

# SchillerServer Software API

## DICOM Conformance Statement SCHILLER ECG Modality v1.5

**CONFIDENTIAL**

Application Note #5015



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The Art of Diagnostics



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# 1 Overview

SCHILLER Modalities can be configured to produce DICOM ECG Waveform and DICOM Encapsulated PDF. This document describes the DICOM services supported by SCHILLER Modalities.

## 1.1 Network Services

The following network services are supported.

SOP Classes	User of Service (SCU)	Provider of Services (SCP)
<b>Transfer</b>		
12-Lead ECG Waveform Storage	Yes	No
General ECG Waveform Storage	Yes	No
Encapsulated PDF Storage	Yes	No
<b>Query/Retrieve</b>		
-	-	-
<b>Workflow Management</b>		
Verification	Yes	No
Modality Worklist	Yes	No
Storage Commitment Push Model	Yes	No
Modality Performed Procedure Step	Yes	No

## 1.2 Media Services

SCHILLER Modalities do not support any DICOM media services.

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## 3 Introduction

### 3.1 Revision History

Doc. Version	Date of Issue	Author	Description
1.0	09.01.2010	Patric Bonavetti	Initial Draft
1.1	08.08.2012	Patric Bonavetti	Added Encapsulated PDF
1.2	03.09.2012	Patric Bonavetti	Added Modality Worklist
1.3	01.10.2013	Patric Bonavetti	Added LeadConfig: IcStdRPrecV6R AdmissionId (0038,0010) contains the VisitId StudyId (0020,0010) will be blank Added StudyDescription (0008,1030) Edited enumerated values of Ethnic Group (0010,2160) Manufacturer (0008,0070) contains "SCHILLER"
1.4	03.06.2014	Patric Bonavetti Johan Sandberg	Restructured the document Documented Storage Commitment in Section 4.2.1 Documented Worklist Request Identifier in Section 4.2.3 <u>Changes:</u> <ul style="list-style-type: none"> <li>Removed SCHILLER Private Module and Coding Schemes</li> <li>Patient Comments (0010,4000) contains Patient Comments</li> <li>Document Title (0042,0010) contains recording data</li> <li>Name of Physician(s) Reading Study (0008,1060) contains the Validating or Interpreting Physician</li> <li>Performing Physician's Name (0008,1050) contains Consulting Physician</li> <li>Multiplex Group Label (003A,0020) for the group of median data is now "MEDIAN_BEAT"</li> <li>Concept Name Code Sequence (0040,A043) for Lead System Acquisition Context is now EV (10:11345, MDC, "Lead System")</li> <li>Corrected Waveform Annotation Group #3's Temporal Range Type (0040,A130) to "MULTIPOINT"</li> <li>Concept Name Code Sequence (0040,A043) for Pacemaker Spike Waveform Annotations is now EV (10:4096, MDC, "Pacemaker spike")</li> <li>Shortened Code Meaning (0008,0104) and removed internal lead codes in 7.3.2 ECG Leads</li> <li>Removed internal codes in 7.3.3 ECG Lead Systems, 7.3.4 ECG Global Measurements, 7.3.5 ECG Position Markers, and 7.3.6 ECG Per-Lead Measurements</li> </ul> <u>Additions:</u> <ul style="list-style-type: none"> <li>Added Other Patient IDs Sequence (0010,1002) with Issuer of Patient ID (0010,0021) = "SSN" as Patient's Social Security Number</li> <li>Added Physician(s) of Record (0008,1048) as Attending Physician</li> <li>Added Procedure Code Sequence (0008,1032) as Recording Types defined in 7.3.1</li> <li>Added Protocol Name (0018,1030) and Performed Protocol Code Sequence (0040,0260)</li> <li>Added Comments on the Performed Procedure Step (0040,0280) as Recording Remarks</li> <li>Added Verification Flag (0040,A493)</li> <li>Added Channel Status (003A,0205) as "OK"</li> <li>Added Acquisition Context EV (R-00728, SRT, "Pacemaker in situ")</li> </ul>
1.4.1	12.02.2015	Johan Sandberg	New layout / Minor corrections to conformance statement text
1.4.2	24.04.2015	Johan Sandberg	Added new Procedure Codes and generated Study Descriptions in Section 7.3.1

Doc. Version	Date of Issue	Author	Description
1.5	25.01.2016	Johan Sandberg	<p>Restructured the document</p> <p><u>Changes:</u></p> <ul style="list-style-type: none"> <li>Storage AE's Implementation Version Name (0002,0013) contains "schiller-dcm-1.5"</li> <li>Study ID (0020,0010) always contains Internal Recording ID</li> </ul> <p><u>Additions:</u></p> <ul style="list-style-type: none"> <li>Connectivity Verification (ECHO) in Section 4</li> <li>Modality Performed Procedure Step (MPPS) in Sections 4 and 5.5</li> <li>DICOM General ECG – Resting Rhythm Waveform Export in Sections 5.1.3 and 7</li> <li>DICOM General ECG – Exercise ECG Waveform Export in Sections 5.1.4 and 7</li> <li>Other Patient IDs Sequence (0010,1002) with Issuer of Patient ID (0010,0021) = "ACCT" as Patient's Account Number in Sections 4.2.3 and 5.2.1</li> <li>Instance Creation Date/Time (0008,0012/0013) as Date/Time of Export in Section 5.2.5</li> <li>Series Date/Time (0008,0021/0031) as Acquisition Date/Time in Section 5.4.1</li> <li>Series Description (0008,103E) in Sections 5.3.1 and 5.4.1</li> <li>Various generated Performed Procedure Step attributes in Sections 5.3.1 and 5.4.1</li> <li>Equivalent SCPECG[1.3] Code Value information in Section 7</li> </ul>

### 3.2 Audience

This document is the DICOM Conformance Statement for SCHILLER Devices having the DICOM Option. It is intended for use by hospital staff, health system integrators, software designers or implementers. It is assumed that the reader has a working understanding of DICOM.

### 3.3 Remarks

None.

### 3.4 Terms and Definitions

Terms	Definitions
AE	Application Entity
DCID	Defined Context ID
DTID	Defined Template ID
DICOM	Digital Imaging and Communications in Medicine
DIMSE	DICOM Message Service Element
EV	Enumerated Value
IOD	Information Object Definition
MPPS	Modality Performed Procedure Step
NEMA	National Electrical Manufacturers Association
PACS	Picture Archival and Communication System
SCP	Service Class Provider
SCU	Service Class User
SOP	Service Object Pair
UID	Unique Identifier

### 3.5 References

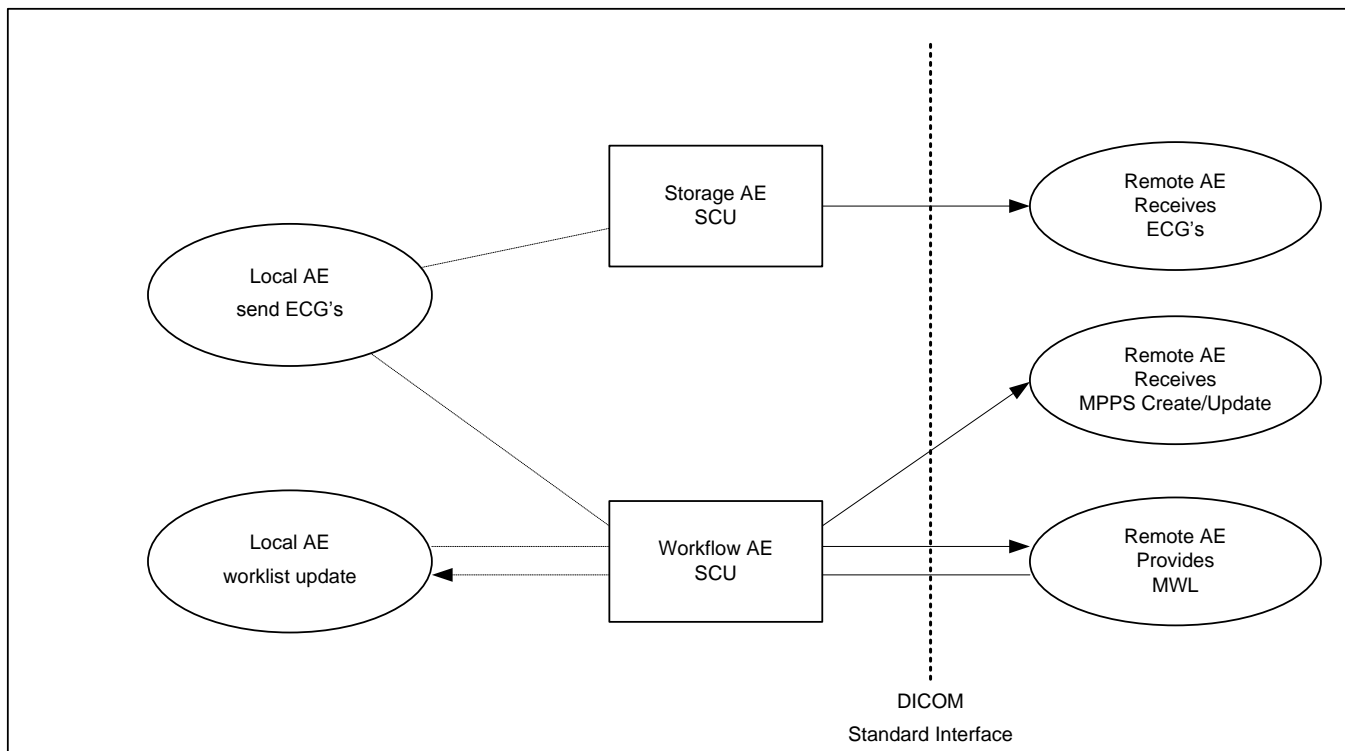
- [1] NEMA PS3 Digital Imaging and Communications in Medicine (DICOM) Standard, available free at <http://medical.nema.org/standard.html>
- [2] ISO/IEEE 11073 Health Informatics – Medical device communication standard. Annotated ECG nomenclature support files can be downloaded from <http://standards.ieee.org/downloads/11073/>



## 4 Networking

### 4.1 Implementation Model

#### 4.1.1 Application Data Flow



#### 4.1.2 Functional Definitions of Application Entities

##### 4.1.2.1 Functional Definition of Storage SCU

After acquiring one or more ECG's from a modality that does not support a DICOM interface, the operator can initiate a single or batch transmission of ECG's to a DICOM storage system by using the SemaServer as an intermediary (acting as an SCU).

##### 4.1.2.2 Functional Definition of Worklist SCU

When updating the worklist on a modality that does not support a DICOM interface, the operator can initiate a Modality Worklist query to a DICOM MWL system by using the SemaServer as an intermediary (acting as an SCU).

When transmitting an ECG to a DICOM storage system, the SemaServer is used as an intermediary (acting as an SCU) to create and update Modality Performed Procedure Step instances managed by a remote AE.

## 4.2 AE Specifications

### 4.2.1 Storage Application Entity Specification

#### 4.2.1.1 SOP Classes

This Application Entity provides Standard Conformance to the following SOP Classes:

SOP Class Name	SOP Class UID	SCU	SCP
12-lead ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1	Yes	No
General ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2	Yes	No
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	Yes	No
Storage Commitment Push Model	1.2.840.10008.1.20.1	Yes	No

#### 4.2.1.2 Association Policies

##### 4.2.1.2.1 General

The standard Application Context Name is used:

Application Context Name	1.2.840.10008.3.1.1.1
--------------------------	-----------------------

##### 4.2.1.2.1 Number of Associations

Number of Associations as an Initiator for SCHILLER Device:

Maximum number of simultaneous associations	1
---	---

Number of Associations as an Acceptor for SCHILLER Device:

Maximum number of simultaneous associations	1
---	---

##### 4.2.1.2.2 Asynchronous Nature

Asynchronous Nature as an Associations Initiator for SCHILLER Device:

Maximum number of outstanding asynchronous transactions	0
---	---

##### 4.2.1.2.1 Implementation Identifying Information

Implementation Identifying Information

Implementation Class UID	2.16.756.5.25.4.1.2
Implementation Version Name	schiller-dcm-1.5

## 4.2.1.3 Association Initiation Policy

4.2.1.3.1 Activity: Send ECG's

### Proposed Presentation Context

SCHILLER Modalities are capable of proposing the Presentation Contexts shown in the following table:

Presentation Context Table					
Name	Abstract Syntax	Transfer Syntax		Role	Ext. Neg.
	UID	Name List	UID List		
12-Lead ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
General ECG Waveform Storage	1.2.840.10008.5.1.4.1.1.9.1.2	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
Encapsulated PDF Storage	1.2.840.10008.5.1.4.1.1.104.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		
Storage Commitment Push Model	1.2.840.10008.1.20.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		

## 4.2.1.4 Association Acceptance Policy

4.2.1.4.1 Activity: Receive Storage Commitment Response

### Accepted Presentation Contexts

The Storage AE is capable of accepting Presentation Contexts shown in the following table:

Presentation Context Table					
Name	Abstract Syntax	Transfer Syntax		Role	Ext. Neg.
	UID	Name List	UID List		
Storage Commitment Push Model	1.2.840.10008.1.20.1	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		

## 4.2.2 Workflow Application Entity Specification

### 4.2.2.1 SOP Classes

This Application Entity provides Standard Conformance to the following SOP Classes:

SOP Class Name	SOP Class UID	SCU	SCP
Verification	1.2.840.10008.1.1	Yes	No
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Yes	No
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Yes	No

### 4.2.2.2 Association Policies

#### 4.2.2.2.1 General

The standard Application Context Name is used:

Application Context Name	1.2.840.10008.3.1.1.1
--------------------------	-----------------------

#### 4.2.2.2.2 Number of Associations

Number of Associations as an Initiator for SCHILLER Device:

Maximum number of simultaneous associations	1
---	---

Number of Associations as an Acceptor for SCHILLER Device:

Maximum number of simultaneous associations	0
---	---

#### 4.2.2.2.3 Asynchronous Nature

Asynchronous Nature as an Associations Initiator for SCHILLER Device:

Maximum number of outstanding asynchronous transactions	0
---	---

#### 4.2.2.2.4 Implementation Identifying Information

Implementation Identifying Information

Implementation Class UID	1.2.40.0.13.1.1
Implementation Version Name	dcm4che-2.0

### 4.2.2.3 Association Initiation Policy

#### 4.2.2.3.1 Activity: Worklist Update

Proposed Presentation Context

SCHILLER Modalities are capable of proposing the Presentation Contexts shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Modality Worklist Information Model – FIND	1.2.840.10008.5.1.4.31	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		

## SOP Specific Conformance for Modality Worklist

Section 4.2.3 provides a description of the Modality Worklist Request Identifiers and specifies the attributes that are copied into the created SOP instances. Unexpected attributes returned in a C-FIND response are ignored.

### 4.2.2.3.2 Activity: Send ECGs

#### Proposed Presentation Context

SCHILLER Modalities are capable of proposing the Presentation Contexts shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
Name	UID	Name List	UID List		
Modality Performed Procedure Step	1.2.840.10008.3.1.2.3.3	Implicit VR Little Endian	1.2.840.10008.1.2	SCU	None
		Explicit VR Little Endian	1.2.840.10008.1.2.1		

## SOP Specific Conformance for MPPS

Section 4.2.4 provides a description of the MPPS N-CREATE and N-SET Request Identifiers sent by SCHILLER Modalities.

### 4.2.2.3.3 Activity: Connectivity Verification

#### Proposed Presentation Context

SCHILLER Modalities are capable of proposing the Presentation Context shown in the following table:

Presentation Context Table					
Abstract Syntax		Transfer Syntax		Role	Ext. Neg.
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
		Explicit VR Little Endian	1.2.840.10008.1.2.1		

### 4.2.2.4 Association Acceptance Policy

Not applicable.

## 4.2.3 Modality Worklist Request Identifiers

The default SPS Query Configuration is set to single value matching on "Modality" (default "ECG") and "Scheduled Station AE Title" (default calling "Device ID"), and range matching on "Scheduled Procedure Start Date" (default 120 minutes into the future).

Older versions of SchillerServer ( $\leq$  v3.6.1) did not update imported MWL items, nor did it cancel MWL items which were no longer provided by the MWL SCP.

Detailed descriptions of the Modality Worklist Information Module are available in [PS 3.4 section K.6.1.2.2](#) of the DICOM Standard [1].

Attribute Name	Tag	VR	Matching Key	Return Key	Patient Dialog	Worklist	Instance IOD	Value
<b>SOP Common Module (<a href="#">PS 3.3 section C.12.1</a>)</b>								
Specific Character Set	(0008,0005)	CS		x				
<b>Scheduled Procedure Step Module (<a href="#">PS 3.3 section C.4.10</a>)</b>								
Scheduled Procedure Step Sequence	(0040,0100)	SQ		x				
> Scheduled Station AE Title	(0040,0001)	AE	S	x				Device ID – used to determine the target equipment for the specified Workitem
> Scheduled Procedure Step Start Date	(0040,0002)	DA	R	x		x		Workitem start date and time (date part). Defaults to current date.
> Scheduled Procedure Step Start Time	(0040,0003)	TM	R	C		x		Workitem start date and time (time part). Requires date part to be present. Defaults to current time plus 120 minutes.
> Modality	(0008,0060)	CS	S					Used for matching only (default "ECG"). Value of default created Modality attribute is defined in section 5.4.1 below.
> Scheduled Performing Physician's Name	(0040,0006)	PN		x			x	Consulting Physician Name (max 50 chars in total)
> Scheduled Procedure Step Description	(0040,0007)	LO		(x)				(Alt. source of Workitem remark)
> Scheduled Station Name	(0040,0010)	SH	(S)	(x)				(Alt. source of Device ID)
> Scheduled Procedure Step Location	(0040,0011)	SH	(S)	(x)				(Alt. source of Device ID)
> Scheduled Procedure Step ID	(0040,0009)	SH						Not used
> Comments on the Scheduled Procedure Step	(0040,0400)	LT		(x)				(Alt. source of Workitem remark)
<b>Requested Procedure Module (<a href="#">PS 3.3 section C.4.11</a>)</b>								
Requested Procedure ID	(0040,1001)	SH						Not used
Requested Procedure Description	(0032,1060)	LO		x			x	Copied into Study Description in created SOP instances.
Requested Procedure Code Sequence	(0032,1064)	SQ		x		x		Recording Type. DCID (Section 7.3.1) Procedures. Defaults to EV (P0-00000, SRT, "Unspecified procedure") (configurable) if not provided.
Study Instance UID	(0020,000D)	UI		x			x	(SCHILLER) Study ID (must be unique)
Requested Procedure Priority	(0040,1003)	SH		x		(x)		Workitem priority

Attribute Name	Tag	VR	Matching Key	Return Key	Patient Dialog	Worklist	Instance IOD	Value
Reason for the Requested Procedure	(0040,1002)	LO	x	(x)				Indication
Requested Procedure Location	(0040,1005)	LO	(x)					(Alt. source of Device ID)
Reason for Requested Procedure Code Sequence	(0040,100A)	SQ	(x)					(Alt. source of Indication) (From "Code Meaning (0008,0104) LO")
Requested Procedure Comments	(0040,1400)	LT	(x)					(Alt. source of Workitem remark)
<b>Imaging Service Request Module (PS 3.3 section C.4.12)</b>								
Accession Number	(0008,0050)	SH	R	x	x	x		Order ID (must be unique)
Requesting Physician	(0032,1032)	PN	x	(x)				Ordering Provider
Referring Physician's Name	(0008,0090)	PN	x	(x)	(x)	x		Referring Physician Name (max 50 chars in total)
Placer Order Number	(0040,2016)	LO	(x)					(Alt. source of Order ID, only for HL7 ORU export)
Imaging Service Request Comments	(0040,2400)	LT	(x)					(Alt. source of Workitem remark)
<b>Visit Identification Module (PS 3.3 section C.3.2)</b>								
Admission ID	(0038,0010)	LO	x	x	(x)	x		Visit ID (max 50 chars)
Institution Name	(0008,0080)	LO	(x)					(Alt. source of Device ID)
<b>Visit Status Module (PS 3.3 section C.3.3)</b>								
Current Patient Location	(0038,0300)	LO	x	(x)	x			Patient's Location
Patient's Institution Residence	(0038,0400)	LO	(x)					(Alt. source of Patient's Location)
Visit Comments	(0038,4000)	LT	x	(x)				Visit Comment
<b>Visit Admission Module (PS 3.3 section C.3.4)</b>								
Admitting Date	(0038,0020)	DA	x					Admit start date and time (date part). Default to current date.
Admitting Time	(0038,0021)	TM	x					Admit start date and time (time part). Requires date part to be present. Defaults to midnight.
Admitting Diagnoses Description <sup>(n)</sup>	(0008,1080)	LO	x	(x)				Workitem diagnosis
<b>Patient Identification Module (PS 3.3 section C.2.2)</b>								
Patient's Name	(0010,0010)	PN	x	x	x	x		Patient's name as: "FamilyName^GivenName^MiddleName^NamePrefix^NameSuffix" (each component max 50 chars)
Patient ID	(0010,0020)	LO	x	x	x	x		Patient ID (max 50 chars) (must be unique). Will default to auto generated as a GUID if not provided.
Other Patient IDs <sup>(1)</sup>	(0010,1000)	LO	x	(x)		x		Alternate Patient ID (max 50 chars)
Other Patient IDs Sequence	(0010,1002)	SQ	x	(x)		x		Social Security Number and/or Account Number (max 50 chars). (From: "Patient ID (0010,0020) LO", only if "Issuer of Patient ID (0010,0021)" = "SSN" or "ACCT".)
Patient's Birth Name	(0010,1005)	PN	x	(x)				Patient's maiden name
<b>Patient Demographics Module (PS 3.3 section C.2.3)</b>								
Patient's Birth Date	(0010,0030)	DA	x	x		x		Date of Birth (as YYYYMMDD)

Attribute Name	Tag	VR	Matching Key	Return Key	Patient Dialog	Worklist	Instance IOD	Value
Patient's Sex	(0010,0040)	CS		x	x			Gender. Enumerated values: "M" = male; "F" = female; "O" = other. Defaults to undefined.
Patient's Primary Language Code Sequence	(0010,0101)	SQ		x	(x)			Language. (From: "Code Meaning (0008,0104) LO")
Patient's Size	(0010,1020)	DS		x	x		U	Height of the patient in meters
Patient's Weight	(0010,1030)	DS		x	x		U	Weight of the patient in kilograms
Country of Residence	(0010,2150)	LO		x	(x)			Nationality
Patient's Telephone Numbers <sup>(1)</sup>	(0010,2154)	SH		x	(x)			Phone Number
Ethnic Group	(0010,2160)	SH		x	x		x	Ethnic group or race of the patient. Enumerated values are defined in section 5.2.1.
Patient's Religious Preference	(0010,21F0)	LO		x	(x)			Religion
Patient Comments	(0010,4000)	LT		x	(x)		U	Patient Comment
<b>Patient Medical Module (<a href="#">PS 3.3 section C.2.4</a>)</b>								
Medical Alerts <sup>(n)</sup>	(0010,2000)	LO		x		(x)		Workitem remark
Allergies <sup>(n)</sup>	(0010,2110)	LO		x	(x)			Allergies

<sup>(1)</sup> Only first item is read

<sup>(n)</sup> All items are read

The above table should be read as follows:

- Matching Key:** An "S" indicates that the modality will supply an attribute value for Single Value Matching, an "R" indicates Range Matching and a "\*" denotes wildcard matching. Enclosing "( )" indicates that it can be configured to be additionally supplied.
- Return Key:** An "x" indicates supported attributes, "(x)" optional attributes (usually mutually exclusive with another attribute), "R" required attributes, and "C" conditional attributes.
- Patient Dialog:** An "x" indicates that the attribute is displayed to the user in the Patient Information Dialog prior to an examination, and an "(x)" that some modalities with extended functionality may display the attribute.
- Worklist:** An "x" indicates that this attribute is displayed to the user in the modality's worklist, and an "(x)" that some modalities with extended functionality may display the attribute.
- Instance IOD:** An "x" indicates that this attribute is included into all Object Instances (where supported) created after performance of this Worklist Request. A "U" indicates that the attribute may be changed by the user before being included.



## 4.2.4 MPPS N-CREATE and N-SET Request Identifiers

Detailed descriptions of the Modality Performed Procedure Step SOP Class are available in [PS 3.4 section F.7](#) of the DICOM Standard [1].

Attribute Name	Tag	VR	N-CREATE	N-SET	Presence of Value	Source
DIMSE-N (PS 3.7 section 10)						
Affected SOP Class UID	(0000,0002)	UI	“1.2.840.10008.3.1.2.3.3”	n/a	ALWAYS	AUTO
Affected SOP Instance UID	(0000,1000)	UI	System generated Unique identifier of the MPPS	n/a	ALWAYS	AUTO
Requested SOP Class UID	(0000,0003)	UI	n/a	“1.2.840.10008.3.1.2.3.3”	ALWAYS	AUTO
Requested SOP Instance UID	(0000,1001)	UI	n/a	System generated Unique identifier of the MPPS	ALWAYS	AUTO
SOP Common Module (PS 3.3 section C.12.1)						
SOP Class UID	(0008,0016)	UI	n/a	n/a	NEVER	AUTO
SOP Instance UID	(0008,0018)	UI	n/a	n/a	NEVER	AUTO
Specific Character Set	(0008,0005)	CS	See section 5.2.5 SOP Common Module		ALWAYS	CONFIG
Performed Procedure Step Relationship (PS 3.3 section C.4.13)						
Scheduled Step Attributes Sequence	(0040,0270)	SQ	There will be one item in this sequence	n/a	ALWAYS	AUTO
> Study Instance UID	(0020,000D)	UI	From MWL or generated by the system	n/a	ALWAYS	MWL / AUTO
> Referenced Study Sequence	(0008,1110)	SQ	Not used	n/a	EMPTY	MWL
> Accession Number	(0008,0050)	SH	Order ID	n/a	VNAP	MWL
> Requested Procedure ID	(0040,1001)	SH	Not used	n/a	EMPTY	MWL
> Requested Procedure Code Sequence	(0032,1064)	SQ	Not used	n/a	NEVER	MWL
> Requested Procedure Description	(0032,1060)	LO	Not used	n/a	EMPTY	MWL
> Scheduled Procedure Step ID	(0040,0009)	SH	Not used	n/a	EMPTY	MWL
> Scheduled Procedure Step Description	(0040,0007)	LO	Not used	n/a	EMPTY	MWL
> Scheduled Protocol Code Sequence	(0040,0008)	SQ	Not used	n/a	EMPTY	MWL
Patient’s Name	(0010,0010)	PN	Patient’s name as: “FamilyName^GivenName^MiddleName^NamePrefix^NameSuffix” (each component max 50 chars)	n/a	VNAP	MWL / USER
Patient ID	(0010,0020)	LO	Patient ID (max 50 chars) Will be auto generated as a GUID if no Patient ID was provided by MWL or USER	n/a	ALWAYS	MWL / USER / AUTO
Patient’s Birth Date	(0010,0030)	DA	Date of Birth (as YYYYMMDD)	n/a	VNAP	MWL / USER
Patient’s Sex	(0010,0040)	CS	Enumerated values: “M” = male; “F” = female; “O” = other; (not used) = undefined	n/a	VNAP	MWL / USER

Attribute Name	Tag	VR	N-CREATE	N-SET	Presence of Value	Source
Referenced Patient Sequence	(0008,1120)	SQ	Not used	n/a	EMPTY	MWL
Admission ID	(0038,0010)	LO	Visit ID (max 50 chars)	n/a	ANAP	MWL / USER
<b>Performed Procedure Step Information (PS 3.3 section C.4.14)</b>						
Performed Procedure Step ID	(0040,0253)	SH	Hexadecimal Internal Recording ID	n/a	ALWAYS	IOD
Performed Station AE Title	(0040,0241)	AE	Device ID	n/a	ALWAYS	CONFIG
Performed Station Name	(0040,0242)	SH	Station Name (see 5.2.4 General Equipment Module)	n/a	VNAP	IOD
Performed Location	(0040,0243)	SH	Patient's Location	n/a	VNAP	MWL / USER
Performed Procedure Step Start Date	(0040,0244)	DA	Acquisition start date of the recording	n/a	ALWAYS	IOD
Performed Procedure Step Start Time	(0040,0245)	TM	Acquisition start time of the recording	n/a	ALWAYS	IOD
Performed Procedure Step Status	(0040,0252)	CS	This will be "IN PROGRESS"	This will be "COMPLETED"	ALWAYS	AUTO
Performed Procedure Step Description	(0040,0254)	LO	From "Study Description (0008,1030)"	n/a	ALWAYS	IOD
Performed Procedure Type Description	(0040,0255)	LO	Not used	n/a	EMPTY	AUTO
Procedure Code Sequence	(0008,1032)	SQ	Recording type		ALWAYS	IOD
> Include 'Code Sequence Macro'			DCID (Section 7.3.1) Procedures			
Performed Procedure Step End Date	(0040,0250)	DA	Not used	Acquisition end date of the recording if available, otherwise date of export	EMPTY / ALWAYS	IOD
Performed Procedure Step End Time	(0040,0251)	TM	Not used	Acquisition end time of the recording if available, otherwise time of export	EMPTY / ALWAYS	IOD
Comments on the Performed Procedure Step	(0040,0280)	ST	Recording remarks		VNAP	USER
<b>Image Acquisition Results (PS 3.3 section C.4.15)</b>						
Modality	(0008,0060)	CS	This will be "ECG"	n/a	ALWAYS	IOD
Study ID	(0020,0010)	SH	Internal Recording ID	n/a	ALWAYS	IOD
Performed Protocol Code Sequence	(0040,0260)	SQ	See Section 5.3.1 Encapsulated Document Series Module and 5.4.1 General Series Module		ALWAYS	IOD
Performed Series Sequence	(0040,0340)	SQ	There will be one item per generated series in this sequence		ALWAYS	AUTO
> Performing Physician's Name	(0008,1050)	PN	Consulting Physician		VNAP	IOD
> Protocol Name	(0018,1030)	LO	See Section 5.3.1 Encapsulated Document Series Module and 5.4.1 General Series Module		ALWAYS	IOD
> Operator's Name	(0008,1070)	PN	Acquiring Technician		VNAP	IOD
> Series Instance UID	(0020,000E)	UI	System generated Unique identifier of the Series		ALWAYS	IOD
> Series Description	(0008,103E)	LO	See Section 5.3.1 Encapsulated Document Series Module and 5.4.1 General Series Module		ALWAYS	AUTO
> Retrieve AE Title	(0008,0054)	AE	Not used		EMPTY	AUTO

Attribute Name	Tag	VR	N-CREATE	N-SET	Presence of Value	Source
> Referenced Image Sequence	(0008,1140)	SQ	Not used. There will be zero items in this sequence.	References all SOP Instances created during the acquisition of the procedure. There will be zero or more items in this sequence	VNAP	AUTO
>> Referenced SOP Class UID	(0008,1150)	UI	Encapsulated PDF: "1.2.840.10008.5.1.4.1.1.104.1" 12-Lead ECG Waveform: "1.2.840.10008.5.1.4.1.1.9.1.1" General ECG Waveform: "1.2.840.10008.5.1.4.1.1.9.1.2"		ALWAYS	AUTO
>> Referenced SOP Instance UID	(0008,1155)	UI	System generated Unique identifier of the referenced SOP Instances		ALWAYS	AUTO
> Referenced Non-Image Composite SOP Instance Sequence	(0040,0220)	SQ	Not used. All referenced SOP Instances are included in Referenced Image Sequence (0008,1140)		EMPTY	AUTO

## 5 IOD Contents

The following tables use a number of abbreviations. The abbreviations used in the “Presence of ...” column are:

<i>VNAP</i>	<i>Value Not Always Present (attribute sent zero length if no value is present)</i>
<i>ANAP</i>	<i>Attribute Not Always Present</i>
<i>ALWAYS</i>	<i>Always present</i>
<i>EMPTY</i>	<i>Attribute is sent without a value</i>

The abbreviations used in the “Source” column:

<i>MWL</i>	<i>the attribute value source Modality Worklist</i>
<i>USER</i>	<i>the attribute value source is from User input</i>
<i>AUTO</i>	<i>the attribute value is generated automatically</i>
<i>CONFIG</i>	<i>the attribute value source is a configurable parameter</i>

For brevity, coded entries (‘Code Sequence Macro’ contents) referenced in the tables may be summarized as tuples of the form

*(P2-25101, SRT, “Spirometry”), or  
(uV, UCUM[1.4], “microvolt”)*

with the first entry indicating the Code Value (0008,0100), the second indicating the Coding Scheme Designator (0008,0102) – with an optional Coding Scheme Version (0008,0103) enclosed in brackets – and the third the Code Meaning (0008,0104). The code meaning will always be enclosed in quotes.

### 5.1 Created SOP Instances

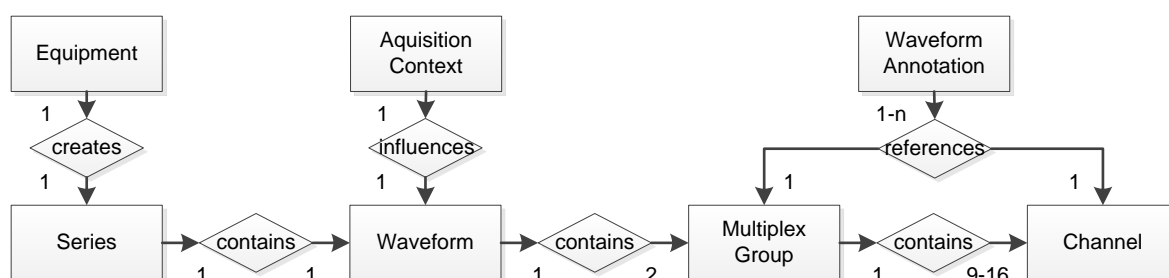
#### 5.1.1 Encapsulated PDF

##### 5.1.1.1 Encapsulated PDF IOD Module Table

Detailed descriptions of the IOD are available in [PS 3.3 section A.45.1](#) of the DICOM Standard [1].

IE	Module	Reference	Presence of Module
Patient	Patient	5.2.1	ALWAYS
Study	General Study	5.2.2	ALWAYS
	Patient Study	5.2.3	ALWAYS
Series	Encapsulated Document Series	5.3.1	ALWAYS
Equipment	General Equipment	5.2.4	ALWAYS
	SC Equipment	5.3.2	ALWAYS
Encapsulated Document	Encapsulated Document	5.3.3	ALWAYS
	SOP Common	5.2.5	ALWAYS

## 5.1.2 Resting ECG



The General Study Module's "Procedure Code Sequence (0008,1032)" will always be: (P2-3120A, SRT, "12 lead ECG").

The Waveform Module's "Waveform Sequence (5400,0100)" will always contain two multiplex groups of rhythm data (group #1) and median data (group #2).

### 5.1.2.1 12-Lead ECG IOD Module Table

Detailed descriptions of the IOD are available in [PS 3.3 section A.34.3](#) of the DICOM Standard [1].

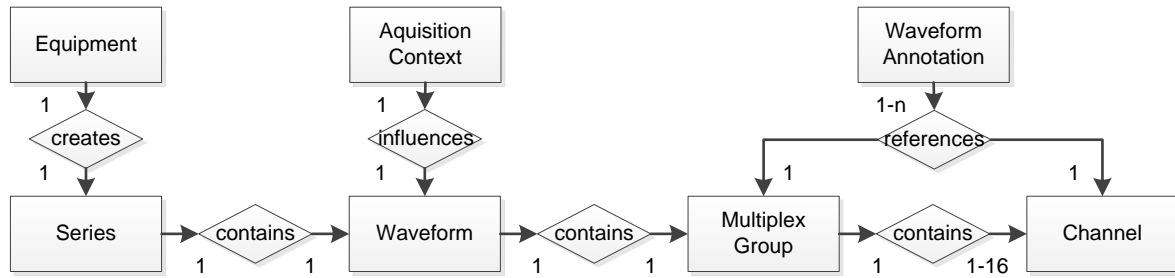
IE	Module	Reference	Presence of Module
Patient	Patient	5.2.1	ALWAYS
Study	General Study	5.2.2	ALWAYS
	Patient Study	5.2.3	ALWAYS
Series	General Series	5.4.1	ALWAYS
Equipment	General Equipment	5.2.4	ALWAYS
Waveform	Waveform Identification	5.4.2	ALWAYS
	Waveform	5.4.3	ALWAYS
	Acquisition Context	5.4.4	ALWAYS
	Waveform Annotation	5.4.5	ALWAYS
	SOP Common	5.2.5	ALWAYS

### 5.1.2.2 General ECG IOD Module Table

Detailed descriptions of the IOD are available in [PS 3.3 section A.34.4](#) of the DICOM Standard [1].

IE	Module	Reference	Presence of Module
Patient	Patient	5.2.1	ALWAYS
Study	General Study	5.2.2	ALWAYS
	Patient Study	5.2.3	ALWAYS
Series	General Series	5.4.1	ALWAYS
Equipment	General Equipment	5.2.4	ALWAYS
Waveform	Waveform Identification	5.4.2	ALWAYS
	Waveform	5.4.3	ALWAYS
	Acquisition Context	5.4.4	ALWAYS
	Waveform Annotation	5.4.5	ALWAYS
	SOP Common	5.2.5	ALWAYS

### 5.1.3 Resting Rhythm



The General Study Module's "Procedure Code Sequence (0008,1032)" will always be: (P2-31001, SRT, "Rhythm ECG").

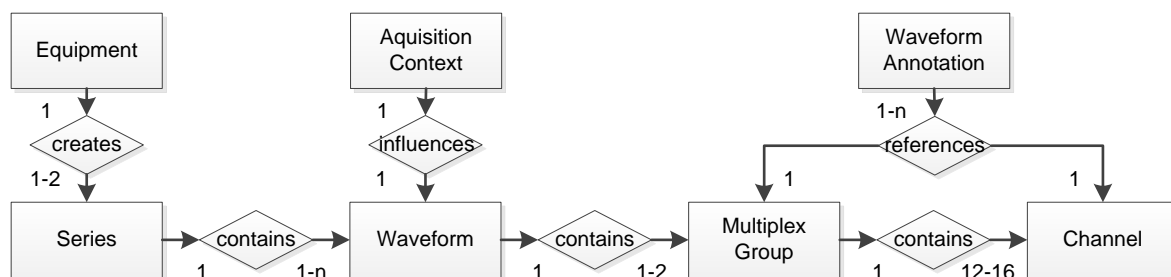
The Waveform Module's "Waveform Sequence (5400,0100)" will only contain one multiplex group of rhythm data of variable length.

#### 5.1.3.1 General ECG IOD Module Table

Detailed descriptions of the IOD are available in [PS 3.3 section A.34.4](#) of the DICOM Standard [1].

IE	Module	Reference	Presence of Module
Patient	Patient	5.2.1	ALWAYS
Study	General Study	5.2.2	ALWAYS
	Patient Study	5.2.3	ALWAYS
Series	General Series	5.4.1	ALWAYS
Equipment	General Equipment	5.2.4	ALWAYS
Waveform	Waveform Identification	5.4.2	ALWAYS
	Waveform	5.4.3	ALWAYS
	Acquisition Context	5.4.4	ALWAYS
	Waveform Annotation	5.4.5	ALWAYS
	SOP Common	5.2.5	ALWAYS

## 5.1.4 Exercise ECG



The General Study Module's "Procedure Code Sequence (0008,1032)" will always be: (P2-31010, SRT, "Exercise ECG").

The first Series #1 will contain 10 second Stress Stage ECGs at the end of every stage. This Waveform Module's "Waveform Sequence (5400,0100)" may contain (1) one multiplex group of median data, or (2) two multiplex groups of rhythm data and median data depending on the source equipment's transmission capabilities.

A second Series #2 may be present, which contain a Stress Rhythm ECG for the duration of the procedure. This Waveform Module's "Waveform Sequence (5400,0100)" contains one multiplex group of rhythm data.

### 5.1.4.1 General ECG IOD Module Table

Detailed descriptions of the IOD are available in [PS 3.3 section A.34.4](#) of the DICOM Standard [1].

IE	Module	Reference	Presence of Module
Patient	Patient	5.2.1	ALWAYS
Study	General Study	5.2.2	ALWAYS
	Patient Study	5.2.3	ALWAYS
Series	General Series	5.4.1	ALWAYS
Equipment	General Equipment	5.2.4	ALWAYS
Waveform	Waveform Identification	5.4.2	ALWAYS
	Waveform	5.4.3	ALWAYS
	Acquisition Context	5.4.4	ALWAYS
	Waveform Annotation	5.4.5	ALWAYS
	SOP Common	5.2.5	ALWAYS

## 5.2 Common Modules

The following modules are shared between multiple IODs. Any restrictions, such as the value of General Study Module's Procedure Code Sequence (0008,1032) are mentioned under each subsequent IOD section.

MWL import restrictions in addition to the ones imposed by the VR – such as maximum supported characters – are mentioned as needed.

### 5.2.1 Patient Module

Detailed descriptions of the Module are available in [PS 3.3 section C.7.1.1](#) of the DICOM Standard [1].

Attribute Name	Tag	VR	Value	Presence of Value	Source
Patient's Name	(0010,0010)	PN	Patient's name as: "FamilyName^GivenName^MiddleName^NamePrefix^NameSuffix" (each component max 50 chars)	VNAP	MWL / USER
Patient ID	(0010,0020)	LO	Patient ID (max 50 chars) Will be auto generated as a GUID if no Patient ID was provided by MWL or USER.	ALWAYS	MWL / USER / AUTO
Patient's Birth Date	(0010,0030)	DA	Date of Birth (as YYYYMMDD)	VNAP	MWL / USER
Patient's Sex	(0010,0040)	CS	Enumerated Values: "M" = male; "F" = female; "O" = other; (not used) = undefined	VNAP	MWL / USER
Other Patient IDs	(0010,1000)	LO	Alternate Patient ID (max 50 chars)	ANAP	MWL / USER
Other Patient IDs Sequence	(0010,1002)	SQ	There may be up to two items in this sequence: <ul style="list-style-type: none"> <li>• Patient's Social Security Number</li> <li>• Patient's Account Number</li> </ul> Sequence not available if neither Patient's Social Security Number or Account Number are available	ANAP	AUTO
> Patient ID	(0010,0020)	LO	Patient's Social Security Number or Patient's Account Number if available (max 50 chars)	ALWAYS	MWL / USER
> Issuer of Patient ID	(0010,0021)	LO	This will be: <ul style="list-style-type: none"> <li>• "SSN" if the item's <i>Patient ID</i> is a Social Security Number</li> <li>• "ACCT" if the item's <i>Patient ID</i> is an Account Number</li> </ul>	ALWAYS	AUTO
> Type of Patient ID	(0010,0022)	CS	This will be "TEXT"	ALWAYS	AUTO
Ethnic Group	(0010,2160)	SH	Ethnic group or race of the patient. Enumerated Values: <ul style="list-style-type: none"> <li>• "Undefined"</li> <li>• "Caucasian"</li> <li>• "Asian"</li> <li>• "Black"</li> <li>• "AmericanIndian"</li> <li>• "PacificIslander"</li> <li>• "Hispanic"</li> <li>• "Oriental"</li> <li>• "Other"</li> </ul>	ANAP	MWL / USER
Patient Comments	(0010,4000)	LT	Patient Comments (max 1024 chars)	ANAP	MWL / USER



## 5.2.2 General Study Module

Detailed descriptions of the Module are available in [PS 3.3 section C.7.2.1](#) of the DICOM Standard [1].

Attribute Name	Tag	VR	Value	Presence of Value	Source
Study Instance UID	(0020,000D)	UI	From MWL or generated by the System	ALWAYS	MWL / AUTO
Study Date	(0008,0020)	DA	Acquisition start date of the recording	ALWAYS	AUTO
Study Time	(0008,0030)	TM	Acquisition start time of the recording	ALWAYS	AUTO
Referring Physician's Name	(0008,0090)	PN	Referring Physician (max 50 chars in total)	VNAP	MWL / USER
Study ID	(0020,0010)	SH	Hexadecimal Internal Recording ID	ALWAYS	AUTO
Study Description	(0008,1030)	LO	From MWL (Requested Procedure Description) or system generated description of the Study. Enumerated values in case of system generated are defined in section 7.3.1 Procedures.	ALWAYS	MWL / AUTO
Accession Number	(0008,0050)	SH	Order ID	VNAP	MWL
Physician(s) of Record	(0008,1048)	PN	Attending Physician, from HL7 interface or user input	ANAP	USER
Name of Physician(s) Reading Study	(0008,1060)	PN	Validating or Interpreting Physician	ANAP	AUTO
Procedure Code Sequence	(0008,1032)	SQ	Recording type	ALWAYS	AUTO
> Include 'Code Sequence Macro'			DCID (Section 7.3.1) Procedures		

## 5.2.3 Patient Study Module

Detailed descriptions of the Module are available in [PS 3.3 section C.7.2.2](#) of the DICOM Standard [1].

Attribute Name	Tag	VR	Value	Presence of Value	Source
Patient's Age	(0010,1010)	AS	Calculated age of the patient at the time of recording	ANAP	AUTO
Patient's Size	(0010,1020)	DS	Height of the patient in meters	ANAP	MWL / USER
Patient's Weight	(0010,1030)	DS	Weight of the patient in kilograms	ANAP	MWL / USER
Admission ID	(0038,0010)	LO	Visit ID (max 50 chars)	ANAP	MWL / USER

## 5.2.4 General Equipment Module

Detailed descriptions of the Module are available in [PS 3.3 section C.7.5.1](#) of the DICOM Standard [1].

Attribute Name	Tag	VR	Value	Presence of Value	Source
Manufacturer	(0008,0070)	LO	This will be "SCHILLER"	ALWAYS	AUTO
Institution Name	(0008,0080)	LO	Institute of the acquiring technician	ANAP	CONFIG
Station Name	(0008,1010)	SH	Device ID	ANAP	CONFIG
Institutional Department Name	(0008,1040)	LO	Department of the acquiring technician	ANAP	CONFIG
Manufacturer's Model Name	(0008,1090)	LO	Device model name	ANAP	AUTO
Device Serial Number	(0018,1000)	LO	Device serial number	ANAP	AUTO
Software Version(s)	(0018,1020)	LO	Device version	ANAP	AUTO

## 5.2.5 SOP Common Module

Detailed descriptions of the Module are available in [PS 3.3 section C.12.1](#) of the DICOM Standard [1].

Attribute Name	Tag	VR	Value	Presence of Value	Source
SOP Class UID	(0008,0016)	UI	Encapsulated PDF: "1.2.840.10008.5.1.4.1.1.104.1" 12-Lead ECG Waveform: "1.2.840.10008.5.1.4.1.1.9.1.1" General ECG Waveform: "1.2.840.10008.5.1.4.1.1.9.1.2"	ALWAYS	AUTO
SOP Instance UID	(0008,0018)	UI	System generated	ALWAYS	AUTO
Specific Character Set	(0008,0005)	CS	This will be one of: <ul style="list-style-type: none"> <li>"ISO_IR 100" (ISO-8859-1; Latin alphabet #1)</li> <li>"ISO_IR 101" (ISO-8859-2; Latin alphabet #2)</li> <li>"ISO_IR 109" (ISO-8859-3; Latin alphabet #3)</li> <li>"ISO_IR 110" (ISO-8859-4; Latin alphabet #4)</li> <li>"ISO_IR 144" (ISO-8859-5; Cyrillic)</li> <li>"ISO_IR 127" (ISO-8859-6; Arabic)</li> <li>"ISO_IR 126" (ISO-8859-7; Greek)</li> <li>"ISO_IR 138" (ISO-8859-8; Hebrew)</li> <li>"ISO_IR 192" (UTF-8; Unicode) – default</li> </ul>	ALWAYS	CONFIG
Instance Creation Date	(0008,0012)	DA	Date of export ( <i>should be same for mutli-instance "simultaneous" export</i> )	ALWAYS	AUTO
Instance Creation Time	(0008,0013)	TM	Time of export ( <i>should be same for mutli-instance "simultaneous" export</i> )	ALWAYS	AUTO

## 5.3 Encapsulated PDF Modules

### 5.3.1 Encapsulated Document Series Module

Detailed descriptions of the Module are available in [PS 3.3 section C.24.1](#) of the DICOM Standard [1].

Attribute Name	Tag	VR	Value	Presence of Value	Source
Modality	(0008,0060)	CS	"ECG"	ALWAYS	AUTO
Series Instance UID	(0020,000E)	UI	System generated	ALWAYS	AUTO
Series Number	(0020,0011)	IS	This will be "1"	ALWAYS	AUTO
Referenced Performed Procedure Step Sequence	(0008,1111)	SQ	There will be one item in this sequence	ALWAYS	AUTO
> Referenced SOP Class UID	(0008,1150)	UI	This will be "1.2.840.10008.3.1.2.3.3" (Modality Performed Procedure Step)	ALWAYS	AUTO
> Referenced SOP Instance UID	(0008,1155)	UI	System generated Unique Identifier of the MPPS	ALWAYS	AUTO
Protocol Name	(0018,1030)	LO	From <i>first</i> "Procedure Code Sequence (0008,1032) > Code Meaning (0008,0104)"	ALWAYS	AUTO
Series Description	(0008,103E)	LO	This will be "ProcedureReport"	ALWAYS	AUTO
Performed Procedure Step ID	(0040,0253)	SH	Hexadecimal Internal Recording ID	ALWAYS	AUTO
Performed Procedure Step Start Date	(0040,0244)	DA	Acquisition start date of the recording	ALWAYS	AUTO
Performed Procedure Step Start Time	(0040,0245)	TM	Acquisition start time of the recording	ALWAYS	AUTO
Performed Procedure Step End Date	(0040,0250)	DA	Acquisition end date of the recording, if available	ANAP	AUTO
Performed Procedure Step End Time	(0040,0251)	TM	Acquisition end time of the recording, if available	ANAP	AUTO
Performed Procedure Step Description	(0040,0254)	LO	From "Study Description (0008,1030)"	ALWAYS	MWL / AUTO
Performed Protocol Code Sequence	(0040,0260)	SQ	From <i>first</i> "Procedure Code Sequence (0008,1032)"	ALWAYS	AUTO
Comments on the Performed Procedure Step	(0040,0280)	ST	Recording Remarks	ANAP	USER

### 5.3.2 SC Equipment Module

Detailed descriptions of the Module are available in [PS 3.3 section C.8.6.1](#) of the DICOM Standard [1].

Attribute Name	Tag	VR	Value	Presence of Value	Source
Conversion Type	(0008,0064)	CS	This will be "WSD"	ALWAYS	AUTO

### 5.3.3 Encapsulated Document Module

Detailed descriptions of the Module are available in [PS 3.3 section C.24.2](#) of the DICOM Standard [1].

Attribute Name	Tag	VR	Value	Presence of Value	Source
Instance Number	(0020,0013)	IS	This will be "1"	ALWAYS	AUTO
Content Date	(0008,0023)	DA	Date of export	ALWAYS	AUTO
Content Time	(0008,0033)	TM	Time of export	ALWAYS	AUTO
Acquisition DateTime	(0008,002A)	DT	Acquisition start date and time of the recording	ALWAYS	AUTO
Burned In Annotation	(0028,0301)	CS	This will be "YES"	ALWAYS	AUTO
Document Title	(0042,0010)	ST	System generated title with "LastName, GivenName MiddleName [PatientID] - RecType [AcquisitionDateTime]"	ALWAYS	AUTO
Concept Name Code Sequence	(0040,A043)	SQ	Not used	EMPTY	AUTO
Verification Flag	(0040,A493)	CS	"UNVERIFIED" for Stored and Edited recordings "VERIFIED" for Validated and Revalidated recordings	ALWAYS	AUTO
Encapsulated Document	(0042,0011)	OB	Binary data of PDF.	ALWAYS	AUTO
MIME Type of Encapsulated Document	(0042,0012)	LO	This will be "application/pdf"	ALWAYS	AUTO

## 5.4 ECG Waveform Modules

The following modules are shared between multiple ECG IODs. Any restrictions, such as the number of waveform multiplex groups in the Waveform Sequence (5400,0100) are mentioned under each subsequent IOD section.

### 5.4.1 General Series Module

Detailed descriptions of the Module are available in [PS 3.3 section C.7.3.1](#) of the DICOM Standard [1].

Attribute Name	Tag	VR	Value	Presence of Value	Source
Modality	(0008,0060)	CS	"ECG"	ALWAYS	AUTO
Series Instance UID	(0020,000E)	UI	System generated Unique identifier of the Series	ALWAYS	AUTO
Series Number	(0020,0011)	IS	This will be an incrementing number per created Series within a Study starting with "1".	ALWAYS	AUTO
Laterality	(0020,0060)	CS	Not used	EMPTY	AUTO
Series Date	(0008,0021)	DA	Acquisition start date of the recording	ALWAYS	AUTO
Series Time	(0008,0031)	TM	Acquisition start time of the recording	ALWAYS	AUTO
Performing Physician's Name	(0008,1050)	PN	Consulting Physician	ANAP	MWL / USER
Operators Name	(0008,1070)	PN	Acquiring Technician	ANAP	AUTO
Referenced Performed Procedure Step Sequence	(0008,1111)	SQ	There will be one item in this sequence	ALWAYS	AUTO
> Referenced SOP Class UID	(0008,1150)	UI	This will be "1.2.840.10008.3.1.2.3.3" (Modality Performed Procedure Step)	ALWAYS	AUTO
> Referenced SOP Instance UID	(0008,1155)	UI	System generated Unique Identifier of the MPPS	ALWAYS	AUTO
<i>Include 'Procedure Specific Protocol Macro'</i>			<ul style="list-style-type: none"> <li>• For "Resting ECG" include Section 5.4.1.1</li> <li>• For "Resting Rhythm" include Section 5.4.1.2</li> <li>• For "Exercise ECG" include Section 5.4.1.3</li> </ul>		
Performed Procedure Step ID	(0040,0253)	SH	Hexadecimal Internal Recording ID	ALWAYS	AUTO
Performed Procedure Step Start Date	(0040,0244)	DA	Acquisition start date of the recording	ALWAYS	AUTO
Performed Procedure Step Start Time	(0040,0245)	TM	Acquisition start time of the recording	ALWAYS	AUTO
Performed Procedure Step End Date	(0040,0250)	DA	Acquisition end date of the recording, if available	ANAP	AUTO
Performed Procedure Step End Time	(0040,0251)	TM	Acquisition end time of the recording, if available	ANAP	AUTO
Performed Procedure Step Description	(0040,0254)	LO	From "Study Description (0008,1030)"	ALWAYS	MWL / AUTO
Comments on the Performed Procedure Step	(0040,0280)	ST	Recording Remarks	ANAP	USER

#### 5.4.1.1 Resting ECG Protocol Macro

This Macro allows Resting ECG specific Protocol information to be included in the General Series Module in section 5.4.1 above.

Attribute Name	Tag	VR	Value	Presence of Value	Source
Protocol Name	(0018,1030)	LO	This will be "Resting ECG – {Lead System Name}"	ALWAYS	AUTO
Series Description	(0008,103E)	LO	This will be "RestingECG"	ALWAYS	AUTO
Performed Protocol Code Sequence	(0040,0260)	SQ	There will be two items in this sequence <ul style="list-style-type: none"> <li>The resting ECG type</li> <li>The lead system used</li> </ul>	ALWAYS	AUTO
> Include 'Code Sequence Macro'			<i>This will be EV (P2-3120A, SRT, "12 lead ECG")</i>	ALWAYS	AUTO
> Include 'Code Sequence Macro'			<i>DCID (Section 7.3.3) ECG Lead Systems</i>	ALWAYS	AUTO

#### 5.4.1.2 Resting Rhythm Protocol Macro

This Macro allows Resting Rhythm specific Protocol information to be included in the General Series Module in section 5.4.1 above.

Attribute Name	Tag	VR	Value	Presence of Value	Source
Protocol Name	(0018,1030)	LO	This will be "Resting Rhythm – {Lead System Name}"	ALWAYS	AUTO
Series Description	(0008,103E)	LO	This will be "RestingRhythm"	ALWAYS	AUTO
Performed Protocol Code Sequence	(0040,0260)	SQ	There will be two items in this sequence <ul style="list-style-type: none"> <li>The resting rhythm type</li> <li>The lead system used</li> </ul>	ALWAYS	AUTO
> Include 'Code Sequence Macro'			<i>This will be EV (P2-31001, SRT, "Rhythm ECG")</i>	ALWAYS	AUTO
> Include 'Code Sequence Macro'			<i>DCID (Section 7.3.3) ECG Lead Systems</i>	ALWAYS	AUTO

## 5.4.1.3 Exercise ECG Protocol Macro

This Macro allows Exercise ECG specific Protocol information to be included in the General Series Module in section 5.4.1 above.

Attribute Name	Tag	VR	Value	Presence of Value	Source
Protocol Name	(0018,1030)	LO	This will be "{Stress Test Type} – {Lead System Name} – {Stress Protocol Name}"	ALWAYS	AUTO
Series Description	(0008,103E)	LO	This will be: <ul style="list-style-type: none"> <li>"ExerciseStageECGs" for Series #1, and</li> <li>"ExerciseRhythm" for Series #2.</li> </ul>	ALWAYS	AUTO
Performed Protocol Code Sequence	(0040,0260)	SQ	There will be two items in this sequence <ul style="list-style-type: none"> <li>The stress test type</li> <li>The lead system used</li> </ul>	ALWAYS	AUTO
> Include 'Code Sequence Macro'			<p>Series #1: Depending on the type of test, this will be:</p> <ul style="list-style-type: none"> <li>EV (P2-31102, SRT, "Stress test ECG - bicycle") or</li> <li>EV (P2-31103, SRT, "Stress test ECG - treadmill") or</li> <li>EV (P2-31107, SRT, "Stress test ECG - pharmacologic")</li> </ul> <p>Series #2: This will be:</p> <ul style="list-style-type: none"> <li>EV (P2-31205, SRT, "ECG ST-segment Monitoring")</li> </ul>	ALWAYS	AUTO
> Include 'Code Sequence Macro'			DCID (Section 7.3.3) ECG Lead Systems	ALWAYS	AUTO

## 5.4.2 Waveform Identification Module

Detailed descriptions of the Module are available in [PS 3.3 section C.10.8](#) of the DICOM Standard [1].

Attribute Name	Tag	VR	Value	Presence of Value	Source
Instance Number	(0020,0013)	IS	This will be an incrementing number per acquired Waveform within a Series starting with "1"	ALWAYS	AUTO
Content Date	(0008,0023)	DA	Acquisition start date of the waveform	ALWAYS	AUTO
Content Time	(0008,0033)	TM	Acquisition start time of the waveform	ALWAYS	AUTO
Acquisition DateTime	(0008,002A)	DT	Acquisition start date and time of the waveform	ALWAYS	AUTO

## 5.4.3 Waveform Module

Detailed descriptions of the Module are available in [PS 3.3 section C.10.9](#) of the DICOM Standard [1].

Attribute Name	Tag	VR	Value	Presence of Value	Source
Waveform Sequence	(5400,0100)	SQ	This may have up to two multiplex groups containing: <ul style="list-style-type: none"> <li>• Rhythm data</li> <li>• Median data</li> </ul> <i>Please see Section 5.1 for details of the presence of the multiplex groups in different types of procedures.</i>	ALWAYS	AUTO
> Multiplex Group Time Offset	(0018,1068)	DS	This will be "0"	ALWAYS	AUTO
> Trigger Time Offset	(0018,1069)	DS	This will be "0"	ALWAYS	AUTO
> Waveform Originality	(003A,0004)	CS	This will be <ul style="list-style-type: none"> <li>• "ORIGINAL" for the group of rhythm data and</li> <li>• "DERIVED" for the group of median data.</li> </ul>	ALWAYS	AUTO
> Number of Waveform Channels	(003A,0005)	US	This will be "9", "12", "15", or "16" depending on the lead system used (see 7.3.3 ECG Lead Systems below).	ALWAYS	AUTO
> Number of Waveform Samples	(003A,0010)	UL	For Resting ECG and Exercise Stage ECG series, this will be between "2000" and "10000" for the group of rhythm data, and between "200" and "1200" for the group of median data, depending on the source equipment For Resting Rhythm and Exercise Rhythm ECG series, this will vary depending on the length of the recording and on the source equipment.	ALWAYS	AUTO
> Sampling Frequency	(003A,001A)	DS	This will be between "200" and "1000" Hz depending on the source equipment sample rate.	ALWAYS	AUTO
> Multiplex Group Label	(003A,0020)	SH	This will be <ul style="list-style-type: none"> <li>• "RHYTHM" for the group of rhythm data, and</li> <li>• "MEDIAN_BEAT" for the group of median data.</li> </ul>	ALWAYS	AUTO
> Channel Definition Sequence	(003A,0200)	SQ	There will be one item for each lead in this sequence	ALWAYS	AUTO
>> Channel Label	(003A,0203)	SH	This will be "Lead_{Channel Source Sequence::Code Meaning}"	ALWAYS	AUTO
>> Channel Status	(003A,0205)	CS	This will be "OK"	ALWAYS	AUTO
>> Channel Source Sequence	(003A,0208)	SQ	Lead name coded entry	ALWAYS	AUTO
>>> Include 'Code Sequence Macro'			DCID (Section 7.3.2) ECG Leads		
>> Channel Sensitivity	(003A,0210)	DS	This is the LSB in microvolts.	ALWAYS	AUTO
>> Channel Sensitivity Units Sequence	(003A,0211)	SQ	Lead sample unit	ALWAYS	AUTO
>>> Include 'Code Sequence Macro'			This will be EV (uV, UCUM[1.4], "microvolt")		
>> Channel Sensitivity Correction Factor	(003A,0212)	DS	This will be "1"	ALWAYS	AUTO
>> Channel Baseline	(003A,0213)	DS	This will be "0"	ALWAYS	AUTO
>> Channel Time Skew	(003A,0214)	DS	Not exported. Channel Sample Skew is valued.	NEVER	AUTO
>> Channel Sample Skew	(003A,0215)	DS	This will be "0"	ALWAYS	AUTO
>> Waveform Bits Stored	(003A,021A)	US	This will be "16"	ALWAYS	AUTO
>> Filter Low Frequency	(003A,0220)	DS	High pass filter 3 dB cutoff frequency in Hz	ALWAYS	AUTO
>> Filter High Frequency	(003A,0221)	DS	Low pass filter 3 dB cutoff frequency in Hz	ALWAYS	AUTO
>> Notch Filter Frequency	(003A,0222)	DS	AC notch filter center frequency in Hz if applicable	ANAP	AUTO



Attribute Name	Tag	VR	Value	Presence of Value	Source
> Waveform Bits Allocated	(5400,1004)	US	This will be "16"	ALWAYS	AUTO
> Waveform Sample Interpretation	(5400,1006)	CS	This will be "SS"	ALWAYS	AUTO
> Waveform Data	(5400,1010)	OW	Encoded data samples – channel multiplexed	ALWAYS	AUTO

Data values are encoded interleaved, incrementing by channel and then by sample (i.e., C1S1, C2S1, C3S1, ... CnS1, C1S2, C2S2, C3S2, ... CnSm), with no padding or explicit delimitation between successive samples.

## 5.4.4 Acquisition Context Module

Detailed descriptions of the Module are available in [PS 3.3 section C.7.6.14](#) of the DICOM Standard [1].

Attribute Name	Tag	VR	Value	Presence of Value	Source
Acquisition Context Sequence	(0040,0555)	SQ		ALWAYS	AUTO
> Include Template			<p><i>"Resting ECG" and "Resting Rhythm":</i></p> <ul style="list-style-type: none"> <li>• DTID (Section 7.1.1) Resting ECG and Resting Rhythm Acquisition Context</li> </ul> <p><i>"Exercise ECG":</i></p> <ul style="list-style-type: none"> <li>• Series #1: DTID (Section 7.1.2) Exercise Stage ECG Acquisition Context</li> <li>• Series #2: DTID (Section 7.1.3) Exercise Rhythm ECG Acquisition Context</li> </ul>		

## 5.4.5 Waveform Annotation Module

Detailed descriptions of the Module are available in [PS 3.3 section C.10.10](#) of the DICOM Standard [1].

Attribute Name	Tag	VR	Value	Presence of Value	Source
Waveform Annotation Sequence	(0040,B020)	SQ		ALWAYS	AUTO
> Include Template			<p><i>"Resting ECG":</i></p> <ul style="list-style-type: none"> <li>• DTID (Section 7.2.1) Resting ECG Waveform Annotations</li> </ul> <p><i>"Resting Rhythm":</i></p> <ul style="list-style-type: none"> <li>• DTID (Section 7.2.2) Resting Rhythm Waveform Annotations</li> </ul> <p><i>"Exercise ECG":</i></p> <ul style="list-style-type: none"> <li>• Series #1: DTID (Section 7.2.3) Exercise Stage ECG Waveform Annotations</li> <li>• Series #2: DTID (Section 7.2.4) Exercise Rhythm Waveform Annotations</li> </ul>		

## 5.5 Attribute Mapping

The relationships between attributes received via Modality Worklist, stored in created SOP instances, and communicated via MPPS are summarized below.

Further information is available in [PS 3.17 section J](#) of the DICOM Standard [1], as well as Appendix A of the IHE Radiology Technical Framework, Volume 2.

Attribute Name	Tag	Modality Worklist	Created SOP Instances	MPPS
Patient's Name	(0010,0010)	Return Key	MWL / USER	IOD
Patient ID	(0010,0020)	Return Key	MWL / USER / AUTO	IOD
Other Patient IDs	(0010,1000)	Return Key	MWL / USER	n/a
Other Patient IDs Sequence	(0010,1002)	Return Key	MWL / USER	n/a
> Patient ID where > Issuer of Patient ID (0010,0021) = "SSN"	(0010,0020)	Return Key	MWL / USER	n/a
> Patient ID where > Issuer of Patient ID (0010,0021) = "ACCT"	(0010,0020)	Return Key	MWL / USER	n/a
Patient's Birth Date	(0010,0030)	Return Key	MWL / USER	IOD
Patient's Sex	(0010,0040)	Return Key	MWL / USER	IOD
Ethnic Group	(0010,2160)	Return Key	MWL / USER	n/a
Patient Comments	(0010,4000)	Return Key	USER / MWL	n/a
Patient's Size	(0010,1020)	Return Key	USER / MWL	n/a
Patient's Weight	(0010,1030)	Return Key	USER / MWL	n/a
Admission ID	(0038,0010)	Return Key	MWL / USER	IOD
Referring Physician's Name	(0008,0090)	Return Key	USER / MWL	n/a
Procedure Code Sequence	(0008,1032)	n/a	MWL (0032,1064) / AUTO	IOD
Study Description	(0008,1030)	n/a	MWL (0032,1060) / AUTO	n/a
Study Instance UID	(0020,000D)	Return Key	MWL / AUTO	IOD
Referenced Study Sequence	(0008,1110)	Not used	NEVER	EMPTY
Accession Number	(0008,0050)	Return Key	MWL / EMPTY	IOD / EMPTY
Requested Procedure Description	(0032,1060)	Return Key	NEVER	EMPTY
Requested Procedure ID	(0040,1001)	Not used	NEVER	EMPTY
Requested Procedure Code Sequence	(0032,1064)	Return Key	NEVER	NEVER
Scheduled Procedure Step Description	(0040,0007)	Not used	NEVER	EMPTY
Scheduled Protocol Code Sequence	(0040,0008)	Not used	NEVER	EMPTY
Scheduled Procedure Step ID	(0040,0009)	Not used	NEVER	EMPTY
Scheduled Performing Physician's Name	(0040,0006)	Return Key	n/a	n/a
Modality	(0008,0060)	n/a	AUTO	IOD
Study ID	(0020,0010)	n/a	AUTO	IOD

Attribute Name	Tag	Modality Worklist	Created SOP Instances	MPPS	
Performed Procedure Step ID	(0040,0253)	n/a	AUTO	IOD	
Performed Procedure Step Start Date	(0040,0244)	n/a	AUTO	IOD	
Performed Procedure Step Start Time	(0040,0245)	n/a	AUTO	IOD	
Performed Procedure Step End Date	(0040,0250)	n/a	AUTO	IOD	
Performed Procedure Step End Time	(0040,0251)	n/a	AUTO	IOD	
Performed Procedure Step Description	(0040,0255)	n/a	MWL (0008,1030) / AUTO	IOD	
Performed Protocol Code Sequence	(0040,0260)	n/a	AUTO	IOD	
Comments on the Performed Procedure Step	(0040,0280)	n/a	USER / n/a	IOD	
Performing Physician's Name	(0008,1050)	n/a	MWL (0040,0006) / USER	Performed Series Seq. (0040,0340)	IOD
Operator's Name	(0008,1070)	n/a	AUTO		IOD
Protocol Name	(0018,1030)	n/a	AUTO		IOD
Series Instance UID	(0020,000E)	n/a	AUTO		IOD
Series Description	(0008,103E)	n/a	AUTO		IOD
Referenced SOP Class UID	(0008,1150)	n/a	Ref. Performed Procedure Step Sequence (0008,1111)	AUTO	n/a
Referenced SOP Instance UID	(0008,1155)	n/a		AUTO	n/a
Affected SOP Class UID	(0000,0002)	n/a		n/a	N-CREATE: IOD (0008,1150) N-SET: n/a
Affected SOP Instance UID	(0000,1000)	n/a		n/a	N-CREATE: IOD (0008,1155) N-SET: n/a
Requested SOP Class UID	(0000,0003)	n/a		n/a	N-CREATE: n/a N-SET: IOD (0008,1150)
Requested SOP Instance UID	(0000,1001)	n/a		n/a	N-CREATE: n/a N-SET: IOD (0008,1155)

## 6 Communications Profiles

### 6.1 Supported Communication Stacks

SCHILLER Modalities provide DICOM V3.0 TCP/IP Network Support as defined in PS 3.8 [1].

#### 6.1.1 TCP/IP Stack

SCHILLER Modalities inherit the TCP/IP stack from the Java virtual machine, and, by default, the underlying platform on which the virtual machine is executing.

#### 6.1.2 Physical Media Support

SCHILLER Modalities are indifferent to the physical medium over which TCP/IP executes; it inherits this from the Java Runtime Environment.

# 7 Coded Terminology and Templates

## 7.1 Acquisition Context Templates

This section specifies any extensions to standard templates and/or any private templates that are used, and defines them. Definitions follow the format for templates specified in [PS 3.16 section 6](#) of the DICOM Standard [1].

The Requirement Type field specifies the presence or absence of the Content Item or included Template.

The following symbols are used:

*M – Mandatory. Will be present.*

*MC – Mandatory Conditional. Will be present if the specified condition is satisfied.*

*U – User Option. May or may not be present.*

*UC – User Option Conditional. May not be present. May be present according to the specified condition.*

Note: There is an interaction between the VM and the Requirement Type with respect to the number of times that a content item (or included Template) may actually be present, as follows:

Req Type	VM	Actual number of occurrences in the content tree
M	1	1
M	1-n	1 to n
U	1	0 or 1
U	1-n	0 to n

The Condition field specifies any conditions upon which presence or absence of the Content Item or its values depends. This field specifies any Concept Name(s) or Values upon which there are dependencies.

The following abbreviations are used:

*XOR = Exclusive OR. One and only one row will be selected from mutually-exclusive options.*

*IF = Will be present if the condition is TRUE; may be present otherwise.*

*IFF = If and only if. Will be present if the condition is TRUE; shall not be present otherwise.*

## 7.1.1 Resting ECG and Resting Rhythm Acquisition Context

The following acquisition context is shared between the Resting ECG and Resting Rhythm IODs.

	VT	Concept Name	VM	Req	Condition	Value Set Constraint
			Type			
1	CODE	EV (10:11345, MDC, "Lead System")*	1	M		DCID (Section 7.3.3) ECG Lead Systems
2	CODE	EV (R-00728, SRT, "Pacemaker in situ")	1	UC	IFF pacemaker is active and reported	EV (G-D30B, SRT, "In progress")
3	NUMERIC	EV (F-008EC, SRT, "Systolic Blood Pressure")	1	U		UNITS = EV (mmHg, UCUM[1.4], "millimeters Hg")
4	NUMERIC	EV (F-008ED, SRT, "Diastolic Blood Pressure")	1	U		UNITS = EV (mmHg, UCUM[1.4], "millimeters Hg")
5	TEXT	EV (G-02D0, SRT, "Regular Medication")	1	U		

\*) Equivalent to EV (5.4.5-33-1, SCPECG[1.3], "Electrode Placement")

## 7.1.2 Exercise Stage ECG Acquisition Context

	VT	Concept Name	VM	Req	Condition	Type	Value Set Constraint
1	CODE	EV (10:11345, MDC, "Lead System")*	1	M			DCID (Section 7.3.3) ECG Lead Systems
2	CODE	EV (R-00728, SRT, "Pacemaker in situ")	1	UC	IFF pacemaker is active and reported		EV (G-D30B, SRT, "In progress")
3	CODE	EV (G-7292, SRT, "Procedure Phase")	1	M			DCID (Section 7.3.7) Exercise ECG Stage Types
4	CODE	EV (113743, DCM, "Patient Orientation")	1	UC	IFF stage type = resting		DCID (Section 7.3.8) Patient Orientation
5	NUMERIC	EV (109055, DCM, "Protocol Stage")	1	M			UNITS = EV ({stage}, UCUM, "stage")
6	NUMERIC	EV (121128, DCM, "Procedure Action Duration")	1	M			UNITS = EV (s, UCUM, "second")
7	NUMERIC	EV (F-031F9, SRT, "Time since start of exam")	1	M			UNITS = EV (s, UCUM, "second")
8	NUMERIC	EV (122702, DCM, "Treadmill Speed")	1	MC	IFF test type = treadmill		UNITS = EV (km/h, UCUM, "km/h") or EV ([mi_i]/h, UCUM, "mph")
9	NUMERIC	EV (122702, DCM, "Treadmill Gradient")	1	MC	IFF test type = treadmill		UNITS = EV (% , UCUM, "%")
10	NUMERIC	EV (122703, DCM, "Ergometer Power")	1	MC	IF test type = bicycle		UNITS = EV (W, UCUM, "Watts")
11	NUMERIC	EV (F-008EC, SRT, "Systolic Blood Pressure")	1	U			UNITS = EV (mmHg, UCUM[1.4], "millimeters Hg")
12	NUMERIC	EV (F-008ED, SRT, "Diastolic Blood Pressure")	1	U			UNITS = EV (mmHg, UCUM[1.4], "millimeters Hg")
13	NUMERIC	EV (122709, DCM, "Activity Workload")	1	UC	IF test type = treadmill		UNITS = EV ([MET], UCUM, "METS")
14	NUMERIC	EV (122706, DCM, "Rating of Perceived Exertion")	1	U			UNITS = EV ({0:10}, UCUM, "range 0:10")
15	NUMERIC	EV (2518-9, LN, "Lactate in arterial blood")	1	U			UNITS = EV (mmol/l, UCUM, "mmol/l")
16	NUMERIC	EV (2:16028, MDC, "Count of VPC beats")	1	U			UNITS = ({beats}, UCUM, "beats")
17	NUMERIC	EV (20564-1, LN, "Blood Oxygen Saturation")	1	U			UNITS = EV (% , UCUM, "%")

\*) Equivalent to EV (5.4.5-33-1, SCPECG[1.3], "Electrode Placement")

### 7.1.2.1 Content Item Descriptions

Row 3	Procedure Phase contains the type of exercise stage reported (resting, baseline, stress, or recovery).
Row 5	Protocol Stage contains the number of the stage within the Procedure Phase (i.e. it starts at 1 within each of the resting, baseline, stress, and recovery phases).
Row 6	Procedure Action Duration contains the total duration of the Protocol Stage.
Row 7	Time since start of exam contains the start of the Protocol Stage within the context of the complete Exercise ECG.
Row 14	Rating of Perceived Exertion is provided in the Borg CR10 scale.
Row 16	Number of VPC beats for the duration of the stage.

## 7.1.3 Exercise Rhythm ECG Acquisition Context

VT	Concept Name	VM	Req	Condition	Type	Value Set Constraint
1	CODE	EV (10:11345, MDC, "Lead System")*	1	M		DCID (Section 7.3.3) ECG Lead Systems
2	CODE	EV (R-00728, SRT, "Pacemaker in situ")	1	UC	IFF pacemaker is active and reported	EV (G-D30B, SRT, "In progress")
3	NUMERIC	EV (F-008EC, SRT, "Systolic Blood Pressure")	1	U		UNITS = EV (mmHg, UCUM[1.4], "millimeters Hg")
4	NUMERIC	EV (F-008ED, SRT, "Diastolic Blood Pressure")	1	U		UNITS = EV (mmHg, UCUM[1.4], "millimeters Hg")
5	TEXT	EV (G-02D0, SRT, "Regular Medication")	1	U		
6	NUMERIC	EV (40443-4, LN, "Resting Heart Rate")	1	U		UNITS = EV ({H.B.}/min, UCUM[1.4], "heart beats per minute")
7	NUMERIC	EV(F-04F92, SRT, "Target HR")	1	U		UNITS = EV ({H.B.}/min, UCUM[1.4], "heart beats per minute")
8	NUMERIC	EV (122716, DCM, "Maximum Power Output Achieved")	1	UC	IF test type = bicycle	UNITS = EV (W, UCUM, "Watts")
9	NUMERIC	EV (122717, DCM, "Peak activity workload")	1	UC	IF test type = treadmill	UNITS = EV ([MET], UCUM, "METS")
10	NUMERIC	EV (F-00E11, SRT, "Maximum Systolic Blood Pressure")	1	U		UNITS = EV (mm[Hg], UCUM, "mmHg")
11	NUMERIC	EV (F-00E21, SRT, "Maximum Diastolic Blood Pressure")	1	U		UNITS = EV (mm[Hg], UCUM, "mmHg")

\*) Equivalent to EV (5.4.5-33-1, SCPECG[1.3], "Electrode Placement")

### 7.1.3.1 Content Item Descriptions

Rows 3 & 4 Blood pressure measurements contain the baseline values in resting state.



## 7.2 Waveform Annotation Templates

This section uses a modified version of the format for templates specified in [PS 3.16 section 6](#) of the DICOM Standard [1]. It uses the same symbols and abbreviations for Requirement Types, Value Multiplicity (VM), and Conditions as described in section 7.1 above.

The Group Number allows multiple annotations to be associated logically, while allowing annotations to be semantically separable. The Group is encoded as Annotation Group Number (0040,A180).

The Value Type field specifies the type of the Content Item as

*“TEXT” – Encoded as Unformatted Text Value (0070,0006), which is mutually exclusive with Concept Name Code Sequence (0040,A043)*  
*“NUMERIC” – Encoded as Numeric Value (0040, A30A) with Measurement Units Code Sequence (0040,08EA)*  
*“CODE” – Encoded as Concept Code Sequence (0040,A168)*  
*“INCLUDE” indicates that the Template specified in the Concept Name field will be included.*

Constraints on the value of the Temporal Range Type (0040,A130) are specified in the Value Set Constraint field. If the constraint is defined, the Referenced Sample Positions (0040,A132) will contain a list of samples within a multiplex group specifying temporal points for annotation.

Modifiers on the code value of the Concept Name Code Sequence (0040,A043) are specified in the Value Set Constraint field. If the constraint is defined, the Modifier Code Sequence (0040,A195) will further describe the semantics of the concept name.

Referenced Waveform Channels (0040,A0B0) contains a list of channels in waveform to which the annotation applies. “00xx” is used to specify that different channels may be defined in each instance of the Content Item.

For complete details of syntax and encoding, please see [PS 3.3 section C.10.10](#) of the DICOM Standard [1].

## 7.2.1 Resting ECG Waveform Annotations

Grp	VT	Concept Name	VM	Req	Condition	Value Set Constraint	Ref WF Channels
0	TEXT	N/A	1-n	U			0001 0000
1	NUMERIC	DCID (Section 7.3.4) ECG Global Measurements	1-n	MC	IFF measurement has a value	UNITS = DCID (Section 7.3.4) ECG Global Measurements	0002 0000
2	CODE	DCID (Section 7.3.5) ECG Position Markers	1-n	MC	IFF marker has a value	TEMPORAL RANGE TYPE = {POINT}	0002 0000
3	CODE	DCID (Section 7.3.5) ECG Position Markers	1-n	MC	IFF marker has a value	TEMPORAL RANGE TYPE = {MULTIPOINT}	0001 0000
4	NUMERIC	DCID (Section 7.3.6) ECG Per-Lead Measurements	1-n	MC	IFF measurement has a value	UNITS = DCID (Section 7.3.6) ECG Per-Lead Measurements	0002 00xx

### 7.2.1.1 Content Item Descriptions

- Group 0* Interpretation Statements referring to all rhythm leads in multiplex group #1. There will be one item per statement.
- Group 1* Global Measurements referring to all median beats in multiplex group #2. There will be one item per measurement.
- Group 2* Global Position Markers referring to all median beats in multiplex group #2. There will be one item per marker and sample position.
- Group 3* Global Rhythm Position Markers, including detected and suppressed pacemaker spikes, referring to all rhythm leads in multiplex group #1. There will be one item per marker with an array of sample positions.
- Group 4* Median Beat Per-Lead Measurements referring to a specified lead in multiplex group #2. There will be one item per lead and measurement.

## 7.2.2 Resting Rhythm Waveform Annotations

Grp	VT	Concept Name	VM	Req	Condition	Value Set Constraint	Ref WF Channels
0	TEXT	N/A	1-n	U			0001 0000

### 7.2.2.1 Content Item Descriptions

- Group 0* Interpretation Statements referring to all rhythm leads in multiplex group #1. There will be one item per statement.

## 7.2.3 Exercise Stage ECG Waveform Annotations

Grp	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint	Ref WF Channels
0-9	INCLUDE	DTID (Section 7.2.1) Resting ECG Waveform Annotations	1	M			

### 7.2.3.1 Content Item Descriptions

*Group 0* Interpretation Statements will contain a summary label for the stage, including the type of stage, the load or power, and time since start of exam.

*Group 1-9* For detailed descriptions, see section 7.2.1.1 above.

## 7.2.4 Exercise Rhythm Waveform Annotations

Grp	VT	Concept Name	VM	Req Type	Condition	Value Set Constraint	Ref WF Channels
0	TEXT	N/A	1-n	U			0001 0000
1	NUMERIC	DCID (Section 7.3.9) Exercise ECG Global Measurements)	1-n	MC	IFF measurement has a value	UNITS = DCID (Section 7.3.9) Exercise ECG Global Measurements)	0001 0000
10	TEXT	N/A	1-n	U			0001 0000

### 7.2.4.1 Content Item Descriptions

*Group 0* Interpretation Statements referring to all rhythm leads for the entire duration of the test in multiplex group #1. There will be one item per statement.

*Group 1* Global Measurements referring to all rhythm leads for the entire duration of the test in multiplex group #1. There will be one item per measurement.

*Group 10* Reasons for stopping test. There will be one item per reason.

## 7.3 Coded Terminology

### 7.3.1 Procedures

Code Value (0008,0100)	Coding Scheme Designator (0008,0102)	Code Meaning (0008,0104)	System generated Study Description (0008,1030)	Equivalent SNOMED CT Code Value
P2-3120A	SRT	12 lead ECG	RestingECG	268400002
P2-31001	SRT	Rhythm ECG	RestingRhythm	70878000
P2-31600	SRT	Signal-averaged ECG	SaECG	33442008
P2-31010	SRT	Exercise ECG	ExerciseECG	46136006
P0-00FBB	SRT	Cardiopulmonary exercise test	ErgoSpirometry	447346005
P2-25101	SRT	Spirometry	Spirometry	127783003
P5-B0512	SRT	Total body plethysmography	Bodyplethysmography	28275007
P2-26210	SRT	Diffusion capacity	Diffusion	87529006
P2-25300	SRT	Airway resistance	Resistance	44236004
P2-31009	SRT	Ambulatory ECG	HolterECG	164850009
P2-30103	SRT	Ambulatory BPM	HolterBloodpressure	164783007
P2-3032D	SRT	Advanced cardiopulmonary resuscitation	Rescue	428805003
P0-00000	SRT	Unspecified procedure	Unknown	71388002

## 7.3.2 ECG Leads

From Baseline Context [CID 3001 \(PS 3.16\)](#) – [ECG lead identifiers](#) of ISO/IEEE 11073-10101 [2].

Code Value (0008,0100)	Coding Scheme Designator (0008,0102)	Code Meaning (0008,0104)	Description	Equivalent SCPECG[1.3] Code Value
2:1	MDC	I	Lead I	5.6.3-9-1
2:2	MDC	II	Lead II	5.6.3-9-2
2:61	MDC	III	Lead III	5.6.3-9-61
2:62	MDC	aVR	Lead aVR	5.6.3-9-62
2:63	MDC	aVL	Lead aVL	5.6.3-9-63
2:64	MDC	aVF	Lead aVF	5.6.3-9-64
2:3	MDC	V1	Lead V1	5.6.3-9-3
2:4	MDC	V2	Lead V2	5.6.3-9-4
2:5	MDC	V3	Lead V3	5.6.3-9-5
2:6	MDC	V4	Lead V4	5.6.3-9-6
2:7	MDC	V5	Lead V5	5.6.3-9-7
2:8	MDC	V6	Lead V6	5.6.3-9-8
2:9	MDC	V7	Lead V7	5.6.3-9-9
2:66	MDC	V8	Lead V8	5.6.3-9-66
2:67	MDC	V9	Lead V9	5.6.3-9-67
2:11	MDC	V3R	Lead V3R	5.6.3-9-11
2:12	MDC	V4R	Lead V4R	5.6.3-9-12
2:13	MDC	V5R	Lead V5R	5.6.3-9-13
2:14	MDC	V6R	Lead V6R	5.6.3-9-14
2:70	MDC	D	Lead D (Nehb – Dorsal)	5.6.3-9-70
2:71	MDC	A	Lead A (Nehb – Anterior)	5.6.3-9-71
2:72	MDC	J	Lead J (Nehb – Inferior)	5.6.3-9-72
2:16	MDC	X	Lead X (Frank or orthogonal)	5.6.3-9-16
2:17	MDC	Y	Lead Y (Frank or orthogonal)	5.6.3-9-17
2:18	MDC	Z	Lead Z (Frank or orthogonal)	5.6.3-9-18
2:75	MDC	A1	Auxiliary unipolar lead #1 (placement anywhere, EX4)	5.6.3-9-75

## 7.3.3 ECG Lead Systems

From Baseline Context [CID 3263 \(PS 3.16\)](#) – [ECG lead systems](#) of ISO/IEEE 11073-10101 [2].

Code Value (0008,0100)	Coding Scheme Designator (0008,0102)	Code Meaning (0008,0104)	Equivalent SCPECG[1.3] Code Value
	<i>SCHILLER ID</i>	<i>SCHILLER Description</i>	<i>Included Leads</i>
10:11264	MDC	Unspecified 12-lead	5.4.5-33-1-0
	<i>lcNotDef</i>	<i>Undefined 12-lead</i>	<i>I,II,III,aVR,aVL,aVF,V1,V2,V3,V4,V5,V6,NaVR</i>
10:11265	MDC	Standard 12-lead	5.4.5-33-1-1
	<i>lcStandard</i>	<i>Standard 12-lead</i>	<i>I,II,III,aVR,aVL,aVF,V1,V2,V3,V4,V5,V6</i>
10:11270	MDC	Non-standard 12-lead	5.4.5-33-1-0
	<i>lcExtRPREC</i>	<i>Standard 12-lead with V4R</i>	<i>I,II,III,aVR,aVL,aVF,V1,V2,V3,V4R,V5,V6</i>
	<i>lcExtRPRECChld</i>	<i>Pediatric 12-lead</i>	<i>I,II,III,aVR,aVL,aVF,V7,V2,V3R,V4R,V5,V6</i>
	<i>lcExtRPRECFull</i>	<i>Right Precordials 12-lead</i>	<i>I,II,III,aVR,aVL,aVF,V1,V2,V3R,V4R,V5R,V6R</i>
	<i>lcExtLPostFull</i>	<i>Left Posterior 12-lead</i>	<i>I,II,III,aVR,aVL,aVF,V4,V5,V6,V7,V8,V9</i>
10:11280	MDC	Nehb	5.4.5-33-1-0
	<i>lcLimbNehb</i>	<i>Nehb (Chest)</i>	<i>I,II,III,aVR,aVL,aVF,D,A,J</i>
10:11274	MDC	Frank XYZ	5.4.5-33-2-1
	<i>lcLimbXYZFrank</i>	<i>XYZ (Frank orthogonal)</i>	<i>I,II,III,aVR,aVL,aVF,X,Y,Z</i>
10:11277	MDC	Bipolar XYZ	5.4.5-33-2-4
	<i>lcLimbXYZBipolar</i>	<i>XYZ (Frank bipolar)</i>	<i>I,II,III,aVR,aVL,aVF,X,Y,Z</i>
10:11287	MDC	Standard 12-lead and Nehb	5.4.5-33-1-0
	<i>lcStdNehb</i>	<i>Standard 12-lead + Nehb</i>	<i>I,II,III,aVR,aVL,aVF,V1,V2,V3,V4,V5,V6,D,A,J</i>
10:11286	MDC	Standard 12-lead and XYZ	5.4.5-33-1-0
	<i>lcStdXYZDerived</i>	<i>Standard 12-lead + XYZ (derived)</i>	<i>I,II,III,aVR,aVL,aVF,V1,V2,V3,V4,V5,V6,X,Y,Z</i>
	<i>lcStdXYZBipolar</i>	<i>Standard 12-lead + XYZ (bipolar)</i>	<i>I,II,III,aVR,aVL,aVF,V1,V2,V3,V4,V5,V6,X,Y,Z</i>
	<i>lcStdXYZFrank</i>	<i>Standard 12-lead + XYZ (orthogonal)</i>	<i>I,II,III,aVR,aVL,aVF,V1,V2,V3,V4,V5,V6,X,Y,Z</i>
10:11291	MDC	Standard 12-lead Extended Right	5.4.5-33-1-0
	<i>lcStdRPREC</i>	<i>Standard 12-lead + Right Precordials</i>	<i>I,II,III,aVR,aVL,aVF,V1,V2,V3,V4,V5,V6,V3R,V4R,V5R</i>
10:11292	MDC	Standard 12-lead Extended Left	5.4.5-33-1-0
	<i>lcStdLPost</i>	<i>Standard 12-lead + Left Posterior</i>	<i>I,II,III,aVR,aVL,aVF,V1,V2,V3,V4,V5,V6,V7,V8,V9</i>
10:11290	MDC	Standard 12-lead Extended	5.4.5-33-1-0
	<i>lcStdRPRECChld</i>	<i>Standard 12-lead + Pediatric</i>	<i>I,II,III,aVR,aVL,aVF,V1,V2,V3,V4,V5,V6,V3R,V4R,V7</i>
	<i>lcStdNehbEX4</i>	<i>Standard 12-lead + Nehb + EX4</i>	<i>I,II,III,aVR,aVL,aVF,V1,V2,V3,V4,V5,V6,D,A,J,A1</i>
	<i>lcStdRPRECPost</i>	<i>Standard 12-lead + Balanced</i>	<i>I,II,III,aVR,aVL,aVF,V1,V2,V3,V4,V5,V6,V3R,V4R,V8,V9</i>
	<i>lcStdRPRECEx4</i>	<i>Standard 12-lead + Right Precordials + EX4</i>	<i>I,II,III,aVR,aVL,aVF,V1,V2,V3,V4,V5,V6,V3R,V4R,V5R,A1</i>
	<i>lcStdRPRECv6R</i>	<i>Standard 12-lead + Right Precordials Full</i>	<i>I,II,III,aVR,aVL,aVF,V1,V2,V3,V4,V5,V6,V3R,V4R,V5R,V6R</i>
	<i>lcStdRPRECChldEX4</i>	<i>Standard 12-lead + Pediatric + EX4</i>	<i>I,II,III,aVR,aVL,aVF,V1,V2,V3,V4,V5,V6,V3R,V4R,V7,A1</i>
	<i>lcStdLPostEX4</i>	<i>Standard 12-lead + Left Posterior + EX4</i>	<i>I,II,III,aVR,aVL,aVF,V1,V2,V3,V4,V5,V6,V7,V8,V9,A1</i>

## 7.3.4 ECG Global Measurements

Code Value (0008,0100)	Coding Scheme Designator (0008,0102)	Code Meaning (0008,0104)	Unit of Measurement	Equivalent SCPECG[1.3] Code Value
<i>From Baseline Template <a href="#">TID 3713 (PS 3.16)</a> – <a href="#">ECG global measurements</a> of ISO/IEEE 11073-10101 [2]</i>				
2:16016	MDC	Ventricular Heart Rate	({H.B.}/min, UCUM[1.4], “heart beats per minute”)	5.10.2.5-1
2:16020	MDC	Atrial Heart Rate	({H.B.}/min, UCUM[1.4], “heart beats per minute”)	5.10.2.5-3
<i>From Baseline Context <a href="#">CID 3228 (PS 3.16)</a> – <a href="#">ECG global waveform durations</a> of ISO/IEEE 11073-10101 [2]</i>				
2:16168	MDC	RR Interval	(ms, UCUM[1.4], “millisecond”)	5.10.2.1-3
2:16140	MDC	PP Interval	(ms, UCUM[1.4], “millisecond”)	5.10.2.1-5
2:16184	MDC	P Duration	(ms, UCUM[1.4], “millisecond”)	5.13.5-5
2:15872	MDC	PR Interval	(ms, UCUM[1.4], “millisecond”)	5.13.5-7
2:16156	MDC	QRS Duration	(ms, UCUM[1.4], “millisecond”)	5.13.5-9
2:16160	MDC	QT Interval	(ms, UCUM[1.4], “millisecond”)	5.13.5-11
<i>From Baseline Context <a href="#">CID 3227 (PS 3.16)</a> – <a href="#">ECG global corrected QT measurements</a> of ISO/IEEE 11073-10101 [2]</i>				
2:16164	MDC	QTc Interval (Bazett)	(ms, UCUM[1.4], “millisecond”)	5.10.2.5-5
2:15880	MDC	QTc interval using Bazett	(ms, UCUM[1.4], “millisecond”)	n/a
2:15884	MDC	QTc interval using Framingham	(ms, UCUM[1.4], “millisecond”)	n/a
2:15892	MDC	QTc interval using Fredericia	(ms, UCUM[1.4], “millisecond”)	n/a
2:15888	MDC	QTc interval using Hodges	(ms, UCUM[1.4], “millisecond”)	n/a
<i>From Baseline Context <a href="#">CID 3229 (PS 3.16)</a> – <a href="#">ECG global axis measurements</a> of ISO/IEEE 11073-10101 [2]</i>				
2:16128	MDC	P Axis	(deg, UCUM[1.4], “degree”)	5.10.3-11
2:16132	MDC	QRS Axis	(deg, UCUM[1.4], “degree”)	5.10.3-13
2:16136	MDC	T Axis	(deg, UCUM[1.4], “degree”)	5.10.3-15
<i>From <a href="#">ECG rhythm annotations</a> of ISO/IEEE 11073-10101 [2]</i>				
10:9456	MDC	Atrial Flutter	(%, UCUM[1.4], “percent”)	D.3.2.6-AFLT
<i>From SNOMED RT</i>				
F-04C6C	SRT	Cardiac Pacing Rate	(1/10 /min, UCUM[1.4], “1/10 /minute”)	n/a

## 7.3.5 ECG Position Markers

From Baseline Context [CID 3335 \(PS 3.16\)](#) – [ECG waveform components](#) of ISO/IEEE 11073-10101 [2].

Code Value (0008,0100)	Coding Scheme Designator (0008,0102)	Code Meaning (0008,0104)	Description	Equivalent SCPECG[1.3] Code Value
10:4096	MDC	Pacemaker spike		5.10.1.2
10:260	MDC	P wave onset		5.10.3-1
10:261	MDC	P wave offset		5.10.3-2
10:1604	MDC	QRS wave onset	Fiducial Point	5.10.3-3
10:1605	MDC	QRS wave offset		5.10.3-4
10:1029	MDC	T wave offset		5.10.3-5

## 7.3.6 ECG Per-Lead Measurements

Code Value (0008,0100)	Coding Scheme Designator (0008,0102)	Code Meaning (0008,0104)	Unit of Measurement	Equivalent SCPECG[1.3] Code Value
<i>From Baseline Context <a href="#">CID 3687 (PS 3.16)</a> – <a href="#">ECG per-lead waveform durations</a> of ISO/IEEE 11073-10101 [2]</i>				
2:6656	MDC	P wave duration	(ms, UCUM[1.4], "millisecond")	5.13.5-5
2:32768	MDC	PP interval	(ms, UCUM[1.4], "millisecond")	5.10.2.1-5
2:7168	MDC	PR interval	(ms, UCUM[1.4], "millisecond")	5.13.5-7
2:7680	MDC	Q wave duration	(ms, UCUM[1.4], "millisecond")	5.13.5-13
2:7936	MDC	QRS complex duration	(ms, UCUM[1.4], "millisecond")	5.13.5-9
2:11264	MDC	R1 wave duration	(ms, UCUM[1.4], "millisecond")	5.13.5-15
2:33024	MDC	RR interval	(ms, UCUM[1.4], "millisecond")	5.10.2.1-3
2:11520	MDC	R2 wave duration	(ms, UCUM[1.4], "millisecond")	5.13.5-19
2:11776	MDC	R3 wave duration	(ms, UCUM[1.4], "millisecond")	n/a
2:12032	MDC	S1 wave duration	(ms, UCUM[1.4], "millisecond")	5.13.5-17
2:12288	MDC	S2 wave duration	(ms, UCUM[1.4], "millisecond")	5.13.5-21
2:12544	MDC	S3 wave duration	(ms, UCUM[1.4], "millisecond")	n/a
2:8192	MDC	QT interval	(ms, UCUM[1.4], "millisecond")	5.13.5-11
2:8448	MDC	QTc interval (Bazett)	(ms, UCUM[1.4], "millisecond")	5.10.2.5-5
2:34048	MDC	QTc interval using Bazett formula	(ms, UCUM[1.4], "millisecond")	n/a
2:34304	MDC	QTc interval using Fredericia formula	(ms, UCUM[1.4], "millisecond")	n/a
2:11008	MDC	Ventricular activation time	(ms, UCUM[1.4], "millisecond")	5.13.5-53
<i>From Baseline Context <a href="#">CID 3688 (PS 3.16)</a> – <a href="#">ECG per-lead waveform amplitudes</a> of ISO/IEEE 11073-10101 [2]</i>				
2:1024	MDC	J point amplitude	(uV, UCUM[1.4], "microvolt")	5.13.5-33
2:14848	MDC	J point + 20 ms amplitude	(uV, UCUM[1.4], "microvolt")	5.13.5-57
2:15104	MDC	J point + 40 ms amplitude	(uV, UCUM[1.4], "microvolt")	n/a
2:14336	MDC	J point + 60 ms amplitude	(uV, UCUM[1.4], "microvolt")	5.13.5-59
2:14592	MDC	J point + 80 ms amplitude	(uV, UCUM[1.4], "microvolt")	5.13.5-61
2:1280	MDC	Maximum P wave amplitude	(uV, UCUM[1.4], "microvolt")	5.13.5-35
2:1536	MDC	Minimum P wave amplitude	(uV, UCUM[1.4], "microvolt")	5.13.5-37
2:1792	MDC	Q wave amplitude	(uV, UCUM[1.4], "microvolt")	5.13.5-23
2:12800	MDC	R1 wave amplitude	(uV, UCUM[1.4], "microvolt")	5.13.5-25
2:13056	MDC	R2 wave amplitude	(uV, UCUM[1.4], "microvolt")	5.13.5-29
2:13312	MDC	R3 wave amplitude	(uV, UCUM[1.4], "microvolt")	n/a
2:13568	MDC	S1 wave amplitude	(uV, UCUM[1.4], "microvolt")	5.13.5-27
2:13824	MDC	S2 wave amplitude	(uV, UCUM[1.4], "microvolt")	5.13.5-31
2:14080	MDC	S3 wave amplitude	(uV, UCUM[1.4], "microvolt")	n/a
2:2560	MDC	Maximum T wave amplitude	(uV, UCUM[1.4], "microvolt")	5.13.5-39
2:2816	MDC	Minimum T wave amplitude	(uV, UCUM[1.4], "microvolt")	5.13.5-41
<i>From Baseline Context <a href="#">CID 3335 (PS 3.16)</a> – <a href="#">ECG waveform components</a> of ISO/IEEE 11073-10101 [2]</i>				
10:1282	MDC	I wave duration	(ms, UCUM[1.4], "millisecond")	5.13.5-49
10:1346	MDC	K wave duration	(ms, UCUM[1.4], "millisecond")	5.13.5-51



## 7.3.7 Exercise ECG Stage Types

Code Value (0008,0100)	Coding Scheme Designator (0008,0102)	Code Meaning (0008,0104)	Description
<i>From Baseline Context <a href="#">CID 3207 (PS 3.16)</a></i>			
F-01604	SRT	Resting state	Resting (incl. 7.3.8 Patient Orientation)
F-01602	SRT	Baseline state	Warm-up
F-05019	SRT	Cardiac stress state	Work
F-05018	SRT	Cardiac stress recovery state	Recovery

## 7.3.8 Patient Orientation

Code Value (0008,0100)	Coding Scheme Designator (0008,0102)	Code Meaning (0008,0104)	Description
<i>From Baseline Context <a href="#">CID 20 (PS 3.16)</a></i>			
F-10340	SRT	supine	
F-103A0	SRT	sitting	
F-10320	SRT	standing	

## 7.3.9 Exercise ECG Global Measurements

Code Value (0008,0100)	Coding Scheme Designator (0008,0102)	Code Meaning (0008,0104)	Unit of Measurement
<i>From Baseline Template <a href="#">TID 3312 (PS 3.16)</a></i>			
F-04FA6	SRT	Maximum HR Achieved	({H.B.}/min, UCUM, "BPM")
F-04FA6	SRT	Maximum HR Achieved	(%, UCUM, "%")
122718	DCM	Peak Double Product	(mm[Hg]{HB})/min, UCUM, "mmHg*BPM")
F-031F8	SRT	Total Exercise duration	(min, UCUM, "min")
F-031F7	SRT	Total Test duration	(min, UCUM, "min")

## 8 Extensions/Privatizations

Not applicable.

## 9 Configuration

Not applicable.