

# MR Imaging System

ECHELON Smart  
(for IRCP system)

## TECHNICAL MANUAL

Special Notes to Operators and Maintenance Managers

- ★ Before using this system, be sure to thoroughly read this manual and make yourself familiar with this system.
- ★ After reading this manual, keep it in an easily accessible place close to the system.

 **Hitachi, Ltd.**  
Tokyo, Japan

Q1E-HM1658-03

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## Manufacturer

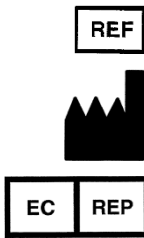
Hitachi, Ltd.  
2-16-1, Higashi-Ueno, Taito-ku,  
Tokyo, 110-0015, Japan

## CE Marking


Only for EU countries

The Medical Device as specified below and related options meet the provisions of the EC-Directive 93/42/EEC.

Product Name	:	MR Imaging System
Product Classification	:	IIa
Model	:	ECHELON Smart
Manufacturer	:	Hitachi, Ltd. 2-16-1, Higashi-Ueno, Taito-ku, Tokyo, 110-0015, Japan
European Representative	:	Hitachi Medical Systems GmbH Otto-von-Guericke-Ring 3 D-65205 Wiesbaden, Germany Phone: +49 6122 7036 0 Fax: +49 6122 7036 10



## WEEE Marking

Symbol	Description
	<p>Only for EU countries</p> <p>Do not dispose medical devices together with household waste! In observance of the European Directive on waste electrical and electronic equipment and its implementation in accordance with national law, medical devices that have reached the end of their product life must be collected separately and returned to an environmentally compatible recycling facility. Please contact your local Hitachi distributor for information about qualified recycling facility.</p>

## **Introduction**

Precautions that must be taken when exporting this equipment:

When exporting this equipment, be sure to check the Foreign Exchange and Foreign Trade Control Law and the regulations related to export control of the United States of America, and take the necessary procedures. If any question arises, contact Hitachi or an authorized representative.



Revision history:

First edition: February 2019

















Second edition: April 2019







Third edition: May 2019

**General Technical Description**

- |                 |   |   |   |                 |  |            |
|-----------------|---|---|---|-----------------|--|------------|
| 1.              | Manufacturer  |  | Hitachi, Ltd.<br>2-16-1, Higashi-Ueno, Taito-ku, Tokyo, 110-0015,<br>Japan  |                 |  |            |
| 2.              | Model   |  | ECHELON Smart   |                 |  |            |
| 3.              | Nature of supply  |   | Three-phase alternating current   |                 |  |            |
| 4.              | Rated supply voltage  |   | <table border="0" style="width: 100%;"> <tr> <td style="text-align: center;">380/ 400/ 415 V</td> <td style="border-left: 1px solid black; border-right: 1px solid black; width: 1px;"></td> <td style="text-align: center;">460/ 480 V</td> </tr> </table>   | 380/ 400/ 415 V |  | 460/ 480 V |
| 380/ 400/ 415 V |   | 460/ 480 V  |   |                 |  |            |
| 5.              | Rated supply frequency  |   | <table border="0" style="width: 100%;"> <tr> <td style="text-align: center;">50 Hz</td> <td style="border-left: 1px solid black; border-right: 1px solid black; width: 1px;"></td> <td style="text-align: center;">60 Hz</td> </tr> </table>  | 50 Hz           |  | 60 Hz      |
| 50 Hz           |   | 60 Hz   |   |                 |  |            |
| 6.              | Rated input   |   | 75kVA(short time)<br>29kVA(continuous)  |                 |  |            |
| 7.              | Protection against electric shock                                 |   | CLASS I ME EQUIPMENT<br><br>[Exceptions]<br>Receiver coils: CLASS II ME EQUIPMENT.<br>PMM: INTERNALLY POWERED ME EQUIPMENT.<br>TYPE B APPLIED PARTS: Patient table top, Technologist-alert.<br>TYPE BF APPLIED PART: Receiver coils<br>DEFIBRILLATION-PROOF TYPE CF APPLIED PART: PMM                 |                 |  |            |
| 8.              | Protection against harmful ingress of water or particulate matter |   | IPX1: Foot switch<br>IPX0: The exteriors expect the above.  |                 |  |            |
| 9.              | Mode of operation   |   | Continuous operation  |                 |  |            |
| 10.             | Environmental conditions for transport and storage                |   | Ambient temperature:        - 15 °C to + 55 °C<br>Relative humidity:            10 % to 95 %<br>Atmospheric pressure:        70 kPa to 106 kPa  |                 |  |            |
| 11.             | Repair  |   | Manufacturer will make available on request circuit diagrams, component part lists, descriptions, calibration instructions, or other information that will assist service personnel to repair those parts of ME equipment that are designated by the Manufacturer as repairable by service personnel. |                 |  |            |

12. Symbols

Symbol	Title
	Warning, RISK of strong magnetic field
	Warning, Non-ionizing radiation
	Warning, Electricity
	Warning, Pinch hazard
	Caution for laser radiation
	Caution for electrostatic discharge
	Wear ear protection
	Refer to instruction manual/ booklet
3~	Three-phase alternating current
	Protective earth (ground)
	Earth (ground)
	Caution
	"ON" (power)
○	"OFF" (power)
●	"ON" for part of equipment
○	"OFF" for part of the equipment
	CLASS II equipment
	TYPE B APPLIED PART
	TYPE BF APPLIED PART
	DEFIBRILLATION-PROOF TYPE CF APPLIED PART
	RF coil, receive-only

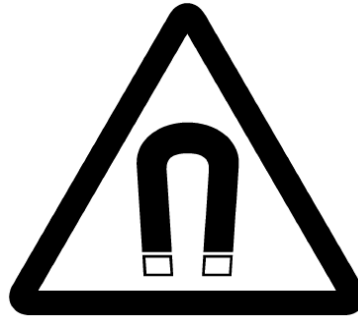
Symbol	Title
	Do not reuse
	Dangerous voltage
	Emergency stop
<b>SN</b>	Serial number
<b>REF</b>	Catalogue number
	Date of manufacture
	Manufacturer
	Operating instructions

# For service member.

## Strict Prohibitions during Installation, Adjustment, Maintenance and Inspection

The inside of the MRI room is a strong magnetic field.

Strictly observe the following and provide a cautions marking at the entrance of the MRI room.



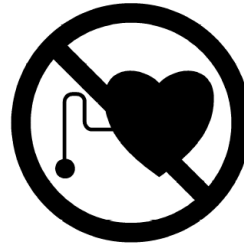
1. The servicing engineer carrying a magnetic substance such as an artificial joint, surgical clip, etc. should never be permitted to enter the MRI room.



BRAIN CLIPS  
POWERED  
ARTIFICIAL EYES

METALLIC IMPLANTS

2. Any person using a pacemaker must be strictly prohibited from entering the MRI room.



PACEMAKERS

3. Cash dispensing ID cards, mechanical wristwatches, floppy disks, magnetic tapes, etc. are affected by the magnetic field. Do not carry them into the MRI room.



WATCHES  
CAMERAS  
BEEPERS  
CALCULATORS

PRECISION ELECTRONIC  
INSTRUMENTS

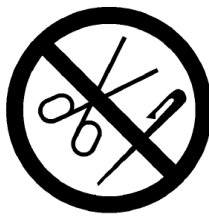


CREDIT CARDS  
FLOPPY DISKS  
TELEPHONE CARDS

MAGNETIC  
MEMORY MEDIA

## For service member.

4. Magnetic jigs and tools are strictly prohibited inside the MRI room. The jigs and tools to be used in the room must be of a nonmagnetic material.



SCISSORS  
PENS  
KEYS  
PAPER CLIPS  
LIGHTERS

LOOSE  
FERROMAGNETIC  
OBJECTS



WHEEL CHAIRS  
CRUTCHES  
STRETCHERS  
STANDS  
NEEDLES  
HEARING AIDS  
STETHOSCOPES  
BLOOD  
PRESSURE  
CUFFS

IRON WHEEL CHAIRS

OR

OTHER FERROMAGNETIC  
MEDICAL SUPPLIES



FIRE  
EXTIN-  
GUISHERS  
GAS  
CYLINDERS  
CRYOGEN  
DEWARs

FERROMAGNETIC  
CONTAINERS



SCREW-  
DRIVERS  
SPANNERS  
HAMMERS  
VACUUM  
CLEANERS  
MOPS

FERROMAGNETIC  
TOOLS OR  
CLEANING EQUIPMENT



CARRIERS  
WAGONS  
HAND CARTS

FERROMAGNETIC  
CARTS

5. The following measuring instruments may be used in the MRI room, but they are not applicable within 0.5mT line.
- (1) Impedance analyzer
  - (2) Oscilloscope
6. It is prohibited to work by the person who does not received professional training.

**For service member.**



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**For service member.**

## PREFACE

This technical document summarizes guidance mainly for technical information. Since it is necessary to pay a special attention when any medical device is used, please use and install those devices in accordance with the guidance for the technical information which are provided in this document. Please also refer to the attached document on MRI system, "SITE PLANNING GUIDE" written as information on its installation and power environment.

### 1. System Composition, Technical specification

#### 1.1 Standard composition

- (1) Gantry
  - Superconductive magnet
  - Helium Refrigerator
  - Actively shielded Gradient coil
  - T/R Body coil
  - Speaker
- (2) Patient Table
- (3) SVU
- (4) Emergency Run Down Unit
- (5) Operator Console
  - PC Unit
  - Switch unit
  - LCD Monitor
  - Keyboard / Mouse
- (6) IRCP unit
- (7) Gradient Amplifier (GPA)
- (8) Sense Unit
- (9) Compressor Unit
- (10) Filter Box
- (11) Standard receiver coils
- (12) Physiological gating unit (ECG, Peripheral, Respiratory)
  - Battery

(13) Standard Accessory

- Phantom set
- Patient immobilizing pads and straps
- Patient table mattress set

(14) Standard Software

## 1.2 Options

- (1) Option receiver coils
- (2) Option software
- (3) UPS
- (4) Foot switch
- (5) Patient immobilizing pads and straps
- (6) Microphone

## 1.3 Gantry

- (1) Magnet type : Superconductive magnet
- (2) Field strength : 1.5 +/- 0.0023 Tesla
- (3) Resonance frequency : 63.86MHz +/-100 kHz
- (4) Magnetic shielding : Active magnetic shield
- (5) Leakage flux (0.5 mT line) : Axially : 4.0m (the direction of Z)  
Radially : 2.5 m (the direction of X and Y)  
(Refer to the leakage magnetic field in "SITE PLANNING GUIDE" for X, Y, Z axis)
- (6) Gantry dimensions : 1,880×2,200×2,204mm
- (7) Bore diameter : 600 m
- (8) Magnet Weight : 5,000kg (Helium level 70%)

(9) Spatial Gradient of the Main Magnetic Field

1) Maximum Gradient of Main magnetic field

Position: R: 335 mm, Z: 690 mm from center of magnet

B0: 1.59 T

Spatial gradient field :  $\text{Grad}(B_0) = 6.26 \text{ T/m}$

Product :  $B_0 * \text{Grad}(B_0) = 9.95 \text{ T}^2/\text{m}$

2) Maximum of the product of magnetic field and its gradient

Position : R:335mm, Z : 655mm from center of the magnet

Magnetic field strength : 1.73 T

Spatial gradient of the magnetic field : 6.07 T/m

Product :  $B_0 * \text{Grad}(B_0) : 10.5 \text{ T}^2/\text{m}$

(10) Light Localizer

In this MRI system, class II laser products are used.

Maximum output : Less than 1mW

Output wavelength : CW 635nm

Beam divergence : 1.5mrad



(11) Lighting

The lighting is located inside the gantry.

It is switched in 3 lighting stages.

All lights OFF > All lights ON (Half luminance) > All lights ON (Maximum luminance)  
> All lights OFF

(12) Ventilation

A ventilation duct is located inside the gantry.

Air volume can be switched from Weak (half side), Strong(Both side), Weak to OFF.

(13) Communication method

Intercom and technologist alert are equipped.

Intercom is used for two-way communication between the patient inside the gantry and the operator. The switch unit as well as mic and speaker of the gantry are used.

The patient can notify the operator by pressing the technologist alert when uncomfortable.

(14) Shim

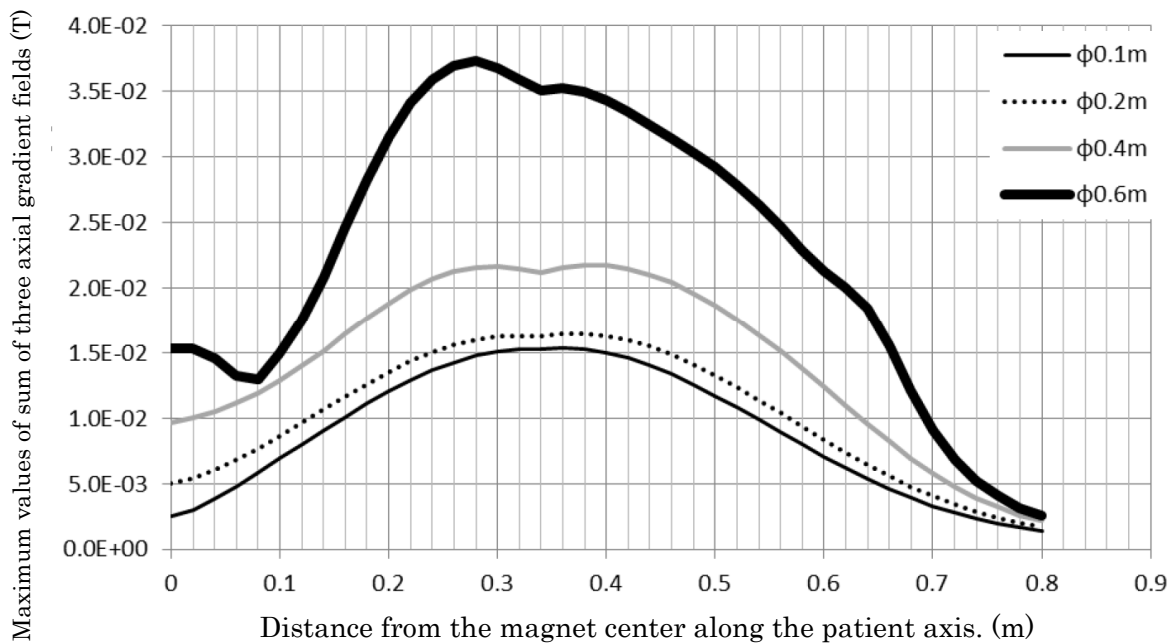
Passive shim and shim coil with gradient magnetic field coil (active shim)

### 1.4 Cryogen

- (1) Type : Liquid helium
- (2) Capacity : 968 liter
- (3) Cryogen refill level : 56.7 %
- (4) Cryogen boil off : Substantially zero with 4K He refrigerator  
(This numerical value changes by the condition of operation of the device.)
- (5) Emergency run down time : less than 20 seconds

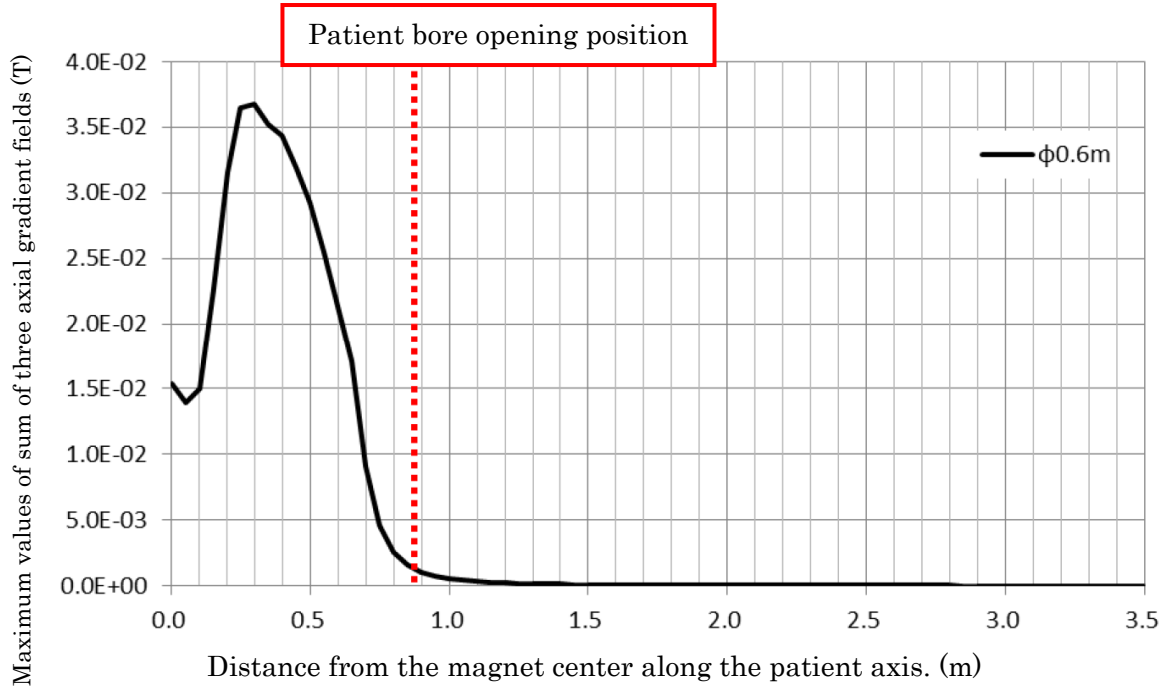
### 1.5 Gradient System

- (1) Type : Whole Body Gradient System
- (2) Maximum Strength : 33m T/m
- (3) Maximum Slew Rate : 130T/m/sec
- (4) The following diagrams show Maximum values of sum of three axial gradient fields versus Distance from the magnet center along the patient axis. Each curve represents the value that the diameter of the virtual cylinder is 0.1 m, 0.2 m, 0.4 m and 0.6 m, respectively.



Spatial distribution of the maximum magnitude values of the vector sum of all three gradient outputs in the gantry (Calculated value)

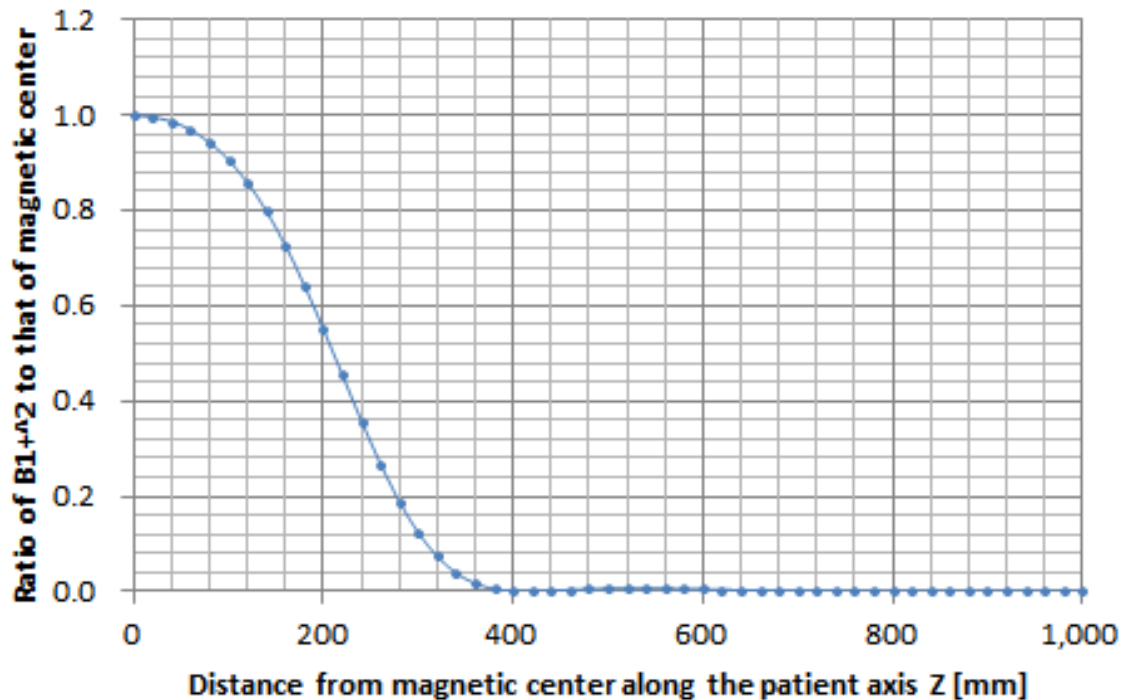
**For service member.**



Spatial distribution of the maximum magnitude values of the vector sum of all three gradient outputs in the space accessible by workers (calculated value)

## 1.6 RF System

- (1) R/F coil type : 2 ch for whole body, volume R/F coil, birdcage type.  
(RF transmission is " QD (CP) ". (QD : Quadrature drive, CP : Circularly polarized) )
- (2) R/F Amplifier Peak Power : less than 18kW.PEP, 1 channel
- (3) Band width of the maximum transmit RF magnetic field: 63.86±0.275 MHz
- (4) Maximum B1+RMS (with load): 13.3  $\mu$ T, Axial cross-sectional average, No.11 phantom  
(with a load of the equivalent of body weight 90kg)
- (5) Maximum center of the transmit RF magnetic field (without load): 52.3  $\mu$ T
- (6) Maximum center of the transmit RF magnetic field is at the Z axis of -3dB: 210 mm from the center, -10dB of the Z axis: 310 mm from the center
- (7) Spatial distribution :



Spatial distribution of the maximum transmit RF magnetic field (calculated value)

- (8) Receiver channel: Max 16ch
- (9) Receive frequency: 63.86MHz
- (10) Receive bandwidth: +/- 275kHz



## 2. Functional test for the peripheral equipment

The electromagnetic interference level complies with IEC60601-1-2:2014.

The user or the manufacturer of the peripheral equipment can investigate/take measures of influence of the MR system on it according to the following protocols.

Caution: These tests are not intended for estimation of the possible effect of the peripheral equipment on the resulting image quality of the MR system and no guarantee that the peripheral equipment will function properly.

- (1) Run scan with routine protocol
- (2) Switch off the MR system
- (3) Change the direction or the position of concerned equipment
- (4) Move the concerned equipment to the distance away from the MR system
- (5) Be sure the concerned equipment power is not shared with the MR power

### 3. Electromagnetic Compatibility (EMC)

Electromagnetic compatibility (EMC) of this system has been tested in compliance with the international standard of EMC for medical equipment (IEC60601-1-2:2014).

(Except within the controlled access area)

The unit and system functions determined as essential are stated below.

- (1) The main power of the system can be turned on and off normally.
- (2) Scanning can be started and stopped.
- (3) RF/GC is output normally at start of scanning.
- (4) Movements of the patient table can be controlled normally.

If the essential performance is lost or degraded due to EM disturbances, dB / dt and SAR might be output in the FIRST CONTROLLED OPERATING MODE.

#### 3.1 Prevention of Electromagnetic Interference

In occasion, a medical device may cause an electromagnetic disturbance or may incur it caused by other devices. EMC criteria prescribe the testing for the incidence of an electromagnetic disturbance or for an electromagnetic wave interference caused by the electromagnetic disturbance.

In the ECHELON Smart, it is constituted from powerful RF transmitter by  $63.86 \pm 0.1$  MHz, a powerful superconductive magnet, and the electronic circuit and computer systems that dislike a noise, the feeble signal from a human body is acquired by  $63.86 \pm 0.1$  MHz, and it displays as a subject image by operating reconfiguration. Since a computer is used for operation and signal processing of a system, interference of the electric wave generated from the source of an electromagnetic interference may be received, and a nearby electric device may be influenced by RF transmitter which is a maximum of 18kW.

Be sure to avoid using a MRI system together with any adjacent device that may be a source of an electromagnetic disturbance.

The source of an electromagnetic disturbance that may cause an electromagnetic interference includes medical devices, communication devices, and radio or television antennas. It is considerably difficult to identify what causes an electromagnetic disturbance. Please make sure to consider the followings when you attempt to identify the factor of an electromagnetic disturbance.

- Is the electromagnetic disturbance occurring intermittently or continuously?
- Of which is the electromagnetic disturbance damaging, image display or device operation?
- Is any electronics not used at a short distance from the devices?
- Is there any antenna for communication or for broadcasting located near the facility?

By checking followings, it will aid you to determine a factor of which causes the electromagnetic disturbance, the system or the environment. Please contact our information desk if none of factor is detected despite that you have checked all written above.

### 3.2 Electromagnetic Emissions

The test is regarding the electromagnetic disturbance generated from equipment under testing. The result of our investigation has proved that this system does not generate any electromagnetic disturbance being against the criteria of electromagnetic disturbance. (Except within the controlled access area)

### 3.3 Electromagnetic Susceptibility (Immunity)

The EMC standards require the system to operate securely in under the existence of electromagnetic interference. Also, the EMC standards define that immunity is a scale to what extent the system can operate without degradation under the existence of the electromagnetic interference. However, the criteria of image quality degradation due to mixing of noises caused by electromagnetic interference are qualitative and thus cannot help but subjective. Also, the criteria for the degree of degradation deterioration are not standardized and differ depending on the manufacture.

This system has been tested for each mode over a wide range of frequencies required by the EMC standards. (Except within the controlled access area)

### 3.4 Test results

The followings are the results of the tests.

#### 3.4-1 Standards

: IEC60601-1-2: 2014
----------------------

#### 3.4-2 The summary of emission testing for compliance

No.	Requirements	Standards
1)	Radiated disturbance	: CISPR11:2009+A1:2010, Group 2, Class A
2)	Conducted disturbance	: CISPR11: 2009+A1:2010, Group 2, Class A

## For service member.

### 3.4-3 The summary of immunity testing for compliance

No.	Requirements	Standards	Levels of requirements
1)	Electrostatic discharge (ESD)	: IEC61000-4-2:2008	±8kV (contact) ±2,4,8,15kV (air)
2)	Radiated RF Electromagnetic Field, Proximity fields from RF wireless communications equipment	: IEC61000-4-3:2006 + A1:2007+A2:2010	80MHz~2.7GHz, 3V/m (1kHz, AM80%)
			385MHz, 27V/m (18Hz, PM50%)
			450MHz, 28V/m (FM±5kHz deviation, 1kHz sine)
			710,745,780MHz, 9V/m (217Hz, PM50%)
			810,870,930MHz, 28V/m (18Hz, PM50%)
			1700, 1845, 1970, 2450MHz, 28V/m (217Hz, PM50%)
			5240, 5500, 5785MHz, 9V/m (217Hz, PM50%)
3)	Electrical fast transient / burst	: IEC61000-4-4:2012	±2kV (for power supply lines) ±1kV (for input/output lines)
4)	Surge	: IEC61000-4-5:2005	±0.5, ±1, ±2kV (common mode) ±0.5, ±1kV (differential mode)
5)	Conducted RF common mode	: IEC61000-4-6:2013	150k~80MHz: 3V (1kHz, AM80%), ISM band: 6V (1kHz, AM80%)
6)	Power frequency magnetic field	: IEC61000-4-8:2009	30A/m, 50Hz
7)	Short interruptions	: IEC61000-4-11:2004	0% UT 250cycles (50Hz)

#### 3.4-4 Precautions

As for MRI system may be influenced by the electromagnetic interference by external apparatus, and a noise may mix it in a image. The doctor should determine whether those noises caused by the electromagnetic disturbance have negative impacts on the quality of its images and diagnosis followed after.

Please use MRI system and receiver coils for the following points carefully. Please do not use the equipment which electric waves, such as a portable phone and a transceiver, generate near MRI system and the receiver coils. Equipment may carry out malfunction by the electric wave which a crisis generates, or an image may be affected.

- Accessories, such as the receiving coils and cables, should use only what suits this system.
- Please do not place except the equipment specified MRI system and near the receiving coil.
- Be sure to use MRI system and receiver coils in a scan room (shield room).
- Be sure to use the conformity apparatus of MRI system in a scan room (shield room).
- Please do not place the receiving coils which are not used in a gantry and on tabletop.
- The EMISSIONS characteristics of this equipment make it suitable for use in industrial areas and hospitals (CISPR 11 class A). If it is used in a residential environment (for which CISPR 11 class B is normally required) this equipment might not offer adequate protection to radio-frequency communication services. The user might need to take mitigation measures, such as relocating or re-orienting the equipment.
- Failure to use this EQUIPMENT in the specified type of shielded location could result in degradation of performance, interference with other equipment or interference with radio services.
- Portable RF communications equipment (including peripherals such as antenna cables and external antennas) should be used no closer 30cm (12inches) to any part of this MRI system, including cables specified by the manufacturer. Otherwise, degradation of the performance of this equipment could result.

### 3.5 Guidance for the environments of electromagnetic emission

MRI system is intended for the use under the environments defined as follows. Any user must use the scanner under the following environments.

Emission Tests	Conformity	Electromagnetic environment - guidance
RF emissions <b>CISPR11</b>	Group 2	This MRI system must emit electromagnetic energy in order to perform its intended function. Nearby electronic equipment may be affected.
RF emissions <b>CISPR11</b>	Class A (This MRI system in combination with the shielded location) (Except within the controlled access area)	The MRI system must be used only in a shielded location with a minimum RF shielding effectiveness and, for each cable that exits the shielded location, a minimum RF filter attenuation of 20MHz to 80MHz, 80dB.
Harmonic emissions <b>IEC61000-3-2</b>	Not applicable	
Voltage fluctuations/flicker emissions <b>IEC61000-3-3</b>	Not applicable	

NOTE: It is essential that the actual RF shielding effectiveness and filter attenuation of the shielded location be verified to ensure that they meet or exceed the specified minimum values.

### 3.6 Guidelines for the environments of electromagnetic immunity


#### 3.6.1 Guidelines for Environments (1)

MRI system is intended for the use under the environments defined as follows. Any user must use the scanner under the following environments.

Immunity test	IEC60601 Test level	Compliance level	Electromagnetic environment - guidance
Electrostatic discharge (ESD) <b>IEC61000-4-2</b>	$\pm 8\text{kV}$ contact $\pm 2,4,8,15\text{kV}$ air	$\pm 8\text{kV}$ contact $\pm 2,4,8,15\text{kV}$ air	It is necessary to prevent the electrostatic charging. Set the environment in accordance with the specifications for the installation based on "SITE PLANNING GUIDE".
Electrical fast transient / burst <b>IEC61000-4-4</b>	$\pm 2\text{kV}$ for power supply lines $\pm 1\text{kV}$ for input/output lines	$\pm 2\text{kV}$ for power supply lines $\pm 1\text{kV}$ for input / output lines (Except within the controlled access area)	The quality of electric source and power needs to be in the electric environment in accordance with "SITE PLANNING GUIDE".
Surge <b>EN61000-4-5</b>	$\pm 0.5, \pm 1\text{kV}$ differential mode $\pm 0.5, \pm 1, \pm 2\text{kV}$ common mode	$\pm 0.5, \pm 1\text{kV}$ differential mode $\pm 0.5, \pm 1, \pm 2\text{kV}$ common mode	The quality of electric source and power needs to be in the electric environment in accordance with "SITE PLANNING GUIDE".
Voltage dips, short interruption and voltage variations on power supply input lines <b>IEC61000-4-11</b>	$<5\% U_T$ ( $>95\%$ dip in $U_T$ ) for 0.5-cycle	Not applicable	The quality of electric source and power needs to be in the electric environment in accordance with "SITE PLANNING GUIDE".
	$40\% U_T$ ( $60\%$ dip in $U_T$ ) for 5-cycles	Not applicable	
	$70\% U_T$ ( $30\%$ dip in $U_T$ ) for 25-cycles	Not applicable	
	$0\% U_T$ 250 cycles (50Hz)r 5-seconds	$0\% U_T$ 250 cycle (50Hz)	
Power frequency magnetic field <b>IEC61000-4-8</b>	30A/m	30A/m (Except within the controlled access area)	It is necessary to prevent the power frequency magnetic field. Set the environment in accordance with the specifications for the installation based on "SITE PLANNING GUIDE".
Remarks : $U_T$ is the a.c. mains voltage prior to application of the test level.			

3.6.2 Guidelines for environments (2)

MRI system is intended for the use under the environments defined as follows. Any user must use the scanner under the following environments.

Immunity test	IEC60601-1-2 Test level	Compliance level	Electromagnetic environment - guidance
<p>Conducted RF <b>EN61000-4-6</b></p> <p>Radiated RF <b>EN61000-4-3</b></p>	<p>3Vrms : 150kHz~80MHz</p> <p>6Vrms : ISM band</p> <p>80MHz~2.7GHz : 3V/m (1kHz, AM80%), 385MHz : 27V/m(18Hz, PM50%), 450MHz : 28V/m(FM±5kHz deviation, 1kHz sine), 710,745,780MHz : 9V/m (217Hz, PM50%), 810,870,930MHz : 28V/m (18Hz, PM50%), 1700,1845,1970,2450MHz : 28V/m (217Hz, PM50%), 5240,5500,5785MHz : 9V/m (217Hz, PM50%)</p>	<p>3Vrms: 150kHz~80MHz</p> <p>6Vrms: ISM band</p> <p>(Except within the controlled access area)</p> <p>80MHz~2.7GHz: 3V/m (1kHz, AM80%), 385MHz : 27V/m (18Hz, PM50%), 450MHz : 28V/m (FM±5kHz deviation,1kHz sine), 710,745,780MHz : 9V/m (217Hz, PM50%), 810,870,930MHz : 28V/m (18Hz, PM50%), 1700,1845,1970,2450MHz : 28V/m (217Hz, PM50%), 5240,5500,5785MHz : 9V/m (217Hz, PM50%)</p> <p>(Except within the controlled access area)</p>	<p>The MRI system must be used only in a shielded location with a minimum RF shielding effectiveness and, for each cable that enters the shielded location, a minimum RF filter attenuation of 20MHz to 80MHz, 80dB. Set the environment in accordance with the specifications for the installation based on “SITE PLANNING GUIDE”.</p> <p>Field strengths outside the shielded location from fixed RF transmitters, as determined by an electromagnetic site survey, should be less than 3V/m(a)</p> <p>Interference may be caused near the devices marked with the symbol below.</p> 
<p>NOTE1: These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, object and people.</p> <p>NOTE2: It is essential that the actual shielding effectiveness and filter attenuation of the shielded location be verified to assure that they meet the minimum specification.</p>			
<p>(a) Field strengths from fixed transmitters, such as base stations for radio (cellular/cordless) telephones and land mobile radios, amateur radio, AM and FM radio broadcast and TV broadcast cannot be predicted theoretically with accuracy. To assess the electromagnetic environment due to fixed RF transmitters, an electromagnetic site survey should be considered. (If the measured field strength outside the shielded location in which the MRI system is used exceeds 3V/m, the MRI system should be observed to verify normal operation. If abnormal performance is observed, additional measured may be necessary, such as relocating the MRI system or using a shielded location with a higher RF shielding effectiveness and filter attenuation.</p>			



## For service member.

### 3.7 Cable List

As for connecting cables to each unit MRI system, please avoid using cables other than the ones listed as follows.

By using cables other than specified, it may increase emissions and worsen its immunity performance, and therefore, may result in the imperfect performance of the function intended.

No.	Cable No.	Cable connection section		Cable Length(M)	Cable Type
		FROM	TO	Maximum	
1	503	SENSE	Gantry	30	NCB-19
2	504	SENSE	Gantry	30	NCB-19
3	505	SENSE	GPA	11	NCB-25
4	506	SENSE	GPA	11	NCB-25
5	501	SENSE	Power Distribution Panel	11	NCB-25
6	502	SENSE	Power Distribution Panel	11	NCB-25
7	509	SENSE	Compressor	20	NCB-12
8	510	SENSE	Compressor	20	NCB-12
9	008	IRCP	BE PC	25	UL1683 6AWG (Y/G)
10	003	IRCP	GPA	10	UL1683 2AWG (Y/G)
11	004	Filter Box	GPA	17	UL1683 2AWG (Y/G)
12	007	IRCP	SENSE	10	UL1015 12AWG Y/G
13	005	IRCP	Filter Box	17	UL1683 2AWG (Y/G)
14	001	IRCP	Power Distribution Panel	10	UL1683 2AWG (Y/G)
15	010	Filter Box	Gantry	17	UL1683 2AWG (Y/G)
16	011	Filter Box	Gantry	17	UL1683 2AWG (Y/G)
17	201	GPA	Filter Box	17	UL44,1685 RHH, RHW-2 2/0AWG
18	202	GPA	Filter Box	17	UL44,1685 RHH, RHW-2 2/0AWG
19	203	GPA	Filter Box	17	UL44,1685 RHH, RHW-2 2/0AWG
20	211	Filter Box	Gantry	17	UL44,1685 RHH, RHW-2 2/0AWG
	212	Filter Box	Gantry	17	UL44,1685 RHH, RHW-2 2/0AWG
21	213	Filter Box	Gantry	17	UL44,1685 RHH, RHW-2 2/0AWG
	214	Filter Box	Gantry	17	UL44,1685 RHH, RHW-2 2/0AWG
22	215	Filter Box	Gantry	17	UL44,1685 RHH, RHW-2 2/0AWG
	216	Filter Box	Gantry	17	UL44,1685 RHH, RHW-2 2/0AWG
23	303	IRCP	Gantry	30	Optical Fiber
24	304	IRCP	Gantry	30	Optical Fiber
25	354	IRCP	Gantry	30	Optical Fiber
26	356	IRCP	Gantry	30	Optical Fiber

## For service member.

No.	Cable No.	Cable connection section		Cable Length(M)	Cable Type
		FROM	TO	Maximum	
27	358	IRCP	Gantry	30	Optical Fiber
28	360	IRCP	Gantry	30	Optical Fiber
29	342	IRCP	Filter Box	18	Optical Fiber
30	322	IRCP	GPA	10	Optical Fiber
31	359	IRCP	Gantry	30	Optical Fiber
32	350	Filter Box	Gantry	18.4	UL CMR/MPR LMR600FR
33	319	IRCP	Filter Box	18.4	UL CMR/MPR LMR600FR
34	315	IRCP	Filter Box	18	UL20276 HM-8C-1
35	316	IRCP	Filter Box	18	UL20276 HM-8C-1
36	351	Filter Box	Gantry	17	UL20276 HM-8C-1
37	352	Filter Box	Gantry	17	UL20276 HM-8C-1
38	161	IRCP	SENSE	10.5	RO-FLEX1100T 3C×18AWG
39	344	IRCP	BE PC	25	UL20276-SB 14PX28AWG
40	321	IRCP	GPA	8	UL2464-SB 4P×22AWG
41	104	IRCP	GPA	9	UL ST-SB 3C×4AWG
42	101	IRCP	Power Distribution Panel	16	UL ST-SB 3C×2AWG
43	133	IRCP	BE PC	25	ST-SB 14AWG×3C
44	110	IRCP	Filter Box	17	UL ST-SB 3×10AWG
45	141	Filter Box	Gantry	20	UL ST-SB 3×18AWG
46	365	Filter Box	Gantry	19	UL2464 SVV-SB 14AWG (TA)X6C
47	143	Filter Box	Gantry	18	UL2464-SB 10AWGX4C LF
48	394	Filter Box	Gantry	18	UL2464-SB 4CX20AWG
49	142	Filter Box	Gantry	18	UL2464-SB 10AWGX4C LF
50	113	IRCP	Filter Box	17	ST-SB 2CX18AWG
51	149	Filter Box	Gantry	25	UL2464 VV-SB 21/0.18TAX4C
52	145	Filter Box	Gantry	25	UL2464-SB 10AWGX4C LF
53	150	Filter Box	Gantry	25	CL3-SB 14X14AWG
54	346	IRCP	BE PC	25	LAN 09474747122
55	320	IRCP	GPA	8	UL2464 22AWGX2P
56	411	GPA	SENSE	15	UL2464 22AWGX2P

**For service member.**

No.	Cable No.	Cable connection section		Cable Length(M)	Cable Type
		FROM	TO	Maximum	
100	151	Compressor	Filter Box	10	-
101	430	Compressor	SVU	25	-
102	176	IRCP	Compressor	20	-
103	152	IRCP	SVU	25	-
104	013	IRCP	SVU	25	-
105	412	SENSE	SVU	25	-
106	334	SVU	Filter Box	25	-
107	335	SVU	Filter Box	25	-
108	507	Compressor	Gantry	20	Gas line
109	508	Compressor	Gantry	20	Gas line
110	155	Filter Box	Gantry	15	-
111	332	Filter Box	Gantry	13	-
112	333	Filter Box	Gantry	13	-