

## COMPACT UNDERWATER UNIT FOR RADIONUCLIDES IDENTIFICATION

# GAMON-Diver

### APPLICATIONS AND SCENARIOS

The GAMON-Diver is a waterproof gamma radiation spectroscopy system designed to search for dispersed radiological materials in water.

This system is available for salted and fresh water monitoring application and can be easily deployed from a boat or a buoy for application like:

- Monitoring of the water basins around nuclear power plants, as lakes, rivers, or sea
- Monitoring of drinking water sources, at the extraction or purification points
- Control of the TENORM content in the waste of industrial processing facilities and monitoring of the pipes for Oil&Gas transportation
- Search of orphan sources in fresh- or saltwater
- First emergency response and site remediation in case of nuclear accident or radiological material dispersion

### DESCRIPTION

The **GAMON-Diver** is a highly efficient spectroscopic measurement system designed to perform for submerged 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 access points.



The **GAMON-Diver** can be deployed in salt- and freshwater, dragged from a boat or stably mounted on a buoy for gamma spectroscopic measurements in real time. The hermetic case allows the instrument to operate at depths of 450 meters (45 ATM in water).

The **GAMON-Diver** can identify gamma-emitting radionuclides and differentiate them based on the category they belong to, distinguishing between NORM, medical and industrial.

The **GAMON-Diver** runs spectrum analysis algorithms that can perform simultaneous identification of multiple radiological sources and provides quantitative measurements in terms of dose and activity per radionuclide with its builtin detector efficiency calibration.

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

The gamma spectrometer is composed by an inorganic scintillation crystal. The system integrates NaI(Tl) inorganic scintillator with configurable volume of 2"x2" or 3"x3". Other high resolution scintillator detectors like CeBr<sub>3</sub> or LaBr<sub>3</sub>(Ce) can be integrated on request. The options like NaI(Tl) or CeBr<sub>3</sub> scintillators are best suited for low background measurements. Optional NaIL<sup>®</sup> can be installed, which gives the capability of detecting neutrons.



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.

The spectroscopy detector is configured to collect gamma interactions in the energy range from 30 keV to 3 MeV. It provides statistically accurate dose rate measurements starting from 1 nSv/h.

The **GAMON-Diver** has RJ45 Ethernet and a WiFi wireless interface thanks to the surface junction box, where a GPS receiver is also installed.



The **GAMON-Diver** 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.

The GUI of the software is a web interface reachable by a common browser. No apps or software installation is needed. Security level of the web interface can be configured by the user to avoid unauthorized setting changes.

## MAIN FEATURES

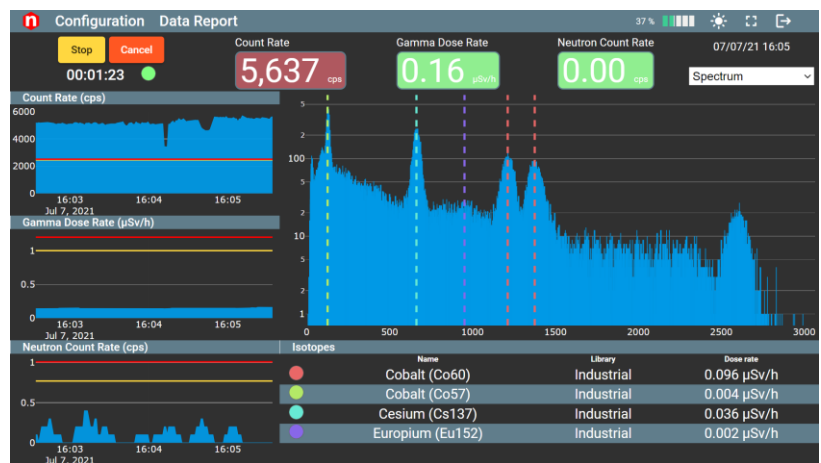
- High detection efficiency for detecting minimal variation in background radioactivity during survey
- Field Intensity and Radiation Activity calculation/Display
- Gamma Isotopic Identification in real time
- Rugged housing and resistant eyebolts for mobile surveys
- Web page for an easy system configuration 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

The web interface shows the real time counting rate of the scintillator, the real time ambient dose equivalent rate, and the live spectrum by the scintillator is available on the dashboard. Counting and dosimetry trend of the last ten minutes are displayed in flow chart to help the user in the search of radiological dispersal device.

Through the web interface the user can set the library of the radionuclides, set the alarm thresholds for each radionuclide and modify the measurement settings.

The **GAMON-Diver** integrates a GPS sensor in the surface unit to provide georeferenced display of the measured quantities. Values are presented in a dynamic map both in real time acquisition and in the reports that are automatically generated.

The **GAMON-Diver** can run an interface for attended operation modes suited for manned and unmanned surveys, for scuba divers or underwater ROV respectively. Also rugged IP65 tablets or laptop can be optionally provided, compliant with military standards for drop and vibration resistance (MIL-810G).



In alternative the system can acquire and display the data in a form suited for long term monitoring and provide alarms to a data monitoring centre. The web interface has a comprehensive dashboard with the status parameters of the monitoring station.



Marine cables can be provided of desired length. Cable reels and custom defined surface units can be provided under request.

Scintillation Detector	Nal(Tl) Ø78 x 78 mm	Nal(Tl) Ø51 x 51 mm	CeBr <sub>3</sub> Ø51 x 51 mm
Ordering Code	WSGDIVMNAAC	WSGDIVMNAAB	WSGDIVMCBAAB
Energy Range	40 keV - 3 MeV	40 keV - 3 MeV	40 keV - 3 MeV
Typical Resolution	7%	7%	4%
H*(10) Range	0.001 - 100 uSv/h	0.001 - 200 uSv/h	0.001 - 300 uSv/h
Total Efficiency to Cs-137	4000 cps/uSv/h	1850 cps/uSv/h	2000 cps/uSv/h
Peak Efficiency to Cs-137	1100 cps/uSv/h	360 cps/uSv/h	520 cps/uSv/h
Activity range for Cs-137 (10 min acquisition)	0.5 - 5x10 <sup>5</sup> Bq/kg	1 - 1x10 <sup>6</sup> Bq/kg	0.5 - 1x10 <sup>6</sup> Bq/kg

### Typical Background in 1 mt. deep Marine environment

## TECHNICAL SPECIFICATIONS

### Scintillation Detectors

- 3"x3" or 2"x2" Nal(Tl)
  - Energy range: 40 - 3000 keV
  - Energy resolution: FWHM @ 662 keV: 7.0%
- 2"x2" CeBr<sub>3</sub>
  - Energy range: 40 - 3000 keV
  - Energy resolution: FWHM @ 662 keV: 4.0%
- Other scintillators size and types on request

### Spectrometer dimensions and weight

- Diameter: 15 cm
- Height: 54 cm
- Weight: 11 Kg
- Immersion depth up to 450 m in water

### Surface Unit Interfaces

- Ethernet RJ45
- Communication protocol TCP/IP
- Connector protection level IP68
- WiFi

### Environmental

- Temperature range -10 ÷ 50 °C

### Sensors

- Internal temperature sensor for stabilization
- GPS in the surface unit.

### Data acquisition

- MCA depth: 2048 channels
- 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
- Nuclide analysis
- Configurable spectrum stabilization with natural background
- Configurable isotope library
- Adjustable isotope related alarms
- Installed and stand-alone GIS map server

### Power supply

- Power consumption: 5 to 10 W depending on acquisition mode, 12 V
- Voltage: 5 ÷ 12 VDC
- Li-Ion battery for >8 hours operation in surface unit

### Standard Military Tablet 10.1"

- IP65
- Temperature range -10 ÷ 50 °C (battery mode)
- drop test resistance up to 1.2 m
- MIL-STD-810G shock, vibration and drop resistant

### Order packages WSGDIVMNAAC WSGDIVMNAAC and WSGDIVMCBAAB include:

- Submersible Gamma Spectrometer
- Spectrometer handles and lead weight kits
- IP67 Case containing Power Supply/Battery
- IP67 Ethernet cable
- Military Tablet 10.1"
- Preinstalled GIS map for 1 selected region
- Other Optional Tablets or Laptops under request

### Cable options

- WAGDIVCAB050, 50 m marine cable
- WAGDIVCAB090, 90 m marine cable
- WAGDIVRELO01, cable reel up to 100 m
- WAGDIVRELO02, cable reel up to 50 m



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