NEON Sensor Configuration, Command and Control – 2D Wind Sonic Anemometer

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1 DESCRIPTION

1.1 Purpose

This document specifies the configuration and command and control details for the 2D wind sonic anemometer sensors. It includes a detailed discussion of all necessary requirements for operational control parameters, conditions/constraints, set points, and any necessary error handling.

1.2 Scope

Gill's WindObserver II 2D Sonic Anemometer (RD [03]), and Extreme Weather WindObserver 2D Sonic Anemometer Heated (RD [04]) will be used throughout NEON's Observatory to monitor wind conditions. For the remainder of this document, the WindObserver II and Extreme Weather WindObserver will be referenced as 'WOII' and 'EWWO', respectively. Two versions of the WOII will be used: version 1 (no heater, NEON P/N: 0303440000) and version 3 (heater, NEON P/N: 0303440001). Version 1 will be used in locations where icing is not plausible, while version 3 will be used in areas where icing is likely. If severe icing is eminent (e.g. Tundra, mountainous terrain), the EWWO (NEON P/N: 0303440005) will be used. The firmware that shall be used with these sensors is version 6.01. As these different models produce different data streams, care is taken to discuss the respective data flows in the associated Algorithm Theoretical Basis Document (TBW). This document specifies the configuration and command and control that are needed for operating each of these anemometers. It does not provide implementation details, except for cases where these stem directly from the sensor conditions as described here.

2 RELATED DOCUMENTS AND ACRONYMS

2.1 Applicable Documents

AD [01]	NEON.DOC.000001	NEON Observatory Design (NOD) Requirements
AD [02]	NEON.DOC.000291	NEON Configured Sensor List
AD [03]	NEON.DOC.005003	NEON Scientific Data Products Catalog
AD [04]	NEON.DOC.005005	NEON Level 0 Data Products Catalog

2.2 Reference Documents

RD [01]	NEON.DOC.000008 NEON Acronym List
RD [02]	NEON.DOC.000243 NEON Glossary of Terms
RD [03]	Gill Instruments Ltd. 2007. User Manual: WindObserver II Ultrasonic Anemometer. Document # 1390-PS-004. Issue 17.
RD [04]	Gill Instruments Ltd. 2011. User Manual: Extreme Weather WindObserver with Enhanced Heating Ultrasonic Anemometer. Document # 1390-PS-0018. Issue 6.
RD [05]	Sims, Murree. "RE: Questions regarding Gill's 2D Ultrasonic anemometers." Email to Joshua Roberti. 14 March 2012. (P:\FIU\TIS Assemblies\4. Tower Mid Level Wind-2D sonic\Questions regarding Gill's 2D Ultrasonic anemometers.pdf)

2.3 Acronyms

Acronym	Explanation
ATBD	Algorithm Theoretical Basis Document
C^3	Command, Control, and Configuration Document
SOP	Standard Operating Procedures
QA/QC	Quality Assurance/Quality Control
TIS	Terrestrial Instrument System
L0	Level 0
L1	Level 1
ENG	NEON Engineering group
CI	NEON Cyberinfrastructure group
DPS	NEON Data Products group
CVAL	NEON Calibration, Validation, and Audit Laboratory
WOII	Gill's WindObserver II
EWWO	Gill's Extreme Weather WindObserver
P/N	Part Number

2.4 Verb Convention

"Shall" is used whenever a statement expresses a convention that is binding. The verbs "should" and "may" express non-mandatory provisions. "Will" is used to express a declaration of purpose on the part of the design activity.

3 INTRODUCTION

This document describes the configuration and command and control related with each of the 2D wind sonic anemometer sensors and their corresponding data products (FIU.0.0001). The communication standard for digital output with the 2D wind sonic anemometer shall be RS422. For more information regarding maintenance or topics concerning computer algorithms, please refer to the SOP (AD [#]) and ATBD (AD [#]) documents, respectively.

4 OVERVIEW OF SENSOR CONFIGURATION

Three ultrasonic anemometer models will be used throughout NEON. Although there is some discrepancy, the default configurations of both models are mostly consistent with respect to one another. In the attempt to obtain the highest quality of data and ensure uniformity across the Observatory, some of the default settings of each anemometer model shall be changed (Table 1).

Table 1. Sensor configuration settings. Certain configurations are only applicable for the WOII model; these configurations are denoted by *. If a sensor is equipped with a heater (WOII version 3 or EWWO), the heater shall be activated (H2) prior to deployment within the field. This adapted setting is denoted by **. If the sensor is not equipped with a heater, the default setting shall not be changed.

Parameter	Default Setting	Code	Adapted Setting	Code
Baud rate	9600 (pulses s^{-1})	B3		
Duplex mode	Full Duplex	E1		
Data & parity options	8 bit, no parity, 1 stop bit	F1		
Averaging	Off	G0000		
Heater	Off	H1	Activated**	H2**
NMEA settings	"IIMWV"	K1		
ASCII message terminator	"CR LF"	L1		
Data output	ASCII Polar continuous	M2	ASCII UV continuous	M1
Node address	<A>	NA		
Output format	CSV	O1		
Output (acquisition) rate	1 Hz	P1		
Speed output	m s^{-1}	U1		
Vertical output padding	Off	V1		
45° Offset *(WOII)*	Off	X1	Mount Upside Down	X3
45° Offset *(EWWO)*	On	X2	Mount Upside Down	X3
Speed of sound / Sonic Temp.*	Off	A0	On	A3
Wind wraparound*	On	C1	Off	C2
Data acquisition streams	Start of string Unit Identification U-component V-component Units Speed of sound * Sonic temperature * Status End of string Check sum	N/A		

5 COMMAND AND CONTROL

5.1 Error handling

If the sensor is operating under the influence of error, the data output's status will reference a variable other than 00, 60, or 66. If this is the case, the condition shall be deemed "failed" (Table A1). Since Gill Instruments does not offer any command / control functions to handle errors, the sensor may need to be manually repaired.

If there is ice buildup on any of the transducers (Condition = Ice flag), the sensors will not report any data, and the transducers will be heated accordingly to melt the ice. Because there may be instances where ice buildup is sufficient, a time threshold of three hours shall be allotted to melt the ice (Table 1). Unfortunately, due to the manufacturing of the sensor/heater, there is insufficient information to calculate the heating time necessary to melt a specified volume of ice, so three hours has been chosen as an arbitrary compromise. The sensor will resume transmitting data once all the ice has melted (RD [05]). If an 'Ice flag' error persists for longer than three hours, or other errors occur (FIU.0001.007 – FIU.0.0001.013), it is recommended that these issues be forwarded to Problem Resolution and Tracking and the sensor be manually repaired.

Table 2. Truth table for sensor error handling. Any products accompanied by * are only applicable for the WOII.

Control parameter(s)	Condition	Data acquisition system action	Output to CI
Sensor error status	Not failed	Do nothing	Sensor error flags (FIU.0.0001.001 - FIU.0.0001.003; FIU.0.0001.014* – FIU.0.0001.015*)
Sensor error status	Ice flag	Wait 3 hours. If error persists, forward to Problem Resolution and Tracking	Sensor error flags (FIU.0.0001.004 – FIU.0.0001.006)
Sensor error status	Failed	Forward to Problem Resolution and Tracking	Sensor error flags (FIU.0.0001.007 – FIU.0.0001.013)

For all purposes, if the anemometer is equipped with a heater, the setting of the heater shall be changed from its default of 'off' (H1) to the adapted setting of 'activated'. The heater of the WOII will automatically be turned on when the *temperature of the transducer* is <15°C, and will turn off when the *temperature of the transducer* is ≥25°C. The heater of the EWWO will automatically be turned on when the *ambient air temperature* is ≤5°C and will turn off when the *ambient air temperature* is ≥10°C (RD [05]).

Since the heaters for each model operate automatically, there is no need for any heating command / control statement at this time. Although it may be beneficial to generate a command /control function that is based on site-specific

climate characteristics, it is not possible to override the preset heater settings (RD [05]). In addition to this, the status of the heater presents another problem.

When the heater is activated (H2), there is no way to determine when the heater is actually on/off. It is required that the status of the heater must be known at all times. In order to accomplish this, the proposed plan is to monitor the current draw from the heater. Once a temperature threshold is reached at a specific sensor head, the appropriate 2.0 – 3.0A for the WOII and 6.0 – 7.0A for the EWWO. The current draw will lessen as the transducer heads reach their target temperature (RD [05]). Once the heater turns off, the current draw will drop to ±0.01A (based on temperature chamber tests by Aaron Joos (ENG)). Monitoring the current draw will be the only viable way of acknowledging the heater's status unless ENG and FIU decide to use WOII (version 1) models, and apply an external heater.

6 APPENDIX

6.1 Sensor error codes as of October 2011

Table A1. Error codes and interpretation of sensor error messages as of October 2011 (RD [03], RD [04]).

Code	Status	Condition
00	**OK Heating set off**	**Valid data, sufficient samples in average period**
60 (H2) 66 (H3)	OK and heating enabled	Valid data, sufficient samples in average period
A	OK	NMEA data Acceptable
01	Axis 1 failed	Insufficient samples in average period on U axis
02	Axis 2 failed	Insufficient samples in average period on V axis
04	Axis 1 and 2 failed	Insufficient samples in average period on both axes
08	NVM error	NVM checksum failed, data could be uncalibrated.
09	ROM error	ROM checksum failed, data could be uncalibrated.
10	System gain at max.	Inaccurate data likely
50	Marginal system gain	Data valid, but marginal operation
51	Measurement average building.	Data valid but warns that average period not reached when averaging used.
62 (H2) 67 (H3)	No power to heating module	Valid data still output
63 (H2) 68 (H3)	Hardware fault – e.g Heater pcb faulty	Valid data still output.
65 (H2) 69 (H3)	Warning – Heater Supply volts too high or pcb too hot.	Valid data still output.
V	NMEA data Void	Invalid data output