



<i>Title:</i> NEON Sensor Command, Control and Configuration (C3) Document: Soil Longwave Radiation		<i>Date:</i> 05/16/2022
<i>NEON Doc. #:</i> NEON.DOC.000778	<i>Author:</i> N. Pingintha-Durden	<i>Revision:</i> B

NEON SENSOR COMMAND, CONTROL AND CONFIGURATION (C3) DOCUMENT: SOIL LONGWAVE RADIATION

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Change Record

REVISION	DATE	ECO #	DESCRIPTION OF CHANGE
A	09/18/2014	ECO-00767	Initial Release
B	05/16/2022	ECO-06818	<ul style="list-style-type: none">• Revised NEON logo• Added fine print



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1 DESCRIPTION

1.1 Purpose

This document specifies the command, control, and configuration details for operating the IR01 pyrgeometers as the components of the Hukseflux NR01 Net Radiation Sensor. 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 are identified.

1.2 Scope

The IR01 pyrgeometers as the components of the Hukseflux NR01 Net Radiation Sensor (NEON P/N: 0300070002) will be used to make measurements of incident and reflected longwave radiation above the soil surface in the soil arrays. There is no firmware required for this sensor and the reference document for the Hukseflux IR01 pyrgeometer is RD [03].

This document specifies the command, control, and configuration that is 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.



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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
AD [05]	NEON.DOC.000254	NEON Data Product Naming Convention
AD [06]	NEON.DOC.000809	Soil Radiation: Longwave Radiation ATBD
AD [07]	NEON.DOC.000850	Humidity and Temperature Sensor Command, Control, and Configuration

2.2 Reference Documents

RD [01]	NEON.DOC.000008	NEON Acronym List
RD [02]	NEON.DOC.000243	NEON Glossary of Terms
RD [03]	Hukesflux Thermal Sensors NR01 RA01 Manual Version 0715. Hukesflux Thermal Sensors Elektronikaweg 25, 2628 XG Delft. The Netherlands	

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

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.



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3 INTRODUCTION

The IR01 pyrgeometers as the components of the Hukseflux NR01 Net Radiation Sensor are selected to measure longwave radiation at the soil surface applied in the soil arrays. The related longwave radiation Level 0 data products acquired from Hukseflux IR01 pyrgeometer are listed in **Table 1**. A description of how sensor readings shall be converted to standard longwave radiation units of $W.m^{-2}$ is presented in the associated ATBD (AD [06]).

Table 1. L0 data products acquired form Hukseflux IR01 pyrgeometer.

Parameters	L0 data products NEON.DOM.SIT.DPL.PRN.REV.SPN.HOR.VER.REP	Unit*
Incident longwave radiation	NEON.DOM.SIT.DP0.000105.001.001.00N.000.001	V
Reflected longwave radiation	NEON.DOM.SIT.DP0.000105.001.002.00N.000.001	V
Sensor body temperature (T_b)	NEON.DOM.SIT.DP0.000105.001.003.00N.000.001	Ohms
Heater diagnostic flag	NEON.DOM.SIT.DP0.000105.001.004.00N.000.001	Binary (0/1)

* Units acquired from the GRAPE.



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4 OVERVIEW OF SENSOR CONFIGURATION

The radiation data from the sensor shall be unfiltered and uncorrected mV. Sensor body temperature will be unfiltered and uncorrected Ohms. Note that sensor readings will be reported in units Volts and Ohms due to signal processing for analog sensors by the GRAPE.

Table 2. Sensor configuration settings.

Parameter	Default Setting
Heater	Off
Incident longwave radiation: Acquisition rate	1 Hz
Reflected longwave radiation: Acquisition rate	1 Hz
Sensor body temperature (T_b): Acquisition rate	1 Hz



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5 COMMAND AND CONTROL

5.1 Error Handling

This sensor provides no error notification.

5.2 Sensor Heating Controls Specification

Heater control is recommended to prevent condensation from forming on the sensor, resulting in larger uncertainties in the longwave radiation data product when applied. The heater shall be turned on or off accordingly to the difference between the ambient dew point temperature (T_{dew} : NEON.DOM.SIT.DP0.000106.001.005.000.001.001, refers to AD [07]) and the sensor body temperature (T_b : NEON.DOM.SIT.DP0.000105.001.003.001.000.001). As per the current design, T_{dew} is measured using the HMP155 humidity and temperature sensor (NEON P/N: 031565000). A ‘flagged’ data product will indicate when the heater is off (0) or on (1). **Table 3** specifies the command and control structure for the heater.

Table 3. Truth table for controlling sensor heater.

Control parameter(s)	Condition	Data acquisition system action	Output to CI
T_{dew} and T_b	$T_b - T_{dew} \leq 2.5 \pm 1 \text{ }^\circ\text{C}$	Turn heater on	Heater flag (1) (NEON.DOM.SIT.DP0.000105.001.004.00N.000.001)
T_{dew} and T_b	$T_b - T_{dew} > 3.5 \pm 1 \text{ }^\circ\text{C}$	Turn heater off	Heater flag (0) (NEON.DOM.SIT.DP0.000105.001.004.00N.000.001)



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The ambient dew point temperature (NEON.DOM.SIT.DP0.000106.001.005.000.001.001) will be retrieved from the HMP155 humidity and temperature sensor (NEON P/N: 031565000) installed at the soil array. The command, control, and configuration of HMP155 is AD [07]. The difference between the ambient dew point temperature and the sensor body temperature (NEON.DOM.SIT.DP0.000105.001.003.00N.000.001) measured by the pyrgeometer will be used to determine when the heater should be automatically switched on or off (**Table 3**).



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7 APPENDIX & BIBLIOGRAPHY

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