

# anemoi – DATA INTERFACE PROTOCOL SPECIFICATION

**Ref.: anemoi\_ICD**

**ISSUE 3.0**

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## Approval

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## Document Version

|                            |         |
|----------------------------|---------|
| Original Version:          | English |
| Other languages available: | none    |

## Change History

| Issue | Reason for Change   | Date       | Author       |
|-------|---|------------|--------------|
| 1.0   | Initial Issue   | 07.07.2022 | A. Koujalgi  |
| 1.1   | Correction Table 2-6  | 25.10.2022 | M. Weinzierl |
| 1.2   | Correction Table 2-1  | 04.08.2023 | M. Weinzierl |
| 3.0   | Updated protocol for software release 3.0   3.0<br>Changes relative to previous protocol version<br>marked in red | 22.04.2024 | B. Bachmaier |

## Reference Documents

| No. | Document Ref.   | Document Title                     | Issue | Date       | Author        |
|-----|-----------------|------------------------------------|-------|------------|---------------|
| 1   | IOM_anemoi_v3.0 | Installation /<br>Operation Manual | 3.0   | 15.04.2024 | Dr. Weinzierl |
|     |                 |                                    |       |            |               |
|     |                 |                                    |       |            |               |

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## 1 INTRODUCTION

This data interface protocol specification document describes the data protocol based on RS232 which is the interface between the anemoi Sensor Unit and anemoi Display Unit.

The purpose of the anemoi RS232 communication is to transmit various sentences on the two RJ12 ports on the anemoi Sensor Unit that contains the information described in Chapter 2.

### 1.1 SCOPE

This document defines the signal format, protocols, and associated sentence structure between the host system – anemoi Sensor Unit and the peripheral system – anemoi Display Unit.

### 1.2 CHARACTERISTICS

**Table 1-1: Data protocol characteristics**

| Parameter | Description          |
|-----------|----------------------|
| Type      | Serial Communication |
| Protocol  | RS232                |
| Baud Rate | 19200                |
| Data      | 8-bit                |
| Stop-bit  | 1                    |
| Parity    | None                 |

**Table 1-2: Sentence structure**

| Parameter       | Character                |
|-----------------|--------------------------|
| Start Byte      | 0x24 (ASCII \$)          |
| Identifier Byte | (Unique ASCII character) |
| Content Byte    | (Sentence content)       |
| End Byte        | 0x0A (ASCII \n)          |
| Checksum Byte   | (8-bit CCITT CRC)        |

**Table 1-3: Pin assignment Sensor Unit**

| Pin  | Function   |
|------|--|
| 1, 2 | 5 VDC out (max. 200 mA)                            |
| 3    | Push-button input for menu control (normally open) |
| 4    | Serial data out (RS232)                            |
| 5, 6 | GND  |

**Figure 1-1: Pinout**



## 2 AVAILABLE SENTENCES

**Table 2-1: Sentences Overview**

| Sentences Type         | Identifier (ASCII) | Content Bytes | Description   |
|------------------------|--------------------|---------------|---|
| Sensor health sentence | S                  | 3             | Contains sensor health bitfield. Only available on boot for about 5s, or if not all sensors are deemed healthy.   |
| Wind sentence          | w/W                | 9             | Contains live and average wind speed and direction, aircraft heading, and wind estimation quality indicator. Available during normal operations at ~15Hz. |
| AHRS sentence          | a/A                | 10            | Contains roll, pitch, heading, circle diameter and time information. Available during normal operations at ~15Hz.   |
| Data sentence          | d/D                | 12            | Contains ground speed, true airspeed, track, heading, temperature, pitot calibration value, and FL. Available during normal operations at ~15Hz.          |
| Menu sentence          | M                  | 4             | Contains menu control commands. Only available if menu is active.   |

## 2.1 SENSOR HEALTH SENTENCE

| Start byte | Identifier | Content Bytes                               | Stop byte | Checksum |
|------------|------------|---|-----------|----------|
| 0x24       | 0x53       | Orientation, SensorHealthData[7...0], vMain | 0x0A      | CRC      |

### 2.1.1 ORIENTATION

The contents of the orientation bytes contain the display orientation information.  
The value and the corresponding orientations are described in the table below.

**Table 2-2: Display Orientation**

| Value | Orientation |
|-------|-------------|
| 0     | Conn bottom |
| 1     | Conn right  |
| 2     | Conn top    |
| 3     | Conn left   |

### 2.1.2 SENSOR HEALTH DATA

The sensor health data contains the health of sensors and non-sensors as described below:

**Table 2-3: Sensor Health Data**

| Bitfield | Function        |
|----------|-----------------|
| [7]      | Indication mode |
| [6]      | IMU health      |
| [5]      | Baro health     |
| [4]      | Temp health     |
| [3]      | GPS health      |
| [2]      | Airdata health  |
| [1]      | AHRS health     |



---

|     |               |
|-----|---------------|
| [0] | Kalman health |
|-----|---------------|

- SensorHealthData[7] contains the **Indication Mode**:
  - 0: Sensor health state upon entering the sensor health mode (active for 0.5 seconds)
  - 1: Sensor health state during the sensor health checks (active thereafter)
- SensorHealthData[6...0] contains the various sensors **Health flag**:
  - 0: healthy
  - 1: faulty
- SensorHealthData[2...0] contains the **Health Definition On Non-Sensors**:
  - Airdata health: pitot calibration factor out of bounds
  - AHRS health: gyro bias out of bounds
  - Kalman health: Math error

### 2.1.3 VMAIN

This contains the firmware version of the anemoi Sensor Unit.

- 4 MSB: Major
- 4 LSB: Minor

## 2.2 WIND SENTENCE

| Start byte | Identifier | Content Bytes                     | Stop byte | Checksum |
|------------|------------|-----------------------------------|-----------|----------|
| 0x24       | ID         | B0 B1 B2 B3 B4 B5 B6 B7 <b>B8</b> | 0x0A      | CRC      |

**Table 2-4: Wind sentence**

| Bytes     | Function  |
|-----------|---|
| ID        | 0x77: Page not active; 0x57: Page active  |
| B0        | Wind direction (live), MSB  |
| B1        | Wind direction (live), LSB  |
| B2        | Wind magnitude (live)   |
| B3        | Wind direction (avg), MSB   |
| B4        | Wind direction (avg), LSB   |
| B5        | Wind magnitude (avg)  |
| B6        | Heading, MSB  |
| B7        | Heading, LSB  |
| <b>B8</b> | <b>Live wind uncertainty indicator (0 = Very high certainty ... 255 = Very low certainty)</b> |

## 2.3 AHRS SENTENCE

| Start byte | Identifier | Content Bytes                        | Stop byte | Checksum |
|------------|------------|--------------------------------------|-----------|----------|
| 0x24       | ID         | B0 B1 B2 B3 B4 B5 B6 <b>B7 B8 B9</b> | 0x0A      | CRC      |

**Table 2-5: AHRS sentence**

| Bytes     | Function  |
|-----------|---|
| ID        | 0x61: Page not active; 0x41: Page active        |
| B0        | Roll angle [deg], MSB, 2's complement (int16_t) |
| B1        | Roll angle [deg], LSB, 2's complement (int16_t) |
| B2        | Pitch angle [deg], 2's complement (int8_t)      |
| B3        | Heading, MSB                                    |
| B4        | Heading, LSB                                    |
| B5        | Circle diameter, MSB                            |
| B6        | Circle diameter, LSB                            |
| <b>B7</b> | <b>UTC time, hours</b>                          |
| <b>B8</b> | <b>UTC time, minutes</b>                        |
| <b>B9</b> | <b>UTC time, seconds</b>                        |

## 2.4 AHRS SENTENCE (IF LOCKED)

| Start byte | Identifier | Content Bytes                        | Stop byte | Checksum |
|------------|------------|--------------------------------------|-----------|----------|
| 0x24       | ID         | B0 B1 B2 B3 B4 B5 B6 <b>B7 B8 B9</b> | 0x0A      | CRC      |

**Table 2-6: AHRS sentence**

| Bytes     | Function                                 |
|-----------|--|
| ID        | 0x61: Page not active; 0x41: Page active |
| B0        | 0xFA                                     |
| B1        | Day of unlock                            |
| B2        | Month of unlock                          |
| B3        | 0xFA                                     |
| B4        | 0xFA                                     |
| B5        | Year of unlock, MSB                      |
| B6        | Year of unlock, LSB                      |
| <b>B7</b> | <b>UTC time, hours</b>                   |
| <b>B8</b> | <b>UTC time, minutes</b>                 |
| <b>B9</b> | <b>UTC time, seconds</b>                 |

## 2.5 DATA SENTENCE

| Start byte | Identifier | Content Bytes                         | Stop byte | Checksum |
|------------|------------|---------------------------------------|-----------|----------|
| 0x24       | ID         | B0 B1 B2 B3 B4 B5 B6 B7 B8 B9 B10 B11 | 0x0A      | CRC      |

**Table 2-7: Data sentence**

| Bytes | Function                                 |
|-------|--|
| ID    | 0x64: Page not active; 0x44: Page active |
| B0    | vGND (km/h), MSB                         |
| B1    | vGND (km/h), LSB                         |
| B2    | vTAS (km/h), MSB                         |
| B3    | vTAS (km/h), LSB                         |
| B4    | track (deg), MSB                         |
| B5    | track (deg), LSB                         |
| B6    | heading (deg), MSB                       |
| B7    | heading (deg), LSB                       |
| B8    | Temperature (C), 2's complement (int8_t) |
| B9    | Pitot calibration (%)                    |
| B10   | FL, MSB                                  |
| B11   | FL, LSB                                  |

## 2.6 MENU SENTENCE

| Start byte | Identifier | Content Bytes | Stop byte | Checksum |
|------------|------------|---------------|-----------|----------|
| 0x24       | 0x4D       | B0 B1 B2 B3   | 0x0A      | CRC      |

**Table 2-8: Menu sentence**

| Bytes | Function |
|-------|----------|
| B0    | Page     |
| B1    | Marker   |
| B2    | Clock    |
| B3    | Number   |

**Table 2-9: Page definition**

| Value | Function                    |
|-------|-----------------------------|
| 0     | Main menu                   |
| 1     | Rotate screen menu          |
| 2     | Calibrate pressure menu     |
| 3     | Calibrating screen          |
| 4     | Set DOF Orientation screen  |
| 5     | Disable AHRS menu           |
| 6     | Confirm disable AHRS screen |
| 7     | Error AHRS screen           |

**Table 2-10: Marker definition**

| Value | Function     |
|-------|--------------|
| 0     | Calibrate    |
| 1     | Rotate       |
| 2     | Disable AHRS |
| 3     | Exit         |

**Table 2-11: Clock definition**

| Value | Function            |
|-------|---------------------|
| 0     | No clock            |
| 1     | Empty clock         |
| 2     | Quarter clock       |
| 3     | Half clock          |
| 4     | $\frac{3}{4}$ Clock |
| 5     | Full clock          |

**Number definition**

The number byte, B3 contains selected number of days for which AHRS should be locked / Front orientation of IMU.

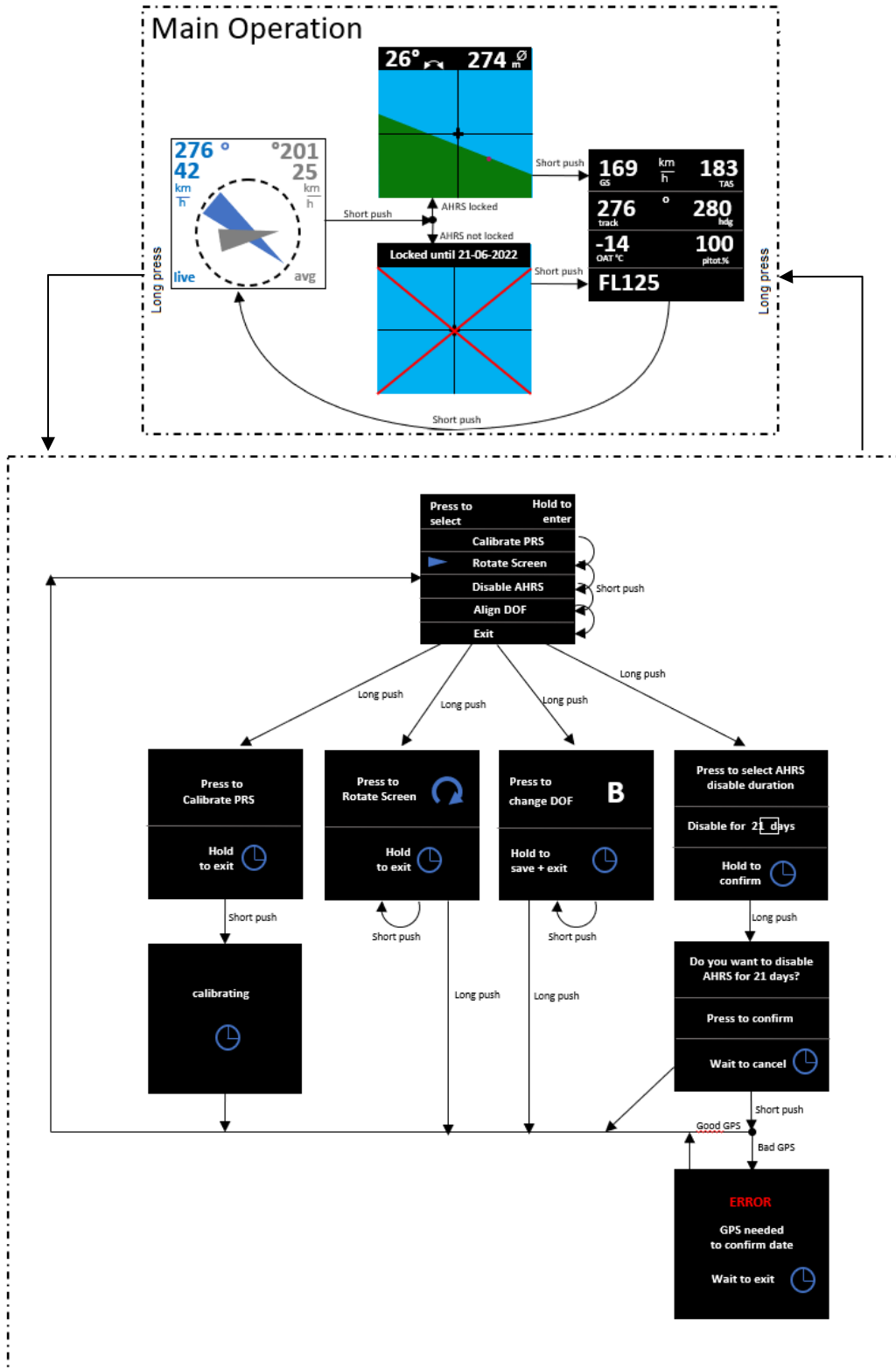
### 3 CHECKSUM CALCULATION

The checksum calculation is a standard CRC-8-CCITT.

```
/*  
 * crc8.c  
 *  
 *  
 */  
  
static const uint8_t CRC_TABLE[256] = {  
    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  
};  
  
uint8_t crc8ccitt(const void * data, size_t size) {  
    uint8_t val = 0;  
    uint8_t * pos = (uint8_t *) data;  
    uint8_t * end = pos + size;  
  
    while (pos < end) {  
        val = CRC_TABLE[val ^ *pos];  
        pos++;  
    }  
  
    return val;  
}
```



## 4 MENU OPERATION OVERVIEW



End of Document