

**Portable Isotopic Neutron Spectroscopy System for the  
Identification of Chemical Warfare Agents and TICS/TIMS.**



# PINS3-CW-G2

## Portable Chemical Identification System

Working with the U.S. Department of Defense and Idaho National Labs, ORTEC has developed the PINS3-CW-G2 Portable Isotopic Neutron Spectroscopy (PINS) Non-Destructive Assay System. This new system is lighter, more portable, easier to set up, and easier to deploy on missions.

The ORTEC PINS3-CW-G2 analyzes and provides on-site identification information about the chemical contents inside munitions or other unopened containers without the need to disassemble or take a physical sample. It is widely deployed by military and intelligence organizations around the world to identify the contents of “suspect” packages.

The PINS3-CW-G2 is simple and easy to use with the addition of the ORTEC trans-SPEC-N Mechanically Cooled High Purity Germanium Spectrometer. The trans-SPEC-N has been specifically designed and tested to replace the detectors in previous generation PINS systems which used liquid nitrogen to cool the detector. The PINS3-CW-G2 provides significant advantages over previous liquid nitrogen-based systems by eliminating the logistical and safety problems associated with the storage and transport of liquid nitrogen, equipment handling, maintenance, and training.

The PINS3-CW-G2 incorporates the miniGEN D-D Neutron Generator which is approximately 66% smaller, 66% lighter, and uses 60% less power than the previous generator.

The PINS3-CW-G2 stand is made of a lightweight, carbon fiber that makes it >50% lighter than the previous stand.

The complete PINS3-CW-G2 system packs into 2 Pelican-style cases.



### Benefits

- Users have limited exposure to the material of interest.
- Users do not have to handle hazardous materials such as LN<sub>2</sub>.
- Simple, fast setup and operation.
- Longer operational times require less battery changes.
- Prepackaged in 2 Pelican Cases for easy shipping and handling.
- Reduces risk to the public, workers and emergency response personnel by rapidly obtaining detailed information and distributing it to the appropriate authorities and responders.
- Optional Detective software will allow the trans-SPEC-N to operate as a DETDX-100T-GP.

### Features

- No liquid nitrogen required.
- Uses a mechanically cooled, field deployable gamma spectrometer (ORTEC trans-SPEC-N).
- No Californium-252 source required.
- Auto analysis of chemicals.
- Uses a new smaller, portable Neutron Generator that saves weight, power, and space.
- Ruggedized laptop with latest PINS3 Chemical Analysis and Identification software.
- 12 hour runtime with external rechargeable battery.
- Lightweight carbon fiber measurement stand.
- USB and Power cables.
- Safety kit.
- Hardened wheeled transport case.

# ***PINS3-CW-G2***

## Portable Chemical Identification System

### **PINS Overview**

The Portable Isotopic Nuclear Spectroscopy (PINS) Chemical Identification System identifies dangerous compounds and mixtures non-destructively. The test object need not be opened or touched, providing significant safety benefits. As shown, PINS probes a test object with neutrons that excite the atomic nuclei within, causing the excited nuclei to produce gamma rays. The energy intensity pattern or spectrum of these gamma rays is unique for each chemical element, and by analyzing the gamma-ray spectrum, the PINS software identifies the chemical elements inside the test object and determines if the object contains a chemical warfare agent, a fill (such as sand), or a smoke generating chemical.

### **How It Works**

PINS3-CW-G2 uses neutrons produced by an electrical neutron generator to excite nuclei inside the object under test. The fusion of deuterium atoms (D + D) inside the neutron generator results in the formation of He-3 ions and a neutron with a kinetic energy of approximately 2.5 MeV. The standard PINS3-CW-G2 neutron generator produces ten million neutrons per second. The generator emits neutrons omni-directionally, and approximately 1,000 neutrons per second strike each square centimeter of the test object surface. Since neutrons are a very penetrating form of radiation, most pass through the test object casing and interact with the chemicals inside.

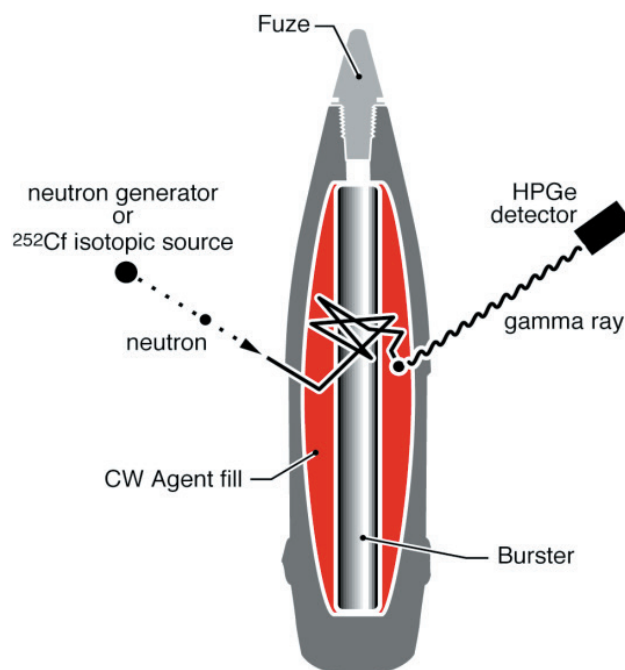
Neutrons from the generator excite the nuclei they encounter by inelastic scattering or by neutron capture. In either case, the excited nuclei decay to their ground states by gamma-ray emission, and the gamma rays are characteristic of the emitting nucleus. That is, the gamma-ray energies and intensities vary, often strongly, from one nucleus to another. For example, the hydrogen nucleus emits a 2.2-MeV gamma ray under neutron bombardment, while a phosphorus nucleus emits a 1.3-MeV gamma ray.

The neutron-induced gamma rays are measured by a high-purity germanium (HPGe) spectrometer and sorted into a spectrum by the spectrometer electronics. By analysis of the spectrum, the chemical elements excited by the neutrons are determined, and the chemical substance inside the test object can be identified.

### **PINS in Operation**

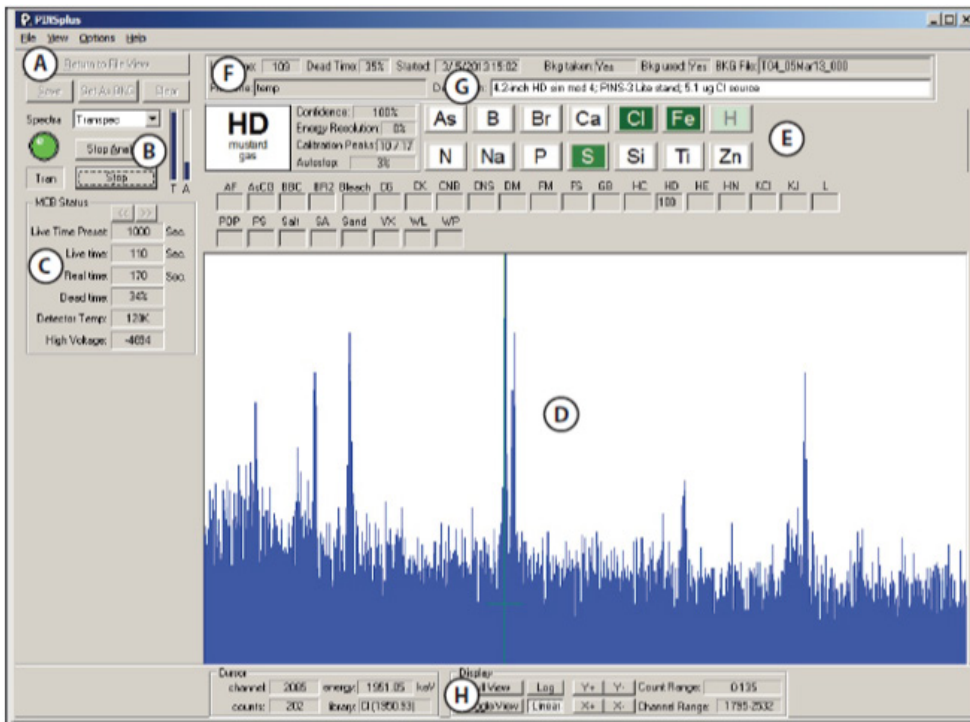
Developed for field deployment, the PINS3-CW-G2 is both portable and rugged. Its components include a mechanically cooled spectrometer with integrated multichannel analyzer, a neutron generator, a stand and shielding for the detector, and a laptop computer for user interface. Customized software displays the data in real time as it is gathered and offers powerful options for monitoring and analysis.

The laptop computer serves as the PINS3-CW-G2 control panel. The computer allows the user to initialize the instrument, start and stop data acquisition by the gamma-ray spectrometer, and display and analyze the resulting gamma-ray spectra. Connecting cables 82 feet (25 meters) long allow the computer to be set up at a safe distance from the radiation exclusion area, and also provide communication between the computer, gamma-ray spectrometer, and the neutron generator.

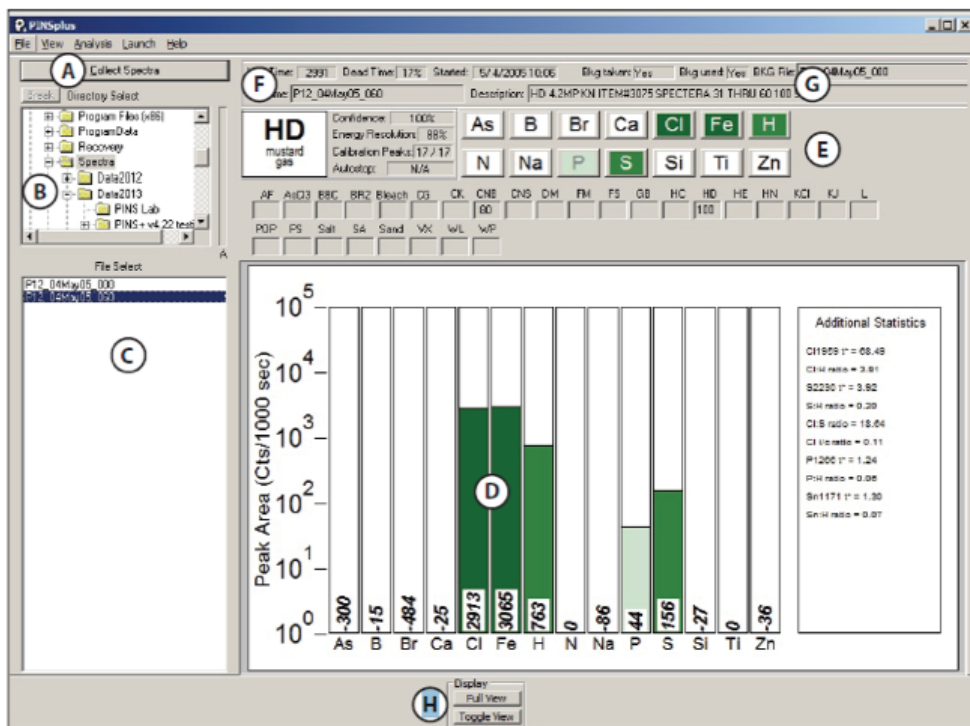


# PINS3-CW-G2

## Portable Chemical Identification System



- A) Return to file View Button
- B) Analysis Box
- C) MCA Status Box
- D) Spectra Display
- E) Element Browse Buttons
- F) Analysis Information Box
- G) Assay Information Box
- H) Toggle View Button



- A) Collect Spectra Button
- B) Folder Browser
- C) Results Display
- D) Element Browse Buttons
- E) Analysis Information Box
- F) Assay Information Box
- G) Toggle View Button

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## Portable Chemical Identification System

### **trans-SPEC-N Mechanically Cooled High Purity Germanium Spectrometer**

Unlike the liquid-nitrogen-cooled HPGe spectrometers used in previous PINS systems, PINS3-CW-G2 uses the trans-SPEC-N mechanically-cooled HPGe spectrometer, requiring no liquid nitrogen. The electrical power required to cool the spectrometer detector is approximately 30 watts. The trans-SPEC-N lithium ion battery can keep the detector cold for 10 to 12 hours and the external battery can be “hot-swapped” for extended field use of the instrument. The trans-SPEC-N provides a flexible and modular solution to support field inspections of chemical threats with the following additional features:

- No LN<sub>2</sub> — Miniature, high-reliability, “run-forever” Stirling-cycle cooler eliminates the need for LIQUID NITROGEN; detector element is encapsulated in high reliability, low loss, all-metal sealed cryostat.
- High Sensitivity — Large (>50% relative efficiency) HPGe detector.
- High Stability — Digital electronics give you the solution for the toughest analysis in the toughest conditions.
- Bright and Clear — VGA resolution display with touch sensitive operator screen.
- All-in-one Integrated Package — Rugged and compact with no interconnections — easy to setup and go.
- Smart — Nuclide ID and activity calculation for nine Regions of Interest (ROI).
- Well Connected — USB 2.0 and Wireless.
- 802.11 Communications, built-in GPS, and Secure Digital Input/Output (SDIO) storage of acquired spectra.
- Flexible — A variety of power sources can be used, including internal battery, supplemental external battery, automobile battery (any 12 V DC), and line power; all with automatic switchover.



### **miniGen Neutron Generator**

The miniGen Neutron Generator is a derivative of the popular P 385 neutron generator in a more compact format, with the DNC III control interface. The miniGen is 66% lighter and occupies 60% less space. All input and output signals are consolidated into two connectors on the front face.

The integrated front connectors have inputs for control of advanced functions such as a run timer, data logging, pulse counting, stand-by, and a facility interlock. The connectors have outputs for the source pulse and user adjustable Delay TTL signals.

The new design combines the accelerator head and control electronics into a single, compact unit.



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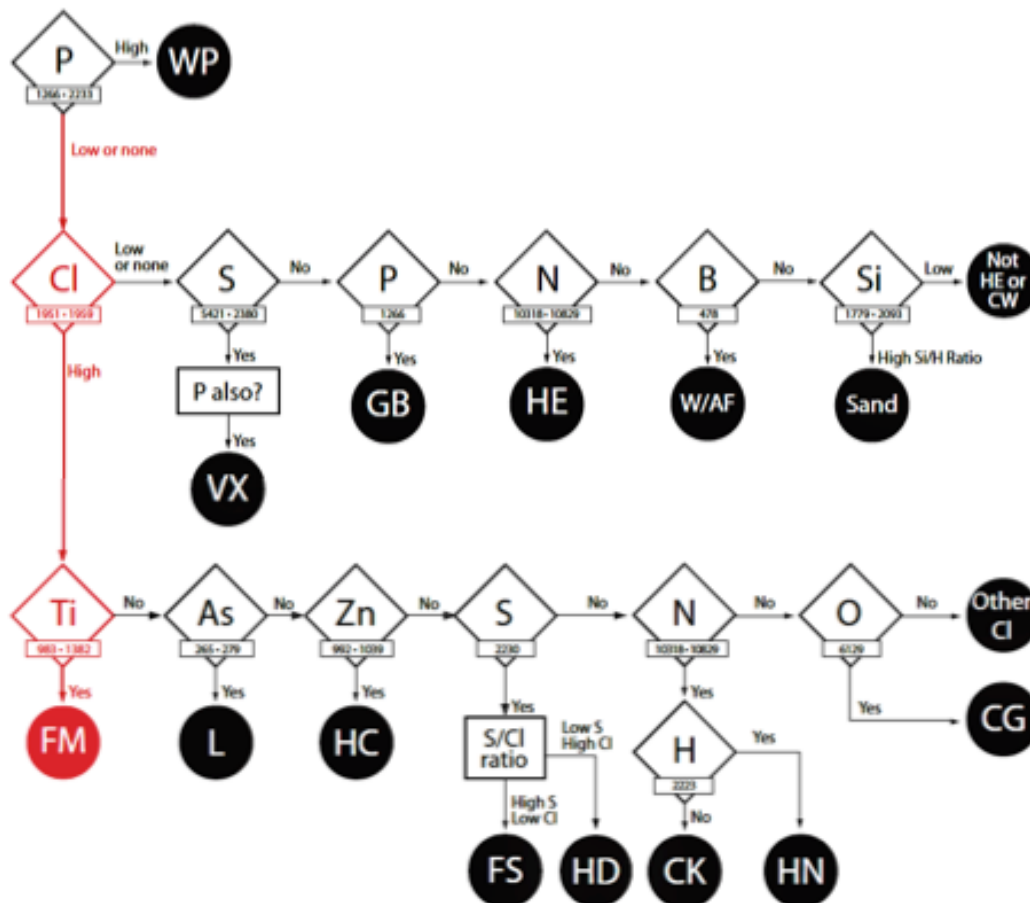
## Portable Chemical Identification System

### Auto Analysis of Chemicals

The PINS data acquisition program records and displays the incoming spectra measurements from the trans-SPEC-N. It also analyzes the spectrum being recorded every 10 seconds, fitting the peaks of interest, re-calibrating the energy scale, and performing a chemical analysis. The new chemical analysis method, based on the shown decision tree logic, attempts to identify the chemical inside the object under test. The new probabilistic method traces through every path in the decision tree, and computes a score for each possible content chemical. The chemical with the highest score is chosen as the content chemical.

The new chemical analysis method is faster and more accurate, plus it is easier to expand the list of chemicals that PINS can identify automatically. Currently, the PINS auto analysis software recognizes the chemicals shown to the right.

- | Chemicals Automatically Identified by PINS |
|--|
| <b>Chemical Warfare Agents</b>             |
| BR-2                                       |
| CG   |
| CK   |
| GB   |
| HD   |
| HN   |
| VX   |
| WL   |
| <b>Practice Fills</b>                      |
| Bleach                                     |
| POP  |
| Sand                                       |
| Water-antifreeze                           |
| <b>Riot Agents</b>                         |
| CA   |
| CNB  |
| CNS  |
| <b>Smoke Chemicals</b>                     |
| FM   |
| FS   |
| HC   |
| WP   |



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## Portable Chemical Identification System

### Specifications

Gamma-Ray HPGe Spectrometer	
Model	ORTEC trans-SPEC-N
Relative Efficiency	>50% typical (ANSI/IEEE 325-1996)
Energy Resolution	<1600 eV @ 122 keV and $\leq 2.5$ keV @ 1332 keV (FWHM Warranted at optimum settings and detector type)
Multichannel Analyzer (MCA)	Built in digital signal processing MCA
MCA Channels	Up to 16k
Dimensions	15.5 in. L x 6.55 in. W x 13.75 in. H (39.4 cm L x 16.3 cm W x 34.9 cm H)
Weight	24.4 lb. (11.1 kg)
Input Power	10–17 V DC @ 30 Watt
Internal Battery Life	>3 hours @ 77°F (25°C) for a cold detector
External Battery	Extends operating time to 12 hours @ 77°F (25°C) for a cold detector
Initial Cooldown Time	<10 hours @ 77°F (25°C)
Maintenance	Periodic detector annealing is recommended as part of a routine maintenance program for any HPGe detector operating in a high neutron environment. The scheduling of this maintenance will be dependent on the utilization and intensity of the high energy neutron source.
Laptop Computer	
Model	Panasonic Toughbook CF
Operating System	Microsoft Windows 7 or Windows 10
Hard Disk Drive Capacity	320 GB
Battery Operation Time	12.5 hours
Charging Time	4.5 hours
Dimensions	11.9 in. x 11.5 in. x 2.9 in. (30.2 cm x 29.2 cm x 7.3 cm)
Weight	8.2 lb. (3.7 kg)
Neutron Generator	
Model	miniGen
Neutron Yield, Nominal	6E+06 n/s
Pulse Range	0.5 to 20 kHz
Duty Cycle	5% to 90%, continuous
Mean Neutron Energy	2.5 MeV
External Battery	Extends operating time to 12 hours @ 77°F (25°C)
Control Interface	RS-232 or Ethernet (UDPv4)
Safety Features	Key lock, emergency On/Off, automatic pressure interlock switch, flashing warning light
Pressurized Gas Shipping Permit	DOT SPECIAL PERMIT 14690, allows the unit to ship fully pressurized. A copy of this special permit may be obtained at <a href="https://cms7.phmsa.dot.gov/approvals-and-permits/hazmat/file-serve/offer/SP14690.pdf/offerserver/SP14690">https://cms7.phmsa.dot.gov/approvals-and-permits/hazmat/file-serve/offer/SP14690.pdf/offerserver/SP14690</a>
Total Weight	16 pounds (7.3 kg)
Power Consumption	Less than 75 watts typical
Control Module Details	Open-source text and GUI
Maximum Accelerator Voltage	130 kV
Typical Tube Lifetime	1500 hours @ 3E+08, 4500 hours @ 1E+08
Outputs	Source, Delay-1, Delay-2, Delay-3, Control
Dimensions	4.25 x 8 x 10 inches
Operating Range	20 to 70 $\mu$ A, 60 to 130 kV
Input Power	24 V DC $\pm$ 10%
Operating Temperature	-10 to +50°C
Minimum Pulse Width	5 $\mu$ s

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### Ordering Information

Model	Description
<b>PINS3-CW-G2</b>	Portable Chemical Identification System. Includes miniGen Neutron Generator, trans-SPEC-N HPGe Gamma Spectrometer, Laptop, PINS Chemical Analysis and Identification Software, measurement table assembly, safety signs and tools, external DC power supply, and ruggedized, wheeled transport/shipping containers.
<b>PINS3-CW-G2-RN</b>	Portable Chemical Identification System. Includes miniGen Neutron Generator, trans-SPEC-N HPGe Gamma Spectrometer, Laptop, PINS Chemical Analysis and Identification Software, measurement table assembly, safety signs and tools, external DC power supply, and ruggedized, wheeled transport/shipping containers and Radiological and Nuclear Identification Software.
<b>SIMULANTS-12</b>	Calibration and Training Simulants. Qty 1 EA: CG, HE (Comp. B), HE (HMX), PoP, FS, GB, HC, HD, WP, L, VX, and Sand. Includes HazCom labels and 3 shipping drums.
<b>PINS3-SW-UPG</b>	PINS3 Software Upgrade to Latest Version. Requires previous purchase of PINS3 System and ITAR approval. Software will be delivered via AMEFEX Secure File Transfer. Includes MAESTRO software.