TOSHIBA

DICOM CONFORMANCE STATEMENT

STORAGE SCU

FOR

TOSHIBA WHOLE-BODY X-RAY CT SCANNER MODEL COT-15A

(MIICT0001EA)

TOSHIBA CORPORATION

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Table of Contents

1 Introduction

This document is a DICOM Conformance Statement for Toshiba CT scanner X-series. 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

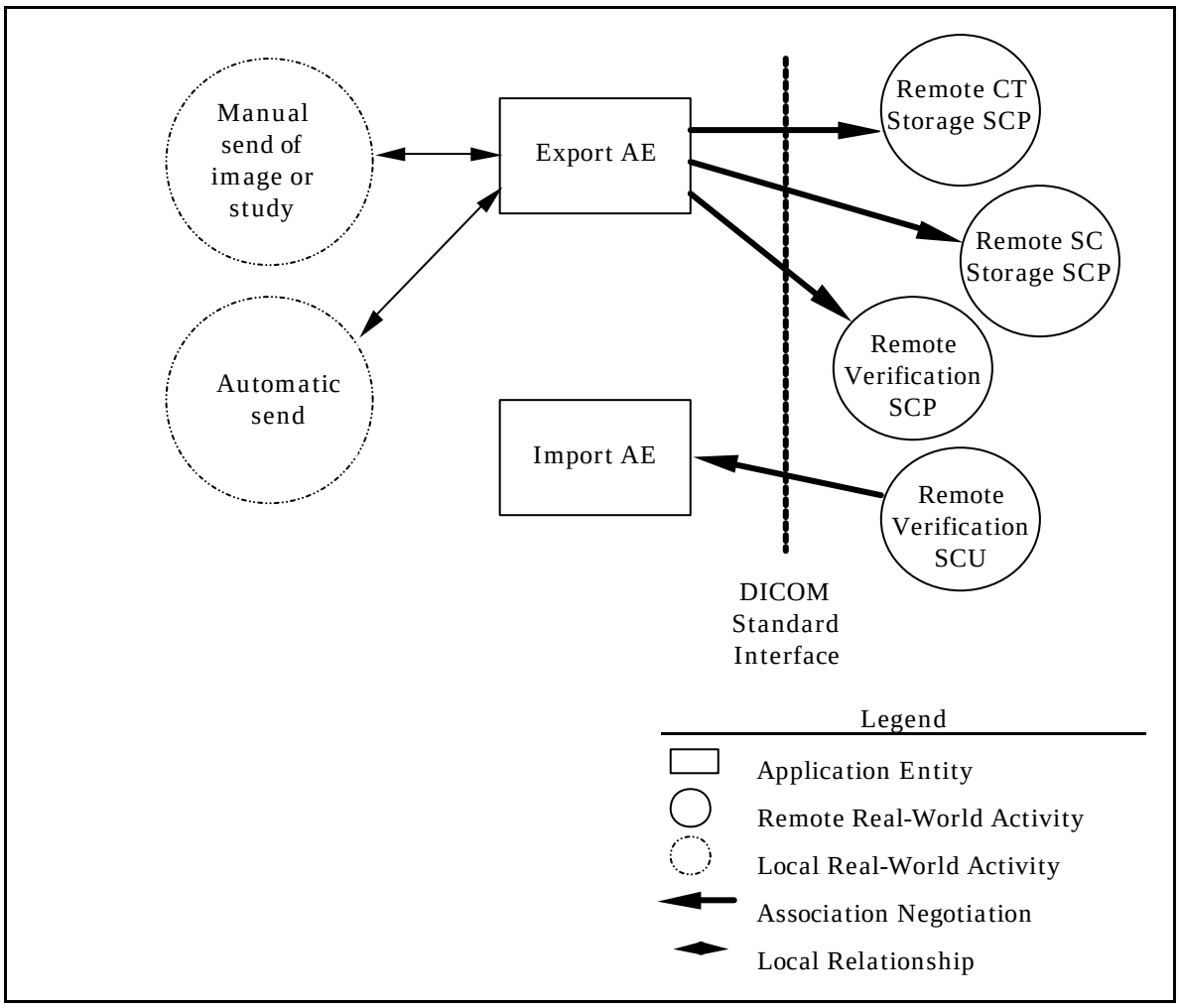

Figure 1

2.2 Functional Definitions of AE's

2.2.1 Export AE

Export AE is used to verify that a remote DICOM device is active on the network, and to transmit images to a remote DICOM device. It therefore performs the following tasks:

- Builds DICOM CT, SC Information Objects
- Establishes DICOM Association with remote DICOM device
- Performs storage of DICOM CT, SC Information Objects to remote DICOM device
- Performs verification of remote DICOM device's presence on network

2.2.2 Import AE

Import AE is used to respond to requests to verify that the X-series is present and active on the network.

2.3 Sequencing of Real World Activities

2.3.1 Features

2.3.1.1 Manual Send of Image or Study

- Operator requests to send image after selecting the images to be transferred from the Study List, or the Image List.
- When the image transfer fails, the X-series CT Scanner automatically attempts to resend the image at a later time.

2.3.1.2 Automatic Send

- Auto-transfer-mode allows the transfer of images automatically after the scan and image reconstruction are done.
- When the image transfer fails, the X-series CT Scanner automatically attempts to resend the image at a later time.

2.3.2 Operation

2.3.2.1 Manual Send of Image or Study

The operation for sending images is described below:

Step-1: Select the destination of image sending.

Step-2: Select the image or the studies to be sent.

Step-3: Request sending.

2.3.2.2 Automatic Send

Setting up automatic transmitting request:

Step-1: Select “on” of Auto-requesting-mode.

3 AE Specifications

3.1 Export Specification

Export AE provides Standard Conformance to the following DICOM SOP Classes as an SCU:

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
SC Image Storage	1.2.840.10008.5.1.4.1.1.7

3.1.1 Export Association Establishment Policies

3.1.1.1 Export General

Export 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

Export AE supports the PDU size of 16 Kbytes only. The default value is set to 16 Kbytes.

3.1.1.2 Export Number of Associations

Export AE can only establish one association at a time, independent of the number of destinations chosen.

3.1.1.3 Export Asynchronous Nature

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

3.1.1.4 Export Implementation Identifying Information

Export AE will specify the following Implementation Identifying Information:

- Implementation Class UID 1.2.392.200036.9116.2.1.1
- Implementation Version Name TM_CT_DCM_V1.0

3.1.2 Export Association Initiation by Real-World Activity

Export AE initiates an association when the following activity is chosen by the operator:

- "Manual send of image or study"
  - Verification- Verify that a remote DICOM device is present on the network
  - Storage - Create and store a CT, SC image to a remote DICOM device

  Verification is initiated automatically at the "Manual send of image or study"

3.1.2.1 Export Real-World Activity - Verification

3.1.2.1.1 Export Associated Real-World Activity - Verification

Export AE performs Verification automatically before performing an image transfer request. This feature can be turned off in the configuration, should the destination device not support the Verification Service.

3.1.2.1.2 Export Proposed Presentation Contexts - Verification

Export AE proposes the following Presentation Contexts shown below:

Table 3

Presentation Context Table

Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	**UID**	**Name List**	**UID List**		
Verification	1.2.840.10008.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None

3.1.2.2 Export Real-World Activity - Storage

3.1.2.2.1 Export Associated Real-World Activity - Storage

Storage is executed by the X-series after the operator's image transfer requests are queued.

3.1.2.2.2 Export Proposed Presentation Contexts - Storage

Export AE proposes the following Presentation Contexts shown below:

Table 4

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Extended Negotiation
Name	UID	Name List	UID List		
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	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	SCU	None
SC Image Storage	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
SC Image Storage	1.2.840.10008.5.1.4.1.1.7	Explicit VR Big Endian	1.2.840.10008.1.2.2	SCU	None

3.1.2.2.2.1 Export SOP Specific Conformance - CT, SC Image Storage

Export AE operation involves the following sequence of steps for each image transfer.

(1) Association establishment (requestor only)

(2) Data transfer (SCU only)

(3) Association release (requestor only)

Export AE judges that the transfer of one image succeeded when the result of (2) “Data transfer” is “Success” even if the result of (3) “Association release” is “Failure”.

CT and SC Information Object Definition is described in chapter 8.

3.1.3 Export Association Acceptance Policy

Export AE does not accept any associations generated by remote applications.

3.2 Import Specification

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

Table 5

SOP Class Name	SOP Class UID
Verification	1.2.840.10008.1.1

3.2.1 Import Association Establishment Policies

3.2.1.1 Import General

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

Table 6

DICOM V3.0 Application Context	1.2.840.10008.3.1.1.1

Export AE supports the PDU size of 16 Kbytes only. The default value is set to 16 Kbytes.

3.2.1.2 Import Number of Associations

Import AE supports up to three associations at a time.

3.2.1.3 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.

3.2.1.4 Import Implementation Identifying Information

Import AE will specify the following Implementation Identifying Information:

- Implementation Class UID 1.2.392.200036.9116.2.1.1
- Implementation Version Name TM_CT_DCM_V1.0

3.2.2 Import Association Initiation by Real-World Activity

Import AE never initiates an association.

3.2.3 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 X-series is active on the DICOM network

3.2.3.1 Import Real-World Activity - Verification

3.2.3.1.1 Import Associated Real-World Activity - Verification

The X-series responds to Verification made by a remote Verification SCU.

3.2.3.1.2 Import Presentation Context Table - Verification

Import AE accepts all of the Presentation Contexts shown below:

Table 7

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

3.2.3.1.2.1 Import SOP Specific Conformance - Verification

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

Table 8

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

3.2.3.1.3 Import Presentation Context Acceptance Criterion - Verification

Import AE accepts the Presentation Contexts listed in the Presentation Context Table(Table 7).

3.2.3.1.4 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.

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 X-series, the configuration can be set using the DICOM Online Setup interface.

Note: Settings is performed by Toshiba Service Personnel at the time of installation of the X-series.

6.1 AE Title/Presentation Address Mapping

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.
- The X-series has following default values:

Local Port No.	104
Local AE Title	TM_CT_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.

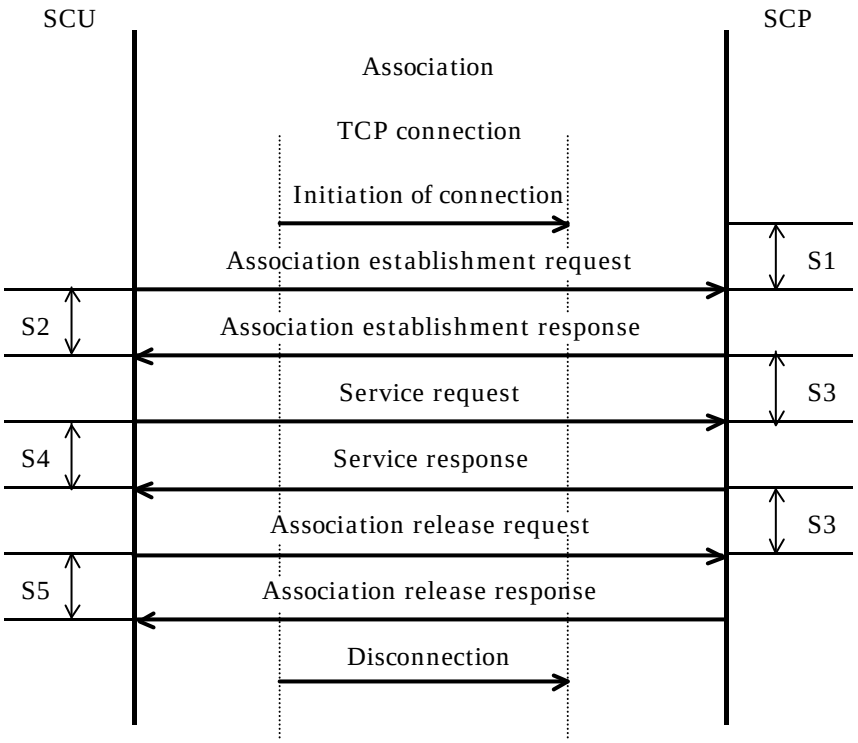

Figure 2

Table 9

Status	Item	Time-out value	Retry count	Retry interval	Remarks
S1	Association establishment request waiting time	default: 30 seconds range: 1 to 999999	Not set	Not set	Only one parameter can be set in the X-series.
S2	Association establishment response waiting time	default: 30 seconds range: 1 to 999999	default: Once range: 0 to 999999	default: 30 seconds range: 0 to 999999	Only one parameter can be set in the X-series.
S3	Service request waiting time	default: 180 seconds range: 1 to 999999	Not set	Not set	Only one parameter can be set in the X-series.
S4	Service response waiting time	default: 180 seconds range: 1 to 999999	Not set	Not set	Can be set for each provided service
S5	Association release response waiting time	default: 5 seconds range: 1 to 999999	Not set	Not set	Only one parameter can be set in the X-series.

6.2.2 Warning Status Criteria

The warning status criteria can be set for each station and each service, for Export AE.

6.2.2.1 CT Image Storage

If SUCCESS is set, the X-series judges that the image transfer succeeded.

If FAIL is set, the X-series judges that the image transfer failed.

Table 10

Warning response	Default	Parameter setting range
Coercion of Data Elements	FAIL	SUCCESS or FAIL
Data Set does not match SOP Class	FAIL	SUCCESS or FAIL
Elements discarded	FAIL	SUCCESS or FAIL

6.2.2.2 SC Image Storage

If SUCCESS is set, the X-series judges that the image transfer succeeded.

If FAIL is set, the X-series judges that the image transfer failed.

Table 11

Warning response	Default	Parameter setting range
Coercion of Data Elements	FAIL	SUCCESS or FAIL
Data Set does not match SOP Class	FAIL	SUCCESS or FAIL
Elements discarded	FAIL	SUCCESS or FAIL

6.3 Implementation Information and Maximum Reception PDU Size

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

Table 12

Parameter	Default
Implementation Class UID	1.2.392.200036.9116.2.1.1
Implementation Version Name	TM_CT_DCM_V1.0
Maximum length received	0x4000 (16Kbytes)

6.4 Default Transfer Syntax

In CT Image Storage and SC Image Storage, when two transfer syntax responses are received, the X-series performs the transfer using the following setting:

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

8 Information Object Definition - Storage SCU

8.1 Entity Module Definitions

The information modules for the X-series are defined below.

8.1.1 CT IOD Modules

Table 13

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
	CT Image Module	8.2.11	M
	VOI LUT Module	8.2.12	U
	SOP Common Module	8.2.13	M

1: M=Mandatory, C=Conditional, U=User option

8.1.2 SC IOD Modules

Table 14

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
Equipment	General Equipment Module	8.2.6	U
	SC Equipment Module	8.2.14	M
Image	General Image Module	8.2.7	M
	Image Pixel Module	8.2.9	M
	SC Image Module	8.2.15	M
	VOI LUT Module	8.2.12	U
	SOP Common Module	8.2.13	M
	Overlay Plane Module	8.2.16	U

1: M=Mandatory, U=User option

8.2 Information Object Definitions

8.2.1 Patient Module

Table 15

Attribute Name	Tag	Type	Attribute Description
Patient's Name	(0010,0010)	2	Always set.
Patient ID	(0010,0020)	2	Always set.
Patient's Birth Date	(0010,0030)	2	Length 0 when no entry is made.
Patient's Sex	(0010,0040)	2	Length 0 when no entry is made.
Patient Comments	(0010,4000)	3	Not set when no entry is made.

8.2.2 General Study Module

Table 16

Attribute Name	Tag	Type	Attribute Description
Study Instance UID	(0020,000D)	1	Always set.
Study Date	(0008,0020)	2	Always set.
Study Time	(0008,0030)	2	Always set.
Referring Physician's Name	(0008,0090)	2	Length 0 when no entry is made.
Study ID	(0020,0010)	2	Always set.
Accession Number	(0008,0050)	2	Length 0 when no entry is made.
Study Description	(0008,1030)	3	Not set when no entry is made.

8.2.3 Patient Study Module

Table 17

Attribute Name	Tag	Type	Attribute Description
Admitting Diagnoses Description	(0008,1080)	3	Not set when no entry is made.
Patient's Age	(0010,1010)	3	Not set when no entry is made.
Patient's Size	(0010,1020)	3	Not set when no entry is made.
Patient's Weight	(0010,1030)	3	Not set when no entry is made.

8.2.4 General Series Module

Table 18

Attribute Name	Tag	Type	Attribute Description
Modality	(0008,0060)	1	Always set (“CT”).
Series Instance UID	(0020,000E)	1	Always set.
Series Number	(0020,0011)	2	Always set.
Series Date	(0008,0021)	3	Not set when no entry is made.
Series Time	(00080031)	3	Not set when no entry is made.
Operator's Name	(0008,1070)	3	Not set when no entry is made.
Body Part Examined	(0018,0015)	3	Not set when no entry is made.
Patient Position	(0018,5100)	2C	Always set in CT Storage. Not set in SC Storage.

8.2.5 Frame of Reference Module

Table 19

Attribute Name	Tag	Type	Attribute Description
Frame of Reference UID	(0020,0052)	1	Always set.
Position Reference Indicator	(0020,1040)	2	Length 0 when no entry is made.

8.2.6 General Equipment Module

Table 20

Attribute Name	Tag	Type	Attribute Description
Manufacturer	(0008,0070)	2	Always set (“TOSHIBA_MEC”).
Institution Name	(0008,0080)	3	Always set.
Station Name	(0008,1010)	3	Always set.
Institutional Department Name	(0008,1040)	3	Length 0 when no entry is made.
Manufacturer's Model Name	(0008,1090)	3	Always set.
Device Serial Number	(0018,1000)	3	Always set.
Software Versions	(0018,1020)	3	Always set.

8.2.7 General Image Module

Table 21

Attribute Name	Tag	Type	Attribute Description
Image Number	(0020,0013)	2	Always set.
Patient Orientation	(0020,0020)	2C	Always set in CT Storage. Not set in SC Storage.
Image Date	(0008,0023)	2C	Always set.
Image Time	(0008,0033)	2C	Always set.
Image Type	(0008,0008)	3	Always set.
Acquisition Number	(0020,0012)	3	Always set in CT Storage. Not set in SC Storage.
Acquisition Date	(0008,0022)	3	Always set.
Acquisition Time	(0008,0032)	3	Always set.

8.2.8 Image Plane Module

Table 22

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

8.2.9 Image Pixel Module

Table 23

Attribute Name	Tag	Type	Attribute Description
Samples per Pixel	(0028,0002)	1	Always set.
Photometric Interpretation	(0028,0004)	1	Always set.
Rows	(0028,0010)	1	Always set (0x0200).
Columns	(0028,0011)	1	Always set (0x0200 or 0x0280).
Bits Allocated	(0028,0100)	1	Always set (0x0010).
Bits Stored	(0028,0101)	1	Always set (0x0010).
High Bit	(0028,0102)	1	Always set (0x000f).
Pixel Representation	(0028,0103)	1	Always set (0x0001).
Pixel Data	(7FE0,0010)	1	Always set.

8.2.10 Contrast/Bolus Module

Table 24

Attribute Name	Tag	Type	Attribute Description
Contrast/Bolus Agent	(0018,0010)	2	Always set.
Contrast/Bolus Volume	(0018,1041)	3	Not set when no entry is made.

8.2.11 CT Image Module

Table 25

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008,0008)	1	Always set.
Samples per Pixel	(0028,0002)	1	Always set.
Photometric Interpretation	(0028,0004)	1	Always set.
Bits Allocated	(0028,0100)	1	Always set.
Bits Stored	(0028,0101)	1	Always set.
High Bit	(0028,0102)	1	Always set.
Rescale Intercept	(0028,1052)	1	Always set (“ 0”).
Rescale Slope	(0028,1053)	1	Always set (“ 1”).
KVP	(0018,0060)	2	Always set.
Acquisition Number	(0020,0012)	2	Always set.
Scan Options	(0018,0022)	3	Always set. One of the following choices is set for Scan Options: "SCANOSCOPE", "NORMAL_CT", "DYNAMIC_CT", "HELICAL_CT", “FLUORO_CT”
Reconstruction Diameter	(0018,1100)	3	Always set.
Gantry/Detector Tilt	(0018,1120)	3	Always set.
Table Height	(0018,1130)	3	Always set.
Rotation Direction	(0018,1140)	3	Always set.
Exposure Time	(0018,1150)	3	Always set.
X-ray Tube Current	(0018,1151)	3	Always set.
Exposure	(0018,1152)	3	Always set.
Convolution Kernel	(0018,1210)	3	Always set.

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8.2.12 VOI LUT Module

Table 26

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

8.2.13 SOP Common Module

Table 27

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

8.2.14 SC Equipment Module

Table 28

Attribute Name	Tag	Type	Attribute Description
Conversion Type	(0008,0064)	1	Always set (”WSD”).
Modality	(0008,0060)	3	Always set (“CT”).
Secondary Capture Device ID	(0018,1010)	3	Not set when no entry is made.
Secondary Capture Device Manufacturer	(0018,1016)	3	Not set when no entry is made.
Secondary Capture Device Manufacturer's Model Name	(0018,1018)	3	Not set when no entry is made.
Secondary Capture Device Software Version	(0018,1019)	3	Not set when no entry is made.

8.2.15 SC Image Module

Table 29

Attribute Name	Tag	Type	Attribute Description
Date of Secondary Capture	(0018,1012)	3	Not set when no entry is made.
Time of Secondary Capture	(0018,1014)	3	Not set when no entry is made.

8.2.16 Overlay Plane Module

Table 30

Attribute Name	Tag	Type	Attribute Description
Overlay Rows	(60xx,0010)	1	Always set (0x0200).
Overlay Columns	(60xx,0011)	1	Always set (0x0200 or 0x0280).
Overlay Type	(60xx,0040)	1	Always set.
Overlay Origin	(60xx,0050)	1	Always set.
Overlay Bits Allocated	(60xx,0100)	1	Always set.
Overlay Bit Position	(60xx,0102)	1	Always set.
Overlay Data	(60xx,3000)	1C	Always set.