NEON SENSOR COMMAND, CONTROL AND CONFIGURATION (C3) DOCUMENT: SUNA NITRATE ANALYZER, WADEABLE STREAMS

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See configuration management system for approval history.

Change Record

REVISION	DATE	ECO #	DESCRIPTION OF CHANGE
A	11/02/2016	ECO-03745	Initial Release
B	08/23/2017	ECO-04759	Update table of configuration parameters and number of dark frames reported
C	11/13/2018	ECO-05839	Update configuration parameters for adaptive integrations, lower absorbance cutoff, switch to 20 frames from 50 total and added additional parameter information to appendix.
D	12/10/2018	ECO-05973	Update to buoy and stream c3 for changes to the SUNA configuration. Update PERDSMPPL to 20 from 50
E	03/16/2022	ECO-06785	Updated logo
F	12/10/2024	ECO-07126	Updated light samples at buoy sites from 20 to 25 to allow for samples dropped by poor radio connections. Updated default settings in Appendix based on newer SeaBird manual.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF EQUATIONS

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 SUNA Nitrate Analyzer assembly 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
0329950000	Sensor, SUNA Nitrate with Integrate Wiper

Further detailed sensor info under each DGD is as following:

1. Under 0329950000:
    a. Firmware shall be maintained to the current release during annual maintenance plans.

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.002181 ATBD Nitrate

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
RD [03]	SUNA Manual, Rev. E, SAT-DN-00628

2.3 Acronyms

Acronym	**Explanation**
AIS	Aquatic Instrument System
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
SUNA	Submersible Ultraviolet Nitrate Analyzer
CVAL	NEON Calibration, Validation, and Audit Laboratory

3 SUNA NITRATE ANALYZER INTRODUCTION (0329950000)

The sensor configuration and sensor command and control described herein are related to the nitrate in surface water data product. 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 this data product consists of a Satlantic, SUNA V2 nitrate analyzer placed in a PVC enclosure, which maintains flow through the optics of the sensor while mitigating against sediment deposition, fouling and impacts from debris in the stream. It is assumed that communication and control of the sensor will be executed via RS-232. The sensor may be queried to change settings or perform a "selftest" for error handling. Under the full ASCII output, the sensor generates 286 (0-285) data streams. NEON software has been developed to allow for these 286 data streams to be compressed to a single binary stream which may be parsed out during the ingest process. This scheme is described in Eq.1.

Equation 1 Stream#0= {0: <value>, 1: <value>,…285:<value>}

The L0 data products resulting from this sensor are listed in Table 2 of Section 4 and under Section 7.1 in the appendix. The identification for each of the compressed data fields (e.g. the field numbers in Equation 1) are listed in Table 3 of Section 4.

4 SUNA NITRATE ANALYZER OVERVIEW OF SENSOR CONFIGURATION (0329950000)

Sensor configuration settings are shown in Table 1. The sampling frequency shall be initially set to 15 min in order to capture the natural variability in the environment while minimizing the costs of maintenance and consumables. We will waive the requirements <Draft.N3> that nitrate be measured with a frequency of 1 min +/-until technology develops to allow for optimization of lamp life.

The wiper shall be configured on so that it clears the optics at the beginning of each measurement. This cycle takes approximately 30 seconds. The sensor takes approximately 15 seconds to warm up coming out of standby/sleep mode. Once a measurement is engaged, the sensor will take 10 measurements without the lamp engaged, although only one dark frame will be transmitted from the instrument, to provide the background current as a reference and correction factor. Then, at wadeable stream sites the sensor shall take 20 samples at between 0.5 - .667 Hz before returning to standby/sleep mode. At lake and river sites 25 samples shall be collected, to allow for some values that get dropped during radio transmission from the buoy to the shore.

The lamp used as the light source for the UV detector has a supported lifespan of 900 hours. The sampling strategy as stated will result in a usage according to Equation 2. (For buoy sites this will be approximately 20% less).

Equation 2

$$\left(\mathbf{15}\ \boldsymbol{second\ warm\ up} + \mathbf{20}\left(\frac{\boldsymbol{samples}}{\boldsymbol{measurement}}\right) \times \mathbf{1.4}\left(\frac{\boldsymbol{seconds}}{\boldsymbol{sample}}\right)\right) \times \mathbf{4}\left(\frac{\boldsymbol{measurements}}{\boldsymbol{hour}}\right) \times \mathbf{24}\left(\frac{\boldsymbol{hours}}{\boldsymbol{day}}\right) \times \frac{\mathbf{1}}{\mathbf{900}\left(\frac{\boldsymbol{replacement}}{\boldsymbol{hours}}\right)} = \mathbf{785}\ \boldsymbol{days\ between\ reommended\ replacement}$$

Table 1. Sensor configuration settings.

Parameter Code	Parameter Type	Value
PATHLGTH	Factory Set	Sensor specific, usually 10 mm (can be 5 mm)
INTWIPER	Factory Set	Available
EXTPPORT	Factory Set	Missing
SUPRCAPS	Factory Set	Available
PWRSVISR	Factory Set	Available
USBSWTCH	Factory Set	Available
RELAYBRD	Factory Set	Missing

INTDATLG	Factory Set	Available
APFIFACE	Factory Set	Missing
SCHDLING	Factory Set	Available
STUPSTUS	Factory Set	Done
BAUDRATE	Default	57600 for wadeable stream, 115200 for lakes and rivers
MSGLEVEL	Default	Info
MSGFSIZE	Default	2
DATFSIZE	User Configurable	5
OUTFRTYP	Default	Full_ASCII
LOGFRTYP	Default	Full_ASCII
OUTDRKFR	Default	Output
LOGDRKFR	Default	Output
LOGFTYPE	User Configurable	Daily
AFILEDUR	Default, not used unless LOGFTYPE = Acquisition	
ACQCOUNT	Default, not used unless LOGFTYPE = Acquisition	
CNTCOUNT	Not Configurable, used to create filenames	
DCMINNO3	Factory Set	-5
DCMAXNO3	Factory Set	100
WDAT_LOW	Factory Set	217
WDAT_HGH	Factory Set	250
SDI12ADD	Default	48

DATAMODE	Factory Set	Real
OPERMODE	User Configurable	Periodic
OPERCTRL	User Configurable	Samples
EXDEVTYP	User Configurable	Wiper
EXDEVPRE	User Configurable	30
EXDEVRUN	Default	Off
EXDVIVAL	User Configurable	0
COUNTDWN	User Configurable	15
FIXDDURA	User Configurable	60
PERDIVAL	User Configurable	15m
PERDOFFS	Default	0
PERDDURA	Default, not used unless OPERCTRL = Duration	
PERDSMPL	User Configurable	20 for wadeable stream, 25 for lakes and rivers
POLLTOUT	User Configurable	15
APFATOFF	Default	10
STBLTIME	User Configurable	10
SKPSLEEP	Default	Off
LAMPTOFF	Factory Set	35
SPINTPER	Factory Set	200:800, set during calibration
DRKAVERS	Default	1
LGTAVERS	Default	1
DRKSMPLS	User Configurable	1

LGTSMPLS	User Configurable	20 for wadeable stream, 25 for lakes and rivers
DRKDURAT	Default, not used unless OPERCTRL = Duration	
LGTDURAT	Default, not used unless OPERCTRL = Duration	
TEMPCOMP	Default, not used for freshwater configurations	
SALINFIT	Default, not used for freshwater configurations	
BRMTRACE	Default	Off
BL_ORDER	Factory Set	1
FITCONCS	User Configurable	1
DRKCORMT	Default	SpecAverage
A_CUTOFF	User Configurable	1.3
INTPRADJ	Default	On
INTPRFAC	Default	1
INTADSTP	User Configurable	5
INTADMAX	User Configurable	5
WFIT_LOW	Factory Set	217
WFIT_HGH	Factory Set	240

Table 2. L0 data streams from SUNA Nitrate Analyzer (0329950000) at a frequency of 1 dark frame and 20 light frames per 15 minutes

fieldName	description	Units

rawNitrateSingleCompressedStream	Single compressed data stream from SUNA to be parsed at NEON headquarters	NA

Table 3. Data fields and position that are captured with the SUNA and placed into the compressed L0 data stream identified in Table 2 above.

L0 Data Stream Field Position	Full ASCII Data Fields
0	Light Frame/Dark Frame
1	Date field (numeric)
2	Time field (numeric)
3	Nitrate concentration as micromolar
4	Nitrogen in nitrate as mg/L
5	Absorbance at 254 nm
6	Absorbance at 350 nm
7	Bromide trace
8	Spec Average or SW Average(Dark Correction Method)
9	Dark Signal Average (average dark intensity)
10	Integration Time Factor
11	spectrometer intensity at wavelength #1
12	spectrometer intensity at wavelength #2
13	spectrometer intensity at wavelength #3
14	spectrometer intensity at wavelength #4
15	spectrometer intensity at wavelength #5
16	spectrometer intensity at wavelength #6
17	spectrometer intensity at wavelength #7
18	spectrometer intensity at wavelength #8
19	spectrometer intensity at wavelength #9
20	spectrometer intensity at wavelength #10
21	spectrometer intensity at wavelength #11
22	spectrometer intensity at wavelength #12
23	spectrometer intensity at wavelength #13
24	spectrometer intensity at wavelength #14
25	spectrometer intensity at wavelength #15
26	spectrometer intensity at wavelength #16
27	spectrometer intensity at wavelength #17
28	spectrometer intensity at wavelength #18
29	spectrometer intensity at wavelength #19

30	spectrometer intensity at wavelength #20
31	spectrometer intensity at wavelength #21
32	spectrometer intensity at wavelength #22
33	spectrometer intensity at wavelength #23
34	spectrometer intensity at wavelength #24
35	spectrometer intensity at wavelength #25
36	spectrometer intensity at wavelength #26
37	spectrometer intensity at wavelength #27
38	spectrometer intensity at wavelength #28
39	spectrometer intensity at wavelength #29
40	spectrometer intensity at wavelength #30
41	spectrometer intensity at wavelength #31
42	spectrometer intensity at wavelength #32
43	spectrometer intensity at wavelength #33
44	spectrometer intensity at wavelength #34
45	spectrometer intensity at wavelength #35
46	spectrometer intensity at wavelength #36
47	spectrometer intensity at wavelength #37
48	spectrometer intensity at wavelength #38
49	spectrometer intensity at wavelength #39
50	spectrometer intensity at wavelength #40
51	spectrometer intensity at wavelength #41
52	spectrometer intensity at wavelength #42
53	spectrometer intensity at wavelength #43
54	spectrometer intensity at wavelength #44
55	spectrometer intensity at wavelength #45
56	spectrometer intensity at wavelength #46
57	spectrometer intensity at wavelength #47
58	spectrometer intensity at wavelength #48
59	spectrometer intensity at wavelength #49
60	spectrometer intensity at wavelength #50
61	spectrometer intensity at wavelength #51
62	spectrometer intensity at wavelength #52
63	spectrometer intensity at wavelength #53
64	spectrometer intensity at wavelength #54
65	spectrometer intensity at wavelength #55
66	spectrometer intensity at wavelength #56
67	spectrometer intensity at wavelength #57
68	spectrometer intensity at wavelength #58

69	spectrometer intensity at wavelength #59
70	spectrometer intensity at wavelength #60
71	spectrometer intensity at wavelength #61
72	spectrometer intensity at wavelength #62
73	spectrometer intensity at wavelength #63
74	spectrometer intensity at wavelength #64
75	spectrometer intensity at wavelength #65
76	spectrometer intensity at wavelength #66
77	spectrometer intensity at wavelength #67
78	spectrometer intensity at wavelength #68
79	spectrometer intensity at wavelength #69
80	spectrometer intensity at wavelength #70
81	spectrometer intensity at wavelength #71
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108	spectrometer intensity at wavelength #98
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111	spectrometer intensity at wavelength #101
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147	spectrometer intensity at wavelength #137
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157	spectrometer intensity at wavelength #147
158	spectrometer intensity at wavelength #148
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161	spectrometer intensity at wavelength #151
162	spectrometer intensity at wavelength #152
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200	spectrometer intensity at wavelength #190
201	spectrometer intensity at wavelength #191
202	spectrometer intensity at wavelength #192
203	spectrometer intensity at wavelength #193
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205	spectrometer intensity at wavelength #195
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209	spectrometer intensity at wavelength #199
210	spectrometer intensity at wavelength #200
211	spectrometer intensity at wavelength #201
212	spectrometer intensity at wavelength #202
213	spectrometer intensity at wavelength #203
214	spectrometer intensity at wavelength #204
215	spectrometer intensity at wavelength #205
216	spectrometer intensity at wavelength #206
217	spectrometer intensity at wavelength #207
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221	spectrometer intensity at wavelength #211
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225	spectrometer intensity at wavelength #215
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259	spectrometer intensity at wavelength #249
260	spectrometer intensity at wavelength #250
261	spectrometer intensity at wavelength #251
262	spectrometer intensity at wavelength #252
263	spectrometer intensity at wavelength #253

264	spectrometer intensity at wavelength #254
265	spectrometer intensity at wavelength #255
266	spectrometer intensity at wavelength #256
267	Temperature of sensor
268	Spectrometer temperature
269	Lamp temperature
270	Cumulative lamp time
271	Relative humidity
272	Main voltage
273	Lamp voltage
274	Internal voltage
275	Main current
276	Fit aux 1
277	Fit aux 2
278	Fit base 1
279	Fit base 2
280	Fit RMSE
281	CTD Time
282	CTD Salinity
283	CTD Temperature
284	CTD Pressure
285	Check sum of data stream

5 SUNA NITRATE ANALYZER, LAKE COMMAND AND CONTROL (0329950000)

5.1 Error handling

This sensor does not report errors as part of the data output stream. Rather in the event of a failure or erroneous data outputs the status of the sensor may be queried. If values in the data stream do not pass automated quality control tests as described in AD[05], including internal humidity and power levels, those data may generate a flag which requires a self-test be performed by using the command <selftest>. The self-test will generate a $Ok for all components which pass; while all components which fail will be terminated by (!). The sensor status will determine what action needs to be taken to address a reported error.

5.2 Sensor controls specification

5.3 Rationale for wipers

Biofouling is anticipated to occur at all aquatic sites in the NEON Domains to varying degrees. Biofouling may result in the accumulation of multiple species of aquatic organisms adhering to the surface of the sensor, having deleterious effects on measurements. Wipers are required to remove biofouling from optical lenses of the sensors. The wiper is integrated into the sensor and will perform a wipe prior to every measurement. The external device run time will be set to 30 seconds as described above. This will allow the wiper to complete a cleaning of the optics prior to data acquisition.

6 ASSEMBLY INTEGRATION

N/A

7 APPENDIX

7.1 List of Level 0 data product

Table 4. List of Level 0 data product associated with DPName: Nitrate in Surface Water.

DGD Agile PN	DPNumber	fieldName	description	Acquisition frequency (Hz)	dataType	units
0329950000	NEON.DOM.SITE.DP0.20033.001.02242.HOR.VER.000	rawNitrateSingleCompressedStream	Single compressed data stream from SUNA to be parsed at NEON headquarters	1 dark frame and 20 light frames per 15 minutes	String	NA

8 APPENDIX

8.1 List of Sensor Configurations and Information from SUNA Manufacturer

Table 5. List of Sensor Configurations and Information from SUNA Manufacturer.

Category	Units	Parameter Code	Default set when shipped	Possible Range	Description	OK to Change by customer or Not
Build		Pathlgth	build	5mm or 10mm	Sensor specific	Not
Build		INTWIPER	available with wiper option.	available or missing	The integrated wiper is Available or Missing. When a wiper has been integrated into the sensor, control of the wiper operation is enabled.	Do not change, unless you don't want the wiper to run.
Build		Extpport	missing	available or missing	An external power port may be supported in future SUNA versions	Not
Build		SUPRCAPS	Available unless SUNA has relay board.	available or missing	During startup, the capacitors are charged to provide brief internal power in the evant of a sudden power loss. Internal backup power allows the sensor to shut down into a safe state. The disavantage of super capacitors is an increased total power consumption.	Not
Build		PWRSVISR	Available unless SUNA has relay board.	available or missing	Sensors are optionally equipped with the PCB supervisor, which allows the sensor to enter power saving mode.	Not

Category	Units	Parameter Code	Default set when shipped	Possible Range	Description	OK to Change by customer or Not
Build		RELAYBRD	missing unless it is deep SUNA with relay board installed.	available or missing	If power relay required, set relaybrd available, set supercaps missing, set the pwrsvisr missing, otherwise set relaybrd missing, set suprcaps available, set pwrsvisr available. This feature is only available in the Deep SUNA.	Not
Build		USBSWTCH	Available unless SUNA has relay board.	available or missing	Sensors are optionally equipped with USB communication. Sensors can always communicate via RS-232	Not
Build		INTDATLG	Available	available or missing	Sensors are optionally equipped with memory for internal data logging	Not
Build		APFIFACE	Available	available or missing	This feature is only available in deep SUNA	Not
Build		SCHDLING	Available	available or missing	Sensors are optionally capable to run on a configured schedule.	Not
Build		STUPSTUS	Done	Required , Done	Force setup execution at next reboot by typing set stupstus required at the prompt. This is done during SUNA build only.	Not

Category	Units	Parameter Code	Default set when shipped	Possible Range	Description	OK to Change by customer or Not
I/O		BAUDRATE	57600	9600, 19200, 38400, 57600, 115200		OK
I/O		MSGLEVEL	Info	Error, Warn, Info, Debug, Trace	The message level is one of Error, Warn, Info, Debug, or Trace. Messages are sent to the output stream and are also saved in message log file.	OK
I/O	MB	MSGFSIZE	2 MB	0:65	The message file size is in the 0 to 65 MB range, and initially set to 2 MB. Setting the file size to zero turns off logging of messages to file.	OK
I/O	MB	DATFSIZE	2 MB	1:65	The data file size is in the 1 to 65 MB range, and initially set to 2 MB. This value applies only if the data file type is set to continuous. Daily and per-acquisition file will contain as much data as is generated during the day or the particular acquisition.	OK

Category	Units	Parameter Code	Default set when shipped	Possible Range	Description	OK to Change by customer or Not
I/O		OUTFRTYP	Full_ASCII	None, APF, MBARI, Full_ASCII, Full_Binary, Concentration, Reduced_Binary	The frame type is one of None, APF, MBARI, Full_ASCII, Full_Bianary, Reduced_Binary, or Concentration. If set to None, no frame data will be written to serial output/data log file, respectively. For reprocessing of data, Full_ASCII or Full_Binary frame are necessary. Reduced binary and APF frame allow reporcessing for seawater deployments. APF frames only allow reprocessing of data that were collected with the integration time adjustment turned off.	OK
I/O		LOGFRTYP	Full_ASCII	None, APF, MBARI, Full_ASCII, Full_Binary, Concentration, Reduced_Binary	The frame type is one of None, APF, MBARI, Full_ASCII, Full_Bianary, Reduced_Binary, or Concentration. If set to None, no frame data will be written to serial output/data log file, respectively. For reprocessing of data, Full_ASCII or Full_Binary frame are necessary. Reduced binary and APF frame allow reporcessing for seawater deployments. APF frames only allow reprocessing of data that were collected with the integration time adjustment turned off.	OK
I/O		OUTDRKFR	Output	Output, Suppress	The frames output and logging is either Output or Suppress. This configuration flag is provided in case when dark frames are not required or desired.	OK

Category	Units	Parameter Code	Default set when shipped	Possible Range	Description	OK to Change by customer or Not
I/O		LOGFTYPE	Daily	Acquisition, Continuous, Daily	The data log file type is one of Acquisition, Continuous, or Daily. Data log files names have a single letter (A, C, or D) folloed by a 7 digit number, followed by a 3 digit letter extension (csv for ASCII, bin for binary data). Acquisition- based data files are started new whenever power is cycled. Continuous- data log files are appended to until the data file size is reached. Daily- data log files contain all data that are collected within a 24 hour period.	OK
I/O		AFILEDUR	60 minutes		The Acquisition file duration is set to 60 minutes. This setting is only used if the log file type is set to Acquisition. The duration can be in range from 0 to 1440 minutes. A value of zero forces the creation of new data log file with every power cycle.	OK
I/O		ACQCOUNT	Acquisition file counts		This counts keeps track of how many data files have been created in acquisition mode.	OK
I/O		CNTCOUNT	Continuous file counts		This counts keep track of how many data files have been created in continuous mode.	OK
I/O	µM	DCMINNO3	-5		The DAC minimum nitrate value is initially set to -5 µM, the DAC maximum nitrate value is set to 100 µM. These values effect the output generated by the optional analog output system.	Not

Category	Units	Parameter Code	Default set when shipped	Possible Range	Description	OK to Change by customer or Not
I/O	µM	DCMAXNO3	100		The DAC minimum nitrate value is initially set to -5 µM, the DAC maximum nitrate value is set to 100 µM. These values effect the output generated by the optional analog output system.	Not
I/O	nm	WDAT_LOW	217	210:350	Nitrate processing uses the 217–240 nm wavelength range, which is approximately 35 spectrometer channels. The precision of the nitrate concentration is related to the number of absorbers into which the measured absorbance is decomposed. High absorbance conditions introduce inaccuracies into the nitrate concentrations. Channels with an absorbance of more than 1.3 are not included in the processing. If less than approximately 10 channels remain, the sensor cannot give a nitrate concentration. The user can increase the absorbance cutoff and get decreased-accuracy nitrate concentration at higher absorbance.	Not
I/O	nm	WDAT_HGH	250	210:350	Same as above	Not
I/O		SDI12ADD	48	48:57	The SDI-12 address is factory set to the numerical value 48 (ASCII character '0'). This address is used by an SDI-12 controller when interfacing with a SUNA in SDI-12 operating mode.	OK

Category	Units	Parameter Code	Default set when shipped	Possible Range	Description	OK to Change by customer or Not
Operate		DATAMODE	Real	Real, FakeLamp, FakeSpec, FakeAll	This setting should always be Real unless performing troubleshooting at Seabird.	

Category	Units	Parameter Code	Default set when shipped	Possible Range	Description	OK to Change by customer or Not
Operate		OPERMODE	fixedtime	Continuous, Fixedtime, Periodic, Polled, APF, SDI12	The operation mode is Continuous, Fixedtime, Periodic, Polled, APF, or SDI12. In Continuous mode the sensor starts to acquire data as soon as initialization is complete and countdown has expired. Data acquisition proceeds, depending on the Operation Control setting, either in a sample based (1 dark sample, then Light Samples, Dark Samples, Light Samples, ...) or time based (1 dark sample, then Light Duration, Dark Duration, Light Duration) infinite cycle. In Fixedtime mode, the sensor behaves as in Continuous mode, but terminates after a maximum of Fixed Time Duration seconds. In Periodic mode, the sensor acquires data in regular periods, and collects data, depending on the Operation Control setting, either a fixed number of light samples (Periodic Samples) or for a fixed time (Periodic Duration). In Polled mode, the sensor stays in low power sleep, to acquire data only after woken up by activity on the RS-232 line and then receiving a command (“Start” for indefinite or “Measure n” for a fixed number of measurements). In SDI-12 mode, the sensor operates as a SDI-12 device.	OK

Category	Units	Parameter Code	Default set when shipped	Possible Range	Description	OK to Change by customer or Not
Operate		OPERCTRL	duration	Duration, Samples	The operation control is Duration or Samples based. Operation control applies to Continuous, Fixed time, and Periodic mode. Either of these operating modes is further controlled by additional parameters, and Operation Control determines which parameters apply.	OK
Operate		EXDEVTYP	Wiper if installed	None, Wiper	The external device is None or Wiper. If the external device is set to Wiper, power will be applied whenever a data collection begins. Thus, there will be a single wipe at the beginning of a continuous data acquisition, a single swipe at each collection event in periodic mode, or a single swipe for each collection command in polled or SDI-12 mode.	OK
Operate	s	EXDEVPRE	15	0:120	The external device pre-run time can be set to a value between 0 and 120 seconds. This is the time that the sensor waits to acquire data after applying power to the external device. The purpose of this configuration parameter is to let the external device complete its action without interfering with the sensor's measurements.	OK

Category	Units	Parameter Code	Default set when shipped	Possible Range	Description	OK to Change by customer or Not
Operate		EXDEVRUN	off	On, Off	The external device on during acquisition can be set to On or Off. This configuration parameter allows the sensor to control if the external device is to continue operating during the sensor's data acquisition.	OK
Operate	s	EXDVIVAL	0	0:86400	The external device minimum interval is a value between 0 and 1440 minutes (one day).This configuration parameter limits the frequency of the operation of the external device. At each data acquisition event when the device might be run, the SUNA compares the current time against the most recent time the device was run. Only if more than the configured minimum interval has passed, the device will be operated.	OK
Operate	s	COUNTDWN	3	0:3600	The countdown is measured in units of seconds, and initially set to 15. The countdown is used in Continuous and Fixedtime operation modes.	OK
Operate	s	FIXDDURA	10	1:1000000	The fixed time duration is measured in units of seconds, and can take any positive number up to and including 1000000.	OK

Category	Units	Parameter Code	Default set when shipped	Possible Range	Description	OK to Change by customer or Not
Operate	min or hours	PERDIVAL	1h	1m, 2m, 5m, 6m, 10m, 15m, 20m, 30m, 1h, 2h, 3h, 4h, 6h, 8h, 12h, 24h	The periodic interval is restricted to a subset of values that divide the day into integer parts: 1m, 2m, 5m, 6m, 10m, 15m, 20m, 30m, 1h, 2h, 3h, 4h, 6h, 8h, 12h, 24h.	OK
Operate	s	PERDOFFS	10	any	The periodic offset is measured in seconds. Whereas the periodic interval establishes a grid of acquisition times, the offset locates the grid relative to the start of the day (hour 0). Note: There is a side effect when an external device needs to run prior to data acquisition.	OK
Operate	s	PERDDURA	5	0:255	The periodic duration is measured in seconds. This parameter is used when Operation Control is set to Duration.	OK
Operate	s	PERDSMPL	10	0:255	The periodic samples are measured in number of light frames. This parameter is used when Operation Control is set to Samples.	OK

Category	Units	Parameter Code	Default set when shipped	Possible Range	Description	OK to Change by customer or Not
Operate	s	POLLTOUT	10	0:65535	The polled timeout is measured in seconds. It determines for how long the firmware will wait for a command upon wake-up before returning to low power standby. A value of zero means there is no timeout.	OK
Operate	hour	APFATOFF	10	0:100	The APF timeout is only available in Deep SUNA sensors.	OK
Operate	s	STBLTIME	5	0:255	The lamp stabilization time is in units of 1/10 of a second. After the lamp has ignited, a short time is required to stabilize the lamp output. Typically, lamps can be used 500 ms after being switched on. This parameter is provided to adjust the stabilization time.	OK
Operate		SKPSLEEP	off	off, on	This setting is either On or Off. If this setting is On, the sensor will not enter the low-power state in polled mode when first powered up. This flag allows for faster sensor response.	OK

Category	Units	Parameter Code	Default set when shipped	Possible Range	Description	OK to Change by customer or Not
Build		LAMPTOFF	35c	35c	The lamp switch off temperature is set to 35 C. The lamp should not operate at temperatures above 35 C. When the lamp exceeds the switch-off temperature, the sensor overrides the configured (continuous and fixedtime operation) or enforces (polled and periodic operation) a lightto-dark cycle. Upon reaching the switch-off temperature, initially five cycles of 5-light to 5-dark samples are acquired, and after those, the cycle ratio drops to 1-light to 10-dark samples. As soon as the lamp temperature has dropped below the switch-off temperature, the configured acquisition cycle resumes. If the sensor is deployed in a warm environment, and data acquisition is only sporadic, please consult with Satlantic on ways to safely changing this configuration.	Not
Acquire	ms	SPINTPER	set during cal only	5:60000	The spectrometer integration period is factory set. The integration period should be as large as possible, to obtain a good signal; the integration period must not be so large as to cause saturation of the signal. The spectrometer integration time should not be changed, because the SUNA is calibrated for the factory configured value.	Not

Category	Units	Parameter Code	Default set when shipped	Possible Range	Description	OK to Change by customer or Not
Acquire		DRKAVERS	1	1:200	The spectrometer can perform internal averaging. Internal averaging reduces the noise of a measurement at the expense of a reduced sampling rate. However, the sampling rate is higher using internal averaging when compared to averaging the samples after separate collection. Another advantage of internal averaging is the reduction in the amount of data generated.	OK
Acquire		LGTAVERS	1	1:200	Same as above	OK
Acquire		DRKSMPLS	1	1:65535	These parameters are used when Operation Control is set to Samples. Dark and light samples are used in Continuous and Fixedtime mode, and control the lamp off/on cycle.	OK
Acquire		LGTSMPLS	10	1:65535	Same as above	OK
Acquire		DRKDURAT	10	1:65535	These parameters are used when Operation Control is set to Duration. Dark and light duration are used in Continuous and Fixedtime mode, and control the lamp off/on cycle.	OK
Acquire		LGTDURAT	120	1:65535	Same as above	OK

Category	Units	Parameter Code	Default set when shipped	Possible Range	Description	OK to Change by customer or Not
Process		TEMPCOMP	off	off, on	The temperature compensation flag is On or Off. Real-time processing temperature compensation only works for saltwater calibrated sensors running in APF mode. The current temperature and salinity values must be provided via the CTD command. This setting will be ignored if the sensor is not able to perform this task.	OK
Process		SALINFIT	on	off, on	The salinity fitting flag is On or Off. Salinity fitting can only be switched off in saltwater calibrated sensors running in APF mode. The current temperature and salinity values must be provided via the CTD command. This setting will be ignored if the sensor is not able to perform this task.	OK
Process		BRMTRACE	off	off, on	The bromide tracing flag is On or Off. Freshwater calibrated sensors, or saltwater calibrated sensors set to operate as freshwater sensors (Concentrations to Fit set to 1) can be used to detect bromide, at an expense of the sensor's nitrate accuracy.	OK
Process		BL_ORDER	1	1:1	The baseline order is fixed to 1. Historically, different baseline orders were available. However, there is currently no need to change the baseline order.	Not

Category	Units	Parameter Code	Default set when shipped	Possible Range	Description	OK to Change by customer or Not
Process		FITCONCS	build	1:3	The number of concentrations to be used for processing is 1, 2, or 3. Freshwater calibrated sensors only use 1 concentration; saltwater calibrated sensors can be made to act like freshwater sensor by setting concentrations to fit to 1. Normally, saltwater calibrated sensors use 3 concentrations.	OK
Process		DRKCORMT	specaverage	SpecAverage, SWAverage, FormulaBased		
Process		A_CUTOFF	1.3	0.01:10	The absorbance cutoff is a value between 0.01 and 10.0. It is normally set to 1.3. Whenever the absorbance of a channel exceeds the specified absorbance cutoff, that channel is excluded from processing. Setting the cutoff to the maximum value of 10.0 will guarantee that all channels will be included in processing.	OK

Category	Units	Parameter Code	Default set when shipped	Possible Range	Description	OK to Change by customer or Not
Process		INTPRADJ	on	Off, On, Persistent	Integration time adjustment can be Off, On, or Persistent. When set to On or Persistent, in low transmittance conditions, the sensor multiplies the normal integration time by the Integration Time Step. When the transmittance increases later on, the integration time reverts to the normal value. When set to Persistent, the current Integration Time Factor is kept at power-down to be used at the next power-up event. Otherwise, the sensor starts with the normal integration time.	OK
Process		INTPRFAC	1	1:20	The integration time factor is initially set to 1. When integration time adjustment is On or Persistent, the integration time factor can be greater than 1. Currently, only a value of 1 or 20 is permitted.	OK
Process		INTADSTP	5	1:20	With INTADSTP set to 5, the SUNA will adapt sooner than a setting of 20.	OK
Process		INTADMAX	25	1:20	Once adapted to 5 x, if the SUNA encounters even higher absorbance, it will adapt again 5x if required - the 25 value for INTADMAX is multiplicative 5 x 5 so it will adapt twice if necessary as maximum.	OK

Category	Units	Parameter Code	Default set when shipped	Possible Range	Description	OK to Change by customer or Not
Process		WFIT_LOW	217	210:350	The processing (also called fitting) interval is normally from 217 to 240 nm. Changing the fitting interval should be done with caution; an unsuitable fitting interval generates invalid results.	Not
Process		WFIT_HGH	240	210:350	Same as above	Not

9 BIBLIOGRAPHY

SeaBird. (2018) SUNA V2 User Manual. SeaBird Electronics, Bellevue WA, pp. 56, Document No. SUNA180725, Rev. F.