ORTEC®

Detective X

Ultra High Resolution HPGe Radioisotope Identification Device



The New “Gold Standard” for
Mission Critical Detection and Identification

AMETEK®
ADVANCED MEASUREMENT TECHNOLOGY

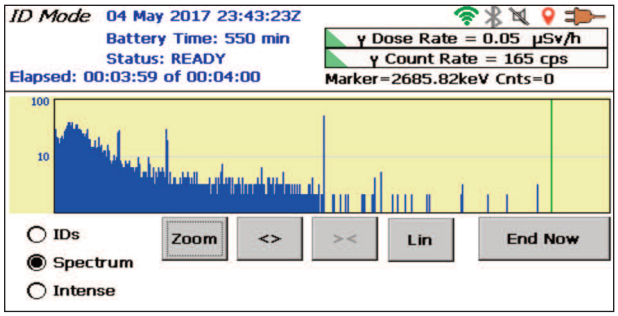
Detective X

How do you improve on “The Gold Standard” for nuclear threat detection and identification? ORTEC’s new Detective X high purity germanium (HPGe) “RIID” does exactly that with a combination of identification improvements, operational (conops) improvements, better interconnectivity capabilities, and longer battery life.

What Makes ORTEC’s New Detective X Better?

Detection and Identification Features

- Larger HPGe crystal, three times more efficient than the Micro-Detective-HX.
- Improved Algorithm that increases detection probability.
- Comprehensive library of over 175 radionuclides including new radiopharmaceuticals.
- Better standoff detection and ID capability.





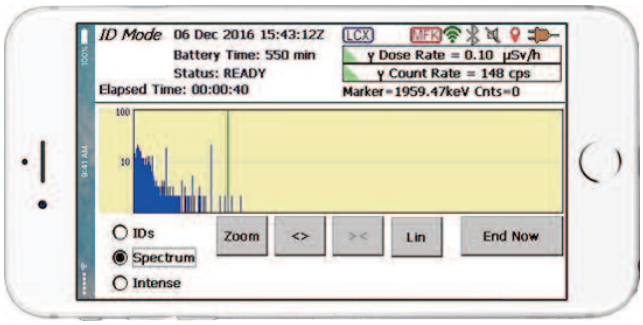
Operational Improvements

- Rugged Instrument designed for harsh environments (IP65 compliant).
- Weight Significantly Reduced (about half of Detective-EX-100T).
- Battery life doubled and batteries are hot swappable.
- New Li^6/ZnS Neutron Detector Module (NDM), no ^3He required.
- Bigger display screen, easily readable in sunlight.

Quality Improvements

- New Stirling cooler with more cooling capacity and improved mean time between failures.
- Designed with extremely hard polycarbonate case, making it both lighter and more rugged.



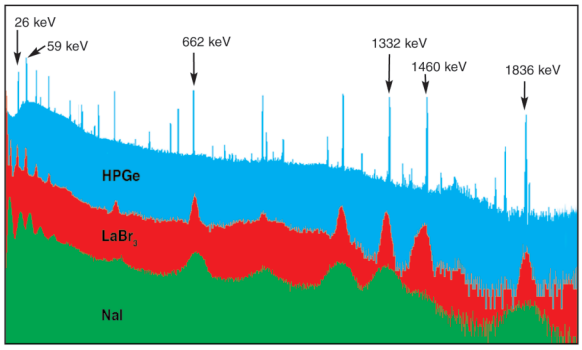


Enhanced Connectivity Options

- System includes built-in Ethernet connection (RJ45).
- USB Connection to PC is plug and play.
- USB memory stick stores >100,000 spectra.
- Mobile phone Interconnectivity and control of instrument for iOS, Android, and Windows platforms.
- WiFi and Bluetooth are standard with Detective X.

Detective X

Why are High Purity Germanium Detectors needed for Radiation Identifiers?



High Purity Germanium (HPGe) Detectors are acknowledged as "the Gold Standard" detector for radioisotope identification because they provide ~35 times better in energy resolution (selectivity) than Sodium Iodide and ~15 times better in resolution than LaBr, CeBr, or SrI. HPGe can be manufactured in diameters of >3 inches, making them much bigger (more efficient) than CZT detectors. The resolution advantage results in significantly better performance (superior standoff detection, fewer false IDs, improved sensitivity to threat materials, and better spectra for reachback review).

Unlike lower-resolution detector types, HPGe crystals operate at cryogenic temperatures. This created a technology challenge ORTEC solved over 30 years ago. Portable HPGe detectors historically have used Liquid Nitrogen for cooling, but since ORTEC introduced the first electro-mechanically cooled, hand-held Germanium system in 2004, ORTEC's Detective family of RIIDs with Stirling coolers have become the industry standard. There are now more than 1,300 ORTEC Detective family instruments in over 60 countries to detect and identify nuclear or radiological threats.

ORTEC has worked with customers to integrate features needed to meet CONOPS or mission requirements. These new features allow the Detective X to meet a variety of deployment scenarios. The Detective X has its roots in the GE-Mini hand-held RIID development at Lawrence Livermore National Lab where it was funded by the Department of Defense and the Defense Threat Reduction Agency (DTRA). ORTEC exclusively licensed this technology from LLNL.

The Detective X crystal is 65 mm x 50 mm which makes it approximately three times more efficient than the Micro-Detective or Micro-Detective-HX.

The Detective X Features

- Portable – Light weight, "one-hand" operation with GPS location. The Detective X is about 50% lighter than the industry-leading ORTEC Detective-EX-100T.
- Extremely Rugged – Designed for military use. Can accommodate –20°C to +50°C temperatures. IP65 rating (water proof, dust proof) and drop hardened.
- Superior Algorithms – Excellent detection and ID capability and a much better false alarm rate compared to other systems. There are more than 175 radionuclides in the library.
- Auto Calibration – Continuous real-time detector stabilization keeps the instrument calibrated at all times.
- Enhanced Communication Capability – Equipped with 802.11 a/b/g wireless, wired Ethernet, USB, remote control via smartphones (Android, iOS, and Windows PC). Bluetooth capability also included. Can easily be remotely controlled and monitored from a central location.
- Optional $Li^{6}ZnS$ neutron detector (no ^{3}He).
- Removable high capacity USB Flash Drive.
- Simple to operate: Bright, clear, SUNLIGHT READABLE display, touch sensitive screen, and intuitive menus.
- Operating time of up to 10 hours with dual batteries (hot swappable).
- Large HPGe Crystal (65 mm x 50 mm).



Display and Control Buttons.

Detective X

Detective X Algorithms

Beyond the intrinsic selectivity of the HPGe detector type, the ultimate performance in terms of the Detective X fidelity of identification depends on the software algorithms. ORTEC licensed the original Lawrence Livermore RadScout algorithm in 2003 and has made numerous improvements to it over the years. For example, as part of the DHS/DNDO HPRDS Program, ORTEC developed the Advanced HPRDS RIID (Micro-HPRDS) from 2008 to 2010. This algorithm advancement greatly improved ID capabilities and minimized false alarms. Over the past 10 years ORTEC has participated in a variety of test campaigns sponsored by DNDO, DoD/DTRA, IAEA, and DOE National Labs to continue to improve the algorithms and enhance the radionuclide library. The Detective X incorporates the latest algorithms in combination with the large 65 mm x 50 mm crystal, making it the most sensitive and most accurate RIID on the market. Further reductions in both false positive and false negative results have been achieved. When actionable intelligence is needed on a potential threat source, reachback experts need HPGe spectra. It is widely recognized as “The Gold Standard”.

Detective X Hardware Overview

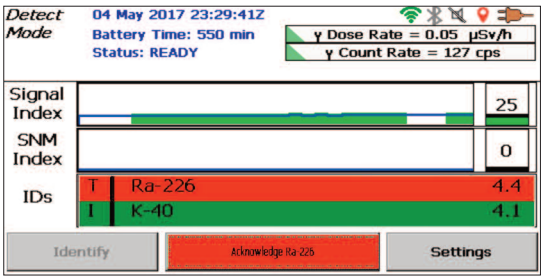
ORTEC has more than 12 years of experience with HPGe RIIDs. Users from around the globe have provided input that has been integrated into the Detective X. The Detective X features compact, light weight and rugged hardware. A large 45% efficient (65 mm x 50 mm) HPGe crystal in a “hardened” cryostat is cooled by an integrated low-power Stirling-cycle cryocooler. The Detective X features a new cooler, offering a greater lift capacity. The hardened cryostat is entirely free of a conventional molecular sieve, allowing the instrument to be turned off or on at any point in the detector cool down or warm up cycle without risk. ORTEC is the only manufacturer that offers this functionality in a handheld HPGe RIID.

A built-in digital MCA system and powerful data processor are included. The Detective X features a bright VGA resolution display, readable in direct sunlight, with a touch sensitive operator screen. The operation of the Detective X is highly intuitive. The radionuclide gamma-ray spectrum may be displayed and manipulated (e.g., vertical scale, zoom) like a conventional multichannel analyzer. Gamma count rate, neutron flux, and gamma dose rate are displayed continuously.

Detective X Benefits

Customer Requests/Input	Detective X
Lighter Weight & Smaller Form Factor	✓
Longer Battery Life & hot swappable batteries	✓
Reliable Stirling Cooler	✓
Larger HPGe Crystal for Better Sensitivity	✓
Non He-3 Neutron Detector	✓
RJ45 Internet Connectivity	✓
IDs for Shielded & Masked Sources	✓
Mobile Phone Interconnectivity	✓

The Detective X in Use: Overview



- A high-resolution, sunlight readable, color touchscreen as the standard method to operate the system and enter data such as passwords and alarm limits.
- Alternatively, three buttons on the top of the unit, Power, Navigate (N) and Select (S), can also be used for survey and sampling operations.

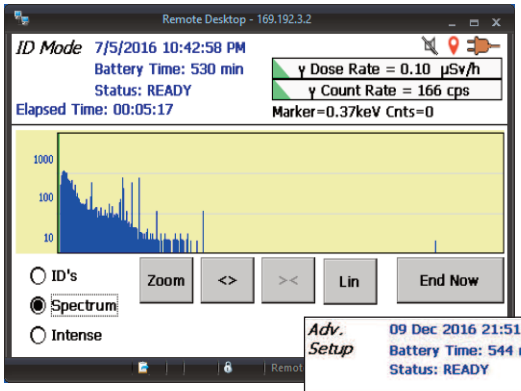
Audio-visual feedback:

- An audio alarm can be used with the the Bluetooth headphone. A vibration alarm is provided in the handle.
- Indicators at the top of the screen show the current dose rate in mrem/hr (or µSv or µGy). An icon is shown if the instrument has a fix on a GPS (green) or no fix on a GPS (red). Icons also show the status of MFK, Bluetooth, LCX Mode stabilizer status (when disabled) and WiFi (connected or not connected).
- When radiation is detected and identified, the identification is posted to the real-time identification area of the screen. This area lists the names of any radioisotopes currently being detected.

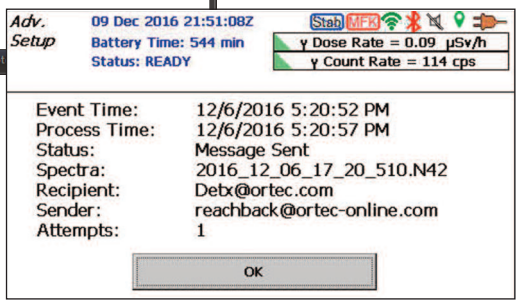
Detective X

The Detective X Operation

- Clear.
- Simple and intuitive.
- Informative.
- Based on simple-to-use hardware (even with one gloved hand).
- Automated packaging of data for reachback.



Detective X Spectral Display (8 MeV range).



Reachback Default General Settings.

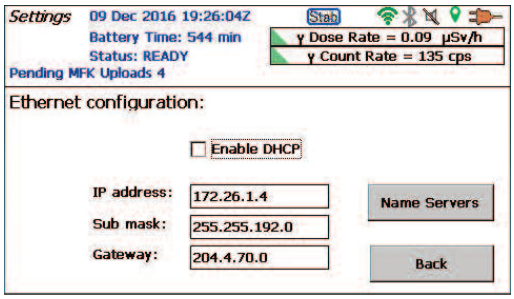
Modes of Operation

Detect Mode Operation

Detect mode is used to locate and identify sources. In this mode, the instrument is continuously "looking" but not storing data. The "Detect Mode" screen shows the detector count rate and dose rate. It is also the search mode and monitoring mode.

The "Detect Mode" screen displays "Signal Index" and "SNM Index" strip charts in the middle of the screen. The strip charts update every half second. They are real time indicators of the presence of radioactive material. The strip charts will sometimes show an increase before identifications appear on the screen.

A Survey always begins with a Detect mode measurement. The Detective X is set to automatically start in Detect Mode.



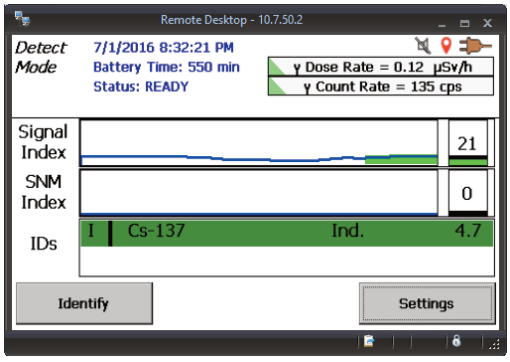
Ethernet Setup.

Identify Mode Operation

This mode is used to identify radionuclides by counting an object or area of interest from a stationary position for an extended period of time. Data is acquired for a preset time period or until the acquisition is stopped.

The identify mode can operate in "single" spectrum mode or in "multiple spectrum analysis" mode. The mode is selected by the administrator. Single spectrum mode starts a spectrum collection and performs a radionuclide identification as the spectrum is collected. In multiple spectrum mode, background, known, and unknown spectra are collected, automatically packaged, and sent to reachback.

The preset is real time. During this time, radionuclide IDs are displayed by nuclide name on the screen. The operator can view the spectrum in real time or can display the ten most intense gamma-ray lines in the spectrum during the identification period.



Detect Mode Survey.

Detective X

The Detective X and Background Radiation — No more NORM alarms

The Detective X uses the background measurements saved on the instrument to recognize and suppress NORM Identifications unless the NORM material is at a significantly higher level than the stored background.

The Detective X and Digital Stabilization — Making the best of it

Although a digital germanium spectrometer is a highly stable instrument, even with varying temperatures, the Detective X is designed for use in conditions that could be considered extreme. An automatic gain stabilizer system "locks onto" the natural background K-40 peak (if present) to ensure "perfect" calibration is maintained even in conditions of harsh handling. The stabilizer is "smart." If K-40 is not found in the spectrum, the gain stabilizer will be turned off. Also, the user can choose to disable the stabilizer and proceed directly to ID measurements to minimize setup time in mission critical scenarios.

The Detective X Nuclide Library

The Detective X has a very comprehensive nuclide list. A subset of the entire nuclide library is the default "Threat Isotopes"; these are marked in RED in Table 1. The advanced user is able to add any of the nuclides marked in GREEN to the list of red-marked threat isotopes. The color coding in the table shows the default background screen colors and visual alarms the instrument will present when these nuclides are encountered.

Table 1. Detective X Nuclide Library.

2235 keV Peak Present	Am-241	Am-241 (shielded)	Am-241 (unshielded)	Neutrons	Cf-252/Cf-249
Enriched Uranium	Geiger Muller CR	HEU	Neutrons	Neutrons on Al	Neutrons on Boron
Neutrons on Fe	Neutrons on Hydrogen	Neutrons on Pb	Neutrons or H.E. Gammas	Np-237	Pu-238
Pu-239	Radiation Detected	U-232	U-233	U-235	U-235
U-238	Unknown Peak	Unknown/Beta Emitter	1001 keV Peak Present	186 keV Peak Present	2614 keV Peak Present
356 keV Peak Present	375/414 keV Peak Present	662/722 keV Peak Present	Ac-225	Ac-227	Ag-110m
Ar-41	As-72	As-74	At-211	Au-198	Ba-133
Ba-140	Be-7	Beta Emitter	Bi-207	Bi-212 (Th-232/U-232 daughter)	Bi-214 (Ra-226 daughter)
Br-76	Br-76 (Heavily Sheilded)	Br-76 (Shielded)	Br-77	Ca-47	Cd-109
Cd-115	Ce-139	Ce-141	Ce-144	Cm-242	Cm-243
Cm-244	Co-55	Co-56	Co-56 (Shielded)	Co-57	Co-57 (Shielded)
Co-58	Co-60	Cr-51	Cs-131	Cs-134	Cs-137
Cu-64	Cu-67/Ga-67	Eu-152	Eu-154	Eu-155	Eu-156
F-18	Fe-59	Ga-64	Ga-64 (Shielded)	Ga-67	Ga-67
Ga-67 (Shielded)	Gd-153	Gd-159	Ge-68/Ga-68	Hf-181	Hg-203
Ho-166	Ho-166m	Ho-166m (Shielded)	I-123	I-123 (Shielded)	I-124
I-125	I-126	I-126 (Shielded)	I-131	I-131 (Shielded)	I-132
I-133	I-134	I-135	In-111	Ir-192	Ir-192 (Shielded)
Ir-194 (Shielded)	K-40	Kr-87	Kr-88	Kr-88 (Shielded)	La-138
La-140	Lu-172	Lu-176	Lu-177	Lu-177m	Mn-52
Mn-54	Mn-56	Mo-99	Na-22	Na-24	Nb-92m
Nb-94	Nb-95	Nb-96	Nd-96 (Shielded)	Nd-147	Os-194/Ir-194
Pa-231	Pb-203	Pd-103	Po-210	Pr-144	Ra-223
Ra-226	Rb-83	Rb-86	Rh-105	Ru-103	Ru-106/Rh-106
Ru-97	Sb-124	Sb-124 (Shielded)	Sb-125	Sb-127	Sc-46
Se-75	Sm-153	Sm-153 (Shielded)	Sn-113	Sr-82/Rb-82	Sr-85/Kr-85
Sr-89	Sr-89	Suspect Neutrons	Ta-182	Tc-96	Tc-99m
Te-132	Th-229	Th-230	Th-232	Tl-200	Tl-201
Tl-202	Tl-204	Tm-170	Tm-171	V-48	W-187
W-188/Re-188	Xe-127	Xe-131m	Xe-133	Xe-133m	Xe-135
Y-88	Y-91	Yb-169	Zn-62	Zn-65	Zr-95

Detective X Technical Specifications

Detectors

Nuclide Identification P-type high-purity germanium (HPGe) crystal with Coaxial construction. Crystal nominal dimensions 65 mm diameter x 50 mm length.

Cryostat and Cooler "Hardened" cryostat, with high-reliability, low-power Stirling cooler. The cryostat design is such that the Detective X may be switched off at any time and power subsequently re-applied, without having to wait for a full thermal cycle (full warm up before cool down). This feature greatly increases system availability during measurement campaigns.

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 device. Initial cool down time depends on ambient temperature, but is typically 8 hours at 25°C.

Gamma Dose Rate Detector Three detectors determine the gamma dose rate over a wide range from <0.05 mR/h to >100 R/h, a dose-rate range of over six decades. Instrument switches between the three automatically.

Neutron Detector Module The optional neutron detector is a large volume segmented lithium-6 fluoride/zinc sulfate (Li^6F/ZnS) detector that is ANSI N42.34 2015 compliant.

Hardware

Digital MCA and Data Processor

Display 4.3" WQVGA (480 x 272 pixels) sunlight readable, touch sensitive, operate with finger or stylus.

Data Processor FREESCALE I.MX535 operating at 1 GHz.

Data Storage

Media To internal RAM and removable low profile USB flash drive. The unit is shipped with a 16 GB Flash drive which holds over 100,000 spectra.

File Format ANSI N42.42.

Computer Interfacing USB and Ethernet TCP/IP v4 connections via standard RJ45 Ethernet connection (10/100Base-T – 10/100Mbps, auto-sensing). Ready for use with MFK (Mobile Field Kit for DoD users), ORTEC GammaVision, iOS devices and Android devices. Wi-Fi (802.11) communication software. Wireless Mobile MCB Server software.

Wireless Connectivity IEEE 802.11b wireless and Bluetooth.

GPS The instrument is equipped with an internal GPS. The location information associated with a measurement is optionally stored in the N42 files.

Digital MCA with Internal Storage of Multiple Spectral Data

Digital Noise Suppression "LFR Filter".

Conversion Gain 16k channel.

Maximum Number of Stored Spectra Unlimited on removable media.

Physical Specifications

Maximum Overall Dimensions (including handle and Ge detector endcap) 15.5 in L x 6.25 in W x 8.25 in H (39.5 cm L x 16 cm W x 21 cm H).

Weight 15.4 lbs (6.98 kg) gamma only. 16.8 lbs (7.2 kg) gamma/neutron.

Internal Battery 2 Rechargeable Lithium Ion. 98 Wh each, nominal. Over 8 hours of battery life at 25°C when HPGe detector is cold. <4 hour time to charge. Internal battery is easily swapped.

External Battery Battery lifetime may be extended indefinitely by the use of optional external battery packs. An external military battery (Model 2590) weighs less than 3.25 lbs and extends lifetime to >16 hrs.

Input Power 12 to 17 V DC from battery or DC power supply (universal mains supply included).

Power Usage Highest during cool down and charging battery: <100 Watt. Cold with fully charged battery <35 W.

Operation Range

Temperature: –20°C to 50°C.

Relative Humidity: 95% non-condensing.

Instrument Enclosure IP65 Sealed against ingress of dust and water. All perforations are sealed by rubber plugs (connectors, memory cards, etc.).

Detective X

Communication Software

The Detective X is a member of the ORTEC CONNECTIONS family. Remote MCA control, even over a network, is achieved simply by the use of ORTEC CONNECTIONS products such as MAESTRO MCA Emulation software.

Multiple spectra may be block-transferred from the instrument controller to an external PC via the USB connection. The Detective X appears as a flash drive when connected to a laptop or PC. Exported files are in the N42 format and may be read by many programs used by Reachback teams such as CAMBIO and PeakEasy and by ORTEC software products such as MAESTRO and GammaVision.

Detective X is equipped with IEEE 802.11b wireless and Bluetooth, allowing the Detective X to be used with cell phones, laptops, and remote computer systems. The Detective X is ready to use with MFK software, ORTEC GammaVision software, iOS devices (iPhone®, iPAD) and Android® devices.

Mobile MCB Server

The Mobile MCB Server software application enables the Detective X to communicate wired or wirelessly with ORTEC software applications such as MAESTRO, GammaVision, and Detective-Remote®.

Users can develop their own applications through the use of the optional A11 tool kit.

Ordering Information

Model	Description
DETECTIVE-X	3 MeV Enhanced Capability, Ultra-Light-Weight, Portable High Efficiency HPGe Identifier (Gamma only). Includes GPS, mains adapter, vehicle power cable, 16 GB mini USB flash drive, shoulder strap, Bluetooth headset and wheeled hard-sided case.
DETECTIVE-X-N	3 MeV Enhanced Capability, Ultra-Light-Weight, Portable High Efficiency HPGe Identifier (Gamma and Neutron). Includes GPS, mains adapter, vehicle power cable, 16 GB mini USB flash drive, shoulder strap, Bluetooth headset and wheeled hard-sided case.
DETECTIVE-X-8	8 MeV Enhanced Capability, Ultra-Light-Weight, Portable High Efficiency HPGe Identifier (Gamma only). Includes GPS, mains adapter, vehicle power cable, 16 GB mini USB flash drive, shoulder strap, Bluetooth headset and wheeled hard-sided case.
DETECTIVE-X-8-N	8 MeV Enhanced Capability, Ultra-Light-Weight, Portable High Efficiency HPGe Identifier (Gamma and neutron). Includes GPS, mains adapter, vehicle power cable, 16 GB mini USB flash drive, shoulder strap, Bluetooth headset and wheeled hard-sided case.
Accessories	
DETECTIVE-X-ACC-BAT	Lithium-Ion Battery.
DETECTIVE-X-ACC-DUAL-CHGR	Standalone dual battery charger and calibrator.
DETECTIVE-X-ACC-VEHCHGR	Vehicle powered adapter cable.
DETECTIVE-X-ACC-PS	Universal AC mains power supply.
DETECTIVE-X-ACC-2590-CABLE	Battery Cable for connection to Military 2590 battery.
DETECTIVE-X-ACC-RCFILTER	Low Energy Gamma Filter.
DETECTIVE-X-ACC-COL-W	Tungsten Collimator 4 mm thick.
DETECTIVE-X-ACC-COL-ST	Steel Collimator 4 mm thick.
DETECTIVE-X-ACC-TRANSPORTCASE	Wheeled Transport Case.
DETECTIVE-X-ACC-BLUETOOTH-HS	Bluetooth Headset.
DETECTIVE-X-ACC-16GB-USBFLASH	16 GB USB Mini Flash Drive.
DETECTIVE-X-NEUTRON-DETECTOR	Li^6/ZnS Neutron Detector.

Specifications subject to change
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