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Author(s): J. K. Halbig, S. F. Klosterbuer, P. A. Russo, J. K. Sprinkle, Jr., and S. E. Smith

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ADVANCES IN GAMMA-RAY FIELD INSTRUMENTATION AT LOS ALAMOS*

J. K. Halbig, S. F. Klosterbuer, P. A. Russo, and J. K. Sprinkle, Jr., Safeguards Assay N-1, MS-E540, Los Alamos National Laboratory, Los Alamos, New Mexico 87545 USA

S. E. Smith, Martin Marietta Energy Systems, Inc., Y-12 Plant, Oak Ridge, TN 37830 USA

We have developed a prototype miniature and modular multi-channel analyzer (M^3CA). The prototype brings together hardware and software technologies in an instrument that can be effectively used in many safeguards, arms control, nuclear industry, and environmental applications. The design uses modular building blocks for both hardware and software. It is hardware bus independent and, because of its interface philosophy, it is very versatile and is much easier to interface to external controllers than previous instruments. The prototype instrument demonstrates that low-power instruments now have the capabilities and performance required in many applications where, previously, only mains-powered instruments have been used.

Notable features of the system include the following:

1. Small size: 10 cm by 20 cm by 9 cm, including battery, power, and bias supplies.
2. Maintains spectroscopy-grade performance at input counting rates exceeding 60 k/s.
3. Software and interface designed to be easy to use, versatile, and robust in operation and communication.
4. Modular construction of both hardware and software.
5. Low power consumption.

Reference 1 describes the architecture and philosophy of the design, and Refs. 2 and 3 describe the first application. This paper will summarize performance results of the prototype with regard to this application as well as the ultimate performance of such an instrument.

We will report on a NaI enrichment user function implemented using an HP-100 palmtop computer interfaced to the prototype.

We are aware that many applications do not require the performance that is possible with the original prototype. Once the foundation is in place, application-specific building blocks can be quickly, efficiently, and relatively inexpensively developed in the context of the interface philosophy and existing software. For example, the high-performance amplifier and analog to digital converter (ADC) boards of the original prototype may be replaced by a single amplifier/ADC board for use in lower-performance applications. However, the basic hardware and software foundation will remain in place. Except for specific applications, the lower-performance instrument will respond exactly as the high-performance instrument. An example of such an application is an HM-4 performance instrument with user programs.

Because of the increase in performance of small, low-powered instruments, one can now use them across the spectrum of safeguards applications. This benefits safeguards authorities because separate hardware, development, training, and logistical efforts for in-plant and portable applications are no longer required.

Effective use of the building-block and interface philosophy leads to timely and cost-efficient adaptation of technology to solve new problems because it minimizes hardware and software development or adaptation efforts. When such a system is implemented by a safeguards authority, training, support, and maintenance costs should be reduced.

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The basic M^3CA has the versatility to support many types of detectors. A compressor-cooled germanium system is described that requires approximately 50 W of power to hold temperature. The basic M^3CA software controls the on-off status of the compressor and monitors crystal temperature and leakage current. The reduction of microphonics has been addressed by the vendor of the cryostat and crystal. In addition, for this application, the size of the electronics is being significantly reduced. Delivery and testing of the completed measurement system, an MCA-plus compressor-cooled detector, is anticipated for second quarter of calendar year 1994. We will report on preliminary tests.

The basic M^3CA design is highly adaptable to both attended and unattended use. It has features that make it attractive for unattended radiation monitoring applications.

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