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MAGNETOM Skyra^fit

Operator Manual – MR System

syngo MR E11

Answers for life.

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syngo MR E11

Legend

	Indicates a hint Provides information on how to avoid operating errors or information emphasizing important details
»	Indicates the solution to a problem Provides troubleshooting information or answers to frequently asked questions
■	Indicates a list item
✓	Indicates a prerequisite A condition that has to be fulfilled before starting a particular operation
◆	Indicates a single-step operation
1 2 3	Indicates steps within operating sequences
Italic	Used for references and for table or figure titles
→	Used to identify a link to related information as well as previous or next steps
Bold	Used to identify window titles, menu items, function names, buttons, and keys, for example, the Save button
Blue	Used to emphasize **particularly** important sections of the text
Courier	Used for on-screen output of the system including code-related elements or commands
Courier	Identifies inputs you need to provide
Menu > Menu Item	Used for the navigation to a certain submenu entry
<variable>	Identifies variables or parameters, for example, within a string
⚠ CAUTION	CAUTION Used with the safety alert symbol, indicates a hazardous situation which, if not avoided, could result in minor or moderate injury or material damage. CAUTION consists of the following elements: ■ Information about the nature of a hazardous situation ■ Consequences of not avoiding a hazardous situation ■ Methods of avoiding a hazardous situation

WARNING

Indicates a hazardous situation which, if not avoided, could result in death or serious injury.

WARNING consists of the following elements:

- Information about the nature of a hazardous situation
- Consequences of not avoiding a hazardous situation
- Methods of avoiding a hazardous situation

WARNING

Legend

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1 Introduction

In order to operate the MR system accurately and safely, the operating personnel must have the necessary expertise as well as knowledge of the complete operator manual. The operator manual must be read carefully prior to using the MR system.

1.1 Layout of the operator manual

Your complete operator manual is split up into several volumes to improve readability. Each of these individual operator manuals covers a specific topic:

- Hardware components (system, coils, etc.)
- Software (measurement, evaluation, etc.)

Another element of the complete operator manual is the information provided for the system owner of the MR system.

The extent of the respective operator manual depends on the system configuration used and may vary.

All components of the complete operator manual may include safety information that needs to be adhered to.

The operator manuals for hardware and software address the authorized user. Basic knowledge in operating PCs and software is a prerequisite.

1.2 The current operator manual

This manual may include descriptions covering standard as well as optional hardware and software. Contact your Siemens Sales Organization with respect to the hardware and software available for your system. The description of an option does not infer a legal requirement to provide it.

The graphics, figures, and medical images used in this operator manual are examples only. The actual display and design of these may be slightly different on your system.

Male and female patients are referred to as “the patient” for the sake of simplicity.

1.3 Intended use

Your MAGNETOM MR system is indicated for use as a magnetic resonance diagnostic device (MRDD) that produces transverse, sagittal, coronal and oblique cross sectional images, spectroscopic images and/or spectra, and that displays the internal structure and/or function of the head, body, or extremities. Other physical parameters derived from the images and/or spectra may also be produced. Depending on the region of interest, contrast agents may be used. These images and/or spectra and the physical parameters derived from the images and/or spectra when interpreted by a trained physician yield information that may assist in diagnosis.

Your MAGNETOM MR system may also be used for imaging during interventional procedures when performed with MR compatible devices such as in-room displays and MR Safe biopsy needles.

The MAGNETOM MR system is not a device with measuring function as defined in the Medical Device Directive (MDD). Quantitative measured values obtained are for informational purposes and cannot be used as the only basis for diagnosis.

For the USA only: Federal law restricts this device to sale, distribution and use by or on the order of a physician.

Your MR system is a medical device for human use only!

1.4 Authorized operating personnel

The MAGNETOM MR system must be operated according to the intended use and only by qualified persons with the necessary knowledge in accordance with country-specific regulations, e.g. physicians, trained radiological technicians or technologists, subsequent to the necessary user training.

This user training must include basics in MR technology as well as safe handling of MR systems. The user must be familiar with potential hazard and safety guidelines the same way the user is familiar with emergency and rescue scenarios. In addition, the user has to have read and understood the contents of the operator manual.

Please contact Siemens Service for more information on available training options and suggested duration and frequency of such training.

1.4.1 Definitions of different persons

Term used	Explanation
User/Operator/ Operating personnel	Person who operates the system or software, takes care of the patient or reads images Typically physicians, trained radiological technicians, or technologists
System owner	Person who is responsible for the MR environment. This includes legal requirements, emergency plans, employee information and qualifications, as well as maintenance/repair.
MR worker	Person who works within the controlled access area or MR environment User/Operator as well as further personnel (for example, cleaning staff, facility manager, service personnel)

Term used	Explanation
Siemens Service/service personnel	Group of specially trained persons who are authorized by Siemens to perform certain maintenance activities References to “Siemens Service” include service personnel authorized by Siemens.

2 Safety

2.1 Preface about safety

2.1.1 Hazards and risks

An MR system may present various hazards. Some occur only during the examination, while others exist permanently and thus are also relevant to non-users (e.g. cleaning personnel).

The various hazards and the corresponding safety instructions are explained in the safety chapter of this operator manual.

2.1.2 Common causes of accidents

Despite safety instructions, some hazards lead to accidents time and again. In particular, this includes magnet accidents and RF burns/loop formation, as well as the use of incompatible devices and the wearing of clothing with electrically conductive materials. A detailed patient screening ensures that the patient is free of metallic objects and clothing with metallic yarns or appliqués.

The following sections provide information on how to avoid the most common mistakes and the resulting safety risks. These sections were prepared based on the long-time experience of Siemens.

2.1.3 Responsibility

Siemens accepts no responsibility for the safety, reliability, and performance of the MR system, if the MR system is not used in accordance with the instructions for use (Operator Manual, System Owner Manual). Siemens is also not responsible for any direct or indirect damages caused by incorrect operation. This includes, but is not limited to, accidents with ferromagnetic objects. This applies even if the consequences only become obvious at a later point in time.

2.1.4 Configuration of hazard hints

All hazard hints are identified in a special way. The following keywords signal the level of hazard involved:

WARNING	Warning regarding risks that may result in death or serious physical injury.
CAUTION	Warning regarding risks that may result in minor physical injury or material damage.

Example:

WARNING

Source of danger!

Consequences

- Countermeasure.

2.2 Common/permanently existing hazards

The frequency at which the potential hazards mentioned in this section lead to accidents is still too high. Therefore, it is especially important to observe the instructions on how to avoid these dangerous situations.

The most significant hazards include:

- Electromagnetic fields
- Contraindications
- Mechanical hazards
- Incompatible devices

2.2.1 Electromagnetic fields

In the examination room, there are different kinds of electromagnetic fields and the resulting risks.

Fields	Most serious hazards
Static magnetic field	Movement by implants and prostheses in the body Attraction, alignment, and projectile-like acceleration of magnetizable objects (→ Page 18 *Safety instructions on the static magnetic field*)
Gradient fields	Peripheral nerve stimulation (→ Page 20 *Safety instructions on RF and gradient fields*)
RF fields	Warming of body tissue (→ Page 20 *Safety instructions on RF and gradient fields*)

All persons (e.g. patients, physicians, operating and cleaning personnel, accompanying persons, and rescue personnel/fire fighters) are exposed to these fields in the examination room. Therefore, all limits and safety measures regarding electromagnetic fields equally apply to patients and MR workers.

- Observe prohibition signs in the area near the entrances to the MR system and the controlled access area.

Static magnetic field/controlled access area

The static basic field is generated by a superconductive magnet and may extend beyond the examination room (walls, ceilings).

In order to minimize the hazards mentioned, the controlled access area of the basic field is identified on the floor (0.5 mT line). Outside the controlled access area, the magnetic flux density is less than 0.5 mT. See: **System owner manual**

Gradient fields

Linearly rising additional fields of variable strength - gradient fields - are superimposed on the static main magnetic field in three different orientations. They may cause shifts in charge in the patient's tissue and lead to peripheral nerve stimulation.

RF fields

The nuclear spins of the body tissue are stimulated via pulsed electromagnetic RF fields. These RF pulses are generated by an RF transmit amplifier and transferred via RF coils to the object to be measured.

RF fields lead to warming of the body tissue. In this context, an important value per body weight is the specific absorption rate or SAR. (→ Page 108 *Physiological effects*)

Side effects Possible undesirable side effects for MR are dizziness, heating, claustrophobia and nerve stimulation.

2.2.2 Safety instructions on the static magnetic field

The list of objects in this chapter is not exhaustive. It only serves as an illustration of objects that present hazards in the presence of magnetic forces.

- Only use equipment specified or recommended for use in the controlled access area.

WARNING

Movement and/or alignment of implants and prostheses in the body, as well as attraction, alignment, and projectile-like acceleration of magnetizable objects may result in very serious hazards!

Injury to patient and operating personnel

- Do not use resuscitation devices - for example, defibrillators or oxygen bottles - in the examination room.
- Do not use transport trolleys, movable beds, stretchers, etc. that consist of magnetizable parts.
- Do not wear or carry any magnetizable objects on your person - for example, watches, pens, scissors, etc..
- Use only proven MR Safe or MR Conditional accessories, parts subject to wear and tear, and disposable articles with the MR system.
- Use only MR Safe or MR Conditional tools and devices.
- Service work on the MR system may only be performed by Siemens Service.
- Ensure that only authorized personnel enter the controlled access area (0.5 mT exclusion zone), for example, electricians or cleaning personnel trained in MR safety.
- Keep the door to the examination room closed.

WARNING

Magnetizable objects introduced into the magnetic field become projectiles!

Injury to patient and operating personnel

- Inform the operating personnel about the effect of forces on ferromagnetic parts or implants, especially on systems with a higher field strength (for example, 3T). Explain that the forces increase with the field strength of the magnet!

For China only: In 3-T systems medical supervision is required for all patients according to IEC 60601-2-33 (2nd edition).

Dizziness during exposure

When persons (e.g. MR workers or patients) are exposed to the static magnetic field, possible effects are dizziness, light-headedness, or metallic taste, especially in 3-Tesla magnetic fields.

1 Ask the patient to lie still during the measurement.

2 Keep a sufficient distance to the magnet and avoid rapid movements of the head.

⚠ CAUTION

Dizziness, light-headedness or metallic taste in the patient's mouth during measurements and/or table movements in a 3-Tesla magnetic field!

Reaction of fear by the patient

- Prior to the examination, inform the patient about the possible occurrence of these symptoms.

Device malfunctions

Magnetic flux densities exceeding 0.5 mT can interfere with electronic implants or other devices. The main magnetic field may either affect or destroy electronic data carriers such as check or credit cards, hard disks, ID cards with magnetic strips and/or magnetic tapes, diskettes or pocket calculators, as well as RFID chips (Radio Frequency Identification).

2.2.3 Safety instructions on RF and gradient fields

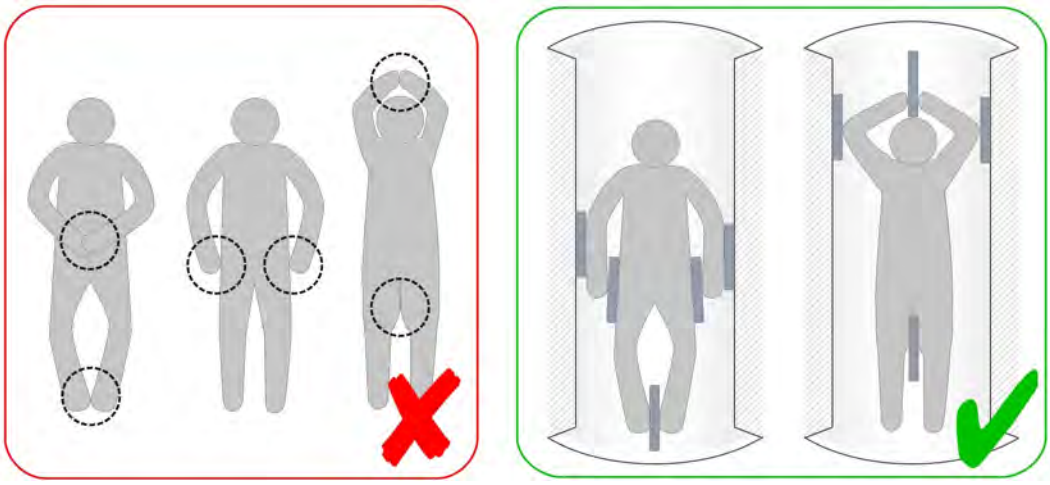
Patients at risk

- Do not examine patients unable to communicate potential overheating effects (e.g. small children, seriously ill, paralyzed, unconscious, sedated, or handicapped patients).

Current loops and bore wall contact

Dangerous current loops may be generated when parts of the patient's body touch. These loops may lead to burns or increase the probability of stimulation.

Current loops are also generated when the patient's skin contacts the tunnel lining or RF coil cables.



Ensure to prevent potential current loops as shown in the red labeled illustration.

Ensure the patient is positioned with proper distance (5 mm) to magnet tunnel as well as proper distance between parts of the body as shown in the green labeled illustration.

- To lower the effects of gradient fields or RF fields, keep a sufficient distance from the RF coils and the magnet tunnel (gradient coils), and reduce the time of exposure during measurements.

CAUTION

The patient is wearing electrically conductive material! Incorrect patient positioning!

Formation of electric current loops

Peripheral nerve stimulation of the patient

- Ensure that the patient does not wear clothing that is wet or dampened by perspiration.
- Ensure that the patient is free of metallic rings, chains, or electrically conductive materials worked into items of clothing (for example, brassiere support wires, metallic appliqués or woven metallic yarns).
- Always position the patient so that the patient's arms are aligned with the torso and ensure that hands, arms, and legs do not touch (minimum distance: 5 mm).
- Ensure that the minimum distance of 5 mm is maintained between patient and tunnel covering.
- To ensure this distance, use positioning aids, e.g. blankets made of linen, cotton, or paper, or dry material that is permeable to air.
- Ensure sufficient ventilation.

CAUTION

Heating up/ignition of synthetic blankets via the RF field during the measurement!

Patient burns

- Use only covers made of paper, cotton or linen.

CAUTION

Heating up of RF blankets or shields used to avoid aliasing artifacts!

Patient burns

- Never use RF blankets or other conductive sheets within the MR system.

2.2.4 Contraindications

This chapter contains very important information about MR safety: In principle, a qualified physician must evaluate the risk/benefit ratio of the MR examination for every patient.

To date, there is no scientific proof that MR examinations are harmless for pregnant women, the unborn (embryos or fetuses) and children under two years of age.

In general, an MR examination is contraindicated for patients with electronic or electronically conductive implants or metals, especially those containing ferromagnetic foreign matter.

Typical contraindications for MR examinations are:

- Electronic implants: e.g. pacemakers, stimulators, insulin pumps
- Artificial heart valves, aneurysm clips
- Metal splinters in the eye (danger of retinal detachment)
- Artificial anus (anus praeter) with magnetic closure
- Transdermal drug patches with metallic backings
- Electrically conductive implants and prostheses
- Metallic spirals for contraception (IUDs = Intrauterine Devices)
- Transdermal or other similar implants (for example, body piercings as well as magnetic piercings)

⚠ WARNING

Electronic and/or electrically conductive implants and magnetizable inclusions in static and low-frequency magnetic fields and RF fields!

Risk of patient death/patient injury

- Ask the patient about implants and inclusions.
- Do not perform MR examinations on patients with electronic or electrically conductive implants and magnetizable inclusions.
- Ensure that patients wearing such implants and/or inclusions remain outside the exclusion zone (0.5 mT line).

Exceptions: Certain implantable medical devices have been cleared, approved and/or licensed by the Competent Governmental Authorities and/or labeled by the device manufacturer as “MR Conditional”. For such implantable medical devices, the previously mentioned list of general contraindications and the warning may not be applicable in its entirety.

It is the responsibility of the device manufacturer to declare an implantable medical device as MR Conditional if appropriate and to define the conditions (constraints) for safe MR scanning. The MR operator must be aware of any such conditions for MR scanning. It is the obligation of the MR operator to assure that these conditions are strictly adhered to. To obtain these specific conditions the MR operator may refer to the labeling of the implantable medical device or contact the device manufacturer. Siemens MR does not assume responsibility or liability for the operation of the MR system with any implantable medical device. Especially, Siemens MR is not responsible for controlling technical parameters of the MR system other than those defined by the normal operating mode, the first level controlled operating mode and the data provided in the system owner manual, such as spatial gradient field plots.

⚠ CAUTION

Eddy currents induced by low-frequency magnetic fields!

Patient burns

- Do not examine patients with electrically conducting implants or prostheses.

⚠ CAUTION

Electrically conducting objects!

Injury to patient due to warming

Incorrect diagnosis due to artifacts

- Request that the patient removes all electrically conducting objects, e.g. necklaces, rings, braces, rubber bands for long hair, piercings as well as jewelry.
- Request that the patient removes all clothing including electrically conducting material, for example, bras, metallic appliqués or woven metallic yarns.
- Inform patients that eyeliners and tattoos may contain ingredients causing artifacts or skin irritations during MR examinations. In some cases, patients have been burned.
- To prevent injuries, instruct patients to remove makeup prior to the examination.
- Instruct patients to seek medical attention in case of discomfort during or following the MR examination.

2.2.5 Mechanical hazards

Collision and points of injury

Collisions and injuries are more prevalent when using the exchangeable tabletop, the patient table or when performing maintenance activities.

- Observe the warning and prohibition signs as well as the safety information.

CAUTION

Accidental patient table movement!

Injury to the patient

- If you plan an intervention outside the magnet, activate the **Table Lock** function at the Dot display with the control unit to avoid accidental patient table movement, or injury to the patient. After completing the intervention, the table can be unlocked.

WARNING

Cover of the table lifting column is defective; access to moving parts is possible!

Risk of severe contusion during vertical movement

- Complete the current examination and then shut down the system.
- Notify Siemens Service.

CAUTION

Vertical and horizontal movement of the patient table!

Injury to patient and other persons

Damage to the patient table

- Ensure that there are no obstacles (e.g. extending or overhanging body parts, hair, clothing, straps) between table and the magnet, or that the additional equipment (e.g. IV tube, respirator or ECG) does not get caught and remains in and on the patient when moving the tabletop.
- Secure the patient's arms and legs with straps so that the patient is not caught between the tabletop and the magnet cover. Remain in the MR examination room with helpless patients (e.g. children and patients who are either seriously ill, paralyzed, unconscious, sedated, handicapped or medicated), even if the patients are secured during the examination.
- Ensure that the sensor for height detection is not obstructed by clothing, sheets, or accessories, etc.
- Keep the patient under visual or acoustic control.
- In case of hazardous conditions, press the **Table Stop** button.
- Explain the significance of protocol-controlled table movements to the patient.

WARNING

Improper patient transport with the dockable patient table, improper use of the side rails!

Injury to the patient

Damage to the patient table

- Carefully transport the patient on the dockable patient table. Secure the patient if necessary.
- Do not pull/push the tabletop or use the emergency release to avoid any unintended horizontal movement.
- Use the side rails as intended (as an arm rest or in the vertical position e.g. for securing the patient). Always make sure that the side rails are completely engaged after moving them and consider possible pinching parts on the side rails.
- Fold the side rails down to move the tabletop.

Risk of stumbling

The risk of stumbling is related in particular to the unfavorable routing of cables/hoses of interventional components.

CAUTION

Cable/hoses of interventional components!

Injury to patient and operating personnel

- Route cables/hoses of interventional components so that it is not possible to trip over them.

2.2.6 Compatibility

Combinations with other systems, accessories

Among other things, the following hazards or complications may occur through the use of third-party products during MR examinations:

- Heating of system cables or connection cables
- Interference with MR image quality
- Malfunctioning of third-party products

Auxiliary equipment, which has not been specifically tested and approved for use in the environment of the MR equipment, may result in burns or other injuries to the patient.

If the MR system is combined with other systems or components, it must be ensured that the planned combination and cable routing do not affect the safety of patients, personnel, or the environment.

Ensure that the devices used in the examination room are compatible with the field strength of the MR system. For example, devices compatible with 1.5 T systems may be unsuitable for 3 T systems, and vice versa. See also MR Conditional: (→ Page 29 *Labeling*)

- Contact Siemens Service prior to combining the MR system with other devices.

Interferences

Peripheral equipment (e.g. patient monitoring, life support or emergency care equipment) which is not specified or recommended for use in the MRI environment, including the controlled access area, may be disturbed by the RF field or the magnetic fringe field of the MR system. This equipment may also disturb the proper function of the MR system.

Labeling

ASTM International developed a new classification system for implants and ancillary clinical devices. The following definitions apply:

MR Safe 	An item that poses no known hazards in all MR environments. MR Safe items include nonconducting, nonmagnetic items such as a plastic petri dish. An item may be determined to be MR Safe by providing a scientifically based rationale rather than test data.

MR Conditional 	An item that has been demonstrated to pose no known hazards in a specified MR environment with specified conditions of use. Field conditions that define the specified MR environment include field strength, spatial gradient, dB/dt (time rate of change of the magnetic field), RF fields, and SAR. Additional conditions, including specific configurations of the item, may be required. MR Conditional devices (for example, RF communications equipment) may present hazards as well. Observe the manufacturer's operator manual to avoid potential hazards and injuries.
MR Unsafe 	An item that is known to pose hazards in all MR environments. MR Unsafe items include magnetic items such as a pair of ferromagnetic scissors.

Technical data Detailed information on B_0 values, gradient and RF data, as well as graphic representations of the spatial distributions are included in the MR compatibility data sheet. See: **System Owner Manual**

2.3 What else must be observed?

2.3.1 Ambient conditions

As the ambient conditions and SAR have a considerable effect on the patient's body temperature, you must regularly check the ambient conditions.

Regulating the room temperature The patient's ability to dissipate surplus heat is increasingly affected as the room temperature and relative humidity increase.

- Ensure that the room temperature is at or below 22°C and the relative humidity does not exceed 60%.

2.3.2 Access to the examination room

Free access to and exit from the examination room must be ensured at all times.

1 Regularly check the correct functioning of the door to the examination room.

2 Ensure that the door to the examination room opens and closes correctly.

2.3.3 Noise development

By switching the currents in the gradient coils for imaging purposes, the mechanical forces lead to noise development (humming, knocking noises) during the MR examination which can exceed 99 dB(A) in the bore.

⚠ CAUTION

Noise development during the MR examination!

Injury to patient and people in the examination room (hearing impairment)

- Provide the patient with appropriate hearing protection that lowers noise to at least 99 dB(A).
- Mandatory provide anesthetized or unconscious patients with hearing protection. Ear protection for these patients should not be omitted even at moderate sound levels.
- Ensure that personnel and accompanying persons in the examination room wear hearing protection during the examination that lowers noise to at least 85 dB(A).

- For required level of hearing protection, see: **System Owner Manual, Technical data: Hearing protection data**. All hearing protection devices must provide the required level of sound attenuation.

Adequate attenuation levels can be achieved by using, for example, ear plugs. Ear plugs offering sufficient hearing protection can be found in the Siemens Accessories catalog.

The standard Siemens headphones are intended for communication with the patient and can be used in combination with ear plugs.

- For appropriate sound attenuation, the proper use of hearing protection is important. All personnel should be trained to correctly apply the hearing protection.
- Special attention and training of the operator is required for proper positioning of the hearing protection for neonates and infants. In addition this applies to any other condition where an alternative form of hearing protection might be necessary.
- For MR examinations of infants special hearing protection may be required.
- Due to increased anxiety the permissible sound pressure level may be a reason for concern for pregnant women and their unborn, for newborns, infants and small children as well as older persons.

2.3.4 Patient care

Patient information

Patients must be informed about the hazards and safety measures during MR examinations. Before doing so, it must be confirmed that an MR examination is permissible and/or checked if increased precautions are necessary.

⚠ CAUTION

Patient received insufficient clarification of facts!

Injury to patient

- Explain to the patient the conduct expected and possible risks involved.
- Inform the patient about the monitoring and communication equipment e.g. squeeze ball, intercom.
- Instruct the patient regarding possible heat development during the MR examination.
- Inform the patient about noise developing during the MR examination.
- Prior to the MR examination, instruct patients of possible stimulations during the examination i.e. twitching muscles, tingling sensation.

Patient monitoring

Patients may be acoustically as well as visually and physiologically monitored in the MR system.

- The viewing window or a video system is used for visual monitoring.
- The intercom can be used to acoustically contact the patient. (→ Page 74 *Description*)
- Medical supervision: MR Conditional monitoring devices are used to monitor the patient's vital parameters, provided the conditions for safe operation are observed.

Medical supervision means adequate medical management of patients who can be at risk from some parameters of exposure to the MR equipment, either because of the medical condition of the patient, the levels of exposure or a combination.

All patients should receive at least routine monitoring. For some (e.g. sedated, physically unstable) patients, monitoring of the vital parameters is mandatory. In the First Level Controlled Operating Mode medical supervision is also mandatory.

⚠ CAUTION

Incompatible monitoring devices!

Patient burns

- Use only monitoring devices, for example, ECG electrodes and pulse sensor, that meet the conditions for safe use (MR Safe or MR Conditional).

2.3.5 Artifacts and imaging errors

Due to their magnetizability, foreign objects in the area of the magnet bore cause strong local distortions of the basic field and lead to considerable image artifacts. Depending on the level of distortion, diagnosis may be difficult, impaired or completely impossible.

Causes: Artifacts and imaging errors are listed according to their source for error:

- System-related artifacts/imaging errors
- Patient-related artifacts/imaging errors
- User-related artifacts/imaging errors, see: **Software operator manual**

User-related and patient-related artifacts/imaging errors can be largely avoided through patient instructions and proper conduct of patient and personnel.

System-related artifacts/ imaging errors

The MR image may show system-related artifacts/imaging errors despite careful preparation.

- If the same artifact/imaging error appears repeatedly, document and submit it to Siemens Service.

Stripe artifacts

CAUTION

RF-signal interference caused by incompatible accessories e.g. patient monitoring devices!

Streaks and bright spots in the MR image

- Use only accessories tested and approved for the MR system.
- Keep the door to the examination room closed.
- Vary the bandwidth of the MR sequence.
- Whenever possible, use local coils for the MR examination.

Incorrect slice positioning

CAUTION

Phasing of MR signal is not set correctly!

Structure is shown in the wrong position

- Repeat the measurement for the structure in question by using a second orthogonal slice and check whether the position of the structure is reproducible nor not.

Variations in brightness

CAUTION

Local variation in the sensitivity of local coils!

Continuous fluctuations in MR image brightness

- Whenever possible, use a local coil with transmit characteristics that are more suitable for the field of view desired.
- Use the normalization filter.

CAUTION

Static and/or stationary brightness errors on the LCD monitor due to aging!

Incorrect diagnosis

- Scroll through the images to ensure that the MR image does not show differences in brightness, spots, or cloudiness and check bright objects for afterglow.
- Keep your eyes always in central monitor position with a vertical view angle towards the screen surface for best image quality.

Variations in signal and contrast

CAUTION

Inhomogeneous RF field!

Asymmetry of contrast in the MR image

- Whenever possible, use a local coil with transmit characteristics that are more suitable for the desired field of view.

Distortions/signal obliteration along the edges

CAUTION

Spatial non-linearity of the gradient field and inhomogeneity of the static magnetic field!

Pin-cushion and barrel-shaped distortions and/or loss of signal in the margins of the MR image

- Go through a distortion correction.
- Position the region to be examined as close to the magnet isocenter as possible.
- Use phantoms for the control measurements.

Localization errors due to distortion

CAUTION

Incorrect localization data due to spatial non-linearity of the gradient field and inhomogeneity of the static magnetic field!

Incorrect stereotactic planning or breast biopsy

- Take localization errors into account while planning stereotactic interventions or breast biopsies.

Potato chip artifact

CAUTION

Distorted slice edges in the margin due to spatial non-linearity of the gradient field and inhomogeneity of the static magnetic field!

Incorrect stereotactic planning

- When planning stereotactic interventions, take into account slice distortion at the margins of the MR image. This applies in particular to graphic slice positioning (GSP) as well as other graphic slice displays and slice positioning data independent of the possible use of distortion correction.

DIXON swapping

WARNING

When using the DIXON method, water and fat swaps might occur!

Incorrect diagnosis

- Diagnosis should be confirmed by a second contrast and/or a different orientation.

Patient-related artifacts/ imaging errors

CAUTION

Poor image quality! Wrong image position!

Incorrect diagnosis

- Prior to the examination, inform patients about movements and their negative effects on the measurement.
- Ensure that the patient does not move during the measurement.
- Monitor the patient during the MR examination.

CAUTION

Imprecise localization due to patient movement during functional MR imaging (fMRI)!

Incorrect stereotactic planning and injury of the patient

Incorrect assignment of active brain areas

- Prior to the examination, inform patients about movements and their negative effects on the measurement.
- Use Siemens scan protocols with motion correction.
- Monitor the patient to ensure that the task is performed correctly.

2.3.6 Maintenance/repair

WARNING

High voltage and currents inside the electronics cabinets!

Risk of death by electrocution

- Electronics cabinets should only be opened by Siemens Service.

Daily checks

Windows, doors, and emergency flaps must not be blocked.

Safety-relevant accessories

The following safety-relevant accessories should be checked:

- All RF coils for the transmitting and receiving system
- ECG and respiratory sensor
- Disposable electrodes
- Pulse sensor

Maintenance

For detailed information about maintenance of the MR system, see: **System owner manual**

Serious malfunctions

In case of serious malfunctions, shut down the MR system immediately and notify Siemens Service.

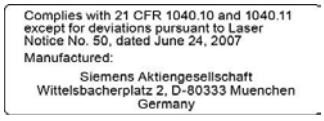
2.3.7 Signs and symbols

Warning signs

 Magnetic field	 RF field	 Observe operator manual

 Potential injury to persons	 Risk of injury	 Laser radiation
 Risk of breaking	 Maximum load side rails	

Laser

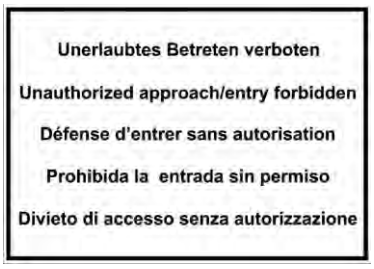


Laser (for the US only)

Refilling with liquid nitrogen and helium

Prohibition signs The following objects are prohibited in the examination room:

 Implants susceptible to electromagnetic effects	 Open flames, no smoking	 Metallic implants and other metallic objects inside the body	 Mechanical watches and electronic data carriers
 Fire extinguishers with magnetizable metal housing	 Metal parts, e.g. tools	 Electronic data carriers	



Unauthorized access

Implants susceptible to electromagnetic effects

Further symbols

 Sign requiring mandatory hearing protection	 Non-ionizing radiation

 Protective class symbol B for application parts	 Protective class symbol BF for application parts

2.3.8 System owner-related advices

Some safety instructions address the system owner. They are included as "Safety information" in a separate operator manual, see: **System owner manual**. This manual also contains the technical description of the system.

2.3.9 Coils/quality assurance

Safety instructions covering the intended use of coils and measurement phantoms are included in a separate operator manual. See: **Coil operator manual**.

2.4 In case of emergency

1 Before working with the system, familiarize yourself with the location and functionality of the emergency switches installed.

2 Report all accidents resulting in personal injury immediately to the appropriate authorities.

3 Observe the established emergency plans (e.g. emergency plan in case of coolant accidents, emergency plan for fire fighting).

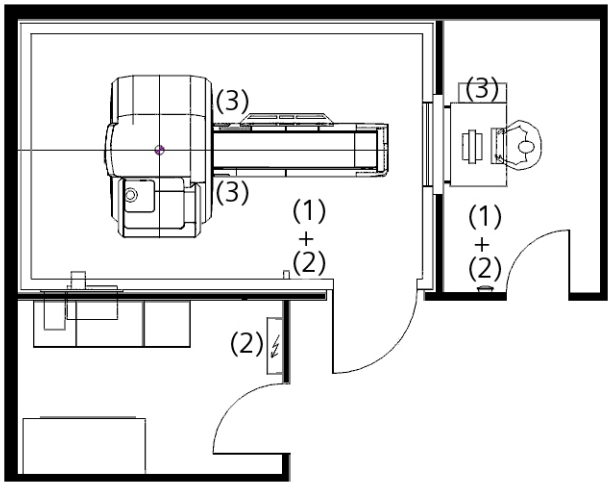
2.4.1 Emergency switches

The MR system has different types of emergency switches.

Switch	Effect	Emergency
Magnet Stop	Shutting down the static magnetic field (quenching)	E.g. in case of accidents with attracted metal parts or in case of fire

Switch	Effect	Emergency
Emergency Shut-down	Electric power of the entire MR system is switched off, but magnet remains at field	E.g. in case of fire
Table Stop	Motorized table movement is stopped	In case of accidents or injury due to table movement

In case of emergency, the relevant switch should be pressed.



(1) **Magnet Stop** switch

(2) **Emergency Shut-down** switch

(3) **Table Stop** button

Magnet Stop switch

The **Magnet Stop** switch triggers a controlled magnet quench (shutting down the magnetic field). The MR system is not disconnected from the power.

There are two different versions of the **Magnet Stop** switch on the MR system: as an individual switch or as an integral part of the alarm box. The switches may also be installed in other places of the MR system.

After the **Magnet Stop** switch has been pressed, an alarm is triggered at the alarm box. The **WARNING** LED will light up and an alarm signal will sound.

As a rule, Siemens Service must be called following a quench. The magnet must only be put back into operation by Siemens Service personnel.

WARNING

Formation of droplets due to condensation during quenching!

Personal injury

Risk of fire

- Do not touch the exhaust line.
- Do not stand under the exhaust line.
- Avoid open flames and do not smoke.

WARNING

System indicates **Magnet Stop** error!

Hazardous conditions because the magnet cannot be quenched in case of emergency

- Immediately remove the patient from the magnet.
- Restrict the access to the examination room.
- Notify Siemens Service.

Emergency Shut-down switch

Typically there are two **Emergency Shut-down** switches installed: one near the alarmbox and another one in the examination room. The switch is used to switch off the electric power of the entire MR system.

WARNING

Fire or electrical accidents!

Personal injury

- Press the **Emergency Shut-down** switch immediately.
- Contact your fire department.

Table Stop button

It is located on the intercom and on the patient table.

2.4.2 Medical emergency

WARNING

Medical emergency during MR measurements!

Risk of death to patients

- Terminate the measurement immediately.
- Remove patients from the examination room for treatment unless it is certain that the medical equipment required is appropriate for use inside an MR room.
- Do not store or operate oxygen bottles, defibrillators, or other auxiliary tools for resuscitation in the examination room.

⚠ CAUTION

Squeeze bulb is defective!

Risk of injury to patient because emergencies cannot be communicated

- Check the functionality of the squeeze bulb daily.

2.4.3 Coolant accidents

First aid in case of shortness of breath

During a quench, a person might become unconscious due to severe shortness of breath:

1. Remove unconscious persons immediately from the examination room.
2. Start adequate first aid measures and contact a physician immediately.

First aid in case of frostbite

Direct contact with subzero liquids, gases, and surfaces (e.g. pipes) may lead to frostbite. The eyes and mucous membranes are especially vulnerable.

⚠ CAUTION

Improper handling of liquid helium!

Skin damage caused by frostbite

- Do not rub frostbitten skin areas.

1. Remove clothing carefully from the locations involved.
2. Rinse frostbitten skin with lukewarm water.
3. Cover frostbitten skin with sterile bandages.
4. Do not apply powder or creams.
5. Contact a physician immediately.

2.4.4 Fire/Fire fighting

The following devices/materials may be used for fire fighting:

- Non-magnetic CO_2 extinguisher
- Self-contained, anti-magnetic compressed-air breathing apparatus (or hose connection)
- Airtight chemical protective suit

3 MR system components

3.1 Overview MR system

3.1.1 About function

A detailed specification of the systems hardware and software is available in the **Info** dialog box (main menu **Help > Info**).

3.1.2 Super-conducting magnet

Magnetic field

The super-conducting magnet generates a strong homogeneous magnetic field with a field strength of 3 T.

Cooling system

The magnet is filled with liquid helium as a coolant. Following installation, it is adjusted to the desired operating field strength. The ramped-up magnet does not require additional electric power to maintain the magnetic field. Under normal operating conditions, there is no helium boil-off.

Shielding

To minimize the effects of the magnetic fringe field on the environment, the magnet of the MR system is equipped with active super-conducting shielding.

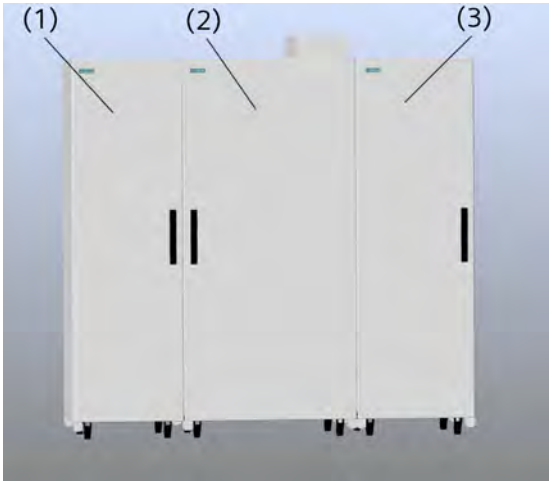
Gradient system

The gradient system provides precise localizing slice positions.

For details on the gradient system, please refer to the **System owner manual**.

3.1.3 Electronics cabinets

The electronics cabinets are located in the engineering room or the operating room.



(1) Gradient cabinet

(2) Control cabinet

(3) System separator

Gradient cabinet

The gradient cabinet contains the power electronics for generating the magnetic field gradients.

Control cabinet

The control cabinet includes different electronics components to operate the MR system.

The control cabinet includes a sequence-programmable, optical trigger signal output which can be made externally accessible by Siemens Service via installation of a fiber optic cable.

Please note that Siemens provides customers with the optical trigger signal output for research purposes only. No devices connected to this output have been tested by Siemens. Before connecting devices to the MR suite using the optical trigger signal output, they must be tested for safety by trained personnel.

Before using devices in the proximity of the magnet, their non-magnetic properties and clinical operation in the magnetic field have to be confirmed.

The use of devices connected to the optical trigger signal output has to comply with any applicable governmental or local hospital Institutional Review Boards (IRBS).

Siemens will not be held responsible for the use of any device and resulting consequences in connection with the optical trigger signal output.

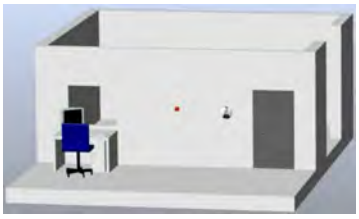
System separator

The system separator contains electronics components and cooling-equipment to deliver an adequate cooling power for the system. If a special cooling system (chiller) is installed, the system separator is not necessary.

3.1.4 RF coils

The description, handling and quality measurements for RF coils are included in a separate operator manual. See: **Coil operator manual**

3.2 *syngo* Acquisition Workplace



The workplace in the control room is known as *syngo* Acquisition Workplace (*syngo* Acq WP). It includes the host processor with the operating elements monitor, keyboard, and mouse.

An additional component of the *syngo* Acquisition Workplace is the intercom. (→ Page 74 *Description*)

3.2.1 Host

Among other things, the host processor includes the following functions:

- Patient management
- Image selection and storage
- Measurement sequence management

Measured MR images may be transferred to other systems or computers via the network connection (e.g. PACS or RIS systems). MR images from other systems or computers can be received via the network as well.

Information about network connections is displayed in the **Info...** dialog window.

3.2.2 Data recording

The MR system provides the following modules for data recording:

- CD/DVD burner
- DVD drive

An interface (e.g. USB connection) for a paper printer is also available.

The burn and read process is started via the software. See: **Software operator manual**

Data carrier

Only CD-Rs/DVD-Rs (Recordable) labeled “Medical Grade” and having a gold-colored layer are suitable for documenting data for medical purposes. Siemens Service will provide you with CD-Rs/DVD-Rs.

Please take into account the handling, care, storage of CDs/DVDs and CD-Rs/DVD-Rs as specified by the respective manufacturers.

3.2.3 Monitor

The monitor is used for displaying MR images as well as user dialogs. It is switched on or off as part of the overall MR system.

All other adjustments are blocked since the monitor is already optimally configured by Siemens Service.

Do not touch the surface of the screen using sharp, pointed objects.

Do not position containers holding fluids, e.g. cups or glasses, on top of the monitor.

In addition, general cleaning instructions must be observed.

The monitor may only be opened by authorized Siemens Service personnel.

3.2.4 Keyboard

The *syngo* Acquisition Workplace is equipped with an original Siemens keyboard. This keyboard is a modified Windows keyboard where the numeric keys have been replaced with symbol keys.

The symbol keys are used to access frequently used functions. The **F4**, **F5**, **F6**, **F7**, and **F8** function keys enable you to access the individual task cards. The **F1** function key lets you access the Online help.

Function	Original Siemens key	Windows key
Increase/decrease image brightness (set window position)		**NUM / /**
Increase/decrease contrast (set the window width)		***** / **-**
Automatically set contrast and brightness		**9**
Page forth/back in the examination		**8** / **7**

Function	Original Siemens key	Windows key
Page forth/back in the series		**5 / 4**
Page forth/back image by image		**2 / 1**
Open patient registration		**Ins**
Selecting the Patient Browser		**Del**
Copy to film sheet		**Enter**
Highlight		**3**
Send to node 1		**+**

If the computer system is connected to a clinic-wide processor network (HIS/RIS), use the **Examination** task card to send images to other network addresses via node 1.

3.2.5 Mouse

The system is equipped with a wheel mouse.

- Left mouse button:
  - Selecting or moving objects
  - Starting applications
  - Executing commands
- Center mouse button/wheel:
  - Changing the window values of patient images
  - Scrolling (for example, through the Patient list)
- Right mouse button:
  - Opening the context menu (depending on the position of the mouse pointer)

3.2.6 *syngo* MR Workplace (optional)

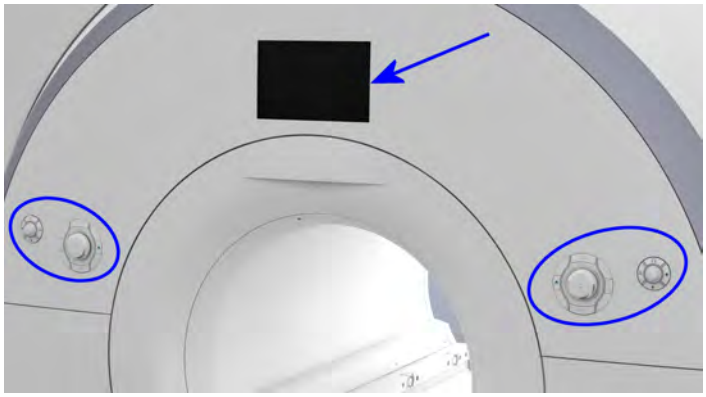
The *syngo* MR Workplace allows for evaluation, documentation and post-processing of previously measured images while acquiring images at the *syngo* Acquisition Workplace. It accesses the database of the host processor.

It is not possible to perform measurements at the *syngo* MR Workplace. It is not connected to the MR scanner or the image reconstruction system.

3.3 System control

3.3.1 Description

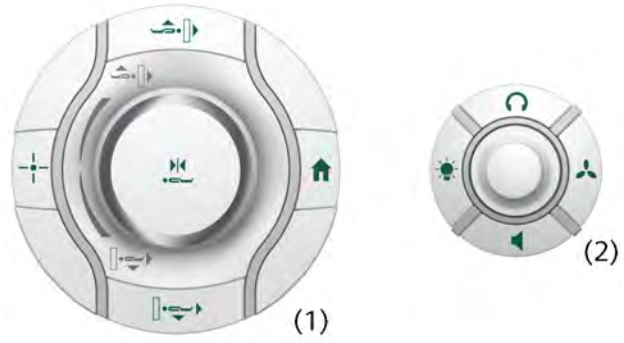
The system control is used to operate the system and the patient table. It comprises control units and the Dot display.



Control units

The control units are located at the right and the left side of the patient table at the front of the magnet cover. Optionally, additional control units are located at the back of the magnet.

Each control unit consists of a jogwheel and several additional buttons.



(1) Control unit for positioning the table

(2) Control unit for menu navigation and for adjusting settings for patient comfort

(→ Page 59 *Operating the patient table*)

(→ Page 57 *Operating the Dot display*)

(→ Page 105 *Preparing the MR system*)

For better user guidance, the jogwheels and buttons are backlit.

Depending on the situation, the small jogwheel can have different functions:

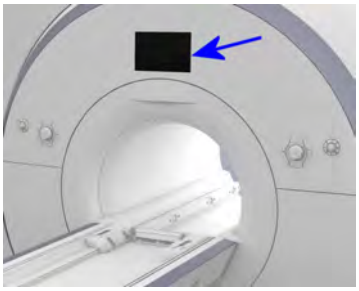
- Rotate: e.g. for navigating through the display menu or for changing settings of, for example, ventilation
- Push: e.g. for resetting the patient alert or for starting a measurement

Alternatively, use the intercom to reset the patient alert or to change the volume settings of the headphones and loudspeakers.

The optional control units at the back of the magnet additionally comprise a **Table Stop** button.

Dot display

The Dot (Day Optimized Throughput) display provides status information as well as several tools.



The display is located above the magnet bore opening at the front of the magnet cover. Optionally, at the back of the magnet, a second display can be installed for the additional control unit.

Information service

The display shows several pieces of information:

- Information concerning patient positioning (e.g. patient orientation, current table position, auto-positioning)
- Information about the connected coils

- Guidance for attaching ECG electrodes, docking the table and emergency evacuation
- General patient information submitted from the software
- Information concerning troubleshooting

Tool bar You can navigate between the depicted icons by using the small jogwheel. The selected icon is highlighted.

	Confirm patient data Displays the patient data of the registered patient
	Table overview Displays the current table position as well as the patient orientation
	Physio data Displays the physiological data of the patient
 	Table lock/Table unlock Activates/Deactivates the table lock function for interventional examination (toggle icon)
	Start Starts a prepared measurement, during the measurements, the display will be shut off
	Info Displays further information (e.g. undocking of the dockable patient table)
	Close patient comfort Confirms the patient comfort settings

3.3.2 Operating the Dot display

To operate the Dot display, use the jogwheel of the smaller control unit. (→ Page 54 *Control units*)

1 Turn the jogwheel to navigate through the icons.

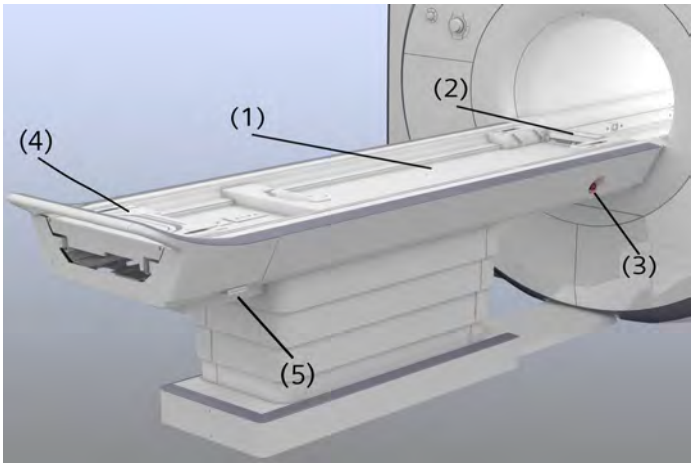
2 Press the jogwheel to confirm the selection.

3 If necessary, adjust your settings by turning and pressing the jogwheel.

3.4 Patient table

3.4.1 Description

The patient table is used for positioning the patient and the coils. The table comprises several sockets and connections.



(1) Tabletop

(2) Head end

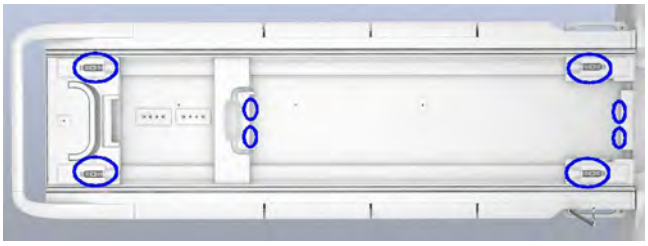
(3) **Table Stop** button

(4) Handle to pull out the table top in case of emergency

(5) Emergency release

The tabletop can be moved horizontally into the magnet bore. When moved completely out of the magnet, the tabletop may be moved vertically as well.

Coil sockets

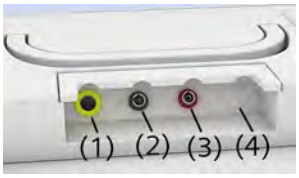


The coil sockets are located at the head end and the foot end of the patient table. For more information concerning the occupation of the coil sockets, see: **Coil operator manual**

Make sure that no liquids such as contrast medium, blood, or cleaning agents get into the table connections.

Connections

The following connections are located at the foot end of the patient table:



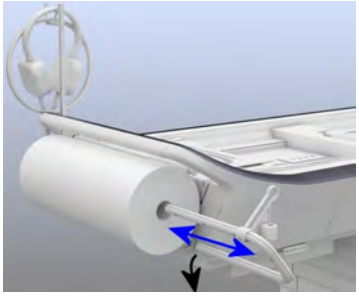
(1) Headphones

(2) Vacuum cushion

(3) Squeeze bulb

(4) Placeholder [Intended for future use]

Paper roll holder

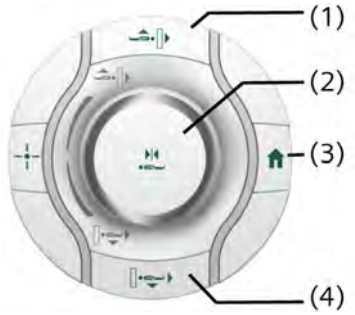


The paper roll holder can be mounted at the foot end of the table below the handle. It includes a holder to reposit the headphones and can be removed if required. To replace the paper roll (disposable), you need to detach the headphone holder. If you remove the stick on the paper roll, you can pull out the right mounting bracket. Then you can replace the roll and let the bracket again lock into place.

3.4.2 Operating the patient table

The patient table can be controlled via the movement buttons and the jogwheel on the larger control unit. (→ Page 54 *Control units*)

Please note that this section only describes the operation of the patient table. For details on positioning the patient, see: **Operator Manual Coils**



(1) **Table Up/Inward** button

(2) Jogwheel, **Center Position** button

(3) **Home Position** button

(4) **Table Down/Outward** button

To operate the patient table safely and efficiently, operating personnel must be familiar with its most important positions.

Home Position	Table is at the height of moving into the magnet bore, tabletop is moved completely out of the magnet
Last Scan Position	If the tabletop was moved only in the horizontal direction, the tabletop can be returned into the position of the last measurement
Default Position	The center of the Head/Neck 20 is in the magnet isocenter
Center Position	The body region to be measured is in the magnet isocenter
Relative Position	Distance between the slice marked with the light localizer and the magnet isocenter

For interventional examinations, a table lock function is available via the Dot display. (→ Page 55 *Dot display*)

For some measurements, the tabletop is moved automatically.

Using the jogwheel

1 Keep the jogwheel turned to move the patient table up/into or down/out of the magnet bore.

Depending on how far the jogwheel is turned, the speed increases. The table movement stops immediately once you release the jogwheel.

2 Press the jogwheel for one second to move the patient table into the *Center Position*.

Depending on the situation, you can also move the table horizontally into the *Last Scan Position* or the *Default Position* by pressing this jogwheel.

Pressing the jogwheel during an automatic table movement (e.g., to the *Home Position*) stops the table immediately. Turning the jogwheel in this case adjusts the speed and movement direction according to the jogwheel position.

Using the buttons

- Press the corresponding button to move the patient table into the required position.

The **Table Up/Inward** and the **Table Down/Outward** button can be pressed in two stages for horizontal movements. Pressing the button softly moves the table slowly. Pressing the button forcefully moves the table more quickly.

Pressing one of these buttons during an automatic table movement (e.g., to the *Home Position*) stops the table immediately.

Stopping table movement

1 Press the **Table Stop** button to stop the table movement.

2 To reset the table stop, turn the **Table Stop** button clockwise until it releases mechanically. Then simultaneously press the **Table Up/Inward** and the **Table Down/Outward** button fully.

Rescuing the patient in an emergency

In case of accidents, e.g. patient emergency situation (e.g. heart attack), the tabletop and patient must be moved out of the magnet bore.

The fastest method for moving the tabletop out of the magnet bore is to press the **Home Position** button. Select this method whenever the power supply and/or motorized drive are intact.

1 Press the **Home Position** button.

The tabletop moves completely out of the magnet.

2 Rescue the patient.

Rescuing the patient manually

In case of power failure and/or defective motorized drive, pull the tabletop manually out of the magnet bore.

WARNING

Patient rescue during emergency situations, e.g. quench with failing quench pipe, fire with strong smoke development, emergency situation involving patient (e.g. heart attack) and simultaneous power failure!

Personal injury

- After releasing the emergency release, pull the tabletop with the patient manually out of the magnet.

1 Pull the Emergency release (location is indicated by a label) outward up to the end stop.

The MR measurement is terminated and the table loses the referenced position.

2 Turn up the pull-out handle and pull the tabletop out of the magnet.

3 Rescue the patient.

Resetting the Emergency release

✓ The error regarding the power supply and/or the motorized drive has been removed.

1 Press the Emergency release back into its original position while shifting the tabletop slightly in any direction until it audibly locks into position.

2 To reset the table, simultaneously press the **Table Up/Inward** button and the **Table Down/Outward** button fully.

3 Press the **Home Position** button.

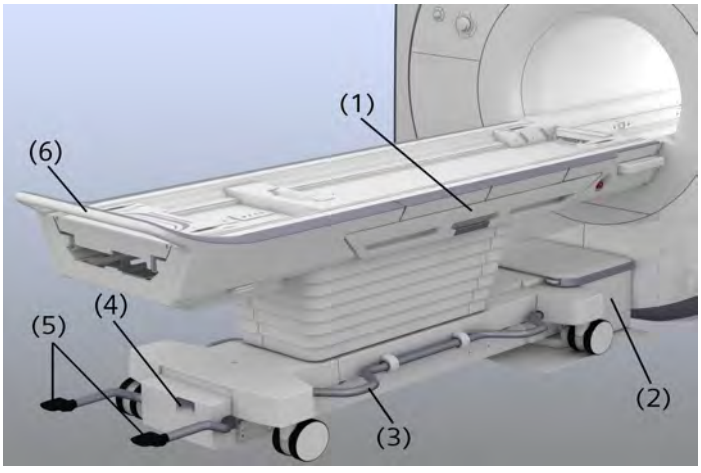
After reaching the Home Position, the patient table is ready for operation again.

3.5 Dockable patient table

3.5.1 Description

The dockable patient table is an optional table that can be completely removed from the magnet system. This enables the transport of immobile patients.

The configuration of the dockable patient table is similar to the standard table. This section only mentions the differences. For the standard patient table, please refer to: (→ Page 57 *Description*)



(1) Side rails

(2) Docking station

(3) Lateral pedal

(4) Emergency undocking handle

(5) Pedals

(6) Handle at the foot end

Pedals If the table is removed from the system, you can use the pedals to lift and lower the table manually.

Side rails The side rails can be folded out to secure patients during transport, or as a arm rest for patients with infusions.

Guiding wheel For better maneuverability, a fifth wheel is positioned in the middle, underneath the dockable patient table. This fifth wheel functions as center of rotation - the table can rotate around this center.

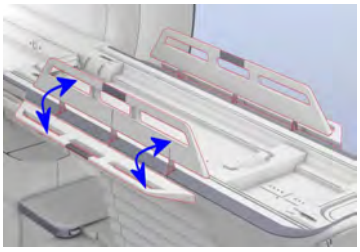
Identification label

The label at the foot end of the dockable table indicates that your table can only be operated on the 1.5 T system or the 3 T system, respectively.

3.5.2 Operating the dockable patient table

To avoid injuries during vertical table movement, a safety shut-down is available at the carriage of the dockable patient table and a safety switch is available at the docking station. If the table is docked, table movement stops automatically if obstacles constrict vertical table movement.

Undock the table only if the tabletop is in the *Home* position.



- Position the side rails as required: e.g. in a vertical position to secure the patient, or in a horizontal position as arm supports.

Undocking the table

✓ The tabletop is in *Home Position*.

✓ Brake for the castors is released.

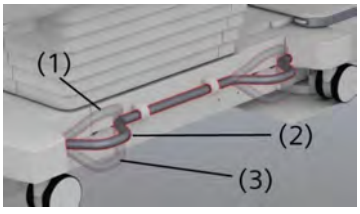
- Step completely on the left pedal to undock the table.

  The table is removed from the system and can be moved in any direction.

Moving the dockable patient table

You can use the side rails to steer the table.

The guiding wheel (5th wheel underneath the table) allows for better directional stability and easier steering.



(1) Guiding wheel is lifted/deactivated

(2) Guiding wheel is lowered/activated

(3) Table is braked

1 For turning the table in place, navigating in curves and moving the table straight ahead, set the lateral pedal to the middle position (2) to lower/activate the guiding wheel.

2 For moving the patient table laterally, lift the lateral pedal (position 1) to lift/deactivate the guiding wheel.

3 Lower the pedal to the lowest position (3) to brake the table.

CAUTION

Dockable patient table may move against the wall or the door!

Possible injuries (for example, squashed fingers)

- To move the table, always grasp the middle area of the handle (not the outside edges).

4 Move the table with the handle at the foot end of the table.

If the dockable patient table is not in use, make sure not to move it to the back of the magnet.

Docking the table

✓ Guiding wheel is activated.

✓ Side rails are lowered.

CAUTION

Points of injury during docking of the table!

Damage to the system, injury to the patient

- Ensure that the patient's hair, parts of the body, or items of clothing do not get caught between the table and the system.

1 Use the table's momentum (to save strength) and move the table into the docking station.

2 Position the table so that the docking nose is positioned in the docking station and the table is positioned at the end stop of the docking station.

The display shows if the table is positioned correctly and completely in the docking station.

3 Check the display if the table is ready for docking. If the table is not ready for docking, reposition the table in the docking nose.

4 Press the right pedal down fully with your foot to lock the table to the MR system - in doubt press the pedal twice.

5 Wait for the table to get ready after docking.

The “Wait” message at the display disappears and the tabletop moves into the reference position.

Do not undock the table again, before the tabletop is in the reference position.

Table cannot be docked to the system?

- Position the table again so that the docking nose is positioned correctly and completely in the docking station. Try again to press the right pedal.

Troubleshooting: Problems during docking

Pedal cannot be pressed
Check that the tabletop is completely in *Home* position and the emergency undocking handle is not activated/pulled (reset with left pedal).

Control units flash
Make sure that the **Table Stop** buttons are not pressed (at the table and at the intercom) and that the intercom is powered on.

Table cannot be lowered
Remove any weight from the docking station and the table carriage cover.

Table moves downwards despite you want to lift the table

In certain cases (for example, after docking), the table must find the reference position and moves slightly down. This is normal behavior.

Table does not move horizontally

Check that the side rails are fully stored in the carrying frame - otherwise no table movement is possible.

Troubleshooting: Problems during undocking

Pedal cannot be pressed and the table is not pushed away from the MR System

Set the lateral pedal to the middle position to deactivate the brake and make sure that the tabletop is completely in *Home* position.

Undocking in case of emergency

If undocking via the pedals does not work, the table can be undocked by using the emergency undocking handle at the foot end (between the pedals).

WARNING

Wrong tabletop position for emergency undocking!

Uncontrolled table movement, tabletop crashes

- Use the emergency undocking handle only when the tabletop is in the outermost position (**Home** position).

✓ Tabletop is in *Home* position.

✓ Brake for the castors is released.

◆ Pull the emergency undocking handle to undock table.

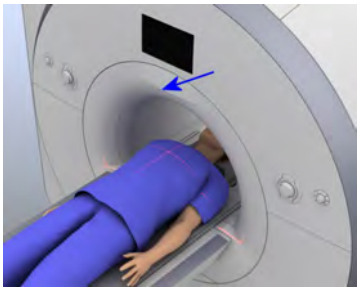
The table can be removed from the system.

Resetting the emergency undocking handle

1 Press the emergency undocking handle back into its original position.

2 Position the table with the docking nose in the docking station up to the end stop. Then press the left pedal down fully with your foot.

3.6 Laser light localizer



The laser light localizer facilitates correct patient positioning. The laser light localizer is located on top at the entrance to the magnet bore.

All laser-relevant locations at the MR system are identified by warning labels affixed directly next to the laser opening.

For some examinations, a manual alignment of the laser light localizer to the coil is not necessary. If all relevant data (e.g. patient orientation, body height, examination) are registered, auto-positioning is indicated on the Dot display at the magnet cover.

3.6.1 Using the laser light localizer

Anesthetized patients or patients who do not have an eye blink reflex must be protected against the effects of the laser beam.

✓ The patient is positioned on the tabletop.

✓ The patient table has been moved to measurement height.

WARNING

Laser beam of the laser light localizer!

Eye injury caused by laser beam

- Ensure that the operating and adjustment devices as well as methods given are used as described.
- Inform the patient about the laser and request that he keeps his eyes closed during positioning.
- Ensure that helpless patients keep their eyes closed during the positioning procedure.

1 Press the **Laser Light Localizer** button on the control unit.

The laser light localizer is switched on. A crosshair is visible directly below the area.

2 Move the tabletop so that the crosshairs point precisely to the region of interest.

The slice for measurement is marked. The display shows the relative tabletop position of the marked slice.

3 If the laser is correctly positioned, press the **Center Position** button for one second to move the table into the magnet isocenter.

The tabletop moves to the selected position and the laser shuts off automatically.

When the table is not moving, the laser light localizer shuts off automatically after 60 seconds.

3.7 Alarm box

3.7.1 Description

The alarm box has the following functions:

- Displays alarm signals
- Switches the MR system on and off
- Magnet Stop / Magnet Quench

The alarm box is installed near the *syngo* Acquisition Workplace.

3.7.2 Checks

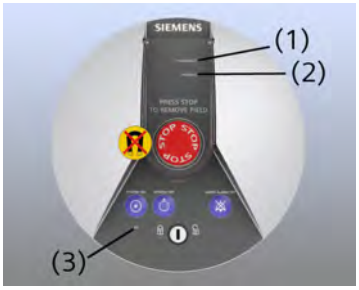
WARNING

MR system malfunction!

Hazardous conditions for patients

- Note the sounding alarm and signal.
- Do not perform MR examinations.
- Notify Siemens Service.

Checking the LEDs



(1) **WARNING** LED

(2) **POWER** LED

(3) **SYSTEM ON** LED

LED	LEDs light up to indicate
WARNING	Error message, e.g. helium fill level is too low
POWER	Voltage supply of MR system is satisfactory
SYSTEM ON	The MR system is switched on

1 Check the **WARNING** LED for alarm messages.

An alarm is present when a yellow LED lights up and/or an alarm sounds.

2 In case of an alarm: Check the host computer for error messages. Press the **Audio Alarm Off** button to silence the alarm, and notify Siemens Service.

3 Verify that the **POWER** LED is green.

4 If the **POWER** LED is not on: Check the power supply of the MR system.

The POWER LED is off, even though the power supply is functioning properly?

- Notify Siemens Service.

After a power failure, the battery powers the circuit of the magnet emergency shutdown for another 14 days. During this time, the magnet can still be quenched i.e. the magnetic field can be shut down by pressing the **Magnet Stop** switch in case of emergency.

Remote monitoring

After installing remote monitoring, various error messages can be output centrally (e.g. to the front door or gate):

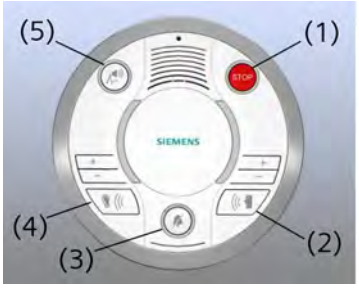
- Please contact Siemens Service regarding questions about remote monitoring.

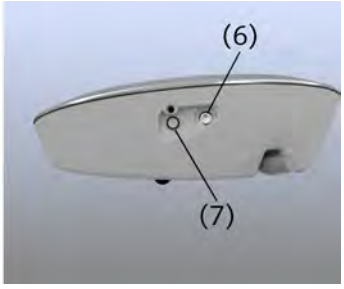
3.8 Intercom

3.8.1 Description

The intercom allows personnel and patients to communicate during the examination. In addition, some important operations like stopping the patient table can be managed from the intercom. Optionally, music or automatic voice outputs can be played in the examination room via the loudspeaker or the headphones.

The operating unit of the intercom is located at the *syngo* Acquisition Workplace.





(1) **Stop** button

(2) **Talk** button

(3) **Reset Patient Alert** button

(4) **Listen** button

(5) **Physio Signal** button

(6) Audio connection

(7) **Reset Stop** button

Patient alert

Patients may use the squeeze bulb to alert the operating personnel (patient alert):

- Acoustically:
  - Continuous tone over the intercom
  - Brief feedback signal via the patient's headphones and loudspeaker in the examination room
- Visually:
  - Blinking button on the intercom
  - Message on the Dot display in the examination room

The alert can be reset by pressing the **Reset Patient Alert** or the **Talk** button on the intercom. Alternatively, the alert reset is possible at the control unit in the examination room.

Patients, for example, sedated patients, who may not be able to alert the personnel must be monitored by a person present in the examination room.

3.8.2 Operating the intercom

The intercom operation is partially software-based. The **Patient Comfort Configuration** dialog box allows for several settings, for example, **Active Noise Cancellation** to reduce background noise from the system, can be activated. For detailed information regarding the operation of the software, see: **Software operator manual**

Button	Function
Listen	Enables listening to the patient in the examination room
Talk	Allows speaking to the patient (as long as the button is pressed)
Reset Patient Alert	Resets the patient alert
Physio Signal	Switches the transmission of physiological signals on/off

Button	Function
Stop	Stops the table movement and the measurement immediately
Reset Stop	Resets the table Stop

1 Press the corresponding button.

2 If necessary, adjust the volume using the **+/-** buttons. Press and hold the buttons to adjust the volume.

If you hold the button for about one second, the volume increases/decreases until you release the button.

Transmitting automatic voice output

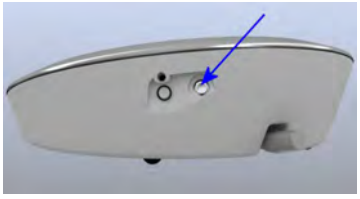
Automatic voice output can be used for transmission of commands e.g. breath hold commands.

1 Use the **Patient Comfort Configuration** dialog box in the software to initiate automatic voice output: **Software Operator Manual**

2 On request, adjust the volume in the **Patient Comfort Configuration** dialog box to the desired level in the examination room.

Transmitting music

To play music in the examination room, an audio device can be connected at the intercom.



1 Connect a suitable cable to the audio device and to the connection at the intercom.

2 Adjust the final volume to the desired level using the control unit at the magnet or the **Patient Comfort Configuration** dialog box.

3 Start the music at the audio device.

3.9 In-Room *syngo* Acquisition Workplace

3.9.1 Description

The In-Room *syngo* Acquisition Workplace (In-Room *syngo* Acq WP) is an additional operating console in the examination room. It is used for image viewing and MR system operation.

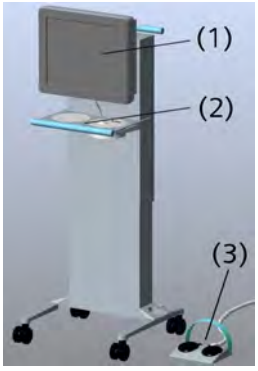
The In-Room *syngo* Acq WP is connected with the host processor and facilitates the examination process by allowing the operating personnel to remain inside the examination room between procedures.

The In-Room *syngo* Acq WP is used as follows:

- Displaying MR guided procedures
- Quickly adjusting patient positioning for survey measurements
- Immediately starting the measurement after administering contrast medium

The constant presence of operating personnel inside the examination room allows uninterrupted patient care and quick intervention in case of complications.

The In-Room *syngo* Acq WP comprises the following components:



(1) LCD monitor

(2) Tray with trackball and keys

(3) Foot switch (optional)

As an alternative, the monitor can be suspended from the ceiling. For this option, the tray with trackball and keys is not available.

3.9.2 Operating the In-Room *syngo* Acquisition Workplace

The In-Room *syngo* Acquisition Workplace (In-Room *syngo* Acq WP) is operated via the trackball and three keys. The same software functions are available as with the *syngo* Acquisition Workplace.

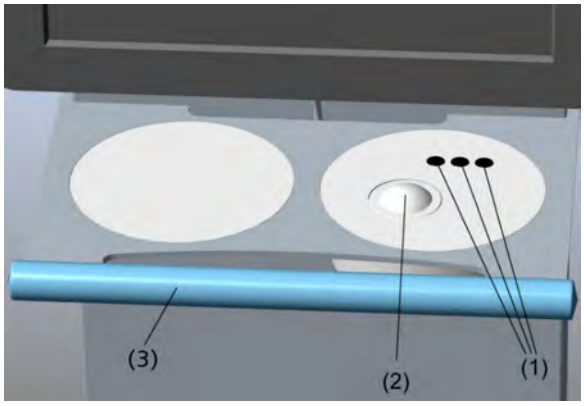
CAUTION

Diagnosis at the In-Room *syngo* Acquisition Workplace or use for interventional procedures!

Risk of patient injury; incorrect diagnosis

- Always plan appropriate emergency measures prior to starting an MR-guided or MR-monitored interventional procedure.
- Do not use the In-Room *syngo* Acquisition Workplace for diagnostic purposes.

Operating the trackball and the keys



(1) Keys

(2) Trackball

(3) Handle

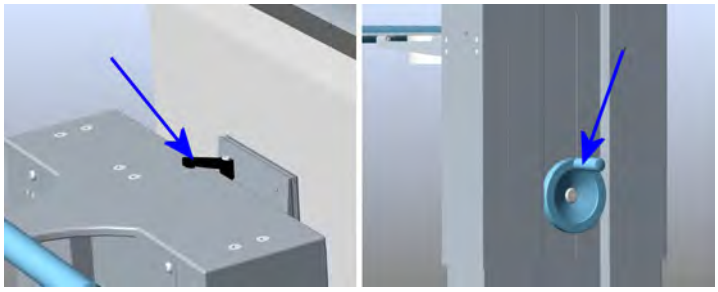
The keys have the same functions as those of the mouse.

1 Roll the trackball to move the pointer on the program interface.

2 Press the keys to execute a specific application.

Adjusting the monitor tilt

The monitor height and tilt can be adjusted for easy and comfortable operation.



1 Release the locking lever by turning it counter-clockwise by 90°.

2 Press lightly against the upper or lower edge of the display to move the monitor into the desired tilt position.

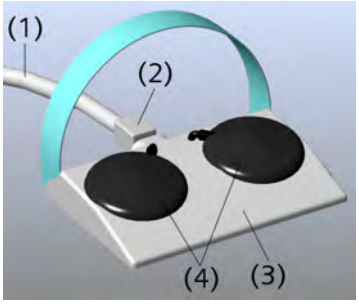
Adjusting the monitor height

1 Turn the wheel clockwise to raise the monitor.

2 Turn the wheel counter-clockwise to lower the monitor.

Operating the footswitch

The footswitch is used to start and stop the MR measurement in the examination room.



(1) Hose

(2) Hose connector

(3) Pushbutton unit

(4) Footswitch Start/Stop

For additional support, labels can be affixed to the footswitches.

Start label	START
Stop label	STOP

Performing the measurement

MR measurements with the footswitch are only possible for protocols that were configured for manual start-up. This is the case e.g. for protocols with MR measurements after administering contrast medium.

If the protocol is configured for repeated measurements, the next measurement can be started with the footswitch after completing the preceding measurement. For more information regarding the configuration of protocols, see: **Software operator manual**

1 Push the hose plug into the retaining rings of the pushbutton unit.

2 Load a suitable protocol and start it at the *syngo* Acq WP or the In-Room *syngo* Acq WP.

The MR system is waiting for the manual start of the protocol.

3 Press the **Start** footswitch to begin the measurement.

As an alternative, you can start and end the measurement via the In-Room *syngo* Acq WP or the *syngo* Acq WP.

4 Press the **Stop** footswitch to end the measurement.

3.10 Other components and accessories

3.10.1 Gradient supervision

To prevent damage to the MR system by a malfunction of the gradient system, a specially designed supervision is installed at your MAGNETOM system.

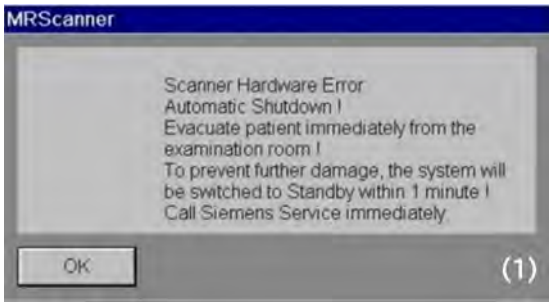
This supervision monitors that cables, connections, or other components of the gradient system do not show excessive heating. In case of a malfunction, the measurement is stopped and an alarm message is issued.

After 1 minute the system will be automatically switched to Standby.

Acting in case of an alarm

✓ Gradient malfunction is detected.

✓ An alarm message appears at the *syngo* Acquisition Workplace.



Dialog box at the *syngo* Acquisition Workplace

(1) Scanner hardware error

Automatic shutdown! Evacuate patient immediately from the examination room! To prevent further damage, the system will be switched to Standby within 1 minute! Call Siemens Service immediately.

1 Immediately move the patient out of the magnet bore by pressing the **Home Position** button.

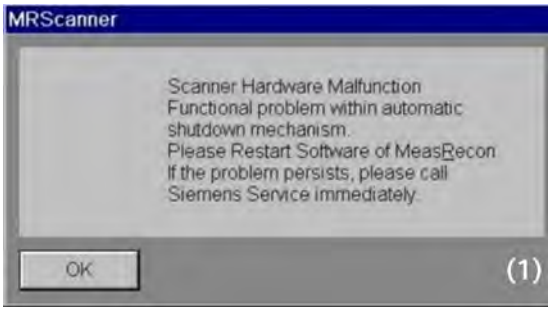
Within the next 60 seconds, the system will be switched to Standby automatically. Then, the patient table motors can not be operated any longer.

2 Call Siemens Service.

Acting in case of a supervision malfunction

✓ A malfunction within the supervision system is detected.

✓ A corresponding error message appears at the *syngo* Acquisition Workplace.



Dialog box at the *syngo* Acquisition Workplace

(1) Scanner hardware malfunction

Functional problem within automatic shutdown mechanism. Please restart software of MeasRecon. If the problem persists, please call Siemens Service immediately.

◆ Call Siemens Service.

The supervision sensitivity is potentially affected, but the operation of your MR scanner is still possible.

4 Physiological imaging

4.1 Triggering methods

MR imaging procedures are sensitive to patient movement. Images may exhibit artifacts in the form of smears when motion times - for instance, during respiration or heartbeat - are short compared to measurement times. In particular, this problem occurs as a result of the patient's heartbeat during cardiac examinations or as a result of the patient's breathing during abdominal examinations.

Two different procedures are used to avoid motion artifacts in images: prospective triggering and retrospective gating. Both procedures are based on the correlation between measurement and physiological signal (ECG signal, respiratory signal, pulse signal).

4.1.1 Prospective triggering

During prospective triggering (or antegrade triggering), a measurement is triggered by using a so-called trigger signal derived from the patient's physiological signal. This signal is usually defined based on the time period during which organ movement is as low as possible. The trigger delay is, for example, set to the end of the systole for certain cardiac examinations so that the measurement is running during the akinetic diastole. For respiratory triggering during abdominal examinations, it is recommended to start the measurement at the end of the respiratory period.

To determine the start time for the measurement, an acquisition window is defined based on the signal form (e.g. R-wave in ECG, minimum of respiratory curve). For example, the size of the acquisition window is approx. 80 % of the RR interval for ECG measurements. The acquisition window defines the range in which the measurement can be triggered. The trigger time is defined by the trigger delay.

Prospective triggering can be used for ECG, pulse, or respiratory signal curves as well as for external trigger signal curves.

4.1.2 Retrospective gating

Retrospective gating fundamentally differs from prospective triggering. No actual triggering is taking place. The physiological signal and data acquisition times are recorded simultaneously. The measurement is performed completely independently of the patient's heartbeat or pulse. A temporal assignment of images to the corresponding phase (e.g. heart stimulation) is performed after the measurement (retrospectively).

In particular, retrospective gating is used to acquire images of the beating heart. As compared to measurements using prospective triggering, this technique is especially useful for displaying the late diastole. Temporal resolution is freely selectable and may be higher or lower than selected for the measurement.

Retrospective gating can be used for ECG, pulse, or external trigger signal curves.

4.2 Physiological Measurement Unit (PMU)

4.2.1 Description

The Physiological Measurement Unit (PMU) lets you control MR measurement sequences using a patient's physiological signals (ECG, respiration and pulse).

The PMU consists of the following components:

- PERU (Physiologic ECG and Respiratory Unit): ECG and respiratory sensor
- PPU (Peripheral Pulse Unit): Pulse sensor
- External trigger input

The physiological signals are acquired with receptors - ECG electrodes, respiratory cushion and pulse sensor - directly at the patient via the PERU (ECG, respiration) and PPU (pulse). The measured data can be viewed at the Dot display in the examination room and in the **Physiological Display** dialog window at the *syngo* Acquisition Workplace.

Only *one* PERU or PPU can be located in the examination room!

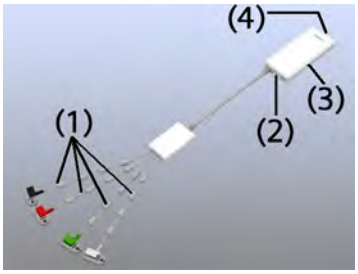
Two ECG and respiratory sensors in the examination room interfere with one another in signal transmission. It is not possible to determine the results.

Patient monitoring systems are optional accessories and are not part of the PMU.

The Physiological Measurement Unit may be used only for controlling MR measurement sequences. The unit does not replace a patient monitoring system.

ECG and respiratory sensor (PERU)

The wireless PERU simultaneously acquires three ECG channels as well as the respiratory channel of the patient.



(1) ECG leads with clips

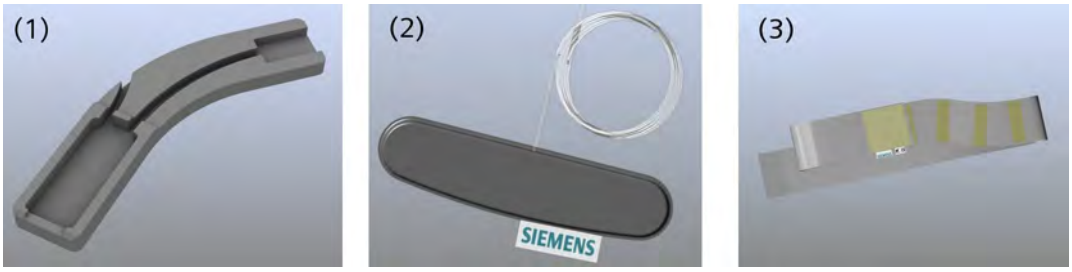
(2) Plug for respiration cushion

(3) Transmitter unit

(4) Control LEDs

The ECG electrodes and respiratory cushion are connected to the PERU.

To prevent skin irritations, the PERU has to be located in the application cushion during the examination.



(1) Application cushion

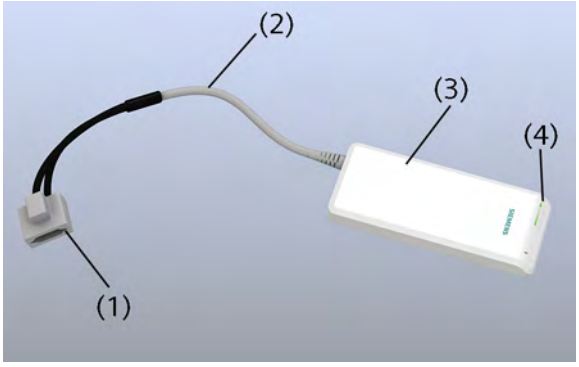
(2) Respiratory cushion with pressure hose

(3) Respiratory belt

The respiratory cushion is attached to the patient using the respiratory belt.

Wireless pulse sensor (PPU)

The PPU acquires the patient's peripheral pulse. It consists of a transmitter unit, a fiber-optic sensor and a removable finger adapter (available in different sizes).



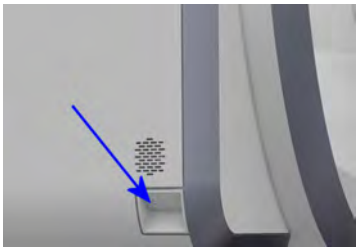
(1) Finger adapter

(2) Fiber optic cable

(3) Transmitter unit

(4) Control LEDs

External trigger input



External trigger sources (e.g. patient monitoring system) may be connected with the help of the trigger input to drive MR sequences.

The connection for the trigger input is located on the cover of the MR system. Trigger input is galvanically isolated with respect to the MR system.

Charging station

Both the PERU and the PPU are supplied with power via accumulators. All other components of the PMU are supplied by system-internal voltage sources. The charging station is installed separately near the *syngo* Acquisition Workplace and is used for storing both units.

Accumulators should not be fully discharged before recharging them. If only one green LED flashes, you should charge the accumulator for the next patient. The maximum charging time is approx. 3 hours. After being fully charged, the operating hours for the units cover approximately 24 hours.

To charge a unit, it has to be placed firmly in the charging station. The PERU and PPU can be charged together or separately in the charging station. (→ Page 88 *Control LEDs*)

Use only the charger included with delivery. Charging the units with non-Siemens equipment may destroy the PERU and PPU.

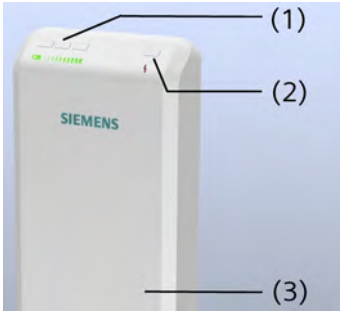
If proper charging of the accumulators is not possible anymore, please contact Siemens Service, as the PMU accumulators cannot be exchanged.

LEDs during charging

The red LED goes out when the unit is positioned correctly in the charging station. While charging, the green LEDs flash alternately as moving light. If the accumulator is nearly discharged, only one LED flashes at the beginning. With increasing charging status, a second green LED flashes and then also the third LED. If the accumulators are fully charged, the 3 green LEDs are on and stop flashing.

Control LEDs

The transmitter unit includes three green LEDs for signaling the battery status and one red LED as fault indicator (for example, insufficient skin contact of the ECG electrodes).



(1) 3 Green LEDs (battery status)

(2) 1 Red LED (fault)

(3) Transmitter unit

Battery status and faults are also indicated on the Dot display and the **Physiological Display** dialog window.

If the accumulator is not in the charging station, the green LEDs flash regularly and simultaneously.

3 Green LEDs flash	Fully or nearly fully (2/3) charged accumulator
2 Green LEDs flash	1/3 to 2/3 fully charged accumulator
1 Green LED flashes	Nearly discharged accumulator; remaining operating duration is 1 hour
Red LED flashes (as regular as the green LEDs)	Transmit function deactivated, unit is positioned outside the static magnetic field; no electrode/application fault detected
Red LED is off	Transmit function activated; unit is positioned on the patient table in the static magnetic field; no electrode/application fault detected
Red LED flashes rapidly	PERU: electrode fault - one or more ECG electrodes are not applied correctly or fell off PPU: application fault - pulse sensor is not applied correctly at the finger

A second set of sensors with charging station may be useful in hospitals or radiology facilities because *one* PPU and PERU can be permanently ready for operation, while a *second* PPU and PERU are being charged.

Data display

The physiological signals are shown on the Dot display.
(→ Page 55 *Dot display*)

Additionally, battery status and electrode/application fault are indicated on the display.

Physiological Display

The **Physiological Display** lets you view the patient's physiological signals at the *syngo* Acquisition Workplace. See: **Software operator manual**

4.2.2 Preparing the measurement

WARNING

Monitoring vital parameters via the Dot display!

Anomalies of the vital parameters are not recognized or recognized too late

- Never use the Dot display to monitor the vital parameters of a patient.
- Use only suitable patient monitoring systems for monitoring vital parameters.

Informing the patient

1 Ask the patient to lie still during the measurement.

2 Inform the patient that the knocking sounds during the measurement are caused by switching the gradients on and off. The PERU may also vibrate slightly.

Knocking sounds may affect the heart rate of patients, either consciously or subconsciously. The resulting irregular cardiac cycles adversely affect image quality.

Attaching the PERU

The PERU is used together with ECG and respiratory triggering.

✓ ECG electrodes are attached.

✓ The patient table is in the Home position.

CAUTION

Hot ECG cables!

Patient burns

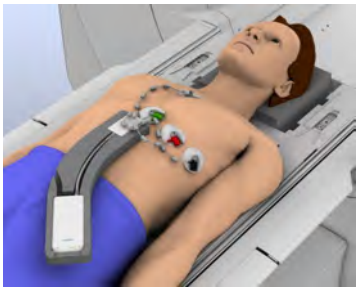
- Place absorbent natural material between the ECG cables/ leads of the PERU and the patient's skin.

1 Position the patient on the patient table with the head toward the magnet bore.

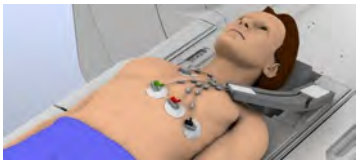
2 Position the PERU in the application cushion.

Especially with respect to whole-body examinations, it should be noted that artifacts (homogeneity distortions) may occur in the direct vicinity of the PERU transmitter unit.

3 Use the application cushion and position it together with the PERU on the patient.



4 Align the PERU on the patient in the direction of the patient's feet.



5 For the special case of triggered flow measurements/flow quantification in the head region, please position the PERU next to the patient's head (as shown in the picture) to reduce gradient interference.

Position and connect the PERU and electrodes as usual. Then use the electrodes as a pivot point and turn the PERU with the application cushion counterclockwise until the cushion is lying next to the patient's head.

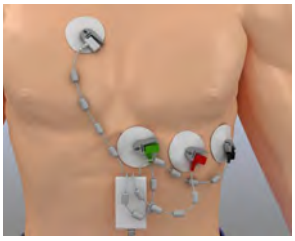
4.3 ECG triggering

4.3.1 Description

ECG triggering is a method for measuring heart sequences including dynamic studies. It is also suitable for studies where pulse flow causes artifacts. Provided that special sequences are in use, ECG triggering can be applied in combination with respiratory-controlled methods.

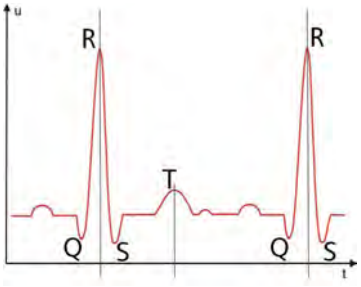
A number of special sequences support retrospective gating.

ECG leads



The ECG leads are selected according to the potential difference between the connected electrodes.

The three leads I, II and III are used and acquired in parallel via the ECG channels. All curves display a prominent R wave when the ECG electrodes and leads are correctly attached.



The characteristic QRS complex of the ECG signal is used as a trigger signal. Simultaneous acquisition and overlaying of the orthogonal leads (vector cardiography) is used to minimize triggering errors due to gradient switching and the magneto-hydrodynamic effect (i.e. excess T-wave amplitude).

Trigger methods

In the dialog box of the **Physiological Display** several trigger methods are available:

- **VCG standard**: VCG activated
- **ECG I**: VCG inactive
- **ECG II**: VCG inactive
- **ECG III**: VCG inactive
- **Auto:** Improved trigger algorithm; VCG activated; default trigger method

If **Auto** is used, the signal characteristics can be relearned by selecting **Relearn** in the context menu of the **Physiological Display**.

If triggering with **Auto** fails, preferably **VCG standard** should be used.

Disposable electrodes

For ECG triggering, special MR Conditional and disposable electrodes are used (the recommended ones are available through the Accessories catalog).

4.3.2 Performing

Image quality

The quality of the ECG signal for triggered measurements is enhanced by:

- Proper placement of the electrodes
- Good skin contact of the electrodes

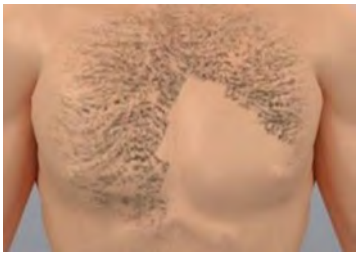
- Reduction of interference signals caused by electromagnetic induction.
  - Due to cable loops
  - Interferences from electrical potentials caused by muscle movement

Attach the electrodes so that interferences from electrical potentials caused by muscle movement and baseline drifts are minimized. Suitable contact points are therefore areas that show very little muscle or fatty tissue.

Preparing the patient

1 Prepare the patient for the examination as early as outside the examination room.

2 On the chest of the patient, select locations with minimal muscle and fat tissue for attaching the electrodes.



3 In case of hairy skin: shave the points where you intend to attach the electrodes.

Shave the patient outside the examination room to prevent accidents.

4 Thoroughly clean the patient's skin at the locations involved. However, do not use solutions containing alcohol.

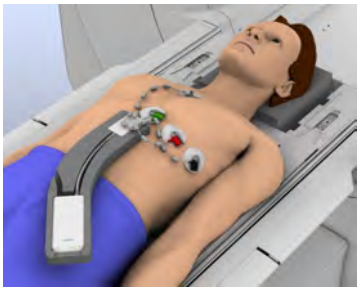
5 Then dry the skin with a paper towel.

6 Use a suitable gel to prepare the skin for better signal transmission.

Applying ECG electrodes

Finding the best position for the electrodes is a matter of trial and error. (→ Page 91 *ECG leads*)

Patients with an offset heart axis (e.g. dilatative cardiomyopathy) may require a different orientation than parallel to the spine.



1 Check the expiration date of disposable electrodes and order new ones if necessary.

2 Pull the protective foil off the electrodes and attach them.

3 Use the application cushion and position it together with the PERU on the patient. (→ Page 89 *Preparing the measurement*)

4 Connect the electrode clips of PERU to the ECG electrodes.

Performing the examination

◆ Perform the examination. See: **Software operator manual**

Evaluating the signal quality

1 Check to see if the leads show a preferably pronounced R-wave on the Dot display. Information about the ECG signal quality is also available at the display.

2 In case you are using the Body 18 coil, position it over the heart. Connect the coil and secure it with the belts. See: **Coil operator manual**

The display shows the following message: **Initial Learningphase active. Don´t move table.**

3 Wait at least 10 heart beats (learning phase for triggering) before you move the patient table into the magnet.

The patient must not move during this learning phase. The patient table is in the Home position.

The red LED (fault) at the PERU is flashing rapidly?

No analyzable signal is available.

◆ Ensure that the ECG electrodes are attached correctly.

4.4 Pulse triggering

4.4.1 Description

Pulse triggering uses the patient's pulse to trigger the measurement. A pulse sensor is connected to the patient's toe or finger. The first pulse wave (“premature pulse wave”) is used for triggering. This wave corresponds to the systolic blood pressure.

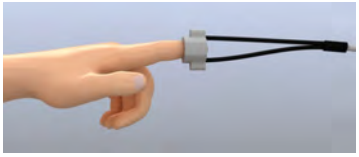
A number of special sequences support retrospective gating.

4.4.2 Performing

Attaching the pulse sensor

✓ Suitable finger adapter is attached.

1 Ensure that the cable is not bent.



2 Attach the pulse sensor to a finger or on a toe.

3 Ensure that the pulse sensor is attached properly.

» **The red LED (fault) at the PPU is flashing rapidly?**

No analyzable signal is available.

◆ Ensure that the pulse sensor is attached correctly.

Performing the examination

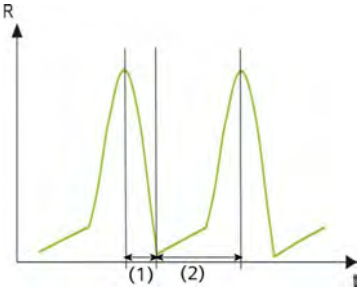
✓ The pulse sensor is attached.

◆ Perform the examination. See: **Software operator manual**

4.5 Respiratory triggering

4.5.1 Description

To keep respiratory artifacts to a minimum, respiratory triggering is primarily used in abdominal imaging. Data acquisition for respiratory triggering begins when the respiratory signal reaches a predefined level (approx. 20 % of the maximum value). Respiratory movement is minimal in this range.



(1) Expiration

(2) Inspiration

The respiratory signal is acquired using a respiratory cushion connected via a pressure hose to the ECG and respiratory sensor (PERU). The respiratory cushion is attached to the patient via the respiratory belt.

Retrospective gating cannot be applied.

4.5.2 Performing

Informing the patient

1 Ask the patient to lie still during the measurement.

2 Inform the patient that the knocking sounds during the measurement are caused by switching the gradients on and off. The PERU may also vibrate slightly.

Attaching the respiratory cushion and belt

✓ The plug of the respiration cushion is NOT connected.

CAUTION

Incorrect MR image due to disconnected respiratory cushion!

Incorrect diagnosis

- As a last step, plug the connector of the respiratory cushion into the allocated jack.

1 Determine whether the patient is a thoracic or abdominal breather.

Women and athletes are usually thoracic breathers.

Men and obese patients are usually abdominal breathers.

2 If the patient is an abdominal breather, place the respiration belt around his abdomen.

– or –

If the patient is a thoracic breather, place the respiration belt around his chest.

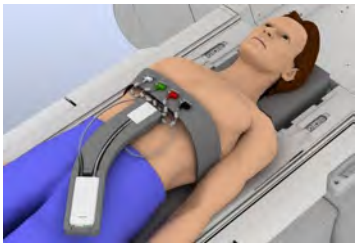
As an alternative, the respiratory cushion and belt can be used in combination with the Body 18.

3 Slide the respiratory cushion underneath the respiratory belt.

Connecting the respiratory cushion

✓ The respiratory cushion is attached.

1 Use the application cushion and position it on the patient together with the PERU. (→ Page 89 *Preparing the measurement*)



2 For respiratory triggering alone, position the electrode leads loosely on the respiratory belt.

3 Connect the plug for the respiratory cushion to the appropriate socket on the PERU.

4 Ensure that the pressure hose of the respiration cushion is not crimped or bent. Make sure the respiration cushion is not unduly compressed.

With quiet patients, a periodic signal will appear on-screen.

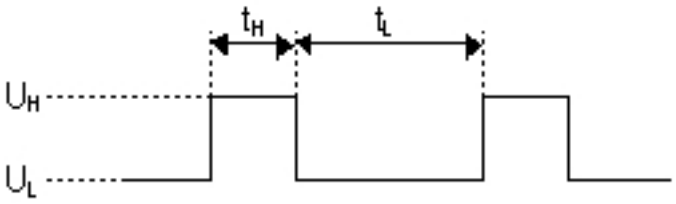
Performing the examination

◆ Perform the examination. See: **Software operator manual**

4.6 External triggering

4.6.1 Input for external trigger signal

The external trigger signal has to meet the following specifications:



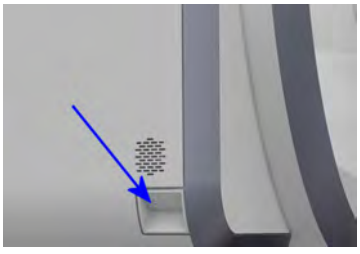
Voltage-tim diagram for external triggering of the PMU

Name	Value
U_L	0 V ... 0.8 V
U_H	2.5 V ... 5 V
t_L(min.)	10 ms
t_H(min.)	10 ms
Input current	min. 5 mA
Input voltage	max. ± 5 V
Internal contact	+
External contact	-

The measurement sequence is triggered by the rising edge of the external signal.

The external trigger signal can be supplied via the connections in the magnet cover.

4.6.2 Performing



1 Connect the source of the external trigger signal to the cinch jack trigger input (magnet cover, left).

2 Perform external triggering. See: **Software operator manual**

5 MR system operation

5.1 Daily functionality checks

Before using the MR system, the functionality and/or cleanliness of the following parts and areas must be checked:

- Alarm box
- Warning signs
- Floor
- Magnetizable materials
- Exhaust vent
- Patient table
- Squeeze bulb

5.1.1 Checking the functionality and cleanliness

⚠ WARNING

Large amount of liquid (for example, phantom fluid) spilled onto patient table and seeping into electrical connections!

System malfunction due to electrical hazards

- Immediately stop the running examination.
- Shut down the computer system and power off the MR system (**SYSTEM OFF**).
- Notify Siemens Service.

1 Check the LEDs on the alarm box.

2 Check if all warning symbols and signs are present inside and outside the examination room.

CAUTION

Leaking hydraulic system!

Slipping hazard

- Check the area around the patient table for hydraulic fluids on the floor.

3 Check the examination room, control room, and electronics room for liquid spills and puddles on the floor.

4 Ensure that no magnetizable materials or objects such as vacuum cleaners, carts, ladders, and tools are present in the examination room.

5 Ensure that the outlet of the exhaust vent line is not obstructed.

6 Ensure that any contrast medium residue has been cleaned off the patient table.

7 Check the functionality of the squeeze bulb. The patient must be able to trigger the patient alert using the squeeze bulb.

5.2 Starting up and shutting down the MR system

There are three operating modes:

- System On (full operation)

  All MR system components are switched on. Examinations may be performed.

- System Off (system is not working)

  All MR system components except cooling are switched off.

- Standby (standby operation)

  Only the host computer is switched on. Standby is useful for patient evaluations on the computer after performing an examination.

The operating modes can be selected by pressing the corresponding button on the alarm box or by using the System Manager in the *syngo* MR software. See: **Software operator manual**

Additionally a main circuit breaker is located in the control room which should *NOT* be used during proper functioning of the MR system. It switches off the overall system including cooling, which leads to helium boil-off.

5.2.1 Starting the system (System On)

System start-up includes the following steps:

- Switching on the MR system at the alarm box
- Switching on the *syngo* MR Workplace
- Checking the MR system components

Do not perform preliminary examination steps (e.g. moving the patient table, connecting coils) at the MR system while starting up the system.

Prior to starting the system, the patient table should be in the Home Position.

After "system off" or Standby, wait at least 30 seconds before you switch on the system again.

Switching on the MR system at the alarm box

✓ The daily functionality checks have been completed.
(→ Page 99 *Daily functionality checks*)

✓ The coils used are fully connected to the coil sockets.

✓ Coils comprising several parts (e.g. head coils) are closed.

1 Turn the keyswitch to the right.

2 Press the **SYSTEM ON** button.

The **SYSTEM ON** LED lights up. The MR system is switched on.

The software starts at the *syngo* Acquisition Workplace.

Switching on the *syngo* MR Workplace

Since the *syngo* MR Workplace has its own voltage supply, it is switched on separately from the *syngo* Acquisition Workplace.

◆ Press the Power On switch at the computer of the *syngo* MR Workplace.

The software of the *syngo* MR Workplace starts.

After switching on the *syngo* Acquisition Workplace and the *syngo* MR Workplace, the system requires approx. 18 minutes to warm up and get ready for acquisition.

Checking the MR system components

1 If a dialog window is displayed at the *syngo* Acquisition Workplace informing you that the helium fill level is too low: Close the window and notify Siemens Service or have the magnet refilled.

2 Check all **Table Stop** buttons (at the intercom and at the patient table). Ensure that these buttons function properly and stop the table immediately.

3 Check if pressing the squeeze bulb triggers the patient alert.

4 Check if communication with the patient in the examination room works properly.

5 Check if image transmission of the video systems works properly.

6 Check if the contact spring connectors at the door frame and the door to the examination room are free of residues, such as cleaning agents, oil, grease, paint splatters, blood drops, etc.

5.2.2 Shutting down the system (System Off)

Shutting down the system includes the following steps:

- Shutting down the computer system
- Switching off the MR system at the alarm box

When shutting down the system, the software of the *syngo* MR Workplace is automatically ended as well.

Prior to shutting down the system, the patient table should be in the **Home** Position.

To avoid possible data losses at the *syngo* MR Workplace, shut down the *syngo* MR Workplace before the *syngo* Acquisition Workplace.

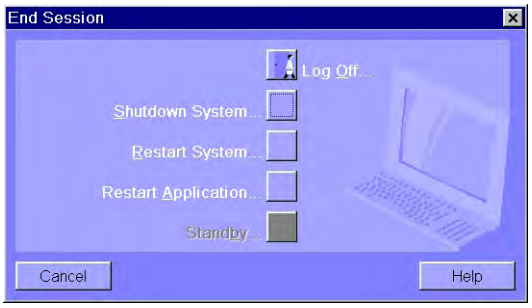
If the user is logged on, the system must be shut down using **System > Control...** or **System > End Session**. Otherwise, data are lost.

Shutting down the computer system

✓ All data have been saved - at the *syngo* Acquisition Workplace as well as at the *syngo* MR Workplace.

1 Select **System > End Session** at the *syngo* Acquisition Workplace.

The **End Session** dialog window is displayed.



2 Select the **Shutdown System** option.

The computer system shuts down.

» **The software does not respond?**

- Simultaneously press the **Ctrl**, **Alt**, and **S** keys on the keyboard and shut down the system with the System Manager.

» **The System Manager cannot be opened?**

You can shut down the *syngo* Acquisition Workplace via the Windows platform, which can cause data loss.

- Simultaneously press the **Ctrl**, **Alt**, and **Del** keys on the keyboard and choose the shutdown option.

» **System Manager and Windows do not respond?**

- Switch off the *syngo* Acquisition Workplace.

Switching off the MR system at the alarm box

✓ The computer system has been shut down (indicated by a message that the system can be switched off).

1 Press **SYSTEM OFF**.

2 Turn the keyswitch to the left.

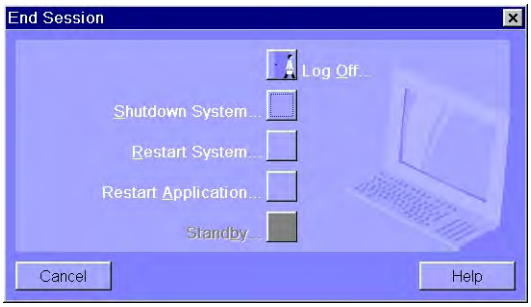
5.2.3 Shutting down the *syngo* MR Workplace

In the System On mode, you can only shut down the *syngo* MR Workplace.

1 Save your data.

2 At the *syngo* MR Workplace, select **System > End session**.

The **End Session** dialog window is displayed.



3 Select the **Shutdown System** option.

The computer system shuts down.

In case of problems during shutting down, see troubleshooting information: (→ Page 103 *Shutting down the computer system*)

5.2.4 Starting/ending Standby

Standby can be switched on by using the System Manager in the *syngo* MR software. See: **Software operator manual**

1 Select **System > Control** to open the System Manager.

2 To start Standby: On the **Meas & Recon** tab, click the **Standby** button.

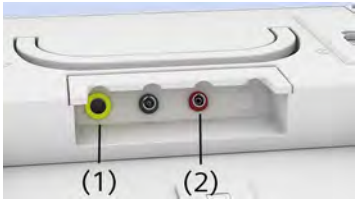
The **System Manager - Scanner StandBy** dialog box opens.

3 To end Standby: At the alarm box, press the **SYSTEM ON** button.

5.3 Preparing the MR system

To use the holder for infusion bottles you can position the rod on the right side of the patient table (head end). If not in use, you can clamp the holder in the affixing elements at the side of the table.

5.3.1 Connecting the squeeze bulb



(1) Connection for headphones

(2) Connection for squeeze bulb

1 Connect the hose connector of the squeeze bulb to the corresponding connector at the foot end of the patient table.

2 Connect the headphone to the corresponding connector at the foot end of the patient table.

5.3.2 Setting tunnel conditions

Use the buttons and the jogwheel of the small control unit to set the conditions in the magnet tunnel.

(1) **Headphone** button

(2) Jogwheel for settings

(3) **Tunnel ventilation** button

(4) **Loudspeaker** button

(5) **Tunnel lighting** button

1 Click the corresponding button and use the jogwheel to increase or decrease the setting.

2 Confirm your setting by pressing the jogwheel.

The setting of the music volume has no effect on the voice volume of patient announcements.

5.4 Preparing the patient

To use the holder for infusion bottles you can position the rod on the right side of the patient table (head end). If not in use, you can clamp the holder in the affixing elements at the side of the table.

CAUTION

Heat development during the examination!

Patient burns

- Instruct patients to press the squeeze bulb in case of strong heat sensations.

WARNING

Use of unapproved fMRI stimulation devices for the given magnetic field strength!

Injury to patient and operating personnel

- Ensure that the stimulation devices are approved for the field strength of your MR systems. For example, devices approved for low and medium field systems (0.2 – 1.5T) must not be used on a 3T system.

5.4.1 Informing the patient

1. Please note the safety instructions.
2. Inform the patient about the possible effects of MR examinations and the risks associated with the magnetic field.
3. Show the patient how to activate the patient alert by pressing the squeeze bulb.
4. Ensure that the patient holds the squeeze bulb in his/her hand during the measurement.

5.5 Physiological effects

Due to the presence of alternating electromagnetic fields, patients may experience various physiological effects during MR measurements:

- Peripheral nerve stimulation through low-frequency fields of the gradient coils (→ Page 110 *Exposure to low frequency electromagnetic fields*)
- Warming of body tissue through RF fields of the RF transmitter coil (→ Page 112 *Exposure to RF electromagnetic fields*)

These physiological effects can be evaluated by the technical quantities dB/dt (stimulations) and SAR (warming) respectively.

It is generally accepted that no published evidence supporting the occurrence of cumulative and/or long-term effects after exposure to EMF emitted by the MR equipment exists.

5.5.1 Operating modes

To prevent health risks during MR measurements, several international organizations (for example, IEC) and various national health organizations have published guidelines and limit values. In compliance with country-specific approval guidelines, they are the basis for the monitoring functions integrated in the MR system with respect to stimulation and warming effects. The limits against too intense stimulation and warming effects (for example, dB/dt limits and SAR limits) are based on current scientific literature related to safety.

Two different operating modes are available depending on the patient's tolerance. With respect to stimulation and warming effects, the operating modes are defined independently of each other and can be selected separately.

Normal Operating Mode

The *Normal Operating Mode* can be used safely for all patients. This is the standard mode. Routine patient monitoring is required. (→ Page 33 *Patient monitoring*)

Scanning of pregnant patients with the Body coil must be limited to the *Normal Operating Mode* with respect to the SAR level.

First Level Controlled Operating Mode

In the *First Level Controlled Operating Mode*, patients may experience noticeable stress levels depending on the measurement programs selected. The decision to change to the *First Level Controlled Operating Mode* must be based on a medical consideration of the potential risks and benefits for the patient.

⚠ CAUTION

Exposure to RF electromagnetic fields in the *First Level Controlled Operating Mode*!

General or local hyperthermia of the patient

- Do not examine patients with restricted thermoregulatory capability (e.g. small children, elderly, sick, or medicated patients).
- Do not examine patients unable to communicate potential overheating effects (e.g. small children, seriously ill, paralyzed, unconscious, sedated, or handicapped patients).
- Ensure that patients wear light clothing (e.g. light pajamas or nightgown).
- Remove all additional insulation, e.g. blankets which could interfere with heat dissipation.
- Carefully observe the patient and advise the patient once again about the squeeze bulb.

Ensure medical monitoring of the patient (as required by the IEC standard). Also consider the need for breaks during the measurements, to allow the patient to cool off, for example.

CAUTION

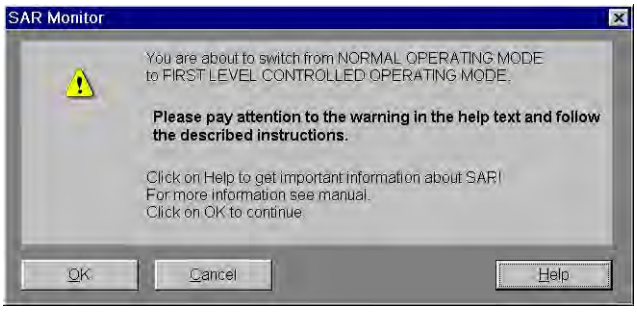
Stereotactic frames and similar devices: tips of screws may heat up considerably, especially if MR examinations are performed in the *First Level Controlled Operating Mode*!

Localized burns of the patient

- Please observe the recommendations and notes of the manufacturer of the stereotactic frame.
- If the device consists of conductive material, only perform measurements in the *Normal Operating Mode*, if possible.
- If you still need to switch to the *First Level Controlled Operating Mode*, please observe the related safety notes.

Switching operating modes

To switch from the *Normal Operating Mode* to the *First Level Controlled Operating Mode*, the user must explicitly select and confirm the change. The request appears in the dialog window of the *syngo* Acquisition Workplace. In the *First Level Controlled Operating Mode*, medical supervision is mandatory.



Dialog window SAR Monitor

5.5.2 Exposure to low frequency electromagnetic fields

During the measurement, patients are exposed to an electrical field created by the time-varying magnetic fields of the gradient coils. Assuming all other conditions remain constant, the strength of the electrical field is directly proportional to the change of the magnetic flux (dB/dt).

Peripheral nerve stimulation

Stimulation threshold: The electrical field affects the patient. If the strength of the electrical field exceeds a certain threshold (stimulation threshold), the patient experiences peripheral nerve stimulation. Nerve stimulation manifests itself as e.g. tingling sensations or slight muscle spasms in the ribs, side, abdomen, hip, buttock, or thoracic regions, along the upper arms or the back muscles in the shoulder region. Depending on physiological conditions, the stimulation threshold may vary greatly from patient to patient.

Stimulation limits: So-called stimulation limits were determined by averaging the individual stimulation thresholds of test subjects during an extensive clinical trial. Based on the statistical distribution, it can be expected that up to 50 % of all patients will experience at least mild stimulations after reaching this stimulation limit.

Monitoring

The MR system software includes a monitoring feature (stimulation monitor) which monitors how close patients are to the stimulation limit.

Look Ahead monitoring: Prior to starting an MR measurement protocol, the stimulation monitor checks whether the stimulation limits may be exceeded. If so, the measurement cannot be started. To perform the examination, the parameters of the measurement sequence must be adjusted accordingly.

Online monitoring: If the stimulation limit is exceeded while a measurement is in progress, the active measurement is aborted.

Operating modes

The MR system can be operated in two operating modes which differ with respect to different levels of stimulation.

The power limits are based on stimulation models derived from the statistically determined stimulation limits. The higher the gradient output is, the higher the probability and the intensity of the effects (for example, peripheral nerve stimulation). To minimize the occurrence of peripheral nerve stimulations, it is recommended to operate the system in the *Normal Operating Mode*. However, heart stimulations can be excluded.

Normal Operating Mode: In the *Normal Operating Mode*, the limit is set to 80 % of the stimulation limit according to IEC 60601-2-33. At the maximum performance allowed in this operating mode, the ratio of patients affected by peripheral nerve stimulation is rather low.

First Level Controlled Operating Mode: In the *First Level Controlled Operating Mode*, the performance limits are determined directly from the statistically determined stimulation limits. Accordingly, at the maximum performance allowed in this operating mode, up to 50 % of all patients may experience stimulations.

5.5.3 Exposure to RF electromagnetic fields

During the course of an MR measurement, the patient's body absorbs energy from the RF field of the transmitter coil. Depending on the type of transmitter coil used, the absorption is either concentrated locally (when using so-called "Local RF Transmit Coils") or relatively uniform across the part of the body examined (when using volume coils, for example, head, extremity, or body coil).

The *Specific Absorption Rate* (SAR), expressed as W/kg, serves as a stress indicator.

Unacceptably high local SAR values may lead to RF burns. High global SAR values (head, exposed part of the body, whole body) may lead to overstress the patient's thermoregulation and the cardiovascular system.

The B1+ rms value (root mean square value of the MR-relevant component of B1, which is indicated by the "+") is displayed at the *syngo* Acquisition Workplace for each sequence and may serve as an indication of the RF magnetic field intensity. This can be used to assess the risk of scanning a patient with an active or passive implant.

Warming of body tissue

The energy absorbed in the course of the MR measurement warms the tissue. The heat generated is dissipated by the thermoregulation mechanisms of the patient, e.g. through increased perspiration and blood flow.

The body temperature increases if the patient absorbs more energy per unit of time than can be dissipated through thermoregulation. The longer this condition lasts, the greater the increase in temperature.

The increase in core body temperature is usually well below 1°C during the course of the MR examination (if the SAR limits described below are maintained). Nevertheless, patients with a core temperature higher than 39.5°C must not be scanned and patients with a core temperature higher than 39.0°C must only be scanned in the *Normal Operating Mode*.

Noticeable effects on the patient

During the MR measurement, patients may experience heat sensations on the skin and, as a consequence of the RF energy absorption, patients may begin to perspire during the course of the MR examination. Their pulse rate may increase as well. The individual effects vary from patient to patient. The intensity of these effects depends on the measurement program selected. As compared to the *Normal Operating Mode*, measurement programs with considerably higher intensities may be used in the *First Level Controlled Operating Mode*. Following the examination, the body will cool off. The pulse rate will return to normal.

Temperature control inside the examination room: A temperature sensor, located near the air intake for the tunnel ventilation, monitors the room temperature. If the room temperature exceeds 25°C, the SAR limits are regulated and lowered by 0.25 W/kg per °C exceeding 25°C. As a result, the parameters of certain MR measurement sequences may need to be adjusted.

SAR limits

Considering all possible tolerances, the SAR values (quantities) are always calculated based on the worst-case assumption. This ensures that the specific SAR limit is maintained.

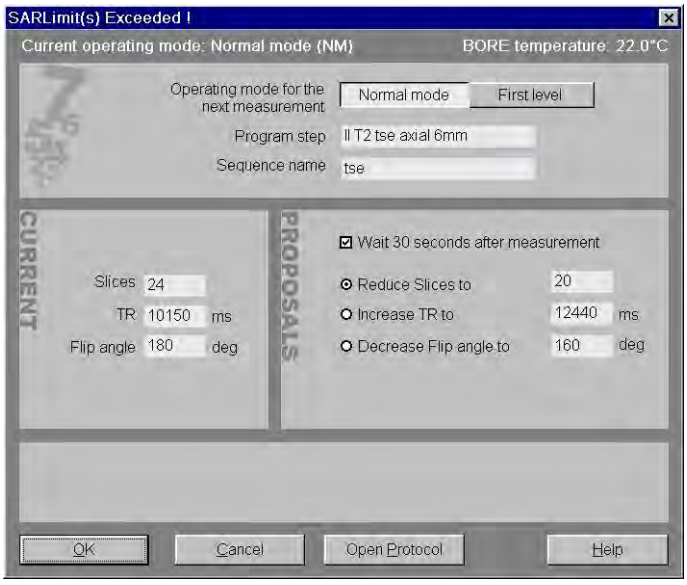
Depending on the medical question, different coils are used for the RF transmission (for example, head, extremity or body coil). The different coils lead to different RF exposure situations for the patient. Therefore, different SAR quantities and corresponding limits have been established (for example, head SAR, whole body SAR, local SAR, and SAR of the exposed part of the body). According to the guideline for monitoring SAR, the software automatically determines the SAR quantities and the corresponding limits to be monitored and to be applied respectively. For the actual RF exposure situation, one of the above-mentioned SAR quantities will show the highest "value to limit ratio". For example, in the case of a head examination with a typical head coil, this will be the global head SAR. If however, a transmitting coil with an inhomogeneous RF field is applied, this will be the local SAR.

SAR monitoring

SAR limits are observed by a software monitoring function.

Look Ahead monitoring: Prior to each measurement, the values of the SAR quantities to be observed are calculated (always as worst-case values) and compared with the corresponding limit values. If one of the calculated SAR values exceeds the corresponding limit, the measurement cannot be started. The following message appears in the dialog window of the *syngo* Acquisition Workplace: **SAR Limit(s) Exceeded!**

To ensure correct calculation of the SAR values, the weight of the patient must be entered during registration.



This dialog window includes suggested changes to the examination parameters which allow the examination to continue. In addition, a button in the dialog window may be used to change the operating mode.

In the *First Level Controlled Operating Mode*, often only minor modifications (if any) may be required.

Online monitoring: The system constantly measures the transmit power and ensures that the appropriate limit values are observed. Examinations in progress will be aborted if the limit is exceeded.

Limit values: The SAR limits used by the Look Ahead monitoring function are set according to country-specific approval guidelines at the time of the *syngo* MR installation.

Normal operating mode: In the *Normal Operating Mode*, the patient barely notices the effects of the RF field. The stress on the cardiovascular system is negligible.

First Level Controlled Operating Mode: In the *First Level Controlled Operating Mode*, patients may experience noticeable stress levels depending on the measurement programs selected. This usually includes perspiration accompanied by an increase in pulse rate. Patients with reduced thermoregulatory capability and higher sensitivity toward increases in body temperature (e.g. patients with fevers or cardiac decompression, patients with perspiratory impairments, or pregnant women) may experience additional effects.

Display of SAR values: The current SAR values, encoded according to the body regions of interest, can be accessed at any time. See: **Software operator manual**

5.6 Starting/Stopping the measurement

5.6.1 Starting the measurement

✓ The measurement protocol is loaded.

✓ No MR measurement is active.

◆ Select the **Start** icon at the Dot display. (→ Page 55 *Dot display*)

The measurement begins.

The display is deactivated.

5.6.2 Stopping the measurement

✓ The MR measurement is active.

◆ Press any of the table movement buttons on the control unit. (→ Page 54 *Control units*)

The measurement is stopped.

The display is activated.

6 Maintenance

6.1 Cleaning

All instructions in the operator manual regarding cleaning and, when applicable, regarding disinfecting and sterilization must be always observed.

WARNING

Improper cleaning of the MR system!

Risk of electric shock

- Only clean the MR system with a damp cloth.

For information regarding cleaning of RF coils, see: **Operator Manual Coils**

6.1.1 Cleaning the LCD monitor/video display

The LCD monitor of the *syngo* Acquisition Workplace and the video display are cleaned in the same way.

1. Clean the LCD monitor/video display at least every two months.
2. Prior to cleaning, switch off the LCD monitor/video display and disconnect the main power plug. But if the monitor/display is under hot running conditions, please wait till the monitor/display is chilled (this can take up to one hour).
3. Clean the monitor/video display using a microfiber cloth.
4. If the LCD monitor/video display cannot be effectively cleaned with the microfiber cloth: use window cleaner. Do *not* use window cleaner on the monitor housing.
5. Immediately remove any water drops from the LCD monitor/video display.
6. Avoid scratching the surface area of the LCD monitor/video display.
7. Avoid impacts to the LCD monitor/video display.

The LCD monitor/video display are highly sensitive to mechanical damage.

6.1.2 Cleaning the camera lens

- Carefully clean the camera lens with a lint-free cloth and lens cleaner.

6.1.3 Cleaning the data carrier

1. Clean contaminated data carriers with a clean cloth (cotton or microfiber).
2. Follow the manufacturer's notes when cleaning CD/DVD data carriers.

6.1.4 Cleaning the plugs and connectors

1. Dampen a soft cloth with water or a diluted household cleaner solution. Do *not* use organic solvents such as alcohol or acetone.
2. Carefully wipe the plugs and connectors with the cloth. Do *not* touch the contacts.

6.1.5 Cleaning the patient table and the straps

1. Clean the patient table using a liquid household agent.
2. Wash the straps of the patient table at a temperature of 60°C.
3. Use commercial disinfecting materials. However, do *not* use solutions with alcohol or acetone.

6.1.6 Cleaning and disinfecting the receptors

1. Do *not* use cleaners or disinfectants containing alcohol or ether.
2. Do *not* use hard or sharp objects (e.g. knives or tweezers) to remove residue.
3. Clean the receptors with a commercially available cleaner. Follow manufacturer's instructions.

4 Use a dampened cloth for cleaning.

Do not submerge the receptors in cleaning liquid.

5 Disinfect the receptors with a commercially available disinfecting agent. Follow the manufacturer's instructions.

6.1.7 Disinfecting system components

Disinfecting sprays damage electronic components. For this reason, components may only be cleaned with a semi-dry cloth.

WARNING

Flammable cleaning or disinfection agents may cause fire or explosion!

Injury to patient

- Disinfect the system components with commercial disinfecting materials. However, do not use solutions with alcohol or acetone. Follow manufacturer's instructions.

Siemens does not test alcohol-containing, phenol-alkaline and alkaline-based disinfectants for harmful effects on surfaces. Avoid disinfecting system components with these materials.

6.1.8 Care and cleaning of floors

Do *not* use the following cleaning or care products:

- Sprays
- Silicon-based cleaning or care products
- Cleaning or care products with substances that release ammonia
- Cleaning or care products that destroy the anti-static properties of the floor covering

- Use commercially available cleaning or care products for the floor. Follow manufacturer's instructions.

6.2 Return and disposal

6.2.1 MR System

WARNING

Explosion hazard during improper disassembly!

Injury of persons

- Ensure that only trained personnel disassemble the MR system because the system includes a pressurized container and cryogenic helium.

1 Contact Siemens Service in case of questions about returning and disposing the MR system and/or its components and accessories.

2 Observe national regulations.

6.2.2 Packaging

Siemens AG is obligated to accept the return of packaging material.

1 Contact Siemens Service regarding questions with respect to the return as well as subsequent disposal of packaging material.

2 Observe national regulations.

6.2.3 Batteries and accumulators

Siemens AG is obligated to accept the return of batteries and accumulators and to dispose of them.

1 Contact Siemens Service with respect to questions regarding the return and disposal of batteries and accumulators.

2 Observe national regulations.

6 Maintenance

7 Appendix: regulatory information

7.1 Medical devices of other manufacturers

Please note that this manual may also contain information about medical devices that are NOT legally manufactured by Siemens. These medical devices are either only distributed by Siemens, or only mentioned for additional information.

In the following table you will find information about the medical device, the corresponding legal manufacturer and, if applicable, the authorized representative.

Product and CE	Legal manufacturer
Respiration cushion, respiratory belt CE	Pi-Products GmbH Heinrich-Hertz-Straße 8a 92224 Amberg, Germany www.pi-products.de
Application cushion for PMU CE	Polyform GmbH & Co. KG Kunststofftechnik Braasstraße 15 DE-31737 Rinteln, Germany www.polyform.de
Patient table CE	TRUMPF Medizin Systeme GmbH + Co.KG Carl-Zeiss-Str. 7-9 07318 Saalfeld, Germany www.de.trumpf.com

7.2 CE for Physiological Measurement Unit (PMU)

The PMU (PPU, PERU) bears a CE marking in accordance with the provisions of regulation 1999/5/EC of March 9, 1999 for radio and telecommunications terminal equipment.

Changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

This device complies with **Industry Canada licence-exempt RSS standard(s) and** part 15 of the FCC Rules. Operation is subject to the following two conditions: (1) this device may not cause interference, and (2) this device must accept any interference, including interference that may cause undesired operation of the device.

Le présent appareil est conforme aux CNR d'Industrie Canada applicables aux appareils radio exempts de licence.
L'exploitation est autorisée aux deux conditions suivantes :
(1) l'appareil ne doit pas produire de brouillage, et
(2) l'appareil doit accepter tout brouillage radioélectrique subi, même si le brouillage est susceptible d'en compromettre le fonctionnement.

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CE 0123

Manufacturer's note:

This device bears a CE mark in accordance with the provisions of Council Directive 93/42/EEC of June 14, 1993 concerning medical devices and the Council Directive 2011/65/EU of June 08, 2011 on the restriction of the use of certain hazardous substances in electrical and electronic equipment.

The CE marking applies only to medical devices which have been put on the market according to the above-mentioned EC Directives. Unauthorized changes to this product are not covered by the CE mark and the related Declaration of Conformity.

Please note: For products that are not legally manufactured by Siemens but distributed, please refer to the Appendix of this manual!

Global Business Unit
Siemens AG
Medical Solutions
Magnetic Resonance
Henkestr. 127
DE-91052 Erlangen
Germany
Phone: +49913184-0
www.siemens.com/healthcare

Global Siemens Headquarters
Siemens AG
Wittelsbacherplatz 2
80333 Muenchen
Germany

Global Siemens Healthcare Headquarters
Siemens AG
Healthcare Sector
Henkestraße 127
91052 Erlangen
Germany
Phone: +49 9131 84-0
www.siemens.com/healthcare

Legal Manufacturer
Siemens AG
Wittelsbacherplatz 2
DE-80333 Muenchen
Germany

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