

NEXIS™

X-Ray Detector Module



Multiple-Energy X-Ray Imaging

NEXIS™ (N-Energy X-ray Image Scanning) is a modular detector system designed for high-flux, multiple-energy x-ray imaging. It consists essentially of detector boards equipped with linear (CdZnTe) detector arrays read out by XENA™ signal processor chips.

NEXIS™: Features and Capabilities

- Multiple-energy imaging
- Fast photon counting
- Modular, scalable construction
- Advanced components optimized for manufacturability
- Automated materials recognition
- Scatter elimination via energy discrimination
- Real-time object scanning
- High throughput inspection

XENA™ Detector Readout Chip

- Multichannel monolithic construction
- Simultaneous multiple energy band output per channel (up to five bands)
- Good energy resolution
- Charge sensitive amplifiers with fast pulse shaping
- High count rate (up to 2 MCounts/sec per channel)
- Submicron process fabrication

CZT Linear Detector Array

- (2 x 16) 1 mm or (1 x 32) 0.5 mm pixel pitch
- Uniform pixel-to-pixel x-ray response
- Wide x-ray energy range (10 keV to 300 keV)
- High energy resolution (≈ 3.5 keV @ 60 keV and ≈ 8 keV @ 122 keV)
- Multispectral imaging capability for scanner applications
- Short electron collection times (≈ 100 ns @ 400 V bias for 2 mm thickness)
- High-flux operation (up to 2 MCounts/sec per channel)
- Low dark (leakage) current per pixel
- Room temperature operation

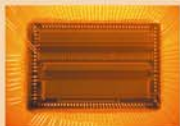


Availability

The standard NEXIS™ system consists of: one detector board with eight socket strips for connecting eight CZT pixel arrays read out by eight XENA™ ICs; one control board; one custom PCI I/O which goes into a Windows platform PC; a metal enclosure in which the detector boards and control board are mounted; control and data acquisition firmware and software; and cables for the system. The CZT detectors come in the form of (2 x 16) 1 mm or (1 x 32) 0.5 mm pixel pitch arrays with 1.75 mm or 3 mm thickness. Up to eight detector boards have been operationally tiled together to form a detector length of about one meter; a maximum of sixteen detector boards can be accommodated.

*NEXIS™ was developed with support in part from CALTIP, CCAT and OTTC-CCAT commercialization grants. It supersedes NOVA's earlier ABIS (Automated Baggage Inspection System) detector technology developed under sponsorship of the Army/ARDEC and the USDA/APHIS.





XENA™ for NEXIS™

Chip Specifications

Number of Channels:

32 + two test channels

Data Readout:

160 counters read out sequentially over 16-bit parallel data bus

Readout Time:

≈ 20 μs for all 160 counters

Counter Dynamic Range:

16 bits

Count Rate Capability:

> 2 × 10⁶ counts per second per channel

Energy Counting Bins per Channel:

1 to 5 selectable

Comparator Levels:

Independent comparator threshold voltages,
≈ 1.5 - 3.5 V range common to all channels

Gain and Offset:

Digitally adjustable for each channel

Input Loading Capacitance :

3.5 pF optimum

Pulse Shaping Time:

Externally adjustable in two ranges: 250 ns to 4.0 μs.

Input Energy Range:

≈ 20 - 300 keV

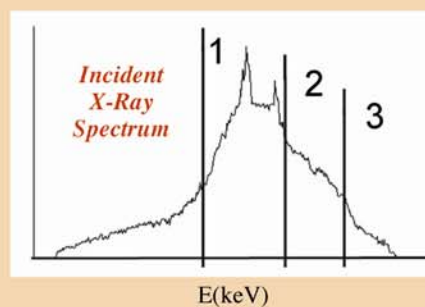
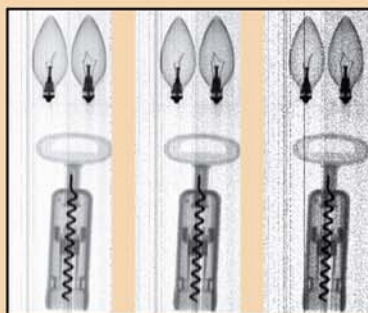
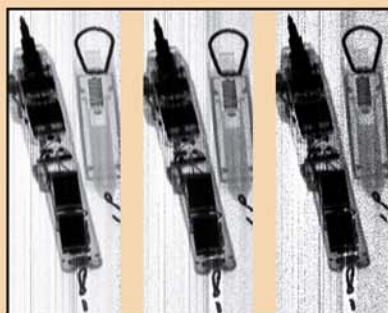
Input Referred Noise:

≈ 1000 e rms (4.5 keV for CZT)

Power Consumption:

500 mW nominal

XENA™ stands for X-ray ENergy-binning Applications



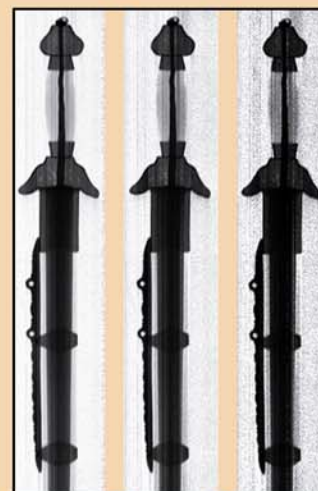
Two sets of objects (drill and scale; bulbs and corkscrew) imaged, from left to right, using x-ray energy bands 1, 2 and 3 shown qualitatively in incident spectrum displayed above-right.



NEXIS™ Control Board



NEXIS™ PCI I/O Card.



Right: Three-energy-bin images of metal sword with wooden handle and scabbard.

