Data

MAGNETOM Avanto
A **Tim** System

SIEMENS

medical

SIEMENS

MAGNETOM **Avanto**
A Tim System

- Tim – Total imaging matrix
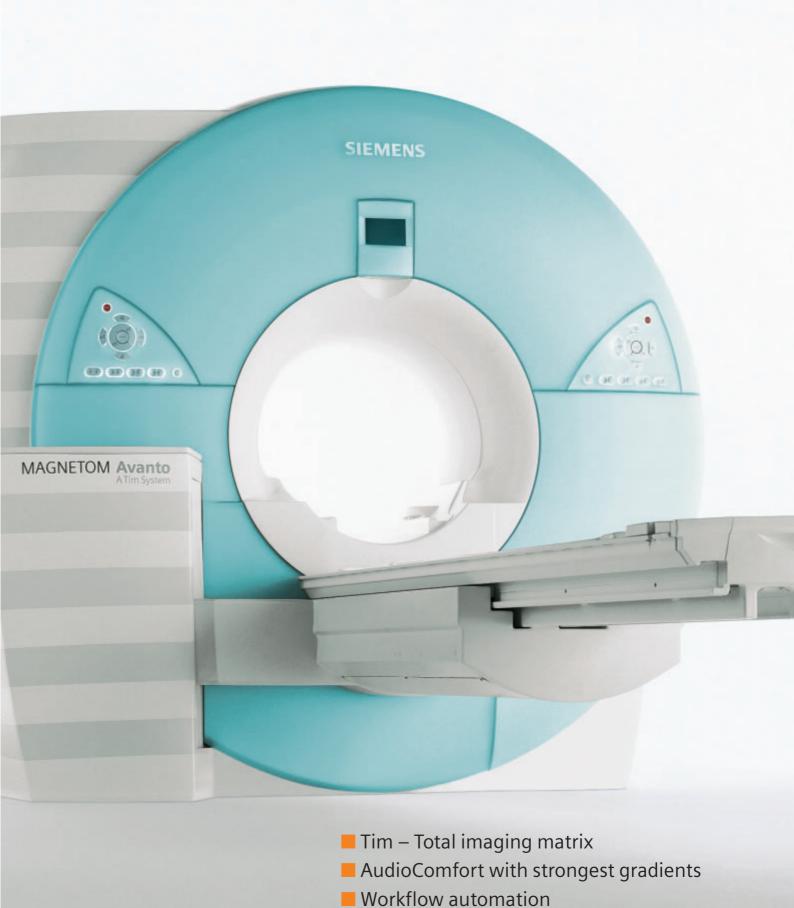- AudioComfort with strongest gradients
- Workflow automation

Tim
will change MR forever.

It's a whole new way to think about MR.
Going beyond incremental enhancements in
magnet technology and gradient power to
something radically different. A transforming
technology that shifts the spotlight onto a
new and tremendously innovative RF system
and matrix coil concept. Tim technology
is a unique combination of features that
will launch the next era in powerful MR
advances. From revolutionary acquisition
quality to breakthrough applications and
remarkable profitability. It's opening up
new worlds of possibility.

- Tim is a revolutionary. **Select exams,
  not coils.** [76 x 32] Up to 76 seamlessly
  integrated matrix coil elements and up
  to 32 RF channels combined to create one
  Total imaging matrix.

- Tim sees all. **Local becomes total.**
  True 205 cm (6' 9") seamless, whole-body
  anatomical coverage with no coil
  reconfiguration or patient repositioning.

- Tim knows no boundaries. **Parallel in all
  directions.** Head to toe, front to back, and
  side to side for unlimited Parallel Imaging.

■ Content

Tim – Total imaging matrix

Total imaging matrix technology. It's a whole new way to think about MR. Tim goes beyond incremental enhancements in magnet technology and gradient power to something radically different. A transforming technology that shifts the spotlight to a new and tremendously innovative RF system and matrix coil concept. A unique combination of features that enable a quantum leap forward with up to 76 matrix coil elements and up to 32 RF channels. For pristine image quality. Acquisition speed that breaks new records. True whole-body coverage. Highest signal to noise ratio. Dramatically streamlined workflow. And flexibility that's virtually unlimited. Tim will open up new worlds of possibility.

■ 76 seamlessly integrated coil elements with 18, respectively with up to 32 RF channels [1].

This unique combination of up to 76 coil elements can be connected to a large number of channels allowing for highest flexibility in the choice of examinations covering all clinical questions, without the need for coil changes or patient repositioning.

Customer's advantage: Selects exams, not coils.

■ 205 cm FoV. Whole Body at the highest quality.

Tim puts it all together, for the very first time. It allows to exploit maximum SNR while enabling seamless, head-to-toe imaging with a total FoV of up to 205 cm [2] at full surface coil quality. And all that without the need to reposition the patient, or to change a single coil, not even once. Tim or Total imaging matrix revolutionizes MRI and resolves typical limitations of local anatomy MR imaging.

Customer's advantage: Local becomes total.

■ PAT. Unlimited.

Tim provides total iPAT (integrated Parallel Acquisition Techniques) functionality, in all directions, throughout the entire FoV of 205 cm [2]. Siemens iPAT with Tim has highest signal-to-noise, provides two different PAT algorithms (mSENSE and GRAPPA) for Parallel Imaging, and integrates the time-saving AutoCalibration into a single scan. The new iPAT[2] enables speed/resolution factors up to 12 [3].

Customer's advantage: Parallel Imaging in all directions.

1) Tim [76 x 32] systems are equipped with 32 independent receiver channels, Tim [76 x 18] systems are equipped with 18 independent receiver channels.
2) Whole body coverage of 205 cm is optional and included in the Tim Whole Body Suite.
3) iPAT[2] is optional and included in the iPAT Extensions option.

Tim will change MR forever.

Tim – Total imaging matrix

■ Matrix coils

The new multi-element Matrix coil concept is an essential part supplementing the most innovative Total imaging matrix.

Matrix coils have multiple receive coil elements that are clustered in groups. Each receive coil element is equipped with a low noise preamplifier to maximize signal-to-noise ratio. The Matrix coil concept includes an intelligent logic combining signals into various permutations and combinations to yield best SNR from the numerous coil elements.

The Head Matrix, Neck Matrix, Spine Matrix, and Body Matrix are examples of the new revolutionary multi-element Matrix coils. The Head Matrix, for example, has 12 receive coil elements. The receive coil elements are clustered in 4 groups with 3 coil elements per group. Since clusters are working in the left-right direction, they do not compromise image quality. The signals from the receive coil elements within a cluster can be chosen from three different Matrix Coil Modes. Depending on the Matrix Coil Mode selected, the Head Matrix can be operated as a 4, 8 or 12 channel array.

■ Matrix Coil Mode

The Matrix Coil Mode is a user-selectable parameter determining the mode extracted from a cluster of receive coil elements.

There are three Matrix Coil Modes available
• CP (Circularly Polarized)
• Dual
• Triple

The CP Mode is optimized to obtain maximum signal-to-noise (SNR) at the center of the region of interest. The Dual and Triple-modes contain additional information which can be used to improve SNR in the periphery of the image and/or enable higher PAT factors.

The Matrix Coil Modes, which are automatically pre-selected by the system, can be best compared with the mono, stereo and quattro-reception known from audio receiver systems: While the mono signal already contains the audio information, the stereo or quattro signal adds spatial information.
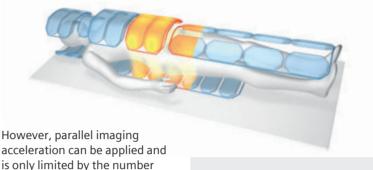
CP Mode

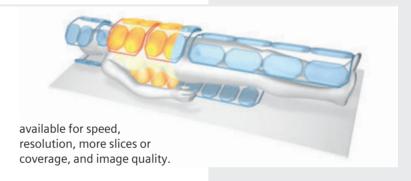With the CP Mode selected, the Head Matrix can be operated as a 4-element CP head array.

There are 4 virtual CP elements. Each virtual CP element is generated from a cluster of 3 receive coil elements. This is the standard mode for non-parallel imaging.

However, parallel imaging acceleration can be applied and is only limited by the number of virtual coil elements. As in conventional CP array coils, the CP Mode guarantees optimum SNR at the center of the image.
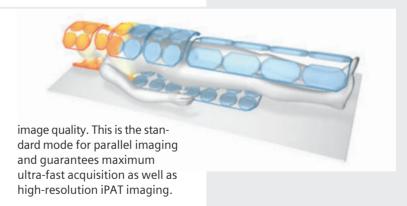
Dual Mode

With the Dual Mode selected, the Head Matrix can be operated as an 8-element CP head array. There are 8 virtual coil elements. The Dual Mode improves SNR and CNR (contrast-to-noise ratio), particularly in the periphery, as more coil elements receive signal. Higher PAT factors are available for speed, resolution, more slices or coverage, and image quality.

Triple Mode

With the Triple Mode selected, the Head Matrix can be operated as a 12-element head array. The Triple Mode further improves SNR and CNR, particularly in the periphery of the image. As more coil elements receive signal and are available for post-processing. In addition, higher PAT factors are available for speed, resolution, more slices or coverage, and image quality. This is the standard mode for parallel imaging and guarantees maximum ultra-fast acquisition as well as high-resolution iPAT imaging.

In the past, the signals from independent receiver coils within an array were directly connected to independent receiver channels. The Matrix coil concept allows an unprecedented flexible and efficient use of receiver channels. The higher the Matrix Coil Mode, the more independent receiver channels per Matrix coil are utilized, resulting in higher SNR and CNR, particularly in the periphery of the image. On one hand, it allows for a higher flexibility of iPAT as well as higher acceleration factors. On the other hand, even with the CP or Dual Mode selected, the SNR at the center of the region of interest is always optimal.

Superior Tim technology, revolutionary multi-element Matrix coils, excellent experience with iPAT and the intelligent logic available with the Coil Mode are collectively triggering a revolution in MR imaging.

Tim Application Suite

The Tim Application Suite has a complete range of clinically optimized examinations for all regions. Excellent head-to-toe imaging can be accomplished with the sequences and features included in this application suite. There are seven dedicated application packages: **Neuro Suite, Angio Suite, Cardiac Suite, Body Suite, Onco Suite, Ortho Suite and Pediatric Suite** have been included as standard applications. All of them are based on the revolutionary Tim technology.
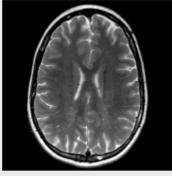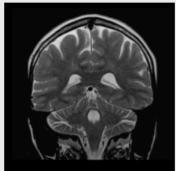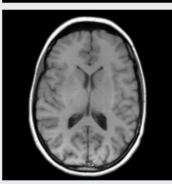
■ Neuro Suite

The Neuro Suite is a part of the Tim Application Suite. Comprehensive head and spine examinations can be performed with dedicated programs that are optimized for clinical examinations. High resolution protocols and fast protocols for uncooperative patients are provided, as well as protocols optimized for pediatric applications. Neuro Suite also includes protocols for diffusion imaging, perfusion imaging, and fMRI.
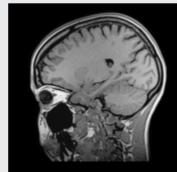
This package includes, for example:

- EPI sequences and protocols for diffusion imaging, perfusion imaging, and fMRI for advanced neuro applications
- 3D isotropic resolution volume imaging using T1 3D MPRAGE/3D FLASH and T2 dark fluid 3D TSE
- Whole spine protocols in multiple steps with software-controlled table movement
- T2-weighted high resolution 3D RESTORE protocols optimized for inner ear examinations
- 2D and 3D MEDIC protocols for T2-weighted imaging, particularly for C-spine examinations in axial orientation where reproducibility is difficult due to CSF pulsations and blood flow artifacts
- 3D Myelo with 3D HASTE and 3D TrueFISP for anatomical details
- Dynamic sacro-iliac joint imaging using fast T1-weighted FLASH 2D sequence
- Spine diffusion protocols to differentiate osteoporosis versus tumor infiltration and post radiotherapy changes versus residual tumor with PSIF sequence
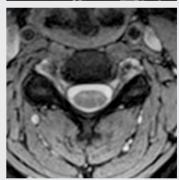
■ **Angio Suite**

The Angio Suite is also a part of the Tim Application Suite. Excellent MR Angiography can be performed to visualize arteries and veins with or without contrast agent.

This package includes, for example:

Contrast-enhanced MRA

• 3D contrast-enhanced MRA protocols with or without iPAT for head, neck, thorax, abdomen, peripheral regions with the shortest TR and TE. The strong gradients make it possible to separate the arterial phase from the venous phase. No venous contamination is seen due to the ultra-fast ce-MRA protocols.

• CareBolus functionality for excellent results. It supports accurate determination of the Bolus arrival time and the "Stop and Continue" of the 3D ce-MRA protocol after the 2D bolus control scan.

• Excellent peripheral ce-MRA can be acquired with flexible coil combinations.

Non-contrast MRA and venography

• 2D and 3D Time-of-Flight (ToF) protocols for MRA for Circle of Willis, carotids, neck vessels, and breath-hold protocols for abdominal vessels

• Triggered 2D/3D ToF sequences for non-contrast MRA, particularly in the abdomen and the extremities

• 2D/3D phase-contrast

• MR venography with 2D/3D Time-of-Flight (ToF) and phase-contrast

• Tilted optimized non-saturating excitation and MTC techniques for improved CNR

• Water-excitation 3D ToF protocol for better suppression of orbital fat
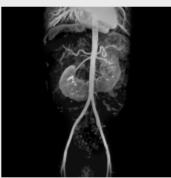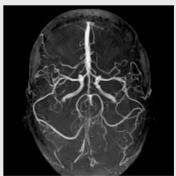
Image processing tools

• MIP, MinIP, and 3D SSD

• Inline MIP for immediate results

• Inline standard deviation maps of phase-contrast measurements for delineation of arteries and veins

Dedicated workflow and ease-of-use features

• Matrix coils provide flexibility to combine coil elements and have a large anatomical coverage

• Software-controlled table movement

Cardiac Suite

The Cardiac Suite[1] covers the complete application range from morphology, ventricular and valvular functions to dynamic signal, late enhancement, coronary imaging and angiography.

This package includes, for example:

Cardiac view creation
- Fast acquisition of the basic cardiac views for further examination planning
- Cardiac scouting provides users with a step-by-step procedure for the visualisation and planning of typical cardiac views, e.g. based on TrueFISP or dark blood TurboFLASH: Short-axis, 4-Chamber and 2-Chamber views

Morphology – Heart and Vessel structure and valve function
- Various breath-hold techniques for strong contrast between the blood and vascular structures (dark-blood TSE and HASTE imaging are available for the structural evaluation of the cardio-thoracic anatomy, including vessels or heart valves. Standard cine techniques (FLASH) can also be used to visualize valvular function
- Optimized workflow with Drag & Drop recall (Phoenix), Scan button and Copy Position
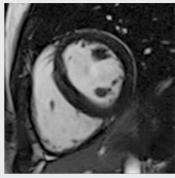
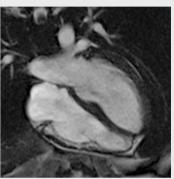1) PMU option required

Ventricular function and wall motion

Tools for rapid evaluation of left or right ventricular function:
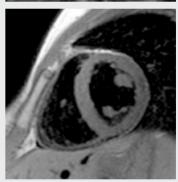
- Acquisition of a stack of short-axis slices (standard segmented FLASH, or advanced segmented TrueFISP)
- Automatic adjustment of the acquisition window to the current heart rate
- Use of the Inline ECG for graphical ECG triggering setup
- Prospective gating with cine sequences (TrueFISP, FLASH)
- Protocols for coverage of the whole heart
- iPAT integration for highest temporal/spatial resolution

Tissue characterization

Protocols for high contrast and high spatial resolution tissue characterization (first pass and delayed enhancement imaging):

- Ultra-fast protocols for dynamic imaging, e.g. for 8 arbitrarily oriented slices per heart beat. These protocols provide multi-slice information for the assessment of coronary heart disease (Turbo FLASH)
- Segmented IR TrueFISP/FLASH for the assessment of myocardial viability in 2D and in 3D by delayed enhancement
- TI Scout for optimization of contrast between infarction and normal myocardium
- Protocols for paediatric examinations, stress imaging and plaque characterisation

Coronary Imaging

- Coronary imaging based on
  a breath-hold 3D FLASH
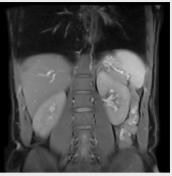 sequence or motion correction
  with 1D PACE
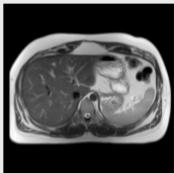
■ Body Suite
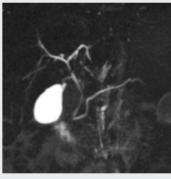
The Body Suite is dedicated for clinical body applications. Ultrafast high-resolution 2D and 3D protocols are provided for abdomen, pelvis, MR Colonography, MRCP, dynamic kidney, and MR Urography applications. Siemens-unique 2D PACE technique makes body imaging simple, allowing for multi-breath-hold examinations as well as free breathing during the scans. Motion artifacts are mostly reduced with the 2D PACE Inline technology.
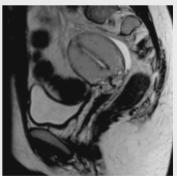
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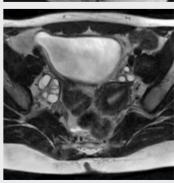
• Free breathing 2D PACE applications with 2D/3D HASTE (RESTORE) and 2D/3D TSE (RESTORE)

• Optimized fast single-shot HASTE protocols and high-resolution 3D RESTORE protocols for MRCP and MR Urography examinations

• Excellent fat suppression protocols with Quick FatSat, STIR, FLASH and HASTE in-phase/opposed-phase protocols and multi-echo TSE

• Dynamic 3D VIBE protocols for best detection of focal lesions with high spatial and temporal resolution

• High resolution pelvic imaging (prostate, cervix) for tumor detection

• Colonography bright lumen with T2-weighted TrueFISP and dark lumen with T1-weighted VIBE

• Dynamic volume examinations with 3D VIBE
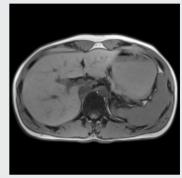
■ Onco Suite
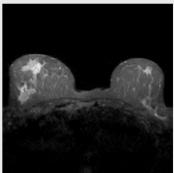
MR imaging has the biggest advantage of excellent soft tissue contrast, multi-planar capabilities and the possibility of selectively suppressing specific tissue e. g. fat or water. This helps in the detection of pathologies, particularly metastases. The Onco Suite features a collection of sequences as well as protocols and evaluation tools that guide through a detailed screening of clinical questions. This includes protocols and breast evaluation post-processing programs for comprehensive breast imaging.

This package includes, for example:
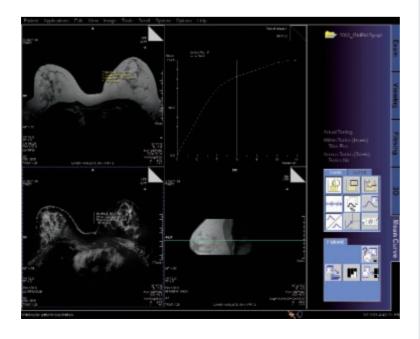
- STIR TSE and FLASH in-phase/opposed-phase protocols with a high sensitivity to metastases detection
- Breast imaging protocols with iPAT for highest temporal and spatial resolution

- Dynamic imaging protocols for assessment of the kinetic behavior for lesion detection and characterization
- Special protocols that increase lesion conspicuity in the vicinity of breast implants
- Quantitative evaluation and fast analysis of the data with colorized Wash-in, Wash-out, Time-To-Peak, Positive-Enhancement-Integral, MIP-time, and combination maps with Inline technology or for offline calculation
- Display and analysis of the temporal behavior in selected regions of interest with the included MeanCurve post-processing application. This includes the capability of using additional datasets as a guide for defining regions of interest even faster and easier than before.
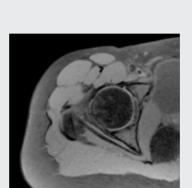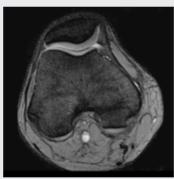
■ Ortho Suite

The Ortho Suite is a comprehensive collection of protocols for joint imaging including the spine. Avascular necrosis and internal derangements may benefit from MR. Also in case of tumors and infections, a large amount of additional information can be acquired using the protocols provided as standard material in this suite.
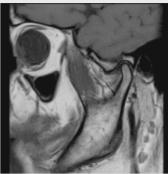
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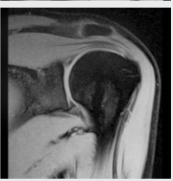
- 2D TSE protocols for PD, T1, and T2-weighted contrast with high in-plane resolution and thin slices
- 3D MEDIC, 3D TrueFISP protocols with water excitation for T2-weighted imaging with high in-plane resolution and thin slices
- High resolution 3D VIBE protocol for MR arthrography (knee, shoulder and hip)
- 3D MEDIC, 3D TrueFISP, 3D VIBE protocols with water excitation having high isotropic resolution optimized for 3D post-processing
- 3D TSE with variable flip angle and high isotropic resolution optimized for 3D post-processing
- Whole-spine single-step or multi-step protocols
- Excellent fat suppression in offcenter positions, e. g. in the shoulder due to high magnet homogeneity
- Dynamic TMJ and ilio-sacral joint protocol
- Susceptibility-insensitive protocols
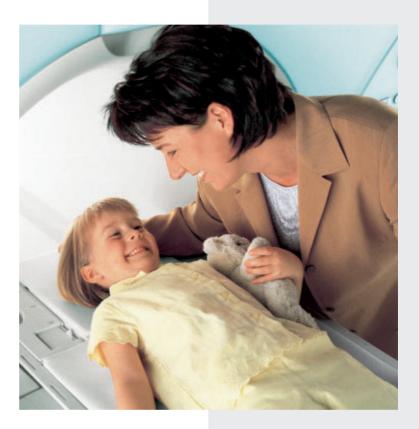
■ Pediatric Suite

The parameters for pediatric imaging vary significantly in comparison to the parameters for adults. The reasons for the difference in parameters are: developing tissues, body size, faster heart rates and compliance with breath-hold commands. The Pediatric Suite provides dedicated protocols for pediatric imaging by age groups, e. g. available for tumors, malformations and epilepsy in the brain, cardiac morphology as well as functional imaging and contrast enhanced MR Angiography.

This package includes, for example:

Neuro
- Head protocols divided according to age groups and providing best contrast-to-noise ratio with optimized parameters, e. g. protocols for under 6 months old infants, protocols for infants between 6 months and one year, protocols for toddlers between one and two years of age
- Excellent T1-weighted contrast with optimized TR, TE and flip angles
- Protocols with MTC pulse for post-contrast T1-weighted imaging that provides excellent contrast-to-noise ratio resulting in improved conspicuity of lesions/pathologies

Cardiovascular
- Cardiac morphology protocols according to age groups, optimized for a small FoV and faster heart rates in congenital heart diseases (CHD)
- Imaging protocols for ventricular function as well as valvular and septal defects
- ce-MRA as an adjuvant in the assessment of CHD and vasculature

■ Sequences

- Spin Echo (SE):
  Single, Double and Multi Echo
  (up to 32 echoes)
- Inversion Recovery (IR)
- 2D/3D FLASH (spoiled GRE)
- 2D/3D FISP
- 2D GRE segmented
- 2D/3D PSIF
- PSIF Diffusion
- 2D/3D TrueFISP
- TrueFISP segmented
- Shared Phases Real-time
  TrueFISP
- 2D/3D MEDIC (Multi Echo Data
  Image Combination)
- 2D/3D TurboFLASH (MPRAGE)
- 3D VIBE (Volume Interpolated
  Breath-hold Examination),
  using interpolation and quick
  fat saturation
- 2D/3D TSE
- Echo Sharing technique for
  dual-contrast TSE enhancing
  speed by using acquired
  echoes in both proton density
  and T2 images simultaneously.
  Speeds up dual-contrast
  TSE by almost a factor of 2
- 2D/3D RESTORE TSE
- Single slab 3D TSE with ultra-
  high turbo factors for T2
  and dark-fluid applications
  with isotropic resolution
- 2D/3D TurboIR (TrueIR, STIR,
  DarkFluid T1 and T2)

- 2D/3D HASTE (Half-Fourier
  Acquisition with Single Shot
  Turbo Spin Echo)
- 2D/3D HASTE IR for fat or
  fluid suppression
- 2D/3D Single Shot TSE for
  heavy T2 weighting
- 2D/3D Time-of-Flight
  (ToF) Angiography, single and
  multi slab
- 2D/3D Time-of Flight (ToF),
  triggered and segmented
- 2D/3D Phase Contrast
  and multi-venc Phase Contrast
  Angiography
- 2D/3D Phase Contrast
  triggered
- ce-MRA sequences
- Single-shot EPI (SE and FID)
- 2D/3D Segmented EPI
  (SE and FID)

■ **Tim Application Suite: Acquisition and Reconstruction Techniques**

- Diffusion-weighted imaging
- Perfusion imaging
- fMRI BOLD imaging
- 1D/2D PACE (Prospective Acquisition CorrEction)
- Whisper Mode for scanning with reduced noise; beneficial for children, non-cooperative, or anxious patients
- LOTA (Long Term Data Averaging) technique for motion and flow artifact reduction without increasing scan time
- Elliptical scanning reduces scan time for 3D imaging
- Selectable centric elliptical phase reordering via the user interface
- Inversion Recovery to nullify the signal of fat, fluid or any other tissue
- True Inversion Recovery to obtain strong T1-weighted contrast
- Dark Blood inversion recovery technique that nulls fluid blood signal

- Saturation Recovery for 2D TurboFLASH, gradient echo, and T1-weighted 3D Turbo-FLASH with short scan time (e. g. MPRAGE)
- Presaturation Technique. RF saturation pulses to suppress flow and motion artifacts. Up to six saturation bands may be positioned in any orientation
- Tracking SAT Bands maintain constant saturation of venous and/or arterial blood flow, e. g. for 2D/3D sequential MRA
- Fat Saturation. Additional frequency selective RF pulses, used to suppress bright signal from fatty tissue. Two selectable modes: weak, strong
- Water Saturation. All sequences used for fat saturation can also be used to suppress the water signal
- Quick FatSat
- Fat Excitation. Spectral selective RF pulses for exclusive fat excitation
- Water Excitation. Spectral selective RF pulses for exclusive water excitation

- Silicone detection for breast examinations
- MTC (Magnetization Transfer Contrast). Off-resonance RF pulses to suppress signal from certain tissues, thus enhancing the contrast. Used e. g. in MRA
- TONE (Tilted Optimized Nonsaturating Excitation). Variable excitation flip angle to compensate inflow saturation effects in 3D MRA. TONE pulse selectable depending on the desired direction of flow sensitivity
- GMR (Gradient Motion Rephasing). Sequences with additional bipolar gradient pulses, permitting effective reduction of flow artifacts
- Freely adjustable receiver bandwidth, permitting studies with increased signal-to-noise ratio
- Freely adjustable flip angle. Optimized RF pulses for image contrast enhancement and increased signal-to-noise ratio

■ **Highlights**

- *syngo* MR – the intuitive user interface
- *syngo* Scan Assistant
- Inline technology
- 1D/2D PACE Inline motion correction
- Advanced workflow features such as image stamps, Inline display, Inline movie functionality
- iPAT – high-performance and flexible Parallel Imaging. Tim and its Matrix coils are combined with the most innovative

implementation of PAT for highest speed and resolution.
- The Tim Assistant and the Intelligent Coil Control help maximize PAT factors according to the selected coils to achieve exemplary image quality in the shortest time.
- Phoenix functionality for reproducible image quality and for benefitting from other MAGNETOM users sharing their protocols
- Argus viewer for reviewing cine studies

- Dynamic Analysis for addition, subtraction, division, standard deviation, calculations of ADC maps, T1 values, T2 values, z-score analysis etc.
- 3D post-processing MPR, MIP, MinIP, SSD
- Software-controlled patient table movement for a total coverage of 154 cm (standard)
- Flexible film formats and paper print
- Data storage of images and cine avi files on CD ROM with DICOM viewer as the viewing tool

Inline Technology – Processing Instead of Post-processing

Inline Technology helps to streamline the clinical workflow by automating mundane post-processing steps before image viewing. See the clinical results immediately.

Examples are:

- Automatic subtraction of images, e. g. pre- and post-contrast enhancements
- Automatic on-the-fly calculation of standard deviation, for better differentiation of arterial and venous phases
- MIP on the fly, i. e. MR Angiography with automatic image subtraction and following MIP in three orthogonal planes, stored as a separate study
- Prospective motion correction (1D and 2D PACE) on-the-fly
- Diffusion and perfusion imaging
- Automated breast evaluation
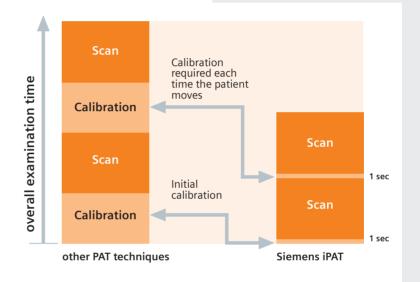
■ **iPAT (integrated Parallel Acquisition Techniques)**

- iPAT is the Siemens Parallel Imaging solution. It is fully integrated. PAT factors up to 4 are implemented in the Tim Application Suite
- Two algorithms – mSENSE and GRAPPA – included for maximum quality for all applications
- Integrated AutoCalibration includes an immediate reference (calibration) scan to additionally save on total scan time
- iPAT is compatible with all relevant sequence techniques (e.g. SE, TSE, RESTORE, MEDIC, TIRM Darkfluid, HASTE, EPI, MPRAGE, 3D VIBE, FLASH, TrueFISP, TurboFLASH, etc)
- iPAT is compatible with all Matrix coils, all array coils, as well as coil combinations
- Tim Assistant facilitates optimized iPAT settings

Higher speed and temporal resolution can be used for:
- Improved image resolution
- Improved image quality due to reduced artifacts
- More slices and coverage in the same breath-hold

overall examination time

Scan

Calibration
Calibration required each time the patient moves

Scan

Calibration
Initial calibration

Scan
1 sec

Scan
1 sec

other PAT techniques

Siemens iPAT

■ **1D PACE Fast Navigator**

Prospective Acquisition
CorrEction
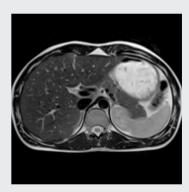
Quick and easy acquisition
control, e. g. for cardiac imaging

• Allows examination of
patients with free breathing
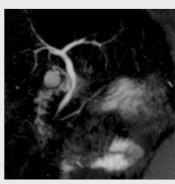
■ **2D PACE Precise Motion Correction**

New robust pattern matching
to detect and correct respiratory
motion of the heart, liver, etc.

• Significantly increased
image quality
• Improved security in the
diagnosis of diseases in
moving organs and precise
slice registration for multi-
breath-hold studies
• Data acquisition during free
breathing for high resolution
2D and 3D examinations

Tim – Matrix Coils and RF Technology

One of the major benefits of the revolutionary Total imaging matrix is that it optimizes coil positioning and virtually eliminates coil changing times.

■ RF Receiver Technology

The MAGNETOM Avanto equipped with Tim facilitates the integration of up to 76 coil elements within one examination.

Ten (10) coil connectors enable the simultaneous use of a large number of coils. All coil elements of all connected coils can be flexibly selected for each scan.

■ Intelligent Coil Control

- Automatic detection of the exact coil position on the patient table
- What you see is what you get: graphical visualization of coils at their current position within the user interface
- Choice of coil setting via software buttons at the MR console
- Storage of coil settings within the protocols and adaptation when the protocol is recalled

Additional benefits
- No coil changing with multi-exam studies
- All coils are time-saving "no-tune" coils
- Low-noise preamplifiers

■ Matrix coils

The multi-element Matrix coil concept is an essential part supplementing the Total imaging matrix.

It is the next generation IPA (Integrated Panoramic Array) concept from Siemens. With new advances in MR imaging, the IPA coil concept evolved into the Matrix coil concept. The Matrix coil concept has an intelligent logic that combines signals in various permutations and combinations to yield best SNR from the numerous coil elements.

The following Matrix coils are standard:
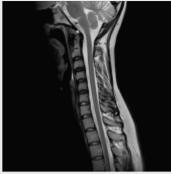
- Head Matrix coil
  4-channel CP Mode,
  8-channel Dual Mode,
  12-channel Triple Mode

- Neck Matrix coil
  2-channel CP Mode,
  4-channel Dual Mode

- Spine Matrix coil
  8-channel CP Mode,
  16-channel Dual Mode,
  24-channel Triple Mode

The following Matrix coils are optional:

- Body Matrix coil
  2-channel CP Mode,
  4-channel Dual Mode,
  6-channel Triple Mode
  (up to 4 Body Matrix coils can be utilized simultaneously)

- PA Matrix coil
  (Peripheral Angio Matrix)
  8-channel CP Mode

> Refer to the appendix: "Matrix Coils"

■ Additional RF Coils

The following RF coils are standard:

• CP Flex coil, large

• CP Flex coil, small

(including the CP Flex coil interface)
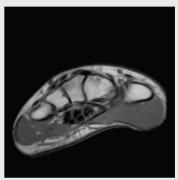
For information about other available RF coils:
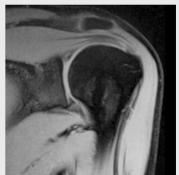
> Refer to the appendices: "Dedicated Coils", "RF Flexible Coils" and "Special Head Coils"

In addition to the Matrix coils, a large variety of Siemens MAGNETOM Symphony and Sonata coils as well as 3rd party coils are compatible with the MAGNETOM Avanto.

Integrated CP Body Coil

Integrated whole-body antenna system

- No tune transmit/receive coil
- Circularly polarized (CP)
- Optimized RF efficiency and signal-to-noise-ratio (SNR)

Digital Signal Processing System

- Solid-state amplifier, maintenance-free
- Digital quadrature demodulation

- Digital filtering
- Receiver with high dynamic range without adjustments

	Frequency stability (5 min)	$\pm\, 2 \times 10^{-10}$
	Frequency control	32 bits (0.015 Hz)
	Phase control	16 bits (0.006 degrees)
Transmitter Path	Transmit amplitude	16 bit control 50 ns resolution
	Gain stability (5 min)	< 0.1 dB (low signal path) < 0.3 dB (power amplifier)
Transmit Amplifier	Extremely compact water-cooled	
	Transmit amplifier bandwidth	500 kHz
	Peak power	15 kW
Receive Path	Receiver bandwidth	500 Hz-1 MHz (for each channel)
	Receiver signal resolution	32 bits
	Number of independent receiver channels	18/32
	Sampling rate (Sampling resolution)	10 MHz 100 ns
	Preamplifier noise figure	< 0.5 dB
	Total gain	36 dB/51 dB with automatic control
	Dynamic range	135 dB instantaneous at receiver 142 dB with automatic control

Tim – Workflow and Patient Handling

Tim ensures increased patient comfort and optimized workflow efficiency.

- Only one patient setup, no repositioning, no changing of coils
- Ultra-light weight coils
- Imaging with optimized surface coil quality
- Remote table move
- Feet-first examinations for many applications

The majority of applications can be performed in the feet first position, e.g. cardiac, liver, upper abdomen, pelvis, colonography, body angio, reducing the level of anxiety experienced by highly claustrophobic patients.

The scan range of 205 cm[1] allows for whole body examinations with full usage of the surface coils, however, without the need for patient repositioning. This saves time without compromising image quality.

■ Patient Table
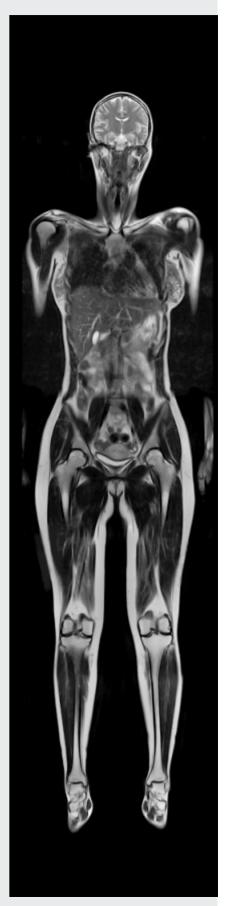
Free-floating table: Free foot room for the attending staff and better access to the patient (cantilevered table design)

Table extends 53 cm (103 cm[1]) beyond the back of the system for additional patient access

Removable tabletop and trolley (optional)

Max. patient weight (including vertical movement)		200 kg
Max. scan range		154 cm opt. 205 cm[1]
Vertical table movement	Range	47-89 cm
	Max. speed	10 cm/s
Longitudinal table movement	Max. range	263.5 cm
	Max. speed	20 cm/s

1) With Tim Whole Body Suite option.

Patient Positioning Aids

Standard set of cushions for comfortable and stable patient positioning together with restraining straps.

Additional positioning supports (optional)
• Set of vacuum cushions (large, medium, small) with vacuum pump
• Cushions filled with gel for improved fat saturation

Patient Comfort Facilities

Facilities at the tableside control unit and at the operator's console

• In-bore lighting (3 levels)
• In-bore ventilation (3 levels)

• In-bore intercom via loudspeaker, microphone and earphones
• Look-out mirror 90°

Tableside Control Units

Two ergonomically designed units integrated into the front covers (one on each side of the patient tunnel; 3rd unit at the rear end, optional)

Controls
• Table up/down
• Table in/out in 2 speed levels
• Table stop
• Laser light localizer
• Automatic transfer to isocenter
• Home position (auto transfer)

• Ventilation within the patient tunnel (adjustable in 3 levels)
• Lighting within the patient tunnel (adjustable in 3 levels)
• Scan start, scan stop
• Volume of speaker and headphones in examination room for external audio system

Table functions can also be controlled via software from the operator's console.

CAUTION
Laser Radiation
do not stare into beam
PEAK POWER <3mW
WAVE LENGTH 540–700nm
CLASS II LASER PRODUCT

■ Patient Communication

Assistance call via squeeze-bulb for the patient

Ergonomically designed patient communication unit – may be placed at any convenient location on the console table

- Intercom communication with the patient
- Response to the patient's activation of the squeeze-bulb
- Table stop
- Volume of speaker in control room
- Volume of speaker and headphones in examination room for voice commands

- Connection to external audio system
- Independent volume control of voice and music
- Pneumatic system of headphones
- Loudspeaker
- Microphone

Automatic and freely programmable voice commands for breath-hold examinations.

Magnet System

■ Superconducting Magnet

Short bore, patient-friendly design with large flared opening
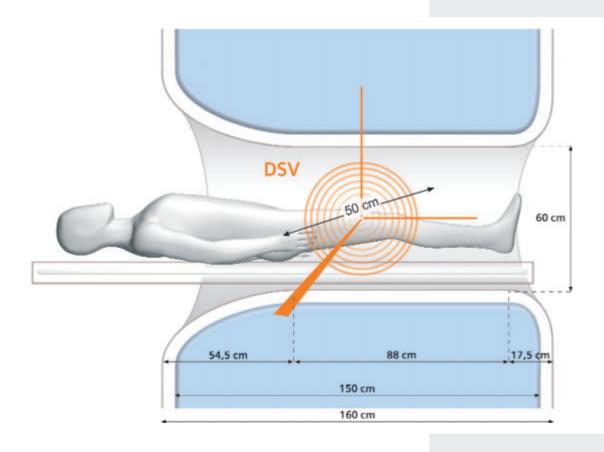
Large DSV (diameter spherical volume), high homogeneity

Easy siting due to AS (Active Shielding) and E.I.S. (External Interference Shielding) magnet technology

■ Magnet Bore

Magnet length	150 cm
Magnet bore diameter[1]	90 cm
Inner tunnel length	85 cm
Length of flared opening	37.5 cm
Inner diameter[2]	60 cm
System length	160 cm

1) w/o shim coils, gradient coil, RF body coil
2) incl. shim coils, gradient coil, RF body coil

■ **Magnet Parameters**

Operating field strength	1.5 Tesla
Superconductor	Niobium-Titanium
Field stability over time	< 0.1 ppm/h

■ **Homogeneity (based on highly accurate 24 plane plot)**

DSV	Guaranteed	Typical
50 cm	< 1.5 ppm	1 ppm
45 cm	< 1 ppm	0.5 ppm
30 cm		0.4 ppm
20 cm		0.25 ppm
10 cm		0.1 ppm

*DSV = Diameter spherical volume
(x, y, and z direction)*

*Standard deviation Vrms
(volume root-mean square)*

*measured with highly accurate 24 plane plot
method (20 points per plane)*

Standard active shim with 3 linear channels

■ **3D Shim**

Patient-specific automated shim	For optimization of the magnetic field homogeneity
Time to shim	approx. 20 sec

■ **Active Shielding (AS)**

Fringe field	0.5 mT*	axial x radial 4.0 m x 2.5 m
	0.1 mT	axial x radial 5.5 m x 3.1 m

5th generation active shielding
(AS) technology with counter coils

* pacemaker safety limit

■ **External Interference Shield (E.I.S.)**

Patented shielding system
integrated into the magnet

Continuous compensation
and automatic suppression of
external magnetic field inter-
ferences during measurement
(caused by moving ferro-
magnetic object

■ **Magnet Cooling System**

The MAGNETOM Avanto
Magnet incorporates
Zero-Helium-Boil-Off technology

Refill interval (typical)	10 years*
Boil-off rate (typical)	0.0 l/h*
Helium capacity	1,600 liters

** for typical clinical use, depending on
sequences and operating time*

Gradient System

The combination of our world-class gradients together with Tim (Total imaging matrix) enables the most demanding applications.

General Features

- Actively shielded (AS), super-compact whole-body gradient coil system
- Extremely low eddy currents
- Water-cooled coil and amplifier for maximum performance
- Gradient coil length 122 cm

Excellent spatial and temporal resolution

Shortest TE and TR for high image contrast and best signal-to-noise ratio

Patient-specific shimming

Active shim via 3 linear channels with 20 coils

Prepared for 5 additional non-linear 2nd order channels with 32 coils for advanced high order shim (optional)

Features and Technical Data

> Refer to appendices:
Tim [76 x 18] with Q-engine
Tim [76 x 18] with SQ-engine
Tim [76 x 32] with SQ-engine
for the different system options

AudioComfort

The integrated design of the MAGNETOM Avanto as well as the hardware and software measures included reduce the acoustic noise to a minimum without compromising gradient performance.

AudioComfort incorporates aspects of the gradient coil, body coil and magnet as well as the sequence design.

■ Gradient

- Special epoxy resin and casting technology for damping vibrations.

- Reduction of gradient stray field to decrease eddy currents which generate acoustic noise.

- Noise-optimization of the gradient coil with a suspension in the magnet that makes the structure stiffer.

- This reduces vibration amplitudes without the drawbacks of supporting the gradient coil directly on the floor.

■ Body Coil

- The supporting tube of the body coil is built from epoxy instead of filament winding for higher stiffness, increasing internal damping and minimizing vibration amplitudes.

- In order to achieve maximum noise reduction, the body coil tube was extended beyond the gradient coil.

This is an extremely efficient method for reducing noise, since most of the noise is generated at the ends of the gradient coil.

- Eddy current circuit boards are permanently attached to the GFK tube to reduce high frequency noise.

- The special suspension of the Body coil acts acoustically decoupling.

■ Magnet

- Encapsulation of the entire magnet
- Efficient floor decoupling for reduction of noise transferred to the building

- Noise-optimized cold head

Sequence Design

- Optimized sequence timing
- Sequences automatically avoid parameter settings that cause the gradient coil to resonate

- No relevant application drawbacks – no increase in sequence parameters, i. e. full performance

"Whisper Mode"

The "Whisper Mode" is a user-selectable mode that reduces the max. slew rate and max.

amplitude of the gradients. It is compatible with nearly all sequence techniques.

Acoustic Noise

Max. acoustic noise level[1]:
93 dB(A) for Q-engine
97.2 dB(A) for SQ-engine

With AudioComfort, acoustic noise is reduced by up to 30 dB(A) as compared to conventional systems. This is a reduction of 97% in sound pressure.

1) According to NEMA specifications with max. gradient amplitude and max. gradient slew rate.

Clinical Benefits

- High performance combined with quietness. All gradient demanding protocols using EPI techniques such as diffusion, perfusion or fMRI examinations show a significant acoustic noise reduction, thanks to Siemens unique AudioComfort.

- AudioComfort makes MR examinations a comfortable experience even for children.
- AudioComfort prevents the necessity of implementing noise-absorbing measures to gain a comfortable noise level for technicians and neighbors.

Acquisition Parameters*

■ 2D Slices

Number of slices	per single slice stack	1-128 (steps of 1)
	per series (total number of slices in one dynamic measurement)	up to 262,144 (depending on matrix size)
Slice order		ascending, descending or interleaved

■ 3D Slabs/Partitions

Number of 3D partitions	per single slab	4-512
Number of 3D slabs	(3D volumes)	1-128 (steps of 1%)

■ Acquisition Matrix

Frequency encoding	(true imaging matrix without interpolation or oversampling)	64-1024 (in steps of 64)
Phase encoding		32-1024 (in steps of 1%)

■ Partial Fourier Imaging

Phase partial Fourier	(1/2 = Half Fourier)	4/8-1 (steps of 1/8)
Read partial Fourier	(asymmetric echo)	selectable
Slice partial Fourier	(3D volumes)	6/8-1 (steps of 1/8)

■ Rectangular Field of View

Rectangular Field of View	(in phase-encoding direction)	3%-100%

■ Averaging

Number of data acquisitions		1-32 (steps of 1)
Averaging mode		short term, long term (LOTA)

Combinations of the parameters stated are not always possible; some parameters may depend on optional application packages

■ Oversampling

Read oversampling		100% standard
Phase oversampling		0%-100% (steps of 12.5%)
Slice oversampling	(3D volumes)	0%-100% (steps of 12.5%)

■ Interpolation

In-plane interpolation	in frequency-encoding and phase-encoding direction	selectable (factor of 2)
3D interpolation	(3D volumes)	selectable (up to factor of 2)

■ Slice Orientation

Slice orientations	for 2D scans and 3D scans	transverse, sagittal, coronal, oblique, double oblique (steps of 0.1°)
Multi-slice multi-angle	(simultaneously)	yes

■ Off-center Shift

Longitudinal direction	(head-feet)	-250 mm to +250 mm
Horizontal direction	(left-right)	-250 mm to +250 mm
Vertical direction	(anterior-posterior)	-250 mm to +250 mm

■ Serial Acquisitions

Number of repeat scans	with constant delay times	1-4096
	with different delay times	1-65

■ Swap

Exchange of read-out and phase-encoding direction		yes

* Combinations of the parameters stated are not always possible; some parameters may depend on optional application packages

syngo MR Software

syngo®, the unique software platform for medical applications and systems integrates all patient related information, physiological and imaging data across your entire clinical workflow. In every workplace *syngo's* innovative user interface allows you to know intuitively what to do. Its intelligent automation features accelerate your examination, enabling

smooth, efficient workflow, across modalities, departments and people. With *syngo,* your workplace is uniquely customized to the way you work. The "program" concept in *syngo* MR enables scanning patients with a minimum of mouse clicks. This speeds up the total examination time.
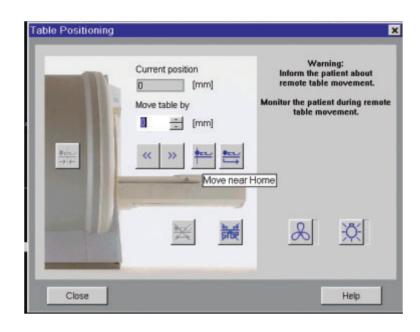
syngo MR Highlights

■ **Intelligent Features**

The *syngo* MR user interface is the cockpit for dynamic MRI.

The ergonomic and easy-to-use interface supports the clinical workflow.

| Tim Assistant	Helps to make Parallel Imaging easy by automatically recommending the appropriate PAT factor for the selected application. Tim Assistant always knows the selected coil elements and the MR protocol, ensuring the optimal iPAT configuration for each application.
Intelligent Coil Control	Detects the position and orientation of coils automatically and offers it in the user interface right within the graphical slice positioning.
Inline Applications Card	Programming of Inline processes for the current protocol • Subtraction • Standard deviation • MIP • Breast evaluation
syngo Scan Assistant	Shows parameter constraints and offers possible solutions.
Inline Display	Automatically shows reconstructed images. It offers real-time control of the results and opens automatically for e. g. real-time interactive scanning or CareBolus examinations.
Inline Movie	Inline technology automatically starts the cine image display.
Scan Open Protocol	Allows faster workflow for breath-hold exam.
Table Positioning Interface	Remote software control of table move and patient comfort facilities, such as in-bore ventilation and lighting.
Physiological Display	Displays the pulse, ECG or respiration signal, combined with a graphical indication of the acquisition window (requires PMU option).
Automatic Voice Command	Records and plays freely programmable language-dependent voice commands, e. g. for breath-hold instructions to the patient.
Online Help	Functions as a context-sensitive and quick resource for questions about software operation or MR physics.

37

■ **Phoenix – What you see is what you get**
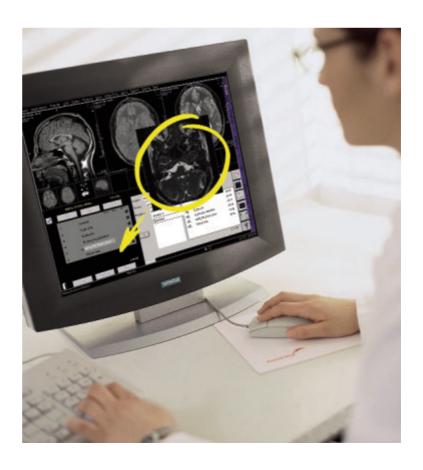
The unique Phoenix technique from Siemens is the easiest way to exchange protocol data. It supports intelligent extraction of sequence parameters from images acquired worldwide with MAGNETOM systems via network, CD exchange, or the Internet.

By simply dragging the desired image into the measurement queue, Phoenix extracts the protocol from the DICOM header in the images, and instantly duplicates the protocol – TR, TE, bandwidth, number of slices, echo spacing, etc. The same parameters can be applied for subsequent scans.

Phoenix is standard on all MAGNETOM systems.

- Supports multi-center protocol standardization

- Improves reproducibility of studies, e. g. in case of follow-up or research

- Helps to establish new applications quickly. Expertise from other sites is available in seconds

- Shares optimized protocols on the different MAGNETOM systems

- Is an effective tool for monitoring and assessing quality and can help to maintain the highest possible performance level

- Is a tool for the visual selection of applications that are either new to a facility or are in the start-up phase

- Enables MAGNETOM users around the world to exchange protocols and benefit from the experience of other experts, e. g. by downloading images from the internet

syngo MR Examination

■ Integrated Exam Programs

- Executable with just one mouse click
- Selects automated examinations with less interaction
- Enables automated scanning
- Allows queuing of multiple protocols as program steps during an examination

- Pending program steps can be rearranged or removed from the queue, as required
- Allows for predefined pauses between program steps, e. g. contrast agent pauses
- Allows for the appending and deleting of program steps
- Parameters can be copied either manually or automatically

- Programs can be saved to the exam explorer
- Enables easy exchange of program steps between queue area and exam explorer
- Both program steps and the whole queue can be repeated, as required

■ Exam Explorer

- Allows free and flexible programming of customized integrated exam programs

- Simple change of exam programs via drag & drop

■ Scan Preparation

- Automatic adjustment of frequency, transmitter power and 3D Shim

- Eliminates the need for receive adjustments through dynamic receiver gain control, significantly reducing scan time

- Allows for individual interactive adjustments
- No coil tuning necessary, also saving examination time

■ Autoscout

- Allows for automatic start of localizer scan with very short acquisition time

- Allows for arbitrary orientations (multi-slice multi-angle)

- Automatically loads images into Graphical Slice Positioning

■ Graphical Slice Positioning

Simultaneous use of three arbitrary localizer images from possibly different measurements for graphically positioning slices and sat regions.

Interactive modification of measurement parameters (slice thickness, distance factor, oversampling etc.):

- Graphical selection of coil elements
- Off-center positioning (shift of FoV within the selected slice position)

- True Multi slice-Multi angle, i.e. simultaneous measurement of multiple images (stacks with different orientation)
- Recall of previous slice and/or sat region positioning
- Paging through all images during graphical positioning
- Inline Movie, allowing positioning of slices on e.g. the beating heart

- Loads images immediately when they are available, i.e. during image reconstruction
- Allows quick overview via image stamps. Loads entire series of planning images with drag & drop
- Slice positioning (GSP) on 3D reconstructed images

syngo MR Image Viewing and Filming

■ Image Recall

Images are stored in DICOM format, allowing fast image access and recall

- Combines images in a new series, e.g. post-processed images

- Loads images automatically
- Inline Display

■ Image Display

- Various display layouts selectable
- Up to 3 patients can be simultaneously active in the viewer

- Image annotation and labeling
- Non-interpolated display
- Fast paging through up to 500 images with 15 images/s for full screen display

■ Windowing

- Freely selectable window width and center

- Windowing on succeeding images
- Auto-windowing for optimized contrast

- Saves and sends window values

syn*go*
s p e a k i n g

■ Automatic Movie for cine display

Interactive movie paging
by dragging the mouse or

Automatic Movie mode by
clicking the icon

■ Evaluation

Parallel evaluation of up to
40 regions of interest

• Circle

• Rectangle

• Freehand ROI

• Pixel lens with position marker

• Statistical evaluation

• Area

• Standard deviation

• Mean value

• Min/max values

• Image scrolling

• Magnification

• Distance

• Angle

■ 2D Post-processing

Image manipulations

• Reversal of gray-scale values

• Image rotation by 90° or by
user-defined angle

• Flip horizontally/vertically

• Image zoom and pan

• Shutter

• Annotation

■ Position display

Displays measured slice
positions on localizer image and
selected series.

■ Argus Viewer

Viewing software for cardiac MR
studies and large data sets

• Efficient cine review of cardiac
and other dynamic data sets

• Flexible multi-level sorting

• Single movie as well as 2, 4, or
8 simultaneous slices together
in movie mode

• Rapid avi creation of 1 or 4
simultaneous slices

• Creates and edits reports

▪ Mean Curve

Time-intensity analysis for
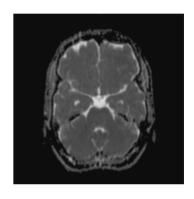contrast-enhanced examinations

e. g. in combination with MR
breast examinations

▪ Dynamic Analysis

Arithmetic operations on
images and series (e. g.
for evaluation of contrast
media studies)

Several evaluation functions
may be started consecutively in
background

- Addition, subtraction,
  multiplication, division of single
  images and whole series
- Arithmetic mean and
  standard deviation across a
  range of selected images
- Calculation of T1 and T2, and
  logarithmic images
- Differentiation/integration
  of selected images
- Calculation of a mean
  slope image from a range of
  selected images
- Calculation of z-score (t-test)
  images for evaluation of
  BOLD imaging data (Blood
  Oxygenation Level Dependent)
- Time-to-peak evaluation (TTP)
- ADC maps

*syn**go***
s p e a k i n g

■ **Filming**

- Connection via DICOM Basic print
- Interactive filming
- Filming parallel to other activities
- Independent scanning and documentation – no wait time due to camera delays

- Freely selectable positioning of images onto virtual film sheet
- Selectable various film layouts
- Mother-in-Child display
- Windowing, image zoom and pan on film sheet
- Configurable image text

- Simultaneous handling of multiple film jobs
- Up to 100 virtual film sheets

■ **Printing on Paper**

Interface and software for printing images on paper (laser printer not included) Grey

levels and color printing supported Data format Post-script Level 2

syngo MR 3D Post-processing

■ **MPR Multiplanar Reconstruction**

Real-time multiplanar reformatting of secondary views

Viewing perspectives:
- sagittal
- coronal
- axial
- oblique
- double oblique
- curved (freehand)

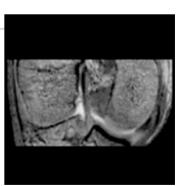Reconstruction along polygon and/or curved (freehand) cut lines

Reconstruction based on reconstructed planes

Reconstruction of user-defined ranges of parallel, radial or freehand cuts.

Selectable slice thickness and slice increment of reconstructed images

Storing of post-processing protocols

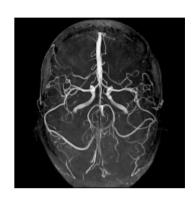Annotations and 2D evaluations such as distance, ROI

■ MIP Maximum Intensity Projection

3D reconstructions of vessels from a 3D data set, or a 2D sequential slice data set (acquired with dedicated MR Angiography sequences)

- Volume of Interest (VoI) defined to increase reconstruction speed and to improve image quality
- Freehand MIP: eliminating interfering overlays by manually drawn, irregular contours in all dimensions

- Arbitrary views along any direction defined interactively with mouse-driven virtual trackball
- Multiple view angles around any orthogonal axis
- Projections displayed as single images, as interactive movie or through fast paging
- MIP thin/MIP thick

■ MinIP Minimum Intensity Projection

Similar to MIP but reconstructs the minimum intensity (e. g. for dark blood techniques)

- Volume of Interest (VoI) defined to increase reconstruction speed and to improve image quality
- Freehand minMIP: eliminating interfering overlays by manually drawn, irregular contours in all dimensions

- Arbitrary views along any direction defined interactively with mouse-driven virtual trackball
- Multiple view angles around any orthogonal axis
- Projections displayed as single images, as interactive movie or through fast paging
- MinIP thin/MinIP thick

■ SSD – Shaded Surface Display

Three-dimensional display of surfaces, such as contrast-enhanced vessels

- Selectable variable threshold values
- Multiple view angles around any orthogonal axis

Rectangular and irregular Volumes of Interest (VoI) can be defined to improve image quality

syngo MR Network Communication

syn*go*
s p e a k i n g

■ **DICOM Services (Digital Imaging and Communications in Medicine)**

Interface for transmitting medical images and information in the DICOM 3.0 industrial standard

Allows for communication between devices from different manufacturers

• DICOM Send/Receive
• DICOM Query/Retrieve
• DICOM SC Storage commitment
• DICOM Basic print
• DICOM Modality worklist
• DICOM MPPS Modality-performed procedure steps; communication back to information system (optional)

DICOM Conformance Statements can be found on the Internet:
www.SiemensMedical.com

> Services
> DICOM
> Magnetic Resonance

■ **Image Transfer**

Local network	Ethernet
Data transfer rate	max. 100 MBit/s
Transfer rate (256 x 256 image)	approx. 4 images/s

■ **Exchange Media**

Storage of images and additional data (e. g. avi files) on CD.

A viewing tool (DICOM Viewer) can be stored together with images on a DICOM CD to be handed out to the patient.

■ **Remote Diagnostics**

Direct computer link to the local Siemens service department or the Siemens service centers (via router with telephone connection)

Image transfer for further evaluation

• Image and file transfer in batch mode

• Reading of entries in the error logbook
• Remote trouble shooting
• Remote access to service manuals written in easy-to-use HTML format
• Remote access to Service Site Database
• Start of preventive main-tenance and quality assurance routines

Provided in conjunction with a service contract with Siemens (UPTIME Services)

• Remote access granted only with permission of the institution. Data security is ensured by secure access

Computer System

■ MR Main Console (MRC)

Full multi-tasking for simul-
taneous functionality, e.g.:

• Patient registration and
  pre-registration
• Scanning

• Reconstruction
• Viewing
• Post-processing
• Filming
• Data storage

■ Color LCD Monitor
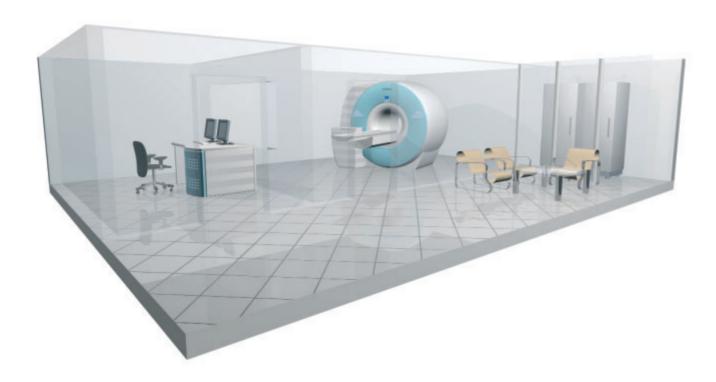
Screen size (diagonal)	18"
Horizontal frequency	30-82 kHz
Vertical frequency	56-76 Hz
Screen matrix	1280 x 1024

High-resolution flicker-free
flat-screen monitor

Horizontally tiltable, forward
and backward

Automatic backlight control for
long-term brightness stability

■ Host Computer and Panoramic Recon Image Processor: Technical Data

> Refer to appendix
Computer System

MAGNETOM Avanto
A Tim System

Installation

■ **Radio Frequency Shielding**

For shielding the examination
room from external RF sources

RF attenuation factor	> 90 dB
Frequency range	15-65 MHz

■ **Magnetic Shielding**

Room shielding
For additional reduction of the
magnetic fringe field, suitable
iron shielding can be installed
in the walls of the examination
room. The room shielding can
be used to create a magnetic
shielding enclosure.

One-Floor Installation
A combination of active
shielding and a special shielding
installed on the ceiling of the
magnet room or below it will
keep the 0.5 mT line within the
same floor as the MAGNETOM,
even in case of very low room
heights.

■ System Electronics Cabinets

2 cabinets which may be placed directly against the wall or even in a corner

Require service access only from the front, saving considerable space

Integrated water cooling cabinet eliminates the need for a dedicated computer room

■ Power Requirements

Line voltage	380, 400, 420, 440, 480 V
Stability tolerances	±10 %
Line frequency	50/60 Hz, ±1 Hz
Connection value	90 kVA*

Long-term average in full operation

■ Cooling Water Requirement

Water consumption	>90 l/min[1]
Heat dissipation to water	≤ 60 kW

1) water temperature:
6° C -12° C
(43° F-54° F)

■ Power Consumption

System off[1]	≤ 6.5 kW
Stand-by	≤ 8 kW
Ready for measurement	≤ 20 kW
Typical measurement	≤ 30 kW
Highest average power	≤ 60 kW

1) refrigerator only, 24 h/d

■ Space Requirements

Min. total space requirement (for magnet, electronics and console room)	≤ 30 m²

■ **Dimensions**

Component	Width [cm]	Depth [cm]	Height [cm]	Weight [kg]	Heat Dissipation [kW]
Examination Room					
Magnet 1.5 Tesla AS (incl. Helium)	207	150	210	3,550 ± 80	
Magnet in operation, incl. gradient coil, body coil, patient table, and covers	229.5	405	230	5,500	2
Patient table	54 (top)	243	47-89	350	0.2
Required min. room height clearance			235		
Min. transport dimensions	230/207**	305/170**	210**		
Control Room					
MR console (table + monitor)	120	80	72 + 45 = 117		
Host computer	22	46	47		
MR satellite console (optional) (table + monitor)	120	80	72 + 45 = 117		
Equipment Room					
Electronics cabinet, incl. system control, RF system, gradient power system, image processor	160	65	189*	1,500	2.5
Cooling system	65	65	189*	500	

*   *Without attachments*
** *Without covers, electronics, table and table bracket*

■ **System Cover**

The system is available in three indivual design variants:

• Satin White

• Zebra

• Warm Wood

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Erlangen, Germany

The information in this document contains general
descriptions of the technical options available, which
do not always have to be present in individual cases.
The required features should therefore be specified in
each individual case at the time of closing the contract.

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