No.MIICT0004EA

TOSHIBA

# DICOM CONFORMANCE STATEMENT

# STORAGE SCU

# FOR

# TOSHIBA WHOLE-BODY X-RAY CT SCANNER

# AUKLET

# (COT-17A)

# IMPORTANT!

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# Table of Contents

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# 1 Introduction

This document is a DICOM Conformance Statement for Toshiba's CT Scanner Auklet. 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. 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

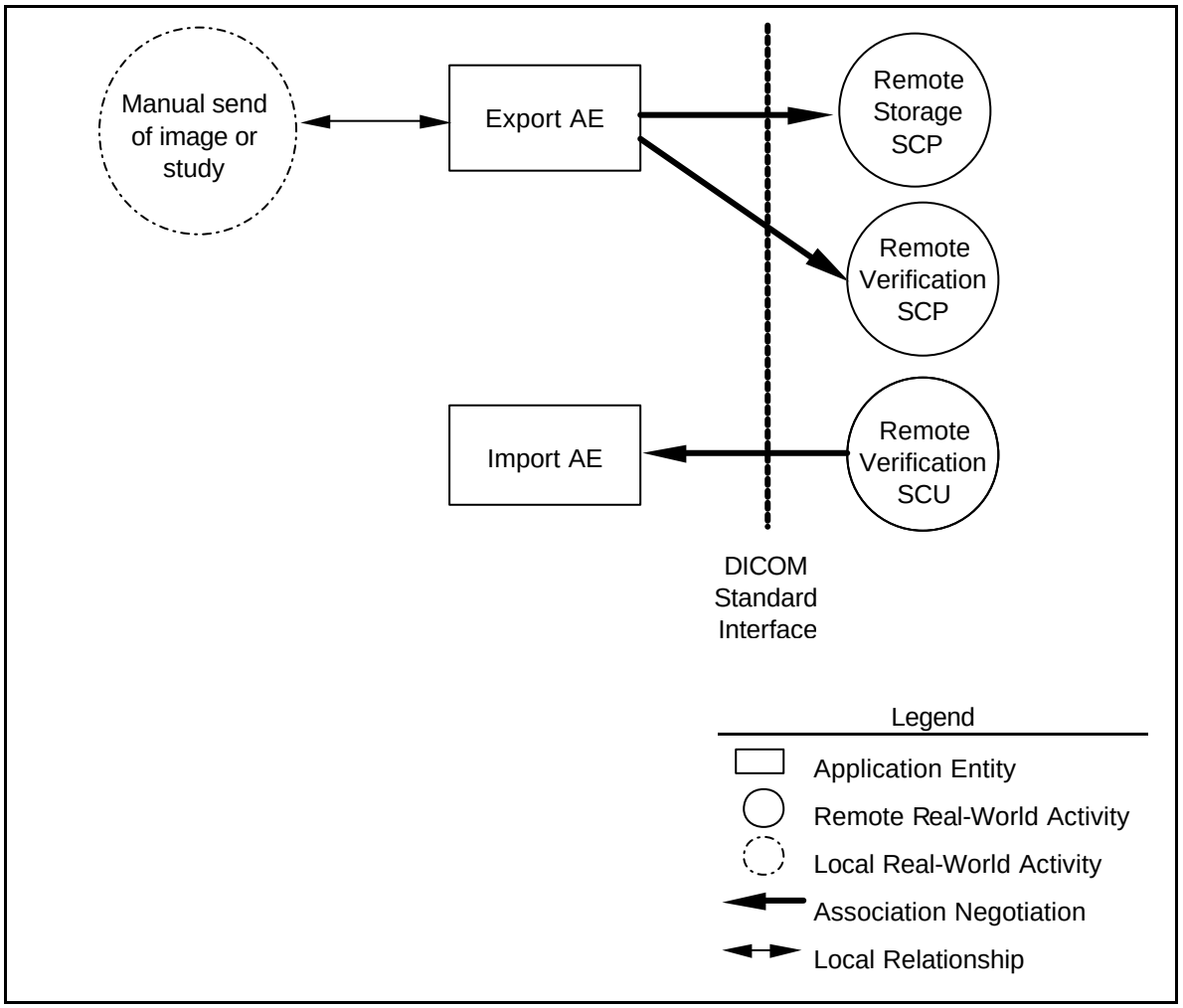


**Figure 1**

## 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 Information Objects
- Establishes DICOM Association with remote device
- Performs storage of DICOM CT 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 CT Scanner 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 images after selecting the transferred images from the Study List or from the Image List.
- When the image transfer fails, the 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 images or the studies to be sent.

Step-2: Select the destination of image sending.

Step-3: Request sending.

# 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 |

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

#### 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 1.2.392.200036.9116.2.2.1.100
- Implementation Version Name TM_CT_CMW_V1.00

### 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 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 CT Scanner 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 |

##### 3.1.2.2.2.1 Export SOP Specific Conformance - CT 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”.

### 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 |

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

#### 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 DICOM specification.

#### 3.2.1.4 Import Implementation Identifying Information

Import AE will specify the following Implementation Identifying Information:

- Implementation Class UID 1.2.392.200036.9116.2.2.1.100
- Implementation Version Name TM_CT_CMW_V1.00

### 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 CT Scanner 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 CT Scanner responds to Verification created 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 CT Scanner, 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 CT Scanner.

## 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.
- Up to five remote hosts can be described.
- The CT Scanner has following default values:

| | |
|---|---|
| Local Port No. | 2700 |
| Local AE Title | TM_CT_CMW_V1.00 |

## 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.

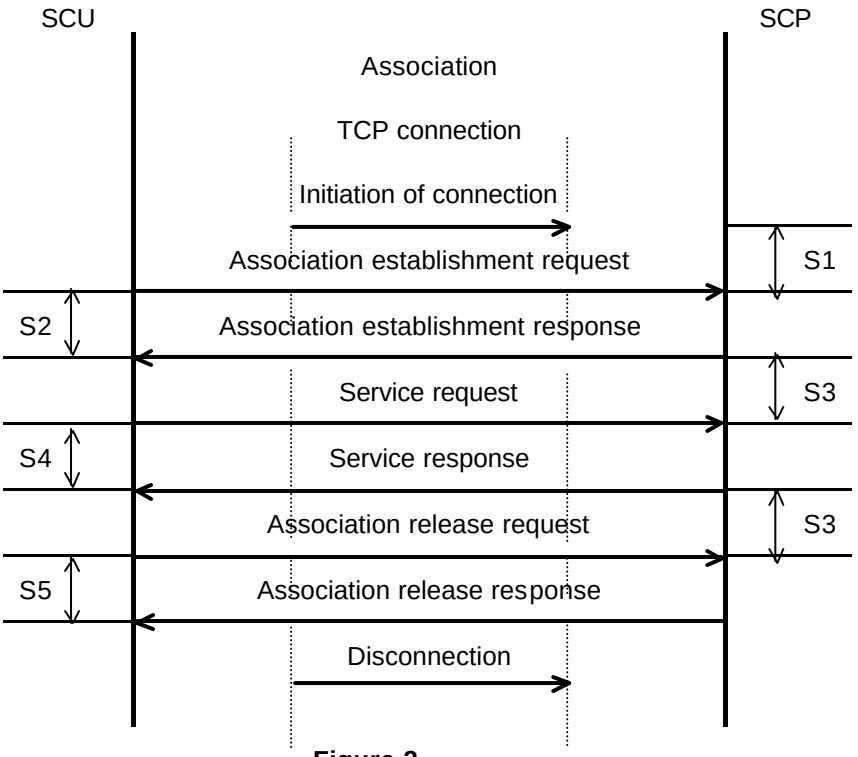


**Figure 2**

**Table 9**

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

### 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 CT Scanner judges that the image transfer succeeded.

If FAIL is set, the CT Scanner 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 |

## 6.3 Implementation Information and Maximum Reception PDU Size

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

**Table 11**

| Parameter | Default |
|---|---|
| Implementation Class UID | 1.2.392.200036.9116.2.2.1.100 |
| Implementation Version Name | TM_CT_CMW_V1.00 |
| Maximum length received | 0x4000(16Kbytes) |

## 6.4 Default Transfer Syntax

### 6.4.1 Export AE

In CT Image Storage, when two transfer syntax responses are received, the CT Scanner 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 CT Scanner Storage SCU are defined below.

### 8.1.1 CT IOD Modules

**Table 12**

| 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

## 8.2 Information Object Definitions

### 8.2.1 Patient Module

**Table 13**

| 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 14**

| 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 |

### 8.2.3 Patient Study Module

**Table 15**

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Patient’s Age | (0010,1010) | 3 | Not set when no entry is made |

### 8.2.4 General Series Module

**Table 16**

| 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 | Always set |
| Series Time | (0008,0031) | 3 | Always set |
| Operator's Name | (0008,1070) | 3 | Not set when no entry is made |
| Patient Position | (0018,5100) | 2C | Always set |
| Laterality | (0020,0060) | 2C | Length=0 when no entry is made |

### 8.2.5 Frame of Reference Module

**Table 17**

| 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 18**

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Manufacturer | (0008,0070) | 2 | Always set(“TOSHIBA”) |
| Institution Name | (0008,0080) | 3 | Always set |
| Station Name | (0008,1010) | 3 | Always set |
| Institutional Department Name | (0008,1040) | 3 | Not set when no entry is made |
| Manufacturer's Model Name | (0008,1090) | 3 | Always set |
| Device Serial Number | (0018,1000) | 3 | Not set when no entry is made |
| Software Versions | (0018,1020) | 3 | Not set when no entry is made |

### 8.2.7 General Image Module

**Table 19**

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Instance Number | (0020,0013) | 2 | Always set |
| Patient Orientation | (0020,0020) | 2C | If the setting conditions are met, Length=0 when no entry is made |
| Image Date | (0008,0023) | 2C | Always set |
| Image Time | (0008,0033) | 2C | Always set |
| Image Type | (0008,0008) | 3 | Always set (See 8.2.13) |
| Acquisition Number | (0020,0012) | 3 | Always set |
| Acquisition Date | (0008,0022) | 3 | Always set |
| Acquisition Time | (0008,0032) | 3 | Always set |
| Image in Acquisition | (0020,1002) | 3 | Not set when no entry is made |
| Image Comments | (0020,4000) | 3 | Not set when no entry is made |

### 8.2.8 Image Plane Module

**Table 20**

| 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 |

### 8.2.9 Image Pixel Module

**Table 21**

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Samples per Pixel | (0028,0002) | 1 | Always set (See 8.2.13) |
| Photometric Interpretation | (0028,0004) | 1 | Always set (See 8.2.13) |
| Rows | (0028,0010) | 1 | Always set(0x0200) |
| Columns | (0028,0011) | 1 | Always set(0x0200) |
| Bits Allocated | (0028,0100) | 1 | Always set (See 8.2.13) |
| Bits Stored | (0028,0101) | 1 | Always set (See 8.2.13) |
| High Bit | (0028,0102) | 1 | Always set (See 8.2.13) |
| Pixel Representation | (0028,0103) | 1 | Always set |
| Pixel Data | (7FE0,0010) | 1 | Always set |

### 8.2.10 Contrast/Bolus Module

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

**Table 22**

| 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 VOI LUT Module

**Table 23**

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

### 8.2.12 SOP Common Module

**Table 24**

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

### 8.2.13 CT Image Module

**Table 25**

| Attribute Name | Tag | Type | Attribute Description |
|---|---|---|---|
| Image Type | (0008,0008) | 1 | Always set ("ORIGINAL¥PRIMARY¥AXIAL", "ORIGINAL¥PRIMARY¥LOCALIZER" or "DERIVED¥SECONDARY") |
| Samples per Pixel | (0028,0002) | 1 | Always set (1) |
| Photometric Interpretation | (0028,0004) | 1 | Always set ("MONOCHROME2") |
| Bits Allocated | (0028,0100) | 1 | Always set (16) |
| Bits Stored | (0028,0101) | 1 | Always set (16) |
| High Bit | (0028,0102) | 1 | Always set (15) |
| 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<br>One of following choices is set for Scan Options:<br>"SCANOSCOPE","NORMAL_CT", " DYNAMIC_CT", "HELICAL_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 |