SOMATOM Sensation 4
Computed Tomography System
for Multislice Spiral Scanning
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.

The 4-slice-system SOMATOM Sensation 4 is designed to keep pace with the future. The open architecture of the entire system, including the user interface and detector design philosophy, is ready to take advantage of new improvements and technologies as they become available, protecting your investment for years to come.
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Introduction – Technology and Data

**Outstanding volume acquisition**
Up to 8 slices/s with 0.5 s* rotation time.

**Outstanding temporal resolution**
Down to 125 ms/slice based on 0.5 s* rotation time and dedicated patented reconstruction algorithms.

**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 multimodality interconnectivity.

**Fully integrated workstream**
Customizable Multislice workflow helping to fully exploit the new capabilities and speed. Up to 1.5 slices/s reconstruction, instant data access on shared data base for advanced data evaluation and quantification for total examination times < 10 min for routine applications.

**Advanced evaluation tools**
Rapid 3D-based semi-automated viewing, analysis, quantification and customizable documentation, fully integrated into a seamless workflow.
HeartView CT* – New Frontiers in Cardiac Imaging
0.5 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 package 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

<table>
<thead>
<tr>
<th><strong>Gantry</strong></th>
<th><strong>High frequency generator</strong></th>
<th><strong>Tube assembly</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Aperture</td>
<td>70 cm</td>
<td>Max. power 60 kW</td>
</tr>
<tr>
<td>Scan field</td>
<td>50 cm</td>
<td>Tube DURA Akron B</td>
</tr>
<tr>
<td>Tilt</td>
<td>±30°</td>
<td>Tube current 28 – 500 mA</td>
</tr>
<tr>
<td>Rotational times</td>
<td>HiSpeed* 0.5 s</td>
<td>Tube voltages 80, 120, 140 kV</td>
</tr>
<tr>
<td>Temporal resolution</td>
<td>down to 125 ms*</td>
<td>Anode heat storage capacity 5.3 MHU</td>
</tr>
</tbody>
</table>

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 | 8 |
| Elements                | 5376 |
| 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 precision quantitative CT

High frequency generator

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

- Computer controlled monitoring of anode temperature
- Multifan principle with Flying Focal Spot

**CARE Filter (tube and prefiltration)**

<table>
<thead>
<tr>
<th>Tube</th>
<th>equivalent to 5.5 mm Al</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prefiltration device</td>
<td>1.6 mm PTFE</td>
</tr>
</tbody>
</table>

*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:

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

<table>
<thead>
<tr>
<th>Table:</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Real-time reconstruction</td>
<td>up to 1.5 slices/s</td>
</tr>
<tr>
<td>Reconstructed slice widths:</td>
<td></td>
</tr>
<tr>
<td>HiRes*</td>
<td>0.5, 0.75 mm</td>
</tr>
<tr>
<td>Standard:</td>
<td>1.0, 1.25, 1.5, 2, 3, 4, 5, 6, 7, 8, 10 mm</td>
</tr>
<tr>
<td>Slice increment</td>
<td>0.1 – 10 mm</td>
</tr>
<tr>
<td>Pitch Factor (Volume Pitch)</td>
<td>0.25 – 2.0 (1 – 8)</td>
</tr>
<tr>
<td>Spiral scan time</td>
<td>max. 100 s</td>
</tr>
<tr>
<td>Scan length</td>
<td>max. 157 cm</td>
</tr>
</tbody>
</table>

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

Aorta 600 mm coverage,
4 x 2.5 mm collimation at e.g. 120 kV,
130 mAs in 21 s

Angio Head 60 mm coverage,
4 x 1.0 mm collimation at e.g. 120 kV,
90 mAs in 7 s

Upper Abdomen 300 mm coverage
4 x 2.5 mm collimation at e.g. 120 kV,
165 mAs in 10 s

Peripheral Angio 900 mm coverage,
4 x 2.5 mm collimation at e.g. 120 kV,
130 mAs in 31 s
## Technology and Data – Topogram

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

<table>
<thead>
<tr>
<th>Length</th>
<th>128 – 1024 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scan times</td>
<td>1.6 – 10.6 s</td>
</tr>
<tr>
<td>Views</td>
<td>a.p., p.a., lateral</td>
</tr>
</tbody>
</table>

## Technology and Data – Sequence

### Reconstructed slice widths:
- **HiRes***: 0.5, 0.75 mm
- **Standard**: 1.0, 2.5, 5, 8, 10 mm

<table>
<thead>
<tr>
<th>Number of uninterrupted scans per range</th>
<th>100</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. number of images 400 per range</td>
<td></td>
</tr>
<tr>
<td>Max. number of ranges in Autorange</td>
<td>9</td>
</tr>
<tr>
<td>Scan cycle time (scan time 0.5 – 1.5 s)</td>
<td>0.75 – 60.0 s (±10%)</td>
</tr>
</tbody>
</table>

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

*optional
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)

**High-contrast resolution**

<table>
<thead>
<tr>
<th></th>
<th>0% MTF</th>
<th>±10%</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>30 lp/cm</td>
<td>0.17 mm</td>
</tr>
<tr>
<td>2% MTF</td>
<td>24 lp/cm</td>
<td>0.21 mm</td>
</tr>
<tr>
<td>Technique</td>
<td>150 mA</td>
<td>120 kV</td>
</tr>
<tr>
<td></td>
<td>0.75 s</td>
<td>1 mm</td>
</tr>
</tbody>
</table>

**Spiral**

<table>
<thead>
<tr>
<th>Phantom</th>
<th>CATPHAN (20 cm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Object size</td>
<td>5 mm</td>
</tr>
<tr>
<td>Contrast diff.</td>
<td>3 HU</td>
</tr>
<tr>
<td>Dose at the Surface</td>
<td>17 mGy*</td>
</tr>
<tr>
<td>Technique</td>
<td>120 kV</td>
</tr>
<tr>
<td></td>
<td>10 mm slice width</td>
</tr>
</tbody>
</table>

**Sequence**

<table>
<thead>
<tr>
<th>Phantom</th>
<th>CATPHAN (20 cm)</th>
</tr>
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<tr>
<td>Object size</td>
<td>5 mm</td>
</tr>
<tr>
<td>Contrast diff.</td>
<td>3 HU</td>
</tr>
<tr>
<td>Dose at the Surface</td>
<td>21 mGy*</td>
</tr>
<tr>
<td>Technique</td>
<td>120 kV</td>
</tr>
<tr>
<td></td>
<td>10 mm slice width</td>
</tr>
</tbody>
</table>

*Air KERMA, measured on the surface of the phantom

**Homogeneity**

Cross-field uniformity in
a 20 cm water phantom    typ. ±2HU
Phantom positioned near center of rotation

**Dose, CTDI<sub>100</sub> values**

<table>
<thead>
<tr>
<th>Phantom</th>
<th>80</th>
<th>120</th>
<th>140</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>(mGy/100 mAs)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>16 cm</td>
<td>6.4</td>
<td>18.3</td>
<td>25.8</td>
</tr>
<tr>
<td>(Special head mode)</td>
<td>B</td>
<td>8.6</td>
<td>22.2</td>
</tr>
<tr>
<td>32 cm</td>
<td>1.2</td>
<td>4.6</td>
<td>7.0</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>3.4</td>
<td>10.6</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Phantom</th>
<th>80</th>
<th>120</th>
<th>140</th>
</tr>
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<td></td>
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<td>7.0</td>
</tr>
<tr>
<td></td>
<td>B</td>
<td>3.4</td>
<td>10.6</td>
</tr>
</tbody>
</table>

A: at center    B: 1 cm below surface

**Technique**

- 2 x 10 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
SOMATOM WorkStream™ is one of the SOMATOM Sensation 4 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.

*optional*
WorkStream – Patient Handling

Patient Table

<table>
<thead>
<tr>
<th>Feature</th>
<th>Specification</th>
</tr>
</thead>
<tbody>
<tr>
<td>Max. table load</td>
<td>200 kg/450 lbs</td>
</tr>
<tr>
<td>Table speed</td>
<td>1 – 150 mm/s</td>
</tr>
<tr>
<td>Vertical table travel range</td>
<td>48 – 102 cm (at table top)</td>
</tr>
<tr>
<td>Vertical travel speed</td>
<td>2.5 – 50 mm/s</td>
</tr>
<tr>
<td>Scanable range (metal-free)</td>
<td>157 cm</td>
</tr>
<tr>
<td>Distance between Gantry front and Table base</td>
<td>40 cm</td>
</tr>
<tr>
<td>Optional with installation</td>
<td>64 cm</td>
</tr>
</tbody>
</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 display (RTD)

<table>
<thead>
<tr>
<th>Slice thickness</th>
<th>HiRes*: 0.5, 0.75 mm</th>
</tr>
</thead>
<tbody>
<tr>
<td>Standard</td>
<td>1.0 – 10 mm</td>
</tr>
<tr>
<td>Scan field</td>
<td>50 cm</td>
</tr>
<tr>
<td>Recon field</td>
<td>5 – 50 cm</td>
</tr>
<tr>
<td>Recon time</td>
<td>up to 1.5 images/s</td>
</tr>
<tr>
<td>Recon matrix</td>
<td>512 x 512</td>
</tr>
<tr>
<td>HU scale</td>
<td>–1024 to +3071</td>
</tr>
<tr>
<td>Extended HU scale</td>
<td>–10240 to + 30710</td>
</tr>
</tbody>
</table>

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

Image display: Standard monitor

<table>
<thead>
<tr>
<th>Monitor size</th>
<th>21&quot;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor resolution</td>
<td>1,280 x 1,024</td>
</tr>
<tr>
<td>Image display matrix</td>
<td>1,024 x 1,024</td>
</tr>
<tr>
<td>Pixel size</td>
<td>min. 0.26 mm</td>
</tr>
</tbody>
</table>

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 Storage Commitment

* optional
**Image Storage**
- Main storage: 36 GB (60,000 images)

**Raw Data**
- Capacity: 72 GB

**Archiving**
- CD-R: 650 MB (1,100 images)
- MOD DICOM*: 5.2 GB drive
  - 2.3/4.1 GB cartridge
  - 4000/7500 images
- MOD Pioneer read-only*: 1.7 GB

*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.
  (prerequisite: Wizard)

*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.
- 0.5 s* rotation time and patented reconstruction algorithms to achieve a temporal resolution up to 125 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 external ECG monitor. (Siemens approved ECG monitor and interface)

**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 (prerequisite: Wizard).
**CARE Solutions**

**syngo Argus***
- Dedicated software, compatible for CT and MR data, for virtual 4D-viewing and semi-automated quantification of ventricular function (prerequisite: Wizard).

**syngo LungCARE***
- Software on Wizard for rapid 3D-based visualization of pulmonary nodules, with minimum possible radiation exposure (prerequisite: Wizard).

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 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).

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

**HandCARE**
- Part of CARE Vision CT*, the Interventional Fluoroscopy package.
- Online dose reduction algorithm to reduce radiation exposure to the operator and patient during an intervention.

**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 Configuration Choices

**SOMATOM Sensation 4**
- Rotation time down to 0.75 s/360°
- SOMATOM WorkStream including Navigator

**Advanced package***
- HiSpeed (rotation time down to 0.5 s/360°)
- High-Resolution (HiRes) package  
  (30 lp/cm, 0.5 mm slice thickness)
- SOMATOM WorkStream including Navigator and Wizard
- CARE Solutions  
  - CARE Dose  
  - CARE Bolus  
  - Pediatric Protocols
- 3D Power Package  
  - Auto 3D  
  - 3D-VRT  
  - Enhanced Processor and Graphics Power  
  - Prepared for Advanced 3D Applications

*optional*
System Options

Export devices

• MOD (Magneto-optical-disc)
• CD-Recorder

Remote Access

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

<table>
<thead>
<tr>
<th>Image display: Flat screen</th>
</tr>
</thead>
<tbody>
<tr>
<td>Monitor size</td>
</tr>
<tr>
<td>Monitor resolution</td>
</tr>
<tr>
<td>Image display matrix</td>
</tr>
<tr>
<td>Pixel size</td>
</tr>
</tbody>
</table>

syngo 3D Workstation Leonardo

• Advanced Multi-Modality 3D workstation connected via DICOM.
## Installation

<table>
<thead>
<tr>
<th>Dimensions</th>
<th>Height (mm)</th>
<th>Width (mm)</th>
<th>Length (mm)</th>
<th>Weight (kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gantry</td>
<td>≤ 1990</td>
<td>≤ 940</td>
<td>≤ 2280</td>
<td>≤ 2100</td>
</tr>
<tr>
<td>Patient table</td>
<td>≤ 850</td>
<td>≤ 690</td>
<td>≤ 2430</td>
<td>≤ 500</td>
</tr>
<tr>
<td>Operator's console</td>
<td>≤ 720</td>
<td>≤ 800</td>
<td>≤ 1400</td>
<td>≤ 65</td>
</tr>
<tr>
<td>Power cabinet</td>
<td>≤ 1815</td>
<td>≤ 905</td>
<td>≤ 800</td>
<td>≤ 550</td>
</tr>
<tr>
<td>Cooling system</td>
<td>≤ 1815</td>
<td>≤ 905</td>
<td>≤ 860 w/w</td>
<td>≤ 200 w/w</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>≤ 900 w/a</td>
<td>≤ 400 w/a</td>
</tr>
<tr>
<td>Computer system</td>
<td>≤ 484/600</td>
<td>≤ 685</td>
<td>≤ 302</td>
<td>≤ 30/30</td>
</tr>
</tbody>
</table>

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

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

### 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)

### Protection against input power fluctuation
#### Interruptions
- **X-ray**: 5 ms
- **Controllers**: 20 ms
- **Image Reconstruction System, Navigator and Wizard**: 20 ms, 300 s optional with UPS

#### Fluctuation
- **Nominal voltage**: ±10%
- **Nominal Frequency**: ±5%

### Electromagnetic compatibility
- In compliance with IEC 601-1-2
- **Emissions class**: A, CISPR11
- **Emissions class**: according to IEC 601-1-2

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