Siemens Medical Solutions USA, Inc.
Cordell Fields
Regulatory Specialist
40 Liberty Blvd Mailcode 65-1A
Malvern, Pennsylvania 19355

November 6, 2018

Re: K181613
Trade/Device Name: MAGNETOM Avanto, MAGNETOM Verio with software syngo MR E11D
Regulation Number: 21 CFR 892.1000
Regulation Name: Magnetic Resonance Diagnostic Device
Regulatory Class: Class II
Product Code: LNH, LNI, AND MOS
Dated: October 10, 2018
Received: October 11, 2018

Dear Cordell Fields:

We have reviewed your Section 510(k) premarket notification of intent to market the device referenced above and have determined the device is substantially equivalent (for the indications for use stated in the enclosure) to legally marketed predicate devices marketed in interstate commerce prior to May 28, 1976, the enactment date of the Medical Device Amendments, or to devices that have been reclassified in accordance with the provisions of the Federal Food, Drug, and Cosmetic Act (Act) that do not require approval of a premarket approval application (PMA). You may, therefore, market the device, subject to the general controls provisions of the Act. Although this letter refers to your product as a device, please be aware that some cleared products may instead be combination products. The 510(k) Premarket Notification Database located at https://www.accessdata.fda.gov/scripts/cdrh/cfdocs/cfpmn/pmn.cfm identifies combination product submissions. The general controls provisions of the Act include requirements for annual registration, listing of devices, good manufacturing practice, labeling, and prohibitions against misbranding and adulteration. Please note: CDRH does not evaluate information related to contract liability warranties. We remind you, however, that device labeling must be truthful and not misleading.

If your device is classified (see above) into either class II (Special Controls) or class III (PMA), it may be subject to additional controls. Existing major regulations affecting your device can be found in the Code of Federal Regulations, Title 21, Parts 800 to 898. In addition, FDA may publish further announcements concerning your device in the Federal Register.

Please be advised that FDA's issuance of a substantial equivalence determination does not mean that FDA has made a determination that your device complies with other requirements of the Act or any Federal statutes and regulations administered by other Federal agencies. You must comply with all the Act's

requirements, including, but not limited to: registration and listing (21 CFR Part 807); labeling (21 CFR Part 801); medical device reporting (reporting of medical device-related adverse events) (21 CFR 803) for devices or postmarketing safety reporting (21 CFR 4, Subpart B) for combination products (see https://www.fda.gov/CombinationProducts/GuidanceRegulatoryInformation/ucm597488.htm); good manufacturing practice requirements as set forth in the quality systems (QS) regulation (21 CFR Part 820) for devices or current good manufacturing practices (21 CFR 4, Subpart A) for combination products; and, if applicable, the electronic product radiation control provisions (Sections 531-542 of the Act); 21 CFR 1000-1050.

Also, please note the regulation entitled, "Misbranding by reference to premarket notification" (21 CFR Part 807.97). For questions regarding the reporting of adverse events under the MDR regulation (21 CFR Part 803), please go to http://www.fda.gov/MedicalDevices/Safety/ReportaProblem/default.htm.

For comprehensive regulatory information about medical devices and radiation-emitting products, including information about labeling regulations, please see Device Advice (https://www.fda.gov/MedicalDevices/DeviceRegulationandGuidance/) and CDRH Learn (http://www.fda.gov/Training/CDRHLearn). Additionally, you may contact the Division of Industry and Consumer Education (DICE) to ask a question about a specific regulatory topic. See the DICE website (http://www.fda.gov/DICE) for more information or contact DICE by email (DICE@fda.hhs.gov) or phone (1-800-638-2041 or 301-796-7100).

Sincerely,

For

Robert A. Ochs, Ph.D.
Director
Division of Radiological Health
Office of In Vitro Diagnostics
and Radiological Health
Center for Devices and Radiological Health

Enclosure

DEPARTMENT OF HEALTH AND HUMAN SERVICES
Food and Drug Administration

Indications for Use

Form Approved: OMB No. 0910-0120
Expiration Date: 06/30/2020
See PRA Statement below.

510(k) Number *(if known)*
K181613

Device Name
MAGNETOM Avanto and MAGNETOM Verio with software syngo MR E11D

Indications for Use *(Describe)*
Your MAGNETOM MR system is indicated for use as a magnetic resonance diagnostic device (MRDD) that produces transverse, sagittal, coronal and oblique cross sectional images, spectroscopic images and/or spectra, and that displays the internal structure and/or function of the head, body, or extremities.

Other physical parameters derived from the images and/or spectra may also be produced. Depending on the region of interest, contrast agents may be used. These images and/or spectra and the physical parameters derived from the images and/or spectra when interpreted by a trained physician yield information that may assist in diagnosis.

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

Type of Use *(Select one or both, as applicable)*

☒ Prescription Use (Part 21 CFR 801 Subpart D) ☐ Over-The-Counter Use (21 CFR 801 Subpart C)

CONTINUE ON A SEPARATE PAGE IF NEEDED.

This section applies only to requirements of the Paperwork Reduction Act of 1995.

DO NOT SEND YOUR COMPLETED FORM TO THE PRA STAFF EMAIL ADDRESS BELOW.

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510(k) Summary

MAGNETOM Avanto and MAGNETOM Verio with software *syngo* MR E11D

Company: Siemens Medical Solutions USA, Inc.
40 Liberty Boulevard
Malvern, PA 19355, USA
Establishment Registration Number: 2240869

Date Prepared June 14, 2018

This summary of 510(k) safety and effectiveness information is being submitted in accordance with the requirements of the Safe Medical Devices Act of 1990 and 21 CFR § 807.92.

1. General Information

Importer/Distributor:
Siemens Medical Solutions USA, Inc.
40 Liberty Boulevard
Malvern, PA 19355, USA
Establishment Registration Number: 2240869

Manufacturing Sites:
Siemens Shenzhen Magnetic Resonance Ltd.
Siemens MRI Center, Gaoxin C. Ave., 2nd
Hi-Tech Industrial Park
518057 Shenzhen
China
Establishment Registration Number: 3004754211

Siemens Healthcare GmbH
Henkestr. 127
91052 Erlangen
Germany
Establishment Registration Number: 3002808157

2. Contact Information

Cordell L. Fields, Esq.
Regulatory Affairs Specialist
Siemens Medical Solutions USA, Inc.
40 Liberty Boulevard, 65-1A
Malvern, PA 19355, USA

Phone: (610) 448-6545
Fax: (610) 448-6469
E-mail: cordell.fields@siemens-healthineers.com

3. Device Name and Classification

Trade Name	MAGNETOM Avanto and MAGNETOM Verio with software *syngo* MR E11D
Classification Name:	Magnetic Resonance Diagnostic Device (MRDD)
Classification Panel:	Radiology
CFR Code:	21 CFR § 892.1000
Classification:	Class II
Product Code:	Primary: LNH Secondary: LNI, MOS

4. Legally Marketed Predicate Device

Trade Name	MAGNETOM Avanto and MAGNETOM Verio with software *syngo* MR D13A
510(k) Number	K121434, Cleared November 05, 2012
Classification Name:	Magnetic Resonance Diagnostic Device (MRDD)
Classification Panel:	Radiology
CFR Code:	21 CFR § 892.1000
Classification:	Class II
Product Code:	Primary: LNH Secondary: LNI, MOS

5. Device Description

The subject device, MAGNETOM Avanto and MAGNETOM Verio D with software *syngo* MR E11D, is a modification of the previously cleared predicate device, MAGNETOM Avanto and MAGNETOM Verio with software *syngo* MR D13A (K121434). Software version *syngo* E11D for MAGNETOM Avanto and MAGNETOM Verio includes software applications migrated from the previously cleared MAGNETOM Aera and Skyra systems with *syngo* MR E11C (K153343). Only minor adaptations were needed to support the system specific hardware and optimize the sequence/protocols. The following are the software applications migrated from previously cleared software to the subject device:

Software

- **Sequences or Algorithms:**

  - **New** sequences for both systems with *syngo* MR E11D with respect to *syngo* MR D13A :
    - HISTO sequence (as part of the new application LiverLab)
    - Beat_map
    - DSI (Diffusion Spectrum Imaging)
    - Improvements in BLADE Imaging (fast TSE)

- **Modified** sequences for both systems with syngo MR E11D with respect to syngo MR D13A:
  - *syngo* WARP-SEMAC (Advanced WARP)
  - Fast DIXON (TSE DIXON)
  - SPAIR fat sat improvements (applicable for 3T MR Systems addressed by *syngo* MR E11D)
  - Improvements in Liver Segmentation
  - Improvement in Multi Echo Dixon for Fat Iron Quantification
  - A flow compensated SE sequence for 3T systems
  - Improvements in Inline Ventricular function
  - Improvements in VIBE (TWIST-VIBE)

- **Minor** modifications of sequences or algorithms for both systems with syngo MR E11D with respect to syngo MR D13A:
  - EPI sequence: B1 control loop for a better DTI signal stability
  - Improved Body DWI imaging using a Flash-based PAT reference scan
  - Improved SPAIR fat saturation in haste acquisitions
  - Improved ACC algorithm to reduce artifacts
  - Improved spoiling for the TurboFLASH sequence, especially for MPRAGE protocols
  - Improved FatSat option for MSK imaging
  - B1-corrected abdominal T1 mapping
  - ICEPAT algorithm change
  - Improved Dixon sequence
  - Prepulese functionality now available for Petra sequence

- **Applications:**
  - **New** applications for MAGNETOM Avanto /Verio with syngo MR E11D with respect to syngo D13A:
    - LiverLab
    - MyoMaps
    - TWIST VIBE (FREEZEit Body MRI)
    - Advanced WARP (WARP-SEMAC)
    - Dot Cockpit
    - Dynamic Breast Evaluation and Auto Bolus Detection for Breast Dot Engine

  - **New** Dot Engines for MAGNETOM Avanto /Verio with syngo MR E11D with respect to MAGNETOM Aera/Skyra with software syngo D13A:
    - Spine Dot Engine
    - Large Joint Dot Engine (knee, hip, shoulder)
    - Breast Dot Engine

  - **Minor** modifications of applications for MAGNETOM Avanto /Verio with syngo MR E11D with respect to syngo D13A:

- Improvements in Abdomen Dot Engine and Tim CT Onco Dot Engine
- Improvement in Auto Coil Selection
- TimCT Onco Improvements
- Neuro DTI: Customized diffusion directions

· **Minor** modifications to support the usability of the Avanto /Verio with syngo MR E11D with respect to syngo D13A:

- Improvement based on stimulation monitoring
- AutoAlign Spine is integrated within Spine Dot Engine
- Support for Internet protocol v6 support
- Economic mode intended for energy saving
- Inclusion of:
  - § Local AIF within Neuro Perfusion
  - § *syngo* BreVis
- Ability to interface with *syngo*.via post-processing
- SEEit (Marketing bundle being made available for all subject device systems)

Hardware

· **New** HW-components for MAGNETOM Avanto /Verio:

· MaRS (Measurement and reconstruction system)

The MAGNETOM Avanto and MAGNETOM Verio with software *syngo* MR E11D will be offered as in-field upgrades for the currently installed MAGNETOM Avanto and Verio systems.

6. Indication for Use

The indications for use for the subject device is the same as the predicate device and is as follows:

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

These images and/or spectra and the physical parameters derived from the images and/or spectra when interpreted by a trained physician yield information that may assist in diagnosis.

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

7. Substantial Equivalence

The MAGNETOM Avanto and MAGNETOM Verio with software *syngo* MR E11D is substantially equivalent to the following device:

Predicate Device	FDA Clearance Number	FDA Clearance Date	Product Code
MAGNETOM Avanto and MAGNETOM Verio with software *syngo* MR D13A	K121434	November 05, 2012	LNH, LNI, MOS

As described above, the MAGNETOM Avanto Dot and MAGNETOM Verio Dot with software *syngo* MR E11D includes features already cleared on the following devices:

Reference Device	FDA Clearance Number	FDA Clearance Date	Product Code
Software *syngo* MR E11C for the MAGNETOM System Aera and MAGNETOM System Skyra	K153343	April 15, 2016	LNH, LNI, MOS

8. Summary of Technological Characteristics of the Subject Device as Compared with the Predicate Device

The subject device MAGNETOM Avanto and MAGNETOM Verio with software *syngo* MR E11D is substantially equivalent to the predicate device, MAGNETOM Avanto and MAGNETOM Verio with software *syngo* MR D13A, with regard to the operational environment, programming language, operating system, and performance.

The subject device, MAGNETOM Avanto and MAGNETOM Verio with software *syngo* MR E11D, conforms to the IEC 62304, Edition 1.1, 2015-06, standard for software medical devices and other relevant IEC and NEMA standards.

While there are some differences in technological characteristics between the subject device and predicate device including new and modified software applications and hardware additions, these differences have been tested and the conclusions from the non-clinical data suggests that the features bear an equivalent safety and performance profile as that of the predicate device.

9. Nonclinical Performance Testing

The following performance testing was conducted on the subject device:

- Software verification and validation testing was completed in accordance with the FDA guidance document, "*Guidance for the Content of Premarket Submissions for Software Contained in Medical Devices*", dated May 11, 2005.
- Performance testing was completed in accordance with the FDA guidance document, "*Submission of Premarket Notifications for Magnetic Resonance Diagnostic Devices*", dated November 18, 2016

The results from each set of tests demonstrate that the device performs as intended and is thus substantially equivalent to the predicate device to which it has been compared.

MAGNETOM Avanto and MAGNETOM Verio with software *syngo* MR E11D conforms to the following FDA recognized and international IEC and ISO standards:

Recogniton Number	Product Area	Title of Standard	Reference Number and date	Standards Development Organization
19-4	General II (ES/EMC)	C1:2009/(R)2012 and A2:2010/(R)2012 (Consolidated Text) Medical electrical equipment - Part 1: General requirements for basic safety and essential performance (IEC 60601-1:2005, MOD)	ES60601-1:2005/(R)2012 and A1:2012,	AAMI ANSI
19-1	General II (ES/EMC)	Medical electrical equipment - Part 1-2: General requirements for basic safety and essential performance - Collateral standard: Electromagnetic compatibility - Requirements and tests	60601-1-2 Edition 3: 2007-03	IEC
12-271	Radiology	Medical electrical equipment - Part 2-33: Particular requirements for the basic safety and essential performance of magnetic resonance equipment for medical diagnosis	60601-2-33 Ed. 3.1:2013	IEC
5-40	General I (QS/RM)	Medical devices - Application of risk management to medical devices	14971 Second Edition 2007-03-01	ISO
5-89	General I (QS/RM)	Medical electrical equipment - Part 1-6: General requirements for basic safety and essential performance - Collateral standard: Usability	60601-1-6 Edition 3.1 2013-10	IEC
13-32	Software/Informatics	Medical device software - Software life cycle processes	IEC 62304 Edition 1.1 2015-06	AAMI ANSI IEC

No clinical tests were conducted to support the claim of substantial equivalence between the subject and predicate device. Sample clinical images have been provided in accordance with the FDA guidance document, "Submission of Premarket Notifications for Magnetic Resonance Diagnostic Devices," dated November 18, 2016.

10. General Safety and Effectiveness Concerns

The device labeling contains instructions for use and any necessary cautions and warnings to provide for safe and effective use of the device.

Risk management is ensured via compliance with ISO 14971:2007 to identify and provide mitigation of potential hazards in a risk analysis early in the design phase and continuously throughout the development of the product. These risks are controlled via measures realized in hardware and software development, testing, and product labeling. To minimize risks, Siemens adheres to recognized and established industry practices and standards, such as the IEC 60601-1 series, to minimize electrical and mechanical risk. Furthermore, the device is intended for healthcare professionals familiar with and responsible for the acquisition and-post processing of magnetic resonance images.

11. Conclusion as to Substantial Equivalence

There are no changes to the indications for use for the subject device as compared to that of the legally marketed predicate device, MAGNETOM Avanto and MAGNETOM Verio with software *syngo* MR D13A (K121434).

While the new and modified software and hardware features provide additional capabilities compared to the predicate device, the additional capabilities are currently cleared features of the reference devices MAGNETOM Aera and MAGNETOM Skyra with software *syngo* MR E11C (K153343) and do not raise new questions of safety and effectiveness. All features have been verified and validated to support the claim of substantial equivalence to the predicate device.

Siemens believes that the subject device, MAGNETOM Avanto and MAGNETOM Verio with software *syngo* MR E11D, is substantially equivalent to the predicate device, MAGNETOM Avanto and MAGNETOM Verio with software *syngo* MR D13A.