DICOM CONFORMANCE STATEMENT
CD-R MEDIUM FSC/FSR/FSU
FOR
TOSHIBA WHOLE-BODY X-RAY CT SCANNER
MODELS TSX-101A /7, TSX-101A /9, TSX-021B /4
(CRDM-001A)

TOSHIBA MEDICAL SYSTEMS CORPORATION

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(2) The contents of this manual are subject to change without prior notice and without our legal obligation.

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1 INTRODUCTION

This document is a DICOM Conformance Statement for Toshiba CT Scanner A-Series. It is intended to provide the reader with the knowledge of how to integrate the A-Series within a DICOM compliant hospital archive. It details the DICOM Service Classes, Information Objects, and Communication Protocols that are supported by the A-Series as follows:

- CD-R Medium Storage Service Class (FSC/FSR/FSU)

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

1.1 REFERENCE

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

1.2 DEFINITIONS

- **Application Profile:** A Media Storage Application Profile defines a selection of choices at the various layers of the DICOM Media Storage Model that are applicable to a specific need or context in which the media interchange is intended to be performed.
- **DICOM File Service**: The DICOM File Service specifies a minimum abstract view of files to be provided by the Media Format Layer. Constraining access to the content of files by the Application Entities through such a DICOM File Service boundary ensures Media Format and Physical Media independence.
- **DICOM File**: A DICOM File is a File with a content formatted according to the requirements of this Part of the DICOM Standard. In particular such files shall contain, the File Meta Information and a properly formatted Data Set.
- **DICOMDIR File**: A unique and mandatory DICOM File within a File-set that contains the Media Storage Directory SOP Class. This File is given a single component File ID, DICOMDIR.
- **File**: A File is an ordered string of zero or more bytes, where the first byte is at the beginning of the file and the last byte at the end of the File. Files are identified by a unique File ID and may by written, read and/or deleted.
- **File ID**: Files are identified by a File ID that is unique within the context of the File-set they belong to. A set of ordered File ID Components (up to a maximum of eight) forms a File ID.
- **File ID Componen**t: A string of one to eight characters of a defined character set.

- **File Meta Information**: The File Meta Information includes identifying information on the encapsulated Data Set. It is a mandatory header at the beginning of every DICOM File.
- **File-set**: A File-set is a collection of DICOM Files (and possibly non-DICOM Files) that share a common naming space within which File IDs are unique.
- **File-set Creator (FSC)**: An Application Entity that creates the DICOMDIR File (see section 8.6) and zero or more DICOM Files.
- **File-set Reader (FSR)**: An Application Entity that accesses one or more files in a File-set.
- **File-set Updater (FSU)**: An Application Entity that accesses Files, creates additional Files, or deletes existing Files in a File-set. A File-set Updater makes the appropriate alterations to the DICOMDIR file reflecting the additions or deletions.
- **DICOM File Format**: The DICOM File Format provides a means to encapsulate in a File the Data Set representing a SOP Instance related to a DICOM Information Object.
- **Media Format**: Data structures and associated policies that organize the bit streams defined by the Physical Media format into data file structures and associated file directories.
- **Media Storage Model**: The DICOM Media Storage Model pertains to the data structures used at different layers to achieve interoperability through media interchange.
- **Physical Media**: A piece of material with recording capabilities for streams of bits. Characteristics of a Physical Media include form factor, mechanical characteristics, recording properties and rules for recording and organizing bit streams in accessible structures
- **Information Object Definition (IOD)** - An IOD is a data model that 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/Object Pair (SOP) Class** - A SOP Class is defined as the union of 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 as 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

The following acronyms and abbreviations are used in this document.

- 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
- FSC File-Set Creator
- FSR File-Set Reader
- FSU File-Set Updater
- HIS Hospital Information System
- HL7 Health Level 7
- IE Information Entity
- IOD Information Object Definition
- ISO International Standard Organization
- JIRA Japan Industries Association of Radiological Systems
- NEMA National Electrical Manufacturers Association
- RIS Radiology Information System
- SOP Service Object Pair
- UID Unique Identifier

2 IMPLEMENTATION MODEL

2.1 APPLICATION DATA FLOW DIAGRAM

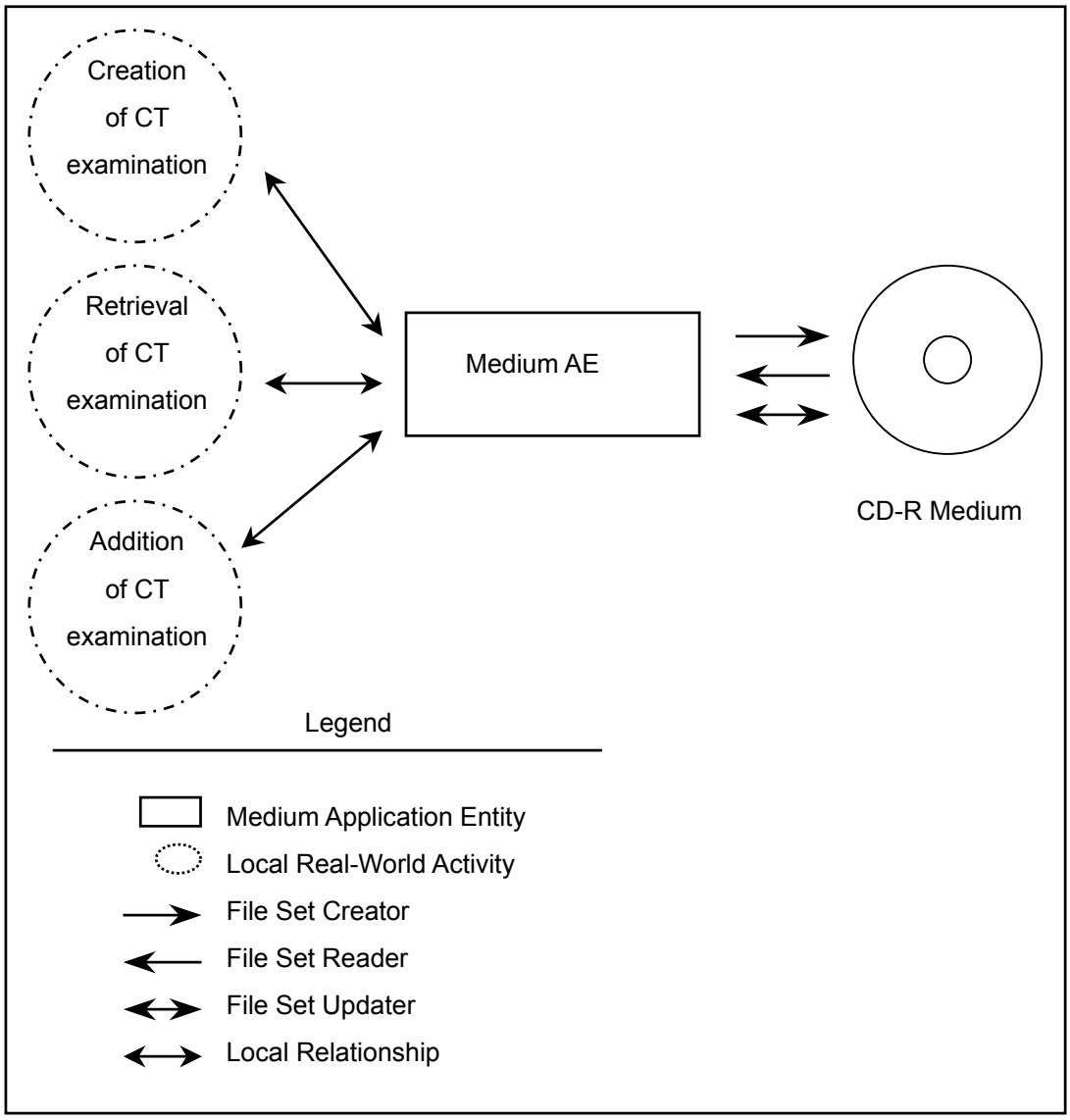

Figure 1

2.2 FUNCTIONAL DEFINITIONS OF APPLICATION ENTITIES

The Medium AE is used to create/read/add studies/series/images to/from an offline DICOM CD-R medium. It therefore performs the following tasks:

- Builds DICOM CT, SC Information Objects.
- Creates a DICOMDIR file that represents the contents of the DICOM CT, SC Information Objects to be recorded.
- Records DICOM CT, SC Information Objects and a DICOMDIR file to a CD-R medium.
- Reads the DICOMDIR file that represents the contents of the data as recorded.
- Displays the ordered list of studies/series/images, identifying information.
- Reads the selected studies/series/images from a CD-R medium and displays them on the monitor.
- Reads the File-set of the CD-R medium and writes it to the local storage device.
- Modifies the DICOMDIR file.
- Adds the studies/series/images.

Note:

- The FSU role updates to the CD-R medium created by the A-Series itself.

2.3 SEQUENCING OF REAL WORLD ACTIVITIES

2.3.1 FEATURES

2.3.1.1 CREATION OF CT EXAMINATION

- Operator requests to create a new File-set onto a new CD-R.
- Creation requests are placed in a queue and are executed in the background.

2.3.1.2 RETRIEVAL OF CT EXAMINATION

- Operator requests to retrieve the File-set from the CD-R.
- Retrieval requests are placed in a queue and are executed in the background.

2.3.1.3 ADDITION OF CT EXAMINATION

- Operator requests to add new objects to an already existing File-set on the CD-R.
- Addition requests are placed in a queue and are executed in the background.

2.3.2 OPERATIONS

2.3.2.1 CREATION OF CT EXAMINATION

The operation for creation of CT examination is described below:

Step-1: Select the CT and/or SC image(s), series or studies on the local storage device to be created to the CD-R medium.

Step-2: Select the image archiving.

Step-3: Select the Virtual CD device as a destination.

Step-4: Request to copy to the CD-R.

2.3.2.2 RETRIEVAL OF CT EXAMINATION

The operation for retrieval of CT examination is described below:

Step-1: Select the CT and/or SC image(s), series or studies on the CD-R medium to be retrieved to the local storage device.

Step-2: Select the image retrieval.

Step-3: Select the local storage device as a destination.

2.3.2.3 ADDITION OF CT EXAMINATION

The operation for addition of CT examination is described below:

Step-1: Select the CT and/or SC images, series or studies on the local storage device to be added to the CD-R medium.

Step-2: Select the image archiving.

Step-3: Select the Virtual CD device as a destination.

Step-4: Request to copy to the CD-R.

2.4 FILE META INFORMATION FOR IMPLEMENTATION CLASS AND VERSION

Medium File Meta Information will specify the following Identifying Information:

- File Meta Information Version 1
- Implementation Class UID 1.2.392.200036.9116.2.2.2.100
- Implementation Version Name TM_CT_CMW_V2.00

3 AE SPECIFICATIONS

3.1 MEDIUM AE SPECIFICATION

The Medium AE provides Conformance to DICOM Interchange of the Media Storage Service Class. The Application Profiles and roles are listed in the Table 1.

Table 1

Application Profiles Supported	Real-World Activity	Roles	SC Option
STD-CTMR-CD, STD-GEN-CD	Creation of CT Examination	FSC	Interchange
	Addition of CT Examination	FSU	Interchange
STD-GEN-CD	Retrieval of CT Examination	FSR	Interchange

3.1.1 STD-CTMR-CD PROFILE

The SOP Classes and corresponding Transfer Syntax supported by the STD-CTMR-CD Profile are listed in the Table 2.

Table 2

Information Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Basic Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian Uncompressed	1.2.840.10008.1.2.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Explicit VR Little Endian Uncompressed	1.2.840.10008.1.2.1
SC Image Storage (Grayscale)	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian Uncompressed	1.2.840.10008.1.2.1

3.1.2 STD-GEN-CD PROFILE

The SOP Classes and corresponding Transfer Syntax supported by the STD-GEN-CD Profile as the FSC and FSU are listed in the Table 3.

Table 3

Information Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Basic Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian Uncompressed	1.2.840.10008.1.2.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Explicit VR Little Endian Uncompressed	1.2.840.10008.1.2.1
SC Image Storage (Grayscale)	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian Uncompressed	1.2.840.10008.1.2.1
SC Image Storage (Color, RGB)	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian Uncompressed	1.2.840.10008.1.2.1

The SOP Classes and corresponding Transfer Syntaxes supported by the STD-GEN-CD Profile as the FSR are listed in the Table 4.

Table 4

Information Object Definition	SOP Class UID	Transfer Syntax	Transfer Syntax UID
Basic Directory	1.2.840.10008.1.3.10	Explicit VR Little Endian Uncompressed	1.2.840.10008.1.2.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Explicit VR Little Endian Uncompressed	1.2.840.10008.1.2.1
CT Image Storage	1.2.840.10008.5.1.4.1.1.2	Implicit VR Little Endian Uncompressed	1.2.840.10008.1.2
SC Image Storage (Grayscale)	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian Uncompressed	1.2.840.10008.1.2.1
SC Image Storage (Grayscale)	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian Uncompressed	1.2.840.10008.1.2
SC Image Storage (Color, RGB)	1.2.840.10008.5.1.4.1.1.7	Explicit VR Little Endian Uncompressed	1.2.840.10008.1.2.1
SC Image Storage (Color, RGB)	1.2.840.10008.5.1.4.1.1.7	Implicit VR Little Endian Uncompressed	1.2.840.10008.1.2

3.1.3 FILE META INFORMATION

3.1.3.1 SOURCE APPLICATION ENTITY TITLE

The Medium AE does not set the Source Application Entity Title.

3.1.4 REAL WORLD ACTIVITY

3.1.4.1 CREATION OF CT EXAMINATION

The Medium AE acts as an FSC using the Interchange option when copying from the local storage device to an empty CD-R.

3.1.4.2 RETRIEVAL OF CT EXAMINATION

The Medium AE acts as an FSR using the Interchange option when copying from the CD-R to the local storage device.

3.1.4.3 ADDITION OF CT EXAMINATION

The Medium AE acts as an FSU using the Interchange option when copying from the local storage device to the CD-R created by the A-Series itself.

4 AUGMENTATED AND PRIVATE APPLICATION PROFILES

4.1 AUGMENTED PROFILES

Not applicable to the A-Series.

4.2 PRIVATE APPLICATION PROFILES

Not applicable to the A-Series.

5 EXTENSIONS/SPECIALIZATIONS/PRIVATIZATIONS

Not applicable to the A-Series.

6 CONFIGURATION

Not applicable to the A-Series.

7 SUPPORT OF EXTENDED CHARACTER SETS

The A-Series supports the following character sets:

- ISO-IR 6 (default) Basic G0 Set
- ISO-IR 100 (Latin Alphabet No.1) Supplementary set of ISO 8859

8 MEDIA STORAGE INFORMATION OBJECT DEFINITION

8.1 ENTRY MODULE DEFINITIONS

Table 5

Object	Module/Key	Reference	Usage[1]
DICOM File Meta Information		8.1.1.1 / 8.1.1.2	M
Basic Directory Information Object	File-set Identification Module	8.1.2.1	M
	Directory Information Module	8.1.2.2	U
Definition of Specific Directory Records	PATIENT keys	8.1.3.1	M
	STUDY keys	8.1.3.2	M
	SERIES keys	8.1.3.3	M
	IMAGE keys	8.1.3.4	M

[1] M=Mandatory, U=User option

8.1.1 DICOM FILE META INFORMATION

8.1.1.1 DICOM FILE META INFORMATION OF DIRECTORY IOD

Table 6

Attribute Name	Tag	Type	Attribute Description
File Preamble	No Tag	1	Always set
DICOM Prefix	No Tag	1	Always set (“DICM”)
Group Length	(0002, 0000)	1	Always set
File Meta Information Version	(0002, 0001)	1	Always set (0001H)
Media Storage SOP Class UID	(0002, 0002)	1	Always set (“1.2.840.10008.1.3.10”)
Media Storage SOP Instance UID	(0002, 0003)	1	Always set
Transfer Syntax UID	(0002, 0010)	1	Always set (“1.2.840.10008.1.2.1”)
Implementation Class UID	(0002, 0012)	1	Always set
Implementation Version Name	(0002, 0013)	3	Always set (“TM_CT_CMW_V2.00”)

8.1.1.2 DICOM FILE META INFORMATION IMAGE IOD

Table 7

Attribute Name	Tag	Type	Attribute Description
File Preamble	No Tag	1	Always set
DICOM Prefix	No Tag	1	Always set (“DICM”)
Group Length	(0002, 0000)	1	Always set
File Meta Information Version	(0002, 0001)	1	Always set (0001H)
Media Storage SOP Class UID	(0002, 0002)	1	Always set (“1.2.840.10008.5.1.4.1.1.2” or “1.2.840.10008.5.1.4.1.1.7”)
Media Storage SOP Instance UID	(0002, 0003)	1	Always set
Transfer Syntax UID	(0002, 0010)	1	Always set
Implementation Class UID	(0002, 0012)	1	Always set
Implementation Version Name	(0002, 0013)	3	Always set (“TM_CT_CMW_V2.00”)

8.1.2 BASIC DIRECTORY INFORMATION OBJECT

8.1.2.1 FILE-SET IDENTIFICATION MODULE

Table 8

Attribute Name	Tag	Type	Attribute Description
File-set ID	(0004, 1130)	2	Always set (“TOSHIBA_CT”)

8.1.2.2 DIRECTORY INFORMATION MODULE

Table 9

Attribute Name	Tag	Type	Attribute Description
Offset of the First Directory Record of the Root Directory Entity	(0004, 1200)	1	Always set
Offset of the Last Directory Record of the Root Directory Entity	(0004, 1202)	1	Always set
File-set Consistency Flag	(0004, 1212)	1	Always set
Directory Record Sequence	(0004, 1220)	2	Always set
>Offset of the Next Directory Record	(0004, 1400)	1C	Always set
>Record In-use Flag	(0004, 1410)	1C	Always set (FFFFH)
>Offset of Referenced Lower-Level Directory Entity	(0004, 1420)	1C	Always set
>Directory Record Type	(0004, 1430)	1C	Always set ("PATIENT","STUDY","SERIES" or "IMAGE",
>Referenced File ID	(0004, 1500)	1C	Set if the Directory Records of Type IMAGE
>Referenced SOP Class UID in File	(0004, 1510)	1C	Set if the Directory Record Type is IMAGE
>Referenced SOP Instance UID in File	(0004, 1511)	1C	Set if the Directory Record Type is IMAGE
>Referenced Transfer Syntax UID in File	(0004, 1512)	1C	Set if the Directory Record Type is IMAGE
> Record Selection Keys	See below		

8.1.3 DEFINITION OF SPECIFIC DIRECTORY RECORDS

8.1.3.1 PATIENT KEYS

Table 10

Attribute Name	Tag	Type	Attribute Description
Specific Character Set	(0008, 0005)	1C	Required if an extended or replacement character set is used in the Patient's Name ("ISO_IR 100")
Patent's Name	(0010, 0010)	2	Set if present in image object.
Patient ID	(0010, 0020)	1	Always set
Patient's Birth Date	(0010, 0030)	3	Set if present in image object.
Patient's Sex	(0010, 0040)	3	Set if present in image object.

8.1.3.2 STUDY KEYS

Table 11

Attribute Name	Tag	Type	Attribute Description
Study Date	(0008, 0020)	1	Always set
Study Time	(0008, 0030)	1	Always set
Accession Number	(0008, 0050)	2	Set if present in image object.
Study Description	(0008, 1030)	2	Set if present in image object.
Patient's Age	(0010, 1010)	3	Set if present in image object.
Study Instance UID	(0020, 000D)	1	Always set
Study ID	(0020, 0010)	1	Always set

8.1.3.3 SERIES KEYS

Table 12

Attribute Name	Tag	Type	Attribute Description
Modality	(0008, 0060)	1	Always set
Series Instance UID	(0020, 000E)	1	Always set
Series Number	(0020, 0011)	1	Always set

8.1.3.4 IMAGE KEYS

Table 13

Attribute Name	Tag	Type	Attribute Description
Image Type	(0008, 0008)	1C	Always set
Acquisition Date	(0008, 0022)	3	Set if present in image object.
Image Date	(0008, 0023)	3	Set if present in image object.
Acquisition Time	(0008, 0032)	3	Set if present in image object.
Image Time	(0008, 0033)	3	Set if present in image object.
Referenced Image Sequence	(0008, 1140)	3	Set if present in image object.
> Referenced SOP Class UID	(0008, 1150)	1C	Set if Referenced Image Sequence is present.
> Referenced SOP Instance UID	(0008, 1155)	1C	Set if Referenced Image Sequence is present.
Slice Thickness	(0018, 0050)	3	Set if present in image object.
KVP	(0018, 0060)	3	Set if present in image object.
Reconstruction Diameter	(0018, 1100)	3	Set if present in image object.
Gantry/Detector Tilt	(0018, 1120)	3	Set if present in image object.
X-ray Tube Current	(0018, 1151)	3	Set if present in image object.
Convolution Kernel	(0018, 1210)	3	Set if present in image object.
Instance Number	(0020, 0013)	1	Always set
Image Position (Patient)	(0020, 0032)	1C	Set if present in image object.
Image Orientation (Patient)	(0020, 0037)	1C	Set if present in image object.
Frame of Reference UID	(0020, 0052)	1C	Set if present in image object.
Slice Location	(0020, 1041)	3	Set if present in image object.
Rows	(0028, 0010)	1	Always set
Columns	(0028, 0011)	1	Always set
Pixel Spacing	(0028, 0030)	1C	Set if present in image object.

E