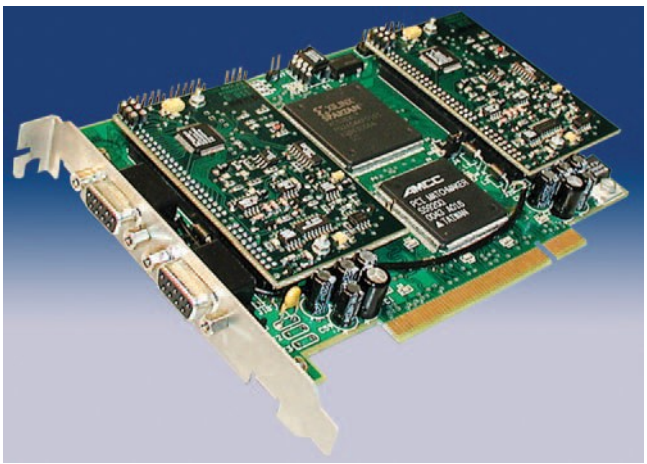


Research International, Inc. • 17161 Beaton Road SE, Monroe, Washington 98272-1034 USA
Toll Free: 1-800-927-7831 • Email: info@resrchintl.com

Spectrometric ADCs with constant conversion time (USB, RS, PCI bus interfaces)

BASIC CHARACTERISTICS

		ADC-USB-8K-SA	ADC-RS-8K-SA	ADC-8K-SA1 (-
Conversion method		Successive approximations with leveling		
Conversion clock frequency		3.5 µs		
Analogue input signal	Polarity	Positive		
	Amplitude	50 mV – 10 V		
	Rise time	0.25 µs		
	Decay time	100 µs		
Input resistance		2 kΩ		
Integral nonlinearity		0.04 %		
Programmable selection of conversion resolution		1K-2K-4K-8K		
Channel memory capacity		2^{24}-1		
Real/live time setting accuracy		5 ms		
Lower-level discriminator threshold range		20 mV – 5V		
Upper-level discriminator threshold range		100 mV – 5V		
Correction of spectra against signals from external pile-up detector		√		
Live time error when piled-up pulse rejection is used	At intensity 100,000 pulses/s	7 %		
	At intensity 50,000 pulses/s	4 %		
"Ratemeter" input - logic signal with frequency		Up to 300 kHz		
"Inhibit" input with programmable polarity		√		
Multichannel count mode:				
Number of channels		from 32 to 8192	——	
Minimum time of channel accumulation		1	——	
Maximum time of channel accumulation		2^{32} – 1	——	
Number of cycles		from 1 to 65535	——	
Maximum frequency of logic signals, MHz		1	——	
Time of logic signals, ns		50	-——	
Bus interface		USB	RS	PCI
Dimensions		215x105x33 mm		180 x 110 mm



Research International, Inc. • 17161 Beaton Road SE, Monroe, Washington 98272-1034 USA
Toll Free: 1-800-927-7831 • Email: info@resrchintl.com

BPA-03-8K-SA, BPA-03-8K-W
Spectrometric ADS with CompactPCI bus interface

Units of format 3U (overall dimensions 160x100 mm) contain single-channel spectrometric ADCs and are used in industrial spectrometric systems.
They are made in two versions:

- BPA-03-8K-W1 – Wilkinson ADC, resolution 2K - 8K, software-specified channel width adjusted in steps of 5 µV, input signal 50 mV - 10 V;
- BPA-03-8K-SA1 – ADC with constant conversion time of 3.5 µs, programmable resolution 1K-2K-4K-8K and channel width of 5 mV, 2.5 mV, 1.25 mV, 0.625 mV, input signal 20 mV - 5 V.

GENERAL DATA

Analogue input signal (BNC connector)	Polarity	Positive
	Rise time, no less than	0.25 µs
	Decay time, no less than	100 µs
Input resistance		2 kΩ
Channel memory capacity		2^{24} - 1
Real/live time setting accuracy		5 ms
"Ratemeter" input - logic signal with frequency		300 kHz (DB9 connector)
"Inhibit" input with programmable polarity		(LEMO connector)

BASIC DATA OF BPA-03-8K-SA

Conversion method		Successive approximations with leveling
Conversion time		3.5 µs
Analogue input signal amplitude		20 mV - 5 V
Programmable selection of resolution (number of channels)		1K-2K-4K-8K
Differential nonlinearity at resolution of 1K, 2K, 4K, 8K		1 %
Integral nonlinearity		0.04%
Lower-level discriminator threshold range		20 mV - 5 V
Upper-level discriminator threshold range		100 mV - 5 V
Correction of spectrum against signals from the external pile-up detector		✓
Live time error when piled-up pulse rejection is used:	At intensity 100,000 pulses/s, no more than	7%
	At intensity 50,000 pulses/s, no more than	4%

BASIC DATA OF BPA-03-8K-W

Conversion method	Wilkinson, 100 MHz
Analogue input signal amplitude	50 mV – 10 V
Resolution (numbers of channels)	2K – 8K
Programmable channel width with step of 5 µV	2.5 mV - 10 mV
Differential nonlinearity	1%
Integral nonlinearity	0.04%
Channel width setting accuracy	5%
Temperature instability of channel width, less than	0.01%
Lower-level discriminator threshold range	30 mV – 10 V
Upper-level discriminator threshold range	100 mV – 10 V

GAMMA-1P
SEMICONDUCTOR GAMMA SPECTROMETER

PURPOSE
Qualitative and quantitative analysis of samples for gamma-emitting radionuclides

APPLICATION
- Analyze various environmental samples for presence of gamma-emitting radionuclides
- Control technological processes
- Carry out research in various fields of fundamental and applied physics

OPERATION
Operation of the spectrometer is based on conversion of the gamma-ray energy in the sensitive volume of the semiconductor detector into electric pulses of a proportional amplitude with their subsequent recording by the multichannel amplitude analyzer. The spectrometer allows highly sensitive measurement of gamma radiation spectra over a wide energy range with high resolution.

The spectrometer software allows:
- Configuring of the system for various types of detectors
- Control of analyzer parameters, data collecting
- Visualization of spectra and their processing results on the computer display
- Energy, peak-shape, and efficiency calibration
- Automatic processing of gamma spectra with identification of isotopes (by libraries) and determination of their activity
- Storage of spectra and their processing results in files on any information carrier

TECHNICAL DATA AND CHARACTERISTICS

Detectable energies, MeV	0.05 – 10
Number of channels	8192
Integral nonlinearity, %	0.05
Maximal statistical input intensity, pulse/s	$5x10^4$
Energy resolution of the spectrometer (depending on the resolution of the detector used) for the ^{60}Co 1332-keV gamma line, keV	1.8 – 3.5
Relative detection efficiency at the total gamma absorption peak for the 1332-keV line for a point ^{60}Co nuclide at the source-detector distance 25 cm (depending on the volume of the detector	10
Lowest ^{137}Cs activity measured in a sample for 1 hour with using a protection screen, Bq	2
Activity measurement error for point geometry when a protection screen is used, %	20
Power consumption (220V, 50Hz), W	300
Operating temperatures, °C	10…35
Protection screen wall thickness: steel 4 mm, lead 82 mm, copper 1.5 mm, cadmium 1 mm	

OVERALL DIMENSIONS AND WEIGHT OF MAIN SPECTROMETER COMPONENTS

Completed component	Overall dimensions, mm	Weight, kg
Shielding screen and detector with Dewar vessel	650x570x1100	600
Pulse analyzer (computer, ADC, printer)	Depending on the computer model	
Spectrometric device SU-03P (single unit)	375x350x85	4.6
Spectrometric device SU-04P (NIM crate with modules)	320x315x235	8.9
Spectrometric device SU-05P (Euromechanics crate with	260x250x130	4.5

FEATURES
The spectrometer hardware and software are easily configured and adapted for the work with various types of detectors (germanium, germanium-lithium - for various energy ranges, resolutions, and efficiencies; silicon - for detection of low-energy gamma radiation etc.)

Research International, Inc. • 17161 Beaton Road SE, Monroe, Washington 98272-1034 USA
Toll Free: 1-800-927-7831 • Email: info@resrchintl.com

COMPONENTS

- Semiconductor germanium detector (HPGe or Ge(Li))
- Charge-sensitive spectrometric preamplifier PUG-01 (external, for the Ge(Li) detector)
- Spectrometric device including a spectrometric amplifier, a high-voltage power supply, and a low-voltage power supply; one of the options below:

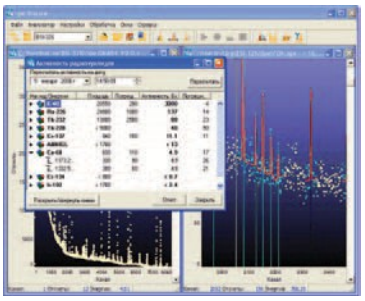
Spectrometric device, standard	Components	Detector output voltage ratings	Preamplifier output voltage ratings	Input signal parameters	Output signal parameters
SU-03P, single unit		Polarity (+/–) 50–4000 V, 100 mA Automatic step-up/ step-down no more than 15 V/s	± 24 V ± 12 V	Polarity (+/-) Rise time ≤200 ns Decay time constant ≥50 ms	Polarity (+) Maximum amplitude 10 V Forming time constants 0.5, 1, 2, 4, 6, 10 ms
SU-04P, NIM	BNN-01 UIS-02 BNV-05 (or BNV-08)	Polarity (+/–) 50–4000 V, 100 mA; (or 25–1000, 100 mA) Automatic step-up / step-down no more than 15 V/s	± 24 V ± 12 V	Polarity (+/-) Rise time ≤200 ns Decay time constant ≥50 ms	Polarity (+) Maximum amplitude 10 V Forming time constants 0.5. 1. 2, 4, 6, 10 ms
SU-05P, Euromechanics	BNN-03 UIS-04 BNV-07 (or BNV-09)	Polarity (+/–) 50–4000 V, 100 mA (or 5–100 V, 100 mA, or 50–1000 V, 100 mÀ) Automatic step-up/ step-down no more than 15 V/s	± 24 V ± 12 V	Polarity (+/-) Rise time ≤200 ns Decay time constant ≥50 ms	Polarity (+) Maximum amplitude 8.2 V Forming time constants 2,6 ms

- Spectrometric amplitude-to-digital converter (ADC) selected for the type of interface and required characteristics from the following:

Type of ADC	Design	Interface	Conversion method	Conversion frequency, MHz (time,	Number of inputs	Number of
ADC-8K-2M	PC circuit card	ISA (16-bit)	Wilkinson' s	100	2	1
ADC-8K-W1	PC circuit card	PCI	Wilkinson' s	100	1	1
ADC-8K-W2					2	2
ADC-8K-P1	PC circuit card	PCI	Successive approximation	(3.5)	1	1
ADC-8K-P2					2	2
BPA-02	Euromechanics	RS-232	Wilkinson' s	100	1	1
BPA-02-N	NIM					
ADC-USB-8K-W	Stand-alone	USB	Wilkinson' s	100	1	1
ADC-USB-8K-P			Successive approximations	(3.5)		
ADC-RS-8K-W	Stand-alone	RS-232/485	Wilkinson' s	100	1	1
ADC-RS-8K-P			Successive approximations	(3.5)		

- Personal computer of the IBM PC type with a printer
- Low-background combined lead protection screen Ekran-1P or Ekran-2P
- Applied software for Windows LSRM
- Upon request, the spectrometer can be supplied with the UZ-01 refilling unit

SpectraLineGP (Gamma Precision) Software PURPOSE

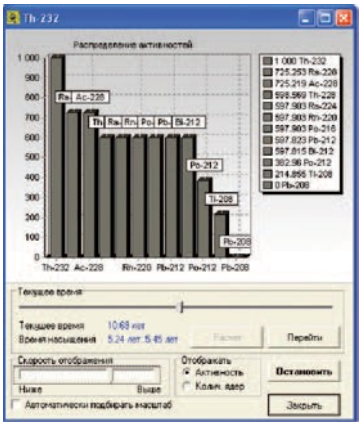


The software is intended for spectrometric measurements and precision processing of gamma spectra received from semiconductor detectors. Processing includes calibration, search for parameters of peaks, identification of radionuclides, calculation of activities and correction for true summation for subsequent correction of gamma radiation intensity.
Possible connection of external software allows using SpectraLineGP as an auxiliary tool for solving nonstandard spectrometric tasks.
This software is supplied with the Gamma-1P spectrometer.

FEATURES

- Automatic search for peaks with the necessary detection level
- Energy, half-width, peak shape calibrations
- Calculation of peak parameters – position, half-width, area; storage of calculation results in a text file
- Efficiency calibration, getting of approximating curves
- Activity calculation by various methods
- Calculation of correction factors for the true summation for subsequent correction of gamma radiation intensity
- Storage of measured spectra and processing results in the data base to analyze multiple measurements for the coincidence of the parameters
- Simultaneous processing of any number of spectra
- Use of several spectrum peaks from various energy ranges during the shape calibration
- Quantitative and visual control of calibration quality

Nuclide Master Software PURPOSE



The software is intended for getting information about radioactive decay parameters of a majority of known radionuclides (more than 3000, including metastable states) and creation of user libraries of nuclide lines in the format adopted in the LSRM software (*.lib files).
This software is supplied with the Gamma-1P spectrometer.

FEATURES

- Display of the decay chain of a selected nuclide, creation of a list of alpha and gamma lines
- Calculation of nuclide activity from the decay chain during the preset time
- Dynamic display of changes in the nuclide activity against the decay chain for the preset time
- Obtaining of alpha and gamma spectra for a selected nuclide within selected time interval taking into account daughter nuclides for the whole decay chain for spectrometer with the preset parameters. With the data base of transport containers, it is possible to get the gamma-spectrum of the source located in the container, taking into account absorption
- Display of the decay mode of the nuclide of interest

Nuclide Master Plus Software

PURPOSE

A complement to the Nuclide Master software. Calculation of correction factors for the real summation and subsequent correction of gamma radiation intensity in the library of radionuclides with the help of the TCCFCALC (True Coincidence Correction Factor CALCulation) software utility

FEATURES

- Calculation of corrections for various measurement geometries, including two types of detectors (scintillation and coaxial HPGe detectors), point and volume sources (cylindrical and Marinelli vessels of any size)
- Creation and correction of a measurement geometry, group calculation of corrections for the true summation for several nuclides with different calculation parameters
- Termination of calculation due to its visualization when the required accuracy of the calculations is achieved
- Correction of gamma radiation intensity in the library of radionuclides
- Use of all Nuclide Master software capabilities

GAMMA-1S
SCINTILLATION GAMMA SPECTROMETER

PURPOSE

Quantitative and qualitative analysis of samples for gamma-emitting radionuclides

APPLICATION

- For controlling the quality of edible raw materials and foodstuffs, forest industry products, livestock farming products, soils, building materials
- For research in various fields of fundamental and applied physics
- At factories for controlling production processes
- To analyze environmental samples

COMPONENTS

- 63x63 NaI(Tl) single-crystal scintillator detecting unit BDS-G with a built-in amplifier, a high- voltage converter, a system for stabilization by the reference peak of the light-emitting diode, and temperature compensation of the conversion characteristic*
- Spectrometric amplitude-to-digital converter ADC-1K-W1, IBM PC standard, with a buffer memory, a live/real timer, and a PCI interface bus
- Lead protection screen Ekran-1SG (floor type)
- IBM PC with a printer
- Applied software for Windows LSRM

OPERATION

- Measurement of spectra with live-time and real-time exposures**
- Energy, peak-shape and detection-efficiency calibration
- Automatic storage and processing of spectra, including identification of radionuclides, and saving of the spectra and results of their processing on any information carriers
- Visualization of spectra and processing results on the display
- Printing of the spectrum and results of its processing in the required form

*NOTES.*Upon request, a UDS-G63x63 –USB assembly with a built-in ADC and an USB interface can be supplied instead of the ADC-1K-W1 and the BDS-G*
***The standard Gamma-1S spectrometer is efficiency calibrated for operation in two geometries (1-liter Marinelli vessel and 0.12-liter Denta vessel) with sample density ranging from 0.2 to 2 g/cm^3. New calibrations can be added by the user to operate with other geometries and sample densities.*

BASIC TECHNICAL DATA

Detectable energies, MeV	0.05–3
Number of channels	1024
Relative energy resolution for the 661-keV line (137Cs), %	8
Integral nonlinearity, %	±1
Operating temperature, °C	10÷35
Power consumption, 220 V, 50 Hz, VA	250
Time instability, %	1
Maximal input statistic load, s^{-1}	50000

OVERALL DIMENSIONS AND WEIGHT

	Lead protection screen (lead thickness –	Detecting unit BDS-G	PC with ADC board, printer
Overall dimensions	700x700x730 mm	Ø.88x 315 mm	Depending on the model
Weight	172 kg	1.4 kg	

CERTIFICATES

The spectrometer is listed in the Russian State Register of Measuring Devices under No 15294-96

Research International, Inc. • 17161 Beaton Road SE, Monroe, Washington 98272-1034 USA
Toll Free: 1-800-927-7831 • Email: info@resrchintl.com

BETA-1S, BETA-1S-150
SCINTILLATION BETA SPECTROMETERS

PURPOSE
Measurement of specific activity of beta-emitting radionuclides in environmental and foodstuff samples of mass 5 to 30g (Beta-1S) and 15 to 40g (Beta-1S-150) placed in a standard dish of the spectrometer.

APPLICATION
- Food safety laboratories, forest industry, veterinary and agricultural services for controlling the quality of edible raw materials, foodstuffs, forest industry products, livestock farming products, and soils
- Nuclear physics centers for research in various fields of fundamental and applied physics
- Factory control of production processes
- Environmental sample analysis

COMPONENTS
- Plastic-scintillator detecting units BDS-B or BDS-B-150 with a built-in amplifier, high-voltage power supply, and an independent system of stabilization by the LED reference peak (plastic scintillator 70 mm x20 mm for Beta-1S, and 150 mm x 5 mm for Beta-1S-150)
- Spectrometric amplitude-to-digital converter ADC-1K-W1 IBM PC standard, with a buffer memory, live/real timers, and a PCI interface bus
- IBM PC with a printer
- Applied software LSRM for Windows
- Two reference Sr-90+Y-90 mix sources for spectrometer calibration and operation test
- Lead protection screen Ekran-1SB or Ekran-1SB-150
- Sample compactor
- Dishes for samples: 70x8 mm (30 ml) for Beta-1S, and 150x8 mm (140 ml) for Beta-1S-150

FEATURES
- Measurement of spectra with live-time and real-time exposures
- Energy and sensitivity calibration in energy windows*
- Automatic collection and processing of spectra, including identification of radionuclides, and saving of spectra and results of their processing on any information carriers
- Visualization of spectra and results of their processing on the display
- Report on the processing results

** During the manufacture, the devices are calibrated to detect the Sr-90 radionuclide against the background of Cs-137 and K-40. The spectrometers have hardware and software necessary to detect other beta-emitting radionuclides and to calculate their activity.*

TECHNICAL DATA

Detectable energies, MeV	0.1 – 3
Number of channels	1024
Relative energy resolution with respect to the peak of Cs-137 624 keV conversion electrons,	15
Time instability, %	1
Operating temperatures, °C	10 ÷ 35
Power consumption, 220 V, 50 Hz, VA	250

OVERALL DIMENSIONS AND WEIGHT

	Lead protection screen (lead thickness		Detection unit		PC with ADC, printer
	Ekran-1SB	Ekran-1SB-150	BDS-B	BDS-B -150	
Overall dimensions,	300x300x440	364x300x271	90x250	185x281	Depending on the model
Weight, kg	92	132	1.3	4.8	

CERTIFICATES
The Beta-1S is listed in the Russian State Register of Measuring Devices under No 15292-96

Research International, Inc. • 17161 Beaton Road SE, Monroe, Washington 98272-1034 USA
Toll Free: 1-800-927-7831 • Email: info@resrchintl.com

GAMMA-BETA-1S
SCINTILLATION GAMMA-BETA SPECTROMETER

PURPOSE
Measurement of specific activity of gamma-, beta-emitting radionuclides

APPLICATION
- Measurement of count samples (filters, smears), with subsequent identification of radionuclide composition; calculation of total volumetric activity of aerosols in the air and partial radionuclide contribution to total volumetric activity of aerosols; and determination of beta flux density. Data from the Gamma-Beta-1S spectrometer is stored in the data base and can be used for calculation of radiation doses to personnel during the work.
- Perform radiochemical control of aqueous solutions:
  - measurement of total volumetric activity of beta-emitting radionuclides
  - measurement of total volumetric activity of iodine
  - measurement of volumetric activity of reference radionuclides (rapid chromatographi radiochemical analysis)
- For environmental monitoring

COMPONENTS
- Plastic-scintillator detecting unit BDS-B with a built-in amplifier, high-voltage power supply, and an independent system of stabilization by the LED reference peak (plastic scintillator of size 70×7 mm)
- 63× 63 single-crystal NaI(Tl) scintillator detecting unit BDS-G with a built-in amplifier, a high-voltage converter, a system for stabilization by the LED reference peak and temperature compensation of the conversion characteristic
- Spectrometric amplitude-to-digital converter circuit board ADC-1K-W2, IBM PC standard, with a buffer memory, a live/real timer, and a PCI interface bus
- Lead protection screens Ekran-1SG and Ekran-1SB
- IBM PC type personal computer with a printer
- Applied software for Windows (depending on the purpose of the spectrometer, one of two packages is installed):
  - LSRM
  - GAMBIT

FEATURES
- Measurement of spectra with live-time and real-time exposures
- Energy, peak-shape, detection-efficiency, and sensitivity calibration
- Automatic collection and processing of spectra, including identification of radionuclides, and saving of the spectra and their processing results on any information carriers
- Visualization of spectra and processing results on the monitor screen
- Printing of the spectrum and its processing results

TECHNICAL DATA

	Gamma-1S	Beta-1S
Detectable energies, MeV	0.05–3	0.1 - 3
Relative energy resolution for the peak, %	8 (for 661 keV Cs-137)	15 (for 624 keV Cs-137)
Numbers of channels	1024	
Maximum statistical input intensity, pulses/s	50000	
Integral nonlinearity, %	±1	
Operating temperature, °C	10…35	
Power consumption, ac 220 V, 50 Hz, W	250	
Time instability, %	1	

CERTIFICATES
- The Gamma-1S is listed in the Russian State Register of Measuring Devices under No 15294-96 of 14.03.2002
- The Beta-1S is listed in the Russian State Register of Measuring Devices under No 15292-96 of 14.03.2002

Research International, Inc. • 17161 Beaton Road SE, Monroe, Washington 98272-1034 USA
Toll Free: 1-800-927-7831 • Email: info@resrchintl.com

SOFTWARE

LSRM 2000DB software

The Software is intended for spectrometric measurements and precision processing of gamma-, beta- spectra from scintillation detectors.
This software allows fulfillment of the tasks based on spectrometric methods of activity measurement:

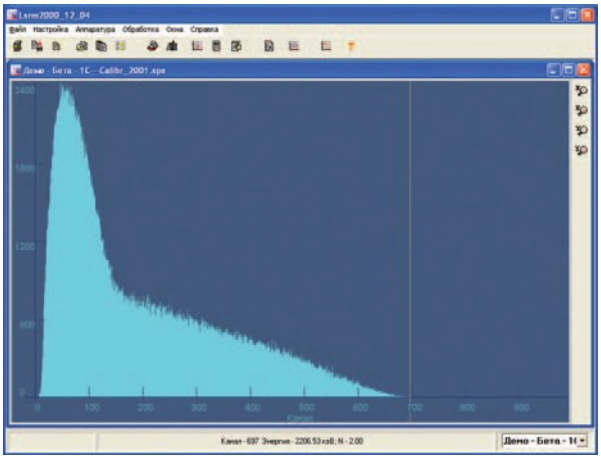
- Gamma-spectrometric analysis with the use of scintillation detectors
- Beta spectrometry – direct identification of strontium-90 and other beta-emitting nuclides.

Multifunctional capabilities of this software allow its use for both standard spectrometric analyses and precision measurements.
This software is supplied with the Gamma-1S, Beta-1S spectrometers.

The LSRM-2000DB software is a development of the basic LSRM2000 software and supports all functions of the latter.

Additional capabilities of LSRM-2000DB:

- Storage of spectra and measurement results in the data base, processing of multiple measurements, package processing of spectra
- Fitting with pre-identification
- Fitting over the whole spectrum
- Allowance for cascade summation effects



GAMMA-1S/NB1

PORTABLE SCINTILLATION GAMMA SPECTROMETER

PURPOSE

The spectrometer is intended to determine the isotopic composition of radioactive materials; activity of radionuclides in packing sets; enrichment of uranium compounds in transport containers; gamma dose rate; and to carry out qualitative and quantitative analysis of various items for presence of gamma-emitting radionuclides under both laboratory and hard field conditions

APPLICATION

- By customs officials to control legally transported radioactive and fissionable materials (RFM) with known isotopic composition or illegally transported RFM with unknown isotopic composition without opening the shipping containers.
- By external radiation dosimetry services to carry out radiation control of territories adjacent to radiation-hazardous installations, such as nuclear power plants, nuclear recycling facilities, military installations, etc.
- By environmental services to test various items for contamination with gamma-emitting radionuclides. This may also be used in a mobile radiological laboratory.
- In other areas of science and technology where nuclear-physics methods of analysis are used.

COMPONENTS

- 35x50 NaI(Tl) crystal scintillator detecting unit BDS-G5 with a built-in system of stabilization and temperature compensation by the reference peak of the light-emitting diode
- Multichannel pulse-height analyzer AI-8K/NB complete with a storage battery and an ac/dc adapter, which also serves as a battery charger
- Portable Note Book type computer
- Software package for Windows LSRM Customs
- Collimator
- Holder for the detecting unit BDS-G5
- Source holder (for positioning of the calibration source)
- Calibration source (supplied on request)
- Case

FEATURES

Spectrometer operates in the following modes:

- Detection of gamma radiation source in the search mode
- Determination of isotope composition of gamma-emitting radionuclides
- Determination of sources activity in package sets (containers)
- Determination of activity of point-geometry open sources
- Determination of degree of uranium enrichment
- Determination of specific activity in long objects
- Determination of gamma radiation dose rate

The spectrometer and the software are easily configured and adapted for addressing tasks other than original ones

TECHNICAL DATA

Detectable energies, MeV	0.05 – 3
Energy resolution for the 661-keV line (^{137}Cs), %	8
Number of channels	1024
Integral nonlinearity in the measured energy range, %	±1
Time instability over the 24-h period of continuous work, %	1
Range of activity measurement for ^{137}Cs radionuclide, Bq	8 - 10^5
Error in measurement of the external gamma ray activity at the confidence level P = 0.95,	10 – 50
Range and error of gamma radiation EDR measurement	0.1 – 100
Continuous operation from the storage battery (without PC), h	8
Operating temperatures, °C	-20…50
Protection class	IP65

- Data display – PC display and (or) graphical LCD display of the analyzer with the resolution 240x64
- Number of spectra stored by the analyzer AI-8K/NB during operation without PC is no less than 30

Research International, Inc. • 17161 Beaton Road SE, Monroe, Washington 98272-1034 USA
Toll Free: 1-800-927-7831 • Email: info@resrchintl.com

OVERALL DIMENSIONS AND WEIGHT OF THE MAIN COMPONENTS

	Analyzer AI-8K/NB	Detecting unit BDS-G5	Collimator
Overall dimensions	160×250×60 mm	80×300 mm	126×200×246 mm
Weight	2 kg	1.5 kg	10 kg

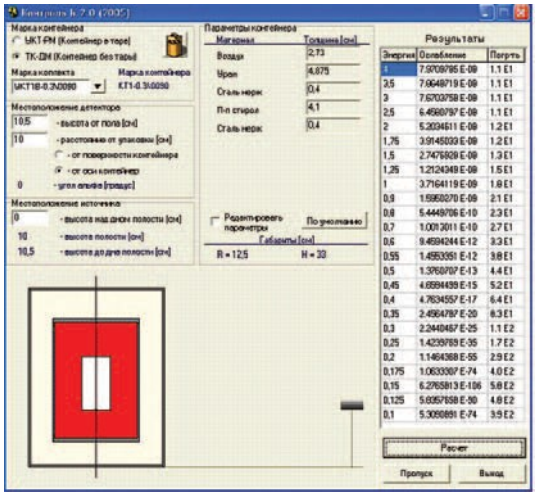
SOFTWARE

LSRMCustoms

The software is intended for measurement of activity of gamma-emitting sources in containers using gamma radiation spectrometer data.
Parameters of the containers are preset in the data base, which contains data for a wide range of containers. It allows calculation of gamma radiation absorption in the container walls.
This software is supplied with the Gamma-1S/NB1 spectrometer.

FEATURES

- Operation with a large library of radionuclides (more than 50 radionuclides)
- Determination of nuclide activity in the container
- Determination of the degree of uranium enrichment
- Determination of point source activity
- Identification of radionuclides



SEA-13P
SEMICONDUCTOR ALPHA SPECTROMETER

PURPOSE

The semiconductor alpha radiation spectrometer SEA-13P is intended for measuring alpha energy spectra; identifying alpha-active nuclides; determining their concentration in environmental samples prepared by radiochemical separation; and directly in samples of aerosol discharges into the atmosphere, and air samples taken from AFA-RSP-20 type aerosol filters without their radiochemical treatment

APPLICATION

- For research in various fields of fundamental and applied physics
- For controlling production processes
- At factories for controlling environmental objects
- For use by environmental, epidemiological and agricultural services for controlling the quality of centralized and non-centralized water supply, livestock farming products, and soils

COMPONENTS

- Measurement chamber unit of the alpha spectrometer with a semiconductor detector (the detector area from 450 to
- 3000 mm2 is to be specified by the customer) and with a built-in ADC (for SEA-13P1)
- Amplitude-to-digital converter ADC-8K-W11(for SEA-13P)
- Applied software for Windows LSRM
- Personal computer with printer
- Vacuum pump

OPERATION

Operation of the spectrometer is based on conversion of the energy of alpha-particles, which hit the semiconductor detector located in the vacuum chamber, into electric pulses of proportional amplitude with their subsequent recording and analysis

TECHNICAL DATA

Detectable energies, MeV	3.5–9.0
Number of analyzer channels	4096
Time to get ready for operation, min	45
Integral nonlinearity in the working range of alpha energies, keV	10
Background in the energy range from 3.5 to 6.0 MeV, pulse/s	0.003
Time instability over the period of continuous operation, keV	0
Maximum statistical input intensity, pulse/s	10000
Continuous operation time, h	8

Characteristic	Rated value
Energy resolution for the 5156-keV line from the ^{239}Pu source of the OSAI set placed at a distance of 50 mm from the alpha detector of size	
450 mm^2	35 keV
1000 mm^2	50 keV
2000 mm^2	70 keV
3000 mm^2	80 keV
Absolute detection efficiency for the 5156-keV line from the ^{239}Pu source of the placed at a distance of 5 mm from the alpha detector of size	
450 mm^2	20%
1000 mm^2	25%
2000 mm^2	30%
3000 mm^2	35%

- The maximum diameter of the sample measured is 70 mm
- The range of sample-detector distances is 5–50 mm with a step of 5 mm
- Power consumption, ac 220 V, 50 Hz, is 500 W

Research International, Inc. • 17161 Beaton Road SE, Monroe, Washington 98272-1034 USA
Toll Free: 1-800-927-7831 • Email: info@resrchintl.com

OVERALL DIMENSIONS AND WEIGHT OF THE MAIN COMPONENTS

	Measurement chamber unit of alpha spectrometer	ADC-8K-W1 (for SEA-13P1)	Vacuum pump NVR-1.25D
Overall dimensions, mm	350× 180× 250	180×110	136×340×90
Weight, kg	7.5	0.3	10

The instrument is listed in the Russian State Register of Measuring Devices under No 15293-96

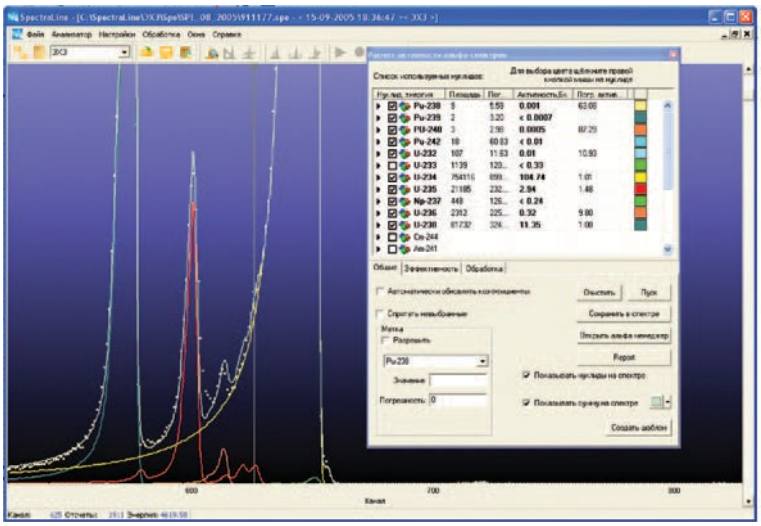
SOFTWARE

ADA (Alpha Decay Analysis)

The software is intended for processing of alpha-spectra. It is based on SpectraLine and supplied with an alpha-spectrum activity calculation module. All interface capabilities of SpectraLine are retained and access to the data base is added. This software is supplied with the SEA-13P spectrometer.

SOFTWARE FEATURES

- Activity calculation module based on the parametrical representation of alpha-spectrum lines
- Display of processing results, report in the form set by the user
- Graphical display of fitting results as spectra of separate radionuclides for visual evaluation of the fitting quality
- Storage of measured spectra and processing results in the data base to analyze multiple measurements against the preset parameters
- Determination of detection efficiency and operation with the marking



RSKV-01
RADIOMETER–SPECTROMETER FOR WATER RADIATION CONTROL

PURPOSE
Continuous control of gamma-emitting radionuclides in running water.

APPLICATION
- Water monitoring at waterworks
- Waste water monitoring at plants which use gamma-emitting radionuclides in their operation

FEATURES
- Continuous automatic measurement mode
- High time and temperature stability
- High detection sensitivity
- Alarm if the preset value of the total gamma-activity is exceeded
- Integration into an automated radiation control system
- Creation of data base of spectra and measurement results
- Processing of scintillation gamma spectra
- Identification of radionuclides and calculation of their specific activity
- Certified measurement technique

COMPONENTS
- Measurement chamber with a protection screen
- Scintillation gamma radiation detecting device
- UDS-G3 on the basis of NaI (Ti) 63x160 mm*
- PVC-03 control panel
- Water treatment unit

Note: If the RSKV-01 is used as a part of a radiation control system, the system will need to include communication equipment, operator's workstation with software for radiation monitoring and spectrum processing software.

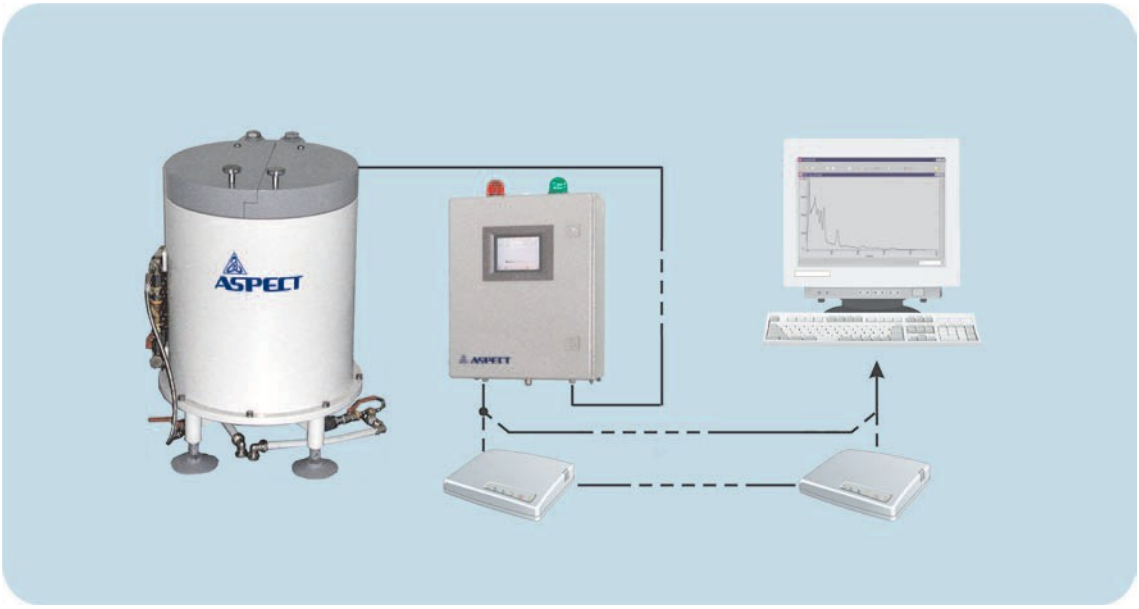
TECHNICAL DATA

Detectable energies, MeV	0.05 – 3
Relative energy resolution of radiometer against gamma radiation line with energy of 661 keV(Cs-137), %	9
Integral nonlinearity, %	1
Maximal statistic input loading, s^{-1}	$5x10^4$
Minimal detected activity of Cs-137 nuclide in a sample during 1 hour measurement time,	0.5
Time instability of conversion characteristic during 24 hours, %	1
Number of radiometer ADC channels	1024
Time necessary for operation mode setting, min	60
Continuous operation time, h	24
Power consumption 220 V, rated supply voltage, VA	50
Operating temperatures, °C	5…35
Overall dimensions:	
- PVC-03	400x586x226
- measurement chamber	985x585x852
Weight (radiometer as on assembly), kg	600

**Upon request, dimensions of the crystal and the measurement chamber can be modified*

OPERATION
The scintillation detecting device detects gamma radiation in the monitored fluid (water) and transfers the results in the form of spectra to the PVC-03 control panel. Based on these data, the PVC-03 control panel calculates total gamma activity of the monitored water. If the total gamma activity exceeds the preset threshold, sound and visual alarm is triggered. Measurements are performed in the continuous automated mode. If the radiometer operates as a part of a radiation monitoring system, spectra and processing results are transferred to the upper-level computer for their detailed processing, including identification and calculation of activity of radionuclides, recording in the data base and report generation.

Research International, Inc. • 17161 Beaton Road SE, Monroe, Washington 98272-1034 USA
Toll Free: 1-800-927-7831 • Email: info@resrchintl.com



The radiometer-spectrometer for water radiation control RSKV-01 (measurement chamber and local control panel PVC-03) is installed directly at drawoffs. The operator's workstation is installed at the central control point.

CERTIFICATES

The radiometer-spectrometer for water radiation control RSKV-01 is listed in the Russian State Register of Measuring Devices under No22385-02

SOFTWARE

LSRMWater

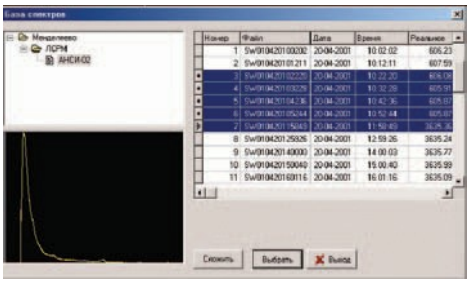
This software is intended for quantitative spectrometric analysis of measurements performed with the radiometer- spectrometer for water radiation control RSKV-01.

OPERATION WITH SPECTRUM BASE

The software is connected with the radiation control system through the spectrum base. The spectrum base is filled in by the radiation control system in the remote access mode. If the RSKV-01 is connected directly to the computer, it is possible to perform monitoring via the LSRMWater software, which allows:

- Periodical measurements and automated recording of spectra into the data base
- Sorting, viewing and selection of spectra from the data base for their processing
- Summation of several spectra

The software is based on LSRM2000 and supports all its functions, including calculation of specific activity of radionuclides



SKG-02
RADIOACTIVE WASTE INVENTORY SYSTEM

PURPOSE
Fast, reliable analysis of solid and liquid radioactive waste (RAW) located in barrels of 200 dm^3

APPLICATION
- Control of RAW at its generation and processing facilities
- RAW control at storage facilities
- Quality control and inventory monitoring of production at nuclear processing facilities

FEATURES
- Parallel recording of gamma spectra at three levels along the height of the barrel
- Automatic rotation of the barrel around its axis during the measurement
- Use of attenuation filters during measurement of high-level waste
- Determination of the composition of gamma-emitting radionuclides and their specific activity
- Automatic classification of RAW into categories according to specific activity
- Control of gamma radiation dose rate
- Storing of measurement results and spectra in the data base with possible authorized access through the local network
- Generation of a report on measurement results in accordance with the operator's request
- Two optional designs: with a built-in computer and with possible connection of a remote computer.

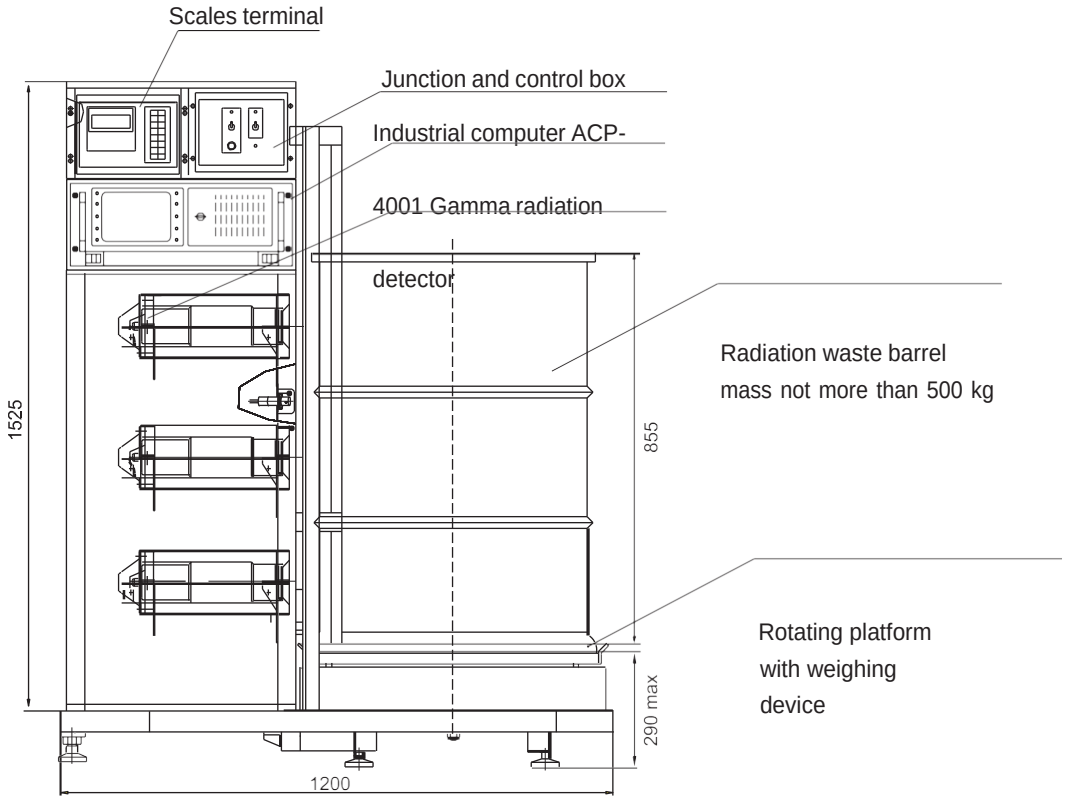
COMPONENTS
- Three spectrometric collimated gamma channels on the basis of the NaJ (Tl) crystal
- Gamma dose rate sensor
- Industrial computer
- "Diogen" software
- Weighing device
- Controllable rotating platform

TECHNICAL DATA

Energy resolution for the 661.66 keV (137 Cs) gamma line for each spectrometric channel, %		8
Ranges of specific activity measurements without attenuation filters (P=0.95), Bq/kg	Cesium – 137	25 – $6x10^6$
	Cobalt - 60	20 – $1.5x10^6$
Limits for the tolerable relative error in activity measurement (P= 0.95), %		± 30
Range of measured gamma radiation dose rates, µSv/h		0.1 – $1x10^5$
Limits for the tolerable relative error of the gamma radiation dose rate, %		± 20
Range and error of measured barrel weight with RAW, kg		(10 – 500) ± 1
Rotation velocity of the platform, rotation/ min		2
Device power supply, V		220 / 380
Operating temperature, °C		5…40
Overall dimensions, mm		700x1200x1525
Weight, kg		350

CERTIFICATES
An approval certificate of radioactive waste inventory device SKG-0 No 16310 of 24.11.2003, is listed in the Russian State Register of Measuring Devices under No 25923-03

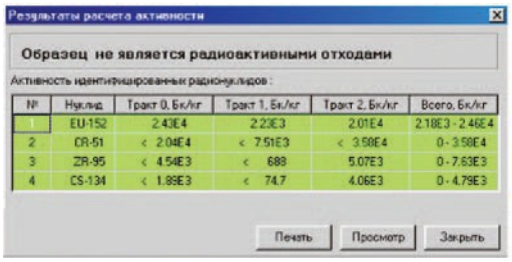
Research International, Inc. • 17161 Beaton Road SE, Monroe, Washington 98272-1034 USA
Toll Free: 1-800-927-7831 • Email: info@resrchintl.com



SOFTWARE

Diogen

Diogen software is used as a part of the radiation waste inventory system SKG-02



SOFTWARE PROVIDES:

- Software control of the device
- Measurement of the sample mass
- Spectrometric and dose information
- Energy, half-width and detection efficiency calibration of detection units
- Identification of radionuclides and calculation of specific activity of a sample
- Storage of spectra and their processing results in the data base
- Automatic classification of samples by the waste activity levels in compliance with standards

FEATURES

- Flexible system of spectrometric channels, which allows operation with any number of channels
- Two-level authorized access to the system control, which allows full setup of the system (administrator mode) and measurement the sample via a minimum of commands (operator mode)
- Unique processing algorithms for complicated scintillation spectra
- Remote access to the data base with measurement results
- Optimization of the Diogen user interface for the operation with an industrial computer with a 640*480 video mode

SNS-01A
ACTIVE-WELL COINCIDENCE COUNTER

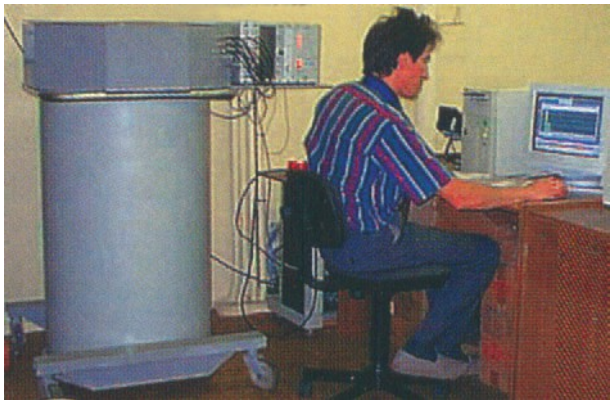
PURPOSE
For determining the mass of the U-235 elements in active mode and Pu-239 in passive mode.

APPLICATION
- Control of nuclear materials at factories where they are produced, processed, or stored.
  - The device has 42 proportional He-3 counters arranged in two rows around the measuring chamber. In the active mode, two Am-Li neutron sources with intensity 103 n/s each are used.
  - Electronic modules allow the number of coincidences to be analyzed in the optimum time window.
  - The device parameters are set and the measurement results are processed using an IBM PC type computer to which the device is connected through an RS-232 serial port.

COMPONENTS
- He-3 counters
- Moderator unit with configuration inserts
- Data acquisition and processing electronics
- Software for data exchange with the computer and data processing

TECHNICAL DATA

Detectors		Proportional He-3 counters
Detection efficiency for fission neutrons		30%
Sensitivity	thermal mode for 1000 s , U-235	No less than 5 g
	fast mode for 1000 s in the measuring volume ⌀ 320x530, U-235	No less than 200 g
	fast mode for 1000 s in the measuring volume ⌀ 320x200, U-235	No less than 100 g
Operating temperatures, °C		10…50
Power supply, V		220
Overall dimensions, mm		1281x1215 x 800
Weight, kg		450



Research International, Inc. • 17161 Beaton Road SE, Monroe, Washington 98272-1034 USA
Toll Free: 1-800-927-7831 • Email: info@resrchintl.com

SNS-02A
ACTIVE-WELL COINCIDENCE COUNTER

PURPOSE
Determination of the amount of fissile materials (uranium and plutonium isotopes) in various samples and products using nondestructive analysis (without opening the casing or packing).

APPLICATION
- Measurement of the concentration of nuclear materials in products and waste
- Inventory use at facilities where nuclear materials are produced, used, or stored.

OPERATION
The counter operation is based on measurement of the intensity and analysis of time correlations of the neutron radiation from samples placed in the measuring chamber surrounded with highly efficient proportional neutron counters.
Counter control, data acquisition, and processing of results are carried out remotely with the computer connected to the counter through an electronic module.
There are four operation modes:
- Passive mode of counting the total number of neutrons emitted by the sample, which provides the highest sensitivity in measurement of spontaneously fissioning isotopes.
- Passive mode of counting coincidence multiplicity in a given time window, which allows discrimination between neutrons from spontaneous fission and neutrons from the (α, η) reaction.
- Active mode of counting multiplicity of spontaneous fission neutron coincidences in bombardment of samples with thermal neutrons from an external neutron source, which is used to determine the U-235 content of low-enriched uranium.
- Active mode of counting coincidence multiplicity in bombardment of samples with fast neutrons from an external neutron source, which is used to determine the U-235 content of highly enriched uranium.

TECHNICAL DATA

Measuring chamber dimensions, mm	diameter	200
	height	200
Fission neutron detection efficiency, %		25
Maximum detectable coincidence multiplicity		16
Sensitivity to Pu-240 in passive mode of total counting, mg		1
Sensitivity to U-235 in active mode with thermal neutrons, g		1
Power supply, V		220
Overall dimensions, mm		1000 x 700 x 700
Weight, kg		150

Research International, Inc. • 17161 Beaton Road SE, Monroe, Washington 98272-1034 USA
Toll Free: 1-800-927-7831 • Email: info@resrchintl.com

GRANAT
MOBILE RADIATION MONITOR

PURPOSE
Detection of radioactive and nuclear materials and initial identification of radionuclides by checking pedestrians and vehicles at check points.

TECHNICAL DATA
Detection thresholds for nuclear and radioactive materials on an object moving in the search area no larger than 1.5m:

137 Cs	30 kBq
60 Co	15 kBq
WGPu	0.3 g
HE U	10 g
Pb-shielded WGPu	40 g

Pb-shielded WGPu is a sample of WGPu shielded with 3-5 cm of Pb.

Detection channels*	Gamma, neutron
Range of gamma radiation detected energies, MeV	0.05 – 3
Power consumption, W	2
Recommended speed, km/ h	5
Dimensions, mm	450x340x120
Total weight, kg	13

**On request, the system can be delivered with one of the detection channels*

- False alarm rate – no more than 1/1000
- Operation – continuous, automatic
- Uninterrupted operation after disconnection of 220V power supply – no less than 12 hours
- Service life – 12 years
- Backbone – Bluetooth

FEATURES
- Automatic adaptation to the varying natural background
- Archival storage of the alarm event data: date, time, detector count rate, channel type (gamma, neutron). An optional video monitoring system provides a record of the alarm-causing object
- Gamma detector – NaI(Tl)
- Neutron detector – proportional 3He counters
- Operating temperature – from -20 to +50°C
- Compliance with EMC requirements for nuclear instruments
- Possible remote access
- Developed self-diagnostics system.

COMPONENTS
The basic set consists of:
- Case
- Control panel based on a Pocket PC

Optional:
- Video monitoring system
- Set for remote access via a cell phone
- Devices of additional visual and audible alarm
- Software (database, video recording, operation in the local area network)

Note: Granat is under development now. Contact Research International for status.

Research International, Inc. • 17161 Beaton Road SE, Monroe, Washington 98272-1034 USA
Toll Free: 1-800-927-7831 • Email: info@resrchintl.com