

Premier Sensor Communications protocol

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1 COMMUNICATIONS PROTOCOL

The communications protocol used by the Premier sensor is used for communications between devices connected via an RS232 connection. This point-to-point, P2P, protocol is a frame-based protocol.

Note: the protocol allows two-way communications, read – write, between the sensor and external device, However this document only describes the read aspect of the protocol.

1.1 Control Byte Constants

The following control byte constants are used in the P2P protocol¹.

| | | | | |
|-----------------------|-----|---|------|------------|
| Read, | RD | = | 0x13 | (00010011) |
| Data Link Escape, | DLE | = | 0x10 | (00010000) |
| Write, | WR | = | 0x15 | (00010101) |
| Acknowledge, | ACK | = | 0x16 | (00010110) |
| Negative Acknowledge, | NAK | = | 0x19 | (00011001) |
| Single Data Frame, | DAT | = | 0x1A | (00011010) |
| End of Frame, | EOF | = | 0x1F | (00011111) |

1.2 Frame Structure

The start of a frame is indicated by a DLE byte followed by the type of frame to follow (RD, WR, ACK, NAK, DAT). The end of frame is indicated by a DLE byte followed by an EOF byte.

Note: Each of the constants has bit 4 set and so is slip-resistant (i.e. if shifted this bit will be out of position). The values have a Hamming Distance of 2 (each code is at least 2 bits different from every other code).

Any DLE bytes that occur between a frame's start and end are prefixed with another DLE (byte-stuffing).

Following the EOF is a 16-bit checksum of the entire frame, each byte is added to produce the checksum.

1.3 Variables

Each piece of accessible data on a device is referred to as a *Variable*. Each variable is referenced by a *Variable ID*. A *variable ID* may be any number of bytes long.

The available Variables and their corresponding Variable IDs depend on the type of device, but here are a few examples for Premier sensor:

| Purpose | Variable id | Comments |
|------------------|-------------|-----------|
| Live Data | 1 | read only |
| Live Data Simple | 6 | read only |

The structure of the data returned in each variable usually depends both on the type of device and the version of firmware running on the device. Refer to section 2 for more information.

Note: Live data simple only transmits the first 8 bytes of the structure.

The StatusFlags field give the user additional information about the sensor as follows:

| Name | Bit |
|----------------------|--------|
| FLAG_SIGNAL_TIMEOUT | 0x0001 |
| FLAG_SIGNAL_NOISE | 0x0004 |
| FLAG_DET_LOW | 0x0040 |
| FLAG_REF_LOW | 0x0080 |
| FLAG_VMON_ERROR | 0x0800 |
| FLAG_CONFIG_CSUM | 0x1000 |
| FLAG_PRIVATE_CSUM | 0x2000 |
| FLAG_USER_EEP_CSUM | 0x4000 |
| FLAG_PROG_CSUM_ERROR | 0x8000 |

The flags are added together to form one integer result, 2 bytes. If the sensor signals are too low then the returned flag word would be 0x00C0.

2 VARIABLE STRUCTURES

The data transferred is byte orientated with the following sizes:

| | |
|---------|---------|
| Byte | 8 bits |
| Integer | 2 bytes |
| Double | 4 bytes |
| Long | 4 bytes |

2.1 Live data structure

The live data takes two distinct forms:

```

Struct 1{ unsigned int Version;
            unsigned int StatusFlags;
            double Reading;
            double Temperature;
            unsigned int Det;
            unsigned int Ref;
            double Fa;
        } LiveData;
    
```

```

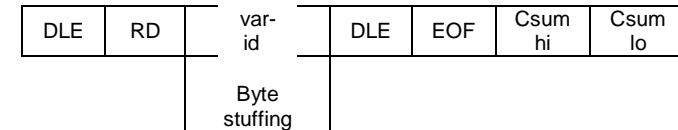
struct 2{ unsigned int Version;
            unsigned int StatusFlags;
            double Reading;
            double Temperature;
            unsigned int Det;
            unsigned int Ref;
            double Fa;
            long Uptime;
        } LiveData;
    
```

Note that structure 2 has an extra variable and is 32 bytes in length, 4 more than structure 1.

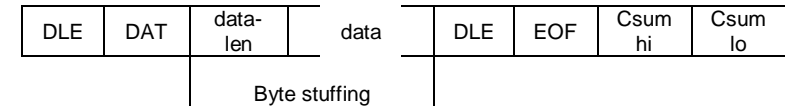
The Version number remains the same even when extra variables are added to the structure. Thus if software is written to accept structure 1 but receives more data, i.e structure 2, then it simply ignores the extra bytes.

1.4 Reading a Variable

Send a read frame with the Variable ID to be read:



Device response on success, where requested variable data < 255 bytes:



Device response on failure:



Where 'reason' is a single byte failure code, the meaning of which depends on the device type, i.e.

- 1 p2pNAKvarNotReadable,
- 2 p2pNAKvarNotWritable,
- 3 p2pNAKoutOfRange,
- 4 p2pNAKincorrectLength,
- 5 p2pNAKunexpectedBytes,
- 6 p2pNAKchecksumFailed,
- 7 p2pNAKincorrectVersion,
- 8 p2pNAKbusy,

1.4.1 Read example - read live data

Send the following bytes:

DLE, RD, Variable ID, DLE, EOF, Checksum High byte, Checksum low byte i.e.

0x10, 0x13, 0x01, 0x10, 0x1F, 0x00, 0x53

Device response on success:

DLE, DAT, Data length, Data, DLE, EOF, Checksum High byte, Checksum low byte, i.e.

| | |
|------------------------|--|
| 0x10 | DLE |
| 0x1A | DAT |
| 0x14 | Data length |
| 0x01, 0x00 | Version |
| 0x00, 0x00 | Status flags |
| 0x00, 0x00, 0x28, 0x41 | Gas reading, 32 bit floating point - IEEE-754 format |
| 0x00, 0x00, 0x1E, 0x42 | Temperature, 32 bit floating point - IEEE-754 format |
| 0x2C, 0x04 | Detector signal |
| 0x86, 0x02 | Reference signal |
| 0x80, 0x1A, 0x09, 0xBC | Absorbance, 32 bit floating point - IEEE-754 format |
| 0x10 | DLE |
| 0x1F | EOF |
| 0x03 | Checksum high byte |
| 0xA5 | Checksum low byte |

Note 1: 0x41280000 = 10.50

Note 2: the data length may increase depending upon the sensor firmware.

The data can be read and any extra bytes can be ignored if not needed.

1.4.2 Read example - read live data simple

Send the following bytes:

DLE, RD, Variable ID, DLE, EOF, Checksum High byte, Checksum low byte i.e.

0x10, 0x13, 0x06, 0x10, 0x1F, 0x00, 0x58

Device response on success:

DLE, DAT, Data length, Data, DLE, EOF, Checksum High byte, Checksum low byte, i.e.

| | |
|------------------------|--|
| 0x10 | DLE |
| 0x1A | DAT |
| 0x08 | Data length |
| 0x01, 0x00 | Version |
| 0x00, 0x00 | Status flags |
| 0x00, 0x00, 0x28, 0x41 | Gas reading, 32 bit floating point - IEEE-754 format |
| 0x10 | DLE |
| 0x1F | EOF |
| 0x00 | Checksum high byte |
| 0xCB | Checksum low byte |

Note 1: 0x41280000 = 10.50

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