CAEN SyS

CAEN Spectroscopy Division

SPECIAL NUCLEAR MATERIAL PORTABLE IDENTIFIER

SNIPER-GN

APPLICATIONS AND SCENARIOS

The **SNIPER-GN** special nuclear material portable identifier is designed for the **nuclear & homeland security** communities.

SNIPER-GN detects the presence of radiological threats by **gamma and neutron** counting comparison with the measured background. It also performs the identification of the sources by a patented analysis.

SNIPER-GN is the only portable device on the market that can detect and identify both gamma and neutron sources. The special features of SNIPER-GN is the **capability to identify neutron sources** distinguishing between: **SNM** as **Plutonium** and **Uranium**, fissile material (e.g. ^{252}Cf) and alpha-n sources (e.g. Am/Be)

The SNIPER-GN can be used in **multiple scenarios** ranging from the public event fast deployment to the critical infrastructure's perimeter monitoring. The SNIPER-GN can be deployed in:

- Harbor's containers or cargo airport areas;
- for customs border inspections
- Preventive and early warning detection in public access areas and for event protection
- Access point of critical infrastructures and nuclear industrial facilities
- First responder

DESCRIPTION

The **SNIPER-GN** is a radiation detection system designed to be quickly employed by the nuclear security community for homeland security purposes and/or for emergency response.
This new compact and transportable instrument can be easily hidden in a backpack or a trolley to be used in multiple scenarios ranging from the public event fast deployment to the critical infrastructure perimeter monitoring.
SNIPER-GN can also be employed for radiation monitoring of harbor's or airport's cargo areas, for custom inspection at borders and for emergency response.

The **SNIPER-GN** users can perform undercover searching measurement of orphan sources in public crowded areas (airports, stadiums …) without causing concern among the population.
SNIPER-GN *performs real time neutron/gamma discrimination by using the same Pulse Shape Discrimination algorithm implemented by* **CAEN** for the **IAEA** *Fast Neutron Collar Monitor*

SNIPER-GN runs automatic real-time counting of surrounding gamma and neutron emissions for detecting radiological threats. It can detect small deviation from the measured natural background thanks to the high efficiency detectors. The background is continuously updated while the user moves around the area. Gamma and neutron counting rates are shown separately on the software which runs on a tablet and alarm thresholds are calculated from the background moving average automatically.
Alarms are triggered separately when the rate of gamma or neutron is above the alarm threshold. The alarm thresholds are set to get a detection probability of 95% with 95% confidence level.

Software tabs show on the tablet display. Dashboard, mapping and report tabs are shown in the pictures

When the alarm pop-up appears, the user can start the 1 minute long identification measurement. The **SNIPER-GN** runs automatic isotope identification. The unique feature of SNIPER-GN respect to commercially available radiation identification devices is the neutron source identification algorithm. The **SNIPER-GN** can detect and identify neutron sources automatically, discriminating between fissile material (e.g. ^{252}Cf), alpha-n

MAIN FEATURES

- **Detection** and **localization** of radioactive materials such as **Special Nuclear Materials** (SNM) and Radiological Dispersal Devices (RDD)
- **Neutron source identification** with discrimination between fissile material, alpha-n source, plutonium and uranium
- Identification of gamma ray emitters and NORM sources
- Wi-Fi connection to tablet for data visualization
- Software functionalities: search, mapping and identification
- Backpack or trolley portable system (<10 kg)
- Battery powered with more than 10 hours of autonomy

SOFTWARE FUNCTIONALITIES

The software runs on a tablet connected through Wi-Fi to the SNIPER-GN. Data are shown in real time on the tablet

- DASHBOARD: start, pause and shutdown buttons. Real-time counting rate of gamma and neutrons
- SEARCH: Counting rate trend of gamma and neutrons in the last minute. Alarm thresholds of gamma and neutrons are plotted
- MAPPING: real-time position plot and route of the device on the map. The position where an alarm is triggered is also highlighted on the map
- REPORT: the report of the last identification measurement is reported: spectra, list of identified isotopes and their category and the confidence level

PERFORMANCES

Alarming

- Alarm for neutron and gamma are calculated with 95% detection probability at 95% confidence level for a dose rate on the front face of the scintillator of at least 50 nSv/h
- neutron alarm detection has been tested also in high gamma ray fields up to 0.1 mSv/h
- 1 second for gamma alarm
- 2 second for neutron alarm
- < 1 minute for isotope identification (also for neutron emitters)
- Detector with the best discrimination between gamma and neutron on the market.

Neutron sources identification

- IEC 62327 requirements: neutron alarm triggered in 2 seconds for a Cf-252 source with 20.000 neutrons/s @ 25 cm
- 1 minute to identify the source

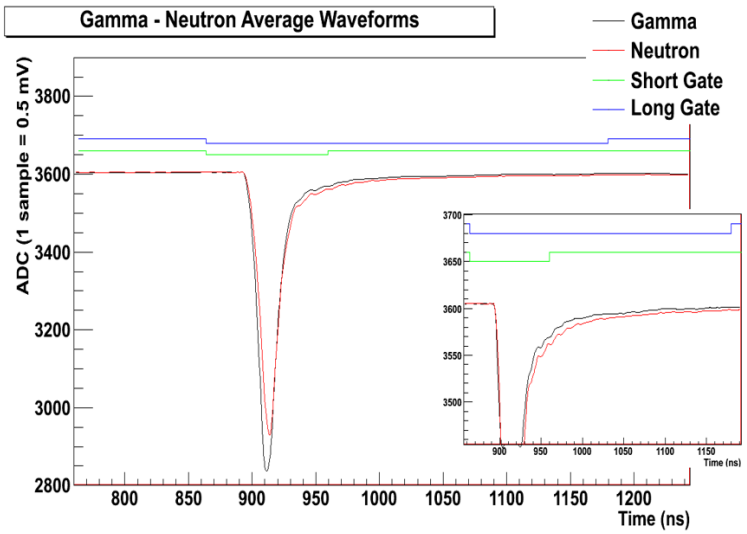
SNIPER-GN performances for 1 minute of identification

distance	shield	success
Cf-252		
25 cm	5 cm Pb + 6 cm Poly	100%
50 cm	10 cm Poly	100%
110 cm	/	100%
Am/Be		
50 cm	/	100%
Source 70% enriched in Pu-239		
125 cm	5 cm Pb + 6 cm Poly	100%
625 cm	/	100%
Source 61% enriched in Pu-239		
570 cm	/	100%

sources (e.g. Am/Be), Plutonium and Uranium. Moreover, the standard gamma isotope identification through peak search is performed thanks to the high resolution CeBr3 detector installed in the device. The isotope library is based on the ANSI 42.48 Spectroscopic Personal Radiation Detectors for Homeland Security standard. The spectrum stabilization is obtained by the identification of natural occurring radionuclides as the 40K.

Backpack and trolley options are available

SNIPER-GN software runs on a common windows tablet. Tablet and **SNIPER-GN** are connected through Wi-Fi connection thus allowing the user to control the device remotely from a greater distance than Bluetooth. This feature enhances the ALARA concept allowing to leave the measurement system close to the contamination and avoiding the possible contamination of the operator. The software shows the real-time counting of gamma and neutron and, when the counts exceed the thresholds, it visualizes an alarm.



Pulse Shape Discrimination (PSD) algorithm runs in real-time on the SNIPER-GN CPU thus discriminating gamma from neutron by using digital dual gate charge integration technique

Thanks to the integrated GPS the system position can be easily monitored real time in the mapping tab of the software. Alarmed measurements are permanently shown on the map with a highlighted icon printed on the track. The track of the user is recorded and saved in a dedicated file.
After each identification a report is automatically shown on the software. The report includes data, hour, user, GPS coordinates, spectra accumulated by the CeBr3 detector, identified radionuclides and their category (SNM, NORM, industrial or medical).
The database of the reports is always accessible from the software and it's also saved locally in a dedicated folder of the tablet.

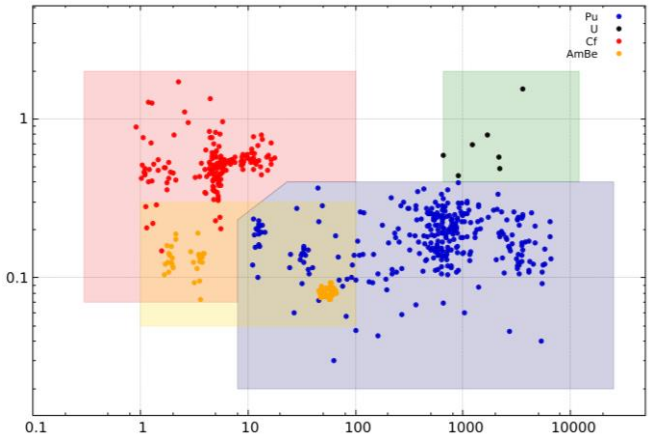
SNIPER-GN is easily transportable and ready to use with a battery pack included in the shockproof case. The battery ensures an autonomy of more than 8 hours.
Two detectors are installed inside the device:

- a novel PSD detector which can distinguish between gamma and neutron and perform the neutron identification
- a CeBr3 detector only for gamma spectroscopy measurement and gamma isotope identification

The patented analysis algorithm is based on Pulse Shape Discrimination (PSD) operated by the digitizer that allows the discrimination between neutrons and gamma rays. Tests were performed to check the neutron detection in high gamma ray field (up to 100 µSv/h) as required in the current specification for Homeland Security instrumentation. Neutron identification test were performed following the indication of ANSI N42.34-2016. Thanks to high efficiency of the neutron detector SNIPER-GN can identify the Cf-252 source:

- with emission of 20.000 neutrons/s at more than 4 times the standard distance (up to 200 cm)
- @25 cm a source with 1/16 of the emission rate (1.250 neutrons/s)

For other neutron sources like Pu-239, U-235 and Am/Be SNIPER-GN can detect at higher distances up to 25 times the standard one.



Patented neutron source identification algorithm results plotted on a 2D plot. The overlap regions are resolved by using a third parameter that allows a reliable discrimination between the sources

TECHNICAL SPECIFICATIONS

Standard procedure

- 3 minutes warm up of the system at power up.
- 3 minutes background measurement.
- Typical scanning times:
  - 1 s for a gamma ray alarm
  - 2 s for a neutron alarm
  - 1 minute for identification of gamma or neutron emitter

Power supply

- Battery powered by pouch $LiFePO_4$ rechargeable battery
  - Nominal voltage: 12 V
  - Capacity: 25 Ah
  - Storage Temperature: Best 20±5C for long-time storage
  - Cycle life: >1000 cycles
- 5 A for $LiFePO_4$ battery charger included

Mechanical

- Compact sizes: (L x W x D) = 470 x 175 x 335 mm^3
- Easy transportable: weight < 10 kg
- Rugged and shockproof containing case

Tablet

- 10.1” display
- Wi-Fi connection with the SNIPER-GN for data visualization
- Report and data logging saved locally on the tablet SSD
- *Optional: rugged tablet compliant with military standard

Neutron/Gamma PSD detector

- Dimension: 2” x 2”
- Neutron source identification allows discriminating U, Pu, Cf or Am/Be sources
- Flash Point: 144 °C

$CeBr_3$

- Spectroscopy with isotope identification
- Nuclide library compliant with the ANSI N42.34
- Energy Resolution FWHM at 662 keV < 4.2%

Environmental

- Temperature range -20 ÷ 45 °C

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