VariCam

Dual-Head, All-Purpose, Variable-Angle, Slip-Ring, All-Digital Gamma Camera

VariCam™ is a variable-angle, dual-detector gamma camera. Variable detector geometry switches easily from 180° to 90° orientation. The detectors are optimally shielded for imaging at 40-520 keV energy range. CoDe™ coincidence detection of high energy positron emitters* potentially enhances lesion detectability. It features the unique Evolving Positron Imaging mode based on Slip-Ring technology. All-digital VLSI Detector architecture ensures high-precision digital event-positioning all the way from the photomultiplier tubes to the final image. It features five dimensional real-time digital corrections - for each event, yielding distortion-free signal processing and inherent long-term camera stability.

eleGANTRY™
- Open, stationary, robust gantry design ensuring high precision SPECT and WB scans.
- Convertible 90° through 180° detector geometry, doubling imaging efficiency in both cardiac SPECT and WB scans.
- OptiTrack™: fully automated on-line body contour* tracking system maximizes detector-to-patient proximity by enabling radial adjustment of scanning radius in ECT and whole body scans.
- Single-key user-programmable “home positioning” of gantry and table streamlines operation.
- Simultaneous, automatic, dual-collimator exchange maximizes operator comfort and minimizes set-up time.

Slip-Ring for unique applications
- Continuous SPECT orbiting for optimal tomographic imaging performance.
- Cable-free orbiting combined with high-speed optronic data transmission yields unsurpassed system reliability and high-fidelity data acquisition.

all-digital camera design
- “ADC per PMT” design ensures signal fidelity, maximizes data precision and enhances overall imaging performance
- On-the-fly digital corrections for sensitivity, linearity, energy, isotope decay and center-of-rotation results in enhanced image contrast and resolution.
- State-of-the-art VLSI design, features high-precision signal processing ensures optimal image quality and long-term stability.
OPTIMAL CLINICAL APPLICATIONS

oncology
- Two extra-large detectors featuring truly rectangular 540x400 mm UFOV with uncut corners
- Excellent resolution enhanced by high precision MicroCast™ and MasterPiece™ collimators*
- OptiTrack™ real-time, automatic body contouring for operator independent, consistent, high resolution scans
- VCoDe™ Coincidence Detection* with volumetric acquisition and reconstruction

neurology
- Ultra-flared fan-beam collimation* yields better than 7 mm SPECT resolution, with double imaging efficiency
- Less than 4” orbital SPECT radius, enhance scanning resolution, while 2.36” brain-reach ensures maximal detector-to-patient proximity.
- VCoDe™: Coincidence Detection* with volumetric acquisition and reconstruction.

cardiology
- Variable detector geometry (180°/90°) and OptiTrack* body contouring maximizes detector-to-patient proximity in cardiac SPECT scans.
- VTransACT™: Simultaneous Emission/Transmission Attenuation Corrected Tomography* potentially increases diagnostic precision.
- DISA: Dual Isotope Simultaneous Acquisition of 140/511 keV enhances assessment of myocardial perfusion and viability in a single scan.

BASIC CONFIGURATION

detectors
Two high-resolution detectors, each featuring 3/8” (5/8”*) NaI(Tl) crystal, 59 high quantum efficiency photomultiplier tubes, and a truly rectangular 540 x 400 mm UFOV (21.25”x15.75”), optimally shielded for imaging at 40-520 keV energy range in single photon and in coincidence detection modes.

gantry
A fixed, open gantry design, enables variable angle positioning of the detectors. High capacity power transmission to the rotating module is facilitated via a Multi-Channel Slip Ring. High-speed data transmission from the detectors is achieved by an ultra-fast optronic data link.

patient handling system
A cantilevered scanning table capable of automatic “home positioning”, fast vertical motion and pallet translation, features ultra-thin low-attenuation carbon-fiber pallet, including head, leg and arm support attachments.

acquisition workstation
Independent, high-performance workstation featuring Intel’s Pentium II processor, with 512 KB cache memory and 64 MB on board memory, 4 GB* hard disk, 2.3 GB* erasable optical disk and 1280 x 1024 resolution display with 17” color monitor. The station features a true real-time windows, IBM OS/2 multi-tasking operating system, with universal connectivity via DICOM 3.0 and Interfile 3.3 TCP/IP protocols.
**SYSTEM PERFORMANCE**

**MECHANICAL PERFORMANCE**

**gantry**

All gantry movements are programmable, enabling real-time fully automated body-contoured scans and automatic "home" positioning.

**detector "brain reach":** 6.9 cm (2.36"

**radial motion**

head travel: 10-30 cm (4"-12"

setup speed (per min): 30 or 75 cm (12" or 29"

scan speed (per min): 5 to 75 cm (2" to 29"

**rotational motion**

scan speed: 0.025 or 2.5 rpm

Modes: Continuous, Step & Shoot

Range: Unlimited, CW/CCW

**lateral motion**

head travel: 0-35 cm (0"-14"

setup speed (per min): 30 or 70 cm (12" or 29"

**patient handling system**

A low-attenuation carbon-fiber cantilevered table, with an all-purpose pallet.

attenuation: < 7% (140 keV)

max. load: 200 kg (440 lbs)

**horizontal motion**

scan modes: Continuous, Step & Shoot-sequential multi-spot

travel range: 10 to 200 cm (4" to 80"

scan length: 0 to 200 cm (0" - 80"

setup velocity (per min): 100 / 300 cm (39"/117"

scan velocity (per min): 5 to 300 cm (2" to 118"

**vertical motion**

setup velocity (per min): 30 or 150 cm (12" or 59"

travel range: 55 to 85 cm (22" to 33"

**NEMA performance specifications**

**auto calibration**

DIGITAL GUARD™, a high-speed, automatic digital detector calibration package

**shielded energy range**

40 - 520 keV

**intrinsic spatial resolution**

**crystal thickness** 3/8" 5/8"

CFOV: FWHM ≤ 3.8 mm ≤ 4.5 mm

FWTM ≤ 7.4 mm ≤ 8.5 mm

UFOV: FWHM ≤ 3.9 mm ≤ 4.6 mm

FWTM ≤ 7.5 mm ≤ 8.7 mm

**intrinsic energy resolution**

≤ 9.8% ≤ 9.9%

**intrinsic linearity**

CFOV: Absolute ≤ 0.4 mm ≤ 0.4 mm

Differential ≤ 0.1 mm ≤ 0.1 mm

UFOV: Absolute ≤ 0.4 mm ≤ 0.4 mm

Differential ≤ 0.1 mm ≤ 0.1 mm

**flood field uniformity**

CFOV: Integral ≤ 3.0% ≤ 3.0%

Differential ≤ 2.1% ≤ 2.1%

UFOV: Integral ≤ 3.6% ≤ 3.6%

Differential ≤ 2.3% ≤ 2.3%

**intrinsic spatial resolution (at 75 Kcps)**

FWHM: 4.0 mm 4.6 mm

FWTM: 7.8 mm 8.7 mm

**flood field uniformity (at 75 Kcps)**

CFOV: Integral ≤ 3.6% ≤ 3.6%

Differential ≤ 3.0% ≤ 3.0%

UFOV: Integral ≤ 4.8% ≤ 4.8%

Differential ≤ 3.2% ≤ 3.2%

**additional specifications**

multiple window spatial registration

Max. displacement (20Ga): ≤ 0.5 mm

intrinsic count rate performance

20% count rate loss rate, 20% window

3/8" 5/8"

incident: 225 Kcps 225 Kcps

observed: 180 Kcps 180 Kcps

maximum count rate at 20% window

320 Kcps 320 Kcps

maximum count rate

480 Kcps 480 Kcps

**system resolution with LEHR collimator (VPC-45K-C)**

FWHM (mm) without scatter

7.4 8.0

FWTM (mm) without scatter

13.9 14.6

**system sensitivity**

counts/min/Cµi

380 380

**system resolution with LEGP collimator (VPC-35K-C)**

FWHM (mm) without scatter

9.0 9.6

FWTM (mm) without scatter

16.9 17.5

**system sensitivity**

counts/min/Cµi

590 590

VCoDe™ Volumetric Coincidence Imaging

**PERFORMANCE SPECIFICATIONS**

<table>
<thead>
<tr>
<th>Parameter/Feature</th>
<th>VCoDe-3</th>
<th>VCoDe-5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Crystal thickness NaI(Tl)</td>
<td>3/8&quot;</td>
<td>5/8&quot;</td>
</tr>
<tr>
<td>Energy resolution @ 511 Kev</td>
<td>9 %</td>
<td>10 %</td>
</tr>
<tr>
<td>Maximum singles rate per head - detected</td>
<td>2 Mc/s</td>
<td>3 Mc/s</td>
</tr>
<tr>
<td>Maximum singles rate per head - processed</td>
<td>1.0 Mc/s</td>
<td>1.0 Mc/s</td>
</tr>
<tr>
<td>Maximum true coincidence count rate (3D)</td>
<td>6.5 Kc/s</td>
<td>13 Kc/s</td>
</tr>
<tr>
<td>Spatial resolution (FWHM) @ 511 Kev - without scatter</td>
<td>3.9 mm</td>
<td>4.6 mm</td>
</tr>
<tr>
<td>Spatial resolution (FWHM) @ 511 Kev - with scatter</td>
<td>4.2 mm</td>
<td>5.5 mm</td>
</tr>
<tr>
<td>Sensitivity (2D) Kc/s/mC/cc</td>
<td>----</td>
<td>30</td>
</tr>
<tr>
<td>Sensitivity (3D) Kc/s/mC/cc</td>
<td>----</td>
<td>300</td>
</tr>
</tbody>
</table>
ACQUISITION

VariCam acquires images in static, dynamic, multi-gated, SPECT, Gated SPECT, Whole Body singles acquisition modes, and in coincidence detection mode.

- Acquisition termination by preset time, preset count or manual stop
- User-definable preset protocols for easy acquisition set-up
- Up to four isotopes/peaks enabling multi-isotope or multi-peak (summed) acquisition modes
- Persistence mode display
- Continuous range off-center magnification
- Rotated and reflected acquisition orientation
- 512 channel PHA display

multi-gated acquisition

- Equi-time and equi-phase gating modes
- “Live” ECG display during acquisition
- On-line R to R histogram display

multi-gated acquisition capacity

<table>
<thead>
<tr>
<th>matrix</th>
<th>max. frames/cycle</th>
</tr>
</thead>
<tbody>
<tr>
<td>256 x 256 x 16</td>
<td>24</td>
</tr>
<tr>
<td>128 x 128 x 16</td>
<td>64</td>
</tr>
<tr>
<td>64 x 64 x 16</td>
<td>128</td>
</tr>
</tbody>
</table>

SPECT imaging performance

Measurements were taken using LEUHR collimator, 120 views, 3° per step, 15 cm radius-of-scan, acquisition magnification factor (x 2), Ramp-filtered back projection, 128x128 frame size.

<table>
<thead>
<tr>
<th></th>
<th>$3/8''$</th>
<th>$5/8''$</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tangential FWHM</td>
<td>6.2</td>
<td>8.0</td>
</tr>
<tr>
<td>Radial FWHM</td>
<td>8.7</td>
<td>8.7</td>
</tr>
<tr>
<td>Central FWHM</td>
<td>8.8</td>
<td>8.8</td>
</tr>
</tbody>
</table>

whole body scanning

- Sequential multi-spot scanning mode
- Fully-automated real-time body-contouring scanning
- Simultaneous dual-view anterior/posterior scan
- 1024 x 256 acquisition matrix
- Scanning area: 54 x 200 cm²

ARCHIVING

- Storage media: 1 GB (4 GB optional) SCSI disk and 1.44 MB 3 1/2” flexible disk drive.
- Management of clinical data flow and storage within the system and through the ApexNet enables access to clinical data by patient name, patient I.D., date or study label. Archived data includes images, curves, ROIs, markers, and “live reports”.
- High efficiency, unified archive management. Direct access to all tiers of information, including local archive, network-wide archive and clinical applications archive.
- User-friendly utilities include: archive generation; data sorting; data transfer from/to remote stations; backup and restore; study deletion.
- Data compatibility with APEX/SP/SPX and XPert/XPertView archives and with DICOM and Interfile data formats.
- CD ROM drive: for system software loading

DISPLAY

- 17” (21”*) color monitor (0.28 mm dot pitch), 1280 x 1024 pixels 60 Hz non-interlaced display.
- Simultaneous display of up to four independent color tables on the same image screen.
- Four independent display layers (overlays), 1280 x 1024 pixels each, containing data, graphics, text and operating system user-interface.
- Independent manipulation of base-line and windowing in multiple window setting.
- Simultaneous cine-mode display of multiple image-sequences.

standard fixed disk capacity-1 GByte

<table>
<thead>
<tr>
<th>matrix</th>
<th>capacity</th>
</tr>
</thead>
<tbody>
<tr>
<td>1024 x 1024</td>
<td>750 frames</td>
</tr>
<tr>
<td>512 x 512</td>
<td>3000 frames</td>
</tr>
<tr>
<td>256 x 256</td>
<td>12000 frames</td>
</tr>
<tr>
<td>128 x 128</td>
<td>48000 frames</td>
</tr>
<tr>
<td>64 x 64</td>
<td>192000 frames</td>
</tr>
<tr>
<td>32 x 32</td>
<td>768000 frames</td>
</tr>
</tbody>
</table>

NETWORKING

- DICOM 3.0* universal compatibility for multimodality, multi-vendor communication
- TCP/IP local and remote (modem)* communication protocols
- Direct interface and control with digital, network-resident, TCP/IP and DICOM printers
### OPTIONS

#### ACQUISITION

**VCoDe**  
Volumetric coincidence imaging

**VDET-5**  
Thick crystal detectors (5/8") optimized for high energy in lieu of the standard 3/8" crystal

#### PROCESSING

**XPertPro**  
Advanced processing workstation

**XPertView**  
Advanced NM viewing and teleradiology station

#### SCANNING ATTACHMENTS

**VRSCN-1**  
OptiTrack: fully automated on-line body-contoured scanning

**VTransACT**  
Simultaneous Emission/Transmission Attenuation Corrected Tomography package

**ACCESSORIES**

**AXM-21**  
21" color monitor in lieu of the 17" monitor

**AEG-1A**  
ECG amplifier/synchronizer

**AXM-15**  
Auxiliary 15" image monitor

**NETWORKING**

**XDICOM**  
TCP/IP DICOM 3.0 DATA Export/Import to/from CT/MRI and other NM systems

**XMODEM**  
Fast TCP/IP based Modem communication package (33,600 BPS)

**XCM-22**  
Single port fast Ethernet link (thin cable connector for connection to APEX/SP/SPX)

**HARDCOPY DEVICES**

**Helios 810**  
Polaroid digital laser imager, dry processing

**CODONICS NP-1600/1660**  
Digital color printer with dye sublimation

**AGFA DRYSTAR/N**  
Networked dry processing color or B&W multi-imager

### COLLIMATOR SPECIFICATIONS:

<table>
<thead>
<tr>
<th>Name</th>
<th>Application</th>
<th>Energy keV</th>
<th>Septal Penetration %</th>
<th>Geometric Res. FWHM (mm) @0</th>
<th>Geometric Res. FWHM (mm) @100</th>
<th>System Res.FWHM (mm) @100 mm</th>
<th>Sensitivity Counts/min/1Ci</th>
</tr>
</thead>
<tbody>
<tr>
<td>VPC-35K</td>
<td>LEGP General applications</td>
<td>140</td>
<td>0.8</td>
<td>2.1</td>
<td>8.4</td>
<td>9.0</td>
<td>590</td>
</tr>
<tr>
<td>VPC-40K</td>
<td>LEFR General applications</td>
<td>140</td>
<td>0.4</td>
<td>2.0</td>
<td>7.2</td>
<td>7.9</td>
<td>450</td>
</tr>
<tr>
<td>VPC-45K</td>
<td>LEHR Bone scans</td>
<td>140</td>
<td>0.3</td>
<td>2.0</td>
<td>6.7</td>
<td>7.4</td>
<td>380</td>
</tr>
<tr>
<td>VPC-5-C</td>
<td>MEGP 47Ga studies</td>
<td>300</td>
<td>2.0</td>
<td>4.0</td>
<td>9.4</td>
<td>9.9</td>
<td>320</td>
</tr>
<tr>
<td>VPC-6-C</td>
<td>HEGP 111In studies</td>
<td>360</td>
<td>2.0</td>
<td>5.3</td>
<td>10.7</td>
<td>12.4</td>
<td>380</td>
</tr>
<tr>
<td>VPC-75-C</td>
<td>LEUHR Brain SPECT (Fan beam)</td>
<td>140</td>
<td>0.1</td>
<td>2.0</td>
<td>5.5</td>
<td>6.5</td>
<td>440</td>
</tr>
<tr>
<td>VPC-8-C</td>
<td>HEGP Thyroid scan</td>
<td>360</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Pinhole (3 inserts)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>VPC-93-C</td>
<td>UHE Ultra High Energy applications</td>
<td>520</td>
<td>3.5</td>
<td>5.9</td>
<td>12.3</td>
<td>12.9</td>
<td>190</td>
</tr>
<tr>
<td>VPC-94-C</td>
<td>UHEHR Ultra High Energy High Res applications</td>
<td>520</td>
<td>4.1</td>
<td>4.1</td>
<td>8.7</td>
<td>11.8</td>
<td>120</td>
</tr>
</tbody>
</table>

*Defined for 3/8" crystal*
Varicam

MINIMUM ROOM LAYOUT
1. Gantry
2. Patient handling system
3. Collimator carts
4. Operator’s console
5. Acquisition station
6. Operator’s chair
**Product Data**

**Physical Characteristics**

**Electrical Requirements**
- **Power Consumption**: 4.5 KVA
- **Heat Dissipation**: 8550 BTU/H

**Mains**
- Rated voltage: 208/400 (±110%) VAC 3 phases
- Rated frequency: 50/60 (±1%) Hz

**Gantry Floor Load**
- 2850 kg dynamic weight on a 185x120 cm area
  (at maximal detectors rotational speed
  with asymmetric detectors positioning)

**Operating Environment**
- **Temperature**: 18° C-27° C (64° F-80° F)
- **Maximum Temp. Gradient**: 3° C (5° F) per hour
- **Humidity**: 40%-60%, non-condensing
- **Quality Standards**:
  - IEC-601-1 certified
  - TÜV certified
  - PAL certified
  - CE certified

**Dimensions & Weights**

<table>
<thead>
<tr>
<th></th>
<th>Height cm (in)</th>
<th>Width cm (in)</th>
<th>Depth cm (in)</th>
<th>Weight Kg (in)</th>
<th>Heat Dissipation (BTU/H)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Gantry</strong></td>
<td>210 (82.7)</td>
<td>155 (61)</td>
<td>175 (69)</td>
<td>2400 (5291)</td>
<td>6500</td>
</tr>
<tr>
<td><strong>Computer Cabinet</strong></td>
<td>52 (20.5)</td>
<td>22 (8.7)</td>
<td>66 (26)</td>
<td>30.5 (67.2)</td>
<td>1710</td>
</tr>
<tr>
<td><strong>Monitor</strong></td>
<td>52 (20.5)</td>
<td>66 (26)</td>
<td>22 (8.7)</td>
<td>37 (81.6)</td>
<td>342</td>
</tr>
</tbody>
</table>
| **Patient Handling**   | 98 (38.6)      | 250 (98.4)    | 40 (27.5)     | 1038 (881.8)   | Included in
  *GANTRY* specifications
  (above)                   |
| **Colimator Cart**     | 130 (48.8)     | 130 (19.3)    | 60 (34.2)     | 100 (220.5)    | -                        |

---

§ Add 85-190 kg (187-419 lb) when collimators are loaded for VPC - 5, 6, 8, 93 or 43-60 kg (95-132 lb)
when VPC - 35, 45, 46, 40 or VUB - 75 are loaded.
* Optional
* * Based on NEMA publication NU 1-1994
* * * Nema class standard
# W.I.P.
## combined performance of both detectors

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