Protocol Specification of Stephan PDMS Protokoll EN

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December 17, 2012

Abstract

In this document the communication protocol version 1.0 used for communication of a Stephan device with a patient monitor, a hospital information system (KIS) or a patient data management system (PDMS) is described. The communication of a Stephan device with such an external system is only designed for exporting numerical values and not for an export of real time data.

Contents

1 Introduction

In the neonatal respirator STEPHANIE is already the first version of the Stephan pdms protocol implemented (see CommunicationStephanie-PDMS.pdf). In this document is a corrected description of the protocol, which is now also supported by the respirator Sophie and the Anaesthesia machine Akzent, included. For the anaesthesia machine there is an extension of the protocol available. For details see the document StephanPDMSProtocolEN.pdf
In the chapter starting on page 3 we discuss the physical layer of the communication protocol and the conceptual design of the protocol. Afterwards the description of the protocol on application layer is discussed. In the appendix at page 11 algorithms of the crc check sum calculation in pascal and "C" is shown.

2 Concept of the communication

The Communication is based on a request answer mechanism. The external Device (eg PDMS) send a request the Stephan device and the Stephan device send his answer immediately. Each data packet starts with a separate start byte and ends with a stop byte. Furthermore is the length of each telegram fixed and a crc checksum is calculated and transfered with the data. In the first version of the protocol exists three different kinds of telegrams. These are:

- Measurements; Packet 1
- Alarmdaten; Packet 2
- Settings; Packet 3

The data transfer is done via seriell line over RS232 with 8 bit data, 1 stopbit, none hardware handshake and no parity bit. The connector is like the pc connector. That mean he is male with Tx at Pin 3, Rx at Pin 2 and GND at Pin 5.

3 Protocol Definition

The layout of the communication protocol is already described in section 2. One request is always done with a six byte length request command. The command has the following structure where the "?" is a placeholder for a number:

STX	GET?	ETX
↓	↓	↓
0x02	0x47 0x45 0x54 0x3?	0x03

3.1 Command Definition

There are three original commands defined. These are GET1 to request measurement data of the ventilator, GET2 to request alarmdata and GET3 to request basic settings. The table 1 gives an overview of the various commands.

Command			Description
STX	GET1	ETX	
↓	↓	↓	
0x02	0x47 0x45 0x54 0x31	0x03	Request measurements
STX	GET2	ETX	
↓	↓	↓	
0x02	0x47 0x45 0x54 0x32	0x03	Request alarm data
STX	GET3	ETX	
↓	↓	↓	
0x02	0x47 0x45 0x54 0x33	0x03	Request basic settings

Table 1: Table of commands

3.2 Response Definition

The Stephan Device response to a request by sending the requested data package. All messages have the same structure and it is like the structure of the commands. Each package starts with a STX and the end is marked with ETX. Behind the STX we send one byte with the length of the data. After the length follows a byte with a message identifier. This byte is followed by the data. Each part of data is composed of one byte data identifier and two byte of data. The low byte of the data is transmitted first. In front of the ETX are two bytes with a CRC checksum (see chapter A). Every response telegram to one request has the identical structure especially the same data length and order of the data identifier. Together with the CRC is this useful to check the correctness of the whole message. The following telegrams are defined. The "?" is a wild-card for an integer number:

STX	Length	Msg ID 1	Message Content	CRC	ETX
↓	↓	↓	↓	↓	↓
0x02	0x25	0x31	0x01 0x?? 0x?? ... 0x0C 0x?? 0x??	0x?? 0x??	0x03
STX	Length	Msg ID 2	Message Content	CRC	ETX
↓	↓	↓	↓	↓	↓
0x02	0x0D	0x32	0x0D 0x?? 0x?? ... 0x10 0x?? 0x??	0x?? 0x??	0x03
STX	Length	Msg ID 3	Message Content	CRC	ETX
↓	↓	↓	↓	↓	↓
0x02	0x2B	0x33	0x12 0x?? 0x?? ... 0x67 0x?? 0x??	0x?? 0x??	0x03

3.3 Definition of the used Identifier

Disregarding the alarm data the message data contain identifier to identify the message content. So in the definition of the complete protocol we are using two different kinds of identifier. First the identifier of one message and second the identifier to identify the data within a telegram. These second types of identifier are listed in the following subsections. If a requested value is not available the two data bytes are set 0xFF, but for the alarm message the alarmcolor is set to 0x00 in that case.

3.3.1 Measurement Identifier

Name	ID	Description
Pmax	0x01	Maximum endinspiratoric pressure in $\frac{1}{10}cmH_2O$
Posc	0x02	Peak-Peak Oscillation-Amplitude in $\frac{1}{10}cmH_2O$
Pmean	0x03	Mean Airwaypressure in $\frac{1}{10}cmH_2O$
PEEP	0x04	Positive endexpiratoric Pressure in $\frac{1}{10}cmH_2O$
MV	0x05	Minutevolume in $\frac{1}{10}\frac{L}{min}$
VT	0x06	Expiration-Tidal-Volume in $\frac{1}{10}mL$
Freq	0x07	Breathing frequency in $\frac{1}{10}bpm$
Insp	0x08	Part of the inspiration, I:E ratio $\frac{1}{10}\%$
FiO_2	0x09	Inspiratoric Oxygenconcentration $\frac{1}{10}\%$
Temp	0x0A	Temperature at Y-Piece in $\frac{1}{10}^{\circ}C$
R	0x0B	Resistance in $\frac{1}{10}\frac{cmH_2O}{\frac{L}{s}}$
C	0x0C	Compliance in $\frac{1}{10}\frac{mL}{cmH2O}$

3.3.2 Alarm-Identifier

Name	ID	Description
Alarm1	0x0D	look at Table 2 und 3.3.2
Alarm2	0x0E	look at Table 2 und 3.3.2
Alarm3	0x0F	look at Table 2 und 3.3.2
Alarm4	0x10	look at Table 2 und 3.3.2

Alarm No	Alarmtext
0	CONTROLLER FAIL
1	PC FAILURE
2	HARDWARE FAILURE
3	POWER SUPPLY FAIL
4	BATTERY FAILURE
5	ADC FAILURE
6	VALVE FAILURE
7	POT. / Pmax, PEEP, Ti
8	COMMUNICATION
9	CONTROL PANEL
10	LOW GAS PRESSURE
11	LOW INLET GASES
12	SUPPLY VOLTAGE
13	PATIENT VALVE
14	PRESS.SENSOR FAIL
15	PROL. HIGH PRESS.
16	VT(INSP) LOW
17	APNEA
18	NEGATIVE PRESSURE
19	PEAK PRESS. >0.3s
20	LOW MIN. VOLUME
21	LOW PRESSURE / DISC
22	PRESSURE SENSORS
23	TEMPERATURE >41°C
24	SAFETY VALVE
25	O2 SENSOR
26	AIR PRESSURE
27	O2 VALVE
28	SUBSTIT. VALVE
29	LOW AIR PRESSURE
30	LOW O2 PRESSURE
31	PNEUMOTACHOGRAPH
32	FLOW SENSOR VALVE
33	PATIENT PART?
34	PEAK PRESSURE

Alarm No	Alarmtext
35	BATTERY LOW
36	HIGH MIN. VOLUME
37	TEMP. SENSOR WB
38	TEMP. SENSOR DIST
39	TEMP. SENSOR PROX
40	AIR PRESS. SENSOR
41	O2 PRESS. SENSOR
42	HIGH FIO2
43	LOW FIO2
44	HIGH TEMPERATURE
45	LOW TEMPERATURE
46	HIGH TEMP. WB
47	LOW TEMP. WB
48	VALVE / NEB., INJ
49	POT. / VT, HFO, TEMP.
50	BUTTON
51	TEMP. PNEUMATIC
52	GAS TOO DRY
53	FLOWLIMIT/DISC.?
54	P-OSC HIGH
55	P-OSC LOW
56	P-MEAN HIGH
57	P-MEAN LOW
58	WATERLEVEL LOW
59	EXTPCB FAILURE
60	REFILL FAIL
61	WATERLEVEL HIGH
62	WATERLEVEL?
63	LEAKVOL. > 50%
64	SOFTWARE
65	VT HIGH
66	FREQUENCY HIGH

Table 2: Alarmtable of the respirator

Alarmcolor	Value	Description
black	0	No Alarm
green	10	Acknowledged Alarm
red	12	HP Alarm
yellow	14	MP / MHP Alarm

In the respirator Stephanie there are two colorcodes used for the HP Alarm. The mentioned code 12 and the code 4.

3.3.3 Settings-Identifier

Settingparameter	ID	Description
Temperature	0x12	Gastemperature in $\frac{1}{10}^{circ}C$
Resist.	0x13	Resistive unloading under PAV in $\frac{cmH_2O}{\frac{L}{s}}$
Elast.	0x14	Elastic unloading under PAV in $\frac{1}{10}\frac{mL}{cmH_2O}$
HFO Freq.	0x15	Set HFO Frequency in $\frac{1}{10}Hz$
PEEP	0x16	PEEP setting in $\frac{1}{10}cmH_2O$
Pmax	0x17	Pmax setting in $\frac{1}{10}cmH_2O$
Pattern	0x18	Breathingpattern
V_t	0x19	V_t setting in $\frac{1}{10}mL$
Tinsp	0x1A	Inspiration time setting in $\frac{1}{10}$ s
Trigger	0x1B	Triggerthreshold in $\frac{1}{10}cmH_2O$, $\frac{1}{10}\frac{L}{min}$ or $\frac{1}{10}Arb$ depending on trigger kind.
FiO_2	0x1C	Oxygenconcentration setting in $\frac{1}{10}$ %
HFO Amp.	0x1D	Oscillation amplitude
Texp	0x40	Expiration time setting in $\frac{1}{100}$ s
Switch	0x43	Breathmode setting

Following values for the breathing patterns are defined:

Value	Description
0	undefined
1	Flowcontrol rectangle
2	Flowcontrol sinusoidal
3	Flowcontrol decelerate
4	Pressurecontrol linear rise
5	Pressurecontrol sinusoidal
6	Pressurecontrol rectangle
7	Pressurecontrol sinusoidal without flowmeassurement
8	Pressurecontrol rectangle without flowmeassurement

Following values for the breath mode are defined:

Value	Description
0	undefined
1	Controlled mechanical ventilation
2	Assist control ventilation
3	Synchronized intermittent mandatory ventilation
4	Continuous positive airway pressure ventilation
5	reserved
6	reserved
7	reserved
8	reserved
9	manual ventilation

A CRC Algorithms

A.1 "C"

```
unsigned int calccrc(char *packdata, int len)
{
  const unsigned int polynom = 0x8810;
  unsigned short int sum, i;

  sum = 0;
  while (len > 0)
  {
    sum ^= ((((*packdata) & 0xFF) ) << 8);
    packdata++;

    for (i = 0; i <= 7; i++)
    {
      if ((sum & 0x8000) != 0 )
      {
        sum ^= polynom;
        sum = (sum << 1) + 1;
      }
      else
        sum = sum << 1;
    }
    len--;
  }
  return(sum & 0xFFFF);
}
```

A.2 Pascal

```
function crc(p : pointer_to_byte ; laenge : word) : word;
const generator_polynom = $8810;
var i, j, carry : integer;
sum : word;
begin
sum:=0; j:=1;
while laenge > 0 do
begin
sum := sum xor (p^[j] shl 8);
for i:=0 to 7 do
begin
```

```
if (sum and $8000) <> 0 then
begin
sum := sum xor generator_polynom;
sum := sum shl 1 + 1;
end else sum := sum shl 1;
end;
j:=j+1;
laenge:=laenge-1;
end; { while }
crc:=sum;
end; { CRC }
```

B Document history

Ver. 1.3	$Date: 2012/12/17 10:14:05 $
Author : *tloeffler*	C:

Ver. 1.1	Date: 2012/07/26 08:12:40
Author: wbraun	C:

```
$Log: StephanPDMSProtocolENV1.tex,v $
Revision 1.3  2012/12/17 10:14:05  tloeffler
Correction of the Settings-Identifier description (HFO Amp.).
Update of the Alarm-Identifier description.

Revision 1.2  2012/07/26 16:00:43  wbraun
Correction of the description of the rs 232 connector
Minor corrections of the protocol description

Revision 1.1  2012/07/26 08:12:40  wbraun
PDMS Protocol description V1.0
```