ORTEC®

DET-SW-UPG

Detective-EX/DX-100T and Micro-Detective
Software Upgrade (Version 3)

Latest Software Features

- Three Search Modes:
  - Gamma/Neutron total count rate.
  - SNM search mode.
  - Sliding average "monitor" mode. (NEW)
- User choice of identification schemes:
  - Classify mode (by nuclide type: nuclear, natural, medical, industrial, etc.).
  - ANSI mode.
  - Time preset or continuous count selectable to match CONOPS (concept of operations).
  - Suspected Nuclides (not in preset mode).
  - More sensitive LCX mode for SNM detection. (NEW)
- Background collect feature eliminates reporting of background nuclides. (NEW)
- "Smart" spectrum stabilizer ensures optimum results, even with hard-to-analyze spectra. (NEW)
- ANSI N42.42 format storage of spectra.
- Integrates with ORTEC Ge-SS search system.

Since the announcement of the ORTEC Detective-EX/DX and Micro-Detective HPGe-based portable nuclide identifiers, many hundreds of instruments have been set to work across the world and continue to help in the battle to prevent illicit trafficking of nuclear materials. Favorable comments have been received about the usability of the "classic" instrument as well as suggestions for improvement. We constantly strive to improve analysis software performance. The latest version, "V3," now includes many of these improvements with no loss of familiarity to those who use the instruments often. Detective V3 software represents the current "best of the best" among hand-held nuclide identifiers.[1]

Ease of Use

From the beginning, the Detective hand-held identifiers have been designed for ease of use. Although they are highly sophisticated instruments, they are often in the hands of non-experts. They have been engineered as simple to use "expert instruments." Conceptually, they are "press a button and get an answer" instruments which, in latest form, have been enhanced in the sophistication of analysis and by the addition of flexible "set and forget" mode options which allow the instrument to match the concept of operations, "CONOPS," applying at the point of deployment.

Source Location with the Detective V3 Software

Before a source is subjected to the scrutiny of the full Detective ID algorithm, it must first be located. To locate a source it is more important to avoid false negatives (not found) than to avoid false positives, which can subsequently be resolved by the use of the full ID algorithm. Three tools to help in source location are provided:

[1]Version 3 Detective software is supplied as standard on the following new Detective family instruments: Micro-Detective, Micro-Detective-DX, Detective-DX-100T, Detective-EX-100T. All other Detective instruments may be upgraded to benefit from the powerful features of version 3 software. Contact your service center with serial number for help with upgrade paths.

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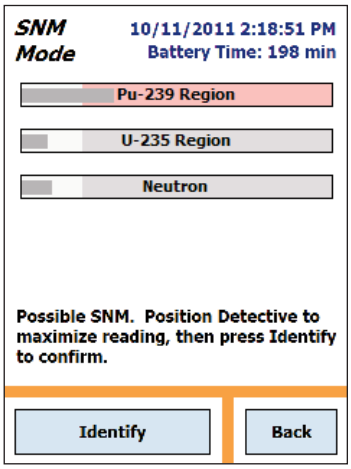
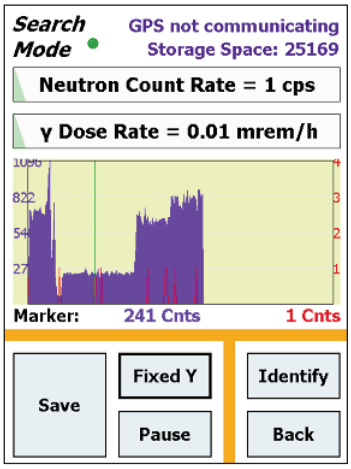
Basic Search Mode: Gamma and neutron (if applicable) count rates are presented as a time tracking strip chart. Neutron counts are displayed in red and gamma counts in blue.

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. Key regions of the spectrum are monitored which are critical to the determination of both U-235 (the key constituent of HEU) and Pu-239. The peak region confidence level is displayed in the form of a bar graph. A high and steady reading indicates that "something" is present which is worthy of more investigation. Once the maximum reading has been located, the "identify" key initiates the full identification algorithm.

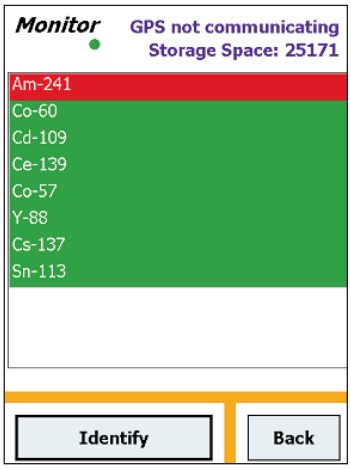


SNM Search Mode.

Monitor Mode: (New in V3.) When in this mode, the Detective collects one spectrum per second and runs the full ID algorithm against an 8 second sliding average. This method is more sensitive to sources which move relative to the instrument than a continuous data acquisition in which background would be accumulated before and after the source was present. Monitor mode is a valuable search method, but is also useful, for example, in ad-hoc portal monitoring applications.



Search Mode.



Monitor Mode.

Source Identification with Detective V3

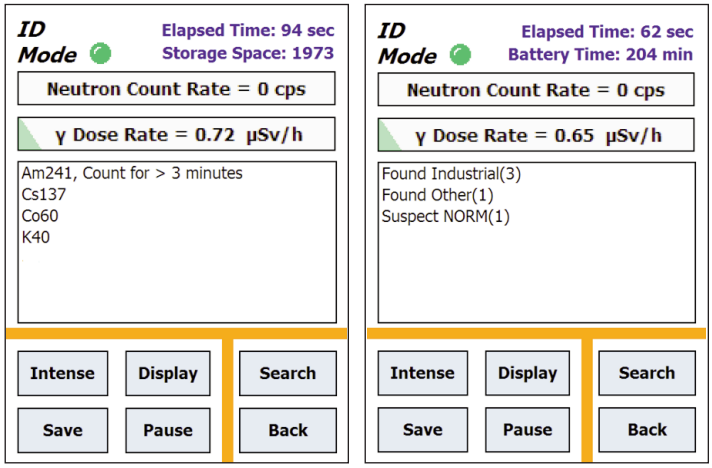
In order to meet the requirements of multiple CONOPS, a high degree of flexibility is provided in Detective V3. The operational settings are through password protected "set once and forget" selections. The choices are as follows:

Classify Mode (the "classic" Detective mode). In this mode, the instrument runs without preset and classifies found and suspect nuclides according to the scheme:

- Medical
- Industrial
- NORM
- Bremsstrahlung
- Other
- Nuclear Uranium
- Nuclear Plutonium
- Nuclear Neptunium

Nuclides are initially reported as "suspect" and change to "found" when the statistical criteria are fulfilled. Tapping on the classification will reveal the actual nuclides suspected or identified.

Alternatively to no-preset operation, a preset time may be specified for Classify Mode. The instrument counts up to the preset specified and reports "found" classifications and nuclides ONLY, no suspects are reported. The operator may request a count time extension, adding multiples of the original preset period.



Classify Mode Nuclide ID.

ANSI Mode: In ANSI mode, no classification of nuclides is performed. Only identifications are reported with the name of the identified nuclide.

LCX (Low-Confidence Expert) ID Mode: (New in V3.) LCX mode is password protected. LCX denotes "Low Confidence-Expert," and is intended for expert users. This identification mode displays suspected threat alarms and identifications at a lower confidence level than the normal mode. This results in more hits on suspected threat nuclides, but should be used in conjunction with a non-LCX identification to avoid false positive IDs. When LCX mode is enabled, LCX "hits" are color-coded in yellow.

LCX Mode.

V3 Instrument Calibration

The Detective energy calibration may be checked and adjusted with any known source with a clean gamma ray between 0 and 3 MeV. A higher energy is recommended. Cs-137 is often used. Calibration can be manual or automatic. In Detective V3, background collection is now a required part of calibration. The instrument will no longer report nuclides detected in the background unless their activities are higher than when the background was established. These background IDs on former versions have sometimes caused user-confusion. The background must be updated on a schedule which is chosen by the privileged user.

V3 Smart Stabilizer

The "smart stabilizer" fixes the instrument gain very precisely on the 1460 keV peak of K-40, if present. The "smart" part is if there is no K-40 present or if Eu-152 is detected, which could interfere with the K-40 peak, the stabilizer setting is held but not adjusted until "normal" conditions return. Even though the Detective is a highly stable instrument, the smart stabilizer allows accurate determination of more complicated mixed spectra.

V3 Analysis Algorithm Improvements

Detective series instruments have proven highly resistant to false positive and false negative results. Recent improvements to the Detective algorithms have enhanced this already excellent performance still further. The use in V3 of the smart stabilizer and the subtraction of background has improved further the resistance to false positives. The smart stabilizer has further improved the analysis of some difficult masking scenarios.

Classify Mode Nuclides and Messages

The form of the primary ID messages is:

"Found CLASS(#)" or "Suspect CLASS(#)"
where “CLASS” is

Medical
Industrial
NORM
Bremsstrahlung
Other
Nuclear Uranium
Nuclear Plutonium
Nuclear Neptunium

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

The following table lists the Detective Library v8.5 radionuclides according to their categories in the “Classify” ID mode.

DET-SW-UPG

Detective-EX/DX-100T and Micro-Detective Software Upgrade (Version 3)

Industrial

Am-241
Am-241 (unshielded)
Cs-137
Ho-166m
Ho-166m (shielded)
Ir-192
Ir-192 (shielded)
W-187
Ac-227
Ag-110m
Ar-41
As-72
Au-198
Ba-133
Ba-140
Be-7
Bi-212 (Th-232/U-232 daughter)
Br-77
Ca-47
Cd-115
Ce-144
Cm-242
Cm-243
Cm-244
Co-55
Co-57
Co-57 (shielded)
Co-60
Cs-134
Hf-181
Hg-203
I-126
I-126 (shielded)
I-132
I-133
I-134
I-135
Kr-87
Kr-88
Kr-88 (shielded)
Mn-52
Mn-56
Nb-92m
Nb-94
Nb-95
Nb-96
Nb-96 (shielded)
Nd-147
Pa-231
Pb-203
Pr-144
Ra-223
Rh-105
Ru-103
Ru-97
Sb-124
Sb-124 (shielded)
Sb-125
Sb-127
Sr-85/Kr-85
Tc-96
Te-132
Th-229
Th-230
Tm-171
W-188/Re-188

Medical

F-18
I-125
Lu-177
Lu-177m
Mo-99
Pd-103
Se-75
Sm-153
Sm-153 (shielded)
Tc-99m
Xe-133
Ac-225
As-74
Ce-139
Ce-141
Co-58
Ga-67
Ga-67 (shielded)
Ge-68/Ga-68
I-123
I-123 (shielded)
I-124
I-131
I-131 (shielded)
In-111
Lu-172
Na-24
Rb-83
Rb-86
Ru-106/Rh-106
Sc-46
Sr-82/Rb-82
Sr-89
Tl-201
Tl-204
Tm-170
V-48
Xe-133m
Yb-169
Zn-62
Zn-65
Zr-95

NORM

La-138
Ra-226
Bi-214 (Ra-226 daughter)
K-40
Lu-176
Th-232

Other

Cr-51
Cu-64
Eu-152
Gd-159
La-140
Mn-54
Neutrons on Fe
Neutrons on Hydrogen
Unknown Peak
Unknown/Beta emitter
Xe-131m
At-211
Bi-207
Br-76
Br-76 (heavily shielded)
Br-76 (shielded)
Cd-109
Co-56
Co-56 (shielded)
Eu-154
Eu-155
Eu-156
Fe-59
Ga-64
Ga-64 (shielded)
Gd-153
Ho-166
Ir-194 (shielded)
Na-22
Neutrons
Os-194/Ir-194
Po-210
Sn-113
Ta-182
Tl-200
Tl-202
Xe-135
Y-88

Bremsstrahlung

Beta emitter

Nuclear Uranium

Enriched Uranium
HEU
U-232
U-233
U-235
U-238
186 keV peak present
2614 keV peak present

Nuclear Plutonium

Pu-239
Pu-238
375/414 peak present
Am-241 (shielded)

Nuclear Neptunium

Np-237

Classify Mode Special Messages

The following explains the criteria for selected Classify ID Display Mode messages.

HEU (highly enriched uranium)**:** This message is displayed if the major lines of uranium are detected and the ratios of the intensities of the lines indicates the U-235 content to be above about 70%.

Am241 (unshielded) in the "Industrial" category: This message is displayed if the 59 keV peak is located. It could mean that an Am-241 source such as a smoke detector is present. Move closer to the source and/or count longer. This will allow the higher-energy gamma rays to accumulate in the spectrum, in case plutonium is also present.

Unknown Peak and **Unknown/Beta Emitter**: This indicates the gamma count rate is higher than can be accounted for based on the peaks in the library. The implication is that either an unexpected nuclide or a beta emitter is present (beta emitters typically producing counts over a broad range of energies). Move closer to the source and count longer to determine the nature of the suspect item. If another ID is found, then the Unknown Peak or the Unknown/Beta Emitter ID are suppressed.

"Found Nuclide" Screen Messages

RDD Detected: This message is posted when estimated activity is >100 mCi, whether the activity is from threat or innocent nuclides. The gamma count-rate and dose-rate meters on the Survey Mode and ID Mode screens display a flashing red background and extremely high count and dose rates.

ANSI Mode Nuclides and Messages

The table is divided according to the threat category used to determine ID background color in Monitor Mode and on the Found and Suspect Nuclide reports, e.g., green for innocent IDs, yellow for LCX-mode suspects, and red for threats. NB: if desired and under password protection, the color coding, and therefore the threat classification can be disabled.

Identification	Classification
Innocent	
Ac-225	Medical
Ac-227	Industrial
Ag-110m	Industrial
Am-241 (unshielded)	Industrial
Ar-41	Industrial
As-72	Industrial
As-74	Medical
At-211	Other
Au-198	Industrial
Ba-133	Industrial
Ba-140	Industrial
Be-7	Industrial
Beta emitter	Bremsstrahlung
Bi-207	Other
Bi-212 (Th-232/U-232 daughter)	Industrial
Bi-214 (Ra-226 daughter)	NORM
Br-76	Other
Br-76 (heavily shielded)	Other
Br-76 (shielded)	Other
Br-77	Industrial
Ca-47	Industrial
Cd-109	Other
Cd-115	Industrial
Ce-139	Medical
Ce-141	Medical
Ce-144	Industrial
Cm-242	Industrial
Cm-243	Industrial
Cm-244	Industrial
Co-55	Industrial
Co-56	Other
Co-56 (shielded)	Other
Co-57	Industrial
Co-57 (shielded)	Industrial
Co-58	Medical
Co-60	Industrial
Cr-51	Other
Cs-131	Medical
Cs-134	Industrial
Cs-137	Industrial
Cu-64	Other
Cu-67/Ga-67	Medical
Eu-152	Other
Eu-152	Other

Eu-154	Other
Eu-156	Other
F-18	Medical
Fe-59	Other
Ga-64	Other
Ga-64 (shielded)	Other
Ga-67	Medical
Ga-67 (shielded)	Medical
Gd-153	Other
Gd-159	Other
Ge-68/Ga-68	Medical
Hf-181	Industrial
Hg-203	Industrial
Ho-166	Other
Ho-166m	Industrial
Ho-166m (shielded)	Industrial
I-123	Medical
I-123 (shielded)	Medical
I-124	Medical
I-125	Medical
I-126	Industrial
I-126 (shielded)	Industrial
I-131	Medical
I-131 (shielded)	Medical
I-132	Industrial
I-133	Industrial
I-134	Industrial
I-135	Industrial
In-111	Medical
Ir-192	Industrial
Ir-192 (shielded)	Industrial
Ir-194 (shielded)	Other
K-40	NORM
Kr-87	Industrial
Kr-88	Industrial
Kr-88 (shielded)	Industrial
La-138	NORM
La-140	Other
Lu-172	Medical
Lu-176	NORM
Lu-177	Medical
Lu-177m	Medical
Mn-52	Industrial
Mn-54	Other
Mn-56	Industrial
Mo-99	Medical
Na-22	Other
Na-24	Medical
Nb-92m	Industrial
Nb-94	Industrial
Nb-95	Industrial
Nb-96	Industrial
Nb-96 (shielded)	Industrial
Nd-147	Industrial
Os-194/Ir-194	Other
Pa-231	Industrial
Pb-203	Industrial
Pd-103	Medical
Po-210	Other
Pr-144	Industrial
Ra-223	Industrial
Ra-226	NORM
Rb-83	Medical
Rb-86	Medical
Rh-105	Industrial
Ru-103	Industrial
Ru-106/Rh-106	Medical
Ru-97	Industrial
Sb-124	Industrial
Sb-124 (shielded)	Industrial
Sb-125	Industrial
Sb-127	Industrial
Sc-46	Medical
Se-75	Medical
Sm-153	Medical
Sm-153 (shielded)	Medical
Sn-113	Other
Sr-82/Rb-82	Medical
Sr-85/Kr-85	Industrial
Sr-89	Medical
Ta-182	Other
Tc-96	Industrial
Tc-99m	Medical
Te-132	Industrial
Th-229	Industrial
Th-230	Industrial
Th-232	Thorium
Tl-200	Other
Tl-201	Medical
Tl-202	Other
Tl-204	Medical
Tm-170	Medical
Tm-171	Industrial
V-48	Medical
W-187	Industrial
W-188/Re-188	Industrial
Xe-127	Industrial
Xe-131m	Other
Xe-133	Medical
Xe-133m	Medical
Xe-135	Other
Y-88	Other

Y-91	Industrial
Yb-169	Medical
Zn-62	Medical
Zn-65	Medical
Zr-95	Medical
Suspect (LCX Mode only)	
186 keV peak present	Uranium
2614 keV peak present	Uranium
375/414 peak present	Plutonium
Threat	
Am-241	Industrial
Am-241 (shielded)	Plutonium
Enriched Uranium	Uranium
HEU	Uranium
Neutrons	Other
Neutrons CR	Neutron
Neutrons on Fe	Other
Neutrons on Hydrogen	Other
Np-237	Neptunium
Pu-238	Plutonium
Pu-239	Plutonium
U-232	Uranium
U-233	Uranium
U-235	Uranium
U-238	Uranium
Unknown Peak	Other
Unknown/Beta emitter	Other

Remote Mode

Detective V3 instruments can participate as nodes within the Ge-SS Detective Mobile search system. For more information, see www.ortec-online.com/download/GE-SS-Detective-Mobile-Nuclide-Search-Identification-System.pdf.

Frequently Asked Questions

Q: Why should I purchase this upgrade?

A: The ORTEC Detective family of instruments has been in evolutionary development since the introduction of the first instrument in January 2004, more than 6 years ago. There are many hundreds of units across the world daily engaged in the vital work of protecting against nuclear terrorism and helping in other nuclear related activities such as lost source recovery.

Over that period, ORTEC has actively engaged in numerous test programs and has tried to remain in close contact with users and their experiences with these instruments.

We try to protect your initial investment by making available to existing users the latest improvements and developments which we make based upon that wide experience.

Your Micro-Detective or Detective instrument can benefit from these improvements at moderate cost.

In the first instance please contact our Service Department via our website at www.ortec-online.com/Service/index.aspx

Ordering Information

Currently, software upgrades are return to factory only. Please contact the factory before placing an upgrade order.

All Detective instruments may be upgraded, but models other than Detective-EX/DX-100T or Micro-Detective models will require a hardware upgrade.

Model	Description
DET-SW-UPG	Software upgrade for Micro-Detective models and Detective-EX/DX-100T models.[2]

[2]Contact the factory for other model upgrades.

DET-SW-UPG

Detective-EX/DX-100T and Micro-Detective Software Upgrade (Version 3)

Specifications subject to change
110311

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