TriFoil Imaging

Triumph® II

Next generation pre-clinical tri-modality (PET/SPECT/CT) imaging system

The Triumph pre-clinical PET/SPECT/CT system is a fully integrated molecular imaging system designed to provide solutions for biomedical research and drug discovery.

PRODUCT DESCRIPTION

The Triumph pre-clinical imaging system offers multiple configurations to address users' needs. It can be combined with up to three different imaging modalities (PET, SPECT, CT) in a single platform.

It combines functional imaging provided by SPECT and PET with high-resolution anatomical imaging provided by CT, creating a high-throughput imaging system designed specifically by animal researchers for animal researchers. Triumph helps researchers easily and effectively monitor disease processes and understand the effects of new drug treatments. The same animal can be studied over time with repeat measurements.

Accessories, which may be essential for performing reproducible and reliable molecular imaging studies in live animals (i.e. radiopharmaceutical injectors, vital sign monitors, blood counter, bed motion sequence, etc.), can all be controlled from a single user-friendly interface. Complex imaging protocols can be pre-programmed in advance, saving valuable scanner time for imaging and allowing a smooth operational workflow. In addition, relevant information about the scan is collected during imaging and recorded in a DICOM-compatible database.

HIGHLIGHTS

- Digital detector technology for PET and SPECT delivers high resolution and high contrast images.

- Fully integrated tri-modality system (PET/SPECT/CT)

- Well suited for multi-isotope imaging in SPECT

- Multiple configurations and upgradeable on-site to address users' needs

- Wide range of integrated features and optional accessories to enable efficient and high-throughput studies.

Triumph system overview

- Accommodates the following choices of modalities available individually, in any combination of two, or all three: digital PET with three different axial fields of view, CT, and one, two, or four digital gamma detectors for SPECT.

- Features the eXplore Console - intuitive software that allows the control of acquisition, data browsing, reconstruction and visualization and analysis all from a single user interface.

- Single-axis animal bed track facilitates automated co-registration between modalities.

- Fully shielded cabinet for X-rays

- Carbon fiber animal beds for mouse (25 mm), rat (50 mm), and rabbits (125 mm)

- Integrated animal bed heating system

- Pre-plumbed lines for gas anesthesia and waste-gas management

- Access for catheters and other accessory lines

- Integrated physiological monitoring system for ECG, respiration, and temperature

- Videomonitoring system for live view of animal during imaging

- Hand controller to position detectors, X-ray tube, gantry, and animal bed

- Optional items:

  - Automated injection pump

  - Automated Microvolumetric Blood Counter system for input function measurement

eXplore Console

- User configurable protocols

- Enables efficient management of study information

- eXplore View multimodal data browser for fast data lookup and retrieval

- Intuitive graphic ROI selection for acquisition planning.

- eXplore Reconstruction Queue manager allows for large batches of reconstructions to be performed in the background during scanner use.

- Acquisition to reconstruction based data integrity validation to support 21CFR part 11 reporting requirements

PET SUBSYSTEM OVERVIEW

The LabPET® subsystem provides researchers with the ability to visualize and quantify biological processes in small animals with a reconstructed resolution better than 1.0 µl. LabPET's core technology features Avalanche PhotoDiode (APD) detectors and digital signal processing,

which enable high performance imaging. LabPET's detector design achieves true crystal geometric resolution: no resolution loss due to light sharing or electronic coding. The fine full-width-at-tenth-of-maximum (FWTM) resolution improves image contrast and edge sharpness, leading to high contrast and clear images. Its individual pixel detectors and independent parallel signal processing provide wide dynamic range imaging capability for fast, reliable, and quantitative pharmacokinetic analysis.

PET acquisition features:
- List mode data acquisition for high post-processing and reconstruction flexibility
- Automatic decay correction
- Single and automated multiple bed positions
- Gating support for cardiac, respiratory and user defined inputs
- Integrated control of accessory features like automatic injector pump.

PET reconstruction features:
- Algorithms include FBP, 2D MLEM, 3D MLEM, 3D OSEM
- User selectable transverse FOV from 46-100 mm
- CT based attenuation correction
- Quantitative calibration
- 3D AMPS reconstruction technology - for ultra-high through-put
- Static and dynamic parsing
- Automated batch mode reconstruction

PET subsystem characteristics

	LABPET4	LABPET8	LABPET12
Ring Diameter (cm)	15.6	15.6	15.6
Bore Size (cm)	15	15	15
Axial Field of View (cm)	3.7	7.5	11.2
Multi Bed Position Axial FOV (cm)	30	30	30
Number of APD Detectors	1536	3072	4608
System Maximum Count Rate (Mcps)	15	30	46

High Image Quality and Detectability
- High resolution
- FWHM <1 mm with MLEM
- FWHM <1.35 mm and FWTM <2.2 mm with FBP
- 1.35 mm rods in Ultra Micro Hot Rod Phantom clearly resolved
- Recovery Coefficient >0.75 at 2 mm >0.95 at 3 mm

- High count rate provides excellent image quality in the most demanding experiments - including wide dynamic range and high activity from SPECT isotopes.

SPECT SUBSYSTEM OVERVIEW

The X-SPECT® subsystem provides high quality pre-clinical SPECT imaging using solid-state Cadmium Zinc Telluride (CZT) detector technology.

- System accommodates up to four CZT gamma cameras.
- High energy resolution (better than 4.5 % at 140 keV) generates clear images by reducing radiation scatter, and is well suited for simultaneous multi-isotope imaging.
- Compact, high spatial resolution gamma cameras in combination with single and multiple pinhole technologies delivers high sensitivity and SPECT resolution.
- Wide gamma-ray energy range of 25-250 keV to cover a variety of isotopes (e.g. 99mTc, 123I, 125I, 201Tl, and 111In) for imaging.
- The Variable 'Radius of Rotation' for SPECT (1.5 to 17.5 cm) enables flexibility for imaging studies allowing the user to zoom in on a specific organ, or image an entire animal.
- The high sensitivity allows for a significant reduction in acquisition time or delivered dose.

SPECT subsystem image acquisition and reconstruction
- Planar static, planar dynamic, tomographic (SPECT), dynamic SPECT acquisitions
- User selectable pinhole SPECT orbits, circular or spiral motion
- Frame and list mode acquisitions
- FBP reconstruction for parallel hole collimators
- 3-D OSEM for single and multi-pinhole collimator reconstruction
- CT based attenuation correction
- Multiple energy window imaging with post-processing list mode data

SPECT subsystem and detector characteristics

Detector material	Cadmium Zinc Telluride (CZT)
Detector configuration	Up to 4 detectors
Detector pixel size	1.6 mm pitch
Detector field of view	125 mm x 125 mm
Energy resolution	< 4.5 %
Energy range	Down to 500 μm
Spatial resolution	Down to 500 μm
Sensitivity	Up to 6,500 cps/MBq

SPECT Collimators

A wide range of advanced single-, multi-, and parallel hole collimators are available including:

- 0.5, 1.0, and 2.0 mm Single Pinhole

- 0.5, 1.0, and 2.0 mm Mouse and Rat Multi-Pinhole Parallel hole collimators including:

- Low Energy High Resolution

- Low Energy High Sensitivity

- Medium Energy General Purpose

CT SUBSYSTEM OVERVIEW

The X-O® CT subsystem, is equipped with an advanced CMOS digital X-ray detector technology and has the flexibility to perform a wide range of scanning, includ- ing whole body imaging in less than a minute. The CT Zoom® feature facilitates optimization of the field of view and resolution. A large field of view can be used for imaging animals larger than rats, while high resolution can be obtained for smaller animals.

CT subsystem characteristics

The X-O® system allows researchers to image a large range of test subjects with its 9.3cm diameter by 9.7 cm axial field of view.

- 118.4 mm x 112 mm X-ray CMOS detector with 2368 x 2240 pixels and 50 µm pitch

- X-ray generator tunable from 40 to 80 kVp, 40 W maximum

- Scout View for graphically assigning acquisition and reconstruction ROIs

- Live Fluoro View for X-ray guided animal positioning

- Whole body mouse acquisition in less than 1 minute

- Continuous rotation scan mode allows use of rapidly clearing contrast agents

- Delivered X-ray dose < 2 cGy (continuous rotation mode)

- User selectable CT Zoom feature for acquiring a large field of view or high resolution with magnification ranging from 1.29 to 4.45

- User selectable CT reconstruction options to optimize soft tissue contrast or spatial resolution

- User selectable X-ray detector binning from 1 x 1 to 4 x 4 for optimal resolution and scanning speed

- Acquisition graphical user interface to display projection data during a scan

- User selectable step or continuous rotation scanmode

MEASUREMENTS AND VISUALIZATION

Image display and analysis features are provided within Volumetric Image Visualization Identification and Display (VIVID) package:

- Automatic registration of PET, SPECT, and CT images from Triumph

- Volume of Interest (VOI) tools (box, ellipse, trace)

- Visualization and quantification of both 2-D and 3- D image data: generate, view and save isosurfaces, opacity based volume rendering

- Multiple-slice viewing, single plane viewing, arbitrary oblique slicing, volume reorientation and re-alignment

- Control of data viewing: zoom, pan, rotate, sub-volume viewing, window and level

- Comprehensive suite of measurement tools: measure distances, pixel values, histogram, line profiles, image statistics

- Measurement data export into formatted text for use with spreadsheets and data analysis software

- Imports a wide range of images including 8, 16, or 32 bit files

- Multi-platform environment

- On-line documentation

SYSTEM SITING SPECIFICATIONS

Scanner size (L x W x H): 2500 x 1220 x 1500 mm Scanner mass, total: approximately 1200 kg depending on actual system configuration

Computer/Power supply size: 820 x 58 x 1080 mm

Computer/Power supply weight: 140 kg

Monitor/Keyboard stand size: 1060 x 880 x 1430 mm

Monitor/Keyboard stand weight: 40 kg

Minimum room size: 3200 mm wide by 4500 mm deep.

Minimum ceiling height: 2900 mm

Maximum Thermal Output of Scanner: 7.2 kW

The operating temperature range: 19° to 21°C (66° to 70°)

Humidity range: 20 % to 60 %

A network connection with internet access is required for remote service features.

ELECTRICAL POWER REQUIREMENTS

Scanner: 208 V, 2 phase (USA) or 220/240 V (Europe) input, rated at 30 Amps

Frequency: 50/60 Hz

REGULATORY AND COMPLIANCE

This product is a CE compliant device that satisfies requirements regarding Electro-Magnetic Compatibility (EMC), Electro-Magnetic Interference (EMI) pursuant to IEC 61010. This product is also designed to comply with applicable standards under the Radiation Control for Health and Safety Act of 1968.

CAUTION
LASER RADIATION
DO NOT STARE INTO BEAM
860nm, 1mW
CLASS II LASER PRODUCT

TriFoil
Imaging

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