ORTEC®

Detective-EX and Detective-EX-100

HPGe-Based Portable Nuclide Identifier

The "Gold Standard" Gamma-Ray and Neutron Sensitive Hand-Held Radioisotope Identifier!

Positive Gamma-Ray and Neutron Identification of Radioactive Materials in a portable "expert" instrument.

- No more guesswork: definitive answers to the detection of illicit nuclear materials trafficking in seconds
- Fast, Simple and ULTRA-Reliable Classification of NORM, Medical, Industrial, Nuclear and Natural Isotopes
- ~20 to 100 times better[1] than even the most advanced NaI and CZT instruments
- Faster still with EX-100 version
- High Sensitivity Detection of Neutron Sources
- Gamma-Ray and Neutron Search Modes
- Battery operated instrument with high visibility color touch screen display
- Instantly ready to use at all times, straight from docking station

[1]"Better" = faster to identify single source to the same confidence level and/or ability to find Uranium or Plutonium when masked by other nuclide in specified quantity ratio. NaI = sodium iodide detector. CZT = cadmium zinc telluride detector.

As organisations trying to prevent illicit nuclear materials trafficking gain experience of real-world, in-situ nuclide identification, there is a continuing demand for ever more effective instrumentation in order improve detection abilities and reduce false determinations.

Portable instruments represent the detection front line. The ORTEC Detective family of Hand-held Radioisotope Identifiers ("HHRIDs") are based on high purity germanium (HPGe) gamma-ray detectors and represent the current technology state-of-art. Increasingly they are recognized as the "gold standard." This gold standard is now further enhanced by the addition of the Detective-EX-100 model which, including a substantially larger gamma-ray detection element, has greatly increased sensitivity, and thus even shorter time to identify, with no loss in certainty of identification.

The Problem Described

The primary method for detection of illicit nuclear materials uses gamma-ray signatures. The problem is made complex because radioactive materials are very common in everyday life. Radioactive materials are commonly used in industry, in medicine and are found in nature. Material which can be used to make a nuclear weapon, (plutonium or uranium) is often termed "Fissile" material.

An ideal HHRID must overcome at least two major technical obstacles. One is SENSITIVITY, lack of which can give rise to failures to find any radioactivity at all. A second, and perhaps more important obstacle for a hand held instrument is SELECTIVITY, lack of which can lead to the innocent alarm or false positive situation, in which a benign radioactive signature is misinterpreted as being a threat. Moreover, lack of selectivity in a hand held instrument can result in the instrument being defeated by “masking” in which an innocent nuclide is intentionally used to “hide” the signature from the illicitly trafficked nuclear material. Innocent alarms lead to unnecessary disruption at check points such as a port or airport whereas failure to detect illicit trafficking has potentially devastating consequences.

These are tough problems to deal with on the "front-line," especially with a portable instrument.

Examples of common substances, which can produce innocent alarms, are:

- Potassium nitrate fertilizers
- Vegetable produce
- Camera lenses
- Thoriated tungsten welding rods
- Lantern mantles
- Granite or marble
- Porcelain bathroom fixtures
- Ceramic tile
- Kitty litter
- Medical isotopes

Around 90% of innocent alarms at airports are due to medical isotopes in the bodies of travelers, while in cargo freight, the major problem is caused by common natural emitters.

The Detective Solution

Reliable detection and identification of radionuclides with a minimum of false negatives and false positives is a tough assignment for ANY instrument, not just portable instruments. Fortunately ORTEC has developed the Detective-EX family of HHRIDs, which feature:

- Ruggedized HPGe gamma-ray detector cooled by proven miniature, high-reliability mechanical cooler
- Operates from internal battery, line power or 12 V DC
- Moderated ^{3}He neutron detector
- Digital spectrometer electronics, performance enhanced by digital noise filter
- Proprietary nuclide identification software

The false negative issue is demonstrated by the spectra shown in Figure 1.

The spectra show the energy range 220 to 480 keV. They show respectively, barium-133 (an innocent industrial isotope), in the upper part, and barium-133 mixed with weapons grade plutonium in the lower part. The left hand spectra are from an NaI detector and the right hand spectra were taken with an HPGe detector. The yellow arrows mark the positions of the Pu peaks. The mixtures were of equal dose rate from both Ba-133 and Pu. The NaI detector mixture spectrum (lower left) shows little or no evidence of the presence of the Pu, whereas in the HPGe spectrum (lower right) the Pu peaks are distinct.

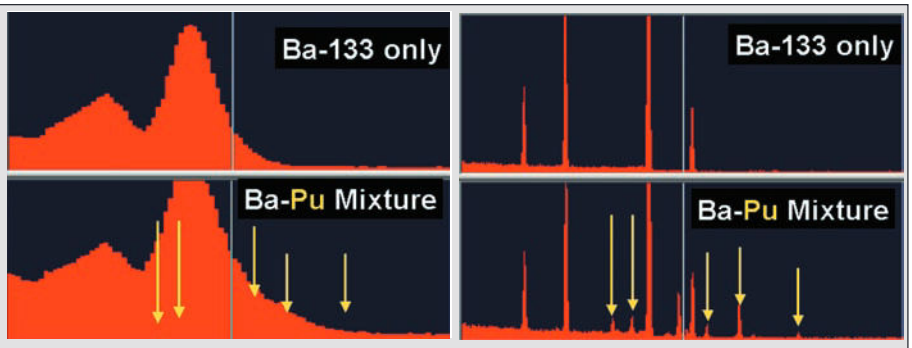


Figure 1.

With a low-resolution NaI detector, it is possible to miss a nuclear material such as plutonium, because of the presence of an innocent nuclide which may be intentionally used as a "mask." Intermediate-resolution detectors such as CZT are not able to solve the problem because their small size and low efficiency make them impractical. The low efficiency gives unreasonably long measurement times to "clear" a suspect case. Moreover, their inferior resolution to HPGe means they are still more easily "fooled" than a HPGe detector.[1]

ORTEC Detectives employ a unique class of gamma-ray detector, based upon High Purity Germanium (HPGe). ORTEC pioneered these detectors in the early 1970s and has been manufacturing them ever since, from "home grown" germanium, refined in its own facility. HPGe combines both sensitivity (the availability of large detector volume) and selectivity (the instrinsically high "energy resolution" of these detectors). Until recently, a major disadvantage of HPGe, especially for portable use, was the requirement that it operate at cryogenic temperatures. ORTEC has solved this problem by the use of miniature, ultra-reliable cryocoolers.

Other detector materials such as Sodium Iodide (NaI(Tl)) and Cadmium Zinc Telluride (CZT) are in common use in hand-held nuclide identifiers. While available in large sizes, the NaI detector has ~20 times inferior energy resolution as HPGe and is easily "fooled," especially by mixtures of radioisotopes. CZT is of intermediate energy resolution, but is only available in such small detector sizes as to make it impractical.

Independent testing has shown that room temperature gamma-ray detectors such as NaI or CZT are incapable of providing rapid, reliable and clear results.[2,3]

Neutron Detection

Fissile material such as uranium or plutonium also emit spontaneous fission neutrons, which can be detected even in the presence of heavy metal shielding. The ORTEC Detective-EX can detect these neutrons, via its high sensitivity, moderated neutron detector giving additional confirmation when such fissile nuclear materials are present.

[1] In a recent report from the United States Government Accountability Office (GAO) "GAO Report 06-389 COMBATING NUCLEAR SMUGGLING (March 2006)" Pages 32–34. The limitations of NaI instruments are well described.

[2] ITRAP final report concluded that no tested instrument could fulfill the IAEA minimum requirements concerning Isotope Identification, Results Section 5.5 Point 3, FINAL REPORT ITRAP, ARC Seibersdorf.

[3] See LANL Report LA-UR-03-2742 "Evaluation of Handheld Isotope Identifiers" J.M. Blackadar et al . All were NaI or CZT devices and in 443 measurements, the false positive plus false negative rate exceeded 60% of the total results.

Detective-EX Summary Benefits

The use of the Detective-EX means:

- Fewer False Negatives
- Fewer False Positives
- "Expert Level" Determinations without an Expert
- Confirmation of SNM Material by High Resolution Gamma ID and Neutron Detection

The use of the Detective-EX-100 means

- Even faster identification with no loss of certainty.

In Widespread Use

The ORTEC Detective family is being deployed ever more widely in the battle against illicit nuclear trafficking. Currently instruments are being deployed world wide by:

Departments of Homeland Security	Emergency Management Teams
Departments of Defense	Civil Support Teams
National Security Organizations	Police Departments
Bomb Disposal Teams	Nuclear Safeguards organizations
Emergency Response Teams	Nuclear Fuel Manufacturers
Customs and Border Control	Nuclear Researchers

Operational Capabilities

Both model Detective-EX Portable Nuclide Identifiers provide the following functions:

SEARCH: Scanning mode for location of gamma-ray-emitting and neutron-emitting radioactive sources, with audio alert using an external ear piece.

IDENTIFY: Proprietary scheme[4] for identification and classification of gamma-emitting radionuclides such as:

Industrial: Including ^{57}Co, ^{60}Co, ^{133}Ba, ^{137}Cs, ^{192}Ir, ^{241}Am, ^{75}Se

Medical: Including ^{18}F, ^{67}Ga, ^{99m}Tc, ^{111}In, ^{123}I, ^{131}I, ^{133}Xe, ^{201}Tl

Natural (NORM): Including ^{40}K, ^{226}Ra, ^{232}Th, ^{238}U

Nuclear: Including ^{233}U, ^{235}U, ^{237}Np, ^{239}Pu, ^{252}Cf

These classifications are based on an internal, fixed library according to ANSI N42.34. Customized libraries for specific applications can be supplied by special order.

GAMMA DOSE RATE: Gamma Dose Rate is monitored by the HPGe detector and by an internal compensated GM tube. The dose rate is displayed at all times. Dose rate units may be chosen as μSv/hr or mR/hr.

NEUTRON COUNT RATE: Neutron Count Rate is displayed continuously.

The data can be quickly saved and transmitted for further offsite analysis.

[4]TL-01754-03 and TL-01753-03 Technology Transfer from LLNL.

Gamma-Ray Identification Performance Data for Uranium and Plutonium

(Typical values based on data obtained from actual measurements by ORTEC personnel)

Single Sources

Unless otherwise stated, these data were taken at a standard dose rate from the source of 500 nSv/h measured with a calibrated dose rate meter at the instrument detector face according to ANSI N42.34.

When an absorber was present, the dose rate at the detector was measured THROUGH the absorber. EX-100 performance is given in brackets, e.g., "EX-100 <2 sec."

Unshielded and Shielded Uranium: DU, U-NAT, LEU, HEU

The time to identify as uranium, either unshielded or shielded by up to 5 mm steel, is <5 sec (EX-100 <2.5 sec). For LEU and HEU samples, the type ("LEU" or "HEU") is also reported in <5 sec (EX-100 <2.5 sec). LEU and HEU samples shielded by 1.6 mm lead are identified as uranium in <5 sec (EX-100 <2.5 sec).

Unshielded and Shielded Plutonium: Weapons Grade (WG), Reactor Grade (RG) (~60–93% Pu-239)

Time to identify as Pu, unshielded or shielded by up to 5 mm steel or 10 mm lead: <40 seconds for all types of Pu (with Cd filter if high Am content) (EX-100 <13 sec). For WG Pu the type "WG Pu" is also reported in less than 100 sec (EX-100 <35 sec).

Mixtures

In all cases, the mixture consists of 500 nSv/h of the "mask" nuclide, added to the specified quantity of uranium or plutonium. The "dose ratio threshold" is defined to be the standard 500 nSv/h dose rate from the mask in ratio to the smallest dose rate from U or Pu detectable in the time stated.

Uranium at 500 nSv/h in the presence of ^{137}Cs or ^{57}Co mask (unshielded)

Time to identify as uranium <5 sec (EX-100 <2.5 sec). For LEU and HEU, the type ("LEU" or "HEU") is also reported in <5 sec (EX-100 <2.5 sec).

Uranium Dose ratio threshold for 60 second measurement in the presence of ^{137}Cs or ^{57}Co mask (results apply to both EX and EX-100) (Dose from mask:Dose from uranium)

>7:1 for identification as uranium unshielded, >3:1 shielded 5 mm steel
>2:1 for reporting as LEU or HEU unshielded, >1.5:1 shielded 5 mm steel

Plutonium at 500 nSv/h in the presence of ^{133}Ba mask

Time to identify as Pu <60 sec (EX-100 <20 sec), unshielded or shielded by 5 mm steel or 10 mm lead. Identified type as RG Pu or WG Pu in <300 sec (EX-100 <100 sec).

Plutonium Dose ratio threshold for 5 minute measurement in the presence of ^{133}Ba mask (results apply to both EX and EX-100)

>6:1 for identification as Pu unshielded, >4:1 shielded by 5 mm steel or 10 mm lead
>1:1 for reporting as WG Pu or RG Pu unshielded or shielded by 5 mm steel or 10 mm steel (with Cd filter if high Am content)

Detective-EX Models in Use

The large and bright LCD Display with touch-sensitive screen is a real benefit to operation.

Figure 2 shows the main operator screen. Gamma and neutron count rate and gamma dose rate are displayed continuously both numerically and in bar graph form. The battery life remaining is shown at the top.

When the on-screen search button is tapped, the display in Figure 3 appears.

The search screen shows gamma-ray and neutron count rate second-by-second as a sliding "strip chart" from left to right with new data on the left. The display also shows current neutron count rate and gamma dose and count rate. The search process runs until stopped by the user. The user may save the search data as a spectrum.

When the Identify (ID) button is tapped, a screen like Figure 4 appears.

Unlike other identifiers in which the instrument counts for a pre-set number of seconds and then attempts an identification, Detective-EX is a "real time" identifier. Immediately after the ID button is touched, Detective-EX begins to identify. While the current standards, such as ANSI N42.34 call for identification to take place in one or two minutes, Detective-EX typically reports in a much shorter period, in some cases less than 1 second.

"Suspected" nuclides are indicated if the statistical accuracy is not adequate; with more time, this tentative identification will often change from "suspected" to "found." This dynamic process is halted at any time by tapping STOP.

In Figure 4, one industrial isotope has been identified.

Tapping the the word "FOUND" in Figure 4 takes the operator to the screen in Figure 5 where the identity of the found nuclide(s) is listed. Again, nuclear materials receive special treatment.

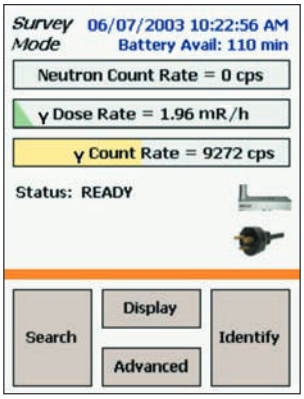


Figure 2. Note Dose Rate Displayed in mR/h.

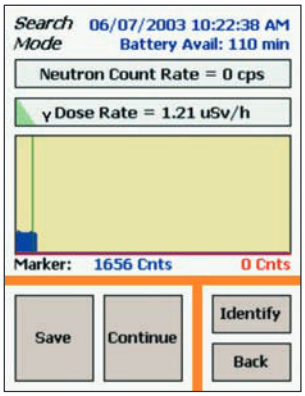


Figure 3. Search Mode.

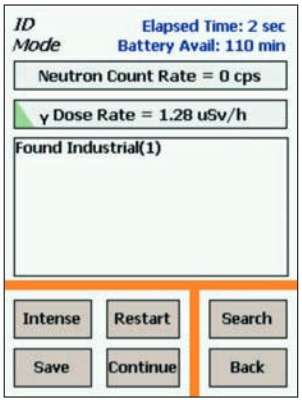


Figure 4. ID Mode.

Figure 5. Found Nuclide ID.

Spectral Display

The radionuclide gamma-ray spectrum may be displayed and manipulated (e.g., vertical scale, zoom) like a conventional multichannel analyzer. (Figure 6.)

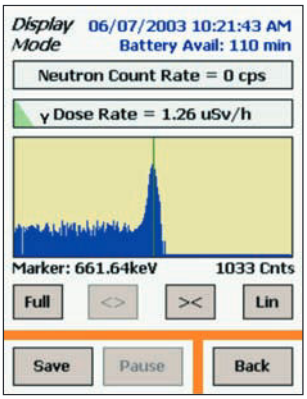


Figure 6. Spectrum Display.

Identification Messages

Help messages may appear on the main screen to assist the operator, such as:

"Consistent with background, keep counting"
"Count Rate consistent with background"
"Elevated radiation field"
"Possible beta emitter or unknown gamma"
"Possible nuclear material"
"Medical - positron emitter"

The form of the primary ID messages is:

"Found CLASS(#)" or "Suspect CLASS(#)"

where CLASS is

Medical
Industrial
NORM
Bremsstrahlung
Other

And "#" is the number of nuclides of that class identified.

In compliance with the IAEA specifications, nuclear materials and thorium-bearing NORM get special treatment. Possible messages include:

"Found nuclear uranium"
"Found nuclear plutonium"
"Found nuclear neptunium"
"Found NORM-Th"

If uranium has been detected, possible messages include:

"Highly enriched uranium"
"Depleted uranium"
"Low enriched uranium"
"Natural uranium"
"Elevated uranium concentration"

Similarly, for plutonium, and depending on the nature of the sample, shielding and the counting statistics, the following may appear:

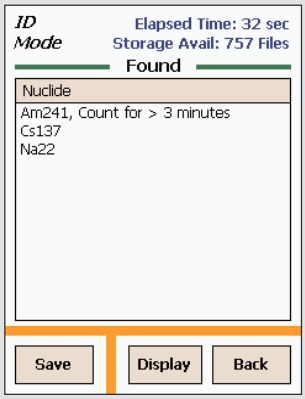
"Count for >5 minutes for Weapons/Reactor Grade"

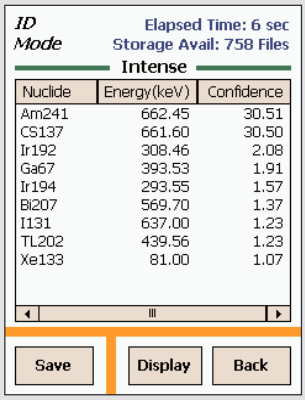
Followed by:

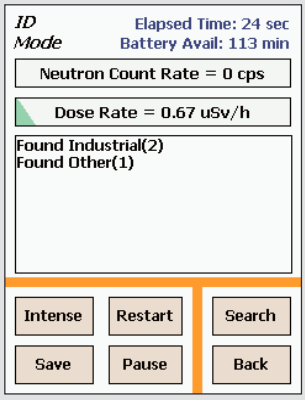
"Pu"
"Reactor Grade Pu"

or alternatively

"Pu"
"Weapons Grade Pu"







Calibration Check

Detective-EX is supplied pre-calibrated from the factory. The advanced digital electronics and detector are very stable, giving a constant peak position. A very simple procedure is used to verify and update the factory calibration. A small ^{137}Cs source is used, which is installed in the docking station for use while recharging. (Figure 7.)

When on the docking station, Detective-EX can be set to check its calibration at preset intervals, meaning that when it says "READY," it is READY for you to use.

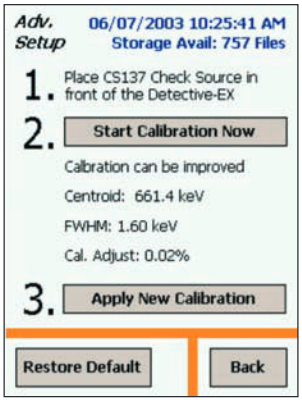


Figure 7. Calibration.

Detective-EX Power Sources

Detective-EX will go where you go. In addition to the internal battery, it can draw power from a variety of sources. For initial cool down from ambient temperature, the Detective-EX is placed on the docking station, or attached to the compact AC/Power Adapter/Charger (PAC). The docking station provides small air movers to assist with initial cool down in conditions of high ambient temperature (>40ºC). The PAC is a much more compact solution. The Detective-EX is typically ready for use in less than 12 hours from starting to cool at room temperature. Once cold, sustaining the Detective-EX requires only a few tens of watts.

The internal batteries provide an operating life of more than 3 hours before additional power support is needed. The optional battery belt can be used to extend the operating time without limit. An automobile adaptor is supplied to provide charging through the docking station and support while in transit. For mains use, the docking station is supplied with a mains supply.

PAC Power Supply

Docking Station with Calibration Check Source

Specifications

OPERATION MODES

SEARCH
Scanning mode for location of radioactive sources, with audio alert using an external ear piece. Both neutron and gamma search is simultaneous; 5 speed settings.

IDENTIFY-Gamma
Proprietary scheme for identification and classification of radionuclides as:

Industrial: Including ^{57}Co, ^{60}Co, ^{133}Ba, ^{137}Cs, ^{192}Ir, ^{241}Am, ^{75}Se

Medical: Including ^{18}F, ^{67}Ga, ^{99m}Tc, ^{111}In, ^{123}I, ^{131}I, ^{133}Xe, ^{201}Tl

Natural (NORM): Including ^{40}K, ^{226}Ra, ^{232}Th, ^{238}U

Nuclear: Including ^{233}U, ^{235}U, ^{237}Np, ^{239}Pu , ^{252}Cf

These classifications are based on an internal, fixed library according to ANSI N42.34. Customized libraries for specific applications can be supplied by special order.

Dose Rate
Visual overrange indication and continuous audible alarm at dose rates >10,000 μSv/hr.

DETECTORS

Internal HPGe Detector
Detective-EX Crystal Nominal Dimensions:
50 mm diameter x 30 mm deep.

Detective-EX-100 Crystal Nominal Dimensions:
65 mm diameter x 50 mm deep.

P-type high-purity germanium. Coaxial construction.

Cooler: Hymatic SAX101-002 high reliability, low power Stirling Cooler. Cooler design life >5 years continuous running. Dual piston design, 1 W nominal lift at 100°K.

Digital Noise Suppression: "LFR Filter" ORTEC Patent Pending.

Gamma Dose Rate Detector
Two detectors determine the gamma dose rate over a wide range from <0.05 μSv/h to >10000 μSv/h, a dose-rate range of around six decades. For low dose rates, below ~20 μSv/h, the dose rate is determined from the Ge detector spectrum. For dose rates above this value, the internal compensated GM tube is used. Detective-EX switches between the two automatically: Dose rate uncertainty ≤50% to +100%; continuous audible alarm at dose rates >10,000 μSv/h.

Neutron Detector Module
4 each ^{3}He tubes: 4" active length, 0.5" diameter, 20 atm He^{3} fill pressure.

High Density Polyethylene moderator.

DIGITAL MCA AND DATA PROCESSOR

Display 4.0" TFT Transreflective Color display (240 x 320 portrait resolution with 64k colors) touch-sensitive, operate with finger or stylus.

Data Processor Intel® PXA263 processor 400 MHz.

Control Interface Large single key for initiation of ID, Search and MCA display modes on touch sensitive screen.

- Simple to use menu operation
- Digital MCA with internal storage of multiple spectral data
- Maximum number of stored spectra >40; unlimited on removeable media (CF or SD).
- 8k channel conversion gain
- Monitoring of vital system functions:
  - Instrument Battery life remaining
  - System DC voltages
  - Detector Bias for both HPGe and GM
  - HPGe Crystal Temperature
  - Spectrum Storage Space

Instrument is supplied factory pre-calibrated and adjusted. A recalibration function allows correct performance to be verified and adjusted using a small ^{137}Cs source.

DETECTIVE-EX DISPLAYS AND MENUS

Main Screen

Gamma Count Rate Bar Graph 20 kcps full scale. Should the gamma count rate exceed 20 kcps, bar is completely red and the rate line flashes.

Dose Rate Bar Graph 10 mSv/hr full scale, flashes on overrange.

Status Lines:

WARNING!! High Dose Rate — Displayed when Dose rate exceeds 10 mSv/hr.

Detector is Warm — Displayed when crystal temperature is above working limit.

Bias Supply Error — Displayed if any power supply is bad.

WARNING!! Low Battery.

Tapping Search starts a search mode acquisition.

Tapping Identify starts an identify operation.

Tapping Display brings up the spectral display.

Tapping Advanced brings up Advanced Setup Menu.

Search
Search starts when the "Search" button is tapped. In search mode, a "strip chart" is drawn across the screen showing gamma and neutron count rates versus time on a log scale.

5 speed settings are available. If dose rate is beyond the maximum, the bar is black and flashes. The data may be saved.

Identify
When Identify mode is selected, data is cleared and acquisition starts.

Nuclides are divided into 5 basic types (Nuclear, Industrial, Medical, Natural, and Other).

As the identification process continues, messages inform the operator that nuclides have been found or are suspected. Tapping on the list takes the user to sub-lists which provide more information about the found or suspected nuclides and their precise identities.

"Intense" shows the most intense lines list, which is a continuously updating list of the 12 best peaks currently detected. The nuclides and energies are based on the internal nuclide library. The rank is based on the confidence value for the peak.

"Save" Saves the spectrum.

"Display" brings up the spectral display. The spectrum may be manipulated via the arrow keys and various accelerator keys for cursor movement. Energy and channel contents are displayed with the spectrum.

Advanced Setup
This password protected function is provided in order to set up the instrument parameters for routine operation. The following may be adjusted: audio settings, clicker sensitivity, dose rate units, password, search mode settings, and automatic recalibration interval. The spectral display may also be disabled under Advanced Setup.

Calibration
The Calibrate function, which may be manual or automatic, looks for the ^{137}Cs peak in a range of 650 keV–680 keV. Once the peak is located, and there are at least 1000 counts in the peak (net area), a new fine gain is calculated. This can be executed automatically when on the docking station.

View Data Acquisition Parameters
Reports instrument status, for example:

+12V	OK
–12V	OK
+3.3V	OK
Detector Temp	
Body Temp	OK
Cold Tip Temp	OK
Cooler Drive	OK
HV Volt	OK

PHYSICAL SPECIFICATIONS

Maximum Overall Dimensions (including handle, Ge detector endcap and shock absorbers)

Detective-EX:	37.3 cm L x 18.3 cm W x 34.3 cm H (14.7" L x 7.2" W x 13.5" H)
Detective-EX-100	39.4 cm L x 18.3 cm W x 34.9 cm H (15.5" L x 7.2" W x 13.75" H)

Weight

Detective-EX	25.9 lb (11.75 kg)
Detective-EX-100	26.3 lb (12 kg)

Internal Battery Life >3 hours at 25°C when HPGe detector is cold. Battery lifetime may be extended indefinitely by the use of external battery packs which are available in "battery belt" formats.

Input Power 10 to 17 V DC 30 W or from battery or auto-sensing Mains powered Battery Charger.

External Power DC In and battery Charge In. MS3112E12-10-s or Bendix PT02E-12-10S connector.

Temperature
Operation Range: 0°C to 40°C
Relative Humidity: <90% at 35°C, non-condensing

Communications Ports
External Connectivity to the system:
- 1 Type I/Type II CF Card slot (3.3 V)
- 1 SD (Secure Digital) card slot (3.3 V)
- 1 USB connection for "ActiveSync" capability from the PDA to an external computer
- 1 USB connection for control of the MCA board from an external computer
- 1 Audio headphone jack
- 1 External power connector for docking station power

Communication Software
The Detective-EX is a member of the ORTEC *CONNECTIONS* family. Remote control and individual spectrum download, even over a network, is achieved simply, by the use of ORTEC *CONNECTIONS* products such as MAESTRO-32 MCA Emulation software.

Multiple spectra may be block-transferred from the instrument controller to external PCs by industry standard means.

Cool Down Time
The high reliability cooler is designed for continuous operation. Between making measurements the unit is powered from a DC supply, car battery or other high capacity device. The cooler life is expected to exceed 50,000 hours continuous operation. Initial cool down time depends on ambient temperature, but is typically <12 hours at 25°C.

Ordering Information

Model	Description
DETECTIVE-EX	Includes Detective-EX HPGe Identifier, docking station with calibration check source, universal mains supply, automobile power cables and shoulder strap.
DETEX-PKG-1	Includes Detective-EX HPGe Identifier, docking station with calibration check source, universal mains supply, automobile power cables, shoulder strap, A65-B32 software and large wheeled transport case.
DETECTIVE-EX-PAC	Includes Detective-EX HPGe Identifier, ac/dc power adapter/charger (PAC), automobile power cables, and shoulder strap. (No Source.)
DETEX-PAC-PKG-1	Includes Detective-EX HPGe Identifier, ac/dc power adapter/charger (PAC), automobile power cables, shoulder strap, A65-B32 software and compact wheeled transport case.
DETECTIVE-EX-100	Includes Detective-EX-100 HPGe Identifier, docking station with calibration check source, universal mains supply, automobile power cables and shoulder strap.
DETEX-100-PKG-1	Includes Detective-EX-100 HPGe Identifier, docking station with calibration check source, universal mains supply, automobile power cables, shoulder strap, A65-B32 software and large wheeled transport case.
DETEX-100-PAC	Includes Detective-EX-100 HPGe Identifier, ac/dc power adapter/charger (PAC), automobile power cables, and shoulder strap. (No Source.)
DETEX-100-PAC-PKG1	Includes Detective-EX-100 HPGe Identifier, ac/dc power adapter/charger (PAC), automobile power cables, shoulder strap, A65-B32 software and compact wheeled transport case.

Note on Calibration Check Source

The calibration check source is internal to the docking station. It comprises a solid, sealed, ~0.25-μCi (9250-Bq) ^{137}Cs calibration source housed in the source holder on the front of the docking station. This source is exempt under U.S. and European regulations and is only supplied pre-installed by ORTEC (not separately). It is not recommended that it be removed, and ORTEC will not accept any responsibility for its removal. If this source is NOT required with the instrument because of local issues, this must be stated at time of order. THE SOURCE CANNOT BE SUPPLIED SEPARATE FROM THE DOCKING STATION.

Options

A separate data sheet covering Detective Options and accessories is available on request.

Software for Detective-EX and Detective-EX-100

Detective-EX/Detective-EX-100 is fully supported by the latest versions of the highly successful MAESTRO-32 MCA Emulator as well as the well-known ORTEC Gamma Spectroscopy Packages such as GammaVision-32 for generalized HPGe spectrum analysis, PC/FRAM and MGAHI for Pu and U isotopic ratio analysis and ISOPlus for in-situ waste assay analysis.

The integral USB connection in the instrument hardware provides full PC control, real-time live MCA display, fast data transfer of single and multiple spectra to the PC, and full ORTEC CONNECTIONS network support. Separate brochures are available on request.

PLEASE NOTE: MAESTRO-32 (A65-B32) is supplied as part of packages containing "PKG" in the model number, or it can be purchased separately at a later date.

Detective-EX and Detective-EX-100

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