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|  | | **SmartBP数据通信协议SmartBP data communication protocol** | | |
| 深圳源动创新科技有限公司  Shenzhen Viatom Technology Co., Ltd. | | 文档编码 Document Number | | 版本 Revision |
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# **概述Overview**

此通信协议包括协议和通讯，通讯接口可支持蓝牙、RS232串口、USB等，目的做到协议和通讯独立相互不影响可移植。

**Notes:协议传输字节序都采用小端模式，解析数据时需注意**

This communication protocol includes protocol and communication, and it’s communication interface enable Bluetooth, RS232 serial port, USB, etc., making the protocol and communication independent and portable.

**Notes: The sequence of bytes in this protocol is little-endian, pay attention when parsing data.**

# **协议Protocol**

|  |  |  |  |
| --- | --- | --- | --- |
|  | **Command** | **Length** | **Data** |
| Size | 1 | 4 | Length |
| Description | 指令  Command | 数据长度(当作为返回包时：bit31为错误标志，长度最大支持2G)  Data length(as a return packet: bit31 is error flog, maximum length is 2G ) | 数据(object)  Data(object) |

**Notes:**

1. **协议总长度受主机资源限制，具体以获取设备信息参数为主**
2. **Protocol total length is limited by host resources, which is mainly based on the parameters with information obtaining from device.**
3. **协议返回见Code表**
4. **See table Code for protocol return.**

协议需给通讯传递重发标志

Delivering reissue flag to communication is needed in protocol.

通讯函数接口

Communication function interface.

/\*

参数Parameter:

Data:协议内容 Protocol content

Length: 协议内容长度Protocol content length

Ack: 协议是否需要应答支持重发Whether the protocol require a response to support retransmission.

mode: 通讯模式Communication mode

return:

NULL: 成功Success

(void\*)-1: 失败Fail

\*/

void\* comm\_send(uint8\_t \*data, uint32\_t length, uint8\_t ack, uint8\_t mode);

**CODE表**(0xE0-0xFF为通用错误类型,0x01-0xDF为私有错误类型)

**Table CODE** (0xE0-0xFF is general error type, 0x01-0xDF is private error type)

|  |  |  |
| --- | --- | --- |
| **Code** | **Description** | |
| 0x00 | 成功  Success | |
| 0xE0 | 找不到文件  File not found | |
| 0xE1 | 打开文件失败  Open file failed | |
| 0xE2 | 读文件内容失败  Read file failed | |
| 0xE3 | 写文件内容失败  Write file failed | |
| ... |  | |
| 0xFD |  | |
| 0xFE | 找不到指令  Command not found | |
| 0xFF | 通用错误  General error | |
|  | 血压计  Blood pressure monitor |  |
| 0x01 |  |  |
| 0x02 |  |  |
| 0x03 |  |  |
| .. |  |  |
| 0xDF |  |  |

**Notes：Code表适用于所有协议，指令有返回值时需根据长度或内容进行区分，因此添加指令时需要考虑区分问题**

**Notes: The table Code is applicable to all protocols. When the command has a return value, it needs to be distinguished according to the length or content. Therefore, you should consider the distinction when adding a command.**

## Command

**Send: 往设备端发送数据Send data to device.**

**Receive: 从设备端接收数据Received data from device.**

### Universal command(0xE0-0xFF)

#### 0xE1:获取设备信息Get device information

|  |  |  |
| --- | --- | --- |
| **Send** | | **Description** |
| **Length** | 0x00000000 |  |
| **Data** | N/A |  |
| **Receive** | | **Description** |
| **Length** | 0x80000001/ Sizeof(DeviceInfo) | DeviceInfo对象长度  The length of DeviceInfo object |
| **Data** | Code/DeviceInfo | 见Code表/DeviceInfo成员如下  See table **Code** / DeviceInfo members are as follow |

DeviceInfo {

Unsigned char hw\_verson; //硬件版本 Hardware version e.g. ‘A’ : A 版version

Unsigned int fw\_version; //固件版本 Firmware version e.g. 0x010100 : V1.1.0

Unsigned int bl\_version; // 引导版本Bootloader version e.g. 0x010100 : V1.1.0

Unsigned char sn[11]; // SN e.g. “2017022211” : 2017022211

Unsigned short device\_type; // 设备类型Device type e.g. 0x8611: 血压计Blood pressure monitor

Unsigned short protocol\_version; // 协议版本Protocol version e.g.0x0100:V1.0

Unsigned char cur\_time[7]; // 时间Time e.g.0xE1070301090000:2017-03-01 09:00:00

Unsigned short comm\_max\_len; // 通讯最大长度Maximum length of communication

unsigned pro\_max\_len; // 协议最大长度（因主机资源限制需要）Maximum length of protocol (as the limitation of host resource)

char branch\_code[8];

unsigned char reserved[12]; // 预留Reserved

}

#### 0xE4: 获取电池状态Get battery status

|  |  |  |
| --- | --- | --- |
| **Send** | | **Description** |
| **Length** | 0x00000000 |  |
| **Data** | N/A |  |
| **Receive** | | **Description** |
| **Length** | 0x80000001/ Sizeof(BatteryInfo) | BatteryInfo对象长度  The length of BatteryInfo object |
| **Data** | Code/BatteryInfo | 见Code表/BatteryInfo成员如下  See table **Code** / BatteryInfo members are as follows |

BatteryInfo {

Unsigned char state; //电池状态 Battery status e.g. 1: charging充电中 2: full充满

Unsigned char percent; //电池状态 Battery status e.g. 电池电量百分比Battery charge percentage

Unsigned short voltage; // 电池电压Battery voltage(mV) e.g. 3950 : 3.95V

}

### Private command(0x00-0xDF)

#### 血压计Blood pressure monitor

##### 0x00: 获取设置配置参数Get settings configuration parameters

|  |  |  |
| --- | --- | --- |
| **Send** | | **Description** |
| **Length** | 0x00000000 |  |
| **Data** | N/A |  |
| **Receive** | | **Description** |
| **Length** | 0x80000001/ Sizeof(Configuartion) | ConfigPara对象长度  ConfigPara object length |
| **Data** | Code/ConfigPara | 见Code表/ConfigPara成员如下  See table **Code** / ConfigPara members are as follow |

Configuartion {

unsigned short prev\_calib\_zero; // 上一次校零adc值The adc value of zero calibration last time. e.g. 2800<=zero<=12000 128mV~550mV

unsigned short last\_calib\_zero; // 最后一次校零adc值The last time the adc value is zeroed. e.g. 2800<=zero<=12000 128mV~550mV

unsigned short calib\_slope; // 校准斜率值Calibration slope value\*100 e.g. 13630<=slope<=17040 136.3LSB/mmHg-170.4LSB/mmHg

unsigned short slope\_pressure; // 校准斜率时用的压力值Pressure value for calibrating slope.

unsigned short stop\_pressure; // 停止打气压力值Stop pumping pressure value. unit:mmHg

time\_t sleep\_ticks; // 上次进休眠时间Sleep time last time.

time\_t calib\_ticks; // 最后一次校准时间The last time of calibrating time.

time\_t reset\_ticks; // 上次重启进低功耗模式时间Last restart into low energy mode time.

unsigned char sleep\_flag; //是否进入低功耗模式标志 The flag that whether enter low energy mode.

unsigned char reserved[4]; //预留 Reserved.

}

##### 0x04:启动测量 Start measurement

双向通信,当主机往上位机发送时,为通知主机已进入测量

（测量结束后静态压降至15mmHg发送**停止测量**通知）

Use duplex port for communication . When the host sends to the master computer, it is notify that the host has entered into measurement.

(After the measurement, if the static pressure drops to 15mmHg, a notification of stopping measurement will be sent.)

|  |  |  |
| --- | --- | --- |
| **Send** | | **Description** |
| **Length** | Sizeof(SendRate) | 如无参数，默认为原始采样率  With no parameter, the default is original sampling rate with no parameter. |
| **Data** | SendRate |
| **Receive** | | **Description** |
| **Length** | 0x80000001/ Sizeof(RealTimePressure) | RealTimePressure对象长度  RealTimePressure object length |
| **Data** | Code/RealTimePressure | 见Code表/RealTimePressure成员如下  See table **Code** / RealTimePressure members are as follows |

SendRate {

Unsigned char rate; //数据发送频率 Data transmission frequency(Hz)

}

RealTimePressure {

Short pressure\_static; //静态压通道实时压 The real-time pressure of static pressure channel.

Short pressure\_pulse; //脉搏通道实时压 The real-time pressure of pulse channel.

}

##### 0x05:停止测量 Stop measurement

双向通信,当主机往上位机发送时,为通知主机已停止测量

Use duplex port for communication. When the host sends to the master computer, it is notify that the measurement of host has been stopped.

|  |  |  |
| --- | --- | --- |
| **Send** | | **Description** |
| **Length** | 0x00000000 |  |
| **Data** | N/A |  |
| **Receive** | | **Description** |
| N/A | | 无需返回  No return |

##### 0x06: 当前运行状态(提示信息,当算法运行状态切换时发送)Current running status (Prompt message and sent when the algorithm running state is switched)

|  |  |  |
| --- | --- | --- |
| **Send** | | **Description** |
| **Length** | 0x00000001 |  |
| **Data** | RunStatus | 当前运行状态  Current running status |
| **Receive** | | **Description** |
| **Length** | 0x80000001 |  |
| **Data** | Code | 见Code表  See table **Code** |

enum RunStatus {

//以算法测量状态为主 Mainly based on algorithm measurement status.

}

##### 0x07:测量结果(测量结束时主机主动发送) Measurement result (The host takes the initiative to send at the end of the measurement)

|  |  |  |
| --- | --- | --- |
| **Send** | | **Description** |
| **Length** | 0x00000000 |  |
| **Data** | N/A |  |
| **Receive** | | **Description** |
| **Length** | 0x80000001/ Sizeof(BloodPressureResult) | BloodPressureResult对象长度  BloodPressureResult object length |
| **Data** | Code/BloodPressureResult | 见Code表/BloodPressureResult成员如下  See table **Code** / BloodPressureResult members are as follows |

BloodPressureResult {

Unsigned char time[7]; //时间 Time e.g.0xE1070301090000:2017-03-01

Unsigned char state\_code; //状态码 Status code

Unsigned short [systolic](javascript:void(0);)\_[pressure](javascript:void(0);); //收缩压 Systolic blood pressure

Unsigned short [diastolic](javascript:void(0);)\_[pressure](javascript:void(0);); //舒张压 Diastolic blood pressure

Unsigned short mean\_pressure; //平均压 Mean blood pressure

Unsigned short pulse\_rate; //脉率 Pulse rate

}

##### 0x08:工程启动测量(工程模式) Engineering start measurement (engineering mode)

|  |  |
| --- | --- |
| **Send** | **Description** |
| 同0x04:启动测量  Same as **0x04: Start measurement** | |
| **Receive** | **Description** |
| 见0x04:启动测量，返回指令为0x04  See **0x04: Start measurement**，and the return instruction is 0x04 | |

**Notes：和正常启动测量区别在于测量会持续到静态压为15mmHg以下才结束**

**Notes: The difference from normal start-up measurement is that the measurement will continue until the static pressure is below 15mmHg.**

# 通讯Communication

## 蓝牙通讯Bluetooth Communication

Packets ：

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | **Head** | **Pkg.No.** | **ACK** | **Content** | **crc** |
| Size | 1 | 1 | 1 | 0- (comm\_max\_len-4)\* | 1 |
| Description | 固定值  Fixed value  0xA5 | 包号，协议内容大小拆分包序号  Packet number, protocol content size split packet sequence number. | 应答类型（见ACK\_CODE表）  Response type (See table **ACK\_CODE**) | 协议内容/协议返回/空(应答包)  Protocol content / protocol return / empty (response packet) | CRC8(见CRC表)  CRC8(See table **CRC**) |

**Notes：**

1. comm\_max\_len: **以获取设备信息参数为主**Focus on obtaining device information parameters
2. **Content字段只有在ACK为0x00/0x01（数据包时才有效）The Content field is only valid when the ACK is 0x00/0x01 (data packet).**

**ACK\_CODE表**

**Table ACK\_CODE**

|  |  |
| --- | --- |
| **ACK value** | **Description** |
| 0x00 | 正常数据包  Normal packet |
| 0x01 | 带应答请求数据包包  Request packet with response |
| 0x02 | 应答包  Response packet |
| … |  |
| 0xFC | 协议长度超出范围  The protocol length is out of range. |
| 0xFD | 包序错误  Packet sequence error |
| 0xFE | CRC错误  CRC error |
| 0xFF | 通讯超时  Communication timeout |

const unsigned char Table\_CRC8[256]={ /\* Table CRC8 \*/

0x00, 0x07, 0x0E, 0x09, 0x1C, 0x1B, 0x12, 0x15, 0x38, 0x3F, 0x36, 0x31, 0x24, 0x23, 0x2A, 0x2D,

0x70, 0x77, 0x7E, 0x79, 0x6C, 0x6B, 0x62, 0x65, 0x48, 0x4F, 0x46, 0x41, 0x54, 0x53, 0x5A, 0x5D,

0xE0, 0xE7, 0xEE, 0xE9, 0xFC, 0xFB, 0xF2, 0xF5, 0xD8, 0xDF, 0xD6, 0xD1, 0xC4, 0xC3, 0xCA, 0xCD,

0x90, 0x97, 0x9E, 0x99, 0x8C, 0x8B, 0x82, 0x85, 0xA8, 0xAF, 0xA6, 0xA1, 0xB4, 0xB3, 0xBA, 0xBD,

0xC7, 0xC0, 0xC9, 0xCE, 0xDB, 0xDC, 0xD5, 0xD2, 0xFF, 0xF8, 0xF1, 0xF6, 0xE3, 0xE4, 0xED, 0xEA,

0xB7, 0xB0, 0xB9, 0xBE, 0xAB, 0xAC, 0xA5, 0xA2, 0x8F, 0x88, 0x81, 0x86, 0x93, 0x94, 0x9D, 0x9A,

0x27, 0x20, 0x29, 0x2E, 0x3B, 0x3C, 0x35, 0x32, 0x1F, 0x18, 0x11, 0x16, 0x03, 0x04, 0x0D, 0x0A,

0x57, 0x50, 0x59, 0x5E, 0x4B, 0x4C, 0x45, 0x42, 0x6F, 0x68, 0x61, 0x66, 0x73, 0x74, 0x7D, 0x7A,

0x89, 0x8E, 0x87, 0x80, 0x95, 0x92, 0x9B, 0x9C, 0xB1, 0xB6, 0xBF, 0xB8, 0xAD, 0xAA, 0xA3, 0xA4,

0xF9, 0xFE, 0xF7, 0xF0, 0xE5, 0xE2, 0xEB, 0xEC, 0xC1, 0xC6, 0xCF, 0xC8, 0xDD, 0xDA, 0xD3, 0xD4,

0x69, 0x6E, 0x67, 0x60, 0x75, 0x72, 0x7B, 0x7C, 0x51, 0x56, 0x5F, 0x58, 0x4D, 0x4A, 0x43, 0x44,

0x19, 0x1E, 0x17, 0x10, 0x05, 0x02, 0x0B, 0x0C, 0x21, 0x26, 0x2F, 0x28, 0x3D, 0x3A, 0x33, 0x34,

0x4E, 0x49, 0x40, 0x47, 0x52, 0x55, 0x5C, 0x5B, 0x76, 0x71, 0x78, 0x7F, 0x6A, 0x6D, 0x64, 0x63,

0x3E, 0x39, 0x30, 0x37, 0x22, 0x25, 0x2C, 0x2B, 0x06, 0x01, 0x08, 0x0F, 0x1A, 0x1D, 0x14, 0x13,

0xAE, 0xA9, 0xA0, 0xA7, 0xB2, 0xB5, 0xBC, 0xBB, 0x96, 0x91, 0x98, 0x9F, 0x8A, 0x8D, 0x84, 0x83,

0xDE, 0xD9, 0xD0, 0xD7, 0xC2, 0xC5, 0xCC, 0xCB, 0xE6, 0xE1, 0xE8, 0xEF, 0xFA, 0xFD, 0xF4, 0xF3

};

e.g. 以血压计校零为例(假设校零值为7800)：

指令包数据 {0xA5, 0x00, 0x00, 0x01, 0x00, 0x00, 0x00, 0x00,0xEC}

回应包数据 {0xA5, 0x00, 0x00, 0x01, 0x02, 0x00, 0x00, 0x00 0x78, 0x1E, 0xBD}

红色字体部分属于通讯内容

e.g. Take the zero calibration of blood pressure monitor as an example (assuming the zero calibration value is 7800):

Instruction packet data {0xA5, 0x00, 0x00, 0x01, 0x00, 0x00, 0x00, 0x00,0xEC}

Response packet data {0xA5, 0x00, 0x00, 0x01, 0x02, 0x00, 0x00, 0x00 0x78, 0x1E, 0xBD}

The red font part is communication content.

## 串口通讯Serial communication

同**蓝牙通讯**

It is the same as **Bluetooth communication.**