

GE Healthcare

## **SIGNA® 1.5T EXCITE® HD** Product Data

Powered by High Definition (HD) technology, the GE Signa® 1.5T EXCITE® HD MR System is the first MR system designed to create high definition MR images.



EXCITE HD is designed to create high definition MR images through a synergy between clinical applications and technology. The HD technology features significant advances in acquisition, gradients, and the human interface. The result of these advances is the only MR system capable of delivering high definition images for even the most challenging patients.

The EXCITE HD MR system is the product of a long line of industry firsts, featuring a detachable patient table, actively-shielded magnet, actively-shielded magnetic-field gradients, phased-array digital radiofrequency electronics, high-density coils, and EXCITE (EXpanding applications with multi-Channel Imaging TEchnology) to manage the flow of data through the MR system.



## Table of Contents

Signa 1.5T EXCITE HD Overview .....	3
1.5T Magnet .....	4
HD Acquisition .....	6
HD Gradient Subsystem .....	7
HD Scanning Parameters .....	9
Patient Table and Transport .....	11
HD RF Coils and Arrays .....	12
HD Human Interface .....	16
HD ScanTools .....	20
Optional HD Applications .....	22
Siting and Other Specifications .....	29



# Signa 1.5T EXCITE HD Overview

EXCITE HD Technology revolutionizes MR scanning by providing unprecedented spatial resolution, the speed to image physiological processes, and scanning strategies to minimize patient artifacts. Three unique technologies are the key: HD Acquisition, HD Gradients, and the HD Human Interface.

## HD Acquisition

Built upon GE's exclusive EXCITE™ data pipeline, HD Acquisition accommodates up to 16 independent channels of data today and is capable of much more in increments of 16 channels. The unique architecture of one array-processing unit per receiver permits the simultaneous use of all coil elements, receivers, and array processors. This unique electronics makes practical the use of receiver coils with a high density of coil elements to create high definition MR images.

## HD Gradients

The second key element of HD technology is the most accurate and repeatable gradients ever designed. This is critical for high image quality with echoplanar imaging, fast spin echo imaging, and complex techniques such as PROPELLER. This new capability, combined with high amplitude and slew rate, enables EXCITE HD to create MR images with a quality previously unattainable.

## HD Human Interface

The HD Human Interface offers innovations to make it easier for the patient, technologist, and radiologist. It builds on the detachable patient table, which remains an industry exclusive for patient safety. The HD Coil Interface creates a secure coil connection to ensure the highest possible image quality. HD Gating improves the consistency of ECG triggering to approximately 99%. With the HD Scan Interface, which is designed around the Linux operating system, most of scan setup is accomplished on a single screen. The Scan Interface includes ProtoCopy to facilitate the development and sharing of scan protocols and take the guesswork out of scanning.

## Neurological Applications

HD Technology brings high definition to neuro imaging, through HD coils and applications such as PROPELLER to overcome patient motion, Diffusion Tensor Imaging for surgical planning, BrainWave for functional studies, and proton spectroscopy with metabolite maps created in Functool. These applications bring superb image quality even with the most challenging of patients.

## Cardiovascular Applications

TRICKS is the industry standard for time-resolved MRA, because of its simplicity, reliability, and inherent ability to add flow information without sacrificing spatial resolution. Fluoro-triggering and automated multi-station techniques complement TRICKS. For the heart, there is a new technique inspired by echocardiography, called MR Echo. High-resolution coronary artery imaging is feasible using 3D FatSat FIESTA. There are techniques to study myocardial evaluation, wall motion, and cardiac function. And to complete the study, ReportCARD is tailor-made to create the type of report that referring physicians expect.

## Body Applications

A new HD application called LAVA (Liver Acquisition with Volume Acceleration) offers 25% better spatial resolution, 25% better coverage, all in a 25% shorter breath-hold. The high-density body array coil generates more signal-to-noise through its high density of coil elements. VIBRANT™ provides the unique capability to acquire sagittal or axial 3D images of both breasts with excellent fat saturation in the same time as it takes to image only one breast.

## Orthopedic Applications

EXCITE HD brings high definition to musculoskeletal imaging. Coupled with advances in image acquisition software is the new high-density knee coil. Its unique hybrid transmit-receive phased-array design prevents wrap-around artifacts and the high density of elements affords higher signal-to-noise -- making knee imaging better than ever.



## 1.5T Magnet

The 1.5T EXCITE HD MR system features a short-bore superconducting magnet that creates the most homogeneous magnetic field throughout the entire imaging volume. This translates into the best image quality. The open appearance of the magnet accommodates patients without compromising image quality. And an extremely low helium consumption rate means a long time between refills.

Operating field strength	1.5 Tesla
Shim coils	18 superconducting
Magnet shielding	Active
EMI shielding factor	99%
Size (w/o enclosures) (length x width x height)	172 cm x 208 cm x 216 cm
Size (enclosures and He port) (length x width x height)	196 cm x 208 cm x 241 cm
Magnet weight (with cryogenics and gradient coil)	5155 kg (11340 lbs) 5382 kg (11840 lbs) for Twin Speed
Magnet cooling	Liquid helium only
Temporal field stability	< 0.1 ppm/hr
Long-term stability	< 0.1 ppm/hr over 24 hour period
Cryogen refill period	> 3 years, depending on frequency of shimming
Boil-off rate under normal operation	<0.03 liters/hr
Fringe field (axial x radial)	5 Gauss = 4.0 m x 2.48 m 1 Gauss = 5.7 m x 3.28 m
Manufacturer	GE Healthcare

### LV-RMS Homogeneity Specifications

Diameter of Spherical Volume -DSV	Specified Minimum ppm	Typical ppm
10 cm	< 0.05	< 0.025
20 cm	< 0.25	< 0.05
30 cm	< 0.50	< 0.25
40 cm	< 1.00	< 0.50
45 cm	< 1.25	< 0.63
48 cm	< 2.00	< 0.95

Large Volume Root-Mean-Square (LV- RMS) method is most rigorous with over 173,000 measurements collected over spherical volume.

### V-RMS Homogeneity Specifications

Diameter of Spherical Volume -DSV	Specified Minimum ppm	Typical ppm
10 cm	< 0.02	< 0.004
20 cm	< 0.06	< 0.02
30 cm	< 0.14	< 0.06
40 cm	< 0.35	< 0.27
45 cm	< 0.97	< 0.81
48 cm	< 2.00	< 1.65

Volume Root-Mean-Square (V – RMS) method is based on 24 measurements in each of 13 planes.



## High-Order Shim

### (TwinSpeed HD only, Optional)

In addition to the 18 super-conducting shim coils integrated into the magnet, the TwinSpeed HD model in the Signa 1.5T product line includes an optional resistive shim set, known as room temperature shims. Five 2nd order shim coils (XY, XZ, YZ, X2-Y2, and Z2) compensate for the magnetic field distortion induced by the patient. These shim coils are controlled from the operator's console through an automated shimming program. The resulting higher homogeneity translates directly into higher image quality in spectroscopy, ultra-fast imaging techniques such as Diffusion Tensor Imaging (DTI), and Diffusion-Weighted EPI, and in applications such as orthopedic imaging, in which high-quality fat saturation is critical.

## Magnet Enclosure

The magnet enclosure on the Signa 1.5T EXCITE HD MR system is designed to maximize patient comfort. A patient-friendly appearance results from the Wide Open enclosures, dual-flared design, well-illuminated, well-ventilated, and short inner bore.

Patient Bore (L x W x H)	70 cm x 60 cm x 60 cm 105 cm x 60 cm x 60 cm (TwinSpeed HD)
Enclosure length	185 cm total system length
Patient positioning features	Laser alignments for axial, sagittal, and coronal reference planes Dual table top panels
Patient comfort module	Dual-flared patient bore 2 way in-bore intercom system In-bore FiberTrack lighting system Interface for music system In-bore patient ventilation system In-bore music system (optional) Look-out head coil mirror Noise reduction with Quiet Technology (TwinSpeed HD)

This magnet enclosure is designed to provide several benefits for the patient and technologist:

- Patient anxiety is eased, resulting in reduced exam time for uncooperative patients.
- Technologists have easy access to the patient.
- Dual-sided controls improve access to cables and IV lines.
- Feet-first positioning facilitates run-off studies and set-up for claustrophobic patients.
- Quiet technology on the TwinSpeed HD enhances patient comfort.



## HD Acquisition

The key enabler of high-definition MR (HDMR) is a collection of electronics that receive the radio emissions from the patient, digitize these weak signals, and compute these signals into images. With the advent of advanced applications that generate an order of magnitude more data than ever before and require an order of magnitude more computational power than ever before, HD Acquisition plays a most critical role. This is even more the case with the advent of phased-array RF coils comprised of numerous independent coil elements allowing signals to be received across many independent channels in this so-called data pipeline.

EXCITE, which stands for EXpanding applications with multi-Channel Imaging TEchnology, is GE-exclusive technology for keeping the data flowing through the data pipeline. The power of EXCITE is that it integrates the three major components of the data pipeline: (1) Transmission, (2) Reception and (3) Processing. This integration enables greater clinical productivity, higher image quality, and is essential for the data-intensive advanced applications in high-definition MR.

EXCITE technology has a major impact on the transmission of the RF pulses and magnetic-field gradient pulses in the MR pulse sequences used to acquire the data for MR images. The technology enables rapid play-out of gradient pulses and RF pulses to realize the shortest TR, TE, and EPI echo-spacing, which in turn translates to faster acquisition, higher SNR, higher spatial resolution, and higher image quality.

The EXCITE data pipeline delivers the shortest echo spacing (ESP) in the industry, which enables the highest image quality on echoplanar imaging and fast spin echo sequences.

Resonance frequency	63.86 MHz
Maximum power output	21 kW
Simultaneous RF channels	16
High bandwidth receivers	16
Quadrature demodulation	Digital
RF filtering	Digital non-recursive
Noise	<0.5dB Noise Rating
Transmit bandwidth	>0.6 MHz with automatic control
Transmit amplitude dynamic	>100 dB range
Resolution	50 ns resolution
Frequency resolution	<0.6 Hz/step
Phase resolution	<0.1 degree/step
Amplitude resolution	16 bit control
RF preamplifiers	10
Preamplifier gain	36 dB
Receiver sampling bandwidth	1000 Hz to 1 MHz
Receiver dynamic range	>135 dB
Receiver signal resolution	Up to 32 bits
Instantaneous dynamic range	96 dB [16 bits]
Converter sampling resolution	16 bit
Sampling resolution alignment	50 ns



## HD Gradient Subsystem

HD Gradients deliver the highest accuracy and reproducibility of any magnetic-field gradient design in the industry. This assures the highest quality imaging across all applications – especially echoplanar imaging. It also means the shortest possible repetition time (TR), echo time (TE), and echo spacing (ESP).

The Signal 1.5T EXCITE HD MR gradient family delivers a level of performance matched to a range of needs. From the HiSpeed HD to the EchoSpeed HD and TwinSpeed HD, the right configuration to realize the desired spatial and temporal resolution can be chosen. The following table presents the specifications for maximum amplitude, rise time, and slew rate.

The gradients are non-resonant and actively shielded to minimize eddy currents. The gradient coil and the RF body coil are integrated into a single module, which is water-cooled for maximum performance. The electronics, including the High Fidelity Gradient Driver (HFD) to power the gradient coils, are housed in a single gradient cabinet to conserve space.

Gradient Performance	Hi Speed HD	Echo Speed HD	Twin Speed HD (Zoom)	Twin Speedm HD (Whole-Body)
Maximum Amplitude in each Orthogonal Plane (mT/m)	33	33	50	23
Rise Time to Maximum Amplitude (μsec)	428	276	267	287
Slew Rate (T/m/s)	77	120	150	77

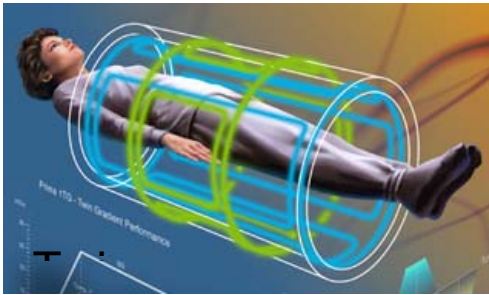
The specifications apply separately to each of three orthogonal directions. A 70% higher maximum amplitude and slew rate are possible for oblique slices when all three gradients are activated concurrently. These impressive specifications enable extremely short values for the minimum TR, TE, and ESP, which translate to superb image quality.





## TwinSpeed HD Zoom and Whole-Body Gradient Modes

The TwinSpeed HD model in the Signa 1.5T EXCITE HD product line features a gradient subsystem with two concentric sets of non-resonant gradient coils. These two sets allow two modes of operation -- Zoom and Whole Body. The availability of both modes circumvents the compromise between high amplitude and slew rate versus large field of view.



The Zoom mode offers high maximum amplitude with high slew rate while avoiding peripheral nerve stimulation. The key is to restrict the high performance to a relatively small field of view (FOV). In the diagram above, the Zoom gradient coil is the inner set shown in green. With maximum amplitude of 50 mT/m and a slew-rate of 150 T/m/sec, the Zoom mode delivers the highest possible performance for pediatric, cardiovascular, neurovascular, abdominal, and orthopedic applications -- without compromising patient safety or comfort.

The Whole-Body mode is intended for use when the FOV exceeds approximately 35 cm. Thus, the Whole-Body mode is particularly well suited for certain abdominal protocols, off-center high-resolution orthopedic imaging, and other large FOV applications.

## Quiet Technology

State-of-the-art clinical imaging demands the routine use of ultra-fast imaging techniques such as DW-EPI, FRFSE, EFGRE3D, and FGRET. Such techniques tend to generate considerable acoustic noise. Quiet Technology reduces the level of acoustic noise experienced by the patient inside the magnet bore without compromising the maximum amplitude, slew rate, or duty cycle of the gradients. This means that Quiet Technology preserves image quality.

The reduction in acoustic noise is achieved through the innovative combination of a vacuum chamber and special damping material. The gradient coil is installed inside this vacuum chamber and the vacuum level is monitored with remote diagnostic equipment.





## HD Scanning Parameters

### Spatial Resolution Parameters

Signa 1.5T EXCITE HD MR systems are capable of creating images with superb spatial resolution. This is due in part to the EXCITE data pipeline and also to the performance of the magnetic-field gradients. The table below showcases the minimum slice thickness and minimum field of view (FOV) achievable on Signa 1.5T EXCITE HD MR systems.

Minimum slice thickness in 2D	0.5 mm
Minimum slice thickness in 3D	0.1 mm
Minimum FOV	10 mm
Maximum FOV	480 mm

### Spiral Acquisition

	Hi Speed HD	Echo Speed HD	Twin Speed HD
Minimum TR (128x128 matrix)	0.76 ms	0.71 ms	0.71 ms
Minimum TE (128x128 matrix)	0.50 ms	0.46 ms	0.46 ms
Minimum Slice Thickness	1.3 mm	1.3 mm	0.7 mm
Minimum FOV	4 cm	4 cm	2 cm
Maximum FOV	48 cm	48 cm	44 cm
Maximum Samples per Arm	32,768	32,768	32,768

TR = Trajectory time \* Number of arms / 128

TE = TR - (128/2) \* (1/ max bandwidth)

### EPI

	Hi Speed HD	Echo Speed HD	Twin Speed HD
Minimum TR (64x64 matrix)	4.0 ms	4.0 ms	4.0 ms
Minimum TR (128x128 matrix)	5.0 ms	5.0 ms	5.0 ms
Minimum TR (256x256 matrix)	6.0 ms	6.0 ms	5.0 ms
Minimum TE (64x64 matrix)	1.1 ms	1.1 ms	1.0 ms
Minimum TE (128x128 matrix)	1.3 ms	1.2 ms	1.1 ms
Minimum TE (256x256 matrix)	1.6 ms	1.6 ms	1.4 ms
Minimum Slice Thickness	1.9 mm	1.9 mm	1.6 mm
Minimum FOV	4 cm	4 cm	4 cm
ESP at 99 cm FOV (64x64 matrix)	0.300 ms	0.252 ms	0.216 ms
ESP at 99 cm FOV (128x128 matrix)	0.408 ms	0.344 ms	0.320 ms
ESP at 99 cm FOV (256x256 matrix)	0.596 ms	0.580 ms	0.596 ms
ESP at 25 cm FOV (64x64 matrix)	0.564 ms	0.456 ms	0.412 ms
ESP at 25 cm FOV (128x128 matrix)	0.796 ms	0.660 ms	0.632 ms
ESP at 25 cm FOV (256x256 matrix)	1.16 ms	1.03 ms	0.964 ms
Minimum shots	1	1	1
Maximum b Value	4,000 s/mm <sup>2</sup>	7,000 s/mm <sup>2</sup>	10,000 s/mm <sup>2</sup>
Images per second (64x64 matrix)	30	33	35
Images per second (128x128 matrix)	19	21	22
Images per second (256x256 matrix)	6	6	9
Maximum Diffusion Tensor Directions	N/a	55	55
Maximum Echo Train Length	512	512	512



## 2D Fast Gradient Echo

	Hi Speed HD	Echo Speed HD	Twin Speed HD
Minimum TR (128x128 matrix)	2.5 ms	2.3 ms	2.3 ms
Minimum TR (256x256 matrix)	3.0 ms	2.8 ms	2.7 ms
Minimum TE (128x128 matrix)	0.9 ms	0.9 ms	0.8 ms
Minimum TE (256x256 matrix)	1.1 ms	1.0 ms	1.0 ms
Minimum Slice Thickness	0.7 mm	0.7 mm	0.5 mm
Minimum FOV	1 cm	1 cm	1 cm
Maximum FOV	48 cm	48 cm	44 cm
Maximum Echo Train Length	12	12	12

## 3D Fast Gradient Echo

	Hi Speed HD	Echo Speed HD	Twin Speed HD
Minimum TR (128x128 matrix)	1.3 ms	1.1 ms	0.8 ms
Minimum TR (256x256 matrix)	1.7 ms	1.6 ms	1.1 ms
Minimum TE (128x128 matrix)	0.5 ms	0.4 ms	0.3 ms
Minimum TE (256x256 matrix)	0.7 ms	0.6 ms	0.5 ms
Minimum Slice Thickness	0.1 mm	0.1 mm	0.1 mm
Minimum FOV	2 cm	2 cm	1 cm
Maximum FOV	48 cm	48 cm	44 cm

## 2D Spin Echo

	Hi Speed HD	Echo Speed HD	Twin Speed HD
Minimum TR	10.0 ms	10.0 ms	7.0 ms
Minimum TE	2.5 ms	2.5 ms	2.5 ms
Minimum Slice Thickness	0.9 mm	0.9 mm	0.5 mm
Minimum FOV	1 cm	1 cm	1 cm
Maximum FOV	48 cm	48 cm	44 cm

## Fast Spin Echo

	Hi Speed HD	Echo Speed HD	Twin Speed HD
Minimum TR (128x128)	10.0 ms	10.0 ms	10.0 ms
Minimum TR (256x256)	11.0 ms	10.0 ms	10.0 ms
Minimum TE (128x128)	2.5 ms	2.5 ms	2.5 ms
Minimum TE (256x256)	2.6 ms	2.5 ms	2.5 ms
Minimum Slice Thickness (2D)	0.8 mm	0.8 mm	0.6 mm
Minimum Slice Thickness (3D)	0.3 mm	0.3 mm	0.3 mm
Minimum FOV	1 cm	1 cm	1 cm
Maximum FOV	48 cm	48 cm	44 cm
Minimum Echo Spacing (128x128)	2.5 ms	2.5 ms	2.5 ms
Minimum Echo Spacing (256x256)	2.6 ms	2.5 ms	2.5 ms
Minimum Shots	1	1	1
Maximum Echo Train Length for SSFSE	262	262	262

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



## Patient Table and Transport

The Signa 1.5T EXCITE HD System includes a detachable patient table that provides maximum patient comfort and is a natural safety consideration for MR imaging. In those instances where emergency evacuation is required, patients can be transported from the magnet room in under 30 seconds, obviating the need for 1.5T-compatible emergency equipment.

Easily docked and undocked by a single operator, the patient table is easy to transport to and from the room during patient preparation procedures. This becomes a vital feature when dealing with sick or uncooperative patients. This unique capability of the Signa MR table also makes it ideally suited for multi-station exams with no scan room intervention, such as peripheral vascular (run-off) imaging.

An additional optional table can provide significant improvement in site productivity by enabling positioning of the next patient outside the magnet room while the current patient is undergoing an examination.



### Table Specifications

Patient table height	68.58cm (27 inches) to 96.52 cm (38 inches) continuous
Patient table drive	Automated, power driven vertical & longitudinal
Longitudinal speed	10.26 cm/sec (fast) and 1.29 cm/sec (slow)
Vertical speed	2.58 cm/sec (1.02 inches/sec)
Total cradle length	210.8 cm (83 inches)
Total cradle travel	244cm (96.25 inches)
Positioning accuracy	+/- 0.05 cm (+/- 0.0019 inches)
Maximum patient weight for scanning	159 kg (350 lbs)
Maximum weight for patient guardrails	113.4 kg (250 lbs)
Patient transport accessories	Self storing non-ferrous IV pole Positioning pads Immobilization straps Table pad and Head Coil accessory
Compatibility	Also compatible with Signa 3.0T systems.



## HD RF Coils and Arrays

High-density arrays that focus coil elements around the anatomy of interest, while providing extended coverage where needed, ensure optimal image quality for every procedure. The open and flexible RF architecture of the Signa 1.5T EXCITE HD system also facilitates access to coils developed by other vendors. These attributes lead to the best possible coil for each clinical application and also ensure a steady supply of new coils in the future.


The coils listed below are commercially available at the time of printing. Please contact your local GE sales representative for the most current list.


Two coils are standard on the Signa 1.5T EXCITE HD MR System:

- Quadrature Transmit and Receive Head Coil
- Quadrature Transmit and Receive Body Coil integrated with the gradient coil.


There are many optional receiver coils available to configure a Signa 1.5T EXCITE HD MR system to meet specific applications requirements.


### Standard Coils with each MR System

	16-rung quadrature birdcage Patient-friendly split-top design 28 cm diameter x 38 cm length Head and Brain Extremities Pediatric imaging
<b>Transmit / Receive Head Coil</b>	

	Fully integrated 32-rung quadrature birdcage 60 cm inner diameter Up to 48 cm FOV General applications
<b>Transmit / Receive Body Coil</b>	

### Coils for Neurological Applications (Optional)

	12-element phased-array coil Highest SNR in head ASSET optimized Extensive coverage & uniformity Higher productivity without repositioning Carotids, soft tissue neck, Cervical spine, brain
<b>HD Neurovascular Array</b> (not available until Q1'05)	

	13-element phased-array coil High SNR in head ASSET optimized Higher productivity with head and neck imaging without repositioning Up to 40 cm FOV without repositioning patient or coil Carotids, soft tissue neck, cervical spine, brain
<b>8-Channel Neurovascular Array</b>	

	8-element phased-array coil Patient friendly open design Head and Brain Pediatric imaging MRA Ankles and Feet
<b>8-Channel Brain Array</b>	

	Extensive coverage & uniformity Up to 44 cm FOV without repositioning patient or coil Carotids, soft tissue neck, cervical spine, brain MRA from aortic arch to circle of Willis
<b>4-Channel Neurovascular Array</b>	





**8-Channel CTL Spine Array**

12-element phased-array coil  
High SNR, high uniformity, and extensive coverage  
Feet-first or head-first positioning  
High productivity for multi-station exams  
Built-in volume neck coil  
Conforms to curvature of spine  
75-cm (29.5-in) in S-I direction for whole spine coverage



**4-Channel CTL Spine Array**

6-element quadrature phased-array receive coil  
High productivity for multi-station exams  
Built-in volume neck coil  
Conforms to curvature of spine  
75-cm (29.5-in) in S-I direction for coverage of entire spine



**Anterior Neck Coil**

Single-element receive-only coil  
Conforms to anterior portion of neck and upper chest  
30 cm S/I coverage  
Soft tissue neck, pharynx, carotids

## Coils for Body Applications (Optional)



**8-Channel Body Array**

12-element coil  
Very high SNR  
ASSET optimized  
Extensive longitudinal coverage of 50 cm (20 in) for imaging of abdomen and pelvis without repositioning



**4-Channel Torso Array**

4-element phased-array coil  
ASSET compatible  
S/I coverage of 32 cm (12.5 in); R/L coverage of 34 cm (13.4in)  
Flexible and light



**HD Breast Array**  
(not available until Q1'05)

8-element phased-array coil  
Optimized for VIBRANT  
High SNR and uniformity  
Open design  
Single breast Imaging  
Bilateral breast imaging  
Biopsy using immobilization device available elsewhere



**4-Channel Breast Array**

4-element phased-array coil  
Compatible with VIBRANT  
Open design  
Single breast Imaging  
Bilateral breast imaging  
Biopsy using immobilization device available elsewhere



**Auto Tune Device**

ATD-T Allows combination of Endorectal coil with 4-Channel Torso Array  
Prostate imaging and spectroscopy



**Endorectal Coil**

5 disposable units per package  
Can be combined with Torso Array using ATD-T and Pelvic Array using ATD-III  
Prostate imaging and spectroscopy, rectum, and cervix





## Coils for Cardiovascular Applications (Optional)



**8-Channel Cardiac Array**

8-element phased-array coil  
High SNR  
ASSET optimized, even for double-oblique slices  
Open design for comfort and greater access to ECG leads  
Extensive coverage of 30 cm in S/I and R/L directions  
Whole heart imaging, coronary arteries, thorax, and abdomen



**4-Channel Cardiac Array**

4-element phased-array coil  
Whole-heart coverage  
Whole heart imaging, coronary arteries, thorax, and abdomen



**HD Lower Leg Array**  
(not available until Q1'05)

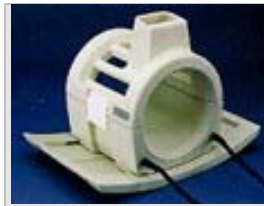
32-element phased array coil  
Approximately 15 times higher SNR than body coil  
High resolution MR angiography of peripheral vasculature

## Coils for Orthopedic Applications (Optional)



**HD Knee Array**  
(not available until Q1'05)

Transmit / receive phased-array coil  
High density of coil elements delivers highest possible SNR for knee imaging



**Quad Lower Extremity Coil**

birdcage coil  
Unique "chimney" design adds versatility for ankle and foot imaging  
Sensitive volume covers 22 cm FOV for knee imaging and 28 cm FOV for foot imaging



**Shoulder Phased Array**

Higher SNR than linear or quadrature coils  
Unique sleeve design  
Comprehensive shoulder imaging  
Humeral head and neck, rotator cuff, glenoid labrum, acromium process, and glenohumeral articular surfaces



**Wrist Array Coil**

4-channel phased array coil  
High SNR to enable high spatial resolution images  
Position overhead or at patient's side, vertical or horizontal  
12 cm S/I coverage wrist and hand





**Shoulder Coil**

Single-element receive coil  
Uniform signal intensity allows for superior fat suppression and depiction of soft tissues  
Contoured for shoulder joint  
Intended for shoulder, humeral head and neck, glenoid fossa, acromion process, rotator cuff, and glenoid labrum



**Dual Coil Accessory**

Capability to combine two receive-only non-phased array coils (not included)  
Package includes Dual Coil Combiner, TMJ Positioning Device, and Eye/TMJ/IAC surface coil positioning device  
Intended for bilateral imaging



**Dual Array Adapter**

Allows two receive-only non-phased array coils to be combined  
Allows extension of FOV through use of two coils  
Intended for simultaneous imaging of anatomical sites with bilateral symmetry, including TMJ, hip, wrists, ankles, and neck



**3-inch General Purpose Circular Coil**

Single-element receive-only coil  
High SNR over small FOV  
7.5 cm (3 inches) in diameter  
Can be combined with a similar coil using Dual Array Adapter for bilateral imaging  
Intended for orbits, ankle, internal auditory canal, wrist, and small structures



**Dual Array Package**

Combined capability of 3-inch Coil and Flex Coil  
Includes Dual Coil combiner, TMJ Positioning Device, Two 7.5 cm (3 inch) Coils, Two General Purpose Flex Coils, Eye/TMJ/IAC surface coil positioning device  
Intended for bilateral imaging -- TMJ, IAC, and orbits



**5-inch General Purpose Circular Coil**

Single-element receive-only coil  
High SNR over moderate FOV  
12.5 cm (5 inches) in diameter  
Can be combined with a similar coil using Dual Array Adapter for bilateral imaging  
Intended for medium-sized anatomical structures



**TMJ Kit**

Combined capability of 7.5 cm (3-inch) coils  
Package includes Dual Coil Combiner, TMJ Positioning Device, Two 7.5 cm (3 inch) Coils, Eye/TMJ/IAC surface coil positioning device  
Intended for bilateral imaging – TMJ, IAC, and orbits



**General Purpose Flex Coil**

Single-element, receive-only coil  
Versatile  
Coil wraps around anatomy of interest  
Intended for hip, shoulder, brachial plexus, large knee, ankle, thigh, elbow, and neck





## HD Human Interface

Designed to lighten the workload of the operator, the 1.5T Signa EXCITE HD computer platform is built upon a parallel, multiprocessor design that delivers the simultaneity and speed needed for clinical and advanced research operation. Productivity, efficiency and streamlined data management are guaranteed through simultaneous scanning, reconstruction, filming, archiving, networking and post-processing.



## HD Scan Interface

The HD Scan Interface incorporates many features designed to lighten the workload of the operator, beginning with an optimized, intuitive and flexible 3-plane graphic localizer process.

Once a prescription has been made, it is easily carried through to all subsequent series with the simple click of a mouse button.

The HD Scan Interface revolutionizes scanning. Users effortlessly move between six (6) simultaneous desktops, streamlining the scanning, post-processing, filming and patient entry processes.

SmartPrescan optimizes image quality and streamlines the scanning process. Prescan once only at the start of the patient procedure, and optimized values are assigned to subsequent series. SmartPrescan also removes the guesswork, such that each series is scanned centered on the water peak, and optimized for the region of interest.

Separate databases of optimized GE protocols as well as site-authored scan protocols provide the ideal scan parameters for any procedure.

OneTouch™ filming allows the user to film an entire series, multi-image display or page with just one selection from either the screen or keyboard.

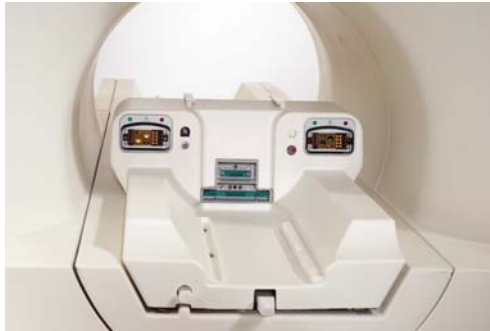
## ProtoCopy

Standard on every HD system, ProtoCopy enables a complete protocol to be downloaded with the click of a mouse into the protocol base from any digitized, GE image format. Note that this feature will be made available only when the HD product is in full production.



## HD Coil Interface

HD Technology takes the guesswork out of coil plug-in and identification by automatically identifying the coil that is connected. Through a prominent LED display on the coil connector itself, it allows the technologist to ensure a secure coil connection, every time, for every procedure.



## HD Gating

Standard on every HD system, HD Gating takes the guesswork out of gating with simple lead placement and an algorithm that ensures 99% gating accuracy every time, on every patient – even in the presence of a strong magnetic field.

## Operator Console

The HD system comes equipped with a scan control keyboard assembly that contains intercom speaker, microphone and volume controls, and an emergency stop switch. Keyboards are available in English, Scandinavian, French, Spanish, and German – all with a 3-Button Mouse.



## HD Computing Platform

Main CPU	Intel® Xeon™ Dual Processors with Hyperthreading with dual 2.66 GHz Processors AGP 8X Pro 50 Graphics 533MHz System Bus 512 KB full Speed L2 Advanced Transfer Cache
SpecMark	512 KB full Speed L2 Advanced Transfer Cache SPECfp2000 > 900 SPECint2000 > 900
Word Size	32 Bit
Host Memory	2 GB ECC DDR 266
Graphics Subsystem	Main Display: NVidia® Quadro®4 980XGL - 128 MB DDR Graphics Memory - proe-01: 21.6 - ugs-01: 20.2 - 3dsmax-01: 17.3 Waveform Display: NVidia® PCI GForce4™ MX-420 64MB
Cabinets	Single, tower configuration
Disk Subsystem	System Disk: 1-36GB, 15K RPM, Ultra 320 SCSI Data Disk: 72 GB(2-36GB), 15K RPM, Ultra 320 SCSI, Raid 0 Dual Channel Ultra 320 SCSI Controller 400,000 uncompressed 256 x 256 image files Sustained rates to 75 MB/s
Network	3 x Gigabit (10/100/1000) Ethernet Ports



## HD Reconstruction

Recon- struction	<p>Mercury Array Processors</p> <p>SVP16 array processor matched to 16-channel architecture with 4 GB memory and capable of 1700 2D FFT operations/second on 256 x 256 matrix</p> <p>SVP8 array processor matched to 8-channel architecture with 2 GB memory and capable of 850 2D FFT's/second on 256 x 256 matrix</p> <p>SVP4 array processor matched to 4-channel architecture with 1 GB memory and capable of 425 2D FFT's/second on 256 x 256 matrix</p> <p>32 bit floating point data format</p> <p>Linked to host computer via DataBlizzard high speed bus-to-bus interface, which transmits data at 72MB/sec (16 x Ethernet rate)</p>
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## HD Archiving

Standard MOD drive	<p>Maxoptix™ Erasable, rewritable media 1.3 or 2.3 GB unformatted</p> <p>Assigned to DICOM 3.0 format image file and protocol file storage/retrieval</p> <p>Stores up to 15,000 (for 1.3 GB) or 30,000 (for 2.3 GB) loss-less JPEG compressed 256 x 256 image per MOD</p> <p>Offline retrieval of image files.</p>
DVD Interchange	<p>SONY DRU-530A DVD-RW</p> <p>Data transfer rate 21.6MB/s</p> <p>Access speed – average random stroke approx. 200ms.</p>

## HD Filming

Filming	<p>Drag &amp; Drop filming</p> <p>One button Print Series</p> <p>One button Print Page</p> <p>Multi-image formats - 1:1, 2:1, 4:1, 6:1, 9:1, 12:1, 15:1, 16:1, 20:1, 25:1 and 35 mm slide</p> <p>DICOM 3.0 Basic Grayscale Print Service Class</p>
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## HD Display

AutoView	<p>256 x 256 Image Window (standard)</p> <p>512 x 512 Image Window (maximized)</p>
Window / Level (W/L)	<p>7 user-programmable keys on scan control keyboard plus one key for returning to prior setting</p> <p>6 user-programmable buttons in image viewer</p> <p>Arrow keys on scan control keyboard</p> <p>On-image through middle mouse button</p> <p>Save State stores user-selected image orientation and window level.</p>
Image Display	<p>Zoom / Roam / Flip / Rotate / Scroll</p> <p>Explicit Magnify &amp; Magnifying Glass</p> <p>Image Measurement Tools Grid On / Off</p> <p>Cross Reference / User Annotation</p> <p>Exam / Series Page</p> <p>Hide Graphics / Erase Annotation / Screen Save</p> <p>Accelerator Command Bar</p> <p>Compare Mode / Reference Image / Image Enhance</p> <p>ClariView Image Filtering</p> <p>Smooth and Sharpen Edge Filters</p> <p>Minified Reference Scoutview</p> <p>Cine Paging (up to 4 windows and 128 images/window)</p> <p>Add/Subtract / Edit Patient Data</p>
Image Display	<p>256 Image buffer (256 x 256) at 30fps</p>
Image Annota- tion	<p>Shadowed to permit ease in reading</p> <p>Two Graphic/Text planes overlay the entire screen.</p> <p>Grid placement with anatomical reference on an image.</p> <p>Drawing and annotation may be added to and removed from images</p>



## HD Display Monitor

Display Monitor	18" Color LCD Flat Panel 1280 x 1024 dot resolution Non-interlaced, flicker free presentation. Contrast ratio 300:1 89kHz horizontal deflection frequency, 72 Hz refresh rate Undistorted image display for siting up to 50 Gauss
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## Standard Image Post Processing

Multi-Projection Volume Reconstruction (MPVR)	Quick and easy way to generate volumetric images for MR or CT Angiography without threshold data or removing unwanted anatomy. An entire volume is used to generate images in any plane, creating real time frames of reference at the same time.
Multi-Planar Reformation (MPR)	Provides real time assessment of anatomy in off-axis planes. Sagittal, coronal, oblique, and curved planar reformations available.
Other standard analysis features	Curved reformations Batch reformations Interactive Vascular Imaging (IVI) Comparison Mode Multi-image ROI 3D Surface Rendering



## HD ScanTools

### Standard Pulse Sequences

The Signa EXCITE HD scanner comes standard with a package of pulse sequences and applications optimized for 1.5T performance.

Spin Echo	The gold standard for generating T1, proton density and T2 images
Fast Spin Echo (FSE) Fast Spin Echo-XL (FSE-XL)	These techniques use echo-train technology to reduce the time for image acquisition. T2 blurring is minimized by short echo spacing with EXCITE technology.
Fast Recovery Fast Spin Echo (FRFSE) (FRFSE-XL)	The new 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.
Fast Recovery Fast Spin Echo (FRFSE) (FRFSE-XL)	The new 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 images for MR cholangiopancreatography (MRCP) studies.
Single Shot Fast Spin Echo (SSFSE)	An ultra-fast technique that permits complete image acquisition following a single RF excitatio. It can acquire slices in less than one second, making it an excellent complement to T2-weighted brain and abdominal imaging and MRCP studies.

Gradient Echo (GRE) Fast Gradient Echo (FGRE) Spoiled gradient echo (SPGR) Fast Spoiled Gradient Echo (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 ensure the performance needed for state-of-the-art vascular and contrast-enhanced MRA studies.
Dual Echo Gradient Echo	A vital tool for abdominal imaging. This variation on conventional gradient echo provides a pair of images for which the signal from water and fat either add constructively or interfere. By design, all of the images acquired within a single breath-hold are in perfect registration.
SPECIAL	(Spectral Inversion at Lipids) is a spectral spatial inversion technique for fat saturation in 3D GRE pulse sequences.
T1 FLAIR T2 FLAIR	These pulse sequences have been designed expressly for neuro applications. FLAIR allows suppression of signal from 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  FLAIR Echo-planar Imaging	Essential tools for any high-throughput site employing advanced techniques. EchoPlanar imaging is what enables the rapid imaging required for such studies as functional brain mapping. And both EchoPlanar and FLAIR EchoPlanar techniques make it easier to generate neuro studies from uncooperative patients who simply refuse to stay still long enough for conventional techniques.



2D and 3D Time of Flight Imaging	2D Time of Flight Imaging, 2D Gated Time of Flight Imaging, 3D Time of Flight Imaging and Enhanced 3DTOF Imaging are all ideal for MR angiography. Based on conventional gradient echo scanning, these time of flight (TOF) imaging techniques rely primarily on flow-related enhancements to distinguish moving from stationary spins.
2D-Gated Time of Flight Imaging	
2D Phase Contrast (2DPC)	These techniques demonstrate flow velocities and directional properties in vessels and other moving fluids such as cerebrospinal fluid.
3D Phase Contrast (3DPC)	
Smart-Prep	SmartPrep uses a special tracking pulse sequence to monitor the MR signal through a user-prescribed volume ... to detect the arrival of an injected contrast bolus ... and to trigger the acquisition, for optimum contrast enhancement.
Double / Triple IR	These pulse sequences are included to allow black-blood imaging for studies of cardiac morphology.
FastCine	This pulse sequence is included specifically for studies of cardiac ventricular function. Through the use of retrospective gating, it allows full R-R coverage.
i-Drive Pro	i-drive 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 i-Drive Pro technique allows the user to change scan parameters on the fly, during scanning—and, to evaluate the results immediately.
IVI	An interactive user interface that allows operators to remove background from MR angiography 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.

FuncTool Performance	FuncTool Performance enables advanced MR-image post-processing using a wide range of sophisticated algorithms, including ADC maps and eADC maps Correlation Coefficients for mapping of motor strip and visual/auditory stimuli NEI (Negative Enhancement Integral) MTE (mean time to enhance) Positive Enhancement Integral Signal Enhancement Ratio Maximum Slope Increase Maximum Difference Function Difference Function
FuncTool Performance combined with optional software	Diffusion Tensor Post-Processing* (requires Diffusion Tensor option). The Diffusion Tensor imaging package offers basic post processing on the operator's console such as ADC, diffusion-weighted image and fractional anisotropy. The results can be displayed in a variety of user-defined formats, including time intensity curves, parametric color overlays and metabolite ratio maps. 3DCSI Post Processing* (requires PROSE option key).





## Optional HD Applications

### ASSET

The Array Spatial Sensitivity Encoding Technique (ASSET) is a technique to scan more rapidly – up to three times faster in certain cases. Reducing scan times is a critical consideration for patient comfort. ASSET can also be used to increase spatial or temporal resolution or to acquire more slices for the same scan time. ASSET also offers the means to minimize the RF exposure to a patient.

ASSET is compatible with the following sequences:

- 2D Fast Gradient Echo (2DFGRE)
- 2D Fast Spoiled Gradient Echo (2DFSPGR)
- 3D Fast Gradient Echo (3DFGRE)
- 3D Fast Spoiled Gradient Echo (3DFSPGR)
- 3D Time of Flight Gradient Echo (3DTOFGRE)
- 3D Time of Flight Fast Spoiled Gradient Echo (3DFSPGR)
- 2D Fast Spin Echo (2DFSE)
- 2D Fast Spin Echo-XL (2DFSE-XL)
- 2D Fast Recovery Fast Spin Echo (2DFRFSE)
- 2D Fast Recovery Fast Spin Echo-XL (2DFRFSE-XL)
- 2D Fast Spin Echo Inversion Recovery (2DFSE-IR)
- 2D T1-Fluid Attenuated Inversion Recovery (T1-FLAIR)
- Single Shot Fast Spin Echo (SSFSE)
- Echoplanar imaging (EPI)
- Diffusion-weighted Echoplanar imaging (DW-EPI)
- Diffusion tensor Imaging (DTI)
- LAVA (Optional HD Body Application)
- VIBRANT

ASSET is compatible with the following receiver coils:

- 8-Channel Brain Array
- 8-Channel Neurovascular Array
- HD Neurovascular Array
- 4-Channel Torso Array
- 8-Channel Body Array
- 8-Channel Cardiac Array
- 4-Channel Breast Array
- HD Breast Array
- HD Knee Array

### ConnectPro Plus

ConnectPro is software that enables the DICOM 3.0 worklist server class for the Signa Operator's Console, making it possible for the console to query the HIS/RIS by name, modality, or scheduled date, and to download patient demographics directly to the scanner. This may require separate gateway hardware to connect non-DICOM-compatible HIS/RIS systems to the MR system.

### Bar Code Reader

This bar-code reader allows the download of pre-coded patient demographics directly to the scanner.

### Performed Procedure Step

Performed Procedure Step (PPS) is an important step towards the filmless and paperless environment. 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 to billing.

### i-Drive Pro Plus

iDRIVE Pro Plus expands the capabilities of standard i-Drive 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.





## Neuro Applications

### PROPELLER

PROPELLER is a technique derived from fast spin echo (FSE) for brain imaging and named for its unique k-space acquisition, in which data are acquired in radial “blades” that rotate similar to the propeller on an airplane until the acquisition is completed.

Since each blade passes through the center of k space, PROPELLER has unusually low sensitivity to motion artifacts and exceptionally high contrast-to-noise properties. This makes it ideal for producing high-resolution image quality even under challenging circumstances.

PROPELLER comes in 3 different flavors that deliver real clinical impact. T2 FSE PROPELLER creates T2-weighted images that are degraded much less by head motion than conventional FSE, with a 25-75% increase in contrast to noise without any time penalty. Imagine acquiring a motion-free scan, every time, and even on the most difficult of patients.

T2 FLAIR PROPELLER combines T2 FLAIR image contrast with the tolerance of motion and superb contrast-to-noise characteristic of PROPELLER.

Diffusion-weighted PROPELLER is an alternative to the more conventional technique based on echoplanar imaging, which tends to be compromised in the presence of large changes in magnetic susceptibility. Diffusion-weighted PROPELLER produces high quality images in the skull base even in the presence of dental work, craniotomies or other abnormalities that cause a magnetic field disturbance.

### Diffusion Imaging (EchoPlus)

This diffusion-weighted EPI package can improve the ability to detect acute and hyper-acute stroke. It includes:

- Single Shot FLAIR EPI and Single Shot diffusion-weighted EPI with b-value up to 10,000 s/mm<sup>2</sup>
- Automatic isotropic diffusion weighted imaging
- Multi-NEX capability
- On-line image processing
- ADC maps (enabled by ScanTools)

### Diffusion Tensor Imaging

This package expands EPI capability to include diffusion tensor imaging, a special technique that utilizes 6 to 55 diffusion-sensitizing gradient directions. Excellent image contrast is generated, based on the degree of diffusion anisotropy in cerebral tissues such as white matter. FuncTool capabilities on the console (included as part of ScanTools) create Fractional Anisotropy Maps (FA Maps) and Volume Ratio Anisotropy Maps (VRA Maps).

### FIESTA-C

This phase-cycled FIESTA reduces sensitivity to susceptibilities that may be encountered when 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 T2 imaging through the cervical spine.

### 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.

### PROBE-P Single Voxel Spectroscopy

PROBE-P single-voxel spectroscopy permits non-invasive evaluation of the relative concentrations of in-vivo metabolites and the acquisition and display of water-suppressed hydrogen spectra localized to a single voxel. Localization is achieved through the PRESS technique, in which spatially selective RF pulses affect perpendicular slices. The software also includes special techniques to achieve the shortest possible echo time, TE. Graphic prescription of spectroscopic volumes is one of many innovations designed to facilitate preparations for data acquisition. And the package also features the automatic reconstruction of spectroscopic data.



## **PROBE-P and PROBE-S Single Voxel Spectroscopy**

Intended for advanced spectroscopy users, this package provides the software to perform single-voxel spectroscopy through two different localization techniques, PRESS and STEAM. PRESS is generally the preferred technique, because of the associated higher SNR and shorter TE. In certain circumstances, STimulated Echo Acquisition Mode (STEAM) can provide more accurate localization and water suppression, although it has inherently lower SNR and generally a longer minimum TE compared to PRESS.

## **PROBE 2DCSI**

Extend the capability of PROBE-P single-voxel spectroscopy to multiple voxels in a two-dimensional slice with PROBE 2DCSI. Post-processing, including the capability to create metabolite maps automatically, is enabled in the FuncTool Performance Package included in ScanTools HD.

## **PROBE 3DCSI**

Extend the capability of PROBE-P spectroscopy to multiple voxels in a three-dimensional volume with PROBE 3DCSI. Post-processing, including the capability to create metabolite maps automatically, is enabled in the FuncTool Performance Package included in ScanTools HD.

## **Multi-Nuclear Spectroscopy**

This package includes a powerful RF amplifier and Sage 7 post-processing software. All T/R switches and MNS coils must be purchased separately.

## **Sage 7 Software**

SAGE 7 (Spectroscopy Analysis by General Electric, Version 7) is designed for the processing of spectroscopy data. An intuitive graphical interface offers access to a powerful toolkit of filters, transformations, correction algorithms, segmentations and quantifications. The data can be sent either to a postscript printer or exported in various formats, including BMP, EPS and GIF to JPEG, PICT and TIF.

## **BrainWave RT**

BrainWave RT is software for real-time functional brain mapping. It allows a single operator to acquire, process and display BOLD (Blood Oxygen Level Dependent) fMRI color activation images in real-time, directly on the scanner operator console. Up to 25 frames per second of EPI imaging are supported, with these images being installed directly in the scanner database (~20,000 images/series). Multiple options for displaying 2D real-time activation images are available in order to assure patient compliance. This package may be used with "soft" paradigms with custom stimulus equipment supplied independent of GE. Captured images may be rendered in 3D with the BrainWave Post Acquisition (BrainWave PA) option.

## **BrainWave Post-Acquisition Package**

This advanced visualization software permits rendering detailed 3D brain images displaying functional activation, from fMRI data acquired with BrainWave Real-Time. Display modes for the composite (one or more paradigms) color activation Z-maps include segmented (brain only) and unsegmented (transparent skull) modes. Additional interrogation tools permit detailed visual exploration (cut, peel, cross-reference) of activated areas on 3D rendered model.

## **BrainWave Hardware Lite Supplemental Paradigm Delivery**

BrainWave Hardware Lite is a supplemental paradigm generation system for functional MRI, intended for use in conjunction with the BrainWave Real-Time (RT) image acquisition software on the EXCITE HD MR system. BrainWave HW Lite 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 custom protocols. The visual and auditory output can be coupled to fMRI delivery systems purchased separately from other vendors.



## Cardiovascular Applications

### 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 now integrated with Elliptical-Centric data sampling to create the ideal imaging technique for contrast-enhanced MRA of the lower extremities in even the most challenging circumstances.

Easy to set up and easy to use, 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.

### Fluoro-Triggered MRA

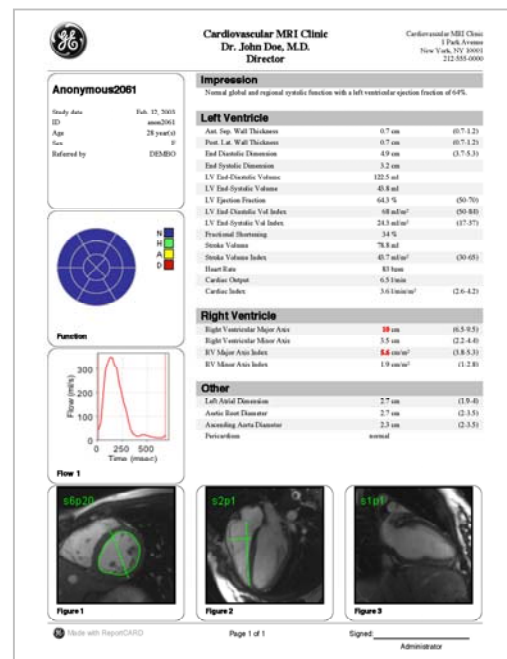
Fluoro-triggered MRA (FTMRA) is designed to If you want to capture angiographic images at the precise moment of peak opacification. Rather than automating the image-acquisition upon detection of the bolus arrival, FTMRA allows the operator to trigger each acquisition almost instantly (less than 1 second 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 contrast-enhanced MRA.

### MR Echo

MR Echo combines the contrast and image quality expected of MR with the real-time speed and interaction characteristic of echocardiography. It comprises a dedicated user interface, a 2D FIESTA acquisition sequence accelerated using 0.5 NEX and ASSET, and the fast processing that is integral to EXCITE HD. Images can be acquired without the need for breath holding or even ECG gating. The result is a reliable, fast functional study of heart ... even for patients with arrhythmias.

### ReportCARD®

ReportCARD is a software package designed specifically for the clinical practice of cardiac MRI. It greatly facilitates the viewing and analysis of cardiac MR images and the generation of a report to communicate precisely the information requested by the referring physician – and in a familiar format. Previously available only on a standalone computer, it will be possible to install ReportCARD also on an Advantage Workstation when EXCITE HD is in full production.



Measurements are compared automatically to a predetermined set of normal values and if these measurements are outside the normal range, the corresponding fields are flagged to attract the attention of the reviewer. Apply these measurements to pre-written (and user programmable) macros, and the end result is a comprehensive cardiac report that will impress the most discerning referring physician. ReportCARD also allows the complete evaluation for patent foramen ovale through the analysis of a non-invasive, IR-prepared fast gradient echo-train sequence.



## 2D FIESTA Cine

Fast Imaging Employing STeady state Acquisitions 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 for Coronary Artery Imaging

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 breath-holding requirements or allows for higher spatial resolution.

## 2D IR Prepared Gated FGRE for Myocardial Evaluation

Vital to MRI myocardial assessments, this technique can help distinguish living tissue from dead and therefore have a major impact on patient management – particularly on revascularization strategies. 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; i.e., 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 for Myocardial Evaluation

3D IR Prepared gated FGRE is an advanced tool for myocardial assessment. It uses VAST (Variable Sampling in Time) technology to acquire 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 for 3D Cardiac Imaging

This software package is designed for use in conjunction with 3D IR Prepared FGRE 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

Used to improve visualization of contractile function, this tagging application combines cardiac-gated FastCINE gradient-recalled echo to acquire data throughout the cardiac cycle, with spatial SAT pulses applied 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 data acquisition.

## Fast GRAdient Echo using EPI Echo Train

This technique combines a short-TR FGRE (Fast GRAdient Echo) pulse sequence with an EPI echo train to acquire multiple views, or phase encoding steps, per TR. It features uniform RF excitation, centric phase encoding, segmented k-space filling, retrospective gating in FastCARD-ET, EPI-caliber interleaving, and EPI-like acquisition of multiple views in one TR. Multi-phase FGRET is useful for applications such as multi-slice, multi-phase imaging of myocardial function.

## Real Time Fast GRAdient Echo using EPI Echo Train

Real Time FGRET (Fast GRAdient Echo using an EPI Echo Train) uses a short TR FGRE pulse sequence with the ability to acquire multiple views, or phase-encoding steps, per TR via an EPI echo train. The result is a useful combination of gradient-echo and EPI features, such as, uniform RF excitation, centric phase encoding, segmented k-space filling, retrospective gating in FastCARD-ET, EPI-caliber interleaving, and EPI-like acquisition of multiple views in one TR. Used in conjunction with iDrive Pro Plus,



Real Time FGRET is useful for obtaining higher-resolution interactive cardiac images.

### **Hi-Resolution Spiral Imaging**

Developed to acquire high-resolution images in less than one second, Spiral Imaging is ideally suited for imaging moving structures such as the coronary arteries. Instead of collecting data in the conventional rectilinear grid pattern, it simultaneously applies the x and y gradients in conjunction with a 2D GRE or SPGR pulse sequence, quickly gathers the data in a spiral pattern, and then interpolates the data onto a rectilinear grid for image generation. Non-gated sequences can be used with one or more slice locations; gated acquisitions can be conducted in sequential or non-sequential mode. The advantages of Spiral Imaging include faster acquisition from the more efficient k-space data collection, higher SNR from oversampling of the center of k-space, and intrinsic flow- and motion-compensation from the short echo times.

### **Real-Time Spiral Imaging**

Developed to generate images at high temporal resolution, Real-Time Spiral Imaging is ideally suited for rapid localization of moving anatomy, such as the heart. Instead of collecting data in the conventional rectilinear grid pattern, it simultaneously applies the x and y gradients in conjunction with a 2D GRE or SPGR pulse sequence to quickly gather the data in a spiral pattern – and then interpolates the data onto a rectilinear grid for image generation.





## Body Applications

### LAVA (Liver Acquisition with Volume Acceleration)

LAVA is a three-dimensional (3D) spoiled gradient echo technique designed specifically to image the liver with unprecedented definition, coverage, and speed. Excellent fat suppression, through a version of the SPECIAL technique 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 ASSET with acceleration factors of up to 2.5 at 1.5T. What is the clinical benefit of LAVA? It enables the highest quality 3D MR imaging of the liver during short breath-holding periods.

### FIESTA

Fast Imaging Employing STeady-state Acquisition (FIESTA) is designed to produce high SNR images extremely rapidly and with unique contrast between tissues. The contrast relies on a steady state for the transverse magnetization, which builds as a series of radiofrequency pulses and special gradient pulses are repeated after an extremely short repetition time, TR. FIESTA accentuates the signal from tissues that have a long T2 and short T1. New for FIESTA on 1.5T EXCITE HD is the capability to suppress the signal from fat, especially to create more contrast between the vasculature and surrounding tissues.

### VIBRANT

VIBRANT (Volume Imaging for Breast Assessment) permits high definition bilateral imaging of both breasts in the time that it normally takes to image a single breast. VIBRANT integrates ASSET technology with unique bilateral shimming and a patented fat-suppression technique developed specifically for breast imaging. This enhanced version of VIBRANT for 1.5T EXCITE HD allows the slices to be acquired in either the sagittal or axial orientation. It also provides for the automatic subtraction of pre-contrast images from post-contrast images to highlight abnormalities.

### CADstream

CADstream is a package consisting of hardware and software designed to facilitate the viewing and analysis of breast MR studies. It requires an Advantage Workstation operating with version 4.2. MR images of the breast are pushed from the MR system to the CADstream server on a dedicated computer where image-processing operations are performed automatically, according to predefined templates. These operations, which require minimal effort from the radiologist, include non-rigid image registration, subtraction, parametric maps, maximum intensity projection, and multi-planar reformation. The Advantage Workstation 4.2 is used for visualization of the results. The software allows a report comprised of key findings, images, and graphs from the data analysis to be created and sent in PDF or DICOM formats. CADstream will be available when EXCITE HD is in full production.



## Siting and Other Specifications

This section provides an overview of the siting requirements for a Signa 1.5T EXCITE HD MR system with a CX150 magnet. More detailed information is available on request.

### Typical Room Layouts

	System Configuration Minimum Values
Magnet Room W x D	3.33 m x 6.00 m (10'-11.3" x 19'-4")
Minimum Ceiling Height	2.5 m (8'-2.4")
Magnet Room (TwinSpeed HD) W x D m	3.33 m x 6.00 m (10'-11.3" x 19'-4")
Minimum Ceiling Height	2.5 m (8'-2.4")
Equipment Room W x D	3.65 m x 2.74 m (12' x 9')
Control Room W x D	1.52 m x 2.13 m (5' x 7')

### Fringe Field

	Axial	Radial
0.5 mT (5 Gauss)	4.00 m (13.12 ft.)	2.48 m (8.13 ft.)
0.1 mT (1 Gauss)	5.70 m (18.7 ft.)	3.28 m (10.76 ft.)

### Installation Dimensions and Weights

	Width	Height	Weight
Magnet Assembly CX150 with K4 Technology Active Shield	212 cm (83.27 in.)	241 cm (94.96 in.)	5155 kg (11340 lbs.)
TwinSpeed HD Magnet Assembly CX150 with K4 Technology Active Shield, Quiet Technology and RF Body coil	212 cm (83.27 in.)	241 cm (94.96 in.)	5382 kg (11840 lbs.)
Patient Transport	67 cm (26.13 in.)	97 cm (37.83 in.)	286 kg (629 lbs.)
Vibroacoustic Mat (optional WIP)			231 kg (510 lbs)
Control Room Equipment			80 kg (175 lbs.)
MR Equipment			1492 kg (3282 lbs.)
MR Equipment (TwinSpeed HD)			1840 kg (4048 lbs)

### Electrical Supply Requirements

Supply System	Recommended Configuration	3 phase Grounded WYE with Neutral and Ground (5 wire system)  Note: Neutral must be terminated inside Main Disconnect Control.
	Alternate Configuration	3 phase DELTA with Ground (4 wire). Recommend corner Grounded Delta configuration.
Voltage	480 Vrms or 380 / 400 / 415 Vrms	
Frequen cy	50 ± 0.5 Hz or 60 ± 0.5 Hz (Local voltage adaptation may be required)	





## Power Consumption

Power consumption depends on actual usage. The following values are an approximation. They exclude consumption by Shield Cooler Compressor (9 kVA).

Standby (no scan)	8 kVA
Standby (no scan) (TwinSpeed HD)	9 kVA
Average Power	18kVA
Continuous Sustained Power (> 5 seconds)	45 kVA
Peak Instantaneous Power (in< 5 seconds)	56.2 kVA

## TwinSpeed HD System Cooling Options

System Cooling Options	Continuous Power Draw
Indoor / Outdoor Single Loop Chiller	6.2 kVA
Heat Exchanger	1.4 kVA

## 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	15 - 21 °C	15 - 32 °C	15 - 32 °C
Max. Temperature Change Rate	3 °C / hour	3 °C / hour	3 °C / hour
Humidity (non-condensing)	30 - 60 %	30 - 75 %	30 - 75 %

## Alternative Environments

Modular buildings may also be available (including air-conditioning, heating, chiller, RF shielding, additional magnetic shielding in walls). Contact your local GE representative for GE certified designs and vendors.

Please ask your local GE sales representative for a comprehensive installation and siting manual.

## Filming Considerations

Filming requires the Signa 1.5T EXCITE Analog or Digital Filming Interface (purchased separately) unless DICOM Print will be used exclusively for software filming to DICOM Print peripheral devices. An Analog/VDB or Digital/LCAM Camera Interface is typically required for most installations.

## Accessory Package

- SPT Phantom Set with Storage Cart
- Customer Diagnostic Software
- Operator Manuals
- Patient Log books

## Emergency Stop

Disconnects electrical power from RF and gradient components in the magnet room (duplicate control at the magnet).

## Warranty

The published Company warranty in effect on the date of shipment shall apply. The Company reserves the right to make changes.

## InSite™ Remote Diagnostics

GE unique remote service and applications support including magnet monitoring. Also allows downloading of applications software such as eFlex trials program.

## GE Regulatory Compliance

The 1.5T Signa EXCITE HD System is a CE-complaint device that satisfies Electro-Magnetic Compatibility (EMC) and Electro-Magnetic Interface (EMI) regulations, pursuant to IEC-601.

Laser alignment devices contained within this product are appropriately labeled according to the requirements of the Center for Devices and Radiological Health.

