GE Healthcare

Discovery MR750w 3.0T Wide Bore MR with GEM Suite

Technical Data

This datasheet is intended for European Healthcare Professionals. The Discovery MR750w cannot be put into service until it has been made to comply with CE marking. It may not be available in all regions. 510(k) pending at FDA. Not available for sale in the USA.

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Discovery MR750w Overview

Patient expectations of MR have shifted in recent years, as people have begun demanding a better, more comfortable scanning experience. Increasing the size of the bore is a good first step – but it's only the beginning.

The right system should overcome traditional limitations of wide-bore MR, offering both excellent images and a user-friendly experience. Patients should be more comfortable during their scan, and clinicians more comfortable in making a definitive diagnosis. All the while, organizations should expect their MR system to help them deliver solid financial returns, maintain a high standard of patient safety, and increase the quality of their care.

Thanks to cutting edge technologies, we've advanced the capabilities of wide-bore MR by delivering both 3.0T image quality, high productivity – all with an expansive 50 cm field of view. But it's about more than the bore. Built on the fully redesigned Discovery MR platform, the Discovery MR750w offers a full-range of advanced clinical functionality, making it a workhorse system for practices of all sizes and specialties.

Magnet

When it comes to delivering on the promise of 3.0T image quality while enhancing the openness and patient experience, no other MR component has greater impact than the magnet. The Discovery MR750w system features a compact, light-weight, superconducting magnet designed to provide excellent homogeneity ensuring uniform signal and fat-suppression over a larger FOV. While improving the patient experience with a 70 cm bore size, the Discovery MR750w magnet supports a large 50 cm FOV and may reduce exam time since fewer acquisitions are needed to cover a large anatomy.

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 x W x H)	1.74 x 2.12 x 2.40 meters
Size (with enclosures) (L x W x H)	1.96 x 2.13 x 2.34 meters
Magnet weight	15,684 lbs (7,187 kg) with cryogens
Magnet cooling	Cryogenic
Long-term stability	< 0.1 ppm per hour over a 24 hour period
Cryogen refill period	Zero-Boil Off*
Boil-off rate under normal operation	Zero-Boil Off*
Fringe field – (axial x radial)	7.8 m x 4.9 m at 1 Gauss 5.2 m x 3.0 m at 5 Gauss
Manufacturer	GE Healthcare

***Normal Operating Conditions**

Easy siting and affordable operation:

Complemented by GE's active shielding technology, the Discovery MR750w has very flexible installation specification for easy siting. And with zero-boil-off technology helium refills are effectively eliminated, thus reducing operating costs and maximizing uptime (versus previous generation products).

Magnet Enclosure

The Discovery MR750w magnet enclosure system is designed to provide several benefits for the patient and technologist:

- Patient anxiety can be eased, helping reduce exam time for uncooperative patients
- Technologists have easy access to the patient
- Dual-sided controls improve access to cables and IV lines
- Head or feet-first positioning facilitates different types of studies and set-up for claustrophobic patients

Patient Bore (L x W x H)	130 cm x 70 cm x 70 cm
Patient Aperture	78 cm at magnet flair 70 cm at isocenter
Patient comfort module	Head 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

Magnet shim

High homogeneity is assured – your Discovery MR750w magnet provides excellent results 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 and spectroscopy

GE's incorporates 3D field mapping to determine the field homogeneity after integrating the gradients, RF body coil, 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 precise measurement of the field uniformity throughout the imaging volume. This process allows GE to customize the magnet shim for each unique environment.

LV-vrms Homogeneity Specifications	
Diameter of Spherical Volume -DSV	Guaranteed ppm
20 cm	<0.050
30 cm	<0.150
40 cm	<0.500
45 cm	<1.500
40 (z) x 50 cm	<3.000
50 x 50 cm	<4.000

Gradients

The gradients of an MR system play a crucial role when it comes to imaging performance, throughput, and consistency during clinical practice. Gradient speed, accuracy, and reproducibility often determine the success of demanding acquisitions like fMRI, DTI, and Fiesta.

Gradient performance	
Peak amplitude	44 mT/m
Slew-rate	200 T/m/s

The gradients are non-resonant and actively shielded to minimize eddy currents and mechanical forces within the system. The gradient coil and the RF body coil are integrated into a single module, which is water and air-cooled for optimum duty-cycle performance and patient comfort.

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	300uAs
Shot-to-Shot repeatability*	100uAs
Symmetry*	200UAs

*** Typical gradient fidelity expressed in a relative scale is derived from the following measurements of 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.**

Fidelity, accuracy, and reproducibility

Gradient systems have historically been defined in terms of peak amplitude (mT/m) and slew rate of the generated field (T/m/s). While these parameters are important in achieving high temporal resolution parameters, such as TRs and TEs, applications such as fMRI, PROPELLER 3.0, TRICKS, and spectroscopy rely more heavily on gradient fidelity, accuracy and reproducibility.

Fidelity is defined as the degree to which an electronics system accurately and reproducibly amplifies an input signal. Applied to MR gradient systems, gradient fidelity refers to the systems ability to generate requested waveforms. The high fidelity of the Discovery MR750w 3.0T gradients is achieved through the use of innovative design of the digital control architecture within the gradient amplifier. This architecture has two digital control paths.

- Dedicated active feedback loop to regulate current errors
- Unique feed-forward model to match amplifier output to gradient coil response

ART (Acoustic Reduction Technology) Quiet Technology

State-of-the-art clinical imaging demands the routine use of ultra-fast imaging techniques. At 3.0T, the strong gradients interact with the magnetic field to create mechanical forces resulting in acoustic noise. GE has implemented Quiet Technology on many components of the system to reduce acoustic noise and improve the patient environment.

Gradient Coil Isolation and Acoustic Damping

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 ensures minimal component interactions. In addition, mass- damped acoustic barriers are used under the system enclosures to further reduce acoustic noise for the patient.

RF Coil Isolation

During gradient pulses, the RF body coil acts as a secondary source of noise. To further reduce the noise heard by the patient, the RF body coil mounting has been optimally designed with features to reduce acoustic noise.

Optical RF Receive

The RF acquisition technology of the Discovery MR750w enables greater clinical performance and higher image quality especially for data-intensive applications and provides an improvement in SNR versus previous generation systems.

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 ensuring clear signal reception and data analysis. To help ensure that the high-density approach will be maintained, the scalable Discovery MR750w architecture is designed to expand in the future. 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	144 with 40 ports embedded in table
Receiver sampling per channel	80 Mhz
Quadrature demodulation	Digital
Receiver dynamic range at 1 Hz BW	> 165 dB
Receiver resolution	Up to 32 bits

RF Transmit Technology

The RF technology of the Discovery MR750w system integrates an innovative RF transmit architecture designed to improve the overall image uniformity. This technology optimizes RF transmit by adjusting the amplitude and phase of the RF output depending on the anatomy being scanned. This technology enables excellent clinical performance, optimal SAR management for patient comfort, and enhanced productivity.

MultiDrive

At 3.0T, precise control over the RF environment in a 70 cm patient bore has been challenging until now. The Discovery MR750w RF transmit architecture technology consists of a liquid-cooled 30 kW solid-state RF power amplifier with multiple independent output channels. By optimizing the phase and amplitude of each RF amplifier output channel that is applied to GE's 70 cm 4-port drive whole-body RF transmit coil, 4-port drive whole-body RF transmit coil improves RF uniformity and signal homogeneity regardless of patient shape, size, and/or body habitus.

SAR Optimization

At 3.0T, staying within FDA-and IEEC-mandated guidelines for Specific Absorption Rate (SAR) can potentially limit the ability to scan efficiently. Leveraging over a dozen years' 3.0T experience, GE has overcome these limitations on the Discovery MR750w with an innovative SAR management system called PERFORM 2.0. Combining RF body coil design, optimized pulse sequences, detailed predictive SAR modeling during prescription, and real-time SAR feed-back and correction during scanning helps ensure high system performance across all applications, tailored for each patient.

The results can include fast exams, productivity, patient comfort and improved diagnostic results, scan after scan, patient after patient.

RF Transmit Architecture	
RF Amplifier	Multi-output Small foot-print water cooled
Maximum output power	15 kW Body per chain (30 kW peak total) 4.5 kW Head
Maximum B1 field with whole-body RF coil	> 16 uT at 75 kg (> 25 uT 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 4 port drive, 16 rung quadrature birdcage 70 cm inner diameter 50 cm FOV

Volume Reconstruction Engine

Reconstruction performance today is challenged by explosive growth in data, and increased computational complexity. The amount of data to be stored and processed continues to increase with the advances in MR system technology. The Discovery MR750w meets that challenge head-on with innovations in reconstruction to take full advantage of computing power by leveraging both software and hardware technology.

The Discovery MR750w features a powerful volume reconstruction engine (VRE 3.0) that enables real-time image generation, even when massive parallel-imaging datasets are involved. The reconstruction engine features onboard memory and local raw data storage to support and maintain simultaneous data acquisition and reconstruction under the most demanding applications.

VRE 3.0 uses 64-bit computing, delivering high acquisition memory and fast performance. Optimized parallel processing enables maximum performance for each CPU core. Further scalability is possible through high-speed network interconnect.

With acquisition-to-disk capability, applications demanding more memory capacity than locally available can stream raw data to the hard disk to permit reconstruction of extremely large datasets.

Reconstruction Engine	
Recon speed	13,000 2D FFTs/second
Recon speed density	406 2D FFTs/second/channel
CPU	Dual Intel Nehalem Processor Quad core
Memory	36 GB ECC DDR3 1333
Hard disk storage	4 x 146 GB

GEM Suite

Description

The GEM Suite consists of a set of receive-only RF arrays designed for use with the Discovery MR750w with GEM 3.0T MR system. GEM stands for Geometry Embracing Method, an approach to MR imaging that reflects the importance of conforming the geometry of the equipment and technology to that of the patient.

The Suite includes a head and neurovascular array, a pos-terior imaging array embedded in the Express patient table, an anterior array, a small anterior array, and a peripheral vascular array. The Suite is indicated for use for: head, neck, brachial-plexus, spine, pelvis, hips, prostate, abdominal, cardiac, lower extremities, blood vessels, and long bone imaging. The combined use of the entire GEM Suite will facilitate high-resolution, high-SNR whole-body imaging from the top of the head down to the feet.

Coil Mode Configuration

The 3.0T GEM Suite was designed to reduce multiple physical coil changes within a single exam and between different exams, and to improve patient comfort. The system will automatically select the coil mode configuration that best fits the selected region of interest. The combined effect is to help reduce the total duration of an exam and improve workflow.

GEM Express Table & Posterior Array (PA)

The GEM Express Patient Table is a mobile patient transport device that includes an embedded high-density, posterior RF array.

Geometric Optimization

The GEM Posterior array has optimal coil element geometry for each patient and targeted anatomy. Unlike many matrix arrays that use the exact same coil element size and shape for all anatomy, the GEM Posterior Array uses optimized element layouts for the cervical-to-thoracic spine transition, thoracic and lumbar spine, and the body. This approach maximizes the signal-to-noise ratio by matching the geometry of the coil elements to the anatomical size and shape of the anatomy.

The posterior array is a 40 element phased array coil that is 101 cm long and 38 cm wide and is designed to support parallel imaging in all 3 planes.

To simplify the workflow for the technologist and increase efficiency, the system will automatically select the appropriate subset of coil elements based upon the prescribed field-of-view.

Symmetric Scan

The Express patient table and embedded GEM coil is designed to accommodate head-first or feet-first imaging for all supported exams.

The Integrated Posterior Array is symmetrically positioned within the patient supporting cradle, and coil connection ports are located at both ends of the detachable table. This design enables all components of the GEM Suite to support either patient orientation and ensure the most comfortable patient position.

Whole body imaging may also be supported in the feet-first orientation.

GEM Posterior Array Specifications	
S/I Coverage	100 cm (39.4 in)
Head-first or feet-first imaging	
Elements	40

GEM Suite

Patient Comfort Pads

To improve patient comfort and safety, the GEM Suite includes an innovative set of Patient Comfort pads.

The pads are designed with variable density foam that uniquely compresses based on patient geometry and weight. Certain sections of the GEM Suite pads are designed to compress more easily than others and this optimal design may minimize pressure points and improve patient comfort. The pads have been designed to support a wide range of patient sizes and weights.

The pads are made with UltraFresh protective coating, are strong, fluid-proof, air tight, and easily cleanable. An anti-skid undersurface reduces pad movement and thus may simplify patient setup and egress.

GEM Express Table with Patient Comfort Pads

The Express Patient Table also includes an innovative and adjustable comfort tilt feature to lift the patient's neck, to increase the comfort of patients.

GEM Head & Neck Unit (HNU)

The GEM HNU is a standard component of the GEM Suite. The HNU consists of four imaging components: a head base-plate, an anterior neuro-vascular face-array, the GEM cervical array, and the open face adapter. The coil maybe positioned at either end of the GEM table to support head-first or feet-first imaging.

The open-face design provides a patient-friendly feel. The base plate may be used with the dedicated GEM cervical array for C-spine imaging. Alternatively, the base plate may be used with the open face adapter to accommodate cervical spine exams in large or claustrophobic patients. Improved access and patient comfort may be achieved through elevation of the superior end of the coil. The HNU with anterior NV Face-Array consists of 21 elements arranged to provide parallel imaging support in all 3 planes.

HNU Open Face Adapter

HNU Cervical Array

HNU with comfort tilt adapter

HNU with anterior NV Face-Array

Head Neck Unit NV Specifications	
Length	49.5 cm (19.5 in)
Width	38.8 cm (15.3 in)
Height	36.8 cm (14.5 in)
Weight of HNU base	5.9 kg (13.0 lb)
Weight of Anterior Adapter	3.4 kg (7.4 lb)
S/I Coverage	50 cm (19.7 in), when combined with the PA and 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 PA and AA
Head-first or feet-first imaging	
Up to 28 elements in the FOV, when combined with the PA and AA	
Acceleration factors	1D R=3, 2D R=6

Head Neck Unit Cervical Specifications	
Length	49.5 cm (19.5 in)
Width	38.8 cm (15.3 in)
Height	33.6 cm (13.2 in)
Weight of Cervical Adapter	2.0 kg (4.5 lbs)
S/I Coverage	28 cm (11 in)
R/L Coverage	24 cm
Head-first or feet-first imaging	
Up to 20 elements in the FOV, when combined with the PA	

Head Neck Unit with Open Face Adapter Specifications	
Length	49.5 cm (19.5 in)
Width	38.8 cm (15.3 in)
Height	25.7 cm (10.1 in)
Weight of Open Face Adapter	1.6 kg (3.5 lbs)
S/I Coverage	28 cm (11.0 in) with all 7 elements
R/L Coverage	24 cm (9.4 in)
Head-first or feet-first imaging	
Up to 12 elements in the FOV, when combined with the PA	

GEM Anterior Array (AA)

The GEM AA is a standard component of the GEM Suite that facilitates chest, abdomen, pelvis, and cardiac imaging with the GEM RF coil suite. The GEM AA is lightweight, flexible, thin and pre-formed to conform to the patient's size and shape. With 54 cm of S/I coverage, the coil permits upper abdominal and pelvic imaging without repositioning the patient. The 16 element electrical design supports parallel imaging in all 3 planes.

GEM Anterior Array

Anterior Array Specifications	
Length	57.4 cm (22.6 in)
Width	70.2 cm (27.6 in)
Height	3.6 cm (1.4 in)
Weight	2.4 kgs (5.3 lb) resting on patient 3.9 kgs (8.6 lb) with cable
S/I Coverage	54 cm (21.3 in)
R/L Coverage Head-first or feet-first imaging	to the full 50 cm (19.7 in) FOV of the system
Up to 36 elements in the FOV, when combined with the PA	
Acceleration factors (with PA):	1D R=3, 2D R=9

GEM Small Anterior Array (Optional)

The GEM Small Anterior Array is a receive-only, high-density RF coil designed to produce images with optimal signal to noise ratio and uniform coverage for cardiovascular, pulmonary, renal, and abdominal imaging. The light-weight coil design contains 16 channels, with parallel imaging capability in all three dimensions to speed up high-resolution, breath-held, and free breathing cardiovascular exams.

GEM Small Anterior Array

Optional Small Anterior Array Specifications	
Length	45 cm (17.7 in)
Width	40.5 cm (15.9 in)
Height	4.5 cm (1.8 in)
Weight	2.94 kgs (6.5 lbs)
S/I Coverage	27 cm (10.6 in)
R/L Coverage	35 cm (13.8 in)
Head-first or feet-first imaging	
Up to 33 elements in the FOV, when combined with the PA	

GEM Suite

GEM Peripheral Vascular/Lower Extremity Array (PVA) – Optional

The GEM PVA is an optional component of the GEM Suite that facilitates imaging of the thighs and lower legs. The high-density layout supports parallel imaging in all 3 planes. The coil incorporates an innovative hinge design between the upper & lower elements to simplify patient setup. In addition, to improve patient comfort, the lower leg section of the coil is fully supported by the GEM table and not the patient.

GEM PVA in un-folded position

Optional Peripheral Vascular/Lower Extremity Array Specifications	
Length	105 cm (41.3 in)
Width	2nd station: 51.6 cm (20.3 in) 3rd station: 64.2 cm (25.3 in)
Height	24.8 cm (9.8 in)
Weight	9.1 kg (20.0 lbs)
S/I Coverage	104 cm (49.9 in) overall 2nd station: 52 cm (20.5 in) 3rd station: 52 cm (20.5 in)
R/L Coverage	to the full 50 cm (19.7 in) FOV of the system
Head-first or feet-first imaging	
Up to 35 elements in the FOV, when combined with the PA	
Acceleration factors	1D R=3, 2D R=6

PA Invisibility and Compatible Features

The GEM PA is designed to be used in conjunction with the GEM head-neck and cervical imaging unit, the GEM anterior array, and GE peripheral vascular array. When needed, the GEM Posterior Array has also been designed to become invisible when additional surface coils are placed directly on top of the table. With innovative electronic decoupling circuits, the Posterior Array can support additional coils directly on top of its surface with no impact to image quality. This feature is critically important for technologist workflow, especially for breast and musculoskeletal exams.

The Discovery MR750w with GEM Suite is compatible with a full complement of additional surface coils for imaging the breast, extremities, and other anatomies.

Additional patient tables may be purchased for use with the same Discovery MR750w with GEM Suite system. The integrated posterior array is an optional accessory with each additional table.

RF Coils and Arrays

There are many optional receiver coils available to configure a Discovery MR750w system to meet specific applications requirements.

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

RF Coils

HD Brain Array

- 8-channel, 8-element phased-array design
- Parallel imaging compatible
- Coil dimensions: 69 x 38 x 41 cm (27 x 15 x 16 in)
- 24 cm S/I coverage

32-Channel Brain

- 32-channel array design for high signal-to-noise ratio (SNR) and excellent contrast to- noise ratio (CNR)
- Optimized for fMRI studies
- Parallel imaging compatible in all three planes
- Sliding coil design for ease of patient positioning
- Coil dimensions

  Inner diameter: 24 cm (9.5 in)

  Coil size: 29 cm OD x 30 cm long (11.4 x 11.8 in)

  Base size: 41 cm x 48 cm (16 x 19 in)

6-Channel Carotid Array

- 6-channel, 6-elements phased-array coil design enabling bilateral diagnostic imaging of the carotid artery bifurcation
- Complete coverage of the head and neck vasculature from the sternal notch through the internal carotid arteries at the level of the cervical vertebrate C1
- Allows for sub-millimeter resolution of the carotids lumen, vessel walls, and atherosclerotic plaques
- Parallel imaging compatible
- Each antenna set articulates, rotates, and locks to facilitate patient comfort and imaging performance
- Coil dimensions 61 x 35 x 18 cm (24 x 14 x 7 in)
- 15 cm FOV coverage

RF Coils and Arrays

RF Coils

Endo-Rectal

- 1 Channel, inflatable and auto-tuned coil
- Small FOV and high spatial resolution, sensitivity, and specificity for clear pictures that can help improve diagnosis and treatment planning
- Offers high resolution imaging of prostate, colon, rectum, cervix, and surrounding areas
- Provides visualization of prostate internal structures, including prostate capsule and neurovascular bundles
- Inflatable design conforms to prostate shape and size for immobilization and optimal placement
- Disposable RF Probe heads connect quickly to interface box to allow for rapid setup and disassembly
- Interface box dimensions: 44.4 x 44.4 x 21.5 cm (17.5 x 17.5 x 8.5 in)
- Coil Coverage: 10 – 20 cm (Sagittal, Axial, and Coronal)

32-Channel Cardiac

- 32-channel, 32-element cardiovascular coil
- Optimized for parallel imaging
- Posterior coil coverage (FOV): Supererior / inferior 27 cm (10.6 in), right / left 35 cm (13.8 in)
- Anterior coil coverage (FOV): Superior / inferior 27 cm (10.6 in), right / left 35 cm (13.8 in)
- Posterior coil dimensions (L x W x H): 45 cm (17.7 in) x 40.5cm (15.9 in) x 4.5 cm (1.8 in)
- Poster coil weight: 2.94 kg (6.5 lbs)
- Anterior coil dimensions (L x W x H): 45 cm (17.7 in) x 40.5cm (15.9 in) x 4.5 cm (1.8 in)
- Anterior coil weight: 2.94 kg (6.5 lbs)

HD Breast Array

- 8-channel, 8-element phased-array design
- Optimized for uniformity, parallel imaging and VIBRANT
- Bilateral and unilateral breast imaging
- Biopsy plates available
- Coil dimensions: 50 x 54 x 25 cm (20 x 21 x 10 in)

RF Coils

HD Knee Array

- Hybrid transmit/tapered phased-array design
- 8-channel, 8-element phased-array design
- High SNR for knee imaging
- Coil dimensions: 39 x 35 x 19 cm (16 x 14 x 8 in)
- 16 cm S/I coverage

HD Wrist Array Coil

- 8-channel, 8-element phased-array coil
- High SNR to enable high spatial resolution images
- Position overhead or at patient's side
- Coil dimensions: 34 x 23 x 14 cm (13 x 9 x 6 in) (includes base)
- 12 cm S/I coverage for wrist and hand

Quad Lower Extremity Coil

- 12-rung, transmit /receive birdcage coil
- "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
- Coil dimensions: 48 x 31 x 36 cm (19 x 12 x 14 in)

Shoulder Phased Array

- 3-channel phased-array coil
- Sleeve design
- Comprehensive shoulder imaging
- Homogeneous penetration of the humeral head and neck, rotator cuff, glenoid labrum, acromium process, and glenohumeral articular surfaces

HD Shoulder Phased Array

- 8-channel, 8-element phased-array coil
- Comprehensive shoulder imaging
- Uniform signal of the humeral head and neck, rotator cuff, glenoid labrum, acromium process, and glenohumeral articular surfaces
- Coil dimensions: 25 x 23 x 25 cm (10 x 9 x 10 in)
- 20 cm S/I coverage

HD Foot Ankle Array

- 8-channel, 8-element phased-array design
- "Chimney" design adds versatility for high SNR foot and ankle imaging
- Coil dimensions: 53 x 28 x 33 cm (21 x 11 x 13 in)

RF Coils and Arrays

RF Coils

Transmit/Receive Wrist Array Coil

- Quadrature birdcage volume T/R coil
- High SNR to enable high spatial resolution images
- Position overhead or at patient's side
- Coil dimensions: 40 x 40 x 30 cm (16 x 16 x 12 in)
- 10 cm S/I wrist and hand coverage

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

6-Channel Flex Array

- 6-channel, 6-element flexible array
- High SNR and uniformity
- Can operate as a 6-channel coil with both coil halves or a 3-channel coil with one half
- Coil half dimensions (L x W x H): 30 cm (11.8 in) x 30 cm (11.8 in) x 2 cm (0.8 in)
- Maximum FOV: 24 cm (9.5 in)
- Cable length: 155 cm (61 in)

Discovery MR750w Workflow and Patient Handling

Express exam streamlined workflow

The in-room operator console (iROC) streamlines the Discovery MR750w workflow and helps you improve patient care by letting you keep your focus where it's needed most – on your patient.

With Express Exam, entire exams are completed in just a few mouse-clicks due to the automated acquisition, processing, and networking capabilities of the Discovery MR750w's patient setup and workflow features.

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, move, and stop the table
- Return table to the home position
- 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

In-room operator console (iROC)

Simplify exam preparation and reduce the time between patients with the Discovery MR750w 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 ensure thatany necessary changes in patient setup are quickly and clearly related back to the user. The iROC also 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
- 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

The iROC simplifies patient workflow by reducing the time burden of today's most challenging exams. Together, the significant advances of the Discovery MR750w helps improve care by helping technologists to help maintain their focus where it is needed the most – on the patient.

Discovery MR750w express exam

The Discovery MR750w scan interface incorporates many features designed to lighten the workload by automating many routine steps.

The Discovery MR750w includes an automated protocol-driven user interface designed for consistency in generating high-quality imaging for all patients and from all technologists. Designed for efficiency, the computer platform is built upon a parallel, multiprocessor design that delivers the simultaneity and speed needed for advanced clinical operation. Productivity, efficiency and streamlined data management are assured through simultaneous scanning, reconstruction, filming, archiving, networking and post-processing.

Though the protocol-driven workflow can dramatically simplify and automate image acquisition and processing, the flexibility that is synonymous with GE systems is maintained. If desired, the user can have complete control of exact sequence parameters for site optimization and patient specific situations.

Discovery MR750w Workflow and Patient Handling

Modality Worklist

The modality worklist (MWL) provides an automated method of obtaining exam and protocol information for a patient directly from a DICOM Worklist server. For sites with full DICOM connectivity, once a patient has been selected from the MWL, a new session can be opened on the host interface and the iROC will highlight the relevant exam details. For sites that do not have full connectivity, minimal data entry (patient number and weight) is necessary prior to starting a new session. Additional data field for patient-sensitive information such as allergies, pre-medication and history are provided.

The Discovery MR750w MWL provides complete control of the MRI protocol prescription. The protocol may be selected well in advance of the patient's arrival at the MR suite, thereby simplifying exam preparation and reducing necessary work by the technologist during the time-critical procedure.

The ConnectPro software enables the DICOM worklist server class for the Discovery MR750w Operator's Console. This software may require separate gateway hardware to connect non-DICOM-compatible HIS/RIS systems to the MR system.

Protocol libraries and properties

The Discovery MR750w 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. For quick search and selection, each protocol may be archived with independent properties based on patient demographics, anatomy, type of acquisition, or identification number. For commonly used protocols, a favorites flag may be used for quick selection from the Modality Worklist or for sharing across other libraries.

ProtoCopy

Standard on every Discovery MR750w system, the ProtoCopy feature enables a complete exam protocol to be shared with the click of a mouse. The exam protocol can originate from either a library or previously acquired exam. This enables routine archive of protocols for emergency backup and simple management of libraries across multiple systems.

Workflow manager

Once a protocol has been selected for an exam, it is automatically loaded into the Workflow Manager. The Workflow Manager controls image prescription, acquisition, processing, visualization, and networking and may fully automate these steps if requested.

AutoStart™

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.

Linking

Linking automates the prescription of images for each series in an exam. Once the targeted anatomical region has been located the Linking feature combines information from a prescribed imaging series to all subsequent series in the Workflow Manager. All series that have been linked may automatically be prescribed (Rx) and no further interaction will be needed by the technologist to initiate the scan. The user has control over which specific parameters can be linked together. Series can have common fields of view, obliquity, slice thickness, anatomical coverage, saturation bands, or shim volumes. Multiple series can be linked together and saved in the Protocol Library or edited in real time. Linking may be used with any anatomy and with any acquisition. Once the first volume is prescribed, all other subsequent series with the same planes can be automatically prescribed and acquired.

AutoScan™

With AutoScan enabled, the Workflow Manager will sequentially go through the list of prescribed series without any user interaction. Once a series has been completed, the next series will be scanned automatically.

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. This helps ensure that the patient is in the right position and is fully aware of the next step in the acquisition process. AutoVoice is particularly helpful during breath-hold exams. The AutoVoice feature includes instructions in over 14 languages and the user can create and include their own unique voice instructions for local needs.

Inline viewing

Inline viewing allows the user to conveniently view, compare, and analyze images without having to switch to the Browser. Simply select the series to view from the Workflow Manager and the images are displayed along with standard image display tools. Image comparisons can be easily done by selecting multiple series at a time. The integrated viewer allows the user to seamlessly move between scanning and image viewing.

Inline processing

The Discovery MR750w workflow automates many of the routine tasks that previously required user interaction. This dramatically reduces the workload for the user and helps ensure that consistent and repeatable images are presented for review. Processing steps are automatically completed immediately after the data has been reconstructed and the images saved into the database. These automated processing steps can be saved in the Protocol Library to ensure consistent exam workflow for each type of patient.

For certain tasks, such as vascular segmentation, the user must accept the results, or complete additional steps prior to saving the images to the database. In these cases the data is automatically loaded into the appropriate tool, then the system will await further instruction by the user. Examples of fully automated and partially automated inline processing include:

Inline Processing Capabilities	
Diffusion weighted images including ADC/ eADC maps	Automatic compute and save
Image Filtering: SCIC and Clariview	Automatic compute and save
Max / Min Intensity Projections	Automatic compute and save
Reformat to orthogonal planes	Automatic compute and save
T2 mapping	Automatic compute and save
FiberTrak	Automatic load
Spectroscopy (Single voxel brain and breast metabolite)	Automatic compute and save
2D and 3D Chemical Shift Imaging	Automatic load
3D Volume Viewer	Automatic load
BrainStat (Functool)	Automatic load
Image Fusion (Functool)	Automatic load
IVI (Volume Viewer)	Automatic load
Image Pasting	Automatic load
3D ASL	Automatic compute and save
eDWI	Automatic compute and save

Image fusion

To better visualize tissue and contrast, multiple images from separate acquisitions can be overlaid on one another. With the new Discovery MR750w workflow, high-resolution 2D and 3D anatomical images can be fused with functional data or parametric maps for improved visualization for the user. The data is registered using translation and rotation to ensure accurate fusion.

The automated workflow features of the system can be used for any anatomy and for any sequence. When combining the technology of AutoStart,™ Linking, Inline Processing, Auto-Voice,™ and the AutoScan™ features, an entire exam can be completed with just a few actions. The flexibility of the Discovery MR750w user interface and acquisition parameters helps ensure that each acquisition is tailored for every patient. However, the technologist steps are kept consistent.

Image Fusion	
MR Standard	3D Registration
ADC / eADC	3D Registration
Diffusion Tensor	3D Registration
functional MRI (fMRI)	Reformat
BrainStat	3D Registration
T2 Mapping	Reformat
Spectroscopy (Brain and Breast)	Reformat

Computing platform

Operator console

The Discovery MR750w system comes equipped with a scan control keyboard assembly that contains 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.

DICOM

The Discovery MR750w system generates MR Image, Secondary Capture, Structured Report, and 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 Discovery MR750w system supports the CT and PET image objects for display allowing the user to refer to cross-modality studies.

Computing Platform	
Main CPU	Dual Core Intel Xeon w3505 2.53 GHz Processor 4.8 GT/s Intel® QPI interface 4 MB Cache
Host Memory	8 GB DDR3 1066 FBD DIMMs
Graphics Subsystem	Nvidia Quadro FX580 – 512 MB GDDR3 Memory – Spec PROE-04: 27.88 – Spec TCVIS-01: 11.32 – Spec 3DMAX-04: 15.89
Cabinets	Single, tower configuration
System Disk	3 x 146 GB, 15,000 RPM, SAS Drive
Network	3 x Gigabit (10/100/1000) Ethernet Ports

Data Storage	
DVD Interchange	DVD-RW Data transfer rate 21.6 MB/s Access speed – average random stroke approx. 200 ms Average 35,000 images per 4.7 GB DVD

Filming	
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

Wide-screen display monitor	
Display Monitor	24" Widescreen LCD Flat Panel 1920 x 1200 dot resolution Non-interlaced, flicker-free presentation Contrast ratio 1000:1 Digital DVI Interface

Display	
AutoView	560 x 560 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 x 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

Discovery MR750w Scantools

Pulse sequences and imaging options

The Discovery MR750w scanner comes standard with a package of pulse sequences and applications optimized for 3.0T performance.

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 all anatomies and is especially useful for MR cholangiopancreatography (MRCP) studies.
Single-Shot Fast-Spin Echo (SSFSE)	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 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 ensure 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.
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 refuse to stay still long enough for conventional techniques.
2D and 3D Time of Flight (TOF) Imaging 2D-Gated TOF Imaging	2D TOF Imaging, 2D Gated TOF Imaging, 3D TOF Imaging and Enhanced 3D TOF Imaging are all ideal for MR angiography. Based on conventional gradient echo scanning, TOF imaging techniques rely primarily on flow-related enhancements to distinguish moving from stationary spins.
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-linearities 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.
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.
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.
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.

Discovery MR750w Scantools

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
Auto TR	Auto TR dropdown menu replaces the TR dropdown menu located on the Graphic Rx desktop. Displays lowest TR value of each series.
EPI and DW-EPI	Standard on all systems are gradient echo, spin echo, flair, and diffusion-weighted echo planar imaging. The standard EPI sequence supports single and multi-shot imaging, multi-phase imaging, as well as cardiac gating. Diffusion EPI produces images that can detect acute and hyper-acute stroke with b-value up to 10,000 s/mm^2, multi-NEX compatibility and the ability to generate ADC and T2-weighted TRACE images. The FLAIR option suppresses the CSF signal component to ease interpretation.
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 advanced parallel imaging. What is the clinical benefit of LAVA? It enables the high-quality 3D MR imaging of the liver during short breath-holding periods.
BRAVO	Brain Volume imaging is a high-resolution 3D imaging technique designed to produce heavily T1-weighted isotropic images of the brain. BRAVO uses ARC to reduce scan time and minimize parallel imaging artifacts.
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 imrproved T2* contrast, the result is improved cord constrast within the spinal column.

Imaging Options and Parallel Imaging Support

Imaging options

Pulse sequence imaging options

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

Imaging Options and Parallel Imaging Support

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.

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.

With the Discovery MR750w, the following applications are parallel imaging enabled:

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

Neuro Applications

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 magnetic susceptibility regions.

PROPELLER 3.0

PROPELLER 3.0 uses 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-after-plane 2D FSE acquisitions with a single 3D volume scan – providing you with 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 eliminate 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.

SWAN

SWAN is a high-resolution 3D multi-echo gradient echo sequence that produces 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 helps visualize and delineate small vessels, as well as large vascular structures and iron or calcium deposits in the brain.

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.

Neuro Applications

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 that is ideally equated for visualization of the internal auditory canal. It is also ideally suited for T1 imaging through the cervical spine.

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.

eDWI

The eDWI application includes the acquisition sequence and post-processing tools. It is designed to provide high signal-tonoise 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.

Diffusion Tensor Imaging with Fiber Tracking

This package expands EPI 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 generates 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 Variate 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 to visualization of tissue and anatomy.

An optional add-on to the Brain STAT 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.

Functional MRI applications

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
- Display of 2D activation maps overlaid over Echo planar source images in real time
- Multiple 2x2 and 4x4 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:

- Integration into the operator console
- Special graphic user interface for image analysis
- Data quality check, motion correction, temporal filtering and spatial smoothing to optimize statistical analysis and mapping
- Multiple regression analysis
- The structural MRI scan is segmented 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 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 Lite Hardware

BrainWave Lite Hardware provides paradigm-delivering hardware that provides data to paradigm synchronization – thereby paving the way for convenient compatibility with 3rd-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 custom protocols. The visual and auditory output can be coupled to fMRI delivery systems purchased separately from other vendors.

Spectroscopy Applications

Multi-nuclear spectroscopy

The Discovery MR750w system supports a Multi-Nuclear Spectroscopy (MNS) option that includes excitation and reception hardware and a software package tailored for non-proton spectroscopy and imaging. This package includes a powerful 8 kW broadband amplifier, broadband RF pulse generator and an 8 channel receiver configuration operating over a frequency range of 10-130 MHz to support the study of nuclei such as 31P, 13C, 19F, 23 Na, 7Li, 129 Xe, and 3He. In addition, spectroscopic test sequences capable of generating signal from the aforementioned nuclei and an MNS-tailored post-processing package called SAGE is provided to aid in the visualization and quantification of spectral data. The Discovery MR750w is capable of supporting both single and dual-tuned RF coils.

The standard MNS package does not include T/R switches, pre-amps, RF coil or optimized applications. T/R switches tuned to 31P and 13C frequencies are available options.

PROBE – PRESS single-voxel spectroscopy

PROBE – PRESS single-voxel spectroscopy 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 recon, acquisition set-up and graphic prescription of spectroscopic volumes.

The standard 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 acquisitions with TE values ≥ 35 ms.

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. Athough 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 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).

SAGE 7

SAGE 7 (Spectroscopy Analysis by GE, Version 7) allows one to process, display, manipulate, analyze, manage and print invivo 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).

BREASE

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

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 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. 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.

Cardiovascular Applications

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.

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 workflow.

2D FIESTA Cine

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; 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

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

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 FGRE-ET

Also known as Fluoro MRI, this pulse sequence 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 highly 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
- Interleaving, as in EPI
- Acquisition of multiple views in a single TR

Used in conjunction with iDrive Pro Plus, the real-time version of this pulse sequence is essentially a single-slice version of standard FGRET. That makes it especially useful for obtaining higher-resolution interactive cardiac images.

StarMap

StarMap is a technique that acquires multiple echoes at different TE times at each location resulting in images that represent variations 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.

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 (i.e., 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.

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 calibrations 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.

ReportCARD®

GE's exclusive Advantage Workstation ReportCARD cardiac reporting software provides a fast and easy way to simultaneously review and analyze cardiac MR images as well as to generate comprehensive reports for referring physicians.

Its functionality includes the ability to:

- Completely evaluate for patent foramen ovale by analyzing images acquired with a non-invasive, IR-prepared fast gradient echo-train sequence
- Analyze and quantify flow measurements using cine phase contrast images of blood flow or CSF flow
- Conduct quantitative time course imaging analysis
- Perform myocardial scarring analysis
- The added structured reprint and research database reduces the amount of time a clinician spends reporting on a cardiac MRI case

ReportCARD makes it possible to quickly and accurately complete clinical reports on cardiac MR exams including reports tailored specifically to pediatrics and CSF flow. It automatically compares newly acquired measurements against a set of predetermined normal values and flags those that are outside this normal range. Pre-written, user-programmable macros interface to these measurements to generate a complete report in just minutes.

Cardiovascular Applications

Flow Analysis

A subset of the ReportCard 4.0, clinicians interested only 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.

Flow Analysis is available as an Advantage Workstation application or an MR operator console application.

Respiratory Triggering

For patients who cannot hold their breath, respiratory triggering provides the answer. By synchronizing the acquisition to the respiratory cycle, high-resolution images are obtained while mitigating breathing artifacts.

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 the ideal imaging technique for MRA in even the most 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.

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.

Quickstep

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.

Inhance Application Suite

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

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 is improved by the optimized pulse sequence design, resulting in better 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 an arterial only image, with good 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 peripheral arteries.

Body Applications

Inhance Inflow IR

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 angiographic images of arteries that follow almost a straight path (i.e. femoral, popliteal, and carotid arteries). 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

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.

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, and acquisition and reconstruction algorithms to produce Elastograms, 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 the 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.

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 (Autocalibrating Reconstruction for Cartesian sampling), a 2D self-calibrated parallel imaging technique that allows for acceleration in both phase and slice directions for supported coils.

Body Applications

eDWI

The eDWI application includes the acquisition sequence and post-processing tools. It is designed to provide high signal-tonoise 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.

PROPELLER 3.0

PROPELLER 3.0 uses 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 Dual Echo

With improvements in parallel imaging and RF coil arrays, volumetric imaging in the body is becoming a standard of care. The 3D Dual Echo sequence produces in-phase and out-of-phase images in a single breath-hold. As a result, the high-resolution images are in perfect alignment, simplifying the diagnostic process. In addition, the improved SNR of the 3D acquisition permits thinner slice imaging.

3D FRFSE

Coupled with respiratory gating, this 3D FSE sequence uses a novel"recovery" pulse at the end of each echo train to recapture signal for the next repetition. These features result in high-resolution three-dimensional images for MR cholangiopancreatography (MRCP) studies.

Single-Shot Fast-Spin Echo

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.

Respiratory triggering

For patients who cannot hold their breath, respiratory triggering provides the answer. By synchronizing the acquisition to the respiratory cycle, high-resolution images free of breathing artifacts are obtained.

StarMap

StarMap is a technique that acquires multiple echoes at different TE times at each location resulting in images that represent variations 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.

2D Fat Sat Fiesta

Fast Imaging Employing STeady-state Acquisition (FIESTA) is designed to produce high SNR images extremely rapidly and with excellent contrast between tissues. The contrast relies on a steady state for the transverse magnetization, which builds as a series of radio frequency 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. FIESTA has the capability to suppress the signal from fat, especially to create more contrast between the vasculature and surrounding tissues.

Body Applications

3D Cube™

3D Cube replaces several slice-by-slice, plane-after-plane 2D FSE acquisitions with a single 3D volume scan – providing you with 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 eliminate artifacts while accelerating image acquisition.

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 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 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.

2D Fiesta Cine

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.

Musculoskeletal Applications

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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. Post processing of the images generates maps of the T2 signal decay within each voxel.

3D MERGE

This 3D technique offers excellent SNR and fat-saturation capabilities to provide high resolution, isotropic T2* weighted images of the extremities (hand, wrist, knee, ankle, and shoulder). 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 Cube™

3D Cube replaces several slice-by-slice, plane-after-plane 2D FSE acquisitions with a single 3D volume scan – providing you with 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 eliminate artifacts while accelerating image acquisition.

Musculoskeletal Applications

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

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. 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 images in challenging anatomical areas.

Pediatric Applications*

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3D Cube™ 2.0

Cube is a 3D isotropic imaging technique with sub-millimeter spatial resolution and excellent contrast to help visualize even diminutive lesions. Cube can replace several slice-by-slice, plane-after-plane 2D FSE acquisitions with one single 3D scan. You can easily reformat sub-millimeter isotropic volume data into any plane – without gaps, and with the same resolution as the original plane. Cube is enabled for T1, T2, T2 FLAIR or PD contrasts. Our new self-calibrating parallel imaging engine ARC helps eliminate artifacts while accelerating image acquisition.

Diffusion tensor imaging with Fiber Tracking

This package expands EPI 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 generates eigenvector information from the diffusion tensor acquisition and processing. Using a robust and efficient seeding process, 3D renderings of the diffusion along white matter tracts are generated.

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.

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 Scanning has not been established as safe for imaging fetuses or infants. Carefully compare the benefits of MR versus alternative procedures before scanning to control risk to the patient. A physician needs to decide to scan pregnant or infant patients.

Pediatric Applications*

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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 in even the most 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.

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

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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 magnetic susceptibility regions.

Inhance Application Suite

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

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 is improved by the optimized pulse sequence design, resulting in better 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.

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Inhance Inflow IR

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 angiographic images of arteries that follow almost a straight path (i.e. femoral, popliteal, and carotid arteries). 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

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.

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 (Autocalibrating Reconstruction for Cartesian sampling), a 2D self-calibrated parallel imaging technique that allows for acceleration in both phase and slice directions for supported coils.

* MR Scanning has not been established as safe for imaging fetuses or infants. Carefully compare the benefits of MR versus alternative procedures before scanning to control risk to the patient. A physician needs to decide to scan pregnant or infant patients.

Discovery MR750w Scan Parameters

Slice thickness and FOV	
Minimum slice thickness in 2D	0.2 mm
Minimum slice thickness in 3D	0.1 mm
Minimum FOV	3 mm
Maximum FOV	500 mm
Min / Max Matrix	32-1024

2D Fast Spin Echo	
Minimum TR (128x128)	3.6 ms
Minimum TR (256x256)	4.2 ms
Minimum TE (128x128)	2.2 ms
Minimum TE (256x256)	2.5 ms
Min slice thickness	0.5 mm
Min ESP 128x128	1.7 ms
Min ESP 256x256	2.0 ms
Max ETL	480

3D Fast Spin Echo	
Minimum TR (128x128)	50.0 ms
Minimum TR (256x256)	50.0 ms
Minimum TE (128x128)	8.3 ms
Minimum TE (256x256)	9.4 ms
Min slice thickness	0.3 mm
Min ESP	1.7 us
Max ETL	399

2D Fast Gradient Echo	
Minimum TR (64x64)	0.540 ms
Minimum TR (128x128)	0.684 ms
Minimum TR (256x256)	0.956 ms
Minimum TE (64x64)	0.196 ms
Minimum TE (128x128)	0.208 ms
Minimum TE (256x256)	0.220 ms

3D Fast Gradient Echo	
Minimum TR (64x64)	0.536 ms
Minimum TR (128x128)	0.668 ms
Minimum TR (256x256)	0.940 ms
Minimum TE (64x64)	0.192 ms
Minimum TE (128x128)	0.196 ms
Minimum TE (256x256)	0.208 ms

2D Spin Echo	
Minimum TR (128x128)	3.6 ms
Minimum TR (256x256)	4.2 ms
Minimum TE (128x128)	2.2 ms
Minimum TE (256x256)	2.5 ms

3D Fiesta	
Minimum TR (64x64)	0.864 ms
Minimum TR (128x128)	1.248 ms
Minimum TR (256x256)	2.032 ms
Minimum TE (64x64)	0.284 ms
Minimum TE (128x128)	0.420 ms
Minimum TE (256x256)	0.708 ms

Echo Planar Imaging (EPI)	
Minimum TR (64x64)	5.0 ms
Minimum TR (128x128)	5.0 ms
Minimum TR (256x256)	6.0 ms
Minimum TE (64x64)	1.1 ms
Minimum TE (128x128)	1.2 ms
Minimum TE (256x256)	1.6 ms
Minimum FOV	10 cm
ESP at 25 cm FOV	64x64: 0.456 ms 128x128: 0.656 ms 256x256: 1.056 ms
ESP at 48 cm FOV	64x64: 0.328 ms 128x128: 0.460 ms 256x256: 0.672 ms
ESP at 99 cm FOV	64x64: 0.228 ms 128x128: 0.320 ms 256x256: 0.556 ms
Images per second	64x64: 62 128x128: 20 256x256: 9
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.

Siting and Other Specifications

This section provides an overview of the siting requirements for a Discovery MR750w. More detailed information is available on request.

Typical Room Layouts	
	System Configuration Minimum Values
Magnet Room W x D Minimum Ceiling Height	3.6 m x 6.4 m 2.5 m (8 ft 2.4 in) min ceiling height
Equipment Room W x D	2.6 m x 2.5 m (8.8" x 8.2')
Control Room W x D	1.5 m x 1.9 m (5' x 6')
Minimum Total Area (M^2)	

Fringe Field		
	Axial	Radial
0.5 mT (5 Gauss)	5.2 m	3.0 m
0.1 mT (1 Gauss)	7.8 m	4.9 m

Installation Dimensions and Weights			
	Width	Height	Weight
Actively shielded magnet assembly – (not including electronics)	2.1 m	2.4 m	15,684 lbs (7,187 kg) with kryogens
Express patient table	67 cm (26.13 in)	97 cm (37.83 in)	206 kg (453 lbs)
Control Room Equipment			99 kg (175 lbs)
MR Equipment			2387 kg (5363 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:

- 480/415/400/380/Vrms

Frequency:

Power Consumption

Power consumption depends on actual usage.
They exclude consumption by the shield cooler compressor (9 kVA). The following values are approximate:

Standby (no scan)	<17 kVA
Overnight Mode	9 KVA
Typical Power*	41 KVA
Maximum Continuous sustained power (> 5 secs)	99 KVA
Peak Instantaneous Power (< 5 secs)	123 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 - 70 %	30 - 70 %
Max humidity change rate	5% RH/hr	5% RH/hr	5% RH/hr

Altitude Requirements

Altitude lower limit	-30m
Upper limit	2600m

Miscellaneous

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 project manager for a comprehensive installation and siting manual.

Filming considerations

Filming requires the Discovery MR750w 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 GE warranty in effect on the date of shipment shall apply.

InSite™ Remote Diagnostics

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

Optional capabilities

Some features and capabilities listed in this data sheet are optional with a Discovery MR750w and are subject to change without notice. Contact a GE representative for the most recent data.

GE regulatory compliance

The Discovery MR750w 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 that are shaping a new age of patient care. Our broad expertise in medical imaging and information technologies, medical diagnostics, patient monitoring systems, drug discovery, biopharmaceutical manufacturing technologies, performance improvement and performance solutions services help our customers to deliver better care to more people around the world at a lower cost. In addition, we partner with healthcare leaders, striving to leverage the global policy change necessary to implement a successful shift to sustainable healthcare systems.

Our "healthymagination" vision for the future invites the world to join us on our journey as we continuously develop innovations focused on reducing costs, increasing access and improving quality around the world. Headquartered in the United Kingdom, GE Healthcare is a unit of General Electric Company (NYSE: GE). Worldwide, GE Healthcare employees are committed to serving healthcare professionals and their patients in more than 100 countries. For more information about GE Healthcare, visit our website at www.gehealthcare.com.

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