

Title: NEON Sensor Command, Control and Configuration (C3) Document: Multisonde, Stream		Date: 05/12/2016
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NEON SENSOR COMMAND, CONTROL AND CONFIGURATION (C3) DOCUMENT: MULTISONDE, STREAM

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Change Record

REVISION	DATE	ECO #	DESCRIPTION OF CHANGE
A	02/19/2014	ECO-01541	Initial release
B	05/12/2016	ECO-03752	Expand the number of data streams collected from the Multisonde

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1 DESCRIPTION

1.1 Purpose

This document specifies the command, control, and configuration details for operating a NEON sensor used for instrumental observations. It includes a detailed discussion of all necessary requirements for operational control parameters, conditions/constraints, set points, and any necessary error handling. All Level 0 Data Products generated by the sensor should be identified.

1.2 Scope

This document specifies the command, control, and configuration that are needed for operating this sensor. It does not provide implementation details, except for cases where these stem directly from the sensor conditions as described here.

A complete set of the Level 0 data products generated in this document can be found in appendix.

The multisonde assemblies exist in three instances and will consist of following Data Generating Device (DGD) based on Data Generating Device DGD List and Hierarchies doc (AD [05]):

DGD Agile PN	DGD Agile Description
HB07530000	Assembly, Multisonde with Sensors, FDOM
HB07530010	Assembly, Multisonde with Sensors, no FDOM

Further detailed sensor info under each DGD is as following:

1. Under HB07530000 (firmware on all sensors listed herein shall be updated with ongoing releases)
 - a. NEON PN 0320170020, Sensor – YSI EXO2 Multisonde
 - b. NEON PN 0320170001, Sensor – Conductivity/Temperature – YSI EXO sonde
 - c. NEON PN 0320170003, Sensor – Dissolved Oxygen (Optical) – use with YSI EXO sonde
 - d. NEON PN 0320170004, Sensor – Turbidity, use with YSI EXO sonde
 - e. NEON PN 0320170005, Sensor – Total Algae, use with YSI EXO sonde
 - f. NEON PN 0320170006, Sensor – fDOM, use with YSI EXO sonde
 - g. NEON PN 0320170007, Sensor – Central wiper for YSI EXO sonde only
 - h. NEON PN 0320170015, Sensor – pH/ORP, ungarded, use with YSI EXO2 sonde
2. Under HB07530010
 - a. NEON PN 0320170020, Sensor – YSI EXO2 Multisonde
 - b. NEON PN 0320170001, Sensor – Conductivity/Temperature – YSI EXO sonde
 - c. NEON PN 0320170003, Sensor – Dissolved Oxygen (Optical) – use with YSI EXO sonde
 - d. NEON PN 0320170004, Sensor – Turbidity, use with YSI EXO sonde

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- e. NEON PN 0320170005, Sensor – Total Aglae, use with YSI EXO sonde
- f. NEON PN 0320170007, Sensor – Central wiper for YSI EXO sonde only
- g. NEON PN 0320170015, Sensor – pH/ORP, ungarded, use with YSI EXO2 sonde

Other important parts that are not a DGD:

- h. NEON PN 0320170008, Sensor Accessory – Anti fouling guard for YSI EXO2 sonde.

2 RELATED DOCUMENTS AND ACRONYMS

2.1 Applicable Documents

Applicable documents contain information that shall be applied in the current document. Examples are higher level requirements documents, standards, rules and regulations.

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
AD [05]	NEON.DOC.001104	Data Generating Device DGD List and Hierarchies
AD [06]	NEON.DOC.00	

2.2 Reference Documents

Reference documents contain information complementing, explaining, detailing, or otherwise supporting the information included in the current document.

RD [01]	NEON.DOC.000008	NEON Acronym List
RD [02]	NEON.DOC.000243	NEON Glossary of Terms

2.3 Acronyms

Acronym	Explanation
ATBD	Algorithm Theoretical Basis Document
AIS	Aquatic Instrument System
C ³	Command, Control, and Configuration Document
SOP	Standard Operating Procedures
QA/QC	Quality Assurance/Quality Control
AIS	Aquatic 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

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3 MULTISONDE, STREAM INTRODUCTION (HB07530000 (W/FDOM) AND HB07530010 (NO FDOM))

The sensor configuration and sensor command and control described here are related to the multisonde associated data products. A description of how sensor readings shall be converted to L1 DPs is presented in the associated ATBD (AD[06]). The AIS assembly used to generate these data products consists of multiple components, which vary according to the site type and location within a site. This document describes the assemblies that are deployed at stream sites. At stream sites the components include the sonde body, pH, DO, turbidity, total algae (chlorophyll a), temperature, conductivity and fDOM sensors, an enclosure and stainless steel infrastructure which allows water to free flow past the sensors which both protecting the multisonde and holding in position. At stream sites there are two measurement locations. The upstream location does not contain the fDOM sensor, while the downstream location does contain the fDOM sensor; otherwise these assemblies are identical.

Configuration settings and the command and control structure are described below. The L0 data products resulting from this sensor are listed under Section 7.1 in the appendix.

4 MULTISONDE, STREAM OVERVIEW OF SENSOR CONFIGURATION (HB07530000 (W/FDOM) AND HB07530010 (NO FDOM))

4.1 Multisonde, Stream Sensors

The multisonde assemblies shall be configured to output the data streams defined in Tables 1 & 2. The sampling frequency for HB07530000 and HB07530010 is shown in Table 3.

The Multisonde assemblies contain a central wiper that is used to limit the accumulation of biological growth that will impact measurements. The wiper function shall be configured according to Tables 4 for the Multisonde assemblies.

Table 1. L0 data streams from Multisonde, Stream (HB07530000)

fieldName	description	Units
conductance	Conductivity at ambient temperture	microsiemensPerCentimeter
specificConductance	Conductivity auto-corrected to 25 degrees C	microsiemensPerCentimeter
surfaceWaterTemperature	Temperature in surface water	celsius
sensorDepth	Water depth of measurement	meter
sondeSurfaceWaterPressure	Pressure of surface water measured by the multisonde in psi	poundsPerSquareInch
dissolvedOxygenSaturation	Dissolved Oxygen Percent Saturation	percent

dissolvedOxygen	Dissolved Oxygen Concentration	milligramsPerLiter
pH	Measurement of pH in water	pH
pHvoltage	pH meter voltage	millivolt
blueGreenAlgaeRaw	Raw signal of blue-green algae sensor as a percent of full scale detected in the sample	percent
blueGreenAlgaePhycocyanin	Blue-green algae phycocyanin concentration in water	microgramsPerLiter
chlorophyllRaw	Raw signal of chlorophyll a sensor as a percent of full scale detected in the sample	percent
chlorophyll	Chlorophyll a concentration in water	microgramsPerLiter
turbidityRaw	Raw signal of turbidity sensor as a percent of full scale detected in the sample	percent
turbidity	Turbidity of water as FNU	formazinNephelometricUnit
fDOMRaw	Raw signal of fluorescent dissolved organic matter sensor as a percent of full scale detected in the sample	percent
fDOM	Fluorescent dissolved organic matter concentration as quinine sulfate equivalents	quinineSulfateUnit
wiperPosition	Position of wiper	volt
batteryVoltage	Battery voltage	volt
sensorVoltage	Main voltage	volt

Table 2. L0 data streams from Multisonde, Stream (HB07530010)

fieldName	description	Units
conductance	Conductivity at ambient temperature	microsiemensPerCentimeter
specificConductance	Conductivity auto-corrected to 25 degrees C	microsiemensPerCentimeter
surfaceWaterTemperature	Temperature in surface water	celsius
sensorDepth	Water depth of measurement	meter
sondeSurfaceWaterPressure	Pressure of surface water measured by the multisonde in psi	poundsPerSquareInch
dissolvedOxygenSaturation	Dissolved Oxygen Percent Saturation	percent

ation		
dissolvedOxygen	Dissolved Oxygen Concentration	milligramsPerLiter
pH	Measurement of pH in water	pH
pHvoltage	pH meter voltage	millivolt
blueGreenAlgaeRaw	Raw signal of blue-green algae sensor as a percent of full scale detected in the sample	percent
blueGreenAlgaePhycocyanin	Blue-green algae phycocyanin concentration in water	microgramsPerLiter
chlorophyllRaw	Raw signal of chlorophyll a sensor as a percent of full scale detected in the sample	percent
chlorophyll	Chlorophyll a concentration in water	microgramsPerLiter
turbidityRaw	Raw signal of turbidity sensor as a percent of full scale detected in the sample	percent
turbidity	Turbidity of water as FNU	formazinNephelometricUnit
wiperPosition	Position of wiper	volt
batteryVoltage	Battery voltage	volt
sensorVoltage	Main voltage	volt

Table 3. Configuration setting for Multisonde, Stream (HB07530000 and HB07530010)

Parameter	Sample Frequency	Units
Actual conductivity	0.0167 Hz	μSiemens/cm
Specific conductivity	0.0167 Hz	μSiemens/cm
Temperature	0.0167 Hz	celsius
Water depth of measurement	0.0167 Hz	Meter
Pressure of surface water	0.0167 Hz	psi
Dissolved oxygen as percent of saturation	0.0167 Hz	%
Dissolved oxygen concentration	0.0167 Hz	mg/L
pH	0.0167 Hz	pH
pH sensor voltage	0.0167 Hz	mV
Blue-green algae (BGA) phycocyanin (PC) concentration	0.0167 Hz	μg/L
Raw signal of BGA sensor	0.0167 Hz	?
Chlorophyll a concentration	0.0167 Hz	μg/L
Raw signal of chlorophyll sensor	0.0167 Hz	%
Raw signal of turbidity sensor	0.0167 Hz	%

Turbidity of water as FNU	0.0167 Hz	FNU
Raw signal of fluorescent dissolved organic matter sensor	0.0167 Hz	%
Fluorescent dissolved organic matter concentration as quinine sulfate equivalents	0.0167 Hz	QSU*
Wiper Position	0.0167 Hz	V
Battery voltage	0.0167 Hz	V
Main voltage	0.0167 Hz	V
Date and Time	0.0167 Hz	Date and Time

* Quinine Sulfate Units

Table 4. Multisonde wiper configuration, Stream (HB07530000 and HB07530010)

Parameter	Setting
Samples per Wipe	5

5 MULTISONDE, STREAM COMMAND AND CONTROL (HB07530000 AND HB07530010)

5.1 Error handling

This is no active or direct error monitoring. However, if the Multisonde output streams exhibit problems the sonde may be queried to determine if there are any internal faults. The sonde reports these internal faults via the SONDE_FULT YSIP command. The fault code be determined by performing the command Get Device Status and looking at bit 4 in the response. Table 5 shows the bit position descriptions.

Table 5. Truth table for sensor error handling.

Device Status Bit Position	Condition	Data acquisition system action	Output to CI
0	Low Battery (<3.6V)	None	None
1	Low External Voltage (<7.5V)	Send trouble ticket	None
2	Low Real Time Clock Battery (<1.8V)	Send trouble ticket	None
3	microSD card Fault	None	None
4	Bluetooth Fault	None	None
5	Sensor Address Fault (address = 0)	Send trouble ticket	None
6	Power/Comms FPGA Fault	Send trouble ticket	None
7	Sensor #1 Over Power (>2000mW)	Send trouble ticket	None

8	Sensor #2 Over Power	Send trouble ticket	None
9	Sensor #3 Over Power	Send trouble ticket	None
10	Sensor #4 Over Power	Send trouble ticket	None
11	Sensor #5 Over Power	Send trouble ticket	None
12	Sensor #6 Over Power	Send trouble ticket	None
13	Sensor #7 Over Power	Send trouble ticket	None
14	Sensor #8 Over Power	Send trouble ticket	None
15	Sensor #9 Over Power	Send trouble ticket	None
16	Sensor #10 Over Power	Send trouble ticket	None
17	Sensor #11 Over Power	Send trouble ticket	None
18	Sensor #12 Over Power	Send trouble ticket	None
19	Sensor #13 Over Power	Send trouble ticket	None
20	Sensor #14 Over Power	Send trouble ticket	None
21	Sensor #15 Over Power	Send trouble ticket	None
22	Sensor #16 Over Power	Send trouble ticket	None
24-31	Reserved	NA	NA

5.2 Sensor controls specification

N/A

6 ASSEMBLY INTEGRATION

N/A

7 APPENDIX

7.1 List of Level 0 data product

Table 6. List of Level 0 data product associated with DPName: pH, chlorophyll, actual conductivity, fDOM, turbidity, and dissolved oxygen in surface water (HB07530000 and HB07530010)

DGD Agile PN	DPNumber	fieldName	description	Acquisition frequency (Hz)	dataType	units
HB07530000	NEON.DOM.SITE.DP0.20005.001.01657.HOR.VER.000	pH	Measurement of pH in water	0.01667	real	pH
	NEON.DOM.SITE.DP0.20005.001.01658.HOR.VER.000	pHvoltage	pH meter voltage	0.01667	real	millivolt
	NEON.DOM.SITE.DP0.20005.001.01659.HOR.VER.000	blueGreenAlgae Phycocyanin	Blue-green algae phycocyanin concentration in water	0.01667	real	microgramsPerLiter
	NEON.DOM.SITE.DP0.20005.001.01660.HOR.VER.000	chlorophyll	Chlorophyll a concentration in water	0.01667	real	microgramsPerLiter
	NEON.DOM.SITE.DP0.20005.001.01371.HOR.VER.000	conductance	Conductivity at ambient temperture	0.01667	real	microsiemens PerCentimeter
	NEON.DOM.SITE.DP0.20005.001.01093.HOR.VER.000	specificConductance	Conductivity auto-corrected to 25 degrees C	0.01667	real	microsiemens PerCentimeter
	NEON.DOM.SITE.DP0.20005.001.01661.HOR.VER.000	fDOM	Fluorescent dissolved organic matter concentration as quinine sulfate equivalents	0.01667	real	quinineSulfate Unit
	NEON.DOM.SITE.DP0.20005.001.01662.HOR.VER.000	turbidity	Turbidity of water as FNU	0.01667	real	formazinNephelometricUnit

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NEON.DOM.SITE.DP0.20005.001.01360.HOR.VER.000	dissolvedOxygen Saturation	Dissolved Oxygen Percent Saturation	0.01667	real	percent
NEON.DOM.SITE.DP0.20005.001.01151.HOR.VER.000	dissolvedOxygen	Dissolved Oxygen Concentration	0.01667	real	milligramsPerLiter
NEON.DOM.SITE.DP0.20005.001.01378.HOR.VER.000	surfaceWaterTemperature	Temperature in surface water	0.01667	real	celsius
NEON.DOM.SITE.DP0.20005.001.01663.HOR.VER.000	sondeSurfaceWaterPressure	Pressure of surface water measured by the multisonde in psi	0.01667	real	poundsPerSquareInch
NEON.DOM.SITE.DP0.20005.001.01664.HOR.VER.000	sensorDepth	Water depth of measurement	0.01667	real	meter
NEON.DOM.SITE.DP0.20005.001.01372.HOR.VER.000	batteryVoltage	Battery voltage	0.01667	real	volt
NEON.DOM.SITE.DP0.20005.001.01647.HOR.VER.000	sensorVoltage	Main voltage	0.01667	real	volt
NEON.DOM.SITE.DP0.20005.001.01666.HOR.VER.000	chlorophyllRaw	Raw signal of chlorophyll a sensor as a percent of full scale detected in the sample	0.01667	real	percent
NEON.DOM.SITE.DP0.20005.001.01667.HOR.VER.000	blueGreenAlgaeRaw	Raw signal of blue-green algae sensor as a percent of full scale detected in the sample	0.01667	real	percent
NEON.DOM.SITE.DP0.20005.001.01668.HOR.VER.000	fDOMRaw	Raw signal of fluorescent dissolved organic matter sensor as a percent of full scale detected in the sample	0.01667	real	percent

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	NEON.DOM.SITE.DP0.20005.001.01669.HOR.VER.000	turbidityRaw	Raw signal of turbidity sensor as a percent of full scale detected in the sample	0.01667	real	percent
	NEON.DOM.SITE.DP0.20005.001.01670.HOR.VER.000	wiperPosition	Position of wiper	0.01667	real	volt
HB07530010	NEON.DOM.SITE.DP0.20005.001.01657.HOR.VER.000	pH	Measurement of pH in water	0.01667	real	pH
	NEON.DOM.SITE.DP0.20005.001.01658.HOR.VER.000	pHvoltage	pH meter voltage	0.01667	real	millivolt
	NEON.DOM.SITE.DP0.20005.001.01659.HOR.VER.000	blueGreenAlgae Phycocyanin	Blue-green algae phycocyanin concentration in water	0.01667	real	microgramsPerLiter
	NEON.DOM.SITE.DP0.20005.001.01660.HOR.VER.000	chlorophyll	Chlorophyll a concentration in water	0.01667	real	microgramsPerLiter
	NEON.DOM.SITE.DP0.20005.001.01371.HOR.VER.000	conductance	Conductivity at ambient temperture	0.01667	real	microsiemens PerCentimeter
	NEON.DOM.SITE.DP0.20005.001.01093.HOR.VER.000	specificConductance	Conductivity auto-corrected to 25 degrees C	0.01667	real	microsiemens PerCentimeter
	NEON.DOM.SITE.DP0.20005.001.01662.HOR.VER.000	turbidity	Turbidity of water as FNU	0.01667	real	formazinNephelometricUnit
	NEON.DOM.SITE.DP0.20005.001.01360.HOR.VER.000	dissolvedOxygen Saturation	Dissolved Oxygen Percent Saturation	0.01667	real	percent
	NEON.DOM.SITE.DP0.20005.001.01151.HOR.VER.000	dissolvedOxygen	Dissolved Oxygen Concentration	0.01667	real	milligramsPerLiter

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NEON.DOM.SITE.DP0.20005.001.01378.HOR.VER.000	surfaceWaterTemperature	Temperature in surface water	0.01667	real	celsius
NEON.DOM.SITE.DP0.20005.001.01663.HOR.VER.000	sondeSurfaceWaterPressure	Pressure of surface water measured by the multisonde in psi	0.01667	real	poundsPerSquareInch
NEON.DOM.SITE.DP0.20005.001.01664.HOR.VER.000	sensorDepth	Water depth of measurement	0.01667	real	meter
NEON.DOM.SITE.DP0.20005.001.01372.HOR.VER.000	batteryVoltage	Battery voltage	0.01667	real	volt
NEON.DOM.SITE.DP0.20005.001.01647.HOR.VER.000	sensorVoltage	Main voltage	0.01667	real	volt
NEON.DOM.SITE.DP0.20005.001.01666.HOR.VER.000	chlorophyllRaw	Raw signal of chlorophyll a sensor as a percent of full scale detected in the sample	0.01667	real	percent
NEON.DOM.SITE.DP0.20005.001.01667.HOR.VER.000	blueGreenAlgaeRaw	Raw signal of blue-green algae sensor as a percent of full scale detected in the sample	0.01667	real	percent
NEON.DOM.SITE.DP0.20005.001.01669.HOR.VER.000	turbidityRaw	Raw signal of turbidity sensor as a percent of full scale detected in the sample	0.01667	real	percent
NEON.DOM.SITE.DP0.20005.001.01670.HOR.VER.000	wiperPosition	Position of wiper	0.01667	real	volt

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7.2 Assembly schematic drawing

NA

8 BIBLIOGRAPHY

YSI Inc. (2014) EXO User Manual. YSI Incorporated, Yellow Springs, OH. pp. 156. Manual number 603789, Rev. D.