



*Measurement solutions for nuclear safety and security.*



*Passivated Implanted Planar Silicon (PIPS®) Detectors for Industrial Applications and Physics Research*

OEM VAR

## Silicon Detectors

NUCLEAR MEASUREMENTS BUSINESS UNIT OF AREVA



CANBERRA



## Passivated Implanted Planar Silicon (PIPS®) Detectors for Industrial Applications and Physics Research



*Process on high resistivity float zone Silicon*

- > 4, 5 and 6" wafer processing
- > 150 to 1500µm thickness

**CANBERRA Passivated, Implanted, Planar Silicon (PIPS) detectors have proven themselves in thousands of applications worldwide. The performance promised by modern PIPS technology has been realized in alpha spectroscopy, beta detection and Continuous Air Monitors as well as in wide-ranging nuclear physics and space experiments.**

### **PIPS Detector Features:**

- Thin Entrance Windows, 50 nm (eq. silicon)
- Stability and Reliability
- Low Leakage Current and Noise
- Low Alpha Background
- Sizes from 25mm<sup>2</sup> to 5000mm<sup>2</sup>
- Special Geometries – Virtually Limitless
- Touchable, Cleanable Surfaces
- Custom designs for myriad applications

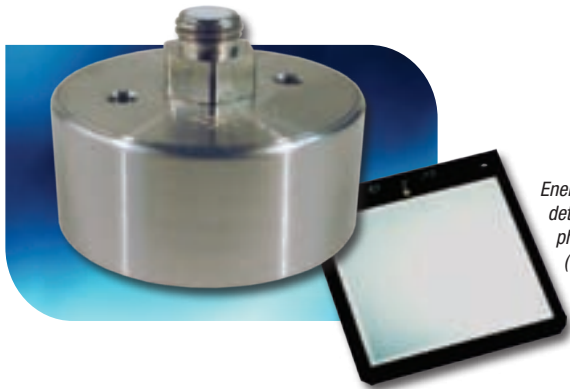
PIPS detectors were developed by CANBERRA. They are designed by CANBERRA device engineers. They are manufactured by CANBERRA. They are tested, packaged and shipped by CANBERRA. Finally they are backed by the full integrity and resources of CANBERRA. Can you accept less from your detector supplier?



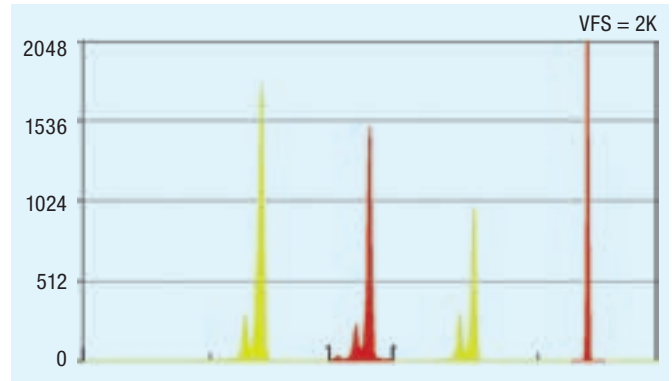
# Charged Particle Detection (E-Detectors)

**Nuclear Physics ■ Astrophysics**  
**Low Energy Beta's and Electrons**

**Excellent Resolution for Alphas, Betas, Protons, Electrons, Heavy Ions...**  
■ Entrance window < 50nm on all models



Energy resolution of Silicon detectors: approaching the physical limit. NIM B85 (1994) 642-649



## Radiochemistry and Physics Research – PD, RF and A-Series

**Features:**

- > Single junction in metal housing or on epoxy board
- > Size: 25 to 5000mm<sup>2</sup>
- > Active thickness: 100 to 1500µm

**Advantages:**

- Stability and Reliability
- Detectors available from stock
- Complete spectroscopy chain available

## Continuous Air Monitoring - CAM-Series

**Features:**

- > Ruggedized detector in metal housing
- > Size: 300 to 5000mm<sup>2</sup>
- > Active Thickness: 100 to 500µm

**Advantages:**

- Excellent reliability
- Perfect Alpha, Beta separation
- Can replace gas detectors in Alpha Beta counters
- Gamma guard versions available

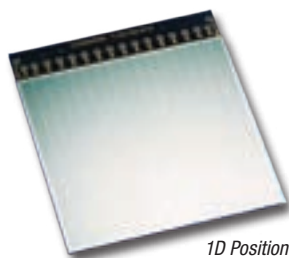
## 1D Position Sensitive Detectors - PF-CT-Series

**Features:**

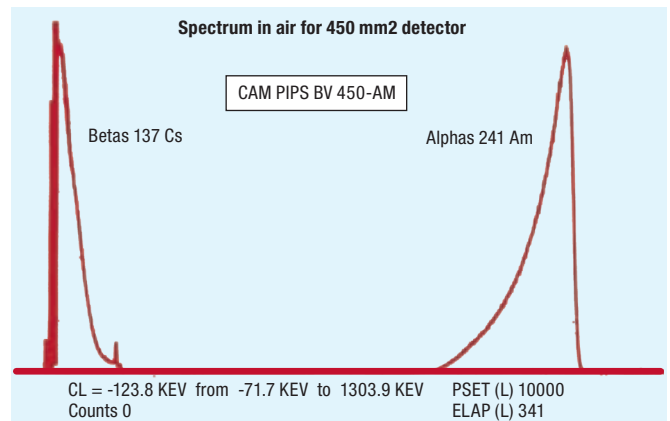
- > Pad detector mounted on epoxy boards
- > Sizes available: see [www.canberra.com](http://www.canberra.com)
- > Active thickness: 200 to 1000µm

**Advantages:**

- Excellent resolution
- Can be assembled on customer board
- Models available from stock



1D Position PF-CT-CD Series



# Silicon Detectors

## Charged Particle Detection *Continued* (E-Detectors)

**Nuclear Physics ■ Astrophysics**  
Low Energy Beta's and Electrons

**Excellent** Resolution for Alphas, Betas, Protons, Electrons, Heavy Ions...

- Entrance window < 50nm on all models

### 2D Position Sensitive Detectors

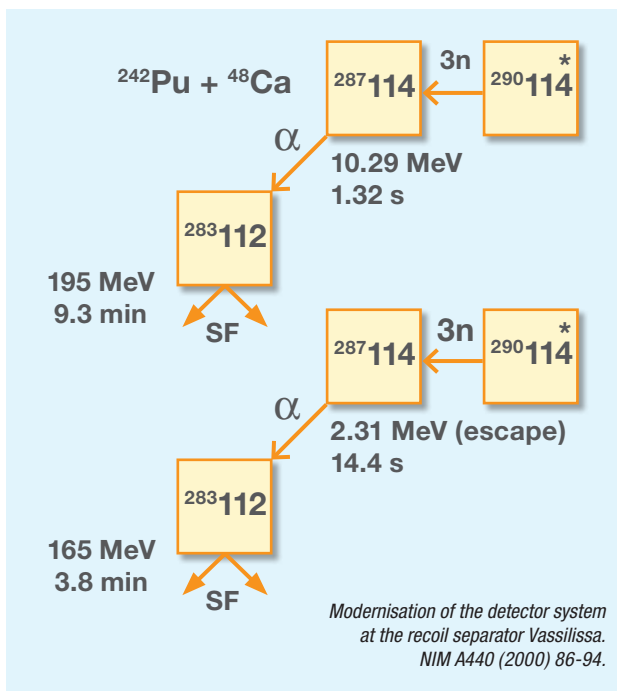
#### Resistive Pad Detector - PF-RT-Series

**Features:**

- > Pad detectors mounted on epoxy boards
- > Size: from 40x40mm<sup>2</sup> on
- > Active thickness: 300 and 500µm

**Advantages:**

- 2D position information (for energies > 2MeV)
- Modest requirement for read-out electronics
- Single sided process
- Can be assembled on customer board
- Models available from stock



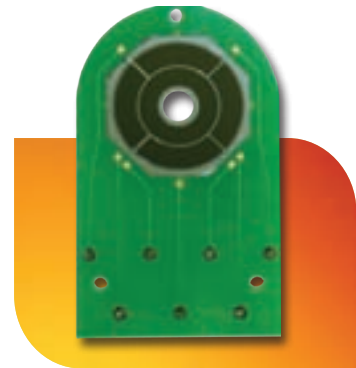
#### Pixel Detector - CD-Series

**Features:**

- > Pixel detectors mounted on epoxy boards
- > Size: Custom Design
- > Active thickness: 200 to 1000µm

**Advantages:**

- Good resolution (low capacitance)
- Can be assembled on customer board



CD-Series

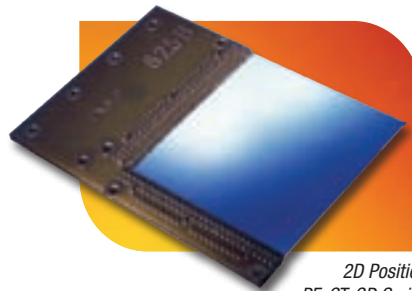
#### Double-Sided Strip Detector - PF-CT-CD Series

**Features:**

- > Strip detectors mounted on epoxy boards
- > Size: from 40x60mm and larger
- > Active thickness: 200 to 1000µm

**Advantages:**

- Good timing performance
- Can be assembled on customer board
- Models available from stock

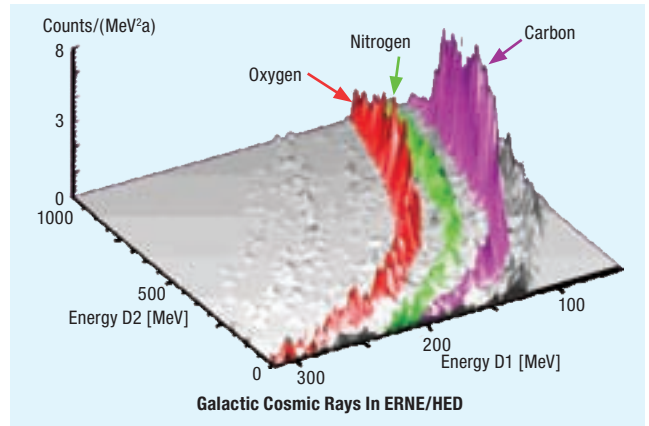


2D Position PF-CT-CD Series



# Particle Identification ( $\Delta E$ -Detectors)

Nuclear Physics ■ Astrophysics  
High Energy Physics



## Fully Depleted Detectors - FD-Series

**Features:**

- > Single junction in metal housing
- > Size: 25 to 900mm<sup>2</sup>
- > Thickness: 150 to 1500 $\mu$ m

**Advantages:**

- Excellent resolution
- Thin windows
  - Entrance window < 50nm
  - Exit window < 150nm up to 500 $\mu$ m thickness
- Detectors available from stock
- Telescope assemblies

FD-Series



## 2D Position Sensitive Detectors

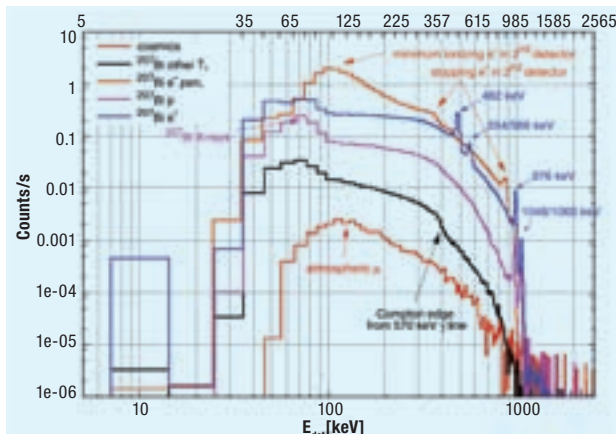
### Pixel Detectors

**Features:**

- > Pixel detectors mounted on epoxy boards
- > Size: Custom Design
- > Thickness: 200 to 1000 $\mu$ m

**Advantages:**

- 2D position information
- Entrance window on non segmented side < 100nm
- Good resolution (low capacitance)



Source: Space Sci Rev DOI 10.1007/s11214-007-9204-4

### Large Area Drift Detectors

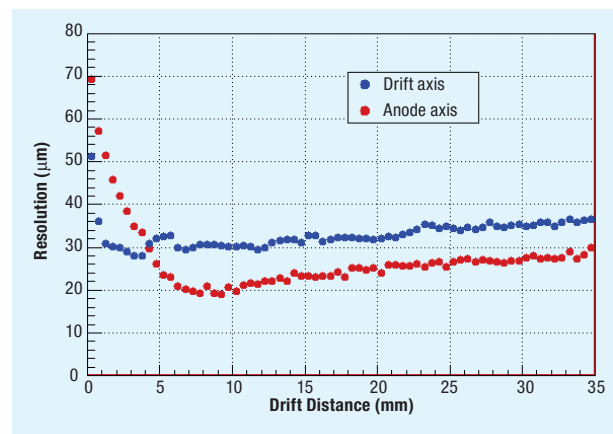
**Features:**

- > 2D position information
- > Spatial Resolution < 50 $\mu$ m on 52cm<sup>2</sup> device
- > MOS injectors for calibration
- > Sensitive to total area equals 88%



**Example shown:**

- LHC Alice project (300 devices supplied)
- Area: 52cm<sup>2</sup>
- Thickness: 300 $\mu$ m



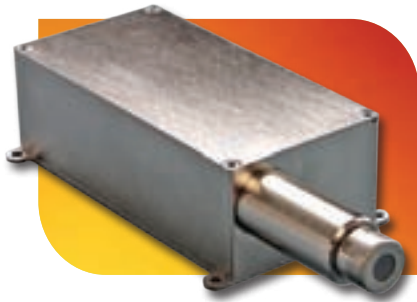
Source: INFN TRIESTE



# Silicon Detectors

## Photon Detection (From Near UV to 30keV)

X-ray Spectroscopy ■ X-ray Diffraction  
Synchrotron Applications



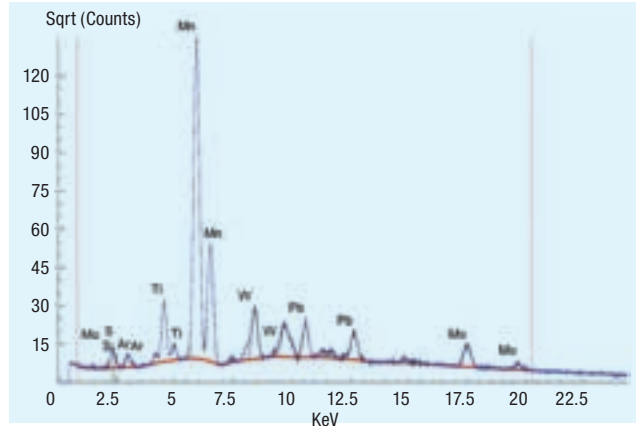
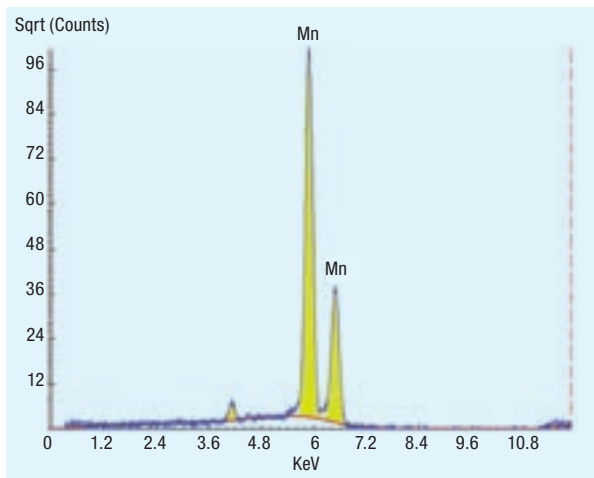
### X-PIPS Series (Based on Drift Technology)

**Features:**

- > Preamplifier included
- > Temp-controlled Peltier cooler included
- > Size: 15mm<sup>2</sup> and larger
- > Thickness: 500µm

**Advantages:**

- Excellent resolution < 150eV
- Peak/Background > 5000
- Good stability
- Good performance with fast shaping time (< 1µs rise time)



### Single and Multi-Anode Drift Detectors

**Features:**

- > Available as silicon chip
- > Size: from 25 to 150mm<sup>2</sup>
- > Thickness: 300 and 500µm
- > Low leakage current typ: < 2nA/cm<sup>2</sup>
- > Entrance window < 50nm





## Special Applications



### Photo-Diodes for Synchrotron Applications

**Features:**

- > Single or multiple junction on ceramic board
- > Size: 50 to 550mm<sup>2</sup>
- > Active thickness: 200 to 1500µm

**Advantages:**

- Low dark current
- Fast read-out
- Used in photovoltaic or biased mode
- No optical window

### Photo-Diodes for Scintillator Read-Out

#### Advanced Photon Detection on the next MARS ROVER

**Features:**

- > Size: Custom Design
- > Thickness: 200 to 500µm

**Advantages:**

- Anti-reflective coating with QE > 80%
- Low dark current
- Direct coupling to scintillator
- Optimization for specific scintillators



### Edgeless Pixel Detectors

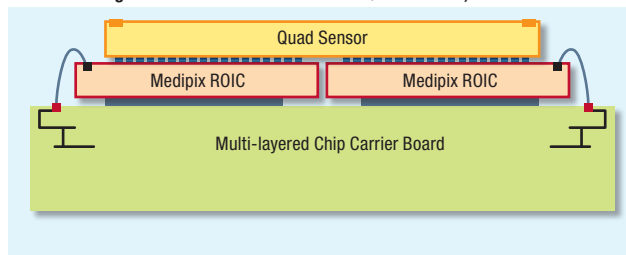
**Features:**

- > Bump bonded to the Medipix2 or Medipix3 chip
- > Size: 55x55µm pixel size
- > Thickness: 200 to 700µm

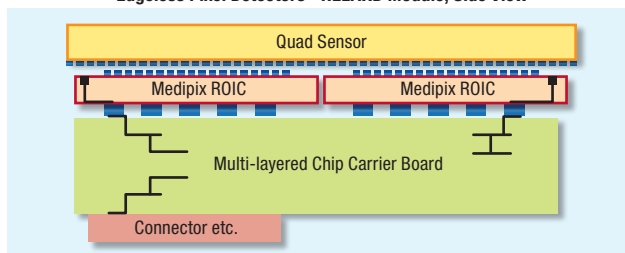
**Advantages:**

- Very fast 2D position information
- Large area device by means of tiling

Edgeless Pixel Detectors - Present Quad Module, Side View



Edgeless Pixel Detectors - RELAXD Module, Side View



## **CANBERRA is part of AREVA**

AREVA supplies solutions for power generation with less carbon. Its expertise and unwavering insistence on safety, security, transparency and ethics are setting the standard, and its responsible development is anchored in a process of continuous improvement.

Ranked first in the global nuclear power industry, AREVA's unique integrated offering to utilities covers every stage of the fuel cycle, nuclear reactor design and construction, and related services. The group is also expanding in renewable energies – wind, solar, bioenergies, hydrogen and storage – to be one of the top three in this sector worldwide in 2012.

With these two major offers, AREVA's 48,000 employees are helping to supply ever safer, cleaner and more economical energy to the greatest number of people.

**[www.canberra.com](http://www.canberra.com)**



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For more information please visit: **[www.canberra.com](http://www.canberra.com)** C39067 - 08/11