NEON SENSOR COMMAND, CONTROL AND CONFIGURATION (C3) DOCUMENT: PRIMARY PRECIPITATION

PREPARED BY	ORGANIZATION	DATE
Derek Smith	FIU	11/03/2015

APPROVALS	ORGANIZATION	APPROVAL DATE
Kate Thibault	SCI	05/16/2022

RELEASED BY	ORGANIZATION	RELEASE DATE
Tanisha Waters	CM	05/16/2022

See configuration management system for approval history.

The National Ecological Observatory Network is a project solely funded by the National Science Foundation and managed under cooperative agreement by Battelle. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Science Foundation.

Change Record

REVISION	DATE	ECO #	DESCRIPTION OF CHANGE
A	1/13/2016	ECO-03565	Initial Release
B	07/13/2018	ECO-05646	Changed "Enable heater report? (Y/N)" in Table 2 from "Y" to "N" for non-heated sensors to be consistent with the rest of the document.
C	05/16/2022	ECO-06813	• Revised Logo

TABLE OF CONTENTS

LIST OF TABLES AND FIGURES

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 primary precipitation assembly will consist of the following Data Generating Devices (DGD) based on Data Generating Device DGD List and Hierarchies doc (AD [05]):

DGD Agile PN	DGD Agile Description
AB09230000	Assembly, Sensor, Precipitation Rain Gauge AEPG 600M, Non-Heated, with Shield
AB09230010	Assembly, Sensor, Precipitation Rain Gauge AEPG 600M, Heated, with Shield

Further detailed sensor info under each DGD is as following:

1. Under AB09230000:
    a. NEON P/N: 0303440001 non-heated Belfort AEPG 600M precipitation gauge. Interface firmware V5.5b and sensor firmwareV4.02.
2. Under AB09230010:
    a. NEON P/N: 0303440001 heated Belfort AEPG 600M precipitation gauge. Interface firmware V5.5b and sensor firmwareV4.02.

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.000898	Primary Precipitation ATBD

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
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
DFIR	Double Fence Inter-comparison Reference
DP	Data Product

3 PRIMARY PRECIPITATION INTRODUCTION (DGD# AB09230000 (NON-HEATED) AND AB09230010 (HEATED))

The sensor configuration and sensor command and control described here are related to the primary bulk precipitation data product. A description of how sensor readings shall be converted to L1 DPs is presented in the associated ATBD (AD[06]). The TIS assembly used to generate this data product consists of two components; a Belfort AEPG 600M precipitation gauge surrounded by a Double Fence Intercomparison Reference (DFIR), which minimizes measurement errors from wind effects. 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 OVERVIEW OF SENSOR CONFIGURATION

4.1 Precipitation Sensor

In order for the operator to modify the configuration and calibration of the AEPG gauge, one must obtain "Super User" privileges. The operator can obtain super user controls at any time by pressing and holding "**Ctrl**" down and then pressing the "**V**" key (i.e., **Ctrl-V**). This will prompt the user to input a password, which is case insensitive. To disengage the super user status at any time type **Ctrl-V** and then hit enter.

4.1.1 RM Command

After the operator has obtained super user status, a list of the different commands that control the AEPG precipitation sensor can be shown by typing "**rM**". This will prompt the list in **Table 1** to be shown. All commands begin with the letter "r", are in a two-character format, and are case insensitive. Also, each command is entered by typing only the two characters of the desired command, i.e., the ENTER key is not needed. However, the ENTER key will be used during sensor configuration. Only the commands necessary to configure the sensor will be discussed here, see the Belfort AEPG 600/1000 manual for additional information.

Table 1. Commands for the precipitation AEPG sensor.

Command	Response
r0	Display serial no. & firmware version.
r1	Toggle 'report raw vs. averaged data' flag.
r2	Toggle 'rounding enable' flag.
rC	Update configuration.
rD	Toggle 'output details' flag.
rH	Toggle state of the orifice heater relay.
rI#	Initialize configuration.
rJ	Toggle 'output inhibit' flag.
rL	Poll for output data.
rM	Display menu.
rN	Display general config. parameters
rR	Reset system.
rS	Start a 'span' calibration.
rV	Display calibration parameters.
rX	Abort a calibration in progress.
rZ	Start a 'zero' calibration.

Note: # The "**rI**" command should **never** be used by the operator, as it will cause for all calibration and instrument specific parameters to be lost. This command will require the sensor to be factory serviced.

4.1.2 RC Command

The rC command will be used to configure the sensor. Sensor configurations for the various commands will be set as listed in **Table 2**. Any command/configuration not listed is to remain set to the default configuration. Responses will appear one line at a time and the operator will be prompted for changes to each configuration parameter. The ENTER key allows the operator to skip to the next parameter. The user can go backwards though the list one line at a time by holding down the shift key and then pressing 6 (i.e., **Shift-6)**. Before a value can be changed the previous value must be removed using the backspace key. After a previous value is removed and a new value is entered, it is saved by pressing ENTER and progressing to the next parameter. Furthermore, to exit the rC command after all values have been changed, press ESC (make sure that the last value entered is saved by pressing ENTER before exiting the rC command).

Table 2. Sensor configuration settings using the rC command.

Parameter	Setting		
	All	Non-Heated (DGD# AB09230000)	Heated (DGD# AB09230010)
Serial Number	Default		
Baud rate NA	9600		
Enable RS-485	N		
Enable Real Time Clock Date and Time? (Y/N)	N		
Enable Memory Stick Logging? (Y/N)	N		
Two Digit Year (20xx)	Current		
Month	Current		
Day of the month	Current		
Hour	Current		
Minutes past the hour	Current		
Date and time are always part of memory stick telegrams Prepend Date and Time to Serial telegrams? (Y/N)	N		
Reporting interval (seconds) 0 for no report, Even values 2-3600 secs.	10		
Report in metric Units	Y		
Select Telegram format - default=1, CSV=2, CRC16=3	2		
Averaging interval (in seconds), Zero for averaging off.	0		
Enable extended output message? (Y/N)	Y		
Show ambient and orifice temperatures? (Y/N)		N	Y
Enable Reporting of input/clock status flags? (Y/N)	N		
Show ping amplitudes? (Y/N)	N		

Frequency Report? 0=Off; 1=Uncomp; 2=Temp. Comp.; 3=both.	3		
Enable rounding to 0.001 place? (Y/N)	Y		
Enable Precipitation Rate Calculation? (Y/N)	Y		
Time span for Precipitation Rate (minutes)	5		
Select number of inlet heaters. (0-3), 0 = None		0	3
Enable precipitation in heater control? (Y/N)	N		
Relay 4? 0=Off; 1=Precip. detection; 2=Tipping bucket	0		
Relay 'on' point, inches of precipitation	0.004000		
Time period for relay 'on' point (minutes)	60		
Averaging interval for relay 'on' point (minutes)	60		
Relay 'off' point, inches of precipitation	0.003000		
Time period for relay 'off' point (minutes)	60		
Averaging interval for relay 'off' point (minutes)	60		
Heater Relay Ambient Temperature Low Limit. (C)	-8		
Heater Relay Ambient Temperature High Limit. (C)	4		
Heater Relay Inlet Temperature Low Limit. (C)	1		
Heater Relay Inlet Temperature High Limit. (C)	4		
Heater off to 1 heater dwell time (minutes)	2		
Heater 1 to 2 heater dwell time (minutes)	2		
Heater 2 to 3 heater dwell time (minutes)	2		
Heater 3 to full on dwell time (minutes)	2		
Enable daily heater test? (Y/N)	N		
Heater daily test on time (minutes)	10		
Heater daily test highest temperature. (C)	2.000000		
Enable heater report? (Y/N)		N	Y
Terminal NZ (40) default	40		
Ping-to-read delay (32Mhz clocks)	380		
Lowest Ping Cycle (3)	4		
Medium Ping Cycle (9)	8		
Highest Ping Cycle (27)	12		
Lowest Amplitude Threshold (800)	300		
Medium Amplitude Threshold (1200)	400		
Highest Amplitude Threshold (1800)	500		
Temp. test qualifying range (0=disable)	0		
Temp. test validity range (0=disable)	0		
Sensors in this rain gauge	3		
Enable Temperature Compensation in results? (Y/N)	N		
Sensor Coefficients? 0=Legacy; 1=CRN1; 2=CRN2	1		
Sensor 1 serial number	Default		

Sensor 2 serial number	Default		
Sensor 3 serial number	Default		
Sensor 1 temperature compensation factor (x 10^6)	Default		
Sensor 1 temperature at calibration (degrees C)	Default		
Sensor 1 first order coefficient (lbs/kHz^2)	Default		
Sensor 1 second order coefficient (lbs/kHz^4)	Default		
Sensor 2 temperature compensation factor (x 10^6)	Default		
Sensor 2 temperature at calibration (degrees C)	Default		
Sensor 2 first order coefficient (lbs/kHz^2)	Default		
Sensor 2 second order coefficient (lbs/kHz^4)	Default		
Sensor 3 temperature compensation factor (x 10^6)	Default		
Sensor 3 temperature at calibration (degrees C)	Default		
Sensor 3 first order coefficient (lbs/kHz^2)	Default		
Sensor 3 second order coefficient (lbs/kHz^4)	Default		
Enable Tipping bucket on Relay 2? (Y/N)	N		
Millimeters of rain for span calibration	Default		
Calibration weight at empty (kgs)	Default		
Calibration weight at span (kgs)	Default		
Calibration weight at zero (kgs)	Default		

4.1.3 RD Command

The rD command toggles the data stream output among the following four levels of detail. In order to capture the related data products listed in **Table 3**, the "**Expanded response message**" will need to be selected and output from the sensor. [R]: will always precede the sensor details and the first three characters of the output will be either an S, P, or F and represent the status of the three strain gauges (described in the notes below). The different rD command options are listed below as a reference.

1) rD details level: **None**[1]
    a. Five different categories are output; the status of the three strain gauges, total weight of precipitation, and total inches of precipitation. Ex. [R]: PPP Total_Wt Total_Inches
2) rD details level: **Expanded response message**[1]
    a. Displays all output variables that are enabled. [Rain Gauge]: (Status 1) (Status 2) (Status 3) (Ambient temp) (Orifice Temp) (Sensor 1 Temp) (Sensor 2 Temp) (Sensor 3 Temp) (Sensor 1 Freq [uncompensated]) (Sensor 2 Freq [uncompensated]) (Sensor 3 Freq [uncompensated]) (Sensor 1 Freq [compensated]) (Sensor 2 Freq [compensated]) (Sensor 3 Freq [temperature compensated]) (Sensor 1 Wt) (Sensor 2 Wt) Sensor 3 Wt) (Total Wt) (Total Inches) (Heater Status) (Precipitation Accumulation rate)
3) rD details level: **Sensor data**[2]

a. Sensor data information is displayed for each strain gauge. This command will not normally be used unless trouble shooting is necessary and is done with the guidance of either CVAL or Belfort.

4) rD details level: **Standard deviation data[2]**

a. Frequency information from the strain gauges is displayed. This command will not normally be used unless trouble shooting is necessary and is done with the guidance of either CVAL or Belfort.

Note:

- [1] indicates that this rD command is normally used for regular operation
- [2] indicates that this rD command is normally used for trouble shooting
- The gauge status is represented by either an S (0), P (1), or F (-1). An S indicates that the transducer is not reporting a stable frequency (i.e. searching), while P represents that the transducer has reached a stable frequency (i.e. passed). An F indicates a failure which can result from either a broken/damaged strain gauge or a broken temperature thermistor.

Since sensor data is output in one string, it must be parsed out into its related data products shown in **Table 3**. The sensor output from the expanded response message is shown below.

Expanded response message: [Rain Gauge]: (Status 1) (Status 2) (Status 3) ***(Ambient temp) (Orifice Temp)*** (Sensor 1 Temp) (Sensor 2 Temp) (Sensor 3 Temp) (Sensor 1 Freq [uncompensated]) (Sensor 2 Freq [uncompensated]) (Sensor 3 Freq [uncompensated]) (Sensor 1 Freq [compensated]) (Sensor 2 Freq [compensated]) (Sensor 3 Freq [temperature compensated]) (Sensor 1 Wt) (Sensor 2 Wt) Sensor 3 Wt) (Total Wt) (Total Inches) ***(Heater Status)*** (Precipitation Accumulation rate)

The sections of the expanded response message that specific data products correspond to are denoted in **Table 3**. Also, the bold and italicized sections are only applicable for heated precipitation gauges.

Table 3. Relation of expanded response message output to primary precipitation-related L0 DPs.

Expanded Response Message	Corresponding Data product	Data Product ID
Status 1	Strain Gauge Stability 1	NEON.DOM.SITE.DP0.00006.001.01897.HOR.VER.000
Status 2	Strain Gauge Stability 2	NEON.DOM.SITE.DP0.00006.001.02068.HOR.VER.000
Status 3	Strain Gauge Stability 3	NEON.DOM.SITE.DP0.00006.001.02069.HOR.VER.000
Orifice Temp*	***Inlet Temperature****	NEON.DOM.SITE.DP0.00006.001.01905.HOR.VER.000
Ambient temp*	***Internal Temperature****	NEON.DOM.SITE.DP0.00006.001.01906.HOR.VER.000
Sensor 1 Temp	Strain Gauge Temperature 1	NEON.DOM.SITE.DP0.00006.001.01898.HOR.VER.000
Sensor 2 Temp	Strain Gauge Temperature 2	NEON.DOM.SITE.DP0.00006.001.02070.HOR.VER.000

Sensor 3 Temp	Strain Gauge Temperature 3	NEON.DOM.SITE.DP0.00006.001.02071.HOR.VER.000
Sensor 1 Freq [uncompensated]	Strain Gauge Frequency 1 - No Temperature Compensation	NEON.DOM.SITE.DP0.00006.001.01900.HOR.VER.000
Sensor 2 Freq [uncompensated]	Strain Gauge Frequency 2 - No Temperature Compensation	NEON.DOM.SITE.DP0.00006.001.02072.HOR.VER.000
Sensor 3 Freq [uncompensated]	Strain Gauge Frequency 3 - No Temperature Compensation	NEON.DOM.SITE.DP0.00006.001.02073.HOR.VER.000
Sensor 1 Freq [compensated]	Strain Gauge Frequency 1 - Temperature Compensated	NEON.DOM.SITE.DP0.00006.001.01999.HOR.VER.000
Sensor 2 Freq [compensated]	Strain Gauge Frequency 2 - Temperature Compensated	NEON.DOM.SITE.DP0.00006.001.02076.HOR.VER.000
Sensor 3 Freq [compensated]	Strain Gauge Frequency 3 - Temperature Compensated	NEON.DOM.SITE.DP0.00006.001.02077.HOR.VER.000
Sensor 1 Wt	Strain Gauge Weight 1	NEON.DOM.SITE.DP0.00006.001.01901.HOR.VER.000
Sensor 2 Wt	Strain Gauge Weight 2	NEON.DOM.SITE.DP0.00006.001.02074.HOR.VER.000
Sensor 3 Wt	Strain Gauge Weight 3	NEON.DOM.SITE.DP0.00006.001.02075.HOR.VER.000
Total Wt	Total Gauge Weight	NEON.DOM.SITE.DP0.00006.001.01903.HOR.VER.000
Total Inches	Total Precipitation Depth	NEON.DOM.SITE.DP0.00006.001.01904.HOR.VER.000
Heater Status*	***Heater Status****	NEON.DOM.SITE.DP0.00006.001.02000.HOR.VER.000
Precipitation Accumulation Rate	Precipitation Accumulation Rate	NEON.DOM.SITE.DP0.00006.001.01907.HOR.VER.000

Note: * only heated gauges will output these data products

4.2 Double Fence Intercomparison Reference (DFIR)

The DFIR does not require any configuration.

5 COMMAND AND CONTROL

5.1 Error Handling

In the event that one strain gauge differs from the other two by a predetermined amount (set at the factory) or a temperature thermistor breaks, the sensor status stream will become an F (-1) and a trouble ticket shall be issued. Additionally, an LED indicator on the inside of the sensor housing will indicate which sensor needs to be replaced. These sensor status LEDs can be seen in **Figure 1**.

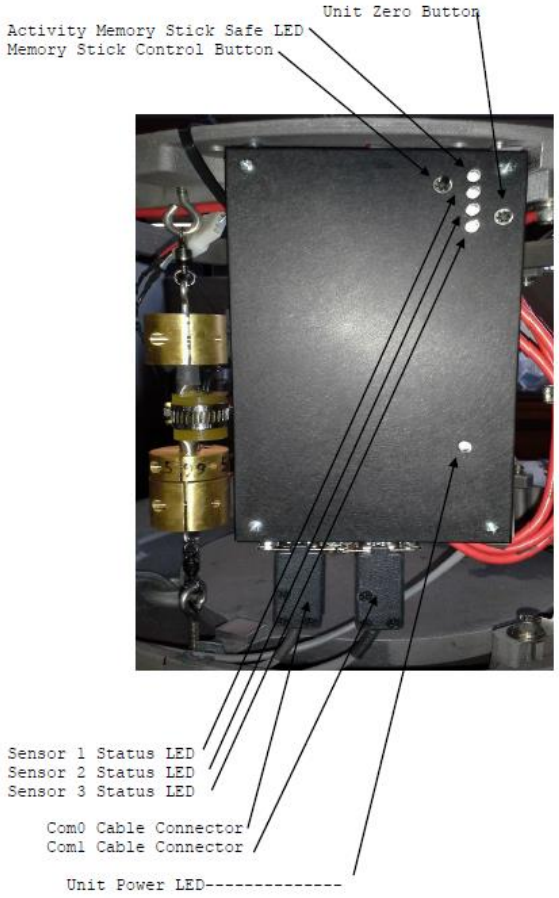

Figure 1. Digital processor and signal conditioning unit within the precipitation sensor, Belfort 2014.

5.2 Heater Controls

The heaters will be controlled for heated units, NEON P/N: 0303440002, according to the set points defined in **Table 3**. The logic shown in **Figure 2** shall monitor heated units and issue trouble tickets to problem tracking and resolution accordingly,

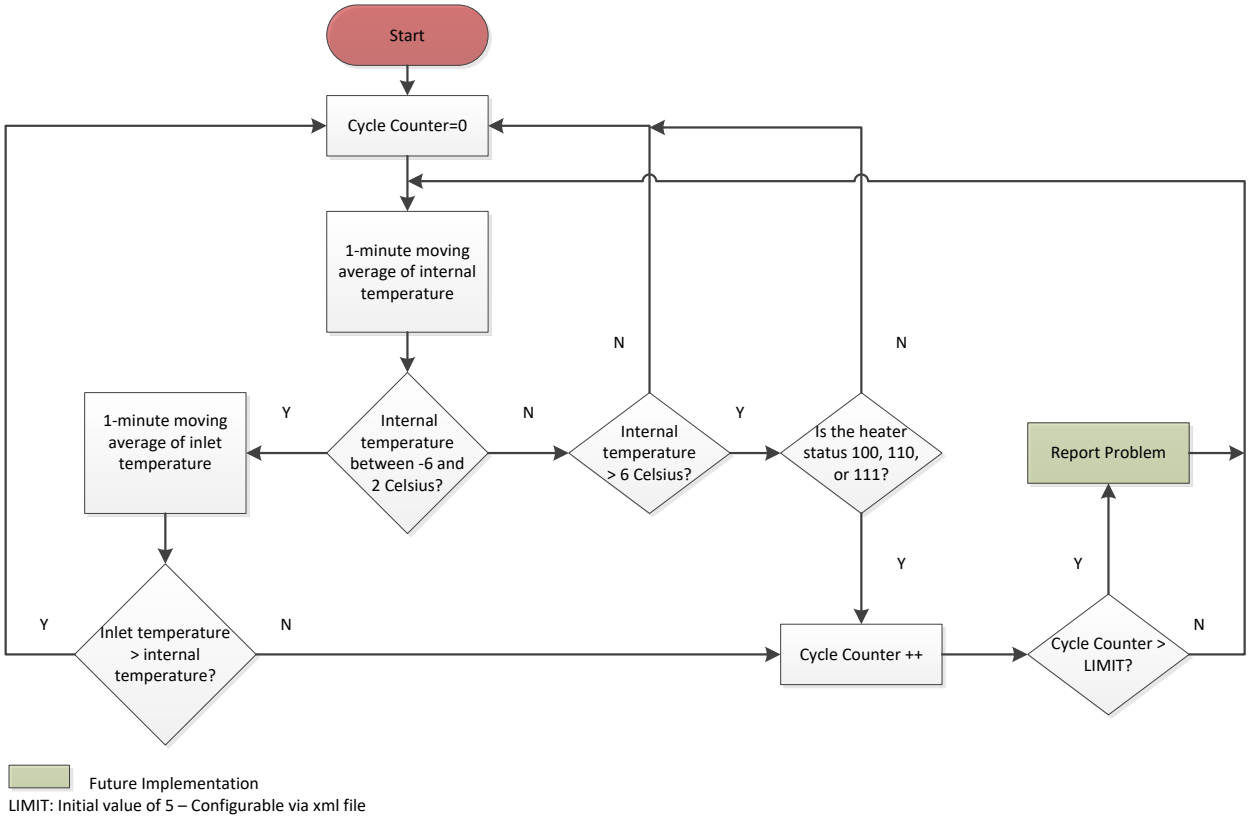

Figure 2. Command and control for reporting heater errors in the event of a malfunction.

6 APPENDIX

6.1 List of Level 0 Data Products

Table 4. List of Level 0 data products associated with primary precipitation (dpID: NEON.DOM.SITE.DP0.00006.001)

DGD Agile PN	Data Product Number	fieldName	Description	Acquisition frequency (Hz)	dataType	Units
AB09230000	NEON.DOM.SITE.DP0.00006.001.01897.HOR.VER.000	strainGauge1Stability	Stability flag indicating if strain gauge 1 in the primary precipitation sensor is reporting a stable frequency (1 = stable, 0 = unstable, -1 = sensor failure)	0.1 Hz	integer	NA
	NEON.DOM.SITE.DP0.00006.001.02068.HOR.VER.000	strainGauge2Stability	Stability flag indicating if strain gauge 2 in the primary precipitation sensor is reporting a stable frequency (1 = stable, 0 = unstable, -1 = sensor failure)	0.1 Hz	integer	NA
	NEON.DOM.SITE.DP0.00006.001.02069.HOR.VER.000	strainGauge3Stability	Stability flag indicating if strain gauge 3 in the primary precipitation sensor is reporting a stable frequency (1 = stable, 0 = unstable, -1 = sensor failure)	0.1 Hz	integer	NA
	NEON.DOM.SITE.DP0.00006.001.01898.HOR.VER.000	strainGauge1Temp	Strain gauge 1 transducer temperature in the primary precipitation sensor	0.1 Hz	real	°C
	NEON.DOM.SITE.DP0.00006.001.02070.HOR.VER.000	strainGauge2Temp	Strain gauge 2 transducer temperature in the primary precipitation sensor	0.1 Hz	real	°C
	NEON.DOM.SITE.DP0.00006.001.02071.HOR.VER.000	strainGauge3Temp	Strain gauge 3 transducer temperature in the primary precipitation sensor	0.1 Hz	real	°C
	NEON.DOM.SITE.DP0.00006.001.01900.HOR.VER.000	strainGauge1FreqRaw	The raw frequency reported by strain gauge 1 in the primary precipitation sensor (i.e., uncompensated for temperature)	0.1 Hz	real	Hz
	NEON.DOM.SITE.DP0.00006.001.02072.HOR.VER.000	strainGauge2FreqRaw	The raw frequency reported by strain gauge 2 in the primary precipitation sensor (i.e., uncompensated for temperature)	0.1 Hz	real	Hz

	NEON.DOM.SITE.DP0.00006.001.02073.HOR.VER.000	strainGauge3FreqRaw	The raw frequency reported by strain gauge 3 in the primary precipitation sensor (i.e., uncompensated for temperature)	0.1 Hz	real	Hz
	NEON.DOM.SITE.DP0.00006.001.01999.HOR.VER.000	strainGauge1FreqComp	The temperature compensated frequency reported by strain gauge 1 in the primary precipitation sensor	0.1 Hz	real	Hz
	NEON.DOM.SITE.DP0.00006.001.02076.HOR.VER.000	strainGauge2FreqComp	The temperature compensated frequency reported by strain gauge 2 in the primary precipitation sensor	0.1 Hz	real	Hz
	NEON.DOM.SITE.DP0.00006.001.02077.HOR.VER.000	strainGauge3FreqComp	The temperature compensated frequency reported by strain gauge 3 in the primary precipitation sensor	0.1 Hz	real	Hz
	NEON.DOM.SITE.DP0.00006.001.01901.HOR.VER.000	strainGauge1Weight	The weight reported by strain gauge 1 in the primary precipitation sensor	0.1 Hz	real	kg
	NEON.DOM.SITE.DP0.00006.001.02074.HOR.VER.000	strainGauge2Weight	The weight reported by strain gauge 2 in the primary precipitation sensor	0.1 Hz	real	kg
	NEON.DOM.SITE.DP0.00006.001.02075.HOR.VER.000	strainGauge3Weight	The weight reported by strain gauge 3 in the primary precipitation sensor	0.1 Hz	real	kg
	NEON.DOM.SITE.DP0.00006.001.01903.HOR.VER.000	totalGaugeWeight	The combined weight from the 3 strain gauges in the primary precipitation sensor	0.1 Hz	real	kg
	NEON.DOM.SITE.DP0.00006.001.01904.HOR.VER.000	totalPrecipDepth	The total depth reported by the internal calculations of the 3 strain gauges in the primary precipitation sensor	0.1 Hz	real	mm
	NEON.DOM.SITE.DP0.00006.001.01907.HOR.VER.000	precipAccumulationRate	Accumulation of precipitation calculated by internal calculations of the 3 strain gauges in the primary precipitation sensor	0.1 Hz	real	mm

AB09230010	NEON.DOM.SITE.DP0.00006.001.01897.HOR.VER.000	strainGauge1Stability	Stability flag indicating if strain gauge 1 in the primary precipitation sensor is reporting a stable frequency (1 = stable, 0 = unstable, -1 = sensor failure)	0.1 Hz	integer	NA
	NEON.DOM.SITE.DP0.00006.001.02068.HOR.VER.000	strainGauge2Stability	Stability flag indicating if strain gauge 2 in the primary precipitation sensor is reporting a stable frequency (1 = stable, 0 = unstable, -1 = sensor failure)	0.1 Hz	integer	NA
	NEON.DOM.SITE.DP0.00006.001.02069.HOR.VER.000	strainGauge3Stability	Stability flag indicating if strain gauge 3 in the primary precipitation sensor is reporting a stable frequency (1 = stable, 0 = unstable, -1 = sensor failure)	0.1 Hz	integer	NA
	NEON.DOM.SITE.DP0.00006.001.01898.HOR.VER.000	strainGauge1Temp	Strain gauge 1 transducer temperature in the primary precipitation sensor	0.1 Hz	real	°C
	NEON.DOM.SITE.DP0.00006.001.02070.HOR.VER.000	strainGauge2Temp	Strain gauge 2 transducer temperature in the primary precipitation sensor	0.1 Hz	real	°C
	NEON.DOM.SITE.DP0.00006.001.02071.HOR.VER.000	strainGauge3Temp	Strain gauge 3 transducer temperature in the primary precipitation sensor	0.1 Hz	real	°C
	NEON.DOM.SITE.DP0.00006.001.01900.HOR.VER.000	strainGauge1FreqRaw	The raw frequency reported by strain gauge 1 in the primary precipitation sensor (i.e., uncompensated for temperature)	0.1 Hz	real	Hz
	NEON.DOM.SITE.DP0.00006.001.02072.HOR.VER.000	strainGauge2FreqRaw	The raw frequency reported by strain gauge 2 in the primary precipitation sensor (i.e., uncompensated for temperature)	0.1 Hz	real	Hz
	NEON.DOM.SITE.DP0.00006.001.02073.HOR.VER.000	strainGauge3FreqRaw	The raw frequency reported by strain gauge 3 in the primary precipitation sensor (i.e., uncompensated for temperature)	0.1 Hz	real	Hz

	NEON.DOM.SITE.DP0.00006.001.01999.HOR.VER.000	strainGauge1FreqComp	The temperature compensated frequency reported by strain gauge 1 in the primary precipitation sensor	0.1 Hz	real	Hz
	NEON.DOM.SITE.DP0.00006.001.02076.HOR.VER.000	strainGauge2FreqComp	The temperature compensated frequency reported by strain gauge 2 in the primary precipitation sensor	0.1 Hz	real	Hz
	NEON.DOM.SITE.DP0.00006.001.02077.HOR.VER.000	strainGauge3FreqComp	The temperature compensated frequency reported by strain gauge 3 in the primary precipitation sensor	0.1 Hz	real	Hz
	NEON.DOM.SITE.DP0.00006.001.01901.HOR.VER.000	strainGauge1Weight	The weight reported by strain gauge 1 in the primary precipitation sensor	0.1 Hz	real	kg
	NEON.DOM.SITE.DP0.00006.001.02074.HOR.VER.000	strainGauge2Weight	The weight reported by strain gauge 2 in the primary precipitation sensor	0.1 Hz	real	kg
	NEON.DOM.SITE.DP0.00006.001.02075.HOR.VER.000	strainGauge3Weight	The weight reported by strain gauge 3 in the primary precipitation sensor	0.1 Hz	real	kg
	NEON.DOM.SITE.DP0.00006.001.01903.HOR.VER.000	totalGaugeWeight	The combined weight from the 3 strain gauges in the primary precipitation sensor	0.1 Hz	real	kg
	NEON.DOM.SITE.DP0.00006.001.01904.HOR.VER.000	totalPrecipDepth	The total depth reported by the internal calculations of the 3 strain gauges in the primary precipitation sensor	0.1 Hz	real	mm

	NEON.DOM.SITE.DP0.00006.001.01907.HOR.VER.000	precipAccumulationRate	Accumulation of precipitation calculated by internal calculations of the 3 strain gauges in the primary precipitation sensor	0.1 Hz	real	mm
	NEON.DOM.SITE.DP0.00006.001.02000.HOR.VER.000	orificeHeaterFlag	Heater flag indicating the number of orifice heaters that were operational for a measurement period, (i.e., 000 = off, 100 = one on, 110 = two on, and 111 = all three on)	0.1 Hz	integer	NA
	NEON.DOM.SITE.DP0.00006.001.01905.HOR.VER.000	inletTemp	The inlet orifice temperature, which is monitored to control orifice heater operation for the primary precipitation sensor	0.1 Hz	real	°C
	NEON.DOM.SITE.DP0.00006.001.01906.HOR.VER.000	internalTemp	Ambient temperature inside the sensor, which is monitored to control orifice heater operation for the primary precipitation sensor	0.1 Hz	real	°C

7 BIBLIOGRAPHY

Belfort. (2014) Universal all environment precipitation gauge model APEG II 1200 instruction manual MK III. Belfort instrument Company. pp. 55, Manual Number 90008-3