CONFORMANCE STATEMENT
FOR NUCLEAR MEDICINE EQUIPMENT
GCA SOFTWARE
FOR
DICOM TRANSFER SOFTWARE (FOR CT/MR IMAGES)
MODEL   NSDO-050A
(MIINM0005EA)

C-1

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1 Introduction

This document is a DICOM Conformance Statement for Toshiba's Nuclear Medicine System, and the applicable models covered by this document are described in Table 3. It is intended to provide the reader with the knowledge of how to integrate this product within a DICOM compliant hospital network. It details the DICOM Service Classes, Information Objects, and Communication Protocols which are supported by this product.

If the reader is unfamiliar with DICOM, it is recommended that they read the DICOM Specification (referenced below) prior to reading this conformance statement. Also note that this document is formatted according to the DICOM Specification, Part 2: Conformance.

1.1 References

- ACR-NEMA Digital Imaging and Communications in Medicine, DICOM V3.0.

1.2 Definitions

- **Association Establishment** - An Association Establishment is the first phase of communication between two DICOM Application Entities. The AEs use the Association Establishment to negotiate how data will be encoded and the type of data to be exchanged.

- **Called Application Entity Title** - The Called AE Title defines the intended receiver of an Association.

- **Calling Application Entity Title** - The Calling AE Title defines the requestor of an Association.

- **DICOM Message Service Element (DIMSE)** - A DIMSE defines the services and protocols utilized by an Application Entity to exchange messages.

- **Information Object Definition (IOD)** - An IOD is a data model which is an abstraction of real-world information. This data model defines the nature and attributes relevant to the class of real-world objects represented.

- **Service Class Provider (SCP)** - A Service Class Provider plays the "server" role to perform operations and invoke notifications during an Association. An example of a Storage Service Class Provider would be an image storage device. In this case, the image storage device is storing the image that was sent by a Service Class User.

- **Service Class User (SCU)** - A Service Class User plays the "client" role to invoke operations and perform notifications during an Association. An example of a Storage Service Class User would be an image acquisition device. In this case, the image acquisition device will create and send a DICOM image by requesting that a Service Class Provider store that image.

- **Service/Object Pair (SOP) Class** - A SOP Class is defined by the union of an Information Object Definition and a set of DIMSE Services. A DICOM Application Entity may support one or more SOP Classes. Each SOP Class is uniquely identified by a SOP Class UID.

- **SOP Instance** - A specific occurrence of a Information Object.

- **Transfer Syntax** - The Transfer Syntax is a set of encoding rules that allow DICOM Application Entities to negotiate the encoding techniques (e.g. data element structure, byte ordering, compression) they are able to support. The Transfer Syntax is negotiated during Association Negotiation.

- **Unique Identifier (UID)** - A Unique Identifier is a globally unique, ISO compliant, ASCII-numeric string. It guarantees uniqueness across multiple countries, sites, vendors and equipment.

1.3 Acronyms, Abbreviations and Symbols

- ACC   American College of Cardiology
- ACR   American College of Radiology
- ASCII   American Standard Code for Information Interchange
- AE   Application Entity
- ANSI   American National Standards Institute
- CEN TC251   Comite Europeen de Normalisation - Technical Committee 251 - Medical Informatics
- DICOM   Digital Imaging and Communications in Medicine
- DIMSE   DICOM Message Service Element
- DIMSE-C   DICOM Message Service Element - Composite
- DIMSE-N   DICOM Message Service Element - Normalized
- HIS   Hospital Information System
- HL7   Health Level 7
- IE   Information Entity
- IOD   Information Object Definition
- ISO   International Standards Organization
- JIRA   Japan Industries Association of Radiological Systems
- NEMA   National Electrical Manufacturers Association
- OSI   Open Systems Interconnection
- PDU   Protocol Data Unit
- RIS   Radiology Information System
- SCP   Service Class Provider
- SCU   Service Class User
- SOP   Service-Object Pair
- TCP/IP   Transmission Control Protocol/Internet Protocol
- UID   Unique Identifier

2 Implementation Model

2.1 Application Data Flow Diagram
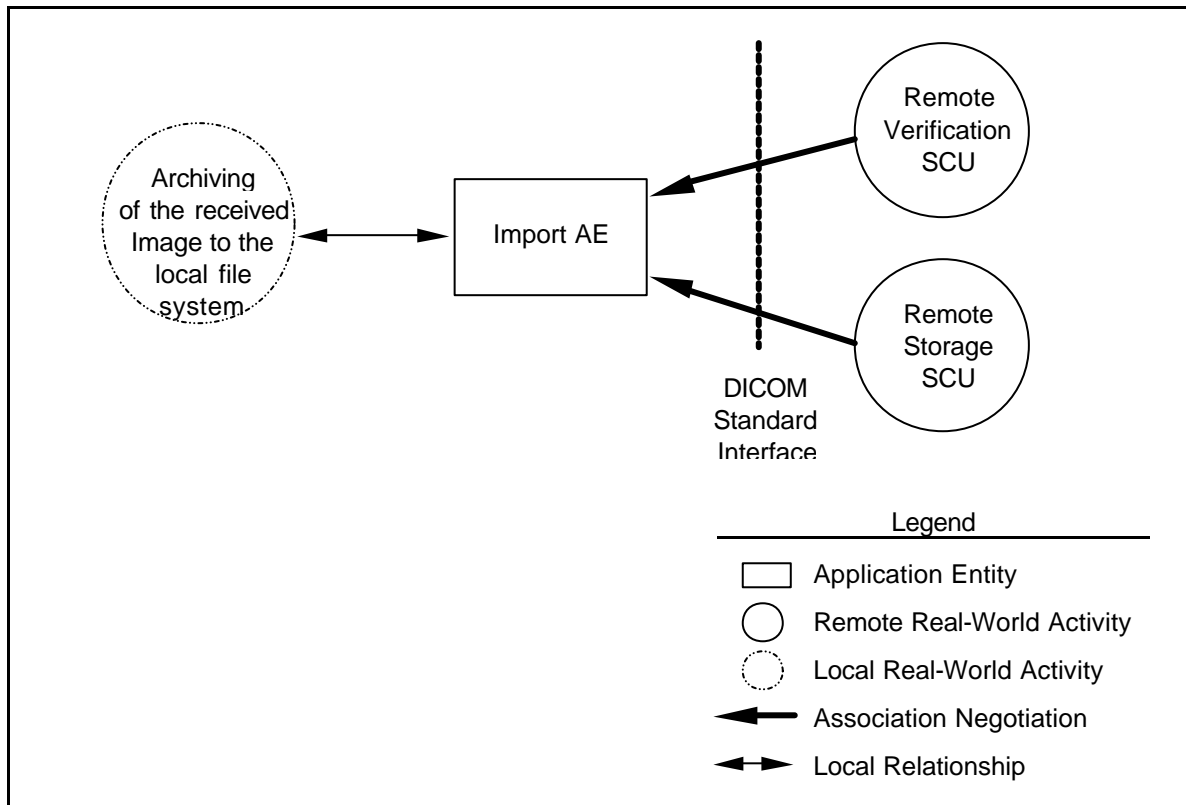
Figure 1

2.2 Functional Definitions of AE's

2.2.1 Import AE

Import AE is used to respond to requests to verify that the NM System is present and active on the network, and to receive CT and MR images from remote DICOM devices.

2.3 Sequencing of Real World Activities

2.3.1 Features

2.3.1.1 Archiving of the Received Image to the Local File System

- The NM System receives CT and MR images from remote DICOM devices.
- The NM System archives the received images to the local file system.

2.3.2   Operation

2.3.2.1   Archiving of the Received Image to the Local File System

There is no specific operation for receiving and archiving images.

3 AE Specifications

3.1 Import Specification

Import AE provides Standard Conformance to the following DICOM SOP Classes as an SCP:

Table 1

SOP Class Name	SOP Class UID
Verification	1.2.840.10008.1.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2
MR Image Storage	1.2.840.10008.5.1.4.1.1.4

3.1.1 Import Association Establishment Policies

3.1.1.1 Import General

Import AE will utilize and understand the following Application Context Name:

Table 2

DICOM V3.0 Application Context	1.2.840.10008.3.1.1.1

Import AE supports a minimum PDU size of 16Kbytes and a maximum PDU size of 16Kbytes. The default value is set to 16Kbytes.

3.1.1.2 Import Number of Associations

Import AE supports up to three associations at a time.

3.1.1.3 Import Asynchronous Nature

Import AE allows a single outstanding operation on any association. Therefore, Import AE does not support asynchronous operations window negotiation, other than the default as specified by the specification.

3.1.1.4 Import Implementation Identifying Information

Import AE will specify the following Implementation Identifying Information:

Table 3

Applicable Models	Implementation Class UID	Implementation Version Name
GMS-5500A/UI, GCA-7100A/UI, GCA-7200A/UI, GCA-9300A/PI, GMS-5500A/PI, GCA-7100A/PI, GCA-7200A/PI, GCA-9300A/PI	1.2.392.200036.9116.5.3.10	"TM_NM_DCM_V1.0"
GMS-5500A/DI, GCA-7100A/DI, GCA-7200A/DI, GCA-9300A/DI	1.2.392.200036.9116.5.1.10	"TM_NM_DCM_V1.0"

3.1.2 Import Association Initiation by Real-World Activity

Import AE never initiates an association.

3.1.3 Import Association Acceptance Policy

When Import AE receives an association request, it will allow the following activities to be performed during that association:

- Verification   - Allow a remote DICOM device to verify that the NM System is active on the DICOM network
- Storage   - Allow a remote DICOM device to send a CT or MR image to the NM System

3.1.3.1 Import Real-World Activity - Verification

3.1.3.1.1 Import Associated Real-World Activity - Verification

The NM System responds to Verification made by a remote Verification SCU.

3.1.3.1.2 Import Presentation Context Table - Verification

Import AE accepts all of the Presentation Contexts shown below:

Table 4

Presentation Context Table					
Abstract Syntax		Transfer Syntax			Extended
Name	UID	Name List	UID List	Role	Negotiation
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None

3.1.3.1.2.1 Import SOP Specific Conformance - Verification

Import AE responds with the following status codes in response to a C-ECHO request.

Table 5

Service Status	Further Meaning	Protocol Codes	Description
Success	Success	0x0000	Operation performed properly

3.1.3.1.3   Import Presentation Context Acceptance Criterion - Verification

Import AE accepts the Presentation Contexts listed in the Presentation Context Table(Table 4).

3.1.3.1.4   Import Transfer Syntax Selection Policies - Verification

Import AE supports only the Implicit VR Little Endian transfer syntax. It rejects any proposed Presentation Context which does not specify the default Implicit VR Little Endian transfer syntax.

3.1.3.2   Import Real-World Activity - Storage

3.1.3.2.1   Import Associated Real-World Activity - Storage

The NM System receives image data sent by a remote Storage SCU, archives it to local file system, and responds to the remote Storage SCU.

3.1.3.2.2   Import Presentation Context Table - Storage

Import AE accepts all of the Presentation Contexts shown below:

Table 6

Presentation Context Table					
Abstract Syntax		Transfer Syntax			Extended
Name	UID	Name List	UID List	Role	Negotiation
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Implicit VR Little Endian	1.2.840.10008.1.2	SCP	None
MR Image Storage	1.2.840.10008.5.1.4.1.1.4	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCP	None

3.1.3.2.2.1   Import SOP Specific Conformance - Storage

Import AE responds with the following status codes in response to a C-STORE request.

Import AE is Level 0 Conformance as described in Part 4 of the DICOM V3.0 Standard document. The attributes to be stored are defined in chapter 8 'Information Object Definition – Storage SCP'.

Table 7

Service Status	Further Meaning	Protocol Codes	Description
Success	Success	0x0000	Operation performed properly
Error	Data Set does not match SOP Class	0xA900	SOP Class UID does not match.
	Cannot understand	0xC000	Invalid data set, or unsupported extended character sets. (see chapter 7 'Support of Extended Character Sets')
Refused	Out of Resources	0xA700	Local resource is insufficient.

When the service status response is "Refused", check the NM System for one of the following situations:

1) Out of free local storage space

2) Busy processes/applications that are draining CPU resources

3.1.3.2.3   Import Presentation Context Acceptance Criterion - Storage

Import AE accepts the Presentation Contexts listed in the Presentation Context Table(Table 6).

3.1.3.2.4   Import Transfer Syntax Selection Policies - Storage

Import AE accepts the Transfer Syntax listed in the Presentation Context Table(Table 6).

The selection priority of acceptable Transfer Syntax is the Default Transfer Syntax. See 6.4.1.

4 Communication Profiles

4.1 Supported Communication Stacks

This product provides DICOM TCP/IP Network Communication Support as defined in Part 8 of the DICOM Standard.

4.2 OSI Stack

Not applicable to this product.

4.3 TCP/IP Stack

This product inherits its TCP/IP stack from the computer system upon which it executes.

4.3.1 API

Not applicable to this product.

4.3.2 Physical Media Support

This product is indifferent to the physical medium over which TCP/IP executes; it inherits the medium from the computer system upon which it executes.

4.4 Point-to-Point Stack

Not applicable to this product.

5 Extensions/Specializations/Privatizations

Not applicable to this product.

6 Configuration

For the NM System, the configuration procedure is described in the installation manual.

Note: Settings and changes are to be performed by Toshiba Service Personnel at the time of installation of the system and at anytime thereafter.

6.1 AE Title/Presentation Address Mapping

The mapping from the AE titles to the presentation addresses are as follows:

- One port number and one AE title can be described for one host name.
- Each AE title is mapped to one port number.
- Up to five remote hosts can be described.
- The NM System has following default values:

Local Port No.   104
Local AE Title   "TM_NM_DCM_V1.0"

6.2 Configurable Parameters

6.2.1 Time-out Value, Retry Count, Retry Interval

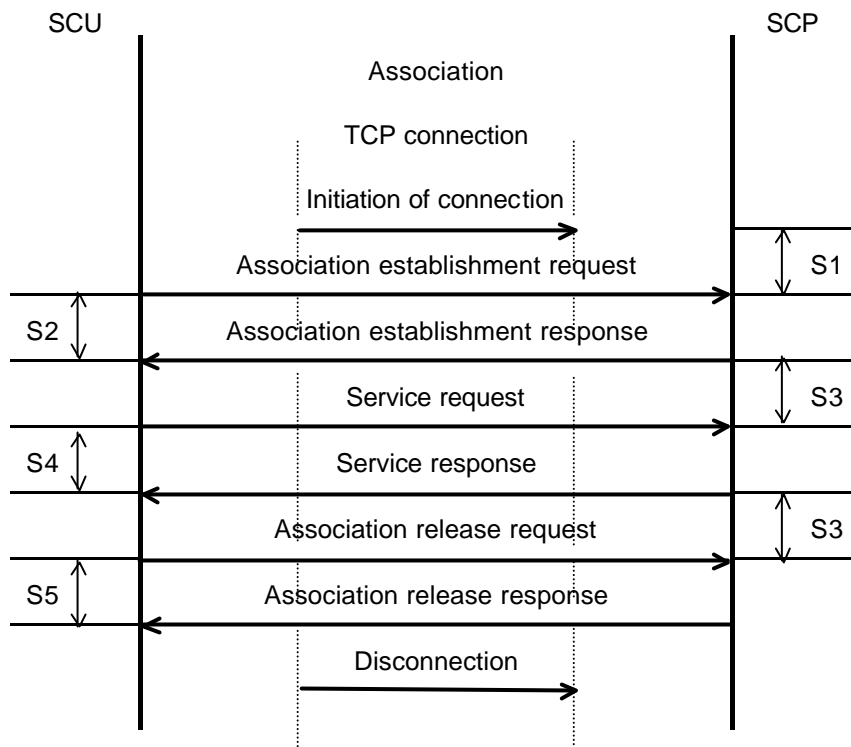The time-out value, retry count, and retry interval in each status are shown below.

Figure 2

Table 8

Status	Item	Time-out value	Retry count	Retry interval	Remarks
S1	Association establishment request waiting time	default: 60 seconds range: 1 to 999999	Not set	Not set	Only one parameter can be set in the NM System.
S2	Association establishment response waiting time	Not set	Not set	Not set	
S3	Service request waiting time	default: 60 seconds range: 1 to 999999	Not set	Not set	Only one parameter can be set in the NM System.
S4	Service response waiting time	Not set	Not set	Not set	
S5	Association release waiting time	Not set	Not set	Not set	

6.3 Implementation Information and Maximum Reception PDU Size

The default values for the NM System are used for the Implementation Class UID, the Implementation Version name, and the Maximum length received. They cannot be changed.

Table 9

Applicable Models	Implementation Class UID	Implementation Version Name	Maximum length received (unit: byte)
GMS-5500A/UI, GCA-7100A/UI, GCA-7200A/UI, GCA-9300A/PI, GMS-5500A/PI, GCA-7100A/PI, GCA-7200A/PI, GCA-9300A/PI	1.2.392.200036.9116.5.3.10	"TM_NM_DCM_V1.0"	0x4000
GMS-5500A/DI, GCA-7100A/DI, GCA-7200A/DI, GCA-9300A/DI	1.2.392.200036.9116.5.1.10	"TM_NM_DCM_V1.0"	0x4000

6.4 Default Transfer Syntax

6.4.1 Import AE

The selection priority of acceptable Transfer Syntax is the following Default Transfer Syntax:

Default = "Explicit VR Big Endian"

7   Support of Extended Character Sets

This product supports the following character sets:

- ISO-IR 6 (default)   Basic G0 Set

If Import AE receives image data that contains characters from an unsupported character set, Import AE will respond with "Cannot understand" to the C-STORE request. (See 3.1.3.2.2.1)

8   Information Object Definition - Storage SCP

8.1   Entity Module Definitions

The information modules for the NM System are defined below.

8.1.1   CT IOD Modules

Table 10

Information Entity	Module	Reference	Usage[1]
Patient	Patient Module	8.2.1	M
Study	General Study Module	8.2.2	M
	Patient Study Module	8.2.3	U
Series	General Series Module	8.2.4	M
Frame of Reference	Frame of Reference Module	8.2.5	M
Equipment	General Equipment Module	8.2.6	M
Image	General Image Module	8.2.7	M
	Image Plane Module	8.2.8	M
	Image Pixel Module	8.2.9	M
	Contrast/Bolus Module	8.2.10	C
	VOI LUT Module	8.2.11	U
	SOP Common Module	8.2.12	M
	CT Image Module	8.2.13	M

[1] M=Mandatory, C=Conditional, U=User option

8.1.2 MR IOD Modules

Table 11

Information Entity	Module	Reference	Usage[1]
Patient	Patient Module	8.2.1	M
Study	General Study Module	8.2.2	M
	Patient Study Module	8.2.3	U
Series	General Series Module	8.2.4	M
Frame of Reference	Frame of Reference Module	8.2.5	M
Equipment	General Equipment Module	8.2.6	M
Image	General Image Module	8.2.7	M
	Image Plane Module	8.2.8	M
	Image Pixel Module	8.2.9	M
	Contrast/Bolus Module	8.2.10	C
	VOI LUT Module	8.2.11	U
	SOP Common Module	8.2.12	M
	MR Image Module	8.2.14	M

[1] M=Mandatory, C=Conditional, U=User option

8.2 Information Object Definitions

8.2.1 Patient Module

Table 12

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	
Patient ID	(0010,0020)	2	
Patient's Birth Date	(0010,0030)	2	
Patient's Sex	(0010,0040)	2	
Other Patient IDs	(0010,1000)	3	
Other Patient Names	(0010,1001)	3	
Patient Comments	(0010,4000)	3	

8.2.2 General Study Module

Table 13

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	
Study Date	(0008,0020)	2	
Study Time	(0008,0030)	2	
Referring Physician's Name	(0008,0090)	2	
Study ID	(0020,0010)	2	
Accession Number	(0008,0050)	2	
Study Description	(0008,1030)	3	
Name of Physician(s) Reading Study	(0008,1060)	3	

8.2.3 Patient Study Module

Table 14

Attribute Name	Tag	Type	Attribute Description
Admitting Diagnoses Description	(0008,1080)	3	
Patient's Age	(0010,1010)	3	
Patient's Size	(0010,1020)	3	
Patient's Weight	(0010,1030)	3	

8.2.4 General Series Module

Table 15

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	
Series Instance UID	(0020,000E)	1	
Series Number	(0020,0011)	2	
Laterality	(0020,0060)	2C	
Series Date	(0008,0021)	3	
Series Time	(0008,0031)	3	
Performing Physicians' Name	(0008,1050)	3	
Protocol Name	(0018,1030)	3	
Body Part Examined	(0018,0015)	3	
Patient Position	(0018,5100)	2C	

8.2.5 Frame of Reference Module

Table 16

Attribute Name	Tag	Type	Attribute Description
Frame of Reference UID	(0020,0052)	1	
Position Reference Indicator	(0020,1040)	2	

8.2.6 General Equipment Module

Table 17

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	
Institution Name	(0008,0080)	3	
Station Name	(0008,1010)	3	
Institutional Department Name	(0008,1040)	3	
Manufacturer's Model Name	(0008,1090)	3	
Device Serial Number	(0018,1000)	3	
Software Versions	(0018,1020)	3	
Spatial Resolution	(0018,1050)	3	
Date of Last Calibration	(0018,1200)	3	
Time of Last Calibration	(0018,1201)	3	

8.2.7 General Image Module

Table 18

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	
Patient Orientation	(0020,0020)	2C	
Image Date	(0008,0023)	2C	
Image Time	(0008,0033)	2C	
Image Type	(0008,0008)	3	
Acquisition Number	(0020,0012)	3	
Acquisition Date	(0008,0022)	3	
Acquisition Time	(0008,0032)	3	
Images in Acquisition	(0020,1002)	3	
Image Comments	(0020,4000)	3	

8.2.8 Image Plane Module

Table 19

Attribute Name	Tag	Type	Attribute Description
Pixel Spacing	(0028,0030)	1	
Image Orientation (Patient)	(0020,0037)	1	
Image Position (Patient)	(0020,0032)	1	
Slice Thickness	(0018,0050)	2	
Slice Location	(0020,1041)	3	

8.2.9 Image Pixel Module

Table 20

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	
Photometric Interpretation	(0028,0004)	1	
Rows	(0028,0010)	1	
Columns	(0028,0011)	1	
Bits Allocated	(0028,0100)	1	
Bits Stored	(0028,0101)	1	
High Bit	(0028,0102)	1	
Pixel Representation	(0028,0103)	1	
Pixel Data	(7FE0,0010)	1	
Pixel Aspect Ratio	(0028,0034)	1C	If any value is set, Import AE will respond with "Cannot understand" to the C-STORE request. (See 3.1.3.2.2.1)
Smallest Image Pixel Value	(0028,0106)	3	
Largest Image Pixel Value	(0028,0107)	3	

8.2.10 Contrast/Bolus Module

This module is set if contrast media was used in the image.

Table 21

Attribute Name	Tag	Type	Attribute Description
Contrast/Bolus Agent	(0018,0010)	2	
Contrast/Bolus Route	(0018,1040)	3	
Contrast/Bolus Volume	(0018,1041)	3	
Contrast/Bolus Start Time	(0018,1042)	3	
Contrast/Bolus Stop Time	(0018,1043)	3	
Contrast/Bolus Total Dose	(0018,1044)	3	

8.2.11 VOI LUT Module

Table 22

Attribute Name	Tag	Type	Attribute Description
Window Center	(0028,1050)	3	
Window Width	(0028,1051)	1C	

8.2.12   SOP Common Module

Table 23

Attribute Name	Tag	Type	Attribute Description
SOP Class UID	(0008,0016)	1	
SOP Instance UID	(0008,0018)	1	

8.2.13   CT Image Module

Table 24

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	
Samples per Pixel	(0028,0002)	1	
Photometric Interpretation	(0028,0004)	1	
Bits Allocated	(0028,0100)	1	
Bits Stored	(0028,0101)	1	
High Bit	(0028,0102)	1	
Rescale Intercept	(0028,1052)	1	
Rescale Slope	(0028,1053)	1	
KVP	(0018,0060)	2	
Acquisition Number	(0020,0012)	2	
Scan Options	(0018,0022)	3	
Data Collection Diameter	(0018,0090)	3	
Reconstruction Diameter	(0018,1100)	3	
Distance Source to Detector	(0018,1110)	3	
Distance Source to Patient	(0018,1111)	3	
Gantry/Detector Tilt	(0018,1120)	3	
Table Height	(0018,1130)	3	
Rotation Direction	(0018,1140)	3	
Exposure Time	(0018,1150)	3	
X-ray Tube Current	(0018,1151)	3	
Exposure	(0018,1152)	3	
Filter Type	(0018,1160)	3	
Generator Power	(0018,1170)	3	
Focal Spot	(0018,1190)	3	
Convolution Kernel	(0018,1210)	3	

8.2.14 MR Image Module

Table 25

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	
Samples per Pixel	(0028,0002)	1	
Photometric Interpretation	(0028,0004)	1	
Bits Allocated	(0028,0100)	1	
Scanning Sequence	(0018,0020)	1	
Sequence Variant	(0018,0021)	1	
Scan Options	(0018,0022)	2	
MR Acquisition Type	(0018,0023)	2	
Repetition Time	(0018,0080)	2C	
Echo Time	(0018,0081)	2	
Echo Train Length	(0018,0091)	2	
Inversion Time	(0018,0082)	2C	
Trigger Time	(0018,1060)	2C	
Sequence Name	(0018,0024)	3	
Echo Number	(0018,0086)	3	
Reconstruction Diameter	(0018,1100)	3	

E