MIRION TECHNOLOGIES

Gamma Analyst™ Integrated Gamma Spectrometer

Features

- Turnkey automatic gamma spectroscopy instrument
- Automatic sample changer handles multiple geometries simultaneously
- Designed to count samples to sensitivities required by regulatory limits
- Low background design
- Straightforward lab oriented user interface dialog
- Extensive QA record keeping built in
- Connects directly to Ethernet network
- Small physical dimensions for mobile or restricted space applications
- Supported by a full suite of integration, installation, calibration and training services

Description

APPLICATION OVERVIEW

Counting laboratories involved in the routine qualification and quantification of gamma emitting nuclides are burdened with the often overwhelming problem of sample management. How can sample throughput be maximized while addressing the need to meet stringent detection limits and quality standards? The normal approach is to utilize one or more technicians to manually load and count successive samples to a fixed counting time. However, this is very labor intensive and not an extremely efficient solution to the problem.

CANBERRA's Gamma Analyst is a dedicated turnkey instrument which maximizes instrument utilization and produces high quality results. The automatic sample changer facilitates maximum sample throughput with the added flexibility to handle multiple sample geometries in any combination in a single sample batch. In addition to the features which facilitate flexible batch maintenance, the sample changer design minimizes the use of critical laboratory space for the gamma spectrometer.

The instrument's performance is further enhanced by the flexibility of the software which allows the operator to define a unique assay protocol (count time, geometry, data reduction sequence, library, reports, etc.) on a sample by sample basis. A unique "Count to MDA" feature makes the most efficient use of the limited counting time available, by actually calculating the count time required to achieve a specified MDA and counting only for that period of time, thus shortening the count time for most samples.

A TURNKEY INSTRUMENT

The Gamma Analyst is a turnkey instrument solution from CANBERRA. The Gamma Analyst is available with a full suite of integration, installation, calibration and training services that let you begin productive sample counting on day one.

Traditionally, the user of a gamma spectroscopy system might spend large amounts of time integrating components, setting up hardware and software, building analysis protocols, calibrating for all the required geometries, training operators and writing operating procedures. With the Gamma Analyst and the full suite of installation and calibration services, this will all be done by CANBERRA – resulting in a much shorter time – usually a few days – to bring the new counting capacity on line.

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The Gamma Analyst is fully integrated at the CANBERRA factory. Trained experts accompany the instrument to your site and perform a full installation, site test, setup and basic training. Optionally, the instrument setup can be extended with a full set of calibrations – thus resulting in an instrument that is tailored to your specific lab operation and ready to count. Written operating procedures are also supplied, so your operators can immediately begin working.

INSTRUMENT PERFORMANCE

CANBERRA has carefully standardized all facets of the spectrometer – detector, shield, electronics and software and optimized those components to provide the optimum sensitivity. This process of standardization allows the Gamma Analyst to be characterized in terms of sensitivity performance (Minimum Detectable Activities).

The instrument is available in two standard designs, the GAMAN1 for routine counting and the GAM-AN2 for applications requiring increased counting sensitivities. Equivalent instruments with electrical cooling (GAM-AN1F and GAM-AN2F respectively) are available. For a brief comparison of the sensitivity performance of the two models see Tables 1 and 2. A more detailed comparison can be found in the “Gamma Analyst Performance Characteristics” application note.

Table 1 One Liter Marinelli – Water Matrix 10 000 Second Count Time

	GAM-AN1		GAM-AN2	
Isotope	pCi/L	Bq/L	pCi/L	Bq/L
Mn-54	12	0.5	7	0.3
Co-57	9	0.4	7	0.3
Co-60	12	0.5	7	0.3
Zn-65	34	1	23	0.8
Zr-95	21	0.8	13	0.5
I-131	12	0.5	8	0.3
Cs-134	14	0.5	8	0.3
Cs-137	14	0.5	8	0.3
Eu-152	27	1	23	0.8
Pb-214	13	0.5	10	0.4
Ra-226	250	9	150	6
U-235	15	0.6	9	0.4

Table 2 Four Liter Marinelli – Water Matrix 10 000 Second Count Time

	GAM-AN1		GAM-AN2	
Isotope	pCi/L	Bq/L	pCi/L	Bq/L
Mn-54	6	0.2	4	0.2
Co-57	5	0.2	4	0.2
Co-60	6	0.2	3	0.2
Zn-65	18	0.7	13	0.5
Zr-95	10	0.4	6	0.2
I-131	7	0.3	4	0.2
Cs-134	7	0.3	4	0.2
Cs-137	7	0.3	4	0.2
Eu-152	17	0.6	13	0.5
Pb-214	8	0.3	6	0.2
Ra-226	120	5	95	4
U-235	7	0.3	6	0.2

Note: MDA values in Tables 1 and 2 presume sea level operation, a single analyte in the sample, and a typical background radiation field. Sample containers are as indicated in Table 4.

FLEXIBLE SAMPLE HANDLING

The automatic sample changer was designed to accommodate a variety of sample geometries, maximize sample throughput and operate in a small physical area. The instrument offers a small physical footprint, only 79 x 132 cm (31 x 52 in.), which makes the Gamma Analyst an ideal instrument for laboratories with limited space, such as mobile laboratories. The low profile loading surface, only 112 cm (44 in.) high, offers convenient operator access, especially with large or heavy samples. The front control panel allows for convenient manual sample changer control during sample loading/unloading or routine maintenance. The sample changer requires no mechanical modifications to switch sample counting geometries.

This flexibility is accomplished with a unique sample carrier design which accommodates a variety of cylindrical counting geometries (see Figure 1). The sample carriers are designed to hold one of the many different types of samples in a fixed, reproducible geometry and to allow precise sample pickup, placement in the counting chamber and return to the changer carousel. This flexibility allows a single sample batch to consist of one or more samples in any combination of precalibrated geometries. Table 3 contains sample capacities for various standard counting geometries.

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Once the sample carriers are loaded onto the automatic sample changer, the operator then enters the batch/ sample specific information into the computer by the easy to follow custom user interface and starts acquisition. The rest is automatic: The samples are counted, analyzed, the data archived, and all of the user specified reports are generated.

Table 3 Standard Counting Geometry Capacities

Geometry	Carrier Required	Sample Capacity*
Marinelli Beaker greater than 15.2 cm (6 in.) in diameter (e.g. 3 L and 4 L Marinelli Beaker)	Marinelli Type	12
Marinelli Beaker less than or equal to 15.2 cm (6 in.) in diameter (e.g. 2 L, 1 L and 500 mL Marinelli beakers)	Marinelli Type	18
Flat Base Samples less than 7.6 cm (3 in.) in diameter (e.g. 20 mL vial, 47 mm Petri dish, 125 mL bottle)	Adjustable Height Type	36
Flat Base Samples less than 12.7 cm (5 in.) and greater than 7.6 cm (3 in.) in diameter (e.g. 100 mm Petri dish)	Adjustable Height Type	18
Miscellaneous samples such as 20 mL vial, 47 mm Petri dish, 125 mL bottle, less than 7.4 cm (2.9 in.) in diameter	Small Sample Cup Holder	36

*Stated sample capacity assumes all sample in the load are of the same sample type – mixed loads will have intermediate sample capacities (e.g. six 4 liter Marinelli beakers can be combined with up to eighteen 5 cm (2 in.) planchets). When using the adjustable height sample carrier, the sum of the sample height and the height above the detector cannot exceed 12.7 cm (5 in.).

LOW BACKGROUND DESIGN

The detector assembly includes a standard coaxial HPGe detector, with a U-type cryostat and integral Dewar, designed to operate in a range from 50 keV to more than 10 MeV. With the U-type cryostat configuration, the preamplifier hardware, which contains small amounts of radioactive material that could potentially elevate background levels, is kept outside of the shield. This detector/shield configuration facilitates the low profile instrument design, and reduces the overall instrument background.

The shield assembly is of a high quality, tight fitting design, consisting of 10 cm (4 in.) of low background lead and a Sn/Cu liner, to reduce background interferences and dead time at lower energies.

The internal volume of the shield assembly and detector end cap are protected by an easily removable spill liner. Thus if a sample leaks into the counting chamber, the liner can simply be removed and either decontaminated or replaced, avoiding costly downtime and expensive decontamination efforts.

INTEGRATING YOUR LABORATORY

As a member of CANBERRA's Genie™ family, the Gamma Analyst offers the same consistency of operation and flexibility, regardless of whether you choose the VMS or PC control option. Both operating interfaces make use of the same Ethernet-based computer controlled MCA, located in the Gamma Analyst. Because it's Ethernet based, the Gamma Analyst can be located and controlled from wherever it's convenient for your operation – including remote instrument control.

Complete computer control of the front end electronics means there are no knobs to turn or buttons to push, so the possibility of tampering or accidental misadjustment is eliminated. Precise adjustment of all front end electronics is accomplished via emulated controls – right on the same screen as your spectrum. Instrument settings are maintained in secure setup files, to which the system manager can restrict access – ensuring the system integrity is maintained at all times.Acomplete copy of all instrument settings is maintained with each and every sample measurement, so the instrument setup for each measurement is directly traceable to the appropriate instrument setup and calibration.

Redundancy of operation is paramount in high throughput applications – instrument down time due to computer failure cannot be tolerated. The Gamma Analyst is totally integrated, containing the detector, signal processing and control electronics – allowing instrument control to be easily switched to any of a number of existing network operating stations. Control can even be switched to a different operating platform. Both theVMSand PC operating platforms have been designed using common file structures so all calibration and analysis information is stored in identically formatted CAM files, which can be utilized by either platform.

GRAPHICAL USER INTERFACE

The instrument operates under a specially designed software package that provides the complete instrument user interface, employed on either a PC- or VMS-based processor. The user interface is procedural in nature, guiding the user through each operation step by step, which lends itself to consistency of operation with minimal training. The graphical nature of the menus presents the operator with an aesthetically pleasing and easy to follow dialog, which can be directed exclusively by mouse or keyboard, or by any combination of the two.

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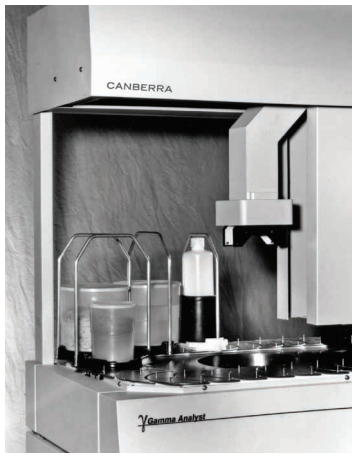

The Gamma Analyst can handle a wide variety of samples ranging from large and small Marinelli beakers to bottles, filters, Petri dishes and vials.

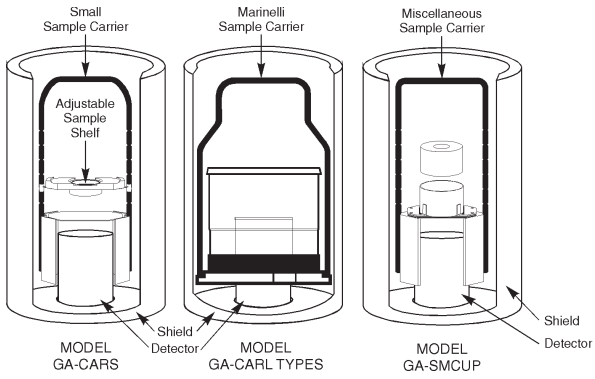

Figure 1.

User interface dialog uses “count room” terminology – not the terminology of general purpose MCAs or computer operating systems. The operator can run the complete system from within the Gamma Analyst software environment. Sample counting,QA checks, calibrations, background counting and system maintenance are all handled within one environment. The user never needs to type on the command line, enter file names or perform any other operations at the operating system level – the applications are totally integrated into one environment.

With data security in mind, the user interface has been designed with two distinct operating levels. The user level allows for operators to perform routine tasks such as data acquisition and analysis and limits the operator’s ability to edit and delete important information.

The manager level is established for those individuals who are responsible for the setup and configuration of system parameters. The system manager also has the flexibility to establish a more extensive security arrangement with multiple operating levels. This security protection has become increasingly important as spectroscopy data is associated with critical human safety and environmental concerns – where data may at some time be considered a legal record.

In the PC-based system, the security is built into the application level. Thus the security provides a level of protection against the casual intruder and inhibits accidental misoperation. For a more robust security environment, the user is advised to specify the VMS®-based Genie-ESP host package which provides security built directly into the operating system. With the Genie-ESP software, even the knowledgeable user intent on compromising the system would be stopped.

QUALITY ASSURANCE

The comprehensive Quality Assurance Software package offers the capability to automatically monitor instrument performance and setup parameters. Parameters to be monitored are defined at setup time for the instrument. Typical parameters include detector FWHM, centroid channel and background as well as manually entered parameters such as room temperature, humidity and liquid nitrogen usage. The user can select any parameter in the system to be monitored for QA. During routine operations, periodic system checks are initiated through simple menu selection – causing a QA standard to be counted and the resulting parameters transferred to the QA database. A QA record is thus created, from which the user can create control charts and reports for evaluation and permanent storage.

With today’s demands for quality, the ability to verify system performance at any given time is essential, even if it’s several years later. This is accomplished with the integrated CAM (Configuration Access Method) file format of the Genie system. CAM files provide a complete sample record every time an analysis is performed. Each CAM file contains sample header information, analysis parameters, intermediate and final analysis results, signal processing setup parameters (including instrument serial numbers) and the complete analysis library. Having this complete history stored with each and every sample enhances the integrity and verifiability of the instrument. Old sample analyses can easily be revisited without the concern for matching up the correct versions of a group of supporting files.

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To provide a historical journal of all instrument activity, an Audit Log File is automatically maintained, recording all actions performed on the system. These files include a chronological record of samples counted, calibrations, instrument QA checks, and background counts. Access to this valuable information is handled through the standard user interface, making it easy to access the information and further demonstrate the system integrity.

STANDARD OPERATING PROCEDURES

The standardized instrument design of the Gamma Analyst eliminates the hours normally needed to write custom operating procedures specific to each user's application. Each instrument includes a complete set of operating procedures governing routine sample analysis, QA checks, background collection and system calibration. Should the end user desire to customize these procedures, they are supplied in both written and electronic formats.

OPTIONAL ON-SITE CALIBRATION

Traditionally, the purchase of a new instrument meant days or even weeks of setup and calibration before you could count your first sample. The Gamma Analyst is available with an optional on-site calibration. The instrument is completely integrated and tested before leaving the factory – so when the instrument is installed on site it's ready to be calibrated by a CANBERRA Field Service Engineer. The on-site calibration option includes: energy, full width half maximum (FWHM), shape and efficiency calibrations for five user selected geometries (see Table 4) over an operating range of 50-2000 keV. Standard counting protocols are established and tested, including the building of standard nuclide libraries. You are ready to count samples in a fraction of the time.

Table 4 Recommended Sample Holders

Geometry	GAM-AN1 (3 in. End Cap)	GAM-AN2 (3.5 in. End Cap)
4 L Marinelli Beaker (1.0 g/cc)	GA-MA Model 433N	GA-MA Model 438G
1 L Marinelli Beaker (1.0 g/cc)	GA-MA Model 133N	GA-MA Model 138G
500 mL Marinelli – (1.0 g/cc)	GA-MA Model 533N	GA-MA Model 538G
500 mL Marinelli – (1.6 g/cc)	GA-MA Model 533N	GA-MA Model 538G
125 mL Polyethylene Bottle – (1.0 g/cc)	Nalgene 332089-0004	Nalgene 332089-0004
20 mL Plastic Scintillation Vial – (1.0 g/cc)	Packard Model 6001075	Packard Model 6001075
47 mm Filter Paper in a 5 cm (2 in.) Petri dish	Whatman EPM 4200/ Gelman 7242	Whatman EPM 4200/ Gelman 7242

Specifications

PHYSICAL

- OVERALL SIZE – 212.1 cm x 132.3 cm x 79.0 cm (83.5 x 52.1 x 31.1 in.) H x L x W, Height is 195.0 cm (77.0 in.) collapsed for shipping.
- WEIGHT – Approximately 1542 kg (3400 lb).
- LOADING SURFACE HEIGHT – 111.7 cm (44.0 in.).
- SHIELD CAVITY – 26.8 cm x 35.6 cm (10.5 x 14.0 in.) ID x H.
- POWER REQUIREMENTS – 110/220 V ac (±10%), 50/60 Hz, 10 A/6 A.

ENVIRONMENTAL

- OPERATING TEMPERATURE – Operating range: 15-30 °C; stable to within ±5 °C.
- OPERATING HUMIDITY – 0 to 80% relative, non-condensing.
- Meets the environmental conditions specified by EN 61010, Installation Category I, Pollution Degree 2.
- GENERAL – Clean, dust free area.

REAR PANEL ELECTRICAL CONNECTIONS

- AC POWER – IEC320 style power entry connector is provided with a shielded removable power cord.
- SERIAL COMMUNICATIONS PORT – 15-pin D-sub miniature connector for PLC control.
- ETHERNET – Two BNC connectors provide input for Ethernet connectivity.

FRONT PANEL CONTROLS

- EMERGENCY STOP – Pressing this large push button switch will immediately stop any motion whether in manual or computer mode. All drive power is immediately disabled. Any motion in progress will immediately stop.
- E-STOP OVERRIDE – Pressing this push button will allow the instrument to recover and continue from an emergency stop condition.
- RESET – When pressed for less than one second, this will send a clear error command to the PLC. If a primary command had been in progress, pressing "System Reset" while in computer mode will abort the command in progress and instruct the Gamma Analyst to perform the reverse task. When pressed for more than one second in manual mode, this will clear any controller errors and initialize the system.
- CONVEYOR ADVANCE – Each time this control is pressed, the conveyor move to the next conveyor (chain) position. If the push button is held down, continuous motion will result until the next "Home" position is reached. To continue, release the push button and press it again. When the push button is released, the conveyor will stop at the next conveyor position. This push button is only active in Manual Mode, and is only active if no sample is loaded on the detector.
- LID CYCLE – Pressing this control will cause the shield lid to manually open or close when in Manual Mode.
- REMOTE – Momentarily pressing this button will return the instrument from Manual Mode to Computer Mode. All front panel controls, except Emergency Stop will be disabled and the Remote button will illuminate.

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- LOCAL – Pressing this button will place the instrument in Manual Mode and enable the front panel Manual controls. Functional commands from the host computer are ignored and the Local button will illuminate.
- POWER – Controls the main ac power to the instrument. This switch also acts as the main circuit breaker for the instrument.

STATUS INDICATORS

- ENABLE – Illuminates when instrument drive power is available.
- IN MOTION – Illuminates when instrument motion is occurring.
- FAULT – Illuminates when the PLC senses a hard error.

ORDERING INFORMATION

MODELS:

- GAM-AN1 – Gamma Analyst Instrument – Regular sensitivity.
- GAM-AN2 – Gamma Analyst Instrument – High sensitivity.
- GAM-AN1F – Gamma Analyst Instrument – Regular sensitivity with electrically refrigerated cryostat.
- GAM-AN2F – Gamma Analyst Instrument – High sensitivity with electrically refrigerated cryostat.
  - – EACH INCLUDES: Sample changer and controller;
  - – Lead shield assembly;
  - – Germanium detector and signal processing electronics;
  - – Instrument integration;
  - – Field installation and familiarization. (Contact local office for details.)
- GAM-ANALYST – Gamma Analyst customized system.

DETECTOR END CAP

- GAM-AN1 7.6 cm (3 in.).
- GAM-AN2 8.9 cm (3.5 in.).

HOST COMPUTER PACKAGES

- GAM-G2 – Gamma Analyst Host Package – Genie 2000.
- GAM-ESP – Gamma Analyst Host Package – Genie-ESP.

ACCESSORIES

- GA-CARS – Set of 36 Adjustable Height Sample Carriers, maximum sample diameter 12.7 cm (5.0 in.).
- GA-CARL1 – Set of 18 Marinelli Sample Carriers, maximum sample diameter 12.7 cm (5.0 in.).
- GA-CARL2 – Set of 18 Marinelli Sample Carriers, maximum sample diameter 15.2 cm (6.0 in.).
- GA-CARL3 – Set of 12 Marinelli Sample Carriers, maximum sample diameter 19 cm (7.5 in.).
- GA-SMCUP – Set of 36 Cup Holder Small Sample Carriers, maximum sample diameter 7.4 cm (2.9 in.); LabSOCS™ compatible sample inserts for GA-SMCUP available – consult factory for quotation.

OPTIONS

- GA-OSCAL – On-site calibration for five geometries using customer-owned sources.
- GASPL-3 – Plastic spill protection liner for 3 in. end cap.
- GASPL-35 – Plastic spill protection liner for 3.5 in. end cap.

SOFTWARE REQUIREMENTS

(for upgrading existing computer systems)

- **S700C** – APEX® Gamma Desktop License – requires current version of S500, S501, S505, S506 and a compatible PC with Ethernet and RS-232 interface.
- **480907LL** – Gamma Analyst Control Software – AXP – requires current version of Genie-ESP base software plus NID, QA, Print/Plot packages and a compatible HP Alpha CPU computer.

MINIMUM COMPUTER REQUIREMENTS

Genie 2000:

- Pentium® 4, 2.06 Hz, minimum
- 40 GB hard disk
- 128 MB minimum on-board RAM memory
- CD-ROM, Floppy Drives
- Windows 2000 or XP Professional operating system
- Ethernet Interface
- RS-232 serial communications port

Genie-ESP:

- ALPHA CPU
- 1 GB memory
- 36 GB hard disk
- Ethernet adapter
- RS-232 serial communications port
- OpenVMS® operating system

CE

ISO 9001 SYSTEM CERTIFIED

CANBERRA