HES®/SCP-ECG
Header Definition

For Internal & External Use

Version 1.3
Revision: 01

Author(s)	Reviewer(s)	Approved by
Ronald Fischer, Christoph Zywietz Date: 25.05.2009	Tosja Zywietz Date: 26.05.2009	Tosja Zywietz Date: 27.05.2009

Content

1 Manufacturer

Biosigna – Institut für Biosignalverarbeitung und Systemanalyse GmbH
Lindwurmstrasse 109
80337 München, Germany
Tel: + 49 + 89 + 23719277
Fax: + 49 + 89 + 23719278
Email: support@biosigna.de

2 Declaration of Conformity

HES fulfils the Essential Requirements of Council Directive 93/42/EEC concerning medical devices.

The quality management system of Biosigna – Institut für Biosignalverarbeitung und Systemanalyse GmbH was certified by TÜV Product Services GmbH in accordance with DIN EN ISO 13485:2003 and DIN EN ISO 9001:2000.

CE 0123

3 Intended Use of HES

HES is an algorithm delivered as library (object code) to be integrated into standard 12 lead resting ECG machines or PC-based ECG systems. It is always delivered for a specific operating system indicated in the delivery note and technical documentation.

HES consists of the so called test driver, delivered as source code, the HES library itself, delivered as object code, technical documentation, 42 test ECGs and this user manual.

***HES* is a software of the risk class IIa according to appendix IX of MDD 93/42/EEC for medical products and software class A according to DIN EN ISO 62304:2006. It is not authorized for use in systems classified higher as class IIa or class A according to DIN EN ISO 62304:2006!**

The HES program can be applied to all populations of western countries. The ECG set used to train HES comprised a balanced mix of male and female, healthy and pathologic patterns, and a wide range of different ages. For adults, the program is applicable for the age range of 16-95 years. For paediatric ECG, the program provides specific results for the ages of 0-1 days, 2-3 days, 4-7 days, 8-30 days, 1-3 months, 4-6 months, 7-12 months, 1-3 years, 4-5 years, 6-8 years, 9-12 years, and 13 -16 years.

HES is not to be applied in any monitoring or alarm system. It does not replace the diagnosis of a trained physician!

4 Introduction

When the development of the HES ECG analysis programs started, it was realized from the beginning that for effective data processing and data storage each ECG data set needed a patient identification and a record identification. To store these data originally a Header of 40 bytes was written in front of each ECG record. Later on, e.g., for clinical studies, additional information on type and number of the study, other patient information like medical history, drugs and diagnoses have been added. Finally a Header of 1024 bytes was established, including some free bytes for future applications.

In 1993 the SCP ECG Standard Communications Protocol was introduced and other additional data were required with each ECG record.

The Header as it is presently specified serves therefore two purposes:

1. It contains and provides all necessary patient and record identification data for unique identification of ECG Raw Data Records, for print outs of processing results like representative cycles and numerical and textual analysis results.

2. The Header serves now also as container for data which are necessary to produce a complete SCP record. There are mandatory and non-mandatory (optional) data sections. As far as those data accompany the ECG raw data they may be put into the Header during data acquisition. There is furthermore some free space for saving data in the Header during processing an ECG which might be stored finally in the respective sections of the SCP ECG record.

   Within the Header specification it is indicated

- which information is mandatory for processing resting ECGs with the **HES** algorithm and

- which information is mandatory for generation of a **SCP** record out of these data.

   If, for any reason, the mandatory information for **HES** is not put in (emergency ECGs), the HES analysis algorithm takes default values (see 8.3).

   The non-mandatory (optional) HES data within the Header are either useful clinical information accompanying the ECG record or it is information helpful for data management. Users of the HES ECG analysis program are encouraged to take advantage of the Header space and specification. The data described there are sufficient for all typical clinical routine processing as well as for ECG exchange during clinical or epidemiological studies.

3. Due to the development history some of the information used, e.g. Patient related data did grow only stepwise and requires today more space than it did originally. For compatibility reasons locations of such data could not always be changed. Therefore some parts as, e.g., Patient ID and Patient related data are somewhat dispersed within the Header.

   However, there are only few bytes of information mandatory for the HES algorithm with fixed links to internal HES data structures and some more for SCP record generation. As long as the user provides and allocates these data correctly, the rest of the Header space may be freely used for proprietary applications.

5 Revision History

5.1 Version Number of the Header and the Header Documentation

The version number of the **Header** is of the style "n.nn" - without any further additions. It is stored in byte 990. For technical reasons byte 990 contains version numer*100. The version number is incremented at any change of it's specification.

The version number of the Header **Documentation** has the form n.nn-m. At any editorial change (without change of the Header specification) m will be incremented.

Since 23.02.99 (version 1.07) the Header contains a "fingerprint" to distinguish it from old versions without a version number.

5.2 Compatibility with previous Header Definitions

1. The Header version 1.09 has been established to accommodate fully the generation of the SCP version 1.3-2.2 SCP records.

2. To fully provide the information for a SCP record size, format and location of a few data items had to be changed (see below Revisions in Version 1.09).

3. The Header version 1.09 is therefore not directly backward compatible. Processing of ECG records with an "older" Header requires some format conversion of the (old) Header data.

5.3 Revisions of the Header Specifications

02/2007 Version 1.09A

- Enhanced codes for ECG lead definition (see 10.2) according to SCP version 2.2
- Enhanced manufacturer specific codes for race (see 8.4Note 2)
- Patch version, because the format is not changed, only the number of defined codes has been enhanced.

06-07/2001 Version 1.09

- Editorial changes for better readability.
  Also, the term mandatory (headline last column) has been replaced by "use". Identification of mandatory items is given in the respective lines – see also section 3 overview.

- The bytes 0-39 shall contain now only the Patient ID, as used for SCP. No information like age or gender is extracted from this field anymore.
- Pacemaker information has been moved from bytes 17 and 18 to bytes 138 and 139.
- The format for storage of recording date and time and birth date is changed – there are no more delimiters
- Recording time contains now also the seconds
- Age is stored only once with an unit specifier like in SCP

- For byte 902 – 965 “SCP code for lead” changed to “SCP lead ID for channel”
- Amplitude Value Multiplier in bytes 994 + 995 has been divided into Amplitude Value Multiplier of the acquiring device (bytes 994 + 995) and Amplitude Value Multiplier of the data provided with this Header (bytes 996+997)
- Resolution in nano Volt (bytes 996 + 997) has been moved and modified to A/D converter resolution in bits (bytes 998 + 999)
- Minimum number increments = neg. extreme Amplitude (bytes 998 + 999) and Maximum number if increments = pos. extreme Amplitude - (bytes 998...1001) have been removed.

04/2001 Version 1.08

The Header version 1.08 was the first step in preparing the HES ECG record for operation with the new SCP version 1.3 standard.

- There are additional entries for demographic data etc units in bytes 152-158
- Correction of the documentation for bytes 961-65. (SCP codes for lead 60-64)
- File name and long file name for an ECG to be stored in one array of 32 bytes; 4 bytes reserved for future use

- Two corrections to make the Header partial identical to SCP
- bytes 463-66 : old yes=0 – new yes =1
- bytes 563-66 : old yes=0 – new yes =1
- bytes 1010/11 units now in Hz instead of 1/100 Hz

- More bytes for medical history
- Names of manufacturers for acquiring and analyzing device
- Names of referring and overreading physician
- Two manufacturer specific arrays for transfer by HES programs
- Referral diagnosis
- Block for demographic data
- Electrode configuration code
- Extended codes for character sets

- IP numbers of acquiring and analyzing device are no longer required by SCP and are removed from the Header.

03/2000 Version 1.07

Correspondence between Header and document version numbers introduced (editorial change).

- The Header contains more information for SCP as before. The age in month/weeks or days contains the remaining values (e.g. 3 years, 4 months and not 40 months)
- New entry for age in months, weeks and days
- Additional information for SCP were added. “Mandatory” data items was distinguished for HES and SCP.

- Introduction of a “finger print” to distinguish the new Headers from old ones.

11/1998 Version 1.06
- Version number for the Header introduced – actual number: 1.06 (see char 990)
- Now different notation of version numbers for the Header itself and for the document, describing the header.
- SCP codes included in this document
- The mandatory information elements are identified.
- Bytes 900-1023 new defined
- Lead identification for up to 64 leads as in SCP
- Definition of data, e.g. AVM, resolution, number of sampled now included.
- New MS-Word structure for this document

04/1998 Version 1.05
- PM flag and type is now specified

02/1998 Version 1.04
- New entry for patient’s ward in 288-292

10/1997 Version 1.03
- Editorial changes

10/1997 Version 1.02
- Extended lead ID, selected leads for presentation now in Header

06/1997 Version 1.01
- Begin of file-name from 251 to 252

06/1997 Version 1.00
- First version of the Header Documentation

6 Overview, Definitions

This document describes the header for the ECG data used by the HESEKG, HESSCP, ... programs. The Header is stored in front of the ECG raw data itself and shall contain identifications for:

- the patient
- recording time and date
- recording and analyzing device, location, recording technician and involved physicians
- ECG raw data
- and other information necessary to create SCP records

The Header has a length of 1024 byte. The first 900 bytes have to be filled with ASCII characters. Entries which are called ´reserved´ and those which are not filled by the actual application have to be initialized with ASCII blanks. The ASCII set is the one of the analyzing device, which is specified in byte 1019.

The last 124 bytes of the Header shall be initially set to binary zero.

All *numerical* entries are stored *flush right* while the *textual* and *α-numeric string* entries are stored *flush left*.

Warning: The ANSI C-Function SPRINTF terminates all character strings by a binary zero. To avoid overwriting of subsequent characters use of ANSI C-Function MEMCPY is recommended!

There are two arrays (bytes 644-704, bytes 856-893) for transfer of data, without specification. These arrays may be used for “transport” of application specific information.

Versions (1.08) 1.09 have been established to accommodate the SCP Standard Version 1.3.

The column “Use” serves

a) to identify whether the information of the respective line is necessary for the HES program or for the SCP record.
b) by the notation it is indicated whether the item is mandatory or optional:

Example:
HES → mandatory for the HES Analysis Program
SCP → mandatory or highly recommended for generation of a SCP record
(HES) → optional, may be useful for the management of ECG raw data and of analysis results
(SCP) → optional for generation of a SCP record
blank → data item may be helpful for management of ECG raw data, and of ECG analysis results in clinical studies

7 Allocation of Header Bytes – Overview

The Header consists of the following data blocks.

Byte	Definition	Length
0 – 39	Patient ID	40
40 – 65	Date and Time of Recording and Date of Birth	26
66 – 105	Patients Name, Weight, Height, Age and Sex	40
106 – 137	Patients First Name and Name at birth	32
138 – 159	Codes for PM, ECG Type, Race, Time Zone and Unit Specifiers	22
160 – 191	Technician Identification	32
192 – 251	Acquiring Institution and Department, Room Identification	60
252 – 287	File Name / Name of Data	36
288 – 299	Identification of Patient's Ward	12
300 – 320	Drugs	21
321 – 334	Blood Pressure	14
335 – 399	Medical History	65
400 – 486	Acquiring Device Identification	87
487 – 499	Referring Physician	13
500 – 586	Analyzing Device Identification	87
587 – 599	Overreading Physician	13
600 – 643	Analyzing Institution and Department	44
644 – 704	Application Specific Info 1	61
705 – 739	Referral Diagnosis	35
740 – 843	Address of Patient and Social Insurance Number	104
844 – 855	Additions for Patient's Name	12
856 – 893	Application Specific Info 2	38
894 – 899	Header Identification - Finger Print	6
900 – 989	Lead ID	90
990–1023	Version Number, Quantization, Resolution, Filter and Configuration	34

Note: Length includes also "reserved" bytes in the direct neighborhood of the respective item.

8 Patient and Acquiring Environment ID

8.1 Overview : Patient Related Data

The Header contains information about the patient, device, the environment, and record specifications. The following table shows all patient related entries of the Header.

The Patient ID in byte 0-39 is for identification of the patient and not for identification of the recording. This information is used for patient identification in SCP section 1 tag 2.

Byte	Definition	Length
0 - 39	Patient ID	40
40 - 47	Date of recording ddmmyyyy	8
48 - 53	Time of recording hhmmss	6
56 - 63	Date of birth ddmmyyyy	8
66 - 95	Patient's name (1): Family name	30
96 - 98	Weight	3
99 – 101	Height	3
102 – 104	Age	3
105	Sex	1
106 – 137	Patient's name (2): First name, Name at birth	32
138 - 151	Pacemaker (PM) Information, ECG type, Race	14
288 - 299	Name of patient's ward	12
300 –320	Drugs	21
321 - 326	Blood pressure	6
335 – 399	Medical history	22
705 – 739	Referral diagnosis	35
740 – 823	Address, phone number	84
824 - 843	Social insurance number	20
844 - 855	Patient's name (3): Additions	12

8.2 Patient ID, Date and Time of Recording and Date of Birth

Byte	Definition	Length	Use
0 – 39	Patient ID (α-numer. string)	40	**SCP**
40	day of recording from ddmmyyyy hhmmss	1	**HES & SCP**
41	day of recording from ddmmyyyy hhmmss	1	**HES & SCP**
42	month of recording from ddmmyyyy hhmmss	1	**HES & SCP**
43	month of recording from ddmmyyyy hhmmss	1	**HES & SCP**
44	year of recording from ddmmyyyy hhmmss	1	**HES & SCP**
45	year of recording from ddmmyyyy hhmmss	1	**HES & SCP**
46	year of recording from ddmmyyyy hhmmss	1	**HES & SCP**
47	year of recording from ddmmyyyy hhmmss	1	**HES & SCP**
48	hour of recording from ddmmyyyy hhmmss	1	**HES & SCP**
49	hour of recording from ddmmyyyy hhmmss	1	**HES & SCP**
50	minute of recording from ddmmyyyy hhmmss	1	**HES & SCP**
51	minute of recording from ddmmyyyy hhmmss	1	**HES & SCP**
52	second of recording from ddmmyyyy hhmmss	1	**HES & SCP**
53	second of recording from ddmmyyyy hhmmss	1	**HES & SCP**
54	reserved	1	
55	reserved	1	
56	day of birth from ddmmyyyy	1	**HES & SCP**
57	day of birth from ddmmyyyy	1	**HES & SCP**
58	month of birth from ddmmyyyy	1	**HES & SCP**
59	month of birth from ddmmyyyy	1	**HES & SCP**
60	year of birth from ddmmyyyy	1	**HES & SCP**
61	year of birth from ddmmyyyy	1	**HES & SCP**
62	year of birth from ddmmyyyy	1	**HES & SCP**
63	year of birth from ddmmyyyy	1	**HES & SCP**
64	reserved	1	
65	reserved	1	

day	from 01 to 31
month	from 01 to 12; 01 = Jan, .., 12 = Dec
year	Gregorian (4 bytes) like 1999, 2000, 2001
hour	from 00 to 23
minute	from 00 to 59
second	from 00 to 59

8.3 Patient's Name, Weight, Height, Age and Sex

Byte	Definition	Length	Use
66 – 95	family name	30	(HES) & **SCP**
96 - 98	weight - unit see 152	3	(SCP)
99 – 101	height - unit see 153	3	(SCP)
102 – 104	age - unit see 159	3	**HES** & (SCP)
105	char sex: m or M for male / f or F for female	1	**HES** & **SCP**
106 - 121	first name	16	(HES) & **SCP**
122 - 137	family name at birth	16	(HES) & (SCP)
844 - 855	patient's name, additions see 8.4	12	(HES)

If the entries for age and sex are not filled, the HES resting ECG analysis program takes default values (35 years; male).

8.4 Codes for Pacemaker Flag, ECG Type, Race, Time Zone and Unit Specifiers

Byte	Definition	Length	Use
138	Pacemaker Flag (P=yes, p=unknown else no PM)	1	**HES**
139	PM-Type (?=unknown, A=atrial, Q=ventricular,B=bi)	1	**HES**
140	type of ECG R = Resting ECG X = Exercise ECG H = Holter ECG A = Arrhythmia/Rhythm ECG M=Mapping	1	(HES) (HES) (HES) (HES) (HES)
141	Resting ECG : patient's position 0=unknown, 1=lying, 2=...	1	(HES)
142	Resting ECG : environment 0=unknown, 1=indoor 2=outdoor 3=car 4=...	1	(HES)
143 - 146	reserved	4	
147 - 148	stat code [1] = level of emergency 0=routine	2	(HES) & (SCP)
149 - 151	code for race[2] 3 char	3	(HES) & (SCP)
152	Unit Code Weight (0= unspec,1=kg,2 =gr,3=pound,4=ounce)	1	(HES) & (SCP)
153	Unit Code Height (0=unspec, 1=cm, 2=inches, 3= mm)	1	(HES) & (SCP)
154 - 157	Date Time Zone [3] : signed integer 4 char	4	(HES) & **SCP**
158	Date Time Zone : manufacturer specific	1	**SCP**
159	char Unit Code Age (0=unspec, 1=years, 2=months, 3=weeks, 4=days, 5=hours)	1	**HES** & (SCP)

Notes:

[1] Stat code has to be set for SCP: 0 = routine ECG; 1...10 = emergency ECG

[2] Additional (manufacturer specific) codes for race:

200 Hispanic

201 Asian

[3] Date Time Zone is an offset from UTC in minutes.

8.5 Technician Identification

Byte	Definition	Length	Use
160 - 175	reserved	16	
176 - 191	technician identification (α-numer. string)	16	(HES) & (SCP)

8.6 Acquiring Institution and Department, Room Identification

For institution or department numbers only digits are allowed.

Byte	Definition	Length	Use
192 - 197	acquiring institution number[1]	6	**SCP**
198 – 213	acquiring institution name	16	**HES** & (SCP)
214 - 219	acquiring department number[1]	6	**SCP**
220 - 235	acquiring department name	16	**HES** & (SCP)
236 - 251	identification of the room where the ECG is acquired[1] (α-numer. string)	16	(HES) & (SCP)

[1] if a number cannot be given insert default code 29999 (numeric flush right!)

9 File Name, Ward, Drugs, Blood Pressure and Medical History

9.1 File Name / Name of Data

Byte	Definition	Length	Use
252 - 283	name of ECG data - HES internal use	32	(HES)
284 - 287	reserved	4	

9.2 Identification of Patient's Ward

Byte	Definition	Length	Use
288 - 299	name of patient's ward	12	(HES)

9.3 Drugs, Blood Pressure

Byte	Definition	Length	Use
300 - 302	drug class 1	2	(SCP)
302 - 303	drug code 1	2	(SCP)
304 – 305	time since medication drug 1	2	
306	time unit for drug 1 (1=min; 2=hour;3=days)	1	
307 - 308	drug class 2	2	(SCP)
309 - 310	drug code 2	2	(SCP)
311 - 312	time since medication drug 2	2	
313	time unit for drug 2 (1=min; 2=hour;3=days)	1	
314 - 315	drug class 3	2	(SCP)
316 - 317	drug code 3	2	(SCP)
318 - 319	time since medication drug 3	2	
320	time unit for drug 3 (1=min; 2=hour;3=days)	1	
321 – 323	diastolic blood pressure	3	(SCP)
324 – 326	systolic blood pressure	3	(SCP)
327 – 334	reserved	8	

9.4 Medical History

Byte	Definition	Length	Use
335 – 337	medical history code 1 (see SCP for coding)	3	(SCP)
338 – 340	medical history code 2	3	(SCP)
341 - 343	medical history code 3	3	(SCP)
344 - 399	medical history text	56	(SCP)

10 Device Identifications, Physicians

10.1 Acquiring Device Identification

Byte	Definition	Length	Use
400 - 405	device ID acquiring device (only ASCII numbers)[1]	6	**SCP**
406	device type (0 = cart; 1 = host)[2]	1	**SCP**
407 - 409	manufacturer code: set "255" ASCII	3	**SCP**
410 - 414	model description acquiring device (α-numer. string)[3]	5	**SCP**
415 - 430	reserved	16	
431 - 446	acquiring program revision number (α-numer. string)	16	**SCP**
447 - 462	serial number acquiring device (α-numer. string)	16	**SCP**
463	print capability of acquiring device (1=yes 0=no)	1	**SCP**
464	analysis capability of acquiring device (1=yes 0=no)	1	**SCP**
465	storage capability of acquiring device (1=yes 0=no)	1	**SCP**
466	acquire capability of acquiring device (1=yes 0=no)	1	**SCP**
467 - 486	Name of manufacturer of acquiring device	20	**SCP**

[1]see SCP Section 1 tag 14, byte 5,6: use up to six meaningful digits of the Serial Number or code 29999 flush right stored if a serial number of the device is not put in.
[2]use code 0 (ASCII) = cart for ECG amplifier of a PC based system
[3]use meaningful code (5 ASCII characters) to identify data acquisition unit (ECG Amplifier)

10.2 Referring Physician

Byte	Definition	Length	Use
487 - 499	Name of referring physician	13	(SCP)

10.3 Analyzing Device Identification

Byte	**Definition**	**Length**	**Use**
500 – 505	analyzing device Id. If PC use code "29999"[1]	6	**SCP**
506	device type (0 = cart; 1 = host) if PC use "1"	1	**SCP**
507 – 509	manufacturer code set "255" ASCII	3	**SCP**
510 – 514	model description analyzing device[2] (α-numer. string)	5	**SCP**
515 – 530	reserved	16	
531 – 546	analyzing program revision number (α-numer. string)	16	**SCP**
547 – 562	serial number analyzing device	16	**SCP**
563	print capability of analyzing device (1=yes 0=no)	1	**SCP**
564	analysis capability of analyzing device (1=yes 0=no)	1	**SCP**
565	storage capability of analyzing device (1=yes 0=no)	1	**SCP**
566	acquire capability of analyzing device (1=yes 0=no)	1	**SCP**
567 – 586	Name of manufacturer of analyzing device	20	**SCP**

[1]see SCP section 1 tag 15, byte 5,6: if the analyzing device is an ECG cart use 6 ASCII digits evtl. from serial number, if it is a PC use code 29999 ASCII flush right stored
[2]if PC use "PC" and evtl. 3 characters to identify its manufacturer

10.4 Overreading Physician

Byte	Definition	Length	Use
587 – 599	Name of overreading physician	13	**HES** & (SCP)

10.5 Analyzing Institution and Department

For institution or department numbers only ASCII numbers are valid.

Byte	Definition	length	Use
600 - 605	analyzing institution number[1]	6	**SCP**
606 - 621	analyzing institution name	16	(SCP)
622 - 627	analyzing department number[1]	6	**SCP**
628 - 643	analyzing department name	16	(SCP)

[1]if a number cannot be given insert default code 29999 (numerical flush right)

8 Application Specific Info, Referral Diagnosis, 2nd Part of Patient ID Data

8.1 Application Specific Info 1

Byte	Definition	Length	Use
644 – 699	application specific info 1 – only transported by the HES programs. (α-numer. string)	56	
700 - 704	reserved	5	

8.2 Referral Diagnosis

Byte	Definition	Length	Use
705 - 739	Referral diagnosis	35	(SCP)

8.3 Address of Patient and Social Insurance Number

Byte	Definition	Length	Use
740 - 759	Street	20	
760 - 764	House number (α-numer. string)	5	
765 – 784	City	20	
785 - 792	Zip code (α-numer. string)	8	
793 - 796	State	4	
797 - 808	Country	12	
809 - 823	Phone number (α-numer. string)	15	
824 - 843	Social insurance number (α-numer. string)	20	(HES)

8.4 Additions for Patient's Name

Byte	Definition	Length	Use
844 – 849	Patient's name – title	6	
850 - 855	Patient's name – addition/2nd, 3rd... initials	6	

8.5 Application specific Info 2

Byte	Definition	Length	Use
856-893	Application specific info 2 – only transported by the HES programs. (α-numer. string)	38	

9 Header Identification – Finger Print

The previous HES Headers up to version 1.05 had no identification or version number. Since Header version 1.07 a special „finger-print“ for Header identification independently from it’s version number has been introduced. This finger print has a length of 6 bytes.

For Headers with a valid Finger Print, the version number is used for data management.

Byte	Definition	Use
894	char1 finger print = “z”	**HES**
895	char2 finger print = ”H”	**HES**
896	char3 finger print = “Y”	**HES**
897	char4 finger print = “e”	**HES**
898	char5 finger print = ”W”	**HES**
899	char6 finger print = ”s”	**HES**

10 Data Definition

This part of the Header (bytes 900...1023) has to be initialized with binary zeros. Specifications for lead identifications, scaling factors for amplitude and time, filter descriptions and configurations can be found here.

10.1 Lead ID

The Lead ID is filled binary with the SCP lead identification codes (see **10.2**0). The first two elements contain the number of used leads.

The data for all HES raw data files or structures are stored in sample order.

Byte	Definition	Length	Use
900	Number of leads	1	**HES & SCP**
901	Number of simultaneously recorded leads [1]	1	**HES & SCP**
902	SCP lead ID for channel 1 see 10.2	1	**HES & SCP**
903	SCP lead ID for channel 2 see 10.2	1	**HES & SCP**
904	SCP lead ID for channel 3 see 10.2	1	**HES & SCP**
905	SCP lead ID for channel 4 see 10.2	1	**HES & SCP**
906	SCP lead ID for channel 5 see 10.2	1	**HES & SCP**
907	SCP lead ID for channel 6 see 10.2	1	**HES & SCP**
908	SCP lead ID for channel 7 see 10.2	1	**HES & SCP**
909	SCP lead ID for channel 8 see 10.2	1	**HES & SCP**
910 - 965	SCP lead IDs for channels 9 - 64	56	**HES & SCP**
966 - 989	Reserved for binary description of recording	24	

[1] In case not all leads are recorded simultaneously, the leads shall be presented in groups corresponding to those recorded simultaneously.

10.2 SCP Codes for Lead ID

These codes are taken from the European Standard Communications Protocol for Computer-Assisted Electrocardiography: prEN 1064,2007-02 (SCP-Version 2.2, February 2007)

SCP-ECG Code	SCP-ECG Name	Description	Vital Ref ID MDC_ECG_LEAD_XXX
0		Unspecified lead	MDC_ECG_LEAD_CONFIG
1	I	Lead I	MDC_ECG_LEAD_I
2	II	Lead II	MDC_ECG_LEAD_II
3	V1	V1	MDC_ECG_LEAD_V1
4	V2	V2	MDC_ECG_LEAD_V2
5	V3	V3	MDC_ECG_LEAD_V3
6	V4	V4	MDC_ECG_LEAD_V4
7	V5	V5	MDC_ECG_LEAD_V5
8	V6	V6	MDC_ECG_LEAD_V6
9	V7	V7	MDC_ECG_LEAD_V7
10	V2R[a]	V2R	MDC_ECG_LEAD_V2R
11	V3R	V3R	MDC_ECG_LEAD_V3R
12	V4R	V4R	MDC_ECG_LEAD_V4R
13	V5R	V5R	MDC_ECG_LEAD_V5R
14	V6R	V6R	MDC_ECG_LEAD_V6R
15	V7R	V7R	MDC_ECG_LEAD_V7R
16	X	X[b]	MDC_ECG_LEAD_X
17	Y	Y[b]	MDC_ECG_LEAD_Y
18	Z	Z[b]	MDC_ECG_LEAD_Z
19	CC5[c]	CC5, per V5 and V5R placement	MDC_ECG_LEAD_CC5
20	CM5	CM5, per V5 placement	MDC_ECG_LEAD_CM5
21	LA	Left Arm	MDC_ECG_LEAD_LA
22	RA	Right Arm	MDC_ECG_LEAD_RA
23	LL	Left Leg	MDC_ECG_LEAD_LL
24	fI[d]	fI	MDC_ECG_LEAD_fI
25	fE	fE	MDC_ECG_LEAD_fE
26	fC	fC	MDC_ECG_LEAD_fC
27	fA	fA	MDC_ECG_LEAD_fA
28	fM	fM	MDC_ECG_LEAD_fM
29	fF	fF	MDC_ECG_LEAD_fF
30	fH	fH	MDC_ECG_LEAD_fH
31	dI	derived lead I	MDC_ECG_LEAD_dI
32	dII	derived lead II	MDC_ECG_LEAD_dII
33	dV1	derived lead V1	MDC_ECG_LEAD_dV1
34	dV2	derived lead V2	MDC_ECG_LEAD_dV2
35	dV3	derived lead V3	MDC_ECG_LEAD_dV3
36	dV4	derived lead V4	MDC_ECG_LEAD_dV4
37	dV5	derived lead V5	MDC_ECG_LEAD_dV5
38	dV6	derived lead V6	MDC_ECG_LEAD_dV6
39	dV7	derived lead V7	
40	dV2R	derived lead V2R	
41	dV3R	derived lead V3R	

SCP-ECG Code	SCP-ECG Name	Description	Vital Ref ID MDC_ECG_LEAD_XXX
42	dV4R	derived lead V4R	
43	dV5R	derived lead V5R	
44	dV6R	derived lead V6R	
45	dV7R	derived lead V7R	
46	dX	derived lead X	
47	dY	derived lead Y	
48	dZ	derived lead Z	
49	dCC5	derived lead CC5	
50	dCM5	derived lead CM5	
51	dLA	derived lead LA	
52	dRA	derived lead RA	
53	dLL	derived lead LL	
54	dfI	derived lead fI	
55	dfE	derived lead fE	
56	dfC	derived lead fC	
57	dfA	derived lead fA	
58	dfM	derived lead fM	
59	dfF	derived lead fF	
60	dfH	derived lead fH	
61	III	Lead III	MDC_ECG_LEAD_III
62	aVR	aVR, augmented voltage, right	MDC_ECG_LEAD_AVR
63	aVL	aVL, augmented voltage, left	MDC_ECG_LEAD_AVL
64	aVF	aVF, augmented voltage, foot	MDC_ECG_LEAD_AVF
65	aVRneg	aVRneg	MDC_ECG_LEAD_AVRneg
66	V8	V8	MDC_ECG_LEAD_V8
67	V9	V9	MDC_ECG_LEAD_V9
68	V8R	V8R	MDC_ECG_LEAD_V8R
69	V9R	V9R	MDC_ECG_LEAD_V9R
70	D	D (Nehb – Dorsal)	MDC_ECG_LEAD_D
71	A	A (Nehb – Anterior)	MDC_ECG_LEAD_A
72	J	J (Nehb – Inferior)	MDC_ECG_LEAD_J
73	Defib	Defibrillator lead: anterior-lateral	MDC_ECG_LEAD_DEFIB
74	Extern	External pacing lead: anterior-posterior	MDC_ECG_LEAD_EXTERN
75	A1	A1 (Auxiliary unipolar lead #1)	MDC_ECG_LEAD_A1
76	A2	A2 (Auxiliary unipolar lead #2)	MDC_ECG_LEAD_A2
77	A3	A3 (Auxiliary unipolar lead #3)	MDC_ECG_LEAD_A3
78	A4	A4 (Auxiliary unipolar lead #4)	MDC_ECG_LEAD_A4
79	dV8	derived lead V8	
80	dV9	derived lead V9	
81	dV8R	derived lead V8R	
82	dV9R	derived lead V9R	
83	dD	derived lead D (Nehb – Dorsal)	
84	dA	derived lead A (Nehb – Anterior)	
85	dJ	derived lead J (Nehb – Inferior)	
86	Chest	Chest lead	MDC_ECG_LEAD_C
87	V	Precordial lead	MDC_ECG_LEAD_V
88	VR	VR, nonaugmented voltage, vector of RA	MDC_ECG_LEAD_VR

SCP-ECG Code	SCP-ECG Name	Description	Vital Ref ID MDC_ECG_LEAD_XXX
89	VL	VL, nonaugmented voltage, vector of LA	MDC_ECG_LEAD_VL
90	VF	VF, nonaugmented voltage, vector of LL	MDC_ECG_LEAD_VF
91	MCL	Modified chest lead (left arm indifferent)	MDC_ECG_LEAD_MCL
92	MCL1	MCL, per V1 placement	MDC_ECG_LEAD_MCL1
93	MCL2	MCL, per V2 placement	MDC_ECG_LEAD_MCL2
94	MCL3	MCL, per V3 placement	MDC_ECG_LEAD_MCL3
95	MCL4	MCL, per V4 placement	MDC_ECG_LEAD_MCL4
96	MCL5	MCL, per V5 placement	MDC_ECG_LEAD_MCL5
97	MCL6	MCL, per V6 placement	MDC_ECG_LEAD_MCL6
98	CC	Chest lead (symmetric placement)	MDC_ECG_LEAD_CC
99	CC1	CC1, per V1 and V1R placement	MDC_ECG_LEAD_CC1
100	CC2	CC2, per V2 and V2R placement	MDC_ECG_LEAD_CC2
101	CC3	CC3, per V3 and V3R placement	MDC_ECG_LEAD_CC3
102	CC4	CC4, per V4 and V4R placement	MDC_ECG_LEAD_CC4
103	CC6	CC6, per V6 and V6R placement	MDC_ECG_LEAD_CC6
104	CC7	CC7, per V7 and V8R placement	MDC_ECG_LEAD_CC7
105	CM	Chest-manubrium	MDC_ECG_LEAD_CM
106	CM1	CM1, per V1 placement	MDC_ECG_LEAD_CM1
107	CM2	CM2, per V2 placement	MDC_ECG_LEAD_CM2
108	CM3	CM3, per V3 placement	MDC_ECG_LEAD_CM3
109	CM4	CM4, per V4 placement	MDC_ECG_LEAD_CM4
110	CM6	CM6, per V6 placement	MDC_ECG_LEAD_CM6
111	dIII	derived lead III	MDC_ECG_LEAD_dIII
112	daVR	derived lead aVR	MDC_ECG_LEAD_daVR
113	daVL	derived lead aVL	MDC_ECG_LEAD_daVL
114	daVF	derived lead aVF	MDC_ECG_LEAD_daVF
115	daVRneg	derived lead aVRneg	
116	dChest	derived lead Chest	
117	dV	derived lead V	
118	dVR	derived lead VR	
119	dVL	derived lead VL	
120	dVF	derived lead VF	
121	CM7	CM7, per V7 placement	MDC_ECG_LEAD_CM7
122	CH5	CH5	MDC_ECG_LEAD_CH5
123	CS5	negative: right infraclavicular fossa	MDC_ECG_LEAD_CS5
124	CB5	negative: low right scapula	MDC_ECG_LEAD_CB5
125	CR5	CR5	MDC_ECG_LEAD_CR5
126	ML	ML, modified limb lead, ~ Lead II	MDC_ECG_LEAD_ML
127	AB1	AB1 (auxiliary bipolar lead #1)	MDC_ECG_LEAD_AB1
128	AB2	AB2 (auxiliary bipolar lead #2)	MDC_ECG_LEAD_AB2
129	AB3	AB3 (auxiliary bipolar lead #3)	MDC_ECG_LEAD_AB3
130	AB4	AB4 (auxiliary bipolar lead #4)	MDC_ECG_LEAD_AB4
131	ES	EASI™ ES^{+C46}	MDC_ECG_LEAD_ES
132	AS	EASI AS	MDC_ECG_LEAD_AS
133	AI	EASI AI	MDC_ECG_LEAD_AI
134	S	EASI upper sternum lead	MDC_ECG_LEAD_S
135	dDefib	derived lead Defib: Defibrillator lead: anterior-lateral	

SCP-ECG Code	SCP-ECG Name	Description	Vital Ref ID MDC_ECG_LEAD_XXX
136	dExtern	derived lead Extern: External pacing lead: anterior-posterior	
137	dA1	derived lead A1 (Auxiliary unipolar lead #1)	
138	dA2	derived lead A2 (Auxiliary unipolar lead #2)	
139	dA3	derived lead A3 (Auxiliary unipolar lead #3)	
140	dA4	derived lead A4 (Auxiliary unipolar lead #4)	
141	dMCL1	derived lead MCL1: MCL, per V1 placement	
142	dMCL2	derived lead MCL2: MCL, per V2 placement	
143	dMCL3	derived lead MCL3: MCL, per V3 placement	
144	dMCL4	derived lead MCL4: MCL, per V4 placement	
145	dMCL5	derived lead MCL5: MCL, per V5 placement	
146	dMCL6	derived lead MCL6: MCL, per V6 placement	
147	RL	right leg	MDC_ECG_LEAD_RL
148	CV5RL	Canine, fifth right intercostal space near the edge of the sternum at the most curved part of the costal cartilage	MDC_ECG_LEAD_CV5RL
149	CV6LL	Canine, sixth left intercostal space near the edge of the sternum at the most curved part of the costal cartilage	MDC_ECG_LEAD_CV6LL
150	CV6LU	Canine, sixth left intercostal space at the costochondral junction	MDC_ECG_LEAD_CV6LU
151	V10	Canine, over dorsal spinous process of the seventh thoracic vertebra	MDC_ECG_LEAD_V10
152	dMCL	derived lead MCL: Modified chest lead (left arm indifferent)	
153	dCC	derived lead CC: Chest lead (symmetric placement)	
154	dCC1	derived lead CC1, per V1 and V1R placement	
155	dCC2	derived lead CC2, per V2 and V2R placement	
156	dCC3	derived lead CC3, per V3 and V3R placement	
157	dCC4	derived lead CC4, per V4 and V4R placement	
158	dCC6	derived lead CC6, per V6 and V6R placement	
159	dCC7	derived lead CC7, per V7 and V8R placement	
160	dCM	derived lead CM Chest-manubrium	
161	dCM1	derived lead CM1, per V1 placement	
162	dCM2	derived lead CM2, per V2 placement	
163	dCM3	derived lead CM3, per V3 placement	
164	dCM4	derived lead CM4, per V4 placement	
165	dCM6	derived lead CM6, per V6 placement	
166	dCM7	derived lead CM7, per V7 placement	
167	dCH5	derived lead CH5	
168	dCS5	derived lead CS5: negative: right infraclavicular fossa	
169	dCB5	derived lead CB5: negative: low right scapula	
170	dCR5	derived lead CR5	
171	dML	derived lead ML, modified limb lead, ~ Lead II	
172	dAB1	derived lead AB1 (auxiliary bipolar lead #1)	
173	dAB2	derived lead AB2 (auxiliary bipolar lead #2)	

SCP-ECG Code	SCP-ECG Name	Description	Vital Ref ID MDC_ECG_LEAD_XXX
174	dAB3	derived lead AB3 (auxiliary bipolar lead #3)	
175	dAB4	derived lead AB4 (auxiliary bipolar lead #4)	
176	dES	derived lead ES: EASI™ ES	
177	dAS	derived lead AS: EASI AS	
178	dAI	derived lead AI: EASI AI	
179	dS	derived lead S: EASI upper sternum lead	
180	dRL	derived lead RL: right leg	
181	dCV5RL	derived lead CV5RL: Canine, fifth right intercostal space near the edge of the sternum at the most curved part of the costal cartilage	
182	dCV6LL	derived lead CV6LL: Canine, sixth left intercostal space near the edge of the sternum at the most curved part of the costal cartilage	
183	dCV6LU	derived lead CV6LU: Canine, sixth left intercostal space at the costochondral junction	
184	dV10	derived lead V10: Canine, over dorsal spinous process of the seventh thoracic vertebra	
185 to 199		Reserved for future expansion[f, g]	
200 to 255		Manufacturer Specific[g]	

Notes:

a) V2R is identical to lead V1. Similarly, lead V1R, not listed in the lead table, is identical to lead V2.

b) Leads X, Y and Z can be recorded by an orthogonal system, such as Frank or McFee lead systems, etc.

c) CM5, CH5, CS5, CC5, CB5, CR5 bipolar leads used in conjunction with stress testing. Macfarlane, Volume 1, page 323. [CX5?].

d) Frank leads indicated by 'f' for clarity and label uniqueness.

e) EASI™ trademark owned by Philips, invented by Dr. Gordon Dower. Leads: S, upper sternum; E, lower sternum (Frank lead fE); A, under left arm, above V6 (Frank lead fA); I, under right arm, above V6R (Frank lead fI).

f) Extension of the lead numbering scheme may be done in future revisions of the protocol.

g) Users of this standard are advised to refer to documents „*HL7 aECG Implementation Guide, Final, March 21, 2005*", „ISO/IEEE 11073-10101, *Health informatics - Point-of-care medical device communication - Part10101: Nomenclature (still commonly known as 'VITAL' from its former ENV 13734 designation)*" and other current standards in the ISO/IEEE Nomenclature series to avoid unintended duplication in these code ranges.

10.3 Version Number, Quantization, Resolution, Filter and Configuration

Byte	Definition	Use
990	Version number of the header *100	**HES** & **SCP**
991	reserved for HES internal use (selection of rhythm lead in Standard Printout)	(HES)
992 + 993	Sample Interval [µSec]	**HES** & **SCP**
994 + 995	AVM = Amplitude Value Multiplier [nV/Increment] of the acquiring device	**HES**
996 + 997	AVM = Amplitude Value Multiplier [nV/Increment] of the data provided with this header	**HES**
998 + 999	A/D converter resolution in bits	**HES**
1000 +1001	reserved	
1002 – 1005	Number of samples (unsigned long)	**HES** & **SCP**
1006 +1007	Line frequency at recording place [Hz]	**HES** & **SCP**
1008 +1009	cut-off frequency (-3db) of the high pass filter in raw data in units of (1/100) Hz	**HES** & (SCP)
1010 +1011	cut-off frequency (-3db) of the low pass filter in raw data in units of Hz	**HES** & (SCP)
1012 +1013	type of other filter Bit 0 = 60 Hz notch 1 = 50 Hz notch 2 = artifact filter 3 = baseline filter else = undefined	**HES** & (SCP)
1014 +1015	SCP Flag 0 = no SCP compressed raw data 1 = SCP redundancy compression 2 = SCP maximal compression 29999 = unknown	**HES** & **SCP**
1016 +1017	Electrode configuration code (see SCP) Byte 1 for 12 lead ECGs (0=unspec, 1=standard, ...) Byte 2 for 3 lead ECGs (0=unspec, 1 = Frank, ...)	(SCP)
1018	Character set used in acquiring device (for 8 bit ASCII only bit 0 has to be set to zero)	**SCP**
1019	Character set used in analyzing device (for 8 bit ASCII only bit 0 has to be set to zero)	**SCP**
1020 - 1023	reserved for HES	

- End of document -