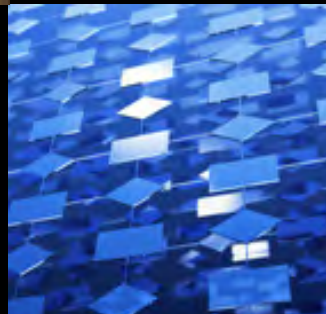
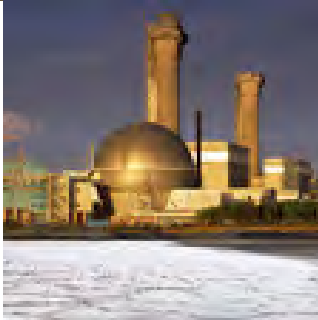


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Nuclear Detection

Who we are

Kromek is a UK platform technology Group that provides digital colour x-ray and gamma ray detection and imaging. Our products enable direct materials identification in the security screening, civil nuclear and medical imaging markets.

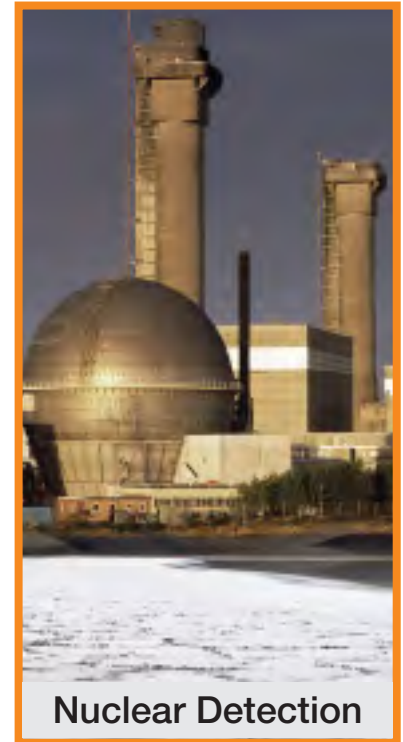
With operations in the UK and US, Kromek sells internationally with partnerships and distribution channels in Asia, Europe, and North America, to a global customer base ranging from national governments and regulatory bodies to international airports and research institutes, and from major energy providers to the world's largest technology and medical equipment groups.



Medical Imaging



Security Screening



Nuclear Detection

Our capabilities

Based on innovation in semiconductor production and electronics supported by technologies such as software, algorithms and systems engineering, Kromek has world-leading, often unique capabilities covering the value chain “from semiconductors to solutions”.

Our products

Kromek’s portfolio of cutting-edge high-resolution products for gamma ray detection and isotope analysis in complex nuclear environments differentiate themselves by their sensitivity, high resolution and small form factor allowing unprecedented flexibility in deployment.

In security, Kromek offers a range of handheld detectors and within aviation security the Kromek Identifier liquid explosive detection system (ECAC level 3) brings speedy threat detection that, uniquely, can accurately scan ALL container types, including metal.

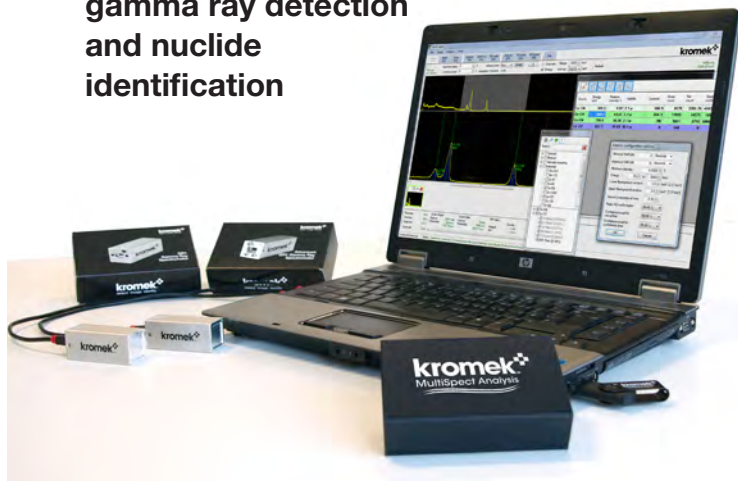
We also have an exciting suite of products under development with partners in the medical imaging market including CT, SPECT, PET and Bone Mineral Densitometry.

GR1-A™ and GR1™

Now with flexible
functionality to meet
specialist requirements



Compact high-resolution
gamma ray detection
and nuclide
identification



Main features:

Common to GR1 - GR1-A

- High spectral resolution
- High efficiency
- Compact
- Simple to use
- CZT solid state detector
- USB Powered
- Low power consumption

GR1-A specific

- Operational flexibility
- MCX connectors
- Analogue energy output
- Timing output
- MCA gate input

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GR1-A™ and GR1™ the World's Smallest and Highest Resolution Room Temperature Gamma-Ray Spectrometers

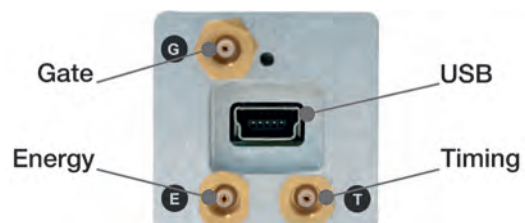
The **GR1™** and **GR1-A™** high-performance gamma-ray spectrometers utilize a 1 cm³ CZT solid state detector and offer world-leading specification in a compact form.

Both are completely self-contained, with a built-in preamplifier, shaping amplifier, baseline restorer, pulse height digitizer, and HV supply. The digitized pulse heights of detected gamma-ray signals are sent to a PC via the mini-USB which also powers the unit, so no external power supply is required.

The **GR1™** comes with K-Spect, Kromek's entry-level Windows-based (XP/Vista/7/8) software, built for detailed sample and spectral analysis. K-Spect, which is available to download, free of charge, from the Kromek website, provides the spectrum acquisition, display, analysis, and storage functions.

The **GR1-A™** is the advanced model of the GR1™, containing auxiliary input/outputs that greatly increase operational flexibility. These allow the GR1-A™ to be tailored for specific applications in nuclear research and academia. Three MCX connectors provide energy and timing outputs and gate inputs.

The GR1-A™ is supplied with MultiSpect Analysis™ software, a unique application that allows connection of multiple GR1-As to a PC, and has the ability to display multiple spectra; both live and saved, from previous measurements. It provides the spectrum acquisition, display and storage functions, and the export of data for further analysis as well as match spectra to a pre-loaded library of over 400 radionuclides.



Energy Output: shaped and buffered detector output pulses with amplitude proportional to energy suitable as input to an external multichannel analyser (MCA)

Timing Output: A logic pulse triggered by each detected event and coincident with each output pulse

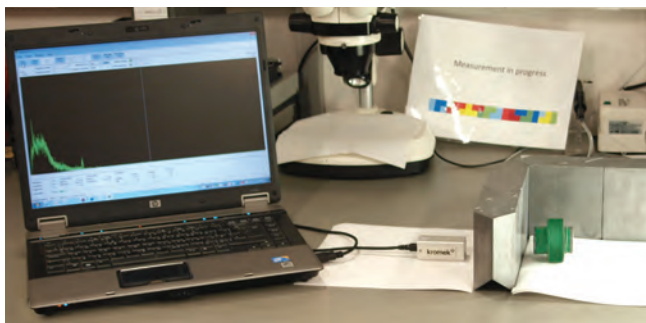
Gate Input: used to suppress pulse height output via the USB interface to K-Spect for anticoincidence. Energy and timing outputs are unaffected.



Health Physics



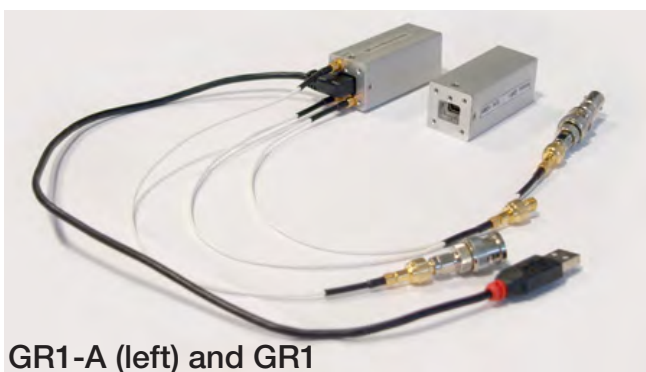
InSitu Monitoring



Nuclear Spectroscopy



Nuclear Industry



GR1-A (left) and GR1

Specifications

Common to GR1 / GR1-A:

Detector	10x10x10mm CZT detector
Energy range	30 keV to 3.0 MeV
Energy resolution	<2.5% FWHM @ 662 keV
Electronic noise	<10 keV
Maximum throughput (USB)	30,000 cps
Number of channels	4096 (12 bit)
Differential non-linearity	< ± 1%
Power consumption	250 mW
Dimensions	25mm x 25mm x 63mm
Weight	60 gram
Temperature range	0 - 50°C

Specific to GR1-A:

Energy Output	Rise time	3 μ s
	Decay time	10 μ s
	Output impedance	< 150 Ω
	Maximum throughput (analogue)	50,000 cps
Timing Output	Shape	TTL compatible rectangular pulse
	Amplitude	5.0 V
	Duration	8 μ s
	Output impedance	< 150 Ω
	Timing Resolution	< 100 ns
Gate Input	Threshold	3 V
	Maximum input voltage	5 V
	Input impedance	10 k Ω
	Timing	Input must be above threshold from at least 0.5 μ s before the energy signal maximum to at least 2 μ s after it.

Note: In the absence of any connection the gate input is held low and all pulses are processed normally.

Tested by the National Physical Laboratory in accordance with the conditions in;

ANSI N42.31 (2003) "Measurement procedures for resolution and efficiency of wide-bandgap semiconductor detectors of ionizing radiation"

ANSI N42.34 (2006) Section 7.1 "Performance criteria for hand-held instruments for the detection and identification of radionuclides"

BS EN 62327:2011 Section 9.6 "Hand-held instruments for the detection and identification of radionuclides and for the indication of ambient dose equivalent rate from photon radiation"

NPL Good Practice Guide No. 14 "The examination, testing and calibration of portable radiation protection instruments"

Environmental: meets or exceeds: EN55011:1998 +A1:1999 +A2:2002 (Radiated Emissions), EN61000-4-2:1995 +A1:1998 + A2:2001 (Immunity to ESD), EN61000-4-3:2002 (Radiated Immunity)

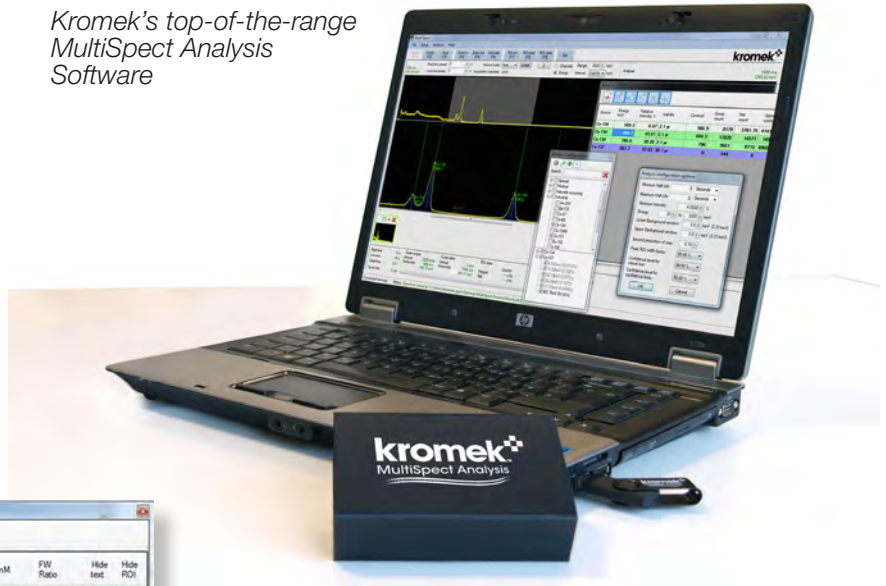
K-Spect and MultiSpect Analysis Software

The GR1™ and GR1-A™ can both be used with Kromek's **K-Spect™** and **MultiSpect Analysis™** software running on any Windows-based (XP/Vista/7/8) PC.

The GR1™ comes with K-Spect™, Kromek's entry-level software which is available to download, free of charge from: www.kromek.com (click on the downloads tab, and follow the on-screen instructions).

K-Spect™ receives the data and performs the spectrum acquisition, display, analysis and storage functions.

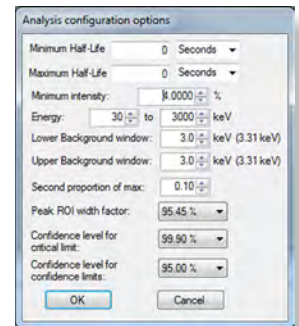
Kromek's top-of-the-range MultiSpect Analysis Software



Source	Energy keV	Relative intensity %	Half life	Centroid	Gross count	Net count	Upper confidence	Lower confidence	FWHM	PWinM	FV Ratio	Hide list	Hide ROI
Ca-134	569.3	6.87	2.1 yr	566.9	8179	3781.75	4143.2178	3420.2822	12.79	29.32	0.5717		
Ca-134	604.7	43.61	2.1 yr	604.3	17820	14571	14945.46	14196.54	10.73	20.01	0.5365		
Ca-134	795.8	38.20	2.1 yr	796	9661	16	8960.5183	8469.4817	11.52	24.1	0.4781		
Ca-137	661.7	91.63	30.1 yr	0	544	0	0	0	0	0	0		

Filter by critical limit, relative intensity of the emission lines, energy windows and half life.

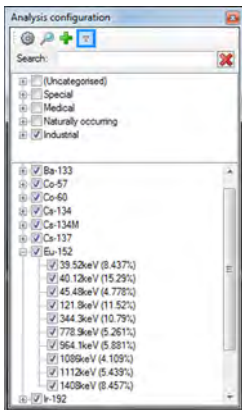
Colour coded results showing which lines are above the critical limit of the information.



Configuration options for the analysis based on statistical significance.

Signals from the CZT solid-state detector are processed and digitized, and the pulse height data is transferred to the computer via the mini-USB.

K-Spect™ users can upgrade to MultiSpect Analysis™, to find out more or apply for an upgrade, contact our commercial team via the Kromek website.



User configurable library of radionuclide emissions

MultiSpect Analysis™ is Kromek's top-of-the-range software and is included on a flash disk with each GR1-A™. In addition to all the K-Spect™ functionality, MultiSpect Analysis™ allows users to acquire and display live spectra from multiple devices simultaneously alongside saved spectra from previous measurements. It also enables grouping and summing of individual spectra plus the ability to match spectra to an on-board library of over 400 nuclides.

Please check the Kromek website regularly for updates.

Feature	K-Spect	MultiSpect Analysis
Spectral acquisition from single unit	✓	✓
Spectral acquisition from multiple units simultaneously (PC dependant 5-20 systems)	-	✓
Energy calibration facility	✓	✓
Display single detector information only + 5 saved Spectra	✓	✓
Display calibrated spectra at the same energy scales to allow comparison	-	✓
Compatible with K102 Multichannel Analyser	✓	✓
Thumbnail indication of loaded spectra	-	✓
Ability to save spectra in SPE or CSV formats	✓	✓
Ability to export data	✓	✓
Ability to save detector calibration information	✓	✓
Association of calibration data with particular detectors by serial number	-	✓
Aggregation of multiple spectra into one spectrum	-	✓
Built in library of 416 isotopes	-	✓
Industry standard categorisation of isotopes	-	✓
User customisable libraries	-	✓
Multiple regions of interest with Spectra	-	✓
Automated peak analysis of Spectra	-	✓

GR1 Family variants	Detector size mm	Resolution at 662 keV	USB	Gate input	Timing output	Energy output	Software included
GR1	10x10x10	<2.5%	✓	-	-	-	
GR1+	10x10x10	<2.0%	✓	-	-	-	
GR1-A	10x10x10	<2.5%	✓	✓	✓	✓	MultiSpect Analysis
GR1-A+	10x10x10	<2.0%	✓	✓	✓	✓	MultiSpect Analysis
GR05	5x5x5	<2.5%	✓	-	-	-	
GR05+	5x5x5	<2.0%	✓	-	-	-	

K-Spect is compatible with all products and is available to download free of charge from the Kromek website

The GR1 can be interfaced with other software packages, and driver information can be provided as part of the project deliverables for selected partners.

3x MCX and 3x BNC adaptors included with GR1-A products

Example applications of the GR1 / GR1-A

- Radionuclide identification:** The GR1 and MultiSpect Analysis provide a powerful platform to perform radionuclide identification in a variety of industrial and health physics applications such as environmental monitoring and sample analysis.
- Classroom teaching:** The GR1 module is an ideal and portable tool that can be utilised for educational purposes in teaching concepts of radiation as well as for training in the use of radiation sensors.



Example research applications of the GR1-A

- Particle-gamma coincidence measurements:** The high resolution of the GR1-A allows it to be paired with charged-particle or neutron detectors in order to observe coincidence particle decays with gamma-ray emission.
- Gamma-gamma coincidence measurements:** Multiple GR1-A's can be used in unison in order to identify multiple gamma rays that are emitted in coincidence; because of this, the GR1-A can be used as a tool in studies of nuclear structure.
- Pulse-shape analysis:** The analogue energy output can be used for studies of charge collection pulse-shapes, which can yield information on interaction points, scattering and charge mobility within the detector crystal. The timing output can also be employed as an input for time-to-analogue converters.

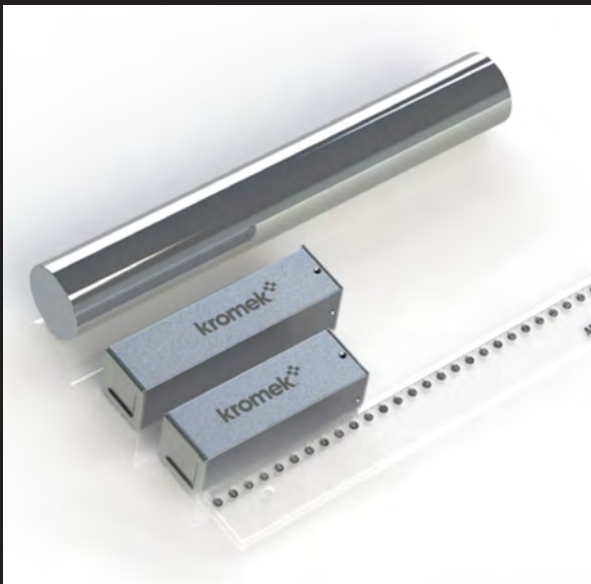


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SIGMA™



How Kromek's SIGMA™ compares to other integrated scintillator detectors



Typical Applications:

- Radiation Safety
- Health Physics
- Industrial and Medical
- Homeland Security
- Research Laboratories

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Introducing Kromek's new generation of scintillator products

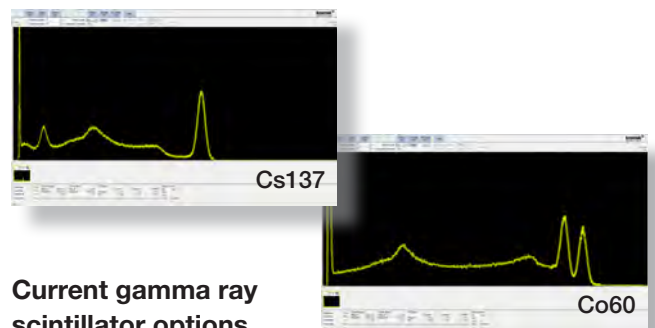
Kromek's next generation of scintillator products replace conventional photomultiplier technology with state of the art silicon photomultipliers (SiPMs). These gamma-ray detectors offer over 16cm³ of detection volume, delivered in a package providing significant benefits in cost, size, weight, power consumption and temperature stability.

Kromek's SIGMA™ product range interfaces directly with the existing MultiSpect Analysis™ platform providing all the analysis benefits currently enjoyed by users of Kromek's CZT detector product.

As with the CZT technology, Kromek's SIGMA probes will be available for the RayMon™ platform allowing the user to seamlessly switch between detection needs for both search and detailed analysis.

SIGMA technology will also be available in the RadGrid™ network detector family allowing customers to choose between a range of sensitivity and resolution options to best meet their measurement needs.

Other products exploiting the SIGMA™ technology platform in quantitative analysis for food and decommissioning assay will follow.



Model	Case size (mm)	Crystal size (mm)	Volume cm ³	Resolution (%@Cs137)	Weight (g)
SIGMA50	35x35x130	25.4x25.4x51	32.8	<7.2	300
SIGMA25	35x35x105	25.4x25.4x25.4	16.4	<7.2	200

USB powered 250 mW

Specifications

Detector	SIGMA50 1" x 1" x 2" CsI(Tl) Detector SIGMA25 1" x 1" x 1" CsI(Tl) Detector
Energy Range	50 keV – 1.5 MeV
Maximum throughput	5,000 cps
Energy resolution	< 7.2 % FWHM @ 662 keV (21°C operation)
Number of Channels	4096 (12 bit)
Power consumption	250 mW
Dimensions	34.5 mm x 34.5 mm x 130 mm
Weight	300g
Operational temperature range	-10 to 40°C



SIG A4E SPF-DOC-1225 Rev5

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**High Sensitivity
and
Ultra-compact**



**TN15™
Thermal Neutron
Scintillation Detector**

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TN15™ High Sensitivity Ultra-compact Thermal Neutron Scintillation Detector

The TN15™ high sensitivity thermal neutron detector utilizes a state-of-the-art Silicon photomultiplier (SiPM) and offers world-leading specification in a compact form. The TN15™ surpasses the performance of a 100mm long 13mm ³He tube at 4 atmospheres.

This highly compact device is completely self-contained, with a built-in preamplifier, shaping amplifier, pulse discrimination, and HV supply. The digitized neutron data is sent to a PC via the mini-USB which also powers the unit, so no external power supply is required.

The TN15™ comes with K-Spect™, Kromek's entry-level Windows-based (XP/Vista/7/8) software, built for detailed sample and spectral analysis. K-Spect™, which is available to download, free of charge, from the Kromek website, provides the spectrum acquisition, display, analysis, and storage functions.

The software can be upgraded to Kromek's top-of-the-range MultiSpect Analysis™ software, a unique application that allows connection of multiple detectors to a PC, and has the ability to display multiple spectra; both live and saved, from previous measurements.

In addition to providing the spectrum acquisition, display and storage functions, MultiSpect Analysis™ allows the export of data for further analysis as well as matching spectra to a pre-loaded library of over 400 radionuclides.



Main Features:

- High efficiency
- Excellent gamma rejection
- Compact
- Simple to use
- USB Powered
- Low power consumption

Specifications:

Equivalent to 100mm x 13mm Ø ³ He at 4 atmospheres	
Photo-sensor	SiPM array
Thermal Neutron Sensitivity	>50%
Maximum throughput	10,000 cps
Power consumption	250 mW
Dimensions	131mm x 33mm x 24mm
Weight	110 gram
Temperature range	Ž#0 rm20°C



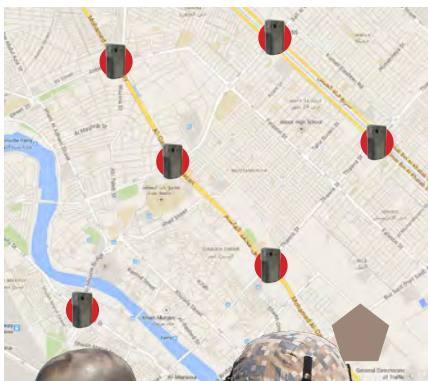
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Introducing a new combined wireless gamma-neutron detector that can be tailored to existing infrastructure

Bluetooth™ platform offers OEMs and end users a complete hardware solution ready to interface to their own software or capability infrastructure.



Creating Intelligent Radiation Detection Networks



D3 Combined Gamma/Neutron Detector

D3 can be used as a blind detector forming part of a covert integrated monitoring network and include use as a terrorist threat detection network at borders

UK radiation detection solutions company, Kromek, has launched a new detector platform for high efficiency radionuclide and neutron search and identification.

Called the 'Discreet Dual Detector', or D3 for short, this new detector is a combination of two of Kromek's leading technologies: the TN15 non-He³ compact thermal neutron scintillator detector and the SIGMA CsI(Tl)/silicon photo-multiplier-based gamma detector. Both detectors offer high levels of sensitivity and benefit in terms of size, weight and power consumption, making them ideal for use within portable instruments.

The D3 hybrid gamma/neutron platform neatly combines high sensitivity with small form factor together with a long-life battery power source, easily recharged via USB connection, and Bluetooth™ interface which allows communications with the combination of a Smartphone, tablet or PC interface and offers both OEMs and end users a complete hardware solution ready to interface to their own software or capability infrastructure.

Applications

Because of its small form factor and portability, the D3 has several notable applications:

- It can be used as a blind detector forming part of a covert integrated monitoring network and include use as a terrorist threat detection network at borders, high profile events or festivals and with enforcement inspection teams (Police, UN or IAEA), or
- be used with a local display as a RIID/SPRD presenting dose and spectral data to the user.

Kromek offers full support and consultancy with integration and development of an interface to the end user's or OEMs own infrastructure.

When used in combination with a Smartphone, tablet or PC interface enhances the D3 with local dose indication and spectral analysis capability.

The D3 is also compatible with Kromek's own KSpec and MultiSpect Analysis acquisition and analysis software.

High Sensitivity and Ultra-compact

The D3 brings two of Kromek's new detectors together: the TN15 non-He³ compact thermal neutron scintillator detector and SIGMA 25 CsI(Tl)/silicon photo-multiplier based gamma detector.

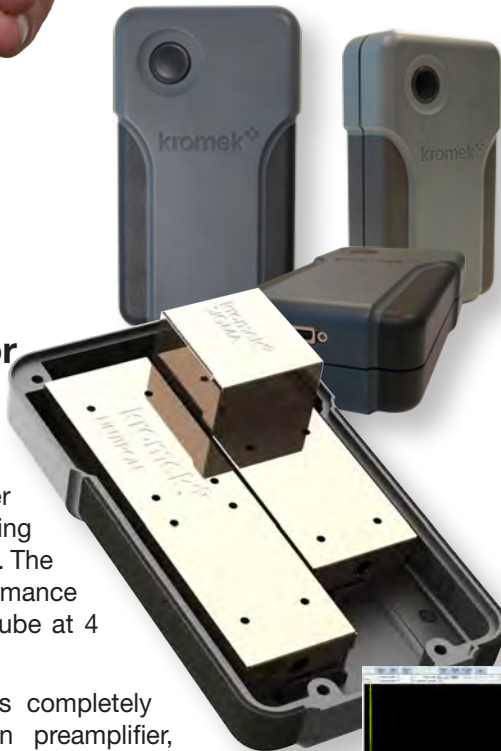
Both detectors offer high levels of sensitivity but benefit in terms of size, weight and power consumption ideally lending them to be used within portable instruments.



TN15™ Thermal Neutron Scintillation Detector

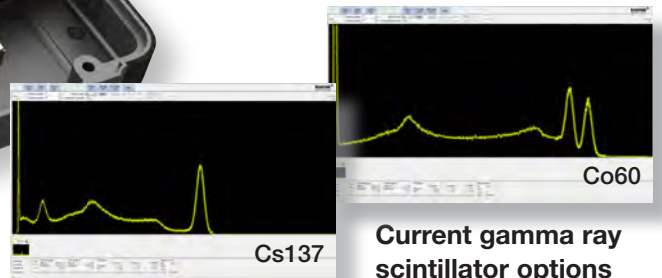
The TN15™ high sensitivity thermal neutron detector utilizes a state-of-the-art Silicon photomultiplier (SiPM) and offers world-leading specification in a compact form. The TN15™ surpasses the performance of a 100mm long 13mm ³He tube at 4 atmospheres.

This highly compact device is completely self-contained, with a built-in preamplifier, shaping amplifier, pulse discrimination, and HV supply. The digitized neutron data is sent to a PC via the mini-USB which also powers the unit, so no external power supply is required.



SIGMA™

Kromek's next generation of scintillator products replace conventional photomultiplier technology with state of the art silicon photomultipliers (SiPMs). These gamma-ray detectors offer up to 32.8 cm³ of detection volume, delivered in a package providing significant benefits in cost, size, weight, power consumption and temperature stability.



TN15 specifications:

Equivalent to 100mm x 13mm Ø ³He at 4 atmospheres

Photo-sensor	SiPM array
Thermal Neutron Sensitivity	>50%
Maximum throughput	10,000 cps
Power consumption	250 mW
Dimensions	131mm x 33mm x 24mm
Weight	110 gram
Temperature range	-10 to 40°C

Model	Case size (mm)	Crystal size (mm)	Volume cm ³	Resolution (%@Cs137)	Weight (g)
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USB powered 250 mW

SIGMA specifications:

Detector	SIGMA50 1" x 1" x 2" CsI(Tl) Detector SIGMA25 1" x 1" x 1" CsI(Tl) Detector
Energy Range	50 keV – 1.5 MeV
Maximum throughput	5,000 cps
Energy resolution	< 7.2 % FWHM @ 662 keV (21°C operation)
Number of Channels	4096 (12 bit)
Power consumption	250 mW
Dimensions	34.5 mm x 34.5 mm x 130 mm
Weight	300g
Operational temp range	-10 to 40°C



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RayMon10TM

**Detect, measure, identify
and analyse radionuclides
with the world's
highest resolution
CZT handheld detector**

Applications include:

- Health physics
- Nuclear installation monitoring
- Nuclear accident response
- Security screening undertaken by customs, police, fire and rescue services
- Military
- Site surveys
- Civil defense
- First responders



Instrument Features:

- Accurate dose in US or SI units
- Dynamic search and alarm capability
- Automated radionuclide ID for ANSI N42.48
- RadBar™ included for spectral dose visualisation
- Library of 94 radionuclides. User can add custom nuclides for their application
- Feature locking with PIN codes
- Fully compatible with Kromek's desktop spectroscopy software, MultiSpect Analysis™

Detector:

- Energy resolution: 2.0-2.5% FWHM @ 662 keV
- Energy range: 30 keV to 3.0 MeV enabling high resolution isotope ID using the latest advances in CZT detector technology

Hardware:

- Rugged handheld platform
- Sunlight-visible VGA display shows images, maps and data in ultra-sharp detail
- Integrated GPS for location tagging
- Long-life rechargeable battery - 8 hours in continuous use
- GSM 3G options (optional)
- Integrated 5MP camera (optional)

RayMon10™

Detect, measure, identify and analyse radionuclides with the world's highest resolution CZT handheld detector

The RayMon10™ is the highest resolution CZT handheld radiation monitor in the world. It can be used to detect, measure, identify and analyse gamma ray emitting radionuclides. The CZT detector produces high resolution gamma-ray spectra for clear and unambiguous interpretation. The RayMon10™ algorithms provide spectral dose, radionuclide identification, line analysis and activity quantification.

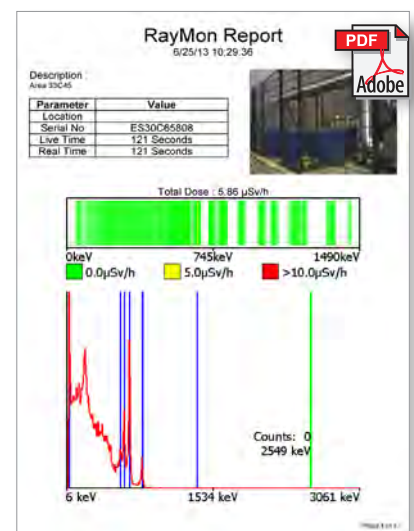
RayMon10™ is robust, lightweight and easy to use; its portability and usability are second-to-none.



RayMon10's detachable probe



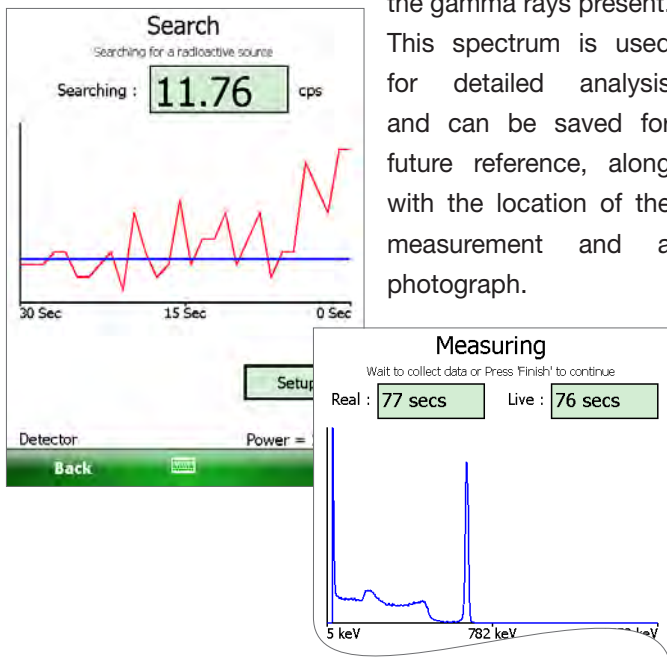
RayMon10™ creates PDF reports including photograph, GPS position, radiation spectra and spectral analysis, with raw data files as attachments. Measurements can be transferred easily to a PC or laptop, with data transfer either via USB, or with reachback over wireless, Bluetooth or cellular networks.



Searching and measuring

The search feature makes locating sources easy. As the detector is moved, clear visual graphs show when the count rate is increasing, guiding the user to the position of the source.

When exposed to radiation the operator can use the high resolution CZT detector to measure a detailed spectrum of the gamma rays present.

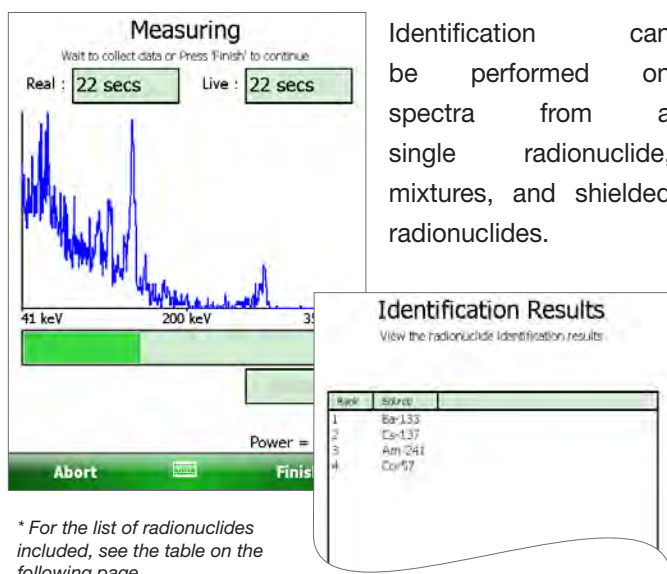


This spectrum is used for detailed analysis and can be saved for future reference, along with the location of the measurement and a photograph.

Automatic Isotope Identification

After recording a spectrum, fully automated radionuclide identification, designed to meet ANSI N42.48, can be performed for a library of 18 commonly encountered radionuclides*.

“Unknown Radionuclide” is displayed if there is a radiation source present that cannot be identified. Results are clearly ranked for the user with the largest contributor at the top of the results table.



* For the list of radionuclides included, see the table on the following page

Dose

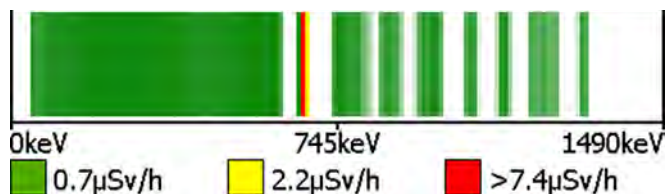
RayMon10™ provides accurate dose measurements to the user from both a simple front screen and as part of a gamma ray spectrum measurement. The user can choose between SI and US standard units.

The spectral data is analysed by a Kromek developed algorithm across all energies to give an accurate dose value without the operator having to change any calibration factors.



RadBar™ Technology

For the first time high resolution CZT technology allows the user to see the dose spectrum clearly in a RadBar™ graphic. When viewed in conjunction with the emission energies of identified radionuclides the major dose contributors can be identified.



Colour scaling can be configured by the user depending on the application.

Alarms

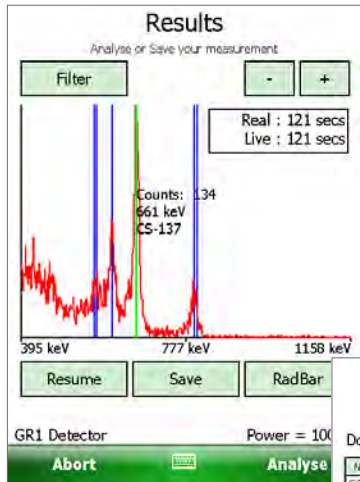
Counts per second alarms are configurable at user chosen levels and clearly visible on the front of the device.

The dynamic search alarms, which utilise statistical significance algorithms, can also be configured to the user's needs.

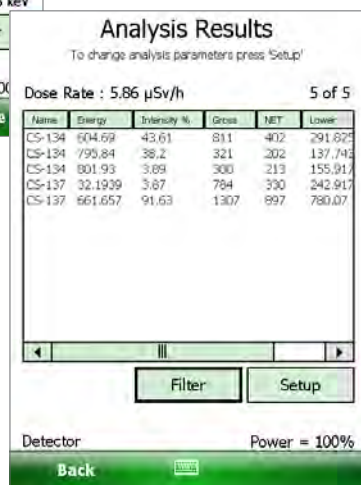


Spectrum analysis for advanced users

For advanced users RayMon10™ contains a detailed library of the emission lines from 94 radionuclides. Libraries can be configured by the user for the radionuclides of most interest.



After a spectrum has been measured emission lines that pass a statistical critical limit test are highlighted to the user allowing the user to interpret the peaks in the spectrum.



Emission peak parameters are calculated and returned to the user. Detailed .csv reports allow the user to access all measured peak parameter values from the spectrum analysis.

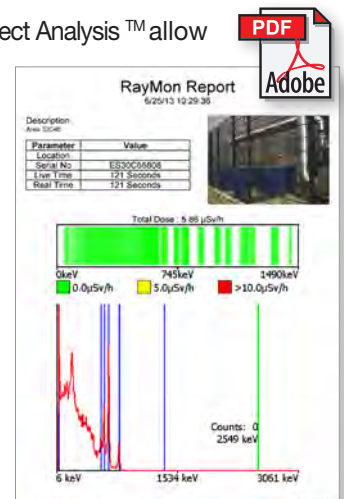
Total Dose Rate	5.86455
FWnMn	0.1
Critical limit confidence level	99.9
Confidence limit confidence level	95

Source	Energy	Relative Intensity	Analysis	Peak Detected	Gross count	Net count	Centroid	FWHM	FWnM	FW ratio	Critical limit
CS-134	31.8174	0.0011	Included	Yes	710	240	34.8702	5.4298	6.30338	0.861412	115.3
CS-134	32.1939	0.0019	Included	Yes	784	330	34.1691	5.89801	7.25725	0.812706	113.4
CS-134	475.34	0.0067	Included	No	554	112	0	0	0	0	172.4
CS-134	563.23	0.0374	Included	No	518	23	0	0	0	0	181.36
CS-134	569.32	0.0687	Included	No	547	98	0	0	0	0	175.6
CS-134	604.69	0.4361	Included	Yes	811	402	605.979	7.34466	20.6735	0.35527	166.4
CS-134	795.84	0.382	Included	Yes	321	202	796.409	4.18142	19.9084	0.210033	103.62
CS-134	801.93	0.0389	Included	Yes	300	213	796.181	4.29306	20.2723	0.211769	91.17
CS-134	1038.555	0.0044	Included	No	12	5	0	0	0	0	47.11
CS-134	1167.92	0.008	Included	No	8	0	0	0	0	0	53.00
CS-134	1365.16	0.0135	Included	No	4	0	0	0	0	0	51.187
CS-137	31.8174	0.021	Included	Yes	710	240	34.8702	5.4298	6.30338	0.861412	115.3
CS-137	32.1939	0.0387	Included	Yes	784	330	34.1691	5.89801	7.25725	0.812706	113.4

Exporting Data and ReachBack Communications

RayMon10™ is fully compatible with Kromek's desktop PC software MultiSpect Analysis™. Spectra, analysis configurations and results can easily be transferred by simply connecting the RayMon10™ to the PC with a USB cable and using the import functions within the MultiSpect Analysis™ measurements database. The analysis of spectra can then continue with the convenience of a desktop and the extensive radionuclide library available in MultiSpect Analysis™.

Both RayMon10™ and MultiSpect Analysis™ allow reports to be generated in pdf format of the measurement, including spectrum, peak analysis, radionuclide identification results, and photographs.



Category	Nuclides Included
Industrial	Co-57 [†] , Co-60 [†] , Ba-133 [†] , Cs-137 [†] , Ir-192 [†] , Tl-204, Ra-226, Am-241 [†] , Cs-134, Cs-134 (M), Eu-152 [†] , Na-22 [†]
Medical	Ga-67 [†] , Cr-51, Se-75, Sr-89, Mo-99, Tc-99m [†] , In-111, I-123 [†] , I-125, I-131 [†] , Sm-153, Tl-201 [†] , Xe-133
NORM	K-40 [†] , Ra-224, Ra-226 [†] , Ac-228, Th-234, Th-228, Th-230, Th-232 [†] , Th-232 ^D , Rn-220, Po-216, Pb-212, Pa-234, Pa-234m, U-234, U-238, U-238 ^D , Rn-218, Rn-222, Bi-210, Bi-212, Bi-214, Po-214, Tl-206, Tl-208, Tl-210, Pb-210, Pb-214, Po-210, Po-218, Hg-206
Special	U-233, U-235 [†] , Np-237, Pu-239 [†] , Pu-240, O-19, Ar-41, Kr-87, Kr-88, Ac-225, Ac-227, At-215, At-217, Bi-211, Bi-213, Bi-215, Fr-221, Fr-223, Pa-231, Pa-233, Pb-211, Po-211, Po-213, Po-215, Ra-223, Rn-219, Th-227, Th-229, Th-231, Tl-207, Tl-209, Xe-133M, Xe-135M, Xe-138, I-134
Other	Mn-54, Zn-65, U-232

^D in equilibrium with daughter products

[†] included in automatic radionuclide identification

Quantitative Analysis with RayMon10™



Quant™ for RayMon10™

Quantitative activity analysis module provides the complete hardware and software package required for accurate measurements of specific radionuclides. The module is fully ruggedised for field use.

Accurate measurements of radionuclide activity can now be made in field with the RayMon10™ using the Quant™ module.

RayMon10™ advanced high resolution detector allows quantitative analysis of isotopes which normally overlap in lower resolution instruments based on LaBr3 or NaI. This unique capability allows rapid in-field analysis and sample classification, avoiding costly delays associated with laboratory or radiochemical analysis.

Quant™ is simple to use for distributed or point sources. The beaker and sample collection tools provided allow either sample type to be accurately presented to the detector in seconds. Measurement time is determined by the required MDA and can be executed in minutes.

Minimum Detectable Activity (Bq/g) for Cs137	Scan Time	Degree of confidence in typical background
4	<1min	95%
0.4	<10min	95%
0.1	<1hr	95%

Applications include:

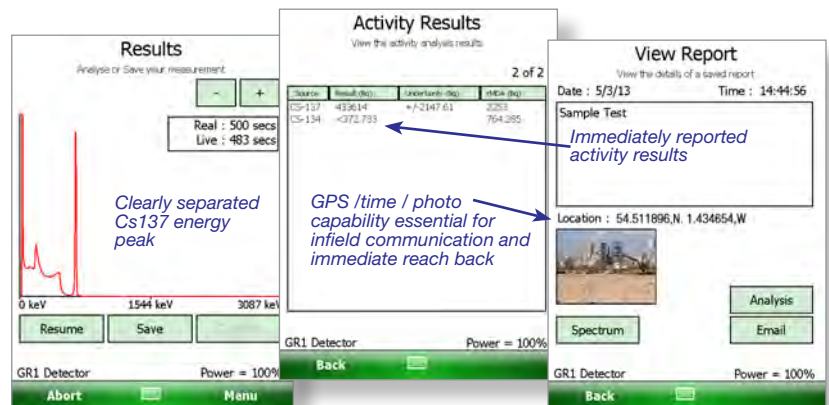
- Decommissioning
- Environmental Monitoring
- Waste Disposal

Features:

- Rugged and easy to operate both in field and laboratory use
- Provides activity analysis in complex spectra where normal detectors cannot be used
- Can be used with distributed (soil, building material sample, liquid waste) and point source (air sampling filters, calibration sources) samples
- Unique field reporting technology allows isotope analysis to be tagged to photographs, notes and GPS coordinates and reports to be transmitted directly from the field for immediate response
- PDF reporting facility
- Radionuclide library tailored to customer needs



The RayMon10 Quant eliminates the need for lab-based intrusive sampling and radiochemical analysis in order to determine the classification of the material



Radionuclide	Minimum Detectable Activity
Cs134	0.1 Bq/g
Cs137	0.1 Bq/g

Other radionuclides available upon request

TECHNICAL DATA

DETECTOR PROBE

Detector: CZT detector 10 x 10 x 10 mm³

High energy resolution: 2.0-2.5% FWHM @ 662 keV

Display: 480 x 640 pixel (VGA) 16-bit colour TFT with LED backlight

Indicator: On screen display confirming detector connected.

Dose rate display: µSv / hr

Connection: USB

Detector Testing: Tested by National Physical Laboratory in accordance with the conditions in;

ANSI N42.31 (2003) "Measurement procedures for resolution and efficiency of wide-bandgap semiconductor detectors of ionizing radiation"

NPL Good Practice Guide No. 14 "The examination, testing and calibration of portable radiation protection instruments"

Automated Radionuclide ID developed for:

ANSI N42.48 (2008) Section 6.10 "Requirements for Spectroscopic Personal Radiation Detectors (SPRDs) for Homeland Security"

PERFORMANCE

Energy range (Gamma): 30 keV to 3.0 MeV

Maximum throughput: 30,000 cps High level indicator warning on screen

Number of channels: 4096

Battery: 5000 mAh Li-ion rechargeable module giving 8 hours of continuous use

Library: 94 radionuclides

Dose rate: Demonstrated up to 1mSv/h@ 662 keV

Dose accuracy: Better than +/- 20%

Stability: Peak drift +/- 1 channel (4096) over 8 hours continuous measurement

Analysis Software: RayMon10™ Analysis software

PDA platform: Windows mobile 6.1

PHYSICAL

PDA Unit: 17.6 x 19.2 x 15.0 cm

Weight: 769 g

Probe + Cable: 24 x 4.5 x 4.5 cm

Weight: 252 g

POWER ADAPTOR

Input: 100 – 240 V 0.8 – 0.4 A 47 – 63 Hz

Output: 5.0V 4.0A

International mains socket adaptors included as standard.

ENVIRONMENTAL

PDA Unit

Performance is specified at an ambient temperature of 25°C. Operation at extreme temperatures (above 50°C or below 5°C) is not recommended. Meets or exceeds:

Water:

Immersed in 3.3 ft (1 m) of water for 240 minutes MIL-STD-810F, Method 512.4, Procedure I, IEC-529, IP68

Sand & dust:

Totally protected against dust MIL-STD-810F, Method 510.3, Procedure I, II, IEC-529, IP68

Drop:

26 drops at room temperature from 4 ft (1.22 m) onto plywood over concrete

6 additional drops at -22 °F (-30 °C)

6 additional drops at 140 °F (60 °C)

MIL-STD-810F, Method 516.5, Procedure IV

Vibration:

General Minimum Integrity and Loose Cargo tests

MIL-STD-810F, Method 514.5, Procedure I, II

Operating Temperature:

-22 °F to 140 °F (-30 °C to 60 °C)

MIL-STD-810F, Method 501.4, Procedure II

MIL-STD-810F, Method 502.4, Procedure I, II, III

Storage Temperature:

-40 °F to 158 °F (-40 °C to 70 °C)

MIL-STD-810F, Method 501.4, Procedure I

MIL-STD-810F, Method 502.4, Procedure I, II, III

Temperature shock:

-22 °F/149 °F (-30 °C/+65 °C)

MIL-STD-810F, Method 503.4, Procedure I

Humidity:

90%RH temp cycle 32 °F/158 °F (0 °C/+70 °C)

MIL-STD-810F, Method 507.4

Altitude:

15,000 ft (4,572 m) at 73 °F (23 °C)

to 40,000 ft (12,192 m) at -22 °F (-30 °C)

MIL-STD-810F, Method 500.5, Procedure I, II, III

Detector Probe

IP65

EMC tested

Recommended service interval: Annual

Applications include:

- Health physics
- Nuclear installation monitoring
- Nuclear accident response
- Security screening undertaken by customs, police, fire and rescue services
- Military
- Site surveys
- Civil defense
- First responders



RayMon10™

Every Kromek RayMon10™ comes complete in its own heavy-duty weatherproofed and ruggedised Peli Case containing the following items as standard:

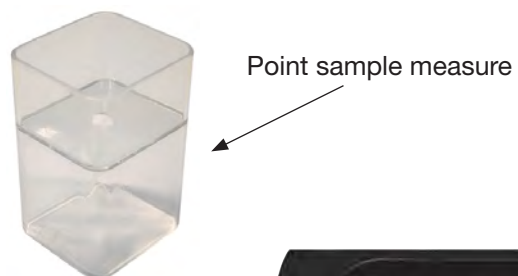
- Ruggedised handheld PC
- RayMon10™ detector probe
- Detachable coiled cable
- Wall charger with universal international plug adapters
- Accessory/storage pocket
- Operating manual
- Test certificates

Optional extras:

- Extra battery pack
- 12 volt in-car charger
- 5MP camera module
- 3G cellular network module



The Quant analysis pack



Flash disk containing Quant software



detect image identify

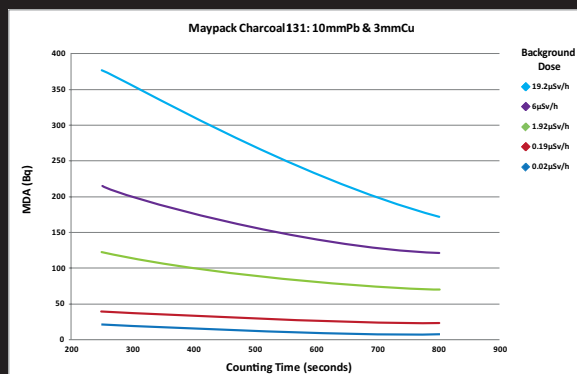
High accuracy and precision



Applications include:

- Environmental Monitoring
- Decommissioning
- Waste Disposal
- Food Inspection

Supplied with Kromek's
top-of-the-range
MultiSpect Analysis
Software



kromekTM
detect image identify

Quant for GR1

Unique Solution for Mobile Laboratory Radionuclide Analysis

Quant for GR1 (Q4-GR1) is a unique solution for measuring the activity of radionuclides in filters, filter papers and beakers.

The low power, small form factor, reliability, and no requirement for cooling, enable measurements of various configurations of samples, without the need for time consuming transport back to offsite laboratory.

Q4-GR1 utilises mature Cadmium Zinc Telluride (CZT) technology, provides less than 2% energy resolution, unmatched by conventional scintillator detector based instruments such as LaBr3 and NaI. This high resolution performance enables clear separation of gamma energy peaks within complex mixed radionuclide samples for accurate quantification of individual radionuclides without the need for chemical separation.

Q4-GR1 comes with an optimised and integrated lead/copper shield that enables operation in both standard and raised backgrounds.

Specifications

Detector Resolution	<2%
Energy Range	30keV to 3MeV
Number of channels	4096
Weight	22kg
Power Consumption	Powered via USB
Dimensions	300mm diameter x 210mm height
Lead/Copper Shield	10mm/3mm
Number of selectable radionuclides as standard	47
Counting Time	User Configurable
Temperature	0-50°C

MultiSpect Analysis Software

Q4-GR1 comes combined with a dedicated Quantitative Activity Analysis module built into the Kromek MultiSpect Analysis software package. This enables full spectrum visualisation, configurable radionuclides, sample geometry selection, and adjustable confidence levels.

The results are stored within a database that can be exported to CSV file format, and reports output to PDF.

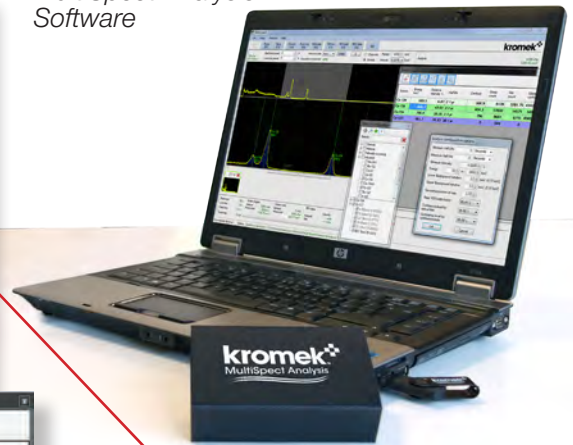
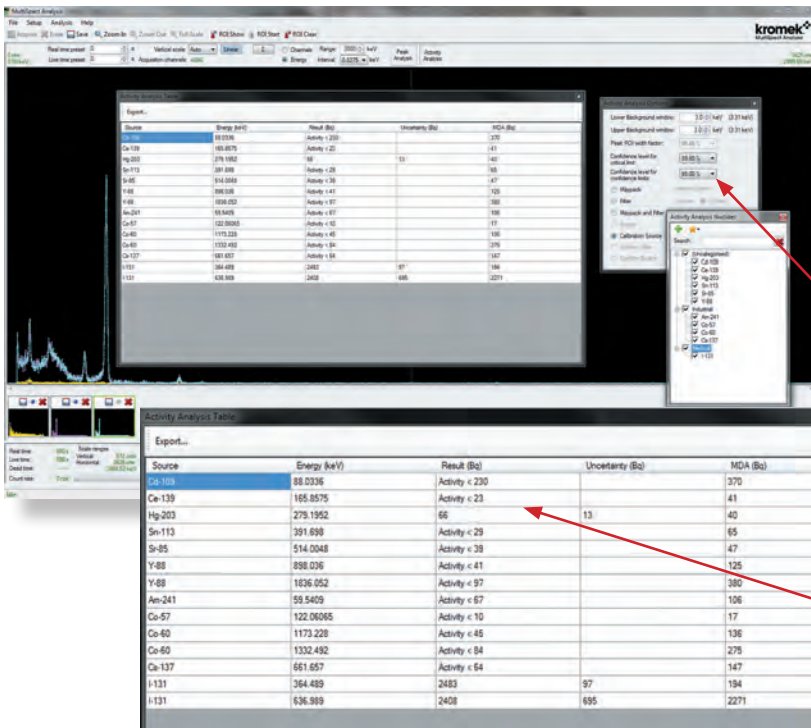
Pre-defined sample types are:

- Standard Maypack filter
- Filter papers
- Maypack charcoal
- Efficiency optimised beaker filled with distributed material
- Calibration source



Maypack not included, requires separate purchase

Kromek's top-of-the-range MultiSpect Analysis Software



Activity Analysis Options allow the user to select sample type and required statistics

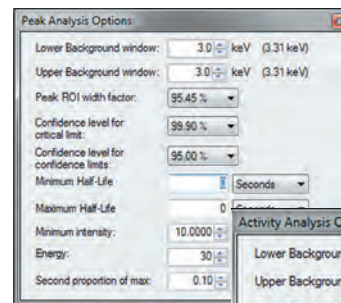
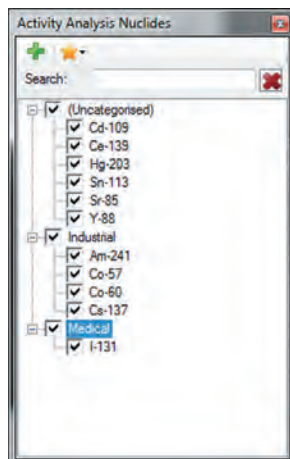
Activity Analysis Table displays the result, uncertainty and MDA of each selected radionuclide with the ability to export to CSV

MultiSpect Analysis™ is Kromek's top-of-the-range software and is pre-loaded on a Windows-based laptop with Quant for GR1™.

MultiSpect Analysis™ performs the spectrum acquisition, display, analysis and storage functions. Signals from the CZT solid-state detector are processed and digitized, and the pulse height data is transferred to the computer via the mini-USB.

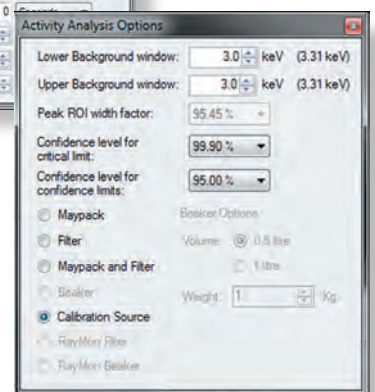
MultiSpect Analysis™ also offers the user the additional option of a calibration source containing the standard NG3 radionuclide mixture.

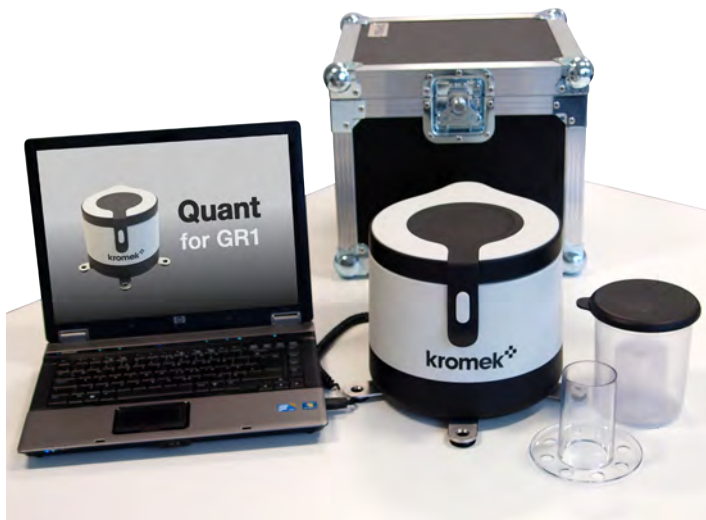
The calibration source is not included in the kit and requires separate purchase



Configuration options for the analysis based on statistical significance.

User configurable radionuclide library





Some of MultiSpect Analysis Key Features

User definable confidence limits	✓
Predefined samples	✓
Quant library of 50 nuclides	✓
User customisable libraries	✓
Display calibrated spectra at the same energy scales to allow comparison	✓
Thumbnail indication of loaded spectra	✓
Ability to save spectra in SPE or CSV formats	✓
Ability to export data	✓
Ability to save detector calibration information	✓
Association of calibration data with particular detectors by serial number	✓
Aggregation of multiple spectra into one spectrum	✓
Built in library of 416 isotopes	✓
Industry standard categorisation of isotopes	✓
Automated peak analysis of Spectra	✓



Options and accessories

Standard kit includes:

- Q4GR1 Quant pot including optimised background shield
- GR1+ <2% resolution
- Windows-based laptop with MultiSpect Analysis with Activity Analysis preinstalled
- Maypack filter attachment

Optional upgrade:

Semi-rugged tablet (Q4GR1 TAB) upgrade laptop to semi-rugged tablet

Q4-GR1 is now available with a 10.1" semi-rugged tablet designed for mobile workers for use in various locations.

With its entire chassis sealed against water and ingress protection up to IP43, the tablet meets stringent MIL-STD-810G tests.

- MIL-STD-810G drop protection from 4 feet (120cm)
- MIL-STD-810G and ASTM D4 169-08 protection against vibration
- Wide humidity operating: 5% ~ 95%
- Wide temperature operating: 0°C ~ +45°C
- Internal magnesium alloy frame
- 12V operation for in-vehicle use
- Vehicle mount

Accessories:

- **Quant B-1000** – pack of five, one litre beakers
- **Quant B-500** – pack of five half-litre beakers
- **Quant B-C** – custom size beaker available on request



Optional upgrade:

Upgrade laptop to semi-rugged tablet, 12V operation and vehicle mount for in-vehicle use



Q4GR1 A4E SPF-DOC-1224 Rev3

detect image identify

The Sample Inspector™

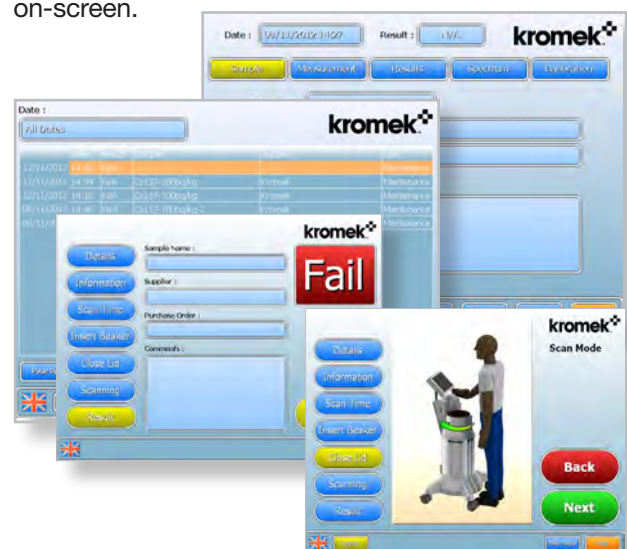
The Kromek Sample Inspector™ is a unique high-performance monitor for detecting the presence of radioactive contaminants in solid foods, liquids, water, soil and vegetation that is quick, reliable and precise.

Distinctive in style and using the highest sensitivity detection systems available today, the Sample Inspector™ provides high throughput for multiple applications.

With a large touch-screen and user-friendly interface, the Sample Inspector's software interface makes it intuitive to use with little training required.

The Sample Inspector uses a sophisticated algorithm to separate gamma energy peaks within mixed radionuclide samples for accurate quantification of individual radionuclides.

Activity can be measured in approximately 10 minutes, though total measuring time may vary to comply with local legislative requirements. When the measurement is complete, a 'PASS' or 'FAIL' indication message together with measured levels of radiation, is displayed on-screen.



High accuracy and precision gamma measuring system for a wide range of samples

Features:

- Short measurement times for meeting or complying with international food standards
- Lowest minimum detectable levels of activity available in the industry
- Instant decision-making: activity can be measured in approximately 10 minutes
- Visual indication - 'PASS' or 'FAIL' message and measured activity displayed on-screen
- Kromek's UltraShield™ technology eliminates the effects of natural background levels on measurement precision
- Measures up to 1 litre of liquids or solids
- Large touch screen, user-friendly interface and easy to use software with clear indication of results
- Adjustable alarm levels
- Simple and quick to locate and setup
- Easy maintenance and cleaning
- Local language options available
- Minimal training times

Applications include:

- Environmental Monitoring
- Decommissioning
- Waste Disposal
- Food Inspection

Detection and resolution in a single, user friendly and easy-to-use system

The sample is placed inside one of the industry standard beaker options.

The user then selects the radioactivity limit required for the sample to be measured against and the specified nuclides.

The intelligent software algorithm calculates the minimum scan time for this mode.

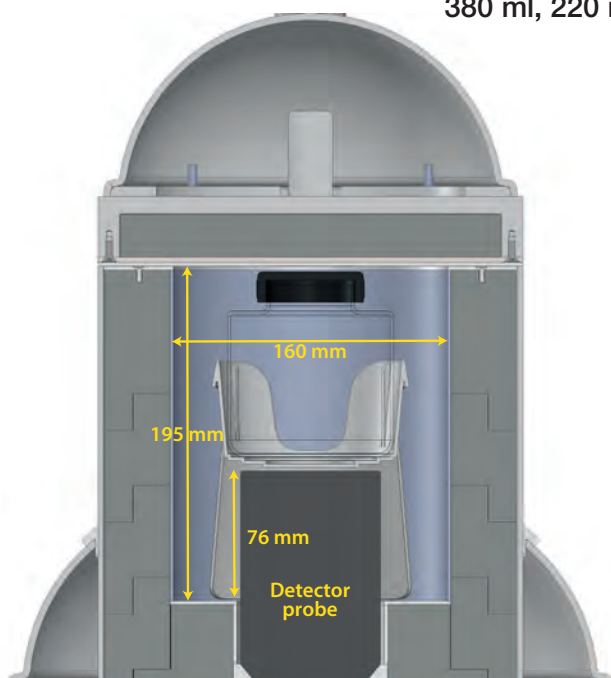
By following the simple instructions on the touch screen, the user is guided through the process of measuring both the sample and a reference water sample for the selected beaker geometry.

At the end of the scan, the screen will display a 'PASS' indication message when the instrument is over 99% certain that the sample is below the set activity limit. The screen also displays the measured activity.



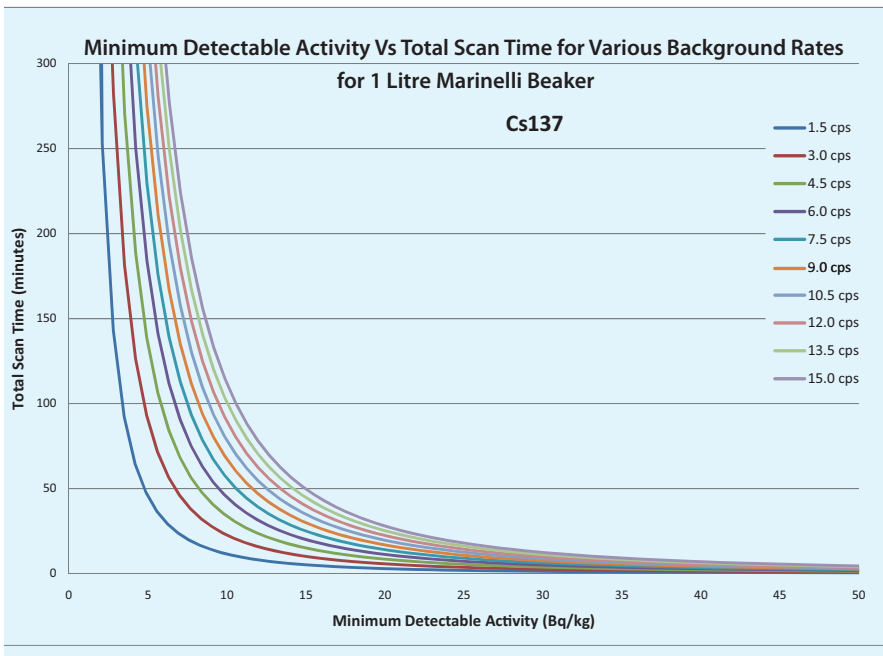
The Sample Inspector includes a specially designed plastic cradle to accommodate a variety of beaker geometries.

Beakers include: 1L Marinelli, SG500, 380 ml, 220 ml, 60 ml and 15 ml



Processor specification:

Fanless box PC barebone, Intel Atom N270 1.6G processor with Intel 945GSE + ICH7M Chipset, 1 x 200 pins DDR2 533 slot, up to 2GB, with adaptor ■ SO-DIMM 200PIN DDR2 533 2GB ■ 4GB CF (SLC 200X) ■ Windows XP Embedded - Licensed and pre-installed ■ Optional printer available

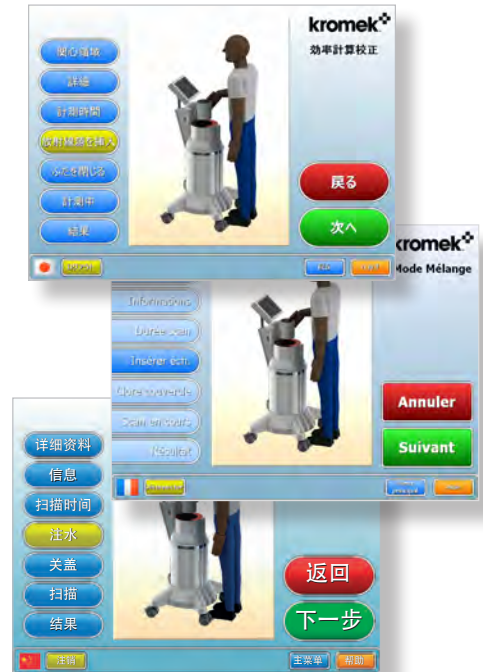


Calibration

Calibration is pre-set during manufacture using calibrated distributed sources in order to convert the measurements into Bq/kg. An annual calibration service is available on request.

Language options:

Kromek's proprietary analytical software can be ordered in most international languages.



Technical Data

Data Storage:	Measurement and Calibration files stored onto embedded PC. These can be downloaded to USB in PDF/CSV format.
User Software:	Kromek's analytical software
Detector:	75 mm x 75 mm NaI (TI) detector
Energy Full Range:	30 keV-3 MeV
Number of nuclides	I ¹³¹ , Cs ¹³⁴ , Cs ¹³⁷
Temperature Range:	5°C - 50°C
Temperature compensated	Yes
Number of Channels:	4096
Measuring Range:	User definable from 10 Bq/kg and above
Protection Class (IP)	Indoor use - IP54
Power Input:	100-250 V
Sample Containment:	1 litre European and Japanese Marinelli beakers, SG500, 380 ml, 220 ml, 60 ml, and 15 ml

Dimensions

Weight:	240 kg
Height:	1280 mm (from floor to top of monitor)
Screen Dimensions:	12 inches, 30 cm
Body Diameter:	1130 mm dia.
Base:	635 x 520 mm
Carriage:	4 medical grade castor wheels
Lead / copper shield	40 mm lead / 2 mm copper
Beaker chamber	195.35 mm (h) x 80 mm (w) with 76 mm inset for probe

MultiSpect Analysis™

Gamma ray spectroscopy software



Main features

- Identification of complex samples
- Measure the peak properties and save data reports in .pdf and .csv format
- Clear colouring of the analysis results for statistical significance
- Connects and acquires from multiple detectors simultaneously
- Easily apply filters for viewing the important data
- Connects with GR1-A™, GR1™, SIGMA and TN15 via USB
- Library of gamma ray emissions from over 400 nuclides
- Save spectra in the industry standard .spe file format
- Advanced radionuclide analysis functions
- Directly import measurements from RayMon10™
- Inbuilt scripting allowing automation with C# code

kromek™
detect image identify

MultiSpect Analysis™ Specialised gamma ray spectroscopy software for analysis of complex samples for radionuclide identification

MultiSpect Analysis™ has been designed specifically for Kromek's range of semiconductor gamma ray detectors. It allows multiple detectors to be connected and managed.

Acquisition from all detectors can be performed and displayed simultaneously, either viewing separate spectra or combining the results together in a single spectrum. Thumbnails are used to give an easy visualisation of the signals from each detector. Spectra can be displayed on an energy axis for fast and direct comparison of data.

Multiple detectors and simultaneous acquisition Analysis results:

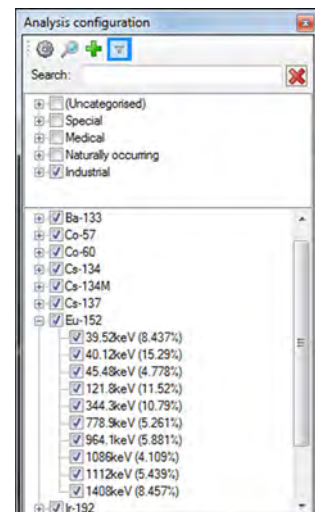
Source	Energy keV	Relative intensity %	Half-life	Centrod	Gross count	Net count	Upper confidence	Lower confidence	FWHM	FWHM	FW Ratio	Hide test	Hide ROI
Cs-134	569.3	6.87	2.1 yr	566.9	8179	3781.75	4143.2178	3420.2822	12.79	22.37	0.5717		
Cs-134	604.7	43.61	2.1 yr	604.3	17820	14571	14945.46	14196.54	10.73	20.01	0.5365		
Cs-134	795.8	38.20	2.1 yr	796	9661	8715	8960.5183	8469.4817	11.52	24.1	0.4781		
Cs-137	661.7	91.63	30.1 yr	0	544	0	0	0	0	0	0		

Colour coded results showing which lines are above the critical limit of the information.

Filter by critical limit, relative intensity of the emission lines, energy windows and half life

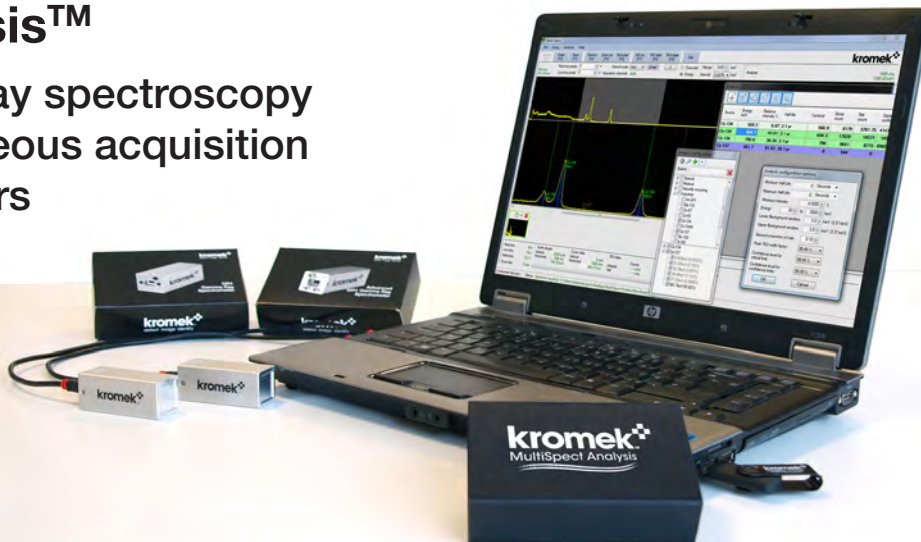
Included within MultiSpect Analysis™ is a user-configurable library of over 400 radionuclides. Results from matching spectra to the library are colour coded according to statistical significance for easy visual processing. The analysis results can be filtered easily and sorted to find the required information.

Analysis of the spectrum gives all the measured peak information and can be exported in csv format for use in other applications.



MultiSpect Analysis™

Specialised gamma ray spectroscopy software for simultaneous acquisition from multiple detectors with advanced radionuclide analysis functions



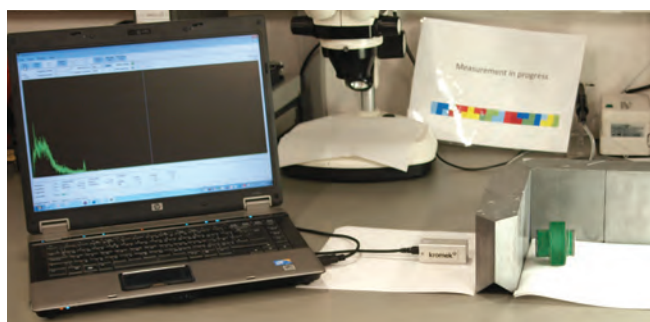
Applications



Health Physics



InSitu Monitoring



Nuclear Spectroscopy



Nuclear Industry

Feature	K-Spect	MultiSpect Analysis
Spectral acquisition from single GR1, GR1-A, SIGMA or TN15	✓	✓
Spectral acquisition from multiple GR1, GR1-A, SIGMA or TN15 simultaneously (PC dependant 5 to 20 systems)		✓
Energy calibration facility	✓	✓
Display single detector information only + 5 saved Spectra	✓	
Display calibrated spectra at the same energy scales to allow comparison		✓
Compatible with K102 Multichannel Analyser	✓	✓
Thumbnail indication of loaded spectra	✓	✓
Ability to save spectra in SPE, CSV or N42.42 formats	✓	✓
Ability to export data	✓	✓
Ability to save detector calibration information	✓	✓
Association of calibration data with particular detectors by serial number		✓
Aggregation of multiple spectra into one spectrum		✓
Built in library of 416 isotopes		✓
Industry standard categorisation of isotopes		✓
Import from RayMon10		✓
Multiple regions of interest with Spectra		✓
Automated peak analysis of Spectra		✓

MultiSpect Analysis Software

MultiSpect Analysis™ software is written specifically for Kromek's range of CZT-based semiconductor and scintillator radiation detectors for use with any Windows-based (XP / Vista / 7 / 8) PC or tablet.

MultiSpect Analysis™ is Kromek's top-of-the-range software and is supplied on a flash disk. It receives the data and performs the spectrum acquisition, display, analysis and storage functions.

Signals from the detectors are processed and digitized, and the pulse height data is transferred to the computer via USB.

In addition to this, MultiSpect Analysis™ allows users to acquire and display live spectra from multiple devices simultaneously alongside saved spectra from

Kromek's new generation of nuclear threat detection products...



SIGMA-50 (L) high sensitivity scintillator detector and TN15 (R) high sensitivity non-Helium³ neutron detector

previous measurements. It also enables grouping and summing of individual spectra plus the ability to match spectra to an on-board library of over 400 nuclides.

Analysis results:

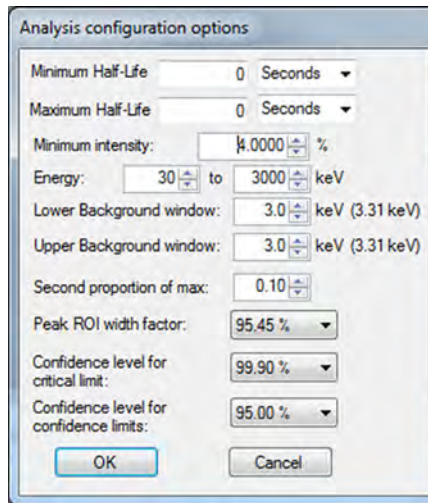
Filter by critical limit, relative intensity of the emission lines, energy windows and half life.

Colour coded results showing which lines are above the critical limit of the information.

source	Energy keV	Relative intensity %	Half-life	Centroid	Gross count	Net count	Upper confidence	Lower confidence	FWHM	FWnM	FW Ratio	Hide text	Hide ROI
Ca-134	569.3	6.87	2.1 yr	566.9	8179	3781.75	4143.2178	3420.2822	12.79	22.37	0.5717	<input type="checkbox"/>	<input type="checkbox"/>
Ca-134	604.7	43.61	2.1 yr	604.3	17820	14571	14945.46	14196.54	10.73	20.01	0.5365	<input type="checkbox"/>	<input type="checkbox"/>
Ca-134	795.8	38.20	2.1 yr	795.8	9661	8715	8960.5183	8469.4817	11.52	24.1	0.4781	<input type="checkbox"/>	<input type="checkbox"/>
Ca-137	661.7	91.63	29.1 yr	0	544	0	0	0	0	0	0	<input type="checkbox"/>	<input type="checkbox"/>

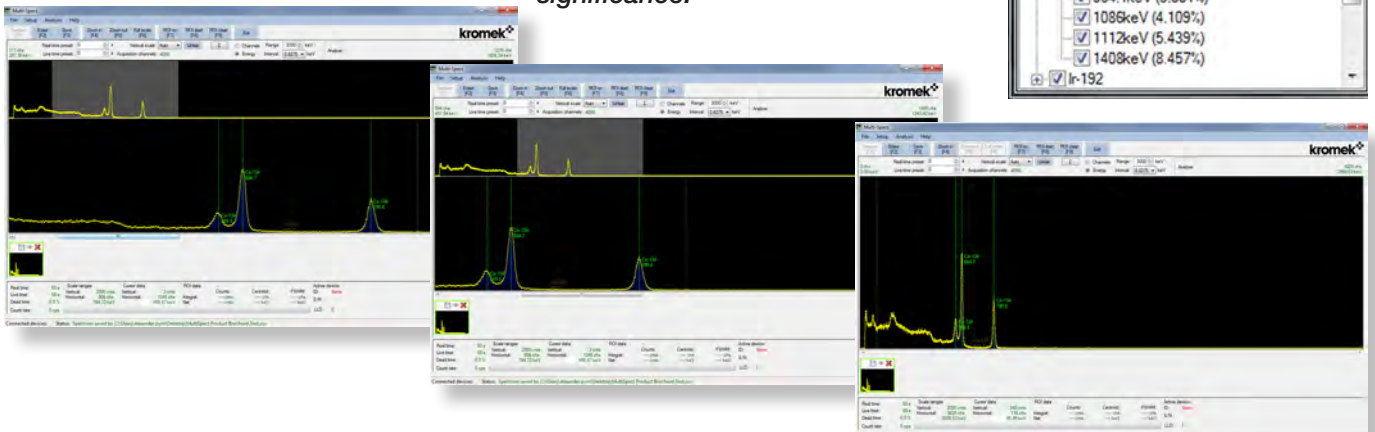
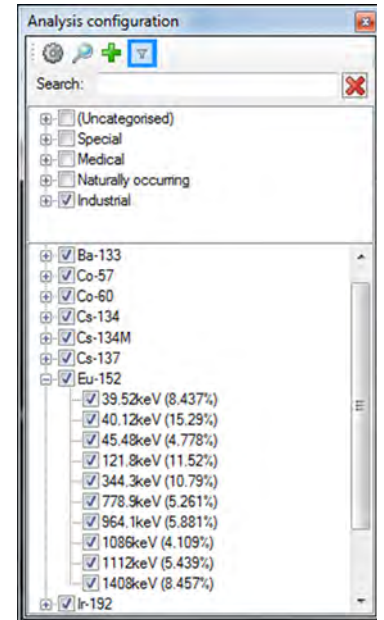
A full export of the analysis results gives an easy to use .csv form of the analysis data with showing:

- Peak identification
- Centroid
- FWHM
- FWnM at user configurable level
- FW ratio
- Gross Counts
- Net Counts
- Stapleton Critical Limit
- Upper and lower confidence limits
- Equations and parameters of the subtracted background
- Clear details of the peak and background region edge locations.



Configuration options for the analysis based on statistical significance.

User configurable library of radionuclide emissions:



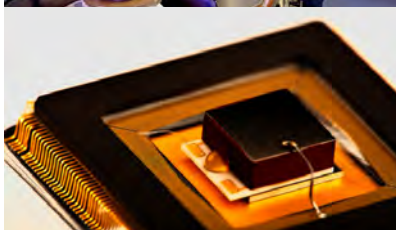
Kromek Capabilities



**Materials &
Detectors**



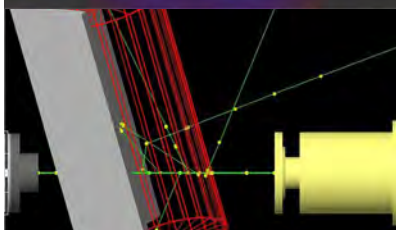
**Detector
Fabrication**



**ASICs &
Electronics**



**Bonding &
Hybridisation**



**Application
Development**



**Algorithms
& Software**



**Systems
Engineering**

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eV Products Inc.
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