MAGNETOM Terra

Translate 7T research power into clinical care

siemens-healthineers.us/terra
“Siemens provides the best possible open hardware and software environment to explore these new transmit and receive concepts, all of which have proved essential to allow ultra-high fields to fulfill their potential for the benefit of human health.”

Professor Lawrence L. Wald, Director
MGH NMR Core at Martinos Center, Department of Radiology,
Boston, Massachusetts, USA
MAGNETOM Terra – Translate 7T research power into clinical care

MAGNETOM Terra is the first 7T MRI scanner for diagnostic imaging and is designed for unprecedented breakthroughs in clinical care. The unique Dual Mode lets you switch between clinical and research operations, with separate databases to distinguish between clinical and research scans. This advanced ultra-high-field (UHF) technology has the potential to keep you at the cutting edge of MRI, to attract the brightest minds to your facility, sharpen your competitive edge, and strengthen your reputation. It unlocks your potential to publish new insights first and set the pace in diagnostic imaging. Discovering new ground in MRI can help you significantly enhance clinical knowledge. Imaging at 7T offers more than double the SNR of 3T to support higher resolution for greater detail. MAGNETOM Terra is the first-ever 7T MRI scanner that produces cross-sectional images of the head and knee for diagnostic imaging, intended for patients over 66 lbs.

Welcome to clinical 7T.

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MAGNETOM Terra – Translate 7T research power into clinical care

Unique Dual Mode functionality

- Uncover a whole new world of clinical knowledge with the flexibility to get more from your scanner
- Secure switch between research and clinical operation in less than 7 minutes
- Operating with 2 separate databases for clear research and clinical distinction

80/200 gradients, and up to 64 channels

- Higher acceleration factors with up to 64 receive channels
- High power for diffusion MRI and fMRI with 80/200 gradients

50% lighter 7T magnet technology

- Commerically available for clinical use in Europe and the U.S.
- Lower weight and cold-shipment for easier integration in clinical environments
- Reduced operating costs thanks to Zero Helium boil-off

Double SNR for more precision

- 0.2 mm in-plane resolution to visualize previously unseen structures
- Submillimeter BOLD fMRI precision to visualize sub-cortical activations
Explore metabolism

- $^{23}$Na MRI and $^{31}$P MRS for metabolic insights in clinical mode\textsuperscript{10}
- Dedicated $^{23}$Na head coil and $^{31}$P loop coil

> 75% global market share in 7T technology

- Over 75% of 7T and 100% of vendor-integrated > 7T MRI human scanners worldwide from Siemens
- 7 of 11 leading U.S. hospitals with a 7T, (2018–2019), trust Siemens when they decide for 7T investment\textsuperscript{10}
- 73% of ISMRM UHF abstracts in 2018 were based on data from Siemens UHF systems\textsuperscript{11}

The world’s largest UHF community

- Largest installed base for exchanging ideas in a strong collaborative network
- An opportunity to enhance your reputation and competitiveness
- Incentive for the brightest minds in the MRI community to work with you
Discovering new ground in MRI can help you significantly enhance patient outcomes. Imaging at 7T offers more than double the SNR of 3T. This delivers potential for better lesion conspicuity, faster image acquisition to reduce motion artifacts, and at submillimeter resolution. MAGNETOM Terra is released for clinical use within Europe and the US. Its Dual Mode lets you switch between clinical and research tasks, unlocking new opportunities and providing a solid, well-founded platform for innovative results.

“Based on higher resolution, 7T provides new insights into gray and white matter disease in the brain, such as multiple sclerosis, focal cortical dysplasia, and hippocampal sclerosis. Furthermore, functional MR benefits from 7T based on a clinically relevant increase in functional sensitivity and specificity. In musculoskeletal imaging, 7T enhances the visualization of small joint structures and subtle pathologies, such as small meniscal tears, triangular fibrocartilage lesions, and early stages of cartilage degeneration.”

Professor Siegfried Trattnig
Director of the MR Centre of Excellence,
MedUni Wien, Vienna, Austria
Uncover a whole new world of clinical insights – Double SNR for more precision with clinical applications in Dual Mode

**Dual Mode flexibility**
MAGNETOM Terra is the first 7T scanner released for clinical use within Europe and the US. With the release for selected neurological and musculoskeletal scan protocols, it has potential to uncover a whole new world of clinical care. Its unique Dual Mode functionality lets you switch between research and clinical operation, giving you flexibility to get more from your scanner.

**Ultra-fine anatomical resolution**
In brain and musculoskeletal MRI, 7T reveals details previously unseen at lower field strengths. For example, cerebral cortex imaging at 0.2 mm in-plane resolution may help visualize cortical microinfarcts and plaques in MS patients and delivers insight into the plaque-vessel relationship and iron accumulation.

**Submillimeter fMRI**
The BOLD contrast increases linearly with field strength. This enables increased spatial resolution at 7T compared to 3T.

**Powerful image reconstruction**
MAGNETOM Terra delivers improvements in workflow for easier operation and better patient handling. Leveraging the latest syngo MR E12 software platform, it lets you work in the same way as you do with cutting-edge 3T technology. What’s more, it comes with the most powerful MaRS (Measurement and Reconstruction System) computing technology ever built.

**Physiology is at your fingertips**
MAGNETOM Terra is the first 7T MRI scanner to unleash the full potential of the increased MR signal with multinuclear imaging and spectroscopy in clinical settings. The multinuclear option allows the use of two dedicated coils – a $^{23}$Na head coil and a $^{31}$P loop coil, to explore metabolic insights.
Switch between research and clinical tasks with Dual Mode²

Ultra-fine resolution to visualize details previously unseen

Explore physiology with multinuclear MR³

Ultra-fast image reconstruction⁴ and syngo MR E12

Clinical insights MAGNETOM Terra
Dual Mode\textsuperscript{2} offers the flexibility to switch from research to clinical tasks

**Clinical Mode**
- 1 transmit channel
- 11 kW RF power
- 2 \textsuperscript{1}H coils (Head 32, Knee 28)
- 2 MNO coils ($^{23}$Na Head 32, $^{31}$P Flex Loop)
- Neuro and MSK optimized clinical applications

**Research Mode\textsuperscript{*}**
- Single channel and up to 16-channel parallel transmit
- 16 x 2 kW RF power
- Wider range of RF coils
- Whole-Body WIP Applications
- Broadband RFPA for X-nuclei MR (10 nuclei)

\textsuperscript{*}Research mode as part of dual mode is available as an option and not intended for clinical use. Research operation may require observation of national regulations.
• syngo MR E12 software line
• XR Gradients 80/200
• Up to 64 receive channels
• Latest MaRS computer
• 3rd order shims
Clinical Mode – Multiple Sclerosis

Hyperintense MS lesion with hypointense center

DarkFluid TSE
0.3 x 0.3 x 3 mm, 5:59 min

SWI minIP/phase
0.2 x 0.2 x 1.2 mm, 5:38 min

Typical central vein and perivenular demyelination is visible.
Multiple Sclerosis with low lesion load

Multiple Sclerosis with high lesion load

Dark Fluid TSE
0.3 x 0.3 x 3 mm, 5:20 min

T2 TSE
0.2 x 0.2 x 3 mm, 5:33 min

SWI
0.2 x 0.2 x 1.2 mm, 5:38 min

FAU, Erlangen, Germany
Clinical Mode – Tumor

3D SWI of Glioblastoma

3D SWI minIP provides superior assessment of the microvasculature.

Erwin L. Hahn Institute for MRI, Essen, Germany

3 Tesla
0.85 x 0.72 x 2 mm

7 Tesla
0.25 x 0.25 x 1 mm
Glioblastoma
Higher SNR for ultra-high 0.2 mm in-plane resolution for imaging tumor vascularization.

DKFZ, Heidelberg, Germany
Clinical Mode – Stroke

Small focus of strong cortical/subcortical signal abnormality in the right precentral gyrus.

FAU, Erlangen, Germany
Clinical Mode – Tumor

High resolution standard protocols for detailed visualisation of pathologies, increased tissue contrast and high resolution at 7T.

FAU, Erlangen, Germany

**Clinical insights MAGNETOM Terra**

**SWI minIP** 0.2 x 0.2 x 3 mm, 5:38 min

**T2 TSE** 0.2 x 0.2 x 3 mm, 5:33 min

**DarkFluid TSE** 0.4 x 0.4 x 3 mm, 4:22 min
Clinical Mode – Healthy volunteer

Hippocampus imaging
High-resolution imaging of the hippocampus at 0.25 mm in-plane resolution.
Scannexus, Maastricht, Netherlands

T2* weighted imaging
High-resolution imaging of the brainstem at 0.3 mm in-plane resolution.
MGH, Boston, USA
Clinical Mode – Diffuse axonal injury

Diffuse axonal injury
The higher sensitivity at 7T reveals hemosiderin from traumatic brain injury in PD images.

Erwin L. Hahn Institute for MRI, Essen, Germany
Clinical Mode – Healthy volunteer

Clear identification of anatomical structures with increased tissue contrast and high resolution at 7T.

0.6 x 0.6 x 0.6 mm, 13:45 min

FAU, Erlangen, Germany
Clinical Mode – Stroke

Time of Flight (ToF) with 400 micron isotropic resolution reveals smallest vessels in the brain. The higher the signal and the longer the T1 at 7T are, the higher the quality of the Maximum Intensity Projection (MIP) gets.

Visualize smallest vessels with 0.4 mm isotropic resolution.
0.4 x 0.4 x 0.4 mm, 8:09 min
FAU, Erlangen, Germany
Clinical Mode – Healthy volunteer

0.2 mm in plane resolution

The basal ganglia Caudate, Putamen and Globus Pallidus can be differentiated. Enlarged sections: cortical veins can be depicted.
Clinical Mode – Enchondroma

Fine structure visible in the lesion with different contrasts.

**PD TSE FS** 0.2 x 0.2 x 2.5 mm, 3:15 min

**T2 TSE** 0.3 x 0.3 x 2 mm, 3:24 min

**3D DESS** 0.5 x 0.5 x 0.5 mm, 3:43 min
Clinical Mode – Healthy volunteer

Clear delimitation of anatomical structures, such as ligaments, vessels or cartilage.

**T1 SE**
0.2 x 0.2 x 2.5 mm,
4:05 min

**T1 qSE**
0.3 x 0.3 x 2.5 mm,
7:21 min
Clinical Mode – Healthy volunteer

PD qTSE FS
0.2 x 0.2 x 2.5 mm, 3:15 min

T1 FL3D WE
0.5 x 0.5 x 0.5 mm, 4:35 min
Clinical Mode – Healthy volunteer

High resolution fiber tracking with SMS RESOLVE at 7T and syngo via Frontier
1.4 mm isotropic, 29:22 min
FAU, Erlangen, Germany

CAIPRINHA acceleration for the SPACE pulse sequence at 7T, acceleration: 3x2
0.7 mm isotropic, 6:52 min
FAU, Erlangen, Germany
Clinical Mode – Healthy volunteer

$^{31}$P FID of the human calf with NOE enhancement
Non selective 1:42 min
FAU, Erlangen, Germany

$^{31}$P CSI of the human liver
15 ml voxel volume, 4:42 min
FAU, Erlangen, Germany
Clinical Mode – Healthy volunteer

Additional metabolic information with $^{23}$Na UTE, fused with T2 TSE

3 mm isotropic, 7:38 min

FAU, Erlangen, Germany
Clinical Mode – Tumor

Additional metabolic information with $^{23}$Na UTE, fused with T2 TSE
3 mm isotropic, 7:38 min
FAU, Erlangen, Germany
Medical research funding has stagnated in the last decade. Ensuring your high-end MRI endeavors have the right business impact is crucial in today’s competitive environment. MAGNETOM Terra is the result of over 25 years of Siemens UHF innovations, culminating in the design of a brand-new, volume-produced 7T magnet. The magnet is 50% lighter than previous generations and supports easier integration into clinical environments. MAGNETOM Terra can help you become more competitive, while making a tangible difference to clinical care, research – and your business.

“When you talk to other people in the field, it is clear that Siemens has by far the greatest expertise in ultra-high-field imaging.”

Professor Rainer Goebel
University of Maastricht & scannexus, Maastricht, The Netherlands
Change the game in UHF business with Siemens Healthineers’ 50% lighter 7T magnet

Innovative magnet technology
Siemens Healthineers’ 7T magnet is a milestone in MR magnet technology. Its unique design and thermally balanced materials minimize physical interactions between core components. The result is 50% lighter than previous generations, with a higher structural stability and a greater fundamental stress capacity. In addition, excellent homogeneity makes for enhanced image quality.

Increased competitiveness
MAGNETOM Terra can help you broaden research funding opportunities, making your institution stand out as a leader in life sciences. By being at the cutting edge of clinical care and research, you have the opportunity to increase competitiveness for grants, benefit from reduced complexity in clinical trials, and open up potential for clinical imaging reimbursements.

Easy clinical integration
Thanks to the lighter magnet, the scanner can be shipped cold via airfreight. What’s more, you benefit from up to 50% faster installation time and ramp-up. Zero Helium boil-off translates into lower lifecycle costs and an improved eco-footprint. All this has the potential to enhance performance, lower resource consumption, improve sustainability, and reduce operating costs.

Forward-looking technology
An investment in MAGNETOM Terra is an investment in the future. Siemens is committed to serving the ultra-high-field community – today and tomorrow – with a host of outstanding innovations. From development and production, to service – all of MAGNETOM Terra’s key components are delivered from a single reliable partner you can trust, for maximum peace of mind.
Released for clinical use in Europe and the U.S.

50% lighter magnet technology

Lower weight and cold-shipment for easy integration

Zero Helium boil-off

MAGNETOM Terra
Proven innovations in the development and production of magnet technology

**1980**
The world’s first superconducting whole-body MRI

**1989**
The world’s first 1.5T active-shielded magnet

**1994**
The world’s first open MRI magnet

**1997**
The world’s first 3T active-shielded magnet

Award-winning development and production

Siemens Magnet Technology in Oxford, UK, has received seven Best Factory Awards and seven Queen’s Awards for Enterprise in multiple categories, including for processes and design. The facility deploys leading-edge supply chain management methods, and prides itself on reliable, robust production and the highest standards of quality.
April 2015 – Installation of Siemens’ first 7T magnet

During the 30 years that we have been producing 1.5T and 3T magnets, we have gained extensive engineering skills and well-founded process expertise. This knowledge and experience has led to the development and production of our own 7T magnet.

“We are extremely proud at Siemens Magnet Technology to have developed the 7T magnet at the heart of the MAGNETOM Terra. Once again our expert design and process teams have demonstrated how their innovative thinking has led to a product that has pushed forward the boundaries of magnet technology. It is wonderful to see how seamlessly the manufacture of this flagship product has already been integrated into our award winning facility.”

Ralph Seidler
Managing Director, Siemens Magnet Technology
The increased spatial resolution offered by 7T MRI enables us to study fine-grained activation patterns within cortical areas and investigate detailed functional topography of the cerebral cortex in individual human subjects. This will provide us with a deeper understanding of the human brain and its connectomics in healthy and diseased populations.”

Professor Kamil Ugurbil
Director of the Center for Magnetic Resonance Research (CMRR), Minneapolis, Minnesota, USA
Join the largest research community

Your reputation plays a pivotal role in your institution’s success. MAGNETOM Terra has the power to let you go deeper than ever before, making your research and patient outcomes stand out from the rest. What’s more, this leading-edge technology can help you attract the brightest minds to your facility, further enhancing your capabilities. MAGNETOM Terra has the potential to put your organization firmly on the map, offering access to an exclusive network of expertise and broad scope for collaboration and exchange.

“When we were in a position to order a 7T system, Siemens was the logical choice.”

Professor Peter Jezzard
Professor of Neuroimaging,
University of Oxford, Oxford, UK
Join the largest research community with over 75% of all UHF users

Enhance your reputation
MAGNETOM Terra helps you achieve your research goals, giving you the opportunity to publish first and become a true opinion leader. This advanced technology has the potential to strengthen your position by attracting the brightest brains to your facility. The scanner lets you deliver previously unseen insights that could improve patient outcomes and further enhance your reputation.

Expand your network
Even if you are taking your first steps in ultra-high-field imaging, you will never be alone. Siemens has proven expertise in UHF MRI and cultivates links with an extensive network of users. As a result, you benefit from the experience of others and can share your own ideas. Siemens is the global leader in 7T – with a market share of over 75% and more than 25 years of experience in this field.

Exchange your ideas with peers
When you become part of the Siemens UHF community, you join an exclusive group of outstanding MRI experts. Through collaboration and exchange with other leaders in your field, you can extend your own knowledge and gain deeper insights. Siemens’ regular user meetings and an online discussion board are the ideal platforms to interact with your peers.

73% of ISMRM UHF abstracts in 2018 were based on data from Siemens UHF systems.¹¹
Over 75% of 7T scanners deployed worldwide are from Siemens

Attract and retain the brightest minds and publish first

Strong network for collaboration and peer-to-peer exchange
UHF systems installed and projects in progress

1. Athinoula A. Martinos Center for Biomedical Imaging of MGH, Boston, Massachusetts, USA
2. Leibniz Institute for Neurobiology (LIN), Magdeburg, Germany
3. Bernard and Irene Schwartz Center for Biomedical Imaging (CBI) of New York University Langone Medical Center, New York City, New York, USA
4. Center for MR Research (CMRR), University of Minnesota, Minneapolis, Minnesota, USA
5. Neuroscience Research Institute (NRI) of Gachon University of Medicine and Science, Incheon, South Korea
6. Advanced Imaging Research Center (AIRC), Oregon Health & Science University, Portland, Oregon, USA
7. Erwin L. Hahn Institute for Magnetic Resonance Imaging (ELH), Essen, Germany
8. Center for Imaging in Biomedicine (CiBM), École polytechnique fédérale de Lausanne (EPFL), Lausanne, Switzerland
9. Max Planck Institute for Biological Cybernetics (MPI KYB), Tübingen, Germany (9.4T)
10. NeuroSpin, French Alternative Energies and Atomic Energy Commission (CEA), Saclay, France
11. NeuroSpin, French Alternative Energies and Atomic Energy Commission (CEA), Saclay, France (11.7T)
12. Magnetic Resonance Research Center (MRRC), University of Pittsburgh Medical Center (UPMC), Pittsburgh, Pennsylvania, USA
13. Max Planck Institute for Human Cognitive and Brain Sciences (MPI), Leipzig, Germany
14. Excellence Center for Highfield MR, Medical University of Vienna (MUW), Vienna, Austria
15. German Cancer Research Center (DKFZ), Heidelberg, Germany
16. Institute of Neuroscience and Medicine (INM), Research Centre Jülich, Jülich, Germany (9.4T)
17. Center For Magnetic Resonance And Optical Imaging (MMRRC), University of Pennsylvania Health System (HUP), Philadelphia, Pennsylvania, USA
18. Berlin Ultrahigh Field Facility (B.U.F.F.), Experimental and Clinical Research Center (ECRC), Berlin, Germany
19. State Key Laboratory of Brain and Cognitive Science, Institute of Biophysics, Chinese Academy of Sciences (CAS), Beijing, China
Siemens’ end-to-end services ensure you stay at the leading edge of MRI technology throughout the entire system lifecycle – from installation, to operation, to upgrades, to ongoing support. Moreover, our diverse communication platforms and communities keep you up to speed on the world of MRI and enable you to share your ideas and experiences with your peers.
Utilization management and reporting
This powerful solution gives you more from your MRI scanner. It allows you to monitor KPIs and benchmark your system against other Siemens MRI machines at any facility or organization. So you can keep track of your MRI performance, and reap the maximum reward from your scanner.

Predictive maintenance
When systems go down, it impacts both your ability to care for your patients and your bottom line. Siemens provides a predictive maintenance service to help you minimize lost time. It informs you when a part of your MRI system is likely to fail, enabling you to plan repairs and prevent downtime before it happens.

EVOLVE
Keep your hardware and software up to date at all times – a key factor in enhancing performance and diagnostic quality. You receive all applicable upgrades for software and the syngo OS, plus at least one workstation hardware upgrade within the first six years.

Proven upgrade paths
With MAGNETOM scanners, taking your MRI system to the next level is simplicity itself, thanks to clearly defined upgrade paths. In fact, Siemens has built an entire organization (CDV) to help customers truly maximize their system life – and increase their return on investment.

Siemens Guardian program
This program provides the latest service technology so you can better manage your MRI system. It combines many features in a single package – offering real-time system monitoring, expert advice to improve workflow efficiency, proactive maintenance, and support. Moreover, it guarantees defined repair times, giving you complete peace of mind.
Service and exchange – Peer-to-peer information

On MAGNETOM Flash:
“An excellent and useful combination of technological and clinical articles that both keep one up to date with advances in MRI and provide practical assistance for day-to-day practice – good and interesting learning material.”

Mark Lourensz
St Vincent’s Hospital, Fitzroy, Victoria, Australia
MAGNETOM World
Siemens Healthineers’ global MRI community offers peer-to-peer support and information. Radiologists, cardiologists, technologists, and physicists have all contributed with publications, presentations, training documents, case studies, and more – all freely available to you via this unique network. Plus, the bi-annual MAGNETOM World Summit is the ideal opportunity to share and exchange ideas.

MAGNETOM Flash
Published quarterly, the MR customer magazine features up-to-date clinical case studies, application tips and technical and product information relevant to you. All content is carefully compiled by experts to meet the needs of today’s MRI users in both clinical and research scenarios. In fact, 98.5% of readers report that MAGNETOM Flash is clinically relevant.

UHF Online Discussion Board
The UHF Online Discussion Board unites users from across the globe in sharing experience and best practices.
# Technical specifications

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<th>MAGNETOM Terra Technical specifications</th>
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<tr>
<td>Field strength</td>
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<td>Rapid Biomedical GmbH 1Tx1Rx 31P Loop Coil</td>
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Why Siemens Healthineers?

At Siemens Healthineers, our purpose is to enable healthcare providers to increase value by empowering them on their journey towards expanding precision medicine, transforming care delivery, and improving patient experience, all enabled by digitalizing healthcare.

An estimated 5 million patients globally everyday benefit from our innovative technologies and services in the areas of diagnostic and therapeutic imaging, laboratory diagnostics and molecular medicine, as well as digital health and enterprise services\(^7\).

We are a leading medical technology company with over 170 years of experience and 18,000 patents globally. With more than 48,000 dedicated colleagues in 75 countries, we will continue to innovate and shape the future of healthcare.
At Siemens Healthineers, our purpose is to enable healthcare providers to increase value by empowering them on their journey toward expanding precision medicine, transforming care delivery, and improving patient experience, all enabled by digitalizing healthcare.

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The outcomes and statements provided by customers of Siemens Healthineers are unique to each customer’s setting. Since there is no “typical” hospital and many variables exist (e.g., hospital size, case mix, and level of service/technology adoption), there can be no guarantee that others will achieve the same results.

On account of certain regional limitations of sales rights and service availability, we cannot guarantee that all products included in this brochure are available through the Siemens Healthineers sales organization worldwide. Availability and packaging may vary by country and is subject to change without prior notice. Some/All of the features and products described herein may not be available in the United States.

The information in this document contains general technical descriptions of specifications and options as well as standard and optional features, which do not always have to be present in individual cases.

Siemens Healthineers reserves the right to modify the design, packaging, specifications, and options described herein without prior notice. For the most current information, please contact your local sales representative from Siemens Healthineers.

Note: Any technical data contained in this document may vary within defined tolerances. Original images always lose a certain amount of detail when reproduced.

References:
1 Compared to 3T systems.
2 Research mode as part of dual mode is available as an option and not intended for clinical use. Research operation may require observation of national regulations.
4 Compared to previous 7T generation.
5 Under normal operating conditions with standard Siemens Healthineers sequences/protocols.
6 Example images available in this brochure: Page 12; SWI mini/phase, Page 13; T2 TSE, SWI, Page 15, Page 16; PD FSE TSE, Page 17; SWI, T2 TSE, Page 22; SWI, Page 23; PD FSE FS, Page 24; T1 SE, Page 25; PD qTSE FS.
10 https://health.usnews.com/best-hospitals
11 https://www.ismrm.org/18m
12 The statements by Siemens’ customers described herein are based on results that were achieved in the customer’s unique setting. Since there is no “typical” hospital and many variables exist (e.g., hospital size, case mix, level of IT adoption) there can be no guarantee that other customers will achieve the same results.
14 Cinematic VRT is recommended for communication, education, and publication purposes and not intended for diagnostic reading.
15 Rendered with a Siemens internal cinematic rendering prototype.
16 Minimum total space requirement for magnet, electronics, and console room.

*Research mode as part of dual mode is available as an option and not intended for clinical use. Research operation may require observation of national regulations.

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Published by Siemens Medical Solutions USA, Inc. · Order No. MR-19-2126 · Printed in USA · 07.2019 · ©Siemens Medical Solutions USA, Inc., 2019