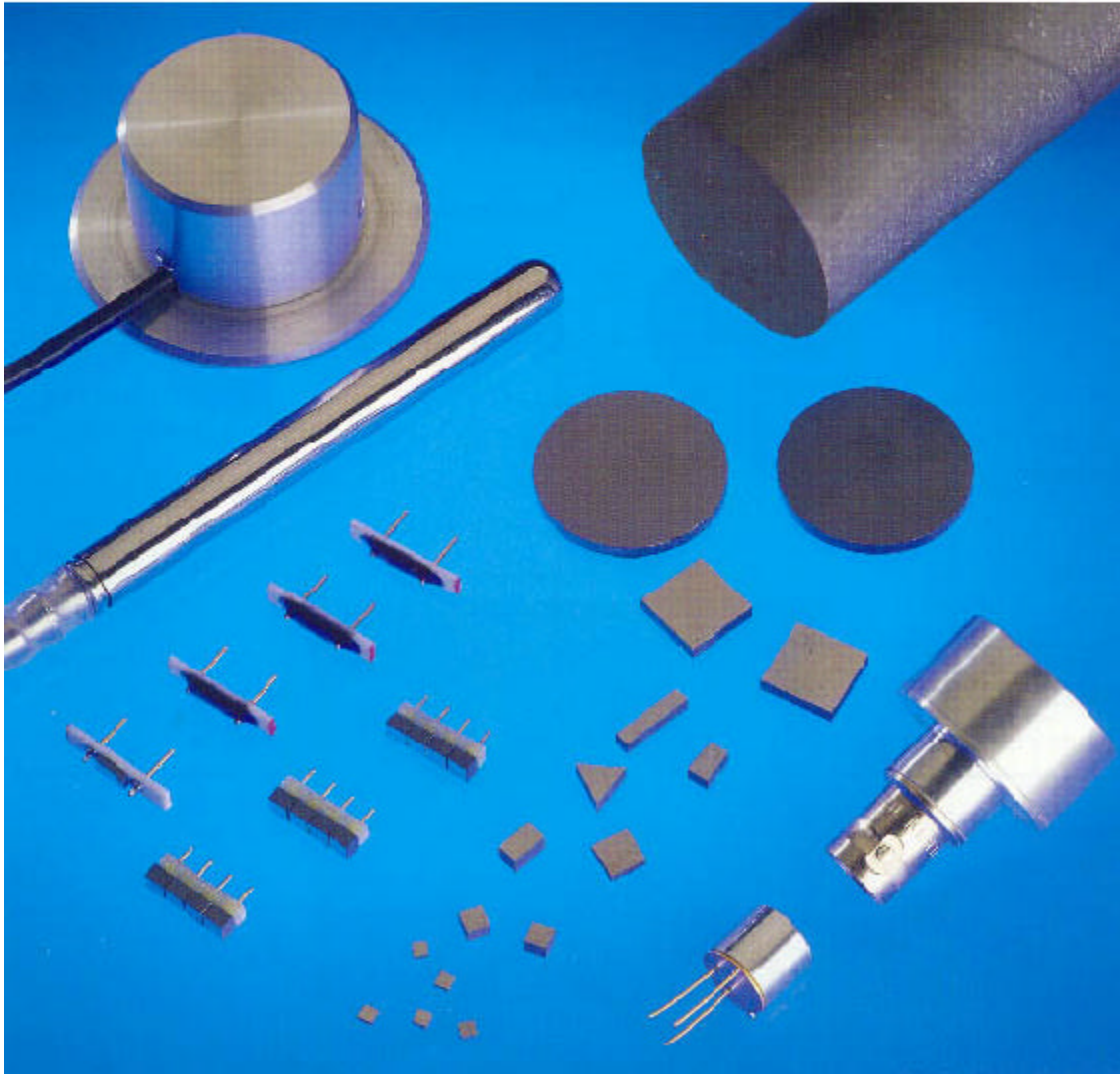


CADMIUM TELLURIDE (CdTe)

**CADMIUM ZINC TELLURIDE
(CdZnTe or "CZT")**

DETECTORS AND PROBES

Distributed by Constellation Technology



CONSTELLATION TECHNOLOGY

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INTRODUCTION

CdTe and CdZnTe are large band gap semiconductors, presenting a high atomic number Z as well as a high density. This gives them certain advantages over other detectors like :

- Room temperature operation and storage, which means that vacuum and cryostat are no longer necessary, thus avoiding stability problems.
- No high voltage, a biasing in the range of 10-100V/mm is sufficient.
- Very high efficiency: 2mm absorption depth of CdTe or CdZnTe are equivalent to 10mm of Ge in gamma-ray detection.
- In imaging applications : possibility to associate a large number of detectors or pixels and to distinguish between primary and scattered events.
- Good energy resolution, especially with pixel structures ("pixel effect").
- Low cost

Due to its unique experience in the field of semiconductor detectors (30 years), Eurorad is the only company in the world manufacturing a wide range of CdTe and CdZnTe (H. P.) detectors of planar and hemispherical shapes.

STANDARD DETECTORS' GRADES & SIZES

COUNTERS

Type	Area (mm ²)	Thickness (mm)	Bias Voltage (V)	Leakage Current (A)
C.1.1	1 x 1	1	5 - 50	10-8 - 10-9
C.2.2	2 x 2	1	5 - 50	10-8 - 10-9
C.2.2.2	2 x 2	2	5 - 50	10-8 - 10-9
C.5.5	5 x 5	1	5 - 50	5.10-8 - 10-9
C.5.5.2	5 x 5	2	5 - 50	5.10-8 - 10-9
C.5.5.3	5 x 5	3	5 - 50	5.10-8 - 10-9
C.5.5.5.	5 x 5	5	5 - 100	10-7 - 10-8
C.10.10.1	10 x 10	1	5 - 50	10-7 - 10-8
C.10.10.2	10 x 10	2	5 - 50	10-7 - 10-8
C.10.10.5	10 x 10	5	5 - 100	10-7 - 10-8

Standard grade : $P/V < 1.5$
 Ultimate grade : $1.5 \geq P/V < 2$

SPECTROMETERS

Type	Area (mm ²)	Thickness (mm)	Bias voltage (V)	Energy Resolution at 122 keV (57Co) (FWHM)
S.I.I.I.S	1 x 1	1	30 - 50	6 - 10 keV
S.I.I.I.U	1 x 1	1	30 - 50	below 5 keV
S.2.2.1.S	2 x 2	1	30 - 50	8 - 12 keV
S.2.2.1.U	2 x 2	1	30 - 50	below 5 keV
S.2.2.2.S	2 x 2	2	50 - 100	8 - 12 keV
S.2.2.2.U	2 x 2	2	50 - 100	5 - 8 keV
S.5.5.1.S	5 x 5	1	30 - 50	6 - 10 keV
S.5.5.1.U	5 x 5	1	30 - 50	below 5 keV
S.5.5.2.S	5 x 5	2	50 - 100	8 - 12 keV
S.5.5.2.U	5 x 5	2	50 - 100	5 - 8 keV

Type "S" (Standard grade) : Peak to Valley ratio $P/V : 1.5 \geq P/V < 3$
 Type "U" (Ultimate grade) : Peak to Valley ratio $P/V : P/V \geq 3$

DETECTORS' ARRANGEMENTS AND HOUSINGS

SINGLE DETECTORS

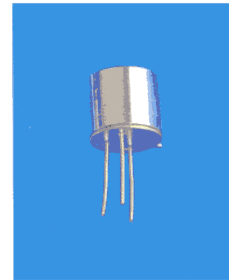
ALUMINIUM BOXES WITH BNC CONNECTOR

All types of detectors up to a total volume of $10 \times 10 \times 5\text{mm}^3$ can be mounted in an aluminium box with BNC connector.



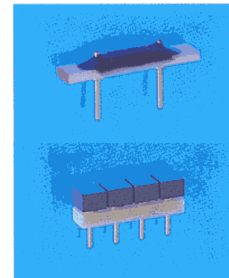
T039 BOXES

All types of detectors up to a total volume of $5 \times 5 \times 5\text{mm}^3$ can be mounted in a T039 box with aluminium cover.

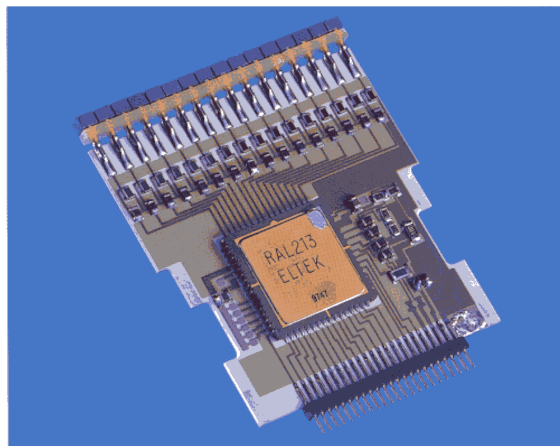


PCB & CERAMIC HOLDERS

All types of detectors can be mounted on a PCB or a ceramic holder.



LINEAR ARRAYS



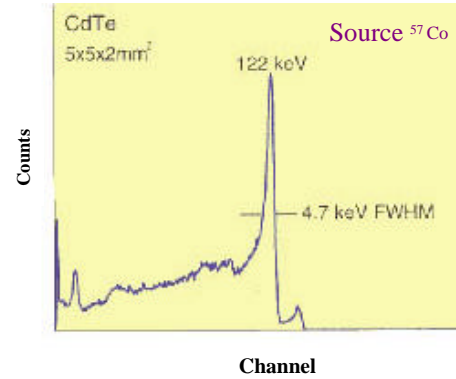
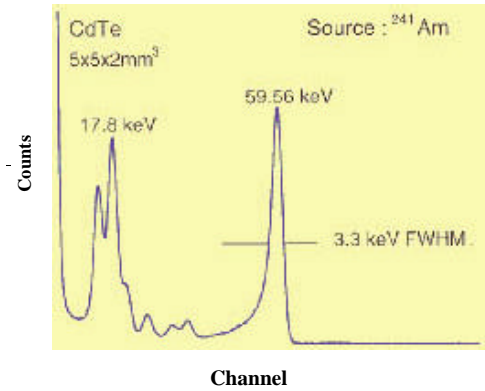
SPECIAL MOUNTINGS ARE ALSO POSSIBLE (ARRAYS, X-Y MATRIXES, PIXELS, ETC)

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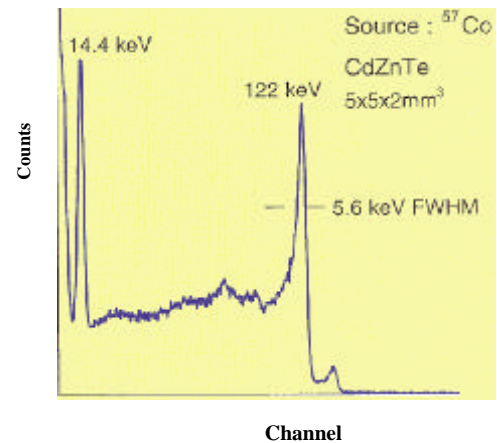
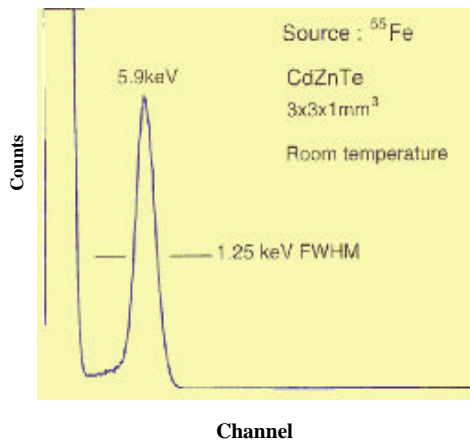
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PLANAR DETECTORS WITHOUT SPECTRUM IMPROVEMENT

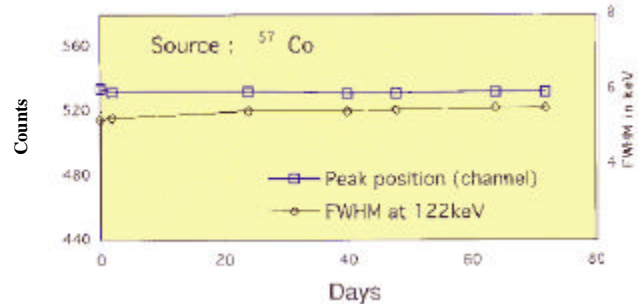
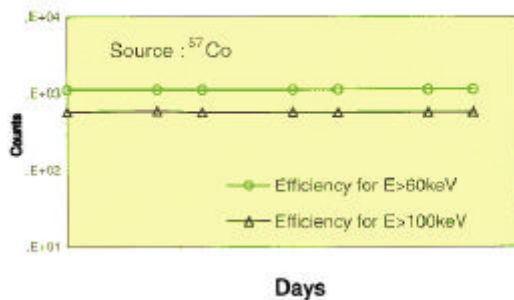
SPECTRA OF CdTe PLANAR DETECTORS



SPECTRA OF CdZnTe PLANAR DETECTORS



STABILITY OVER TIME

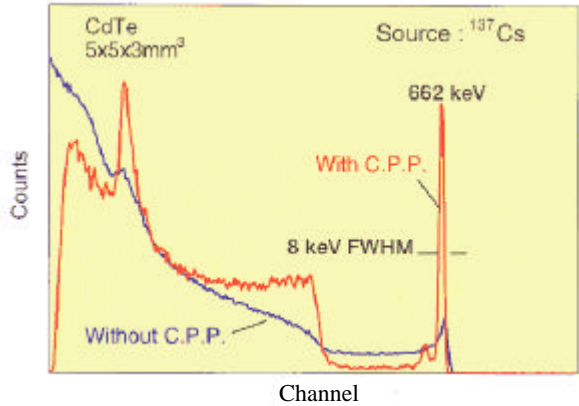


PLANAR DETECTORS WITH SPECTRUM IMPROVEMENT

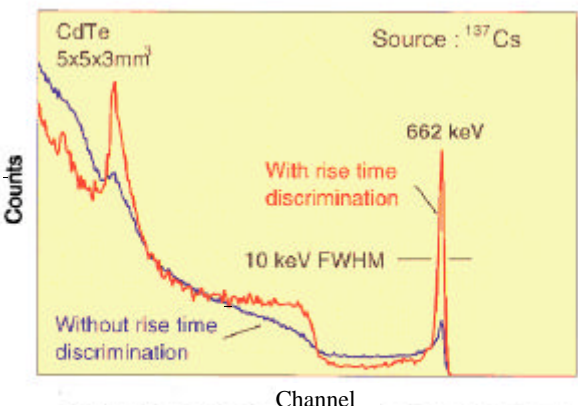
The spectra obtained with planar detectors can be improved with an electronic signal processing. Two ways of improvement are possible :

- the rise time discrimination with the TD1 module (see electronic catalogue)
- the charge compensation with the Charge Pulse Processor, model CPP (see electronic catalogue).

The first module will just reject the bad counts whereas the second module corrects the wrong pulses by shifting them to the right position. Therefore, the efficiency will be better using the second solution. The spectra below show the improvement which is achievable by using such modules.

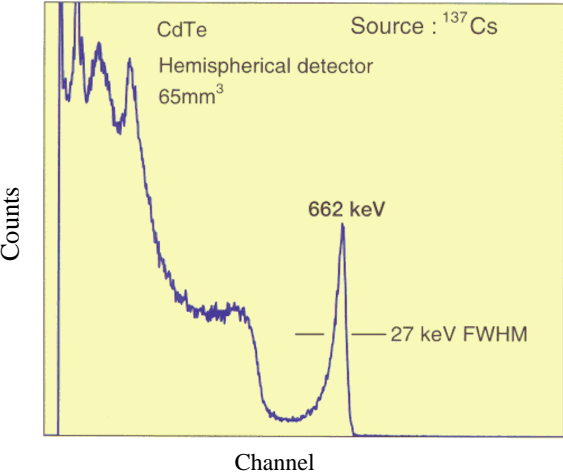


EFFECT OF CHARGE COMPENSATION



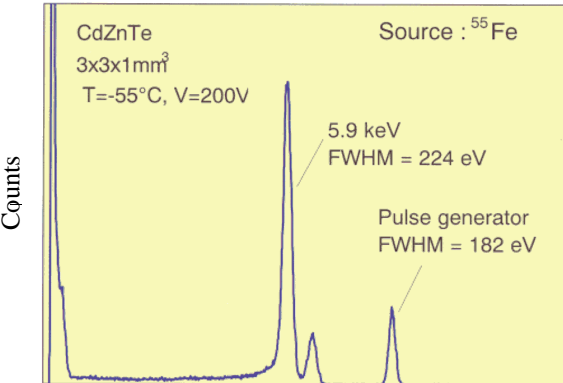
EFFECT OF RISE TIME DISCRIMINATION

HEMISPHERICAL DETECTORS



These detectors have been developed for spectroscopic measurements between 150 keV and 660 keV.

PLANAR DETECTORS WITH PELTIER COOLING

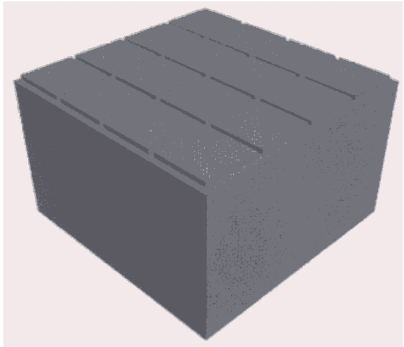
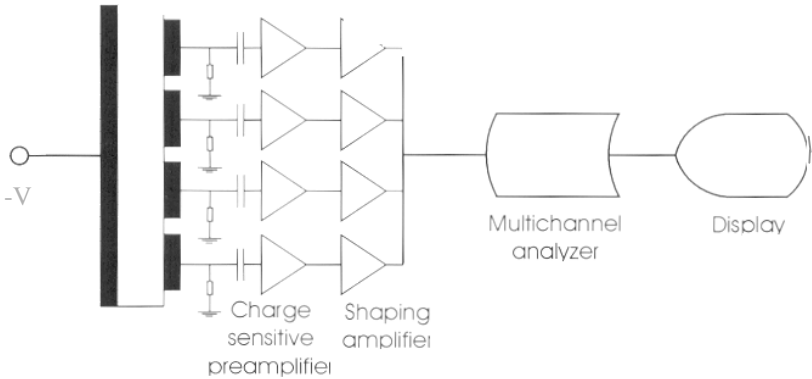
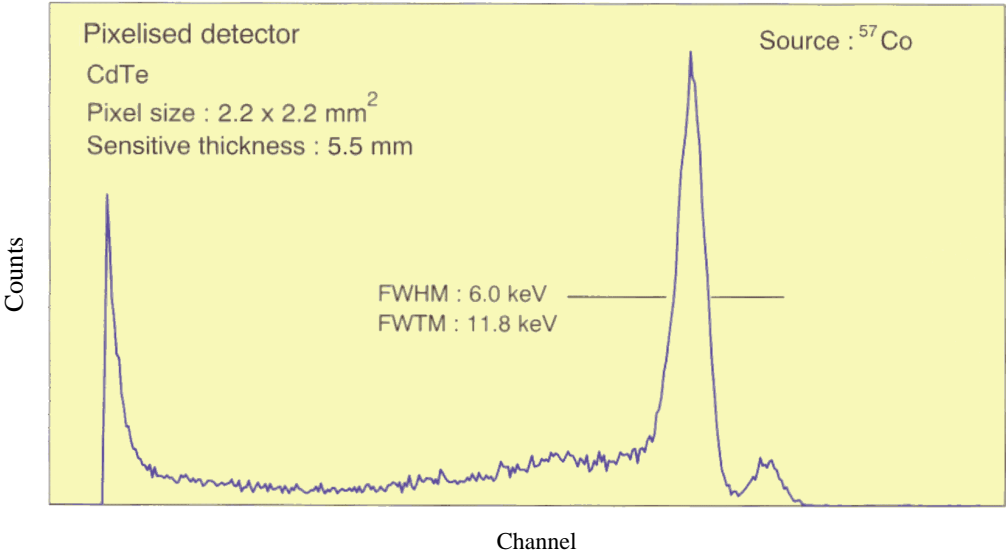


In order to detect low energy X or γ rays, like 6 keV, our R&D laboratory has developed a cooled detection system with a high performance preamplifier.

By associating a 3x3x1 mm³ CdZnTe detector together with a cooling element, Eurorad has been able to reach a 224 eV resolution level at 5.9 keV

PIXELISED DETECTORS (UNDER DEVELOPMENT)

Our R&D department is developing a new generation of detectors, based on both CdTe and CdZnTe which uses an integrated pixel structure with very thick absorption path for the radiations, i.e. in excess of 6.0 mm. The structure is shown on the below figures as well as the performances in spectroscopy, which are quite unique. These new structures open the route to integrated detectors which offer, when compared to conventional planar detectors, very good energy resolution and very high efficiency in the full energy peak.



CdTe & CdZnTe PROBES

EuroRad has developed a large set of probes incorporating the in-house manufactured CdTe & CdZnTe detectors of both COUNTER and SPECTROMETER grade, with active sizes ranging from 1 to 100 mm³ for planar and hemispheric structures.

Some standard models are described below, but probes following customer's specific needs can be manufactured too.

CdTe STANDARD DETECTION PROBE (SO16 PROBE)



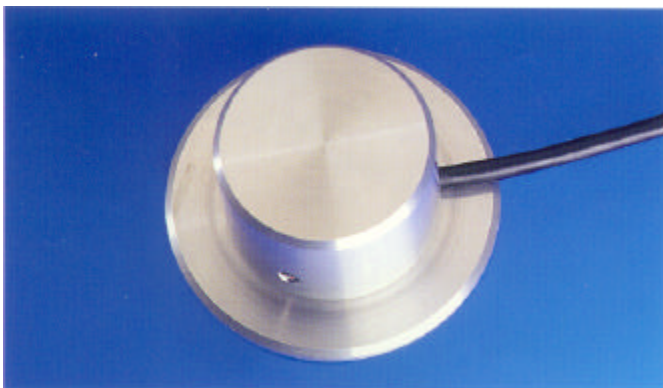
This probe can include detectors of both counter and spectrometer grade of sizes up to 5x5x3 mm³. The preamplifier is mounted perpendicular to the detector in an anodised aluminium box of total length 93 mm with a cylindrical shape of 16 mm in diameter. This set-up can receive an adequate collimator. This small probe is designed for general use in both counting and spectroscopic nuclear applications in the laboratory as well as in industry. Its small weight (<100g), low bias voltages and low energy consumption make this probe practical.

MINIATURE DETECTION PROBE (SO08 PROBE)



This probe has been especially designed to be able to run in tiny locations and wet surrounding conditions. Having a total diameter of only 8mm and 80mm in length, the cylindrical mounting can receive detectors of both counter and spectrometer grade either of planar or hemispherical shape up to 5 x 5mm². A single cable of 3 mm in diameter up to 25 m length can extract the signal from the set-up. This probe has been especially designed for control of tiny remote areas, like fuel rods in pool or in the non totally cooled reactor.

MINIATURE DETECTION PROBE (SMM3 PROBE)



This probe of 30 mm in diameter and 17 mm in length incorporates detectors with a total active surface of up to 10 x 10 x 2 mm³ as well as a collimator and a complete low noise preamplifier. The set-up has a cable output of up to 10 m in length for connection to any electronic set-up (scaler, multi-channel analyzer, etc.)