TOSHIBA
Leading Innovation >>>

PREMIUM OPEN-BORE MRI SYSTEM
MRT-1504

Vantage Titan™

Product Data
No. MPDMR0324EAB

APPLICATION

Vantage Titan™ is an open-bore 1.5-T MRI system that permits outstanding image quality without compromising on features or performance. The 71-cm patient aperture[1] and ultra-short 1.4-m magnet offer a large 55 cm × 55 cm × 50 cm field of view. The system is designed to be eco-friendly, and its low power consumption increases daily cost-performance. In addition, the M-Power user interface and Atlas SPEEDER™ provide a variety of solutions for users at all levels to improve workflow. Incorporating open bore technology and all the capabilities of a 1.5-T system, Vantage Titan combines the best of both worlds in one product.

ADVANTAGE

Patient-focused MRI

The wide bore (71 cm) and ultra-short 1.4-m magnet reduce patient anxiety and ensure comfortable examinations. Toshiba's innovative Pianissimo™ technology dramatically reduces the level of acoustic gradient noise, enhancing patient comfort.

Outstanding image quality

With 36 mT/m of gradient strength[2] and a 32-channel receiver system,[2] image quality is better than ever. Vantage Titan offers a wide variety of imaging techniques to meet the demands of the clinical environment, including noncontrast MRA.

Ease of use

Atlas SPEEDER, Toshiba's new parallel imaging technology with outstanding diagnostic versatility and streamlined workflow, permits easy setup and acquisition for all clinical studies. Innovative functions are newly added to the M-Power user interface, taking MRI performance and flexibility to a new level.

Applicable combinations of area and model number are described below

Area	Standard Gradient	Helios Gradient
Europe	MRT-1504/F4	MRT-1504/F5
Other countries	MRT-1504/I4	MRT-1504/I5

1) The diameter at the narrowest point is 69 cm.
2) Option

COMPOSITION

Standard composition (Model: MRT-1504)

- Gantry
  - 1.5-Tesla Magnet
  - Active Shield Gradient Coil
  - Whole Body Coil
- Patient Table
- Filter Panel
- ECO Cabinet and Gradient Power Supply
- Refrigerator
- Transformer Cabinet
- Fan Box
- Console
  - Host CPU
  - Wide LCD Color Monitor
  - Keyboard and Mouse
  - Control Pad
  - Control Box
  - Microphone
- Software
  - System Software (M-Power Platform)
  - DICOM Software (Standard)
    - Storage SCU
    - Print SCU
    - DICOM Media
    - MWM SCU
- Full Set of Accessories
  - Operation Manual
  - Service Manual
  - Phantom
  - Patient Call
  - Patient Observation Camera
  - Support Devices for Scanning (tabletop mats, wedge mats, pads, belts)
  - Safety Training Video
  - Emergency Run-down Unit
  - Warning Plates
  - Oxygen Monitor
  - Speaker × 2

* Heat exchanger, transformation installation and desk for console are not included in the standard composition.

Optional software[1)]

- mNeuro Package (MSSW-NEURO2/S1)
  - Single Voxel MRS Application (MSSW-MRSS2/S1)
  - Multi Voxel MRS Application (MSSW-MRSM2/S1)
  - DTI Application (MSSW-DTI2/S1)
  - DTT Application (MSSW-DTT/S1)
  - NeuroLine Application (MSSW-LOCNU/S1)
- mVascular Package (MSSW-VASCU/S1)
  - Contrast Free MRA Application (MSSW-CFMRA3 /S1)
  - DRKS Application (MSSW-DRKS2/S1)
- mCardiac Package (MSSW-CFA3/S1)
  - Cardiac Analysis Application (MSSW-CAAS2/S1)
  - CardioLine Application (MSSW-LOCCA/S1)
- mBody Package (MSSW-BODY3/S1)
- mBreast Package (MSSW-BRST3/S1)
- mOrtho Package (MSSW-ORTHO/S1)

DICOM

- Storage Commitment Kit (MSSW-DCCOU1/C1)
- MPPS SCU Kit (MSSW-DCPPU1/C1)
- Q/R SCP Kit (MSSW-DCQRP1/C1)
- Q/R SCU Kit (MSSW-DCQRU1/C1)
- Second Console (MKDN-011A/S1)
  - mNeuro Package for Second Console (MSSW-NEURO2/S2)
  - MRS Application for Second Console (MSSW-MRSS2/S2)
  - DTT Application for Second Console (MSSW-DTT/S2)
  - Cardiac Analysis Application for Second Console (MSSW-CAAS2/S2)

1) The requirements for each package are listed in the product data sheet.

Optional RF coils

- Octave SPEEDER™ Head (MJAH-167A)
- Octave SPEEDER Spine (MJAS-167A)
- Atlas SPEEDER Head (MJAH-127A)
- Atlas SPEEDER Anterior Neck (MJAN-137A)
- Atlas SPEEDER Head/Cervical (MJAH-137A)[2)]
- Atlas SPEEDER Spine (MJAS-147A)
- Atlas SPEEDER Body (MJAB-167A)
- Shoulder SPEEDER (MJAJ-177A)
- Breast SPEEDER[3)]
- 32ch Cardiac SPEEDER (MJAB-187A)[4)]
- Wrist SPEEDER (MJAJ-167B)
- Adaptive Endo Pelvis SPEEDER (MJAP-117A)[2)]
- 4ch Flex SPEEDER (MJAJ-197A)
- 16ch Flex SPEEDER Medium (MJAJ-217A)
- 16ch Flex SPEEDER Large (MJAJ-227A)
- Rectangular Flex Coil (MJLR-107G)
- ϕ70 Flex Coil (MJLC-077G)
- ϕ100 Flex Coil (MJLC-107G)
- ϕ150 Flex Coil (MJLC-157G)
- ϕ200 Flex Coil (MJLC-207G)
- QD Head Coil (MJQH-147A)
- QD Knee/Foot Coil (MJQJ-167A)
- QD Knee Coil (MJQJ-157A)
- Extra Large Knee Array Coil (MJAJ-187A)

Optional coil holder & pad

- Coil Holder for TMJ Imaging (MJCA-147A)
- Flex Breast SPEEDER (MJCA-177A)
- 16ch Flex SPEEDER Pad Kit (MJCA-207A)
- Patient Pads for Spine and Extremities (MBPP-1503/S1)

Optional equipment

- Gantry LCD Monitor (MKSU-LCDK02/S1)
- Interactive Cardiac Gating Unit (MKSU-ECGU04/S2)
- Peripheral Gating Package (MKSU-PPGK02/S1)
- Respiratory Gating Package (MKSU-RSPK03/S1)
- Wireless Cardiac Gating System (MKSU-ECGU06/S1)[2)]
- Wireless Peripheral Pulse and Respiratory Gating System (MKSU-PRGK02/S1)[2)]
- Atlas Extended Table Travel (MZPT-1504/S1)[5)]
- High Load Capacity Table (MZPT-1510/S2)[5)]
- High Order Shim Kit[5)]
  – for Standard Gradient (MZKT-HOSK08)
  – for Helios Gradient (MZKT-HOSK07)
- Gantry Ambient Lighting (MZGL-1501/S1)
- Ceiling Routing Kit (MZCR-1501/S1)
- Additional Patient CAMERA Package (MMPM-GP3001/S1)
- Foot Switch Unit (MKFS-002A/S1)

Optional Receiver Channel Upgrade

Titan (Standard Gradient)

Required option	Number of Receiver Channel
Standard	8
• 16ch RF Receiver Package (MKPA-1506)	16
• 16ch RF Receiver Package (MKPA-1506) • Receiving Circuit Extension Kit (MKPA-1505/S1)	32

Titan (Helios Gradient)

Required option	Number of Receiver Channel
Standard	16
• Receiving Circuit Extension Kit (MKPA-1504/S1)	32

2) This option may not be available in all countries. Please consult your local Toshiba sales representative.
3) Model number depends on selling area.
4) The optional Receiving Circuit Extension Kit is required.
5) Factory option.

HARDWARE SPECIFICATIONS

Magnet

The Vantage Titan uses the world's shortest (1.4 m) self-shielded superconducting magnet. A wide patient aperture with 71 cm[1)] minimizes patient anxiety, ensuring a comfortable examination environment for all patients.
Field strength: 1.5 T
Length: 140 cm

- Homogeneity
  - With passive shimming:
    2 ppm or less at 500 mm DSV (50 cm × 50 cm × 50 cm)
    1 ppm or less at 400 mm DSV
    0.4 ppm or less at 300 mm DSV
    0.15 ppm or less at 200 mm DSV
    0.04 ppm or less at 100 mm DSV
    The above are VRMS (Volume root mean square) values based on measurements obtained by the precise 24-plane plot method. 24 points per plane are measured.
- Shimming method
  - Passive shimming
    Homogeneity is optimized on site by the addition of ferromagnetic material inside the magnet bore during installation using a computerized procedure. This is a very stable optimization method that does not require regular maintenance.
  - AAS (Auto-Active Shimming)
    When a patient is placed in the magnet, the patient's body will affect the magnetic field homogeneity. AAS adjusts the homogeneity to ensure the optimal field uniformity for each patient and/or pulse sequence such as FatSAT, PASTA, and EPI.
- Magnet mass (including liquid helium): Approx. 4,000 kg
- Fringe field
  The magnet employs active shielding. The fringe field line at 0.5 mT (5 gauss) is at 3 m in radial distance and at 5 m in the axial direction from the center of the magnet. This permits flexibility in magnet siting.
- Stability of the magnetic field (bare magnet)
  The superconducting magnet provides an extremely stable magnetic field. Stability is 0.1 ppm/hr or better.
- Cryogen
  The integrated refrigeration unit eliminates liquid nitrogen usage and reduces the boil-off rate of liquid helium to approximately 0.05[2)] liters per hour.
- Operating panel on the magnet
  The operating panel supports the following operations to facilitate patient set-up and scanning: scan start, abort, and pause/resume, emergency table stop, laser light localizer ON/OFF, ventilation adjustment, lighting adjustment, and patient table operation. The panel is also provided with a table position display, interlock display, and system ready LED.

RF coils (T: Transmit RF, R: Receive signals)

- Standard RF coils
  The Vantage Titan features a full range of QD RF coils to cover a wide range of clinical requirements.
  - QD Whole-Body Coil (T/R)
    This coil is integrated into the magnet cover. It provides a uniform RF field with QD transmission and a high SNR with QD reception. The internal diameter of this coil is 69 cm.
- Optional RF coils
  - Octave SPEEDER Head (R) (MJAH-167A)
    11-element array design that is suitable for head and neck studies especially for 8ch receive system.
  - Octave SPEEDER Spine (R) (MJAS-167A)
    12-element array design that is suitable for spine studies especially for 8ch receive system.
  - Atlas SPEEDER Head (R) (MJAH-127A)
    14-element array design that is suitable for head and neck studies with optimal SNR.
  - Atlas SPEEDER Anterior Neck (R) (MJAN-137A)
    This is a 3-element array coil, providing excellent SNR in the anterior neck.
  - Atlas SPEEDER Head/Cervical (R) (MJAH-137A)
    This array coil can be used in combination with Atlas spine and body coils. This advanced technology coil permits the use of up to 17 coil elements for excellent coverage and high SNR.
  - Atlas SPEEDER Spine (R) (MJAS-147A)
    32-element array design that is suitable for spine studies with optimal SNR. This integrated coil design features the unique ability to slide up to 380 mm to permit routine feet-first imaging of the lumbar and thoracic spine.
  - Atlas SPEEDER Body (R) (MJAB-167A)
    16-element array design that is suitable for abdominal studies with optimal SNR.
  - Shoulder SPEEDER (R) (MJAJ-177A)
    This is a soft and flexible 6-channel array coil with a winged Design. The coil can be installed easily, and its flexible structure allows a comfortable fit to be achieved even for large patients.
  - Breast SPEEDER (R)
    This advanced technology array coil permits the use of up to 8 coil elements for high SNR in the breast.
  - 32ch Cardiac SPEEDER (R) (MJAB-187A)
    This coil has a 32-element design with excellent SNR. To use this product, both the Helios Gradient option and Array electronics kit for 32ch (MKPA-1504/S1) are required.
  - Wrist SPEEDER (R) (MJAJ-167B)
    This array coil permits up to 6 elements to be selected, providing an excellent signal-to-noise ratio.
    Hand mode is used for whole-hand imaging with 6 elements. Wrist mode is used for wrist imaging with 6 smaller elements, which results in a higher SNR.

1) The diameter at the narrowest point is 69 cm.
2) This value is provided for reference only and was measured with no gradient pulsing. The actual value will vary depending on usage.

– Adaptive Endo Pelvis SPEEDER (R) (MJAP-117A)
This is a 2-element array coil, providing excellent SNR of the internal pelvis.
– 4ch Flex SPEEDER (R) (MJAJ-197A)
4-element array design that is suitable for a range of anatomical regions
– 16ch Flex SPEEDER Medium (R) (MJAJ-217A)
16-element array design that is suitable for a range of anatomical regions.
– 16ch Flex SPEEDER Large (R) (MJAJ-227A)
16-element array design that is suitable for a range of anatomical regions.
– Rectangular Flex Coil (R) (MJLR-107G)
The coil loop is a rectangle with dimensions of approximately 18 cm × 36 cm and has a large sensitive area. The rectangular loop section is cushioned and flexible.
– ϕ70 Flex Coil (R) (MJLC-077G)
The diameter of the coil loop is 70 mm. The circular loop section is cushioned and flexible.
– ϕ100 Flex Coil (R) (MJLC-107G)
The diameter of the coil loop is 100 mm. The circular loop section is cushioned and flexible.
– ϕ150 Flex Coil (R) (MJLC-157G)
The diameter of the coil loop is 150 mm. The circular loop section is cushioned and flexible.
– ϕ200 Flex Coil (R) (MJLC-207G)
The diameter of the coil loop is 200 mm. The circular loop section is cushioned and flexible.
– QD Head Coil (T/R) (MJQH-147A)
Provides a uniform RF field with QD transmission and optimizes SNR with QD reception. A detachable mirror is provided to minimize patient anxiety.
– QD Knee/Foot Coil (T/R) (MJQJ-167A)
Designed to obtain high-SNR images of the knee, ankle, and foot. An extended coil element allows the foot to be held in a comfortable position during scanning while providing excellent SNR in the distal foot and toes.
– QD Knee Coil (T/R) (MJQJ-157A)
Design optimizes SNR and provides a uniform RF field with QD transmission and reception capabilities. The coil has a large diameter of 195 mm. The upper part of the coil can be opened to facilitate patient handling.
– Extra Large Knee Array Coil (T/R) (MJAJ-187A)
This coil is a transmit-receive 6-channel array coil. Its large internal diameter improves patient comfort, especially for large patients.
– 16ch Flex SPEEDER Pad Kit (MJCA-207A)
This pad kit enables easy and suitable patient settings when it is used with 16ch Flex SPEEDER.
– Bilateral TMJ Imaging Kit
This requires two 70-mm Flex Coils (MJLC-077G) and Circular coil holder for TMJ Imaging (MJCA-147A). The positioning holder (included) allows stable and reproducible imaging of the TMJ bilaterally.
– Flex Breast SPEEDER (MJCA-177A)
Both breasts can be imaged simultaneously by using a pair of ϕ150 Flex Coils or ϕ200 Flex Coils. This product supports SPEEDER technology.

Console

The console features a widescreen LCD color monitor, permitting multiple windows to be clearly displayed for true multitasking operation. It is ergonomically designed to allow operation by a single technician, either standing or seated.

- Display monitor
  The console features a high-resolution 24" LCD color monitor. The display matrix is 1,920 × 1,200 with 256 B/W gradation levels.
- Control pad and control box
  The following operations can be performed using the hardware controls at the console: power ON/OFF, emergency stop, scan start, scan abort, scan pause/resume, tabletop movement and intercom talk and volume.
- Mouse
  Optical two-button scroll mouse. All interfaces can be accessed by simple point-and-click operation except for registration of patient information and comments for image annotation.
- Keyboard
  The keyboard is used to register patient information and comments for image annotation.

Patient table

The patient table is ergonomically designed to maximize both patient comfort and patient throughput. The tabletop can be lowered to 430 mm from the floor. Hydraulic drive ensures smooth and quiet vertical tabletop movement.
Maximum patient load: 200 kg

- Option 1: Atlas Extended Table Travel (MZPT-1504/S1)
  Increases the usable scanning range to 205 cm.
- Option 2: High Load Capacity Table (MZPT-1510/S2)
  Maximum patient load: 250 kg

  Note that for patients weighing more than 200 kg, the following coils are available.

  · QD Whole-Body Coil
  · Octave SPEEDER Head
  · Octave SPEEDER Spine
  · Atlas SPEEDER Head
  · Atlas SPEEDER Head/Cervical
  · Atlas SPEEDER Spine
  · Atlas SPEEDER Body
  · Shoulder SPEEDER
  · 32ch Cardiac SPEEDER
  · Wrist SPEEDER
  · Adaptive Endo Pelvis SPEEDER
  · 4ch Flex SPEEDER
  · 16ch Flex SPEEDER Medium
  · 16ch Flex SPEEDER Large
  · QD Head Coil
  · QD Knee/Foot Coil
  · Extra Large Knee Array Coil
  · Rectangular Flex Coil
  · ϕ70 Flex Coil
  · ϕ100 Flex Coil
  · ϕ150 Flex Coil
  · ϕ200 Flex Coil

* Atlas Extended Table Travel option and High Load Capacity Table option must be used separately.

Computer system

The computer system is designed to provide outstanding multitasking performance, permitting image reconstruction and advanced image processing to be performed simultaneously with scanning. This helps to increase examination productivity. In addition, the computer system is provided with network connectivity for expandability.

- Host computer
  System manager (SM)
  CPU: 6-core dual-processor system or more (12 CPUs or more)
  Clock speed: 2.4 GHz or more
  Main memory capacity: 12 GB or more
  Hard disk drive
  For system use: 300 GB or more (unformatted)
  For image data: 600 GB or more (unformatted)
  Image capacity: Approximately 1,120,000 images (256 × 256 images, raw data not saved)
- System control system
  Real-time manager (RM)
  CPU: 32 bit
  Memory capacity: 256 MB
  System control method: Distributed control
- Reconstruction system
  CPU: 6-core dual-processor system or more (12CPUs or more)
  Clock speed: 2.93 GHz or more
  Main memory capacity: 12 GB (for Standard Gradient)[1)]
  24 GB (for Helios Gradient)[1)]
  Maximum reconstruction speed: 12,600 images/second or more (256 × 256, FFT, potential)
  Hard disk drive capacity: 3.5 TB or more (unformatted)
  1.3 TB or more (RAID 10)
  Reconstruction matrix: 1,024 × 1,024 (maximum)
  Simultaneous image reconstruction during scanning: Possible
- DVD drive unit
  Storage capacity: 9.4 GB (unformatted)
  Saved image capacity: Approximately 44,000 images (256 × 256 images, raw data not saved)
- Connection with external devices
  Interface: Ethernet (1000Base-T)
  DICOM 3.0
- Cabinet
  Installation location: Computer room

Digital RF system

The Digital RF system consists of a digital transmitter and wideband analog/digital receivers supporting array acquisition. The number of receiver channel can be selected as options. The digital transmitter provides the precise RF phase control needed to employ advanced pulse sequences. The high-frequency data sampling capability supports fast scan techniques.

RF power amplifier

An output rating of 20 kW ensures that the system can generate the short pulses required for advanced pulse sequences. To ensure patient safety, RF power is emitted only when the SAR calculated by the system is below a preset limit.

Gradient subsystem

The combination of a powerful gradient power supply unit and a high-precision active shield gradient coil ensures stable image quality with all sequences, eliminating eddy currents.

	Standard Gradient	Helios Gradient
Gradient strength:	34 mT/m	36 mT/m
Slew rate:	148 mT/m/ms	203 mT/m/ms
Gradient duty cycle:	100%	100%

Toshiba's innovative Pianissimo technology is a patented gradient acoustic noise reduction technology that dramatically reduces scanning noise.

Patient comfort and safety

- The world's shortest open gantry (1.4-m magnet) with the largest clinical FOV markedly reduces patient anxiety and ensures comfort during examination.
- Pianissimo
  Pianissimo technology dramatically reduces the level of acoustic gradient noise, thus substantially enhancing patient comfort, especially during scanning with fast sequences.
- Lighting/Ventilation of the patient bore
  Adjustable lighting/ventilation improves patient comfort in the magnet during scanning.
- SAR calculation
  The system always calculates SAR before scanning. If the calculation result indicates that the preset limit will be exceeded, scanning cannot be started.
- Patient call system
  The patient call system allows the patient to signal an emergency during scanning. The system includes a handswitch that is actuated by the patient.
- Intercom system
  The integrated intercom system allows two-way communication between the patient and the operator.
- Patient observation system
  A CCD camera is used to observe the patient during scanning.
- Oxygen monitor
  The oxygen monitor automatically activates the customer-supplied ventilation system if the oxygen level falls in the scan room.
- Emergency run-down unit
  This safety switch allows automatic ramp-down of the magnetic field in the event of an emergency.

1) 48 GB is available as an option.

PERFORMANCE SPECIFICATIONS

Acquisition parameters

The Vantage Titan digital architecture offers extremely flexible acquisition parameters for optimizing image quality and scan times.

- Imaging method[1] : 2DFT and 3DFT
- Imaging nucleus: Proton (hydrogen nucleus)
- Slice orientations[1] : Axial, sagittal, coronal, oblique (single and double)

Refer to the scan parameter table.

Scan parameters[2]	Specifications	Note
FOV [mm]	5 to 550	Adjustable in increments of 1 mm. The 550-mm FOV (550 mm in the X and Y directions) is used for purposes such as locator scanning.
Min. SliceThickness2D [mm]	0.5	Adjustable in increments of 0.1 mm.
Max. SliceThickneess2D [mm]	100	
Min. SliceThickness3D [mm]	0.05	Adjustable in increments of 0.1 mm.
Max. SliceThickness3D [mm]	50	
Min. ETS (Echo Train Spacing)		
EPI	0.4 (Helios Gradient) 0.6 (Standard Gradient)	
FSE	2.6	
Max. Matrix	1,024	Independently adjustable in 16 or 32 steps in both the frequency and phase encoding directions.
– Frequency encoding:	64 to 1,024	
– Phase encoding:	32 to 1,024	
Highest In-Plane Resolution [µm]	20	
Maximum number of slices (2D)	128	
Maximum number of slices (3D)	256	
Number of acquisitions (NAQ):		
– Integer NAQ:	From 1 to 64	Adjustable in increments of one (1, 2, 3, 4, 5, 6, and 7, etc.)
– Variable NAQ:	Available	Adjustable increments of 0.1 from NAQ=1 (NAQ = 1.1, 1.2, etc.)
– AFI (Advanced Fourier Imaging)	Available	Scan time reduced by approximately NAQ=0.5
TI (Inversion time):	9 ms to 10 s	
Flip angle:	1° to 180°	
Flop angle:	30° to 180°	

SPEEDER function

Speed-up factor: Max. 16X[3]

1) Specifications vary depending on the pulse sequence.
2) Some parameters may require an optional package.
3) The factor depends on the coil and the number of RF channels used.

Imaging techniques and parameters

A wide range of imaging techniques are provided to complement the Vantage Titan's precise and powerful digital RF system, computer platform, and high-performance gradient subsystem.

- Conventional pulse sequences
  - SE (spin echo)
  - FE (field echo)
  - IR (inversion recovery)
- Fast scan techniques
  - FastSE
    The flop angle for 180° RF pulses can be varied to reduce saturation transfer contrast (STC) effects and the specific absorption rate (SAR) to ensure patient safety. FastSE is compatible with both 2DFT and 3DFT. Flow compensation and presaturation are available.
  - FastIR
    An inversion pulse is added to the 2DFT FastSE technique to enhance T1 contrast. This results in a much shorter scan time than in conventional IR. Multislice is available.
  - FastFLAIR (fluid-attenuated IR)
    Increases contrast between fluids, such as CSF, and lesions to improve specificity using FastIR with a long TI, TE, and TR. This results in a much shorter scan time than in conventional IR. Multislice is available.
  - FastSTIR
    Suppresses fat signals using FastIR with a short TI. This results in a much shorter scan time than in conventional STIR. Multislice is available.
  - FastFE
    A pre-pulse is applied prior to FE pulse sequences to enhance T1 contrast with short scan times. Segmentation of scans is available to increase spatial resolution.
    FastFE is applicable to both 2DFT and 3DFT.
- Advanced fast scan techniques
  - FASE (fast advanced spin echo)
    This pulse sequence, which is based on FastSE with a large number of echoes (max. 276 ETL), is combined with advanced Fourier imaging (AFI) to reduce the scan time significantly with an echo factor of 512 (scan time reduction factor) in the standard configuration or 1,024 with optional software. A single shot is sufficient to generate an image in a few seconds. A pre-pulse is available for fat suppression. This technique is compatible with both 2DFT and 3DFT. FASE provides T2-weighted images and is an RF refocused echo planar imaging (EPI) technique. High contrast is achieved. T2-weighted images with short scan times can be used to clearly depict the gallbladder, hepatic ducts, and pancreatic duct without contrast agent. FASE expands the range of clinical applications of MRI, supporting magnetic resonance cholangiopancreatography (MRCP), MR urography, and MR myelography.
  - The optional Contrast Free MRA application supports an expanded range of clinical applications such as fresh blood imaging (FBI) or swap phase encode extended data acquisition (SPEED).
  - Hybrid EPI (echo planar imaging)
    The Vantage Titan has Hybrid EPI capabilities to support the use of up to 27 echoes each with a different phase encoding similar to FastSE. Hybrid EPI uses a combination of both FastSE and EPI data, providing T2-weighted contrast while reducing SAR.
  - Multi-Shot EPI
    Utilizes gradient echoes for SE-EPI, which are divided by up to 15 echo factors for one acquisition. Multislice is available.
  - Single-Shot EPI
    Both SE type and FE type are available. FE-type Single-Shot EPI requires the optional mNeuro package.
  - TrueSSFP
    T2/T1-contrast images can be obtained quickly using the steady-state free precession technique. This is suitable for scanning relatively longer T2 tissues and vascular structures during breath-holding. Fat saturation is possible by dividing scans into multiple segments.
  - FSE/FASE T2 Plus
    By promoting transverse magnetization recovery in FSE and FSE 2D, the scan time can be reduced and the resolution can be increased with no loss of T2 contrast and SNR.
  - SSFP
    T2/T1-contrast images can be obtained quickly using the steady-state free precession technique. This is suitable for imaging relatively longer T2 tissues such as CSF and synovial fluid. The slice thickness can be reduced by 3DFT scanning.
  - FASE3D mVox
    Enables acquisition of clear images with reduced SAR by changing the refocusing flip angle for each echo.
- JET™ technique
  JET acquires the data for the k-space in non-cartesian mode and suppresses motion artifacts by detecting and correcting for in-plane motion using the data for the central part of the k-space, which is acquired repeatedly. This application can suppress not only image artifacts in patients who are unable to remain still during scanning, but also artifacts due to involuntary motion such as CSF flow. This technique is based on FastSE 2D, and uses T2W and FLAIR contrast enhancement.

- Vascular imaging techniques
  - 2D-TOF (time of flight)
    The time of flight effect is induced by the in-flow of fresh spins into the imaging slice to differentiate blood flow from tissue. Slices are acquired sequentially through the imaging volume. This technique functions optimally when the vessels are perpendicular to the acquired slices. It depicts relatively slower blood flow and is suitable for cervical, abdominal, and extremity applications. Maximum intensity projection (MIP) images can be displayed from multiple viewing angles. An overlapping scanning technique improves the visualization of vessels. A moving presaturation band can also be applied to differentiate between arterial and venous flow in certain body areas. ECG gating is applicable for 2D-TOF*
  - 3D-TOF (time of flight)
    3DFT with TOF is used to depict multidirectional vascular structures and faster blood flow. MIP images can be displayed from multiple viewing angles. SORS-STC and ISCE RF pulses can be combined with 3D-TOF to improve vessel detail.
  - 3D-CE (contrast enhanced)
    Contrast agent is injected in order to enhance blood signals, followed by a 3D-FE or 3D-FastFE sequence.
  - SORS-STC (slice-selective off-resonance sinc pulse saturation transfer contrast)
    Enhances blood flow and suppresses background signals by using a slice-selective off-resonance pulse. SORS-STC is more effective than conventional spatially nonselective STC (or MTC) because it suppresses background tissues without reducing the signals from bloodflow.
  - ISCE (inclined slab for contrast enhancement)
    Provides increased vessel detail by using an RF pulse with a different flip angle in combination with 3D-TOF to enhance signals from blood flow throughout the imaging volume.
  - Multi coverage
    Separates the data acquisition area of 3D TOF MRA into a few regions in order to limit signal reduction due to saturation effects.
  - 2D-PS (phase shift)
    The phase shift effect is generated by applying a flow encoding gradient pulse. The phase shift is proportional to the flow velocity. 2D-PS can be used with a volume slice to increase coverage of vessels and shorten scan times. Selecting the flow velocity allows specific vessels to be depicted.
  - Cine 2D-PS (phase shift)
    2D-PS can be used with an optional cardiac-gating unit for cine imaging.
  - Flow Quantification
    Blood flow velocity can be measured using cine 2D-PS with an optional cardiac-gating unit.
  - 3D-PS (phase shift)
    The phase shift effect, when used with 3DFT, is suitable for showing multidirectional vascular structures. Selecting the flow velocity allows specific vessels to be visualized. MIP images can be displayed from multiple viewing angles.
  - BEST (blood vessel enhancement by selective suppression technique)
    A postprocessing algorithm that selectively enhances small vessel detail and suppresses background tissue signals.
  - Cardiac tagging*
    Allows myocardial movement to be visualized by applying several presaturation bands. Optional ECG gating is required. The number and positions of tags can be selected.
- Fat suppression techniques
  The Vantage Titan includes a comprehensive selection of fat suppression techniques to support a wide range of applications.
  - STIR (short TI inversion recovery)
    A short TI 180° pre-pulse with IR suppresses fat signals to enhance water-proton images.
  - FastSTIR
    STIR with FastIR to reduce scan times.
  - WFOP (water/fat opposed phase)
    An asymmetric SE technique in which image acquisition is performed at the instant the signals from water and fat go out of phase.
  - FatSAT (fat saturation)
    Fat saturation pulses are applied to presaturate fat only. The multislice off-resonance fat suppression technique (MSOFT), an innovative Toshiba technology, ensures uniform fat suppression over all slices by using an offset RF pulse for each slice. Offset values are determined based on data acquired by auto-active shimming.
  - PASTA (polarity altered spectral and spatial selective acquisition)
    Another innovative technique for suppressing fat signals in SE and FastSE sequences to obtain uniform water images over all slices. It consists of a narrow-bandwidth 90° RF pulse to separate water from fat. Opposing slice gradient polarity is used for 90° and 180° RF pulses to refocus water signals.
  - DIET (dual interval echo train)-FastSE
    A drawback of FastSE is the high brightness levels from fat tissue signals. DIET is a new technique that reduces fat signals in FastSE by utilizing a pulse sequence with irregular echo intervals to achieve contrast near SE levels.

* Option

- Imaging modes
  - Multislice
    Multiple slices can be acquired during a scan.
  - Multi-echo
    Multiple echo data can be acquired within a single TR.
  - Multi-coverage
    If the specified number of slices cannot be acquired within the designated TR, the system automatically repeats the scan to cover the required area.
  - Interleaved scan
    Excites odd slices first and even slices second to eliminate interslice interference.
  - Excitation order for multislice
    The user can select the order of excitation in multislices as follows.
    · Forward (from small to large numbers)
    · Reverse (from large to small numbers)
    · Concentric (from center to outside)
  - Dynamic scan
    Sets up to five continuous dynamic scans in one study. Each dynamic scan is specified independently according to the delay time, scan interval, and number of scans. The minimum scan interval is zero.
  - Gating
    · Cardiac gating
    Multislice/single-phase and single-slice/multiphase imaging techniques are available. Cardiac images can be displayed in cine mode. Retrospective gating is also available as an option.
    · Peripheral pulse gating*
    Reduces CSF pulsation artifacts.
    · Respiratory gating*
    Reduces respiratory motion artifacts.
    · Retrospective gating*

- Artifact suppression techniques
  - Flow compensation
    Utilizes gradient moment nulling techniques to reduce flow artifacts.
  - Presaturation
    Up to seven presaturation bands can be set to reduce motion, flow, and wrap-around artifacts. The Vantage Titan's graphical user interface allows multiple bands in the orthogonal and oblique directions to be set with ease. The following preset presaturation bands are available.
    · Anti-phase aliasing
    · Anti-frequency aliasing
    · Flow suppression
    · Leading or following slices (for 2D-TOF)
  - Skipping SAT*
    Reduces the number of presaturation pulses in order to increase the number of slices.
  - No wrap (frequency and phase directions)
    Eliminates wrap-around artifacts by increasing the sampling data points in frequency or encoding steps in phase. The no wrap function is applicable up to a 512 × 512 matrix with 3DFT.
  - Phase swap
    The phase and frequency encoding directions can be swapped to minimize flow and respiratory motion artifacts.
  - Breath-hold imaging
    An optional Auto-Voice function instructs patients when to hold their breath.

* Option

USER INTERFACE

Vantage Titan employs a new platform to provide user-friendly operability. The user interface is designed for intuitive operation, enabling even those with less experience to operate the system without difficulty. The interface has been created in accordance with the "universal design" concept, with the aim of reducing stress on the operator. This operability is implemented as a common standard among Toshiba medical systems. Vantage Titan also employs a new image processing engine, which provides three-dimensional image processing and color fusion processing, as well as flexible support for clinical application software.

Basic operations

System startup	· System startup is possible. · The initial screen is displayed. · The system status can be checked at the time of system startup. If the system status is determined to be abnormal, data acquisition is disabled or the system is shut down. · The system check is executed at the time of system startup. If an abnormality is detected, system operation is disabled. · Registration and control of authorized users is possible.
Page control	· A processing switching function that allows multiple processing tasks to be performed simultaneously is provided. · Display of errors and warnings is possible.
System shutdown	· System shutdown is possible.

Patient scheduling and registration

Patient information and scanning conditions for examinations can be scheduled and registered. The scanning conditions can be registered simply by selecting a set of conditions preregistered in the database for individual anatomies (PAS function).

• Patient Registration

Scheduling and registration items:	· Patient ID, patient name, weight, sex, birth date (automatic age calculation), date of scanning (selection from calendar is possible), time of scanning, ordering department, name of ordering physician, name of radiologist, name of radiographic technologist
Search function:	· Provided (patient name, date and time of scanning, etc.)
Sorting function:	· Provided (by patient name, by date and time of scanning, etc.)
DICOM MWM:	· IHE is supported as the standard.

• Scanning condition selection and registration: PAS (Programmable Anatomical Scan)

Preset items:	· PAS name (name of a set of scans) · Scanning region (graphic icon) · Type of RF coil · Scan name (names of individual scans) · Scanning conditions (imaging parameters), etc.
Customization function:	· Provided (Automatic sample image registration is possible.)

Scanning

A pilot scan (initial scan) is performed, scans are planned using the acquired data, and the scans are run. Progress of the scans is controlled using the scan list displayed in the Sequence Queue window.

• Sequence Queue operations

Queuing:	· Scans can be copied, added, or deleted, and acquisition order can be changed.
Scan start control: – Auto: – Breath hold: – Pause/resume function, abort function	 · Multiple specified scans can be run in succession automatically. · Each scan is started by pressing the Scan Start button. · Combination with the AutoVoice function is possible.
Automatic tabletop movement:	· Possible

• Pilot scan

Prescan:	· Automatic (manual control is possible for some types of prescan)
Simultaneous multiplane scan:	· Maximum three planes (axial, sagittal, coronal) · Combination with multislice scan is possible.

• Scan planning

Multiplane scan planning:	· Three-plane scan planning is possible.
Image switching during planning:	· Possible
Oblique plan:	· Possible (sequential, multiangle)
Graphical plan:	· Plan items · Slice position and angle, slice thickness, slice gap, FOV, phase encode direction/ readout direction, presaturation area, etc.
Multiple scan planning:	· Possible (multiple scans can be planned during scanning)
Plan duplication:	· A set of planned scanning conditions can be applied to the other scan by a simple operation (scan plan condition history function). · Editing of scan conditions is possible
Autopositioning assistance:	· Autopositioning assistance is available.* (CardioLine, NeuroLine)

• Scanning

Safety functions:	· SAR limitation function, dB/dt limitation function
Wide-area scanning function:	· The center of the target region can be moved to the magnetic field center automatically for each scan.
Move table function:	· The tabletop can be moved so that the slice center is positioned at the magnetic field center.
Remaining scan time display function:	· Provided
SAR display:	· The estimated SAR value is displayed before scanning and the actual SAR value is displayed after scanning.
Gating signal display:	· The ECG gating, peripheral pulse gating, and respiratory gating waveforms can be displayed.

• Reconstruction and AutoView

AutoView function:	· Provided (all images are displayed in the Image Matrix)	
Auto windowing function:	· Provided	
Automatic postprocessing:	· Automatic dynamic subtraction (absolute value) · Automatic dynamic subtraction (complex value) · Automatic MIP preview (three directions) · Automatic Diffusion postprocessing (ADC image, Isotropic image)	Possible Possible Possible Possible

* Option

Image display and processing

Images acquired in scanning are displayed, various processing is applied to these images as required, and the images are printed onto film. Image Matrix, which displays thumbnails of actually acquired images, allows the user to quickly search for and select the desired images. A variety of image processing functions are provided to serve different purposes. The excellent parallel processing capability of Vantage Titan allows image processing to be performed in parallel with scanning.

• Image display

Image selection:	· Selection from Image Matrix · Skipped selection function is provided.
Display template:	· Multiframe display is possible. · Images for two different patients can be switched easily.
Automatic display function:	· Provided (multiple images selected in the Image Matrix are displayed in sequence)
Window adjustment: – Auto windowing: – Apply Contrast function:	· WW/WL adjustment by mouse operation · Possible · Provided
Image-related information:	· Patient information, imaging parameters, RF coil type, etc. · Graphics & annotation function is provided. · Image-related information display ON/OFF is possible.
Reference display:	· All positioning ROIs can be displayed on the image used for scan planning. · ROI corresponding to an arbitrary image slice can be displayed on an arbitrary image.
Inset display: – Size change: – Display position selection:	· Possible · Possible in three levels · Possible
Cine display:	· Possible · Multiframe display is possible · Playback/switching speed can be changed. · Storage of moving images is possible.
Various display functions:	· Black/white reversal, rotation, flipping, grid, zooming (interactive enlargement and reduction), scrolling (interactive scroll), Apply View function

• ROI calculation

Calculation functions:	· Distance, angle, area, pixel value, profile, histogram

• Image processing

Gain algorithm:	· New denoising algorithm can be used.
Image filters:	· Smoothing, edge enhancement, Ringing artifact reduction etc.
MIP: – Projection direction: – Processing time: – Target MIP – Composite MIP*	· Maximum intensity projection, minimum intensity projection · Specified using ROI (specification of multiple projection directions is possible) · Approx. 1 s/projection (original image: 256 × 256 × 64) (Processing time may be longer depending on the workload of the processing that is running in parallel.) · MIP target region can be specified in three directions. · Possible
MPR:	· Interactive MPR, batch MPR · Double oblique is possible. · Slice thickness change function is provided. · Image storage function is provided.
Image calculation:	· Addition, subtraction, multiplication, division, and other functions · Automatic dynamic subtraction: Subtraction image is generated automatically after dynamic scan.
Intensity correction:	· Provided as standard.
Distortion correction:	· Provided as standard.
3D post-process:	· Provided as standard.
Fusion processing:	· Provided as standard.

* Option

• Filming

Virtual filming:	· The dedicated Virtual film window is provided.
Support of multiple imagers:	· Possible

Data management

Patient data and image data are stored on hard disk drive. Image data is transferred over the hospital network as required.

Temporary storage of patient data:	· Hard disk drive
Long-term storage of patient data:	· DVD-RAM disk
Patient data search:	· Possible

• Network transfer of images

Support of DICOM 3.0:	· Support of Storage SCU, Enhanced MR (volume data, MRS data), Print SCU, MWM, and DICOM Media are provided as standard. Two more DICOM service classes are available (support of DICOM 3.0).
Support of HIPAA:	· Provided as standard. · The requirements of Health Insurance Portability and Accountability Act are met.
Support of IHE:	· Provided as standard. · Support of SWF, CPI, PDI, and CT are provided. (IHE: Integrating the Healthcare Enterprise, an activity aiming to establish of inter-system connectivity)

• Utilities

LHe level indication:	· The LHe level data is read from the supervisory unit. · Logging is possible.
Quality control:	· Daily QA · Logging is possible.
Errors:	· Logging is possible.

Image processing

The Vantage Titan's platform supports a wide range of high-speed image processing capabilities.

- Reconstruction
  The maximum reconstruction matrix is 1,024 x 1,024.
  – FINE
    Doubles the reconstruction matrix to improve the in-plane spatial resolution without increasing scan times for both 2D and 3D images. This technique can also be applied to the slice encoding direction for 3D images.
  – Refine filter
    User-selectable reconstruction filter to enhance image quality.
- Batch multiplanar reconstruction
  Provides oblique as well as interactive MPR.

Networking

- DICOM 3.0
  The Vantage Titan supports DICOM 3.0 for transferring image data over networks.
  The system is provided with Storage SCU, Print SCU, DICOM Media, and MWM SCU as standard. In addition, Storage Commitment, Q/R SCU, Q/R SCP, and MPPS SCU are available as options.
  IHE profiles are supported.
- Laser camera
  DICOM Print is available.
- Second console*
  This console includes an independent computer platform and supports all of the functions of the main system console except for scanning and reconstruction. DICOM is supported, and the second console is connected to the system console by Ethernet. The use of an independent platform means that the main and second consoles can be used simultaneously for different tasks.
- Remote Service maintenance
  The InnerVision remote service system permits system diagnosis over a digital connection to the Toshiba Technical Support Center. Please consult your Toshiba representative for details.

* Option

SPECIFICATIONS OF CLINICAL APPLICATIONS

TOF MRA method
Blood vessels can be visualized without contrast medium using the time of flight effect.

- 2D TOF method
  Artery/vein separate: MovingSAT available
  Fat saturation method: Can be used in combination
  Presaturation method: Can be used in combination
- 3D TOF method
  – SORS-STC method:
  The imaging capabilities for blood vessels are improved by selectively suppressing the signals from tissues.
  – Flip angle of SORS-STC pulse: Variable
  – Head MRA scanning coil:
  Transmission and reception type
  (slice-selective off-resonance sinc pulse saturation transfer contrast)
  – ISCE method
  Degradation in peripheral blood vessel images is suppressed.
  – Selection of flip angle distribution in slab: Available
  – Combined use of SORS-STC method: Available (inclined slab for contrast enhancement)
  – Multicoverage method
  This is a wide-range imaging method taking advantage of the TOF effect using a thin slab.
  – Coverage joint suppression method: Available
  – Fat saturation method: Can be used in combination
  – Presaturation method: Can be used in combination
  – Support for Pianissimo Plus: Standard

Noncontrast MRA* by the FASE method
- FBI (fresh blood imaging) method*
  This is a vascular imaging method in which new blood ejected from the heart is visualized by setting an appropriate delay time from the R wave using ECG gating and peripheral pulse gating and performing data acquisition synchronized for each shot.
  – ECG-Prep method*
  – Intermittent breath-hold method in ECG-gated scanning
  – Sequential FASE method*
- SPEED (swap phase encode extended data) method*
  Blood vessels that run through multiple orientations are observed on one image by acquiring two images in which the phase encode direction is rotated by 90° and superimposing them using composite MIP processing*.
  – Automatic composite MIP

PS MRA method
The PS (phase shift) method performs visualization based on the phase differences between moving parts and stationary parts.

- 2D PS method:
  Visualizes the blood vessels in a short time.
  – Scan cross section: Three orthogonal planes
- 3D PS method:
  Covers the slice range continuously without slice gaps.
  – Scan cross section: Three orthogonal planes

MRCP
The bile and pancreatic ducts can be visualized noninvasively using the FASE method (MR cholangiopancreatography).

- 2D MRCP method
  Visualizes the bile and pancreatic ducts in a short time.
  – Single-shot scan: Available
  – Multislice scan: Available
  – Fat saturation method: Can be used in combination
  – Support for Pianissimo Plus: Standard
  – Support for T2 Plus: Supported*
- 3D MRCP method
  Covers the slice range continuously without slice gaps.
  – Fat saturation method: Can be used in combination
  – Support for breath-hold scan: Automatic instruction by Auto-Voice
  Respiratory gating: Can be used in combination
  – Support for Pianissimo Plus: Standard
  – Support for T2 Plus: Supported*

Other types of MR hydrography
FASE and FastSE can be used in various clinical applications such as MR cisternography, MR myelography, MR urography, and MR lymphangiography.

Flow velocity measurement method
- Scan for flow velocity measurement
  – Method: 2D cine PS method
  – Cross section: Three orthogonal planes
  – Direction: Slice/readout/phase encode
- Flow velocity analysis
  Generation of flow velocity time curve

* Option

Diffusion Imaging
Isotropic diffusion-weighted images and ADC images can be obtained using the EPI and the FASE method.

- EPI Diffusion
  - Single-Shot EPI: Available
  - Three-axis continuous acquisition: Available*
- FASE Diffusion*
  - Three-axis continuous acquisition: Available*
- Diffusion postprocessing*
  - Diffusion ADC image (apparent diffusion coefficient image)
  - Diffusion isotropic image (isotropic diffusion-weighted image)
  - Dynamic averaging function: Available
  - Automatic postprocessing: Available (ADC, isotropic)

Diffusion Tensor Imaging (DTI)*
Continuous white matter tracts running in various directions in the head can be visualized using the EPI method.

- EPI Diffusion
  - Single-Shot EPI: Available
- Diffusion postprocessing
  - Fractional anisotropy image (indicating the degree of diffusion anisotropy)
  - Lambda image (characteristic value image)
  - Lambda image (vector image of characteristic value)
  - Dynamic Averaging: Available
  - MAP image (scalar and vector map image)
  - Fusion image (Anatomical (T1, T2, FLAIR etc.) and MAP image)
  - MPR image
  - 3D image (SVR + Plan cut + MAP image + Fiber or Cross section + MAP image + Fiber)

Perfusion Imaging
ASL imaging using the ASTAR method without contrast medium can also be performed.

- ASL*
  - ASTAR method: Available
    The signals from static tissues are suppressed by canceling the MT effect by setting the IR pulse positions asymmetrically and also by suppressing the blood flow from one of the imaging slices.
  - Control IR position: Variable
  - Tag IR position: Variable
  - Tag IT thickness: Variable

Cardiac Imaging
Various types of cardiac imaging can be performed by the combined use of the ECG-gating method.

- Cine imaging
  - Application: FE 2D, FFE 2D (support for TrueSSFP)
  - Sequential multislice multiphase
  - Number of phases: Variable (depending on the R-R interval)
  - ECG-gating : Prospective, retrospective*
- Gate-free Cine imaging
  - Application: FFE 2D (support for TrueSSFP)
  - Taking images without gating in the breath-hold state.
- ViewShare reconstruction: Available
  - Tagging scan: Available
  - Freehand tag: Tag thickness can be set.
  - Parallel tag: Tag pitch can be set.
  - Radial tag: Number of tags and tag angle can be set.
- BB (black blood) method*
  - Application: FASE 2D
  - Sequential multislice
  - Number of slices per breath-hold can be specified.
  - Fat saturation pulse can be used in combination.
- Cardiac function analysis*
  - Target: RAO image, 4-chamber image
  - Cardiac output (CO), ejection fraction (EF)
  - Volume curve is generated and displayed.
  - Percent wall thickness is calculated and displayed.
  - Visual evaluation of cine images of wall motion (Bull's eye map of wall thickness)
- Retrospective*
  - Acquires continuous cine images.
  - An image of the entire cardiac cycle, including diastole, can be obtained.
  - Application: FFE 2D (support for TrueSSFP)
- Myocardium delay imaging*
  - A T1-weighted image obtained using the inversion recovery method.
  - Analysis of delayed myocardial enhancement is available.
  - Application: FFE 2D, FFE 3D
- Myocardial perfusion imaging
  - Multi-slice ECG-gated dynamic scan to acquire images of first pass of contrast.
  - Temporal change of signal intensity can be analyzed
  - Application: FFE 2D
- Real-time motion correction (RMC)*
  An image with reduced respiratory motion artifacts can be obtained by following the scanning cross section relative to diaphragm motion. FFE 3D is applied.
- Positioning assistance for cardiac
  - Assists the operator before scanning (easy operation). The operator can modify the plan position manually after setting with this function.*

* Option

INSTALLATION CONDITIONS

Power requirements

A continuous and stable power supply is required for reliable operation of the system. Frequent power failures may damage the system. The power line shall be free of rapid variations and must not be shared by other equipment.

Line voltage [1]	200 V	400 V
Phase	Three-phase	Three-phase
Voltage fluctuation	±10%	
Frequency	50/60 Hz ±1%	
Power requirements [2]	20 kVA	42 kVA (Standard Gradient) 52 kVA (Helios Gradient)

1) Two line voltages (200 V and 400 V) are required for the system itself.
   Other line voltages may be supported with the use of an additional step-down or step-up transformer. Please consult with your local Toshiba representative and refer to the site planning manual for details.
2) An additional power is required for the water cooling system. (15-20 kVA for Standard Gradient and 20-35 kVA for Helios Gradient)
   Continuous power (day and night) is required for some equipment.

Grounding

Independent grounding is required. Grounding must be provided in accordance with all applicable legal requirements for medically used electrical equipment.

Power consumption and heat dissipation (50/60 Hz)

	Standard Gradient	Helios Gradient
Power consumption	32.2/34.0 kW	35.6/36.8 kW
System heat dissipation	10.8/12.5 kW	11.9/13.7 kW

Note: The heat dissipation value does not include the external heat exchanger.

Air conditioning

An appropriate air conditioning system is required to maintain the specified temperature and humidity. Continuous air conditioning (day and night) is required for some equipment.

Environmental requirements

- Temperature and humidity: No condensation
  - Scan room: 16°C to 24°C, 40% to 60% R.H.
  - Operator's room: 16°C to 30°C, 40% to 75% R.H.
  - Computer room: 20°C to 24°C, with fluctuation +/- 3°C/day or less, 40% to 70% R.H.
- Magnetic field: Less than 1.0 μT peak-to-peak
- Electric field: Less than - 5 dB μV/m (0.56 μV/m) over 63.9 MHz +/- 0.5 MHz
  An RF shield room with more than 90-dB shielding is required.
- Ventilation: 30 m^3 /min or more for the scan room
- Ventilation pipe: A ventilation pipe must be provided in the scan room for emergency quenching of the magnet.
- Rigging clearance: 2.0 m (W) × 2.5 m (H) or more
- Minimum installation area: 38.8 m^2 (for Standard Gradient)
  39.8 m^2 (for Helios Gradient))
  - Scan room: 6.5 m × 3.9 m = 25.3 m^2
  - Operator's room: 2.6 m × 2.0 m = 5.2 m^2
  - Computer room: 3.1 m × 2.6 m = 8.1 m^2 (Standard Gradient)
    3.5 m × 2.6 m = 9.1 m^2 (Helios Gradient)
- Ceiling height: 2.4 m for the scan room, except for the maintenance space for the refrigerator (2.8 m)
- Installation altitude: Less than 2,000 m above sea level
- Cooling water
  - Flow rate: 48 l/min or more (Standard Gradient)
    58 l/min or more (Helios Gradient)
  - Temperature: 18°C to 22°C

COMPATIBILITY WITH INTERNATIONAL STANDARDS

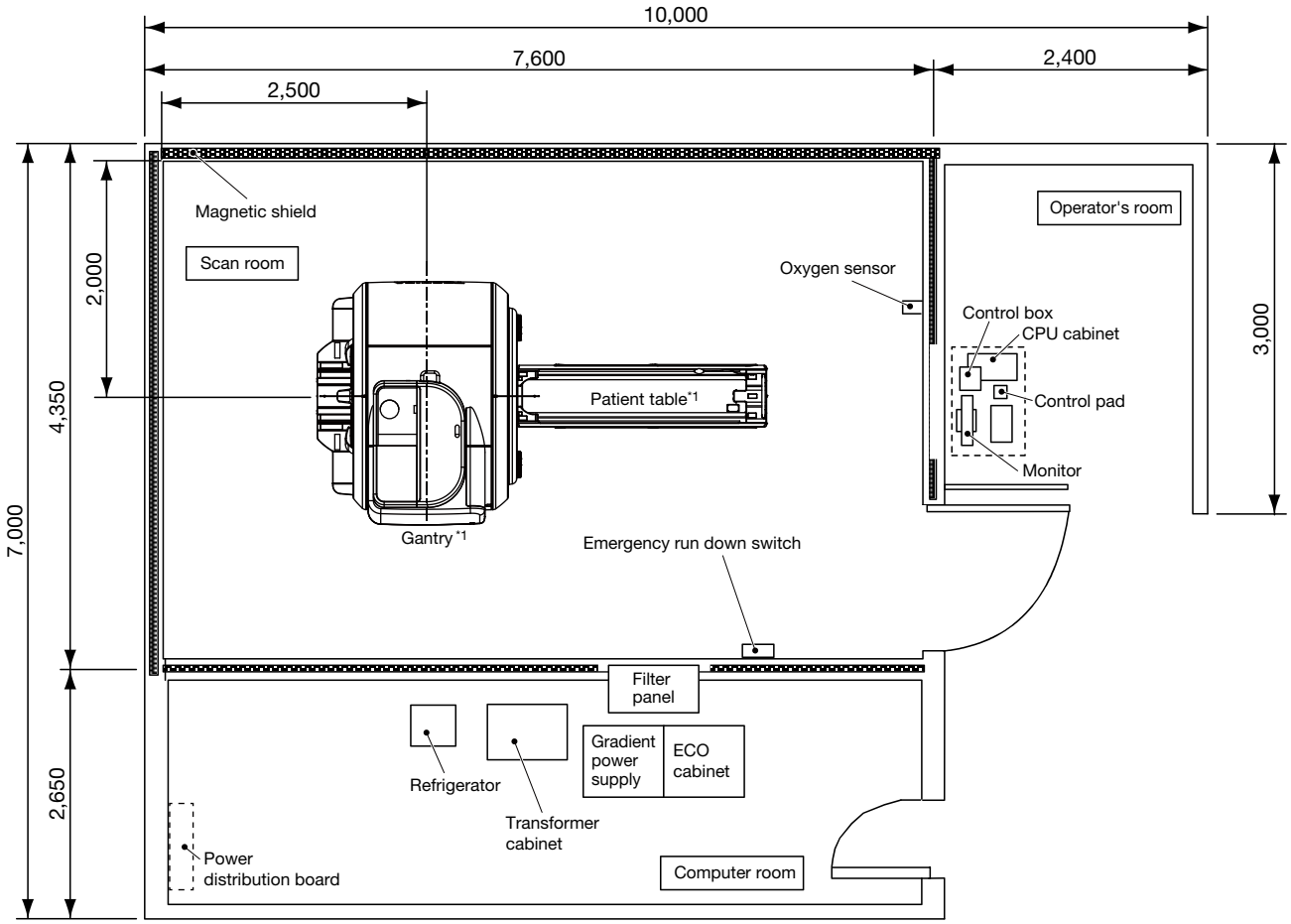
IEC60601-1: 1988 + Amd.1: 1991 + Amd.2: 1995
IEC60601-1-1: 2000
IEC60601-1-2: 2001 + Amd.1: 2004
IEC60601-1-4: 1996 + Amd.1: 1999
IEC60601-1-6: 2006
IEC60601-1-8: 2006
IEC60601-2-33: 2002 + Amd.1: 2005 + Amd.2: 2007
IEC60825-1: 2007
IEC62304: 2006
IEC62366: 2007

DIMENSIONS AND MASS

Unit	Dimensions W × D × H mm	Mass kg
Magnet assembly	2,370 × 1,990 × 2,360	5,400
Patient table	615 × 2,420 × 430 to 845	320
Console		
CPU cabinet	200 × 570 × 440	21
Monitor	570 × 230 × 480	11
Control box	280 × 310 × 85	4
Control pad	130 × 145 × 75	0.3
ECO cabinet and gradient power supply	1,520 × 850 × 1,860* (Standard Gradient)	980
	1,745 × 850 × 1,860* (Helios Gradient)	1,330
Refrigerator	445 × 530 × 625	100
Transformer cabinet	690 × 750 × 1,090	260
Others		216

* Some projecting part has an extra 115 mm

LAYOUT EXAMPLE



*1: Applicable for use in the patient environment

Unit: mm

TOSHIBA MEDICAL SYSTEMS CORPORATION

http://www.toshibamedicalsystems.com

2012-08 TME/KI

Produced in Japan