GE Healthcare

SIGNA™ PET/MR Technical Data

Contents

Section A: Hardware Platform

1. Overview A.1

2. PET Hardware A.2

- **2.1** Silicon Photomultiplier (SiPM) A.3
- **2.2** PET Performance A.3
- **2.3** PET Reconstruction A.3

3. MR Hardware A.4

- **3.1** Magnet Shim A.5
  - **3.1.1** SIGNA PET/MR Enclosure A.5
- **3.2** Gradients A.5
- **3.3** ART (Acoustic Reduction Technology) Quiet Technology A.5
  - **3.3.1** Gradient Coil Isolation A.5
  - **3.3.2** RF Coil Isolation A.6
  - **3.3.3** Vibro-Acoustic Isolation A.6
  - **3.3.4** Gradient Waveform Optimization A.6
- **3.4** RF Subsystem A.6
  - **3.4.1** MultiDrive RF Transmission A.6
  - **3.4.2** OpTix (Optical RF Receive Technology) A.6
  - **3.4.3** Minimization of PET Attenuation A.6
- **3.5** Standard Coils for Whole-Body PET/MR imaging A.7
  - **3.5.1** Coil Mode Configuration A.7
  - **3.5.2** Head and Neck Unit A.7
  - **3.5.3** Head and Neck Unit with Open Face Adapter A.7
  - **3.5.4** Head and Neck Unit Cervical Array A.8
  - **3.5.5** Central Molecular imaging Array A.8
  - **3.5.6** Upper and Lower Anterior Array A.8
  - **3.5.7** PET/MR 8-Channel High Resolution Brain Array A.9
  - **3.5.8** 8-Channel Breast Coil A.9
  - **3.5.9** GEM Flex Suite A.9
  - **3.5.10** Split Head Coil (Transmit/Receive) A.9

4. PET/MR Patient Handling A.10

- **4.1** Patient Comfort A.10
- **4.2** Symmetric Scan A.10
- **4.3** Safety A.10
- **4.4** Ergonomics A.10
- **4.5** In-room Operator Console (iROC) A.10

5. Computing Platform A.11

- **5.1** MR Volume Reconstruction Engine A.11
- **5.2** Host Computer and Operator Console A.11

6. SIGNA PET/MR Scan Parameters A.12

7. System Siting Guidance A.13

8. Siting Requirements Summary A.14

- **8.1** System Power Demand A.14
- **8.2** Operating Environment A.15
- **8.3** Additional Shielding Requirements A.15
- **8.4** Phantoms and PET Spheres A.15
- **8.5** PET Calibration and Daily QA A.16
- **8.6** Gamma Ray Protection A.16
- **8.7** Protection of Equipment A.16
- **8.8** Protection of Personnel A.16
  - **8.8.1** Barriers, Partitions and Shielding A.16
  - **8.8.2** Sources of Radiation A.16
- **8.9** Warranty A.16
- **8.10** InSite Remote Diagnostics A.16
- **8.11** GE Regulatory Compliance A.16

Section B: Applications

9. User Interface and Operator Workflow B.1
- **9.1** Integrated PET & MR User Interface B.1
- **9.2** GraphicRx (PET & MR) B.1
- **9.3** Workflow Automation B.1
  - **9.3.1** Protocol Notes B.1
  - **9.3.2** AutoVoice* B.1
  - **9.3.3** Inline Viewing B.2
- **9.4** PET Imaging/Viewing Options available for the SIGNA PET/MR Scanner B.2

10. SIGNA PET/MR Scantools B.3
- **10.1** MR Sequences available for the SIGNA PET/MR Scanner B.3

11. Imaging Options and Parallel Imaging Support B.6

12. Elite Tools B.7
- **12.1** Neuro Applications B.7
- **12.2** Spectroscopy Applications B.9
- **12.3** Breast Applications B.9
- **12.4** Cardiovascular Applications B.10
- **12.5** Inhance Application Suite B.12
- **12.6** Body Applications B.13
- **12.7** Musculoskeletal Applications B.14
- **12.8** Pediatric Applications B.15
  - **12.8.1** Pediatric Neurology B.15
  - **12.8.2** Pediatric Vascular B.16
  - **12.8.3** Pediatric Cardiology B.17
  - **12.8.4** Pediatric Body B.17

13. DICOM Conformance Standards B.18
- **13.1** Filming B.18

14. Warranty B.18

15. InSite* Remote Diagnostics B.18

16. GE Regulatory Compliance B.18

Section C: Optional Features

17. Optional MR Coils C.1
- **17.1** 8-channel Breast Array C.1
- **17.2** GEM Flex Suite C.1

18. SIGNA PET/MR Patient Table with IntelliTouch C.1

19. Optional Software and Hardware C.2
- **19.1** Multi-Nuclear Spectroscopy (MNS) C.2
- **19.2** SAGE 7 ..... C.2
- **19.3** Functional MRI (fMRI) options C.2
- **19.4** MR Touch C.3
- **19.5** CADstream 5.2 ..... C.3

20. Optional Post-Processing features on the Advantage Workstation (AW) C.4

21. GE Regulatory Compliance C.6

Section A: Hardware Platform

1. Overview

For over 100 years, healthcare providers around the world have relied on GE Healthcare for innovative, leading edge medical technologies and productivity solutions to meet their needs. GE Healthcare's medical equipment is at the forefront of the efforts to transform healthcare to meet the demand not only for new technologies, but also for new processes and ways of providing care.

The SIGNA PET/MR is a result of this continued technology innovation. It combines MR-compatible Time-of-Flight (TOF) PET detectors based on a high performance 3.0T MR platform enabling true simultaneous PET/MR acquisitions.

Silicon Photomultiplier Detector Technology

GE's next generation, MR-compatible Silicon Photomultiplier (SiPM) detector technology provides exceptional PET sensitivity and fast coincidence timing resolution enabling time-of-flight (TOF) reconstruction. The SIGNA PET/MR relies on integrated detection electronics, real-time thermal monitoring and control, and optical signal transfer to provide excellent PET sensitivity and image quality. The SIGNA PET/MR PET ring is integrated into the MR RF body coil structure and offers a 25 cm PET axial Field of View (FOV). This design retains MR performance, the potential for reduced dose, and may help improve diagnostic confidence.

PET/MR Coils

For PET image quality, it is important to minimize attenuating material in the PET FOV. SIGNA PET/MR coils are designed with low 511 keV photon attenuation in mind. The suite of coils includes a Head and Neck Unit (HNU), an integrated Central Molecular imaging Array (CMA), a PET/MR 8-channel high resolution Brain array, and an (Optional) 8-channel Breast array. This suite of coils is fully-characterized and the SIGNA PET/MR system will automatically correct for residual attenuation on the CMA, HNU, 8-channel High Resolution Brain and the optional 8-channel Breast coil. The SIGNA PET/MR system supports a variety of conventional RF coils to cover additional anatomies.

Central Molecular imaging Array

The Central Molecular imaging Array (CMA) is designed to be used in conjunction with the HNU, Upper Anterior Array (UAA) and Lower Anterior Array (LAA). The CMA is fully-integrated into the patient bore and never needs to be removed during routine imaging. The CMA is designed with optimized coil element geometry for spine and general purpose imaging.

Pulse Sequences and Imaging Options

The SIGNA PET/MR comes standard with a package of pulse sequences and applications for exceptional 3.0T MR imaging performance. The system supports PET/MR imaging needs in oncology, neurology, and cardiology. The system supports imaging for brain/spine, musculoskeletal, breast, vascular, and body imaging leveraging GE's latest software and application platform.

Automated PET Attenuation Correction

With PET/CT, the CT scan serves as a reference for performing attenuation correction of the PET data. With the SIGNA PET/MR, a robust, automated, MR-based attenuation correction (MRAC) procedure creates attenuation maps used to correct the PET data. In addition, with TOF PET capability, the SIGNA PET/MR augments these maps by providing truncation correction for tissue extending outside the MR FOV. The SIGNA PET/MR supports output of PET data in list mode to enable offline research manipulations.

Multinuclear Spectroscopy

The SIGNA PET/MR is specifically designed to accommodate simultaneous MNS with PET. MNS, an optional feature, includes excitation and receiving hardware and a software package tailored for non-proton spectroscopy (such as ^{13}C and ^{31}P). In addition, spectroscopy sequences and the SAGE post-processing package are provided to aid in the visualization and quantification of spectral data. The SIGNA PET/MR is capable of supporting both single- and dual-tuned RF coils. The T/R switches, pre-amps, RF coil or optimized applications are also optional.

Simultaneous TOF PET/MR

The SIGNA PET/MR is designed to preserve exceptional MR performance and to perform multinuclear spectroscopy while offering simultaneous PET and MR acquisition. Replacing CT with MR in a traditional PET/CT scanner offers reduced dose for pediatric and radiation-sensitive patients. The high sensitivity of the PET may offer the potential for additional dose reduction or, alternatively, faster PET scans for the same dose. The exceptional TOF capability offers higher signal-to-noise images and improves PET attenuation correction with truncation correction, compared to non-TOF reconstruction systems.

SIGNA PET/MR Key Features

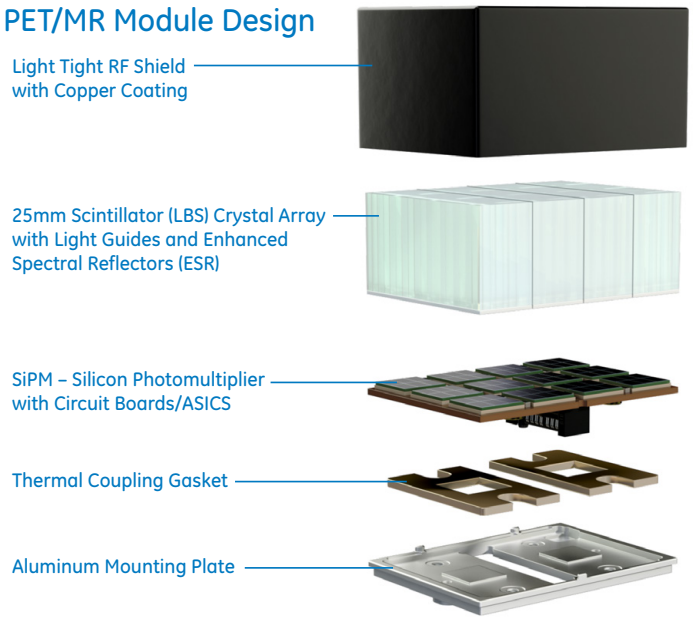
- 3.0T MR System
- Comprehensive MR imaging capability
- PET Characterized RF Coils
- 50 cm MR FOV[1]
- Multinuclear MR Spectroscopy Support
- SiPM TOF PET Detector Technology
- 25 cm Axial PET FOV
- 21.0 kcps/MBq Sensitivity
- < 400 psec Timing Resolution
- TOF Enhanced Attenuation Correction

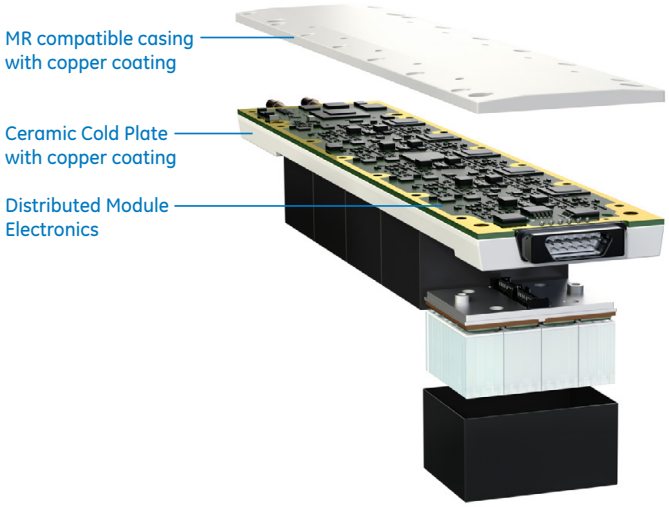
[1] based on system field specifications

2. PET Hardware

Together with our customers, we are focused on improving cost, quality and access while reducing dose in PET imaging – a smarter path to tomorrow's care.

PET/MR Module Design





RETURN TO MAIN MENU

2.1 Silicon Photomultiplier (SiPM)

The SIGNA PET/MR is designed for physicians and physicists looking for an unlimited potential of TOF PET imaging. It is based on a Lutetium-based scintillator (LBS) an innovative MR-compatible Silicon Photomultiplier (SiPM) technology. SiPMs address the limitations of other technologies, providing excellent TOF timing resolution, high gain and low noise of a next generation photomultiplier. LBS crystals have high light output, fast timing and stopping power to enable TOF PET. The SiPMs are carefully supported by active and passive (water cooled) thermal compensation. The detectors are located at the isocenter of the 3.0T magnet and provide a 25 cm FOV. For the first time, the combination of LBS and SiPM gives SIGNA PET/MR the ability to perform TOF PET simultaneously with 3.0T MR imaging.

Detector Construction	
Scintillator Material	LBS-Lutetium based scintillator
Scintillator Dimensions	4.0 mm × 5.3 mm × 25 mm
Number of Detector Rings	45 (20,160 total crystals)
Silicon Photomultiplier	28 Modules × 20 blocks per module × 18 anodes per block (10,080 anodes)
Number of Image Planes	89
Axial FOV	25 cm
Transaxial FOV	60 cm
Slice Overlap	User defined 1-44

2.2 PET Performance

SIGNA PET/MR SiPM detector's 25mm deep crystals and 25cm FOV enables sensitivity that is 3 times higher than the previous generations of PET technology. The detection system also provides high NECR for research studies, up to 21 kcps/MBq. The digital detection system is fully enclosed within the bore of the scanner to realize the timing benefits of the SiPM sensor. As a result, the system achieves excellent timing resolution to provide images with improved contrast and signal-to-noise ratios. Redefining the term PET sensitivity and performance.

PET Performance	
Timing Resolution	< 400 psec
Sensitivity[2]	21.0 cps/kBq
Peak NECR[3]	210 kcps/MBq @ 17.5 kBq/mL
High Activity NECR	175 kcps/MBq @ 30 kBq/mL
Coincidence Window	4.57 ns
Energy Resolution	11%
Energy Threshold Window	425-650 keV

[2] NEMA NU 2-2007 Filtered back projection

[3] NECR measurements include patient cradle and CMA in PET FOV

Spatial Resolution FWHM	NEMA Performance Standards[4]	VUE Point HD[5]
Transaxial @ 1 cm	4.2 mm	3.7 mm
Transaxial @ 10 cm	5.2 mm	4.5 mm
Axial @ 1 cm	5.8 mm	4.8 mm
Axial @ 10 cm	7.1 mm	4.7 mm

[4] The specifications represent typical system performance measured according to NEMA NU2-2007 standards.

[5] Data measured at 4 iterations and 28 subsets and represents typical system performance.

2.3 PET Reconstruction

The SIGNA PET/MR utilizes GE's VUEPoint FX Time of flight reconstruction algorithm. The system also provides a non-Time of flight iterative algorithm (VUEPoint HD), for calibration/image quality control or research applications. SIGNA PET/MR reconstruction includes standard corrections as well as those specific to the challenges of PET/MR. Of particular importance is the use of TOF PET data to enable correction of truncation in MR Attenuation Correction maps (MRAC). TOF PET reduces noise in the uncorrected images such that the boundaries of attenuating tissue outside the MR FOV can be determined. In addition to included reconstruction algorithms, the SIGNA PET/MR supports output of PET data in list mode to enable offline research manipulations including reconstruction.

PET Image Reconstruction	
VUE Point HD (VPHD)	Built on GE's innovative 3D iterative process, VUE Point HD utilizes a fully 3D Iterative Reconstruction technique with all corrections within the loop. VUE Point HD offers enhanced resolution with detector geometry modeling, increased quantitative accuracy with model-based 3D scatter correction inside and scatter estimation outside the FOV and exclusive randoms corrections based on singles and dead-time correction with pile-up estimates
VUE Point FX[6] (VPFX)	VUE Point FX is the TOF version of VUE Point HD, leveraging the benefits of VUE Point HD with timing information to each step within the iterative loop and improving the signal-to-noise ratio
SharpIR[6]	As a part of VUE Point HD and VUE Point FX, SharpIR is advanced system modeling in PET reconstruction that enhances visual contrast and resolution in both whole-body and brain PET images.
Filters	Independent Transaxial, Axial and 3D Post filtering
Matrix Dimension	128 × 128, 192 × 192, 256 × 256

[6] Standard with SIGNA PET/MR

PET Reconstruction	
GPU Accelerator Memory	64 GB ECCC GDDR5 1600 MHz
GPU Accelerator Processors	896 cores × 1.15 GHz NVIDIA
GPU Accelerator Speed	1.03 Teraflops (peak)
CPU	Dual Intel Xeon Processor (six-core)
Memory	64 GB ECC DDR3 1600 MHz
Hard Disk Storage	4 × 900 GB

The powerful GE PET reconstruction engine handles the massive PET/MR data sets with ease. Its dual Quad-Core processors routinely reconstruct PET images for clinically relevant data reconstruction times to display of images while your patient is still on the table.

PET Acquisition & Reconstruction	
Q.Core+2	Standard PET acquisition and reconstruction computer system includes HP Z820 Dual Intel® Xeon® 2.5 GHz Processors with 64 GB DDR3 RAM
Storage	890 GB List Data Storage, 890 GB Sinogram Data Storage. Storage space is amplified by utilizing GE's patented sinogram and list compression technology to shrink the data size while it resides on the scanner. Data is backed up in a RAID configuration to reduce the potential for lost data and system downtime in the event of a storage disk failure

PET Terminology	
Scatter	Scattered events, where one or more of the coincident photons have been scattered
Random	Random events, where the coincident photons arise from different positron decays
Co-emission	Co-emission detection, where a gamma ray from a nuclear decay is in coincidence with an annihilation photon of the positron
Detector Geometry	The aperture and angular response of the two detectors
Compton Scatter Recovery	Recovery of events scattered between adjacent detector blocks at time of acquisition
Decay	Change of activity during measurement caused by radioisotope and/or biological decay, motion uptake and washout
Attenuation	Attenuation along the Line of Response (LOR)
Crystal Sensitivity	Sensitivity of the crystal pair in the LOR
Cardiac Gating	Cardiac Trigger Monitor w/Synchronized Output for R-Wave Synchronization Applications for PET and MR cardiac gated studies

3. MR Hardware

When it comes to delivering on the promise of 3.0T image quality, no other MR component has greater impact than the magnet. The SIGNA PET/MR system features a proven compact, light-weight, superconducting magnet designed to provide excellent homogeneity for uniform signal and fat-suppression over a large FOV. The SIGNA PET/MR magnet supports a large 50 cm FOV for MR imaging.

Complemented by GE's active shielding technology, the SIGNA PET/MR has very flexible installation specification for easy siting. And with zero-boil-off technology, helium refills are effectively eliminated, thus helping to reduce operating costs and helping maximize uptime (versus previous generation products).

Magnet Specifications	
Operating Field Strength	3.0 Tesla
Magnet Shielding	Active
EMI Shielding Factor	97.5% 0.6 Hertz excitation and 94.5% DC step
Size (without enclosures) (L × W × H)	1.74 m × 2.12 m × 2.40 m
Size (Length front bell to rear bell measurements with enclosures. Width is measured from widest point with enclosures on) (L × W × H)	1.84 m × 2.46 m × 2.34 m
Magnet Weight	16,236 lbs (7,365 kg) with PET ring and cryogens
Magnet Cooling	Cryogenic
Long-term Stability	< 0.1 ppm per hour over a 24 hour period
Cryogen Refill Period	Zero-Boil-Off[8]
Boil-off Rate	Zero-Boil-Off[8]
Fringe Field (axial × radial)	7.8 m × 4.9 m at 1 Gauss 5.2 m × 2.8 m at 5 Gauss
Manufacturer	GE Healthcare

[8] Normal Operating Conditions

3.1 Magnet Shim

High homogeneity is consistently proven and your SIGNA PET/MR magnet provides excellent specifications for:

- Large FOV imaging up to 50 cm
- Off-center FOV imaging such as elbow, shoulder and wrist imaging
- Robust fat saturation required for abdominal, breast and musculoskeletal imaging
- High-performance applications, such as cardiac, fMRI, diffusion tensor
- Proton or Multi-Nuclear Spectroscopy (optional)

GE incorporates 3D field mapping to determine the field homogeneity after integrating the gradients, RF body coil, PET ring, and system electronics. This procedure utilizes a field mapping shim camera that samples the field at 32 points in each of the 24 planes at 50 cm DSV within magnet bore to provide a consistent measurement of the field uniformity throughout the imaging volume. This allows GE to customize the magnet shim for each research or clinical environment.

Volume Root Mean Square (VRMS) Homogeneity Specifications		
Diameter of Spherical Volume (DSV)	**Guaranteed ppm**	**Typical ppm**
10 cm		0.02
20 cm	< 0.050	0.03
30 cm	< 0.150	0.08
40 cm	< 0.500	0.27
45 cm	< 1.500	0.70
40 (z) × 50 cm	< 3.000	1.8
50 (z) × 50 cm	< 4.000	2.5

Patient Focused Design	
Patient Bore (L × W × H) Length measured at Bore Liner	98.6 cm × 60 cm × 60 cm
Patient Aperture	77 cm at magnet flare 60 cm at isocenter
Patient Comfort Module	Head first or Feet first imaging Dual-flared patient bore 2 way in-bore intercom system Adjustable in-bore lighting system Adjustable In-bore patient ventilation system

3.1.1 SIGNA PET/MR Enclosure

The SIGNA PET/MR enclosure system is designed to provide several benefits for the patient and technologist:

- The flared, open bore design may ease patient anxiety and help reduce scan time for uncooperative patients
- Dual-sided controls improve access to cables and IV lines

3.2 Gradients

Gradient speed, accuracy, and reproducibility determine the success of demanding acquisitions like fMRI, DTI, and Fiesta. The gradients are non-resonant and actively shielded to minimize eddy currents and mechanical forces within the system.

Gradient Performance	
Peak Amplitude[9]	44 mT/m
Peak Slew Rate[9]	200 T/m/s
Maximum FOV[10]	50 cm
Duty Cycle	100%

[9] Based on a peak performance the product of the gradient coil gain, inductance, and peak gradient amplifier current & voltage.

[10] Based on system field specifications

Gradient Amplifier & Coil (water-cooled)	
Peak Amplifier Current and Voltage	830A/1650V
Control	Full-digital control Frequency dependent feed-forward model to match amplifier output to gradient coil Dedicated active feedback control loop to regulate current errors
Gradient Current Accuracy	300 µAs
Shot-to-Shot Repeatability[11]	100 µAs
Symmetry[11]	200 µAs

[11] Typical gradient fidelity expressed in terms of the absolute integrated errors in micro-Amperes-second (µAs). Gradient integral precision is the maximum integrated current error over a full-scale, echo-planar gradient waveform. Shot-to-shot repeatability is the largest difference between integrated errors across waveforms. Symmetry is the largest difference in integrated current error when comparing positive and negative gradient waveforms.

3.3 ART (Acoustic Reduction Technology) Quiet Technology

GE has implemented Quiet Technology on many components of the system to reduce acoustic noise and improve the patient environment. GE also provides a user-selectable mode to further reduce acoustic noise.

3.3.1 Gradient Coil Isolation

The full performance of the Extreme Gradient Driver is used while helping to maintain a safe environment for the patient. Clear separation between the gradient coil, RF body coil, and patient support structures helps provide minimal component interactions.

3.3.2 RF Coil Isolation

During gradient pulses, the RF body coil acts as a secondary source of noise. The RF body coil mounting has been designed with features similar to the 750w to reduce acoustic noise.

3.3.3 Vibro-Acoustic Isolation

To isolate the magnet from the building and reduce the transmission of acoustic noise in the structure, GE has designed a vibroacoustic-dampening pad that sits under the feet of the magnet. To further reduce the noise heard by the patient, the RF body coil mounting has been designed with features similar to the 750w to reduce acoustic noise.

3.3.4 Gradient Waveform Optimization

User selectable mode to reduce acoustic noise.

3.4 RF Subsystem

3.4.1 MultiDrive RF Transmission

At 3.0T, precise control of the RF environment over a large FOV is challenging. To overcome the large FOV imaging the SIGNA PET/MR RF transmit architecture technology consists of a liquid-cooled 30 kW solid-state RF power amplifier with multiple output channels and uniform signal intensity is provided by optimizing the phase and amplitude of each RF amplifier output channel independently.

RF Transmit Architecture	
RF Amplifier	Multiple output Small footprint Water cooled
Maximum Output Power	15 kW Body per channel (30 kW peak total) 4.5 kW Head
Maximum B1 Field with Whole-body RF Coil	> 16 µT at 75 kg (> 25 µT at 20 kg)
Transmit Gain	40 dB coarse, > 84 dB instantaneous
RF Exciter Frequency Range	127.72 ± 0.625 MHz
Receiver Resolution	< 0.6 Hz/step
Frequency Stability	14 parts per billion (0° to 50° C)
Phase Resolution	0.005 deg/step
Amplitude Control	16 bit with 12.5 ns resolution
Amplitude Stability	< 0.1 dB over one minute at rated power
Digital RF Pulse Control	2 amplitude modulators 2 frequency/phase modulators
Transmit/Receive Body Coil	Fully-integrated 2-port drive 16-rung quadrature birdcage 60 cm inner diameter 50 cm FOV

3.4.2 OpTix (Optical RF Receive Technology)

The OpTix RF system enables high-bandwidth, high channel count reception with improved SNR over conventional MR receiver designs. Conventional MR scanner designs place the RF receivers in the electronics room where the MR signal is subject to significant electrical noise prior to being digitized. The OpTix optical RF receivers are located on the magnet system inside the shielded scan room where the MR signal is digitized and then optically transmitted to the reconstruction engine in the electronics room.

By eliminating sources of noise within the data pipeline, the OpTix acquisition technology enables higher image quality especially for data-intensive (3D) applications.

When combined with GE's use of high-density surface coils, the optical receive chain is a critical path for providing clear signal reception and data analysis. Optical RF technology increases SNR for all volume acquisitions, independent of which surface coil is being used.

OpTix Optical RF Architecture	
Simultaneous RF Receivers (A/D Converters)	32
Coil Input Ports	136
Receiver Sampling per Channel	80 MHz
Quadrature Demodulation	Digital
Receiver Dynamic Range at 1 Hz BW	> 165 dB
Receiver Resolution	Up to 32 bits

3.4.3 Minimization of PET Attenuation

The RF body coil has been designed to accommodate the PET detector modules while minimizing PET attenuation. This provides structural support, electrical power, data transmission and liquid cooling capabilities while minimizing the amount of attenuating material between the detector crystals and the bore in the PET FOV. The patient bridge has been designed into two pieces with minimal attenuating materials over the detectors

3.5 Standard Coils for Whole-Body PET/MR imaging

The SIGNA PET/MR coil system consists of a set of receive-only RF arrays designed for simultaneous PET and MR acquisition when used with the SIGNA PET/MR system.

The Suite, designed to support whole-body imaging, a head and neurovascular array, a Central Molecular imaging Array (CMA), integrated at the magnet isocenter, the two Anterior Arrays, an 8-channel high resolution Brain Array, and an (optional) 8-channel Breast Array. The coil set provides coverage for: head, neck, brachial-plexus, spine, pelvis, hips, prostate, abdominal, cardiac, and blood vessels. The combined use of the PET/MR coils will facilitate high-resolution, high-SNR head to mid-thigh.

3.5.1 Coil Mode Configuration

The PET/MR coils were designed to reduce multiple physical coil changes within a single exam and between different exams, and to improve patient comfort. After positioning the coils, the operator can plug them into several available ports located within the magnet or directly on the patient table. The system will automatically select the coil mode configuration (for PET/MR coils) that appropriately fits the selected region of interest. The combined effect is to help reduce the total duration of an exam and improve workflow.

Head and Neck Unit (HNU), for head and neurovascular studies

Central Molecular imaging Array (CMA) integrated into the table bridge.

Upper anterior array (UAA)

Lower anterior array (LAA)

PET/MR 8 channel high resolution Brain array

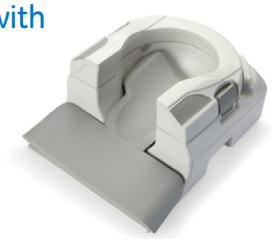
8-channel Breast array (optional, not part of the standard configuration)

3.5.2 Head and Neck Unit

- 19 elements
- Open-face design
- Parallel imaging compatible
- Head first or feet first imaging
- Attenuation corrected

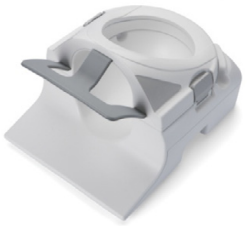
Head Neck Unit Neurovascular (NV) Specifications	
Length	49.5 cm (19.5 in)
Width	38.8 cm (15.3 in)
Height	34.1 cm (13.4 in)
Weight of HNU Base	4.8 kg (10.6 lbs)
Weight of Anterior Adapter	2.7 kg (5.9 lbs)
S/I Coverage	50 cm (19.7 in), when combined with the CMA and Upper AA
R/L Coverage in Head Mode	24 cm (9.4 in)
R/L Coverage for NV	50 cm (19.7 in), when combined with the CMA and Upper AA
Patient Orientation	Head first or Feet first imaging
Up to 27 Elements in the FOV, When Combined with the CMA and UAA	
Acceleration Factors	1D R=3, 2D R=6

3.5.3 Head and Neck Unit with Open Face Adapter



Head Neck Unit with Open Face Adapter Specifications	
Length	49.5 cm (19.5 in)
Width	38.8 cm (15.3 in)
Height	24.6 cm (9.7 in)
Weight of Open Face Adapter	1.3 kg (2.8 lbs)
S/I Coverage	28 cm (11.0 in) with all 7 elements
R/L Coverage	24 cm (9.4 in)
Patient Orientation	Head first or Feet first imaging
Up to 15 elements in the FOV, when combined with the CMA.	

3.5.4 Head and Neck Unit Cervical Array



Head Neck Unit Cervical Specifications	
Length	49.5 cm (19.5 in)
Width	38.8 cm (15.3 in)
Height	31.0 cm (12.2 in)
Weight of Cervical Adapter	1.7 kg (3.8 lbs)
S/I Coverage	28 cm (11.0 in)
R/L Coverage	24 cm (9.4 in)
Patient Orientation	Head first or Feet first imaging
Up to 17 elements in the FOV when combined with the CMA	

3.5.5 Central Molecular imaging Array

- 14 elements
- Parallel imaging compatible
- Head first or feet first imaging
- Attenuation corrected

Central Molecular Imaging Array Specifications	
Length	78.5 cm (30.9 in)
Width	43.5 cm (17.1 in)
Height	8.5 cm (3.3 in)
Weight of Central Matrix Array	9.0 kg (20 lbs)
S/I Coverage	43 cm (16.9 in)
R/L Coverage	43 cm (16.9 in)
Integrated into the PET/MR system the CMA has 14 elements in the FOV and can be combined with the HNU, UAA, and LAA	

3.5.6 Upper and Lower Anterior Array

- 16 elements
- Parallel imaging compatible
- Head first or feet first imaging

Upper and Lower Anterior Arrays Specifications	
Length	55.6 cm (21.9 in)
Width	67.4 cm (26.5 in)
Height	3.3 cm (1.3 in)
Weight	Upper AA – 4.3 kg (9.4 lbs) with cable Lower AA – 3.8 kg (8.4 lbs) with cable
S/I Coverage	54 cm (21.3 in)
R/L Coverage	To the full 50 cm (19.7 in) FOV of the system
Up to 30 elements in the FOV of the UAA or LAA when combined with the CMA	

3.5.7 PET/MR 8-Channel High Resolution Brain Array

- 8 elements
- Parallel imaging compatible
- Attenuation corrected

HD Brain Specifications	
Length	41 cm (16.2 in)
Width	41 cm (16.1 in)
Height	34 cm (13.2 in)
S/I Coverage	24 cm (9.4 in)
R/L Coverage	22 cm (8.7 in)
Patient Orientation	Head first imaging

3.5.8 8-Channel Breast Coil

- 8-channel design
- Parallel and 1H spectroscopy compatible
- Attenuation corrected
- Optional coil

Breast Coil Specifications	
Length	54 cm (21.3 in)
Width	54 cm (21.3 in)
Height	24 cm (9.4 in)
S/I Coverage	20 cm (7.9 in)
R/L Coverage	32 cm (12.5 in)
Patient Orientation	Feet first imaging

Coils for Specific MR Scans

The following additional coils are validated for MR-Only acquisitions:

- Flex Suite Multi-channel Arrays (Small, Medium, and Large)
- Split Head Coil

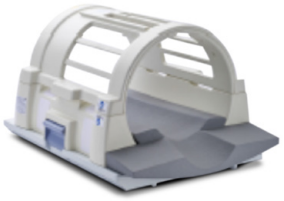
3.5.9 GEM Flex Suite

- 16 elements
- 3 sizes (Small, Medium, and Large)
- Muscular skeletal applications

Flex Suite Coils Component	Coverage (W × L)	Wrap Diameter	Elements	Weight
Flex Coil, Large	23 cm × 70 cm	15.5 cm – 21.5 cm	16	1.2 kg
Flex Coil, Medium	23 cm × 48 cm	11.5 cm – 15.5 cm	16	0.9 kg
Flex Coil, Small	23 cm × 38 cm	9.0 cm – 12.5 cm	16	0.9 kg

3.5.10 Split Head Coil (Transmit/Receive)

- Quadrature Birdcage design
- Internal diameter 28 cm, compatible with third-party stereotaxy frames and localizers
- Integrated mirror minimizes claustrophobia (mirror not-shown)



Split Head Coil T/R Specifications	
Length	42 cm (16.5 in)
Width	42 cm (16.5 in)
Height	37 cm (14.6 in)
S/I Coverage	37 cm (14.6 in)
R/L Coverage	24 cm (9.4 in)
Patient Orientation	Head first imaging

4. PET/MR Patient Handling

The SIGNA PET/MR Patient Table is detachable and can serve as a patient transport device. The SIGNA PET/MR patient table and bore transport system has enhanced positioning accuracy essential to placement of patient and attenuating structures in relation to the isocenter and to aid in bed to bed image overlays. Optional additional patient tables are available to help maximize productivity.

Detachable Patient Table	
Patient Table	Detachable and mobile
Min/max Table Height	70 cm to 97 cm (27.5 in – 38.1 in)
Patient Table Drive	Automated, power driven vertical and longitudinal
Longitudinal Speed	30 cm/sec (11.8 in/sec) (fast) and 1.2 cm/sec (0.47 in/sec) (slow) 10 cm/sec (3.9 in/sec) for patient positioning
Total Cradle Length	225 cm (88 in)
Total Cradle Travel	285 cm (112 in)
Scan Range	MR: 205 cm (80.7 in) PET: 188 cm (74 in)
Maximum Patient Weight for Scanning[12]	227 kg (500 lbs)
Maximum Patient Weight (detached and mobile)	227 kg (500 lbs)
Maximum Lift Capacity	227 kg (500 lbs)
Patient Transport Accessories	Self-storing non-ferrous IV pole Positioning pads Immobilization straps
Landmarking	Laser alignment with S/I and R/L alignment IntelliTouch Landmarking Capability
Coil Connection Ports	One high density auto-coil sensing connection port

[12] Maximum weight includes patient with coils and pads.

4.1 Patient Comfort

The detachable SIGNA PET/MR table can help to reduce patients' anxiety and provide patients personal discretion by preparing them for the exam outside the scan room. Reduced patient table transfers for inpatients or trauma patients can enhance overall patient care. To improve patient comfort, the table includes an innovative set of Patient Comfort pads.

4.2 Symmetric Scan

The patient table and most coils are designed to accommodate head first or feet first imaging for all supported exams. (See patient orientation of each coil description for imaging compatibilities) Coil connection ports are located at both ends of the detachable table.

4.3 Safety

Easily docked and undocked by a single operator, the patient table is simple to move in and out of the exam room for patient transport and preparation. These become vital features in those instances where multiple patient transfers can negatively impact patient care or when emergency evacuation is required; the table can be undocked and removed in less than 30 seconds with just one technologist. In time-sensitive situations there is no need to remove or disconnect surface coils as the system can automatically disconnect the coils for you. The mobility and safety features of the patient table can alleviate the need for MR-compatible emergency equipment or a second technologist.

4.4 Ergonomics

With one hand and one simple motion, the integrated arm boards and IV pole can be optimally positioned to support the transport of the patient and utilized for patient injections. The high density coil interface takes the guesswork out of coil plug-in and identification by automatically identifying the coil that is connected, easing the burden of coil manipulations.

IntelliTouch technology can enhance exam productivity by eliminating the need for laser alignment and reduces the number of steps for patient preparation. Simply pressing on the touch-sensitive strip on the edge of the patient table sets the landmark to that position.

Dual system control panels. For operation on either side of the scanner, two ergonomically designed control panels are integrated into the front of the system enclosures. These panels incorporate backlit buttons to guide the user to the next logical step in exam setup.

A trackball and select buttons guide the use of the in-room operator console. From the system control panels you can:

- Position the table
- Home position
- Stop table
- Control multiple levels of in-bore ventilation and lighting
- Enter patient weight
- Enter patient orientation and patient position
- AutoStart – initiate the scanner to automatically acquire, process, and network images.

4.5 In-room Operator Console (iROC)

Simplify exam preparation and reduce the time between patients with the SIGNA PET/MR with a high-resolution, color in-room operator console.

By consolidating all controls into one place, the iROC provides real-time feedback to the user to help provide that any necessary changes in patient setup are quickly and clearly related back to the user. The iROC enables the user to visualize cardiac and respiratory waveforms directly in the exam room – eliminating the need for the technologist to leave the room and improving the patient experience.

Mounted on the front of the magnet, the display provides real-time interaction with the scanner and the host computer. The user has direct control or selection of the following:

- Display of patient name, ID, study description
- Display and entry of patient weight
- Display and entry of patient orientation and patient position
- Cardiac waveform display and EKG lead confirmation with gating control: trigger select, invert and reset
- Respiratory waveform display
- IntelliTouch technology landmarking
- AutoStart – initiate the scanner to automatically acquire, process, and network images
- Display connected coils and coil status
- Display of table location and scan time remaining
- Screen saver

5. Computing Platform

5.1 MR Volume Reconstruction Engine

Reconstruction Engine	
Recon Speed	13,000 2D FFTs/second
Recon Speed Density	406 2D FFTs/second/channel
CPU	2 × Quad Core Westmere Processor
Memory	72 GB ECC DDR3 1333
Hard Disk Storage	4 × 146 GB

5.2 Host Computer and Operator Console

In addition to the PET reconstruction engine, the SIGNA PET/MR system comes equipped with a scan control keyboard assembly that contains an intercom speaker, microphone and volume controls, and an emergency stop switch. Start-scan, pause-scan, stop-scan, and table advance to isocenter hot keys are also included.

Computing Platform	
Main CPU	Quad Core Intel Xeon® W3565 3.20 GHz Processor 4.8 GT/s Intel® QPI interface 4 MB L2 Cache
Host Memory	24 GB (6 × 4 GB) DDR3 RAM
Graphics Subsystem	Nvidia® Quadro® 600 – 1 GB GDDR3 Memory – Spec PROE-04 – Spec TCVIS-01 – Spec SW-02
Cabinets	Single, tower configuration
System Disk	3 × 146 GB, 15,000 RPM, SAS Drive
Network	Dual port NIC (1 on MB + 2 on NIC) 3 ports total
DVD Interchange	DVD-RW Data transfer rate 21.6 MB/s Average 35,000 images per 4.7 GB DVD

Display	
AutoView	512 × 512 Image Window (standard)
Window / Level (W/L)	7 user-programmable keys on scan control keyboard plus one key for returning to prior setting 6 user-programmable buttons in image viewer Arrow keys on scan control keyboard On-image through middle mouse button Save State stores user-selected image orientation, user annotation and window level
Image Display	Zoom/Roam/Flip/Rotate/Scroll Explicit Magnify and Magnifying Glass Image Measurement Tools Grid On/Off Cross Reference/User Annotation Exam/ Series Page Hide Graphics/Erase Annotation/Screen Save Accelerator Command Bar Compare Mode/ Reference Image/Image Enhance ClariView Image Filtering Smooth and Sharpen Edge Filters Minified Reference Scoutview Cine Paging (up to 4 windows and 128 images/window) Add/Subtract/Edit Patient Data
Image Display Performance	256 Image buffer (256 × 256) at 30 fps
Image Annotation	Shadowed to permit ease in reading Two graphic/text planes overlay the entire screen Grid placement with anatomical reference on an image Drawing and annotation may be added to and removed from images
PET Scan Information	The display window located in the lower right corner of the monitor displays real-time PET coincidence count rate, remaining scan time, and activity graphs.
Display Monitor	24" Widescreen LCD Flat Panel 1920 × 1200 dot resolution Non-interlaced, flicker-free presentation Contrast ratio 1000:1 Digital DVI Interface

6. SIGNA PET/MR Scan Parameters

Slice Thickness and FOV	
Minimum Slice Thickness in 2D	0.2 mm
Minimum Slice Thickness in 3D	0.1 mm
Minimum FOV	10 mm
Maximum FOV	500 mm
Minimum/Maximum Matrix	32-1024

3D Fiesta	
Minimum TR (64 × 64)	0.940 ms
Minimum TR (128 × 128)	1.248 ms
Minimum TR (256 × 256)	1.930 ms
Minimum TE (64 × 64)	0.248 ms
Minimum TE (128 × 128)	0.324 ms
Minimum TE (256 × 256)	0.452 ms

2D Spin Echo	
Minimum TR (128 × 128)	3.4 ms
Minimum TR (256 × 256)	3.9 ms
Minimum TE (128 × 128)	1.6 ms
Minimum TE (256 × 256)	2.0 ms

2D Fast Spin Echo	
Minimum TR (128 × 128)	3.4 ms
Minimum TR (256 × 256)	3.9 ms
Minimum TE (128 × 128)	1.6 ms
Minimum TE (256 × 256)	2.0 ms
Minimum Slice Thickness	0.5 mm
Minimum ESP (128 × 128)	1.6 ms
Minimum ESP (256 × 256)	2.0 ms
Maximum ETL	480

3D Fast Spin Echo	
Minimum TR (128 × 128)	60.0 ms
Minimum TR (256 × 256)	60.0 ms
Minimum TE (128 × 128)	6.9 ms
Minimum TE (256 × 256)	9.4 ms
Minimum Slice Thickness	0.3 mm
Minimum ESP	1.7 ms
Maximum ETL	395

2D Fast Gradient Echo	
Minimum TR (64 × 64)	0.6 ms
Minimum TR (128 × 128)	0.7 ms
Minimum TR (256 × 256)	0.956 ms
Minimum TE (64 × 64)	0.208 ms
Minimum TE (128 × 128)	0.208 ms
Minimum TE (256 × 256)	0.208 ms

3D Fast Gradient Echo	
Minimum TR (64 × 64)	0.540 ms
Minimum TR (128 × 128)	0.7 ms
Minimum TR (256 × 256)	0.928 ms
Minimum TE (64 × 64)	0.2 ms
Minimum TE (128 × 128)	0.208 ms
Minimum TE (256 × 256)	0.208 ms

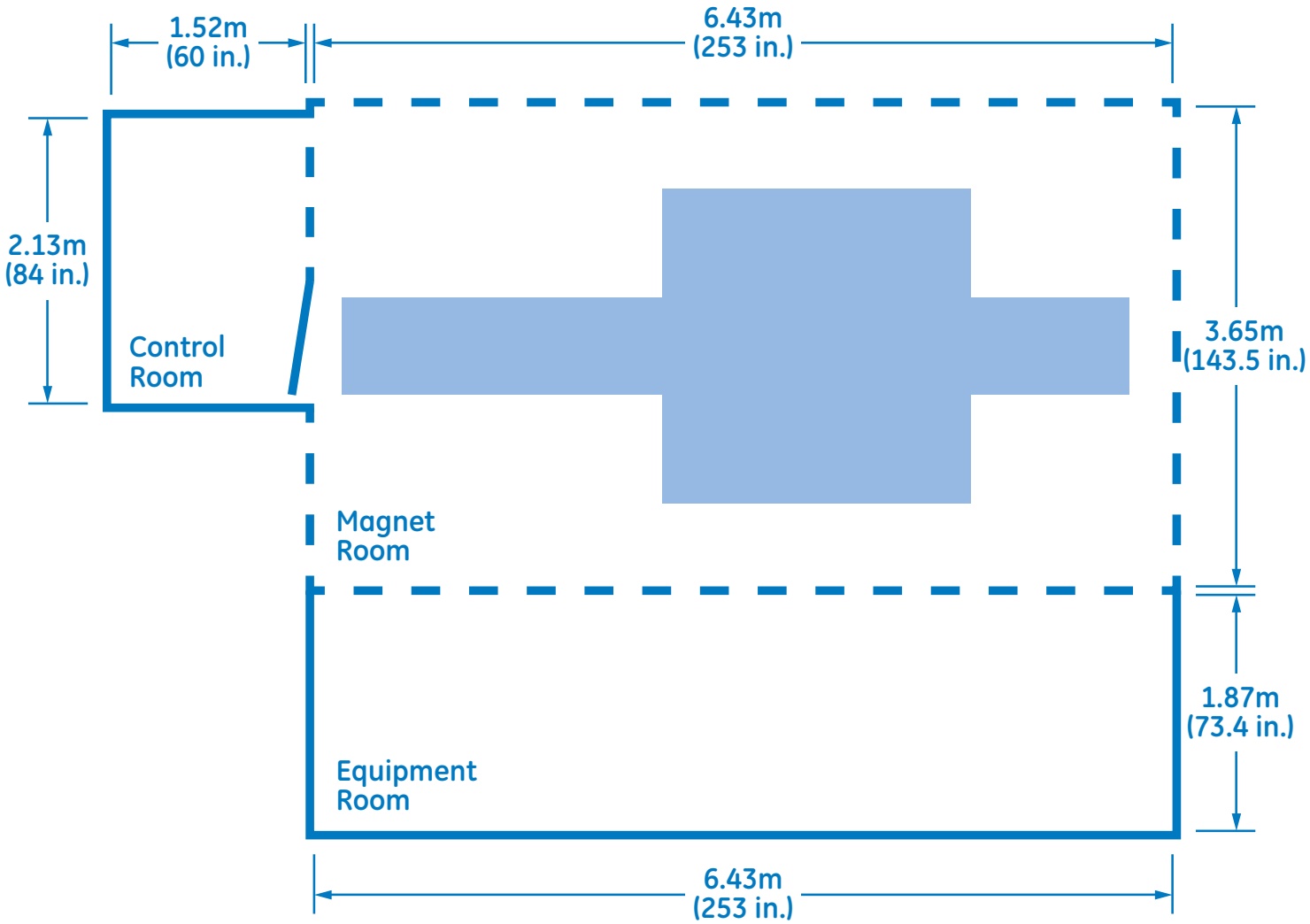
Echo Planar Imaging (EPI)	
Minimum TR (64 × 64)	4.0 ms
Minimum TR (128 × 128)	5.0 ms
Minimum TR (256 × 256)	6.0 ms
Minimum TE (64 × 64)	1.1 ms
Minimum TE (128 × 128)	1.4 ms
Minimum TE (256 × 256)	1.8 ms
Minimum FOV	4 cm
ESP at 25 cm FOV	64 × 64: 0.456 ms 128 × 128: 0.656 ms 256 × 256: 1.056 ms
ESP at 48 cm FOV	64 × 64: 0.328 ms 128 × 128: 0.460 ms 256 × 256: 0.672 ms
ESP at 99 cm FOV	64 × 64: 0.228 ms 128 × 128: 0.320 ms 256 × 256: 0.556 ms
Images per Second	64 × 64: 138 128 × 128: 69 256 × 256: 35
b Value	Maximum (s/mm^2): 10,000 Max # for ADC: 40
Diffusion Tensor Directions	Max: 150

Note: Optional software packages may be required to achieve certain specifications above.

7. System Siting Guidance

The SIGNA PET/MR system can be delivered in two ways: as an integrated PET/MR or as an on-site upgrade from an existing Discovery MR750w. The SIGNA PET/MR scan room dimension requirements are identical to that of a Discovery MR750w 3.0T scanner. The equipment room contains the standard cabinets for an MR750w, the PET cabinet and a chiller for the PET detectors.

This siting guidance document is for the PET and Discovery MR750w GEM system. All information in this document is for preliminary planning purposes only and is subject to change at any time. This document is not intended to be used for detailed site planning. Contact GE Healthcare Installation Services, or refer to the latest Discovery MR750w Pre-installation manual for detailed and complete system requirements and specifications.



Note: For additional details and information, consult the pre-install manual.

RETURN TO MAIN MENU

8. Siting Requirements Summary

Category	Parameter	Requirement
Electrical	Voltage/Frequency	480 VAC 60 ± 3 Hz 400 VAC 50/60 ± 3 Hz 415 VAC 50/60 ± 3 Hz 380 VAC 50/60 ± 3 Hz
	Power Demand	Momentary Maximum: 133 kVA for 5 sec Continuous: 103 kVA Standby: 27 kVA
Water	Availability	The facility must provide a continuous supply of chilled water for the Heat Exchanger Cabinet
	Flow	30-35 gpm
	Temperature (inlet to hec)	6 – 12°C (42.8 – 53.6°F)
	Chiller Size	Minimum 70 kW
	Minimum Continuous Heat Load	7.5 kW
	Note: See the MR750w Preinstallation manual for detailed and complete flow, temperature, and water quality requirements)	
Temperature & Humidity	Range	Control Room: 15 – 32°C (59 – 89.6°F), 30-70% RH Magnet Room: 15 – 21°C (59 – 69.8°F), 30-60% RH Equipment Room: 15 – 32°C (59 – 89.6°F), 30-70% RH
	Heat Output	Control Room: 4947 BTU/h Magnet Room: Average 9863 BTU/h, Max 14,469 BTU/h Equipment Room: Average 39,908 BTU/h, Max 75,516 BTU/h
Construction	RF Magnet Room Shielding	100 dB Shielding Effectiveness at 102.20, 127.72, and 153.30 MHz
	Magnet Room Floor Levelness	0.125 in. between high and low spots in the Magnet Room
	Vibration Requirements	Frequency, Allowable Site Vibration 0.0 ≤ f ≤ 7 Hz, 65 µG 25 < f ≤ 29 Hz, 100 µG 33 < f ≤ 39 Hz, 500 µG 7< f ≤ 25 Hz, 70 µG 29 < f ≤ 33 Hz, 300 µG 39 < f ≤ 45 Hz, 750 µG
	Magnet Room Flooring	Flooring must prevent buildup to 8 kV
Moving Metal and Varying Magnetic Fields	Cars Trucks	20 ft R × 25 ft A 23.3 ft R × 29.2 ft A
	EMI Limits	5.6 mG p-p DC and 17.1 mG rms AC
Venting	Cryogenic Vent	Required (see the PET/MR Preinstallation manual for construction requirements)
	Emergency Exhaust Vent	Required in the Magnet Room: 1,200 CFM
	Pressure Equalization Vent	Required between the Magnet Room and an unoccupied space (24 × 24)
Magnet Field	Equipment Limits	All Operator Workspace equipment must be located outside the 50 Gauss line The Magnet Rundown Unit in the Magnet Room must be located outside the 200 Gauss line All Equipment room equipment must be located outside the 50 Gauss field with the exception of the PEN Panel which must be located outside the 200 Gauss line.
Radiation Protection	Magnet Room	A qualified radiological health physicist should verify that the scan room's radiation shielding will provide adequate radiation protection for the planned system.

8.1 System Power Demand

Power Rating	Equipment Power Draw (kVA)			
	HEC and Cryo	MR PDU	PET PDU	System Total
Continuous	20	73	10	103
5-Second	20	103	10	133
Standby	17		10	27

8.2 Operating Environment

RF Shielding
100 dB for 10 – 100 MHz planewave

Workspace Monitor Position	
	Maximum Field Strength
LCD Flat Panel Monitor	5 mT (50 Gauss)

Temperature and Humidity Requirements			
	Magnet Room	**Control Room**	**Equipment Room**
Temperature	59 – 69.8°F (15 – 21°C)	59 – 89.6°F (15 – 32°C)	59 – 89.6°F (15 – 32°C)
Max. Temperature Change Rate	5°F/hr (3°C/hr)	5°F/hr (3°C/hr)	5°F/hr (3°C/hr)
Humidity (non- condensing)	30 – 60%	30 – 70%	30 – 70%
Max Humidity Change Rate	5% RH/hr	5% RH/hr	5% RH/hr

Altitude Requirements	
Lower Limit	–30 m
Upper Limit	2600 m

8.3 Additional Shielding Requirements

NOTICE: Engage a **QUALIFIED RADIOLOGICAL HEALTH PHYSICIST** to review your scan room shielding requirements, taking into consideration:

- Equipment placement
- Materials used for construction of walls, floors, ceiling, doors, and windows
- Access to surrounding scan room areas
- Equipment in surrounding scan room areas (such as film developer, film storage)

8.4 Phantoms and PET Spheres

Three phantoms and PET Spheres are used for calibrations (listed below) performed on the Signa PET/MR System. During normal operation, they should remain in a customer-provided storage area. Phantom half-life is 260 days; each should be replaced every three years.

Phantom Specifications				
Phantom	**Use**	**Dimensions**	**Dose Rate**	**Frequency**
Annulus	PET Detectors, Normalization Correction, and Daily Quality Assurance Calibrations	Diameter: 5.2 in (13.7 cm) Length: 11.8 in (30.0 cm)	Germanium-68 (Ge-68) 55 MBq	Daily by Customer
Volumetric Quality Control (VQC)	MR and PET Image Alignment Calibration	11.8 in × 11.8 in × 11.8 in (30 cm × 30 cm × 30 cm)	Ge-68 5 × 0.7 MBq	Quarterly
PET Spheres	Cradle, CMA coil and Filler Position Calibration (3 pieces for each site)	Diameter: 0.75 in (1.9 cm)	Ge-68 3 × 0.7 MBq	Quarterly

Note: In addition to PET detector calibrations, the Annulus Phantom is used to assess the relative performance of the detector channels, so differences in individual detector efficiency can be accommodated during image reconstruction.

8.5 PET Calibration and Daily QA

The PET/MR system uses a PET phantom for the Daily QA Check. A PET calibration phantom is used for:

1. Calibration of the PET detector electronics (quarterly)
2. Calibration of the relative crystal efficiency (quarterly)
3. Quality assurance check (daily)

The customer will need to plan to provide a storage location for all phantom sources required that will be used for the Daily QA Check and calibration.

8.6 Gamma Ray Protection

A number of radioactive substances, of various levels of stability are used by the PET unit of the PET/MR system. This material is necessary in imaging procedures. Before the suite is operational, unstable material may be on the premises. It is very important to recognize that clear and significant hazards from ionizing radiation may exist at the site, as it is undergoing preparation. Other equipment may be in place and operational at this time. This may include such equipment as X-ray systems and CT scanners. Calibration sources may be on the site at some time during the preparation process, as well as after the PET imager has been put into operation. A cyclotron may be operational at the site. Definite steps should be taken to insure the safety of workers, patients, and visitors, during all phases of the construction, installation and operation of the facility.

NOTE: By the time the site is ready to have radioactive material brought in; the licensing process must be complete. The site must be properly licensed before receiving radioactive material.

8.7 Protection of Equipment

It is important that background radiation be kept to a minimum. The coincidence detection used in a PET system allows a moderate amount of external singles events. Because area background can be more general than a single source, a lower limit is appropriate. Radioactive sources must be stored in approved shielded containers. It is recommended that any radioactive source be stored in a separate room (hot lab) adjacent to, and accessible from, the Scan Room. This hot lab should be near the cyclotron (if used). Doses should be prepared in the same area. Consideration should be given to the placement of the gantry in relation to existing X-ray, Magnetic Resonance, or Nuclear diagnostic equipment.

8.8 Protection of Personnel

8.8.1 Barriers, Partitions and Shielding

Appropriate barriers such as walls, lead-shielded glass, lead shields, etc., must be installed to protect staff from unnecessary exposure to radiation. A qualified radiological health physicist must be consulted in the design of walls and safety barriers to assure proper attenuation. Keep in mind that patients become significant sources of radioactivity. Consideration should be given to maximize the distance between the patient and operator during the uptake and acquisition phases of scan procedures.

8.8.2 Sources of Radiation

A number of common radio nuclides are used in the PET/MR system. These radio nuclides are either produced at the site or brought to the site from an outside source. In either case, these nuclides have relatively short half-life (2 min to 110 min) and as such decay to benign levels fairly quickly.

8.9 Warranty

The published GE warranty in effect on the date of shipment shall apply.

8.10 InSite Remote Diagnostics

GE's unique remote service and applications support including magnet monitoring. Also allows downloading of applications software such as eFlexTrials program.

8.11 GE Regulatory Compliance

The SIGNA PET/MR complies with all applicable safety standards, including but not limited to UL60601-1 and IEC60601-1-2 (Electromagnetic Compatibility).

Laser alignment devices contained within this system are appropriately labeled according to the requirements of the FDA's Center for Devices and Radiological Health (CDRH)

Section B: Applications

9. User Interface and Operator Workflow

9.1 Integrated PET & MR User Interface

The SIGNA PET/MR integrated user interface (UI) enables flexibility in scanner operation. The PET and MR protocol definition screens have the same look and feel and are both within the same application window to simplify the UI and to help minimize the learning curve. The modality worklist (MWL) provides an automated method of obtaining exam and protocol information for a patient directly from a DICOM Worklist server. To help maintain excellent imaging, the GraphicRx will ensure that simultaneous scans occur at the magnet isocenter. Operators can specify the order in which PET beds and MRs will be acquired. The integration of the UIs enables the operator to confirm that the combined protocol will produce a valid PET/MR dataset upon completion. The automated insertion of MR sequences for MR attenuation correction per prescribed PET bed is just one of the many integrations enabling ease of use of this dual modality console.

9.2 GraphicRx (PET & MR)

Upon completion of the localizer scan, the operator can use the PET & MR GraphicRx application to graphically define the scan parameters for the study and visually define the scan range for each acquisition. The SIGNA PET/MR system provides the user with complete control of protocols for simple prescription, archiving, searching, and sharing. The protocols are organized into two main libraries, GE Optimized and Site Authored and are standard on every SIGNA PET/MR.

9.3 Workflow Automation

Once a protocol has been selected for an exam, it is automatically loaded into the Workflow Manager. The Workflow Manager enables the user to control image prescription, acquisition, processing, visualization, and networking and may fully automate these steps if requested. PET prescription is integrated with the system and accessed through the Workflow Manager, including the definition of simultaneous SIGNA PET/MR acquisitions. Protocols will include PET/MR simultaneous tasks. Technologists can add MR tasks to be simultaneous with PET within specific PET beds as well as prescribe additional MR only scans to be executed subsequent to PET acquisitions. Alternatively, the user can add a PET bed to a prescribed MR sequence thereby keeping the MR in the prescribed location while centering the PET for simultaneous acquisition.

The SIGNA PET/MR system can automatically acquire parallel imaging calibration data. When needed, a calibration scan is automatically prescribed and acquired based on the clinical imaging volumes saved by the user. The reduced time between the calibration and clinical scan may reduce possibility of patient movement and this may help improve image quality. For each PET bed, an MR Attenuation Correction sequence is needed and is automatically prescribed during PET prescription.

The SIGNA PET/MR AutoCoil Rx workflow will automatically determine the optimum subset of elements to enable for scanning based on the prescribed FOV. If AutoStart is selected, once the landmark position has been set and the technologist exits the scan room, the Workflow Manager will automatically start the acquisition. With AutoScan enabled, the system will sequentially go through the list of prescribed series without any user interaction.

Prescribed MR sequences that are simultaneous with PET are auto-scanned for excellent efficiency. Operators may disable auto scanning should manual control of the execution of simultaneous MR sequences be desired. The cradle will be auto advanced for PET/MR acquisitions that require multiple locations.

9.3.1 Protocol Notes

Protocol Notes allow the staff to communicate protocol parameters, graphic prescription locations, and images that is specific to your site. Protocol Notes appear below AutoView.

9.3.2 AutoVoice*

The AutoVoice feature will ensure that consistent and repeatable instructions are presented to the patient for each and every exam. User selectable, pre-recorded instructions are presented at defined points in the acquisition.

9.3.3 Inline Viewing

Inline viewing allows the user to conveniently view, compare, and analyze images without having to switch to the Viewer. The ImageQC application is used to show PET images beside and fused with MR images.

Inline processing capabilities	
Diffusion Weighted Images ADC/eADC Maps	Automatic compute and save
Diffusion Tensor Images FA/ADC Maps	Automatic compute and save
Image Filtering: A-E, SCIC, PURE	Automatic compute and save
Maximum/Minimum Intensity Projection	Automatic compute and save
MR Reformat to orthogonal planes	Automatic compute and save
T2 Map for cartilage evaluation	Automatic compute and save
FiberTrak	Automatic load
Spectroscopy – Single voxel brain and breast metabolite	
3D Volume Viewer	Automatic load
Spectroscopy – 2D/3D Chemical Shift Imaging	Automatic load
BrainStat (Functool)	Automatic load
Image Fusion	Automatic load
IVI (Volume Viewer)	Automatic load
Pasting	Automatic load
SER (Functool)	Automatic load
eDWI	Automatic compute and save
3D ASL	Automatic compute and save

Image fusion	
MR Standard	3D Registration
ADC/eADC	3D Registration
Diffusion Tensor	3D Registration
Functional MRI	Reformat
BrainSTAT	3D Registration
SER (Signal Enhancement Ratio)	Reformat
T2 Mapping	Reformat
Spectroscopy (Brain, Prostate and Breast)	Reformat

9.4 PET Imaging/Viewing Options available for the SIGNA PET/MR Scanner

PET features: Quantitative imaging and visualization	
Volume Viewer	Volume Viewer provides innovative 3D visualization and processing capabilities for reading and comparing PET/MR, PET/CT, CT, MR, and 3D X-ray datasets. Volume viewer also features a broad portfolio of high performance analysis tools, automating routine tasks to simplify 3D processing and streamline your workflow.

10. SIGNA PET/MR Scantools

The SIGNA PET/MR comes standard with a package of pulse sequences and applications optimized for performance.

10.1 MR Sequences available for the SIGNA PET/MR Scanner

Standard Pulse sequences, imaging, and visualization options	
Spin Echo	A technique for generating T1, proton density and T2 images.
Fast-Spin Echo (FSE) Fast-Spin Echo XL (FSE-XL)	These techniques utilize a short echo-train technology to reduce the time for image acquisition while minimizing image blurring from T2 decay.
Fast-Recovery Fast-Spin Echo (FRFSE-XL)	The sequence of choice for high-quality, high-speed, and high-contrast T2-weighted imaging in neurological, body, orthopedic, and pediatric applications. Compared to FSE, FRFSE allows shorter acquisition times or increased slice coverage.
3DFRFSE	A sequence for creating high-resolution, three-dimensional T2-weighted images of anatomies and is especially useful for MR cholangiopancreatography (MRCP) studies.
Single-Shot Fast-Spin Echo (SSFSE) Single-Shot FSE Inversion Recovery (SSFSEIR)	An ultra-fast technique that permits complete image acquisition following a single RF excitation. It can acquire slices in less than one second, making it an excellent complement to T2-weighted brain and abdominal imaging and MRCP studies.
VERSE	Variable-Rate Selective Excitation (VERSE) is a method of reducing B1 and SAR exposure at 3T with FSE and FRFSE. By modulating the RF and gradient waveforms, SAR is reduced by as much as 60% without compromising image contrast or SNR. VERSE is only compatible with 2D FSE and 2D FRFSE.
MART	By modulating the flip angle train in SSFSE, MART reduces SAR exposure and echo spacing while preserving the MR signal for a longer period of time to help reduce blurring and enhance IQ.
GRE FGRE SPGR FSPGR	This suite of gradient-echo techniques uses short TR and TE to generate T1- or T2-weighted images in far less time than conventional SE. The ultra-short TR and TE possible with these sequences also provides the performance needed for high-resolution MRA studies.
2D and 3D Dual Echo Gradient Echo	A vital tool for abdominal imaging. This variation on conventional gradient echo provides a pair of images for which the signals from water and fat either are in-phase or out-of-phase. By design, all of the images acquired within a single breath-hold are in perfect registration.
SPECIAL	Spectral Inversion at Lipids (SPECIAL) is a spectral spatial inversion technique for fat saturation.
FLAIR T1 FLAIR T2 FLAIR	T1 and T2 Fluid Attenuated Inversion Recovery (FLAIR) pulse sequences have been designed expressly for neuro applications. FLAIR allows suppression of signal from cerebrospinal fluid (CSF). In addition to this capability, T1 and T2 FLAIR add extraordinary contrast between white and gray matter to T1- and T2-weighted brain and spine imaging.
Echo Planar Imaging (EPI) FLAIR Echo Planar Imaging	Essential tools for any high-throughput site employing advanced techniques. Echo planar imaging is what enables rapid imaging. And both echo planar and FLAIR echo planar techniques make it easier to generate neuro studies from uncooperative patients who simply are not able to stay still long enough for conventional techniques.
2D and 3D MR Time of Flight (TOF) Imaging 2D-Gated MR TOF Imaging and Enhanced 3DTOF	2D TOF Imaging, 2D Gated TOF Imaging, 3D TOF Imaging and Enhanced 3D TOF Imaging are all excellent for MR angiography. Based on conventional gradient echo scanning, TOF imaging techniques rely primarily on flow-related enhancements to distinguish moving from stationary spins. In this usage, TOF refers to MR time of Flight
2D Phase Contrast (2DPC) 3D Phase Contrast (3DPC)	These techniques demonstrate flow velocities and directional properties in vessels and other moving fluids such as CSF and aortic flow.
3D Gradwarp	3D Gradwarp is a technique integrated into image reconstruction that helps reduce image distortion by compensating for gradient non-linearity in all three dimensions. This correction differs from the default 2D correction that is conventionally performed by incorporating the slice direction into the processing.
SmartPrep™	SmartPrep uses a special tracking pulse sequence to monitor the MR signal through a user-prescribed volume to detect the arrival of an strong signal change and to trigger the acquisition.
SmartStep	SmartStep adds table-stepping capabilities to SmartPrep angiography, greatly facilitating peripheral vascular run-off studies
Double/Triple IR	These pulse sequences are included to allow black-blood imaging for studies of cardiac morphology. Triple IR adds fat suppression to black-blood imaging.

chart continued on page B.4

chart continued from page B.3

Standard Pulse sequences, imaging, and visualization options	
FastCINE	This pulse sequence is included specifically for studies of cardiac function. Through the use of retrospective gating, it allows full R-R coverage.
iDrive Pro	iDrive Pro brings real-time interactive imaging to the MR system, making it easier to generate detailed diagnostic information on just about any anatomy. This includes organs that are subject to motion artifacts, such as spine, heart , diaphragm and GI tract . The iDrive Pro technique allows the user to change scan parameters on the fly, during scanning, to evaluate the results immediately.
iDrive Pro Plus	iDrive Pro Plus expands the capabilities of standard iDrive Pro with: • Geometric changes to image plane location, obliquity, rotation, center FOV and FOV size • Contrast parameters such as spatial pre-saturation on/off, special sat pulses, flow comp and RF spoiling • Application of a non-selective IR pulse • Swapping phase and frequency It starts with an intuitive point-and-click user interface and live, on-image navigation icons. It continues with click of-the-mouse image book-marking and a suite of localization and drawing tools, and includes capabilities from 10-level undo/redo, built-in time, autoNEX and click-of-the-mouse display/review/save, all to streamline even the most complex exams and manipulations.
IVI	An interactive user interface that allows operators to remove background from MRA images. The result: angiographic and maximum intensity (MIP) projections in multiple scan planes. The processed images are saved automatically as a distinct series for quick recall.
Reformat	An online tool that allows the operator to convert image data sets from the acquired plane into orthogonal or oblique views. The reformat tool is easy to use and particularly useful for the interrogation of 3D datasets with complex anatomy. Reformatted images can be saved into the database for further review or filming.
3D Cube*	3D Cube replaces several slice-by-slice, plane-after-plane 2D FSE acquisitions with a single 3D volume scan – providing you with T1, T2, T2 FLAIR or PD sequences. You can easily reformat sub-millimeter isotropic volume data from a single acquisition into any plane – without gaps, and with the same resolution as the original plane. Our new self-calibrating parallel imaging engine ARC helps reduce artifacts while accelerating image acquisition.
3D BRAVO	BRAVO incorporates 1D ARC parallel imaging with 3D IR-prepared FSPGR acquisition to produce isotropic T1-weighted volumes. The center of k-space is over sampled and serves as the calibration data for the parallel imaging reconstruction
3D COSMIC	This is a 3D sequence used to image the axial c-spine. COSMIC (Coherent Oscillatory State Acquisition for the Manipulation of Imaging Contrast) uses a modified fast GRE pulse sequence with steady-state free precession segmented multi-shot centric k-space acquisition. This improves the CNR and SNR of c-spine tissue including the spinal cord, vertebral disks, nerve root canal and contrast between CSF and nerve roots.
2D and 3D MERGE	Multiple Echo Recombined Gradient Echo (MERGE) uses multiple echoes to generate high-resolution images of the c-spine with excellent gray-white matter differentiation. By combining early echoes with high SNR and late echoes with improved contrast, the result is improved cord contrast within the spinal column.
3D FIESTA	3D FIESTA (Fast Imaging Employing Steady-state Acquisition) is a technique that uses an extremely short repetition time (TR) between RF pulses such that high-resolution 3D volume images can be acquired rapidly. The 3D FIESTA technique is especially useful for the rapid acquisition of high-spatial-resolution images of static structures such as cochlea, internal auditory canal, or joints.
IDEAL	This sequence and reconstruction package acquires multiple echoes at different echo times with fast-spin echo readout to create water-only, fat-only, as well as in-phase and out-of-phase images. IDEAL is designed for imaging those difficult regions such as the neck and spine where inhomogeneous magnetic fields yield failures with traditional fat saturation techniques.
eDWI	The eDWI application includes the acquisition sequence and post-processing tools. It is designed to provide high signal-to-noise ratio diffusion images of the brain and liver with short acquisition time. Its multi-B feature is designed to provide measurement of apparent diffusion coefficient (ADC) map with reduced effect of perfusion. In addition, the "3 in 1" combining technique applies diffusion weighting to all three gradients simultaneously, helping improve sensitivity. Built in tetrahedral feature applies four different diffusion weighing combinations of x, y, and z gradients simultaneously to acquire isotropic diffusion weighted images with high signal-to-noise ratio and shorter TE. Its smart NEX feature helps to reduce acquisition time. Inversion recovery has been deployed to provide robust fat suppression.

chart continued on page B.5

chart continued from page B.4

Standard Pulse sequences, imaging, and visualization options	
Functool Performance	Advanced post-processing algorithms: ADC maps, eADC maps, Negative Enhancement Integral, Positive Enhance Integral, Mean Time to Enhance, Signa Enhancement Radio, Maximum Slope Increase, Maximum Difference Function, Correlation Coefficients, Diffusion Tensor, and 2D/3D CSI
Phase Contrast	2D Phase Contrast (2DPC), 3D Phase Contrast (3DPC): These techniques demonstrate flow velocities and directional properties in vessels and other moving fluids such as cerebrospinal fluid.
ASSET	Next generation reference scan algorithm which provides improved control over motion related artifacts and dephasing which can occur during the reference scan step. The new ASSET 3.0 reference algorithm leads to a reduction in artifacts caused by motion or dephasing in clinical results. The improvement is also utilized in the PURE image uniformity correction.
ARC	Auto-Calibrating Reconstruction (ARC) parallel imaging eliminates breath-hold mismatch errors by imbedding the calibration data within the scan data. In addition, this innovative reconstruction permits small FOV imaging by minimizing focal parallel imaging artifacts from the exam. Supporting both 1D and 2D acceleration, net acceleration factors of up to 4 can be achieved. ARC together with CUBE can be used in all anatomies.
LAVA LAVA-XV	LAVA is a three-dimensional (3D) spoiled gradient echo technique designed specifically to image the liver with excellent definition, coverage, and speed. Excellent fat suppression, through a spectrally selective inversion pulse customized for the liver, is one of the reasons for the high definition of anatomical structures. The coverage and speed of LAVA are the result of short TR, innovative use of partial k-space acquisition, and advanced parallel imaging
Fluoro-Triggered MRA	Fluoro-triggered MRA (FTMRA) is designed to capture angiographic images at the precise moment of peak opacification. Rather than automating the image-acquisition upon detection of the bolus arrival, FTMRA allows the operator to trigger each acquisition almost instantly (less than 1 second switch over), as soon as the operator is satisfied with the level of vessel enhancement. The result is an interactive, ASSET compatible, accurate approach to MRA. (This sequence is designed to be used with MR-Only table-stepping techniques.
2D FIESTA 3D FIESTA 2D FatSat FIESTA 3D FatSat FIESTA	FIESTA (Fast Imaging Employing Steady-state Acquisition) is a technique that uses an extremely short repetition time (TR) between RF pulses such that high-resolution 3D volume images can be acquired rapidly. The 3D FIESTA technique is especially useful for the rapid acquisition of high-spatial-resolution images of static structures such as cochlea, internal auditory canal, or joints.
3D FIESTA-C	This phase-cycled FIESTA reduces sensitivity to susceptibilities that may be encountered when imaging in the posterior fossa. It provides exquisite contrast for visualization of the internal auditory canal. It is also well suited for T1 imaging through the cervical spine
Quickstep (MR-Only)	QuickSTEP is an automated multi-station acquisition. This application automatically prescribes, acquires, and combines images from multiple stations for fast acquisition and exam completion. To complete the entire exam in as little as 7 minutes, the system will automatically acquire mask datasets from multiple stations without any user intervention. Secondary images are then acquired at the same independent table positions. The system will automatically subtract the mask images from the secondary dataset and combine the resulting images from the multiple stations into one series. The user only needs to complete a quick review of the data prior to insertion of images into the database. (This sequence is used with MR-Only table-stepping techniques.
Inline Visualization	Inline viewing allows the user to conveniently view, compare, and analyze images without having to switch to the Viewer. The ImageQC application is used to show PET images beside and fused with MR images.
Performed Procedure Step (PPS)	An automated connectivity capability, and a key component in film-less and paperless environments. Used in conjunction with the GE PACS broker, it automatically notifies the HIS/RIS and PACS systems of procedure status, in effect, closing the loop on the information gathered from patient arrival through billing.
ConnectPro	Enables the DICOM worklist server class for the operators' console, making it easy to query your HIS/RIS by name, or scheduled date, and to download patient demographics directly to the scanner. The data is automatically loaded in toe Express Exam Modality Worklist for simple filtering, editing and prescription of protocols for exam preparation. ConnectPro may require separate gateway hardware to connect non-DICOM compatible HIS/RIS systems to the MR scanner.

11. Imaging Options and Parallel Imaging Support

Imaging options

Pulse sequence imaging options

- 3D Slice Zip × 2 (Z2) / Zip × 4 (Z4)
- ARC*
- ART
- Asset
- Blood Suppression
- Cardiac Compensation
- Cardiac Gating / Triggering
- Classic
- DE Prepared
- EDR
- Flow Compensation
- Fluoro Trigger
- Full Echo Train
- IDEAL
- IR Preparation
- Magnetization Transfer MRCP
- Multi-Phase/Dynaplan
- Multi-Station
- Navigator
- No Phase Wrap
- Real Time
- Respiratory Compensation
- Respiratory Gating / Triggering
- Sequential
- SmartPrep*
- Spectral Spatial RF
- Square Pixel
- T2 Prep
- Tailored RF
- VERSE
- Zip 512 / Zip 1024

Parallel imaging

Array Spatial Sensitivity Encoding Technique (ASSET) imaging option is a 1D image-based parallel imaging technique used to speed data acquisition. For temporally sensitive acquisitions, ASSET reduces image blurring and motion, enables greater anatomical coverage, and reduces SAR. Parallel imaging acceleration factors ranging from 1-3.0 are supported depending on the coil selected.

ASSET 3.0

Next generation reference scan algorithm which provides improved control over motion related artifacts and dephasing which can occur during the reference scan step. The new ASSET 3.0 reference algorithm leads to a reduction in artifacts caused by motion or dephasing in clinical results. The improvement is also utilized in the PURE image uniformity correction.

ARC Parallel Imaging

Auto-Calibrating Reconstruction (ARC) parallel imaging eliminates breath-hold mismatch errors by imbedding the calibration data within the scan data. In addition, this innovative reconstruction permits small FOV imaging by minimizing focal parallel imaging artifacts from the exam. Supporting both 1D and 2D acceleration, net acceleration factors of up to 4 can be achieved. ARC together with CUBE can be used in all anatomies.

ASPIR

Adiabatic spectral inversion pulse utilized with FSE based acquisition to improve fat suppression homogeneity over large field of view or off-center imaging acquisitions compared to non-adiabatic inversion pulses.

With the SIGNA PET/MR, the following applications are parallel imaging enabled:

- 2D DT-EPI
- 2D DW-EPI
- 2D FGRE
- 2D FIESTA
- 2D FIESTA FastCARD
- 2D FIESTA FastCINE
- 2D FIESTA Fat Sat
- 2D fMRI EPI
- 2D FRFSE
- 2D FRFSE-XL IDEAL
- 2D FSE
- 2D FSE Double IR
- 2D FSE-IR
- 2D FSE Triple IR
- 2D FSE-XL IDEAL
- 2D FSPGR
- 2D GRE-EPI
- 2D MDE
- 2D MFGRE
- 2D SE-EPI
- 2D SSFSE
- 2D SSFSE 3-Plane
- 2D SSFSE-IR
- 2D SSFSE MRCP
- 2D T1FLAIR
- 2D T2MAP
- 3D BRAVO
- 3D COSMIC
- 3D Cube T1
- 3D Cube T2
- 3D Cube T2 FLAIR
- 3D Cube PD
- 3D Delta Flow
- 3D Dual Echo
- 3D Fast TOF GRE
- 3D Fast TOF SPGR
- 3D FGRE
- 3D FGRE IDEAL
- 3D FIESTA
- 3D FIESTA-C
- 3D FRFSE
- 3D FRFSE MRCP
- 3D FSPGR
- 3D FSPGR IDEAL
- 3D Heart
- 3D LAVA
- 3D LAVA FLEX
- 3D MDE
- 3D MERGE
- 3D QuickSTEP
- 3D SWAN
- 3D TOF GRE
- 3D TOF SPGR
- 3D TRICKS
- 3D Velocity Inflow
- 3D VIBRANT
- 3D VIBRANT FLEX
- Cine IR
- eDWI
- Fast 2D Phase Contrast
- FGRE Timecourse
- IFIR
- Inhance Inflow
- MR Echo Fast GRE Timecourse
- MR Echo FIESTA Timecourse
- MR Echo Function
- MR Echo MDE
- MR Echo Realtime
- MR Touch
- PROPELLER 3.0
- SWAN 2.0
- PS-MDE
- FOCUS
- BB SSFSE
- 3D PROMO

12. Elite Tools

Elite Tools extend the depth and breadth of clinical applications performance for SIGNA PET/MR with advanced, specialized applications and post-processing capability.

12.1 Neuro Applications

Silent Neuro Exam Package

- The Silent Neuro Exam Package includes a completed set of sequences designed to generate high-resolution images that deliver T1, T2, T2 FLAIR, PD-weighted and angiographic weighted contrasts. The Silenz imaging sequence delivers 3D isotropic images with T1, MRA, and/or PD contrast with sound levels that are within 3dB(A) of the ambient conditions. Newly enhanced gradient waveforms have been employed to minimize the acoustic signature of FSE, 3D Cube, and PROPELLER-based acquisitions to generate T2 and T2 FLAIR weighted images. In addition, the localizer, and pre-scan sequences have been optimized to deliver a complete neuro exam at nearly silent levels.

3D ASL (Arterial Spin Labeling)

- 3D ASL utilizes water in arterial blood as an endogenous contrast media to help visualize tissue perfusion and provide quantitative assessment of Cerebral Blood Flow (CBF) in ml/100 g/min. The quantitative CBF maps can be generated and stored in DICOM format.
- 3D ASL deploys stacked spiral FSE readout with modulated flip angle to acquire 3D volumetric data with increased SNR and minimal image distortion. The 3D data can be reformatted to axial sagittal, coronal or oblique planes. A pulsed-continuous labeling is applied to label arterial blood close to the imaging volume thus improving conspicuity of flowing blood. Selective, interwoven pulses are then used to saturate and invert the imaging volume, in order to achieve better background suppression, and reduce sensitivity to motion.
- 3D ASL helps generate robust, reproducible images and perfusion maps with high SNR, reduced motion artifacts and less distortion in high magnet susceptibility regions.

PROPELLER 3.0

- PROPELLER 3.0 uses an innovative k space filling technique and post processing algorithms to help reduce and correct for motion and minimize magnetic susceptibility artifacts.
  - Radial k space filling pattern causes oversampling of the k space center, generating more SNR and providing excellent tissue contrast.
  - Radial k space filling is inherently less sensitive to motion compared to the Cartesian method.
  - In addition, a sophisticated motion correction post-processing algorithm is deployed to reduce effects of motion originating from CSF flow, breathing, patient tremor, or voluntary movements. PROPELLER 3.0 has been enabled for high quality T1 FLAIR, T2, T2 FLAIR imaging in all planes, high quality axial diffusion-weighted imaging for brain, high quality T2 weighted imaging for c-spine, excellent T2 weighted imaging for Body, and excellent T2/PD weighted imaging for MSK.

3D Cube*

- 3D Cube replaces several slice-by-slice, plane-by-plane 2D FSE acquisitions with a single 3D volume scan – providing you with T1, T2, T2 FLAIR or PD sequences.
  - Easily reformat sub-millimeter isotropic volume data from a single acquisition in to any plane – without gaps, and with the same resolution as the original plane.
  - Our new self-calibrating parallel imaging engine, ARC, helps reduce artifacts while accelerating image acquisition.

3D PROMO

- 3D PROMO provides a real time 3D navigator based motion correction algorithm correcting for the 6 rigid body terms where re-acquisition of severely corrupted data provides robust high quality motion reduced 3D outcomes. 3D PROMO is compatible with both T2 and T2 FLAIR CUBE acquisitions.

SWAN 2.0

- SWAN 2.0 is a high-resolution 3D multi-echo gradient echo sequence that produces a $T2^*$ weighted averaging across images with different TE's to achieve higher susceptibility weighting.
  - It provides minimum intensity projections over neighboring slices, enhancing contrast for certain tissues containing iron, venous blood, and other substances with susceptibilities that are different than the background tissues. SWAN 2.0 outputs an unwrapped phase image leading to increased delineation between diamagnetic products and paramagnetic products (such as blood or iron).
  - Due to the nature of the weighted averaging of the multi-echo sequence, the SNR of SWAN is higher than that of a single-echo acquisition.

IDEAL

- This sequence and reconstruction package acquires multiple echoes at different echo times with fast-spin echo readout to create water-only, fat-only, as well as in-phase and out-of-phase images.
  - IDEAL is designed for imaging those difficult regions such as the neck and spine where inhomogeneous magnetic fields yield failures with traditional fat saturation techniques.

2D and 3D MERGE

- Multiple Echo Recombined Gradient Echo (MERGE) uses multiple echoes to generate high-resolution images of the c-spine with excellent gray-white matter differentiation.
  - By combining early echoes with high SNR and late echoes with improved contrast, the result is improved cord contrast within the spinal column.

3D BRAVO

- BRAVO incorporates 1D ARC parallel imaging with 3D IR-prepared FSPGR acquisition to produce isotropic T1-weighted volumes.
  - The center of k-space is over sampled and serves as the calibration data for the parallel imaging reconstruction.

3D COSMIC

- This is a 3D sequence used to image the axial c-spine. COSMIC (Coherent Oscillatory State Acquisition for Manipulation of Imaging Contrast) uses a modified fast GRE pulse sequence with steady-state free precession segmented multi-shot centric k-space acquisition. This improves the CNR and SNR of c-spine tissue including spinal cord, vertebral disks, nerve root canal, and contrast between CSF and nerve roots.

3D FIESTA

- 3D FIESTA (Fast Imaging Employing STeady-state Acquisition) is a technique that uses an extremely short repetition time (TR) between RF pulses such that high-resolution 3D volume images can be acquired rapidly.
  - The 3D FIESTA technique is especially useful for the rapid acquisition of high-spatial-resolution images of static structures such as cochlea, internal auditory canal, or joints.

3D FIESTA-C

- This phase-cycled FIESTA reduces sensitivity to susceptibilities that may be encountered with imaging in the posterior fossa. It provides exquisite contrast that is ideally equated for visualization of the internal auditory canal.
  - It is also ideally suited for T1 imaging through the cervical spine.

eDWI

- The eDWI application includes the acquisition sequence and post-processing tools. It is designed to provide high signal-to-noise ratio diffusion images of the brain and liver with short acquisition time. Its multi-B feature is designed to provide measurement of apparent diffusion coefficient (ADC) map with reduced effect of perfusion. In addition, the “3 in 1” combining technique applies diffusion weighting to all three gradients simultaneously, helping improve sensitivity. Built in tetrahedral features apply four different diffusion weighting combinations of x, y, and z gradients simultaneously to acquire isotropic diffusion weighted images with high signal-to-noise ratio and shorter TE. Its smart NEX features helps to reduce acquisition time. Inversion recovery has been deployed to provide robust fat suppression.

Diffusion Tensor imaging (DTI) with Fiber Tracking

- This package expands the echo planar imaging capability to include diffusion tensor imaging, a technique that acquires diffusion information in up to 150 different diffusion directions. It generates image contrast based on the degree of diffusion anisotropy in cerebral tissues such as white matter. FuncTool capabilities on the console (included with ScanTools) create Fractional Anisotropy (FA), Apparent Diffusion Coefficient (ADC), and T2-Weighted TRACE maps.
- The FiberTrak post-processing utility generated eigenvector information from the diffusion tensor acquisition and processing. Using a robust and efficient seeding process, three-dimensional renderings of the diffusion along white matter tracts are generated.

BrainSTAT

- BrainSTAT is a standard post processing application that automatically generates parametric maps for neuro Blood Flow, Blood Volume, Mean Transit Time and Time-to-Peak signal intensity.
  - A Gamma Variant fitting algorithm is deployed to automatically estimate the values for the four parametric maps. The maps may be saved in DICOM format and fused with high-resolution anatomic datasets for visualization of tissue and anatomy.
- An optional add-on to the BrainSTAT package enables the user to automatically or manually specify the Arterial-Input Function (AIF) based on the temporal form of the signal, to normalized Blood Flow, Blood Volume, Mean Transit Time and Time-to-Peak signal intensity maps based on the patients’ vascular flow dynamics.

READY Brain

- This application automates scan prescription for brain exams helping to enhance precision, repeatability and workflow. Once a whole brain localizer is completed, READY Brain uses automated detection and registration techniques to graphically prescribe scan series.

12.2 Spectroscopy Applications

PROBE – PRESS Single-Voxel Spectroscopy

- PROBE – Press single-voxel allows you to non-invasively evaluate the relative concentrations of in-vivo metabolites and lets you acquire and display volume-localized, water-suppressed H1 spectra in single-voxel mode. The package includes automated reconstruction, acquisition set-up and graphic prescription of spectroscopic volumes.
  - The stand sequence consists of three slice-selective RF pulses with crusher gradients. The PRESS sequence makes use of reduced flip angles to decrease minimum TE time of the sequence. The key advantage of PRESS (over STEAM) is that it provides up to twice the SNR and decreased exam time or voxel size. It is the sequence of choice for all hydrogen single-voxel spectroscopy data acquisition with TE values > 35ms.

PROBE – STEAM Single-Voxel Spectroscopy

- Stimulated Echo Acquisition Mode acquires a stimulated echo from the localized volume.
  - The basic sequence consists of three slice-selective 90-degree RF pulses and a set of crusher gradients. Although STEAM provides more accurate voxel localization, it has inherently lower SNR compared to PRESS. Moreover, since echo times available with STEAM can be shorter, it is better suited than PRESS for chemical species that have a shorter T2.

PROBE 2D CSI

- This extends the PROBE-PRESS capabilities with simultaneous multi-voxel in-plane acquisitions. Post-processing, including the generation of metabolite maps, is automatically generated with the FuncTool Performance package.

PROBE – 3D CSI

- This extends the PROBE – 2D CSI capabilities to add 3D multi-voxel acquisitions. (PROBE 2D CSI is mandatory)

BREASE

- BREASE is a TE-averaged PRESS spectroscopy acquisition that provides the necessary biochemical information to help characterize breast tissue.

12.3 Breast Applications

VIBRANT

- VIBRANT is a technique for simultaneous, high-definition fat-suppressed bilateral breast imaging in both the axial and sagittal scan planes. With VIBRANT, imaging is performed without in-plane data interpolation for enhanced data integrity. VIBRANT allows acceleration in both the phase encoding as well as the slice-select direction.
  - The result is high spatial and temporal resolution images that demonstrate exquisite contrast and high lesion conspicuity.

VIBRANT – Flex

- VIBRANT – Flex uses a time-efficient dual-echo acquisition with 2D ARC parallel imaging to produce water-only, fat-only, in-phase, and out-of-phase images of the breast in a single scan.
  - This processing enables excellent fat saturation to provide a clear depiction of the underlying breast anatomy.

IDEAL

- With FSE-IDEAL, water, fat, in-phase and out-of-phase images can be generated even in the presence of large static-field variations.
  - This sequence and reconstruction package acquires multiple echoes at different echo times using a fast-spin echo readout to create water-only, fat-only, as well as in-phase, and out-of-phase images.
  - IDEAL is designed for imaging those difficult regions such as the neck and spine where inhomogeneous magnetic fields yield failures with traditional fat saturation techniques.
  - This sequence produces consistent and reliable images in challenging anatomical areas.

BREASE

- BREASE is a TE-averaged PRESS spectroscopy acquisition that provides the necessary biochemical information to help characterize breast anatomy.

12.4 Cardiovascular Applications

MR Echo

- MR Echo expands on the capability provided by iDrive Pro Plus and is designed to significantly simplify and reduce cardiac exam times.
  - Presently, patients have to undergo multiple breath-holds to achieve the "whole-heart coverage" for wall motion and other studies.
  - MR Echo employs a bright-blood ultra-fast FIESTA sequence, which virtually eliminates the need for breath-holding.
  - An intuitive interface enables the operator to quickly scan the heart in any orientation and to save real time images to the browser through bookmarks. Scan & Save mode enables high-resolution heart imaging and enables multiple functional images over many slices to be prescribed and scanned in a single breath-hold. MR echo auto-calculates total scan time for the number of prescribed slices, enabling each scan to be tailored to the patient's breath-hold capability.
- MR Echo also incorporates time course and myocardial evaluation imaging within a dedicated cardiac interface. The operator is able to switch rapidly between pulse sequences, which reduce the scan time required for a comprehensive cardiac MRI exam. Time-course imaging includes both a high contrast-to-noise ratio FGRE pulse sequence and a FIESTA pulse sequence.
  - The "Lock Coverage" feature within MR Echo time-course imaging automatically maintains start and end slice coverage despite changes in the patient's heart rate between rest and stress time-course imaging.
  - Myocardial evaluation imaging is also performed within the MR Echo cardiac interface to complete a full assessment of the heart. All the pulse sequences in MR Echo are compatible with the AutoVoice feature in multiple languages to aid the operator.

2D FIESTA

- Fast Imaging Employing STeady state Acquisition is a fully balanced steady-state coherent imaging pulse sequence that has been designed to produce high SNR images at very short TR. The pulse sequence uses fully balanced gradients to re-phase the transverse magnetization at the end of each TR interval. This sequence accentuates the contrast of anatomy with high T2/T1 ratios (such as the cardiac blood pool), while suppressing the signal from tissues with low T2/T1 ratios (such as muscle and myocardium). This enhances the contrast between the myocardium and the blood pool.

3D FatSat FIESTA

- 3D FatSat FIESTA is software designed for imaging of the coronary arteries. The software acquires 3D images using FIESTA (Fast Imaging Employing STeady state Acquisition). Fat suppression is applied to accentuate the coronary arteries. The use of VAST (Variable Sampling in Time) technology greatly shortens breathholding requirements or allows for higher spatial resolution.

2D IR Prepared Gated FGRE

- Vital to MRI myocardial assessments, this technique can help distinguish between viable and necrotic tissue and therefore have a major impact on patient management. This pulse sequence uses an IR-prepared, cardiac-gated fast gradient echo sequence to acquire images whose appearance depends on the tissue's T1 relaxation time.
  - The IR-preparation step allows various tissues to be suppressed or enhanced. The IR prep pulse in this sequence is non-selective; ie., it excites the entire volume inside the body coil, rather than a specific slice. That means that it can suppress both the myocardium and the blood flowing into the slice.

3D IR Prepared Gated FGRE

  - 3D IR Prepared Gated FGRE is an advanced tool for myocardial assessment. IT acquires extensive volumes of data, rather than merely single slices, during breath-holds, with acquisitions gated to the cardiac cycle. The software applies a non-selective inversion-recovery magnetization preparation step to create T1-weighted tissue contrast and suppress the signal from certain tissues.

Navigators

- This software package is designed for use in conjunction with 3D IR Prepared GRES or 3D FatSat FIESTA for cardiac imaging. It consists of navigators that make it possible to track the diaphragm and use the information to acquire crisp 3D gradient echo images of the heart even while the patient breathes.

Cardiac Tagging

- Cardiac Tagging is used to improve visualization of contractile function, by combining a cardiac-gated FastCINE gradient-recalled echo to acquire data throughout the FOV.
  - Using the operator's choice of diagonal stripes or a grid pattern, tagging is applied once per R-R interval immediately following the R-wave ECG trigger, just before the start of the data acquisition. It is a 1D strip and 2D grid spatial saturation pulses for cardiac wall motion assessment.

Black Blood Single Shot Fast Spin Echo

- Black Blood SSFSE is available for either dual or triple inversion pre-pulse singe shot FSE based acquisition utilized for morphological imaging of the heart and vessels.
  - The use of inversion pre-pulses allows for nulling of the blood pool for the improved visualization of vessels and heart structures.
  - Utilization of single shot acquisitions allows for single breath hold multi-slice coverage which leads to larger volume coverage in fewer breath-holds for patient tolerance as well as reduction in overall exam times.

StarMap

- StarMap is a technique that acquires multiple echoes at different TE times at each location resulting in images that represent a variation of $T2^*$ weighting. Post-processing of the images is employed to generate gray scale and color maps of the $T2^*$ signal decay across the echoes, which can be useful in the assessment of the presence of iron.

PS MDE

- Phase Sensitive Inversion Recovery reduces the sensitivity of inversion decay times in the suppression of myocardial signal for MDE results by utilization of a phase-sensitive reconstruction of the resultant image.
  - The use of the phase image provides a more robust information and image appearance.

FGRE Time Course

- The FGRE TC PSD is a Fast Gradient-echo time-course imaging sequence that utilizes single-echo acquisition to help reduce sensitivity to echo misalignment or system calibration variations, which can result in robust image quality with less ghosting and artifact reduction. ASSET parallel imaging and shortened RF pulse design are incorporated to help improve temporal resolution and reduce motion related artifacts. In addition to selective notch pulse, it also supports non-selective saturation pulse for excellent background suppression and multi-plane imaging capability.

Flow Analysis

- A subset of the Report Card 4.0, clinicians interested only in quantifying CSF or blood flow can access all of the Report Card's flow features including: peak and average flow charts and graphs, automated contour detection and PACS' compatibility.
- Flow Analysis is available as an Advantage Workstation application or an MR operator console application.

TRICKS

- Time Resolved Imaging of Contrast KineticS (TRICKS) technology uses intricate temporal sampling with complex data recombination to accelerate the temporal resolution of 3D dynamic imaging – without compromising spatial resolution. This technology is integrated with elliptical-centric data sampling to create an excellent imaging technique for MRA even in challenging circumstances.
- Easy to set up, TRICKS rapidly generates time resolved 3D images of blood vessels to meet the challenge of capturing peak arterial phases with minimal venous contamination. With TRICKS, the different vascular phases can be extracted, quickly and easily, after image acquisition.

3D Heart

- 3D Heart utilizes high resolution 3D FatSat FIESTA-based whole-heart imaging with navigators and real time motion correction allowing free-breathing. This includes Cine IR multi-TI myocardial imaging enables tissue characterization and approximation of the optimal null point for myocardium signal.

CINE IR (Cine Inversion Recovery)

- CINE IR is a conventional ECG-gated, gradient recalled echo FASTCARD or FASTCINE acquisition sequence with an Inversion Recovery (IR) preparation. A single adiabatic inversion pulse is generated upon detection of the cardiac R-wave to trigger the multi-phase readout. Each image (ie., cardiac phase) is at a progressively longer TI time.
  - Cine IR can be used to approximate the myocardial null point for a subsequent delayed enhancement (MDE) study for myocardial viability.

MDE Plus

- Provides a Single-Shot based MDE acquisition which is used to suppress myocardial signal. The single-shot based method lead to a reduction of breath hold times allowing multi-slice coverage in a minimal number of breath holds.
  - MDE Plus additionally, provides a method for fat suppression to ensure uniform suppression of fat for better contrast visualization in conventional MDE acquisitions.

12.5 Inhance Application Suite

- The Inhance 2.0 Suite consists of several sequences designed to provide high-resolution images of the vasculature with short-acquisition times and excellent vessel detail. These sequences include:

Inhance 3D Velocity

- Inhance 3D Velocity is designed to acquire angiographic images in the brain and renal arteries with excellent background suppression in a short scan time. By combining a volumetric 3D phase contrast acquisition with parallel imaging, efficient k-space sampling, and pulse sequence optimization, Inhance 3D Velocity is faster than previous generations and is capable of obtaining the whole neurovascular anatomy in approximately 5-6 minutes.
- Furthermore, background suppression is enhanced by the optimized pulse sequence design, resulting in improved visualization of small branches. Respiratory triggering is also compatible with Inhance 3D Velocity to enable abdominal angiography, specifically renal arteries. This can result in excellent productivity and image quality.

Inhance 3D DeltaFlow

- Inhance 3D DeltaFlow is a 3D non-contrast enhanced MRA application for peripheral arterial imaging. Inhance 3D DeltaFlow is based on the 3D Fast Spin Echo technique, and it utilizes the systolic and diastolic flow differences to help generate arterial signal contrast. A subtraction of the systolic phase from the diastolic phase images results in arterial only images, with venous and background suppression. Interleaved acquisition and parallel imaging (ASSET) with optimized k-space trajectory helps reduce motion misregistration and improve vessel visualization respectively. In addition, with the use of partial-Fourier and coronal plane acquisition, the scan time is considerably reduced. Inhance 3D DeltaFlow is a robust 3D NCE MRA technique that provides excellent, high SNR visualization of peripherals arteries.

Inhance Inflow IR

- The Inhance Inflow IR is an angiographic method, which has been developed to image renal arteries with the ability to suppress static background tissue and venous flow. This sequence is based on 3D FIESTA, which improves SNR while producing bright blood images. A selective inversion pulse is applied over the region of interest, which inverts arterial, venous, and static tissue. At the null point of the venous blood, an excitation pulse is applied to generate signal. The net result is an angiographic image with excellent background suppression and virtually no venous contamination. Uniform fat suppression is achieved using a spectrally selective chemical saturation (SPECIAL) technique while respiratory gating compatibility reduces respiratory motion artifacts during free-breathing renal exams.

Inhance 2D Inflow

- The Inhance 2D Inflow pulse sequence is designed to acquire angiography images of arteries, which follow almost a straight path, i.e. femoral, popliteal, carotid arteries, etc. Arterial blood flow is faster during the systolic phase and slows down during the diastolic phase. Therefore, Inhance 2D Inflow is designed to acquire data during the systolic phase.
- Optimized spatial saturation gap to improve fat suppression and background suppression. With this saturation gap optimization, higher views per segment (VPS up to 48 for slow heart-rate) can be used, resulting in significant scan time reduction.
- Peripheral Gating that minimizes the pulsatile artifacts.
- Optimized view ordering to improve arterial signal.
- ASSET acceleration compatibility to reduce scan time.

12.6 Body Applications

IDEAL

- This sequence and reconstruction package acquires multiple echoes at different echo times with a fast-spin echo readout to create water-only, fat-only, as well as in-phase and out-of-phase images.
  - IDEAL is designed for imaging those difficult regions such as the neck and spine where inhomogeneous magnetic fields yield failures with traditional fat saturation techniques.

IDEAL IQ

- IDEAL IQ is a GE exclusive technique that builds upon the original IDEAL (Iterative Decomposition of water and fat with Echo Asymmetry and Least-squares estimation) technique that acquires multiple images of the anatomy at separate echo times to calculate the phase differences and determine triglyceride fat and water content per pixel. It exploits the resonance frequency differences between triglyceride fat and water, measured as phase differences in multiple echoes, to resolve triglyceride fat and water. It provides a reliable and uniform water-fat separation in the presence of B0 field inhomogeneity and improves the accuracy of water-fat separation by estimating and correcting for the T2* decay between echoes and by more accurately modeling triglyceride fat's spectral profile as multiple peaks rather than a single peak. The result is a triglyceride fat-fraction map image that reflects the spatial distribution of relative concentration of triglyceride fat within a voxel.

LAVA

- LAVA is a three-dimensional (3D) spoiled gradient echo technique designed specifically to image the liver with excellent definition, coverage, and speed. Excellent fat suppression, through a spectrally selective inversion pulse customized for the liver, is one of the reasons for the high definition of anatomical structures. The coverage and speed of LAVA are the result of short TR, innovative use of partial k-space acquisition, and advanced parallel imaging.

LAVA Flex

- LAVA Flex is a 3D FSPGR imaging technique that acquires fat/water, in-phase and out-of-phase echoes in a single acquisition.
  - Up to 4 types of images may be reconstructed within one acquisition: in phase, out of phase, water only, fat only. The water only contrast differs from a conventional fat suppressed image in that an inversion prep pulse is not applied for fat suppression. In fact, the fat information is removed, leaving a water only image that may potentially be used in place of a LAVA type image.
  - LAVA Flex uses ARC (Autocalibrated Reconstruction for Cartesian sampling), a 2D self-calibrated parallel imaging technique that allows for acceleration in both phase and slice directions for supported coils.

FOCUS

- FOCUS delivers a highly efficient method for increasing the resolution in Single Shot DW EPI sequences. The outcome delivers robust high resolution while removing artifacts typically induced from motion, image back-folding or unsuppressed tissue. In addition, with the higher efficiency of the application, the reduced field of view imaging leads to a reduction in blurring that translates into an overall improvement in the image quality. The sequence utilizes 2D selective excitation pulses in DW-EPI acquisitions to limit the prescribed phase encoded field of view.

eDWI

- The eDWI application includes the acquisition sequence and post-processing tools. It is designed to provide high signal-to-noise ratio diffusion images of the brain and liver with short acquisition time. Its multi-B feature is designed to provide measurement of apparent diffusion coefficient (ADC) map with reduced effect of perfusion. In addition, the "3 in 1" combining technique applies diffusion weighting to all three gradients simultaneously, helping improve sensitivity. Built in tetrahedral features apply four different diffusion weighting combinations of x, y, and z gradients simultaneously to acquire isotropic diffusion weighted images with high signal-to-noise ratio and shorter TE. Its smart NEX features helps to reduce acquisition time. Inversion recovery has been deployed to provide robust fat suppression.

Body Navigators

- Body Navigators are designed to deliver real time robust free-breathing respiratory motion compensation to improve routine and advanced body applications.

PROPELLER 3.0

- PROPELLER 3.0 uses an innovative k space filling technique and post processing algorithms to help reduce and correct for motion and minimize magnetic susceptibility artifacts.
  - Radial k space filling pattern causes oversampling of the k space center, generating more SNR and providing excellent tissue contrast.
  - Radial k space filling is inherently less sensitive to motion compared to the Cartesian method.
  - In addition, a sophisticated motion correction post-processing algorithm is deployed to reduce effects of motion originating from CSF flow, breathing, patient tremor, or voluntary movements. PROPELLER 3.0 has been enabled for high quality T1 FLAIR, T2, T2 FLAIR imaging in all planes, high quality axial diffusion-weighted imaging for brain, high quality T2 weighted imaging for c-spine, excellent T2 weighted imaging for Body, and excellent T2/PD weighted imaging for MSK.

StarMap

- StarMap is a technique that acquires multiple echoes at different TE times at each location resulting in images that represents a variation of weighting. Post-processing of the images is employed to generate gray scale and color maps of the T2* signal decay across the echoes, which can be useful in the assessment of the presence of iron.

3D Cube*

- 3D Cube replaces several slice-by-slice, plane-by-plane 2D FSE acquisitions with a single 3D volume scan – providing you with T1, T2, T2 FLAIR or PD sequences.
  - Easily reformat sub-millimeter isotropic volume data from a single acquisition in to any plane – without gaps, and with the same resolution as the original plane.
  - Our new self-calibrating parallel imaging engine ARC, helps eliminate artifacts while accelerating image acquisition.

12.7 Musculoskeletal Applications

PROPELLER 3.0

- PROPELLER 3.0 uses an innovative k space filling technique and post processing algorithms to help reduce and correct for motion and minimize magnetic susceptibility artifacts.
  - Radial k space filling pattern causes oversampling of the k space center, generating more SNR and providing excellent tissue contrast.
  - Radial k space filling is inherently less sensitive to motion compared to the Cartesian method.
  - In addition, a sophisticated motion correction post-processing algorithm is deployed to reduce effects of motion originating from CSF flow, breathing, patient tremor, or voluntary movements. PROPELLER 3.0 has been enabled for high quality T1 FLAIR, T2, T2 FLAIR imaging in all planes, high quality axial diffusion-weighted imaging for brain, high quality T2 weighted imaging for c-spine, excellent T2 weighted imaging for Body, and excellent T2/PD weighted imaging for MSK.

MAVRIC SL

- MAVRIC SL is an advanced magnetic resonance imaging technique for imaging soft tissue and bone near MR conditional metallic devices. MAVRIC SL is designed to greatly reduce susceptibility artifacts, compared to conventional fast spin echo techniques and is suitable for use on all patients cleared for MR exams.

Cartigram

- Cartigram is a T2 mapping sequence and processing utility used to image cartilage and other tissues. This technique acquires multiple echoes at different TE times at each location, resulting in datasets of images that represent different T2 weighting and a non-invasive imaging method for early detection of osteoarthritis. It quantifies the T2 relaxation of knee cartilage and can overlay the quantified parametric maps over high resolution images for clear visualization of the anatomy. Post processing of the images generates maps of the T2 signal decay within each voxel.

IDEAL

- IDEAL is designed for imaging those difficult regions such as the neck and spine where inhomogenous magnetic fields yield failures with traditional fat saturation techniques. Areas such as the foot/ankle, shoulder and off-isocenter wrist make fat saturation a challenge. Water, fat, inphase, and out-of-phase images can be generated even in the presence of large static-field variations. This sequence produces consistent and reliable image in challenging anatomical areas.

12.8 Pediatric Applications

12.8.1 Pediatric Neurology

PROPELLER 3.0

- PROPELLER 3.0 uses an innovative k space filling technique and post processing algorithms to help reduce and correct for motion and minimize magnetic susceptibility artifacts.
  - Radial k space filling pattern causes oversampling of the k space center, generating more SNR and providing excellent tissue contrast.
  - Radial k space filling is inherently less sensitive to motion compared to the Cartesian method.
  - In addition, a sophisticated motion correction post-processing algorithm is deployed to reduce effects of motion originating from CSF flow, breathing, patient tremor, or voluntary movements. PROPELLER 3.0 has been enabled for high quality T1 FLAIR, T2, T2 FLAIR imaging in all planes, high quality axial diffusion-weighted imaging for brain, high quality T2 weighted imaging for c-spine, excellent T2 weighted imaging for Body, and excellent T2/PD weighted imaging for MSK.

3D Cube*

- 3D Cube replaces several slice-by-slice, plane-by-plane 2D FSE acquisitions with a single 3D volume scan – providing you with T1, T2, T2 FLAIR or PD sequences. You can easily reformat sub-millimeter isotropic volume data from a single acquisition in to any plane – without gaps, and with the same resolution as the original plane. Our new self-calibrating parallel imaging engine ARC helps reduce artifacts while accelerating image acquisition.

3D BRAVO

- BRAVO incorporates 1D ARC parallel imaging with 3D IR-prepared FSPGR acquisition to produce isotropic T1-weighted volumes.
  - The center of k-space is over sampled and serves as the calibration data for the parallel imaging reconstruction.

Diffusion Tensor imaging (DTI) with Fiber Tracking

- This package expands the echo planar imaging capability to include diffusion tensor imaging, a technique that acquires diffusion information in up to 150 different diffusion directions. It generates image contrast based on the degree of diffusion anisotropy in cerebral tissues such as white matter. FuncTool capabilities on the console (included with ScanTools) create Fractional Anisotropy (FA), Apparent Diffusion Coefficient (ADC), and T2-Weighted TRACE maps.
- The FiberTrak post-processing utility generated eigenvector information from the diffusion tensor acquisition and processing. Using a robust and efficient seeding process, three-dimensional renderings of the diffusion along white matter tracts are generated.

3D ASL (Arterial Spin Labeling)

- 3D ASL utilizes water in arterial blood as an endogenous contrast media to help visualize tissue perfusion and provide quantitative assessment of Cerebral Blood Flow (CBF) in ml/100 g/min. The quantitative CBF maps can be generated and stored in DICOM format.
- 3D ASL deploys a stacked spiral FSE readout with modulated flip angle to acquire 3D volumetric data with increased SNR and minimal image distortion. The 3D data can be reformatted to axial sagittal, coronal or oblique planes. A pulsed-continuous labeling is applied to label arterial blood close to the imaging volume thus improving conspicuity of flowing blood. Selective, interwoven pulses are then used to saturate and invert the imaging volume, in order to achieve enhanced background suppression, and help reduce sensitivity to motion.
- 3D ASL helps generate robust, reproducible images and perfusion maps with high SNR, reduced motion artifacts and less distortion in high magnet susceptibility regions.

12.8.2 Pediatric Vascular

TRICKS

- Time Resolved Imaging of Contrast KineticS (TRICKS) technology uses intricate temporal sampling with complex data recombination to accelerate the temporal resolution of 3D dynamic imaging – without compromising spatial resolution. This technology is integrated with elliptical-centric data sampling to create an imaging technique for excellent MRA imaging even in challenging circumstances.

Inhance 3D Velocity

- Inhance 3D Velocity is designed to acquire angiographic images in brain and renal arteries with excellent background suppression in a short scan time. By combining a volumetric 3D phase contrast acquisition with parallel imaging, efficient k-space sampling, and pulse sequence optimization, Inhance 3D Velocity is faster than previous generations and is capable of obtaining the whole neurovascular anatomy in approximately 5-6 minutes.
- Furthermore, background suppression may be improved by the optimized pulse sequence design, resulting in improved visualization of small branches. Respiratory triggering is also compatible with Inhance 3D Velocity to enable abdominal angiography, specifically renal arteries. This can result in excellent productivity and image quality.

Inhance 3D DeltaFlow

- Inhance 3D DeltaFlow is a 3D non-contrast enhanced MRA application for peripheral arterial imaging. Inhance 3D DeltaFlow is based on the 3D Fast Spin Echo technique and it utilizes the systolic and diastolic flow differences to help generate arterial signal contrast. A subtraction of the systolic phase from the diastolic phase images results in arterial only images, with venous and background suppression. Interleaved acquisition and parallel imaging (ASSET) with optimized k-space trajectory helps reduce motion misregistration and improve vessel visualization respectively. In addition, with the use of partial-Fourier and coronal plane acquisition, the scan time is considerably reduced. Inhance 3D DeltaFlow is a robust 3D NCE MRA technique that provides excellent, high SNR visualization of peripherals arteries.

Inhance Inflow IR

- The Inhance Inflow IR is an angiographic method, which has been developed to image renal arteries with ability to suppress static background tissue and venous flow. This sequence is based on 3D FIESTA, which improves SNR while producing bright blood images. A selective inversion pulse is applied over the region of interest, which inverts arterial, venous, and static tissue. At the null point of the venous blood, an excitation pulse is applied to generate signal. The net result is an angiographic image with excellent background suppression and virtually no venous contamination. Uniform fat suppression is achieved using a spectrally selective chemical saturation (SPECIAL) technique while respiratory gating compatibility reduces respiratory motion artifacts during free-breathing renal exams.

Inhance 2D Inflow

- The Inhance 2D Inflow pulse sequence is designed to acquire angiography images of arteries, which follow almost a straight path, i.e. femoral, popliteal, carotid arteries, etc. Arterial blood flow is faster during the systolic phase and slows down during the diastolic phase. Therefore, Inhance 2D Inflow is designed to acquire data during the systolic phase.
- Optimized spatial saturation gap to improve fat suppression and background suppression. With this saturation gap optimization, higher views per segment (VPS up to 48 for slow heart-rate) can be used, resulting in significant scan time reduction.
- Peripheral Gating that minimizes the pulsatile artifacts.
- Optimized view ordering to improve arterial signal.
- ASSET acceleration compatibility to reduce scan time.

12.8.3 Pediatric Cardiology

MR Echo

- MR Echo expands on the capability provided by iDrive Pro Plus and is designed to significantly simplify and reduce cardiac exam times. Presently, patients have to undergo multiple breath-holds to achieve the "whole-heart coverage" for wall motion and other studies. MR Echo employs a bright-blood ultra-fast FIESTA sequence, which virtually eliminates the need for breath-holding. An intuitive interface enables the operator to quickly scan the heart in any orientation and to save real-time images to the browser through bookmarks. Scan & Save mode enables high-resolution heart imaging and enables multiple functional images over many slices to be prescribed and scanned in a single breath-hold. MR echo auto-calculates total scan time for the number of prescribed slices enabling each scan to be tailored to the patient's breath-hold capability.
- MR Echo also incorporates time course and myocardial evaluation imaging within a dedicated cardiac interface. The operator is able to switch rapidly between a pulse sequence, which reduces the scan time required for a comprehensive cardiac MRI exam. Time-course imaging includes both a high contrast-to-noise ratio FGRE pulse sequence and a FIESTA pulse sequence. The "Lock Coverage" feature within MR Echo time-course imaging automatically maintains start and end slice coverage despite changes in the patient's heart rate between rest and stress time-course imaging. Myocardial evaluation imaging is also performed within the MR Echo cardiac interface to complete a full assessment of the heart. All the pulse sequences in MR Echo are compatible with the AutoVoice feature in multiple languages to aid the operator in workflow.

12.8.4 Pediatric Body

LAVA Flex

- LAVA Flex is a 3D FSPGR imaging technique that acquires fat/water, in-phase and out-of-phase echoes in a single acquisition.
  - Up to 4 types of images may be reconstructed within one acquisition: in phase, out of phase, water only, fat only. The water only contrast differs from a conventional fat suppressed image in that an inversion prep pulse is not applied for fat suppression. In fact, the fat information is removed leaving a water only image that may potentially be used in place of a LAVA type image.
  - LAVA Flex uses ARC (Autocalibrated Reconstruction for Cartesian sampling) a 2D self-calibrated parallel imaging technique that allows for acceleration in both phase and slice directions for supported coils.

13. DICOM Conformance Standards

The SIGNA PET/MR system generates MR and PET Image, Secondary Capture, Structured Report, and (MR only) Gray Scale Softcopy Presentation State (GSPS) DICOM objects. The DICOM networking supports both send and query retrieve as well as send with storage commit to integrate with the site's PACS archive. DICOM filming support includes both Basic Grayscale and Basic Color Print Service Classes. Additionally, the SIGNA PET/MR system supports the MR and PET image objects for display allowing the user to refer to cross-modality studies.

System conforms to the following standards. For detailed information a DICOM Conformance Statement is available upon request:

- DICOM Storage Service Class
- Service Class User (SCU) for image send
- Service Class Provider (SCP) for image receive
- Service Class User (SCU) for storage commitment
- DICOM Query/Retrieve Service Class
- DICOM Storage Commitment Class Push
- DICOM Modality Worklist
- DICOM Modality Performed Procedure Step (MR only)
- DICOM Print

13.1 Filming

- Drag and Drop filming
- One-button Print Series
- One-button Print Page
- Multi-image formats – from 1 to 24 images displayed simultaneously in various layouts
- DICOM Basic Grayscale Print Service Class
- DICOM Basic Color Print Service Class

14. Warranty

The published GE warranty in effect on the date of shipment shall apply.

15. InSite* Remote Diagnostics

GE's unique remote service and applications support including magnet monitoring. Also allows downloading of applications software such as eFlexTrials program.

16. GE Regulatory Compliance

The SIGNA PET/MR complies with all applicable safety standards, including but not limited to UL60601-1 and IEC60601-1-2 (Electromagnetic Compatibility).

Laser alignment devices contained within this system are appropriately labeled according to the requirements of the FDA's Center for Devices and Radiological Health (CDRH)

RETURN TO MAIN MENU

Section C: Optional Features

17. Optional MR Coils

17.1 8-channel Breast Array

- 8-channel, 8-element phased array design
- Optimized for uniformity, parallel imaging and VIBRANT
- Bilateral and unilateral breast imaging
- Biopsy plates available
- Attenuated for simultaneous PET/MR
- Coil dimensions: 50 × 54 × 25 cm

17.2 GEM Flex Suite

The GEM Flex Suite is a versatile set of high-density 16-channel receive arrays designed to provide high quality imaging in a wide range of clinical applications. The high degree of flexibility is particularly advantageous when imaging patients that do not fit the constraints of rigid coils, improving the patient and technologist experience. Consistent with the GEM design philosophy, the size and shape of the elements in each flexible coil have been optimized for high SNR and parallel imaging.

This extended set includes all three coil sizes and a knee stabilization fixture designed for compatibility with the PET/MR table.

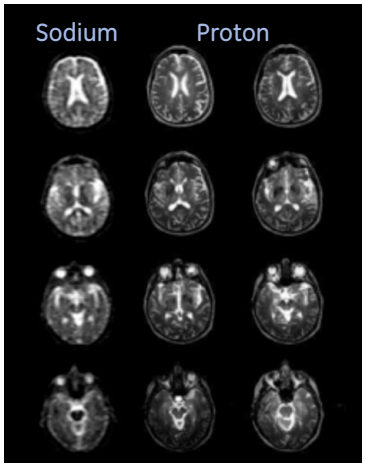
- Large Flex Array: 23 cm × 70 cm
- Medium Flex Array: 23 cm × 48 cm
- Small Flex Array: 23 cm × 38 cm
- GEM Flex Interface Module P-Connector
- GEM Flex Knee Stabilization Fixture
- GEM Flex Positioner
- GEM Flex Strap and Interface Module Cover
- GEM Flex Cable Take-up Pad and
- General Purpose Stabilization Pad

18. SIGNA PET/MR Patient Table with IntelliTouch

The fully detachable SIGNA PET/MR table is easily docked and undocked by a single operator and simple to move in and out of the exam room for patient transport and preparation. These features can be vital in instances where multiple patient transfers may impact patient care or when emergency extraction is required. The SIGNA PET/MR patient table and associated patient handling system have been designed to provide high accuracy and reproducibility of positioning required ensuring maintenance of physical co-registration for simultaneous dual modality imaging.

19. Optional Software and Hardware

19.1 Multi-Nuclear Spectroscopy (MNS)



The Signa PET/MR is designed to accommodate simultaneous MNS with PET. MNS is an optional feature that includes excitation, receiving hardware and software packaging tailored for non-proton spectroscopy (31P and 13C).

PET/MR MNS Elite Package includes:

- Multi-Nuclear Spectroscopy 8 kW Amplifier
  - The high performance Optical RF Receivers of the MR750w are capable of broadband signal detection. This package includes an 8 kW broadband RF amplifier and an 8-channel receiver converter.
  - Multi-nuclear coils may be connected to the "A" Port (Hypertronix connector) of the system for broadband transmission and reception of RF signals.
- 3.0T Phosphorous MNS T/R Switch
  - The kit compliments your multi-nuclear capabilities by adding a 31P T/R switch. A patient 31P coil will need to be purchased separately, but this kit does include a coil for service to ensure that the functionality is operating well on the system.
- 3.0T Carbon MNS T/R Switch
  - The kit compliments your multi-nuclear capabilities by adding a 13C T/R switch.

19.2 SAGE 7

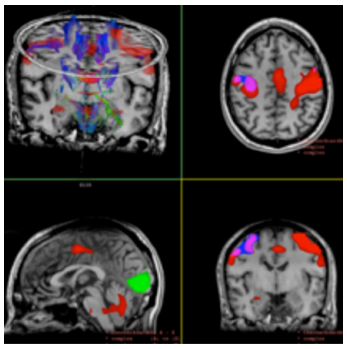
SAGE 7 (Spectroscopy Analysis by GE, Version 7) allows one to process, display, manipulate, analyze, manage and print in vivo spectroscopy data via an easy-to-use, graphical interface. This powerful toolkit furnishes a wide array of filters, transformations, correction algorithms, and segmentation and measurement tools to extract the information contained in spectroscopy data. The results of the analysis can be output to a postscript printer and in electronic formats such as BMP, EPS, JPEG, PICT and TIFF. The processing steps can be customized and saved in macros to streamline application of even the most sophisticated routines. (SAGE is standard with the MNS package)

19.3 Functional MRI (fMRI) options

BrainWave Real Time

BrainWave RT provides real-time acquisition, processing and display of functional results. It allows a single technologist to acquire process and display BOLD (Blood Oxygen Level Dependent) fMRI studies acquired with synchronized stimuli. It is comprehensive, equipping you with all the real-time functionality you need, including paradigm control and development, and real-time display of color activation, overlaid on source EPI images.

The main features are:



- 50,000 image storage per series with data acquisition rates up to 20 images per second.
- Display of 2D activation maps overlaid over Echo Planar source images in real time.
- Multiple 2 × 2 and 4 × 4 display.
- Optional saving of raw data in research mode for off-line analysis with 200,000 images.

BrainWave Post-Acquisition on Console

This high performance software allows you to produce, from raw fMRI data, 3D brain renderings displaying functional activation. Display alternatives for these maps include cross sectional displays, activation Z-maps and composite paradigm displays.

The features include the following:

- Integration into the operator console.
- Intuitive graphic user interface for image analysis and display.
- Data quality check, motion correction, temporal filtering and spatial smoothing to optimize statistical analysis and mapping.
- Multiple regression analysis.
- Segmented structural MRI Scan using completely automatic threshold and histogram methods and mathematical morphology techniques.
- Rapid retrospective motion correction.
- Sophisticated visualization techniques including true volume rendering, light box and orthogonal displays.

BrainWave Advanced AV

BrainWave Advanced Visualization delivers simplified processing workflow tools for fMRI analysis including segmentation and skull stripping of anatomical structures. Paradigm processing support for simple block, complex block, event related and free form conditions in a simplified processing environment including motion detection, exclusion and dismiss options. Registration of 2D/3D anatomical image with the bold overlay maps in color output is supported through BIP (burned in pixel) map format as support for incremental image rotation batch movie.

BrainWave Fusion

BrainWave Fusion is an optional package that provides the ability to fuse high-resolution anatomical images with fMRI activation maps and diffusion tensor fiber maps. This package is useful for evaluating the spatial relationship between activation patterns, fiber tracts, and underlying anatomy and pathology.

BrainWave Advanced DTI

The advanced DTI package provides 3-plane directionally encoded FA maps presented in both grey and color scales in a 3-dimensional presentation. Seed placement can be performed in-plane and in non-acquired plane for 3D seeded ROI's, inclusion and/or exclusion ROI's are now possible. In addition, real-time fiber bundle adjustments can be made through a change in FA, fiber length or angle settings. The output format supports DICOM format.

BrainWave 3.0 Structured Reporting

Reporting of cases is provided in a streamlined reporting structure and process that allows for a comprehensive and detailed description of experiment methods, patient centric feedback (task response, motion plot and activation curves), and colorized screen captures of the image results and a clinical report field for diagnostic summary outcome. The report export format provides user-defined threshold activations maps in DICOM format, available for reformatting and display with third party components such as surgical navigation systems or PACS workstations for review.

BrainWave Lite Hardware

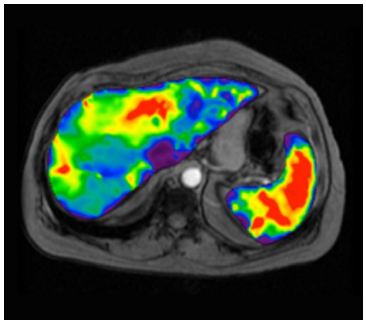
BrainWave Lite Hardware provides paradigm-delivering hardware that provides data to paradigm synchronization – thereby paving the way for convenient compatibility with third-party-supplied sensory equipment such as auditory headphones and visual presentation systems (not included).

BrainWave Lite Hardware includes:

- A dedicated computer workstation.
- Equipment rack and penetration panel waveguide insert.
- Cedrus patient response pads, and related cabling and connectors.

It is designed to deliver visual and auditory stimuli and receive a tactile response. The computer includes preset paradigms and software tools to generate customer protocols. The visual and auditory output can be coupled to fMRI delivery systems purchased separately from other vendors.

19.4 MR Touch



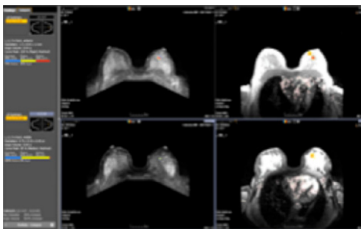
MR Touch is a non-invasive method to measure relative tissue stiffness with MR.

MR Touch is an acquisition and reconstruction technique that combines hardware, acquisition, and reconstruction algorithms to produce Elastograms, which are color-coded anatomical images showing varying degrees of elasticity or stiffness. The image contrast is related to relative stiffness of soft tissue and is generated from a real-time data acquisition during tissue palpation with low amplitude and low frequency sound waves. The hardware component is comprised of an active sound wave generator and a passive transducer that produces small vibrations in the area of the patient to be scanned.

The MR Touch acquisition software is an evolutionary improvement to the echo planar imaging sequence. The acquisition software also triggers the sound wave generator to produce synchronized vibrations on the surface of the patient during the data acquisition. The reconstruction algorithms generate images that show the propagation of waves through the tissue (phase images) and also the corresponding strain wave and relative stiffness images. Parallel imaging is used to accelerate image acquisition.

19.5 CADstream 5.2

CADstream applications were designed for the specific workflow needs of breast, prostate and liver MRI study processing and analysis. Customers can place all of the CADstream applications on one server and set up processing protocols for the different study acquisitions.

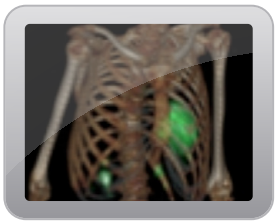


CADstream 5.2 automatically processes studies according to a site's pre-set preferences. Automated processing is not only efficient; it standardizes study analysis and provides consistent interpretation and reporting.

20. Optional Post-Processing features on the Advantage Workstation (AW)

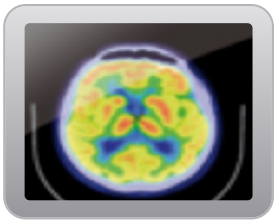
The AW is a 3D visualization and analysis solution, delivering fast and clinically effective post-processing capability. Advantage workstation provides ability to visualize large-volume, thin-slice data, and convenient DICOM compatibility ensuring easy data transfer.

Standard operating software included:

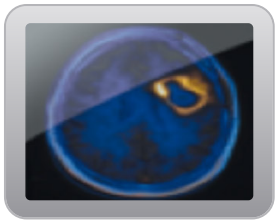


Volume Viewer

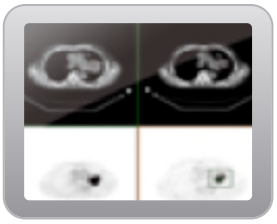
Additional PET/MR Post-processing options



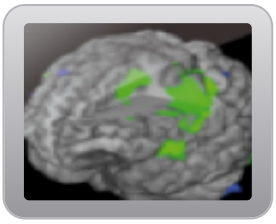
Cortex ID



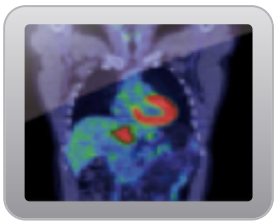
Integrated Registration



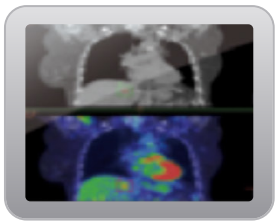
OncoQuant



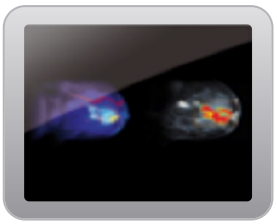
BrainWave



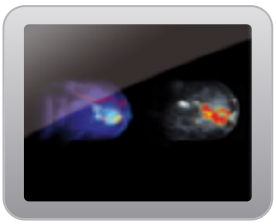
PET VCAR



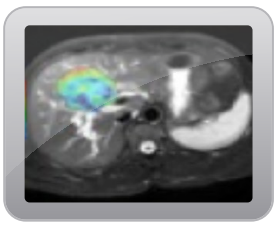
Motion VUE



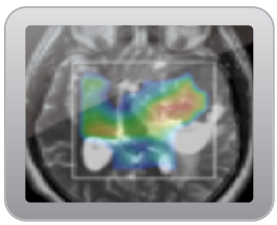
READY View



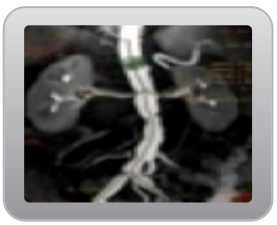
CADstream



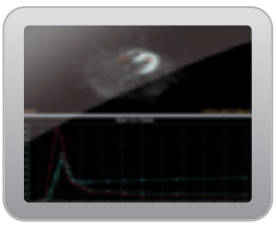
BodyView



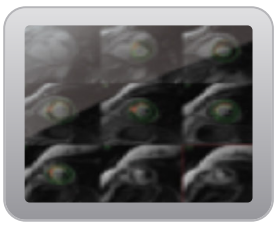
BrainView



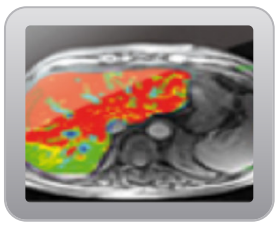
MR VesselIQ



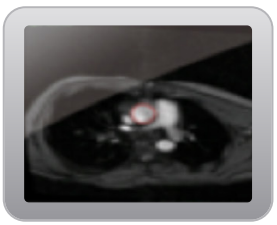
Dynamic VUE



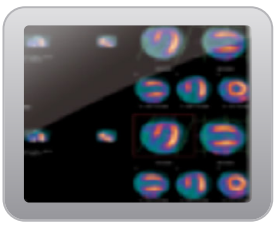
Cardiac VX*



Starmap 4.0™



Flow Analysis 4.0



CardIQ™ Physio

Advantage Workstation	3D visualization and analysis solution, delivering fast and clinically effective post-processing capability. Advantage Workstation provides ability to visualize large-volume, thin-slice data, and convenient DICOM compatibility ensuring easy data transfer.
Volume Viewer (PET/MR Compatible)	Volume Viewer provides innovative 3D visualization and processing capabilities for reading and comparing PET/MR, PET/CT, CT, MR, and 3D X-ray datasets. Volume Viewer also features a broad portfolio of high performance analysis tools, automating routine tasks and to simplify 3D processing and streamline your workflow.
CortexID PET/CT, PET/MR Compatible	CortexID image analysis software has been developed to aid clinicians in the assessment and quantification of pathologies derived from PET brain scans. The software enables the display, co-registration, and fusion of PET and CT images. It enables automated quantitative and statistical analysis of FDG uptake by registration to a standard template space and comparing intensity values. Additionally, CortexID assists with comparison of the activity in defined brain regions of individual scans relative to normal activity values as found in normal subjects. Quantification is presented using volumes of interest, voxel-based or 3D stereotactic surface projection maps of the brain.
Integrated Registration (PET/MR Compatible)	Integrated Registration allows the capability to fuse and register two volumetric acquisitions from either the same or different acquisition modalities. With it, you can easily compare 3D anatomical images from MR, PET, CT, SPECT, and X-ray angiography for a more comprehensive analysis.
OncoQuant (PET data)	OncoQuant medical diagnostic software streamlines Oncology reading so you can spend less time retrieving studies and preparing exams, and more time reading and reviewing. A true cross-modality Oncology reading platform, OncoQuant helps you correlate and compare CT, MR, PET/CT, and 3D X-ray data. It automates workflow to facilitate comparisons over time and makes reviewing follow-up exams more efficient. The Oncology Review protocol and follow-up wizard simplify the assessment, characterization and measurement of findings on the basis of morphologic criteria.
PET VCAR 3.0 (PET data)	Integrated into the OncoQuant oncology platform, PET VCAR (Volume Computer Assisted Reading) improves visualization and analytical monitoring of disease progression or response to therapy.
Motion VUE2 (PET data)	Motion VUE2 allows review and analyzing of PET-only images acquired with respiratory gating followed by respiratory motion correction.
Dynamic VUE (PET data)	Dynamic VUE allows optimal use of the information PET and PET/CT scanners provide from static, dynamic and gated scans. With it, you have the ability to quantitatively review 4D PET datasets and generate time activity curves and summing images over time.
READY View (MR data)	READY View helps you maximize applications from multi-parametric exams by enabling analysis of MR data sets with multiple images for each scan location. The platform offers a combination of protocols, applications, and tools that will help you make quantified analyses of multiple data sets quickly and easily
BodyView (MR data)	BodyView provides algorithms, tools, and workflows for processing time series data acquired in the body. It also calculates parametric image from contrast enhanced images based on the temporal evolution of signal intensity.
BRAIN View (MR data)	Integrated with the Ready View platform, Brain View Plus offers you advanced techniques to easily and confidently analyze information from a variety of MR brain-specific imaging data sets.
Vessel IQ Express (MR data)	MR VesselIQ Express is an AW platform post processing package that provides you with additional tools to help in the analysis of MR angiographic data. The software includes display, measurement, and batch filming/archive features to let you efficiently analyze selected vessels for stenosis, directional tortuosity and other anomalies.

chart continued on page C.6

chart continued from page C.5

CardIQ Physio (PET data)	CardIQ Physio is a totally integrated post-processing assessment package that includes processing, visualization, and quantification protocols. CardIQ Physio gives you the ability to accurately and reproducibly quantify left ventricular volumes, ejection fractions, and myocardial mass. Optimized to perform cardiac function assessment using GE Discovery PET multi-bin, multi-slice cardiac PET images, this non-invasive method may aid in the diagnosis and treatment protocol of cardiovascular disease.
CardiacVX (MR data)	CardiacVX enables you to import MR images into your AW Workstation where you can use a range of reproducible tools for reviewing & reporting. CardiacVX provides you with the capability to access multiple studies and multi-slice, multi-phase images, which can be displayed in cine mode to facilitate visualization.
StarMap (MR data)	StarMap is a post processing technique that helps evaluate iron content in the heart and liver. StarMap includes a variety of tools to streamline workflow and enables you to generate comprehensive reports.
CADstream 5.2	CADstream includes hardware and post processing software that facilitates analysis and management of breast image data. Image processing is performed automatically, using predefined templates for non-rigid image registration, subtraction, parametric maps, maximum intensity projection and multi-planar reformat. CADstream also generates reports that include images and graphs that can be exported in PDF or DICOM formats. CADstream includes SureLoc – a tool that helps radiologists to more efficiently calculate coordinates for MR-guided interventions at the point of procedure. SureLoc reports needle position in real time and displays images and needle position in the patient's orientation. The following new features are available on CADstream 5.2: • CADalog, CADstream's study library provides instant access to CADstream-processed studies. • Easily view and align patient studies side-by-side for comparison. • Automatically calculate differences between studies, including changes in lesion sizes and diameters. • Report changes between studies using the CADstream Portfolio. • Multiple configurations provide improved scalability to accommodate MRI program growth, including increases in study volume, physicians' reading locations. • CADstream integrates at the work-list level with many PACS, including Merge, GE, Carestream, McKesson and Sectra. • The BIRADS-centric user interface guides use through the recommended assessment for location, size, morphology and kinetics analysis, and automates reporting. • Smart, adaptive motion correction automatically registers in 2D or 3D, depending on patient movement. • Allows users to select the worst curve within a lesion. • Provides the ability to grow or shrink region of interest for improved reporting of DCIS or treated lesions. • Improved reports and renderings enhance communication with referring physicians and patients.
Flow Analysis 4.0	A subset of the ReportCard 4.0, clinicians interested in quantifying CSF or blood flow can access all of the ReportCard's flow features including: peak and average flow charts and graphs, automated contour detection and PACS compatibility.

21. GE Regulatory Compliance

The SIGNA PET/MR complies with all applicable safety standards, including but not limited to UL60601-1 and IEC60601-1-2 (Electromagnetic Compatibility).

Laser alignment devices contained within this system are appropriately labeled according to the requirements of the FDA's Center for Devices and Radiological Health (CDRH)

About GE Healthcare

GE Healthcare provides transformational medical technologies and services to meet the demand for increased access, enhanced quality and more affordable healthcare around the world. GE (NYSE: GE) works on things that matter – great people and technologies taking on tough challenges. From medical imaging, software & IT, patient monitoring and diagnostics to drug discovery, biopharmaceutical manufacturing technologies and performance improvement solutions, GE Healthcare helps medical professionals deliver great healthcare to their patients.

GE Healthcare
3200 North Grandview Blvd.
Waukesha, WI 53188
U.S.A.
www.gehealthcare.com

imagination at work

DOC1545629 08/14