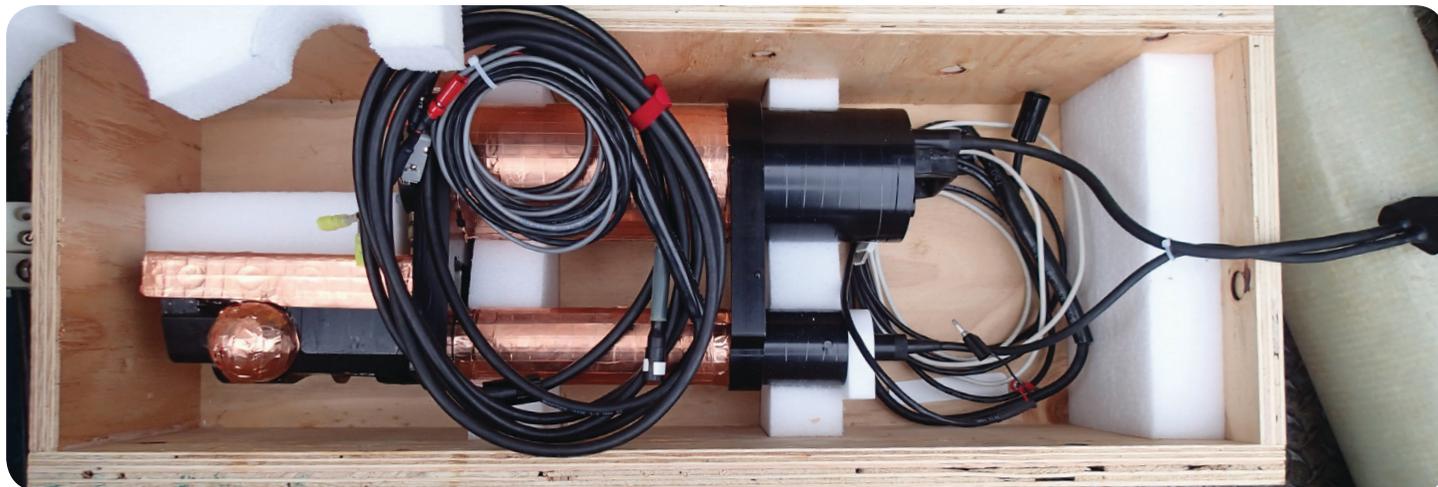# SeapHOx V2 CTD Integration Guide

Configuring a 37-SMP-ODO CTD for Use with a SeapHOx V2

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Introduction

Salinity and temperature data from a **37-SMP-ODO** CTD + dissolved oxygen sensor provide vital data <u>required to optimize the pH</u> measured by the **SeaFET V2** pH sensor. The combination of the two instruments forms the **SeapHOx V2** and **Deep SeapHOx V2**—pH sensors that utilize an Ion Selective Field Effect Transistor (ISFET) and solid-state reference electrode to measure pH with superior accuracy and stability. The ISFET's raw measurement is a combination of <u>pH and other confounding factors</u>, and requires CTD data to remove these confounding factors from the final pH calculation. Thus, if CTD data is not available, the SeapHOx cannot properly calculate pH, resulting in "NaN" values for pH in the final output.

Every SeapHOx V2 comes pre-configured and tested with its CTD, allowing the package to effectively function as a fully integrated multiparameter instrument. However, In rare instances, CTD data may not reach the SeaFET V2. This can occur for the following reasons:

- Failure of the cable connecting the SeaFET V2 pH sensor and the 37-SMP-ODO CTD.
- Exhausted batteries in the 37-SMP-ODO CTD.
- Improper configuration of the 37-SMP-ODO CTD.

In those cases, it is advantageous to have a second CTD that can act as a drop-in replacement. This guide covers the required hardware and instrument configuration, as well as deployment considerations when replacing the original CTD.

> **Note:** Converting a SeaFET V2 to a SeapHOx V2 must be done at Sea-Bird Scientific. The following instructions are meant to guide SeapHOx V2 users in providing a replacement CTD. **This document does not cover how to convert a SeaFET V2 to a SeapHOx V2.**

Required SBE 37-SMP-ODO Hardware

The SeapHOx V2 is only compatible with certain hardware configurations and firmware versions of the SBE 37-SMP-ODO CTD. To determine if a drop-in replacement is compatible, ensure that it has the following hardware:

- Titanium Housing
- Pressure Sensor
- 4-pin MCBH Connector
- RS-232 Output
- DO Sensor

This equates to the part number 37SMP.3**A**20**B**, where:

- A = 1-8
- B = 2-4

Family	Model	.	Housing	Pressure Sensor	Connector	Communication	SBE 63
37	**SMP**	.	**3** – 7000 m (titanium)	**1** – 20 m	**2** – MCBH	**0** – RS-232	**2** – 600 m
				2 – 100 m			**3** – 5000 m
				3 – 350 m			**4** – 7000 m
				4 – 600 m			
				5 – 1000 m			
				6 – 2000 m			
				7 – 3500 m			
				8 – 7000 m			

Table 1: Part number listings of 37-SMP-ODO configurations that are compatible with the SeapHOx V2 (only digits that correspond with compatible SBE 37-SMP-ODOs are listed). The part number is listed on the CTD's sticker above the serial number.

Examples:
- By default, the Shallow SeapHOx V2 uses 37SMP.31202 (20m P sensor) or 37SMP.32202 (100m P sensor)
- The Deep SeapHOx V2 uses 37SMP.33202 (350m P sensor) or 37SMP.36203 (2000m P sensor and 5000m DO sensor)

Required SBE 37-SMP-ODO Firmware

The lowest firmware version that is compatible with the SeapHOx V2 is firmware version 2.2.0. This corresponds roughly with 37-SMP-ODO serial number 10500 and above. Older firmware versions have a different output that is not compatible with the SeapHOx V2.

Note that other types of the SBE 37 CTD (SI, SIP, SIP-IDO, SM, SMP, IM, IMP, or IMP-ODO) are not compatible with the SeapHOx V2; only the 37-SMP-ODO with firmware version 2.2.0 and greater is compatible with the SeapHOx V2.

Required SBE 37-SMP-ODO Configuration

The 37-SMP-ODO requires a specific configuration to send the proper data string to the SeapHOx V2. The SeapHOx V2 cannot interpret data from an improperly configured CTD, and it will not save a backup in the memory. Send the following commands prior to connecting it to the SeapHOx V2:

Stop	Stops the CTD if it is currently logging.
outputformat=0	Sets the output format to raw decimal. The SeapHOx V2 cannot interpret any other data format.
txrealtime=1	Sets the CTD to output data when sampling.
outputexecutedtag=n	Disables the </Executed> tag after each commands response.

> **Note:** The SeapHOx V2 will automatically configure the CTD upon receiving the "resync" command (see below). These commands simply ensure the CTD will send the correct data string in the event that "resync" is not sent.

Commands Sent from the SeapHOx V2

When the correct 37-SMP-ODO configuration is available, the SeapHOx V2 can automatically configure the CTD's output for use with the pH sensor. An improper configuration will result in NaN values for CTD and pH External data. After connecting the replacement CTD, send the following commands and log the output for reference:
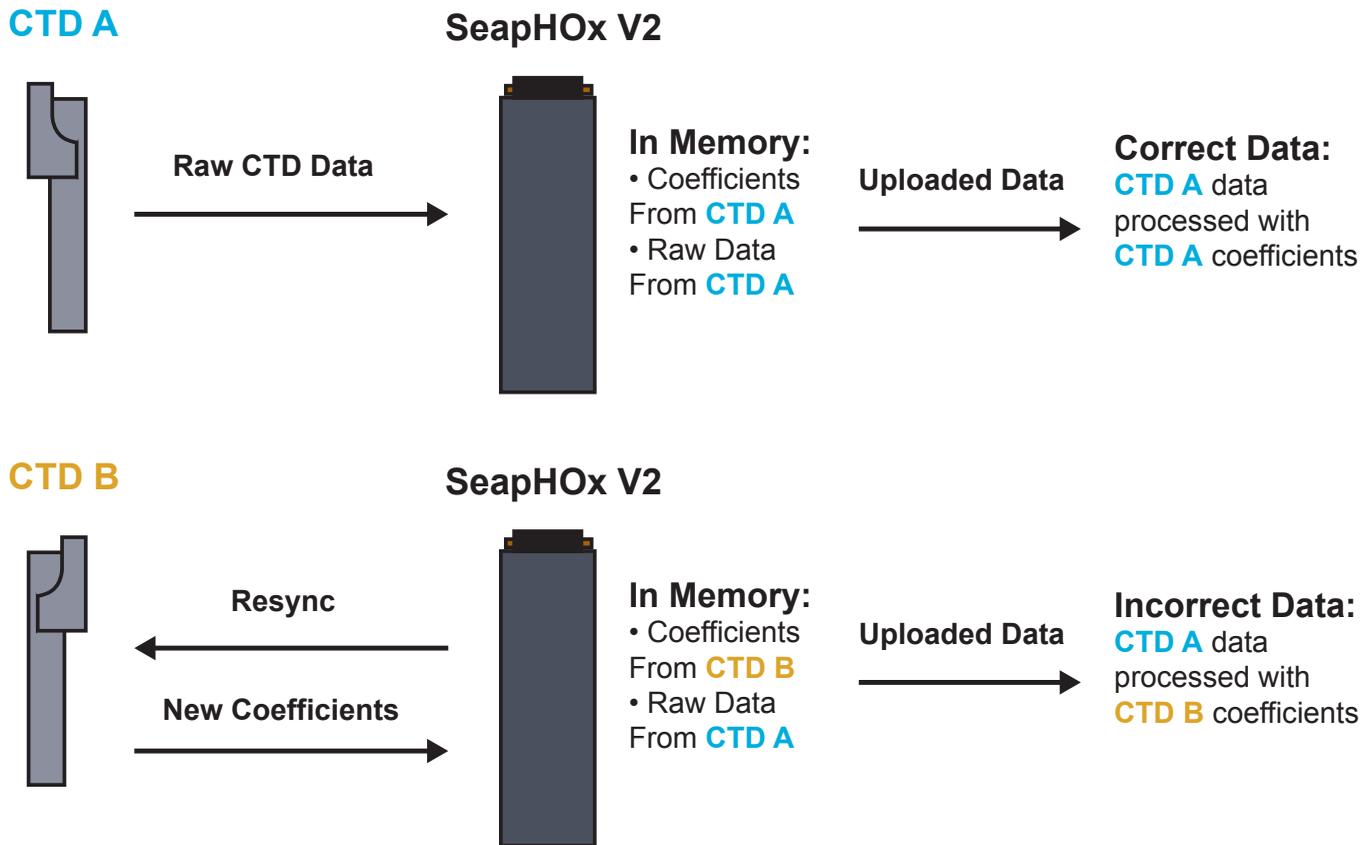
DS	Displays the SeapHOx V2 status.
DC	Displays the current SeapHOx V2 and CTD coefficients.
GetSD	Displays the SeapHOx V2 status in XML format.
GetCD	Displays the SeapHOx V2 configuration in XML format.
GetHD	Displays the SeapHOx V2 hardware data in XML format.
GetEC	Displays the error count.
Resync	**IMPORTANT.** Automatically configures the 37-SMP-ODO CTD to work with the SeapHOx V2 and updates the CTD calibration coefficients in the SeapHOx V2 memory.

```
resync
Disabling <Executed/> tag from
CTD...OK
Setting Output Format...OK
Loading SBE37 info...OK
Loading coefficients...OK
Storing coefficients...OK
Loading SBE63 info...OK
Resync Complete:
SBE37 # 10997, v2.3.1
SBE63 #  0497, v3.2.2
```

Expected response from the **resync** command

Deployment Consideration: CTD and pH Data Processing

     The SeapHOx V2 saves the CTD calibration coefficients in its memory. When uploading data, it uses these coefficients to convert raw sensor data stored in memory to converted pH, temperature, pressure, salinity, and oxygen data. Whenever the SeapHOx V2 receives the "resync" command, it erases the old CTD calibration coefficients and updates them with the coefficients from the current CTD. This can be problematic when uploading data after switching a CTD:

CTD A   **SeapHOx V2**

Raw CTD Data →

In Memory:
- Coefficients From **CTD A**
- Raw Data From **CTD A**

Uploaded Data →

Correct Data:
CTD A data processed with **CTD A** coefficients

CTD B   **SeapHOx V2**

← **Resync**

New Coefficients →

In Memory:
- Coefficients From **CTD B**
- Raw Data From **CTD A**

Uploaded Data →

Incorrect Data:
CTD A data processed with **CTD B** coefficients

     To avoid processing CTD and pH data with the incorrect calibration coefficients, **upload all SeapHOx V2 data before switching the CTD**. If this is not an option, identify the sample range encompassed by each CTD prior to switching CTDs. When uploading data, reconnect and resync each CTD and upload the appropriate samples.

Example

CTD A was used for samples 1 – 1500. After its batteries died, **CTD B** was substituted and provided data for samples 1501 – 3000.

When uploading data with **CTD B** connected, upload samples 1501 – 3000. Then, reconnect **CTD A** to the SeapHOx V2, send resync, and upload samples 1 – 1500. This will ensure that each dataset is processed with the correct CTD coefficients.