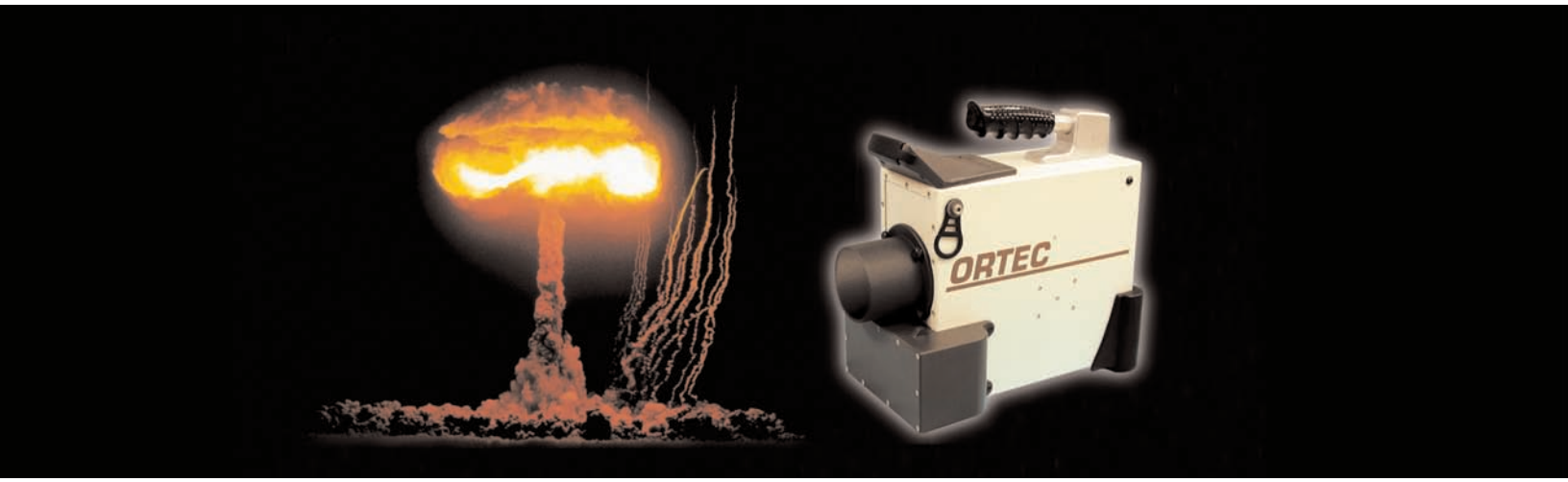
ORTEC®

Detective-EX and Detective-DX

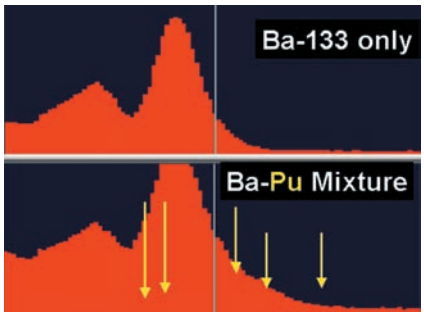
HPGe-based Hand-Held Radioisotope Identifiers

Is it. . . or isn't it?

Looking for special nuclear material can be like looking for a needle in a haystack. Fertilizers, ceramics, kitty litter, medical patients etc. etc., are all radioactive and can confuse most other instruments. When you can't afford to be wrong, ***you need an ORTEC Detective. . .***

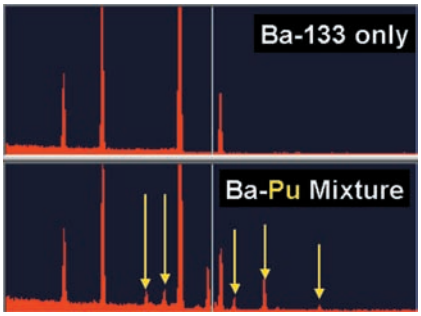


Other instruments see fuzzy and indistinct.

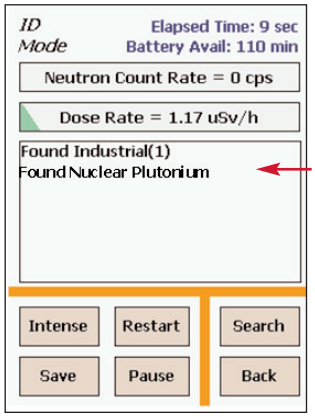


NaI Identifier Spectrum

The Detective sees sharp and clear.



HPGe Detective Spectrum



Detective Result. No guesswork!

NEW Models

- Neutron Detector optional
- Built-in GPS receiver
- Faster "100" models with larger Detectors

NEW Features

- SNM Search Mode™
- Calibrate on any source
- PC remote control Software

When you need to be certain. . . Choose ORTEC.

The ORTEC Detective family of Hand-Held Radioisotope Identifiers (HHRIDs) has gained an unmatched reputation for performance in the rapid identification of radioisotopes in both suspected and actual cases of illicit nuclear materials trafficking.

ORTEC Detectives are deployed ever more widely in the battle against illicit nuclear trafficking. Hundreds are being used world wide by (among others):

Departments of Homeland Security
Departments of Defense
National Security Organizations
Bomb Disposal Teams
Emergency Response Teams
Customs and Border Control
US NNSA second line of defense “Megaports” initiative
Emergency Management Teams
Civil Support Teams
Police Departments
Nuclear Safeguards Organizations
Nuclear Fuel Manufacturers
Nuclear Researchers

Key Benefits of -EX/-DX Models

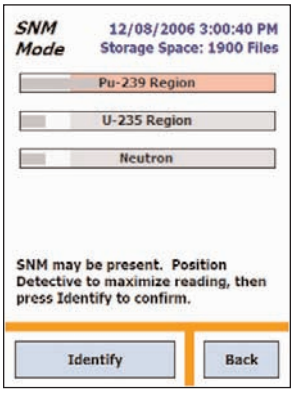
- "Expert Level" Determinations without need for an Expert.
- Simple to Operate: Bright, Clear Displays, touch sensitive screens, intuitive menus.
- High resolution gamma spectroscopy[1] with confirmatory neutron detection in EX models.
- Definitive answers to the detection of illicit nuclear materials (SNM) trafficking in seconds, in a battery operated instrument.
- Fast, Simple and ULTRA-Reliable Classification of NORM, Medical, Industrial, SNM and Natural Isotopes, shielded and unshielded.
- Highly resistant to masking source interferences.
- ~20 to 100 times better[2] than even the most advanced NaI and CZT instruments.
- “-100” models even faster to ID.
- Highest Sensitivity Detection of Neutron Sources in a hand-held instrument.
- Gamma-Ray and Neutron Search Modes.[3]
- SNM Search Mode™ finds SNM sources in the presence of other sources.
- Instantly ready to use at all times, straight from the docking station.
- Integrated GPS.

Models

- **Detective-EX**: The “classic” Detective-EX 50 mm x 30 mm HPGe detector with high efficiency neutron detector.
- **Detective-EX-100**: The Detective-EX made faster! A larger 65 mm x 50 mm HPGe detector version of the -EX.
- **Detective-DX/DX-100**: “Gamma only” versions of the above Detective-EX models.

Features

- SNM Search Mode™: A unique aid to the location of SNM sources, even in the presence of other non-threatening radioactive materials.
- Calibrate on any source: Check instrument calibration on any pre-specified source (e.g., ^{40}K).
- PC remote control software: Remote control and display from your laptop, and spectra transfer.



[1]High resolution High Purity (HPGe) Detector.
[2]"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.
[3]Neutron detection is only available on “EX” models.

Operational Capabilities (all models except where noted)

SEARCH: Count rate scanning mode for location of gamma-ray-emitting sources. -EX models add neutron search capability. An audio alert using an external ear piece is provided, with an adjustable alarm threshold.

SNM Search Mode™: Nuclide-specific “confidence meter” search mode for ^{235}U, ^{239}Pu, and neutron counts.

IDENTIFY: Proprietary scheme for identification and classification of gamma-emitting radionuclides. See specifications section for details.

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 (-EX models): Neutron Count Rate is displayed continuously. The data can be quickly saved and transmitted for further offsite analysis.

GPS Position Information (-GP models): An internal GPS receiver displays GPS coordinates which may be saved along with spectrum data for future use.

Storage of Data (spectrum, search data, ID results): To internal RAM and removable SD card.

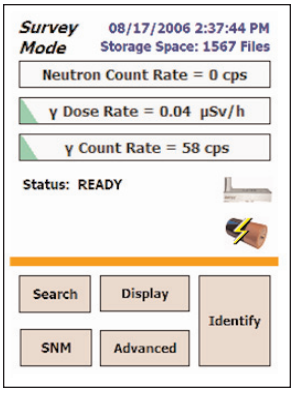
Computer Interfacing: USB connection to laptop. Spectral transfer by MicroSoft® ActiveSync. Remote control via MicroSoft “remotedsp.exe” (supplied). Wi-fi (802.11) communication is optionally available.

All models feature a large, bright and clear LCD Display with touch-sensitive screen. The figure shows the main operator screen. Gamma and neutron (-EX) 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.

New SNM Search Mode™

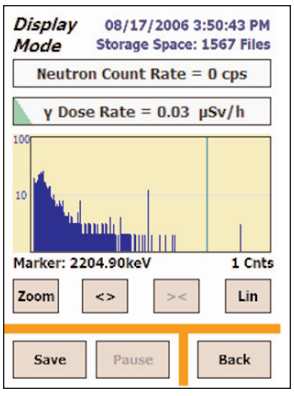
SNM Search mode is designed to help avoid false negatives when determining SNM. It helps in finding the point of maximum count rate which COULD be consistent with SNM. In SNM search modes, key regions of the spectrum are monitored which are critical to the determination of both ^{235}U (the key constituent of HEU) and ^{239}Pu (the key constituent in Weapons Grade and Reactor Grade Plutonium). In SNM search mode, these regions are monitored and the peak confidence level is displayed in the form of a bar graph. If a high and steady reading occurs, that indicates that "something" is present which is worthy of more investigation. Once the maximum reading of the bar graph has been located, the "confirm" key initiates the full identification algorithm.

SNM Search mode is an INDICATOR of SNM. It is a very much more sensitive search method for SNM than the more typical gross-count search, but must always be followed by the confirmatory ID to avoid false positives. In combination, SNM Search and ID modes minimize BOTH false negatives and false positives.



Display

All -EX/-DX models feature the same bright and clear VGA resolution display with touch sensitive operator screen. Menu navigation is highly intuitive. The radionuclide gamma-ray spectrum may be displayed and manipulated (e.g., vertical scale, zoom) like a conventional multichannel analyzer. Y-axis units are now displayed.



Power Sources

Detective can draw power from a variety of sources. For initial cool down from ambient temperature, the Detective 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 (>40°C) and incorporates a source holder for the optional ^{137}CS calibration check source. The docking station is recommended for high ambient temperatures. The PAC is the much more compact solution. ^{40}K, as found in dietary salt substitute, is an easy to obtain calibration check source for use with the PAC.

The optional source is ~0.25-µCi (9250 Bq) solid and sealed. It is an exempt quantity under U.S. and European regualtions and is only supplied pre-installed by ORTEC (not separately).

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"

For plutonium, 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"

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/-DX-100 variant” performance is given in brackets, e.g., "-EX-100/-DX-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/-DX-100 <2.5 sec). For LEU and HEU samples, the type ("LEU" or "HEU") is also reported in <5 sec (-EX-100/-DX-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% ^{239}Pu)

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/-DX-100 <13 sec). For WG Pu the type "WG Pu" is also reported in less than 100 sec (-EX-100/-DX-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/-DX and -EX-100/-DX-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/-DX-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/-DX-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).

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; speed settings 0.1 to 50 seconds/point.

SNM Search Mode™ Nuclide-specific search mode for ^{235}U, ^{239}Pu and neutron counts. ^{133}Ba surrogate detection may be turned on for training purposes. Bar graph display of nuclide confidence level. Aid to Identify mode.

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 over range indication and continuous audible alarm, user settable. Over-ride alarm at dose rates >10,000 µSv/hr.

DETECTORS

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

Detective-EX/-DX-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. Instrument switches between the two automatically.

Dose rate uncertainty ≤50% to +100%; continuous audible alarm at dose rates >10,000 µSv/h (fixed maximum threshold), user settable threshold below this.

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

DIGITAL MCA AND DATA PROCESSOR

Display 3.5" VGA 640 x 480 touch-sensitive, operate with finger or stylus.

Data Processor Intel® PXA270 processor 520 MHz Intel Xscale

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 removable media.
- 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 precalibrated and adjusted. A recalibration function allows correct performance to be verified and adjusted using a small radioactive source.

DISPLAYS AND MENUS

Main Screen

Gamma Count Rate Bar Graph 20 kcps full scale.

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

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.

Search Mode (Gamma/Neutron) Dwell times 0.1 – 50 seconds per point. Over-range warning.

SNM Search Mode™ Nuclide-specific search mode for ^{235}U and ^{239}Pu. Bar graph display of nuclide confidence level.

Identify Nuclide ID and calssification.

"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 Password protected.

Calibration Check Manual or Automatic Calibration Check. Automatic may be triggered by interval or time of day. Instrument is supplied calibrated from factory.

View Data Acquisition Parameters Reports instrument status.

PHYSICAL SPECIFICATIONS

Maximum Overall Dimensions (including handle, Ge detector end cap 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)
Detective-DX	37.3 cm L x 16 cm W x 34.3 cm H (14.7" L x 6.3" W x 13.5" H)
Detective-DX-100	39.4 cm L x 16.3 cm W x 34.9 cm H (15.5" L x 6.55" W x 13.75" H)

Weight

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

-DX versions are 1.9 lb (0.9 kg) lighter.

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 SD (Secure Digital) card slot (3.3 V)
- 1 USB connection for "ActiveSync" capability from the PDA to an external computer (ActiveSync and remote display software included).
- 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

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.

Communication Software

The Detective-EX/-DX 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.

Software for Detective-EX/-DX and Detective-EX-100/-DX-100

Detective-EX/-DX and Detective-EX-100/-DX-100 are 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-DX

HPGe-based Hand-Held Radioisotope Identifiers

Ordering Information

Model	Large HPGe	Neutron Detector	GPS	Docking Station Power Supply	Power Adapter Charger (PAC)	MAESTRO Software	Transport Case
DETECTIVE-EX-GP		•	•	•			
DETEX-PKG-2		•	•	•		•	•
DETEX-PAC-GP		•	•		•		
DETEX-PAC-PKG-2		•	•		•	•	•
DETEX-100-GP	•	•	•	•			
DETEX-100-PKG-2	•	•	•	•		•	•
DETEX-100-PAC-GP	•	•	•		•		
DETEX-100-PAC-PKG2	•	•	•		•	•	•
DETECTIVE-DX-GP			•	•			
DETDX-PKG-2			•	•		•	•
DETDX-PAC-GP			•		•		
DETDX-PAC-PKG-2			•		•	•	•
DETDX-100-GP	•		•	•			
DETDX-100-PKG-2	•		•	•		•	•
DETDX-100-PAC-GP	•		•		•		
DETDX-100-PAC-PKG2	•		•		•	•	•

DETECTIVE-EX-UG Software/firmware upgrade to Detective-EX (Detective-EX-100) (return to factory). Does NOT include GPS hardware upgrade.

Specifications subject to change
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