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

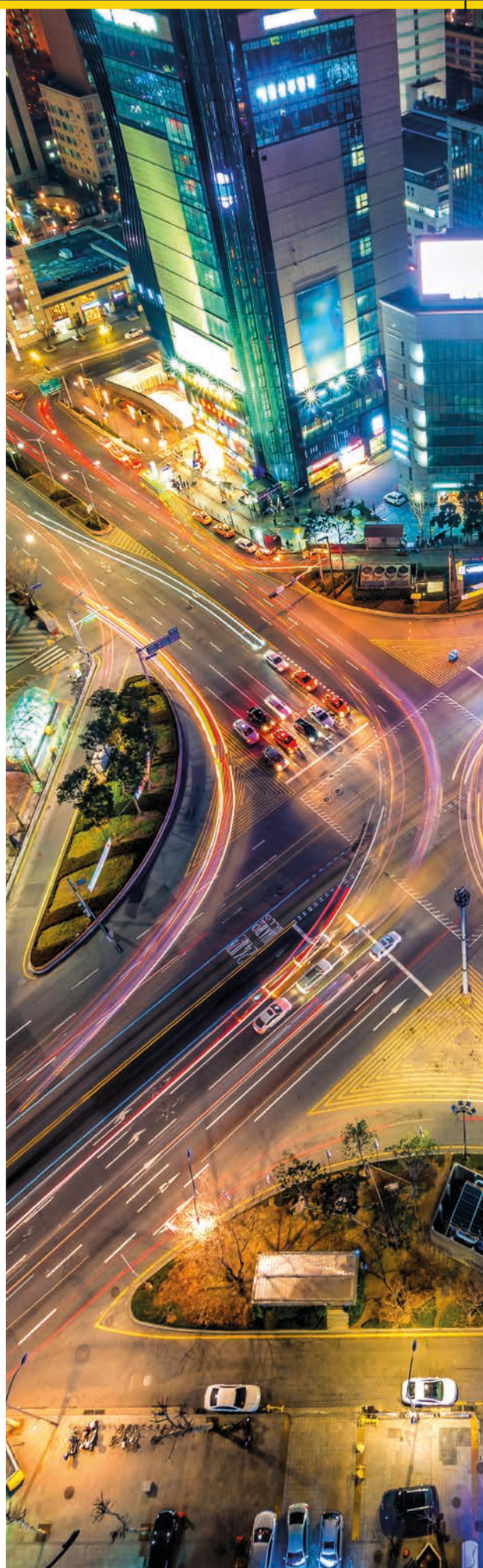
GAMON Platform & Benefits

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 Tollerant

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

WEB INTERFACE

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

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.

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° to +60° C, with fast transient (up to 10°/ 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

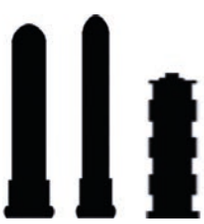
Automatic and real time diagnostics

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 Envonmental 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 RADIATIOON SPECTROMETRY

REAL-TIME UPDATING FLOW CHARTS

IDENTIFIED ISOTOPES FROM A LIBRARY OF MORE THAN 80 TYPES

GAMON Systems


GAMMA Mobile
CAEN
CAEN

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 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 40K.

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.

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

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

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

Moving average algorithm for instantaneous dose rate measurement

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

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

GAMON D

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. Customized extended range dose rate can be provided on request, from 10 nSv/h to 10 Sv/h. It can operate in a wide temperature range from -40 to 60 °C and in adverse weather conditions as it is protected from rain and humidity. The GAMON-D dose rate monitor system has low power consumption and can be powered by common AC-DC converters, additional battery packages or external solar panels.

GAMON Mobile

High efficiency mobile unit for Radionuclides identification

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. Real-time data processing and defined isotope-based alarm allow GAMON Mobile to detect the presence of artificial nuclides more effectively and in a shorter amount of time than traditional dose meters.

The system can be used in multiple scenarios for gamma radionuclide identification in case of incident mitigation, for access point security or environmental monitoring.

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

High detection efficiency for detecting minimal variation in background radioactivity during survey

Rugged housing for outdoor monitoring in public areas

Web page for an easy system configuration and visualization of the measurements

Georeferenced and real time data visualized by the operator

Embedded dosimeter and spectrometer

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

Wifi, Ethernet, USB communication

Embedded Rechargeable battery

Programmable ROI alarm

Operative Application

Radiological threat search

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

Sensitive area (e.g., airports and railway stations) survey and control

Georeferenced measurements for radioactive mapping

Highlights

Discrete housing for outdoor monitoring in public areas

Small and light enough to easily fit within carry-on luggage or backpacks

Spectroscopic and dosimetry probes for the identification of radionuclide gamma 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), CeBr3, LaBr3(Ce) or NaIL™ for gamma and neutron detection

GAMON Pack

Portable and discrete radionuclide identifier

GAMON Pack is a portable detection unit allowing detection and identification of radiation sources in crowded or sensitive areas where vehicle access is restricted.

It has been designed to perform discrete measurements in sensitive areas such as airports and railway stations where the probability for a terrorist attack is elevated.

Real-time data are displayed on a visualization device (smart phone or tablet), thus enabling the operator further discretion and anonymity within a crowded environment.

Optional solar panels (40, 60, or 100W) can be added to create a stand-alone measuring system that is small and light enough to be distributed in multiple positions.

Its setup and control are provided by a web interface supported by all the most common browsers (Chrome, Firefox, Edge). No apps or software installation is required.

A tablet providing control and communication is included with the GAMON Pack system. This tablet can be tailored to the specific application, offering ruggedization options such as MIL-STD-810G and IP65 or IP67. compliance.

The web interface displays the real-time scintillator count rate and the real-time ambient dosimeter equivalent rate (the dosimeter is provided on request).

GAMON Drone

Compact radionuclides Identification mobile unit

The GAMON Drone instrument is specifically designed for UGV/UAV environmental radiation measurement and source detection for border control, public event security, suspicious cargo goods inspection and many other scenarios.

The system can be used as a measurement device for first responders to explore hazardous areas. Its weight and dimensions allow it to easily perform real-time gamma radiation measurements on board UGV/UAV units.

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

Emergency and first response applications for a prompt control of the contaminated area

Location survey and control before, during and after public events

Characterization of the NORM accumulated in Oil&Gas extraction and processing facilities, and pipes.

Detection of orphan sources in scrap material of reprocessing plants.

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 NaI(Tl), LaBr3 & CeBr3

Internal database for an easy handling of the acquired data

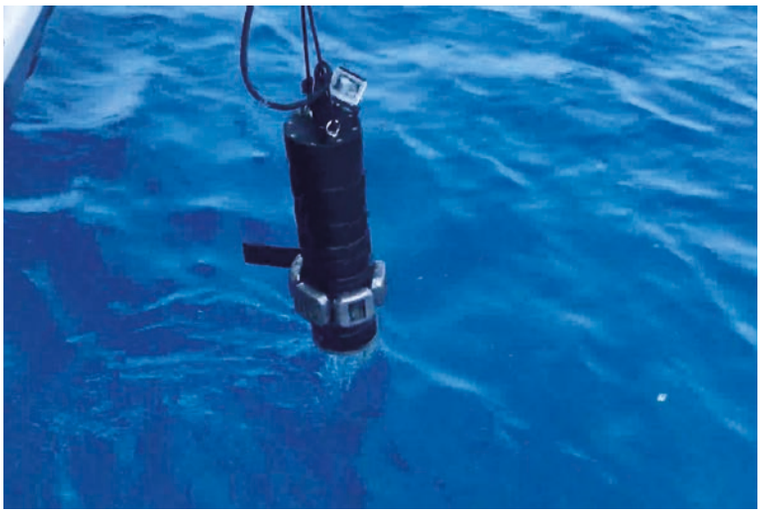
Count rate alarm and alarm reporting to the operator directly on the notebook

Embedded Gain stabilization of the detector

Digital I/O LVTTL available WiFi, Ethernet, USB communication

Embedded PC

Spectra saved in ANSI 42.42 format



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 radiological search and monitoring purposes

Web page for an easy system configuration and visualization of the measurements

Georeferenced and real time data visualized by the operator

System available for salted and fresh water

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

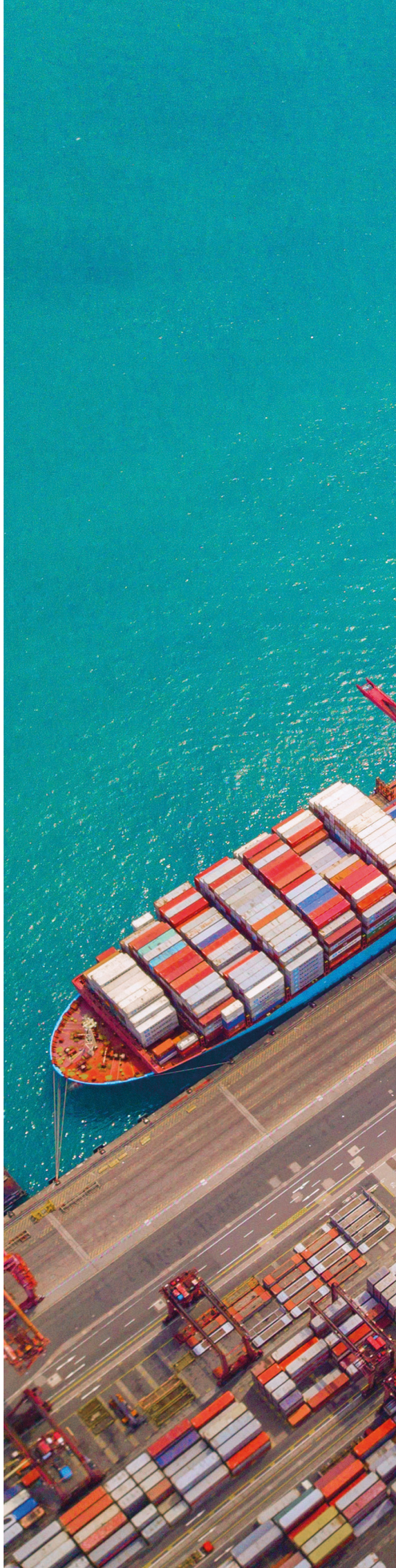
Embedded Gain stabilization of the detector

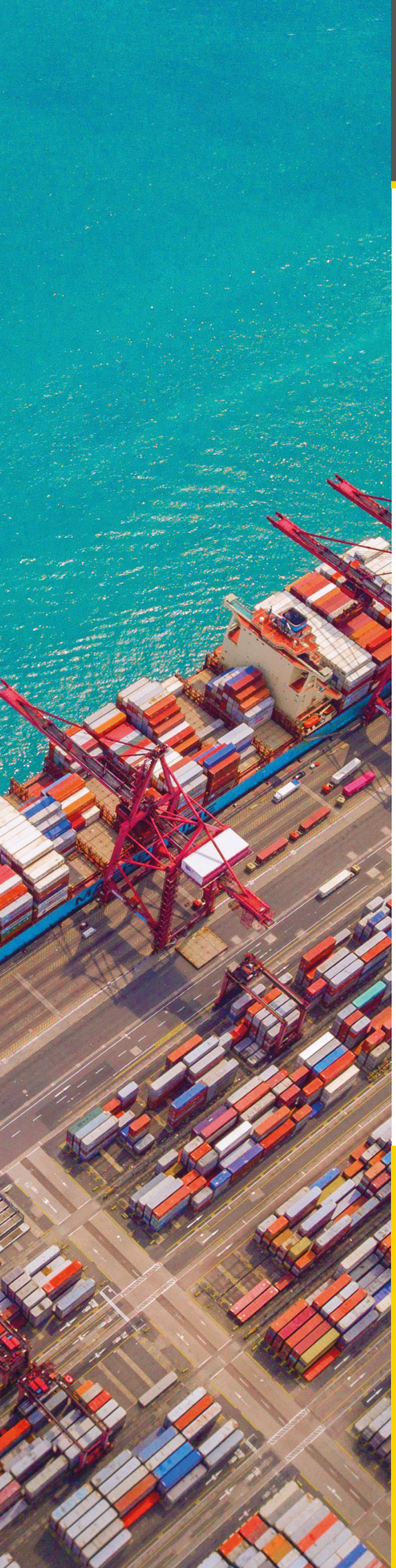
Hermetic housing for underwater and oil & gas waste operation and for an easy cleaning

Rechargeable battery for daily measurements

Integrated GPS used for an easy visualization of the measurements

Wired communication during the measurement session and also wireless capability for the configuration of the system





GAMON Diver

Compact underwater unit for radionuclides identification

The GAMON Diver instrument is specifically designed for submerged radiometric measurement and radiological alerts (e.g. water reservoirs, lakes, ports, etc.). The system can be used as a fast response measurement device, or can be installed as a long term monitoring device for sensitive underwater locations or for oil & gas application. It's weight and dimensions allow it to easily perform real-time Gamma Spectroscopic measurements while being dragged behind a small boat or watercraft.

The unit is assembled in a special hermetic submersible case which contains both the Scintillator Detector and the Digital Signal Processing Electronics that perform a specialized spectrum stabilization. This allows the instrument to operate at depths of up to 50 meters (5 ATM) in both fresh or salt water.

Thanks to the use of proprietary spectrum analysis algorithms, GAMON Diver can perform simultaneous identification of multiple radiological sources. The GAMON Diver system is designed to offer the best combination of portability, low power consumption and performance.

Each GAMON system run an application on its intelligent unit used to configure the system and take measurements.

GAMON Operative Applications

Nuclear Industrial Facilities

GAMON S	GAMON D	GAMON MOBILE	GAMON PACK	GAMON DRONE	GAMON DIVER
•	•				•

Access Point

GAMON S	GAMON D	GAMON MOBILE	GAMON PACK	GAMON DRONE	GAMON DIVER
•	•	•	•		

First Responder

GAMON S	GAMON D	GAMON MOBILE	GAMON PACK	GAMON DRONE	GAMON DIVER
		•	•	•	

Environmental Monitoring

GAMON S	GAMON D	GAMON MOBILE	GAMON PACK	GAMON DRONE	GAMON DIVER
•	•				•

Event Protection

GAMON S	GAMON D	GAMON MOBILE	GAMON PACK	GAMON DRONE	GAMON DIVER
		•	•		

Critical Infrastructure

GAMON S	GAMON D	GAMON MOBILE	GAMON PACK	GAMON DRONE	GAMON DIVER
•	•			•	•

CAEN SyS in a nutshell

CAEN Spectroscopy Division

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

Publications

Characterization of Systems for Spectrometry Measurements in Environmental Monitoring, SECURITY AND SAFETY APPLICATIONS; G. Mangiagalli, M. Morichi, M. Corbo, A. Pepperosa, 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. Pepperosa, 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. Pepperosa, 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. Pepperosa, E. Fanchini, G. Mangiagalli, G. Mini; Abstract ID: 170, AIEA International conference on the Security of radioactive material, December 3-7 2018

Printed in Italy, OCTOBER 2021
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