PREMIUM 1.5T MRI SYSTEM
MRT-1550

Product Data
No. MPDMR0628EAA

Vantage Orian

APPLICATION

Vantage Orian with 35/155 gradient subsystem is a premium 1.5T MRI system. With migrated high end technology, you can be sure you are offering your referring physicians and your patients better MRI services today. Designed to enhance productivity and reduce costs every day, take care of patient comfort and deliver outstanding clinical performance, you can be sure that you are purchasing the complete 1.5T MRI package.

ADVANTAGES

Achieve high SNR and resolution images with intelligence

Utilizing deep learning reconstruction technology, Vantage Orian's advanced MRI technology offers your referring physicians and patients the best 1.5T MRI services available. Advanced intelligent Clear-IQ Engine (AiCE), Precise IQ Engine (PIQE), and Iterative Motion Correction (IMC) produce MR images that are exceptionally detailed and high in SNR, anatomically sharp, and robust against motion.

Productivity focused technology that improves workflow and image consistency

Canon's automated workflow solutions simplify the flow of MR procedures from patient setting down to the scan and check.

Patient preparation can be remotely performed via Tablet UX, Ceiling Camera detects patient on the table for Auto Positioning, and Auto Scan Assist applications support Auto Planning. After scanning, this application asks if the operator would like to proceed the examination according to the predefined scenario.

Patient friendly features putting your patients first

A relaxed patient is key in MRI, and you can be assured that Vantage Orian takes care of this with industry leading whisper quiet sequences with Pianissimo Σ and Pianissimo Zen, 71[1)] cm open bore aperture and MR Theater all designed to put patients at ease. A range of features to ensure easier examinations for even the most challenging patients. With pre-scan, free breathing, contrast free and pediatric applications, you can deliver a better patient experience which improves your facilities MRI reputation, and expands your patient population.

Clinical confidence and consistent imaging mean better diagnosis

With advanced new hardware delivering stable and reliable imaging, Vantage Orian enhances confidence in diagnosis for the most accurate diagnosis. Vantage Orian redefines clinical confidence with outstanding image consistency imaging across all procedures. Achieve excellent MRI diagnostic services with high quality and stable output, improving outcomes for your patients and your business. Our unique digital PURE RF means that stable and consistent imaging performance is ensured, increasing diagnostic confidence and shortening scan times.

1) Patient aperture of 71 cm which is the diameter where cylindrical tunnel meets the front cover.

COMPOSITION

Standard composition (Model: MRT-1550 + MZKT-MP1544)

- Gantry
  - 1.5-Tesla Magnet
  - Active Shield Gradient Coil
  - Whole Body Coil
- Patient Table
- Filter Panel
- Control Cabinet and Gradient Power Supply
- Cooling Cabinet
- FAN Box
- Console
  - Wide LCD Color Monitor
  - Keyboard and Mouse
  - Control Pad
  - Control Box
  - Microphone
- Software
  - System Software (V8.0 + V9.0 Software Package)
  - DICOM® Software (Standard)
    - Storage SCU
    - Print SCU
    - DICOM Media
    - MWM SCU
- Full Set of Accessories
  - Operation Manuals
  - Service Manuals
  - Phantoms
  - Patient Call
  - Patient Observation Camera
  - Support Devices for Scanning (Tabletop Mats, Wedge Mats, Pads, Belts)
  - Safety Training Video
  - Warning Plates
  - Speakers

Note: Heat exchanger, transformation installation, oxygen monitor and desk for console are not included in the standard composition.

Optional software

• DTI Application	MSSW-DTI2
• DTT Application	MSSW-DTT
• Single Voxel MRS Application	MSSW-MRSS2
• Multi Voxel MRS Application	MSSW-MRSM2
• NeuroLine+ Application	MSSW-ASNU1
• Contrast Free MRA Application	MSSW-CFMRA3
• k-t SPEEDER Application	MSSW-KTS1
• SpineLine+ Application	MSSW-LOCSP1
• W-SpineLine+ Application	MSSW-LOCWS
• ProstateLine+ Application	MSSW-LOCPR
• UTE Application	MSSW-UTE
• Olea Nova®+ Sequence	MSSW-CNV
• Pianissimo Zen Application	MSSW-ZEN
• MultiBand SPEEDER Application	MSSW-SMS1
• Quick Star Application	MSSW-SOS1
• Fast 3D for mVox	MSSW-FST3D
• Fast 3D for TOF	MSSW-FST3D2
• Fast 3D for SSFP	MSSW-FST3D3
• GAIN Algorithm	MSSW-GA01
• Compressed SPEEDER Application	MSSW-CS01
• Compressed SPEEDER Application - 3D	MSSW-CS3D1
• Fat Fraction Quantification Application	MSSW-FIQ1
• Advanced intelligent Clear-IQ Engine for MR	MSSW-DLR1
• RDC DWI Application	MSSW-EPIDC[1)]
• IMC Application	MSSW-MCO3
• mART EXP Application	MSSW-MAR1
• pCASL (pseudo-Continuous) Application	MSSW-PCASL
• PIQE Application	MSSW-HRDLR1

Optional software package

• Basic Package	
– mNeuro Package	MSSW-NEURO2
– mVascular Package	MSSW-VASCU
– mCardiac Package	MSSW-CFA3
– mBody Package	MSSW-BODY3
– mBreast Package	MSSW-BRST3
– mOrtho Package	MSSW-ORTHO
• Advanced Package	
– mCardiac Plus Package	MSSW-CPP1
– mOrtho EXP Package	MSSW-ORTHOE
– Fast 3D Package	MSSW-F3DP
– Comfort Package	MSSW-COMFP1[2)]
– Acceleration Package	MSSW-ACCEP1[2)]
– Neuro EXP Package	MSSW-NEXPP1[2)]
– Body EXP Package	MSSW-BEXPP1[2)]
• Auto Scan Assist Package	
– Auto Scan Assist Cardiac Package	MSSW-ASCA1
– Auto Scan Assist Knee Package	MSSW-ASKN1
– Auto Scan Assist Spine Package	MSSW-APSP1
– Auto Scan Assist Liver Package	MSSW-ASLI1
– Auto Scan Assist EXP Package	MSSW-APEX1

1) Optional mNeuro, mBody and/or mBreast package is required to use this application.
2) Only for Europe

DICOM

• Storage Commitment Kit	MSSW-DCCOU1
• MPPS SCU Kit	MSSW-DCPPU1
• Q/R SCP Kit	MSSW-DCQRP1
• Q/R SCU Kit	MSSW-DCQRU1

Second Console

• Second Console	MKDN-014A/S2[3]
• mNeuro Package for Second Console	MSSW-NEURO2
• MRS Application for Second Console	MSSW-MRSS2
• DTT Application for Second Console	MSSW-DTT
• GAIN Algorithm for Second Console	MSSW-GA01

Optional RF Coils

• Shape Coil W	MJAB-217A/S1
• Shape Coil	MJAB-207A/S1
• Atlas SPEEDER Head/Neck	MJAH-177A/S1
• Atlas SPEEDER Spine	MJAS-147A/E1
• Atlas SPEEDER Body	MJAB-167A/P1
• 16ch Tx/Rx Knee SPEEDER	MJAJ-237A/S1
• 4ch Flex SPEEDER	MJAJ-197A/J1
• ϕ100 Flex Coil	MJLC-107H/S1[4]
• ϕ150 Flex Coil	MJLC-157H/S1[4]
• QD Head Coil	MJQH-147A/J1
• 16ch Flex SPEEDER Medium	MJAJ-217A/S1
• 16ch Flex SPEEDER Large	MJAJ-227A/S1
• Pediatric SPEEDER	MJAB-197A/S1
• 32ch Cardiac SPEEDER	MJAB-187A/J1
• Octave SPEEDER Head	MJAH-167A/S1
• Octave SPEEDER Spine	MJAS-167A/S1
• Breast SPEEDER	MJAM-127A/S1
– Breast Riser Kit	MJCA-187A/S1
– Breast Loop kit	MJKM-107A/S1
– Breast Grid	MJCA-197A/S1
• Breast SPEEDER CX	MJAM-147A/S1
– Breast Riser CX	MJCA-247A/S1
• Wrist SPEEDER	MJAJ-167B/J2
• Shoulder SPEEDER	MJAJ-177A/S1
• Knee/Foot SPEEDER	MJAJ-257A/S1

Optional coil holder & pad

• Coil Holder for TMJ Imaging	MJCA-147A/S2
• 16ch Flex SPEEDER Pad Kit	MJCA-207A/S1
• Patient Pads for Spine and Extremities	MBPP-1503/S1
• Patient Adaptable Tilting Device	MJCA-227A/S1
• Patient Pads for Octave SPEEDER coils	MZCM-1501/S1

Optional equipment

• Receiving Circuit Extension Kit	MKPA-1508/S3
• Wireless Cardiac Gating System	MKSU-ECGU13/S1[5]
• Wireless Peripheral Pulse and Respiratory Gating System	MKSU-PRGK13/S1[5]
• Higher Order Shim Kit	MZKT-HOSK14/S1
• Additional Patient CAMERA Package	MMPM-GP3001/S1
• Foot Switch Unit	MKFS-003A/S1[6]
• MR Theater	MZTH-4003/S1
• Extended Table Travel Option	MZPT-1551/S1
• Dockable Table	MZPT-1560/S3[7]
• Advanced Image Reconstruction Unit	MZDL-011B/S4
• T/R Coil Hardware Kit	MJTX-107A/S1
• Uninterruptible Power-supply System Kit	MZUP-001A/S1
• 10GbE High-speed reconstruction kit	MZNC-011A/S1

3) Additional software is required to use optional applications for the Second Console.
4) In the application for approval under relevant national regulations, the coil name "Phi '*XXX*' Flex coil" is used.
5) This option may not be available in all countries. Please consult your local Canon Medical Systems sales representative.
6) For fixed table exclusive use.
7) This is an additional dockable table for the MRI system with dockable table.

HARDWARE SPECIFICATIONS

Magnet

The Vantage Orian uses the industry's shortest self-shielded superconducting magnet. The system combines slim and compact design with a wide patient aperture of 71 cm[1]. This minimizes patient anxiety, ensuring a comfortable examination environment for all patients.

Magnet type	Superconducting magnet		
Field strength	1.5T		
Magnet length	140 cm		
Magnet weight	Approx. 4,100 kg (incl. liquid helium)		
Cryogen	Zero helium boil-off		
Magnetic field stability (bare magnet)	0.1 ppm/hr or better		
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 4.0 m in the axial direction from the center of the magnet.		
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.		
	• Slice shimming When performing the multi-slice image acquisition, parameters for magnetic homogeneity field are corrected per slice.		
	• High Order Shimming (Active Shimming)‡ This function improves the static field homogeneity over the field of view, enabling diagnostic information of extremely high quality to be obtained.		
		Number of additional shim channel:	5
		Components:	ZX/XY/ZY/Z2/X2Y2
		Total shim channels of the system:	8
Homogeneity with passive shimming (24 plane plot method)	at 100 mm DSV	Guaranteed:	0.04 ppm
		Typical:	0.007 ppm
	at 200 mm DSV	Guaranteed:	0.15 ppm
		Typical:	0.03 ppm
	at 300 mm DSV	Guaranteed:	0.4 ppm
		Typical:	0.08 ppm
	at 400 mm DSV	Guaranteed:	1.0 ppm
		Typical:	0.28 ppm
	at 500 mm DSV	Guaranteed:	2.0 ppm
		Typical:	1.61 ppm

1) The diameter where cylindrical tunnel meets the front cover.

‡ Option

Operation 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 stop – Laser light localizer ON/OFF – Ventilation adjustment – Lighting adjustment – Patient table operation incl. Auto-in/Auto-home The panel is also provided with a table position display.
Intelligent monitor on the magnet	The gantry monitor provides the following information. – Patient table information – Patient information – Connecting RF coils status – Respiration/ECG information[2)] The gantry monitor features approximate 12" LCD color monitor. The display matrix is 1,280 × 800.

2) Optional gating system (MKSU-ECGU13/S1 and MKSU-PRGK13/S1) is required to use this function.

RF coils

Atlas SPEEDER COMPASS

This is an automatic receive coil setting function that determines the position of the connected Atlas SPEEDER coil and automatically ON the coil sections that are positioned near the magnetic field center. This function is useful for spine imaging and body imaging in which the coil sections to be selected differ depending on the coil setting and target region and for scanning in which data is acquired at multiple tabletop positions.

Standard RF coils

QD whole-body coil	
Type of coil	Transmit RF, Receive signals
Number of rung	24

The Vantage Orian features a full range of RF array coils to cover a wide range of clinical requirements.
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

Shape Coil W	
Model number	MJAB-217A/S1
Type of coil	Receive signals
Applicable Regions	General human body, including torso, pelvis, joints, bones and extremities variety of anatomical regions
Number of elements	32

This soft and light coil supports patient comfort by adapting flexibility to patient body shape.
To use this coil for imaging with 32 channel, Receiving Circuit Extension Kit (MKPA-1508/S1) is required.

Shape Coil	
Model number	MJAB-207A/S1
Type of coil	Receive signals
Applicable Regions	General human body, including torso, pelvis, joints, bones and extremities variety of anatomical regions
Number of elements	16

This soft and light coil supports patient comfort by adapting flexibility to patient body shape.

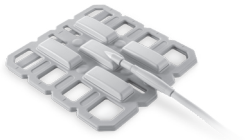
Atlas SPEEDER Head/Neck	
Model number	MJAH-177A/S1
Type of coil	Receive signals
Applicable Regions	Head, Neck and Feet
Number of elements	16

A detachable mirror is provided to minimize patient anxiety.

Atlas SPEEDER Spine	
Model number	MJAS-147A/E1
Type of coil	Receive signals
Applicable Regions	Thoracolumbar spine, Trunk
Number of elements	32

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	
Model number	MJAB-167A/P1
Type of coil	Receive signals
Applicable Regions	Trunk
Number of elements	16



16ch Tx/Rx Knee SPEEDER[3)]	
Model number	MJAJ-237A/S1
Type of coil	Transmit RF, Receive signals
Applicable Regions	Knee, Wrist, Hand, Forefoot
Number of elements	16

4ch Flex SPEEDER	
Model number	MJAJ-197A/J1
Type of coil	Receive signals
Applicable Regions	Extremities, Joints, Trunk
Number of elements	4

ϕ100 Flex Coil	
Model number	MJLC-107H/S1
Type of coil	Receive signals
Applicable Regions	Extremities, Joints
Number of elements	1

The diameter of the coil loop is 100 mm. The circular loop section is cushioned and flexible.

ϕ150 Flex Coil	
Model number	MJLC-157H/S1
Type of coil	Receive signals
Applicable Regions	Extremities, Joints
Number of elements	1

The diameter of the coil loop is 150 mm. The circular loop section is cushioned and flexible.

QD Head Coil[3)]	
Model number	MJQH-147A/J1
Type of coil	Transmit RF, Receive signals
Applicable Regions	Head
Number of elements	1

Its large internal diameter improves patient comfort, especially for large patients.

Provides a uniform RF field with QD transmission and optimizes SNR with QD reception. A detachable mirror is provided to minimize patient anxiety.

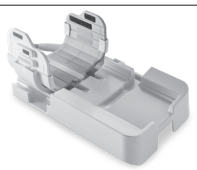
3) Optional T/R Coil Hardware Kit (MJTX-107A/S1) is required to use this coil

16ch Flex SPEEDER Medium	
Model number	MJAJ-217A/S1
Type of coil	Receive signals
Applicable Regions	Shoulder, Hip, Upper and Lower extremities (Elbow, Wrist, Knee, Foot, Ankle, Thigh), Head, Spine, Torso, Cardiac applications.
Number of elements	16

16ch Flex SPEEDER Large	
Model number	MJAJ-227A/S1
Type of coil	Receive signals
Applicable Regions	Shoulder, Hip, Upper and Lower extremities (Elbow, Wrist, Knee, Foot, Ankle, Thigh), Head, Spine, Torso, Cardiac applications.
Number of elements	16

Pediatric SPEEDER	
Model number	MJAB-197A/S1
Type of coil	Receive signals
Applicable Regions	Head and neck of pediatric patients
Number of elements	16

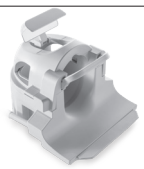
Whole body imaging becomes available by combining additional 16ch Flex SPEEDER Medium.



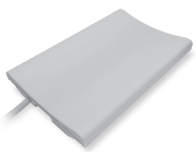
32ch Cardiac SPEEDER	
Model number	MJAB-187A/J1
Type of coil	Receive signals
Applicable Regions	Cardiac
Number of elements	32

To use this product, Receiving Circuit Extension Kit (MKPA-1508/S3) is required.

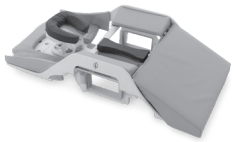
Octave SPEEDER Head	
Model number	MJAH-167A/S1
Type of coil	Receive signals
Applicable Regions	Head and Neck
Number of elements	11



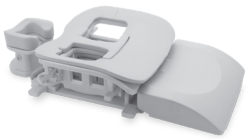
Octave SPEEDER Spine	
Model number	MJAS-167A/S1
Type of coil	Receive signals
Applicable Regions	Spine
Number of elements	12



Breast SPEEDER	
Model number	MJAM-127A/S1
Type of coil	Receive signals
Applicable Regions	Breast
Number of elements	8

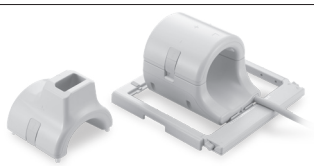


Breast SPEEDER CX	
Model number	MJAM-147A/S1
Type of coil	Receive signals
Applicable Regions	Breast
Number of elements	8



Shoulder SPEEDER	
Model number	MJAJ-177A/S1
Type of coil	Receive signals
Applicable Regions	Shoulder
Number of elements	6

Knee/Foot SPEEDER	
Model number	MJAJ-257A/S1
Type of coil	Receive signals
Applicable Regions	Knee, Wrist, Hand, Foot and Ankle
Number of elements	8



Wrist SPEEDER	
Model number	MJAJ-167B/J2
Type of coil	Receive signals
Applicable Regions	Wrist, Hand
Number of elements	6

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: • System power ON • Emergency stop • Scan start • Scan abort • Scan pause/resume • Tabletop movement • 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.

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	Operating system	Windows® 10 IoT Enterprise
	CPU	8-core dual-processor system (16 CPUs)
	Clock speed	3.2 GHz
	Main memory capacity	32 GB
	Solid state drive (unformatted)	For system use: 480 GB
		For image data: 960 GB
	Image capacity	Approximately 1,680,000 images (256 × 256 images, raw data not saved)
Hardware control system	Real-time manager (RM) CPU	32 bit
	Memory capacity	256 MB
	System control method	Distributed control
Reconstruction system	CPU	8-core dual-processor system (16 CPUs)
	Clock speed	2.5 GHz
	Main memory capacity	128 GB
	Maximum reconstruction speed	62,000 images/second or more (256 × 256, FFT Full FOV, potential) 248,000 images/second or more (256 × 256, FFT 25% rec FOV, potential)
	Hard disk drive capacity	7 TB (unformatted) 2.7 TB (RAID 10)
	Reconstruction matrix	1,024 × 1,024 (maximum)
	Simultaneous image reconstruction during scanning	Possible
USB drive unit	Interface	Type-A
	USB 3.0	
	USB memory capacity requirement	8 GB for 35,000 images of 256 × 256 32 GB for 140,000 images of 256 × 256
Connection with external devices	Interface	Ethernet (100BASE-TX/1000Base-T)
	DICOM 3.0	

RF system

The Vantage Orian has digital RF design which improves SNR and achieves high RF stability.

RF Transmit system

Frequency stability	± 3.8 × 10^{-6} Hz/min
Frequency control	32 bit, 0.64 Hz
Phase control	16 bit, 0.0055 degree
Amplitude resolution	15 bit, 1µs
Gain stability	<0.5 dB (10 min)
Optical signal transmission	Possible
Transmit peak power	24 kW
Transmit bandwidth	550 kHz

RF Receiver system

PURE RF Rx	Enhanced SNR by unique noise-suppression technology which reduces the electrical noise received with MR signal. High- performance amplifier and digitizer for each receiver makes faster sampling which results in higher SNR.
Atlas SPEEDER technology	Atlas SPEEDER technology easily handles multiple studies by allowing you to position and utilize the coils you need in one easy step. Maximum 7 coils is combinable at same time.
Receiver bandwidth	1 MHz (for each channel)
Sampling rate of ADC	100 MHz
Receiver signal resolution (ADC resolution in bits)	16 bit
Receiver signal resolution	32 bit
Pre-amplifier noise figure	<0.5 dB (typical 0.5)
Pre-amplifier total gain	25 dB
Dynamic range	157 dB/Hz
Number of independent receiver channels	128[4]

4) The number of channels for simultaneous image reconstruction is selectable at sales. It may vary depending on sales area. Please consult your local sales representative..

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.

Maximum Gradient amplitude (Each axis)	35 mT/m
Maximum Slew rate (Each axis)	155 T/m/s
Minimum Rise time	217 µs
Maximum effective gradient amplitude (vector summation for three axes)	61 mT/m
Maximum effective gradient slew rate (vector summation for three axes)	268 T/m/s
Gradient duty cycle	100%
Maximum Output voltage (Each axis)	1,550 V
Maximum Output current (Each axis)	550 A

Patient table (Selectable)

The patient table is ergonomically designed to maximize both patient comfort and patient throughput. Hydraulic drive ensures smooth and quiet vertical tabletop movement.

		Fixed table	Dockable table
Minimum table height from floor		430 mm	550 mm (Dock)
			535 mm (Undock)
Maximum table height		845 mm	845 mm (Dock)
			875 mm (Undock)
Maximum patient load		250 kg	250 kg
Scanning range		145 cm‡	145 cm‡
Positional accuracy of patient table		0.5 mm or less	0.5 mm or less
Vertical table speed	Up: Down (typical):	21 sec 23 sec	12 sec 12.5 sec
Horizontal table speed	Normal (selectable): Slow:	250/200/150 mm/s 20 mm/s	300/200/150 mm/s 20 mm/s

‡ Extended table travel option (MZPT-1551/S1) increases the usable scanning range to 205 cm.

- Dockable table
  Vantage Orian can apply dockable table. It allows seamless patient handling as preparation can be achieved in advance outside the scan room, enhancing workflow and allowing medical staff to respond to any patient requirements quickly and easily.

Patient comfort and safety

Open bore	The industry's shortest open gantry (1.4 m magnet) with the large clinical FOV and wide patient aperture of 71 cm significantly reduce 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.
Pianissimo Zen‡	The Pianissimo Zen silent sequence package reduces noise by up to 99%, down to as little as 2 dB above ambient noise. The combination of Pianissimo and Pianissimo Zen make our Vantage series the quietest MR system in its class, providing comfortable examination for your patients.
MR Theater‡	In-bore immersive virtual experience enhances patient comfort. The MR Theater encourages patients to relax and stay still, enabling clinicians to produce stable.
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 hand- switch 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.
Emergency rundown unit	This safety switch allows automatic ramp-down of the magnetic field in the event of an emergency.

‡ Option

SCAN SPECIFICATIONS

Acquisition parameters

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

Imaging method[1)]	2DFT, 3DFT
Imaging nucleus	Proton (hydrogen nucleus)
Slice orientations[1)]	Axial, sagittal, coronal, oblique (single and double) Refer to the scan parameter table.

Sequences[2)]

			64 Matrix	128 Matrix	256 Matrix	512 Matrix
2D Spin Echo	min. TR	[ms]	4	4	4	18
	min. TE	[ms]	1.7	1.7	1.9	8
2D Fast Spin Echo	min. TR	[ms]	5	5	7	27
	min. TE	[ms]	1.6	1.7	2.5	4
	min. ETS	[ms]	1.6	1.7	2.5	4
	max. ETL	–	1,024	1,024	1,024	1,024
3D Fast Spin Echo	min. TR	[ms]	27	32	50	55
	min. TE	[ms]	5	5	7	5
	min. ETS	[ms]	4.5	4.5	4.5	4.5
	max. ETL	–	1,024	1,024	1,024	1,024
2D Fast Field Echo	min. TR	[ms]	1.0	1.7	1.8	5.2
	min. TE	[ms]	0.29	0.4	0.6	2.3
3D Fast Field Echo	min. TR	[ms]	1.0	1.7	1.9	3.6
	min. TE	[ms]	0.29	0.4	0.6	1.5
True SSFP	min. TR	[ms]	1.5	1.8	2.4	–
	min. TE	[ms]	0.75	0.9	1.2	–
Inversion Recovery	min. TI	[ms]	9	9	9	9
Echo Planar Imaging	min. TR	[ms]	3.9	3.9	3.9	23
	min. TE	[ms]	1.8	1.8	1.8	10
	min. ETS	[ms]	0.28	0.28	0.8	3
	min. acquisition time	[ms]	12	74	118	5,000
	max. EPI Factor	–	288	288	288	288
Diffusion Imaging	max. b-value	[s/mm^2]	10,000	10,000	10,000	–
	min. TE with b=1000	[ms]	52	52	73	–
Diffusion Tensor Imaging	max. diffusion tensor directions	–	256	256	256	256

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

Resolution

FOV *Adjustable in increments of 1 mm.	min. max.	[mm] [mm]	2 550 (X-Y plane) 500 (Z direction)
Slice thickness 2D *Adjustable in increments of 0.1 mm.	min. max.	[mm] [mm]	0.1 100
Slice thickness 3D *Adjustable in increments of 0.1 mm.	min. max.	[mm] [mm]	0.05 50
Slab thickness 3D	min. max.	[mm] [mm]	5.4 400
Matrix size	min.[3)] min.[3)] max.	– – –	32 (Phase encoding) 64 (Frequency encoding) 1,024
Highest in plane resolution		[µm]	8
Number of slices 2D	max.	–	128
Number of slices 3D	max.	–	256
Flip angle		[deg]	1 to 180
Flop angle		[deg]	30 to 180
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

3) Independently adjustable in 16 or 32 steps in both the frequency and phase encoding directions.

Imaging techniques and parameters

A wide range of imaging techniques are provided to complement the Vantage Orian'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

SPEEDER	SPEEDER is an image domain parallel imaging method for increased acquisition speed.	
	SPEEDER factor	Max. 6[4)]
	Number of acceleration factor combining SPEEDER with DRKS	Max. 16
	Number of acceleration factor combining SPEEDER with MultiBand	Max. 10 (SP5×MB2)
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.	
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.	
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. 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.	
Contrast Free MRA‡	This 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 such as CSF, synovial fluid, and vascular structures during breath-holding. Fat saturation is possible by dividing scans into multiple segments. The slice thickness can be reduced by 3DFT scanning.	
FSE/FASE T2 Plus	By promoting transverse magnetization recovery in FSE and FASE, the scan time can be reduced and the resolution can be increased with no loss of T2 contrast and SNR.	

4) The factor depends on the coil and the number of RF channels used.

‡ Option

Advanced fast scan techniques

UTE (Ultra short TE)‡	This technique depicts short T2* tissues by radially acquiring k-space data. It can be applied to FFE3D sequences. CG Recon[5], which is based on the CG (Conjugate Gradient) method that solves MRI encoding model equations for image reconstruction is available to reduce scan time while maintaining resolution and SNR.	
mUTE (minimized acoustic noise utilizing UTE)‡	The mUTE applications suppress high-speed gradient field switching, making it possible to provide even quieter scanning.	
FASE3D mVox‡	Enables acquisition of clear images with reduced SAR by changing the refocusing flip angle for each echo.	
FFE3D MP2RAGE‡	This sequence uses FFE3D and images at two different TI values, and FA values are acquired for the same slab at the same time. The image data is acquired at each TI value, and one T1W image is obtained in the last result. T1W images acquired with this sequence are not affected by nonuniformity of B1 or coil sensitivity. T1W images acquired with this sequence are not affected by nonuniformity of B1 or coil sensitivity. T1map can also be calculated at the console using T1calcmp2.	
FSE2D mEcho‡	This sequence uses FSE2D and images at four different TE values are acquired for the same position at the same time. T2map is then calculated on the workstation using these images. T2map can also be calculated at the console using T2calc.	
MultiBand SPEEDER‡	This application allows reducing the scan time for diffusion imaging, expanding the range of its clinical applications. Scan time reduction is achieved by simultaneously exciting and acquiring multiple slices using multiband RF pulses. As the results, scan time for diffusion imaging can be reduced to less than half. With this technique, a whole liver diffusion weighted scan can be acquired in a single breath holding of 15 seconds or less. It can be applied to SEEPI2D sequences.	
k-t SPEEDER‡	This sequence enables scanning with a higher acceleration factor than the conventional SPEEDER scan by changing the sampling pattern in the time direction during data acquisition. Up to x8 accelerated k-t SPEEDER allows high frame rate cardiac cine and perfusion imaging in free breathing without training scan required. It can be applied in cine imaging with SSFP2D sequences (3 phases or more).	
Fast 3D mode	This application allows reducing the scan time while maintaining image quality by up to half for T1, PD, T2, FLAIR, STIR weighted images by adjusting data acquisition ratio. It can be applied to FE3D, FFE3D, FASE3D‡, 3D-TOF‡ and 3D-SSFP‡ sequences.	
Compressed SPEEDER‡	This application allows acceleration factors for shorter scan times or higher resolution based in FSE2D, FASE3D and FFE3D imaging upon the principle of compressed sensing in combination with parallel imaging.	
	Number of acceleration factor in 2D imaging	Max. 4
	Number of acceleration factor in 3D imaging	Max. 16 (PExSE: 4 × 4)
		Combination with Compressed SPEEDER and Fast 3D application provides about 18 times acceleration.
Exsper (Expanded SPEEDER)	This application allows reducing scan time for SEEPI2D, FSE2D, FASE2D/3D, FE2D/3D, SE2D and FFE2D/3D sequences. Exsper technique scans center of k-space data and surrounding area data is undersampled. It finds the coefficient from the data of center of k-space and synthesize the undersampled data by using surrounding data and the coefficient in the image domain.	
	Number of acceleration factor in 2D imaging	Max. 6[6]
	Number of acceleration factor in 3D imaging	Max. 9 (PE×SE: 3×3)

5) Advanced intelligent Clear-IQ Engine (AiCE) for MR (MZDL-010A) or Advanced Image Reconstruction Unit (MZDL-010B) is required to use this application.
6) Available acceleration factor may depend on the sequence and the scanning condition.

‡ Option

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 blood flow.
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.

‡ Option

Fat suppression techniques

STIR (Short TI inversion Recovery)	A short TI 180° pre-pulse with IR suppresses fat signals to enhance water-proton images. It can be applied to FastSE and FASE sequences.
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 our 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)	A drawback of FastSE is the high rightness 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.
SPAIR (SPectral Attenuated Inversion Recovery)	A 180° adiabatic pulse is used to invert the fat signals inside the imaging plane uniformly regardless of B1 inhomogeneity and imaging is started at the null point of fat after TI in order to obtain fat-suppressed images with minimal fat suppression nonuniformity.
Enhanced fat Free	Multiple fat suppression pulses are applied in order to obtain a more stable fat suppression effect.
WET (Water Excitation Technique)	WET enables the spatial-position-selective and frequency-selective excitation of water. This technique can be applied to many types of sequences.
WFS (Water Fat Separation) DIXON	WFS DIXON provides water based images and fat based images by calculating images acquired with two different echo time. It can be applied to FSE2D and FE3D sequences.

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‡

‡ Option

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 Orian'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
Skipping SAT	Reduces the number of presaturation pulses in order to increase the number of slices.
No wrap (frequency and phase directions)	2D: frequency and phase directions 3D: frequency, phase, and slice 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.
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.
2D-RMC (2D-Real-time Motion Correction)‡	An image with reduced respiratory motion artifacts can be obtained by following the scanning cross section and acquisition timing relative to diaphragm motion. This technique can be applied to some types of FFE3D, SEEPI2D, FSE2D, FASE2D and FASE3D sequences.
mART (metal Artifact Reduction Technique)	In acquisition with FSE2D sequences, this technique reduces artifacts at locations with a high magnetic susceptibility which can be caused by the presence of metal by optimizing parameters for band-width, slice thickness, readout matrix and SPEEDER factor.
mART+ (metal Artifact Reduction Technique Plus)‡	mART+ is the application of mART technique in addition to VAT (View Angle Tilting). mART+ further reduces metal related artifact caused by high off-resonance frequency and reduces image artifacts caused by implants.
mART EXP (metal Artifact Reduction Technique EXPansion)‡	mART EXP is 3D method to resolve in-plane and through-plane distortion artifact induced by susceptibility. Each slice is 3D phase-encoded to resolve distortion in slice dimension. In addition, VAT method is combined to resolve in-plane distortion. In the reconstruction, the data of each slice which is encoded in the slice direction is combined and corrected, and finally the images are registered as 2D multi-slice images like normal FSE2D. In addition, this application can be used in combination with Compressed SPEEDER application to reduce scan time.
Iterative Motion Correction (IMC)‡	IMC reduces motion artifact by correcting k-space data based on detecting the amount of motion during scan. Applying IMC in the brain corrects for rigid motion, applying IMC in the c-spine corrects for both rigid and non-rigid motion. From V9.0, IMC utilizes Deep Learning based methods in addition to traditional model-based ones.
Quick Star‡	Quick Star allows high resolution image for liver examination with free breathing.

‡ Option

USER EXPERIENCE

Automated Workflow

Vantage Orian delivers advanced workflow solution that is thoroughly automated and simplified at each phase from entering MRI room to the scan and check.

Basic Operations

System startup	System startup	Possible
	The initial screen display	Possible
	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 shutdown.	
	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	Possible
Page control	A processing switching function that allows multiple processing tasks to be performed simultaneously	Possible
	Display of errors and warnings	Possible
System shutdown	System shutdown	Possible

Patient Preparation

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).

Auto Populate[1)]

Previous scan parameters are easily retrieved and populated if a patient has been scanned before.

Patient registration

Scheduling and registration items	Patient ID, patient name, height, 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.
Adaptive Scan Mode	Scanning conditions are preset available (Patient Orientation, SAR operating mode, B1+RMS limit, CP mode).

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

Preset items	PAS name (name of a set of scans)
	Scanning region (graphic icon), etc.
	Type of RF coil
	Scan name (names of individual scans)
	Scanning conditions (imaging parameters), etc.

1) This function is required DICOM Q/R SCU kit (MSSW-DCQRU1).

Scan Planning

Operator Independent Scan Planning

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.
Auto Scan Assist‡ takes away the variability and helps operators improve workflow with automatic slice alignment, standardizing workflow with automatic positioning. Planning of re-scan which is based on the result of image analysis are also available.

Sequence Queue operations

Queuing	Scans can be copied, added, or deleted, and acquisition order can be changed.	
Scan start control	Auto	Multiple specified scans can be run in succession automatically.
	Breath hold	Each scan is started by pressing the Scan Start button. Combination with the AutoVoice function is possible.
	Pause/resume function, abort function	
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).	
MPR/MIP display for locating	ForeSee View can display MPR or MIP on ForeSee View window in real-time.	
IDC image planning	Intelligent Distortion Correction image is available for scan planning.	
Coil selection	It visualizes the coil selection on locator display.	
Auto Map	Mapping is automatically applied after selecting the coil section.	

‡ Option

Auto Planning

Auto Scan Assist‡

Boosted by artificial intelligence, Auto scan planning reduces unnecessary steps and enhances consistent operation.

Automated VOI recognition	Deep Learning based Machine learning based Non machine learning method	SUREVOI Liver SUREVOI Knee SUREVOI Cardiac
Automated plane detection	Machine learning based	CardioLine+, NeuroLine+, SpineLine+, KneeLine+, W-SpineLine+, LiverLine+, ProstateLine+

Auto Protocol‡

Auto Protocol enables examination with automatic scan planning based on a pre-established PAS. Then, this application asks if the operator would like to proceed the examination according to the pre-defined scenario.

Auto Start

Scanning starts to run automatically when the patient is sent to iso-center and the door of shield room is closed.

‡ Option

Scan and Reconstruction

Scan Management

High SNR, high resolution and robust imaging achieved by AI based solutions are reproducible and operator independent.

Safety functions	SAR limitation function, dB/dt limitation function
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 In-line processing

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

Post Process

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 Orian allows image processing to be performed in parallel with scanning.

Image display

Image selection	Selection from Image Matrix	
	Skipped selection function	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	WW/WL adjustment by mouse operation	
	Auto windowing	Possible
	Apply Contrast function	Provided
Image-related information	Patient information, imaging parameters, RF coil type, etc.	
	Graphics & annotation function	Provided
	Image-related information display ON/OFF	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	Possible	
	Size change	Possible in three levels or more
	Display position selection	Possible
Cine display	Possible	
	Multiframe display	Possible
	Playback/switching speed	Variable
	Storage of moving images	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)

Image processing

Image filters	Smoothing, edge enhancement, etc.	
MIP (Maximum Intensity Projection, Minimum Intensity Projection)	Projection direction	Specified using ROI (specification of multiple projection directions is possible)
	Target MIP	MIP target region can be specified in three directions.
MPR	Interactive MPR, batch MPR	
	Double oblique	Possible
	Slice thickness change function	Available
	Image storage function	Available
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 for both 2D and 3D.	
Distortion correction	Provided as standard for both 2D and 3D.	
3D post-process	Provided as standard.	
Fusion processing	Provided as standard.	
Temporal Filter	The temporal filter is used for images of R-space (real space) in image reconstruction. For images acquired with cine mode or retrospective mode, minor intensity variation of the noise components is suppressed while maintaining the myocardial motion and physiological tissue structures in the image, improving visibility.	

Filming

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

Data management

Temporary storage of patient data	Solid state drive
Long-term storage of patient data	External hard drive (USB 3.0, type A), DVD-R, DVD-RAM, and Blu-ray Disc™
Patient data search	Possible

Security Settings

Meets the requirements of Risk Management Framework (RMF), governed by the Defense Health Agency (DHA)	Provided as a standard. RMF tested and verified.
HIPPA compliance	Provided as a standard. The requirements of US Health Insurance Portability and Accountability Act are met.
White list type antivirus software	Utilizing the highly secure White List security software embedded control security solution that provides a high level of protection against malicious attacks, advanced persistent threats, viruses, and malware.

Utilities

LHe level indication	The LHe level data is read from the supervisory unit.
	Logging is possible.
Quality control	Daily QA (absolute value)
	Logging is possible.
Errors	Logging is possible.

Image processing

Reconstruction	The maximum reconstruction matrix	1,024 × 1,024
	FINE	Doubles the reconstruction matrix to improve the inplane 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.
	DSD Filter	DSD filter removes the noise while retaining the optimal smoothness and sharpness.
	GA Filter‡	GAIN Algorithm filter is available as a reconstruction filter to reduce image noise.
	Advanced intelligent Clear-IQ Engine (AiCE)‡	AiCE intelligently removes noise from images which results in high SNR and leads to enhanced anatomical and spatial resolution utilizing the power of Deep Learning.
	Precise IQ Engine (PIQE)‡	PIQE is Deep Learning based technique that generates higher spatial in-plane resolution images from lower resolution images with the ability to triple the matrix dimensions in both in-plane directions, i.e. a factor of 9x, while mitigating the ringing artifact.
Batch multiplanar reconstruction	Provides oblique as well as interactive MPR	

‡ Option

Networking		
DICOM 3.0	Storage SCU, Print SCU, DICOM Media, and MWM SCU	Available
	Storage Commitment, Q/R SCU, Q/R SCP, and MPPS SCU	Available‡
	IHE profiles	SWF, CPI, PDI and CT are Supported. Only DVD media is supported for PDI.
	Two more DICOM service classes	Available
Laser Imager	DICOM print	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.	
	This 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.	
	DICOM	Supported
Remote Service Maintenance	The InnerVision remote service system permits system diagnosis over a digital connection to the Canon Medical systems Technical Support Center. Please consult your Canon Medical systems 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 simultaneous acquisition:	Available	
	Artery/vein separate:	MovingSAT available	
	Fat saturation method:	Can be used in combination	
	Presaturation method:	Can be used in combination	
	Quiet Scan:	Standard	
3D TOF method	Fat saturation method:	Can be used in combination	
	Presaturation method:	Can be used in combination	
	Quiet Scan:	Standard	
	Multicoverage method:	This is a wide-range imaging method taking advantage of the TOF effect using a thin slab.	
		Coverage joint suppression method:	Available
	SORS-STC method:	The imaging capabilities for blood vessels are improved by selectively suppressing the signals from tissues.	
		Flip angle of SORS-STC pulse:	Available
	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)

Non-contrast MRA

FSBB (Flow Sensitive Black Blood)	FSBB depicts more details of arteries and veins by utilizing the flow dephasing 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‡:	ECG-gated scanning or peripheral-pulse-gated scanning is performed with multiple delay times set in order to acquire images of the same plane in different cardiac phases so that the optimal delay time for visualizing the target vessels in FBI can be determined.
	Intermittent breath-hold method in ECG-gated scanning:	ECG-gated scanning is performed during breath-holding, with the patient permitted to breathe at regular intervals corresponding to a certain number of slice-encoding steps.
	Sequential FASE method:	Images for different slices are acquired sequentially to provide multislice images in the same cardiac phase.
	FlowSpoiled FBI method:	The optimal dephase pulse is applied in the readout direction in order to permit the arteries and veins to be visualized separately for low-velocity blood vessels such as peripheral vessels and collateral vessels, which is difficult with standard FBI.
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°.	
Time-SLIP (Time-Spatial Labeling Inversion Pulse)	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.	
mASTAR	Non-contrast MRA is performed using ASTAR pulses. After uniform Tag pulses are applied, sequential acquisition is performed at different TI timings to acquire MRA images at the different TI timings, allowing hemodynamics to be observed.	
mUTE 4D MRA	UTE sequences allow for less dephasing and more homogeneous vessel signals. At the same time, the use of multiple inversion times (TIs) allows generation of dynamic images (4D) visualizing the blood flow without the need for contrast agents.	

‡ Option

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	

PS MRA method

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

2D PS method	IVisualizes 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

Flow velocity measurement method

Scan for flow velocity measurement	Method:	2D cine PS method
	Cross section:	Arbitrary planes
	Direction:	Slice/readout/phase encode

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‡
	Multi b-value:	Available
FASE Diffusion‡	Three-axis continuous acquisition:	Available‡
RDC DWI (Reverse encoding Distortion Correction DWI) ‡	RDC DWI is intended to reduce distortion in phase encoding direction due to B0 field inhomogeneity or eddy current, in SEEPI2D sequence.	
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)	
	ADC 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)	

‡ Option

Perfusion Imaging

Various types of perfusion imaging are supported.

EPI Diffusion	Single-Shot EPI:	Available
Perfusion postprocessing	ΔR2* image	
	Curve fitting:	Available
	Functional parameters:	Peak Height, Peak Time, Area under Curve, 1st Moment, etc
	Map and color display:	Available
ASL (Arterial Spin Labeling)	The ASTAR method is used to cancel out the MTC effect by setting the IR pulse application position for the control image and that for the tag image asymmetrically with respect to the imaging slice, while the blood flow signal on one side of the imaging slice is suppressed. As a result, images in which the MR signals from stationary tissues are suppressed can be obtained. This technique can be applied to both 2D and 3D. (ASTAR: Modified Signal Targeting Alternating Radiofrequency using Asymmetric Inversion Slabs) (MTC: Magnetization Transfer Contrast)	
	Control IR position:	Variable
	Tag IR position:	Variable
	Tag IR thickness:	Variable
pCASL (pseudo-continuous ASL)‡	pCASL method controls the RF pulse that are intermittently applies and tags and gradient field, and collects images of both tag and control modes at the same position and PD image simultaneously and acquires the perfusion images from those images.	

‡ Option

Cardiac Imaging

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

Cine imaging	Application:	FE2D, FFE2D (support for TrueSSFP)	
	Sequential multislice multiphase		
	Number of phases:	Variable (depending on the R-R interval)	
	ECG-gating:	Prospective, retrospective‡	
		Viewshare reconstruction:	Available
	Tagging scan:	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.
Gate-free Cine imaging	Application:	FFE2D (support for TrueSSFP)	
	Taking images without gating in the breath-hold state.		
BB (Black Blood) method‡	Application:	FASE and FFE	
	Sequential multislice		
	Number of slices per breath-hold can be specified.		
	BB pulse application time can be changed sequentially.		
	Fat saturation pulse can be used in combination.		
Retrospective gating mode‡	Application:	FFE2D (support for TrueSSFP)	
	Acquires continuous cine images.		
	An image of the entire cardiac cycle, including diastole, can be obtained.		
Tissue characterization imaging‡	Application:	FFE2D, FFE3D	
	A T1-weighted image obtained using the inversion recovery method.		
	Analysis of delayed myocardial enhancement is available.		
Time course imaging‡	Application:	FFE2D	
	Multi-slice ECG-gated dynamic scan to acquire images of first pass of contrast.		
	Temporal change of signal intensity can be analyzed		
RMC (Real-time Motion Correction)‡	Application:	FFE3D, SEEPI2D, FSE2D, FASE2D, FASE3D	
	An image with reduced respiratory motion artifacts can be obtained by following the scanning cross section relative to diaphragm motion.		
R-wave monitoring‡	Application:	SSFP2D, SSFP3D	
	Reacquiring the ECG waveform when RR interval offed a preset threshold during ECG-gated scanning.		
MOLLI (MOdified Look-Locker Inversion recovery)‡	In ECG-gated scanning with the FFE2D sequence, MOdified Look-Locker Inversion recovery method is used for image acquisition. In this mode, the TI timing and delay time for the next IR pulse are specified based on the cardiac cycle, in addition to setting of the number of IR pulses and number of acquisitions, and image acquisition is performed.		
PSIR (Phase Sensitive Inversion Recovery)‡	In ECG-gated scanning with the FFE2D sequence, T1 contrast-weighted real images are acquired in this mode. After single IR pulse is applied, acquisition is performed with two different TI timings. Using the image data with a longer TI value which is less affected by T1 contrast, phase correction is performed for the image acquired with another TI value in order to enhance T1 contrast.		
T2 map‡	ECG gating or peripheral pulse gating is used in scanning with FFE2D sequences, and different Pre-contrast pulses are used to obtain multiple TE_{eff} images. The calcRelaxPrep function is then applied to the obtained TE_{eff} images to create T2 map images.		

‡ Option

Imaging Processing for BOLD Imaging‡

Friendly user interface for BOLD Image (functional MRI) processing
Alignment process using 3-dimensional motion correction
Statistically processed images (t-value, correlation coefficient)

UTE Imaging‡

Data is acquired with a very short TE by starting radial scan (in which data is acquired in a radial pattern from the center of the k-space) immediately after the RF excitation pulse is applied, without using a phase encode gradient pulse. Because UTE enables observation of signals with short T2* values and acquires the data starting from the center of the k-space for each TR, this technique is less susceptible to motion.
CG Recon[1)], which is based on the CG (Conjugate Gradient) method that solves MRI encoding model equations for image reconstruction is available to reduce scan time while maintaining resolution and SNR.
This application is also available acquisition of different TE data for T2* mapping of tissues with short T2*.

Pediatric Imaging‡

Various types of technology can be performed for pediatric imaging.

• Pianissimo Zen Application	MSSW-ZEN
• UTE Application	MSSW-UTE

Selection of surface coils are below

• Pediatric SPEEDER	MJAB-197A/S1
• 4ch Flex SPEEDER	MJAJ-197A/J1
• 16ch Flex SPEEDER Medium	MJAJ-217A/S1
• 16ch Flex SPEEDER Large	MJAJ-227A/S1

Fat Fraction Quantification‡

Data is acquired with several different TE and provides PDFF image, R2* image, water image, fat image, in phase image and out of phase image (total 6 kind of images). Proton Density Fat Fraction data is supporting fat content ratio of liver.

MR Spectroscopy‡

Proton spectroscopy provides spectral and metabolic information for enhanced diagnostic confidence in neuro, prostate and breast examinations and is fully integrated in the imaging routine.

Single Voxel method‡	Data acquisition, processing and display are available on the console. The Volume of Interest (VOI) can be set up on the locator MR images of arbitrary orientations.
Multi Voxel method‡	Spectral data processing and analysis are available on the console. Chemical-shift images can be generated and overlaid on the corresponding high-resolution anatomical image.

Note: It is possible to process the MRS data acquired by Canon MRI systems using software LCModel or equivalent, which supports data acquired by single-voxel acquisition and multi-voxel acquisition and it can be implemented on workstation.

1) Advanced intelligent Clear-IQ Engine (AiCE) for MR (MZDL-010A) or Advanced Image Reconstruction Unit (MZDL-010B) is required to use this application.

‡ 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	380/400/415/440/480 V
Phase	Three-phase
Voltage fluctuation	±10%
Frequency	50/60 Hz±1Hz
Power requirements	52 kVA[1)]

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[2)]

Power consumption (Average)		50 Hz	60 Hz
	During scan	23.2 kW	24.5 kW
	Low-power mode	11.4 kW	12.2 kW
	System power off	6.3 kW	7.6 kW
Max. System heat dissipation		2.0 kW	2.2 kW

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.

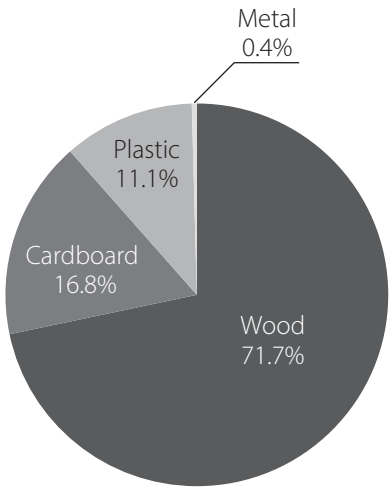
1) An additional 15-20 kVA cooling is required.
   Continuous power (day and night) is required for some equipment.
2) Power consumption is calculated based on COCIR Self-Regulatory Initiative for medical imaging equipment (2011). The heat dissipation value does not include the external heat exchanger.

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 28°C	40% to 75% R.H.
	Computer room	16°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) from 62.0 MHz to 64.0 MHz An RF shield room with more than 90-dB shielding is required.		
Emergency 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.		
Minimum rigging clearance	2.0 m (W) × 2.5 m (H) or more		
Minimum installation area[3)]	24.69 m^2		
	Scan room	5.125 m × 3.20 m = 16.4 m^2	
	Operator's room	1.60 m × 1.30 m = 2.08 m^2	
	Computer room	3.65 m × 1.70 m = 6.21 m^2	
Ceiling height	2.4 m for the scan room, except for the maintenance space for the refrigerator (2.8 m)		
Maximum floor loading	7.0 tons for the scan room		
Installation altitude	2,000 m or less above sea level		
Cooling water	Flow rate	90 L/min or more	
	Temperature	15°C or less	

Packaging materials

	Mass kg (Average)
Wood	841
Cardboard	197
Plastic	130
Metal	5



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

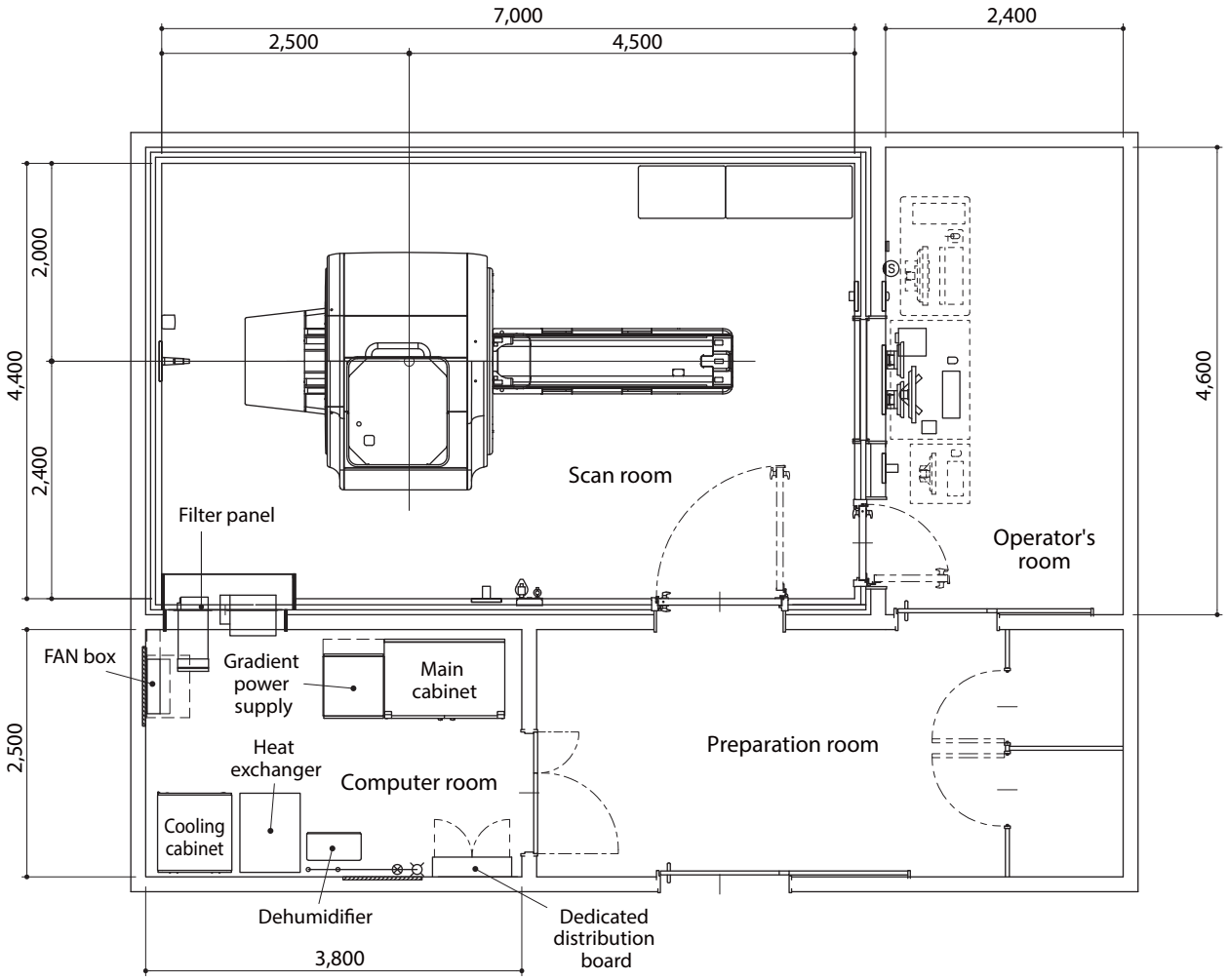
COMPATIBILITY WITH INTERNATIONAL STANDARDS

IEC 60601-1:2005+A1:2012
IEC 60601-1-2:2014+A1:2020
IEC 60601-1-6:2010+A1:2013+A2:2020
IEC 60601-1-9:2007+A1:2013+A2:2020
IEC 60601-2-33:2010+A1:2013+A2:2015
IEC 60825-1:2014
IEC 62304:2006+A1:2015
IEC 62366-1:2015+A1:2020

DIMENSIONS AND MASS

Unit	Dimensions W x D x H mm	Mass kg	Recycling rate %
Magnet assembly			
For fixed table	2,400 × 1,900 × 2,320	5,800	86
For dockable table	2,400 × 2,287 × 2,320	5,800	86
Entire bore length (including covers)	1,690	–	
Patient bore length	1,495	–	
Patient Table			
Fixed table	660 × 2,470 × 430 to 845	318	80
Dockable table	660 × 2,486 × 550 to 845 (Dock) 660 × 2,486 × 535 to 875 (Undock)	262	80
Console			
Monitor	575 × 245 × 423 to 553	8.7	60
Control Box	283 × 310 × 85	4	no data
Control pad	293 × 95 × 82	1.2	71
Main Cabinet and Gradient Power Supply	1,836 × 800 × 1,987	1,300	83
Cooling Cabinet	900 × 800 × 1,920	365	97
FAN Box	630 × 145 × 520	17	95
Filter Panel	1,150 × 770 × 650	67	85
Accessories	–	90	9
Heat Exchanger	609 × 800 × 1170	165	no data

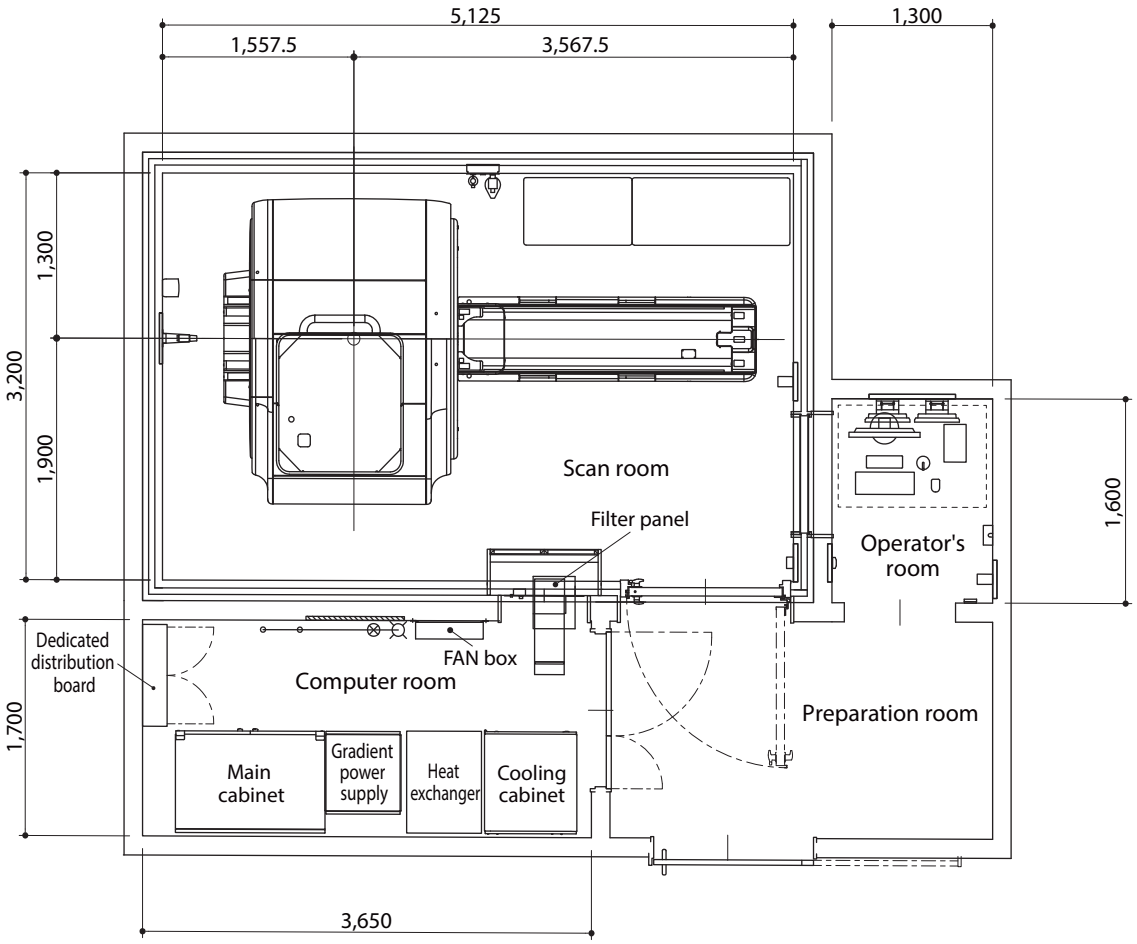
STANDARD LAYOUT EXAMPLE



1) Units drawn in dotted line are not included in the standard composition

Unit: mm

MINIMUM LAYOUT EXAMPLE



1) Units drawn in dotted line are not included in the standard composition

Unit: mm

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Canon Medical Systems Corporation meets internationally recognized standards for Quality Management System ISO 9001, ISO 13485.
Canon Medical Systems Corporation meets the Environmental Management System standard ISO 14001.

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