

GAMMA RADIATION SPECTROSCOPY SYSTEM FOR REAL-TIME RADIATION MONITOR

GAMON-S

APPLICATIONS AND SCENARIOS

The **GAMON-S** gamma radiation spectroscopy system is designed for early environmental warning and emergency response. It runs automatic real-time analysis of surrounding gamma emitting isotopes for detecting radiological threats.

On-field installation allows **GAMON-S** to easily monitor wide surrounding area, detect small deviation from natural background thanks to the high detector efficiency, to provide detailed reports on the radioisotopes found.

GAMON-S system implements the innovative NaI™ detector with the implementation of high efficiency thermal neutron detection combined with gamma ray spectrometry in one detector only.

The **GAMON-S** has redundant alarm types, extended radiation dose rate range and configurable isotope based alarm levels.

The **GAMON-S** can be deployed in multiple scenarios ranging from the public event fast deployment to the nuclear reactor perimeter monitoring
The **GAMON-S** can be deployed in:

- ring monitor systems around nuclear facilities;
- Nationwide environmental monitoring networks;
- area monitor system in nuclear research laboratories;
- portable, mobile measurement stations for emergency response

DESCRIPTION

The **GAMON-S** spectrometer series has been designed for outdoor and indoor real-time radiation monitoring, for early environmental warning and emergency response. It can operate in harsh weather conditions and is protected from rain and moisture. The **GAMON-S** can be deployed in a wide range of scenarios, as in permanent ring monitoring as well as in moving monitoring stations. Thanks to the integrated GPS the system position can be easily monitored real time.

The **GAMON-S** spectrometer runs automatic isotope identification and isotope related dose rate evaluation. The real-time data processing and the defined isotope based alarm allow **GAMON-S** to detect the presence of artificial nuclides in a short time window and more effectively compared to traditional dose rate meters.

The user can select the isotopes to be identified from the library and adjust the thresholds of the isotope related alarms. The spectrum stabilization is obtained with the identification of natural occurring radionuclides as the ^{40}K .



The gamma detector is composed by an inorganic scintillation crystal which can be either NaI(Tl), CeBr₃ or LaBr₃(Ce). NaI(Tl) is preferable its high light yield and moderate cost, LaBr₃(Ce) for its excellent energy resolution and CeBr₃ for its good energy resolution and low internal radioactivity.

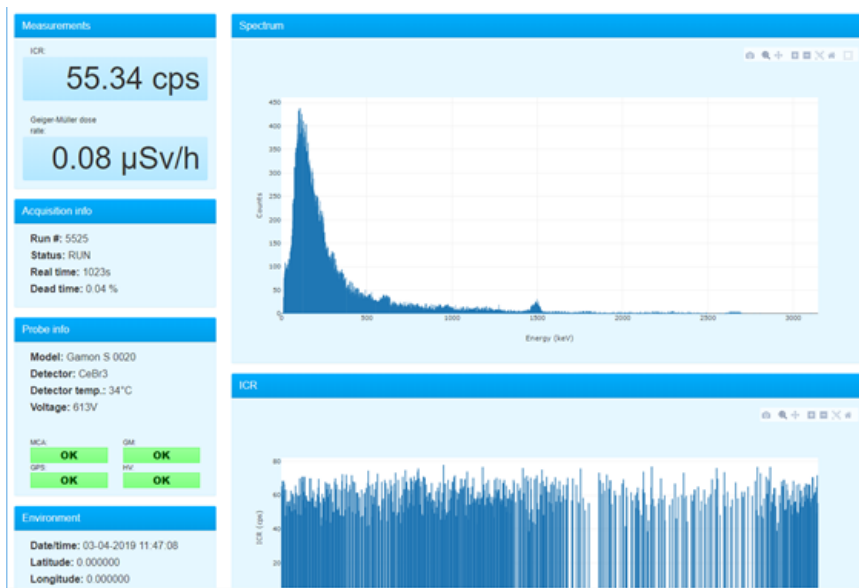
The innovative NaI™ detector can be integrated in the **GAMON-S** systems to obtain high efficiency thermal neutron

n detection combined with gamma ray spectrometry. This allows the system to detect the presence of both gamma ray emitters and special nuclear material.

Signals from scintillation detector is pre-amplified and the pulse is digitized by a 12 bit 62.5 MHz fADC. Digital signal shaping and pulse height analysis is performed by a digital MCA with 2048 channels (it can be configured to have up to 8192 channels).

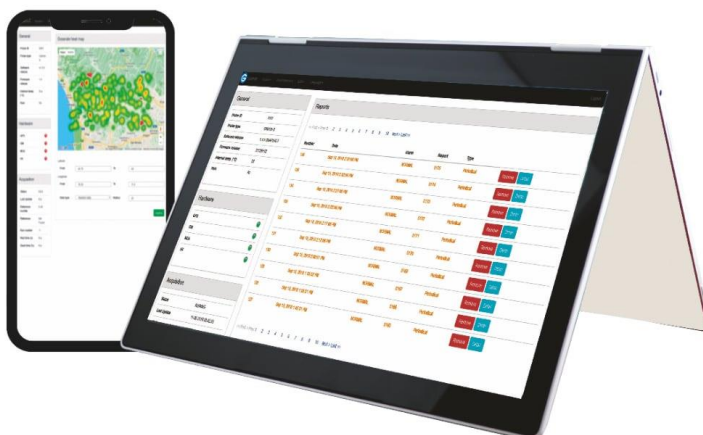
The spectroscopy detector is configured to collect gamma interactions in the energy range from 50 keV to 3 MeV, even though alternative energy ranges can be configured on request. It provides statistically accurate dose rate measurements in the range from 1 nSv/h to 500 µSv/h. An additional Geiger-Mueller counter extends the dose rate measurement up to a level of 10 Sv/h in the energy range from 50 keV to 2 MeV.

The **GAMON-S** spectrometer can be provided with wired connections, RJ45 Ethernet and USB 2.0 port, or embedding additional wireless interfaces as WiFi, GPRS/LTE and LoRa™. The operator can select the preferred communication interface and backup interfaces, which guarantee the communication thanks to its failover capability.



The **GAMON-S** embedded ARM based CPU stores the data in an internal non-volatile memory of 8 GB. The spectrometer CPU runs a web interface to allow the user to easily configure the data acquisition and the isotopic analysis. Security level of the web interface can be configured by the user to avoid unauthorized setting changes.

The spectrum integration time can be adjusted by the user. Each spectrum acquired is saved together with the onboard analysis report. Hourly and daily reports are also automatically generated. The embedded web interface can generate plots and summary tables showing the data available in the system internal database.



MAIN FEATURES

- Gamma radiation spectroscopy system based on scintillation detector and Geiger-Mueller counter
- Based on an active standalone MCA device for the digitization of outdoor gamma spectroscopy signals (patented)
- Onboard web interface for easy configuration of isotope based alarms
- Internal database for summary reports and plots, easily generated by the embedded web interface
- Robust spectrum stabilization algorithms
- Big onboard data storage for long autonomous data taking
- Designed for operating outdoor in extreme weather conditions from -40 to +60 °C
- Robust case, designed to guarantee IP68, including the power and the communication connectors
- Suited for marine environmental survey thanks to the optional fiber glass external case
- Design for easy wall and pole mounting
- Wired and Wireless communication interfaces: USB 2.0, Ethernet, WiFi and 3G/4G LTE
- Implementing long range, low power wireless platform LoRa™
- Configurable list of communication interfaces for selecting primary and backup interfaces
- Quick and easy to install and commission thanks to onboard web graphical interface
- Autonomous delivery of email and SMS on alarm to a configurable list of recipients

MODELS

The **GAMON-S** gamma spectrometer embeds wired communication interfaces or with enhanced connectivity through the integration of LoRa™, WiFi and 3G/4G LTE wireless interfaces. Both spectrometer have IP68 connectors for USB 2.0 and RJ45 Ethernet ports.

Standard Gamma Spectroscopy System:

- USB, Ethernet interfaces;
- 12 VDC power plug.

Wireless Gamma Spectroscopy System:

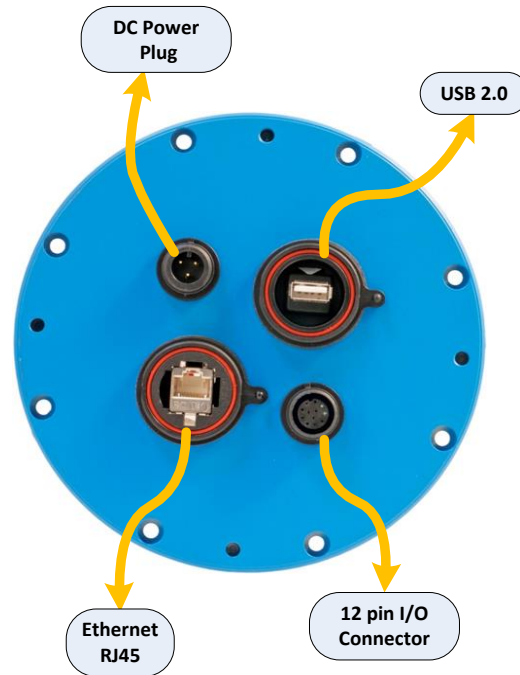
- USB, Ethernet interfaces;
- 12 VDC power plug;
- Extension with LoRa™, 3G/4G LTE and WiFi, optional rain sensor, optional backup battery.

The **GAMON-S** gamma spectrometer can be also integrated in monitoring stations for tailored solution.

Gamma spectroscopy Monitoring Station:

- Pole or wall mounted with mains power supply;
- Backup battery;
- Optional solar panel power supply;

The full spectrometer is designed to guarantee IP68, including the power and the communication interface connectors. The spectrometer case has been designed to ease wall or pole mounting, or the integration for permanent and mobile monitoring stations. The spectrometer can embed a backup battery for temporary power shortage.



The **GAMON-S** spectrometer can interface an external rain sensor for correlating possible dose rate variations due isotopes deposited by the rain. It integrates an internal temperature sensor for gamma spectrum stabilization.



TECHNICAL SPECIFICATIONS

Scintillation Detector

- Available scintillation crystals:
 - Nal(Tl) 2" x 2" – 3" x 3"
 - Nal™ 2" x 2" – 3" x 3"
 - LaBr₃(Ce) 2" x 2"
 - CeBr₃ 1.5" x 1.5"
- Energy range: 50 keV ÷ 3 MeV
- Dose rate range 1 nSv/h ÷ 500 µSv/h
- Dose rate accuracy: 10 %
- Energy resolution:
 - Nal(Tl), FWHM < 7.5 %
 - Nal™, FWHM < 7.5 %
 - LaBr₃(Tl), FWHM < 3.3 %
 - CeBr₃, FWHM < 4.2 %

Geiger-Mueller

- Energy range: 50 keV ÷ 2 MeV
- Dose rate range: 40 µSv/h ÷ 1 Sv/h
- Optional extended range 100 nSv/h ÷ 10 Sv/h

Sensors

- Internal temperature sensor
- External rain sensor on request, with extension
- GPS

Wired Communication interfaces

- Ethernet RJ45
- USB 2.0 port
- Communication protocol TCP/IP
- Connector protection level IP68

Wireless communication interfaces

- LoRa™
- 3G/4G LTE
- WiFi
- Radio communication (military frequencies based on custom request)

Data acquisition

- MCA depth: 2048 channels (8192 on request)
- ADC depth: 12 bits
- ADC sampling frequency: 62.5 MHz
- Digital signal processing

Embedded PC

- Low power ARM based CPU
- Linux based operative system
- 8 GB internal data storage

Software

- Integrated web interface
- Local database and data repository on 8 GB non volatile memory
- Hourly and daily automatically generated reports
- Adjustable integration time: 5, 10, 20, 30 min
- Spectrum stabilization with natural background isotopes
- Configurable isotope library
- Adjustable isotope related alarms
- Unattended operation for more than 1 year

Power supply

- Power consumption: < 4 W
- Voltage: 5 ÷ 12 VDC
- Power connector protection IP68

Physical dimensions and weight

- Length: 81.6 cm
- Diameter: 14.0 ÷ 17.0 cm
- Extension length (with wireless): 20.0 cm
- Extension diameter (with wireless): 26.0 cm
- Weight: up to 8 kg

Environmental

- Temperature range -40 ÷ 60 °C
- Protection level IP68 outdoor extreme weather conditions
- Relative humidity: 100% (water proof)



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