Title	Communications Interface Standard	**Page**	1 of 184
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MS Word Standard
QSD Cover Sheet

Attachments (*Optional*):

1. INTRODUCTION

1.1 Purpose

The purpose of this Interface Control Document is to define the physical and functional interface used to exchange data between Medtronic Emergency Response Systems (Medtronic ERS) products.

1.2 Scope

This document defines the recommended technical interface between Medtronic ERS products. This document is a complete description of all interaction between the two elements when operating together to allow transfer of patient and related data.

1.3 Applicable Documents

1.3.1 Medtronic ERS

LIFENET System Description	PDR-3767
Pyramid Product Family Communications Interface Control Document	2002-048
Interface Control Document, Manufacturing Test	3006154
ECG/Voice Translator MODEM Transmission Format	3005068
ECG/Voice Translator Software Requirements Specification	3005067
ZMODEM Interface Control Document	3011345
Device and Patient Data Report Standard	3012543
LIFENET System Filter Description Standard	PDR-4722
LIFENET Time and Frequency Standard Features	PDR-4628

1.3.2 Government and other External Standards

European Committee for Standardization (CEN): Standard Communications Protocol for Computer Assisted Electrocardiography (short: SCP-ECG), Version 1.0, CEN-Secretariat, Rue de Stassart, Brussels, 1994.

ITU CCITT Blue Book Volume VIII - Fascicle VIII.1 “Data Communication over the Telephone Network”

TIA/EIA RS-232-E “Interface Between Data Terminal Equipment and Data Circuit-Terminating Equipment Employing Serial Binary Exchange.”

TIA/EIA - 592 “Asynchronous Facsimile DCE Control Standard - Service Class 2”

TIA/EIA - 602 “Data Transmission Systems and Equipment - Serial Asynchronous Automatic Dialing and Control.”

Infra-Red Data Organization, IrDA 1.1 Standard Suite

1.4 Acronyms and Abbreviations

ASCII	When used to describe a data item, refers to the ASCII 7-bit printable character set
BPS	Bits Per Second. A unit of measure for identifying the rate of data transmission.
CAD	Computer Aided Dispatch
DME	Data Management Entity: Any device used to store and/or manage data from Medtronic ERS products. These are usually DT-3/DT-4 type devices.
ED	Emergency Department
EVT	ECG/Voice Translator; translates data stored on C60 dual track (voice, ECG) cassette tapes from LIFEPAK 5, 200, 250 or 300 devices to a printer or a computer via MODEM or serial connection.
MTI	Manufacturing Test Interface
PC	A computer based on an Intel compatible 808x or 80x86 processor core and with internal architecture compatible with what is loosely referred to an “IBM compatible”. There are several different interface bus implementations, XT,AT, Micro Channel, ESDI, VESA and PCI are examples of these busses.
ERS	Emergency Response Systems
PDA	Personal Digital Assistant. A small battery powered, hand held computer.
PIF	Peripheral Interface
MODEM	‘Modulator/Demodulator’. In this document’s usage it refers to an interface between a RS-232 serial data stream with an analog telephone system.
ZMODEM	A serial communications file transfer protocol.

1.5 Definitions

ASCII Mnemonic	Full ASCII name	ASCII Character	ASCII keystroke (Control code)
NUL	Null	00h	<ctrl-@>
SOH	Start of Heading	01h	<ctrl-A>
STX	Start of Text	02h	<ctrl-B>
ETX	End of Text	03h	<ctrl-C>
EOT	End of Transmission	04h	<ctrl-D>
ENQ	Enquire	05h	<ctrl-E>
ACK	Acknowledge	06h	<ctrl-F>
BEL	Bell	07h	<ctrl-G>
TAB	Tab	09h	<ctrl-I>
LF	Line Feed	0ah	<ctrl-J>
CR	Carriage Return	0dh	<ctrl-M>
DC1	XON	11h	<ctrl-Q>
NAK	Negative Acknowledge	15h	<ctrl-U>
CAN	Cancel	18h	<ctrl-X>
ESC	Escape	1Bh	ESC key

BREAK - A BREAK is not a character but a signaling condition defined as “start” polarity of at least 2M+3 bits in length, where M = number of bits per character, followed by at least 2M bits of “stop” polarity. This can cause a framing and parity error (if parity is enabled), or a BREAK detection (if provided) at the receiving side which may be used as a signal for a break condition. The time period of 20 milliseconds may be used with any BPS rate of 1200 and higher. This BREAK time period is sufficiently long for any device supported by this document (reference the ITU CCITT Blue Book Volume VIII - Fascicle VIII.1).

2. OVERVIEW

Standardized communication between Medtronic ERS devices can be described as several distinct communications modes. Each mode may be applicable to different device types. Refer to the table below for a list of the device types and communications modes

Table 1: Device Types and Communications Modes

Device Type[1]	Example	Communications Modes	
		Transmit only	
DT-1	LP500 Cedar	Presentation: Transport Protocol: Flow-Control: Connectivity:	Extended SCP, ASCII Zmodem only Xon/Xoff only Direct, Modem
		Transmit only	
DT-1PL	LP-300 EVT	Presentation: Transport Protocol: Flow-Control: Connectivity:	EVT EVT None Direct, Modem
		Transmit only	
DT-1FL	First-Medic 710	Presentation: Transport Protocol: Flow-Control: Connectivity:	First-Medic None RTS/CTS Direct, Modem
		Transmit only	
DT-2	LP12, Cruiser	Presentation: Transport Protocol: Flow-Control: Connectivity:	Extended SCP, ASCII, and Group III Class 2 and Class 2.0 Fax ZMODEM, IrDA OBEX (Cruiser only) Xon/Xoff and RTS/CTS (ZMODEM only), IrDA flow control per IrDA 1.1 Direct, Modem, IrDA
		Transmit only	

[1]Device types with the suffix PL represent “Physio Legacy” devices. Those with FL represent “FirstMedic Legacy” devices.

DT-2PL	LP11	Presentation: Transport Protocol: Flow-Control: Connectivity:	Mortara Medtronic ERS-FTP RTS/CTS Direct, Modem
		Transmit	
DT-3	GrapeVine RS200 PDA	Presentation: Transport Protocol: Flow-Control: Connectivity:	Extended SCP,EVT Zmodem,EVT Xon/Xoff,RTS/CTS Direct, Modem
		Receive	
		Presentation: Transport Protocol: Flow-Control: Connectivity:	Extended SCP,EVT Zmodem, EVT Xon/Xoff, RTS/CTS Direct,Modem
		Transmit	
DT-3PL	RS100	Presentation: Transport Protocol: Flow-Control: Connectivity:	Mortara Medtronic ERS-FTP RTS/CTS Direct, Modem
		Receive	
		Presentation: Transport Protocol: Flow-Control: Connectivity:	Mortara Medtronic ERS-FTP RTS/CTS Direct, Modem
		Transmit	
DT-4	DEVCOMM Comm'n Package (CodeStat 2, 3, 4; LIFENET-RS	Presentation: Transport Protocol: Flow-Control: Connectivity:	Extended SCP Zmodem Xon/Xoff, RTS/CTS Direct, Modem

	1.0 - 1.3)	**Receive**	
		Presentation: Transport Protocol: Flow-Control: Connectivity:	Extended SCP, EVT, Mortara Zmodem, EVT, Medtronic ERS-FTP, IrDA OBEX Xon/Xoff, RTS/CTS (ZMODEM only), IrLAP/IrLMP Direct, Modem, IrDA
		Receive Only	
DT-4PL	CodeStat 1.0	Presentation: Transport Protocol: Flow-Control: Connectivity:	EVT, Mortara EVT, Medtronic ERS-FTP Xon/Xoff, RTS/CTS Direct, Modem
		Receive Only	
DT-4FL	DataManager III	Presentation: Transport Protocol: Flow-Control: Connectivity:	First-Medic None RTS/CTS Direct, Modem

2.1 Functional Overview

2.1.1 DT-1 and DT-2 Devices

Device types which are DT-1, DT-2 products within this system will store data for transfer to Data Management Entities (DME). When transmission of the stored data is required, a connection between the device and DME will be established and data transfer completed. The methods and formats of the connection process as well as the data contents format are defined within this document. DT-2 devices may also optionally support directory services using the SCP-ECG Query-Messaging protocol.

Descriptions of the DT-2 category of devices include the DT2-PL (LP11) which differs slightly from the DT-2 configuration. Wherever such differences exist, there will be an explicit description or notation showing the DT2-PL configuration. Unless so noted, any item labeled as DT-2 applies to both legacy and non-legacy DT-2 equipment.

Facsimile transmissions from DT-2 devices shall conform to the Group III Class 2 or Class 2.0 format. Class 2.0 services are defined in EIA/TIA-592. Each device will specify for implementation a subset of the Class 2 and 2.0 services. Supported

resolutions are restricted to NORMAL and FINE (no support of SUPERFINE resolution).

The following messages shall be printed on faxed reports containing ECG waveforms:

> NORMAL Mode: “Faxed ECG: Normal resolution. May not be adequate for diagnostic purposes. Always use the grid lines printed on the fax copy when assessing ECGs.”
>
> FINE Mode: “Faxed ECG: Fine resolution. Always use the grid lines printed on the fax copy when assessing ECGs.”

All faxed reports shall contain printed data showing the date and time of transmission and identifying the sending entity. The format of the printed data may be determined by the device implementation.

The Cruiser product adds IrDA connectivity using the IrDA OBEX transport protocol over the IrDA 1.1 protocol stack. Communication hardware that presents an IrDA-compatible interface (such as a Bluetooth module) may be substituted for the IrDA hardware without changes to this standard. IrDA communications support data records only.

2.1.2 DT-3 Devices

Devices of DT-3 type are devices which are designed to receive data from DT-1,DT-2 devices, and add limited Patient Identification information to the patient record. It can print reports to a printer and export the data record as a MODEM or direct serial transmission. The data record may also be stored on floppy disk(s) for archival or transportation to another location.

2.1.3 DT-4 Devices

Device types of DT-4 are the destination point for the data record. The DT-4 systems can re-play a recorded event. DT-4 systems may play back an entire incident complete with waveforms, audio recording and all events as they occurred. DT-4 systems may also re-play selected events only. What is reviewed is a function of the data received from a prior transmission and what the device operator selects for playback.

2.1.4 Support for Legacy Devices (EVT, LP11, RS100)

The Data Management system will provide support for devices designed prior to the new software/hardware interface described within this document. These devices have their own data storage formats and data transmission protocols. Detailed descriptions of these formats and protocols are contained within the design documents for the respective products. See Section 1.3, Applicable Documents, for reference to the document numbers. This document describes the connection protocol to the legacy devices. Once identified, communications shall commence per the applicable document.

3. PHYSICAL INTERFACE

3.1 Interface Description

This section is an index of interfaces. Refer to Figures 2 and 3 on the following pages.

All PIF-Mx references are for MODEM connections,

All PIF-Dx references are for Direct connections.

3.1.1 DT-4

PIF-D1	DT-4 Direct Connection
PIF-D11	DT-4 Wireless Connection
PIF-M1	DT-4 to MEDTRONIC ERS Cellular Protocol MODEM
PIF-M2	DT-4 to EIA/TIA MODEM

3.1.2 DT-3

PIF-D2	DT-3 to Direct Connection
PIF-M3	DT-3 to EIA/TIA MODEM
PIF-D8	DT-3 Direct Connection - PDA
PIF-D11	DT-3 Wireless Connection - PDA
PIF-M7	DT-3 to EIA/TIA MODEM - PDA
PIF-D9	DT-3 Direct Connection - CAD
PIF-M8	DT-3 to EIA/TIA MODEM - CAD

3.1.3 DT-2 Serial Interface

PIF-D3	DT-2 to Direct Connection
PIF-D10	DT-2 to Direct Connection
PIF-D11	DT-2 Wireless Connection
PIF-M4	DT-2 to EIA/TIA MODEM
PIF-M8	DT-2 to EIA/TIA MODEM

3.1.4 DT-2 Internal Modem Interface

PIF-M7	DT-2 to Internal MODEM

3.1.5 DT-1 Serial Interface

PIF-D4	DT-1 to Direct Connection
PIF-M6	DT-1 to EIA/TIA MODEM

3.1.6 DT-2PL Serial Interface

PIF-D5	DT-2PL to Direct Connection

Note: DT-2PL to a MODEM are covered in 2002-048 document

3.1.7 DT-3PL Serial Interface

PIF-D6	DT-3PL to Direct Connection

Note: DT-3PL to MODEM connections are covered in 2002-048 document

3.1.8 DT-1PL Interface

PIF-D7	DT-1PL to Direct Connection

Note: DT-1PL to MODEM connection cable is defined by Medtronic ERS doc 3005427 Cable Assembly - Translator to Modem.

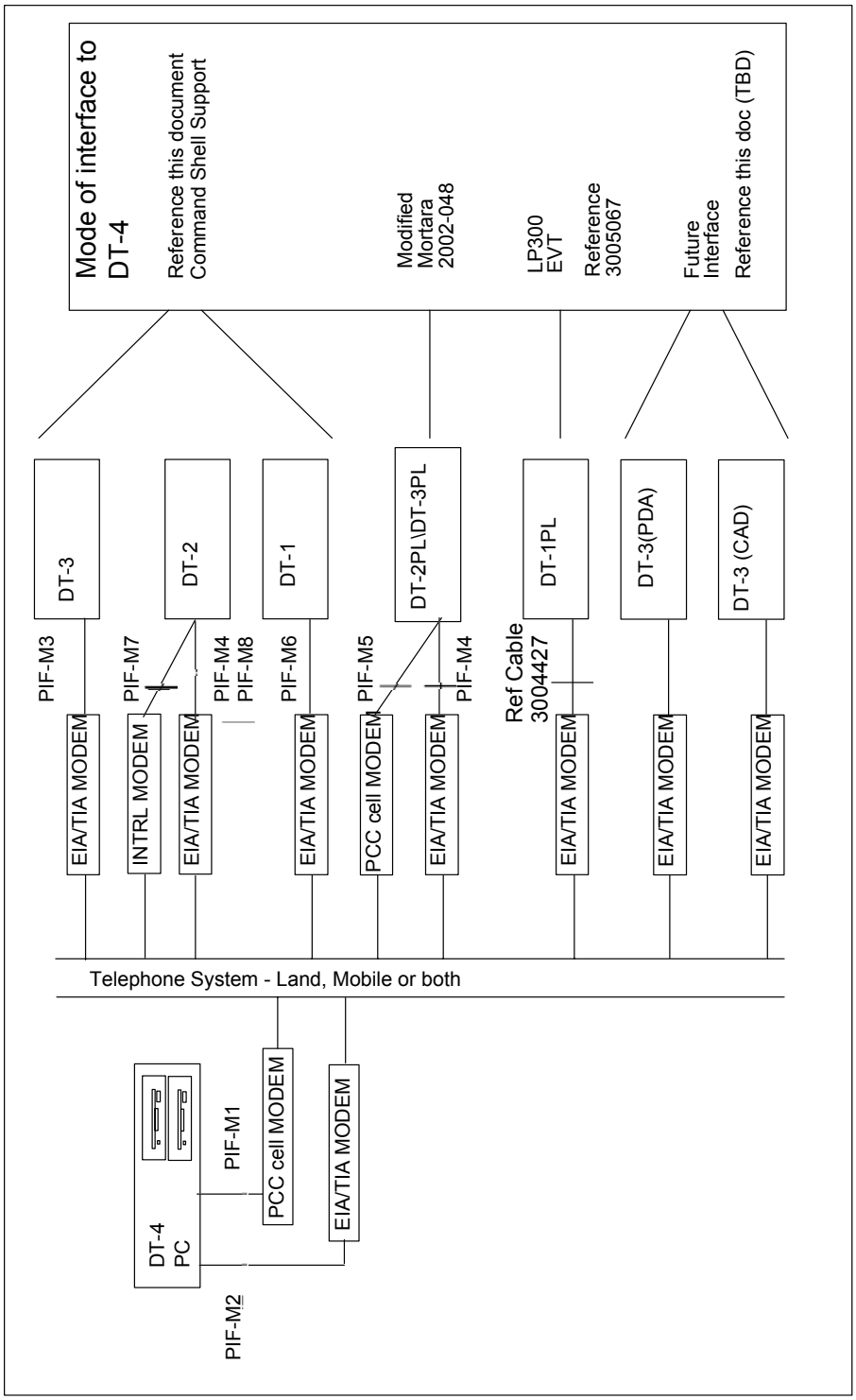


Figure 1 -Interfaces Between DME and External Devices

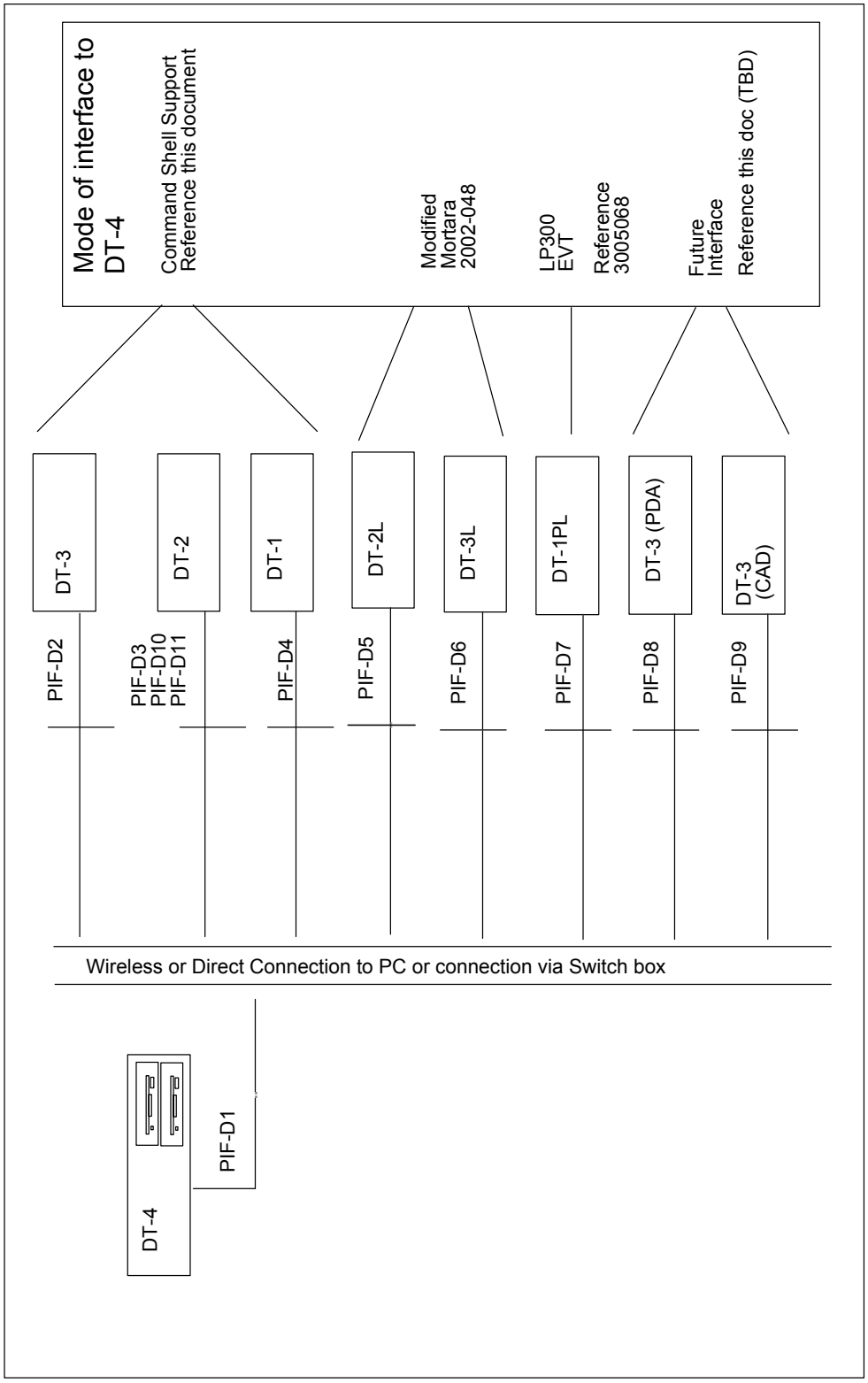


Figure 2 - Direct Interfaces between DME and external devices

3.2 Communications Settings

Table 2: Modem Connections

MEDTRONIC ERS Type	Internal MODEM (1)	External MODEM DTE-DCE rate (bps) and HDLC parameters (1)	MEDTRONIC ERS Protocol MODEM
DT-1	Not Applicable	9600, potential higher speeds. 8 bits, 1 start, 1 stop, no parity	Not Applicable
DT-1PL	Not Applicable	2400, 8bits, 1 start, 1 stop, no parity	Not Applicable
DT-2	PCMCIA version 2.0 interface (data and fax)	DATA: 9600-115200, 8 bits, 1 start, 1 stop, no parity	Not Applicable
		FAX: Group III Class 2 and 2.0 Services	Not Applicable
DT-2PL, and DT-3PL	1200	9600	9600, 8 bits, 1 start, 1 stop, no parity
DT-4	38400, 57600, 115.2k, 8 bits, 1 start, 1 stop, no parity	38400, 57600, 115.2k, 8 bits, 1 start, 1 stop, no parity	9600, 8 bits, 1 start, 1 stop, no parity

Note 1: DT-2 devices following the LP12 Tango release will support the following user-configurable DCE-DCE bit rates for fax; 14.4k, 12k, 9.6k, 7.2k, 4.8k and 2400 bps. The default shall be 9600 bps.

Table 3: Direct Connections

MEDTRONIC ERS Type	Direct Connection bit rate (bps) and HDLCParameters
DT-1PL	4800, 8 bits, 1 start, 1 stop, no parity
DT-2PL	34800, 8bits, 1 start, 1 stop, no parity
DT-3PL	34800, 8bits, 1 start, 1 stop, no parity

DT-1	9600, 19200, 38400, 57600, 8 bits, 1 start, 1 stop, no parity
DT-2	9600, 19200, 38400, 57600, 115200, 8 bits, 1 start, 1 stop, no parity
DT-3	9600, 19200, 38400, 57600, 115200, 8 bits, 1 start, 1 stop, no parity
DT-4	9600, 19200, 38400, 57600, 115200, 8 bits, 1 start, 1 stop, no parity

3.3 Interface Details

3.3.1 DT-4 System Direct Connection Interface - PIF-D1

3.3.1.1 DT-4 Direct Connection Connector - Mechanical Description

DT-4 serial connectors are a DB-9P connector. Optionally, the connector may be a DB-25P connector wired in a DTE (Data Terminal Equipment) configuration.
Pin and signal assignments for both DP-9P and DB-25P connectors are shown below:

DB-9P Pin	DB-25P Pin	Pin Description	Signal abbrev	Signal direction
1	8	Carrier Detect	DCD	Input
2	3	Receive Data	RXD	Input
3	2	Transmit Data	TXD	Output
4	20	Data terminal ready	DTR	Output
5	7	Ground	GND	n.a.
6	6	Data Set Ready	DSR	Input
7	4	Request to Send	RTS	Output
8	5	Clear to Send	CTS	Input

9	22	Ring Indicator	RI	Input

Note: The table above lists signals which are available at the DME. The signals actually required for a given interface may be a subset of those shown.

3.3.1.2 DT-4 Direct Connection Connector - Electrical Description

All signals meet EIA-RS232E Section 2.1 requirements.

3.3.1.2.1 Signal descriptions

3.3.1.2.1.1 RXD

Input: Data received from external system

3.3.1.2.1.2 TXD

Output: Data transmitted to an external system

3.3.1.2.1.3 DTR

Output: Data terminal ready. DT-4 asserts DTR to inform an external system of a request for service. NOTE: DTR handshake is not required by all systems.

3.3.1.2.1.4 CTS

Input: Clear to Send. DT-4 shall wait for this signal to be asserted before transmitting any information. NOTE: Not all systems require CTS handshaking.

3.3.1.2.1.5 GND

Reference for signal input/output.

3.3.1.2.1.6 DCD (also called CXR or RLSD)

Input: Data carrier detect - not utilized during a direct connection.

3.3.1.2.1.7 DSR

Input: Data Set ready - not utilized during a direct connection.

3.3.1.2.1.8 RTS

Output: Request to send - not utilized during a direct connection.

3.3.1.2.1.9 RI

Input: Ring Indicator - not utilized during a direct connection.

3.3.2 DT-4 MEDTRONIC ERS Protocol MODEM Interface - PIF-M1

3.3.2.1 Mechanical Description

The DT-4 system serial connector is a DB-9P connector. Optionally, the connector may be a DB-25P connector wired in a DTE (Data Terminal Equipment) configuration. Signal assignments are the same as PIF-D1 above

3.3.2.2 Electrical Description.

3.3.2.2.1 Signal descriptions

3.3.2.2.1.1 RXD

Input: Data received from external system

3.3.2.2.1.2 TXD

Output: Data transmitted to an external system

3.3.2.2.1.3 DTR

Output: Data terminal ready. The DT-4 asserts DTR to initiate communications to the Medtronic ERS protocol MODEM. NOTE: Release of DTR to the non-asserted condition may be used to signal the MODEM to hang up the phone connection

3.3.2.2.1.4 CTS

Input: Clear to Send. The DT-4 may wait for this signal to be asserted before transmitting any information to the Medtronic ERS Protocol MODEM. GND: Reference for signal input/output.

3.3.2.2.1.5 DCD

Input: Data carrier detect.

3.3.2.2.1.6 DSR

Input: Data Set ready. Not used but available on MODEM.

3.3.2.2.1.7 RTS

Output: Request to send. May be required to be active to allow the MODEM to transfer data to the host.

3.3.2.2.1.8 RI

Input: Ring Indicator. Is asserted by the Medtronic ERS Cellular MODEM whenever an incoming ring is detected on the Medtronic ERS Cellular MODEM phone line.

3.3.3 DT-4 to MEDTRONIC ERS Protocol MODEM Cable - PIF-M1

The table below details the connectors and cable connections for PIF-M1. This cable forms the interconnection between the DT-4 serial port to the Medtronic ERS protocol MODEM. The MODEM connector is a 10 pin female. Refer to Medtronic ERS 202287-001 for part number and dimensions.

DT-4 system DB-9S (female)	DB-25S	DME System Pin Description	Signal abbrev	TO MODEM 10 PIN Male	MODEM Signal abbrev
1	8	Carrier Detect	DCD	2	DCD
2	3	Receive Data	RXD	5	TXD

3	2	Transmit Data	TXD	6	RXD
4	20	Data terminal ready	DTR	3	DTR
5	7	Ground	GND	4	GND
6	6	Data Set Ready	DSR	n/c	n/a
7	4	Enablemux	ENAMUX	8	n/a
8	5	Clear to Send	CTS	5	CTS
9	22	Ring Indicator	RI	1	RI

3.3.4 DT-4 to MODEM Cable PIF-M2

The table below details the connectors and cable connections for PIF-M2. This cable forms the interconnection between the DT-4 serial port to an EIA/TIA MODEM.

DT-4 system DB-9S (female)	DB-25S	DT-4 System Pin Description	Signal abbrev	MODEM DB-25P (male, DTE)	MODEM Signal abbrev
1	8	Carrier Detect	DCD	8	DCD
2	3	Receive Data	RXD	3	TXD
3	2	Transmit Data	TXD	2	RXD
4	20	Data terminal ready	DTR	20	DTR
5	7	Ground	GND	7	GND
6	6	Data Set Ready	DSR	6	DSR
7	4	Request to Send	RTS	4	RTS
8	5	Clear to Send	CTS	5	CTS
9	22	Ring Indicator	RI	22	RI

3.3.5 DT-3 Direct Connection Interface - PIF-D2

The DT-3 Direct Connection PIF-D2 is identical in physical and electrical definition to PIF-D1. See Section DT-4 System Direct Connection Interface - PIF-D1.

3.3.6 DT-3 MODEM Interface - PIF-M3

MODEM interface to the DT-3 device is identical in physical and electrical definition as PIF-M2 above. See section 3.3.4 above.

3.3.7 DT-2 Direct Connection Interface - PIF-D3

3.3.7.1 Mechanical Interface - PIF-D3

The DT-2 system connector is a 9 pin female Hypertronics P/N D02EEB906FRTAH. Refer to MEDTRONIC ERS 805318 for dimensions.

The Pin definitions are as follows:

Pin Number	Pin Description	Signal abbrev	Signal direction
1	Digital Ground	GND	Gnd
2	Transmit serial data	TXD	Output
3	Receive serial data	RXD	Input
4	Data Terminal Ready	DTR	Output
5	Clear to Send	CTS	Input
6	MODEM control signal	DT2-PL: TX/OFF	Output
		DT2: RTS	
7	Analog Ground	GND	n/a
8	ECG output	ECG out	Output
9	+12v	+12v	Output

3.3.7.2 DT-2 System connector Electrical Interface - PIF D-3

Pin Number	Signal Abbrev	Signal direction	Electrical Characteristics		
			Allowable Signal Voltage Levels	Input or Output Impedance	Drive Capability
1	GND	n/a	n/a	n/a	n/a
2	TXD	Output	Meets EIA-RS232E section 2.1 requirements		
3	RXD	Input	Meets EIA-RS232E section 2.1 requirements except 4kOhms <= Zin <= 8 kOhms		
4	DTR	Output	Meets EIA-RS232E section 2.1 requirements		
5	CTS	Input	Meets EIA-RS232E section 2.1 requirements except 4kOhms <= Zin <= 8 kOhms		
6	DT2-PL: TX/OFF	Output	DT2-PL: Meets 74HC voltage levels, nominally: Vol <= 0.25v, Io <= 6.0mA; Voh >=3.75v, Io <= -6mA		
	DT2: RTS		DT2: Meets EIA-RS232E Section 2.1 requirements		
7	GND	n/a	n/a	n/a	n/a
8	ECG out	Output	+/- 5v DC	< 2k Ohm	5000pF
9	+12v	Output	DT2-PL: +12v DC +/- 10%	n/a	DT2-PL: 0.5 Amps
			DT2: 8-18V see note in +12v output		DT2: 0.1 Amps

3.3.7.3 DT-2 Serial Port signal description

3.3.7.3.1 TXD

Output: Data output from device

3.3.7.3.2 RXD

Input: Data input to device

3.3.7.3.3 DTR

Output: Data output used to inform connected devices that the device is requesting service or to disconnect a MODEM call.

3.3.7.3.4 CTS

Input: The DT-2 waits for this signal to be asserted before transmitting any information

3.3.7.3.5 RTS & TX/OFF

Output: For DT2 equipment, Request to Send. May be required to be active to allow the MODEM to transfer data to the host.

Output: For DT-2PL equipment, TX/OFF. This signal is used to turn on and off an external device. When this signal transitions from an VOLTAGE LOW to a VOLTAGE HIGH, the external device should power-up.

3.3.7.3.6 ECG OUT

This signal is not used by any of the systems described in this document.

3.3.7.3.7 +12v output

This signal is used to power external devices. Most "12V devices" are rated for use from automotive supplies, usually specified as 9-16V (sometimes 9-18V) as steady-state, under-load values. Although automotive standards generally require testing from 6-18V without damage, they do not require full functionality over this voltage range.

For DT-2 devices, power is provided from an internal battery bus. If the available voltage is less than 9V, the batteries are nearly discharged. At the end of battery charge, available power will drop below 9V rapidly, in an uncontrolled way.

For DT-2PL devices, power is provided from a regulated power supply at the tolerances specified.

3.3.7.4 DT-2 to DT-4 cable PIF-D3 to PIF-D1(Direct Connection) Cable

The table below details the connectors and cable connections for a connection from PIF-D1 to PIF-D3. This cable forms the interconnection between the DT-2 serial port to a DT-4.

DT-4 system DB-9S (female)	DT-4 System Pin Description	DT-4 Signal abbrev	DT-2 Hypertronics	DT-2 signal abbrev
1	Carrier Detect	DCD	n/c	n/a
2	Receive Data	RXD	2	TXD
3	Transmit Data	TXD	3	RXD

4	Data terminal ready	DTR	n/c	n/a
5	Ground	GND	1	GND
6	Data Set Ready	DSR	n/c	n/a
7	Request to Send	RTS	5	CTS
8	Clear to Send	CTS	6	RTS
9	Ring Indicator	RI	n/c	n/a

3.3.7.5 DT-2 to MODEM cable PIF-M4

The table below details the connectors and cable connections for a connection from the DT-2 device (PIF-M4) to a EIA/TIA MODEM.

DT-2 Hypertronics	DT-2 signal abbrev	MODEM DB-25P (DTE)	MODEM Pin description	Signal Abbrev
8	ECG OUT	n/c	n/a	n/a
2	TXD	2	Receive Data	RXD
3	RXD	3	Transmit Data	TXD
4	DTR	20	Data terminal ready	DTR
1	Dig GND	7	Ground	GND
6	DT2-PL: TX/OFF	n/c	n/a	n/a
	DT2: RTS	5	Clear To Send	CTS
7	Analog Gnd	n/c	n/a	n/a
5	DT2-PL: CTS	8	Clear to Send	CTS

	DT2: RTS	4	Request to Send	RTS
9	+12v	n/c	n/a	n/a

DT-2PL signals are shown only for clarity, see PIF-M5 description.

3.3.7.6 DT-2PL to MEDTRONIC ERS Cellular MODEM cable PIF-M5

Document 2002-048 details the connectors and cable connections required to connect a LIFEPAK 11 Monitor to the MEDTRONIC ERS Cellular MODEM. All devices compatible with the MEDTRONIC ERS Cellular MODEM shall follow the recommendations listed in 2002-048.

3.3.8 DT-1 Direct Connection to DME - PIF-D4

DT-1 devices uses a special variation of its patient cable for the Direct and MODEM serial interface connector. Pins 4 and 8 are tied together to avoid CTS floating when connected to a PC.

DT-4 system DB-9S (female)	DT-4 System Pin Description	Signal abbrev	DT-1 Alden HV connector	DT-1 signal abbrev
1	Carrier Detect	DCD	n/c	n/a
2	Receive Data	RXD	2	TXD
3	Transmit Data	TXD	3	RXD
4	Data Terminal Ready + Connect to Pin 8 CTS	DTR	n/c	n/a
5	Ground	GND	1	GND
6	Data Set Ready	DSR	n/c	n/a
7	Request to Send	RTS	n/c	n/a
8	Clear to Send + Connect to Pin 4 DTR	CTS	n/c	n/a
9	Ring Indicator	RI	n/c	n/a

3.3.9 DT-1 to MODEM Interface - PIF-M6

DT-1 Alden HV connector	DT-1 signal abbrev	MODEM DB-25P (DTE)	MODEM Pin Description	Signal abbrev
n/c	n/a	8 (no connect)	Carrier Detect	DCD
2	TXD	2	Receive Data	RXD
3	RXD	3	Transmit Data	TXD
n/c	n/a	20 (no connect)	Data terminal ready	DTR
1	GND	7	Ground	GND
n/c	n/a	6 (no connect)	Data Set Ready	DSR
n/c	n/a	4 (no connect)	Request to Send	RTS
n/c	n/a	5 (no connect)	Clear to Send	CTS
n/c	n/a	22 (no connect)	Ring Indicator	RI

3.3.9.1 DT-3PL Direct Connection Serial Connector Interface - PIF-D6

Refer to MEDTRONIC ERS document 2002-048

3.3.9.2 DT-1PL Direct Connection Serial Connector Interface - PIF-D7

The EVT connector is documented in MEDTRONIC ERS doc 3004427, Cable assembly Translator to MODEM.

DT-4 system DB-9S (female)	DT-4 System Pin Description	Signal abbrev	DT-1PL Connector	DT-1PL signal abbrev
1	Carrier Detect	DCD	n/c	n/a
2	Receive Data	RXD	2	TXD
3	Transmit Data	TXD	4	RXD

4	Data terminal ready	DTR	n/c	n/a
5	Ground	GND	5	GND
6	Data Set Ready	DSR	n/c	n/a
7	Request to Send	RTS	n/c	n/a
8	Clear to Send	CTS	n/c	n/a
9	Ring Indicator	RI	n/c	n/a

3.3.10 DT-2 Internal Modem Interface - PIF-M7

This interface conforms to PCMCIA standard 2.0.

3.3.11 DT-3 Direct Connection Serial Connector Interface - PIF-D8

A 9 pin ‘PC type’ and a RS-232 standard DTE interface are shown in the table below.

DB-9P Pin	DB-25P Pin	Pin Description	Signal abbrev	Signal direction
1	8	Carrier Detect	DCD	Input
2	3	Receive Data	RXD	Input
3	2	Transmit Data	TXD	Output
4	20	Data terminal ready	DTR	Output
5	7	Ground	GND	n.a.
6	6	Data Set Ready	DSR	Input
7	4	Request to Send	RTS	Output
8	5	Clear to Send	CTS	Input
9	22	Ring Indicator	RI	Input

3.3.12 DT-3 Direct Connection Serial Connector Interface - PIF-D9

A standard RS-232 DTE interface is shown for the CAD cable.

DB-25P Pin	Pin Description	Signal abbrev	Signal direction
8	Carrier Detect	DCD	Input
3	Receive Data	RXD	Input
2	Transmit Data	TXD	Output
20	Data terminal ready	DTR	Output
7	Ground	GND	n.a.
6	Data Set Ready	DSR	Input
4	Request to Send	RTS	Output
5	Clear to Send	CTS	Input
22	Ring Indicator	RI	Input

3.3.13 DT-2 Internal Modem Interface - PIF-M7

This interface conforms to PCMCIA standard 2.1.

3.3.14 DT-2 Direct Connection Interface - PIF-D10

The DT-2 PIF-D10 interface is a 9-pin female DB-9 connector (also called a DB-9S connector.)

The pin definitions are as follows:.

DT-2 system DB-9S (female)	Signal Description	Signal abbrev	Signal Direction
1	Data Carrier Detect	DCD	input
2	Transmit Data	TXD	output

3	Receive Data	RXD	input
4	Data Set Ready	DSR	input
5	Ground	GND	n/a
6	Data Terminal Ready	DTR	output
7	Clear to Send	CTS	input
8	Request to Send	RTS	output
9	Ring Indicator	RI	input

Of the nine signals, DT-2 devices are required to implement a minimum set of GND, RxD, TxD, CTS, and RTS. If signals are not implemented, the corresponding pins shall be left open-circuited and may not be used for non-data signals. This interface is designed to connect to a standard PC COM port male DB-9 interface with a straight-through cable.

The are four common implementations of this interface:

3-wire: GND, RxD, TxD

5-wire: GND, RxD, TxD, RTS, CTS

7-wire: GND, RxD, TxD, RTS, CTS, DCD, RI

9-wire: All signals

The 7-wire set is recommended, with DTR and DSR open-circuited or tied high at each end of the link. This allows for hardware handshaking (RTS/CTS) plus link management with the DCD and RI signals.

3.3.15 DT-2, DT-3, DT-4 Wireless Interface - PIF-D11

The DT-2 device wireless interface consists of the IrDA 1.1 protocol stack with an OBEX topmost layer. Refer to the IrDA standards for a complete description of this interface. Non-IR wireless devices that comply with the IrDA standards may be substituted for the IR interface. An example of this sort of device would be a Bluetooth RF communications module. DT-3 and DT-4 devices also implement this interface.

3.3.16 DT-2 PIF-D10 to MODEM Cable - PIF-M8

To connect a DT-2 PIF-D10 serial interface to a 9-pin modem serial interface a null-modem, 9-conductor cable is required as described in the following table. It is acceptable to use a straight-through 9-conductor cable with a stand-alone null-modem adapter..

DB-9S female Connect to PIF-D10	**DB-9P male** Connect to MODEM	**Signal Description**	**Signal abbrev**
1	1	Carrier Detect	DCD
3	2	Receive Data	RXD
2	3	Transmit Data	TXD
6	4	Data Terminal ready	DTR
5	5	Ground	GND
4	6	Data Set Ready	DSR
8	7	Request to Send	RTS
7	8	Clear to Send	CTS
9	9	Ring Indicator	RI

4. FUNCTIONAL INTERFACE

Overview

This section focuses on the description of communications interfaces between products within the scope of the document. Section 5 describes how a device is identified from the set {DT-1PL, DT-2PL, DT-3PL, DT-1, DT-2, DT-3}. The method in which commands and data are communicated from device to device are defined in section 7. Data stream contents are defined in sections 6, 9 and the referenced document “Standard Communications Protocol for Computer Assisted Electrocardiography (SCP-ECG), Version 1.0”. Facsimile transmission is described in EIA/TIA-592.

Following the Overview are the 4 sections summarized below:

A) Section 5 - DEVICE IDENTIFICATION

Applicability: DT-3, DT-4

Devices will support all or a subset of the three interfaces {MODEM, MEDTRONIC ERS Cellular Modems and Direct Connection}. The system overview diagram (Figure 1) shows which interfaces apply to a given product.

The Data Management Event Review and Database system to support legacy devices (LP300 EVT, LP11 and RS100), they are included in the DEVICE IDENTIFICATION section.

Once identified as a given legacy system, the respective documents for the LP300, LP11 and RS100 products are used to complete data transactions. Presentation of these legacy devices within the DEVICE IDENTIFICATION section gives a global view of all the interfaces involved.

The method of identification may vary between the three interfaces, so the interfaces are covered in three separate sections

Section 5.2	MODEM
Section 5.3	MEDTRONIC ERS Cellular Modems
Section 5.4	DIRECT CONNECTION

B) DATA RECORD FORMATS (Presentation Layer)

Section 6 defines extensions to the SCP-ECG protocol, which will be used to present data from a medical device to a data management system. These extension are to be considered as part of the SCP-ECG standard.

Section 9 describes the ASCII presentation format, which may be used to present data from a medical device to a data management system which cannot decode the SCP-ECG presentation format.

C) COMMAND SHELL

Section 7 defines the extensions to the SCP-ECG command shell. Command and Responses are defined along with error handling for either end of the command/response line.

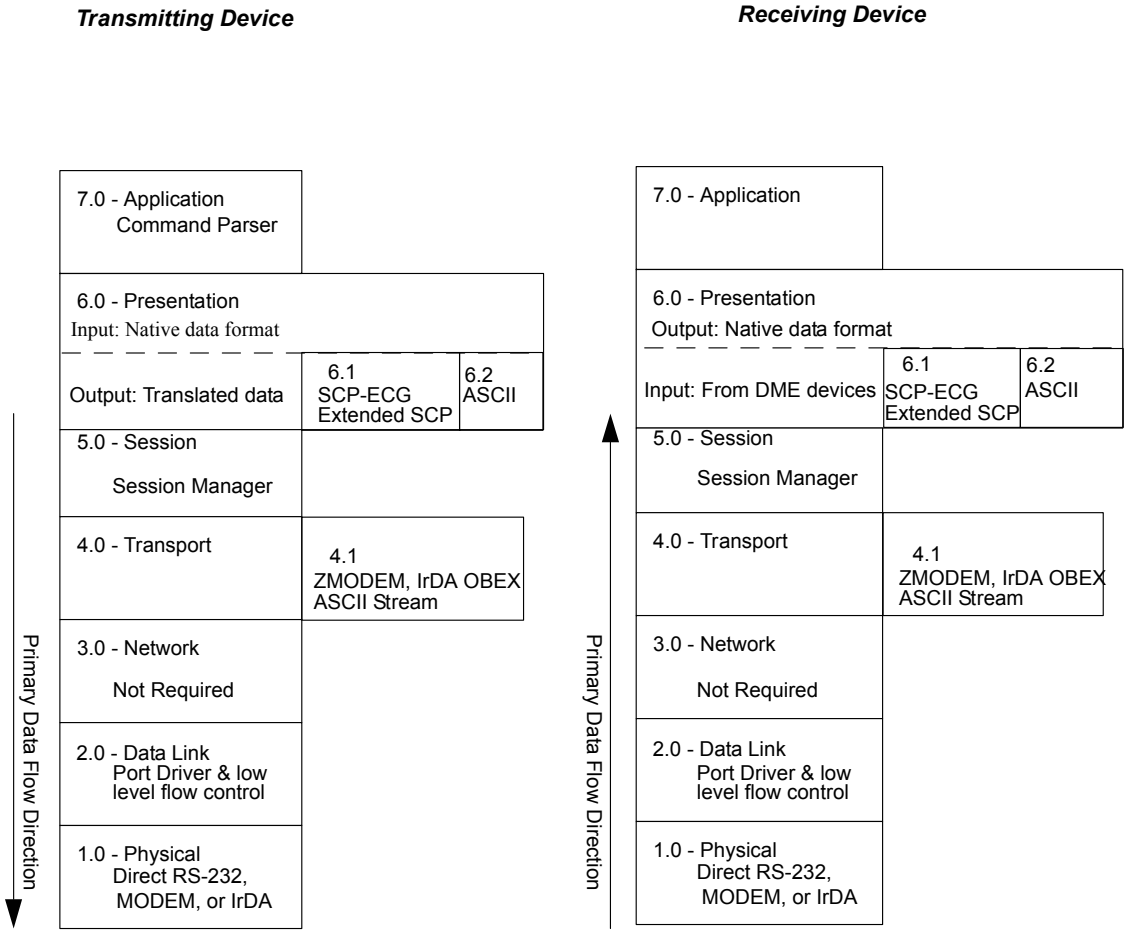
D) ZMODEM FILE TRANSFER PROTOCOL

The ZMODEM implementation used by Medtronic ERS is defined by the ZMODEM ICD (see Referenced Documents).

4.1 OSI/ISO MODEL

In the model below the term ‘Transmitting Device’ describes a device which contains stored patient data to transfer, and ‘Receiving Device’ is the destination point for the data.

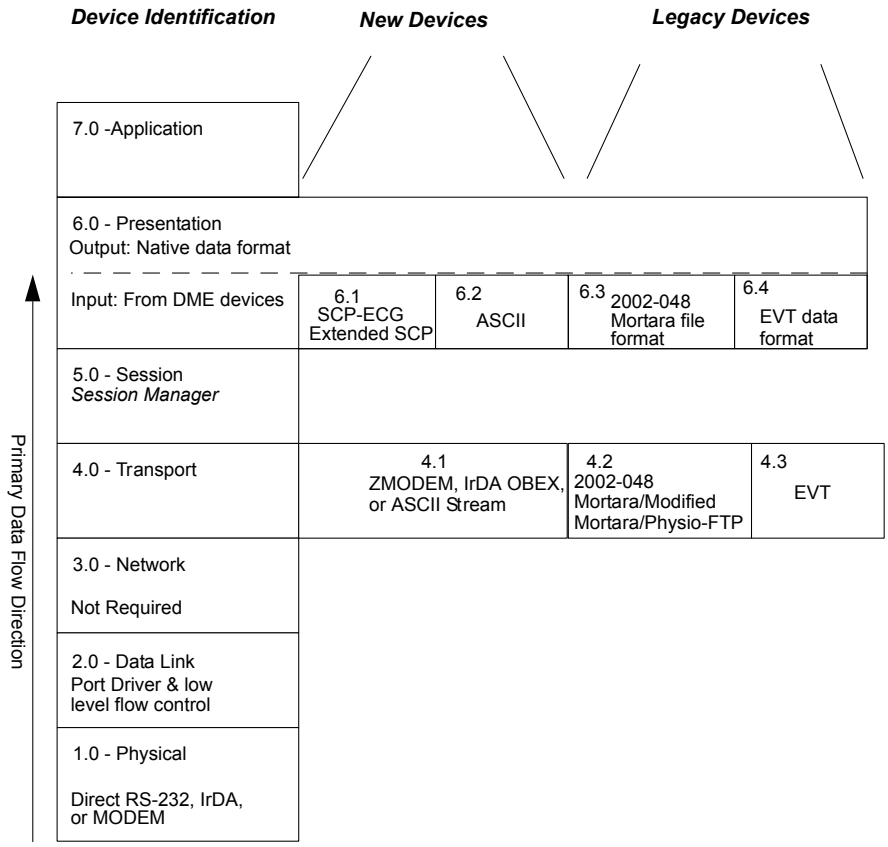
OSI 7 Layer Network Model



4.1.1 Present and Legacy device model for Receiving Device

Some receiving devices must support legacy devices. The requirements of the receiving device will define which transmitting devices are supported.

Receiving Device OSI 7 Layer Network Model



4.1.1.1 Layer 6.0 - Presentation Layer Protocol Description

Performs data format conversions required between the Application Layer and the Presentation Layer.

Transmitting Device

Input:

Native Data Format: The transmitting device may store data

in a format which is designed for size and performance efficiencies appropriate to the chosen processor. Translations to output formats below are performed as needed to put the data in a standard format prior

to transmission.

Output:

6.1 - SCP-ECG Format data
6.2 - ASCII Format data

Receiving Device

Input:

6.1 - SCP-ECG Format data
6.2 - ASCII Format data
6.3 - Mortara File Format
6.4 - EVT Format

Output:

Native Data Format: The transmitting device may store data

in a format which is designed for size and performance efficiencies appropriate to the chosen processor. Translations to output formats below are performed as needed to put the data in a standard format prior to transmission.

6.3 - LP11/RS100 Format (MEDTRONIC ERS document 2002-048)

6.4 - EVT Format (MEDTRONIC ERS documents 3005067, and 3005068)

4.1.1.2 Layer 5.0 - Session Layer Protocol Description

4.1.1.2.1 Session Manager

The functions of the Session Manager are defined in section 7.0 of the SCP-ECG standard and in Command Shell of this document.

4.1.1.2.2 Connection Manager

The Connection Manager establishes, manages and maintains the communications resources needed for data transmission, termed a “connection”. These resources include direct, hardwired connections between transmitting and receiving devices and modem-to-modem connections using non-Medtronic ERS telecommunications network services.

The relationship of the Session and Connection managers for any particular device is defined by the implementation of that device. The scope of the Connection Manager is currently limited to connection-based interaction. Connection-less data transmission is not defined by this document.

The Connection Manager operates the communications resource based on the following sequence:

1) Determine if resource is present
2) Configure or initialize the resource
3) Establish connection with destination device(s)
4) Conduct data transmission

5) Terminate the connection

6) Release the resource

The Connection Manager is responsible for making available to the user interface information about the particular state of the communications process and, if failure occurs, providing information about the failure. For a specific device, the implementation of the user interface with respect to the Connection Manager is under the control of the published requirements for that device.

Note that the “Initializing” and “Trying to Connect” groups do not include direct-connect activities, which are considered to be included in the list of “Connecting” messages. The manner in which (and whether) error codes are reported and stored is determined by a specific device’s implementation requirements.

4.1.1.2.3 Connection Error User Messages

Condition	Message	Error Code
Initializing		
no modem card detected	"No Modem Found"	101
modem card init error	"Modem Initialization Error"	102
FAX modem setup error	“Modem Initialization Error”	103
Failed to detect Class 2.0 or 2	“Modem Initialization Error”	104
other error during modem init	"Modem Initialization Error"	100
Trying to Connect		
no dial tone	“No Dial Tone"	201
busy signal received	“Busy/Waiting to Redial"	202
call not answered	"Call Not Completed"	203
other reason for no response	"Call Not Completed"	200
Connecting		
unable to connect	"Unable to Connect"	301
timeout on connect	"Unable to Connect"	302

	(Fax) Phase A error	"Unable to Connect"	303
	(Fax) Phase B error	"Unable to Connect"	304
	Other reason for connection fail	"Unable to Connect"	300
Connected	lost connection	"Lost Connection"	401
Trying to send			
	unable to start sending	"Transmission Failed"	501
	(Fax) Phase C error	"Transmission Failed"	502
	(Fax) Failed to complete Phase C	"Transmission Failed"	503
	sending failed	"Transmission Failed"	500
Complete			
	host cancelled transmission	"Transmission Failed"	600
	host error during receive	"Transmission Failed"	601
Cancelled	user cancelled transmission	“Transmission Cancelled”	none

From this list each device may select and document which messages are appropriate for display or create (and document) additional messages.

4.1.1.2.4 Device Identification

Receiving Devices (DT-1PL, DT-3 and DT-4) implement a method of *Device Identification* at this layer to identify what formats and protocols are required for communication. (see Device Identification)

4.1.1.3 Layer 4.0 - Transport Layer Protocol Description

Responsible for end to end validity and integrity of data.

Layer 4.1 - ZMODEM, IrDA OBEX, or ASCII stream

ZMODEM actually spans Level 4 and Level 2. The packet to packet integrity data check is a Level 2 function of ZMODEM, while the overall validity of files and

resumption of an interrupted file transmission is a Level 4 function. See the ZMODEM ICD for a complete description of the MPC implementation of this protocol

IrDA OBEX is an “object exchange” protocol that acts as a reliable transport protocol for static data elements. OBEX is described in the IrDA 1.1 Standard Suite.

An ASCII stream (no-protocol) is also supported under layer 4.1. A special interrogation string is used to initiate this transfer format. No integral error-detection (CRC or checksum) is included in the data stream.

Layer 4.2 - Mortara/Modified Mortara/MEDTRONIC ERS File Transfer Protocol (PFTP) is described in MEDTRONIC ERS document 2002-048

Layer 4.3 - EVT 3005067 ECG/Voice Translator Software Requirements Specification also 3005068 ECG/Voice Translator MODEM Transmission format.

4.1.1.4 Layer 3.0 - Network Layer Protocol Description

Not Implemented

4.1.1.5 Layer 2.0 - Data Link Layer Protocol Description

Port driver and low level flow control. This layer is device specific.

4.1.1.6 Layer 1.0 - Physical Layer Protocol Description

Direct RS-232, IrDA, or MODEM (if used) as described in the appropriate external standards.

4.2 Protocol Status and Error Logging

In order to assist both development and Customer Service, each DT-2 and DT-4 device (optional for DT-1 and DT-3 devices) shall log data transmission transactions. The Communications Log shall store the following entries:

External device control strings sent to the port (e.g. - modem init strings) and the response

Entries describing significant user actions (e.g., [Send Data | Send Fax | Cancel] /Patient/Report/Site/Prefix)

Patient Name, Patient ID, or Data Record ID sufficient to identify the particular data package being transmitted.

All error codes generated and supporting data if available

Any datacomm UI message displayed to the user (or representative codes) including transmission status at significant percentages defined by the implementation (such as 86%-completed for LP12 fax transmissions) and notifications of success, retries, and failures.

All entries shall include a time stamp in the format yyyy-mm-dd-hh-mm-ss(hh). (“ss(hh)” indicates seconds and hundredths of seconds, with the hundredths optional)

The number of entries to be maintained may be determined by the implementation but to log the past 10 data transfer attempts is the minimum requirement.

All entries shall be stored in non-volatile memory, discarding the oldest when the storage limit is reached.

The log shall be available in ASCII form through an MTI command sequence.

The log shall be available for printing or viewing as human-readable text in English. (Note, this is a service function and is not required to be translated.)

Implementation notes:

LP12 Tango Implementation:

The LP12 will not log the following information to non-volatile memory, but will instead include it on the printed transmission report. All information is translated per the locally configured language.

"Error Code:" <Code> or if transmission is successful, "Transmission Completed".

<Site Name>

<Date> <Time>

"Patient:" <Patient Name, "All", or blank>

“ID#:” <Data Record ID or “All”>

"Patient ID:" <Patient ID or blank>

"Report:" <Report Type transmitted (Code Summary, Trend Summary, 12-Lead, etc.), or "All">

"Phone #:" <Phone Number for the selected site>

"Prefix:" <Prefix used in dialing. If no prefix is used, leave data field blank.>

"Output Port:" <Output port for the site selected>

"Baud Rate:" <DTE-DCE bit rate if external port is used, otherwise data field is left blank>

"Fax Baud Rate:" <DCE-DCE bit rate if fax transmission, otherwise data field is left blank>

"Init String:" <Configured initialization string for the site selected>

"Archives:" <Yes/No>

LP12 Bluemoon Implementation:

The LP12 Bluemoon Implementation will adhere to the same report format as the LP12 Tango release except for the following changes:

“Output Port:” <Same as the LP12 Tango release except when a wireless site is chosen for transmission. In this case, the word “Wireless” will be added with the state of “On” or “Off” indicated. For example, “Output Port: External Cell - Wireless On”>

“Trusted Device:” <The friendly (human readable) name of the wireless device. This should appear after the “Archives:” section.>

5. DEVICE IDENTIFICATION

Applicable Device types: DT-3, DT-4

5.1 Overview

Device Identification is a mandatory first step for any communications within this system.

Because of required support for legacy devices (LP300 EVT, LP11 and RS100) device ID forms the basis to break out from the communications protocols defined in this ICD, and support the formats required for the legacy devices.

A method for device identification is used to make connections between devices as automated as possible. The methods vary according to the connection type - Direct, MODEM and MEDTRONIC ERS Cellular MODEM. Separate sections detail identification for each connection type.

Defib products and their connections as shown in Diagram 1, page 6 need to be aware of the Device Identification process, as it contains information needed to assure both feasibility of automated device ID as well as a reliable initiation of data connection.

5.2 Device Identification - Modem Connection

Applicable Products: Event Review Station, Data Base Receiving Station

MODEM Type: EIA/TIA 602; 'Hayes Compatible'

The legacy products (LP300 EVT, LP11, RS100) are always the originators of a MODEM session. In no case does the receiving station call these units and expect them to answer the MODEM call.

At the receiving end, the system must be able to support the MODEM transmission speeds, MODEM options (such as error detection/correction and data compression) used by the sender. Legacy devices have their own transmission speeds and protocols which must also be supported. Refer to the table below for connection settings.

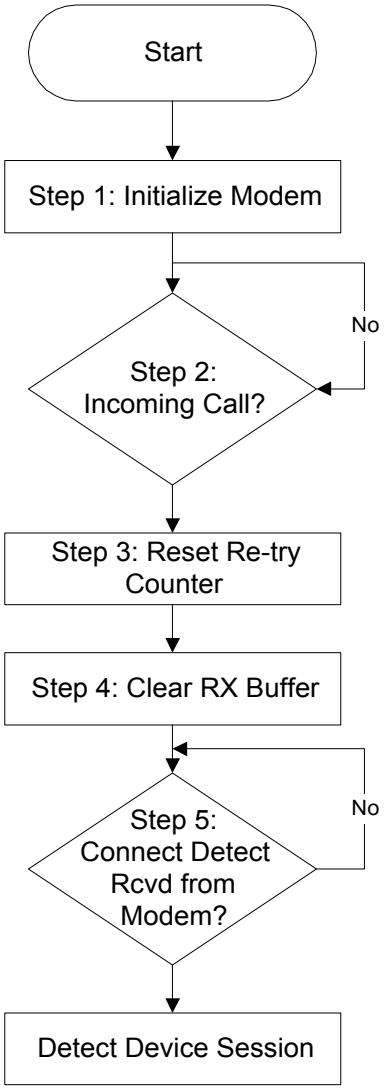
Device type	DTE-DCE settings	MODEM - MODEM rate
DT-1PL	2400, 8bits, 1 start, 1 stop, no parity.	2400 bits/sec
DT-2PL Internal MEDTRONIC ERS Cellular External EIA/TIA	 1200 9600 300,600, 1200, 2400, 4800, 9600, 19200, 38400	 1200 bits/sec 1200, 2400, bits/sec Depends on user supplied modem and phone line conditions

DT-3PL Internal MEDTRONIC ERS Cellular External	1 200 9600 8 bits, 1 start, 1 stop 300, 600, 1200, 2400, 4800, 9600	 1200 bits/sec 1200, 2400 bits/sec 300 to 9600 bits/sec
DT-1	9600, potential higher speeds. 8 bits, 1 start, 1 stop, no parity	9600 bits/sec, potential higher speeds.
DT-2	9600, potential higher speeds. 8 bits, 1 start, 1 stop, no parity	9600 bits/sec, potential higher speeds.
DT-3	38400, 57600, 115.2k, 8 bits, 1 start, 1 stop, no parity	(MODEM and session dependent)
DT-4	38400, 57600, 115.2k, 8 bits, 1 start, 1 stop, no parity	(MODEM and session dependent) expected bit rates are 2400, 9600, 14.4k and 28.8k with rates above and below dependent upon MODEM to MODEM negotiated speed and MODEM to MODEM data compression.

The minimum recommended MODEM to MODEM BPS rate between the Defib and the PC is 9600 BPS. It is recommended that defib products have the ability to sense BPS rate capabilities of the MODEM connected and utilize the BPS rate most advantageous to minimum data transmission times. The PC shall be compatible with 9600, 14.4k and 28.8kbps MODEMs. A data transfer speed advantage with higher speed MODEMs will only be apparent if all elements support the higher BPS rates. The host PC detects the presence of a MODEM by sending an “AT” command sequence to the MODEM and receiving the proper MODEM response.

The following figure illustrates the process of initializing the modem:

INITIALIZE MODEM



Step 1) MODEM Initialization

PC Default BPS rate to MODEM - 57600, 8 bits, 1 start, 1 stop, no parity.

MODEM Reset string - "{MODEM Dependent}"

MODEM Reset Response - "OK"

When initializing the modem, the PC should determine the maximum BPS rate capabilities of the MODEM, then use this for the session. This can be achieved by sending an "AT" command at the test BPS rate, and waiting for the correct MODEM response (This will be "OK" when the MODEM is in the Verbose mode). The MODEM should be initialized to stay at the established PC to MODEM speed rather than switching to the MODEM to MODEM connection speed when a connection is made. The PC will receive state commands from the MODEM detailing the MODEM status.

The examples given below are for an EIA/TIA MODEM in the Verbose mode. It is not required that the MODEM be set to the verbose mode. Individual implementations may chose other methods of MODEM state communications.

RING ; RING is sent each time the receiving phone line rings.

NO CARRIER ; NO CARRIER is sent when the line carrier signal is lost

Step 2) Wait for MODEM Ring

Step 3) Following the detection of a RING, reset any retry counters, and;

Step 4) Clear the Receive buffers

Step 5) Wait for MODEM connection to be established

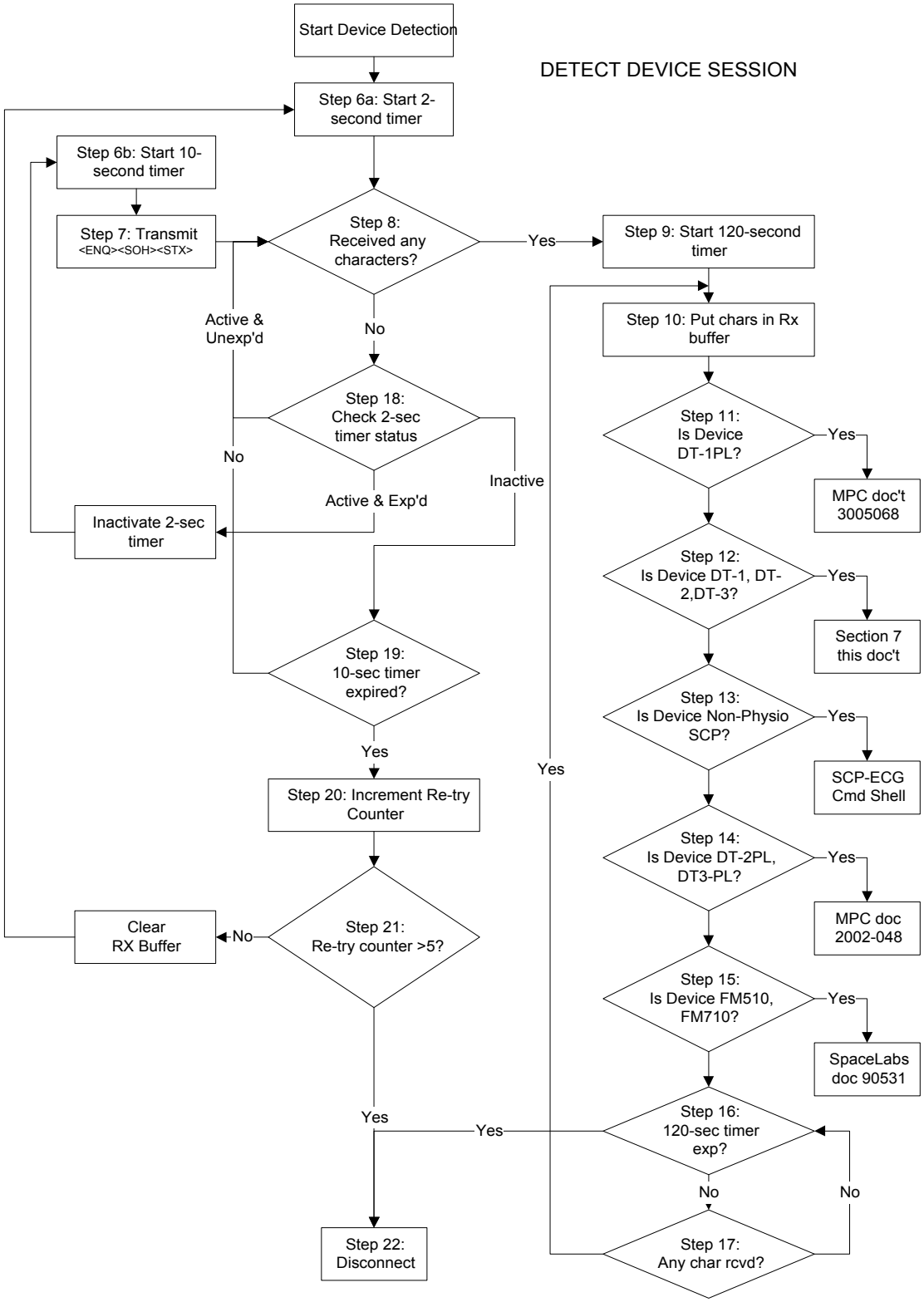
The receiving device should be able to wait for a configurable period of time. If the MODEM is set to the 'verbose' mode, a connection is indicated by the string 'CONNECTxxxx' where XXXX = bit rate.

Upon detection that a connection is established, PC will follow the logic below to determine the connected device from the following set

{DT-1PL, DT-2PL, DT-3PL, DT-1, DT-2, DT-3}

Timeouts: A user or service configurable timeout value is recommended. The time from detection of an incoming call to a connection established varies dependent upon MODEMs and phone line conditions. Minimum timeout value should exceed 60 sec.

The following figure illustrates the process of detecting which Device Session is being started by the calling device:


DETECT DEVICE SESSION
Start Device Detection
Step 6a: Start 2-second timer
Step 6b: Start 10-second timer
Step 7: Transmit <ENQ><SOH><STX>
Step 8: Received any characters?
Yes
No
Active & Unexp'd
Step 9: Start 120-second timer
Step 10: Put chars in Rx buffer
Step 11: Is Device DT-1PL?
Yes
MPC doc't 3005068
Step 12: Is Device DT-1, DT-2,DT-3?
Yes
Section 7 this doc't
Step 13: Is Device Non-Physio SCP?
Yes
SCP-ECG Cmd Shell
Step 14: Is Device DT-2PL, DT3-PL?
Yes
MPC doc 2002-048
Step 15: Is Device FM510, FM710?
Yes
SpaceLabs doc 90531
Step 16: 120-sec timer exp?
Yes
No
Step 17: Any char rcvd?
No
Yes
Step 18: Check 2-sec timer status
No
Active & Exp'd
Inactive
Inactivate 2-sec timer
Step 19: 10-sec timer expired?
Yes
Step 20: Increment Re-try Counter
Step 21: Re-try counter >5?
No
Clear RX Buffer
Yes
Step 22: Disconnect

Step 6a - Start 2 second timer and jump to step 8 - Immediately begin to listen for incoming characters. This allows quick connections to devices initiating a ZMODEM session and also supports the First-Medic FM510 and FM710 legacy devices which can not accept the <ENQ><SOH><STX> sequence at this point in the session.

Step 6b - Start 10 second timer

Step 7) Transmit the <ENQ><SOH> <STX> characters

Step 8) Check for received chars. If none go to step 17., else continue to step 9.

Step 9) Disable the 10 Second Timer and Start 120 second timer

Step 10) Put the data into the receive buffer

Step 11) Detect DT-1PL MODEM session

If the string “<LF><CR>LP200<CR>”, “<CR>LP200CONT” or “<CR>LP300<CR>” or “<CR>LP300CONT<CR>” is received, then the originating device is a LP300EVT. A response of <ACK> must be sent within 3 sec (ref LP300 EVT doc 3005068). The rest of the session shall continue per EVT MODEM Transmission Format document 3005068.

Step 12) Detect DT1, DT-2 MODEM session

If the device receives the string “rz<CR>” followed by the ZMODEM ZRQINT block. The device is a DT-1/DT-2/DT-3. The Command Shell interface running under ZMODEM will be started with the device. See Section 7 for a description of the command shell interface.

Step 13) Detect an SCP-ECG compliant Device

If the device receives the string “<SOH>” followed by the SCP-ECG ID block. The device is a non-Medtronic ERS SCP-ECG compliant device. The Command Shell interface running under enhanced XMODEM will be started with the device. See SCP-ECG standard for a description of the this interface.

Step 14) Detect DT-2PL, DT-3PL session

If the Rx Buffer contains 129 bytes of data then the session is a DT-2PL/DT-3PL. The send /receive protocol for these connections are detailed in the Pyramid communications interface control document 2002-048. The 129 bytes of data are the first ID data and checksum. The receive software must switch to the LIFEPAK 11 communications routine and pass this first data packet over to the comm routine as it is a part of the data transmission.

Step 15 - Detect DT-1FL session

If the Rx buffer contains the string “FIRST MEDIC<null>900<null>” then the device is a First-Medic 710. Refer to the SpaceLabs document “90531 Memory Data Format” for the output memory format which is transmitted as a single data block.

Step 16) Check 120 second timer. Disconnect if timed out (step 21).

Step 17) Check to see if characters have been received.

Step 18) - Check 2 second timer status - If the 2 second timer is active and unexpired, return to Step 8 and continue to watch for incoming characters. If the 2 second timer is active and has expired, inactivate the 2 second timer and jump to step 6b.

Step 19) - Check 10 sec timer. If not expired return to step 8 otherwise continue to step 20.

Step 20) Increment Tries counter

If the timer has expired, then increment the Retry counter. If retries are <5 then clear the rx buffer, re-start the 10sec timer and transmit an <ENQ><SOH><STX>.

Step 21) Disconnect if Tries counter is >= 5.

If retries are 5, then force the MODEM to hang up the phone, and reinitialize the MODEM

Error Condition - NO CARRIER

Upon detection of “NO CARRIER” from the MODEM, the PC host will initialize the MODEM and return to a waiting for call status.

5.3 Device Identification - MEDTRONIC ERS-Protocol Modem

Applicable Defib Products: DT-2, DT-2PL, DT-3, DT-4
The Medtronic ERS receiving station modem can be uniquely identified from a TIA/EIA 602 compatible modem by the process described in the Medtronic ERS Document 2002-048.

5.4 Interaction between Error-Correcting and Non-Error-Correcting Modems

Although not likely, (since the DT-3, DT-4 devices should always employ error-correcting modems), it is possible to configure a system where the answering device is a non-error correcting modem, and the originating device is an error-correcting modem.

In this case the answering device may receive the error-correction link protocol request, instead of the expected response to the data transfer request.

There are several ways to mitigate this problem: the preferred method is to program the originating modem to abort the error-correction link negotiation on the receipt of a <ENQ> character. This is a common feature of most newer error-correcting modems.

In the event this feature in not available there are two other methods which can be employed:

1) In general (V.42, MNP) the modem industry has defined two modes of operation for an error-correcting modem: reliable and auto-reliable. In the reliable mode the modem attempts to establish an error-correction link for up to nine seconds, failing the link the connection is terminated. In the auto-reliable mode the modem attempts to establish a link for up to four seconds, failing the link the modem enters the non-error-correcting mode.

Programming the answering modem to hold-off carrier detect for 5 seconds (ATS9=50), will ensure the response received to the data transfer request is correct and not a protocol link request.

2) Delay four seconds prior to sending the <ENQ><SOH><STX>. If the checksum of the data in the buffer is incorrect, clear the rx-buffer and re-enter the identification process at step 6.

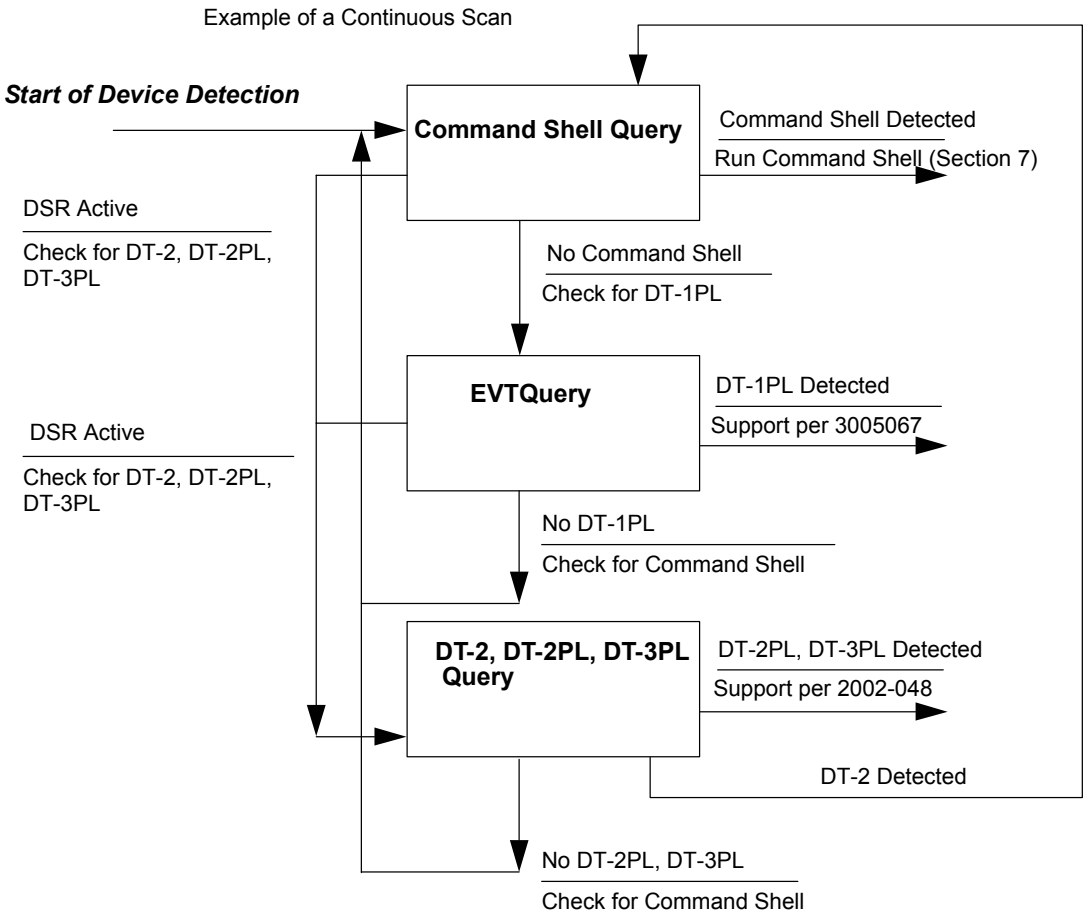
5.5 Detection of a Direct Session

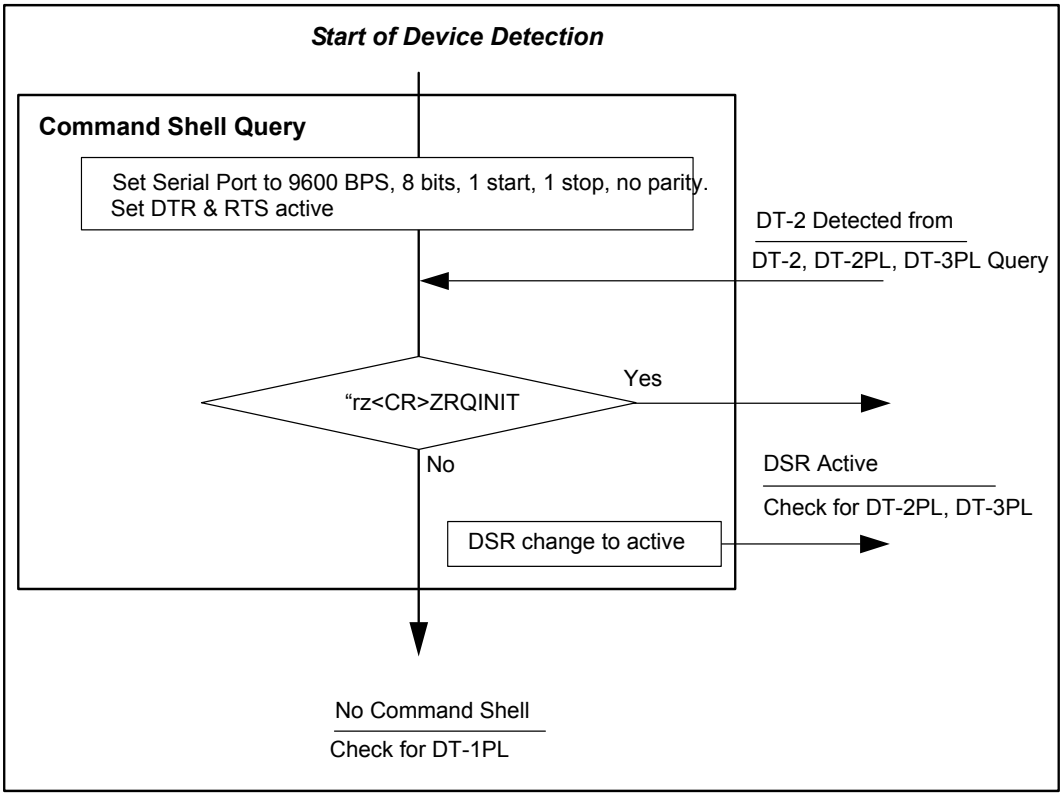
Applicable Device Types: DT-3, DT-4

A Direct Session is one in which the Host and Cart devices are tied together via a cable connection. The flowchart below shows a method to identify which slave device

is present. Since the actual implementation requirements will vary, Host devices may support none, part or all of the detection methods as required. The step by step method of detection is the same as that described in 5.2.1 above, with the exception that the Modem is replaced with direct serial wire, removing the requirement for modem initialization and modem hang-up

.





Expansion of Command Shell Query Block

Detect DT-1, DT-2 Direct session

Initial Host Serial Port Comm. Settings: 9600 baud, 8 bits, 1 start, 1 stop, no parity. (1), (2)

Host Control Line usages: RTS used for Host Receive data flow control.

DTR = Active. DTR is not used by LP500/LP12

but may be looped back to the Host.

exit to SCP-ECG Shell if "rz<CR>ZRQINIT" is received .
exit to SCP-ECG Shell if "AT+{anystring} + <CR> is received

Prior to reception of the SCP-ECG ID block an LP500 may send an "AT + {any string} + <CR><LF>" string at 9600 bps to query for a MODEM connection (3). At the recognition of the "AT" string the PC must send <ENQ><SOH><STX>. The host will wait for the SCP-ECG ID block before entering the command shell mode.

A DT-2 device, due to the use of its RTS output for hardware flow control, is indistinguishable from a DT-2PL device until characters are received by the host. Thus, the DT-2 device is detected in the same fashion as a DT-2PL device at 38400 bps and control transferred to the Command Shell Query block thereafter. Once in the Command Shell Query block, session detection is the same as for the DT-1 devices with respect to the characters received.

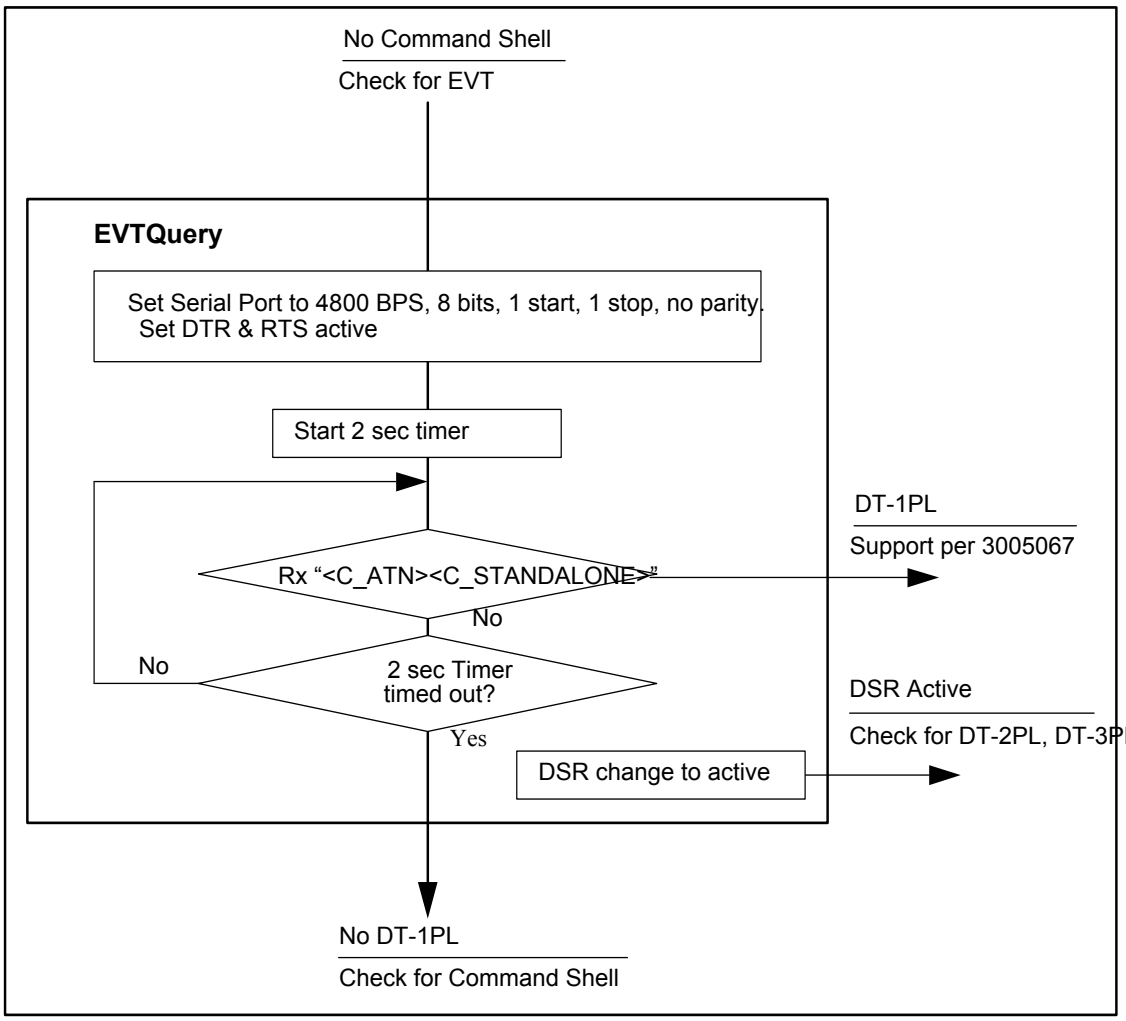
Note : (1) 9600 baud is the initial data rate for DT-1 devices and may be increased during the session.

(2) On entry from the DT-2, DT-2PL, DT-3PL detection block, the baud rate will be 38400 and may be increased during the session.

(3) Any reception of <CR><LF> may be reversed <LF><CR>

(4) DT-2 devices released after the release of revision 9K to this document will send via the PIF-D3 interface an identifying “banner” at power-up before beginning either a modem or direct-session. This banner is described in Device Identification - Modem Connection.

Expansion of EVT and ASCII Event Log Query Block



Detect DT-1PL Direct session

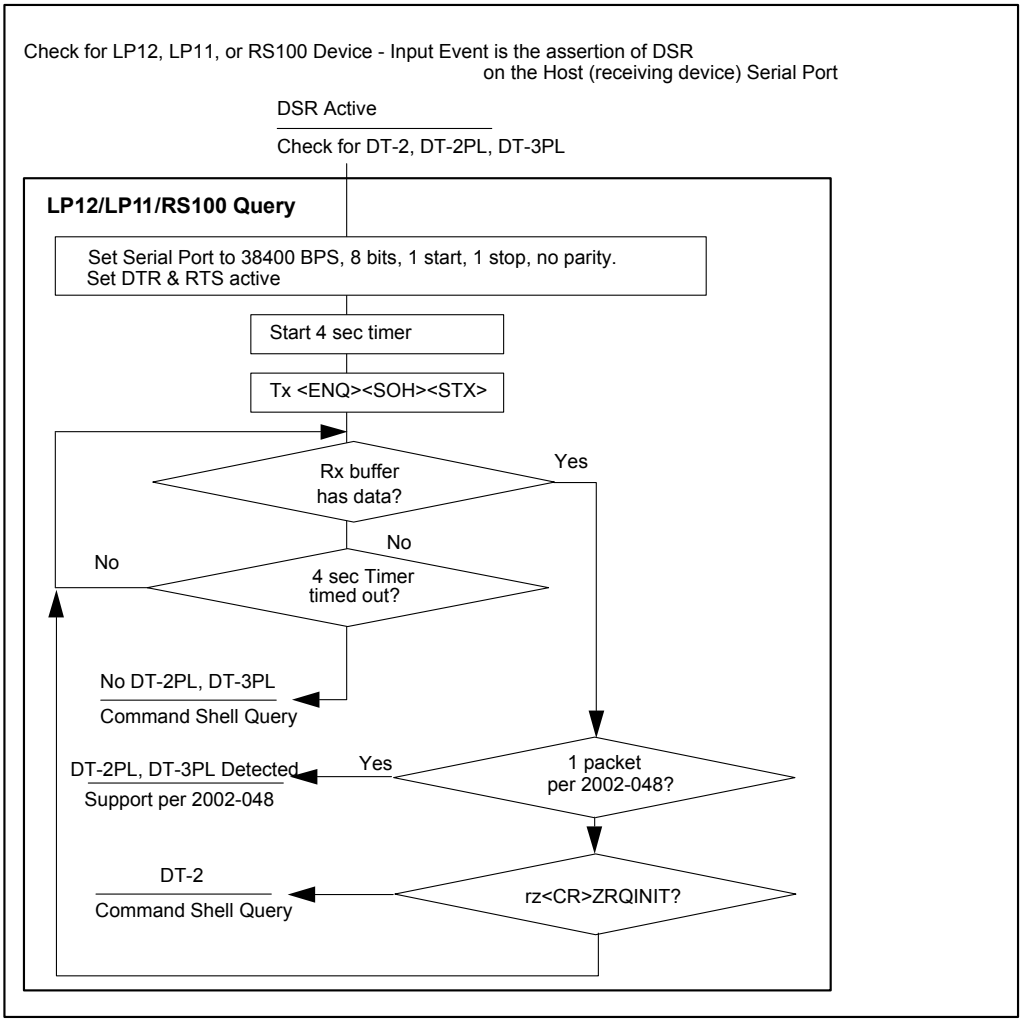
Host Serial Port settings: 4800 BPS, 8 bits, 1 start, 1 stop, no parity
Host Control Line usages: EVT uses none, but DTR and RTS may be looped back to the Host for Host hardware compatibility.

Set a 2 sec timer. Reception of the two characters <C_ATN><C_STANDALONE> (Defined in EVT doc 3005067 as decimal values 255 and 169) shall indicate connection to a LP300 EVT. The rest of the session shall continue per EVT doc 3005067.

The EVT may also transmit these strings:

The EVT may send an “<ESC>?” at 9600 BPS to query for a printer. A “<CR>ATZ” may be sent at 2400 BPS by the EVT to query for a MODEM connection.

Expansion of DT-2, DT-2PL, DT-3PL Query Block



Detect DT-2PL, DT-3P Direct session

Host Serial Port Communications Settings: 38400 BPS, 8 bits, 1 start, 1 stop, no parity.
Host Control line assertions: RTS = High. RTS ties to RS100/LP11 CTS

DTR = Active. DTR is not used by RS100/LP11

but may be looped back to the Host.

Assertion of the Host's RS-232 input line 'Data Set Ready' (DSR) to the active state is the trigger of a DT-2, DT-2PL, or DT-3PL direct session.

For DT-2PL and DT-3PL sessions, as outlined in 2002-048, the Host must respond within 0.5sec to assertion of DSR with a response. The use of the string '<ENQ><SOH><STX>' allows the DT-2PL device to identify interfaces which also support the Command Shell (as outlined in Section 7 of this document) from an DT-3PL device. The DT-2PL and DT-3PL devices will ignore the <ENQ>. Since DSR may also be asserted by a MODEM, if a MODEM connection is also a possibility, the Host will have to handle detection of a MODEM outside of this section.

On assertion of DSR, start a 4 second timer. Send a <ENQ><SOH><STX>. If a DT-2PL, DT-3PL connection is present, the response will be the patient data that the user has selected for transmission. The flowchart shows reception of a data packet as a trigger point for detection of the DT-2PL, DT-3PL session. This received packet must be saved and appended to the rest of the data to be received. The send /receive protocol for DT-2PL, DT-3PL connections is detailed in the Pyramid communications interface control document 2002-048. If the 4 second timer times out, then go on to the next step of device detection.

After asserting RTS (which is connected to the same host input pin as the DT-2PL/DT3-PL DTR signal) DT-2 devices connect attempting to establish a ZMODEM session by sending "rz<CR>ZRQINIT". If this string is received, a DT-2 device has been connected and control transfers to the Command Shell Query block.

5.6 DT-2 Device Banner

Following the initiation of a new incident, DT-2 devices will output via the PIF-D3 or -D10 interface the following "banner" as ASCII text at 9600 bps, with no parity, 8 data bits, 1 stop bit:

<Device Acronym><CR> Per SCP-ECG Section 1: Tag 14, "Physio-Control Model Number"

<Device Serial Number><CR> Per SCP-ECG Section 1: Tag 14, "Device Serial Number"

<Device Software Revision><CR> Per SCP-ECG Section 1: Tag 14, "SW Revision of the Device"

<LIFENET Revision><CR> Per SCP-ECG Section 1: Tag 244, "LIFENET Version"

<Patient Record ID><CR> Per SCP-ECG Section 1: Tag 246, "Patient Record ID" (date and time only)

All data fields shall not contain the characters "AT", "A/", "A>", and "+++". Following the data fields, the string "AT<CR>" shall be output to clear the command buffer of any attached V.25ter modem.

The specified data rate and format are required to maintain compatibility with the "Detect DT-1, DT-2 Direct session" requirements as described in Detection of a Direct Session.

Note that there is no timing requirement imposed by this document on the generation of the banner. An external device, such as Phaser, which may utilize the banner for timing purposes needs to coordinate its requirements with the products implementing this banner output.

5.7 ASCII Event Log Transfers

DT-1 devices provide a text file called an ASCII Event Log. This data may be obtained by responding to the DT-1 modem query strings with a command string. The DT-1 device transmits the ASCII Event Log data as an uninterrupted string of characters; no transport layer protocol, no hardware handshaking. XON-XOFF software flow control is supported during this transfer.

Host Serial Port Communications Settings: 9600 bps, 8 bits, 1 start, 1 stop, no parity

Host Control Line usages: RTS = Not Used

DTR = Not Used, but may be looped back to the host

A DT-1 device continually outputs a modem query string

"AT {any string} <CR><LF>"

at 9600 bps for a MODEM connection. At the recognition of the query string the host device shall send one of the following strings to initiate the transmission of an ASCII Event Log:

<ENQ><SOH><ESC> 0xFF <CR> <LF> requests all stored event logs

<ENQ><SOH><ESC> 0x01 <CR> <LF> requests the most recent event log

<ENQ><SOH><ESC> 0x02 <CR> <LF> requests the next most recent event log

The DT-1 device will then transmit data in the format described in Appendix 1 - Sample ASCII Summary Record of this document.

Following the transmission of the ASCII Event Log data, the DT-1 device enters a direct-connect IDLE state as described in the device design documentation.

6. THE SCP-ECG DATA PRESENTATION FORMAT

6.1 SCP-ECG Background

All newly developed Medtronic ERS devices will exchange data using the SCP-ECG communications protocol. SCP-ECG Version 1.0 defines the format and requirements of the presentation layer in general. This document defines the Medtronic ERS l specific extensions for use with medical data other than that obtained from a 12-Lead electrocardiograph. The construction of the SCP-ECG records shall conform to the specifications of the SCP-ECG standard unless specifically stated otherwise in this document.

The intended use at Medtronic ERS is primarily to provide a standard data format to support in-hospital data management and archival processes. SCP-ECG's function is not to provide a description of the data's presentation, but to provide sufficient data such that a satisfactory presentation can be constructed.

In 1986 and 1987, at the request of the United States Veterans Administration, approximately seven manufacturers of ECG carts began defining a universal communications protocol. This was published under the name UNIPRO. This standard formed the framework for the European standard SCP-ECG, Standard Communications Protocol for Computer Assisted Electrocardiography.

SCP-ECG, similar to its UNIPRO parent, was developed to offer a means by which several manufacturers of ECG carts could exchange information with any other manufacturer's host. This provided the first step in a truly open ECG management system.

SCP-ECG, however, is specifically designed to transmit and exchange information primarily related to 12-Lead ECG. The body of the standard does not include a means for transmitting information such as vital signs, and multi-parameter waveforms such as those found in a pre-hospital setting. Medtronic ERS has developed the following extensions in order to make available in a standard format data from the pre-hospital environment.

6.2 SCP-ECG Data Extensions

6.2.1 Language extensions

All Medtronic ERS devices will use ISO-10646 Unicode as the character set for multibyte language extensions. Unless explicitly noted otherwise, any field described as 'text' will contain UNICODE values. A field described as a 'string' will be NULL-terminated. Tag data fields for strings may contain NULL bytes (0x00) following the string data and string-terminating NULL (either ASCII or UNICODE NULL as required). In this case, the tag length value will be greater than the actual data string length.

6.2.2 Presentation extensions

For the purposes of this document (unless otherwise specified):

•All integers are 16-bits long
•All values are unsigned
•TRUE = any NON-ZERO value
•BOOL are flag data of one-byte length
•Single-byte numerical values are 0-255
•The following are integer constants:

No Data	0x8000
Out of Range (-)	0x8001
Out of Range (+)	0x7FFF

In the case where a signed Out of Range value is not available, Out of Range (+) shall be used.

6.2.2.1 Record CRC extensions:

True SCP-ECG includes, as the first two bytes of the file, the CRC of the entire record to be transmitted. Medtronic ERS allows for the CRC to be optionally sent at the end of the record rather than the beginning of the record. This will be accomplished as follows:

1) The placeholder for the front CRC will be initialized to zero.

2) All data sections 0-11, 905, 906, 916, 919, 922, 923, 1019, 1020, 1022, and 1023 which are present will be included in the CRC calculation as normal. However, the CRC will be sent following the last section in the CRC'ed area.

Section 1021, Non-critical waveform data, will not be subjected to the overall file CRC, and will be appended to the end of the CRC'ed data sections. If the CRC is transmitted at the end of the file rather than the beginning, section 1021 will follow the CRC.

6.2.2.2 Section Numbering

Medtronic ERS extension sections are numbered with either a "900" prefix or "1000" prefix to accommodate different tag constructions.

Only LP500 devices and derivatives use the 1000-prefixed sections, generating sections of type 1019, 1020, 1021, 1022, and 1023. All other SCP-ECG compatible Medtronic ERS devices will use sections with "900" prefixes.

6.2.2.3 Tag/Subtag Rules and Definitions

Sections using the "900" prefix implement the TLV structure as described in the SCP-ECG standard, version 1.0, section 5.4.2.2. Sections using the "1000" prefix omit the 2-byte unsigned integer "Length" field and do not utilize the Terminator Tag.

1. TLV means a Tag-Length-Value data structure. "Tag" and "Subtag" are also used to refer to TLV data structures as defined below. Note that the 2-byte length field restricts the length of the value field to 65,535 bytes.
2. SCP-ECG Sections may contain Tags.
3. Tags may contain other TLV structures called "Subtags". For the purposes of this document, the level of nesting is confined to two layers, Tags and Subtags.
4. TLV structures may contain untagged data of a known format. This data is called "fixed-format data" and will not change within the definition of the TLV structure. Fixed-format data precedes all subordinate TLV structures within the containing TLV.
5. All Tags and Subtags shall be documented as either single- or multiple-instances allowed per containing structure and whether mandatory or optional.
6. Tags and Subtags may have any value from 1 to 254, with 0 reserved for expansion or other messaging uses and 255 reserved for use as a terminator tag as described in the SCP-ECG standard, section 5.4.2.2.

7. All lists of TLV structures (including lists containing only one Tag or Subtag) shall conclude with the terminator Tag of type 255 and a length value of zero.

6.2.2.4 Leads Off Data

For all data items in which ECG waveform data is contained and for which a leads-off condition is true, the actual data shall be replaced with the “no data” value of 0x8000, as defined in Presentation extensions of this document.

6.2.2.5 Scope of Specifications

The specifications for SCP-ECG records contained in The SCP-ECG Data Presentation Format of this document are limited to the descriptions of the allowed syntax of those records. Specifications for the data contained in the records and its use are not within the scope of this document.

6.2.2.6 Boundary Padding NULLs

The LP12 Tango release and all previous releases fail to implement SCP-ECG standard paragraph 5.2.1 correctly when the data element at the boundary is a null-terminated string. The value of the padding byte is random.

6.2.3 Section 1 - Patient Information Header (all report types)

Rules: Shall start with the section ID header as defined in 5.2.7 of the SCP-ECG standard

All common information will follow the guidelines of SCP-ECG section 5.4 (unmodified). Definitions for tags specified in the SCP-ECG standard are as follows:

Tag14: Byte 1-2: Institution ID per the SCP-ECG standard (0 if not used)

Byte 3-4: SITE # per SCP-ECG standard

Byte 5-6: Reserved

Byte 7: Constant: 0

Byte 8: Constant: 21 decimal, indicating Physio-Control Corporation

Byte: 9-14: Medtronic ERS (was PC) Model number:

LP11	“LPK11”<NULL>
LP500	“LP500”<NULL>
LP12	“LP12”<NULL><NULL>
LP600	“LP600”<NULL>
LP20	“LP20”<NULL><NULL>
DT500, QV500	“PCCLN”<NULL>
32-bit DevComm	“PDC32”<NULL>

NOTE: These characters are in ASCII format.

Byte 15: Constant: 10 decimal

Byte 16: Constant: 0100 0001 Binary for XMODEM compatible Devices, OR

Constant: 0100 1111 for non-XMODEM compatible devices

Byte 17-35: as defined by the standard

Byte 17: Bits 1-2 set to indicate Unicode

Byte 36: Length of Software Revision, in bytes, including NULL

Byte 37-: Software Revision of the Device, ASCII, NULL terminated

Byte (beginning at the offset which is the sum of 37 and the value in byte 36):

Device Serial Number in ASCII NULL terminated

Tag 25: Power-on Date (when the power-switch is activated), see SCP-ECG standard for data format

Tag 26: Power-on Time (when the power-switch is activated), see SCP-ECG standard for data format

Tag 27-28: Frequency Response (High Pass/ Low Pass respectively) used for 12-Lead only, optional, single-instances only

Tag 29: Filter Bit Map

All acquiring devices of version LIFENET 2.1 or later with ECG functions are required to send Section 1: Tag 29. Data from legacy devices that are not able to add this functionality will be processed in accordance with the following rules:

1) Installation and configuration of any data management host (type DT-3 or DT-4) will require that the user enter a default value to use for the notch fiilter information; either 50 or 60 Hz.

2) If an acquiring device (type DT-1, DT-1PL, DT-2, DT-2PL) sends Section 1: Tag 29, the data management host will unconditionally use the information in that tag, regardless of the configured default setting.

3) If an acquiring device does not send Section 1: Tag 29, but does send Section 1: Tag 14, the data management host will use the AC Mains Frequency Environment data item in Tag 14 for the notch filter frequency. This value is almost always the same as the true notch filter value.

4) If an acquiring device does not send Section 1: Tag 14 or Tag 29, the data management host will use its configured default value.

5) If a default value has not been configured on the data management host, a value of 60 Hz will be assumed.

Tag 30: Comments - Multiple instances allowed with comment text being reassembled in the order in which Tag 30 fields were received.

Tag 34: Time Zone (used **only** in records compliant with SCP-ECG version 1.3 and higher)

Contains user-set Time Zone information. Not changeable by external device.

If Time Zone is not configured, tag not included in record or sent with time zone of “unknown”

Once configured, Time Zone is always included in the record

Pending adoption of SCP-ECG 1.3:

The Offset field shall allow values of +/-780 minutes.

The Index field shall be two bytes, with values as defined in the RX<13> command.

The Description field of this tag shall use 0x7FFF to indicate that the field is unused or uninitialized.

Manufacturer-specific tags:

Tag 244: LIFENET Configuration ID (ConfID)

This tag records the LIFENET Configuration (ref. LIFENET System Description) to which this record complies.

Mandatory, single-instance only

Tag length - 4 bytes

Bytes 1-2: Configuration Version - UNICODE text character

Byte 3: Minor version

Byte 4: Development version

Implementation ConfID's

Product	Version	ConfID(*)
LP500	4.4	1.0
LP500	4.5	1.1
LP12	019, 022	1.1
LP12	030	2.0
LP12	061	2.1
LP12	V6	2.2
LP12	Tango	2.3
CodeStat Suite	2.0	1.0
CodeStat Suite	3.0	2.1
CodeStat Suite	3.1	2.2
CodeStat Suite	4.0	3.0
LIFENET-RS	1.0, 1.1, 1.2	2.1
LIFENET-RS	1.3	2.3
LIFENET-RS	2.0	3.0
Columbus	n/a	3.0
Phaser	1.0	2.3
Cruiser	n/a	3.0
Zinfandel	n/a	3.0

(*) The ConfID is composed of [Configuration Version].[Minor Version]

Tag 245: Incident ID

Optional, single-instances only

Tag length - variable

Byte 1-len: text string

Tag 246: Device Patient Record ID (all data is ASCII text)

Optional, single-instances only

Tag length - variable

Byte 1-len: text string

Byte 0-3: year

Byte 4-5: month

Byte 6-7: day

Byte 8-9: hour

Byte 10-11: minute

Byte 12-13: second

Byte 14-15: hundredths of seconds (may be sent as '00')

Byte 16-: device serial number, ASCII NULL terminated

Note - the field length count includes the terminating NULL character.

Tag 247: Time difference record

Optional, single-instances only

Tag length - 4 bytes

Byte 1-4: Time delta, signed long, SECONDS, subtracted from record time/date values to derive corrected times.

NOTE: A value of 0x80000000 indicates that a value is not available or has not been stored.

Tag 248: Multi-part data

Optional, single-instances only

Tag length - 3 bytes

This is used when sending multiple records comprising a single data item, such as several Section 922's which would be combined to make up a single waveform.

Rule: Records containing the sections comprising the multi-part data item will be transmitted contiguously. i.e., Records containing data sections not associated with the multi-part data item will not be inserted between records containing the multi-part sections.

Byte 0: Unique session ID

Byte 1: Total number of records making up the data item

Byte 2: Sequence number of this record

Tag 249: Alternate Race Identifier
Optional, single-instance only
Tag length - variable
Note: This data is valid only if the RACE byte is 255 (Section1:Tag9)
Byte 1-2: String length in Bytes
Bytes 3-n: String

Tag 250: Device Configuration
Optional, single-instance only
Tag length - 2 bytes
Byte1-2: binary manufacturing configuration, device-specific

Tag 251: Reserved

Tag 252: Reserved

Tag 253: Record type

Mandatory - single-instance only

Tag length - 1 byte

0x00 = Defib Event Record
0x01 = Pacer Event Record
0x02 = SAS Event Record
0x03 = CPSS Event Record
0x04 = Patient Alarm Event Record
0x05 = 12_lead Event Record
0x06 = Printer Event Record
0x07 = Operator Event Record
0x08 = Vital Signs Event Record
0x09 = *Reserved*
0x0A = First Waveform Event Record
0x80 = Abstract Information/Event Log
0x81 = Continuous ECG Record
0x82 = Test History File and Test Log Records
0x83 = Configuration File Record
0x84 = Real-Time Voice Record
0x85 = Non-displayed, special continuous ECG, 125Hz data Record
0x86 = Patient Record
0x87 = State of the Patient Record (effective with Cruiser product)
0x88 = Trend Data Record

All other values are reserved.

Tag 254: Event ID List

Optional, single-instance only

Tag length - variable

Byte1-2: Event ID (ref. Section 1023:Tag2:Bytes 4-5)

Repeat bytes 1-2, one for each event ID associated with this waveform in a CodeSummary event.

NOTE: This information is obsolete and will not be supported in devices following Initial LP500.

6.2.4 Section 2 - Huffman Tables

All elements of section two will remain the same as defined in the SCP-ECG standard with the following exception:

1) The TABLE MODE SWITCH byte is extended to include the following options

Value: 254: The data is 8-bit original to be sign extended to a 16-bit positive number

Value: 255: The data is 8-bit original to be sign extended to a 16-bit negative number

6.2.5 Section 3: ECG Lead Definitions

Section 3 definitions shall be used for all types of ECG files to be transmitted.

Extensions:

#255 for PADDLEs (hard)

#254 for PADDLEs (QuickCombo)

#253 for PADDLEs (Internal)

#252 for PADDLEs (TestLoad)

#251 for Invasive Pressure, IP1

#250 for NIBP

#249 for Unipolar SPO2-Pleth Waveform

#248 for CO2

#247 for Continuous Audio[2]

#246 for Patient Impedance Magnitude

#245 for Invasive Pressure, IP2

#244 for Invasive Pressure, ART

#243 for Invasive Pressure, PA

#242 for Invasive Pressure, CVP

#241 for Invasive Pressure, ICP

#240 for Invasive Pressure, LAP

#239 for Generic V-lead

#238 for Sterilizable Paddles

#237 for Patient Impedance, Resistive Component

#236 for Patient Impedance, Reactive Component

#235 for Patient Common Mode Voltage

#234 for SPO2-Pleth Bar

#233 for Biploar SPO2-Pleth Waveform

Anticipated Changes:

#66 for V8

#67 for V9

#68 for V8R

#69 for V9R

#70 for D (Nehb - Dorsal)

#71 for A (Nehb - Anterior)

#72 for J (Nehb - Inferior)

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[2]All Continuous audio leads will use TrueSpeech 8.5kbps compression. These techniques are available for license from DSP Group, Inc. 3120 Scott Blvd., Santa Clara, CA. 95054, USA. TrueSpeech is supplied as a standard feature of Microsoft Windows 95.

#73 for Defibrillator lead, anterior-lateral (used as “Generic Paddles” by Medtronic ERS)

#74 for External Pacing lead, anterior-posterior

#75 for A1 (Auxiliary, unipolar leads 1-4)

#76 for A2

#77 for A3

#78 for A4

#79 for V8-cal

#80 for V9-cal

#81 for V8R-cal

#82 for V9R-cal

#83 for D-cal

#84 for A-cal

#85 for J-cal

NOTE: Units for all waveforms are listed in , following the AVM field definition.

NOTE: All ID’s from 66 through 85 are proposed changes by the AAMI SCP-ECG review committee and are listed here pending their incorporation into the SCP-ECG standard by CEN.

6.2.6 Section 7 - Global Measurements

This section outlines the manufacturer specific global measurement block called out in section 7, Paragraph 5.10.3 of prENV 1064:1993 Medical Informatics, Standard communications protocol - Computer assisted electrocardiography (SCP-ECG standard). This is a block of manufacturer specific global measurements that will be appended to section 7after the data on pacemaker spikes.

This block will be made up general measurements specific to the global variables present in the code summary 12 lead report.

Bytes	Contents
Bytes 1-2	This number represents the age of the patient at the time of the 12 lead analysis
Bytes 3-4	This is the determined heart_rate of the patient.
Bytes 5-6	This is the global determined pr interval.
Bytes 7-8	This is the global determined qrs duration.
Bytes 9-10	This is the global determined qt duration.
Bytes 11-12	This is the global determined qtc duration.

The needed set of variables contained within this block are values, input, and determined output scores for the Selker TIPI and ACI_TPI algorithm.

Bytes	Contents
Byte 13	This is the state of the randomizer. Only used in clinical trials. 0 = tpi executed 1 = just 12sl
Byte 14	Unused.
Bytes 15-16	The patient's pain assessment; 0 = primary or chief complaint 1 = secondary complaint 2 = no chest pain present
Byte 17	The patient's diabetic status 0 = unknown 1 = yes 2 = no
Byte 18	The patient's hypertension status 0 = unknown 1 = yes 2 = no
Byte 19-20	NIBP systolic entry in mmHg
Byte 21-22	NIBP diastolic entry in mmHg
Byte 23-24	The onset time in pain in minutes
Byte 25	TPI question status 0 = tpi question not asked 1 = tpi question asked
Byte 26	TPI executed 0 = tpi process was not executed 1 = tpi process was executed
Byte 27	Internal algorithm variable: cpain
Byte 28	Internal algorithm variable : sxicpain
Byte 29	Internal algorithm variable malesex;
Byte 30	Internal algorithm variable age40;
Byte 31	Internal algorithm variable age50;
Byte 32	Internal algorithm variable sexage50;
Byte 33	Internal algorithm variable qwave;
Byte 34	Internal algorithm variable stel;
Byte 35	Internal algorithm variable stdep;
Byte 36	Internal algorithm variable twel;
Byte 37	Internal algorithm variable twinv;
Byte 38	Internal algorithm variable twistdep;
Byte 39	Internal algorithm variable pad2;

Byte 40	pad3;
Byte 41	pad4;
Byte 42	pad5;
Byte 43	pad6;
Byte 44	pad7;
Byte 45-48	TIPI score
Byte 49-52	TPI 30day mortality score with no thrombolysis
Byte 53-56	TPI 30day_mortality_score with thrombolysis
Byte 57-60	TPI 1year_mortality_score with no thrombolysis
Byte 61-64	TPI 1year_mortality_score with thrombolysis
Byte 65-68	TPI cardiac arrest probability with no_ thrombolysis
Byte 69-72	TPI cardiac arrest probability with_ thrombolysis
Byte 73-76	TPI intracranial hemorrhage score
Byte 77-80	TPI major bleed score

The needed set of variables contained within this block are thresholds, and determined summations for the Simoon's reperfusion algorithm.

Byte	Contents
Byte 81-84	Result code
Byte 85-88	Sum ST anterior
Byte 89-92	Sum ST inferior
Byte 93-96	PTCA threshold

6.2.7 Section 10 - Lead Measurement Block

The following measurement variables are added to those defined in the SCP-ECG standard. These are outputs from the Marquette 12SL interpretation algorithm.

Bytes	Variable
105 - 106	p-wave
107 - 108	p'-wave
109 - 110	t-wave
111 - 112	t'-wave
113 - 114	ST-mid
115 - 116	ST-end

All variables are 16-bit signed integers.

6.2.8 900-Series Sections

6.2.8.1 Section 905 - Median Data for Medtronic ERS -Custom Compression

Rules: Section shall follow all rules of Section 5 of the SCP-ECG standard, except for byte 5 of the header field. This byte shall contain the Compression Used information as described in Byte 13 of Section 922.

6.2.8.2 Section 906 - Rhythm Data with Medtronic ERS -Custom Compression

Rules: Section shall follow all rules of Section 6 of the SCP-ECG standard, except for byte 5 of the header field. This byte shall contain the Compression Used information as described in Byte 13 of Section 922.

6.2.8.3 Section 909 - General-Purpose Data Section

Rules: Section shall start with the section ID header as defined in 5.2.7 of the SCP-ECG standard.

Specific Extensions:

Tag 1: Data Tag

Optional, multiple instances allowed

Note: Multiple instances are allowed only for tags with bytes 5-6 greater than 1.

Tag Length - variable

Byte 1-2: Data type, enumeration, integer

0 = unstructured binary field, short integers

1 = unstructured binary field, integers

2 = unstructured binary field, long integers

3 = ASCII free text, not NULL-terminated

4 = ASCII string, NULL-terminated

100 = Marquette 12SL packed-object

Byte 3-4: Sequence number of this data tag, integer. Must be one or greater.

Byte 5-6: Total number of sequential data tags of this data type, integer. Must be one or greater.

Note: Bytes 3-4 and 5-6 make up an index for a data block sent as a sequence of tags of a specific type. (i.e., tag n of m) A data block sent as a single tag must have sequence number and total number set to one.

Bytes 7-len Data

6.2.8.4 Section 916 - Waveform Data Segment Definition

Rules: Section shall start with the section ID header as defined in 5.2.7 of the SCP-ECG standard. Section shall follow the rules of Section 3 of the SCP-ECG standard.

Byte 1: Number of data segment descriptions enclosed

Byte 2: Flag byte (see SCP-ECG section 5.6.1)

Byte 3: Total regions, maximum number of displayed regions (does not correspond to regional composition of the data)

Byte 4-14: Detail for first data segment description

Byte 15-25: Detail for second data segment description

... continued, one detail section for each data segment description

The detailed information for each data segment description is as follows:

Byte 1-4: Starting sample number, S_s, [1-max] of uncompressed data (does not correspond to Bytes 14-17 of Section 922)

Byte 5-8: Ending sample number, S_e, [1-max, >= Starting sample number] of uncompressed data (does not correspond to Bytes 14-17 of Section 922)

There are no restrictions on overlap or gaps in the data segments, but the waveform segments described in Section 922 must correspond exactly.

In cases where data mappings cause over-writing of displayed data, the data with the highest sequence number will be displayed, independent of the order of section construction.

$S_e - S_s, + 1$ = Number of uncompressed samples in the segment

Byte 9: Data identification per Section 3 ECG Lead Definition Extensions

Byte 10: Region number [1-255], directs presentation application as to the placement of data

Byte 11: Sequence within region [1-255]

Note: Segments for the start/end sample numbers indicating an overlap must have the corresponding overlap in the uncompressed data supplied in Section 922.

6.2.8.5 Section 917 - Reserved

6.2.8.6 Section 918 -Reserved

6.2.8.7 Section 919 - Configuration Information

Rules: Section shall start with the section ID header as defined in 5.2.7 of the SCP-ECG standard

Tag 1: ASCII Mapped Configuration String

Optional, single instance only

Tag Length - variable

Byte 1-len: configuration string, MSD to LSD, ASCII, NULL terminated

The format of the configuration string is specified by the Device and Patient Data Reports Standard.

Tag 2: Lead Type Enumeration

Optional, single instance only

Tag Length - variable

Applying the indicated filter to the data sent in Section 922 results in a waveform with the same characteristics as presented by the acquiring device. Repeat bytes 1-4 for each lead-filter pair.

This tag consists of two types of data; lead-type enumerations that associate SCP-ECG lead IDs (ref. Section 3) with data types and filter types defined by the LIFENET System Filter Description standard.

If a lead ID is unknown or does not have a specified Lead Type, either no filtering will be performed or a locally-defined filter will be used.

Byte 1-2	Lead Type, U16, enum	
	0	Unknown
	1	ECG
	2	Paddles ECG
	3	Non-Invasive Blood Pressure (NIBP)
	4	Invasive Pressure (IP)
	5	CO2
	6	SPO2 (Pleth Waveform)
	7	Impedance
	8	Audio
	9	Patient Common Mode Voltage
	10	Pleth Bar
Byte 3-4	Filter ID, U16, enum	

Lead Type	Allowed Lead ID's
ECG	0-66, 239
Paddles ECG	238, 252-255
NIBP	250
IP	240-245, 251
CO2	248
SPO2 (Pleth Waveform)	249
Impedance	236, 237, 246
Audio	247
Common-Mode Voltage	235
Pleth Bar	234

6.2.8.8 Section 920 - Test Log

Definitions:

Composite — An Entry containing a mix of labels and numeric elements.

Element — A single item of numeric or text data.

Element Type — A set of enumerations describing the numeric format (the "hint") and content (the "type")

Entry — Refers to a group of elements from a single time/date. These are commonly presented as a single line or row in a tabular format.

Entry Type — Similar to Log Type, Entry Type is used to allow a presenting device to invoke formatting or interpretation rules specific to that Entry Type. Entry Type is applied on an entry-by-entry basis.

Log — Refers to the entire package of data received from the device and to the entire set of data output by the report-generator or viewer. Logs are assumed to be collections of data elements ordered by time/date or a sequence index in sets (usually presented as rows).

Log Type — In the case of a device supporting multiple types of Test Logs or organizations of information in the log, Log Type is used to cause a presenting device to invoke formatting or interpretation rules specific to that Log Type. Log Type may refer to a particular product in

order to invoke rules germane to a specific use model, but may NOT be used as an indicator of the device generating the log.

Visibility — Refers to whether or not log data entries or elements are to be made visible to the user as opposed to service personnel, such as for information normally used for troubleshooting or Post-Market Surveillance (PMS). Visibility rules may also depend on Log Type.

Rules for section construction within SCP-ECG records:

1. At most, one Test Log Section may be included in an Abstract Record.
2. If an Abstract Record contains a Test Log Section, a record parser may ignore any Test Log Records.

SCP-ECG Record-level Implementation:

1. LP12 Tango release will include one Test Log Section in the Abstract Record. No LP12 release will utilize Test Log Records.
2. All LIFENET 3 implementations will not include Test Log Sections in the Abstract Record and will use Test Log Records, instead.

Rules: Section shall start with the section ID header as defined in 5.2.7 of the SCP-ECG standard.

Tag 1 — Reserved

Tag 2 — Reserved

Tag 3 — Log Description

Mandatory, Single-instance only

Length - variable

Bytes 1-4 — Date of Log Creation, formatted per Section 1: Tag 25

Bytes 5-7 — Time of Log Creation, formatted per Section 1: Tag 26

Bytes 8-9 — Log Type, enumeration, U16

0-9	LP500 Logs
0	Reserved
1	LP500 Test Log
2-9	Reserved
10-19	LP12

10	Reserved
11	LP12 Self-Test Result
12-19	Not Used
20-29	Columbus
20	Reserved
21	Columbus Test Log
22-29	Not Used
30-39	Cruiser
30	Reserved
31	Cruiser Test Log
32-39	Not Used
40-32767	Not Used

Any device may use any of the available enumerations if the format indicated is compatible with the transmitted data. This enumeration may NOT be used to determine the device type of the transmitted data.

Byte 10 Log Visibility, enumeration, U8

0	Normal
1	Post-Market Surveillance (PMS)
2 - 255	Reserved

A log visibility of 1 (PMS) indicates that ALL applicable rules used by the presenting device (or driven by Log Type) are to be applied to ALL of the elements in the log.

Bytes 11-len Log Name, UNICODE string

Tag 4 Log Entry

Optional, Multiple-instances allowed

Length - variable

See Log Entry Type Profiles & Implementations of this document for implementation notes.

Construction notes:

Note 1 - Either a Subtag 1 or Subtag 4 must be present in each Tag 4. If both subtags are present, the primary time order will be determined by Subtag 4 and the secondary time order by Subtag 1.

Note 2 - Subtag(s) 3 shall follow all other subtag types in Tag 4. This greatly aids the parsing of Tag 4.

Note 3 - If Subtag 2 has a value of 1, Subtag 3 may not be present.

Subtag 1 Sequence number, U16

Optional, Single-instance only (note 1)

Length - 2 bytes

Bytes 1-2 Sequence number, U16

Subtag 2 Entry Type (English-version labels in parentheses)

Optional, Single-instance only

Length - 2 bytes

Bytes 1-2 Entry Type, enumeration, U16

0 - No Type Specified

1 - Simple User Test (USER TEST:)

2 - Automated Self-Test Results (AUTO TEST:)

3 - User Test Results (USER TEST:)

4 - Daily Auto Test Results (DAILY AUTO TEST:)

5 - Weekly Auto Test Results (WEEKLY AUTO TEST:)

6 - Self Test Results (SELF TEST:)

7 - User Power On Test Results (USER POWER ON:)

8 - Charge-Pak Removed Test Results (CHARGE-PAK REMOVED:)

9 - Charge-Pak Replaced Test Results (CHARGE-PAK REPLACED:)

10 - Fault Codes (FAULT CODES:)

11 - 32767 reserved

Subtag 3 Entry Data Element

Optional, Multiple-instances allowed (note 2)

Length - 8 bytes

Bytes 1 - 2 Hint enumeration, U16

Hints are used by the record parser to guide preparation of the entry data elements for presentation functions.

0 - unknown

1 - binary byte

2 - binary word

3 - binary double word

4 - hex byte

5 - hex word

6 - hex double word

7 - decimal word

8 - enumeration (indicates that the element is an index into a table based on Element Type)

9 - 32767 - reserved

Byte 3 - 4 Element Type, enumeration, U16

0 - No Type Specified

1 - Major Fault

2 - Minor Fault

3 - Readiness Indicator

4 - Power System Voltage

5 - Device Temperature

6 - Cumulative Number of Shocks

7 - Cumulative On Time

8 - 32767 reserved

Byte 5 - 8 Data Element, U32

Note 1: The data element will always be 4 bytes long no matter what the hint is. (i.e. If the hint is 'binary byte' the first 3 bytes of the data element would be ignored.)

Note 2: When Bytes 1-2 indicates an enumeration and Bytes 3-4 = 3 (Readiness Indicator) the values in Bytes 5-8 will be enumerations from the following table:

0 - OK

1 - Replace Battery

2 - Service

All other values reserved

Subtag 4 Entry Time Stamp

Optional, Single-instance only (note 1)

Length - 9 bytes

Bytes 1-4 Date per Section 1: Tag 25

Bytes 5-7 Time per Section 1: Tag 26

Bytes 8-9 Milliseconds, U16 (if not used, set to zero)

Subtag 5 Entry Text

Optional, Single-instance only

Length - variable

Bytes 1-len UNICODE string, NULL-terminated

Subtag 6 Entry Result Status

Optional, Single-instance only

Length - 1 byte

Result status is used by the presenting device to display an appropriately translated text-string label.

Byte 1 Status, enumeration, U8

0	Pass
1	Fail
2	Go
3	No-Go
4	Valid
5	Invalid
6	Ready
7	Not Ready
8	On-Line
9	Off-Line
10-253	Not Used
254	Unavailable
255	Unknown

Note - Tag 5 and Tag 6 must both be present if either is present.

Tag 5 XML Log
Optional, Single-instance only (note 1)
Length - variable
Bytes 1-len UNICODE string, NULL-terminated

Tag 6 XML Log Style Sheet
Optional, Single-instance only (note 1)
Length - variable
Bytes 1-len UNICODE string, NULL-terminated

6.2.8.8.1 Log Entry Type Profiles & Implementations

1. Simple Pass/Fail Entry Type

The Simple User Test Entry Type consists only of Sequence/Time/Date and a text message, usually "PASS" or "FAIL". There are no numeric elements, such as failure codes.

Tag 4 is constructed as follows:

Subtag 1 Optional
Subtag 2 1

Subtag 3	Not Used
Subtag 4	Per definition
Subtag 5	String per definition
Subtag 6	Not Used

The result will be report entries organized as follows:

[Seq. #][Time][Date][entry label][string]	
[Seq. #]	from Tag 4: Subtag 1
[Time][Date]	from Tag 4: Subtag 4
[entry label]	from table indexed by Tag 4; Subtag 2
[string]	from Tag 4: Subtag 5

2. Composite Log Entry Type

Composite Log Entry Types result in report entries organized as follows:

[Seq. #][Time][Date][entry label][result label][element(s)][text]

[Seq. #]	from Tag 4: Subtag 1
[Time][Date]	from Tag 4: Subtag 4
[entry label]	from table indexed by Tag 4: Subtag 2
[result label]	from Tag 4: Subtag 6 (if present)
[element(s)]	from Tag 4: Subtag 3
[text]	from Tag 4: Subtag 5

Implementations

1. LP12 Tango will construct Section 920 using the Composite Log Entry Type (Profile 2) as follows:

Tag 3	Bytes 1-4, 5-7	per description

	Bytes 8-9	11
	Byte 10	0
	Byte 11-len	"User Test" (or translated equivalent)
Tag 4	one Tag 4 for each test result	
	Subtag 1	Not Used
	Subtag 2	1
	Subtag 3	Not Used
	Subtag 4	per description, with msec set to zero
	Subtag 5	Not Used
	Subtag 6	0 or 1 per definition

2. Columbus will utilize the Composite Log Entry Type (Profile 2) as follows:

Tag 3	Bytes 1-4, 5-7	per description
	Bytes 8-9	21
	Byte 10	0
	Byte 11-len	single UNICODE NULL
Tag 4	one Tag 4 for each log entry	
	Composite entries containing Pass/Fail, status, fault codes, and numeric entries	
	Subtag 1	per description
	Subtag 2	1-9
	Subtag 3	per description
	Subtag 4	per description
	Subtag 5	per description
	Subtag 6	per description

3. The Cruiser test log implementation is TBD

Test Log Report Formats

1. Log Type = 1 (LP500 Test Log)

This report consists of four sections:

Top of page - Title (hard-coded or from Tag 3) and device information block (derived from information not in Section 920)

Test History Log - begins with the title "Test History Log" and contains a complete chronological list of all Tag 4 entries received.

Major Fault Log - begins with the title "Major Fault Log" and contains a complete chronological list of all Tag 4 entries with a Subtag 3 Type of 1.

Minor Fault Log - begins with the title "Minor Fault Log" and contains a complete chronological list of all Tag 4 entries with a Subtag 3 Type of 2.

Note: duplicate Tag 4 entries with a Subtag 3 Type of 1 or 2 will not be printed in the Test History Log section.

2. Log Type = 21 (Columbus Test Log)

This report consists of four sections:

Top of page - Title (hard-coded to "Test Log") and device information block (derived from information not in Section 920)

Test History Log - begins with the title "Test History Log" and contains a complete chronological list of all Tag 4 entries received.except those with a Subtag 3 Type of 1 or 2.

Major Fault Log - begins with the title "Major Fault Log" and contains a complete chronological list of all Tag 4 entries with a Subtag 3 Type of 1.

Minor Fault Log - begins with the title "Minor Fault Log" and contains a complete chronological list of all Tag 4 entries with a Subtag 3 Type of 2.

Test Log report format examples:

Example of 500 Test Log Report (Log Type 1)

TEST LOG REPORT

Test History Log

Date	Time	SELF TEST	PASS
Date	Time	SELF TEST	PASS
Date	Time	SELF TEST	PASS
Date	Time	SELF TEST	PASS
Date	Time	SELF TEST	PASS

Date	Time	SELF TEST	PASS
Date	Time	SELF TEST	PASS
Date	Time	SELF TEST	FAIL

****** END OF REPORT ******

Example of LP12 Test Log Report (Log Type 11)

TEST LOG REPORT

Test History Log

Date	Time	USER TEST	PASS
Date	Time	USER TEST	PASS
Date	Time	USER TEST	FAIL
Date	Time	USER TEST	PASS
Date	Time	USER TEST	PASS
Date	Time	USER TEST	PASS

****** END OF REPORT ******

Example of LP CRP Test Log Report (Log Type 21)

TEST LOG REPORT

Test History Log

Date	Time	SELF-TEST POWER ON	PASS
Date	Time	SELF-TEST	PASS
Date	Time	USER POWER ON	PASS
Date	Time	CHARGE-PAK CHANGED	PASS
Date	Time	SELF-TEST POWER ON	PASS
Date	Time	SELF-TEST	FAIL

Major Fault Log

Date	Time	0xFE32
Date	Time	0xFE33

Minor Fault Log

Date	Time	0x3456
Date	Time	0x4325
Date	Time	0x3456
Date	Time	0x1234

****** END OF REPORT ******

Presenting devices may also apply rules based on any of the Section 920 “type” information to control visibility or formatting of the elements in the final report. Here is an example of a Type 21 Test Log with numeric service data added to the example above:

Example of LP1000 Test Log Report with the extra data displayed (labels at the discretion of the presenting device)

TEST LOG REPORT

Test History Log

				Ready	Pwr	Tmp	Shk	Time	DChrg	BCurr	BType	BLC	BSn
Date	Time	DAILY AUTO TEST:	PASS	0x00	11568	21	4	16	4500	-250	0	0511	1234
Date	Time	DAILY AUTO TEST:	FAIL	0x05	11385	21	4	16	4400	-253	0	0511	1234
Date	Time	USER POWER ON:	PASS	0x00	11547	22	6	46	4400	-249	0	0511	1234
Date	Time	USER POWER OFF:	PASS	0x00	11588	22	6	46	4300	-255	0	0511	1234
Date	Time	USER POWER ON:	PASS	0x00	11628	23	6	47	4200	-250	0	0511	1234
Date	Time	USER POWER OFF:	FAIL	0x05	11547	22	6	47	4100	-254	0	0511	1234

Major Fault Log

Date Time 0xFE32

Minor Fault Log

Date Time 0x3456

Diagnostic Log

Date Time 0x284A
Date Time 0x284A

****** END OF REPORT ******

Where the Test History Log columns headers identify the following information;

Ready – Readiness Indicator
Pwr – Power System Voltage
Tmp – Device Temperature for LPCRP, Battery Temp for LP1000
Shk – Cumulative Number of Shocks
Time – Cumulative On Time
DChrg – Discharge Counter for LPCR, Remaining Capacity for LP1000
BCurr – Battery Current
BType – Battery Type
BLC – Battery Lot Code
BSn – Battery Serial Number

6.2.8.9 Section 921 - Reserved

6.2.8.10 Section 922 - Multi-Parameter encoded data

Rules: Section shall start with the section ID header as defined in 5.2.7 of the SCP-ECG standard.

NOTE: The filter response information in this section pertains ONLY to waveform data contained in this section and shall override any filter settings specified in Section 1: Tags 27 and 28. This is the bandwidth of data included in this section and does not correspond to any presentation history or directives.

NOTE: The following header defines the basic sampling characteristics of the data. Byte 1-len are repeated for each data segment in this section.

Byte 1-2: Multiplier for amplitude value (AVM). The values in the Encoded Data, when multiplied by the value contained in these bytes, result in numeric values with units according to the following table.

Waveform	Units
Delta-impedance	micro-Ohms
All ECG leads	micro-Volts
CO_2, IP, NIBP	mmHg or Torr
SpO_2, Audio, Pleth Bar	no units
Patient Common Mode Voltage	micro-Volts

The normalizing of waveform data is accomplished by multiplier for amplitude value, or AVM. Rev. 1.0 of SCP-ECG specifies only the multiplier for ECG waveforms (nV). Data definitions are per Section 3 or Section 916.

Byte 3-6: The sample rate for the lead in milliHertz [1-max]

Byte 7-8: High-Pass frequency response (-3dB) for waveform data in 1/100Hz

Byte 9-10: Low-Pass frequency response (-3dB) for waveform data in 1/100Hz

Byte 11: Reserved (this byte is ignored)

Implementation note: All LP12 versions assign this byte a value of 1, which should be ignored by receiving devices.

Byte 12: Number of bytes of encoded lead data/sample [1-max]

Byte 13: Compression Used

0	None
1	Second-Difference, Erd Huffman
2	2-to-1 Decimation, 5uV per bit, Second-Difference, Erd Huffman
3	TrueSpeech
4	Second-Difference, Byte-packed
5	Marquette 12SL
6	First-Difference, Erd Huffman, Hi/Lo Byte split

7-127 Reserved

128-255 Reserved to indicate new header format

Byte 14-17: Length of encoded data block, starting at Byte 18

Byte 18-len: Encoded Data (length specified in Bytes 14-17)

Tag 1: Filter Initialization Data

Optional, single instance only

Tag Length - variable

The data contained in this tag is used to set a digital filter to the same state as the acquiring device at the beginning of the waveform segment contained in this section. The filter is specified in Section 919 and the data format by the LIFENET System Filter Description Standard, PDR-4722. If this Tag is not present or contains data which conflicts with the filter description, the filter initialization data will be set to zero.

Byte 1-len Initialization Data

Section 922 Construction Example:

AVM	Sample Rate	Base-line	Lowp ass	Reser ved	Bytes/ Smpl	Comp	Len	Data	Initial'n Data
2	4	2	2	X	1	1	4	var	var

Note that this section may contain multiple instances of data sections as described above and that each instance has a corresponding data definition instance in Section 916. There must be a one-to-one correspondence between the data definition structures of Section 916 and the instances of waveform data in this section.

An example of SCP-ECG Section 3 is included for completeness. This example assumes 15 seconds of waveform/voice/impedance, comprised of 2 segments of each lead recorded simultaneously. The segments are separated by a 3 second gap (post shock). These waveforms consist of SAS, Defib Pre-Post times. The formats are the same for both sections 922 and 1022.

Section 3 - Lead Data

Hdr[3]	CRC 2	3 2	Len 4	Ver 1	Spare 7	Refer to SCP-ECG Section 5.2.7 for header details
1st data part	# leads 0x04	Flag 0x18	Refer to SCP-ECG section 5.6 4 leads (2 set of 2) # leads 2 leads each recorded at the same time (0x18)			
Lead Detail	Start 1	End 1080	Ld typ #254	Start 1	End 540	Ld typ #246
Lead Detail	Start 1440	End 1800	Ld typ #254	Start 720	End 900	Ld typ #246

Section 922 - Waveform Data

Example of the compressed encoded lead data (other than voice), inserted into the lead data section above

Lead 1 Detail	AVM 1250	Smp Rate 8330	Low Pass 5	High Pass 40	Filter 1	Length Var	9 Sec of SAS data	Initial'n Data (opt)
Lead 2 Detail	AVM 10000	Smp Rate 118	Low Pass 20	High Pass 100	Filter 1	Length Var	9 Sec of Impd data	Initial'n Data (opt)
Lead 3 Detail	AVM 1250	Smp Rate 8330	Low Pass 5	High Pass 40	Filter 1	Length Var	6 Sec of SAS data	Initial'n Data (opt)
Lead 4 Detail	AVM 10000	Smp Rate 118	Low Pass 20	High Pass 100	Filter 1	Length Var	6 Sec of Impd data	Initial'n Data (opt)

[3]lower numbers are byte counts not values

Section 922 Data format.

Hdr Len Function:	data var

This data field has no internal structure - only data.

6.2.8.11 Section 923 - Abstract Information/Event Log

Rules: Section shall start with the section ID header as defined in 5.2.7 of the SCP-ECG standard

Example of Abstract Information/Event Section 923

The Abstract Information/Event Log header section consists of two parts, the header (consisting of Tag 1 and Tag 2) and the event records. Tag1 contains the general device information and can have a maximum occurrence of one.

Each Event Record has its own Tag structure.

Example of a SAS event followed by a defibrillation event for section 923

Hdr	CRC 2	923 2	Len 4	Ver 1	Spare 7	Refer to SCP-ECG Section 5.2.7 for header details		
Tag1:	Tag #1 1	Tag Len. 2	Elps Time 3	Total Paced 3	Total 12- Ld 1	Total Shoc k 1	Num. of Event	
Tag2:	Tag #2	Tag Len. 2	Smp. Prior 4	Smp. After 4	Pre- Samp 4	Post- Samp 4		
Tag 12:	Tag #12	Tag Len. 2	Ev. Hdr. 18	Seq. Num. 1	Seg. Num. 1	Out- come 1	Sub- Tags	Tag 255

Tag 10:	Tag #10	Tag Len. 2	Ev. Hdr. 18	Seq. Num. 1	Sel. En'g y 2	Padd. Type 1	Beg. Samp 4	Beg. Time 3	Wave Type 1	Sub-Tags	Tag 255
Tag 255	Tag #255	Tag Len 2									

Tag 1: Abstract Header

Optional, single instance only

Tag Length - 10 bytes

Byte 1-3: Elapsed time, beginning at the time on Section 1: Tag 26 (format per Section 1: Tag 26) (hours 0-255)

Byte 4-6: Total Time Paced (format per Section 1: Tag 26) (hours 0-255)

Byte 7: Total # of 12-Leads (0-255)

Byte 8: Total # of Shocks (0-255)

Byte 9-10: Number of events in the Event Log, integer

Tag 2: Four-Parameter Event Summarization Template

Optional, multiple instances allowed, order dependent

Tag Length - 16 bytes

Byte 1-4: Number of samples prior to the event to display, long integer

Byte 5-8: Number of samples after the event to display, long integer

Byte 9-12: Number of pre-samples, before display, if any, long integer

Byte 13-16: Number of post-sample, after display, if any, long integer

NOTE: All samples are positive integers relative to the event marker.

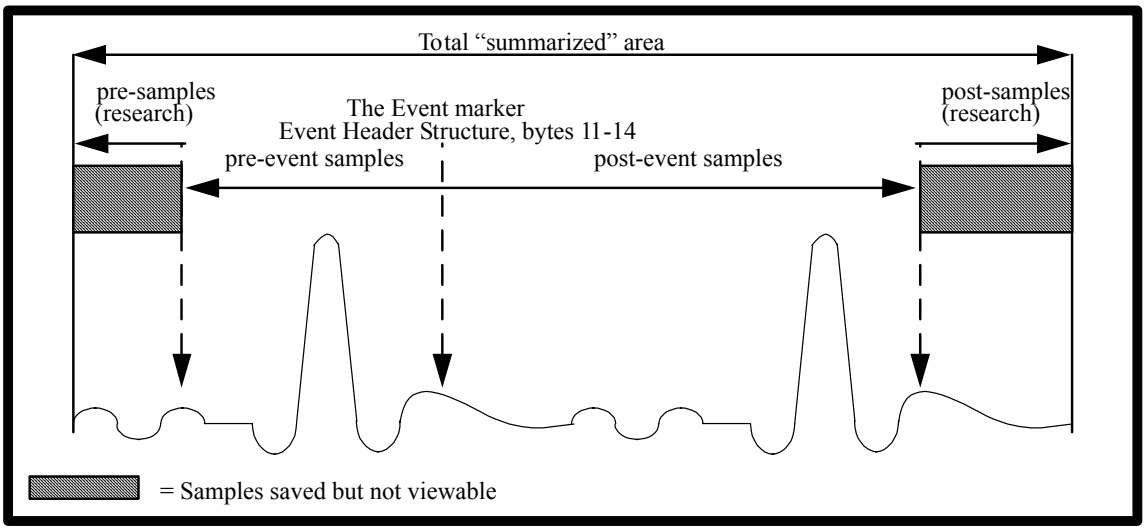
NOTE: The order in which the templates are added to this section corresponds to the Event Template Index used in Subtag 253 of this section.

NOTE: If a template reference is not provided for a waveform data segment, then a default template

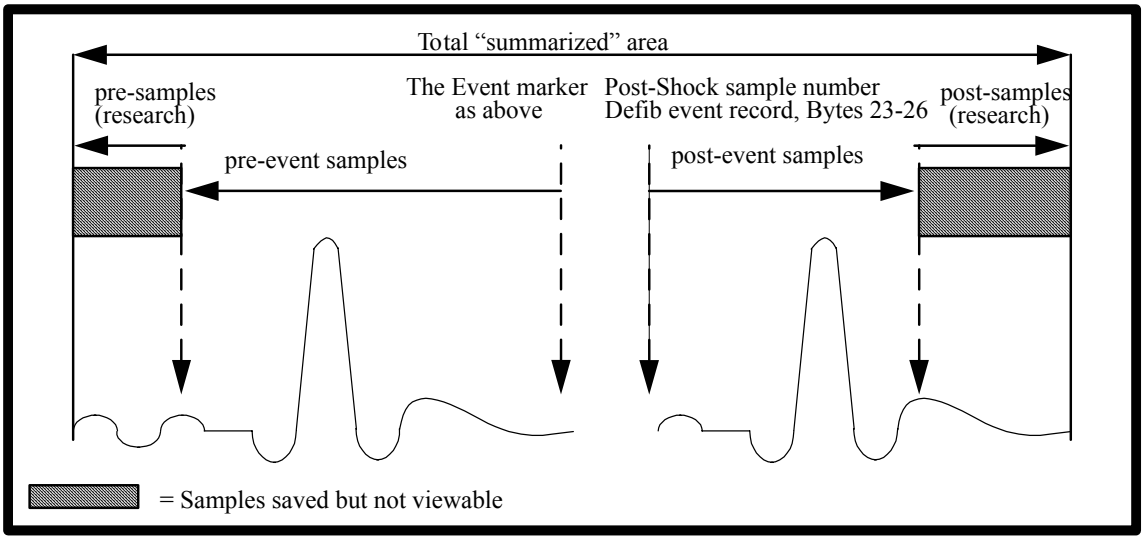
may be used by the data host for display. (see also Subtag 253)

NOTE: Pre- and post-event research sample numbers add to the display pre-and post-event sample numbers.

Example of a template - simple event:



Example of a template - Defib event:



6.2.8.11.1 Event Record Definitions

6.2.8.11.1.1 Tag 10 Defib Event Record

Optional, multiple instances allowed

Tag Length - variable

Byte 1-18: Event Record Header Structure

Byte 19: Sequence number (e.g. 1 for defib event #1), unique and consisten within an episode by tag type

Byte 20-21: Selected Energy (in Joules), integer

Byte 22: PaddleTypeUsed, per SCP-ECG Section 3

Byte 23-26: Absolute sample number at the beginning of the post shock event, long integer [1-max]

Byte 27-29: Time at the beginning of the post shock event (format per Section 1: Tag 26)

Byte 30: Waveform type, byte

1 = EDMARK

2 = BiPhasic - Truncated Exponential

3 = BiPhasic - Gervich

Subtag 1: Link to an associated SAS event (requires a non-null Event Record ID - see Event Record Structure) which must be contained in the same record.

Optional, single instance only

Subtag length - 2 bytes

Byte 1-2: Event Record ID, 2 bytes

Subtag 2: Delivery Status/Faults

Optional, single instance only

Subtag Length - 2 bytes

Byte 1-2: Status/Fault Code, integer

0 = Open Air

1 = Disarmed

2 = Energy Not Delivered

3 = Energy Delivered

4 = Abnormal Energy

Subtag 3: Voltage compensation Impedance

This is an “Absolute Patient Impedance” value.

Optional, single instance only

Subtag length - 5 bytes

Byte 1-4: Voltage Compensation Impedance value in micro-ohms, unsigned integer

Byte 5: Parameter Data Status, BOOL

TRUE = Valid

FALSE = Invalid

Subtag 4: Dynamic Impedance (effective with Cruiser)

This is the impedance value measured during the defibrillation shock.

Optional, single instance only

Subtag length - 5 bytes

Byte 1-4 Dynamic Impedance Value in micro-ohms

Byte 5 Parameter Data Status, BOOL

TRUE = Valid

FALSE = Invalid

Subtag 5 General Impedance Measurement

Optional, multiple instances allowed

Length - variable

Byte 1 Impedance Value Type

Lead ID (per SCP-ECG Section 3 ECG Lead Definition Extensions)

Byte 2 Impedance Acquisition Type

Definitions are listed in the Impedance Standard Features document.

Acquisition Type, enumeration, U8

0	Reserved
1	Patient Connected
2	Analysis Initiated
3	Analysis Stopped
4	Motion Detected
5	Analysis Intermediate
6	Analysis Complete
7	Pre-Shock
8	Defibrillation
9	Post-Shock
10-255	Not Used

Byte 3 Impedance Meaurement Frequency

Measurement Frequency, enumeration, U8

0	DC
1	14.3 kHz
2	20.0 kHz
3	30.8 kHz
4	57.1 kHz

5-255 Not Used

Byte 4-9 Impedance Measurement Value

Bytes 4-5 Amplitude value multiplier (AVM), signed integer

The AVM is the conversion factor between the measurement value and micro-ohms. i.e. - Multiply the measurement value by the AVM to obtain micro-ohms.

Bytes 6-9
Measurement value, signed long integer

Subtag 253: Event Template Index
Mandatory, single instance only
Subtag 254: Pacer/Sync Status Block
Optional, single instance only

6.2.8.11.1.2 Tag 11 The Pacer Event Record

Optional, multiple instances allowed
Tag Length - variable
Byte 1-18: Event Record Header Structure
Byte 19: Sequence Number (see Tag 10)
Byte 20: PacerEventType:
0x01 = Started
0x02 = Set
0x03 = Changed
0x04 = Stopped
0x05 = Pacing Pause Started
0x06 = Pacing Pause Stopped
Subtag 253: Event Template Index
Mandatory, single instance only
Subtag 254: Pacer/Sync Status Block
Optional, single instance only

6.2.8.11.1.3 Tag 12: SAS 1.0 Event Record

Optional, multiple instances allowed
Tag Length - variable
Byte 1-18: Event Record Header Structure
Byte 19: Sequence Number (see Tag 10)

Byte 20: Segment Number [1-255]

Byte 21: Marker type, Type_Outcome

Type_Outcome:

0x01 = No Shock - Intermediate

0x02 = Shock - Intermediate

0x06 = Analysis Started - Intermediate

0x07 = Motion Detected - Intermediate

0x08 = Reserved

0x0A = Analysis Initiated

0x81 = No Shock - Final

0x82 = Shock - Final

0x83 = Analysis Aborted Motion time out - Final

0x84 = Analysis Aborted Device Error - Final

0x85 = Analysis Aborted, Stop Command - Final

0x89 = Analysis Aborted - Leads Off - Final

0x8B = Analysis Aborted, Cable Off - Final

0x8C = Analysis Aborted, Manual - Final

Subtag 1: Link to an associated defib event (must be in the same record)

This subtag is only sent with SAS Events with Marker type of Shock - Final (0x82)

Optional, single instance only

Subtag length - 2 bytes

Byte 1-2: Event Record ID, 2 bytes

Subtag 2: Intermediate Results

This subtag is only sent with SAS Events with Marker type of No Shock - Intermediate (0x01) or Shock - Intermediate (0x02)

Intermediate results can be described by the following structure and are optionally included with each segmental result.

Optional, single instance only

Subtag length - 16 bytes

Byte 1-2: Result, integer

Byte 3-4: Histo1, integer

Byte 5-6: Histo2, integer

Byte 7-8: AveFreq, integer

Byte 9-10: AveAmp, integer

Byte 11-12: Rate, integer

Byte 13: PrNum, byte

Byte 14: PrNumLim, byte

Byte 15: NrNum, byte

Byte 16: NrNumLim, byte

Subtag 253: Event Template Index

Optional, single instance only

When Type_Outcome is one of the following values: 0x01, 0x02, 0x83, 0x84, 0x85, 0x89, then Subtag 253 is mandatory in an SAS Event Record (Sec 1: Tag 253 = 0x02).

Subtag 254: Pacer/Sync Status Block

Optional, single instance only (The LP12 will always include this subtag.)

NOTE: With respect to future expansion, any Type_Outcome enumerator not recognized by the receiving program shall be reported as “Unknown Outcome - Type XX”, where XX will be the ASCII two-character representation of the hexadecimal Marker type enumeration.

6.2.8.11.1.4 Tag 13: CPSS Event Record

Optional, multiple instances allowed

Tag Length - variable

Byte 1-18: Event Record Header Structure

Byte 19: Outcome:

- 0x00 = No Check Patient - Intermediate
- 0x01 = Check Patient - Intermediate
- 0x02 = Start CPSS segment - Intermediate
- 0x80 = No Check Patient - Final
- 0x81 = Check Patient - Final
- 0x82 = Start CPSS segment - Final

Subtag 253: Event Template Index

Mandatory, single instance only

Subtag 254: Pacer/Sync Status Block

Optional, single instance only

6.2.8.11.1.5 Tag 14: Patient Alarm Event Record

Optional, multiple instances allowed

Tag Length - variable

Byte 1-18: Event Record Header Structure

Byte 19-20: Alarm Limit, High, signed integer

Byte 21-22: Alarm Limit, Low, signed integer

Byte 23-24: Violating parameter, integer

- 0 = HR Upper Alarm
- 1 = HR Lower Alarm
- 2 = SPO2 Upper Alarm
- 3 = SPO2 Lower Alarm
- 4 = Expired CO2 Upper Alarm
- 5 = Expired CO2 Lower Alarm
- 6 = NIBP Systolic Upper Alarm
- 7 = NIBP Systolic Lower Alarm
- 8 = NIBP Diastolic Upper Alarm
- 9 = NIBP Diastolic Lower Alarm
- 10 = IP1 Systolic Upper Alarm
- 11 = IP1 Systolic Lower Alarm
- 12 = IP1 Diastolic Upper Alarm
- 13 = IP1 Diastolic Lower Alarm
- 14 = IP2 Systolic Upper Alarm

15 = IP2 Systolic Lower Alarm
16 = IP2 Diastolic Upper Alarm
17 = IP2 Diastolic Lower Alarm
18 = SPO2 PR Upper Limit
19 = SPO2 PR Lower Limit
20 = NIBP PR Upper Limit
21 = NIBP PR Lower Limit
22 = Inspired CO2 Upper Alarm
23 = Inspired CO2 Lower Alarm
24 = EtCO2 Upper Alarm
25 = EtCO2 Lower Alarm
26 = Respiration Rate Upper Alarm
27 = Respiration Rate Lower Alarm
28 = Apnea Alarm
29 = IP1 Mean Upper Alarm
30 = IP1 Mean Lower Alarm
31 = IP2 Mean Upper Alarm
32 = IP2 Mean Lower Alarm

Subtag 1 Lead Label ID

Optional, Single-instance only

Subtag length - 1 byte

Byte 1 Lead, per SCP-ECG Section 3 ECG Lead Definition Extensions

Subtag 253: Event Template Index

Optional, single instance only

Subtag 254: Pacer/Sync Status Block

Optional, single instance only

6.2.8.11.1.6 Tag 15: Twelve Lead Analysis Event Record

Optional, multiple instances allowed

Tag Length - variable

(Some information may be duplicated in SCP-ECG section 9)

Byte 1-18: Event Record Header Structure

Byte 19: Sequence Number

Byte 20: Override Active, BOOL

TRUE = Override Active

FALSE = Override Inactive

Subtag 253: Event Template Index

Optional, single instance only

Subtag 254: Pacer/Sync Status Block

Optional, single instance only

6.2.8.11.1.7 Tag 16: Printer-Activated Event Record

Optional, multiple instances allowed

Tag Length - variable

Byte 1-18: Event Record Header Structure

Byte 19: Sequence Number

Subtag 253: Event Template Index

Optional, single instance only

Subtag 254: Pacer/Sync Status Block

Optional, single instance only

6.2.8.11.1.8 Tag 17: Annotation Event Record

Optional, multiple instances allowed

Tag Length - variable

Byte 1-18: Event Record Header Structure

Subtag 1: Device Annotation ID

Optional, single instance only

Subtag Length - 2 bytes

Bytes 1-2: Device Annotation ID

- 0x0000 Unknown
- 0x0001 Push Analyze
- 0x0002 Connect Electrodes
- 0x0003 Replace Battery
- 0x0004 Stand Clear
- 0x0005 Push to Shock
- 0x0006 Check for Pulse
- 0x0007 If No Pulse
- 0x0008 Low Battery

Subtag 2: Operator Annotation Text String

Optional, single instance only

Subtag Length - variable
Byte 1-len: Text String

Subtag 253: Event Template Index
Optional, single instance only

Subtag 254: Pacer/Sync Status Block
Optional, single instance only

6.2.8.11.1.9 Tag 18: Vital Signs Event Record

Optional, multiple instances allowed

Tag Length - variable

Byte 1-18: Event Record Header Structure

Subtag 252: Event Record ID

Optional, single instances only

Subtag 1: ECG Heart Rate

Optional, single instance only

Subtag Length - 3 bytes

Byte 1-2: pulse rate in bpm, integer

Byte 3: Parameter Data Status, BOOL

TRUE = Valid

FALSE = Invalid

Subtag 2: SpO_2

Optional, single instance only

Subtag Length - 5 bytes

Byte 1-2: % saturation, integer

Byte 3-4: pulse rate, in bpm, integer

Byte 5: Parameter Data Status, BOOL

TRUE = Valid

FALSE = Invalid

Subtag 3: Reserved - previously definition obsolete

Subtag 4: Reserved - previously definition obsolete

Subtag 5: Reserved - previously definition obsolete

Subtag 6: Reserved - previously definition obsolete

Subtag 7: Reserved - previously definition obsolete

Subtag 8: Reserved - previously definition obsolete

Subtag 9: Vital Signs Pulse Rate Mode

This identifies which pulse rate (SPO2 or IP) in a Vital Signs tag is to be displayed is association with the Vital Signs data. NIBP Pulse Rate is transmitted separately.

Optional, single instance only

Subtag Length - 1 byte

Byte 1: Mode, per SCP-ECG Section 3 ECG Lead Definition Extensions

Note that only the following lead values are valid:

0 - no displayed or valid value

2 - Lead II

240-245, 251 - Invasive Blood Pressures

249 - SPO_2

250 - NIBP

Subtag 10: Paddles Impedance

Optional, single instance only

Subtag Length - 6 bytes

Byte 1: Paddles Type, per SCP-ECG Section 3 ECG Lead Defintion Extensions

Bytes 2-5: Paddles Impedance, micro-Ohms, unsigned integer

Byte 6: Parameter Data Status, BOOL

TRUE = Valid

FALSE = Invalid

Subtag 11: EtCO2

Optional, single instance only

Subtag Length - 4 bytes

Byte 1-2: EtCO2, in mmHg, integer

Byte 3: Parameter Data Status, BOOL

TRUE = Valid

FALSE = Invalid

Byte 4: Subsystem Error/Status Code

00 - No Error (Valid)

01 - Subsystem Failed

02 - Subsystem Disabled

03 - Subsystem Not Ready

04 - 09 - Reserved

10 - Calibration Failed

11 - Flow Rate Failure

12 - Gas Input Blocked

13 - 29 Reserved

30 - 39 Oridian Module Service Codes

Codes not listed are reserved

30 - Main Board Failure

31 - Check CO2 Sensor or Main Board

32 - Replace Scrubber and Pump

33 - Change CO2 Sensor

34 - 15V is Out of Range

40 - 99 - Reserved

100 - 254 - Operational Status & Error Codes

Codes not listed are Reserved

101 - Invalid CO2 Value

102 - Initializing

103 - Auto Zero Request

104 - Auto Zero in Progress

105 - Purging

106 - Filter Line not Connected

255 - Reserved

Subtag 12: Respiration Rate

Optional, single instance only

Subtag Length - 4 bytes

Byte 1-2: Respiration Rate, in RR/min, integer

Byte 3: Parameter Data Status, BOOL

TRUE = Valid

FALSE = Invalid

Byte 4: Subsystem Error/Status Code

00 - No Error (Valid)

01 - Subsystem Failed

02 - Subsystem Disabled

03 - Subsystem Not Ready

04 - 09 - Reserved

10 - Calibration Failed

11 - Flow Rate Failure

12 - Gas Input Blocked

13 - 29 Reserved

30 - 39 Oridian Module Service Codes

Codes not listed are reserved

30 - Main Board Failure

31 - Check CO2 Sensor or Main Board

32 - Replace Scrubber and Pump

33 - Change CO2 Sensor

34 - 15V is Out of Range

40 - 99 - Reserved

100 - 254 - Operational Status & Error Codes

Codes not listed are Reserved

101 - Invalid CO2 Value

102 - Initializing

103 - Auto Zero Request

104 - Auto Zero in Progress

105 - Purging

106 - Filter Line not Connected

255 - Reserved

Subtag 13: FICO2

Optional, single instance only

Subtag Length - 4 bytes

Byte 1-2: FICO2, in mmHg, integer

Byte 3: Parameter Data Status, BOOL

TRUE = Valid

FALSE = Invalid

Byte 4: Subsystem Error/Status Code

00 - No Error (Valid)

01 - Subsystem Failed

02 - Subsystem Disabled

03 - Subsystem Not Ready

04 - 09 - Reserved

10 - Calibration Failed

11 - Flow Rate Failure

12 - Gas Input Blocked

13 - 29 Reserved

30 - 39 Oridian Module Service Codes

Codes not listed are reserved

30 - Main Board Failure

31 - Check CO2 Sensor or Main Board

32 - Replace Scrubber and Pump

33 - Change CO2 Sensor

34 - 15V is Out of Range

40 - 99 - Reserved

100 - 254 - Operational Status & Error Codes

Codes not listed are Reserved

101 - Invalid CO2 Value

102 - Initializing

103 - Auto Zero Request

104 - Auto Zero in Progress

105 - Purging

106 - Filter Line not Connected

255 - Reserved

Subtag 14: Ambient Atmospheric Pressure

This variable is intended for use with blood gas pressures to compute an altitude- or barometric-pressure correction.

Optional, multiple instances allowed

In the case of multiple instances, the measurement with the highest Sample Number will be used to make the correction. It is permitted to have blood gas pressure measurement tags without an accompanying ambient pressure measurement.

Subtag Length - 4 bytes

Byte 1-2: Ambient Atmospheric Pressure, in mmHg, integer

Byte 3: Parameter Data Status, BOOL

TRUE = Valid

FALSE = Invalid

Byte 4: Subsystem Error/Status Code

00 - No Error (Valid)

01 - Subsystem Failed

02 - Subsystem Disabled

03 - Subsystem Not Ready

04 - 09 - Reserved

10 - Calibration Failed

11 - Flow Rate Failure

12 - Gas Input Blocked

13 - 29 Reserved

30 - 39 Oridian Module Service Codes

Codes not listed are reserved

30 - Main Board Failure

31 - Check CO2 Sensor or Main Board

32 - Replace Scrubber and Pump

33 - Change CO2 Sensor

34 - 15V is Out of Range

40 - 99 - Reserved

100 - 254 - Operational Status & Error Codes

Codes not listed are Reserved

101 - Invalid CO2 Value

102 - Initializing

103 - Auto Zero Request
104 - Auto Zero in Progress
105 - Purging
106 - Filter Line not Connected
255 - Reserved

Subtag 15: NIBP

Optional, single instance only

Not used by LP12 implementations

Subtag Length - 20 bytes

Byte 1-2: Reserved

Byte 3: Parameter Data Status, BOOL

TRUE = Valid

FALSE = Invalid

Byte 4: Subsystem Error/Status Code

00 - No Error (Valid)

01 - Subsystem Failed

02 - Subsystem Disabled

03 - Subsystem Not Ready

04 - 09 - Reserved

10 - Calibration Failed

11 - Cuff Inflating

12 - 99 Reserved

100 - 254 - Operational Status & Error Codes

Codes not listed are Reserved

102 - Self Test Failed

106 - Loose Cuff

107 - Air Leak

108 - Air Pressure Error

109 - Weak Signal

110 - Range Exceeded

111 - Excessive Motion

112 - Overpressure Sensed

113 - Signal Saturated

114 - Pneumatic Leak

115 - System Failure

119 - Time Out

255 - Reserved

Byte 5-6: Systolic Pressure, in mmHg, integer

Byte 7: Systolic Pressure valid/invalid, BOOL

TRUE = Valid

FALSE = Invalid

Byte 8: Systolic Pressure error/status Code

0 - 255 - Reserved

Byte 9-10: Diastolic Pressure, in mmHg, integer

Byte 11: Diastolic Pressure valid/invalid, BOOL

TRUE = Valid

FALSE = Invalid

Byte 12: Diastolic Pressure error/status Code

00 - 255 - Reserved

Byte 13-14: Mean Pressure, in mmHg, integer

Byte 15: Mean Pressure valid/invalid, BOOL

TRUE = Valid

FALSE = Invalid

Byte 16: Mean Pressure error/status Code

00 - 255 - Reserved

Byte 17-18: Pulse Rate, in bpm, integer

Byte 19: Pulse Rate valid/invalid, BOOL

TRUE = Valid

FALSE = Invalid

Byte 20: Pulse Rate error/status Code

00 - 255 - Reserved

Subtag 16 Invasive Pressure (IP)

Optional, multiple instances allowed

Subtag Length - 20 bytes

There may not be multiple instances of this subtag contained in a single Tag 18 with identical Lead values.

Byte 1 Lead, per SCP-ECG Section 3 ECG Lead Definition Extensions

Byte 2 IP Channel, enum

0	Unknown
1-254	Channel number
255	Reserved

Byte 3 Reserved

Byte 4 Subsystem Error/Status Code

00	No Error (Valid)
01	Subsystem Failed
02	Subsystem Disabled
03	Subsystem Not Ready
04-255	Reserved

Byte 5-6 Systolic Pressure, mmHg, signed integer

Byte 7 Systolic Pressure valid/invalid, BOOL

TRUE = Valid
FALSE = Invalid

Byte 8 Systolic Pressure error/status code
0-255 Reserved
Byte 9-10 Diastolic Pressure, mmHg, signed integer
Byte 11 Diastolic Pressure valid/invalid, BOOL
TRUE = Valid
FALSE = Invalid
Byte 12 Diastolic Pressure error/status code
0-255 Reserved
Byte 13-14 Mean Pressure, mmHg, signed integer
Byte 15 Mean Pressure valid/invalid, BOOL
TRUE = Valid
FALSE = Invalid
Byte 16 Mean Pressure error/status code
0-255 Reserved
Byte 17-18 Pulse Rate, bpm, integer
Byte 19 Pulse Rate valid/invalid, BOOL
TRUE = Valid
FALSE = Invalid
Byte 20 Pulse Rate error/status code
0-255 Reserved

6.2.8.11.1.7 Tag 19: First Waveform Event Record

Optional, single instance only
Tag Length - variable
Byte 1-18: Event Record Header Structure
Subtag 253: Event Template Index
Mandatory, single instance only
Subtag 254: Pacer/Sync Status Block
Optional, single instance only

6.2.8.11.1.8 Tag 20: PowerCycle Event Record

Optional, multiple instances allowed
Tag Length - 19 bytes
Byte 1-18: Event Record Header Structure
Byte 19: Cycle type

1 = Battery Installed/Power Restored (Warm Start)

2 = Battery Pulled/Power Removed

3 = Power-off

4 = Power-on (Cold Start)

6.2.8.11.1.9 Tag 21: General Event Record

Optional, multiple instances allowed

Only one subtag is allowed in a Tag 21. i.e. - all General Event Records consist of a Tag 21 - single Subtag combination.

Tag Length - variable

Byte 1-18: Event Record Header Structure

Subtag 1: Patient Connected

Optional, single instance only

Subtag Length, 1 byte

Byte 1: Patient Connected, BOOL

TRUE = Yes, FALSE = NO

Subtag 2: ECG Leads Off Detected

Optional, single instance only

Subtag Length, 1 byte

Byte 1: Leads Off Detected, BOOL

TRUE = Yes, FALSE = NO

Subtag 3: Shock Button Disarmed

Optional, single instance only

Subtag Length, 1 byte

Byte 1: Shock Button Disarmed, BOOL

TRUE = Yes, FALSE = NO

Subtag 4: Charge Complete

Optional, single instance only

Subtag Length, 1 byte

Byte 1: Charge Complete, BOOL

TRUE = Yes, FALSE = NO

Subtag 5: Connect Therapy Electrodes

Optional, single instance only

Subtag Length, 1 byte

Byte 1: Connect Electrodes, BOOL

TRUE = Yes, FALSE = NO

Subtag 6: Low Battery Detected

Optional, single instance only

Subtag Length, 1 byte

Byte 1: Low Battery Detected, BOOL

TRUE = Yes, FALSE = NO

Subtag 7: CPR Timer Status #1

Optional, single instance only

Subtag Length, 1 byte

Byte 1: CPR Timer Status, BOOL

TRUE = On, FALSE = Off

Subtag 8: Replace Battery Detected

Optional, single instance only

Subtag Length, 1 byte

Byte 1: Replace Battery Detected, BOOL

TRUE = Yes, FALSE = NO

Subtag 9: Out of Memory event

Optional, single instance only

Subtag Length, 1 byte

Byte 1: Out of Memory Type

0 = Event Cleared

1 = General Memory

2 = Audio Memory

3 = Event Memory

4 = Waveform Memory

Subtag 10: Gain

Optional, single instance only

Subtag Length, 2 bytes

Byte 1-2: Gain, integer

0 = Gain 2.5

1 = Gain 5

2 = Gain 10

3 = Gain 15

4 = Gain 20

5 = Gain 25

6 = Gain 30

7 = Gain 40

Subtag 11: Lead Change

Optional, single instance only

Subtag Length, 2 bytes

Byte 1: region number (most-significant bit set if region enabled)

Byte 2: new lead type (per section 3 of SCP-ECG standard)

Subtag 12: Frequency Response
Optional, single instance only
Subtag Length, 2 bytes
Byte 1-2: Frequency Response type, integer
0 = Diagnostic
1 = Monitor

Subtag 13: Shock Advisory Mode
Optional, single instance only
Subtag Length, 1 byte
Byte 1: Advisory, BOOL
TRUE = Advisory, FALSE = Manual

Subtag 14: Service Fault Code
Optional, single instance only
Subtag Length, 6 bytes
Byte 1-2: Fault Code, unsigned integer
Byte 3-6: Auxiliary Code, unsigned long integer

Subtag 15: Sync Mode Status
Optional, single instance only
Subtag Length, 1 byte
Byte 1: Sync Mode Status, BOOL
TRUE = Enabled, FALSE = Disabled

Subtag 16: Asystole Notification Event
Optional, single instance only
Subtag Length, 1 byte
Byte 1: Asystole Notification, BOOL
TRUE = Yes, FALSE = No

Subtag 17: Internal Pacer Detection Status Event
Optional, single instance only
Subtag Length, 1 byte
Byte 1: Internal Pacer Detection Status, BOOL
TRUE = Enabled, FALSE = Disabled

Subtag 18: Alarms Status Event
Optional, single instance only
Subtag Length, 1 byte

Byte 1: Alarm Status, BOOL

TRUE = Enabled, FALSE = Disabled

Subtag 19: VF/VT Detection Status Event

Optional, single instance only

Subtag Length, 1 byte

Byte 1: VF/VT Status, BOOL

TRUE = Enabled, FALSE = Disabled

Subtag 20: Reserved - protects erroneous use of prototype tag structure

Subtag 21: Reserved - protects erroneous use of prototype tag structure

Subtag 22 IP Label Change Event

This event signals that the parameter measured in the IP Channel indicated in byte 2 has been assigned to the lead identified by the value in byte 1.

Optional, single instance only

Subtag Length - 2 bytes

Byte 1 Lead (parameter) to which the IP channel is assigned,

per SCP-ECG Section 3 ECG Lead Definition Extensions

Valid values include 240 - 245, and 251.

Any other value treated as unknown.

Byte 2 IP Channel, enum

0 Unknown

1-254 Channel Number

255 Reserved

Subtag 23 CPR Timer Status #2

Optional, single instance only

Subtag Length, 1 byte

Byte 1: CPR Timer Status, BOOL

TRUE = On, FALSE = Off

Subtag 24: 5-Wire ECG Cable On/Off

Optional, single instance only

Subtag Length, 1 byte

Byte 1: 5-Wire ECG Cable status, BOOL

TRUE = On (5-wire cable connected)

FALSE = Off (5-wire cable disconnected)

A single instance is generated when a 5-wire ECG cable connection or disconnection is sensed. This subtag is not a status indicator and only is used in conjunction with ECG cable changes.

A single instance of this subtag will be generated if a 5-wire ECG cable is connected at power-on (or a cold-start).

6.2.8.11.1.10 Tag 22: DataTransferEvent Record

Optional, multiple instances allowed

Tag Length - variable

Byte 1-18: Event Record Header Structure

Byte 19-20: Status, integer

0 = failed

1 = completed

2 = cancelled

Byte 21-len: Text String, NULL-terminated

6.2.8.11.1.11 Tag 23: Free Form Event Record

Optional, multiple instances allowed

Tag Length - variable

Byte 1-18: Event Record Header Structure

Byte 19: Tag of event record type to associate with

Subtag 253: Event Template Index

Optional, single instance only

Subtag 254: Pacer/Sync Status Block

Optional, single instance only

6.2.8.11.1.12 Tag 24: Absolute Impedance Event Record

Optional, multiple instances allowed

Tag Length - variable

Byte 1-18: Event Record Header Structure

Byte 19: AbsEventID

1 = Connect Electrodes

2 = Analysis Initiated

3 = Pre-Shock

4 = Post-Shock

Byte 20-21: Impedance in Ohms, signed integer

Subtag 253: Event Template Index

Optional, single instance only

Subtag 254: Pacer/Sync Status Block

Optional, single instance only

6.2.8.11.1.13 Tag 25: Waveform Status Events Log

Optional, multiple instances allowed

Tag Length - variable

Byte 1-4: Sample Rate in milliHertz

Subtag 1: R-Wave Detection

optional, multiple instances allowed

Subtag Length, 5 bytes

Byte 1-4: Sample Number, long integer

Byte 5: Region (per Section 916, byte 10)

Subtag 2: Internal Pacer

optional, multiple instances allowed

Subtag Length, 4 bytes

Byte 1-4: Sample Number, long integer

Subtag 3: External Pacer

optional, multiple instances allowed

Subtag Length, 4 bytes

Byte 1-4: Sample Number, long integer

Subtag 4: Saturation Entered (generated when saturation occurs)

optional, multiple instances allowed

Subtag Length, 4 bytes

Byte 1-4: Sample Number, long integer

Subtag 5: Saturation Cleared (generated when saturation clears)

optional, multiple instances allowed

Subtag Length, 4 bytes
Byte 1-4: Sample Number, long integer

Subtag 6: Test Sync
optional, multiple instances allowed
Subtag Length, 4 bytes
Byte 1-4: Sample Number, long integer

Subtag 7: Lead Off (generated when lead detected as off)
optional, multiple instances allowed
Subtag Length, 5 bytes
Byte 1-4: Sample Number, long integer
Byte 5: Region (per Section 916, byte 10)

Subtag 8: Lead On (generated when lead-off condition clears)
optional, multiple instances allowed
Subtag Length, 5 bytes
Byte 1-4: Sample Number, long integer
Byte 5: Region (per Section 916, byte 10)

Subtag 9: Pacing On
optional, multiple instances allowed
Subtag Length, 6 bytes
Byte 1-4: Sample Number, long integer
Byte 5: Region (per Section 916, byte 10)
Byte 6: Pace Mode
0 = Non-demand
1 = Demand

Note: Unlike the Pacer/Sync status block, there is no "off" enumeration - this is the Pacing On subtag.

Subtag 10: Pacing Off
optional, multiple instances allowed
Subtag Length, 5 bytes
Byte 1-4: Sample Number, long integer
Byte 5: Region (per Section 916, byte 10)

Subtag 11: Sync On
optional, multiple instances allowed
Subtag Length, 4 bytes

Byte 1-4: Sample Number, long integer

Subtag 12: Sync Off

optional, multiple instances allowed

Subtag Length, 4 bytes

Byte 1-4: Sample Number, long integer

Subtag 13: Lead Change

Optional, single instance only

Subtag Length, 6 bytes

Byte 1-4: Sample Number

Byte 5: Region number (most-significant bit set if region enabled)

Byte 6: New lead type (per section 3 of SCP-ECG standard)

Subtag 14: CO2 Initializing On

Optional, multiple instances allowed

Subtag Length, 5 bytes

Byte 1-4: Sample number, long integer

Byte 5: Region (per Section 916, byte 10)

Subtag 15: CO2 Initializing Off

Optional, multiple instances allowed

Subtag Length, 5 bytes

Byte 1-4: Sample number, long integer

Byte 5: Region (per Section 916, byte 10)

Subtag 16: CO2 Autozero On

Optional, multiple instances allowed

Subtag Length, 5 bytes

Byte 1-4: Sample number, long integer

Byte 5: Region (per Section 916, byte 10)

Subtag 17: CO2 Autozero Off

Optional, multiple instances allowed

Subtag Length, 5 bytes

Byte 1-4: Sample number, long integer

Byte 5: Region (per Section 916, byte 10)

Subtag 18: CO2 Purging On

Optional, multiple instances allowed

Subtag Length, 5 bytes

Byte 1-4: Sample number, long integer

Byte 5: Region (per Section 916, byte 10)

Subtag 19: CO2 Purging Off

Optional, multiple instances allowed
Subtag Length, 5 bytes
Byte 1-4: Sample number, long integer
Byte 5: Region (per Section 916, byte 10)

Subtag 20: CO2 Filterline Not Connected
Optional, multiple instances allowed
Subtag Length, 5 bytes
Byte 1-4: Sample number, long integer
Byte 5: Region (per Section 916, byte 10)

Subtag 21: CO2 Filterline Connected
Optional, multiple instances allowed
Subtag Length, 5 bytes
Byte 1-4: Sample number, long integer
Byte 5: Region (per Section 916, byte 10)

Subtag 22: CO2 Filterline Blocked
Optional, multiple instances allowed
Subtag Length, 5 bytes
Byte 1-4: Sample number, long integer
Byte 5: Region (per Section 916, byte 10)

Subtag 23: CO2 Filterline Cleared
Optional, multiple instances allowed
Subtag Length, 5 bytes
Byte 1-4: Sample number, long integer
Byte 5: Region (per Section 916, byte 10)

Subtag 24 IP Zeroing
Optional, multiple instances allowed
Subtag Length - 5 bytes
Byte 1-4 Sample number, long integer
Byte 5 Region (per Section 916, byte 10)

Subtag 25 IP Not Zeroed
Optional, multiple instances allowed
Subtag Length - 5 bytes
Byte 1-4 Sample number, long integer
Byte 5 Region (per Section 916, byte 10)

Subtag 26 IP Zeroed
Optional, multiple instances allowed
Subtag Length - 5 bytes
Byte 1-4 Sample number, long integer
Byte 5 Region (per Section 916, byte 10)

Subtag 27 IP Transducer Not Detected
Optional, multiple instances allowed
Subtag Length - 5 bytes
Byte 1-4 Sample number, long integer
Byte 5 Region (per Section 916, byte 10)

Subtag 28 SPO2 Searching for Pulse
Optional, multiple instances allowed
Subtag Length - 5 bytes
Byte 1-4 Sample number, long integer
Byte 5 Region (per Section 916, byte 10)

Subtag 29 SPO2 No Sensor Detected
Optional, multiple instances allowed
Subtag Length - 5 bytes
Byte 1-4 Sample number, long integer
Byte 5 Region (per Section 916, byte 10)

Subtag 30 SPO2 Sensor Off
Optional, multiple instances allowed
Subtag Length - 5 bytes
Byte 1-4 Sample number, long integer
Byte 5 Region (per Section 916, byte 10)

Subtag 31 Enumerated Lead Label Change
Optional, multiple instances allowed
Subtag Length - 6 bytes
Byte 1-4 Sample number, long integer
Byte 5 Region (per Section 916, byte 10)
Byte 6 New lead label (per SCP-ECG Section 3)

Subtag 32 Literal Lead Label Change
Optional, multiple instances allowed
Subtag Length - variable
Byte 1-4 Sample number, long integer
Byte 5 Region (per Section 916, byte 10)
Byte 6-len New lead label, UNICODE string

Subtag 33 SPO2 Normal
Optional, multiple instances allowed
Subtag Length - 5 bytes
Byte 1-4 Sample number, long integer
Byte 5 Region (per Section 916, byte 10)

This subtag is generated whenever the conditions announced by subtags 28, 29, and 30 clear.

Subtag 252: Event Record ID

Optional, single instances only

6.2.8.11.1.14 Tag 26: NIBP Event

Optional, multiple instances allowed

Tag Length - 38 bytes

Byte 1-18: Event Record Header Structure

Byte 19: Subsystem Error/Status Code

- 00 - No Error (Valid)
- 01 - Subsystem Failed
- 02 - Subsystem Disabled
- 03 - Subsystem Not Ready
- 04 - 09 - Reserved
- 10 - Calibration Failed
- 11 - Cuff Inflating
- 12 - 99 Reserved
- 100 - 254 - Operational Status & Error Codes
  - Codes not listed are Reserved
  - 102 - Self Test Failed
  - 106 - Loose Cuff
  - 107 - Air Leak
  - 108 - Air Pressure Error
  - 109 - Weak Signal
  - 110 - Range Exceeded
  - 111 - Excessive Motion
  - 112 - Overpressure Sensed
  - 113 - Signal Saturated
  - 114 - Pneumatic Leak
  - 115 - System Failure
  - 119 - Time Out
- 255 - Reserved

Byte 20-21: Systolic Pressure, in mmHg, integer

Byte 22: Systolic Pressure valid/invalid, BOOL

- TRUE = Valid
- FALSE = Invalid

Byte 23: Systolic Pressure error/status Code
0 - 255 - Reserved
Byte 24-25: Diastolic Pressure, in mmHg, integer
Byte 26: Diastolic Pressure valid/invalid, BOOL
TRUE = Valid
FALSE = Invalid
Byte 27: Diastolic Pressure error/status Code
00 - 255 - Reserved
Byte 28-29: Mean Pressure, in mmHg, integer
Byte 30: Mean Pressure valid/invalid, BOOL
TRUE = Valid
FALSE = Invalid
Byte 31: Mean Pressure error/status Code
00 - 255 - Reserved
Byte 32-33: Pulse Rate, in bpm, integer
Byte 34: Pulse Rate valid/invalid, BOOL
TRUE = Valid
FALSE = Invalid
Byte 35: Pulse Rate error/status Code
00 - 255 - Reserved

6.2.8.11.2 Tag 27: Reserved

6.2.8.11.3 Tag 28: SAS 1.5 Event Record

Optional, multiple instances allowed
Tag Length - variable
Byte 1-18: Event Record Header Structure
Byte 19: Sequence Number (see Tag 10)
Byte 20: Segment Number [1-255]
Byte 21: Marker type, Type_Outcome
Type_Outcome:
Code list is under development
Subtag 1: Link to an associated defib event (must be in the same record)
This subtag is only sent with SAS Events with Marker type of (TBD)
Optional, single instance only
Subtag length - 2 bytes
Byte 1-2: Event Record ID, 2 bytes

Subtag 253: Event Template Index

Mandatory, single instance only

Subtag 254: Pacer/Sync Status Block

Optional, single instance only

NOTE: With respect to future expansion, any Type_Outcome enumerator not recognized by the receiving program shall be reported as “Unknown Outcome - Type XX”, where XX will be the ASCII two-character representation of the hexadecimal Marker type enumeration.

6.2.8.11.4 Tag 29 - General Patient Impedance Measurement Event Record

This tag captures numeric impedance value measurement events in a way useful to many different impedance use models.

Optional, multiple instances allowed

Length - variable

Bytes 1-18 Event Record Header Structure

Subtag 1 Impedance Value Type

Mandatory, single-instance only

Length - 1 byte

Byte 1 Lead ID (per SCP-ECG Section 3 ECG Lead Definition Extensions)

Subtag 2 Impedance Acquisition Type

For definitions of these types, refer to the Impedance Standard Features document.

Mandatory, single-instance only

Length - 1 byte

Byte 1 Acquisition Type, enumeration, U8

0	Reserved
1	Patient Connected
2	Analysis Initiated
3	Analysis Stopped
4	Motion Detected
5	Analysis Intermediate
6	Analysis Complete
7	Pre-Shock
8	Defibrillation

9	Post-Shock
10-255	Not Used

Subtag 3 Impedance Meaurement Frequency

Optional, single-instance only

Length - 1 byte

Byte 1 Measurement Frequency, enumeration, U8

0	DC
1	14.3 kHz
2	20.0 kHz
3	30.8 kHz
4	57.1 kHz
5-255	Not Used

Subtag 4 Impedance Measurement Value

Mandatory, single-instance only

Length - 6 bytes

Bytes 1-2 Amplitude value multiplier (AVM), signed integer

The AVM is the conversion factor between the measurement value and micro-ohms. i.e. - Multiply the measurement value by the AVM to obtain micro-ohms.

Bytes 3-6 Measurement value, signed long integer

6.2.8.11.5 Tag 30 - External Power Status Event Record

Optional, multiple instances allowed

Length - variable

Byte 1-18 Event Record Header Structure

Note 1: If the date/time of this event precedes that of the power-on date/time (Section 1: Tag 25/26) then the Sample Number shall be set to 0.

Note 2: Sample Rate may not be zero.

Byte 19 Power Type, enum

	0	AC
	1	DC
	2-255	Reserved
Byte 20	Power Status, enum	
	0	Off
	1	On-to-Off Transition
	2	On
	3	Off-to-On Transition
	4-255	Reserved
Byte 21-len	Label, UNICODE string (NULL-terminated per string usage rules)	

The following are subtags or structures in general use through Section 923. These definitions apply to all uses of these subtags or structures in any Section 923 Tag.

6.2.8.11.6 Event Record ID Subtag

Subtag ID: 252

Length - 2 bytes

Byte 1-2 Event Record ID

(same format as for Event Record Header structure)

6.2.8.11.7 Event Template Index Subtag

Subtag ID: 253

Length - 2 bytes

Byte 1 Event Template_Tag [1-255]

Selects which form of event templates will be used. If an index is not known, the presenting device will treat the template type as unknown.

Specifies the Tag type in Section 923 to which the Event Template_Index byte applies.

Byte 2: Event Template_Index

Specifies which template is to be selected from the Tag in Section 923 specified by the Event Template_Index byte. If an index is not included, the data host may use a default template for display. (see also Tag 2) A value of zero indicates no template index reference.

Example: Event Template Tag = 2 - and - Event Template Index = 4

These two bytes specify “For this event, use the template found in the **fourth** instance Tag type of **2**.”

Subtag 253 is used to associate a waveform template with an event record containing a waveform. If the Section 923 Tag is the primary event tag for the event record as specified by Section 1: Tag 253, and contains a waveform, then a subtag 253 must be present with a corresponding template (Section 923: Tag 2).

For example, if the record type is a CPSS Event Record (Sec 1: Tag 253 = 0x03) then Sec 923: Tag 13 must contain a Subtag 253 pointing to a valid waveform template in Sec 923: Tag 2. If the record type is not a CPSS Event Record, then subtag 253 is optional.

6.2.8.11.8 Pacer Sync / Status Block Subtag

Subtag ID: 254

Subtag Length - 10 bytes

Byte 1-2: Pace Rate Setting in PPM, integer

Byte 3-4: Pace Current Setting in mA, integer

Byte 5: Pace Mode

0 = Non-demand

1 = Demand

2 = Off

Note - if Pace Mode is OFF, the rate and current setting values may be invalid and should not be used.

Byte 6: Sync Mode Enabled, BOOL

FALSE = Disabled

TRUE = Enabled

Byte 7: QRS Sensing lead, (as defined in SCP-ECG section 3)

Byte 8: Internal Pacer Detection lead, (as defined in SCP-ECG section 3)

6.2.8.11.9 Event Record Header Structure

Byte 1-2: Event Record ID, integer, unique and consistent within a single episode

Byte 3-6: Event Date (format per Section 1: Tag 25)

Byte 7-9: Event Time (format per Section 1: Tag 26)

Byte 10: Lead (defined per Section 3 of the SCP-ECG standard) in which the event occurred defines the lead in which the referenced sample number occurs, not the lead of the event parameter. “Unknown” (value = 0) may be sent with non-waveform events.

Byte 11-14: Sample number on which the event occurred, long unsigned integer [1-max]

Byte 15-18: Sample Rate in milliHertz, long unsigned integer [1-max]

Note: Sample Rate applies to the companion event template referenced by a Subtag 253 included in the tag which includes this structure.

6.2.8.12 Section 924 - Forwarding Instructions and History

Rules: Section shall start with the section ID header as defined in 5.2.7 of the SCP-ECG standard. Records without a Section 924 will not be able to be forwarded by any LIFENET forwarding agent.

Tag 1 Forwarding Request

Mandatory, Single instance only

Tag length - variable

Byte 1 Destination Type, enumeration

0	None (disables forwarding)
1	Telephone number
2	Internet address (IP address format)
3	Email address (Userid@domain_name format)
4	V.25ter dialing string
5	Hub (note 1)
6-254	Reserved
255	Unknown

Byte 2 Forwarding Status, enumeration

0	Forwarding pending
1	Forwarded
2-253	Reserved
254	No Forwarding Allowed
255	No Forwarding Requested

Byte 3 Forwarding Format, enumeration

0	SCP-ECG Record (i.e., unchanged)
1	FAX - note 2
2	PDF - note 2
3	SMTP Attachment
4	Text fields only
5-254	Reserved

255 Not Specified

Byte 4 Forwarding Priority, enumeration

0 Not Specified

1 Diagnostic - information pertaining to a current (active) patient

2 Informative - information pertaining to non-current patients

3-255 Reserved

Byte 5-8 Date of Transmission (per Section 1: Tag 25)

Byte 9-11 Time of Transmission (per Section 1: Tag 26)

Byte 12-* Originating Device Description (per Section 1: Tag 14, bytes 9-14)

Byte *-** Destination Name, UNICODE string (only applies to Destination Type 5)

Tag 2 Forwarding Agent Description

Optional, Multiple instances allowed

Tag length - variable

Byte 1 Agent Type, enumeration

0-255 Reserved

Byte 2-5 Date of Forwarding (per Section 1: Tag 25)

Byte 6-9 Time of Forwarding (per Section 1: Tag 26)

Bytes 10-21 Agent Description - Medtronic ERS Model Number (same information as Section 1: Tag 14, using UNICODE characters and substituting spaces for <NULL>)

Bytes 22-len Agent Description - Medtronic ERS Software Revision Number (same information as Section 1: Tag 14, using UNICODE characters)

Implementation Notes:

LP12 - Tango

Tag 1: Byte 1	255
Tag 1: Byte 2	255
Tag 1: Byte 3	255
Tag 1: Byte 4	255
Tag 1: Bytes 5-8	per description
Tag 1: Bytes 9-11	per description
Tag 1: Bytes 12-17	“LP12<NULL><NULL>” (ASCII)
Tag 1: Bytes 18-len string	Site name used for transmission as UNICODE

Forwarding Instruction Usage:

General

1. When forwarded, Section 924: Tag 1 must be marked as "forwarded".
2. Section 924 may be included only in Abstract/Log or 12-Lead SCP-ECG records (see SCP-ECG Record Set Construction Rules). (Future record sets which consist of single records may also include Section 924.)
3. Anonymous forwarding, where no Section 924s are included with a forwarded SCP-ECG record, is not permitted.
4. Forwarding may not considered to be "reliable" and reporting of forwarding status to the originating device user is not possible.
5. For multiple-hop forwarding, each forwarding agent must add a Tag 2 to this section.
6. If a forwarding agent detects its own Tag 2 in this section, forwarding stops. (This prevents loops.)

Destination Type and Description

Because there are many different types of destinations, the destination must be parsed according to the proper set of rules. Byte 1, the Destination Type, specifies the rules that apply to parsing the instruction. The UNICODE destination name string is free-format. Parsing errors will result in notification to the user of the forwarding agent (possible implementations include logs, message lists, etc. as well as real-time notification). Notification of success or failure of forwarding to the originating device user is optional.

Before a record is forwarded, the forwarding agent must set the Forwarding Status to "forwarded". If the record is stored by the forwarded agent, either of two mechanisms are permitted - the records may be changed to "forwarded" status only after successful forwarding, or they may be immediately be changed to "forwarded" status and a communications log keep track of forwarding success/failure.

Note 1 - Destinations designated as Hub expect that a Hub function is present on the receiving device. Lack of such a function will result in a parsing error as described above.

Forwarding Agent Type and Description

In order to support the identification of point-of-origin for forwarded records, the forwarding device or function is required to identify itself by attaching to any forwarded records a Section 924 containing a self-description. This requires that the forwarding agent be capable of modifying the original record in accordance with SCP-ECG specifications.

In the case of non-originated forwarding, where the forwarding agent forwards a record containing a Section 924 that

a) contains a Tag 1 with forwarding disabled, or

b) contains a Section 924 designating the record as "forwarded", or

c) contains a Section 924 containing one or more Tag 2's,

additional Tag 2's must be added to the record.

Forwarding Format

In most cases, forwarding of the original SCP-ECG record will be sufficient. However, in order to format a printable or displayable copy of a report to a destination not capable of parsing SCP-ECG records (such as fax machine or network printer), it will be necessary to perform format conversion in the forwarding device. The Forwarding Format tag allows this conversion to be specified. Forwarding Format conversion instructions may be over-ridden by a forwarding agent in accordance with the agent's programming.

Note 2 - There is no syntax-level requirement that the SCP-ECG record being forwarded contain information that is compatible with the Destination type specified in Tag 1. For example, a Destination type of email may not be able to receive records converted to FAX format. It is the responsibility of the device and system users to configure the forwarding functions properly.

Forwarding Priority

In order to allow the forwarding agent to manage forwarding requests with the appropriate urgency, this tag allows the record to be designated as "for diagnosis". This priority will be the default status of any forwarding operation. There is no guarantee of any particular Quality of Service associated with this information. Informative priority forwarding is intended for routine QA and reporting functions where delays in forwarding due to congestion, queuing, or resource availability are not considered a patient hazard.

6.2.9 Section 925 - Trend Data

Rules: Section shall start with the section ID header as defined in 5.2.7 of the SCP-ECG standard. Records without a Section 924 will not be able to be forwarded by any LIFENET forwarding agent.

Usage Rules:

1. At most, one Trend Data Section may be included in an Abstract Record.
2. If an Abstract Record contains a Trend Data Section, a record parser may ignore any subsequent Trend Data Records.

Implementation Notes:

1. LP12 Tango release will include one Trend Data Section in the Abstract Record. No future LP12 release will utilize Trend Data Records.
2. Excluding the LP12, all future implementations will not include Trend Data Sections in the Abstract Record and will use Trend Data Records, instead.

Tag 1 - Trend Data

Mandatory, Single-instance only (no empty Section 925 is allowed)

Tag Length - variable

Bytes 1-18 Event Record Header Structure (see Section 923)

Subtag 1-16 Single instances of Section 923: Tag 18 subtags

Subtag 17-99 Reserved (future use will mirror that of Section 923: Tag 18 subtags)

Subtag 100 ST Elevation

Optional, single instance only

Subtag length - variable

Byte 1 Most Prominent Lead ID per SCP-ECG Section 3

Indicates which of the ST Measurement packages (bytes 2-13) contains the lead in which the most prominent ST elevation was observed by the measurement algorithm.

In the case where the acquiring device user decides to select an alternate lead's measurement pacakge for display, this ID will continue to contain the algorithm's selection.

i.e. - There is no data that contains the selection of the acquiring device user.

Bytes 2-13 ST Measurement Package (12 bytes)

Byte 2 Lead ID (per SCP-ECG Section 3)

Byte 3 Valid/Invalid flag, BOOL TRUE = Valid, FALSE = Invalid

Bytes 4-5 AVM per Section 922

Bytes 6-7 ST Mean in microvolts, signed integer

Bytes 8-9 ST End in microvolts, signed integer

Bytes 10-11 ST J-point in microvolts, signed integer

Bytes 12-13 ST Baseline in microvolts, signed integer

Repeat Bytes 2-13 for each lead for which an ST Measurement package is available

Subtag 252 Event Record ID Subtag, per Section 923 definition

Optional, single instance only

Receiving device may use the Event Record ID from this subtag or from the Event Record Header Structure in Bytes 1-18 if both are present.

6.2.10 1000-Series Sections

6.2.10.1 Section 1016 - Reserved

6.2.10.2 Section 1017 - Reserved

6.2.10.3 Section 1018 - Reserved

6.2.10.4 Section 1019 - Configuration File

Rules: Section shall start with the section ID header as defined in 5.2.7 of the SCP-ECG standard

Specific extensions:

Byte 1-2: Optional Fields included, Bit Packed, 1=included, 0=Excluded, in order listed for each type below. LSB = Optional Field #1. Optional field are packed following the last required section. If present optional fields will follow the order listed below (e.g. Opt1 always precedes Opt2, etc.)

Opt 1: Reserved

Opt 2: ASCII mapped configuration:

Byte 1-2: Number of bytes to follow, int

Byte 3-len: configuration string, MSD to LSD ASCII, NULL terminated

Opt 3: Reserved

6.2.10.5 Section 1020 - Device Test History File

Rules: Section shall start with the section ID header as defined in 5.2.7 of the SCP-ECG standard.

Specific extensions:

Tag 0: Date and Time of test history file.

Bytes 1-4: Date (Format per section 1 tag 25)

Bytes 5-7: Time (Format per section 1 tag 26)

Tag 1: Test History File Entry, multiple instances allowed

Byte 1: Test File Type

1 = General Fault Log

2 = Minor Fault Log

3 = Major Fault Log

Byte 2: Test ID, byte

0 = None

1 = self test

2 = daily auto test

3 = weekly auto test

255 = Empty Log

Byte 3 - 6: Date of test (format per Section 1: Tag 25)

Byte 7-9: Time of test (format per Section 1: Tag 26)

Byte 10: Number of fault IDs to follow

Byte 11-len: A series of fault IDs associated with the tests. Each fault ID is organized as follows:

Bytes 1-2: Fault ID code, integer

Bytes 3-(len-1):

Test Log

Byte len: zero, single byte

Note that this is an implementation error that was carried through testing. This byte will be present for all LP500 devices.

6.2.10.6 Section 1021 - Non-critical multi-parameter encoded waveform data

Section 1021 contains non-critical multi-parameter encoded waveforms. Currently, the only non-critical" waveform is scene audio.This section is comprised of three parts, namely the section ID header, the lead details, and the lead data.The section ID header is a standard SCP-ECG section ID header as defined in section 5.2.7 of the SCP standard with one exception. The first two bytes of the section ID header, normally the CRC, is to be replaced by a 16-bit checksum. The domain of the checksum is identical to domain of the standard CRC and is an unsigned byte-wide summation of the data.

The lead details are contained in tag 0. Tag 0 is similar to SCP-ECG section 3. The first two bytes of the section 3 format have been replaced by a single 16-bit unsigned integer containing the number of leads. Details for each lead as specified in section 5.6.2 of the SCP standard will follow the number of leads. Additionally, a sample number for the TrueSpeech encoded audio lead represents one 30 millisecond segment of encoded data, not the underlying 8KHz sample rate prior to encoding the data.

The lead data are contained in tag 1. Tag 1 is identical to Section 1022 bytes 1-15. For TrueSpeech audio encoded leads, the following explanations apply. 1) The amplitude value multiplier, sample rate, baseline filter cut-off, low pass filter cut-off, and filter indicator do not contain useful data for the data management system as the enclosed data will be fed directly into a Windows audio driver. 2) The data contains an integral number (length / 32) of audio segments. 3) This data is not encapsulated by the compression wrapper as implied by the examples.

This section will not be included in the calculation of the overall file CRC and will follow all sections included in the CRC

Specific Extensions:

Tag 0: Lead Detail Information

Bytes 1-2 : Number of Leads

Bytes 3-11:Detail for first lead (See SCP-ECG Section 5.6.2)

Bytes 12-20: Detail for Second Lead (See SCP-ECG Section 5.6.2)

etc.

Tag 1:

Bytes 1-15: Lead data header for first lead

Bytes 16-len: Lead for first lead

etc.

Example of the Non-Critical Waveform Section 1021

This example is comprised of a single segment or real-time voice data.

Section Header

Hdr[4]	Reserved (0 filled) 2	1021 2	Len 4	Ver 1	Spare 7	Refer to SCP-ECG Section 5.2.7 for header details

Tag 0: Lead Data

[4]lower numbers are byte counts not values

1st data part	# leads 0x0001	Flag 0x10	Refer to SCP-ECG section 5.6 1 lead
Lead Detail	Start 1	End 9600000	Ld typ #247

Tag 1: Waveform Data

Lead 1 Detail	AVM 1250	Smp Rate 125	Low Pass 30000	High Pass 3000	Filter 1	Length 4 Bytes	Type[5] 1 Compression_used	20 min of voice data	Checksum for the voice data 2 bytes

Example Record Containing Section 1021

Section Requirement	Section Description
Required	CRC of the file (2bytes) if zero CRC will follow the data
Required	Length of the SCP record (4 bytes)
Required	Section 0: Pointer section
Required	Section 1: Patient Information
Optional	Section 1019: Configuration File
Optional	Section 1020: Test History File
Optional	CRC of the entire file (2 bytes), only present if the first CRC is 0.
Optional	Section 1021: Non critical waveform data

Note: Section zero contains pointers to the actual location of each section transmitted, therefore the actual ordering of the sections may vary from that shown here. However, section 1021 must follow all other data. Section zero will contain an offset pointer to section 1021

[5]Compression_used is defined in the previous example. Refer to “Example of the compressed encoded lead data”

6.2.10.7 Section 1022 - Multi-Parameter encoded rhythm data

Rules: Shall follow the basic rules for section 6 of SCP-ECG. Reference section 5.6 of the SCP-ECG standard.

Note that the filter response information in this section pertains ONLY to waveform data contained in this section.

Specific extensions:

Each lead will contain a header which defines the basic sampling characteristics of the lead data. The header will appear as follows:

Byte 1-2: Multiplier for amplitude value. This operates as defined in 5.9.1 of the SCP-ECG standard

Note : Delta impedance leads will be in Micro ohms”

Byte 3-6: The sample rate for the lead in milliHertz

Byte 7-8: The report’s baseline filter cut-off (-3dB) in 1/100Hz

Byte 9-10: The report’s low pass filter cut-off (-3dB) in Hz

Byte 11: Data is pre-filtered to 7-8 and 9-10 above, BOOL

0 = Data was not filtered before transmission

1 = Data was filtered before transmission

Byte 12-15: Number of bytes in encoded lead

This is followed by the rhythm data.

Example:

AVM	Sample Rate	Base-line	Lowp ass	Filter?	Len	Data lead
2	4	2	2	1	4	var

An example of SCP-ECG Section 3 is included for completeness. This Example assumes 15 seconds of waveform/voice/impedance, comprised of 2 segments of each segment simultaneously recorded. The segments are separated by a 3 second gap (post shock). These waveforms consist of SAS, Defib Pre-Post times. The formats are the same for both sections 922 and 1022.

Section 3 - Lead Data

Hdr[6]	CRC 2	3 2	Len 4	Ver 1	Spare 7	Refer to SCP-ECG Section 5.2.7 for header details
1st data part	# leads 0x04	Flag 0x18	Refer to SCP-ECG section 5.6 4 leads (2 set of 2) # leads 2 leads each recorded at the same time (0x18)			

[6]lower numbers are byte counts not values

Lead Detail	Start 1	End 1080	Ld typ #254	Start 1	End 540	Ld typ #246
Lead Detail	Start 1440	End 1800	Ld typ #254	Start 720	End 900	Ld typ #246

Section 1022 - Waveform Data

Lead 1 Detail	AVM 1250	Smp Rate 8330	Low Pass 5	High Pass 40	Filter 1	Length Var	9 Sec of SAS data
Lead 2 Detail	AVM 10000	Smp Rate 118	Low Pass 20	High Pass 100	Filter 1	Length Var	9 Sec of Impd data
Lead 3 Detail	AVM 1250	Smp Rate 8330	Low Pass 5	High Pass 40	Filter 1	Length Var	6 Sec of SAS data
Lead 4 Detail	AVM 10000	Smp Rate 118	Low Pass 20	High Pass 100	Filter 1	Length Var	6 Sec of Impd data

Example of the compressed encoded lead data (other than voice), inserts into the lead data section above

Section 1022 Data format

Hdr Len Function:	Type 1 Compression_used	Uncompressed Length 2	compressed Length 2	data var

Note : LP500 does not encapsulate TrueSpeech in the Compression structure.

The following enumerations are used in the Compression-Used byte:

0	None
1	Reserved
2	Reserved
3	Reserved
4	Second-Difference, Byte-packed
5-127	Reserved
128-255	Reserved to indicate new header format

6.2.10.8 Section 1023 - Abstract Information/Event Log

Rules: Section shall start with the section ID header as defined in 5.2.7 of the SCP-ECG standard

Examples of Abstract Information/Event Sections 1023

The Abstract Information/Event Log header section consists of two parts, the header (consisting of Tag 1 and Tag 2) and the event records. Tag1 contains the general device information and can have a maximum occurrence of one. A separate Tag2 exists for each distinct event record type in the section.

Each Event Record has its own Tag structure.

Example of a SAS event followed by a defibrillation event for section 1023

Hdr	CRC 2	1023 2	Len 4	Ver 1	Spare 7	Refer to SCP-ECG Section 5.2.7 for header details						
Tag1:	Tag# 1	Elsp Time 3	Total Paced 3	Total 12-Ld 1	Total Shock 1	Num. of Event						
Tag2:	Tag 0x02	Type 0x02 (SAS)	Evt ID 0x01	Date	Time	Template Index	Lead	Sample #	Options Present	ID & Type Info	Result	Opts
Tag2:	Tag 0x02	Type 0x00 - defib	Evt ID 0x02	Date	Time	Template Index	Lead	Sample #	Options Present	Shock Para.	Sh. Time Info	Opts
Tag 255	Tag #255	Tag Len 2										

Tag 1: Type: Abstract Header

Byte 1-2: Optional Fields included, Bit Packed, 1=included, 0=Excluded, in order listed for each type below. LSB = Optional Field #1. Optional field are packed following the last required section. If present optional fields will follow the order listed below (e.g. Opt1 always precedes Opt2, etc.)

Byte 3-5: Elapsed time (format per Section 1: Tag 26)

Byte 6-8: Total Paced (format per Section 1: Tag 26)

Byte 9: Total # of 12-Leads (0-255)

Byte 10: Total # of Shocks (0-255)

Byte 11-12: Number of events in the Event Log, integer

An event associated with a waveform is comprised of some number of samples before and after the event. This is the length of a summarized report from a continuous waveform. These values must be transmitted for all events associated with a continuous waveform. Only one structure needs to be transmitted for each event type used in the record.

The event summarization template

Byte 13 Number of entries to follow, byte (no templates follow if = 0)

Repeat Bytes 14 - 29

Byte 14-17: Number of samples prior to the event to display

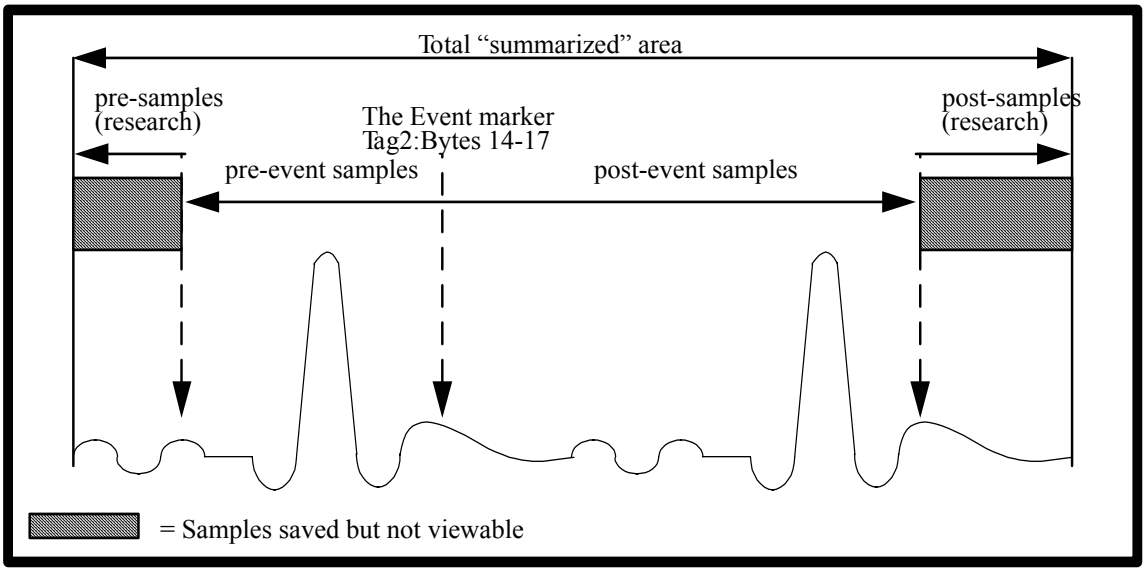
Byte 18-21: Number of samples after the event to display.

Byte 22-25: Number of pre-samples, before display, if any.

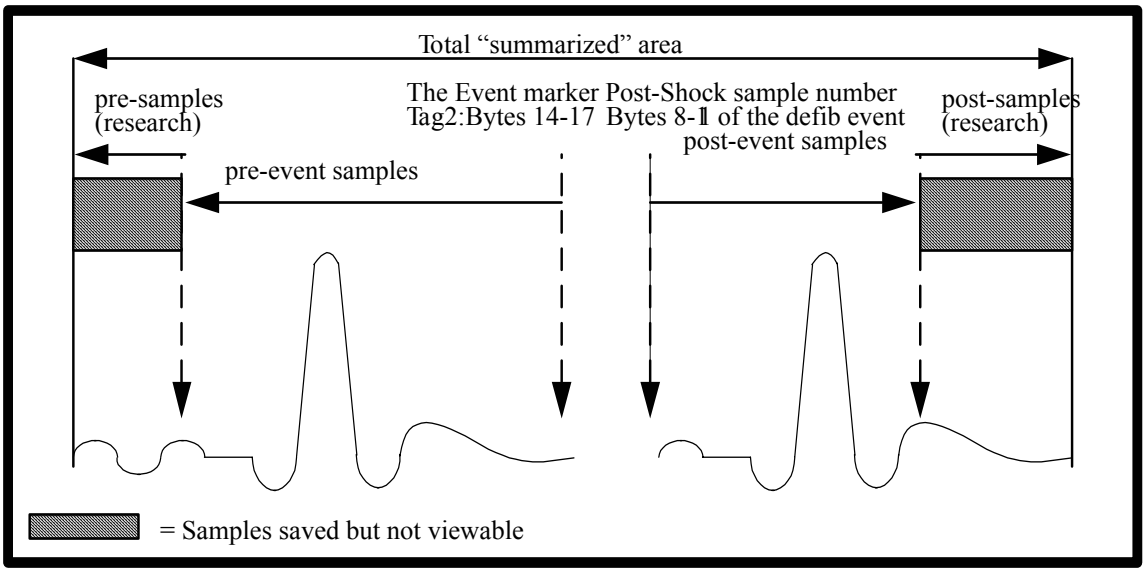
Byte 26-29: Number of post-sample, after display, if any.

NOTE: All samples are positive integers relative to the event marker.

Example of a template - simple event:



Example of a template - Defib event:



Tag 2: Type: The Event Log:

Byte 1-2: Optional Fields included, Bit Packed, 1=included, 0=Excluded, in order listed for each type below. LSB = Optional Field #1. Optional field are packed following the last required section. If present optional fields will follow the order listed below (e.g. Opt1 always precedes Opt2, etc.)

Byte 3: Event Type, defined as follows:

0x00 = Defib Event

0x01 = Reserved

0x02 = SAS event

0x03 = CPSS event

0x04 = Reserved

0x05 = Reserved

0x06 = Reserved

0x07 = Annotation Event

0x08 = Reserved

0x09 = Reserved

0x0A = First Waveform event

0x0B = Power Cycle Event

0x0C = General Events

0x0D = Reserved

0x0E = Reserved

0x0F = Absolute Impedance Event

Byte 4-5: Event ID

Byte 6-9: Event Date (format per Section 1: Tag 25)

Byte 10-12: Event Time (format per Section 1: Tag 26)

Byte 13: Event Template_Index (byte)

Indicates required template for event based on order of templates sent in Section 1023, Tag 1

null = no template for this event

1 = first template in Section 1023 template array

Byte 14: Lead (defined per Section 3 of the SCP-ECG standard) the event occurred on

Byte 15-18: Sample number on which the event occurred

Opt 1: Length of the underlying event, 2 bytes

6.2.10.8.1 Event Record Definitions

Event Records follow all optional fields.

6.2.10.8.1.1 Type 0: The Defib Event Record:

Byte 1-2: Optional Fields included, Bit Packed, 1=included, 0=Excluded, in order listed for each type below. LSB = Optional Field #1. Optional field are packed following the last required section. If present optional fields will follow the order listed below (e.g. Opt1 always precedes Opt2, etc.)

Byte 3: Shock count (e.g. 1 for defib event #1)

Byte 4-5: Shock Energy (in Joules) - see LP500 documentation for definition and useage

Byte 6: PaddleTypeUsed, byte, Per 6.2.3 of this document

Byte 7: SyncModeStatus, BOOL,

FALSE = No Sync

TRUE = Sync

Byte 8-11: Sample number of post shock event

Byte 12-14: Time of the post shock event, (format per Section 1: Tag 26)

Opt1: Reserved

Opt2: Waveform type, byte

1 = EDMARK

2 = BiPhasic - Truncated Exponential

3 = BiPhasic - Gervich

6.2.10.8.1.2 Type 1: Reserved

6.2.10.8.1.3 Type 2: SAS Event Record

Byte 1-2: Optional Fields included, Bit Packed, 1=included, 0=Excluded, in order listed for each type below. LSB = Optional Field #1. Optional field are packed following the last required section. If present optional fields will follow the order listed below (e.g. Opt1 always precedes Opt2, etc.)

Continuous waveform SAS events

Byte 3: Sequence Number, byte

Byte 4: Segment Number, byte

Byte 5: Marker type, Type_Outcome

0x01 = No Shock - Intermediate

0x02 = Shock - Intermediate

0x06 = Analysis Started - Intermediate

0x07 = Motion Detected - Intermediate

0x08 = Motion Stopped - Intermediate

0x09 = reserved

0x0A = Analysis Initiated

0x81 = No Shock - Final

0x82 = Shock - Final

0x83 = Analysis Aborted Motion time out - Final

0x84 = Analysis Aborted Device Error - Final

0x85 = Analysis Aborted, Stop Command - Final

The Analysis Initiated marker type is used when the software is attempting to start an SAS analysis. Typically when the analyze button is pressed on the device. When this marker type is used the sequence number field should indicate the analysis sequence that is being attempted. The segment number field is undefined.

NOTE: With respect to future expansion, any Type_Outcome enumerator not recognized by the receiving program shall be reported as “Unknown Outcome - Type XX”, where XX will be the ASCII two-character representation of the hexadecimal Marker type enumeration.

Opt 1: Reserved

Opt 2: Intermediate Results:

Intermediate results can be described by the following structure and are optionally included with each segmental result.

Byte 1-2: Result, integer

Byte 3-4: Histo1, integer

Byte 5-6: Histo2, integer

Byte 7-8: AveFreq, integer

Byte 9-10: AveAmp, integer

Byte 11-12: Rate, integer

Byte 13: PrNum, byte

Byte 14: PrNumLim, byte

Byte 15: NrNum, byte

Byte 16: NrNumLim, byte

6.2.10.8.1.4 Type 3: CPSS Event Record

Byte 1-2: Optional Fields included, Bit Packed, 1=included, 0=Excluded, in order listed for each type below. LSB = Optional Field #1. Optional field are packed following the last required section. If present optional fields will follow the order listed below (e.g. Opt1 always precedes Opt2, etc.).

Byte 3: Outcome:

Bit 7 denotes the type of the outcome: Intermediate = 0 (Not Used), Final = 1

0 = Not Used

1 = Check Patient

2 = Not Used

6.2.10.8.1.5 Type 4: Reserved

6.2.10.8.1.6 Type 5: Reserved

6.2.10.8.1.7 Type 6: Reserved

6.2.10.8.1.8 Type 7: Annotation Event Record

Byte 1-2: Optional Fields included, Bit Packed, 1=included, 0=Excluded, in order listed for each type below. LSB = Optional Field #1. Optional field are packed following the last required section. If present optional fields will follow the order listed below (e.g. Opt1 always precedes Opt2, etc.)

Byte 3-4: Event type:

0 = Not Used

1 = Device

Opt1: **Reserved**

Opt2: Device Annotation ID

Bytes 1-2 Annotation ID

0x0000	Unknown
0x0001	Push Analyze
0x0002	Connect Electrodes
0x0003	Replace Battery
0x0004	Stand Clear
0x0005	Push to Shock
0x0006	Check for Pulse
0x0007	If No Pulse
0x0008	Low Battery

6.2.10.8.1.9 Type 8: Reserved

6.2.10.8.1.10 Type 9: Reserved

6.2.10.8.1.11 Type 0x0A: First Waveform Event Record

Byte 1-2: Optional Fields included, Bit Packed, 1=included, 0=Excluded, in order listed for each type below. LSB = Optional Field #1. Optional field are packed following the last required section. If present optional fields will follow the order listed below (e.g. Opt1 always precedes Opt2, etc.)

No data items are required as this tag merely flags the containing record as the First Waveform Event Record.

6.2.10.8.1.12 Type 0x0B: PowerCycle Event Record

Byte 1-2: Optional Fields included, Bit Packed, 1=included, 0=Excluded, in order listed for each type below. LSB = Optional Field #1. Optional field are packed following the last required section. If present optional fields will follow the order listed below (e.g. Opt1 always precedes Opt2, etc...)

Byte 3: Cycle type:

1 = Battery Installed/Power Restored

2 = Battery Pulled/Power Removed

3 = Power-off

4 = Power-on

6.2.10.8.1.13 Type 0x0C: General Event Record

Byte 1-2: Optional Fields included, Bit Packed, 1=included, 0=Excluded, in order listed for each type below. LSB = Optional Field #1. Optional field are packed following the last required section. If present optional fields will follow the order listed below (e.g. Opt1 always precedes Opt2, etc.)

Opt1:	Byte 1:	Patient Connected, BOOL
Opt2:	Byte 1:	LeadsOffDetected: BOOL TRUE = Yes
Opt3:	Byte 1:	ShockButtonDisarmed: BOOL TRUE = Yes
Opt4:	Byte 1:	Reserved
Opt5:	Byte 1:	Reserved
Opt6:	Byte 1:	LowBatteryDetected: BOOL TRUE = Yes
Opt7:	Byte 1:	CPRTimerOn: BOOL TRUE = Yes
Opt8:	Byte 1:	ReplaceBatteryDetected TRUE = Yes
Opt9:	Byte 1:	Out of Memory event, byte 0 = Event Cleared

1 = General Memory
2 = Audio Memory
3 = Event Memory
4 = Waveform Memory

Opt10: Byte 1 Asystole Notification Event: BOOL
TRUE = Yes

6.2.10.8.1.14 Type 0x0D: Reserved

6.2.10.8.1.15 Type 0x0E: Reserved

6.2.10.8.1.16 Type 0x0F: Absolute Impedance Event Record

Byte 1-2: Optional Fields included, Bit Packed, 1=included, 0=Excluded, in order listed for each type below. LSB = Optional Field #1. Optional field are packed following the last required section. If present optional fields will follow the order listed below (e.g. Opt1 always precedes Opt2, etc.)

Byte 3: AbsEventID:
1 = Connect Electrodes
2 = Analysis Initiated
3 = Pre-Shock
4 = Post-Shock

Byte 4-5: Impedance, signed integer, Ohms

6.3 SCP Data Exception Handling

This paragraph defines what the response of Data Management devices will be to data exceptions. There are three levels of response:

Fatal (F) A data error which causes the parsing of the Record Set to cease. Errors in key data items without which display or reporting is not possible will generate the fatal response.

Default (D) A data error for which recovery with a specified default is possible. Warnings or other notification to the Data Management device user are not controlled in this document.

Ignore (I) This level of error requires no response by the Data Management device. Typically, this level of response is suitable for data that is not used by the Data Management device for display or reporting purposes. Note that other devices which make use of the data may have a stronger reaction.

6.3.1 General Processing Rules.

These rules may be overridden if explicitly stated in the following table.

Enumerations - A default value is substituted whenever the input value is not contained within a predefined range or list of values.

Waveforms, Sample numbers, BOOLEANs, and Text (free-text or strings) are not tested for value or content.

Numeric values that are tested and found to be out-of-range will always generate a fatal error.

Data relating to waveform constructions (segment, sequence, region counters, etc.) are considered to be adequately tested during record structure parsing.

Table 2 - Data Exception Handling - Specific Rules

Section	Tag	Sub	Byte(s)	Description	Range	Resp	Notes	
1	14	--	7	Cart/Host Mode	0	I		
1	14	--	8	Mfr. ID	21	F		
1	14	--	15	SCP-ECG rev.	--	--	not tested	
1	14	--	16	XMODEM compatibility	--	--	not tested	
1	25, 26	--	--	Power-on Date & Time	Jan 1, 1968 - Dec 31, 2027	F		
1	27, 28	--	--	Frequency Response	--	--	not tested	
1	247	--	--	Time delta	+/- 60 years	F	delta is added to reported time to get correct time	
1	253	--	--	Record type	per list	F	no exceptions	

2	--	--	--	Table Mode Switch	per list	F	no exceptions	
3	--	--	9	Lead (1)	per list	D	reported as "unknown"	
906	--	--	5	Compression Used	per list	F	no exceptions	
916	--	--	1-3	Segments, Flag byte, Total Regions, Region number, Sequence	--	I	structural data	
922	--	--	1-2	Multiplier (AVM)	--	I	not tested	
922	--	--	3-6, 7-8, 9-10, 12	Sample Rate, Filter Cutoffs, Bytes/Sample	--	I	not tested	
922	--	--	13	Compression Used	per list	F	no exceptions	
922	--	--	14-17	Data Length	--	--	structural data	
923	1	--	1-3, 4-6	Elapsed Time, Total Paced	--	I	must be in valid format	
923	1	--	7, 8, 9-10	Total 12-Leads, Total Shock, Number of Events	--	--	structural data	
923	Event Record Header Structure							
--	--	--	1-2	Event Record ID	--	I	not tested	
--	--	--	3-6, 7-9	Event Date, Time	--	I	must be in valid format	

--	--	--	10	Lead (1)	--	--	--	
--	--	--	15-18	Sample Rate	--	I	not tested	
923	--	253	Event Template Index					
--	--	--	1	Event Template Tag	--	--	structural data	
--	--	--	2	Event Template Index	--	--	structural data	
923	--	254	Pacer Sync / Status Block					
--	--	--	1-2, 3-4	Pace Rate, Pacer Current	--	I	not tested	
--	--	--	7	QRS Sensing Lead (1)	--	--	not listed is “reported as unknown”	
--	--	--	8	Internal Pacer Det. Lead (1)	--	--	--	
923	10	--	19	Sequence Number	--	--	structural data	
923	10	--	20-21	Selected Energy	--	I	not tested	
923	10	--	22	Paddle Type	0, 73, 252-255	D	reported as "unknown"	
923	10	--	27-29	Post-shock event time	--	I	must be valid format	
923	10	--	30	Waveform type	per list	D	reported as "unknown"	

923	10	1	1-2	SAS Event Link	--	--	structural data	
923	10	2	1-2	Delivery Status	per list	F	no exceptions	
923	11	--	19	Sequence Number	--	--	structural data	
923	11	--	20	Pacer Event Type	per list	D	reported as "unknown"	
923	12	--	19, 20	Sequence Number, Segment Number	--	--	structural data	
923	12	--	21	Outcome Type	per list	D	reported as "unknown"	
923	12	1	--	Defib Event Link	--	--	structural data	
923	12	2	all	Intermediate Results	--	I	not tested	
923	13	--	19	Outcome	per list	D	reported as "unknown"	
923	14	--	19-20, 21-22	Alarm Limits	--	I	not tested	
923	14	--	23-24	Violating Parameter	per list	D	reported as "unknown"	
923	15	--	19	Sequence Number	--	--	structural data	
923	16	--	19	Sequence Number	--	--	structural data	
923	17	1	1-2	Device Annotation ID	per list	D	reported as unknown	

923	18	1-5	--	Vital Signs Parametric Values	--	I	not tested	
923	18	6	1	Lead (1)	--	--	--	
923	18	6	2-3, 4-5, 6-7, 8-9	IP Parametric Values	--	I	not tested	
923	18	9	3	Lead (1)	--	--	--	
923	20	--	19	Cycle Type	per list	F	no exceptions	
923	21	9	1	Out of Memory Type	per list	F	no exceptions	
923	21	10	1-2	Gain	0-7	F	no exceptions	
923	21	11	1	Region Number	--	--	structural data	
923	21	11	2	Lead (1)	--	--	--	
923	21	12	1-2	Frequency Response	0-1	D	reported as "unknown"	
923	21	14	1-2, 3-6	Fault Code, Auxiliary Code	--	I	not tested	
923	22	--	19-20	Status	0-2	D	reported as "unknown"	
923	23	--	19	Tag of Associated Event Record	--	--	structural data	
923	24	--	19	AbsEvent ID	per list	F	no exceptions	
923	24	--	20-21	Impedance	--	I	not tested	

923	25	1	5	Region	--	--	structural data	

(1) - All lead ID items are subject to the same test rules as specified in the entry for "Lead" in SCP-ECG Section 3 and the extensions listed in this document, **Section 3: ECG Lead Definitions** .

6.4 SCP-ECG Data Transmission Rules

This set of paragraphs specify how the SCP-ECG data sections shall be arranged to construct specific types of information sets for Medtronic ERS products.

6.4.1 Definitions

Record Set	Data structure consisting of one or more Files. Record Sets consisting of multiple Files are typically transmitted to a Data Management device as a batch during a single session of data transfer.
File	Data structure consisting of one or more Records and transferred as a single entity to a Data Management device.
Record	Data structure defined by the SCP-ECG Standard containing one or more Sections.
Section	Data structure defined by the SCP-ECG Standard or this document containing fixed-format data, Tags, and Subtags.
Tag	See Tag/Subtag Rules and Definitions of this document.
SubTag	See Tag/Subtag Rules and Definitions of this document.

6.4.2 SCP-ECG Record Construction Overview

Section Requirement	Section Description
Required	CRC of the file (2bytes) if zero CRC will follow the data
Required	Length of the SCP record (4 bytes)
Required	Section 0: Pointer section
Required	Section 1: Patient Information
Optional	Section 2: Huffman Tables
Required for all waveforms	Section 3: ECG Lead Data
Required for 12-Leads	Section 4: QRS Locations
Required for 12-Leads	Section 5: Encoded Median data

Required for 12-Leads	Section 6: Residual Signal following median subtraction
Required for 12-Leads	Section 7: Global measurements
Required if sending 12-Leads	Section 8: Textual Diagnosis from the Interpretive device
Optional, not used by Medtronic ERS	Section 9: Manufacturers specific diagnosis
Required for 12-Leads	Section10: Lead measurement results
Optional, not used by Medtronic ERS	Section 11: Statement codes resulting from the interpretation
Required for 12-Leads with Medtronic ERS compression and Median beats	Section 905 - Median Data for Medtronic ERS-Custom Compression
Required for 12-Leads with Medtronic ERS compression	Section 906 - Rhythm Data with Medtronic ERS-Custom Compression
Optional; Required for all non-12-lead data transmitted in Section 922	Section 916: Data Segment Definition
Optional	Section 919/1019: Configuration File
Optional	Section 920/1020: Test History File
Optional, required for all event information	Section 923/1023: Abstract Information/Event Log
Optional; either section 922 or 1022 is required for non-12-lead data:	Section 922/1022: Multi-Parameter waveform data
Optional	Section 924: Forwarding Instructions and History
Optional	Section 925: Trend Data
Optional	CRC of the entire file (2 bytes), only present if the first CRC is 0

Note: Section zero contains pointers to the actual location of each section transmitted, therefore the actual ordering of the sections may vary from that

shown here. However, sections comprising a multi-part data item must be contiguous as described in SCP-ECG Record Set Construction Rules .

6.4.3 SCP-ECG Record Set Construction Rules

The following paragraphs show the required construction for each type of SCP-ECG record set to be produced by Medtronic ERS devices.

6.4.3.1 Construction Rules

1. Data Management parsing tools will be expected to traverse any data structure conforming to TLV construction syntax as defined in Tag/Subtag Rules and Definitions.
2. TLV structures of a type unknown to the Data Management device will be discarded without further processing and without notice to the device user(s).
3. Data structures defined as optional may occur none, once, or multiple times subject to specifically stated constraints.

6.4.3.1.1 Implementation Notes for LP12 Tango and subsequent LP12 releases

When a “Code Summary” transmission record set originates with the acquiring device, Abstract/Log Records contain:

Sections 0, 1, 919, 920, 923, 924, and 925 (when Trend data is enabled in the acquiring device)

When a “Trend Summary” transmission record set originates with the acquiring device, the Abstract/Log Record will contain:

Sections 0, 1, 919, 920, 923: Tag 18 mandatory, 924 and 925

When a “Vital Signs” transmission record set originates with the acquiring device, the Abstract/Log Record will contain:

Sections 0, 1, 919, 920, and 923: Tag 18 mandatory, and 924

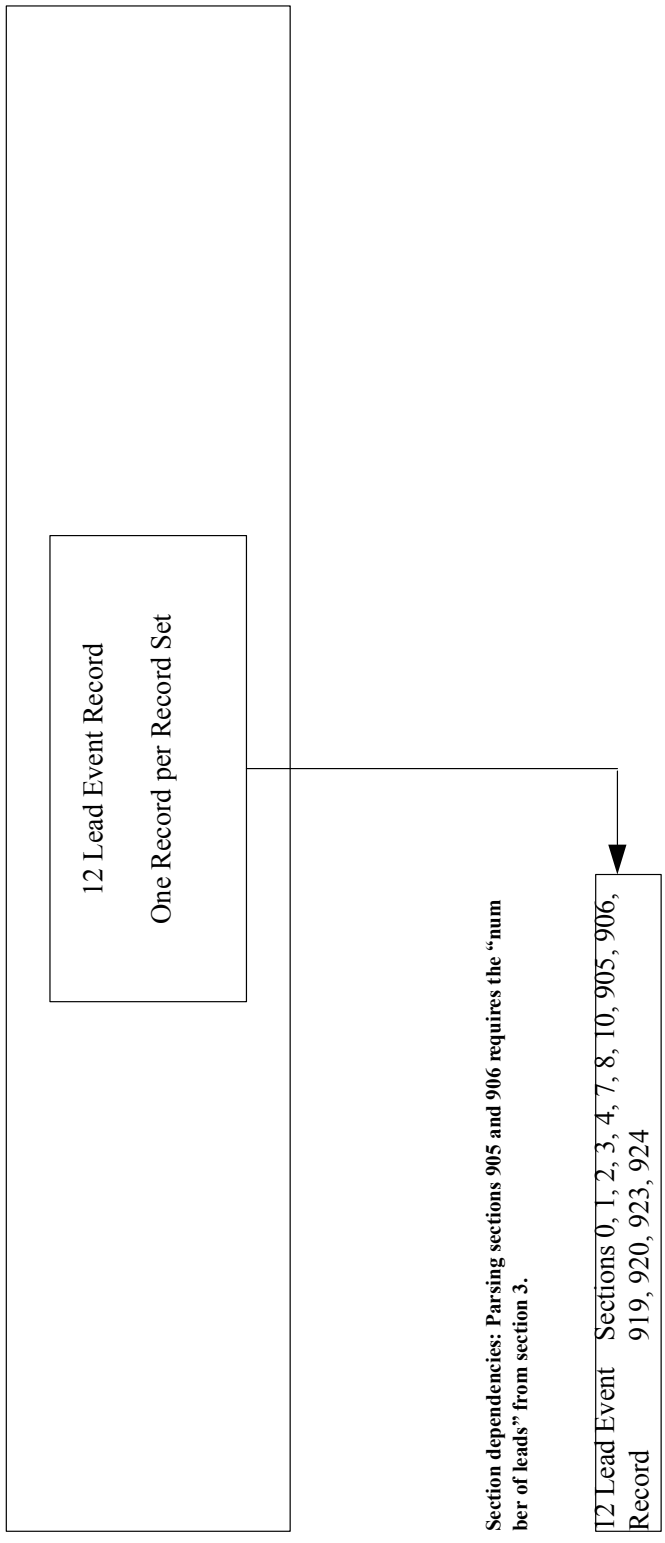
When a “Snapshot” transmission record set originates with the acquiring device, the Abstract/Log Record will contain:

Sections 0, 1, 2, 916, 919, 920, 922, 923, and 924

When a record set containing “12-Lead” and “Vital Signs” is constructed by the acquiring device for transmission to a Data Management system, the “12-Lead” shall be placed in the record set first followed by the “Vital Signs” record.

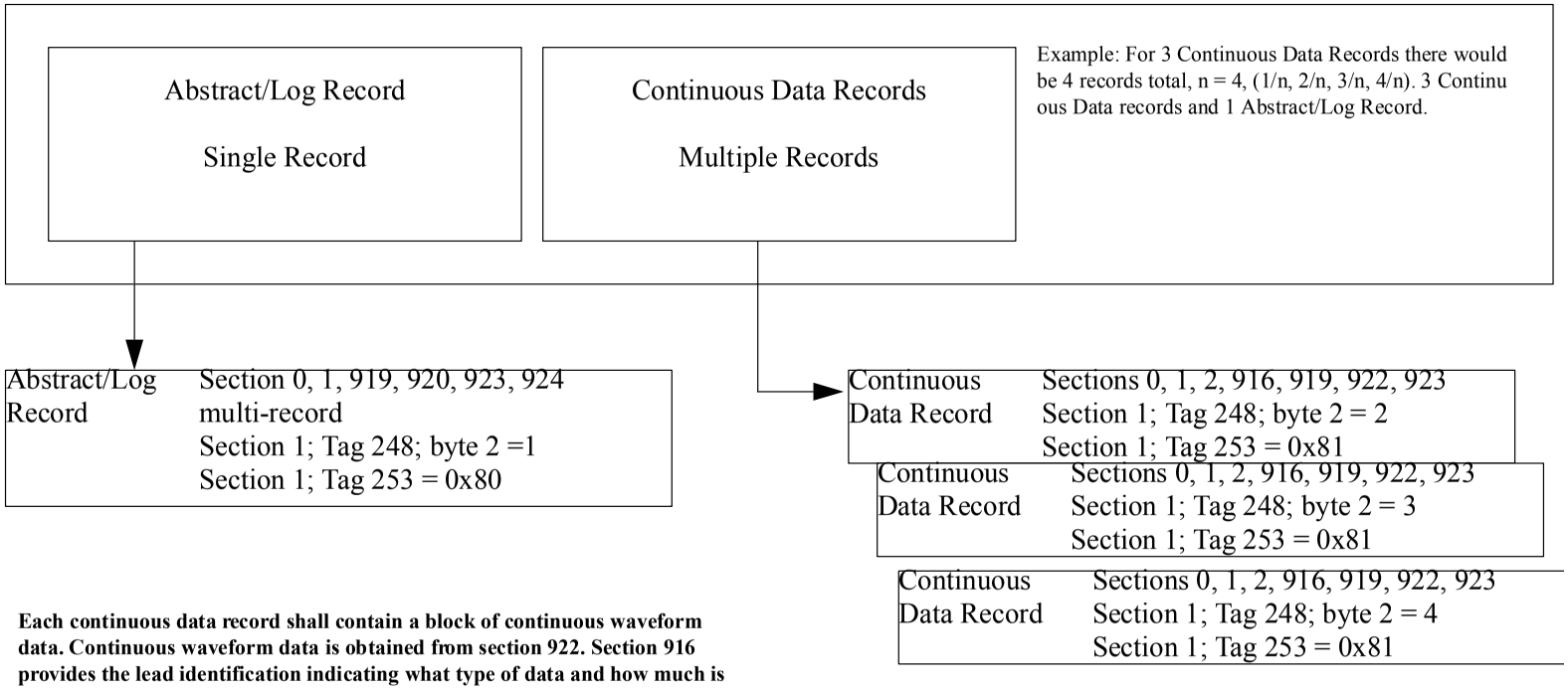
6.4.3.2 12-Lead Record Set

File length is the total number of bytes in all records



6.4.3.3 Complete Episode Record Set

File length is the total number of bytes in all records

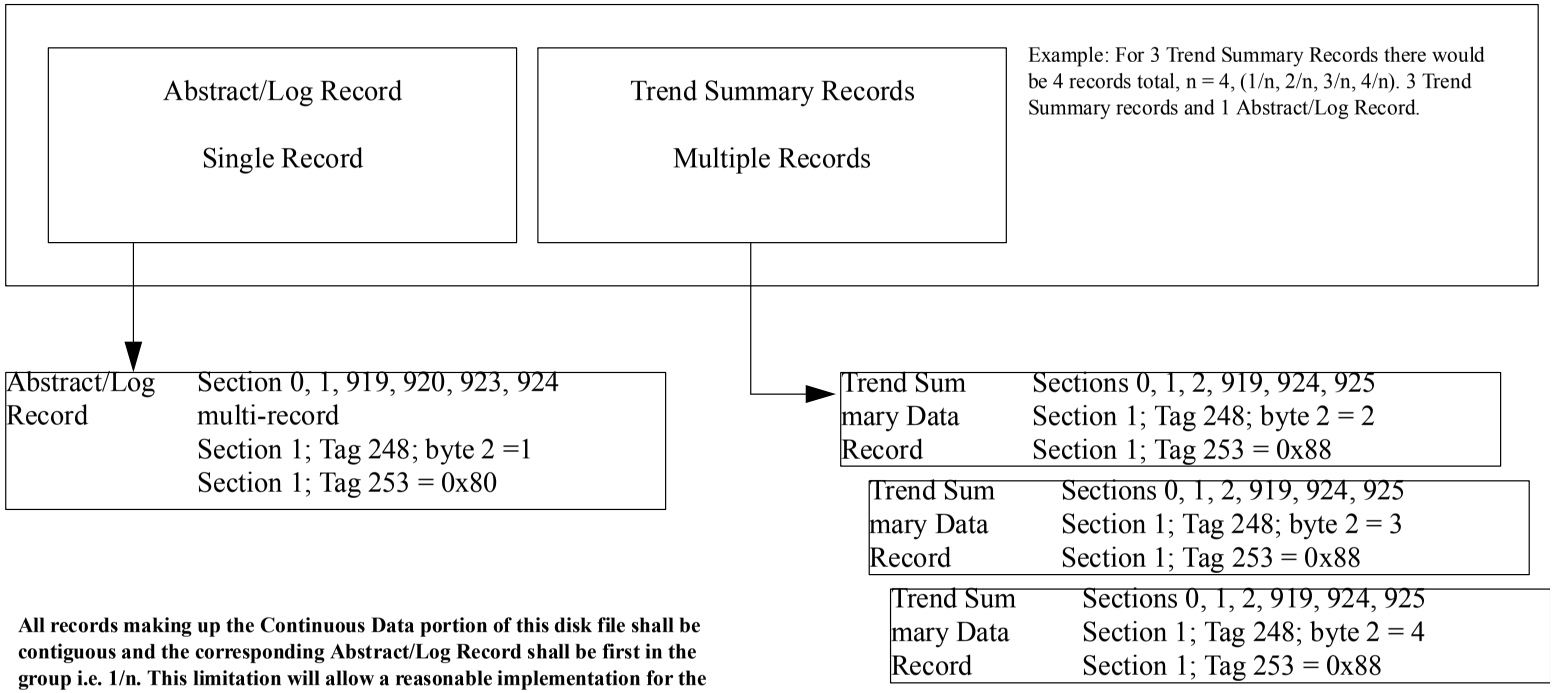


Each continuous data record shall contain a block of continuous waveform data. Continuous waveform data is obtained from section 922. Section 916 provides the lead identification indicating what type of data and how much is being sent i.e., ECG - 15 seconds, impedance - 7 seconds, etc.

All records making up the Continuous Data portion of this disk file shall be contiguous and the corresponding Abstract/Log Record shall be first in the group i.e. 1/n. This limitation will allow a reasonable implementation for the SCP converter parsing mechanism. (Not required for LP500)

6.4.3.4 Trend Summary Record Set

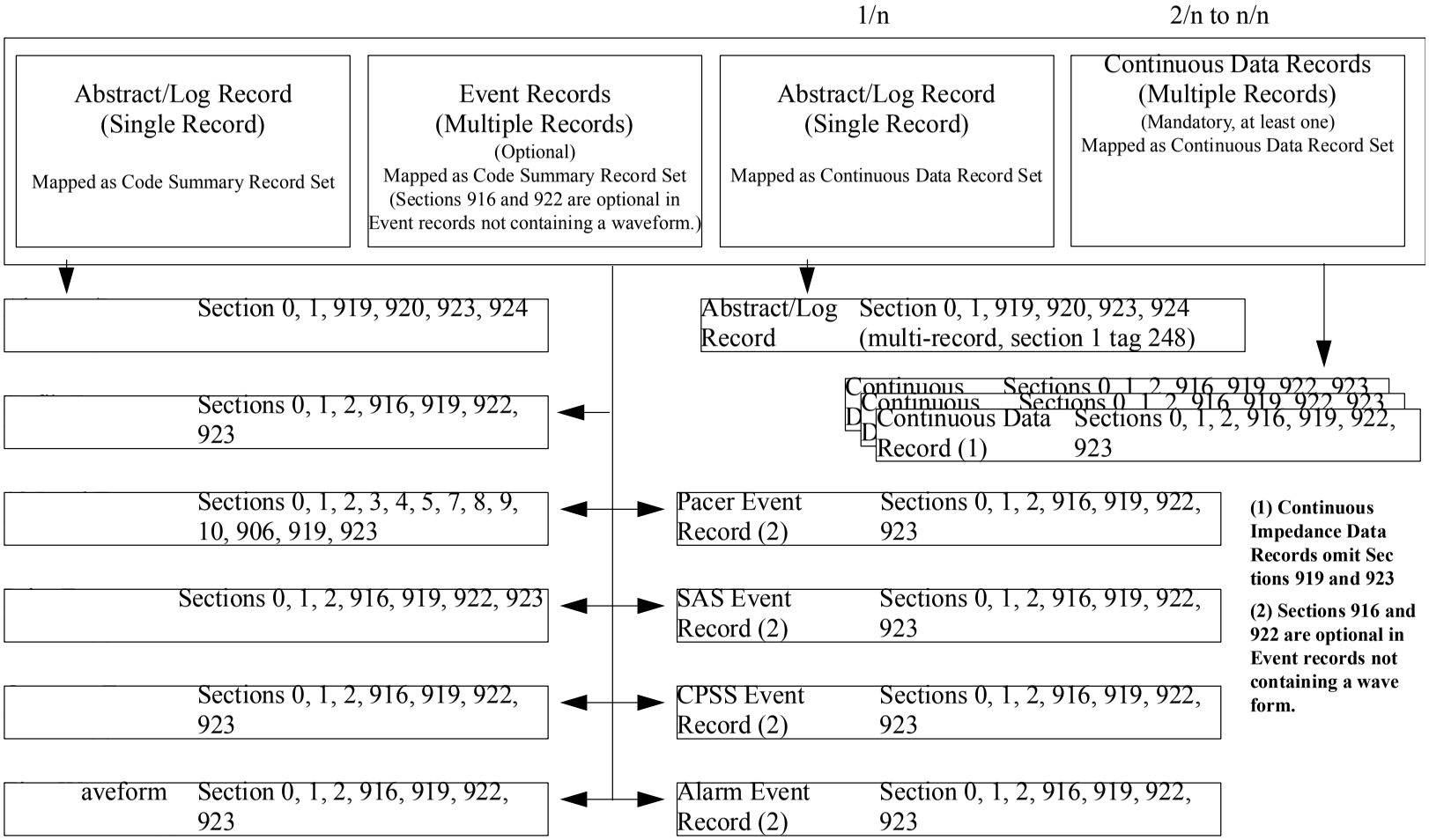
File length is the total number of bytes in all records



All records making up the Continuous Data portion of this disk file shall be contiguous and the corresponding Abstract/Log Record shall be first in the group i.e. 1/n. This limitation will allow a reasonable implementation for the SCP converter parsing mechanism.

6.4.3.5 Complete Episode with Events Record Set

File length is the total number of bytes in all records



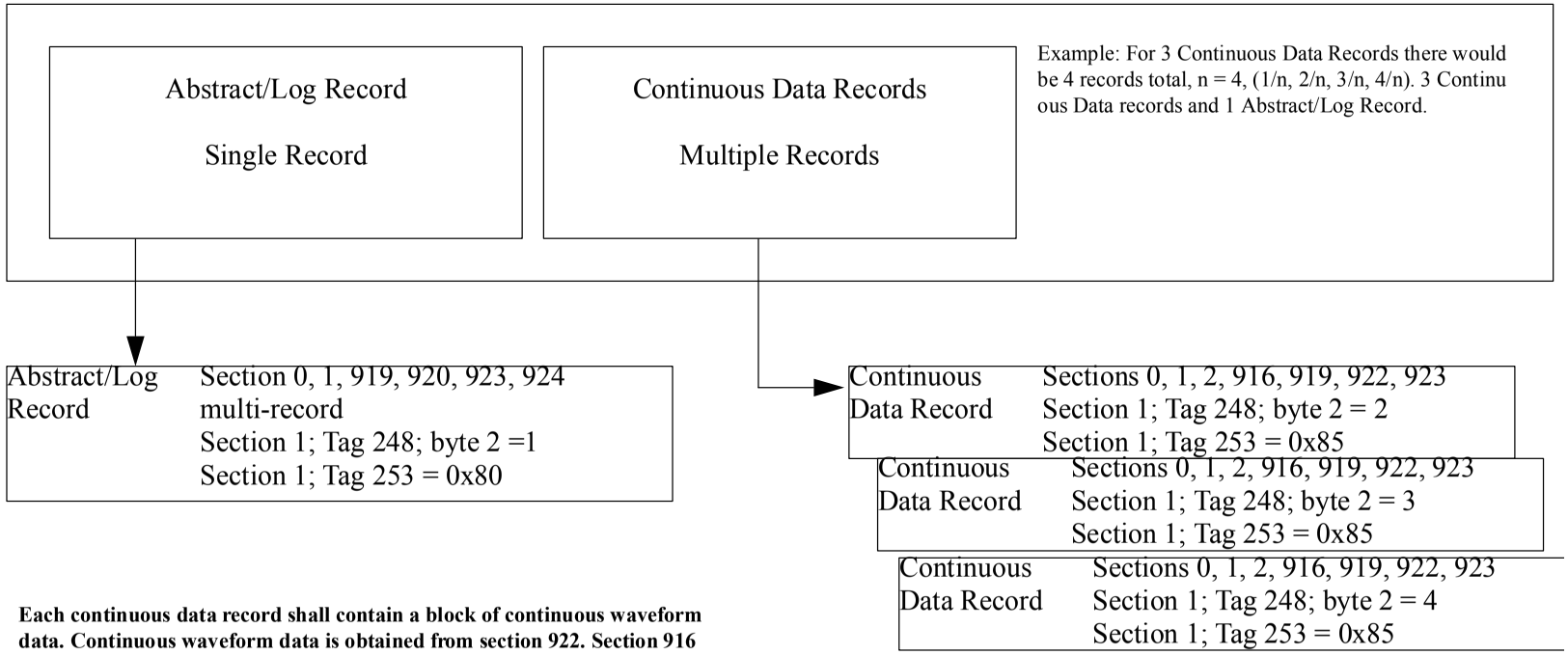
(1) Continuous Impedance Data Records omit Sections 919 and 923

(2) Sections 916 and 922 are optional in Event records not containing a wave form.

All records making up the Continuous Data portion of this disk file shall be contiguous and the corresponding Abstract/Log Record shall be first in the group i.e. 1/n. This limitation will allow a reasonable implementation for the SCP converter parsing mechanism. (Not required on LP500)

6.4.3.6 Special Waveform Record Set

File length is the total number of bytes in all records

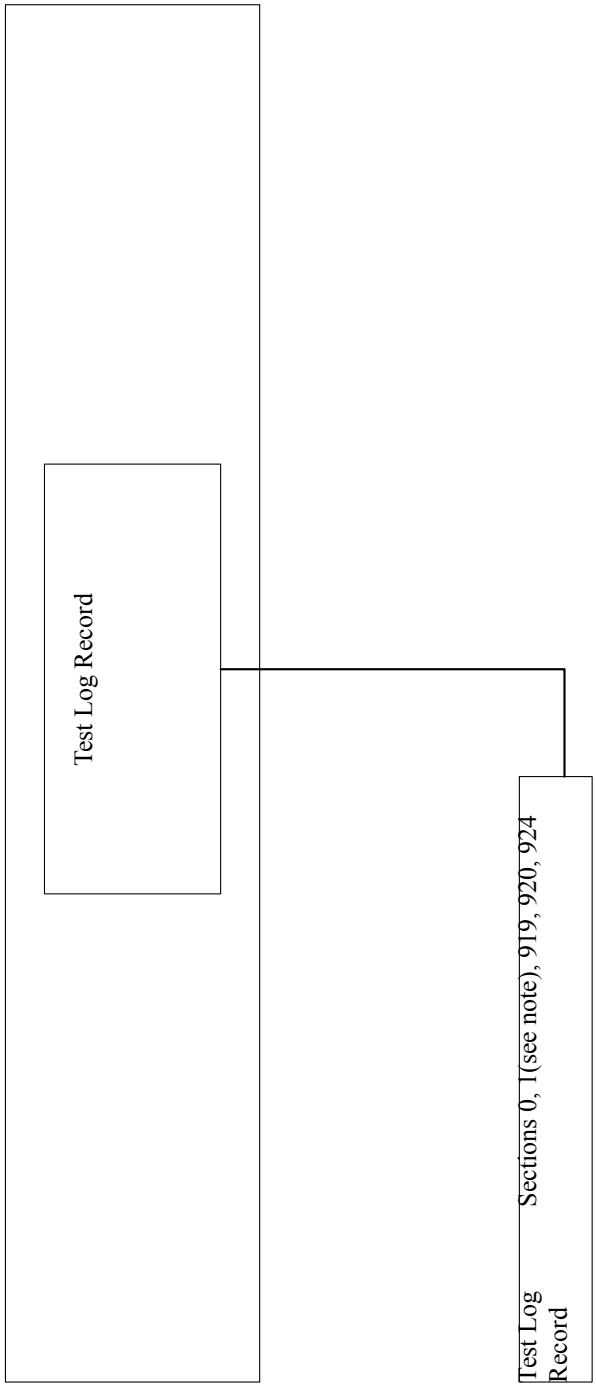


Each continuous data record shall contain a block of continuous waveform data. Continuous waveform data is obtained from section 922. Section 916 provides the lead identification indicating what type of data and how much is being sent i.e., ECG - 15 seconds, impedance - 7 seconds, etc.

All records making up the Continuous Data portion of this disk file shall be contiguous and the corresponding Abstract/Log Record shall be first in the group i.e. 1/n. This limitation will allow a reasonable implementation for the SCP converter parsing mechanism. (Not required for LP500)

6.4.3.7 Test Log Record Set

File length is the total number of bytes in all records

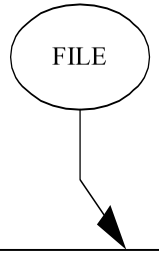


6.4.3.8 LifePak 500 Complete Record Set

Multiple files containing one recrod each (LP500 implementation)

or

Single files containing one record each (Columbus implementation)

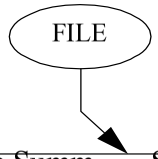


Continuous Data Record	Sections 0, 1, 3, 1019, 1022, 1023
Audio Data File Record	Sections 0, 1, 1021
Test History Record	Sections 0, 1, 1020

3 records make up the complete Record Set

6.4.3.9 LifePak 500 Summary Record Set

Multiple files
Each file contains one record



Code Summ Record	Sections 0, 1, 2, 1019, 1022, 1023
SAS Event Record	Sections 0, 1, 3, 1022
1st Waveform Record	Sections 0, 1, 3, 1022
CPSS Event Record	Sections 0, 1, 3, 1022
Defib Event Record	Sections 0, 1, 3, 1022
Test History Record	Sections 0, 1, 1020

6 files make up the Summary Record Set

7. COMMAND SHELL

Definitions:

Host Device: In general, the host device is a computer device such as the computers which perform data transfer, event review and database reception tasks.

Slave Device: (also referred to as a cart) In general, the slave device is a patient monitoring or patient therapy device.

7.1 Introduction

Applicable Defib Products: LP500, LP12
Other Applicable Devices: Data Transfer, PDA

The devices listed above as Cart Devices thus implement the SCP-ECG command shell with the extensions defined herein. The command shell is used to manage reception of commands and responses.

Default Settings: Per SCP-ECG Standard section 7.0

Applicability: All direct connections for DT-1 and DT-2 devices.

In order to communicate between Host and Cart, both systems must set their serial ports to a compatible setting. The serial settings are 9600 bps, 8 bits, 1 start, 1 stop and no parity. Hardware data flow control between the Host and Cart may be used. When used, the Host will control the Cart's Txd data via the Cart's Clear to Send input line. The LP500 device is an exception - it uses software XON/XOFF flow control (where XON is the ASCII character <ctrl-Q> and XOFF is the ASCII character <ctrl-S>. See Section 3 of this document for individual device details.

7.2 Initiation of an SCP-ECG Command Shell Session

The SCP-ECG Command Shell is supported within the ZTERM mode of the ZMODEM transport layer protocol.

To initiate an SCP-ECG Command Shell session, first establish a ZMODEM session and then enter ZTERM mode. Once the ZTERM mode has been entered, a ZTERM frame containing the SCP-ECG ID message as described in paragraph 7.2.1 of the SCP-ECG standard, rev. 1.0. is sent from the Cart to the Host, initiating the shell session as described in the following paragraphs.

It is acceptable to both enter ZTERM mode and initiate the SCP-ECG Command Shell session by sending the initial ZTERM frame with the SCP-ECG ID message.

7.3 Termination of an SCP-ECG Command Shell Session

The termination of the session shall be performed by the exchange of DONE commands. After the second DONE command has been successfully transmitted, the command shell is responsible for notifying the underlying transport functions that the shell is completed.

A shell activity timer of 110 seconds shall be activated after each shell command requiring a response. If no response is received before the timer expires, the

initiating command shell shall direct the underlying transport functions to terminate the connection.

7.4 Extension to SCP-ECG Command Shell (section 7.0) Standard

7.4.1 Rules

1) All messages are 256 bytes in length unless otherwise noted.

2) ID Messages

The initial ID of a session always comes from the cart.

After a bit rate change, the cart must send an ID. The delay may vary with implementation.

ID messages do not affect or reflect bus ownership.

3) In the “Request” message subrequests (ref. 7.2.2.1- 7.2.2.3 of the SCP-ECG 1.0 standard), all LP12 versions will send the tag lengths in 2-byte fields.

7.4.2 Vendor Specific Extensions to Standard Commands

7.4.2.1 “RR” and “RS” Command Sub-Requests

7.4.2.1.1 RR Message Extensions

This message type is only sent by DT-1 devices.

Sub-Request Values:

0x02	Current Complete Record
0x04	Current Summary
0x08	Previous Summary

7.4.2.1.2 RS Message Extensions

This message type is sent by DT-1 and DT-2 devices.

Sub-Request Value:

0x80

Record Type	Bytes 255-256
0x0001	12-lead Record
0x0002	Code Summary, Vital Signs Log, Trend Summary Record
0x0004	Continuous Record
0x0008	All records
0x0010	Reserved

A DT-2 device may also set each bit for which a record set will be contained in a transmission sequence. This results in two

possible values to indicate All records: 0x0008 and 0x0007. The 0x0007 results from the logical OR of the three values for the individual record types.

Implementation note: LP12 releases for Tango and later will send 0x0007 when “All Records” are transmitted.

The receiving device should examine each bit in the Byte 255:256 field for which it can accept the record sets defined in section 6.4.3 of this document. It is acceptable for a receiver to accept set bits for which a specification is not defined or for which the records will not be completely processed - as long as undefined record sets will not cause the failure of a data transfer operation. The unknown or unprocessed elements may be stored for possible future processing at the option of the receiving device.

7.4.2.2 “RS” Command Batch Transfer Extensions

The following data items specify an “n of m” sequence during a batch-type transfer of multiple records. Current_Record contains, for the record specified, the sequence order in a batch of records. Total_Records contains the total number of records to be sent in the batch. Total_Records may change during the batch transmission as long as the value conforms to the Current_Record relationship rules.

Bytes 251-252 Current_Record, long int

must be greater than zero and less than or equal to Total_Records

Bytes 253-254 Total_Records, long int

must be greater than or equal to Current_Record

7.4.2.3 “I” Command Extensions

The LIFENET version (see SCP-ECG Section 1: Tag 244) is added to the message, designated as “Spare” in the SCP-ECG standard

Byte 252: Connection type - The currently defined values are:
0 - Unknown
1 - Bluetooth Direct (Serial Port Profile).

Bytes 253-254: Rule set type - Unicode text character

Byte 255: Primary Version

Byte 256: Secondard Version

LP12 Implementation:

Internet address: “000.000.000.00”

50/60 Hz AC Environment: 0 (binary)

7.4.2.4 RS Command Implementation Notes

The tags shown in the SCP-ECG standard specification for the RS command’s Request Mask may be in alternative orders and additional tags may be present if specified as an implementation profile in this document. Permitted tags are as defined in Section 1. Tags shown in the SCP-ECG

standard are optional, but if present may be “empty”, in which case the length may be 1 with a NULL data byte OR the length may be 0 with the data byte not present.

The LP12 will send Tag 5 (Date-of-Birth) with an empty data field. Tag 4, containing Patient Age as described in Section 1, will immediately follow the listed tags in what is shown in the SCP-ECG standard as the Spare field. The LP12 implementation of this command sends all RS command Request Mask tag lengths in 2-byte fields as unsigned integers (U16)

7.4.3 Vendor-Specific “RX” Commands

“RX” Command Sub-Requests (values not shown indicate “Not Used”)

01	Reserved
02	Select Link Speed/Go At Link Speed
03	Set Date & Time (without Time Zone)
04	Reserved
05	Reserved
07	Reserved
08	Reserved
09	Reserved
10	Reserved
11	Subsession Bus Turnaround
12	Set Date and Time (with Time Zone)
13	Request/Report Date and Time
14	Set Daylight Saving Time Rules
15	Request/Read ID Parameter
16	Set ID Parameter

7.4.4 Baud Rate Change (RX<02>)

Request: Select BPS Command (host to cart)	Byte Number
Message type = “R” (ASCII 1 Byte)	1
Processing Request = “X” (ASCII 1 Byte)	2
Sub-Request = 2 (Binary, 1 Byte)	3
Request Sequence Number (unsigned int)	4-5

ASCII list of bit rates supported by the host <cr>, <NULL> terminated Example:"9600 14400 19200 38400 57600 115200"	6-len
Spare (Zero Filled)	len-256

Request: GoAtBPS Command (cart to host) Sent in response to a Select BPS Command	Byte Number
Message type = "R" (ASCII 1 Byte)	1
Processing Request = "X" (ASCII 1 Byte)	2
Sub-Request = 2 (Binary, 1 Byte)	3
Request Sequence Number (unsigned int)	4-5
Bit rate to use (9 bytes ASCII string <cr>, <NULL> terminated. Example: "115200<cr><NULL>"	6-14
Spare (Zero Filled)	15-256

7.4.5 Change Date & Time (RX<03>)

Request: Set cart parameters (host to cart)	Byte Number
Message type = "R" (ASCII 1 Byte)	1
Processing Request = "X" (ASCII 1 Byte)	2
Sub-Request = 3 (Binary, 1 Byte)	3
Request Sequence Number (unsigned int)	4-5

Action: UPDATE/REPORT: TRUE = update and report the time FALSE = don't update but report the time	6
For Action = FALSE (time request only), set to 0. For Action = TRUE (change clock), Adjust clock by n seconds: Signed long four bytes = number of seconds to adjust the clock forward or backward (dependent on the sign). The value of 0 is ignored. Limited to +- 86,399.	7-10
Set calendar to date "MM/DD/YY<NULL>" (ASCII, 9 Bytes) <NULL> Strings are ignored	11-19
Spare (zero fill)	20-256

Response: Return cart parameters (cart to host) Sent in response to a Set cart parameters Command	Byte Number
Message type = "R" (ASCII 1 Byte)	1
Processing Request = "X" (ASCII 1 Byte)	2
Sub-Request = 3 (Binary, 1 Byte)	3
Request Sequence Number (unsigned int)	4-5
Action: UPDATE/REPORT: TRUE = updated time is returned FALSE = Current time	6
Updated or current clock to time: "HH:MM:SS<NULL>" (ASCII, 9 Bytes)	7-15
Request Action = FALSE, return zero Request Action = TRUE, return requested clock adjustment: four byte signed long	16-19

Updated or current calendar to date “MM/DD/YY <NULL>” (ASCII, 9 Bytes)	20-28
Requested calendar to date “MM/DD/YY <NULL>” (ASCII, 9 Bytes)	29-37
Spare (zero fill)	38-256

RX<03> is implemented by LP500 and all LP12 releases.

The following tables show the two-digit year mappings for the LP500 and LP12 wherever year is represented as two-char “YY” data.

	“YY” data	Actual Year
LP500	00-94	2000-2094
	95-99	1995-1999
LP12	70-99	1970-1999
	00-38	2000-2038
	39-69	not allowed - will cause Status(Err) to be returned

7.4.6 Subsession Bus Turnaround (RX<11>)

Request: Request for Subsession Bus Turnaround	Byte Number
Message type = “R” (ASCII 1 Byte)	1
Processing Request = “X” (ASCII 1 Byte)	2
Sub-Request = 11 (Binary, 1 Byte)	3
Request Sequence Number (unsigned int)	4-5
Action: Not Applicable, set to Zero	6
Spare (Zero Filled)	7-256

7.4.7 Set Time and Date (RX<12>)

Request: Request to Set Time and Date	Byte Number
Message type = “R” (ASCII 1 Byte)	1
Processing Request = “X” (ASCII 1 Byte)	2
Sub-Request = 12 (Binary, 1 Byte)	3

Request Sequence Number (unsigned int)	4-5
Correction offset (signed long integer): Time differential containing the number of seconds that must be added to current device date and time in order to synchronize it with the host. Processing of this command will also trigger differential time stamping of patient records by the cart. (see also Section 1: Tag 247)	6-9
Spare (Zero Filled)	10-256

Implemented by LP12 Tango and all subsequent product releases that support SCP Query-Messaging protocol.

The same year mappings apply as those described for command RX<03>.

7.4.8 Request/Report Time and Date (RX<13>)

Request: Request to Receive Time and Date Information Response: Current Time and Date Information	Byte Number
Message type = “R” (ASCII 1 Byte)	1
Processing Request = “X” (ASCII 1 Byte)	2
Sub-Request = 13 (Binary, 1 Byte)	3
Request Sequence Number (unsigned int)	4-5
Local Date and Time (unsigned long int) Current local time in seconds from midnight January 1, 1970 When sent as request - 0 (field not used in request) When sent as report - Current local time	6-9

Universal Time Offset (UTO) (signed int, 2 bytes) The number of minutes added to UTC time to generate local time. Allowable values are -1440 through +1440 (i.e., +/- 24 hours) and 0x7FFF. 0x7FFF indicates that the field is not initialized or is unused. When sent as request - 0 (field not used in request) When sent as report - current UTO, ignored if Time Zone Index = 1000	10-11
Time Zone Index (unsigned int) Index identifies the time zone in which the sender operates. It is used by the receiver to determine the current daylight saving time transition dates and bias values. When sent as request - 0 (field not used in request) When sent as report - 0-999: reserved for future use (possible standard mapping) 1000 - see definitions following this table 1001-1074: see Time Zone Index table 1075-32766: reserved for future MPC use 32767: reserved	12-13
Spring-Ahead DST Rule (MMDOHHMMSS, ASCII characters, not-NULL terminated) Date and time of transition to DST defined independently of a specific year's calendar. M - Month (0-11) D - Day-of-Week (0-6) O - Ordinal Week (0 means no transitions,1-5 means 1st to 4th, 5 = last, and 6 = user-disabled) HHMMSS - Time of adjustment When sent as request - "0006000000" or "0000000000" (this field is ignored by the receiver of the request) When sent as report - refer to the definitions following this table	14-23

Fall-Back DST Rule (MMDOHHMMSS, ASCII characters, not NULL-terminated) (see Spring-Ahead DST Rule for definition) When sent as request - “0006000000” or “0000000000” (this field is ignored by the receiver of the request) When sent as report - refer to the definitions following this table	24-33
Daylight Saving Time Bias (signed int) The number of minutes subtracted from current "standard time" to transition to “daylight saving time”, value is typically -60. Range is -1440 to +1440 (+/- 24 hours) When sent as a request - 0 (field not used in request) When sent as a report - the sender's current daylight saving time adjustment value in minutes.	34-35
Spare (Zero Filled)	36-256

For LIFENET 2.x and LIFENET 3.x connections, the use of RX<13> is restricted to requests by an SCP-ECG Host and reporting by SCP-ECG Cart. Implemented by LP12 Tango and all subsequent product releases that support the SCP Query-Messaging protocol.

The preferred implementation is for the Local Date and Time information and UTO to be exchanged in UTC. The Time Zone Index and DST rules will contain the user-configured Time Zone information. The requesting and reporting devices are responsible for making any necessary internal conversions to support the local display of time.

DST Rule Report Special Values:

General definition of "special values" when received in an RX<13> response (Note that responding to RX<13> is taken to mean that the device knows about Time Zone, otherwise, it would respond to RX<13> with SErr):

1) DST Rules of "0006000000" and a Time Zone index of 1000 means that the device has not yet been configured by the user or the user has configured Time Zone to "none".

2) DST Rules of "0006000000" and a valid Time Zone index means that DST has been manually disabled by the user.

3) DST Rules of "0000000000" and a Time Zone index of 1000 is not an expected combination, but will be considered equivalent to definition 1.

4) DST Rules of "0000000000" and a valid Time Zone index means that the device has determined that there are no DST Rules for the particular Time Zone (such as Arizona).

If one of the Spring-Forward or Fall-Back Rules are set to a special value and the other rule to a non-special value, both rules are assumed by the DMS to be set to the special value.

If the Spring-Forward Rule is set to one special value and the Fall-Back Rule to the opposite special value, both shall be assumed by the DMS to be set to “0006000000”.

If the device has a Time Zone of [none] then DST is automatically OFF and the device will report

0x7FFF for UTO

1000 for Time Zone Index

"0006000000" for DST Rules

0 for DST Bias

If DMS encounters a device in this state, it will not attempt to send new rules using RX<14>. If system time sync is enabled, DMS will assume the device is in the same time zone as DMS and will correct the clock accordingly using RX<12>. Thus, it is important that a device that will communicate to DMS have Time Zone configured properly. Note that this is the factory power-up-default state for the LP12.

Once the user selects an initial or new Time Zone, DST defaults to ON, and the device reports the default UTO, DST Rules, Index, and Bias. DMS will evaluate the rule set and update it, if necessary, using RX<14> and will correct the clock accounting for UTO using RX<12>.

If the user turns DST OFF with a Time Zone selected, the device will report

UTO for the selected Time Zone Index, never biasing it for DST

The selected Time Zone Index

"0006000000" for DST Rules (indicates DST has been manually turned OFF)

0 for DST Bias

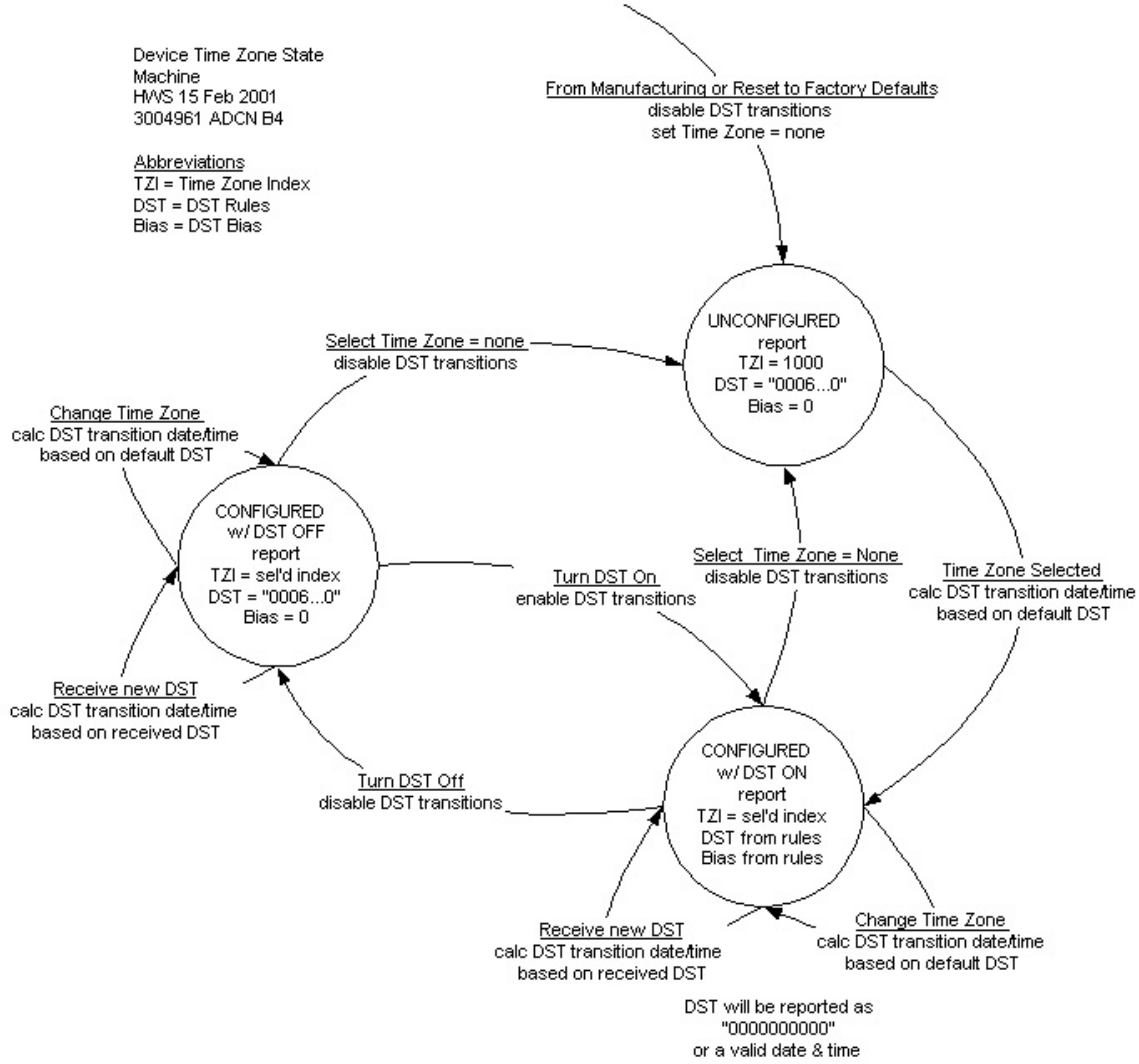
If DMS encounters a device in this state, it will consider the Index valid and correct the clock using RX<12> accounting for UTO. New rules will be sent by the DMS. The device may elect to discard or hold the updated rules based on its own use model. The device will continue to report "0006000000" for DST Rules until DST is manually turned ON.

Once the user turns DST back ON, the default set of DST Rules will be applied for the Time Zone index selected. (The device can optionally elect to save DST Rules when DST is turned off such that turning off DST does not destroy updated rules sent by a DMS. The LP12 will not save the DST Rules if DST is turned off and so will revert to the default rules if DST is turned back on.)

If the device returns an invalid Time Zone index or incorrect UTO for a valid Time Zone index, DMS will not attempt to change any of the DST Rules or correct the clock. Notification of the error is at the discretion of the DMS. There is no mechanism to directly alert the device user that its stored information is incorrect.

If the device returns a valid Time Zone index, but erroneous rule/bias information (including both out-of-range and obsolete values), the DMS will reset the rule/bias information using RX<14>.

This figure describes the LP12 Tango release’s implementation of DST and Time Zone according to the preceding rules.


Device Time Zone State Machine
HWS 15 Feb 2001
3004961 ADCN B4
Abbreviations
TZI = Time Zone Index
DST = DST Rules
Bias = DST Bias
From Manufacturing or Reset to Factory Defaults
disable DST transitions
set Time Zone = none
UNCONFIGURED
report
TZI = 1000
DST = "0006...0"
Bias = 0
Select Time Zone = none
disable DST transitions
Change Time Zone
calc DST transition date/time
based on default DST
CONFIGURED
w/ DST OFF
report
TZI = sel'd index
DST = "0006...0"
Bias = 0
Turn DST On
enable DST transitions
Select Time Zone = None
disable DST transitions
Time Zone Selected
calc DST transition date/time
based on default DST
Receive new DST
calc DST transition date/time
based on received DST
Turn DST Off
disable DST transitions
CONFIGURED
w/ DST ON
report
TZI = sel'd index
DST from rules
Bias from rules
Receive new DST
calc DST transition date/time
based on received DST
Change Time Zone
calc DST transition date/time
based on default DST
DST will be reported as
"0000000000"
or a valid date & time

Time Zone Index Table

Time zone index codes are derived from the Windows 5.0 registry (note that the host device is responsible for maintaining any mapping between these codes and any other internal representation). The complete table of DST Rules is maintained in the Time and Frequency Standard Features document, PDR-4628.

1001 Dateline Standard Time (UTC-12:00) - Eniwetok, Kwajalein

1002 Samoa Standard Time (UTC-11:00) - Midway Island, Samoa

1003 Hawaiian Standard Time (UTC-10:00) - Hawaii

1004 Alaskan Standard Time (UTC-09:00) - Alaska

1005 Pacific Standard Time (UTC-08:00) - Pacific Time (US & Canada); Tijuana

1006 Mountain Standard Time (UTC-07:00) - Mountain Time (US & Canada)

1007 US Mountain Standard Time (UTC-07:00) - Arizona

1008 Central Standard Time (UTC-06:00) - Central Time (US & Canada)

1009 Canada Central Standard Time (UTC-06:00) - Saskatchewan

1010 Mexico Standard Time (UTC-06:00) - Mexico City

1011 Central America Standard Time (UTC-06:00) - Central America

1012 Eastern Standard Time (UTC-05:00) - Eastern Time (US & Canada)

1013 US Eastern Standard Time (UTC-05:00) - Indiana (East)

1014 SA Pacific Standard Time (UTC-05:00) - Bogota, Lima, Quito

1015 Atlantic Standard Time (UTC-04:00) - Atlantic Time (Canada)

1016 SA Western Standard Time (UTC-04:00) - Caracas, La Paz

1017 Pacific SA Standard Time (UTC-04:00) - Santiago

1018 Newfoundland Standard Time (UTC-03:30) - Newfoundland

1019 E. South America Standard Time (UTC-03:00) - Brasilia

1020 SA Eastern Standard Time (UTC-03:00) - Buenos Aires, Georgetown

1021 Greenland Standard Time (UTC-03:00) - Greenland

1022 Mid-Atlantic Standard Time (UTC-02:00) - Mid-Atlantic

1023 Azores Standard Time (UTC-01:00) - Azores

1024 Cape Verde Standard Time (UTC-01:00) - Cape Verde Is.

1025 UTC Standard Time (UTC) - Dublin, Edinburgh, Lisbon, London

1026 Greenwich Standard Time (UTC) - Casablanca, Monrovia

1027 Central Europe Standard Time (UTC+01:00) - Belgrade, Bratislava, Budapest, Ljubljana, Prague

1028 Central European Standard Time (UTC+01:00) - Sarajevo, Skopje, Sofija, Vilnius, Warsaw, Zagreb

1029 Romance Standard Time (UTC+01:00) - Brussels, Copenhagen, Madrid, Paris

1030 W. Europe Standard Time (UTC+01:00) - Amsterdam, Berlin, Bern, Rome, Stockholm, Vienna

1031 W. Central Africa Standard Time (UTC+01:00) - West Central Africa

1032 E. Europe Standard Time (UTC+02:00) - Bucharest
1033 Egypt Standard Time (UTC+02:00) - Cairo
1034 FLE Standard Time (UTC+02:00) - Helsinki, Riga, Tallinn
1035 GTB Standard Time (UTC+02:00) - Athens, Istanbul, Minsk
1036 Israel Standard Time (UTC+02:00) - Jerusalem
1037 South Africa Standard Time (UTC+02:00) - Harare, Pretoria
1038 Russian Standard Time (UTC+03:00) - Moscow, St. Petersburg, Volgograd
1039 Arab Standard Time (UTC+03:00) - Kuwait, Riyadh
1040 E. Africa Standard Time (UTC+03:00) - Nairobi
1041 Arabic Standard Time (UTC+03:00) - Baghdad
1042 Iran Standard Time (UTC+03:30) - Tehran
1043 Arabian Standard Time (UTC+04:00) - Abu Dhabi, Muscat
1044 Caucasus Standard Time (UTC+04:00) - Baku, Tbilisi, Yerevan
1045 Afghanistan Standard Time (UTC+04:30) - Kabul
1046 Ekaterinburg Standard Time (UTC+05:00) - Ekaterinburg
1047 West Asia Standard Time (UTC+05:00) - Islamabad, Karachi, Tashkent
1048 India Standard Time (UTC+05:30) - Calcutta, Chennai, Mumbai, New Delhi
1049 Nepal Standard Time (UTC+05:45) - Kathmandu
1050 Central Asia Standard Time (UTC+06:00) - Astana, Dhaka
1051 Sri Lanka Standard Time (UTC+06:00) - Sri Jayawardenepura
1052 N. Central Asia Standard Time (UTC+06:00) - Almaty, Novosibirsk
1053 Myanmar Standard Time (UTC+06:30) - Rangoon
1054 SE Asia Standard Time (UTC+07:00) - Bangkok, Hanoi, Jakarta
1055 North Asia Standard Time (UTC+07:00) - Krasnoyarsk
1056 China Standard Time (UTC+08:00) - Beijing, Chongqing, Hong Kong, Urumqi
1057 Singapore Standard Time (UTC+08:00) - Kuala Lumpur, Singapore
1058 Taipei Standard Time (UTC+08:00) - Taipei
1059 W. Australia Standard Time (UTC+08:00) - Perth
1060 North Asia East Standard Time (UTC+08:00) - Irkutsk, Ulaan Bataar
1061 Korea Standard Time (UTC+09:00) - Seoul
1062 Tokyo Standard Time (UTC+09:00) - Osaka, Sapporo, Tokyo
1063 Yakutsk Standard Time (UTC+09:00) - Yakutsk
1064 AUS Central Standard Time (UTC+09:30) - Darwin
1065 Cen. Australia Standard Time (UTC+09:30) - Adelaide
1066 AUS Eastern Standard Time (UTC+10:00) - Canberra, Melbourne, Sydney
1067 E. Australia Standard Time (UTC+10:00) - Brisbane
1068 Tasmania Standard Time (UTC+10:00) - Hobart
1069 Vladivostok Standard Time (UTC+10:00) - Vladivostok
1070 West Pacific Standard Time (UTC+10:00) - Guam, Port Moresby

1071 Central Pacific Standard Time (UTC+11:00) - Magadan, Solomon Is., New Caledonia

1072 Fiji Standard Time (UTC+12:00) - Fiji, Kamchatka, Marshall Is.

1073 New Zealand Standard Time (UTC+12:00) - Auckland, Wellington

1074 Tonga Standard Time (UTC+13:00) - Nuku'alofa

7.4.9 Set Daylight Saving Time Rules (RX<14>)

Request: Request to Set Daylight Saving Time Rules	Byte Number
Message type = “R” (ASCII 1 Byte)	1
Processing Request = “X” (ASCII 1 Byte)	2
Sub-Request = 14 (Binary, 1 Byte)	3
Request Sequence Number (unsigned int)	4-5
Spring-Ahead DST Rule (MMDOHHMMSS, ASCII characters) see definitions for RX<13>	6-15
Fall-Back DST Rule (MMDOHHMMSS, ASCII characters) see definitions for RX<13>	16-25
Daylight Saving Time Bias (signed int) see definitions for RX<13>	26-27
Spare (Zero Filled)	28-256

RX<14> is implemented by LP12 Tango release and all subsequent products that support the SCP-ECG Query-Messaging system.

General definition of DST Rule "special values" when sent in an RX<14> command:

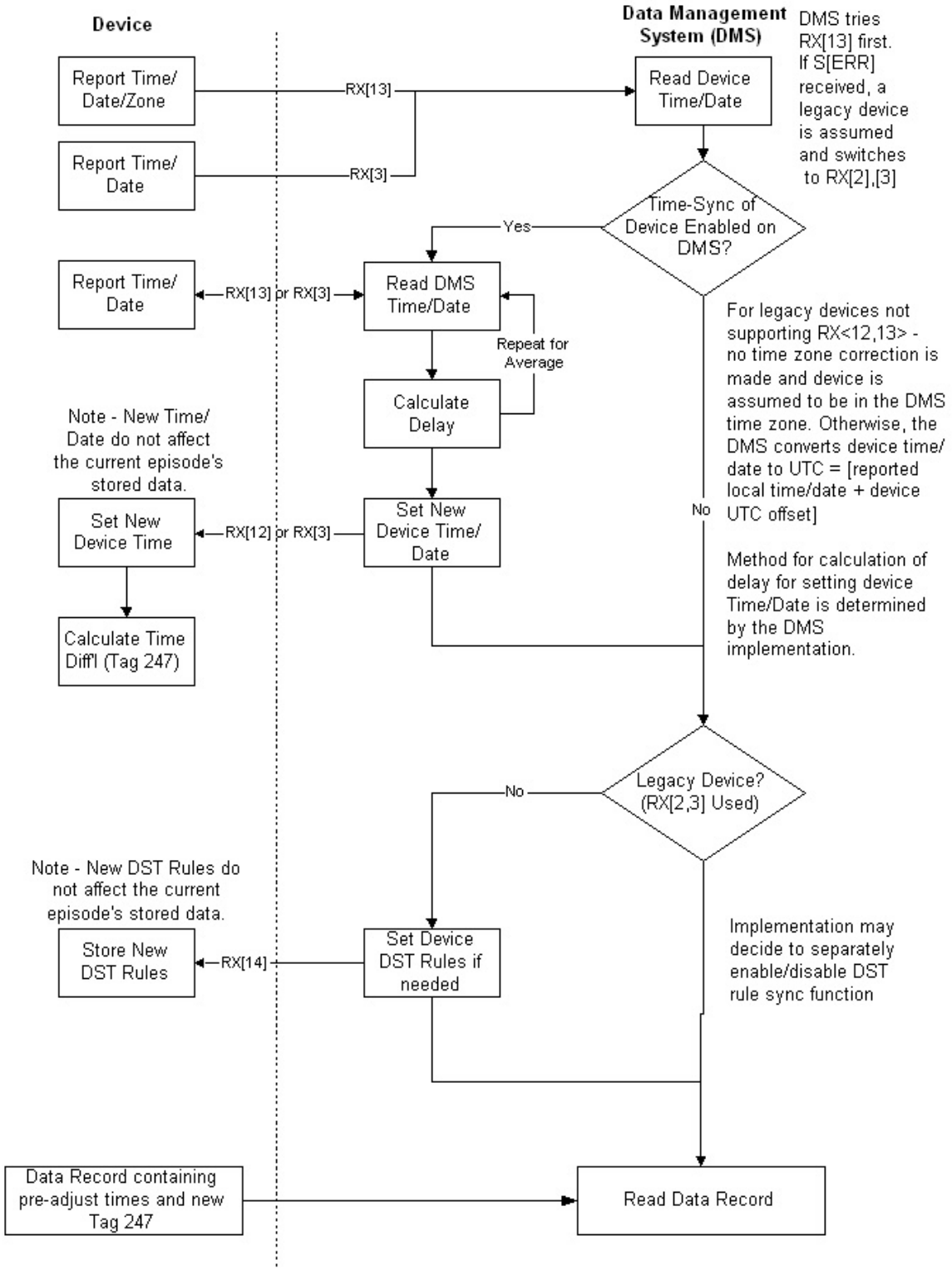
1) DST Rules of "0006000000" are illegal.

2) DST Rules of "0000000000" mean that there are no DST transitions for the Time Zone index reported in the RX<13> response. This value would be returned for the Arizona Time Zone, for example.

3) Nothing the sender of RX<14> puts in the DST Rules will affect the user configuration of the device's Time Zone Index or DST On/Off status.

Implementation Note:

LP12 Tango release will assume DST Bias is always negative (i.e. - clocks advance during Daylight Saving Time). This is in compliance with all existing definitions and is very unlikely to change.


Device
Data Management System (DMS)
Report Time/ Date/Zone
RX[13]
Read Device Time/Date
Report Time/ Date
RX[3]
DMS tries RX[13] first. If S[ERR] received, a legacy device is assumed and switches to RX[2],[3]
Time-Sync of Device Enabled on DMS?
Yes
Report Time/ Date
RX[13] or RX[3]
Read DMS Time/Date
Repeat for Average
Calculate Delay
For legacy devices not supporting RX<12,13> - no time zone correction is made and device is assumed to be in the DMS time zone. Otherwise, the DMS converts device time/ date to UTC = [reported local time/date + device UTC offset]
Note - New Time/ Date do not affect the current episode's stored data.
Set New Device Time
RX[12] or RX[3]
Set New Device Time/ Date
No
Method for calculation of delay for setting device Time/Date is determined by the DMS implementation.
Calculate Time Diff'l (Tag 247)
Legacy Device? (RX[2,3] Used)
No
Note - New DST Rules do not affect the current episode's stored data.
Store New DST Rules
RX[14]
Set Device DST Rules if needed
Implementation may decide to separately enable/disable DST rule sync function
Data Record containing pre-adjust times and new Tag 247
Read Data Record

7.4.10 Read ID Parameter (RX<15>)

Request: Request to Read ID Parameter Response: Value of Requested ID Parameter	Byte Number
Message type = "R" (ASCII 1 Byte)	1
Processing Request = "X" (ASCII 1 Byte)	2
Sub-Request = 15 (Binary, 1 Byte)	3
Request Sequence Number (unsigned int)	4-5
Record Identifier (Bytes 0-15 of the Patient Record ID - if all zero, apply request to current or most recent record)	6-21
ID Parameter Type (enumeration) 1: Patient Last Name (Section 1: Tag 0) 2: Patient First Name (Section 1: Tag 1) 3: Patient Second Last Name (Section 1: Tag 3) 4: Patient ID (Section 1: Tag 2) 5: Incident ID (Section 1: Tag 245)	22
Parameter Data (formatted as described by identified data item) - only sent for response. For requests, this byte is a single ASCII NULL.	23 - len
Spare (Zero Filled)	len+1 to 256

7.4.11 Set ID Parameter (RX<16>)

Request: Request to Set ID Parameter	Byte Number
Message type = "R" (ASCII 1 Byte)	1
Processing Request = "X" (ASCII 1 Byte)	2
Sub-Request = 16 (Binary, 1 Byte)	3

Request Sequence Number (unsigned int)	4-5
Record Identifier (Bytes 0-15 of the Patient Record ID - if all zero, apply request to current or most recent record)	6-21
ID Parameter Type (enumeration) 1: Patient Last Name (Section 1: Tag 0) 2: Patient First Name (Section 1: Tag 1) 3: Patient Second Last Name (Section 1: Tag 3) 4: Patient ID (Section 1: Tag 2) 5: Incident ID (Section 1: Tag 245)	22
Parameter Data (formatted as described by identified data item)	23 - len
Spare (Zero Filled)	len+1 to 256

7.4.12 Vendor-Specific Error codes

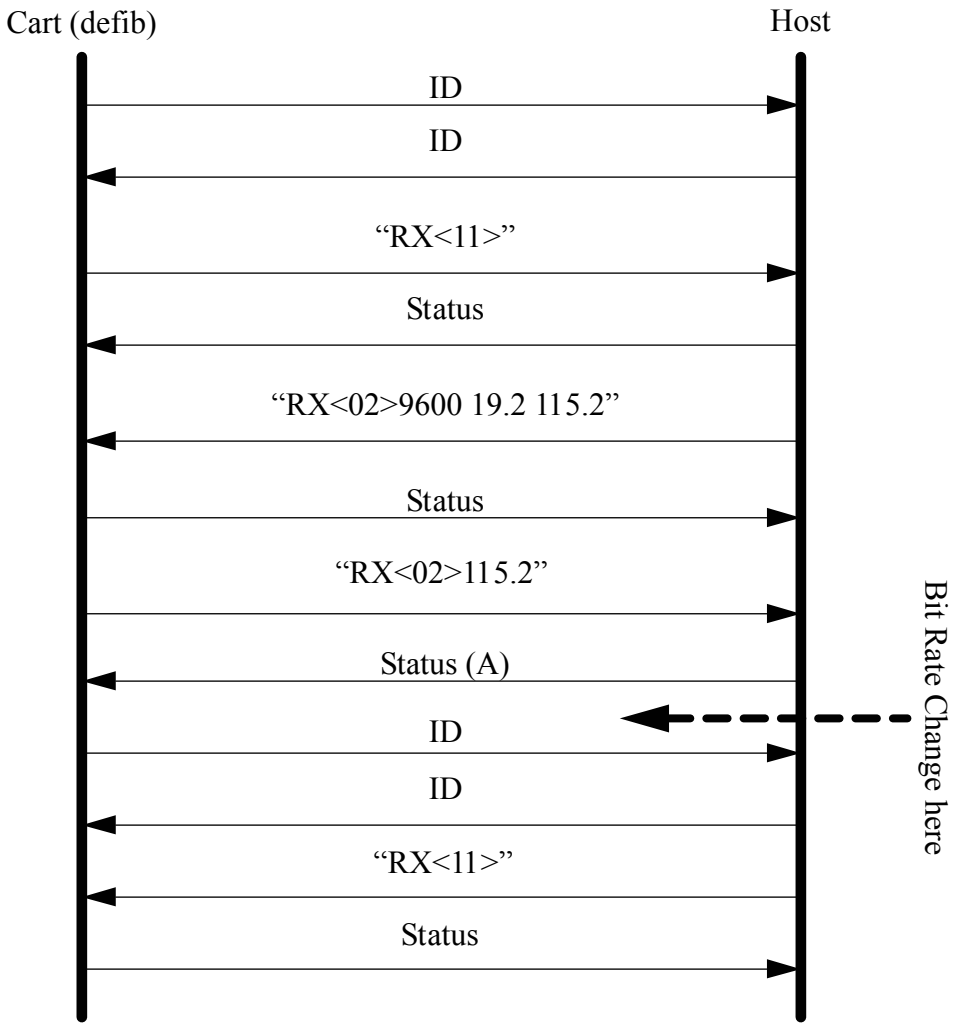
These error codes are included in the standard SCP-ECG Status message. Refer to the SCP-ECG Standard 1.0, Section 7.3, Note 11

128 - Request parameters out-of- range

129 - Configuration changes are locked

7.5 Command Shell examples

Example of setting the bit rate by a DT-2 device (similar to setting the date and time)



When the last byte of status message (A) has cleared the transmit holding register the host will change bit-rates to the specified rate. Following the recognition of a valid status message following the “GoAtBPS” message the cart will change bit rates. The cart and host will then repeat the ID process at the new rate, with the cart sending the first ID message.

7.6 Synchronization of Time

The following diagram illustrates the process of synchronizing time between a master clock (assumed to be the SCP-ECG Host) and another SCP-ECG device - either Host or Cart.

8. APPENDIX 1 - SAMPLE ASCII SUMMARY RECORD

*** PATIENT INFORMATION - Start ***

Incident ID No: <tab> ABC123

Patient ID No: <tab>	ABC123
Incident Date: <tab>	Jan. 15, 1996
Patient Name: <tab>	Last, First Middle
Vehicle ID No: <tab>	
Age: <tab>	
Site No: <tab>	
Sex: <tab>	
Device Type: <tab>	LIFEPAK® 500
Race: <tab>	
Device Serial No: <tab>	00001203
Device Software Rev: <tab>	A1.10, B1.20
Device ID: <tab>	RFD#6
Device Configuration: <tab>	00211020

*** PATIENT INFORMATION - End ***

*** EVENT DATA - Start ***

09:47:08<tab>	POWER ON
09:47:14<tab>	PATIENT DISCONNECTED
09:48:15<tab>	PATIENT CONNECTED
09:48:15<tab>	PUSH ANALYZE
09:48:18<tab>	ANALYSIS #1
09:48:20<tab>	MOTION DETECTED
09:48:28<tab>	MOTION STOPPED
09:48:34<tab>	SHOCK ADVISED
09:48:44<tab>	PUSH TO SHOCK
09:48:45<tab>	SHOCK #1 - 200J
09:49:53<tab>	PATIENT ALERT - “PUSH ANALYZE”
09:49:55<tab>	ANALYSIS #2
09:49:58<tab>	MOTION DETECTED
09:50:24<tab>	DEVICE ERROR - 39
09:50:25<tab>	ANALYSIS ABORTED - MOTION TIME OUT
09:50:37<tab>	PATIENT ALERT - “PUSH ANALYZE”
09:50:38<tab>	ANALYSIS #3
09:50:44<tab>	NO SHOCK ADVISED
09:50:52<tab>	CPR INTERVAL TIMER ON = 120
09:50:54<tab>	LOW BATTERY
09:52:52<tab>	CPR INTERVAL TIMER OFF = 0
09:55:54<tab>	“REPLACE BATTERY”

09:55:58<tab> BATTERY REMOVED
09:56:13<tab> BATTERY REPLACED
09:58:43<tab> PATIENT ALERT - “PUSH ANALYZE”
09:58:46<tab> ANALYSIS #4
09:58:55<tab> SHOCK ADVISED
09:59:02<tab> “PUSH TO SHOCK”
09:59:17<tab> DISARMED
09:59:23<tab> POWER OFF
*** EVENT DATA - End ***

*** WAVEFORM DATA - Start ***
(Note: All waveform data will conform to the rules outlined for Sections 922 or 1022)

09:48:15<tab> PATIENT CONNECTED
09:48:34<tab> SHOCK ADVISED
09:48:45<tab> SHOCK #1 - 200J
09:49:53<tab> PATIENT ALERT - “PUSH ANALYZE”
09:50:44<tab> NO SHOCK ADVISED
09:58:43<tab> PATIENT ALERT - “PUSH ANALYZE”
09:58:55<tab> SHOCK ADVISED

*** WAVEFORM DATA - End **^