Protium 2500

UART Communication Specification

UART Specification

Parameter	Value
Baud Rate	57600 bps
Data Bits	8
Parity Bit	None
Stop Bits	1
Flow Control	None

For this document, sample message output from the Protium-2500 will be written in blue:

```
Sample output
```

Sample commands to the protium-2500 will be written in green:

```
Sample input
```

Hexadecimal values will be written in red, with a “0x” prefix (unless otherwise specified):

```
0x1F
```

Message Output from the Protium-2500

- All UART output **from** the Protium-2500 is displayed in human-readable format (i.e. as a string of ASCII characters).
- In order to decode the information by an external program, the string has to be parsed to extract the values.
- In order to aid the parsing of messages, special characters are used to separate values and messages.

Message Input to the Protium-2500

- All UART input **to** the Protium-2500 is also sent as a string of ASCII characters.
- A full list of all commands can be found in Annex A.
- The Protium-2500 will expect certain commands at certain phases of operation. If an incorrect command is received, it will display the following error message:

```
Command not found.
```

Phases of Operation

- There are 3 phases of operation, during each of which the Protium-2500 will expect different commands:
  - Startup
  - Running
  - End

Startup

Upon powering up, the Protium-2500 will display the following message:

```
Spectronik Protium 2500

 Type help<enter> for list of commands

 Total Mileage:   1.57 kWh
 Total Runtime: 0001:40 hrs


 Ready to start.
```

In order to enter the running phase, the Protium-2500 expects the following command:

```
start
```

Startup

The Protium-2500 will then go through a series of checks before entering the running phase. Do not send any commands during this period. A portion of the messages during this part of the startup phase is shown below:

```
P2500 2203-05 initialising
 Firmware version : V2.5_03032022_0642_2203-05-A

 No. of cells : 80

Entering to Starting phase...
 Anode Supply Pressure OK
 Temperature Check OK
```

Running

As soon as the Protium-2500 enters its running phase, it will output messages in the following format, at a frequency of 1Hz:

```
|FC_V : 71.17 V |   FCT1:  30.90 C   |   H2P1  :  0.61 B |   DCDCV: XX.X V   |
FC_A  : 10.21 A |   FCT2:  28.46 C   |   H2P2  :  0.59 B |   DCDCA: XX.X A   |
FC_W  : 726.6 W |   FAN :    89 %    |   Tank-P: 117.0 B |   DCDCW: XXXX.X W |
Energy:   298 Wh|   BLW :    21 %    |   Tank-T: 25.08 C |   BattV:  23.49 V |
                |                    |                   |                   !

 Fan PWM auto

 Blower auto
```

Running

The pipe character | (0x7C) is used to denote the start of these running phase messages, and to separate values. The exclamation point ! (0x21) is used to denote the end of the message.

```
|FC_V : 71.17 V |   FCT1:  30.90 C   |   H2P1  :  0.61 B |   DCDCV: XX.X V   |
FC_A  : 10.21 A |   FCT2:  28.46 C   |   H2P2  :  0.59 B |   DCDCA: XX.X A   |
FC_W  : 726.6 W |   FAN :    89 %    |   Tank-P: 117.0 B |   DCDCW: XXXX.X W |
Energy:   298 Wh|   BLW :    21 %    |   Tank-T: 25.08 C |   BattV:  23.49 V |
                |                    |                   |                   !

 Fan PWM auto

 Blower auto
```

Running

A string parser is required to extract information from the running phase messages. A sample parsing algorithm would be as follows:

1. Extract the entire message as a string from the first pipe (|) to the exclamation point (!).
2. Separate the string into sub-strings by using the pipes (|) as separators. So for example, you would have sub-strings such as “FC_V : 71.17 V” and “Tank-P: 117.0 B”.
3. From the sub-strings of interest, extract the value of the reading by using the colon (:) to separate the reading name from the value.

End Phase

To exit the running phase, the following command must be given:

```
end
```

This prompts the Protium-2500 to shut down and enter the ending phase, with the following messages:

```
Shutdown initiated

 This Mileage:    14.0 Wh
 This Runtime: 0000:07 hrs


 Total Mileage:   1.57 kWh
 Total Runtime: 0001:40 hrs

System Off
```

End Phase

If an error occurs (e.g. low hydrogen supply), the system will automatically enter the ending phase with the following messages:

```
Abnormal shutdown initiated

 This Mileage:    14.0 Wh
 This Runtime: 0000:07 hrs


 Total Mileage:   1.57 kWh
 Total Runtime: 0001:40 hrs

System Off
```

Annex A: List of Commands

Command	Function	Phase when message is valid	Bytes to be transmitted (hexadecimal)
`start`	To enter the running phase	Starting	`73 74 61 72 74`
`end`	To exit the running phase	Running	`65 6E 64`
`f`	Set the fans to auto	Running	`66`
`b`	Set the blowers to auto	Running	`62`
`p`	Single manual purge	Running	`70`
`ver`	Display the firmware version	Starting	`76 65 72`
`9`	Decrease fan speed by 1%	Running	`39`
`0`	Increase fan speed by 1%	Running	`30`
`-`	Decrease fan speed by 5%	Running	`2D`
`=`	Increase fan speed by 5%	Running	`3D`
`[`	Decrease blower intensity by 3%	Running	`5B`
`]`	Increase blower intensity by 3%	Running	`5D`