

# **GAMON Platform**

Global Measurement Platform for Nuclear Safety and Security



**CAEN SyS**

Systems & Spectroscopy Division



# Enhancing Nuclear Safety and Security



## The Challenge

Increased sensitivity to nuclear safety and security issues has prompted public entities and private institutions to maximize their ability to quickly assess risks and to intervene in the event of an accident or incident. Rapid intervention and response are achieved through nuclear measurements via airborne, ground, and underwater systems that can be effortlessly deployed, remotely controlled, and easily maintained.

Current systems often consist of detectors and monitoring devices, never designed to work together. The result is a quantity data arriving from incompatible devices and detectors that need to be integrated and analyzed. This process wastes valuable time that could otherwise be spent on response and mitigation.

A network of cohesive, well-integrated and easy deployable detection systems combined with real-time fusion and analysis of critical data is essential to facilitate and enhance decision-making process during these critical times, improving the quality of the management plan.

**Dr. Massimo Morichi**

*International Qualified Radioprotection  
and Nuclear Measurements Expert*

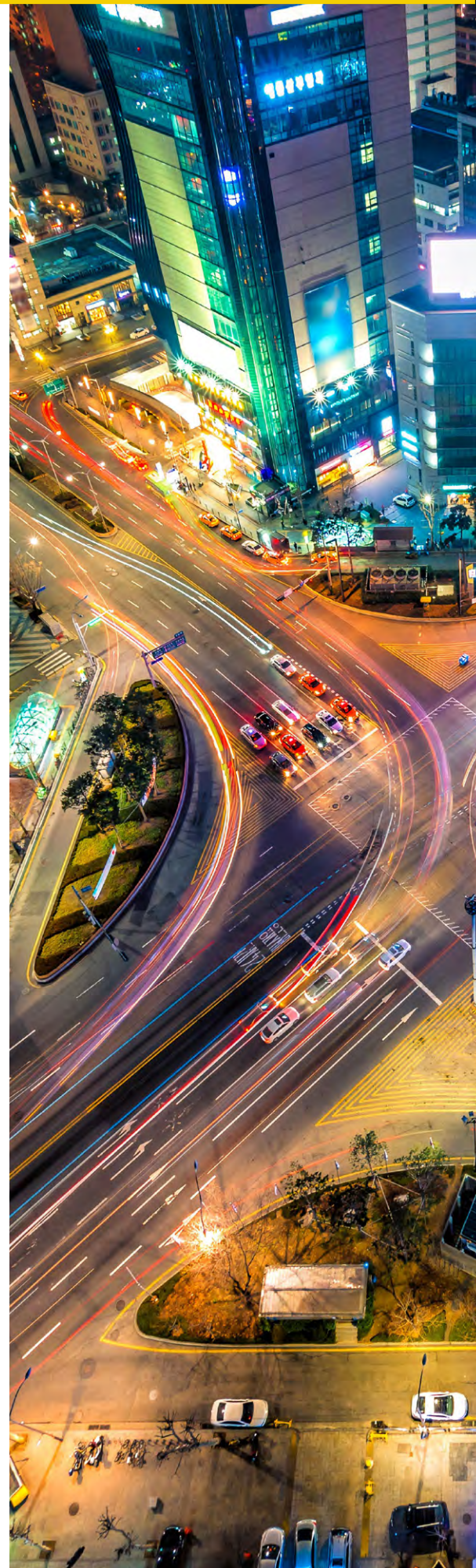
# GAMON Platform & Benefits

## The Solution

The GAMON Platform is a unique and innovative system, capable of empowering authorities and institutions with the ability to respond to a wide range of operational activities and complex radiological situations in a single, simple, reliable solution. It allows the operator to supervise all GAMON systems implemented in the field via a simple yet powerful web interface. The GAMON Platform is built upon a foundation of smart systems designed to be interconnected into a network of sensors. The GAMON Platform combines a cloud database application for visualization and analysis from all GAMON systems for autonomous and real-time measurements.

The GAMON Geo-Referenced web application allows operators and administrators to easily visualize network status and dataflow in real time. Additionally, by leveraging integrated data-fusion algorithms, operators can easily manage ongoing in-field procedures and reduce emergency intervention time.

The GAMON Platform relies on intelligent, cutting-edge, digital MCA electronics to perform data analysis and execute source identification algorithms. System network and integration options include GPS, WiFi, Bluetooth, and Long-Range (LoRa) wireless communication protocols as well as wired communication via USB and Ethernet. All data are automatically stored to a secure database via web (TCP/IP) protocol. The data can be read from this database via the GAMON web application included with the system.





## The Benefits

The GAMON Platform can be tailored to specific customer needs, offering critical advantages and capabilities such as rapid deployment, multi-station network development and increased personnel safety and security, in compliance with international standards. These benefits are achieved by having easy, fast, secure, and reliable access to all real time measurements. Its intuitive graphical interface allows the user to fully monitor and control the detector system, guaranteeing rapid and well-founded decision making for a prompt response to emergencies.



### Data Access

Local database with historical data stored on device non-volatile memory



### Georeferenced System

Georeferenced information for dose rate heat map



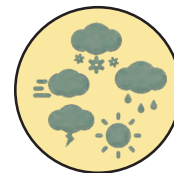
### Fast Deployment

Easy configuration of the network for security purposes



### Smart Communication

Redundant interfaces and failover configuration capability



### Harsh Weather Tolerant

Extended operational temperature range and enhanced spectrum stabilization



### Multi-system Network

Data fusion of heterogeneous systems in the network



## TOTAL BENEFITS

**Multisystem Integration**

**Enhanced ALARA**

**Prompt Deployment and Connection**

**Cost Saving**

# GAMON Platform Functionalities

## MAPPING FUNCTIONALITY

The Mapping Functionality is enabled thanks to the included GPS antenna. It allows to:

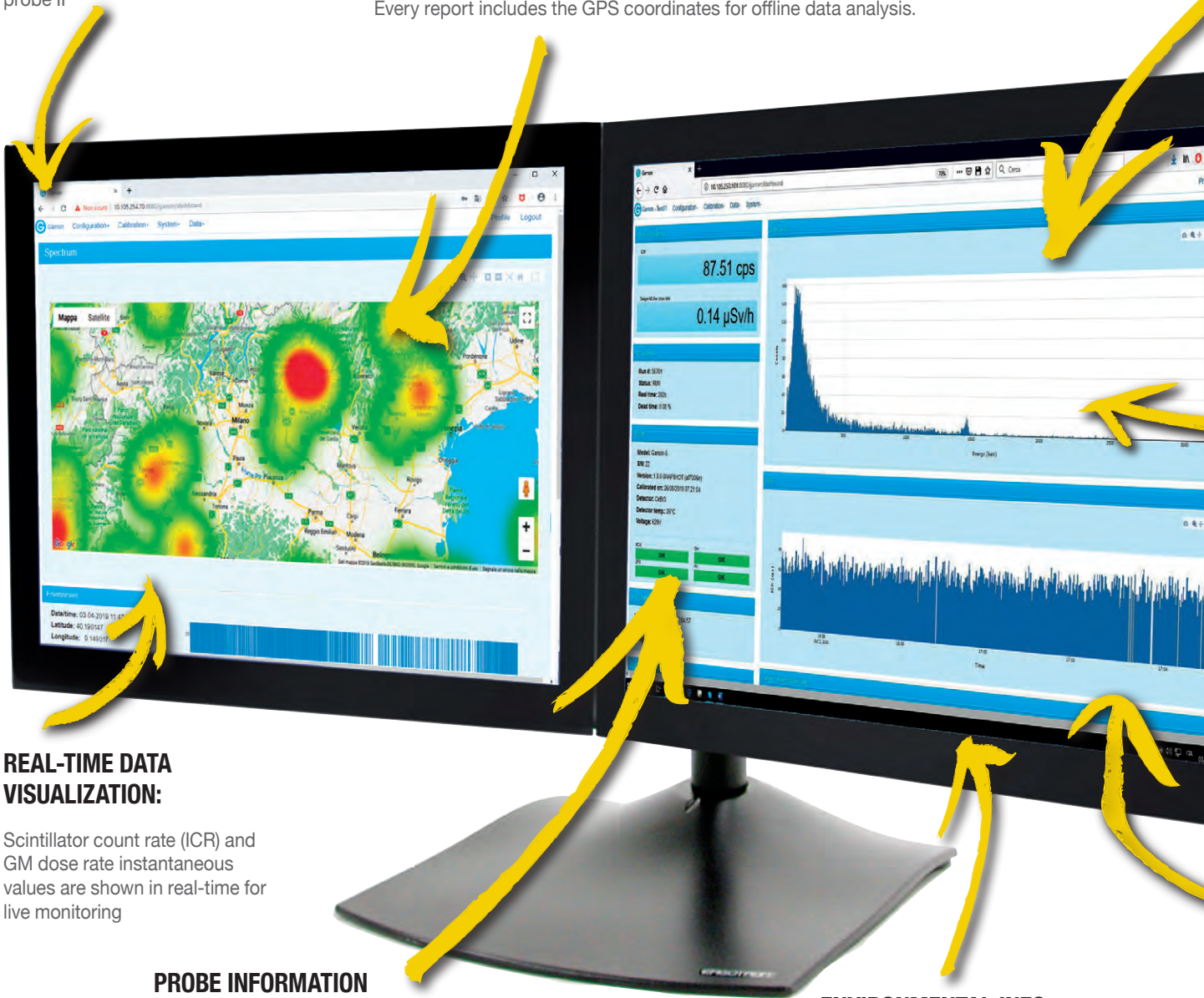
- real-time tracking of mobile systems
- immediate visualization of the distribution of contamination through the georeferenced dosimetric heat map
- depicting system status and critical radiological information and alerting the operator in case of alarm

The total H\*(10) dose heat map is obtained from the data fusion of every GAMON System deployed in the network.

Every report includes the GPS coordinates for offline data analysis.

## WEB INTERFACE

Web interface software requires no installation. Simply open a tab in your favorite browser and connect to the probe IP



## REAL-TIME DATA VISUALIZATION:

Scintillator count rate (ICR) and GM dose rate instantaneous values are shown in real-time for live monitoring

## PROBE INFORMATION

Last calibration date, PMT voltage, detector type...

Internal probe temperature data is integrated into the spectrum stabilization algorithm

## ENVIRONMENTAL INFO

An optional rain sensor detects rainfall and supports correlation analysis between weather conditions and measured data.

The included GPS antenna adds Latitude and Longitude coordinates to the dataset, thus enabling mapping functionalities and geo-referenced data fusion analysis

## AUTOMATIC SPECTRUM STABILIZATION

A state-of-the-art stabilization algorithm maintains spectra stabilization in all the weathers conditions. This feature corrects for temperature dependence in the PMT's response. This algorithm has been extensively evaluated, tested, and optimized in both outdoor environments and in environmental chambers, from  $-40^{\circ}$  to  $+60^{\circ}$  C, with fast transient (up to  $10^{\circ}$ /hour)

## LIVE SPECTRUM VISUALIZATION

Isotope Identification and very fast Spectrum Anomaly detection

## HISTORICAL DATA TREND

Supports visualization of immediate Scintillator count rate (ICR) and GM dose rate trends.

Data are shown on separated waterfall plots to enable radionuclide contamination analysis within an up-to-the-minute time window

## Automatic statistic analysis tool

The Automatic Statistic Analysis Tool allows the user to perform customized searches of reports stored in the internal database by selecting the start and the end date, status and type.

It shows the trend of:

- $H^*(10)$  dose for each identified isotope
- Average scintillator count rate (ICR)
- Average GM dose rate
- Rain (optional)

A pie chart shows the percentage of normal, warning, alert and critical reports over the period selected by the user's queries.



## Automatic calibration tool

Fast and easy Energy and FWHM calibrations may be performed via the web interface. Simply put a source near the probe and launch the calibration tool, which automatically recognizes the peaks in the spectrum and makes the calculation for the new energy and FWHM calibration curves.

## Customizable isotope library

Compliant with environmental monitoring standards, three thresholds (warning, alarm, critical) can be set for each isotope.  $H^*(10)$  dose for each identified isotope present in the library is automatically calculated in the report. Isotopes can be completely customized to the user's needs.

# GAMON Control Software

## Web interfaced based software interated in the gamon system

Each GAMON system includes an internal CPU running a web server application called GAMON Control Software eliminating the need for a central data server. Radiological information is stored in an internal database as well as in the non-volatile memory, allowing autonomous data taking even in the event of connectivity loss. Spectra, acquisition reports, and data history can be displayed and downloaded through a common web browser. Access credentials (such as user, technician, administrator) can be defined, and the degree of access of these user levels can be customized.

Spectral analysis and statistical data treatment are performed according to ISO-11929. These identification routines rely on an extended isotope library which identifies the selected radionuclides in the stabilized spectrum.

### ► Highlights

- No central data server required
- User-friendly web interface with access to data reports and historical data
- Automatic and real time diagnostics
- Isotope-based alarms fully configurable
- Prompt alarms signaling based on spectrum acquisition and Geiger-Muller counting
- Secured data and system configuration with password-controlled access and customizable levels of privileges
- Full control of data acquisition and calibration ensuring system optimization



### Static Environmental Network

Radiation measuring stations for environmental monitoring networks  
GAMON S / GAMON D / GAMON Diver



### Dynamic Monitoring Network

Mobile measuring units for first emergency response and homeland security  
GAMON Mobile / GAMON Pack / GAMON Drone

EASY VISUALIZATION OF INSTANTANEOUS RATES AND ALARMS

REAL-TIME GAMMA RADIATION SPECTROMETRY



REAL-TIME UPDATING FLOW CHARTS

IDENTIFIED ISOTOPES FROM A LIBRARY OF MORE THAN 80 TYPES

# GAMON Systems





# GAMON S

## Gamma radiation spectroscopy system for real-time radiation monitor

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 gamma detector is composed by an inorganic scintillation crystal which can be either NaI(Tl), CeBr<sub>3</sub> or LaBr<sub>3</sub>(Ce). NaI(Tl) is preferable its high light yield and moderate cost, LaBr<sub>3</sub>(Ce) for its excellent energy resolution and CeBr<sub>3</sub> for its good energy resolution and low internal radioactivity.





### ▶ Operative Application

- Ring monitor systems around nuclear facilities
- Nationwide environmental monitoring networks
- Area monitor system in nuclear research laboratories
- Portable, mobile measurement stations for emergency response

### ▶ Highlights

- 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
- 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
- Wired and Wireless communication interfaces: USB 2.0, Ethernet, WiFi and 3G/4G LTE
- Autonomous delivery of email and SMS on alarm to a configurable list of recipients



## ► Operative Application

- Ring monitor systems around nuclear facilities
- Nationwide environmental monitoring networks
- Area monitor system in nuclear research laboratories
- Portable, mobile measurement stations for emergency response

## ► Highlights

- Gamma dose rate monitoring system embedding two energy compensated Geiger–Mueller (GM) detectors
- Onboard web interface for easy configuration
- Wide measurement range from 10 nSv/h to 10 Sv/h with subtraction of intrinsic background
- Automatic switching between GM tubes based on the acquired count-level
- 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
- Wired and Wireless communication interfaces: USB 2.0, Ethernet, WiFi and 3G/4G LTE



## Gamma dose rate monitoring system for real-time radiation monitor

The GAMON D is a gamma dose rate monitoring system series, designed for outdoor and indoor online radiation monitoring, for early environmental warning and emergency response.

The GAMON D can operate in a wide range of scenarios, such as permanent ring monitoring and in-motion monitoring stations. It can be mounted on a tripod to be easily repositioned for typical security or emergency response applications while the GPS monitors the current location.

The GAMON D embeds two energy compensated Geiger-Mueller (GM) detectors to provide a wide detection range for ambient equivalent dose rate  $H^*(10)$ . The high-volume GM is used for low dose rate measurement and can detect small changes in the natural background even in short acquisition cycles.

The control of the two detectors is performed by the internal electronics, which continuously monitors the count rate.



# GAMON Mobile

## Vehicle Mountable Gamma Spectrometric Mapping System

The GAMON Mobile is a high-efficiency detection system designed to perform radionuclide identification from a moving vehicle such as e.g., a car, helicopter or boat. The system is very well suited to be operated on-field to assess rapid threats and to monitor large areas via mobile mounting/deployment. It can identify radionuclides and differentiate them by category, e.g., NORM, Medical, Industrial. GAMON Mobile is ideal for scanning sensitive areas, entry points and strategic areas such as embassies, EXPO events, critical infrastructure, airports, railway stations. GAMON Mobile is composed of spectrometric and dosimetric units.

The GAMON Mobile spectrometer performs automatic isotope identification and the isotope related dose rate evaluation.





### ▶ Operative Application

Radiological threat search

Emergency and first-response application for an easy control of the area

Large area survey and control for public events

Georeferenced measurements for radioactive mapping

### ▶ Highlights

Mobile system for radiological search and monitoring purposes

Spectroscopic and dosimetry probes for the identification of radionuclide gamma emitters

Neutron probe for detection of neutron emitters

Extended operation with rechargeable battery for more than 8-hour continuous acquisition

Wide data storage with the capability of saving more than 1-month continuous data acquisition

Web interface for fast and easy system and isotope-based alarm configurations

Georeferenced measurement map for real time data visualization

Scintillator detectors NaI(Tl), CeBr<sub>3</sub>, LaBr<sub>3</sub>(Ce) or NaI<sup>L</sup>™ for gamma and neutron detection

# GAMON Drone

## Dose and spectrometric detection unit, light weight

The GAMON-Drone is a compact and light weight spectrometer specifically designed for UAV environmental radiation protection, inspection, and site remediation after the dispersion of radiological or nuclear material.

The system can be used as a measurement device for first responders for the exploration of hazardous areas.

The GAMON Drone spectrometer performs automatic gamma isotope identification and isotope-related dose rate evaluation. Real-time data processing and defined isotope-based alarm allow GAMON-Drone to detect the presence of artificial nuclides in a shorter amount of time and more effectively than traditional dose rate meters.

The GAMON Drone system is designed to offer the best combination of portability, low power consumption and performance. The unit is assembled in a lightweight case that contains both the Scintillator Detector and the Digital Signal Processing Electronics that performs spectrum stabilization. The spectroscopy detector is configured to collect gamma interactions in the energy range from 50 keV to 3 MeV.





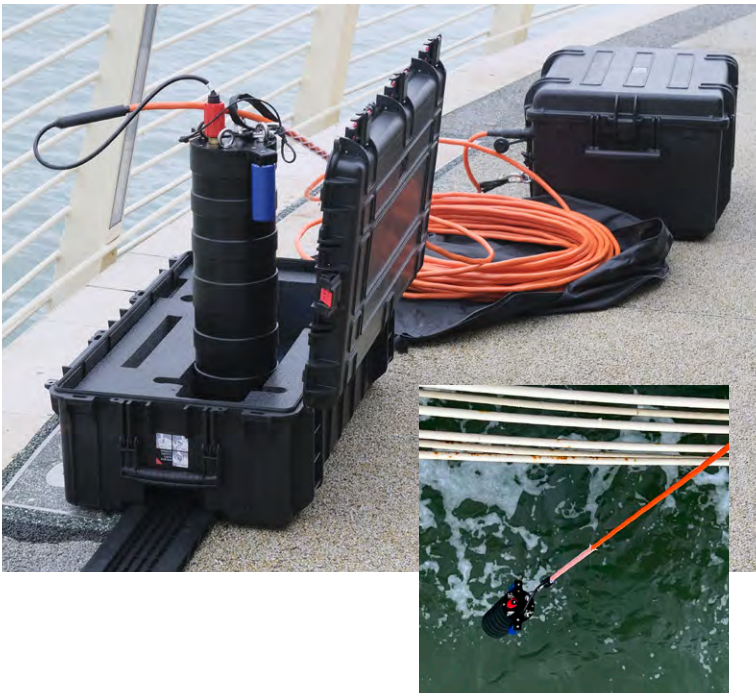
### ► Operative Application

- Survey system for radiological search and monitoring purposes
- Large area survey and control for public events
- Emergency and first-response application for an easy control of the area
- Georeferenced measurements for radioactive mapping
- Access point monitoring

### ► Highlights

- Mobile system for radiological search and monitoring purposes
- Automatic radionuclides analysis with configurable library
- Embedded gamma dose rate and spectrometry measurement units
- Programmable isotope based and dose rate alarms
- Web page for an easy system configuration and visualization of the measurements
- Georeferenced and real time data visualized by the operator
- Compatible with alternative scintillation detectors, e.g. NAIL™ and LaBr3(Ce)
- Internal database for an easy handling of the acquired data
- Count rate alarm and alarm reporting to the operator directly on the notebook
- Embedded Gain stabilization of the detector



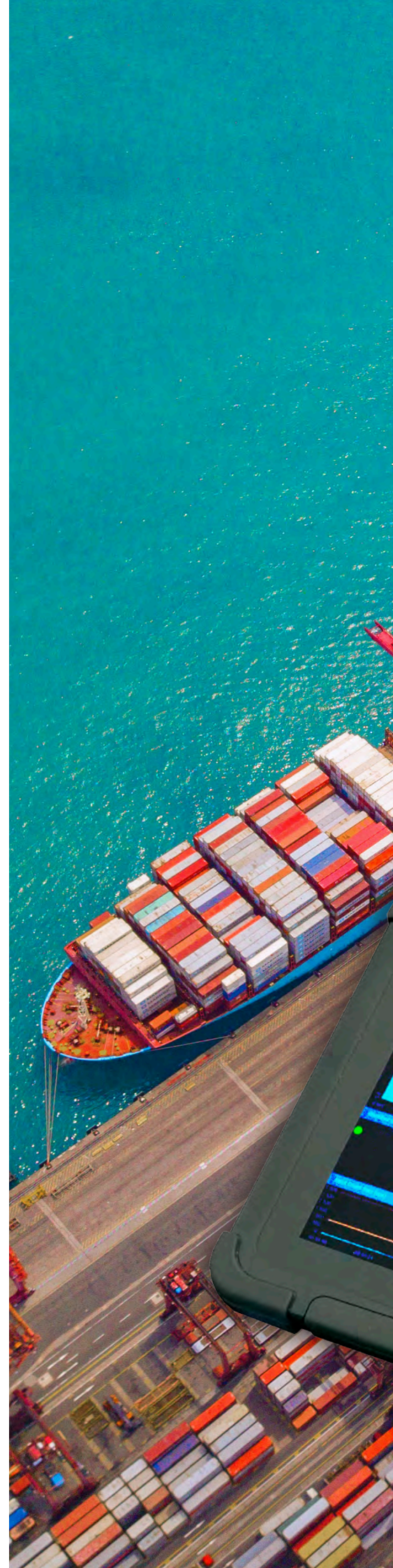


## ▶ Operative Application

- Detection and monitoring of water reservoir, lakes, ports or sea
- Long term monitoring of the environmental conditions in rivers or after a nuclear power plant or before a water extraction point
- Control of the NORM content in the Oil&Gas waste like accumulated sludge from the extraction process

## ▶ Highlights

- Underwater system for up to 450 m depth (45 ATM) in both fresh or salted water for radiological search by diver operator or in static conditions
- Web page for an easy system configuration and visualization of the measurements
- Georeferenced and real time data visualized by the operator
- Reliable and robust structure for oil & gas applications
- Internal database for an easy handling of the acquired data
- Count rate alarm and alarm reporting to the operator directly on the notebook
- Embedded Gain stabilization of the detector
- Hermetic housing for underwater and oil & gas waste operation and for an easy cleaning
- Rechargeable and Hot Swap battery for daily measurements (8h of operation with battery)
- Integrated GPS used for easy mapping of the measurements
- Wired communication during the measurement session and also wireless capability for the configuration of the system
- Easy probe cleaning



## Compact underwater system for radionuclides identification

The GAMON-Diver is a highly efficient spectroscopic measurement system designed to perform for underwater radiometric measurement. The system can be deployed in multiple scenarios for gamma radionuclide identification in case of accident mitigation, first emergency response or can be installed as a long term monitoring device for sensitive underwater locations as port access points, nuclear facilities and Oil&Gas infrastructures.

The GAMON-Diver can be deployed in salt and freshwater. It can be used for dynamic mobile underwater searches or stably mounted on a buoy for gamma spectroscopic measurements in real time. For long term environmental monitoring the data is transmitted to a central monitoring station that gather together the information of the deployed sensor network.

The hermetic case allows the instrument to operate at depths of 450 meters (45 ATM in water). GAMON-Diver can identify gamma-emitting radionuclides and differentiate them based on the category they belong to, distinguishing between NORM, medical and industrial.



FRONT VIEW



REAR VIEW

# GAMON Operative Applications



## Nuclear Industrial Facilities

GAMON S

GAMON D

GAMON MOBILE

GAMON DRONE

GAMON DIVER



## Access Point

GAMON S

GAMON D

GAMON MOBILE

GAMON DRONE

GAMON DIVER



## First Responder

GAMON S

GAMON D

GAMON MOBILE

GAMON DRONE

GAMON DIVER





## Environmental Monitoring

GAMON S	GAMON D	GAMON MOBILE	GAMON DRONE	GAMON DIVER
●	●			●



## Event Protection

GAMON S	GAMON D	GAMON MOBILE	GAMON DRONE	GAMON DIVER
		●		



## Critical Infrastructure

GAMON S	GAMON D	GAMON MOBILE	GAMON DRONE	GAMON DIVER
●	●		●	●



CAEN SyS, the new Systems & Spectroscopy Division of CAEN SpA, is a worldwide leader in development of Radiation Measurements Systems and Spectroscopy Solutions, engaged with high performance operations involving Nuclear Facilities, Measurements Laboratories, Security and Safeguards Applications.

CAEN SyS Systems & Spectroscopy Division is built upon CAEN traditions of teamwork and partnership.

The CAEN Network Companies is a cluster of Companies with excellence know-how. Decades of collaboration and co-development with very large international research projects have maximized CAEN SyS capability to translate customer's needs and expectations into cost-effective and reliable solutions.

CAEN SyS enormously benefits from its foundational relationship with CAEN, a world leader in designing multi-input electronics for a wide range of radiation detectors, and nowadays is involved in several leading-edge R&D collaborative projects, to continue expanding and developing expertise in high-level electronic design, and to extend competence and skills into complementary and relevant applications for the benefit of the community.

CAEN SyS is committed to delivering exceptional nuclear measurement instrumentation, expertise and technical support, offering radiation detection instrumentation and integrated turn-key solutions with added value and operational benefit for customers, enhancing safety and security through nuclear measurements in the SECURITY, SAFETY and LABORATORIES areas.

**For more information visit: [www.caensys.com](http://www.caensys.com)**

# Publications

Characterization of Systems for Spectrometry Measurements in Environmental Monitoring, SECURITY AND SAFETY APPLICATIONS; G. Mangiagalli, M. Morichi, M. Corbo, A. Peppersosa, E. Fanchini; Abstract, ICOND 2020 International Conference on Nuclear Decommissioning, November 24-26 2020

Modular and Integrated Sensor Network of Intelligent Radiation Monitor Systems for Radiological and Nuclear Threat Response, M. Corbo, M. Morichi, E. Fanchini, G. Mini, A. Peppersosa, G. Mangiagalli; 2020 ANIMMA 2019, EPJ Web of Conferences 225, 07005 <https://doi.org/10.1051/epjconf/202022507005>

Modular and integrated sensor network of intelligent radiation monitoring systems for radiological and nuclear threat response, M. Corbo, M. Morichi, E. Fanchini, G. Mini, A. Peppersosa, G. Mangiagalli; IAEA International conference on the Security of radioactive material, December 3-7 2018

Modular and Integrated Sensor Network of Intelligent Radiation Monitoring Systems for Radiological and Nuclear Threat Response; M. Morichi, M. Corbo, A. Peppersosa, E. Fanchini, G. Mangiagalli, G. Mini; Abstract ID: 170, AIEA International conference on the Security of radioactive material, December 3-7 2018

# CAEN global presence

CAEN 

Worldwide presence

CAENsys 



**CAEN Technologies, Inc.**  
Staten Island, NY • USA



**CAEN spa**  
Viareggio • Italy



**CAEN GmbH**  
Solingen • Germany

**NEW**



**CAENspa INDIA Private Limited**  
Mumbai City • India

80

Countries where  
we are present

CAENqs 



**CAEN quantum Security srl**  
Torino • Italy

CAENels 



**CAEN ELS srl**  
Basovizza • Trieste (TS)

CAENRFID 



**CAEN RFID srl**  
Viareggio • Italy



This document, or parts thereof, may not be reproduced in any form or by any means without written permission from CAEN SyS

Although every effort has been made to ensure the accuracy of information presented in this catalog, CAEN SyS reserves the right to modify its products specifications without giving any notice; for up to date information please visit [www.caensys.com](http://www.caensys.com).

© CAEN SyS - 2023

Printed in Italy, OCTOBER 2023 - ADOCUME00168  
Technical Documentation & Communication Office - CAEN SyS



**CAEN S.p.A.**

Via Vetraia 11  
55049 - Viareggio  
Italy

Phone +39 0584 388 398

Fax +39 0584 388 959

info@caen.it

**www.caen.it**

**CAEN GmbH**

Brunnenweg 9  
64331 Weiterstadt - Germany  
Tel. +49 (0)212 254 4077  
Mobile +49 (0)151 16 548 484  
info@caen-de.com

**www.caen-de.com**

**CAEN Technologies, Inc.**

1 Edgewater Street - Suite 101  
Staten Island, NY 10305  
USA

Phone: +1 (718) 981-0401

Fax: +1 (718) 556-9185

info@caentechnologies.com

**www.caentechnologies.com**

**CAENspa INDIA Private Limited**

B205,BLDG42,B Wing,  
Azad Nagar Sangam CHS,  
Mhada Layout, Azad Nagar, Andheri (W)  
Mumbai, Mumbai City,  
Maharashtra, India, 400053

info@caen-india.in

**www.caen-india.in**