Magnetic Resonance 4522 132 68821



Intera 1.5T Release 2.5 series
Achieva 1.5T / 3.0T / XR Release 2.5
Panorama HFO Release 2.5 series

Technical Description

PHILIPS

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Technical Description

1 Introduction

This document describes technical aspects of Achieva 1.5T and 3.0T, Intera 1.5T and Panorama HFO MRI systems according to the requirements of the IEC standards for MR, 60601-1 and 60601-2-33.

Information in this document is meant for the user of the system and addresses typical system specifications and safety related aspects of the system and installation.

Information in this document shall be used for improving safety in relation to the use of the system and environment.

NOTE ***This Technical Description document is only applicable to systems initially delivered as release 2.5. It is not valid for systems upgraded to Release 2.5.***
For upgraded systems please refer to the Technical Description document that was originally delivered with your system.

1.1 Installation instructions

The installation instructions for Philips MR Systems is supplied by Philips Medical Systems in separate documentation.
The installation must be performed by appropriately trained personnel.

Philips Medical Systems can only accept responsibility for basic safety, reliability and performance, if:

- qualified personnel carry out assembly operations, extensions, readjustments or repairs,
- the electrical installation of the technical room complies with the appropriate requirements, and
- the system is used in accordance with the Instructions for Use.

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WARNING ***This equipment/system may cause radio interference or may disrupt the operation of nearby equipment. It may be necessary to take mitigation measures, such as reorienting or relocating the equipment or system or shielding the location.***

1.2 Equipment classification

EQUIPMENT CLASSIFICATION	
Classification according to IEC-60601-1	
According to the type of protection against electrical shock:	Class I equipment.
According to the degree of protection against harmful ingress of water:	Ordinary equipment (enclosed equipment without protection against ingress of water).
According to the methods of sterilization or disinfection:	Non sterilizable. Use of Liquid surface disinfectants only.
According to the mode of operation:	Continuous operation.

2 Controlled Access Area

It is the responsibility of the operator that the following safety requirements are met.

- During the site planning of a Philips MR system, a controlled access area around the MR system must be defined where the field strength will exceed 0.5 mT (= 5 Gauss). Warning signs "CAUTION Magnetic field permanently switched on" shall be used to indicate this area.
- The controlled access area must be clearly visible, e.g. by markings on the floor, barriers or other means to control access to this area by unauthorized persons.
- All entries to the controlled access area shall be labeled by appropriate warning signs, including an indication of the presence of magnetic fields and their attractive force or torque on ferromagnetic materials.
- Persons having pacemakers, neuro stimulators, insulin pumps or similar devices, implants of Ferromagnetic material, such as surgical clips, artificial cardiac valves, prostheses or metal splinters, must stay outside the controlled access zone.
- Ferromagnetic objects, such as scissors, tools, gas bottles, vacuum cleaners and stretchers, must not be brought into the neighborhood of the magnet and be kept outside the examination room. Such objects will be pulled to the magnet and may cause injury to the patient or staff or damage to the equipment.
- Information on magnetic data carriers such as floppy disks, tapes and credit cards can be erased by the magnetic field. A safe limit is 1 mT (= 10 Gauss).
- The security procedures at all entrances of the examination room shall prevent prohibited objects being brought into the examination room. Metal detection equipment can be used.
- The MR system is provided with a magnet emergency rundown unit with two remote push buttons to terminate the magnetic field. This shall only be used in case of emergency.
- If in a medical emergency instruments must be used, the patient must be removed from the examination room first.

- No liquid helium container may be brought into the magnet area unless it has been ascertained that the container is made of nonferrous material.
- Special nonferrous containers are available from liquid gas suppliers and must be appropriately labeled as nonferrous containers.

3 Compatibility technical specification sheet

Magnet Type

Superconductive, actively shielded. Superconducting B_0 compensation function for correcting field variations induced by moving metal objects in the vicinity of the magnet.

Field Strengths

Achieva / Achieva XR	Intera	Panorama HFO
		• 1.0 T
• 1.5 T	• 1.5 T	
• 3.0 T		

Cryogen Consumption

Fixed site magnets:

- 1.0T --> 0.00 l/h typical
- 1.5T --> 0.03 l/h typical.
- 3.0T --> 0.00 l/h typical
- Achieva XR --> 0.00 l/h typical

Mobile systems:

0.03 l/h - 0.1 l/h typical, depending upon transportation conditions.

Bore dimensions

Intera/achieva: the straight central section of the patient bore is 60 cm long, flaring quickly from a width of 60 cm to 110 cm.

Panorama HFO: the height is 45 cm and the width is 160 cm.

Typical spatial distribution of surrounding field

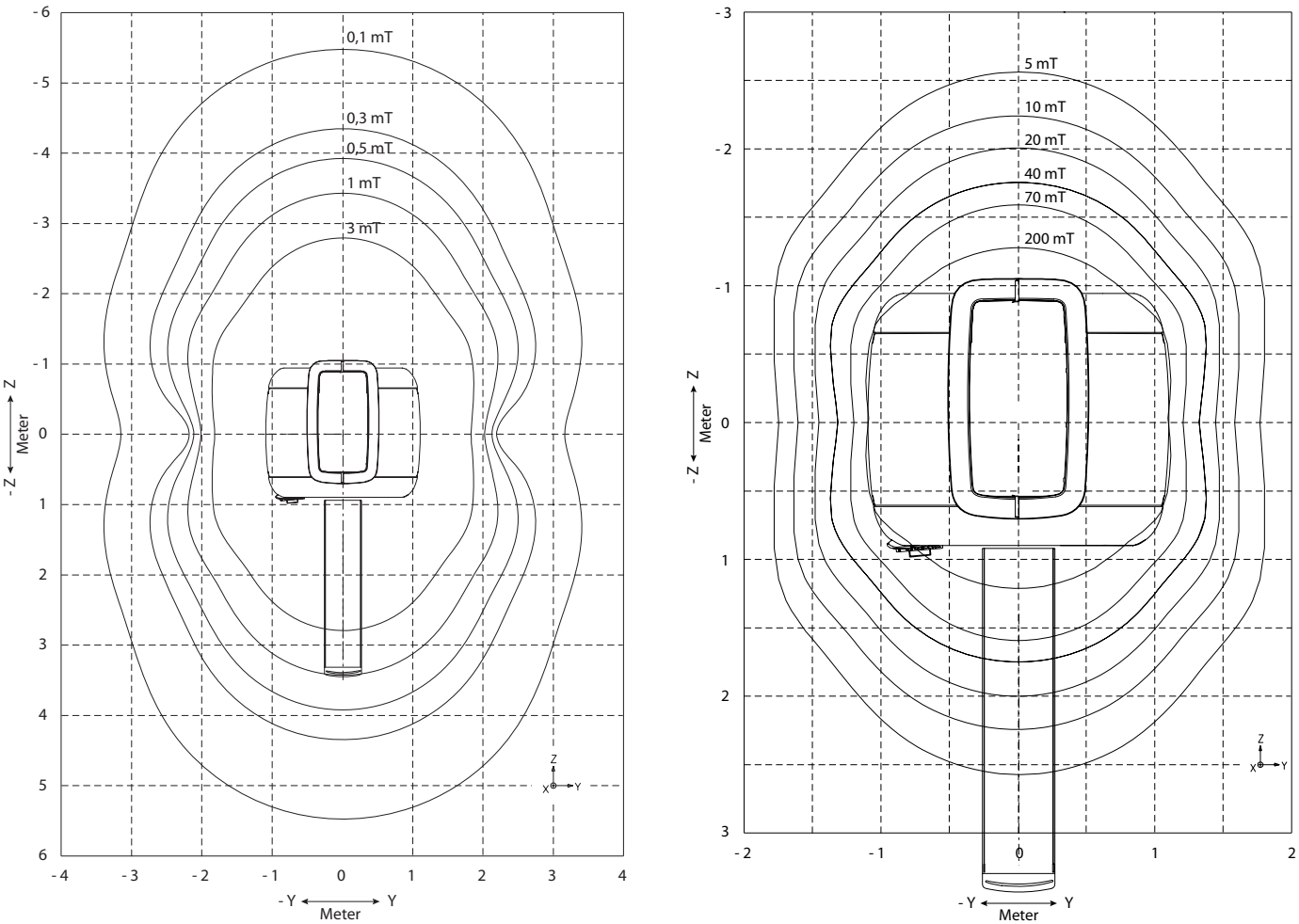


Figure 3.1 Achieva 1.5T and Intera 1.5T, typical spatial distribution of surrounding field (top view)

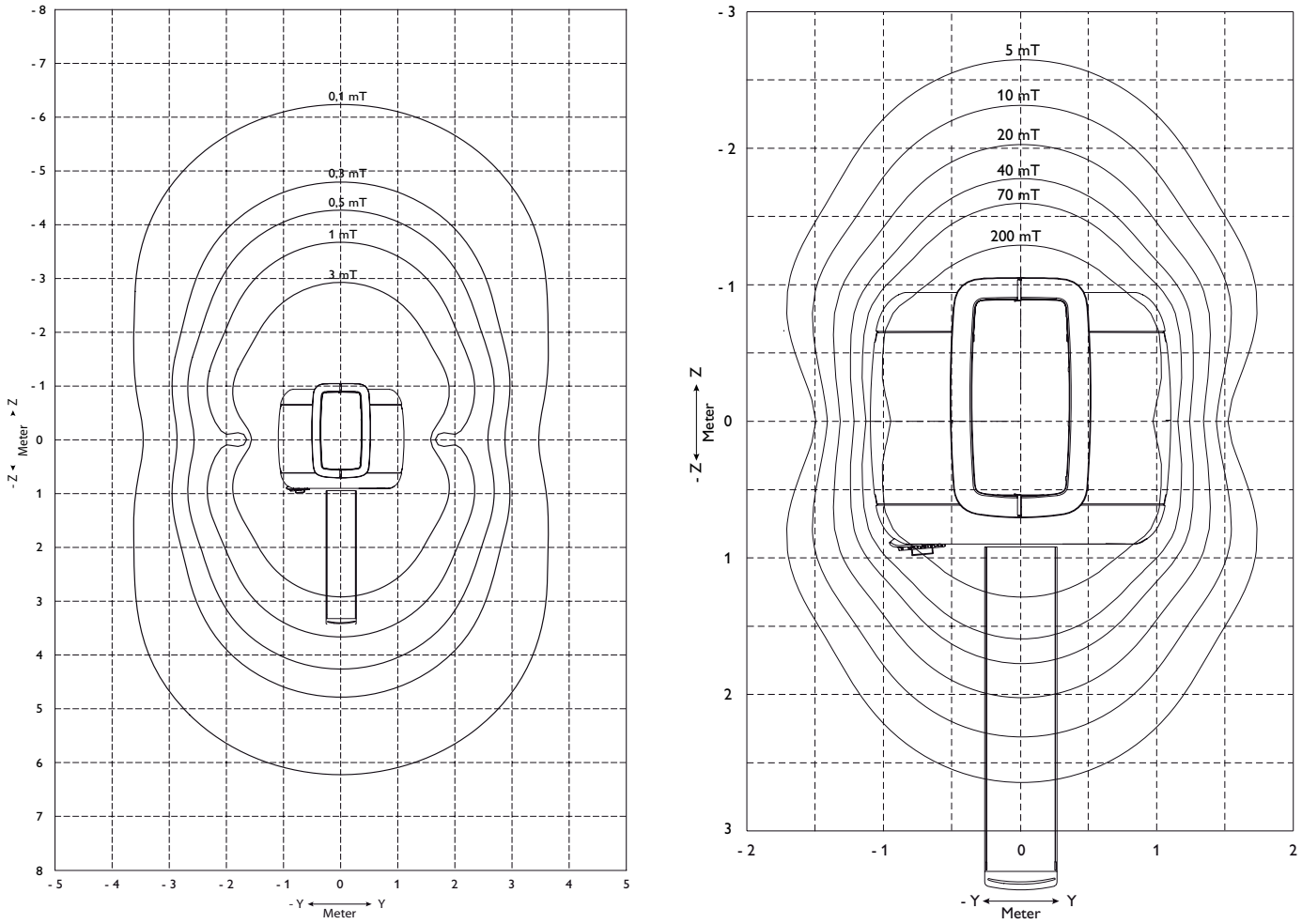


Figure 3.2 Achieva XR at 1.5T, typical spatial distribution of surrounding field (top view)

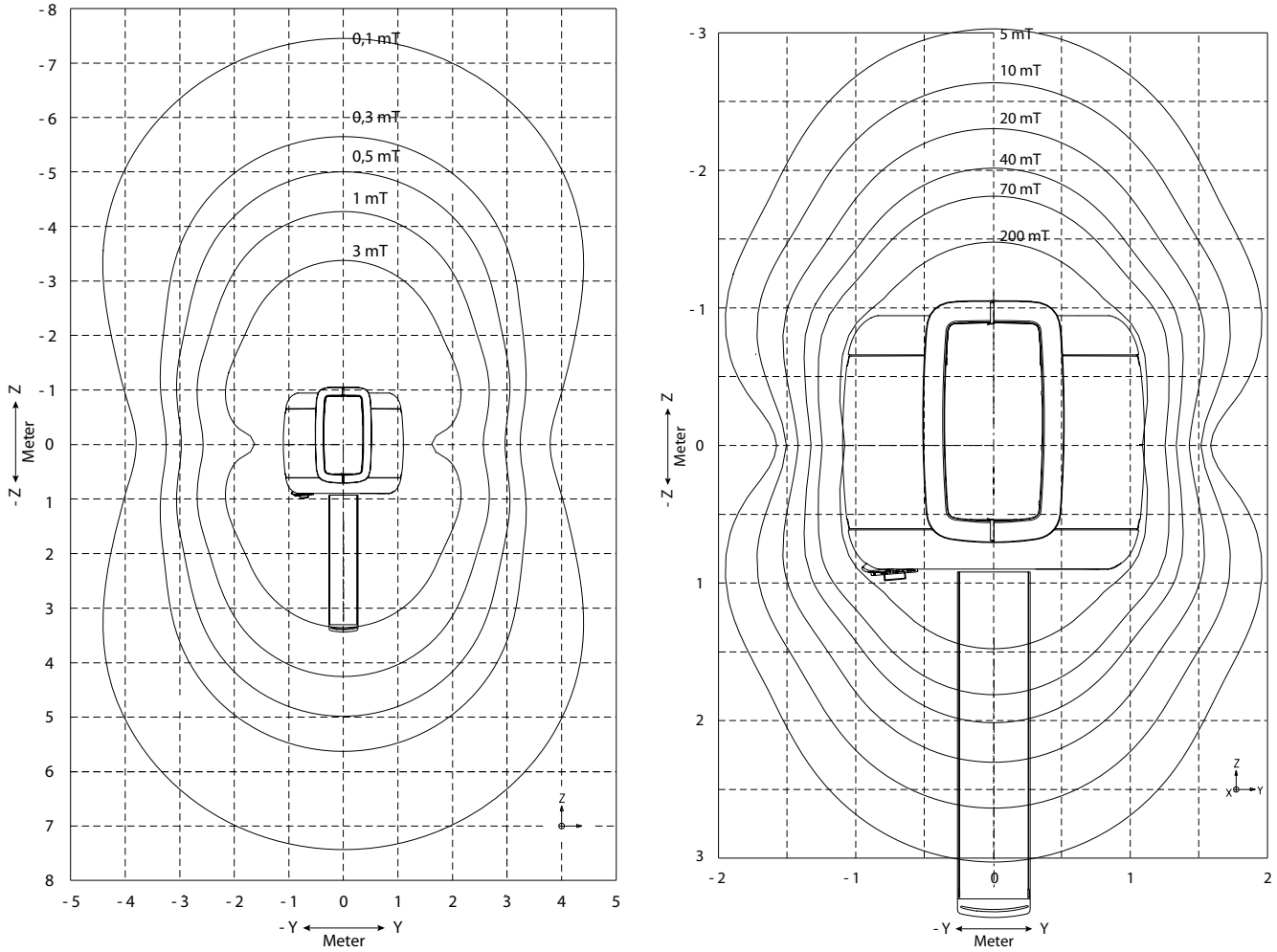


Figure 3.3 Achieva 3.0T and XR at 3.0T, typical spatial distribution of surrounding field (top view)

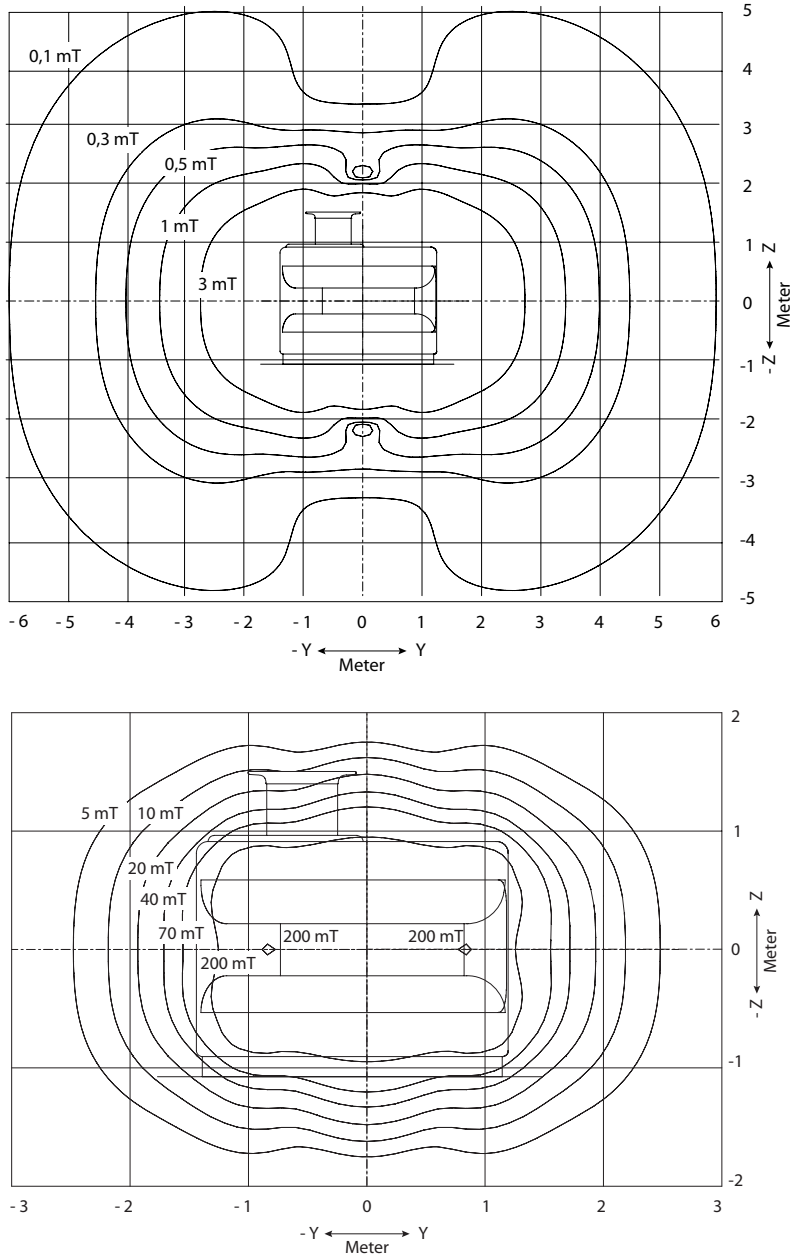
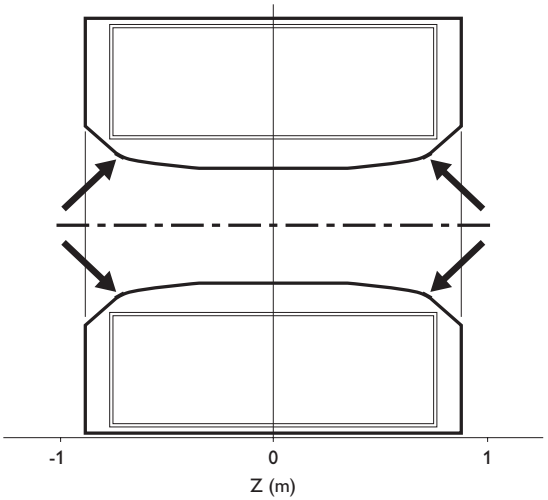
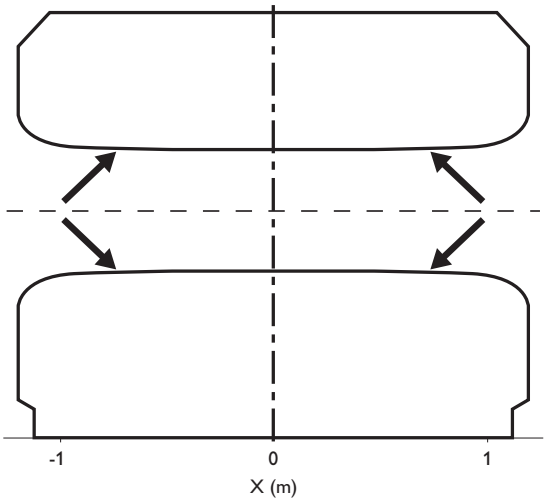


Figure 3.4 Panorama HFO, typical spatial distribution of surrounding field (side view)



Achieva and Intera

Figure 3.5 Achieva and Intera, locations of maximum magnetic field gradient.



Panorama HFO

Figure 3.6 Panorama HFO, locations of maximum magnetic field gradient.

- The position where the spatial gradient of the main magnetic field is a maximum, and the values of B_0 and the spatial gradient of B_0 at that location. At this location the force on a saturated ferromagnetic object resulting from the spatial gradient of the main magnetic field is maximum.
- The position where the product of the magnitude of the magnetic field B_0 and the spatial gradient of B_0 is a maximum and the value of B_0 and the spatial gradient of B_0 at that location. At this location, the force on a diamagnetic or paramagnetic object, or a ferromagnetic material below its magnetic saturation point, is a maximum.

The positions where |grad|B|| and |B|.|grad|B|| are maximum coincide. At that position the following field values apply:			
Achieva and Intera 1.5T	**Achieva XR at 1.5T**	**Achieva 3.0T**	**Panorama HFO**
|B| ≤ 1.7 T	|B| ≤ 1.45 T	|B| ≤ 2.9 T	|B| ≤ 2.0 T
|grad|B|| ≤ 8.0 T/m	|grad|B|| ≤ 8.5 T/m	|grad|B|| ≤ 17 T/m	|grad|B|| ≤ 25 T/m
|B| . |grad|B|| ≤ 12 T^2/m	|B| . |grad|B|| ≤ 12 T^2/m	|B| . |grad|B|| ≤ 48 T^2/m	|B| . |grad|B|| ≤ 50 T^2/m

Gradient Type

For all systems: non-resonant, actively shielded, 100% duty cycle gradients with three fully independent gradient axes for orthogonal, oblique and double-oblique imaging.

The gradient system is a whole body gradient system, following the definition for such a gradient system as given in IEC 60601-2-33.

Gradient Performance

Achieva 3.0T and XR

Gradient System	Amplitude	Maximum Slew rate	Minimum imaging Rise time
Quasar	40mT/m	120 mT/m/ms	0.33 ms
Quasar Dual			
• mode 1	40 mT/m	200 mT/m/ms	0.20 ms
• mode 2	80 mT/m	100 mT/m/ms	0.80 ms

Achieva 1.5T

Gradient System	Amplitude	Maximum Slew rate	Minimum imaging Rise time
Pulsar	33 mT/m	80 mT/m/ms	0.41 ms
Pulsar HP	33 mT/m	100 mT/m/ms	0.33 ms
Nova HP	33 mT/m	180 mT/m/ms	0.18 ms
Nova Dual HP			
• mode 1	33 mT/m	180 mT/m/ms	0.18 ms
• mode 2	66 mT/m	90 mT/m/ms	0.73 ms

Intera 1.5T

Gradient System	Amplitude	Maximum Slew rate	Minimum imaging Rise time
Pulsar	33 mT/m	80 mT/m/ms	0.41 ms
Pulsar HP	33 mT/m	100 mT/m/ms	0.33 ms

Panorama HFO

Gradient System	Amplitude	Maximum Slew rate	Minimum imaging Rise time
Panorama HFO	26 mT/m	80 mT/m/ms	0.33 ms

4 RF system

RF system.

Transmit system characteristics are specified in the table below.

System	Nominal frequency (MHz)	Max frequency offset (kHz)	Amplifier Peak Power (kW)	RF coil type	Max. Transmit Field (uT)
Achieva 3.0T	127.73	415	18 / 25	• Body coil T/R • head coil	13.5 20
Achieva 3.0T Optional P31 RF System	51.705	40	4	• P140 31P coil T/R	70
Achieva XR at 1.5T Achieva 1.5T & Intera 1.5T	63.87	270	18 / 25	• Body coil T/R • head coil	27 45
Panorama HFO	42.58	165	10	• Body coil T/R	16

5 Transmit /receive coils

Quadrature Body Coil

The Quadrature Body coil is a transmit/receive coil for scanning large parts of the body and when large FOV's are required. It is also used for RF excitation in case of imaging with receive-only coils.

Transmit/Receive coils

- Transmit receive head coil 1.5T (Achieva and Intera)
- Transmit receive head coil 3.0T (Achieva only)
- P140 31P transmit receive coil 3.0T (Achieva only)

6 Liquid cryogen and cryogenic gases

A venting system for cryogen gasses is connected to the outside of the examination room and is designed to withstand a quench and to protect near-by persons in the case of a quench. This provision assures that the oxygen concentration in the accessible area remains at acceptable levels during a quench.

Safety with liquid helium and helium gas

Helium gas has the following properties:

- odorless
- nonflammable
- non-poisonous
- on evaporation a cold mist is formed
- lighter than air

A high concentration of helium gas in the examination room can lead to suffocation, as it will dilute the oxygen in the air.
Under normal operating conditions a small amount of helium may evaporate caused by boil-off of the liquid helium in the magnet. It will escape via the helium gas exhaust pipe.

A large amount of helium gas may escape when the magnet emergency stop button is used for immediate shutdown of the magnetic field, or during a spontaneous magnetic field shutdown.

Philips MR systems are equipped with a helium venting system, which ensures that under normal operation and emergency switch-off conditions the escaping helium gas from the magnet is vented outside of the building.

NOTES

- ***Guidelines for the construction (dimension, position, assembly and material to be applied) of the venting system for the superconducting magnet inside and outside the examination room are available from your customer support organization.***
- ***It is recommended to install a preventive maintenance program, which states that regular checks of the adequate function of the venting system for the superconducting magnet are to be made. Full details are available from your customer support organization.***

The design of the examination room must guarantee safety of the patient and other persons inside and outside the examination room in the event of failure of the venting system during a quench.
The design shall address the issues of reducing pressure build-up, temperature decrease and oxygen depletion during a quench. Acceptable solutions of such provisions are:

- Configurations in which the RF door opens outwards or is a sliding RF door. This will enable the door to be opened easily in case of pressure build-up in the examination room.
- Configurations where the RF door opens inwards, if these include extra precautions to prevent PRESSURE build up. This can be realized by one of the following:
  - an extra examination room ventilator system, which can be switched on (possibly automatically via an oxygen monitor in the ceiling of the examination room to detect the escape of helium gas) in case of a QUENCH, or
  - an opening in the wall or ceiling or RF door of the examination room, venting towards an open area, or
  - a possibility of opening the observation window in the examination room outward or by sliding, or
  - a second independent venting system for the superconducting magnet that remains operational in case the regular venting system for the superconductive magnet is obstructed.

NOTES

- ***In the very unlikely event of a failure of the venting system (e.g. venting system is blocked), AND shutdown of the magnetic field, a high concentration of helium gas may penetrate quickly into the examination room, which will be visible as clouds of cold mist.***
- ***If this situation occurs, the patient and personnel must immediately be evacuated from the examination room.***
- ***DO NOT switch off the air conditioning or air circulation in the room (normal procedure in the event of fire), but maintain circulation and replenishment of air to allow the helium gas to dissipate.***

Liquid helium is extremely cold and will cause frostbite when in contact with the human body. Use protective gloves, goggles and clothing when handling liquid helium.

Only properly trained staff shall handle cryogenic liquids such as helium.

Under normal circumstances, always keep the ventilation of the examination room running.

The magnet system has a dedicated venting system, which is to be connected to a helium gas exhaust pipe, leading outside the building. This system prevents escape of helium into the examination room. The helium gas exhaust pipe outside opening shall be located at a non-accessible area. It must be periodically checked that the exhaust pipe is not blocked, dislocated or damaged.

Under no circumstances should the magnet be energized prior to the installation of the helium gas exhaust pipe and the emergency run-down unit.

Monitoring of the oxygen content of the ambient air, may be obligatory under local regulations.

During refill of liquid helium an amount of helium gas will evaporate in the examination room and will dilute the oxygen in the air. For sites with small examination rooms or low ceilings, it is highly recommended to install an oxygen detector with audible alarm, and a remote sensor on top of the magnet. In case of low oxygen level the engineer will be warned. An oxygen detector with audible alarm will be useful as an additional warning instrument in case of an immediate magnetic field shutdown (quench) or failure of the venting system.

NOTE ***Install extra control measures for the patient ventilation system to prevent that the patient is exposed to helium transported by the ventilation system.***

The PATIENT ventilation system shall have its inlet opening at a safe place (i.e. at low level in the examination room or directly connected to the air conditioning of the examination room), or be connected to a QUENCH detector, so that the PATIENT ventilation system can be automatically controlled when a QUENCH occurs preventing helium to be transported to the PATIENT inside the scanner.

Decay characteristics of magnetic field

Decay characteristics of the magnet in case of a quench or of an emergency field shutdown are given to enable the user to implement adequate life supporting and other safety procedures.

In case of an emergency field shut down, the time for the field strength in the centre of the magnet to fall to 10 mT is less than 20 seconds for all systems with the exception of the XR system at 1.5T. On this system the time for the field strength in the centre of the magnet to fall to 10 mT is less than 30 seconds.
The installation manual gives information where and how to install the actuator of the emergency field shut-down unit.

7 Patient environment

The design of the scanner allows easy access to the patient and provides optimal patient visibility for the operator.
The bore dimensions are given in Chapter 3 of this Technical Description.
Variable lighting in the magnet bore contributes to patient comfort, as do the in-bore microphone and ceiling-mounted loudspeakers.
When audio and visual contact to the patient is likely to be limited by the design of the examination room, the patient headset that allows two-way communication with the operator is an important aid to enable audio and visual contact with the PATIENT during the MR EXAMINATION. The audio visual contact shall be sufficient not to hamper the possible need for MEDICAL SUPERVISION of the PATIENT.

The headset, which fully covers the ears, provides stereo music to the patient with minimal disturbance from environmental or MR system acoustic noise.
The connector for the patient headset is located at the patient support unit.
A hand-held nurse call button allows the patient to attract the operator's attention at any time and without talking. The call button is connected to the patient support unit.

The Panorama HFO patient support is equipped with a dockable trolley in order to do patient preparation outside the magnet room. The vertical movement of the patient support is possible in a stand-alone situation.

Tabletop positions can be controlled at the front of the magnet or from the operator's console.

A light visor facilitates patient positioning. A laser light reference cross for patient positioning is available. Head or feet-first patient positioning is possible. There is an automatic calculation of tabletop position adjustment to move the planned slice package to the isocenter in feet head direction for the Achieva and Intera and for both feet-head and left-right direction for the Panorama HFO.

Small adjustments of the tabletop position (up to15 cm) can be controlled by the operator either from the magnet housing or the Operator's Console.

Larger movements can only be performed from the gantry, except in the case of MobiFlex (option) that moves the table over larger distances without operator intervention.

For the Panorama HFO the trolley controls are located at the handle bar of the patient trolley.

Patient Handling Features

Type Removable table top with optional trolley

	Achieva and Intera	Panorama HFO
Weight Capacity	250 kg	250 kg
With Vertical Motion	150 kg	250 kg
Patient Controls on Magnet	Located at front and some controls are duplicated at the magnet rear.	Located on both sides of the tabletop
Coil Connections	Integrated in front patient control.	Integrated in tabletop
Horizontal Drive	Patient control or console operation. Automatic movement of slices to isocentre. MobiTrak/MobiFlex option provides automated multi-station imaging.	Patient control or console operation. Automatic movement of slices to isocentre. MobiTrak/MobiFlex option provides automated multi-station imaging.
Tabletop Travel	215 cm	285 cm
Tabletop acceleration	150 mm/s^2 maximum	150 mm/s^2 maximum
Tabletop Speed	20, 80 and 180 mm/sec	20, 80 and 180 mm/sec
Tabletop Accuracy	± 0.5 mm	± 1.0 mm
Patient Positioning	Laser line marker. table travel to isocenter.	Laser line marker. automatic table travel to isocenter.
Vertical Drive	Electrically powered.	Electrically powered.
Patient Support Height		
• Working Position	89 cm	88 cm
• Minimum Position	52 cm	57 cm
Docking Patient Trolley	Optional mobile tabletop.	Integrated part of the system.

8 Compatibility protocols for third party equipment validation

The MR system contains a set protocols, which can be run routinely on the MR equipment, and enable the manufacturer of peripheral equipment to test the functionality of its equipment. The protocols are designed to run the MR equipment with high transmit RF field or high gradient slew rates and amplitudes so that the manufacturer of peripheral equipment can investigate the influence of the MR equipment on its peripheral equipment. The tests are not intended for estimation of the possible effect of the peripheral equipment on the resulting image quality of the MR equipment and are no guarantee that the peripheral equipment will function properly.

Measurement Configuration

During the evaluation of third party equipment, the equipment has to be set up in the same way as during clinical use of the equipment.

The next set of protocols can be used.

Protocol table

Name	Maximum gradient amplitude	Maximum gradient slew rate	Maximum RF amplitude	Maximum SAR	Remark
MaxGrad	Yes	Yes	No	No	Amplitude and slew rate
MaxB1+SAR	No	No	Yes	Yes	B1 and SAR
MaxGrad+RF	Yes	Yes	Yes	Yes	Gradient and RF

All protocols use the body transmit coil

Scanner info

For each scan the calculated B1 rms [uT] is displayed on the info page. The B1 rms value is defined as the square root of the averaged squared transmit field, whereby the integral over the averaged squared transmit field is taken over an interval equal to the scan repetition time. B1is expressed in uT.

Measurement Procedure

Place a 3-liter bottle vertical on the tabletop and bring the bottle in the isocenter using the travel to scanplane function

The system is to be placed in the scan list scan definition context and a patient has to be created for scanning.

Subsequently select a protocol from the protocol table above:

Protocol selection

1 Press button |Anatomy|
2 Select |12| Phantom studies
3 Select |12| Third Party

9 Electromagnetic compatibility.

The Achieva 1.5T and 3.0T, Intera 1.5T and Panorama 1.0T MRI Magnetic Resonance systems (referred to as system) are designed and in compliance with the IEC 60601-1-2: 2001 electromagnetic emissions and immunity requirements for medical electrical equipment.

The system is classified as:

Group 2 equipment, Class A non-life supporting equipment.

- The system is a large permanently installed system.
- The system uses an intentional transmitter of RF electromagnetic energy for the purpose of its operation.
- The system uses an intentional receiver of RF electromagnetic energy for the purpose of its operation.

For the receive frequency the exclusion band is applicable.

NOTE ***For applicable frequencies see section 4.***

A list of cables in the system is incorporated in the Service documentation supplied with the system.

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WARNING ***The use of accessories, transducers and / or cables other than those specified, with the exception of transducers and / or cables sold by the manufacturer of the system as replacement parts for internal components, may result in increased emissions and / or decreased immunity of the system.***

The system is intended for use in the electromagnetic environment specified on the next pages. The customer or user of the system shall assure that it is used in such an environment.

NOTE ***In order to assure proper functioning of the MR system the site conducted and radiated emissions shall remain within the limits as described in the tables below.***

ELECTROMAGNETIC EMISSIONS		
Emissions test	**Compliance**	**Electromagnetic environment -guidance**
RF emissions CISPR 11	Group 2 Class A	The system must emit electromagnetic energy in order to perform its intended function Nearby electronic equipment may be affected
Harmonic emissions IEC 61000-3-2	Not applicable	Mains power connection is above 16A
Voltage fluctuation/flicker emissions IEC 61000-3-3	Not applicable	Mains power connection is above 16A
		The system is suitable in all establishments other than domestic, and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes
		Interference may occur in the vicinity of equipment marked with the following symbol: 

ELECTROMAGNETIC IMMUNITY			
Immunity tests	**IEC 60601-1-2: 2001 Test level**	**Compliance level**	**Electromagnetic environment -guidance**
Electrostatic discharge (ESD) IEC 61000-4-2	±6kV contact ±8kV air	In compliance In compliance	
Electrical fast transients/bursts IEC 61000-4-4	±2kV for power supply lines ±1kV for input/output lines	In compliance	Mains power quality shall be that of a typical commercial hospital environment
Surge IEC 61000-4-5	±1kV differential mode ±2kV common mode	In compliance In compliance	Mains power quality shall be that of a typical commercial hospital environment
Voltage dips short interruptions and voltage variations on power supply input lines IEC 61000-4-11	<5% U_T (>95% dip in U_T) for 0.5 cycle 40% U_T (60% dip in U_T) for 5 cycles 70% U_T (30% dip in U_T) for 25 cycles 5% U_T (95% dip in U_T) for 5 sec	Not applicable Not applicable Not applicable Not applicable	The system is suitable in all establishments other than domestic, and those directly connected to the public low-voltage power supply network that supplies buildings used for domestic purposes
Power frequency (50/60Hz) magnetic fields IEC 61000-4-8	3 A/m	In compliance	Power frequency magnetic fields shall be at levels characteristic of a typical location in a typical commercial hospital environment

ELECTROMAGNETIC IMMUNITY			
Immunity tests	**IEC 60601-1-2 Test level**	**Compliance level**	**Electromagnetic environment - guidance**
			Portable and mobile RF communications equipment shall not be used closer to any part of the system, including cables, than the recommended separation distance calculated from the equation applicable to the frequency of the transmitter **Recommended separation distance d (m)**
Conducted RF IEC 61000-4-6	3V 150kHz-80MHz	3V	$d = 1.2\sqrt{P}$
Radiated RF IEC 61000-4-3	3V/m 80MHz – 2.5GHz	3V/m	$d = 1.2\sqrt{P}$ 80 MHz-800MHz $d = 2.3\sqrt{P}$ 800 MHz –2.5GHz
			where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer, and d is the recommended separation distance in meter (m). Field strengths from fixed RF transmitters, as determined by an electromagnetic site survey [remark a], should be less than the compliance level in each frequency range [remark b&c].

ELECTROMAGNETIC IMMUNITY			
Immunity tests	**IEC 60601-1-2 Test level**	**Compliance level**	**Electromagnetic environment - guidance**

[Remark 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 may be considered. If the measured field strength in the location in which the system is used exceeds the applicable RF compliance level above, the system must be observed to verify normal operation. If abnormal performance is observed, additional measures may be necessary, such as reorienting, shielding or relocating the system.

[Remark b] Over the frequency range 150 kHz to 80 MHz, field strengths should be less than 3 V/m.

[Remark c] The MR system is a device that intentionally receives RF electromagnetic radiation for the purpose of its operation and is exempt from performance requirements in the exclusion band (frequency of operation) as mentioned in clause 4 of this document. This may include other MR devices nearby the system using the same frequency of operation.

Recommended separation distances between portable and mobile RF communications equipment and the system

The system is intended for use in an electromagnetic environment in which radiated RF disturbances are controlled. The customer or the user of the system can help prevent electromagnetic interference by maintaining a minimum distance between portable and mobile RF communications equipment (transmitters) and the system as recommended below, according to the maximum output power of the communications equipment.

Rated maximum output power of transmitter	**Separation distance according to frequency of transmitter**		
	m		
W	**150 kHz to 80 MHz**	**80 MHz to 800 MHz**	**800 MHz to 2.5 GHz**
	$d = 1.2\sqrt{P}$	$d = 1.2\sqrt{P}$	$d = 2.3\sqrt{P}$
0.01	0.12	0.12	0.23
0.1	0.38	0.38	0.73
1	1.2	1.2	2.3
10	3.8	3.8	7.3
100	12	12	23

For transmitters rated at a maximum output power not listed above, the recommended separation distance d in meter (m) can be estimated using the equation applicable to the frequency of the transmitter, where P is the maximum output power rating of the transmitter in watts (W) according to the transmitter manufacturer.

NOTE 1 At 80 MHz and 800 MHz, the separation distance for the higher frequency range applies.
NOTE 2 These guidelines may not apply in all situations. Electromagnetic propagation is affected by absorption and reflection from structures, objects and people.
NOTE 3 These values are applicable for all frequencies except for the frequencies in the exclusion band as mentioned in the previous table and the Site reference Guide (section 4.5.2).