Biograph mCT VG50A
DICOM Conformance Statement

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Content

1. Introduction

1.1 Overview

This document is applicable to Siemens Biograph products using software syngo MI.PET/CT VG50A.

PETsyngo is based on syngo, the common SW platform for Siemens medical devices, and on Somaris/7, the system software for CT products. The DICOM implementation is based on the DICOM 2011 standard [1].

This DICOM Conformance Statement describes PET specific extensions and specializations of the underlying CT software products. See the corresponding CT DICOM Conformance Statement [2].

1.2 Audience

This document is intended for hospital staff, health system integrators, hospital IT-managers, and software engineers. It is assumed that the reader is familiar with DICOM terminology.

1.3 Scope

This DICOM Conformance Statement applies to the following Siemens Biograph products:

Software Name	Siemens Product
PETsyngo VG50A	Biograph mCT and mCT Flow

1.4 Acronyms and Abbreviations

- DICOM Digital Imaging and Communications in Medicine
- IOD DICOM Information Object Definition
- MWL Modality Worklist
- UID Unique Identifier
- VR Value Representation

1.5 References

[1] Digital Imaging and Communications in Medicine (DICOM), NEMA PS3.1-3.20, 2011

[2] syngo CT 2012B (VA44A) DICOM Conformance Statement, see www.siemens.com/DICOM

2. Extensions and Specializations

2.1 PETsyngo PET Attribute Interpretation

The following section describes attribute interpretations for PET images including mu maps. Mu maps are encoded in PET IOD.

This section is not intended to be a substitute for DICOM Standard documentation.

Name	Tag	Explanation
Implementation Class UID	(0002,0012)	Value: 1.3.12.2.1107.5.1.4
Implementation Version Name	(0002,0013)	Value: SIEMENS_S7VA44
Specific Character Set	(0008,0005)	
Image Type	(0008,0008)	For PET images: Value 1: ORIGINAL Value 2: PRIMARY Value 3: STRESS or REST for Cardiac images For PET topogram image: Value 1: ORIGINAL Value 2: PRIMARY Value 3: LOCALIZER Value 4: PET_TOPO For mu maps: Value 1: DERIVED Value 2: PRIMARY Value 3: AC_MAP For statistics image: Value 1: DERIVED Value 2: SECONDARY Value 3: OTHER
SOP Class UID	(0008,0016)	Value: 1.2.840.10008.5.1.4.1.1.128
SOP Instance UID	(0008,0018)	As specified in DICOM standard Part 5 section 9 Unique Identifiers (UIDs)
Study Date	(0008,0020)	For existing studies their date and time entries are copied into the corresponding entries in a new image's header. If a new study is created the date and time entries from the first series of this new study will be used.
Study Time	(0008,0030)	See above
Series Date	(0008,0021)	Series date and time are set the earliest acquisition date and time of the scan.
Series Time	(0008,0031)	See above

Name	Tag	Explanation
Acquisition Date	(0008,0022)	Acquisition Date and Time is defined as the real-world beginning of the accumulation of data which contribute to a particular image. Whole Body PET images belonging to the same bed position share the same acquisition date and time. In case of dynamic the acquisition time is different for different frames at the same bed position.
Acquisition Time	(0008,0032)	See above
Image (Content) Date	(0008,0023)	Image (Content) Date for PET images is set to the real-world date when the images are generated.
Image (Content) Time	(0008,0033)	Image (Content) Time for PET images is set to the real-world time when the images are generated.
Accession Number	(0008,0050)	Input entered from MWL or during patient registration. May be null-length.
Modality	(0008,0060)	Value: PT
Manufacturer	(0008,0070)	Value: SIEMENS
Institution Name	(0008,0080)	Hospital name read from configuration data or user input entered during patient registration or examination setup.
Institution Address	(0008,0081)	Hospital address read from configuration data. Default format is 4 lines containing Street, City, District and Country.
Referring Physician's Name	(0008,0090)	Input from MWL or entered during patient registration or examination setup. May be null-length.
Station Name	(0008,1010)	Station name as per site specific configuration.
Study Description	(0008,1030)	Is derived from information entered during patient registration or examination setup. Concatenated from Body Region and selected Scan Protocol name, separated by a "^".
Procedure Code Sequence	(0008,1032)	Task flow
>Code Value	(0008,0100)	As defined by task flow
>Coding Scheme Designator	(0008,0102)	99PET_VIA
>Code Meaning	(0008,0104)	As defined by task flow
Institutional Department Name	(0008,1040)	According to site configuration.
Performing Physician's\ Name	(0008,1050)	Input entered from MWL or during patient registration.
Operator's Name	(0008,1070)	According to user input.
Admitting Diagnoses Description	(0008,1080)	Input entered from MWL or during patient registration.
Series Description	(0008,103E)	Based on user input and configured appendix.
Manufacturer's Model Name	(0008,1090)	Biograph model name
Related Series Sequence	(0008,1250)	Reference to CT series used for attenuation correction Not filled for mu maps

Name	Tag	Explanation
>Study Instance UID	(0020,000D)	Instance UID of study to which the related CT series belongs
>Series Instance UID	(0020,000E)	Instance UID of related CT series
>Purpose of Reference Code Sequence	(0040,A170)	Describes the purpose for which the reference is made. Zero or more items may be present. When absent, implies that the reason for the reference is unknown. See 2.2 for supported purposes.
Patient's Name	(0010,0010)	Input from MWL or entered during patient registration or examination setup.
Patient ID	(0010,0020)	Input from MWL or entered or generated during patient registration or examination setup.
Patient's Birth Date	(0010,0030)	Input from MWL or entered during patient registration or examination setup. May be calculated from age.
Patient's Sex	(0010,0040)	Input from MWL or entered during patient registration or examination setup.
Patient's Age	(0010,1010)	Input from MWL or entered during patient registration or examination setup. May be calculated from Patient's Birth Date
Patient's Weight	(0010,1030)	Input from MWL or entered during patient registration or examination setup.
Body Part Examined	(0018,0015)	The Body Part Examined is directly entered by the operator.
Slice Thickness	(0018,0050)	Resulting slice thickness. It should be the same as the CT slice thickness if the PET reconstruction is configured to create PET image that matches CT slice location.
Device Serial Number	(0018,1000)	Serial number of the PET/CT system
Software Version(s)	(0018,1020)	PETsyngo software version. One or two values. If two values are present, the first value indicates the SW version in which the data were acquired; the second is the SW version in which the data have been reconstructed.
Protocol Name	(0018,1030)	Name of Scan Protocol selected during patient registration or examination setup
Trigger Time	(0018,1060)	For trigger gating: time interval in ms from start of trigger to the beginning of data acquisition for this image. For respiratory waveform gating: time offset of the start of the gate from the previous Inspiration Peak. These values are normalized across all the respiratory cycles.
Nominal Interval	(0018,1062)	Average duration of accepted beats or respirations Gated only.
Frame Time	(0018,1063)	Nominal duration per individual frame in ms. Gated only.

Name	Tag	Explanation
Framing Type	(0018,1064)	Value: PHASED Gated only.
Beat Rejection Flag	(0018,1080)	Value: Y for trigger gating, N for respiratory waveform gating Gated only.
Low R-R Value	(0018,1081)	For trigger gating: R-R interval lower limit for beat rejection. For respiratory waveform gating: lowest time interval between respiratory peaks Gated only.
High R-R Value	(0018,1082)	For trigger gating: R-R interval upper limit for beat rejection. For respiratory waveform gating: lowest time interval between respiratory peaks Gated only.
Intervals Acquired	(0018,1083)	Total number of accepted beats or respiratory cycles Gated only.
Intervals Rejected	(0018,1084)	Total number of rejected beats. Gated only.
Skip Beats	(0018,1086)	Number of skipped beats after a detected arrhythmia. Gated only.
Heart Rate	(0018,1088)	Average number of heart beats or respirations per minute for the collection period. This includes all accepted and rejected beats or respirations. Gated only.
Collimator Type	(0018,1181)	Value: NONE
Date of Last Calibration	(0018,1200)	Date of last Gantry Calibration / FOV Offset
Time of Last Calibration	(0018,1201)	Time of last Gantry Calibration / FOV Offset
Convolution Kernel	(0018,1210)	Filter type and parameters: XYZ Gauss<w> XYZ Hamm<w> XYZ Hann<w> XYZ Parz<w> XYZ BUTW<w>-<o> XYZ SHEP<w> XYZ BOX where <w> is the filter width (fwhm), and <o> is the filter order, e.g. XYZ BUTW5.00-1
Actual Frame Duration	(0018,1242)	Actual time elapsed during acquisition
Patient Position	(0018,5100)	As entered for scan. This value is set despite the use of the Patient Orientation Code Sequence (0054,0410).
Study Instance UID	(0020,000D)	From MWL or created
Series Instance UID	(0020,000E)	From MWL or created

Name	Tag	Explanation
Study ID	(0020,0010)	From MWL or created
Series Number	(0020,0011)	Created
Acquisition Number	(0020,0012)	A combination of the scan range number within the examination and bed index. For example, for standard whole-body scans (Topo, Spiral CT range, PET range) , the acquisition number set to 2 * 1000 + bed index
Instance Number	(0020,0013)	Created. The order of the Instance Number is not selectable by the user.
Image Position (Patient)	(0020,0032)	The x, y, z coordinates of the center of the first pixel in mm in the CT coordinate system. The coordinates are generated after the PET/CT FOV offset correction and hence may be used directly by PET/ CT image fusion applications.
Image Orientation (Patient)	(0020,0037)	Direction cosines of the first row and first column with respect to the patient.
Frame of Reference UID	(0020,0052)	Created
Position Reference Indicator	(0020,1040)	Null
Slice Location	(0020,1041)	Relative position of the intersection of the image slice with the z-axis in mm. This position is relative to the current reference point and corresponds to the table position. It is generated after the PET/CT FOV z-offset correction.
Image Comments	(0020,4000)	Concatenated string, separated by "^": - User input for comment - Blood Glucose information <BGL:value:units> - Gate definition for gating - CT series description for attenuation correction - /TF if transformation matrix was applied - /MAR if metal artefact correction was applied - Volume Scaling if Volume Scaling was applied - /Mu for mu maps
Samples per Pixel	(0028,0002)	Value: 1
Photometric Interpretation	(0028,0004)	Value: MONOCHROME2
Rows	(0028,0010)	Number of rows in the image
Columns	(0028,0011)	Number of columns in the image
Pixel Spacing	(0028,0030)	Physical distance in the patient between the center of each pixel, specified by a numeric pair - adjacent row spacing (delimiter) adjacent column spacing in mm.
Corrected Image	(0028,0051)	Terms used: DECY, ATTN, SCAT, DTIM, RAN, NORM, RADL, PGC Blank for mu maps
Bits Allocated	(0028,0100)	Value: 16
Bits Stored	(0028,0101)	Value: 16

Name	Tag	Explanation
High Bit	(0028,0102)	Value: 15
Pixel Representation	(0028,0103)	Value: 0 (unsigned) or 1 (signed) depending on minimum pixel value
Smallest Image Pixel Value	(0028,0106)	Calculated during image reconstruction.
Largest Image Pixel Value	(0028,0107)	Calculated during image reconstruction.
Window Center	(0028,1050)	Calculated during image reconstruction. Identical for all images in a frame if Volume Scaling is selected.
Window Width	(0028,1051)	Calculated during image reconstruction. Identical for all images in a frame if Volume Scaling is selected.
Rescale Intercept	(0028,1052)	Value: 0
Rescale Slope	(0028,1053)	Calculated during image reconstruction. Identical for all images in a frame if Volume Scaling is selected.
(Private data)	(0029,xxxx)	See section 2.3
Energy Window Range Sequence	(0054,0013)	Sequence containing one item describing the energy window used to acquire the PET image series.
>Energy Window Lower Limit	(0054,0014)	The lower limit of the energy window in keV.
>Energy Window Upper Limit	(0054,0015)	The upper limit of the energy window in keV.
Radiopharmaceutical Information Sequence	(0054,0016)	Sequence containing items describing the isotope information. Blank for mu maps
>Radiopharmaceutical Volume	(0018,1071)	Volume of administered radiopharmaceutical in cubic cm.
>Radiopharmaceutical Start Time	(0018,1072)	Time of start of injection (Since there is no attribute for the injection **date**, a day shift between start of injection and start if acquisition is encoded in the last 3 digits of the injection time.)
>Radionuclide Total Dose	(0018,1074)	The radiopharmaceutical dose administered to the patient measured in Becquerel (Bq) at the Radiopharmaceutical Start Time
>Radionuclide Half Life	(0018,1075)	The radionuclide half life, in seconds, that was used in the correction of this image.
>Radionuclide Positron Fraction	(0018,1076)	The radionuclide positron fraction (fraction of decays that are by positron emission) that was used in the correction of this image, e.g. 0.97 for 18F.
>Radiopharmaceutical Start DateTime	(0018,1078)	Date and time of start of administration. The actual date and time of radiopharmaceutical administration to the patient for imaging purposes, using the same time base as Series Time (0008,0031).
>Radionuclide Code Sequence	(0054,0300)	Sequence that identifies the radionuclide.

Name	Tag	Explanation
		Only present for radionuclides defined in section 2.5
>>Code Value	(0008,0100)	See section 2.5
>>Coding Scheme Designator	(0008,0102)	See section 2.5
>>Code Meaning	(0008,0104)	See section 2.5
>Radiopharmaceutical	(0018,0031)	Name of the radiopharmaceutical
>Radiopharmaceutical Code Sequence	(0054,0304)	Sequence that identifies the radiopharmaceutical. Only present for radiopharmaceuticals defined in section 2.6
>>Code Value	(0008,0100)	See section 2.6
>>Coding Scheme Designator	(0008,0102)	See section 2.6
>>Code Meaning	(0008,0104)	See section 2.6
Number of R-R Intervals	(0054,0061)	Value: 1
Number of Time Slots	(0054,0071)	Number of gates (for gated)
Number of Slices	(0054,0081)	If PET slice location is configured to match CT slice location, this number is determined by the available number of CT slices within the PET scan range. Otherwise it is calculated based on bed positions or number of gates/frames, number of detector rings and overlap.
Number of Time Slices	(0054,0101)	Number of frames (for dynamic)
Patient Orientation Code Sequence	(0054,0410)	Sequence containing one item that describes the orientation of the patient with respect to gravity. Values: recumbent
>Patient Orientation Modifier Code Sequence	(0054,0412)	Sequence containing one item that modifies or enhances the orientation specified by Patient Orientation Code Sequence. Values: supine, prone, right lateral decubitus, left lateral decubitus
Patient Gantry Relationship Code Sequence	(0054,0414)	Sequence containing one item that describes the orientation of the patient with respect to the gantry. Values: head-first or feet-first.
Series Type	(0054,1000)	Value 1: WHOLE BODY, DYNAMIC or GATED Value 2: IMAGE
Units	(0054,1001)	BQML for quantitative, attenuation corrected images PROPCPS for non-quantitative, non attenuation corrected images 1CM for mu maps
Counts Source	(0054,1002)	The primary source of counts. EMISSION for PET images TRANSMISSION for mu maps
Randoms Correction Method	(0054,1100)	Value: DLYD
Attenuation Correction Method	(0054,1101)	Value for attenuation corrected PET images: measured, name of used CT Series, calculated, CBAC (=Calculated Brain AC)

Name	Tag	Explanation
		Value for mu maps: measured, calculated
Decay Correction	(0054,1102)	The real-world event to which images in this Series were decay corrected. Value: START. This refers to the Series Date and Time, see (0008,0021) and (0008,0031) and private attribute (0071,1022) NONE for mu maps
Reconstruction Method	(0054,1103)	Values: Backprojection Backprojection+TOF OSEM2D <m>i<n>s OSEM3D <m>i<n>s OSEM3D+TOF <m>i<n>s PSF <m>i<n>s PSF+TOF <m>i<n>s where <m> is the number of iterations and <n> the number of subsets, e.g. OSEM3D 2i8s.
Scatter Correction Method	(0054,1105)	Value: Model-based for scatter-corrected images.
Axial Acceptance	(0054,1200)	The maximum detector ring difference instead of angle in degrees.
Axial Mash	(0054,1201)	Number of adjacent axial lines of response mashed together
Frame Reference Time	(0054,1300)	Time offset from the series time in ms. This value is different for images acquired in different bed positions or dynamic frames, but is the same for all gates.
Decay Factor	(0054,1321)	The decay factor that was used to scale this image. The measured activity is corrected back to the reference time (0054,1102) with the following factor: $e^{\lambda(t_{start}-t_{reference})}\frac{\lambda T_{frame}}{1-e^{-\lambda T_{frame}}}$ with $\lambda=\frac{\ln 2}{T_{1/2}}$ where t_{start} is the frame start time, $t_{reference}$ the reference time, T_{frame} the frame duration, and $T_{1/2}$ the half life time of the radionuclide, see (0018,1075)
Dose Calibration Factor	(0054,1322)	A factor that was used to scale this image from ECAT counts/sec to Bq/ml using a dose calibrator.

Name	Tag	Explanation
		The value is 1 if normalization was not applied.
Scatter Fraction Factor	(0054,1323)	An estimate of the fraction of acquired counts that were due to scatter and were corrected in this image. The value shall be 0 if no scatter correction was applied.
Image Index	(0054,1330)	An encoded index identifying the position of the image within the PET series which is viewed as a multi-dimensional array. Used for sorting of PET images (whole body, dynamic, gated)
Pixel Data	(7FE0,0010)	

2.2 Supported Purposes of Reference Code Sequence

The following table shows supported purposes of Reference Code Sequence (see tag word 0040,A170 in section 2.1):

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SRT	122401	Same Anatomy (indicating that the referenced CT series is used for slice matching)
SRT	122403	For Attenuation Correction (indicating that the referenced CT series is used for attenuation correction)

2.3 Private PET Attributes

The following private attributes are defined for PET images:

Name	Tag	VR	Explanation
SIEMENS MED PT	(0071,0010)		
>Registration Matrix UID	(0071,1021)	UI	UID of Registration matrix between PET and CT images
>Decay Correction DateTime	(0071,1022)	DT	The date and time to which the image was decay corrected. Also refer to (0054,1102)
>Registration Matrix	(0071,1023)	FD	16 float values describing the 4x4 registration matrix from CT to PET
>Table Motion	(0071,1024)	CS	DYNAMIC for CBM, STATIC for Step and Shoot
SIEMENS MED PT MU MAP	(0071,0011)		
>SOP Class of Source	(0071,1101)	UI	For mu maps: 1.2.840.10008.5.1.4.1.1.2 for CT based mu maps 1.2.840.10008.5.1.4.1.1.128 for PET based mu maps
>Related Mu Map Series	(0071,1102)	UI	For PET images: DICOM UID of the mu map series which is used for attenuation correction of the PET images

2.4 PET Extensions of Non-Image Object

PETsyngo uses the following defined terms for Image Type (0008,0008):

- Value 1: ORIGINAL, DERIVED
- Value 2: PRIMARY
- Value 3: PET_CALIBRATION, PETCT_SPL, PET_LISTMODE, PET_EM_SINOGRAM, PET_PHYSIO, PET_REPLAY_PARAM, PET_COUNTRATE, PET_PHYSIO
- Value 4: CARDIAC, RESPIRATORY, PET_PHYSIO_MFL

The following table lists the PETsyngo non-image types and the corresponding values.

Description	**0008,0008 Value 1**	**0008,0008 Value 2**	**0008,0008 Value 3**	**0008,0008 Value 4**
Sinogram data	ORIGINAL	PRIMARY	PET_EM_SINOGRAM	none
Listmode data	ORIGINAL	PRIMARY	PET_LISTMODE	none or CARDIAC or RESPIRATORY
Attenuation correction data	DERIVED	PRIMARY	none	none
Norm data	ORIGINAL	PRIMARY	PET_CALIBRATION	none
Protocol data	ORIGINAL	PRIMARY	PETCT_SPL	none
Physiological data	ORIGINAL	PRIMARY	PET_PHYSIO	CARDIAC or RESPIRATORY
Replay parameters	ORIGINAL	PRIMARY	PET_REPLAY_PARAM	none
Count Rate Data	ORIGINAL	PRIMARY	PET_COUNTRATE	none
Physio Data	ORIGINAL	PRIMARY	PET_PHYSIO	PET_PHYSIO_MFL

2.5 Supported Radionuclides

The following table shows for which radionuclides the Radionuclide Code Sequence is provided (see tag word 0054,0300 in section 2.1):

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SRT	C-111A1	^18^Fluorine
SRT	C-159A2	^82^Rubidium
SRT	C-107A1	^13^Nitrogen
SRT	C-105A1	^11^Carbon
SRT	C-128A2	^68^Germanium
SRT	C-155A1	^22^Sodium
SRT	C-1018C	^14^Oxygen
SRT	C-B1038	^15^Oxygen
SRT	C-127A5	^62^Copper
SRT	C-127A2	^64^Copper
SRT	C-131A1	^66^Gallium
SRT	C-131A3	^68^Gallium
SRT	C-113A1	^75^Bromine
SRT	C-113A2	^76^Bromine
SRT	C-114A5	^124^Iodine
SRT	C-149A1	^52^Manganese
SRT	C-162A3	^86^Yttrium
SRT	C-141A1	^62^Zinc
Not defined	Not defined	Fe-52
Not defined	Not defined	Mn-51
Not defined	Not defined	Tc-94m
Not defined	Not defined	Y-90
Not defined	Not defined	Zr-89

2.6 Supported Radiopharmaceuticals

The following table shows for which radiopharmaceuticals the Radiopharmaceuticals Code Sequence is provided (see tag word 0054,0304 in section 2.1):

Coding Scheme Designator (0008,0102)	Code Value (0008,0100)	Code Meaning (0008,0104)
SRT	C-B1043	Acetate C^11^
SRT	C-B103C	Ammonia N^13^
SRT	C-B07DB	ATSM Cu^64^
SRT	C-B07DC	Butanol O^15^
SRT	C-B103B	Carbon dioxide O^15^
SRT	C-B1045	Carbon monoxide C^11^
SRT	C-B103A	Carbon monoxide O^15^
SRT	C-B103F	Carfentanil C^11^
SRT	C-B07DD	EDTA Ga^68^
SRT	C-B07DE	Flumazenil C^11^
SRT	C-B07DF	Flumazenil F^18^
SRT	C-B07E0	Fluorethyltyrosin F^18^
SRT	C-B1031	Fluorodeoxyglucose F^18^
SRT	C-B07E1	Fluoromisonidazole F^18^
SRT	C-B07E2	Fluoromethane F^18^
SRT	C-B07E3	Fluorouracil F^18^
SRT	C-B07E4	Fluorobenzothiazole F^18^
SRT	C-B1034	Fluoro-L-dopa F^18^
SRT	C-B1046	Germanium Ge^68^
SRT	C-B103D	Glutamate N^13^
SRT	C-B07E5	Mespiperone C^11^
SRT	C-B103E	Methionine C^11^
SRT	C-B07E6	Monoclonal antibody I^124^
SRT	C-B1038	Oxygen O^15^
SRT	C-B1039	Oxygen-water O^15^
SRT	C-B1044	Palmitate C^11^
SRT	C-B07E7	PTSM Cu^62^
SRT	C-B1042	Raclopride C^11^
SRT	C-B1037	Rubidium chloride Rb^82^
SRT	C-B1032	Sodium fluoride F^18^
SRT	C-B07E8	Sodium iodide I^124^
SRT	C-B1047	Sodium Na^22^
SRT	C-B1033	Spiperone F^18^
SRT	C-B1036	Thymidine (FLT)F^18^

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