
# SOMATOM Sensation 16

## Setting new Benchmarks in Multislice CT Imaging

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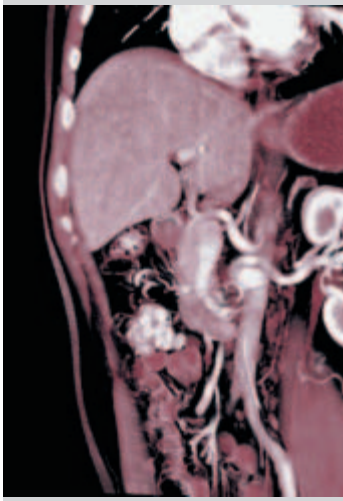
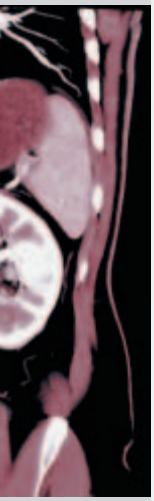


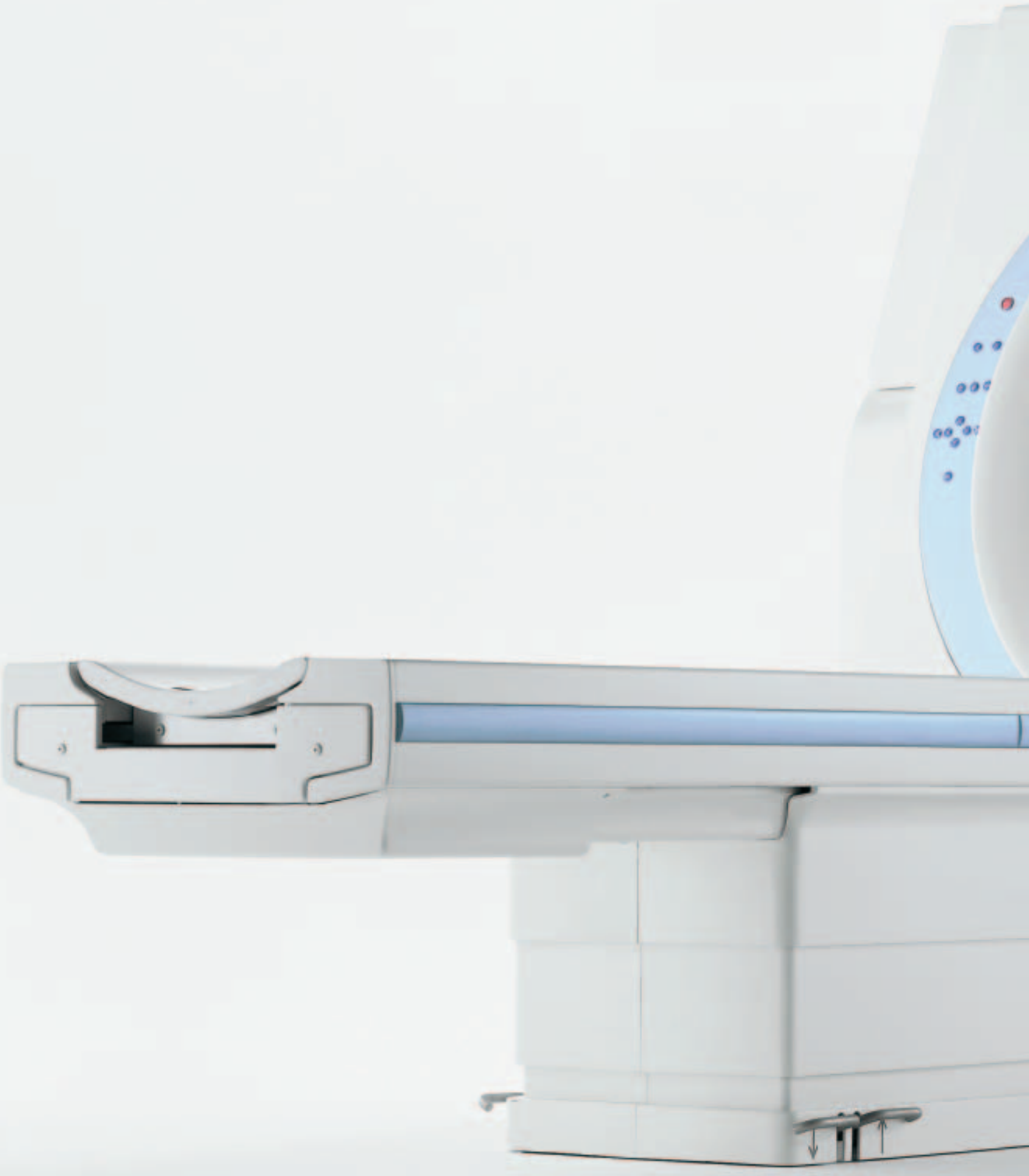
Siemens has been a global player in CT for more than 25 years, having set lots of milestones. The SOMATOM CT success history is a synonym for technological firsts, clinical leadership, customer satisfaction and investment protection.

Our objective is to expand our market leadership role with the introduction of CT products that are based on new cutting-edge technology embedded in optimized workflow concepts resulting in outstanding productivity and high patient throughput.

Up to now, performance in CT has been limited by a series of compromises. Large volumes excluded thin slices within one breathhold. Slow scans cause motion artifacts that impair image quality. The challenge was to perfectly harmonize volume, speed and detail.

The SOMATOM Sensation 16 answers these questions and sets new benchmarks in Multislice CT. The SOMATOM Sensation 16 offers virtually unlimited isotropic volume acquisition with 16 simultaneously acquired slices.



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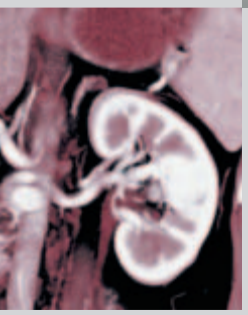




# Introduction – Technology and Data

**Outstanding volume acquisition**

Up to 32 slices/s with 0.5 s rotation time.

**Outstanding temporal resolution**

Down to 105 ms/slice based on 0.42 s rotation time (applicable with HeartView CT*) and dedicated patented reconstruction algorithms.

**Dedicated patented volume reconstruction technique**

Siemens patented solution for Multislice isotropic volume imaging, no compromise of volume coverage vs. thin slices and image quality, real-time reconstruction with full image quality, up to 6 images/s.

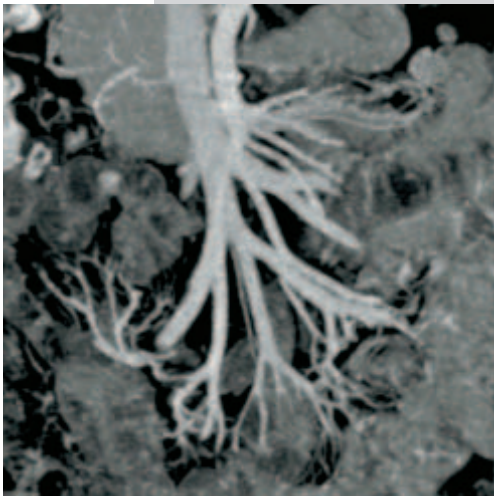
**True isotropic volume acquisition**

Submillimeter detector collimation for 3-dimensional coverage with isotropic resolution within short breathhold times.

**Minimum possible radiation exposure**

With maximum possible acquisition system efficiency using Ultra Fast Ceramic (UFC™) Detectors, optimized application protocols and real-time tube current modulation (CARE Dose).

** optional*



# Introduction – WorkStream™

### *syngo* application platform

Provides easy and intuitive operation, common look and feel and participates in the Siemens unique multi-modality interconnectivity.

### Fully integrated workstream

Scan protocols extended to exam protocols, customizable Multislice workflow helping to fully exploit the new capabilities and speed. Up to 6 slices/s reconstruction and true isotropic resolution, instant data access on shared data base for advanced data evaluation and quantification for typical examination times <10 min for routine applications.

### Advanced evaluation tools

Rapid 3D-based automated viewing, analysis, quantification and customizable documentation, fully integrated into a seamless workflow.

# Introduction – Clinical Applications

### HeartView CT* – New Frontiers in Cardiac Imaging

0.42 s/360° rotation time, ECG-synchronized acquisition of the heart, the coronary arteries and the vascular system, dedicated Cardiac CT evaluation (*syngo* Calcium Scoring*, *syngo* Argus*, *syngo* Vessel View*).

### Dedicated evaluation and enhanced viewing tools

Rapid 3D-based visualization of pulmonary nodules (*syngo* LungCARE*), enhanced 3D functionality (Volume Rendering Technique – *syngo* VRT), enhanced perspective visualization (*syngo* Fly Through*).

### CARE Solutions

Software packages for minimum possible radiation exposure in a wide application range. Thin slices, low-dose scanning protocols or fast volume scanning will extend CT-applications.

** optional*

# Technology and Data – Volume Acquisition System

| Gantry | |
|---|---|
| *Aperture* | *70 cm* |
| *Scan field* | *50 cm* |
| *Tilt* | *±30°* |
| *Rotation times* | *0.42 s (HeartView CT*), 0.5, 0.75, 1.0, 1.5 s* |
| *Temporal resolution* | *down to 105 ms (HeartView CT*)* |

Continuously rotating tube-detector unit with optimized geometry for high-resolution data acquisition across the entire scan field.

| Data acquisition system | |
|---|---|
| *Number of detector rows* | *24* |
| *Elements* | *16128* |
| *Channels per slice* | *1344* |
| *Number of projections* | *up to 2320 (1/360°)* |

- Speed and efficiency based on Ultra Fast Ceramic (UFC)
- Designed to effectively suppress scattered radiation for precise quantitative CT

| High frequency generator | |
|---|---|
| *Max. power* | *60 kW* |

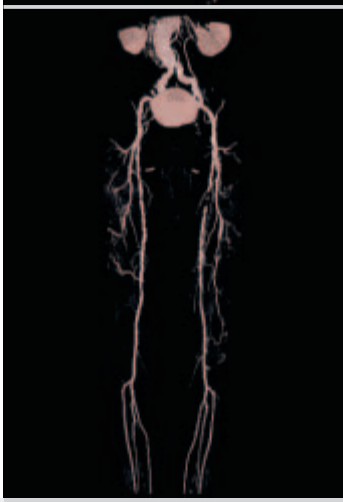
| Tube assembly | |
|---|---|
| *Tube* | *DURA Akron Q* |
| *Tube current* | *28 – 500 mA* |
| *Tube voltages* | *80, 120, 140 kV* |
| *Anode heat storage capacity* | *5.3 MHU* |
| *Focal Spot sizing according to IEC 336/1993* | *0.5 x 0.7 mm/7°*<br>*0.8 x 1.2 mm/7°* |

- High performance CT X-ray tube
- Computer controlled monitoring of anode temperature
- Multifan principle with Flying Focal Spot

| CARE Filter (tube and prefiltration) | |
|---|---|
| *Tube* | *equivalent to 5.5 mm Al* |
| *Prefiltration device* | *1.6 mm PTFE, 0.6 mm Ti (body mode) equivalent to 5.5 mm Al* |

** optional*

# Technology and Data – SureView™ Spiral Image Reconstruction



The Siemens patented solution is pioneering isotropic Volume CT Imaging designed for no compromises in image quality. Full cone correction is combined with the advantages of the SureView approach:

- Free selection of the pitch
- Slice width independent of the pitch
- Image noise and patient dose independent of the pitch

| | |
|---|---|
| *Real-time reconstruction* | *up to 6 slices/s* |
| *Reconstructed slice widths* | *0.75, 1.0, 1.5, 2, 3, 4, 5, 6, 7, 8, 10 mm* |
| *Slice increment* | *0.1 – 10 mm* |
| *Pitch Factor (Volume Pitch)* | *0.5 – 1.5 (8 – 24)* |
| *Spiral scan time* | *max. 100 s* |
| *Scan length* | *max. 157 cm* |

# Technology and Data – Spiral performance: Examples of typical acquisition times

Aorta 600 mm coverage,
16 x 1.5 mm collimation at e.g. 120 kV,
130 mAs in less than 9 s

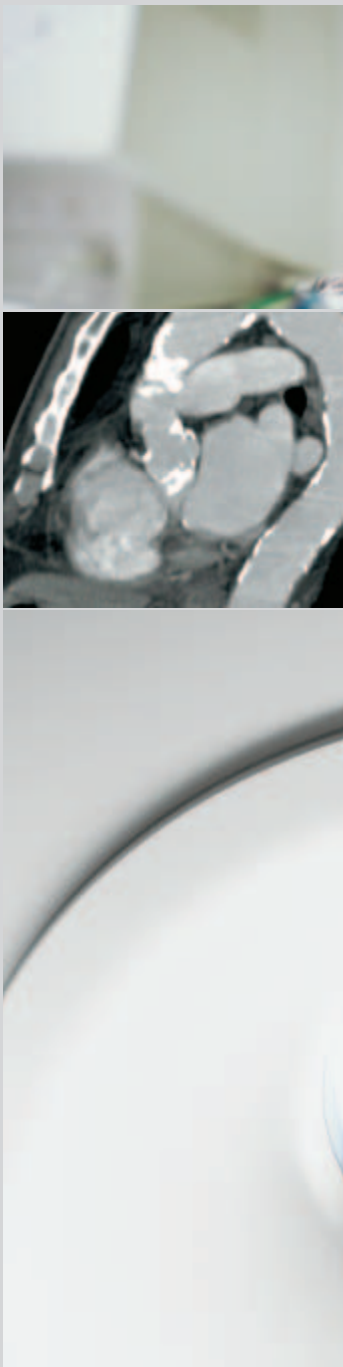
Angio Head 60 mm coverage,
16 x 0.75 mm collimation at e.g. 120 kV,
100 mAs in less than 3 s

Thorax 350 mm coverage,
16 x 1.5 mm collimation at e.g. 120 kV,
120 mAs in less than 6 s

Upper Abdomen 300 mm coverage,
16 x 1.5 mm collimation at e.g. 120 kV,
130 mAs in less than 5 s

Angio Abdomen 400 mm coverage,
16 x 0.75 mm collimation at e.g. 120 kV,
130 mAs in less than 12 s

Peripheral Angio 1000 mm coverage,
16 x 1.5 mm collimation at e.g. 120 kV,
120 mAs in less than 15 s



# Technology and Data – Topogram

| | |
|---|---|
| *Length* | *128 – 1536 mm* |
| *Scan times* | *1.6 – 15.6 s* |
| *Views* | *a.p., p.a., lateral* |

CARE Topo

- Real-Time Topogram
- Manual interruption possible once desired anatomy has been imaged

# Technology and Data – Sequence

| | |
|---|---|
| *Reconstructed slice widths:* | *0.6, 0.75, 1.0, 1.5, 2.0, 3.0, 4.5, 5, 6, 9, 10, 12, 18 mm* |
| *Number of uninterrupted scans per range* | *100* |
| *Max. number of images per range* | *1200* |
| *Max. number of ranges in Autorange* | *9* |
| *Scan cycle time (scan time 0.5 – 1.5 s)* | *0.75 – 60.0 s (±10%)* |

- Acquisition with or without table feed
- Automatic clustering of scans

# Technology and Data – Image Quality

**Low-contrast detectability**

Low-contrast detectability is the ability to see

- a small object (mm)
- with a certain contrast difference (HU)
- in a particular phantom (ø)
- with a certain slice width
- with a particular patient dose (mGy)

| **Spiral** | |
|---|---|
| *Phantom* | *CATPHAN (20 cm)* |
| *Object size* | *5 mm* |
| *Contrast diff.* | *3 HU* |
| *Dose at the Surface* | *17 mGy** |
| *Technique* | *120 kV* |
| | *10 mm slice width* |

| **Sequence** | |
|---|---|
| *Phantom* | *CATPHAN (20 cm)* |
| *Object size* | *5 mm* |
| *Contrast diff.* | *3 HU* |
| *Dose at the Surface* | *21 mGy** |
| *Technique* | *120 kV* |
| | *10 mm slice width* |

** Air KERMA, measured on the surface of the phantom*

| **High-contrast resolution** | |
|---|---|
| *0% MTF* | *30 lp/cm* |
| *±10%* | *0.17 mm* |
| *2% MTF* | *24 lp/cm* |
| *±10%* | *0.21 mm* |
| *Technique* | *150 mA* |
| | *120 kV* |
| | *0.75 s* |
| | *1 mm* |

| **Homogeneity** | |
|---|---|
| *Cross-field uniformity in* | *max. ±4 HU* |
| *a 20 cm water phantom* | *typ. ±2 HU* |

*Phantom positioned near center of rotation*

| **Dose, $CTDI_{100}$ values** | | | | |
|---|---|---|---|---|
| *Phantom* | | | *KV* | |
| *Ø* | | *80* | *120* | *140* |
| | | *(mGy/100 mAs)* | | |
| *16 cm* | *A* | *6.3* | *18.8* | *26.4* |
| | *B* | *8.0* | *21.9* | *30.6* |
| *32 cm* | *A* | *1.2* | *4.6* | *7.0* |
| | *B* | *2.9* | *9.5* | *14.1* |

*A: at center* *B: 1 cm below surface*

**Technique:**

- 12 x 1.5 mm collimation
- 360° rotation
- PMMA-Phantom
- Absorbed dose for reference material air
- Max. deviation ±30%
- typically less than 15%
- values according to IEC 60601-2-44

# WorkStream™

SOMATOM WorkStream is one of the SOMATOM Sensation 16 key features – it consists of two consoles, the Navigator and the Wizard, with fast access to a common data base. Data produced by Volume Scanning can thus be processed smoothly and efficiently. The revolutionary, easy-to-use and intuitive *syngo* application platform helps streamlining clinical throughput by optimizing up-front patient logistics and ensures easy evaluation of complex volumetric images.

**Navigator**

Primarily in charge of the actual scanning procedure, deals with examination functions such as registration, scheduling, protocol selection, reconstruction and standard evaluation applications including multiplanar reconstructions, 3D, CT Angio and other advanced software packages.

**Wizard**

Primarily takes care of multiplanar reconstructions, 3D, CT Angio and other advanced software packages for CT-specific post processing evaluations.

# WorkStream – Patient Handling

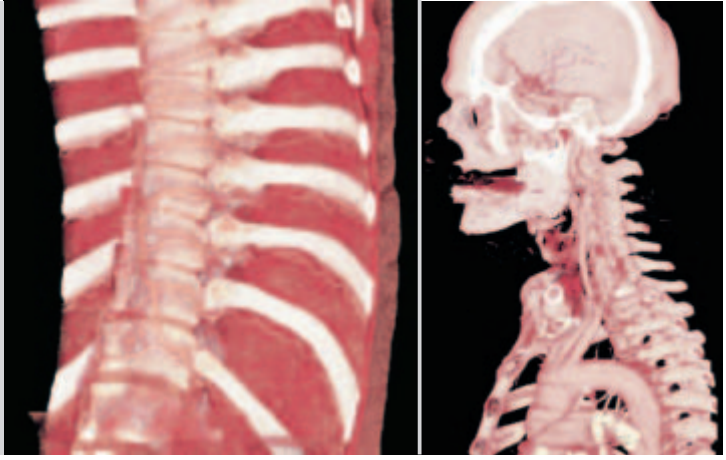
| Patient Table | |
|---|---|
| *Max. table load* | *200 kg/450 lbs* |
| *Table speed* | *1 – 150 mm/s* |
| *Vertical table travel range* | *53 – 102 cm (at table top)* |
| *Vertical travel speed* | *2.5 – 50 mm/s* |
| *Scanable range (metal-free)* | *157 cm* |
| *Distance between Gantry front and Table base* | *37 cm* |
| *Optional with installation* | *61 cm* |

**Foot pedals**

4 pairs of foot pedals are available on the bottom edges of the patient table which allow to higher/lower the table.

**Lateral light marker**

Horizontal and vertical laser light, which controls the isocentric position of the patient.



**Patient communication**

- Integrated patient intercom
- Automatic Patient Instruction (API)
  - Freely recordable
  - 30 API text pairs

**Patient registration**

- Online registration
- Preregistration of patients
- Patient information from HIS/RIS via DICOM Get worklist
- Fast trauma protocols
- Emergency patient registration

# WorkStream – Processing

| Real-time reconstruction and display (RTR) | |
|---|---|
| *Slice thickness* | *0.6 - 10 mm* |
| *Scan field* | *50 cm* |
| *Recon field* | *5 – 50 cm* |
| *Recon time* | *Up to 6 images/s* |
| *Recon matrix* | *512 x 512* |
| *HU scale* | *–1024 to +3071* |
| *Extended HU scale* | *–10240 to +30710* |

- Freely selectable slice thickness for prospective and/or retrospective reconstruction
- Immediate image display with full image quality parallel to spiral acquisition (e.g. for trauma), in 512 x 512 matrix

| Image display: Flat screen | |
|---|---|
| *Monitor size* | *18"* |
| *Monitor resolution* | *1,280 x 1,024* |
| *Image display matrix* | *1,024 x 1,024* |
| *Pixel size* | *min. 0.28 mm* |

### CINE Display

Display of image sequences
- interactively with mouse controlled rate
- or automatically
- max. image rate >10/s

### Windowing

- Window width and center freely selectable
- Single window
- Double window (e.g. bone/soft tissue)
- Organ-specific window settings for soft tissue and bone windows

### Filming

- Digital film documentation, connection to a suitable digital camera
- Connection via DICOM Basic print
- Automatic filming
- Filming interactively
- Filming parallel to other activities
- Independent scanning and documentation
- Freely selectable positioning of images onto film sheet
- Configurable image text

### Printing

Documentation on postscript printer supported

## Image Transfer/Networking

Interface for transmitting medical images and information in the DICOM industrial standard. Permits communication between devices from different manufacturers.

- DICOM Storage (send/receive)
- DICOM Query/Retrieve
- DICOM Basic print
- DICOM Get worklist (HIS/RIS)
- DICOM MPPS
- DICOM Storage Commitment

| **Image Storage** | |
|---|---|
| *Main storage* | *73 GB*<br>*100,000 images* |

| **Raw Data** | |
|---|---|
| *Capacity* | *150 GB* |

| **Archiving** | |
|---|---|
| *CD-R* | *650 MB*<br>*1,100 images* |
| *MOD DICOM** | *5.2 GB drive*<br>*2.3/4.1 GB cartridge*<br>*4000/7500 images* |

**optional*

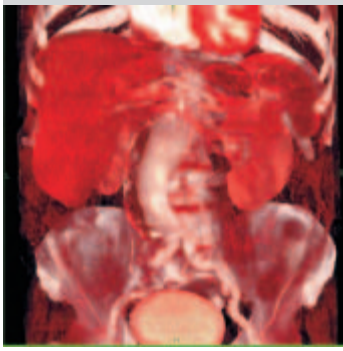
## Evaluation Tools

- Parallel evaluation of more than 10 Regions of Interest (ROI)
  - Circle
  - Irregular
  - Polygonal
- Statistical evaluation
  - Area/Volume
  - Standard deviation
  - Mean value
  - Min/max values
  - Histogram
- Profile cuts
  - Horizontal
  - Vertical
  - Oblique
- Distance measurement
- Angle measurement
- Online measurement of a 5 x 5 pixel size ROI
- Freely selectable positioning of coordinate system
- Crosshair
- Image annotation and labeling

## Dynamic Evaluation

- Evaluation of contrast enhancement in organs and tissues
- Calculation of
  - Time-density curves (up to 5 ROI's)
  - Peak-enhancement images
  - Time-to-peak images

# WorkStream – Processing



**2D post processing**

- Image zoom and pan
- Image manipulations
  - Averaging, subtraction
  - Reversal of gray-scale values
  - Mirroring
- Image filter functions
  - PFO: Posterio Fossa Optimization
  - LCE: Low Contrast Enhancement
  - HCE: High Contrast Enhancement
  - ASA: Advanced Smoothing Algorithm

**Real-Time MPR**

- Real-time multiplanar reformatting of secondary views
- Viewing perspectives
  - sagittal
  - coronal
  - paraxial
  - oblique
  - double oblique
  - freehand (curvilinear)

**CT-Angiography**

- MIP: Maximum Intensity Projection
- Evaluation of spiral images and display of vessels, vascular anomalies, aneurysms, plaques, and stenoses

**3D SSD**

- SSD: Shaded Surface Display
- Three-dimensional display of surfaces with different density values:
  - Soft tissues
  - Bones
  - Contrast-enhanced vessels

**Volume Measurements**

- Measurements of various tissues and organs with HU based region growth algorithms and interactive ROI definition.

***syngo* VRT (Volume Rendering Technique)**

- Advanced 3D functionality as extension to the basic 3D viewer containing Volume Rendering Technique (VRT) and advanced editing functions (icon-based presets).

***syngo* Fly Through***

- Software for perspective visualization of vessels, airways and intestinal organs.

** optional*

# Clinical Applications

***syngo* Dental***

- Reformatting of panoramic slices and paraxial sections through the lower and upper jaw for analysis in connection with implantation surgery.

***syngo* Osteo***

- Quantitative determination of bone mineral density (BMD) of the vertebrae.
- Osteo CT measurement is standardized to the ESP Phantom (ESP: European Spine Phantom).

***syngo* Pulmo***

- Quantitative evaluation of the lung tissue.

***syngo* Fusion***

- Spatial alignment and visualization of 2 different data sets of one patient, generated on different modalities or with different acquisition times.
- Provides optimal diagnosis by fusion of morphological data with functional information.

***syngo* Perfusion***

- Evaluation of dynamic data of the brain following contrast bolus injection.
- Aids in the assessment of cerebral perfusion irregularities.

**HeartView CT***

- ECG-synchronized true isotropic volume acquisition using prospective ECG triggered or retrospective ECG-gating mode.
- 0.42 s rotation time and patented reconstruction algorithms to achieve a temporal resolution up to 105 ms.
- Basis for 3D Cardiac reconstructions, e.g. CT Angiography of the coronary vessels and Calcium Scoring.
- Quality control tools enable retrospective ECG-viewing and interactions as well as computer assisted heart phase definition.
- The ECG trace used for gating of the CT images is supplied by an integrated ECG device and ECG display on the gantry front cover.

***syngo* Calcium Scoring***

- Application for estimating the amount of calcium in CT images obtained with HeartView CT*.
- *syngo* Calcium Scoring calculates different scores (e.g. Agatston scores, volumetric scores) within user-defined regions for up to four coronary regions.


***syngo* Vessel View***

- Dedicated software, compatible for CT and MR data, for semi-automated vessel and lesion quantification.

***syngo* Argus***

- Dedicated software, compatible for CT and MR data, for virtual 4D-viewing and semi-automated quantification of ventricular function.

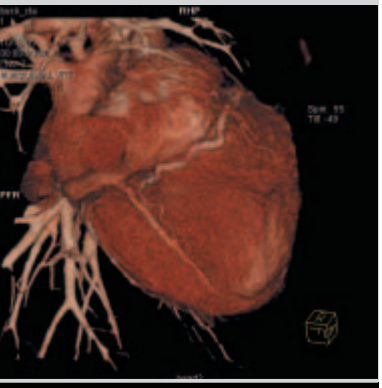
***syngo* LungCARE***

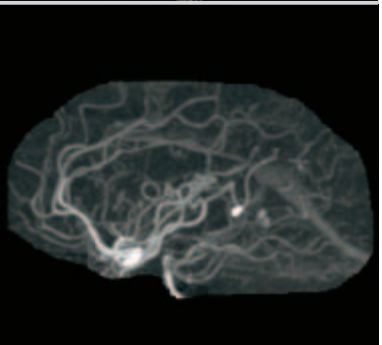
- Dedicated software for rapid 3D-based visualization of pulmonary nodules, with minimum possible radiation exposure.

The application packages **HeartView CS*** and **CI*** are complete workflow solutions for Calcium Scoring

(**HeartView CS***: HeartView CT, *syngo* Calcium Scoring) and advanced cardiac imaging

(**HeartView CI***: HeartView CT, *syngo* Calcium Scoring, *syngo* Vessel View, *syngo* Argus).





* *optional*

# CARE Solutions

**CARE Dose**

- Real-time dose modulated acquisition to adapt the tube current during one scan rotation.
- Reduce dose for anterior and posterior views (with low attenuation) and adapt dose for lateral projections (with larger attenuation).

**Pedriatric Protocols**

- With 80 kV selection and a large range of mAs settings adapting the exposure to a child's weight and age.

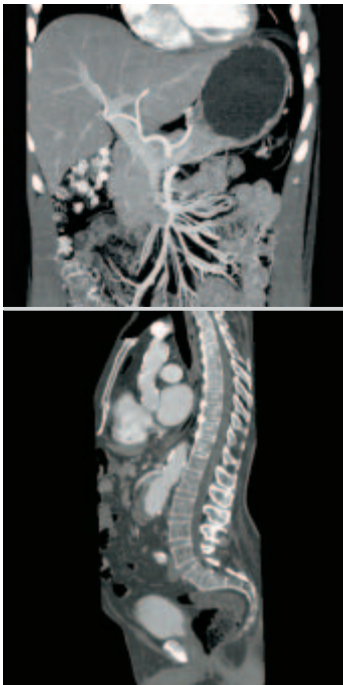
**ECG Pulsing**

- Dose modulated Cardio spiral for dose reduction in systolic heart phase, part of the HeartView CT* package.

**CARE Bolus**

- Scan mode for contrast bolus triggered data acquisition.

** optional*



# System Options

**Export devices**

- MOD (Magneto-optical-disc)

**Remote Access**

- Remote service (diagnostics) via modem of ISDN/analog router.

***syngo* 3D Workstation Leonardo**

- Advanced Multi-Modality 3D workstation connected via DICOM.

# Installation

| Dimensions | | | | |
|---|---|---|---|---|
| **Components** | **Height mm** | **Width mm** | **Length mm** | **Weight kg** |
| *Gantry* | *≤ 1990* | *≤ 940* | *≤ 2280* | *≤ 2100* |
| *Patient table* | *≤ 850* | *≤ 690* | *≤ 2430* | *≤ 500* |
| *Operator's console* | *≤ 720* | *≤ 800* | *≤ 1400* | *≤ 65* |
| *Power cabinet* | *≤ 1815* | *≤ 905* | *≤ 800* | *≤ 550* |
| *Cooling system* | *≤ 1815* | *≤ 905* | *≤ 860 w/w*<br>*≤ 900 w/a* | *≤ 200 w/w*<br>*≤ 400 w/a* |
| *Image Recon. System* | *≤ 1530* | *≤ 610* | *≤ 610* | *≤ 200* |
| **Computer system** | | | | |
| *Navigator, Wizard* | *≤ 484* | *≤ 685* | *≤ 302* | *≤ 30* |

*w/w = water/water* *w/a = water/air (optional)*

| Examination room environment | |
|---|---|
| *Temperature range* | *15 – 28° C* |
| *Relative air humidity without condensation* | *15 – 75%* |

| Cooling | |
|---|---|
| *Max. heat dissipation* | *≤ 13.5 kW scanning* |
| *including cooling system* | *≤ 9.5 kW standby* |

| Electromagnetic compatibility |
|---|
| *This product is in compliance with IEC 60601-1-2 and fulfils CISPR 11 Class A* |

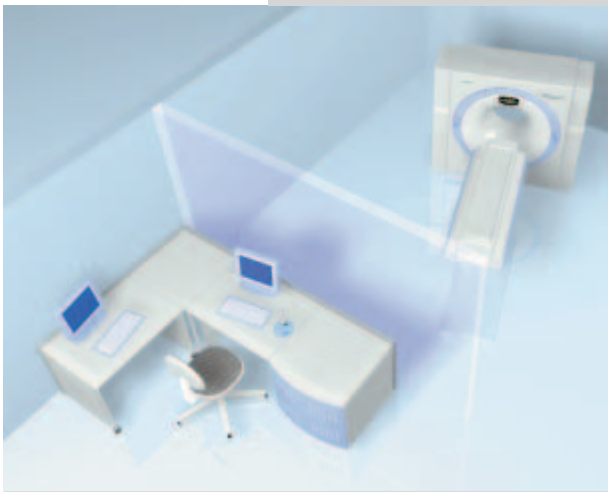
| Surface area for installation | |
|---|---|
| *System* | *30 m²* |
| *Emissions class* | *according to IEC 601-1-2* |

| Power supply | |
|---|---|
| *Nominal voltage 3/N~* | *380 – 480 V in 20 V steps* |
| *Nominal line frequency* | *50; 60 Hz* |
| *Line impedance* | *100 – 160 mOhm (dependent on voltage)* |
| *Nominal power connection* | *66 – 83 kVA (fuse 100 A)* |

| Power consumption | |
|---|---|
| *Computer on* | *3 kVA/2.5 kW* |
| *System on standby* | |
| *w/w* | *7 kVA/5 kW* |
| *w/a* | *10 kVA/7.5 kW* |
| *scanning (120 kV, 260 mA, 80 s)* | |
| *w/w* | *48 kVA* |
| *w/a* | *50 kVA* |

*w/w = water/water* *w/a = water/air*

| Protection against input power fluctuation<br>Interruptions | |
|---|---|
| *X-ray* | *5 ms* |
| *Controllers* | *20 ms* |
| *Image Reconstruction System, Navigator and Wizard* | *180 s optional with UPS* |
| **Fluctuation** | |
| *Nominal voltage* | *±10%* |
| *Nominal frequency* | *±5%* |



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