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Informatique de santé — Communication entre dispositifs médicaux sur le site des soins

Partie 10102: Nomenclature — ECG annoté

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— *Part 00103: Overview*

— *Part 10101: (Point-of-care medical device communication) Nomenclature*

— *Part 10102: (Point-of-care medical device communication) Nomenclature — Annotated ECG*

— *Part 10103: (Point-of-care medical device communication) — Nomenclature — Implantable device, cardiac*

— *Part 10201: (Point-of-care medical device communication) Domain information model*

— *Part 10404: Device specialization — Pulse oximeter*

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— *Part 10406: Device specialization — Basic electrocardiograph (ECG) (1- to 3-lead ECG)*

— *Part 10407: Device specialization — Blood pressure monitor*

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Abstract: The base IEEE 11073-10101 Nomenclature is extended by this standard to provide support for ECG annotation terminology. It may be used either in conjunction with other IEEE 11073 standards (e.g., ISO/IEEE 11073-10201:2001) or independently with other standards. The major subject areas addressed by the nomenclature include ECG beat annotations, wave component annotations, rhythm annotations, and noise annotations. Additional "global" and "per-lead" numeric observation identifiers, ECG lead systems, and additional ECG lead identifiers also are defined.

Keywords: annotated ECG, annotations, arrhythmias, cardiac rhythm, codes, ECG leads, ECG lead systems, ECG measurements, home monitoring, IEEE 11073-10102™, medical device communication, nomenclature, pacemaker, patient monitoring, remote monitoring, terminology

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Introduction

This introduction is not part of IEEE Std 11073-10102-2012, Health informatics—Point-of-care medical device communication—Nomenclature—Annotated ECG.

This standard extends the base ISO/IEEE 11073-10101:2004[a] nomenclature to provide support for electrocardiogram (ECG) annotation terminology. The major subject areas addressed by the nomenclature include ECG beat annotations, wave component annotations, rhythm annotations, and noise annotations. It also defines additional "global" and "per-lead" numeric observation identifiers, ECG lead systems, and additional ECG lead identifiers. The nomenclature extensions may be used in conjunction with other IEEE 11073 standard components (e.g., ISO/IEEE 11073-10201:2004 [B19][b]) or independently with other standards.

[a] Information on references can be found in Clause 2.
[b] The numbers in brackets correspond to those in the bibliography in Annex E.

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Part 10102: Nomenclature—Annotated ECG

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1. Overview

1.1 Scope

This standard extends the base ISO/IEEE 11073-10101:2004[1] to provide support for ECG annotation terminology. Major subject areas addressed by the nomenclature include ECG beat annotations, wave component annotations, rhythm annotations, and noise annotations. It also defines additional "global" and "per-lead" numeric observation identifiers, ECG lead systems, and additional ECG lead identifiers. The nomenclature extensions may be used in conjunction with other IEEE 11073 standard components (e.g., ISO/IEEE 11073-10201:2004 [B19][2]) or independently with other standards.

1.2 Purpose

This standard provides a unified and comprehensive terminology for ECG annotation semantics, making it suitable for medical device data exchange that requires inclusion of ECG annotations. This standard consolidates numerous other standard and nonstandard terminologies that are in current use, resulting in the harmonization of how ECG annotation information is identified, enabling interoperability, and providing information exchange at the application level.

[1] Information on references can be found in Clause 2.
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Currently, many terminologies and protocols, both standard and vendor specific, are used to manage and exchange ECG annotation information. As a result, protocol converters and translators are required to integrate systems and applications, typically with some degree of semantic loss and noninteroperability. This standard provides a single terminology that is capable of supporting applications that require ECG annotations, including evaluation of patient condition (e.g., reviewing ECG data at the point-of-care or remotely) as well as clinical research (e.g., electronically submitting clinical drug trial evidence supporting the efficacy of a new medication). In addition to incorporating ECG annotations into an ISO/IEEE 11073-based information stream acquired at the bedside, the underlying nomenclature can also be used in other persistent and communication standards [e.g., Health Level Seven International (HL7) V2 and V3, and Digital Imaging and Communications in Medicine (DICOM)] for use by various applications, including clinical information systems, electronic patient records, and clinical research.

1.3 Audience

The audience for this document is those who work with monitoring and diagnostic ECG information in the context of systems integration. This may include but is not limited to the following roles:

— Cardiologist or electrophysiologist physicians

— Heart and device clinic specialists or staff

— Primary care physicians

— Clinic information technologists

— Clinic information system vendor engineers

— Academic and clinical research scientists

— Regulatory and quality management agencies

— Clincal trial and research results reporting

— Medical device and system development engineers

The following clinical applications are facilitated by this interoperability enabled by this standard. This may include but is not limited to the following activities:

— Clinical trial and research results reporting [HL7 annotated electrocardiogram (aECG), Clinical Data Interchange Standards Consortium (CDISC), and others]

— Transfer of ECG data in an interoperable manner [DICOM, HL7, IEEE 11073, Integrating the Healthcare Enterprise Patient Care Devices (IHE PCD), and other communication protocols]

— Algorithm development and performance evaluation

— Sophisticated real-time data exchange with option to retrospectively review and correct data

1.4 Context

This nomenclature has been developed within the context of the broader ISO/IEEE 11073 Health Informatics—Point-of-Care Medical Device Communication standards. Its goal is to be consistent with existing 11073 standards and information models.

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2. Normative references

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ANSI/AAMI EC71-2001, Standard Communications Protocol for Computer Assisted-Electrocardiography.[3]

ISO/IEEE 11073-10101:2004, Health informatics—Point-of-care medical device communication—Part 10101: Nomenclature.[4]

3. Definitions, acronyms, and abbreviations

3.1 Definitions

For the purposes of this document, the following terms and definitions apply. The *IEEE Standards Dictionary Online* should be consulted for terms not defined in this clause.[5]

annotation: An observation made on or associated with a time series of events, typically at a specific point in time or over an interval of time.

arrhythmia: Any abnormality of cardiac rhythm. Also termed "dysrhythmia." Specific examples are bradycardia, tachycardia, and ventricular fibrillation.

base term: A fundamental semantic concept.

cardiac monitor: A device that acquires and analyzes the electrical waveforms of the cardiovascular system for measurement, display, and treatment.

cardiologist: Physician specializing in disorders of the heart.

co-constraint: A rule describing a constraint whose scope is inclusive of more than one term.

constraint: A restriction on the set of values being assigned.

control variable: In this nomenclature, an attribute that specifies some aspect of a device configuration, setting, or the observation method.

discriminators: A mechanism to provide additional semantic refinement to multiple base terms.

domain information model (DIM): The model describing common concepts and relationships for a problem domain.

[3] ANSI publications are available from the American National Standards Institute (http://www.ansi.org/).
[4] ISO/IEC publications are available from the ISO Central Secretariat (http://www.iso.org/). ISO publications are also available in the United States from the American National Standards Institute (http://www.ansi.org/).
[5] The *IEEE Standards Dictionary Online* subscription is available at http://www.ieee.org/portal/innovate/products/standard/standards_dictionary.html.

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electrocardiogram (ECG): (**A**) A set of cardiac waveforms (leads) acquired over a contiguous period of time. (**B**) Traditionally 12 waveforms (leads) representing 10 s of cardiac activity while the patient is lying on his or her back at rest. It is the physical or electronic record of the patient's cardiac activity produced by an electrocardiograph.

electrocardiograph: A device that records the electrical activity of the patient's heart by tracing voltage versus time waveforms, either on paper or digitally.

electronic health records: A longitudinal collection of electronic health information about individual patients or populations. It is a record in digital format that is capable of being shared within or across different health care settings by being embedded in network-connected enterprise-wide information system.

electrophysiologist: A physician with advanced study of the electrical properties of the heart.

lead: A vector along which the heart's electrical activity is recorded as a waveform, either as a single "unipolar" lead with respect to a common reference voltage or as a "bipolar" lead that represents the voltage difference measured at two different sites.

nomenclature: A set of names or terms comprising a taxonomy for a specific domain.

pacemaker: A small, battery-powered electrical impulse generator which is implanted in patients to support or maintain heart rate. External pacemakers, typically used in a hospital setting, are also supported by this nomenclature.

reference ID (REFID): A unique, symbolic, and programmatic form for the term. The form is correlated to the context-free code (i.e., titles are by definition context-free with respect to all other titles); in this standard, terms are typically prefixed with "MDC_ECG_" for consistency.

rhythm disturbance: An irregular heart beat or sequence of beats.

systematic name: An organization of differentiating, relational descriptors that are unique for each term.

terminology: A synonym for nomenclature.

3.2 Acronyms and abbreviations

aECG	annotated electrocardiogram
CDISC	Clinical Data Interchange Standards Consortium
DICOM	Digital Imaging and Communications in Medicine
DIM	domain information model
ECG	electrocardiogram
HL7	Health Level Seven
ID	identifier
IDC	implantable device cardiac
IDCO	implantable device cardiac observation
IHE PCD	Integrating the Healthcare Enterprise Patient Care Devices
MDC	medical device communication
REFID	IEEE 11073 reference identifier

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4. Introduction to IEEE Std 11073-10102

The key objectives of this standard are as follows:

— Define a set of annotation mnemonics to describe beat, wave component, rhythm, and noise annotations to support detailed beat-by-beat information about the electrocardiogram.

— Extend the existing IEEE 11073-10101 ECG lead identifiers, including the ability to indicate "derived" leads for every "original" ECG lead.

— Extend the existing IEEE 11073-10101 "per-lead" and "global" ECG measurement identifiers to support the capabilities of contemporary 12-lead ECG analysis algorithms.

— Add additional semantic concept groups the define ECG lead systems (predefined configurations of multiple ECG leads) and control variables that specify ECG signal filter characteristics.

— Where possible, the nomenclature definitions should also support the following:

1) Cardiologist-friendly labels, compatible with present-day cardiac nomenclature conventions, that can be used by clinicians when reviewing or editing annotated waveforms. These should leverage existing nomenclatures, where appropriate.

2) ISO/IEEE 11073-10101 "programmer-friendly" reference identifiers, following existing 11073 labeling conventions wherever possible, and assigning numeric codes to each.

3) Equivalent mappings, where possible, with existing annotated databases and tools, such as the MIT-BIH and PhysioNet annotated ECG databases.

The principal focus is beat and rhythm annotation, scalable from single-lead to 12-lead analysis, applicable to standard and advanced 12-lead ECG, Holter, and patient monitoring applications. In other words, this work extends the concepts typically used to describe simple rhythm monitoring to how a cardiologist would annotate a continuous 12-lead ECG record.

4.1 Clinical background

Millions of people experience irregular heartbeats at some point in their lives. Some of these irregularities may be due to cardiac rhythm disturbances (arrhythmias). Some arrhythmias are determined by medical professionals to be relatively benign, whereas other arrhythmias can be associated with variable degrees of clinical risk. There are certain more extreme cardiac rhythm disturbances that may be dangerous or even fatal.

Arrhythmias are caused by disorders of the heart's electrical system, which in a healthy state would function to help coordinate synchronous and mechanically advantageous electrical activation of the cardiac muscle. In the case of a cardiac arrhythmia, the heart rhythm may be too slow, too fast, or otherwise chaotic; in some instances, different portions of the heart are activated in a dyssynchronous manner. In any of these instances, functional efficiency of the heart suffers and cardiac performance may be significantly impaired.

One of the first steps in monitoring patients who exhibit arrhythmias is to obtain the ECG signal using an electrocardiograph to acquire a short-term (typically 10 s) electrocardiogram or acquiring the signal over several days using a Holter recorder and analyzing it later on. An event recorder can also be used to acquire and analyze the data and to save arrhythmia episodes considered important by the device's algorithms. More modern systems can combine long-term recording and real-time analysis and can upload the

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information to a monitoring service, effectively combining the roles of real-time patient monitoring and sophisticated analysis and review of the data.

Central to these applications is the accuracy of the algorithms used to detect and classify ECG beats and rhythms. One of the most effective ways of documenting the algorithm output is to record each beat and rhythm detected by the algorithm, since this information provides the clinician (as well as the algorithm developer) a clear and unambiguous record of the analysis. The "beat-by-beat" and "rhythm-by-rhythm" representation also can support powerful "retrospective" review and editing tools that can enhance the accuracy of the final summary report. The corrections made on a retrospective data set can also be used to "prospectively" reduce the likelihood making the same error in the future in a real-time monitoring system.

The goal of this nomenclature extension is to provide a standard nomenclature for ECG beats, rhythms, and advanced diagnostic ECG measurements suitable for traditional 12-lead ECG analysis as well as for systems that acquire and analyze a smaller number of leads. It extends the nomenclature developed for earlier annotated data sets (e.g., MIT-BIH) by defining codes for more than 35 different beat types and more than 75 rhythms, commensurate with advanced 12-lead diagnostic ECG acquisition and analysis, acquired in the context of a traditional resting, stress, monitoring, telemetry, or long-term ambulatory ECG. Figure 1 illustrates several of these ECG nomenclature components.

Alternatively stated, a very strong attempt has been made to extend the existing terminology defined by ISO/IEEE 11073-10101:2004, ANSI/AAMI EC71-2001 [B7], and other standards to provide the message semantics required to support advanced 12-lead ECG, short of defining a standardized terminology and grammar for the summary diagnostic statement.

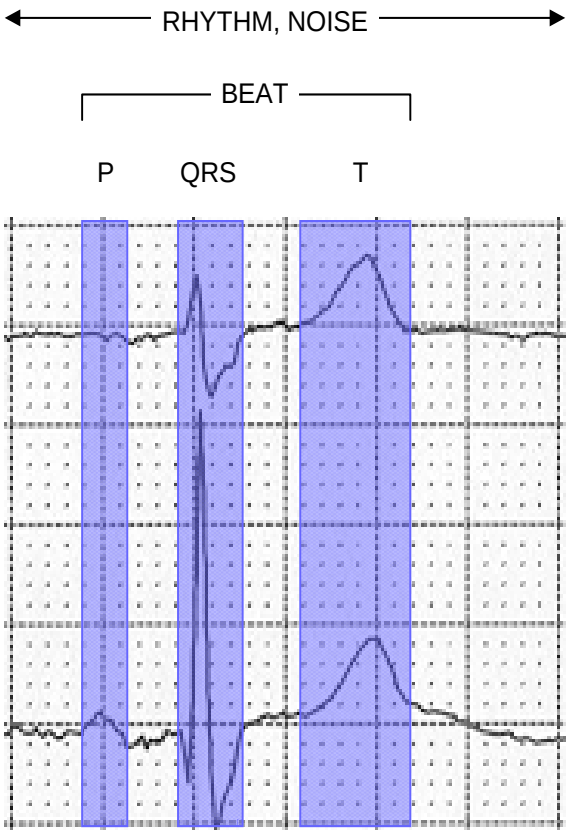

Figure 1—ECG rhythm, noise, beat, and wave components

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5. Nomenclature requirements

5.1 Overview

The nomenclature in this standard defines normative text identifiers and numeric code identifiers for labeling electrocardiographic data. Requirements are defined by subject domain and industry experts.

The requirements for the nomenclature fall into multiple categories, as follows:

— The scope of the nomenclature

— The organizational structure of the nomenclature

— The semantics of the nomenclature

5.2 Scope requirements

The following requirements regarding the scope and content of the standard were used:

— Level of detail shall be summary information as specified and understood by subject domain experts

— Shall only define terms that are common across domain

— Shall allow for specific vendor enumerations of terms, if needed

5.3 Organizational structure requirements

The following requirements regarding the organization structure of the standard were used:

— Term identifiers shall be organized in a consistent hierarchical classification scheme

— Terms should be organized to minimize the need for postcoordination of multiple terms to define commonly used observation identifiers or concepts

5.4 Semantic requirements

The following requirements regarding the semantic definitions were used:

— Domain and industry experts will discuss and define term semantic requirements.

5.5 Distribution format requirements

The following requirements regarding the distribution format were used:

— The nomenclature shall be made available in a computable representation to facilitate incorporation into protocols, devices, systems, and message conformance test tools.

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6. Nomenclature structure

The nomenclature in this standard is structured based on a hierarchical taxonomy. The base root node is MDC_ECG, which is short for Medical Device Communication—ECG. The MDC_ECG nomenclature term codes are assigned numeric codes that extend the existing set of ECG terms in the ISO/IEEE 11073 SCADA partition [PART=2] as well in a new partition [PART=10] allocated for advanced ECG terms.

The principal MDC_ECG terminology groups are listed in Table 1.

Discriminators are used to provide additional semantic refinement that can be applied to multiple terms. Discriminators are used to manage complexity within the nomenclature hierarchy and to promote uniformity of like-kind detailed semantic concepts.

A term is uniquely identified by a Reference ID, Systematic Name, and Code according to the scheme described in ISO/IEEE 11073-10101:2004. A term's Reference ID consists of following a sequential path through the nomenclature hierarchy from the root semantic concept to a leaf semantic concept. Each node on this path becomes a component of the term's Reference ID and Systematic Name, and it appropriately represents the semantic of the term.

After expanding all discriminators, a unique numeric code [CODE10] is assigned to each term from a 16-bit partition [PART] in which the term resides. A 32-bit "context free" numeric code [CF_CODE10] for each term is calculated by computing the sum of (65536 × PART) + CODE10 + any applicable discriminators.

7. Conformance

Conformance to definitions in this standard is specified primarily at the appropriate application or system interface. It is expected that this standard will be referenced by other healthcare systems integration standards or profiles that define specific applications of the nomenclature.

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Table 1—Principal MDC_ECG terminology groups

Top level	Terminology groups
MDC_ECG_**LEAD**_	**ECG leads** (implemented as an eight-bit discriminator)
MDC_ECG_**WAVC**_	**ECG wave components** Normal wave components Composite wave components Abnormal wave components Segments ST measurement Miscellaneous
MDC_ECG_**WAVP**_	**ECG wave pacemaker components** Antibradycardia pace Antitachycardia pace Cardioversion (low-energy shock) Defibrillation (high-energy shock)
MDC_ECG_**BEAT**_	**ECG beats** Nonspecific beats Supraventricular extrasystole Ventricular extrasystole Escape beats Intraventricular block
MDC_ECG_**RHY**_	**ECG rhythms** Sinus rhythm Sinus arrhythmia (originating from the SA node) Atrial ectopic rhythm (atrial sites other than the SA node) Supraventricular (atrial or junctional) ectopic rhythms AV junctional rhythms Atrioventricular block and dissociation Sino-atrial exit block Ventricular ectopic rhythms Ventricular pre-excitation (WPW) rhythm Implanted pacemaker rhythm Pause Miscellaneous ECG rhythms and other interval events Pacemaker stimuli that were expected but are missing
MDC_ECG_**NOISE**_	**ECG noise levels**
MDC_ECG_ ***global***	**"Global" ECG measurements** (apply across multiple leads)
MDC_ECG_ ***per Lead***	**"Per-Lead" ECG measurements**
MDC_ECG_**LDSYS**_	**ECG lead systems** 12-lead ECG electrode placement XYZ electrode placement system Additional 3-lead systems Derived 12-lead systems 15- and 18-lead systems
MDC_ECG_**CTL_VBL**_	**ECG control variables**—filter and threshold settings
MDC_ECG_ ***info attr***	**ECG information attributes** Attributes that convey ECG beat, rhythm and signal types Attributes that convey ECG and pacemaker wave components Attributes that convey ECG interpretation
NOTE—AV = atrioventricular; SA = sinoatrial; ST = ECG voltage and time measurements related to the ST segment; WPW = Wolfe Parkinson White.[6]	

[6] Notes in text, tables, and figures of a standard are given for information only and do not contain requirements needed to implement this standard.

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8. Extensibility and versioning

Normative specifications for term identifiers in this standard are immutable. Identifiers shall not be retired nor reused.

All other constraints and text within the standard can be revised. The standard shall carry a version number that specifies a revision. Modifications to the standard's text clauses, existing term constraints, or the addition of new text clauses or terms shall require a revision and new version number.

The version identifier shall be a string that consists of the following:

— The major version number—This is the leftmost integer value in a sequence of three such values separated by periods. The major version number may only be increased when beginning work toward a version with significant changes that impact backward compatibility.

— The minor version number —This is the middle integer value in a sequence of three such values separated by periods. The minor version number may only be increased when beginning work toward a version with incremental additions, improvements, or fixes over the last version.

— The point version number—This is the third integer in a sequence of three such values separated by periods. The point version number is increased for vendor-specific versions. Point or vendor-specific versions are not normative. If used, it should be followed by version qualifier string described below. The point version numbers shall be "0" for the balloted normative standard.

— The version qualifier string—This is a human-readable string (ideally consisting only of ASCII letters, digits, periods, and dashes) that uniquely identifies the vendor making a point revision. It should be and is only included in the version identifier for point versions. It should be consistent for subsequent point releases by the same vendor. Point or vendor versions are not considered normative.

An example version number could be "1.02.03_vendor" where "1" is the major version number, "02" is the minor version number, "03" is the point version number, and "_vendor" is the version qualifier string.

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Annex A

(normative)

Base terms

A.1 Overview

Annex A presents the base terms of the nomenclature and their attributes. A base term is defined as a term prior to expansion of any included discriminators. Defining attributes at the base term level simplifies management of the nomenclature.

The base terms are defined in A.3 through A.13. For each base term group listed, the discriminators that apply to that group are shown first, followed by a tabular list of each base term within the group. The *total* number of discriminator bits used by each term group is also listed in Table A.1, and if multiple discriminators are used, then the total number is indicated as an arithmetic sum.

Table A.1—Base term groups

Clause	Base term group	tdBits
A.3	ECG lead identifiers	8
A.4	ECG WAVC wave components	2 + 4
A.5	ECG WAVP pacemaker components	4 + 4
A.6	ECG beats	4
A.7	ECG rhythms	4
A.8	ECG noise annotations and levels	4
A.9	ECG measurements—global	2
A.10	ECG measurements—per lead	8
A.11	ECG lead systems	0
A.12	Control variables	0
A.13	Information attributes	0

The discriminator tables that define the semantic modifiers for each term group are listed first. If multiple discriminator tables are used, then they are listed left to right, starting with the most significant discriminator bits first. The content of the discriminator tables is summarized in Table A.2.

Table A.2—Discriminator table content

Column	Description
dOffset	Discriminator value (offset) added to base term
dSuffix	Suffix appended to the REFID
dDescription	Description
bi-uni	For ECG leads, indicates bipolar or unipolar
pos	For ECG leads, indicates the positive electrode site
neg-ref	For ECG leads indicates the negative (for bipolar) or common reference (for unipolar)

The base terms for each term group are listed after the relevant discriminators. Table A.3 specifies the information provided for each base term within a group of terms.

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Table A.3—Base term table content

Column	Description
SysName	Systematic Name
REFID	Reference Identifier
Mnemonic	Display mnemonic (informative)
Description	Description
PART	Nomenclature partition
CODE10	Numeric code within partition

SysName (*Systematic Name*) provides a structured representation of the semantic components that comprise the base term. The SysName may be used for term searching and comparison.

REFID (*Reference Identifier* or *Reference ID*) is a text token that uniquely identifies each term of the nomenclature. The majority of terms in this nomenclature extension start with MDC_ECG_. If discriminators are used to construct the term, then the dSuffix for each discriminator group is appended to the base term Reference ID.

Mnemonic is the preferred text phrase or acronym that describes a term and is suited for presenting terms on a report or user interface.

Description provides a formal statement that describes the meaning or semantic of the term.

PART specifies the IEEE 11073 partition that the term belongs to. This can be the SCADA partition [PART=2] or the partition assigned to the Annotated ECG nomenclature [PART=10].

CODE10 specifies the 16-bit numeric identifier, within the context of the partition that the term belongs to.

After expanding all discriminators, a unique numeric code **CODE10** can be calculated for each expanded term within the 16-bit partition **PART** in which the term resides. A 32-bit, context-free numeric code **CF_CODE10** may also be calculated for the expanded terms by computing the sum of (65536 × PART) + CODE10 plus any applicable discriminators (the CF_CODE10 is calculated for terms listed in Table B.1).

A.2 Discriminators—general

The discriminator sets used by the annotated ECG nomenclature are summarized in Table A.4. The discriminators specific to each term group are listed for each group and include a detailed explanation and rationale for the more complex discriminator concepts.

ECG lead identifiers are also specified as an eight-bit discriminator and are described in the next section.

Table A.4—Discriminators—general

MDC_ECG_discrim_	bits	dOffset	dSuffix	dDescription
WAVC_ASSN	2	0		{unknown association}
		1	_NA	Not associated with a beat
		2	_FB	Associated with following beat
		3	_PB	Associated with previous beat
WAVC_AOI	4	0		{area of interest not specified}
		1	_TIME_POINT	Point-in-time
		2	_DURN	Duration (width)—*time difference between actual _ONSET and _OFFSET*

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MDC_ECG_discrim_	bits	dOffset	dSuffix	dDescription
		3	_PEAK	Peak (time-of)
		4	_ONSET	Actual onset point
		5	_OFFSET	Actual offset point
		6	_ONSET_IMPL	Implied onset point—*actual onset occurs before this point*
		7	_OFFSET_IMPL	Implied offset point—*actual onset occurs before this point*
		8	_AREA	Area—*integral calculated using absolute (positive) values only*
		9	_INTEGRAL	Integral
		10	*reserved*	
		11	*reserved*	
		12	*reserved*	
		13	*reserved*	
		14	*reserved*	
		15	*reserved*	
WAVP_APPR_ASSN	4	0		Pacing stimulus, unspecified appropriateness, unspecified capture
		1	_NC	Pacing stimulus, unspecified appropriateness, no capture
		2	_C	Pacing stimulus, unspecified appropriateness, captured
		3	_FSN	Pacing stimulus, unspecified appropriateness, fusion
		4	_APPR	Pacing stimulus, appropriate, unspecified capture
		5	_APPR_NC	Pacing stimulus, appropriate, no capture
		6	_APPR_C	Pacing stimulus, appropriate, captured
		7	_APPR_FSN	Pacing stimulus, appropriate, fusion
		8	_INAPPR	Pacing stimulus, inappropriate, unspecified capture
		9	_INAPPR_NC	Pacing stimulus, inappropriate, no capture
		10	_INAPPR_C	Pacing stimulus, inappropriate, captured
		11	_INAPPR_FSN	Pacing stimulus, inappropriate, fusion
		12	_EXCP	Pacing stimulus, transient/testing/manual exception, unspecified capture
		13	_EXCP_NC	Pacing stimulus, transient/testing/manual exception, no capture
		14	_EXCP_C	Pacing stimulus, transient/testing/manual exception, captured
		15	_EXCP_FSN	Pacing stimulus, transient/testing/manual exception, fusion
BEAT_RHYTHM_NOISE	4	0		{base pattern}
		1	_TIME_POINT	Time point
		2	_DURN	Duration
		3	_PEAK	Peak
		4	_ONSET	Onset (start)
		5	_OFFSET	Offset (end)
		6	_ONSET_IMPL	Implied onset (start)
		7	_OFFSET_IMPL	Implied offset (end)
		8	_EVENT	Event
		9	_COUNT	Count (of events)

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MDC_ECG_discrim_	bits	dOffset	dSuffix	dDescription
		10	_RATE	Rate (of event)
		11	_RATE_MAX	Maximum rate
		12	_RATE_MIN	Minimum rate
		13	_RATE_MEAN	Mean (average) rate
		14	_TIME	Time of event (nonspecific)
		15	_ANNOT	Annotation
STATISTICAL	2	0		{not specified}
		1	_MAX	Maximum value observed over an interval
		2	_MIN	Minimum value observed over an interval
		3	_MEAN	Mean value observed over an interval
NOTE 1—Additional information regarding selected discriminator values is provided in *italics* above. NOTE 2—Detailed explanation and rationale for the more complex discriminator concepts are provided in their respective term groups.				

A.3 ECG lead identifiers

Table A.5 specifies the ECG lead designators that are defined as an 8-bit discriminator that are applied to all per-lead ECG measurements and waveform identifiers.

This work is an extension of the ECG lead identifiers originally defined by ANSI/AAMI EC71-2001 [B7] with the numeric identifiers 0 to 85, inclusive, and it maintains semantic compatibility with the original set of numeric identifiers.

This work is also an extension of the ECG lead identifiers that were originally defined in Table A.7.1.1 of ISO/IEEE 11073-10101:2004, having discriminator values 0 to 65, inclusive, and it maintains semantic compatibility with that set as well.[7] It is not compatible with the additional ECG lead discriminators [66–116] that were defined in B.3 of ISO/IEEE 11073-10101:2004.

This work expands the 35 original (not derived or calculated or interpolated) ECG leads defined in Table A.7.1.1 in ISO/IEEE 11073-10101:2004 to 92 original leads and 92 derived leads, including several suitable for canine studies.

To construct an identifier for a specific ECG lead (e.g., lead V2), the discriminator dSuffix value of _V2 is appended to the base MDC_ECG_LEAD to produce **MDC_ECG_LEAD_V2**, and the corresponding dOffset value of 4 is added to the base CODE10 for MDC_ECG_LEAD to yield a 16-bit, context-sensitive CODE10 value of 4 as well as a 32-bit, context-free CF_CODE10 value of 4.

For every original ECG lead, a derived lead is also defined. For example, the original lead MDC_ECG_LEAD_**V2** would have the derived lead identifier MDC_ECG_LEAD_**dV2**. This replaces the use of the ANSI/AAMI EC71-2001 [B7] "-cal" designator, and more importantly, it defines a derived or calculated identifier for *every* original lead (including the augmented leads aVR, aVL, and aVF). The "d" prefix essentially provides an orthogonal flag in the REFID lead designator to indicate the derived status, equivalent to the earlier ANSI/AAMI EC71 "–calculated" leads.[8, 9]

[7] As a consequence, the semantic meaning for ECG lead identifier codes [0–65] is identical for ANSI/AAMI EC71-2001 [B7], Table A.7.1.1 of ISO/IEEE 11073-10101:2004, and this standard.
[8] The "d" prefix need not be used in hardcopy and display applications; other characters such as * (asterisk) and ~ (tilde) may used for this purpose. That said, the "d" prefix is mandatory if the REFIDs are transmitted in the messaging protocol.
[9] In order to maintain backward compatibility with ANSI/AAMI EC71-2001 [B7], "-cal" leads, the numeric dOffset codes do not use an orthogonal binary flag bit to indicate their derived status.

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The original and "derived" ECG lead REFIDs (and lead suffixes) are expressed using only uppercase and lowercase letters and numbers (and underscores) to facilitate use by modern-day programming languages.

In addition to the MDC_ECG_LEAD_*xxx* identifiers, the 8-bit ECG lead discriminator is used for all the per-lead ECG terms listed in Table A.13.

Table A.5—ECG lead identifiers

ECG lead identifiers (MDC_ECG_discrim_LEADS) dBits = 8					
dOffset	**dSuffix**	**description**	**bi-uni**	**pos**	**neg-ref**
0		Unspecified lead (else MDC_ECG_LEAD_CONFIG)			
1	_I	Lead I (see NOTE 1)	Bipolar	LA	RA
31	_dI				
2	_II	Lead II	Bipolar	LL	RA
32	_dII				
3	_V1	V1	Unipolar	1	WCT
33	_dV1				
4	_V2	V2	Unipolar	2	WCT
34	_dV2				
5	_V3	V3	Unipolar	3	WCT
35	_dV3				
6	_V4	V4	Unipolar	4	WCT
36	_dV4				
7	_V5	V5	Unipolar	5	WCT
37	_dV5				
8	_V6	V6	Unipolar	6	WCT
38	_dV6				
9	_V7	V7	Unipolar	7	WCT
39	_dV7				
10	_V2R	V2R (see NOTE 2)	Unipolar	2R	WCT
40	_dV2R				
11	_V3R	V3R	Unipolar	3R	WCT
41	_dV3R				
12	_V4R	V4R	Unipolar	4R	WCT
42	_dV4R				
13	_V5R	V5R	Unipolar	5R	WCT
43	_dV5R				
14	_V6R	V6R	Unipolar	6R	WCT
44	_dV6R				
15	_V7R	V7R	Unipolar	7R	WCT
45	_dV7R				
16	_X	X (see NOTE 3)	Frank or orthogonal		
46	_dX				
17	_Y	Y	Frank or orthogonal		
47	_dY				
18	_Z	Z	Frank or orthogonal		
48	_dZ				
19	_CC5	CC5, per V5 and V5R placement	Bipolar	5	5R
49	_dCC5				

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ECG lead identifiers (MDC_ECG_discrim_LEADS) dBits = 8					
dOffset	**dSuffix**	**description**	**bi-uni**	**pos**	**neg-ref**
20	_CM5	CM5, per V5 placement	Bipolar	5	manubrium
50	_dCM5				
21	_LA	Left Arm	Unipolar	LA	RA+LA+LL=0
51	_dLA				
22	_RA	Right Arm	Unipolar	RA	RA+LA+LL=0
52	_dRA				
23	_LL	Left Leg	Unipolar	LL	RA+LA+LL=0
53	_dLL				
24	_fI	I (see NOTE 4)	Frank	fI	
54	_dfI				
25	_fE	E	Frank	fE	
55	_dfE				
26	_fC	C	Frank	fC	
56	_dfC				
27	_fA	A	Frank	fA	
57	_dfA				
28	_fM	M	Frank	fM	
58	_dfM				
29	_fF	F	Frank	fF	
59	_dfF				
30	_fH	H	Frank	fH	
60	_dfH				
61	_III	III	Bipolar	LL	LA
111	_dIII				
62	_AVR	aVR, augmented voltage, right	Unipolar	RA	(LL+LA)/2
112	_dAVR				
63	_AVL	aVL, augmented voltage, left	Unipolar	LA	(LL+RA)/2
113	_dAVL				
64	_AVF	aVF, augmented voltage, foot	Unipolar	LL	(RA+LA)/2
114	_dAVF				
65	_AVRneg	−aVR (see NOTE 5)	Unipolar	-LL	(RA+LA)/2
115	_dAVRneg				
66	_V8	V8 (see NOTE 6)	Unipolar	8	WCT
79	_dV8				
67	_V9	V9	Unipolar	9	WCT
80	_dV9				
68	_V8R	V8R	Unipolar	8R	WCT
81	_dV8R				
69	_V9R	V9R	Unipolar	9R	WCT
82	_dV9R				
70	_D	D (Nehb – Dorsal)	Bipolar		
83	_dD				
71	_A	A (Nehb – Anterior)	Bipolar		
84	_dA				
72	_J	J (Nehb – Inferior)	Bipolar		
85	_dJ				

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ECG lead identifiers (MDC_ECG_discrim_LEADS) dBits = 8					
dOffset	**dSuffix**	**description**	**bi-uni**	**pos**	**neg-ref**
73	_DEFIB	Defibrillator lead (typically anterior-lateral)	Bipolar	anterior	lateral
135	_dDEFIB				
74	_EXTERN	External pacing lead (typically anterior-posterior)	Bipolar	anterior	posterior
136	_dEXTERN				
75	_A1	A1 (Auxiliary unipolar lead #1)	Unipolar	anywhere	WCT
137	_dA1				
76	_A2	A2 (Auxiliary unipolar lead #2)	Unipolar	anywhere	WCT
138	_dA2				
77	_A3	A3 (Auxiliary unipolar lead #3)	Unipolar	anywhere	WCT
139	_dA3				
78	_A4	A4 (Auxiliary unipolar lead #4)	Unipolar	anywhere	WCT
140	_dA4				
86	_C	Chest lead (see NOTE 7)	Generic		
116	_dC				
87	_V	Precordial lead	Bipolar	NOS	
117	_dV				
88	_VR	VR, nonaugmented voltage, vector of RA	Unipolar	RA	RA+LA+LL=0
118	_dVR				
89	_VL	VL, nonaugmented voltage, vector of LA	Unipolar	LA	RA+LA+LL=0
119	_dVL				
90	_VF	VF, nonaugmented voltage, vector of LL	Unipolar	LL	RA+LA+LL=0
120	_dVF				
91	_MCL	Modified chest lead (left arm indifferent)	Bipolar	NOS	CL
152	_dMCL				
92	_MCL1	MCL, per V1 placement	Bipolar	1	CL
141	_dMCL1				
93	_MCL2	MCL, per V2 placement	Bipolar	2	CL
142	_dMCL2				
94	_MCL3	MCL, per V3 placement	Bipolar	3	CL
143	_dMCL3				
95	_MCL4	MCL, per V4 placement	Bipolar	4	CL
144	_dMCL4				
96	_MCL5	MCL, per V5 placement	Bipolar	5	CL
145	_dMCL5				
97	_MCL6	MCL, per V6 placement	Bipolar	6	CL
146	_dMCL6				
98	_CC	Chest lead (symmetric placement)	Bipolar	NOS	NOS
153	_dCC				
99	_CC1	CC1, per V1 and V1R placement	Bipolar	1	1R
154	_dCC1				
100	_CC2	CC2, per V2 and V2R placement	Bipolar	2	2R
155	_dCC2				
101	_CC3	CC3, per V3 and V3R placement	Bipolar	3	3R
156	_dCC3				
102	_CC4	CC4, per V4 and V4R placement	Bipolar	4	4R
157	_dCC4				

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ECG lead identifiers (MDC_ECG_discrim_LEADS) dBits = 8					
dOffset	**dSuffix**	**description**	**bi-uni**	**pos**	**neg-ref**
103	_CC6	CC6, per V6 and V6R placement (see NOTE 8)	Bipolar	6	6R
158	_dCC6				
104	_CC7	CC7, per V7 and V8R placement	Bipolar	7	7R
159	_dCC7				
105	_CM	Chest-manubrium	Bipolar	NOS	manubrium
160	_dCM				
106	_CM1	CM1, per V1 placement	Bipolar	1	manubrium
161	_dCM1				
107	_CM2	CM2, per V2 placement	Bipolar	2	manubrium
162	_dCM2				
108	_CM3	CM3, per V3 placement	Bipolar	3	manubrium
163	_dCM3				
109	_CM4	CM4, per V4 placement	Bipolar	4	manubrium
164	_dCM4				
110	_CM6	CM6, per V6 placement (see NOTE 9)	Bipolar	6	manubrium
165	_dCM6				
121	_CM7	CM7, per V7 placement	Bipolar	7	manubrium
166	_dCM7				
122	_CH5	— (see NOTE 10)	Bipolar	5	forehead
167	_dCH5				
123	_CS5	Negative: right infraclavicular fossa	Bipolar	5	rt infra fossa
168	_dCS5				
124	_CB5	Negative: low right scapula	Bipolar	5	lo rt scapula
169	_dCB5				
125	_CR5	—	Bipolar	5	RA
170	_dCR5				
126	_ML	ML, modified limb lead, ~ Lead II			
171	_dML				
127	_AB1	AB1 (auxiliary bipolar lead #1)	Bipolar		
172	_dAB1				
128	_AB2	AB2 (auxiliary bipolar lead #2)	Bipolar		
173	_dAB2				
129	_AB3	AB3 (auxiliary bipolar lead #3)	Bipolar		
174	_dAB3				
130	_AB4	AB4 (auxiliary bipolar lead #4)	Bipolar		
175	_dAB4				
131	_ES	EASI ES (see NOTE 11)	Bipolar	E (fE)	S
176	_dES				
132	_AS	EASI AS	Bipolar	A (fA)	S
177	_dAS				
133	_AI	EASI AI	Bipolar	A (fA)	I (fI)
178	_dAI				
134	_S	EASI upper sternum lead			
179	_dS				
147	_RL	Right leg			
180	_dRL				

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ECG lead identifiers (MDC_ECG_discrim_LEADS) dBits = 8					
dOffset	**dSuffix**	**description**	**bi-uni**	**pos**	**neg-ref**
148	_CV5RL	Canine, fifth right intercostal space near the edge of the sternum at the most curved part of the costal cartilage (see NOTE 12)	Unipolar	~ rV2	WCT
181	_dCV5RL				
149	_CV6LL	Canine, sixth left intercostal space near the edge of the sternum at the most curved part of the costal cartilage	Unipolar	~ V2	WCT
182	_dCV6LL				
150	_CV6LU	Canine, sixth left intercostal space at the costochondral junction	Unipolar	~ V4	WCT
183	_dCV6LU				
151	_V10	Canine, over dorsal spinous process of the seventh thoracic vertebra	Unipolar	~ V10	WCT
184	_dV10				

NOTE 1—SCP: The Einthoven lead one (coded with the Roman I; lead IDs 1 and 31) should not be confused with the Frank electrode I (eye; lead IDs 24 and 54).

NOTE 2—V2R is identical to lead V1. Similarly, lead V1R is identical to lead V2.

NOTE 3—SCP: Leads X, Y, and Z can be recorded by an orthogonal system, such as Frank or McFee lead systems.

NOTE 4—Frank leads indicated by “f” for clarity and label uniqueness.

NOTE 5—The term “-aVR” is replaced with the more programming-friendly term “aVRneg.”

NOTE 6 —ANSI/AAMI EC71 ECG lead identifiers codes 66 to 85 are supported, in addition to codes 0 to 65.

NOTE 7 —ECG lead identifier codes 86 and above are new, relative to ANSI/AAMI EC71-2001 [B7].

NOTE 8 —CC5 was previously defined with code modifier 19.

NOTE 9—CM5 was previously defined with code modifier 20.

NOTE 10—CM5, CH5, CS5, CC5, CB5, and CR5 bipolar leads used in conjunction with stress testing (Macfarlane [B3], p. 323).

NOTE 11— EASI is a trademark in the U.S. Patent & Trademark Office, owned by the Philips Electronics North America Corporation and invented by Dr. Gordon Dower. Leads: S, upper sternum; E, lower sternum; A, under left arm, above V6; I, under right arm, above V6R.

NOTE 12—The canine leads are summarized in Macfarlane [B3], Volume 2, pp. 1270–1271. The abbreviations used in the left and right-most columns are based on Lannek [B20] modified for use with a Wilson central terminal. The subscripted terms used in the “+” column were proposed by the Committee of the American Academy of Veterinary Cardiology, and they are roughly similar to those used for humans.

NOTE 13—Codes 185 to 199 are reserved for future expansion. Codes 200 to 255 are reserved for manufacturer-specific codes.

A.4 ECG WAVC wave components

An ECG WAVC wave component and WAVP wave pacemaker component describes a wave, segment, or combination of waves that can be as follows:

— Declared as components that are associated with a BEAT

— Waveform fragments that are not associated with a BEAT

— Other nonbeat fragments such as artifact and noncaptured pacemaker spikes

The WAVC and WAVP annotations include a wave component association field that indicates its relationship to an adjacent BEAT annotation: unknown or “not otherwise specified” [0], none [1], following beat [2], and preceeding beat [3]. For WAVP annotations, the association field indicates capture state: unknown or uncertain [0], not captured [1], captured [2], or fused [3]. This relationship is specified by the 2-bit MDC_ECG_discrim_WAVC_ASSN discriminator described in Table A.6.

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Table A.6—WAVC and WAVP component association (relationship to adjacent BEAT)

MDC_ECG_discrim_WAVC_ASSN			Association description
dOffset	**dSuffix**	**dDescription**	
0		Unknown or uncertain association	"**unknown or uncertain association**" with an adjacent BEAT annotation This indicates that a system, algorithm, or person did not attempt to associate this WAVC with an adjacent BEAT. In certain clinical trials, for example, only the P-waves may be annotated, with little interest with the timing details of the QRS complexes. *This discriminator would also be used if the association was described elsewhere in the protocol.*
1	_NA	Not associated with a beat	"**no association**" with an adjacent BEAT annotation This indicates that the WAVC is definitely not associated with an adjacent beat. For example, ectopic P-waves that do not result in "captured" QRS complexes are flagged as "not associated." *For paced WAVP components as well as cardioversion and defibrillation wave components,the nonassociated condition indicates "no capture" and is denoted by the suffix "_NC" rather than by "_NA."*
2	_FB	Associated with following beat	"**associated**" with an adjacent BEAT annotation This indicates that the WAVC belongs to (is a child of) a parent BEAT annotation. In a protocol that can natively show this parent–child relationship between a BEAT and one or more WAVCs, this relationship would be implied. If a binary format similar to the MIT-BIH or AHA is used, embedding this discriminator in the annotation type is very useful. For example, [2] indicates that the WAVC is associated with the immediately following BEAT and [3] indicates that it is associated with the immediately preceeding BEAT. This allows a specific BEAT and its associated WAVC components to be unambiguously identified and associated as a group. *For paced WAVP components as well as cardioversion and defibrillation wave components, the "associated" condition indicates whether the pacemaker stimulus was captured "_C" or fused "_FSN."*
3	_PB	Associated with previous beat	

An ECG WAVC wave component may be further characterized by its area of interest, which may include the following:

— Time fiducials onset, offset, and peak

— Other commonly measured aspects such as its area

The 2-bit MDC_ECG_discrim_WAVC_ASSN and 4-bit MDC_ECG_discrim_WAVC_AOI (area of interest) discriminators are encoded as the lowest 6 bits of the ECG WAVC wave component nomenclature. As an editorial convention, the discriminators used by a particular subset of terms (e.g., WAVC, WAVP, beats, rhythms, etc.) are listed immediately prior to the table that defines all the base terms that comprise the subset. The two discriminators and the base terms for ECG WAVC wave components are specified in Table A.7.

One or more NOTCH wave component(s) can be associated with any WAVC wave component (typically, QWAVE, RWAVE, and/or SWAVE). A NOTCH is a slight but distinct change in the direction of a WAVC deflection and is contained entirely within the time interval of the parent WAVC component (using conventional ECG definitions, a NOTCH does not extend to the baseline; otherwise, it would create an RRWAVE or other WAVC wave component). A NOTCH essentially defines a third level in our BEAT/WAVC/NOTCH hierarchy, and the child relationship to the parent WAVC component can be indicated either explicitly (by message structure) or implicitly (by the containing time interval).

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Table A.7—ECG WAVC wave components

Discriminators (most significant on left side)					
MDC_ECG_discrim_WAVC_ASSN			MDC_ECG_discrim_WAVC_AOI		
dOffset	dSuffix	dDescription	dOffset	dSuffix	dDescription
0		Unknown association	0		{AOI NOS}
1	_NA	Not associated with a beat	1	_TIME_POINT	Point-in-time
2	_FB	Associated with following beat	2	_DURN	Duration (width)
3	_PB	Associated with previous beat	3	_PEAK	Peak (time-of)
			4	_ONSET	Actual onset point
			5	_OFFSET	Actual offset point
			6	_ONSET_IMPL	Implied onset point
			7	_OFFSET_IMPL	Implied offset point
			8	_AREA	Area
			9	_INTEGRAL	Integral
			10 to 15		{reserved}

WAVC wave components					
SysName	REFID	Mnemonic	Description	PART	CODE10
Pattern | Wave, Component, P wave, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_PWAVE	PWAVE	P wave	10	256
Pattern | Wave, Component, P' wave (2nd deflection in P wave), Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_PPWAVE	PPWAVE	P' wave (second deflection in P wave) (P and P' waves have opposite signs)	10	320
Pattern | Wave, Component, P" wave (3rd deflection in P wave), Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_PPPWAVE	PPPWAVE	P" wave (third deflection in P wave) (P' and P" have opposite signs)	10	384
Pattern | Wave, Component, Q wave, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_QWAVE	QWAVE	Q wave	10	448

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WAVC wave components					
SysName	**REFID**	**Mnemonic**	**Description**	**PART**	**CODE10**
Pattern | Wave, Component, QS wave, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_QSWAVE	QSWAVE	QS wave	10	512
Pattern | Wave, Component, R wave, Following Beat, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_RWAVE	RWAVE	R wave	10	576
Pattern | Wave, Component, R' wave (2nd deflection in R Wave), Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_RRWAVE	RRWAVE	R' wave (second deflection in R wave) (R and R' waves have same sign)	10	640
Pattern | Wave, Component, R'' wave (3rd deflection in R Wave), Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_RRRWAVE	RRRWAVE	R'' wave (third deflection in R wave) (R, R', and R'' have same sign)	10	704
Pattern | Wave, Component, Notch, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_NOTCH	NOTCH	Notch, a slight but distinct change in the direction of a WAVC deflection, contained entirely within that deflection. Typically associated with Q, R, and/or S wave.	10	768
Pattern | Wave, Component, S wave, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_SWAVE	SWAVE	S wave (S and R/R' waves have opposite signs)	10	832
Pattern | Wave, Component, S' wave (2nd deflection in S Wave), Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_SSWAVE	SSWAVE	S' wave (second deflection in S wave) (S' and R'/R'' waves have opposite signs)	10	896
Pattern | Wave, Component, S'' wave (3rd deflection in S Wave), Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_SSSWAVE	SSSWAVE	S'' wave (third deflection in S wave) (S'' and R'/R'' waves have opposite signs)	10	960
Pattern | Wave, Component, T wave, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_TWAVE	TWAVE	T wave	10	1024

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WAVC wave components					
SysName	**REFID**	**Mnemonic**	**Description**	**PART**	**CODE10**
Pattern | Wave, Component, T' wave (2nd deflection in T Wave), Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_TTWAVE	TTWAVE	T' wave (second deflection in T wave) (T and T' waves have opposite signs)	10	1088
Pattern | Wave, Component, U wave, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_UWAVE	UWAVE	U wave	10	1152
Pattern | Wave, Component, Delta wave, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_DELTA	DELTA	Delta wave	10	1216
Pattern | Wave, Component, Isoelectric region between global QRS onset and actual onset or QRS in given lead., Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_IWAVE	IWAVE	Isoelectric region between global QRS onset and actual onset of QRS in given lead	10	1280
Pattern | Wave, Component, Isoelectric region between actual offset of QRS in given lead and global QRS offset., Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_KWAVE	KWAVE	Isoelectric region between actual offset of QRS in given lead and global QRS offset	10	1344
Pattern | Wave, Component, Osborne wave, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_JWAVE	JWAVE	Osborne wave, late and typically upright terminal deflection of QRS complex; amplitude increases as temperature decreases. ECG finding typically associated with hypothermia	10	1408
Pattern | Wave, Component, Entire beat (Pon to Toff excluding U), Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_PQRSTWAVE	PQRSTWAVE	Entire Beat (Pon to Toff, excluding U)	10	1472
Pattern | Wave, Component, Entire beat (Qon to Toffexcluding P and U), Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_QRSTWAVE	QRSTWAVE	Entire Beat (Qon to Toff, excluding P and U)	10	1536

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WAVC wave components					
SysName	**REFID**	**Mnemonic**	**Description**	**PART**	**CODE10**
Pattern | Wave, Component, Entire QRS wave (excluding PTand U), Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_QRSWAVE	QRSWAVE	Entire QRS (excluding P, T, and U)	10	1600
Pattern | Wave, Component, TU fused wave, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_TUWAVE	TUWAVE	TU fused wave	10	1664
Pattern | Wave, Component, Ventricular flutter wave, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_VFLWAVE	VFLWAVE	Ventricular flutter wave (optional) (the appropriate ventricular rhythm call is mandatory)	10	1728
Pattern | Wave, Component, Atrial flutter wave, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_AFLWAVE	AFLWAVE	Atrial flutter wave (optional) (the appropriate atrial rhythm call is mandatory)	10	1792
Pattern | Wave, Component, Isoelectric point or segment, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_ISO	ISO	Isoelectric point or segment	10	1856
Pattern | Wave, Component, PR Segment, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_PRSEG	PRSEG	PR Segment	10	1920
Pattern | Wave, Component, ST Segment, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_STSEG	STSEG	ST Segment	10	1984
Pattern | Wave, Component, J-point, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_STJ	STJ	J-point	10	2048
Pattern | Wave, Component, ST measurement point, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_STM	STM	ST measurement point	10	2112
Pattern | Wave, Component, Isolated QRS-like artifact, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_ARFCT	ARFCT	Artifact	10	2176

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WAVC wave components					
SysName	**REFID**	**Mnemonic**	**Description**	**PART**	**CODE10**
Pattern | Wave, Component, Calibration pulse (individual pulse), Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_CALP	CALP	Calibration pulse	10	2240
Pattern | Wave, Component, ST change, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_STCH	STCH	ST change	10	2304
Pattern | Wave, Component, T-wave change, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_TCH	TCH	T-wave change	10	2368
Pattern | Wave, Component, Ventricular Activation Time, Ass'n NOS, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVC_VAT	VAT	Ventricular activation time, also termed the intrinsic or intrinsicoid deflection (onset to peak of depolarization wave)	10	2432

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A.5 ECG WAVP pacemaker components

The ECG WAVP pacemaker component annotations include an additional discriminator that combines two concepts: the "appropriate" concept that indicates whether the pacemaker spike was unspecified, appropriate, inappropriate, or a transient/testing/manual exception, and the "association" concept that indicates whether the capture state relative to depolarization of the paced chamber of the heart was uncertain, not captured, captured, or fusion. The two concepts are combined into the 4-bit discriminator MDC_ECG_discrim_WAVP_APPR_ASSN.

The 4-bit MDC_ECG_discrim_WAVC_AOI discriminator is used to indicate the area of interest, similar to ECG WAVC wave components.

The base pacemaker WAVP component terms in Table A.8 combine the following two most important aspects about a pacemaker spike into the base REFID:

— The purpose (energy level) of the spike (i.e., antibradycardia, antitachycardia, cardioversion, and defibrillation)

— The paced chamber (e.g., generic pace, atrial, ventricular, and transthoracic)

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Table A.8—ECG WAVP pacemaker components

Discriminators (most significant on left side)					
MDC_ECG_discrim_WAVP_APPR_ASSN			MDC_ECG_discrim_WAVC_AOI		
dOffset	**dSuffix**	**dDescription**	**dOffset**	**dSuffix**	**dDescription**
0		Pacing stimulus, unspecified appropriateness, unspecified capture	0		{AOI NOS}
1	_NC	Pacing stimulus, unspecified appropriateness, no capture	1	_TIME_POINT	Point-in-time
2	_C	Pacing stimulus, unspecified appropriateness, captured	2	_DURN	Duration (width)
3	_FSN	Pacing stimulus, unspecified appropriateness, fusion	3	_PEAK	Peak (time-of)
4	_APPR	Pacing stimulus, appropriate, unspecified capture	4	_ONSET	Actual onset point
5	_APPR_NC	Pacing stimulus, appropriate, no capture	5	_OFFSET	Actual offset point
6	_APPR_C	Pacing stimulus, appropriate, captured	6	_ONSET_IMPL	Implied onset point
7	_APPR_FSN	Pacing stimulus, appropriate, fusion	7	_OFFSET_IMPL	Implied offset point
8	_INAPPR	Pacing stimulus, inappropriate, unspecified capture	8	_AREA	Area
9	_INAPPR_NC	Pacing stimulus, inappropriate, no capture	9	_INTEGRAL	Integral
10	_INAPPR_C	Pacing stimulus, inappropriate, captured	10 to 15		{reserved}
11	_INAPPR_FSN	Pacing stimulus, inappropriate, fusion			
12	_EXCP	Pacing stimulus, transient/testing/manual exception, unspecified capture			
13	_EXCP_NC	Pacing stimulus, transient/testing/manual exception, no capture			
14	_EXCP_C	Cing stimulus, transient/testing/manual exception, captured			
15	_EXCP_FSN	Pacing stimulus, transient/testing/manual exception, fusion			

Wave components (paced)					
SysName	**REFID**	**Mnemonic**	**Description**	**PART**	**CODE10**
Pattern, Wave, Pacemaker | Antibradycardia pace; Spike, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVP_PACE	PACE	Antibradycardia pace	10	4096
Pattern, Wave, Pacemaker | Antibradycardia pace, Atrium; Spike, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVP_PACE_ATR	APACE	Atrial antibradycardial pace	10	4352
Pattern, Wave, Pacemaker |	MDC_ECG_WAVP_PACE_ATR_R	RAPACE	Right atrial	10	4608

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Wave components (paced)					
SysName	**REFID**	**Mnemonic**	**Description**	**PART**	**CODE10**
Antibradycardia pace, Right Atrium; Spike, AOI NOS | ECG, Heart | CVS			antibradycardial pace		
Pattern, Wave, Pacemaker | Antibradycardia pace, Left Atrium; Spike, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVP_PACE_ATR_L	LAPACE	Left atrial antibradycardial pace	10	4864
Pattern, Wave, Pacemaker | Antibradycardia pace, Ventricular; Spike, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVP_PACE_V	VPACE	Ventricular antibradycardial pace	10	5120
Pattern, Wave, Pacemaker | Antibradycardia pace, Right Ventricle; Spike, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVP_PACE_V_R	RVPACE	Right ventricular antibradycardial pace	10	5376
Pattern, Wave, Pacemaker | Antibradycardia pace, Left Ventricle; Spike, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVP_PACE_V_L	LVPACE	Left ventricular antibradycardial pace	10	5632
Pattern, Wave, Pacemaker | Antibradycardia pace, Transthoracic; Spike, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVP_PACE_EXT	XPACE	Transthoracic antibradycardial pace	10	5888
Pattern, Wave, Pacemaker | Antitachycardia pace; Spike, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVP_ATPACE	ATPACE	Antitachycardia pace	10	6144
Pattern, Wave, Pacemaker | Antitachycardia pace, Atrium; Spike, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVP_ATPACE_ATR	AATPACE	Atrial antitachycardia pace	10	6400
Pattern, Wave, Pacemaker | Antitachycardia pace,Ventricle; Spike, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVP_ATPACE_V	VATPACE	Ventricular antitachycardia pace	10	6656
Pattern, Wave, Pacemaker | Antitachycardia pace, Transthoracic; Spike, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVP_ATPACE_EXT	XATPACE	Transthoracic antitachycardia pace	10	6912
Pattern, Wave, Pacemaker | Cardioversion; Spike, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVP_CDVS	CDVS	Cardioversion (low-energy shock)	10	7168
Pattern, Wave, Pacemaker | Cardioversion, Atrium; Spike, AOI NOS |	MDC_ECG_WAVP_CDVS_ATR	ACDVS	Atrial cardioversion	10	7424

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Wave components (paced)					
SysName	**REFID**	**Mnemonic**	**Description**	**PART**	**CODE10**
ECG, Heart | CVS					
Pattern, Wave, Pacemaker | Cardioversion, Ventricle; Spike, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVP_CDVS_V	VCDVS	Ventricular cardioversion	10	7680
Pattern, Wave, Pacemaker | Cardioversion, Transthoracic; Spike, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVP_CDVS_EXT	XCDVS	Cardioversion	10	7936
Pattern, Wave, Pacemaker | Defibrillation; Spike, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVP_DEFIB	DEFIB	Defibrillation (high-energy shock)	10	8192
Pattern, Wave, Pacemaker | Defibrillation, Atrium; Spike, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVP_DEFIB_ATR	ADEFIB	Atrial defibrillation	10	8448
Pattern, Wave, Pacemaker | Defibrillation, Ventricle; Spike, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVP_DEFIB_V	VDEFIB	Ventricular defibrillation	10	8704
Pattern, Wave, Pacemaker | Defibrillation, Transthoracic; Spike, AOI NOS | ECG, Heart | CVS	MDC_ECG_WAVP_DEFIB_EXT	XDEFIB	Transthoracic defibrillation	10	8960

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A.6 ECG beats

Beat labels are used to describe cardiac cycles on an individual "beat-by-beat" basis, extending the original beat-by-beat concepts in the earlier AHA and MIT-BIH annotated ECG databases for two-channel Holter to what is now possible with modern 12-lead resting and Holter ECG analysis.

Beat labels use the 4-bit MDC_ECG_discrim_BEAT_RHTYHM_NOISE discriminator to specify key time features of the beat as well as the count and rate of each beat type. The discriminators and base terms for ECG beats are specified in Table A.9.

Also, the <**Mnemonic**> column specifies a "cardiologist-friendly" term that could be used for display or publication purposes.

Not shown but available in the XML[10] on an informative basis are the following:

— The <**mit-bih**> element indicates mappings to the equivalent beat label in the MIT-BIH annotated ECG database.

— The <**scp**> element indicates mappings to the equivalent beat label in ANSI/AAMI EC71-2001 [B7].

Table A.9—ECG beats

MDC_ECG_discrim_BEAT_RHYTHM_NOISE		
dOffset	**dSuffix**	**dDescription**
0		{base pattern}
1	_TIME_POINT	Time point
2	_DURN	Duration
3	_PEAK	Peak
4	_ONSET	Onset (start)
5	_OFFSET	Offset (end)
6	_ONSET_IMPL	Implied onset (start)
7	_OFFSET_IMPL	Implied offset (end)
8	_EVENT	Event
9	_COUNT	Count (of events)
10	_RATE	Rate (of event)
11	_RATE_MAX	Maximum rate
12	_RATE_MIN	Minimum rate
13	_RATE_MEAN	Mean (average) rate
14	_TIME	Time of event (nonspecific)
15	_ANNOT	Annotation

[10] The XML Schema, XSLT transforms, and XML data files are available at the following URL: http://standards.ieee.org/downloads/11073/.

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ECG beat annotations					
SysName	**REFID**	**Mnemonic**	**Description**	**PART**	**CODE10**
Pattern, Beat (NOS), Base Pattern | ECG, Heart | CVS	MDC_ECG_BEAT	BEAT	Any beat (unspecified; included in heart rate)	10	8192
Pattern, Normal beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_NORMAL	NORMAL	Normal beat (sinus beat; normal conduction)	10	8208
Pattern, Abnormal beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_ABNORMAL	ABNORMAL	Abnormal beat	10	8224
Pattern, Dominant beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_DOMINANT	DOMINANT	Dominant beat	10	8240
Pattern, Supraventricular premature or ectopic beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_SV_P_C	SVPC	Supraventricular premature contraction (atrial or nodal premature beat with normal QRS morphology)	10	8256
Pattern, Atrial premature complex (beat), Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_ATR_P_C	APC	Atrial premature contraction (beat)	10	8272
Pattern, Junctional (nodal) premature beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_JUNC_P_C	JPC	Junctional (nodal) premature contraction	10	8288
Pattern, Aberrated atrial premature beat (Ashman), Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_ATR_P_C_ABERR	ABERR	Aberrated atrial premature beat (Ashman beat: atrial premature beat with abnormal QRS morphology)	10	8304
Pattern, Non-conducted p-wave beat (blocked), Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_ATR_PWAVE_BLK	NAPC	Nonconducted P-wave (blocked)	10	8320
Pattern, Premature ventricular contraction (beat), Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_V_P_C	VPC	Ventricular premature contraction (beat)	10	8336

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ECG beat annotations					
SysName	**REFID**	**Mnemonic**	**Description**	**PART**	**CODE10**
Pattern, Fusion of ventricular and normal beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_V_P_C_FUSION	FUSION	Fusion of ventricular and normal beat	10	8352
Pattern, R-on-T premature ventricular beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_V_P_C_RonT	RONT	R-on-T premature ventricular beat	10	8368
Pattern, Supraventricular escape beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_SV_ESC	SVESC	Supraventricular escape beat (least specific)	10	8384
Pattern, Atrial escape beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_ATR_ESC	AESC	Atrial Escape beat	10	8400
Pattern, Junctional (nodal) escape beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_JUNC_ESC	JESC	Junctional (nodal) escape beat	10	8416
Pattern, Ventricular escape beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_V_ESC	VESC	Ventricular escape beat	10	8432
Pattern, bundle branch block beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_BB_BLK	BBB	Bundle branch block beat (unspecified)	10	8448
Pattern, left bundle branch block beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_LBB_BLK_COMP	LBBB	Left bundle branch block beat	10	8464
Pattern, incomplete left bundle branch block beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_LBB_BLK_INCOMP	ILBBB	Incomplete left bundle branch block beat (see NOTE 1)	10	8480
Pattern, right bundle branch block beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_RBB_BLK_COMP	RBBB	Right bundle branch block beat	10	8496

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ECG beat annotations					
SysName	**REFID**	**Mnemonic**	**Description**	**PART**	**CODE10**
Pattern, incomplete right bundle branch block beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_RBB_BLK_INCOMP	IRBBB	Incomplete right bundle branch block beat	10	8512
Pattern, left anterior fascicular block beat (common), Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_BLK_ANT_L_HEMI	LAFB	Left anterior fascicular block beat (common)	10	8528
Pattern, left posterior fascicular block beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_BLK_POS_L_HEMI	LPFB	Left posterior fascicular block beat (rare)	10	8544
Pattern, bifascicular block beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_BLK_BIFAS	BIFAS	Bifascicular block beat	10	8560
Pattern, trifascicular block beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_BLK_TRFAS	TRFAS	Trifascicular block beat	10	8576
Pattern, bilateral bundle-branch block beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_BLK_BILAT	BILAT	Bilateral bundle-branch block beat	10	8592
Pattern, intraventricular conduction disturbance (non-specific block), Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_BLK_IVCD	IVCD	Intraventricular conduction disturbance (nonspecific block)	10	8608
Pattern, pre-excitation (least specific), Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_PREX	PREX	Preexcitation (least specific)	10	8624
Pattern,Wolf-Parkinson-White syndrome (less specific), Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_WPW_UNK	WPW	Wolf-Parkinson-White syndrome (less specific)	10	8640
Pattern,Wolf-Parkinson type A, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_WPW_A	WPWA	Wolf-Parkinson type A beat (see NOTE 2)	10	8656

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ECG beat annotations					
SysName	**REFID**	**Mnemonic**	**Description**	**PART**	**CODE10**
Pattern,Wolf-Parkinson type B, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_WPW_B	WPWB	Wolf-Parkinson type B beat (see NOTE 3)	10	8672
Pattern, Lown-Ganong-Levine syndrome, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_LGL	LGL	Lown-Ganong-Levine syndrome beat (see NOTE 4)	10	8688
Pattern, Paced beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_PACED	PACED	Paced beat (with ventricular capture)	10	8704
Pattern, Pacemaker Fusion beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_PACED_FUS	PFUS	Pacemaker fusion beat	10	8720
Pattern, Unclassifiable beat, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_UNKNOWN	UNKNOWN	Unclassifiable beat	10	8736
Pattern,Learning, Base pattern | ECG, Heart | CVS	MDC_ECG_BEAT_LEARN	LEARN	Learning (beats during initial learning phase)	10	8752

NOTE 1—The term “incomplete” for IRBBB and ILBBB implies conduction is delayed, but not completely blocked.

NOTE 2—QRS is positive in leads V1 and V2, similar to RBBB.

NOTE 3—QRS is negative in leads V1 and V2, similar to LBBB.

NOTE 4—Unlike WPW, the QRS complex has normal morphology in LGL. Activation of the ventricles occurs entirely through the bundle of His and the bundle branches.

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A.7 ECG rhythms

Rhythm annotations identify the state transitions of ECG rhythms. Multiple, concurrent rhythms are permitted. Rhythm annotations apply to all leads.

Rhythm labels use the 4-bit MDC_ECG_discrim_BEAT_RHYTHM_NOISE discriminator to specify key time features of a rhythm episode as well as the count and rate of rhythm episodes. The _ONSET and _OFFSET discriminators are used to indicate the *actual* onset (start) and offset (end) of a rhythm at a specified time. The _ONSET_IMPL and _OFFSET_IMPL discriminators are used to indicate when the *actual* onset occurs before and when the *actual* offset occurs after a specified time, and they would be used for a finite-length rhythm strip or display where the actual onset and offset is not visible. The discriminators and base terms for ECG rhythms are specified in Table A.10.

Not shown but available in the XML on an informative basis are the following:

— The <**mit-bih**> element indicates mappings to the equivalent beat label in the MIT-BIH annotated ECG database.

— The <**scp**> element indicates mappings to the equivalent beat label in ANSI/AAMI EC71-2001 [B7].

— The <**auxinfo**> element suggests additional criteria and thresholds for each rhythm.

Table A.10—ECG rhythms

MDC_ECG_discrim_BEAT_RHYTHM_NOISE		
dOffset	**dSuffix**	**dDescription**
0		{base pattern}
1	_TIME_POINT	Time point
2	_DURN	Duration
3	_PEAK	Peak
4	_ONSET	Onset (start)
5	_OFFSET	Offset (end)
6	_ONSET_IMPL	Implied onset (start)
7	_OFFSET_IMPL	Implied offset (end)
8	_EVENT	Event
9	_COUNT	Count (of events)
10	_RATE	Rate (of event)
11	_RATE_MAX	Maximum rate
12	_RATE_MIN	Minimum rate
13	_RATE_MEAN	Mean (average) rate
14	_TIME	Time of event (nonspecific)
15	_ANNOT	Annotation

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ECG rhythm annotations					
SysName	**REFID**	**Mnemonic**	**Description**	**PART**	**CODE10**
Pattern, Sinus Rhythm, Base pattern | ECG, Heart | CVS	MDC_ECG_RHY_SINUS_RHY	SR	Sinus rhythm	10	9216
Pattern, Normal Sinus Rhythm, Base pattern | ECG, Heart | CVS	MDC_ECG_RHY_SINUS_NORMAL_RHY	NSR	Normal sinus rhythm	10	9232
Pattern, Sinus Bradycardia, Base pattern | ECG, Heart | CVS	MDC_ECG_RHY_SINUS_BRADY	SBRAD	Sinus bradycardia	10	9248
Pattern, Sinus Tachycardia, Base pattern | ECG, Heart | CVS	MDC_ECG_RHY_SINUS_TACHY	STACH	Sinus tachycardia	10	9264
Pattern, Sinus Arrhythmia, Base pattern | ECG, Heart | CVS	MDC_ECG_RHY_SINUS_ARRHY	SAR	Sinus arrhythmia	10	9280
Pattern, Respiratory Sinus Arrhythmia, Base pattern | ECG, Heart | CVS	MDC_ECG_RHY_RESP_ARRHY	RSAR	Respiratory sinus arrhythmia	10	9296
Pattern, Non-Respiratory Sinus Arrhythmia, Base pattern | ECG, Heart | CVS	MDC_ECG_RHY_NON_RESP_ARRHY	NRSAR	Nonrespiratory sinus arrhythmia	10	9312
Pattern, Wandering Sinus Pacemaker, Base pattern | ECG, Heart | CVS	MDC_ECG_RHY_WANDP_ARRHY	WANDP	Wandering sinus pacemaker	10	9328
Pattern, Wandering Pacemaker, Base pattern | ECG, Heart | CVS	MDC_ECG_RHY_WANDPAV_ARRHY	WANDPAV	Wandering pacemaker	10	9344
Pattern, Atrial Ectopic Rhythm, Base pattern | ECG, Heart | CVS	MDC_ECG_RHY_ATR_ECT_RHY	AER	Atrial ectopic rhythm	10	9360

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