TOSHIBA
Leading Innovation >>>

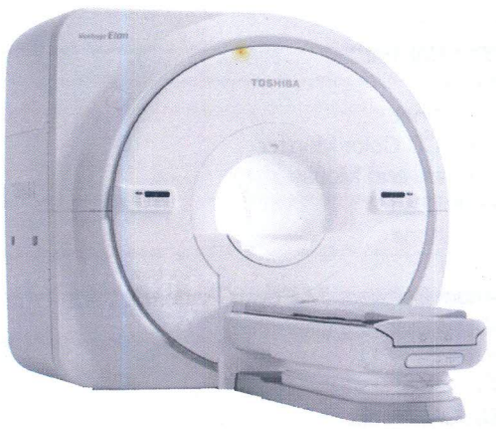
PREMIUM MRI SYSTEM
MRT-2020

Vantage Elan™

Product Data
No. MPDMR0365EA

APPLICATION

Toshiba is proud to introduce the Vantage Elan (M-Power™ V3.0) as a new member of its product line. Vantage Elan provides outstanding clinical and economic benefits together with a wide variety of advanced technologies. A 1.4-m ultra-short magnet with excellent magnetic field homogeneity ensures high image quality, while its zero helium boil-off system and Eco mode minimize system operating costs. Overall system productivity is further improved by enhancing workflow through M-Power and Atlas SPEEDER™ technology. The system requires only a small installation footprint, which means that installation work can be completed quickly and easily. Thanks to its many advanced features, Vantage Elan provides smart solutions in routine clinical practice.



ADVANTAGE

Superior image quality

Vantage Elan incorporates a magnet with high field homogeneity, ensuring high image quality in examinations of all clinical regions. By combining Toshiba's unique scan sequences and imaging techniques, Vantage Elan offers a wide variety of solutions to meet the demands of modern clinical environments, including noncontrast MRA and fat-suppression techniques. Its ultra-short 1.4-m magnet reduces patient anxiety and ensures more comfortable examinations. Toshiba's innovative Pianissimo™ Σ technology also dramatically reduces acoustic gradient noise, further enhancing patient comfort.

Eco friendly and economically competitive

Vantage Elan has been developed based on environmentally friendly design concepts. Its zero helium boil-off system and Eco mode are extremely effective in minimizing system operating costs. Power consumption is dramatically reduced when the system is not in use, making Vantage Elan even more economically competitive. Its small footprint and easy-to-install design mean greater flexibility in system installation, allowing an MRI system to be installed in a wider range of hospitals.

Easy system operation

Vantage Elan incorporates M-Power and Atlas SPEEDER technologies, which allow easy system operation even by inexperienced users. The M-Power user interface, which has been optimized based on analysis of actual clinical workflow, maximizes workflow efficiency in examinations of every clinical region. EasyTech automatically sets the locator positions for the head, spine, and heart, ensuring high image quality. Atlas SPEEDER, Toshiba's integrated coil system featuring parallel imaging technology, provides outstanding diagnostic versatility and streamlined workflow, resulting in easy setup and acquisition in all clinical studies.

COMPOSITION

Standard composition (Model: MRT-2020)

- Gantry
  - 1.5-Tesla Magnet
  - Active Shield Gradient Coil
  - Whole Body Coil
- Patient Table
- Filter Panel
- Main Cabinet
- Cooling Cabinet**
- Console
  - PC Cabinet
  - Wide LCD Color Monitor
  - Keyboard and Mouse
  - Control Pad
  - 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
  - O_2 Monitor
  - Emergency Run-down Unit
  - Warning Plates
  - Speaker

* Transformer unit and desk for console are not included in the standard composition.

** The model of cooling cabinet varies depending on whether a site has secondary cooling system or not. For sites where the secondary cooling system has not been installed, additional chiller should be locally purchased.

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)
- 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)
  - SpineLine Applicatioin (MSSW-LOCSP/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)

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 Body (MJAB-167A)
- Shoulder SPEEDER (MJAJ-177A)
- Breast SPEEDER [2)]
- Wrist SPEEDER (MJAJ-167B)
- 4ch Flex SPEEDER (MJAJ-197A)
- 16ch Flex SPEEDER Medium (MJAJ-217A)
- 16ch Flex SPEEDER Large (MJAJ-227A)
- ϕ100 Flex Coil (MJLC-107H)
- ϕ150 Flex Coil (MJLC-157H)

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)
- Patient Adaptable Tilting Device (MJCA-237A)

Optional equipment

- Gantry LCD Monitor (MKSU-LCDK03/S1)
- Wireless Cardiac Gating System (MKSU-ECGU10/S1)[3)]
- Wireless Peripheral Pulse and Respiratory Gating System (MKSU-PRGK06/S1)[3)]
- Additional Patient CAMERA Package (MMPM-GP3001/S1)
- Foot Switch Unit (MKFS-002A/S2)

2) Model number depends on selling area.
3) This option may not be available in all countries. Please consult your local Toshiba sales representative.

HARDWARE SPECIFICATIONS

Magnet

The Vantage Elan uses the world's shortest (1.4 m) self-shielded superconducting magnet. A wide patient aperture with 63 cm 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. 4,100 kg
- Fringe field
  The magnet employs active shielding. The fringe field line at 0.5 mT (5 gauss) is at 2.5 m in radial distance and at 4 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 provides zero Helium boil-off system.
- 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, lighting, and patient table operation. The panel is also provided with a table position display.

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

- Standard RF coils
  The Vantage Elan 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.
- 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 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.
  - 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.
  - 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.
  - ϕ100 Flex Coil (R) (MJLC-107H)
    The diameter of the coil loop is 100 mm. The circular loop section is cushioned and flexible.
  - ϕ150 Flex Coil (R) (MJLC-157H)
    The diameter of the coil loop is 150 mm. The circular loop section is cushioned and flexible.
  - 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 ϕ100 Flex Coils (MJLC-077H) and Circular coil holder for TMJ Imaging (MJCA-147A). The positioning holder 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 (MJLC-107H). 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 PC cabinet
  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 and intercom talk and volume. A speaker is installed in the cabinet.
- 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 450 mm from the floor. Hydraulic drive ensures smooth and quiet vertical tabletop movement.
Maximum patient load: 200 kg

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
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 and Blu-ray drive unit
  DVD (single side)

– Storage capacity:	DVD 4.7 GB (unformatted)
– Saved image capacity:	Approximately 22,000 images (256 × 256 images, raw data not saved)

  DVD-RAM (both side)

– Storage capacity:	DVD 9.4 GB (unformatted)
– Saved image capacity:	Approximately 44,000 images (256 × 256 images, raw data not saved)

  Blu-ray (Single layer)

– Storage capacity:	25 GB (unformatted)
– Saved image capacity:	Approximately 110,000 images (256 × 256 images, raw data not saved)

  Blu-ray (Double layer)

– Storage capacity:	50 GB (unformatted)
– Saved image capacity:	Approximately 220,000 images (256 × 256 images, raw data not saved)

  * DICOM format data can not be archived in Blu-ray disk.
- Connection with external devices

Interface:	Ethernet (1000Base-T)

  DICOM 3.0

Digital RF system
The Digital RF system consists of a digital transmitter and wideband analog/digital receivers supporting array acquisition. 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 12 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.

Gradient strength:	33 mT/m
Slew rate:	125 mT/m/ms
Gradient duty cycle:	100%

Toshiba's innovative silent scan 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 Σ
  Pianissimo Σ 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
  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
  Detecting oxygen level inside the room. If a ventilation system is supplied at the site, it automatically activates the system when the oxygen level in the room falls[1)].
- Emergency run-down unit
  This safety switch allows automatic ramp-down of the magnetic field in the event of an emergency.

1) Ventilation system is not included in the standard composition.

PERFORMANCE SPECIFICATIONS

Acquisition parameters

The Vantage Elan 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	0.6	
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):	10 ms to 10 s	
Flip angle:	1° to 180°	
Flop angle:	30° to 180°	

SPEEDER function

SPEEDER factor: Max. 6

Combination with SPEEDER and DRKS:16

1) Specifications vary depending on the pulse sequence.
2) Some parameters may require an optional package.

Imaging techniques and parameters

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

- Conventional pulse sequences
  - SE (spin echo)
  - FE (field echo)
- 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).
  - 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.
- Flow imaging
  Various flow dynamics can be observed by sequentially acquiring images with tagging pulses.

• Fat suppression techniques
The Vantage Elan 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.
- WET (Water Excitation Technique)
  WET is a fat suppression technique that is mainly applicable to the selective excitation pulses of sequences in the FE series. This technique enables the spatial-position-selective and frequency-selective excitation of water.

* 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 Elan'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 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 and phase/slice encoding directions. 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 Elan 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 Elan 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 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, SpineLine)

• 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.
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 Elan 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 or more · 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, TIC (Time Intensity Curve), velocity measurement

• Image processing

Gain algorithm:	· New denoising algorithm can be used.
Image filters:	· Smoothing, edge enhancement, Ringing artifact reduction etc.
MIP: – Projection direction: – Target MIP	· Maximum intensity projection, minimum intensity projection · Specified using ROI (specification of multiple projection directions is possible) · MIP target region can be specified in three directions.
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 for both 2D and 3D.
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-R, DVD-RAM and Blu-ray 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, 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 Elan'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

• Laser imager
DICOM Print is available.

• 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 Silent scan: Standard

Noncontrast MRA*

- FSBB (Flow Sensitive Black Blood)
  FSBB depicts more details of arteries and veins by utilizing the flow dephase effect.
  Weak MPG pulses are applied to FE sequence, clearly depicting small vessels with slow blood flow that is difficult to depict by TOF.
- 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
- Time-SLIP
  The inversion pulse is applied space-selectively and after an appropriate wait time to permit the blood or cerebrospinal fluid flowing into or out of the slice to be visualized. This method can be used in combination with FASE or TrueSSFP.

Contrast-enhanced MRA

Blood vessels can be visualized at high temporal resolution with a short TR/TE using contrast medium.

- Dynamic scan
  Scanning is performed automatically according to the specified time sequence.
  - Application: FE (2DFT/3DFT), FastFE (2DFT/3DFT)
  - FastFE data acquisition method: 2DFT Interleave, Sequential 3DFT Interleave, Slice Centric, Sequential, Swirl, Reverse Centric
- Dynamic subtraction
  Subtraction images between the image in the specified base phase and subsequent images are generated.
  - Automatic processing after dynamic scan: Available (absolute and complex)
- VisualPrep method
  Data acquisition, image reconstruction, and display are performed repeatedly for the same plane.
  - Fat suppression: Can be used in combination
  - Complex subtraction: Available
- MovingBed
  The tabletop is moved between scans to allow a wide range of the patient to be acquired.
  - Specification of tabletop movement distance: Available
- Advanced MovingBed
  Individual scan setting can be set for each scan in MovingBed.
  - Specification of tabletop movement distance: Available
  - Scan setting: Available

* Option

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: Arbitrary planes
- 3D PS method:
  Covers the slice range continuously without slice gaps.
  - Scan cross section: Arbitrary 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 Silent scan: 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 AutoVoice
  - Respiratory gating: Can be used in combination
  - Support for Silent scan: 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: Arbitrary planes
  - Direction: Slice/readout/phase encode
- Flow velocity analysis
  Generation of flow velocity time curve

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*
- 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
  - Isotropic image (isotropic diffusion weighted image)
  - Fractional anisotropy image (indicating the degree of diffusion anisotropy)
  - Lambda image (characteristic value image)
  - Lambda image (vector image of characteristic value)
  - 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 IR thickness: Variable

* Option

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 and FASE 3D are 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.*

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)]	380/400/415 V ±10%	480 V ±10%
Phase	Three-phase	Three-phase
Voltage fluctuation	±10%	
Frequency	50 Hz ±1 Hz	60 Hz ±1 Hz
Power requirements	25 kVA	

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)

Power consumption	18.3/19.2 kW
System heat dissipation	3.9/4.9 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[2)]

- Temperature and humidity: No condensation
  - Scan room: 16°C to 24°C, 40% to 60% R.H.
  - Operator's room: 16°C to 28°C, 40% to 75% 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 63.7 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*: 23.25 m^2
  - Scan room: 4.85 m × 3.30 m = 16.01 m^2
  - Operator's room: 2.00 m × 3.62 m = 7.24 m^2

* Minimum room inside clear space dimensions. These dimensions may not be applied to some cases depending on each site situation.

- 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

	Without secondary cooling system	With secondary cooling system
Flow rate	44.5 L/min	67 L/min
Temperature	20 °C to 25 °C	6 °C to 12 °C

1) Other line voltages may be supported with the use of an additional step-down or step-up transformer.
2) Computer room is not necessary for the system installaton. However, in the case that cabinets are installed in a computer room, the condition of computer room should be based on that of operator's room.

COMPATIBILITY WITH INTERNATIONAL STANDARDS

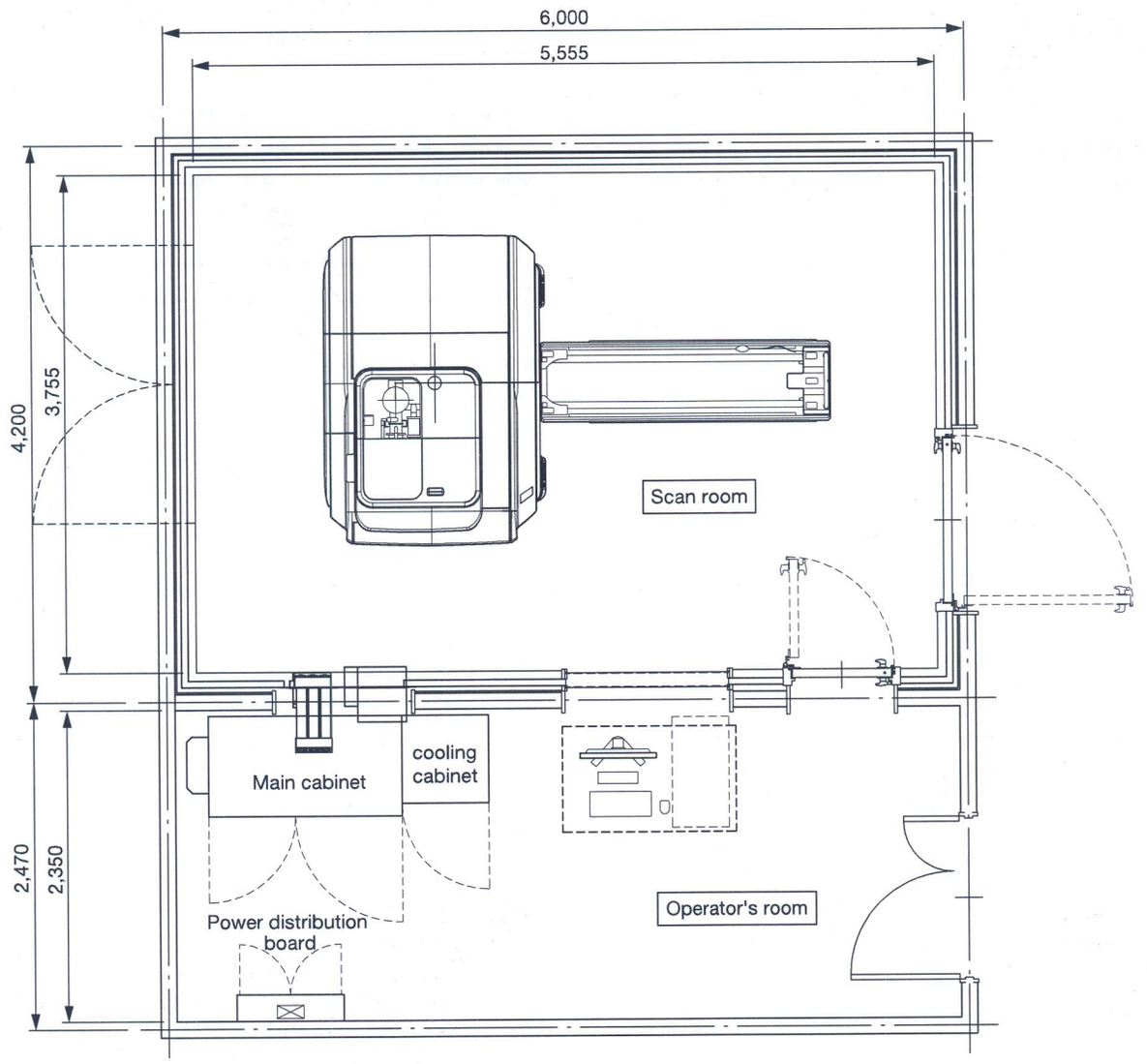
IEC60601-1: 1988 + Amd.1: 1991 + Amd.2: 1995
IEC60601-1-1: 2000
IEC60601-1-2: 2001 + Amd.1: 2004
IEC60601-1-4: 1996 + Amd.1: 1999
IEC60601-1-6: 2010
IEC60601-1-8: 2006
IEC60601-2-33: 2002 + Amd.1: 2005 + Amd.2: 2007
IEC60825-1: 2007
IEC62304: 2006
IEC62366: 2007

DIMENSIONS AND MASS

Unit	Dimensions W x D x H mm	Mass kg
Magnet assembly	2,363 x 1,680 x 2,372	5,400
Patient table	600 x 2,170 x 450 to 875	270
Console		
PC cabinet	425 x 836 x 560	60
Monitor	566 x 209 x 456 to 538	11
Control pad	293 x 95 x 82	1.2
Main cabinet	1,613 x 760 x 1,869	1,050
Cooling cabinet	650 x 760 x 1,869	298[3)] 351[4)]
Others		

3) For sites without secondary cooling system
4) For sites which has secondary cooling system

LAYOUT EXAMPLE



Unit: mm

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Toshiba Medical Systems Corporation Nasu Operations meets the Environmental Management System standard ISO 14001.

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