System specifications

Biograph Vision.X PET/CT

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System hardware

Standard system hardware
Lutetium oxyorthosilicate (LSO)-based digital PET detector (Optiso UDR)
SOMATOM Definition 64-slice CT
CT UFC (Ultra Fast Ceramic) detector
CT STRATON tube
CT z-Sharp technology
CT Adaptive Dose Shield
Laser positioning markers
Front and rear integrated display panels
Bilateral front and rear control panels
Audio system
Acquisition workplace with multilingual graphical user interface, dual 48-cm (19-in) flat screen monitor, keyboard, and mouse plus full DICOM archiving and external USB 2.0/3.0 disk support

System software

Standard system software
HiRez processing
PET offline reconstruction
PET injection time reminder
PET Dose Structured Report
DetectorGuard
Export as JPEG
Auto beat histogram
Camtasia
Ultra-low-dose CT protocols for PET attenuation correction
syngo 3D Bone Removal
syngo Examination
syngo Viewing
syngo Filming
syngo TrueD Basic
syngo VRT (Volume Rendering Technique)
syngo Volume Calculation
syngo 3D SSD (Surface Shaded Display)
syngo 3D Real Time MPR
syngo Archiving and Network
syngo Dynamic Evaluation
syngo Service Solutions

CT-specific standard software
CT HD Field of View Pro—78 cm (HD FoV Pro)
CT Workstream 4D
CT FAST Scan Assistant
CT FAST ROI
CT FAST Adjust
CT CARE Dose4D
CT CARE kV
CT CARE Dashboard
CT Profile
CT CARE Child
CT CARE Topo
CT CARE Filter
CARE Bolus CT
CT CARE Profile
CT SureView—multislice image reconstruction system
CT Dose Logs
CT Dose Notification
CT Dose Alerts
CT DICOM viewer—included on each CD; automatically started on the viewer's PC

System configuration

Standard patient positioning accessories
Knee/leg support
Head/arm support
Mattress
Table extensions
Head holder
Cushion set for head holder
Restraining strap set
Head strap set
Head rest
Standard sources and fixtures
L-bracket and phantom holder
Gantry offset phantom (LS-LA line sources holder)
MI PET water phantom
CT quality control (QC) phantom kit

System configuration

Optional system hardware
SOMATOM Definition Edge/128-slice CT
PET gantry uninterruptible power supply (UPS)
High-performance MARS
Remote cooling system water/air
Flow heater
Biograph sources, including phantom shield
Alternative keyboards (German, Spanish, French, Swedish, Portuguese)
Respiratory triggering system
Universal physiological measurement module (UPMM)
Cardiac trigger with patient cable
syngo.via
syngo MI Workplace
CT-specific optional system hardware
CT High-speed 0.30 s/0.28 s[1]
CT High Power 100 kW (CT64 only)
CT FAST IRS[1]
Adaptive 3D intervention suite
CT Split Filter Box[1]
CT Tin Filter[1]
CT water phantom
Optional system software
PET time of flight (TOF)
HD•PET (TrueX PET reconstruction)
ultraHD•PET
FlowMotion
FlowMotion AI
OncoFreeze
OncoFreeze AI
QualityGuard
PET Cardiac Gating
CardioFreeze
PET Respiratory Gating
Dynamic PET with Dynamic Speed
SMART Neuro AC

Optional system software (cont.)
PET-guided CT
Multi-series CT attenuation correction
FlowMotion MultiParametric PET AI
FAST PET Workflow AI
syngo Expert-i
US Department of Defense (DoD)-level security
CT-specific optional system software
iMAR (metal artifact reduction)
CT SAFIRE (iterative) reconstruction
CT ADMIRE
CARE Contrast
CT Respiratory Gating
CT Adaptive 4D Spiral
CT z-UHR (z-Ultra High Resolution)
CT Cardiac Gating
CT TwinBeam Dual Energy[1]
syngo Image Fusion
syngo Pulmo CT
syngo Security Package
Cardio BestPhase Plus
Intervention Pro with i-Fluoro
CT DirectBreathhold
CT respiratory-guided workflow
CT X-CARE
CT FAST Planning
CT FAST Spine
CT FAST 3D Align
CT FAST Dual Energy Results
CT DirectDensity
CT Single Source Dual Energy scan mode
DICOM SR Viewer

System configuration

Optional accessories
Multi-index radiation therapy planning (RTP) overlay
CT respiratory motion management
Open interface
ANZAI interface
Varian Respiratory Gating for Scanners (RGSC) interface
PET American College of Radiology (ACR)-approved PET phantom
Pediatric cradle
Additional system manuals
Accessory cart
Control room desk
Computer cabinet
NEMA 2018 self-test kit, including phantom kit
NEMA test suite
Acculine installation kit
Mobile installation kit
Seismic installation kit

Patient handling system (PHS) specifications

SMART PHS		
Magnetic drive	Yes	
Positioning accuracy	< 0.5 mm	
Maximum table speed (horizontal/vertical)	200 mm/s (7.9 in/s)/40 mm/s (1.57 in/s)	
Acquisition speed range	0.1-50 mm/s^2	
Maximum patient load	227 kg (500 lb)	
Maximum co-scan range (with pallet extension)	FlowMotion^2	197.4 cm (77.7 in)
	Step and shoot	197.3 cm (77.7 in)
Lowest position (from floor)	53 cm (20.9 in)	
Lowest position (in tunnel)	69 cm (27.2 in)	
Highest position	96 cm (37.8 in)	
Length	381 cm (150 in)	
Width (including handles)	49 cm (19.3 in)	

PET specifications

PET acquisition methods	
Static	
Multi-bed	
List-mode	
Multi-bed list-mode	
Continuous bed motion[2]	
PET reconstruction methods	
Analytic	
Analytic + TOF[2]	
3D iterative ordinary poisson-ordered subset expectation maximization (OP-OSEM)	
3D iterative (OP-OSEM) + TOF[2]	
HD•PET (OP-OSEM + point spread function (PSF))[2]	
ultraHD•PET (HD•PET + TOF)[2]	
PET matrix sizes	
128 x 128	
220 x 220	
256 x 256	
440 x 440	
512 x 512	
880 x 880	
PET filters	
All pass	
Gaussian	
Butterworth	
PET scatter correction methods	
Relative	
Absolute	
Relative whole-body	
Absolute whole-body	
Auto	
PET correction methods	
Attenuation correction	Normalization correction
Randoms correction	Scatter correction
Decay correction	Arc correction
Branching fraction correction	Rb-82/I-124/Y-86—prompt gamma correction
Dead time correction	Metal artifact reduction for cardiac imaging

PET specifications

PET detector assembly	
Bore diameter	78 cm
Detector ring diameter	82 cm
Detector material	LSO
Detector element dimensions	3.2 x 3.2 x 20 mm
Detector elements per module	200
Photosensor	Silicon photo multiplier (SiPM)
SiPMs per module	128
SiPM coverage of crystal array	100%
Crystal elements per ring	760
Modules per ring	38
Plane spacing	1.65 mm
Axial field of view	26 cm
Transaxial field of view[3]	70 cm
PET data acquisition/processing	
Coincidence window	4.7 ns
Energy resolution	9% full width at half maximum (FWHM)

PET specifications

PET NEMA NU 2-2018 performance			
NEMA performance measures represent typical values derived from internal testing. All measurements are performed with the factory lower level discriminator (LLD) setting of 435 keV.			
Scatter fraction at peak noise-equivalent count rate (NECR)	39%		
Scatter fraction (low activity concentration)	38%		
Count rate accuracy (mean bias at peak NEC)	4%		
TOF resolution	178 picoseconds (ps)		
PET/CT coregistration accuracy	1.6 mm		
Spatial resolution—axial	**ANALYTIC[5]**	**ITERATIVE[6]**	**ultraHD•PET[7]**
FWHM @ 1 cm (mm)	3.7	3.4	1.7
FWHM @ 10 cm (mm)	3.9	3.7	1.7
FWHM @ 20 cm (mm)	3.9	3.7	1.7
Spatial resolution—transverse	**ANALYTIC[5]**	**ITERATIVE[6]**	**ultraHD•PET[7]**
FWHM @ 1 cm (mm)	3.5	3.2	1.9
FWHM @ 10 cm (mm)	4.1	3.8	2.0
FWHM @ 20 cm (mm)	4.6	4.5	2.0
System performance			
Sensitivity (cps/kBq)	16		
Peak NEC rate (kcps)	287 kcps ≤ 30 kBq/CC		
Peak true rate (kcps)	1,200 kcps ≤ 50 kBq/cc		
TOF gain[4]	13.1[8] (7.5)[9]		
Effective sensitivity (cps/kBq)[4]	210[8] (120)[9]		
Effective peak NEC rate (kcps)[4]	3,765 kcps[8] (2,151)[9] ≤ 30 kBq/cc		
Effective peak true rate (kcps)[4]	15,741 kcps[8] (8,995)[9] ≤ 50 kBq/cc		
PET reconstruction times	**OSEM-3D + TOF[2]**	**ultraHD•PET[2]**	
Reconstructions are parallel to acquisitions, and two reconstructions jobs can be performed at the same time.			
Reconstruction time per bed (440 x 440 matrix, 159 imaging planes)	36 sec	40 sec	

CT specifications

Gantry dimensions		
Scan field	50/78	
Rotation time	0.28 s[2] 0.30 s[2] 0.33 s	
Data acquisition system	**Biograph Vision.X CT64**	**Biograph Vision.X CT128[2]**
Maximum number of slices/rotation	64 (acquired slices) 192 (reconstructed slices)	128 (acquired slices) 384 (reconstructed slices)
Number of physical detector rows	32	64
Number of detector elements	23,552	47,104
Number of projections	up to 4,608 (1/360°)	up to 4,608 (1/360°)

CT specifications

Tube assembly		
Tube	STRATON X-ray tube	
Tube current	20-666 mA 20-800 mA[2]	
Tube voltage	70, 80, 100, 120, 140 kV	
Tube anode heat storage capacity	0 MHU (0.6 MHU capacity combined with 7.3 MHU/min (5,400 kJ/min) cooling rate is comparable to the performance of a conventional tube with approximately 50 MHU (37,000 kJ) anode heat storage capacity)	
Tube cooling rate	7.3 MHU/min (5.400 kJ/min)	
Focal spot size according to IEC 60336/1993	0.7 x 0.7 mm/7° 0.9 x 1.1 mm/7°	
CARE Filter		
CARE Filter tube	Equivalent to 6.8 mm Al @ 145 kV	
CARE Filter beam limiting device	0.5 mm Al, 0.3 mm Ti (equivalent to 2.0 mm Al) tube: 6.8 mm Al	
Generator		
Maximum power	80 kW; 100 kW[2]	
Topogram		
Length (maximum)	2,200 mm with table extension	
Scan times	1.5-20 s	
Sequence acquisition	**Biograph Vision.X CT64**	**Biograph Vision.X CT128[2]**
Reconstructed slice widths in sequence acquisition	0.6, 0.75, 1, 1.2, 1.5, 2, 2.4, 3, 3.6, 4, 4.8, 5, 6, 7, 7.2, 8, 9, 9.6, 10, 12, 14.4, 15, 20 mm	0.5, 0.6, 0.75, 1, 1.2, 1.5, 2, 2.4, 3, 3.6, 4, 4.8, 5, 6, 7, 7.2, 8, 9, 9.6, 10, 12, 14.4, 15, 20 mm
Full scan times (360° rotation)	0.30[2], 0.33, 0.5, 1.0	0.28, 0.33, 0.5, 1.0
Partial scan times (260° rotation)	0.22[1], 0.24, 0.36, 0.72	0.21, 0.24, 0.36, 0.72
Temporal resolution	150[2], 166 ms	142[2], 166 ms
Number of uninterrupted scans per range	100	100
Number of ranges per protocol	33	33
Scan cycle time (varies with rotation speed)	0.75-60 s (± 10%)	0.5-60 s (± 10%)

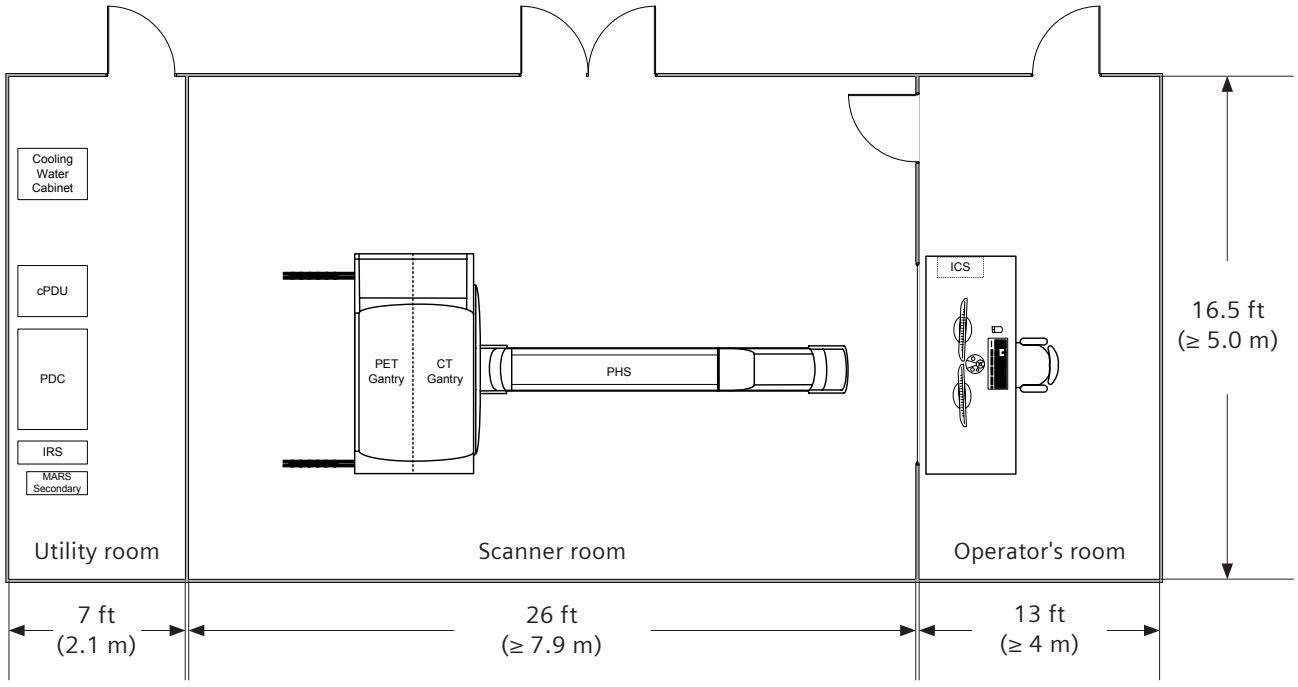
CT specifications

Multislice spiral acquisition	Biograph Vision.X CT64	Biograph Vision.X CT128[2]
Reconstructed slice widths	0.4[2], 0.5[2], 0.6, 0.75, 1, 1.5, 2, 3, 4, 5, 6, 7, 8, 10 mm	0.4[2], 0.5, 0.6, 0.75, 1, 1.5, 2, 3, 4, 5, 6, 7, 8, 10 mm
Scan times full scan (360°)	0.30[2], 0.33, 0.5, 1.0 s	0.28, 0.33, 0.5, 1.0
Reconstruction increment	0.1-10 mm	0.1-10 mm
Pitch factor	0.35-1.5, 0.18[2], 0.09[2]	0.35-1.7, 0.17[2], 0.09[2]
Spiral scan time maximum	100 s (200 s with optional CT Respiratory Gating)	80 s (160 s with optional CT Respiratory Gating)
Temporal resolution	71[2], 82 ms	71[2], 82 ms
Number of ranges per protocol	33	33
Image reconstruction		
Real-time display	512 x 512	
Slice thickness	0.4[2]-10 mm	
Scan field	50 cm/19.7 in 78 cm/30.7 in w/HD FoV Pro	
Reconstruction field	5-50 cm/1.9-19.7 in 5-78 cm/1.9-27.5 in w/HD FoV Pro	
Reconstruction time	up to 25 images/s up to 80 images/s (with FAST IRS[2]) up to 50 images/s with CT128[2]	
Reconstruction matrix	512 x 512	
Hounsfield unit (HU) scale	-1,024 to +3,071	
Extended HU scale	-10,240 to +30,710	

CT specifications

Phantom CATPHAN (20 cm)	Biograph Vision.X CT64					Biograph Vision.X CT128²				
Object size	5 mm					5 mm				
Contrast difference	3 HU					3 HU				
Dose at surface	11 mGy @ 180 mAs					12 mGy @ 180 mAs				
Technique	10 mm, 120 kV					10 mm, 120 kV				
Dose, CTDI100 values (in mGy/100 mAs)	**Biograph Vision.X CT64**					**Biograph Vision.X CT128²**				
Kv	**70**	**80**	**100**	**120**	**140**	**70**	**80**	**100**	**120**	**140**
16 cm A	2.9	4.6	9.3	15.2	22.3	2.6	4.2	8.5	13.9	20.3
16 cm B	3.1	4.9	9.6	15.7	22.9	2.8	4.5	8.8	14.3	20.9
32 cm A	0.7	1.2	2.7	4.7	7.2	0.6	1.1	2.4	4.3	6.6
32 cm B	1.5	2.5	5.1	8.6	12.8	1.4	2.3	4.7	7.8	11.7
A: at center B: 1 cm below the surface										
Technique: - Collimation 32(16) x 1.2 mm, 100 mAs - Polymethylmethacrylate (PMMA) phantom - Absorbed dose for reference material air - Maximum deviation: ± 40% for 70 kV, typically < 15%, values according to IEC 60601-2-44										
High-contrast resolution										
64-slice technique—160 mA/120 kV/0.5 s/2.4 mm With Edge/128-slice CT option technique—240 mA/120 kV/0.5 s/0.5 mm, SAFIRE, strength 5, pitch 0.6										
Plane 0% MTF (± 10%)	17.4 lp/cm									
Plane 2% MTF (± 10%)	16.4 lp/cm									
High-contrast resolution (z-UHR mode²)										
64-slice technique—160 mA/120 kV/1.0s/2.4 mm With Edge/128-slice CT option technique—160 mA/120 kV/1.0s/16 x 0.3 mm										
x-y plane 0% MTF (± 10%)	30 lp/cm, 0.17 mm									
x-y plane 2% MTF (± 10%)	24 lp/cm, 0.20 mm									
High-contrast resolution (z-UHR mode²)										
64-slice technique—160 mA/120 kV/1.0 s/0.4 mm With Edge/128-slice CT option technique—160 mA/120 kV/1.0 s/(16 x 0.3 mm)										
z plane 0% MTF (± 10%)	30 lp/cm, 0.17 mm									
z plane 2% MTF (± 10%)	22 lp/cm, 0.21 mm									
Homogeneity										
Cross-field uniformity in a 20-cm water phantom positioned near the center of rotation	Typical ± 2 HU (maximum ± 4 HU)									

Room layout



Scanner room environment
Temperature range 18-28° C (64-82° F)
Temperature should not vary more than ± 1.5° C (2.7° F) per hour
Relative air humidity 20-75%, with dewpoint below 17° C (63° F)
Heating, ventilation, and air conditioning (HVAC) requirement: 2.0 kW (6824 BTU/hr) 3.0 kW (10,300 BTU/hr) with remote cooling system water/air option
Air pressure: 75-106 kPa (750-1,060 mbar)
Air climate control must be provided 24 hours per day, seven days per week
Variation in floor levelness not to exceed 12.7 mm (0.5 in) over the entire system footprint
Minimum room size: 3.7 m (12 ft) x 7.1 m (23.3 ft)—(requires angling gantry and PHS)
Recommended room size: ≥ 5.0 m (16.5 ft) x ≥ 7.9 m (26 ft)

Utility room environment
Temperature range 18-30° C (68-86° F)
Relative air humidity without condensation 20-75% (Recommended level 30-70%)
Gantry heat exchanger—16 kW to water cooling environment
Air climate control must be provided 24 hours per day, seven days per week
Minimum room size: 3.2 m (10.5 ft) x 2.1 m (7 ft)
Operator's room environment
Temperature range: 18-28° C (64-82° F)
Relative air humidity without condensation 20-75% (Recommended level 30-70%)
Air climate control must be provided 24 hours per day, seven days per week
Recommended room size: ≥ 3.2 m (10.5 ft) x ≥ 4 m (13 ft)
System power requirements
Nominal voltage: 3/N~ 380-480 V (± 10%) in 20-V steps
Nominal line frequency: 50; 60 Hz (± 2 Hz)
Line impedance: 80-140 mOhm (dependent on voltage)
Maximum power consumption: 150 kVA

Note: This layout is for reference purposes only. The system layout varies by site.

System overview

PET/CT gantry and system	
Height	203.6 cm (80.2 in)
Width	234.4 cm (92.3 in)
Depth (gantry)	136 cm (53.5 in)
Tunnel opening	78 cm (30.7 in)
Total system weight	
Biograph Vision.X	3,759 kg (8,287 lb)

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Biograph Vision.X is not commercially available in all countries. Future availability cannot be guaranteed.

[1] Only for Biograph Vision.X CT128.
[2] Optional.
[3] On Sinogram.
[4] With time of flight.
[5] Required by NEMA protocol.
[6] Optional per NEMA protocol. 3D-OSEM + TOF, 2i6s.
[7] NEMA requires a parabolic fit using 3 points/pixels. Analysis of the ultraHD•PET profile through the peak of the point source identifies that at least 80% of the data is located within 2 points/pixels. As 1 of the 3 points/pixels has only a fraction of the data for ultraHD•PET, the parabolic fit is less repeatable than a variance calculation. ultraHD•PET measurements were performed following NEMA 2018 with the deviation of a variance FWHM measurement using 5 points centered on the peak with a 1.65 mm pixel size. Variance was converted to a FWHM assuming a Gaussian model. This method accounts for the small number of pixels within the FWHM.
[8] Considering a 35-cm object size.
[9] Considering a 20-cm object size.

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