



## D-2 INCORPORATED

# Full Ocean Depth CTD Conductivity, Temperature & Depth Sensor

## CTD Sensor



## OPERATION MANUAL P/N 310-010 Firmware Version 1.10

### Revision History:

Rev	Date	Description	
0	13-MAY-20	Written	<b>DLF</b>
1	29-NOV-21	Update for release	<b>SWS</b>
2	26-MAR-24	Update for Firmware and Commands	<b>DLF</b>
3	12-AUG-24	Add Memory Info & Correct Baud Rate & Add CMOS, Remove RS-485	<b>DLF</b>

This manual covers the operational aspects of the D-2 CTD Ocean Conductivity, Temperature and Depth Sensor. D-2 continuously strives to meet the full expectations of our customers and we welcome comments on the structure, content and the ability of this manual to answer your questions regarding our product. If you have any suggestions or comments, please contact us at [sales@D-2inc.com](mailto:sales@D-2inc.com). This document is provided with the understanding that future versions of this instrument may have additional commands, and the function of the commands shown in this document may vary from the present operation. D-2 believes that this handbook is accurate at the time of writing, but its contents may be subject to change. D-2 accepts no liability for errors and omissions in this document. If you have any questions or comments regarding the handbook content, contact D-2.

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**Notes for User:**



***WARNING!***

*There is a danger to life and limb or a risk of serious injury if the notes on safety are disregarded!*



***CAUTION!***

*There is a risk of injury and damage to property if the notes on safety are disregarded!*



***ATTENTION!***

*There is a risk of damage to property if the notes on safety are disregarded!*



***! IMPORTANT !***

*Notes on working procedures.*

Read the instructions in this manual carefully before installing or starting the system. Note throughout this manual the term “CTD” & or “Hybrid CTD” applies to all models of the Ocean Conductivity & Temperature instrument, unless specific individual model numbers are detailed.

D-2 Incorporated will accept no liability for damages due to non-observance of this manual.



### ***ATTENTION!***

**If the instructions in the operating manual are not adhered to or are inadequately adhered to, there shall be no entitlement to services under the warranty.**

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Where manuals are written in several languages, the text it was created in is considered the original.

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## 1.0 GENERAL DESCRIPTION

The D-2 Inc. CTD Conductivity, Temperature, and Depth sensor using Hybrid technology, built for full Ocean depth precision and use. This is a brand-new patented US Technology and the first brand new way to measure conductivity in 30 years. This new conductivity sensor technology allows for smaller lightweight design, improved precision and free flushing of the sensor (no pump required).

The CTD comes configured for various depths. The housing and pressure transducer will change based upon the customers need for various depths. These differences are should be determined at time of purchase and are marked on the label of the unit. Consult factory for further information.

OC-CTD-AL = Aluminum Shallow / Mid Depth Water (0 meters to 3,000 meters)

OC-CTD-SS = Stainless Steel Deep Water (3,000 meters to 7,000 meters)

OC-CTD-TI = Titanium Bottom of Ocean Housing (7,000 meters to 11,500 meters)

NOTE: this is not a complete matrix for this sensor series. Please contact factory for available options with corresponding part numbers

## 2.0 SPECIFICATIONS

### **Power:**

Input Voltage: 7 – 16 VDC

Current Draw: 25 – 30 mA

Power: 175mW – 480mW

### **Power Settle Time:**

Turn on: there is a settle time dependent on user selectable scan rate. A minimum of 1 second before data frame is output.

Turn off: A minimum of 5 seconds should be taken between toggle of power from off to on.

### **Conductivity:**

Range: 0 to 7 S/m

Initial Accuracy: 0.0003 S/m

Resolution: 0.00004 S/m

Typical Stability: 0.0003 S/m per month

### **Temperature:**

Range: -5 to 35 Deg °C

Initial Accuracy: 0.001 °C

Resolution: 0.00002 °C

Stability: 0.002 °C per Month

### **Pressure:**

Range: User defined at time of order

Initial Accuracy: +/- 0.015% of Full Scale

Resolution: .001% Full Scale

Stability: +/- 0.02% of Full Scale per year

**Communications:**

Hardware Protocol: RS-232 or RS-485 Half Duplex

Baud Rate: 57600

Data Bits: 8

Parity: None

Stop Bits: 1

Handshaking: None

Data Modes: Physical Units or Raw Counts

Data Format: ASCII

Data Frame Rate: user configurable through “OR” serial command

1 = ~1 Hz

2 = ~2 Hz

3 = ~4 Hz

4 = ~8 Hz

5 = ~13 Hz

6 = >25 Hz (~30 Hz)

**Connector:**

Manufacturer: SubConn

Series: Micro Circular: MCBH

Pins: 5, see section 5 for definition. Future version may involve more pins



**Male Version**

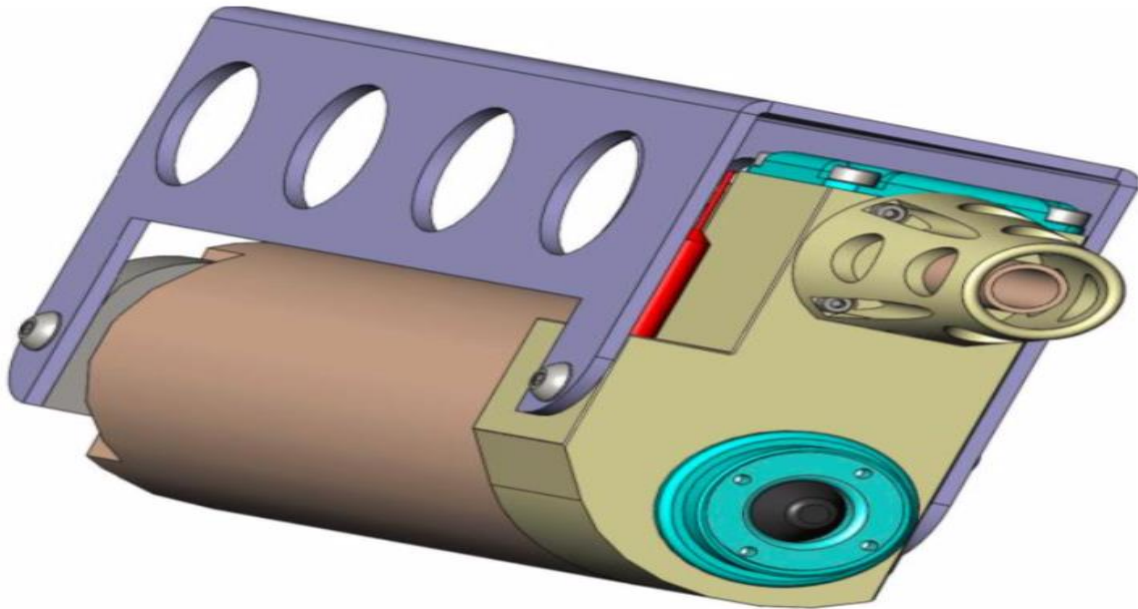
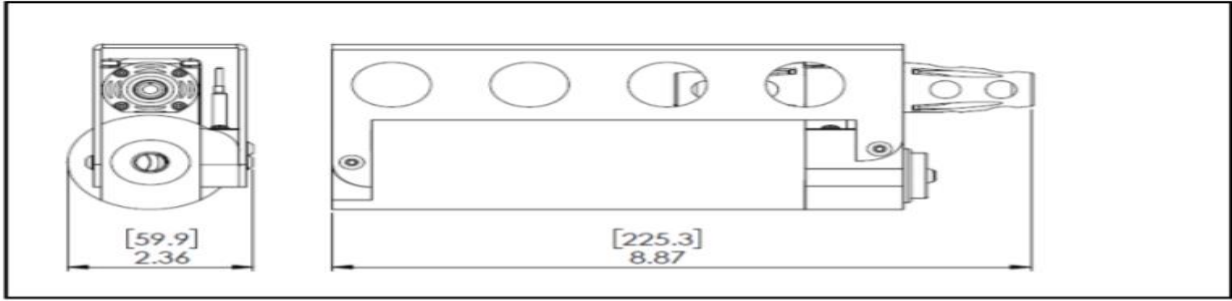
**Hydrostatic:**

Pressure Rating: 1.0 times the full-scale Range of customer selected Pressure Sensor

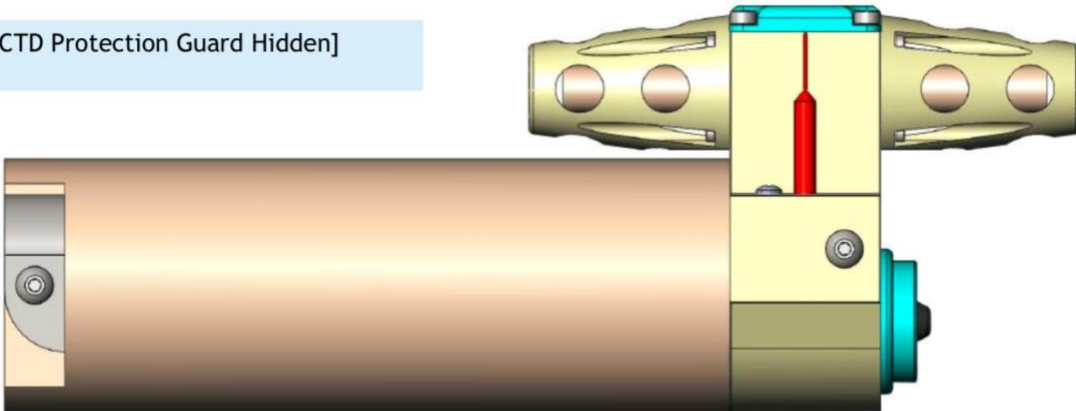
Internal Memory: Two Chips that can store 262,000 scans each, 524,000 scans total. The below is a chart showing how many hours or mins the memory can store data for at various scans per second aka Hz.

All times are approximated due to the scan rates being approximated			
Instrument scan (Hz)	Sec	min	hours
1	524000	8733.33	145.56
2	262000	4366.67	72.78
4	131000	2183.33	36.39
8	65500	1091.67	18.19
16	32750	545.83	9.10

**Dimensional:**



[CTD Protection Guard Hidden]



## 3.0 USAGE

The D-2 Inc. new Hybrid CTD can provide industry leading precision to full Ocean depth. Our series of units are designed to cover the specified customer pressure range, with our most rugged model designed for roughly 10,500 meters. Other outstanding features include...

- exceptionally low power consumption
- small overall design
- Free flowing conductivity cell which allows consistent readings without the use of a pump
- Data precision to match full Ocean depth water column measurement demands.

The Hybrid CTD can be incorporated into almost any platform used for Ocean observation.

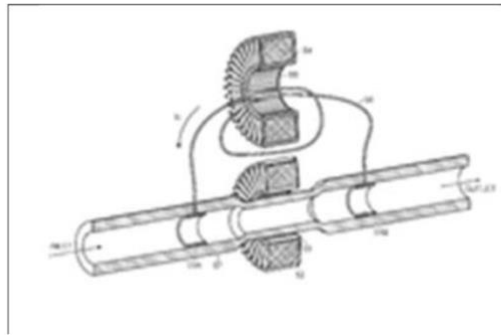
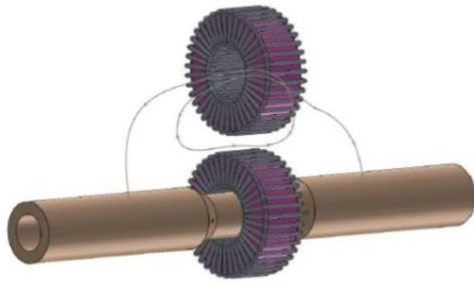
## 4.0 THEORY OF OPERATION

The D2 CTD utilizes a new Hybrid Conductivity Sensor. The Hybrid sensor is a completely novel concept in oceanographic conductivity/salinity measurement. It has the same performance advantage of a 3-electrode sensor where the end electrodes are electrically tied together ensuring there is no external electric field. Common tied end cell electrodes coupled with a novel inductive drive, eliminates the need for additional center electrode, or other electrodes in the measurement field. The two-electrode sensor with inductive drive is hence called a Hybrid as it incorporates the best aspects of both the electrode type & inductive type conductivity sensors; each with a strong history of performance in oceanographic conductivity measurements.

As the two outside electrodes are shorted together electrically the outside potential of the sensor is “zero” hence there is no current flow outside the path of the internally shorted end electrodes. The inductive drive creates a current that flows through the center measurement region, the current flows in direct proportion to the conductivity of sea water. This current is collected by the end electrodes and passed through a simple current to voltage transformer. The rate at which current flows in the sensor is then in direct proportion to the conductivity of sea water and the magnitude to the drive signal. The drive signal level can be precisely controlled, and the collection electrodes and shorting path can be constructed to have very low impedance as compared to the external sea water path, hence the ‘all’ of the current flows through the shorted electrode path, and, therefore the current measurement transformer. The result is a two-electrode cell that is ½ the length of a traditional 3-electrode cell and has a large center diameter. A sensor that can free pass water through the cell without the need for a pump in almost all applications. In applications where a pump is needed, say for biological control, this can be easily added as the sensor measurement volume is 100% enclosed in the unit and the addition of tubing and a pump will not affect the calibration. The sensor is fully described in US Patent #9,410,910.



## D-2 Hybrid Conductivity Sensor



## 5.0 WIRING INSTRUCTIONS



### CAUTION!

The sensor has a standard RS-232 Interface or an optional CMOS output. See specifications sensor for connector definition. All units are shipped with a dummy plug to protect the connector. The pinout is as follows:

**Table 1**

Pinout	RS-232	RS-485
Pin 1	Ground	Ground
Pin 2	Receive Data In	A
Pin 3	Power +	Power +
Pin 4	Transmit Data Out	B
Pin 5	External Turn on	External Turn On

D-2 Inc supplies a 2-foot, female pigtail for connecting to the housing connector.

Connector body

Chloroprene rubber

5 contacts

Female sockets in gold plated brass - UNS C36000

Individual cables

20 AWG, 0.52 mm<sup>2</sup> chloroprene rubber

Wiring Color Code	
1	BLACK
2	WHITE
3	RED
4	GREEN
5	ORANGE

1. Obtain a power supply that conforms to the specifications listed in the power portion of Section 2: Specifications.
2. Connect the power supply and the chosen communication port as specified in the above Table 1.
3. Configure your terminal program as defined in communications portion of Section 2:

Specifications. Apply power to the sensor, then pull the External pin to ground for approximately 1 second. The sensor should respond with the wakeup banner on the terminal screen, as follows...

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CTD

Version 0.85

SN=1234 (serial number subject to change)

Verify wake up banner before proceeding.

Custom configuration at time of order can allow for data response upon hardware power up, please consult factory

4. Pass the sensor a <CR> it will respond with a line of data.
5. Remove power, by pulling the external pin to ground for approximately 2 seconds. You are now ready for mechanical installation

## 6.0 MECHANICAL INSTALLATION



### ***ATTENTION!***

The CTD-Sensor be mounted in many different orientations to help facilitate the acquisition of data for your application. Mounting should always be completed as to minimize obstruction of flow through the cell and by using the mounting holes in the sensor guard.

See drawing below for Guard Mount Hole Locations

## 7.0 SERIAL DATA INTERFACE

### Section 7.1 Serial Protocol

The Serial Protocol can be either RS232 or CMOS. The distinction must be made at time of order. Serial Port parameters are as follows

1. BAUD Rate : 57600
2. Data Bits : 8
3. Parity : none
4. Stop Bits : 1
5. Handshaking : none

Serial commands are one of two different types, action, or read/set. They are comprised of two alpha numeric characters, case-insensitive, followed by a carriage return. The commands have some semblance to their function. For example, to LIST the calibration constants, the command is LI<CR> and it is an action command.

The following is a list of valid user commands:

Two-Letter command	Type	Description
C0	Read/Set	Conductivity Calibration Constant
C1	Read/Set	Conductivity Calibration Constant
C2	Read/Set	Conductivity Calibration Constant
C3	Read/Set	Conductivity Calibration Constant
CD	Read/Set	Calibration Date

CM	Action	Check Memory % Full
DT	Read/Set	Sets Date MM/DD/YY
DY	Read/Set	Sets Day of the Week (1-7) 1=SUN, 7= SAT
EM	Action	Erases Memory
F1	Action	Help, Lists available commands
IT	Read/Set	Interval Time ( 1 – 360 ) minutes
KK	Read/Set	Conductivity Calibration Constant
LA	Action	Log Activation for LT=2, LT=3
LD	Read/Set	Log Delay Time (D:HH:MM)
LG	Action	Toggles Logging in LT=0, LT=1
LI	Action	Lists Calibration Constants
LS	Read/Set	Logging Samples (dependent on OR, IT and LT)
LT	Read/Set	Logging Type (1-4)
MO	Action	Memory Output : Caution dumps entire memory to serial port, make sure to turn on data capture first. Can take over 1 hour.
OR	Read/Set	Output Rate (1-6){ 1,2,4,8,16,32}
P1	Read/Set	Depth Calibration Constant
P2	Read/Set	Depth Calibration Constant
P3	Read/Set	Depth Calibration Constant
P4	Read/Set	Depth Calibration Constant
P5	Read/Set	Depth Calibration Constant
P6	Read/Set	Depth Calibration Constant
P7	Read/Set	Depth Calibration Constant
P8	Read/Set	Depth Calibration Constant
P9	Read/Set	Depth Calibration Constant
PA	Read/Set	Depth Calibration Constant
PT	Read/Set	Pressure Transducer Temperature Calibration Constant
RP	Read/Set	Raw Data on Power up
RR	Read/Set	Conductivity Calibration Constant
RW	Action	Toggle Raw Data Output
SC	Action	Toggle Set Continuous Output
SP	Action	Toggle Set Continuous Output on Power up
ST	Action	Store Constants in EEPROM
T0	Read/Set	Temperature Calibration Constant
T1	Read/Set	Temperature Calibration Constant
T2	Read/Set	Temperature Calibration Constant
T3	Read/Set	Temperature Calibration Constant
T4	Read/Set	Temperature Calibration Constant
T5	Read/Set	Temperature Calibration Constant
T6	Read/Set	Temperature Calibration Constant
TM	Read/Set	Sets Time HH:MM:SS
TR	Read/Set	Conductivity Calibration Constant
VR	Action	Reports firmware Version

## Section 7.2 Output Rate

The Output Rate is a value from 1 to 6 that defines the number of scans of data output through the serial port in 1 second. This value depends heavily on the number of characters needed to be output through the serial port and the time available to the microprocessor. The assigned frequencies are approximated and can vary slightly.

- OR = 1 : 1 Hertz
- OR = 2 : 2 Hertz
- OR = 3 : 4 Hertz
- OR = 4 : 8 Hertz
- OR = 5 : 16 Hertz
- OR = 6 : 32 Hertz

## Section 7.3 Data Logging

The CTD instrument has the capability of logging(saving) data to memory in a real-time function.

**Data scan:** A scan of data consists of four fields of “raw” data used to compute actual Conductivity, Temperature and Depth values. This raw data is obtained through the onboard Analog to Digital converter. Setting the OR field determines how many scans are completed within a time of one second.

**Data Sample:** A sample of data is defined as 8 scans of data, independent of the output rate. When logging, 8 scans of data must occur before the data is saved to memory. Worst case scenario: 7 scans (seconds) of data are missed (Or = 1, 1 Hz) if the power is removed before a complete sample is taken.

The logging function will only save raw data, it is up to the user to convert to computed values.(see section on computing values)

The logging function needs 8 scans of data before it can be logged into memory but each of the data scans will be present in the memory when retrieved. This is important to understand when using certain timed logging functions.

Specific commands enable one of the four different types of logging. Data is logged at the chosen Output Rate (1-6 corresponding to {1,2,4,8,16 or 32 Hertz}).

### 1. Logging Types

- a. **Manual Logging:** Manual logging, the default, is assigned by the command LT=0. This logging type is used when the possibility of communicating with the instrument, when it is deployed and powered, is possible. The use of the LG command toggles the logging function; if it is off, it will turn on, if it is on it will turn off. There is no need for the LA command (Log Activation) command. If invoked, the instrument will reply with, "Activation unnecessary, Real Time Clock is not used." Once turned on, the logging will continue until...
  - Another LG command is sent
  - The power is turned off
  - The memory has been filled.
- b. **Automatic Logging:** Automatic logging is assigned by the command LT=1. This command will automatically initialize the instrument to start logging whenever the instrument is turned on. There is no need for the LA command (Log Activation) command. If invoked, the instrument will reply with, "Activation unnecessary, Real Time Clock is not used." Once turned on, the logging will continue until...
  - Send an LG command to stop the current/active logging function. The automatic logging will continue at next power up.
  - The instrument is turned off. The automatic logging will continue at next power up.
  - Send LT=0 command to stop the current/active logging function, and stops automatic logging on next power up.
  - Send LP command, to stop the current/active logging function. If saved, the automatic logging will not start on next power up. If not saved, automatic logging will continue at power up.
  - The memory is full

- c. Interval Logging: Interval logging is assigned by the command LT=2 and additionally activated with the LA command. The LA command will verify the additional parameters and respond with either "OR/IT/LS combination will not work." or "That works."
- This type of logging turns the instrument on, logs a set amount of data, turns itself off and then waits the interval time to turns itself back on to repeat the process. The external battery must be on and connected for this to work. The instrument will be off and not drawing current, when not logging. This logging type needs additional parameters to operate correctly. It also has an order in which to initiate these parameters. The following depicts this order.
- It is recommended to check the Time, Date and Dy functions first to verify that the Real Time Clock is setup correctly.
  - Verify the Output Rate (OR) is set to the necessary value.
  - A logging interval needs to be set using the IT=X command; where X is any number, between and including, 1 and 360. This number represents, in minutes, how often the instrument will wake itself up and log data.
  - A logging sample needs to be set using the LS=Y command; where Y is a computed value of scans that can be logged is accomplished within the interval period. Absolute maximum value is 65535, even though it may not be allowed.
  - This computed value is highly dependent on the OR command and the LS command.
  - Log samples are difference the scans. Due to the constraints of the memory chip, logging data must consist of 8 individual scans. can be derived from the equation : Y (MUST be an INTEGER) = ((IT \* 60) / (#of sec per sample)) - 1.
- Ex1: A user wants to log data every 30 minutes and take 5 samples of data each time with an output rate of 4 hertz (OR=3)
- $$Y0 = \text{Interval Time} * 60 \rightarrow 30 * 60 = 1800 \text{ secs}$$
- $$Y1 = 1/\text{Hertz} * 8 \rightarrow 1/4 = 0.25 \text{ secs}; 0.25 * 8 = 2 \text{ secs}$$
- $$Y2(\text{MUST be an INTEGER}) = (Y0/Y1) \rightarrow 1800/2 = 900$$
- $$Y = 900 - 1 = 899 \text{ (note: absolute maximum value = 65535)}$$
- LS can be any value from 1 to 899. 1 will get 8 scans of data, 899 will get 7,192 scans of data. (note: this number times Y1 will equal how many secs you will sample)
- Once all the supporting values have been set the LA command must be invoked. This will do a double check to make sure all the parameters are within reason, set the wake-up time to be the interval time away from the time at hand, Set logging on power up, Raw values on power up, save the setup and shut the instrument down. When the timer reaches the interval time, it will wake up and start logging. (Note: since intervals can only occur by the minute, if you activate for 1 minute at a time of 12 minutes and 27 seconds, you will turn back on at 13 minutes and 0 seconds not 13 minutes and 27 seconds.
  - It is always recommended to run a short, benchtop, test to verify the data shows what is expected
  - Once turned on, the logging will continue until...
    - The instrument is turns itself off, but will start up again upon the next interval cycle
    - Set LT=0, (suggested method) will not start up at the next power up cycle
    - The memory is full
- d. Delayed Start Interval Logging: Delayed Start Interval Logging is assigned by the command LT=3 and additionally activated with the LA command. This command follows the functionality of Interval Logging except that the first time it powers up will be a user specified time with each subsequent time the specified interval period. The delay can be up to 7 days in the future. The external battery must be on and connected for this to work. The instrument will be off and not drawing current, when not logging.
- Verify the day of the week is set correctly using the DY command.  
1 = Sunday, 2 = Monday, 3 = Tuesday, 4 = Wednesday, 5 = Thursday, 6 = Friday, 7 = Saturday

- Set Delay using the LD=D:HH:MM, where D is a single digit representing the day of the week you want the instrument to turn on(1-7), HH is a two-digit value of the hour you want the instrument to turn on (00-23) and MM is a two-digit value of the minute you want the instrument to turn on (00-59).
  - Using this type of format, it can get confusing as to startup times. If LD=1:13:15 and the current time is Sunday, 1:14 PM, the instrument will turn on and start logging in one minute (or less depending on the seconds). Whereas, if LD=1:13:15 and the current time is Sunday, 1:16 PM, the instrument will turn on the following Sunday, 7 days in the future. (Note: LD cannot be accessed unless in LT=3 mode)
- Use the LA command to activate this logging type, which will shut off the unit and not wake up until the specified time
- CAUTION: The instrument reverts to interval logging whenever first powered up after it has been activated.
- Once turned on, the logging will continue until...
  - The instrument turns itself off, but will start up again upon the next interval cycle
  - Set LT=0, (suggested method) will not start up at the next power up cycle
  - The memory is full

## 2. Retrieving Data

- a. To retrieve the data from memory. Use the MO (memory output) command. The user should take extreme care when using this command. The time it takes to download a completely full memory array is very long, with no way of stopping the download unless removing power.
- b. Downloading the data does not remove the data from the memory. The process of downloading the data can be done as often as liked if it has not been erased, but it will always start at the beginning memory address. Once the data has been removed and the user no longer has need of the data being stored, the user can use the EM (erase memory) command. This will instantly wipe the memory and there will be no way of retrieving it. CAUTION should be taken.
- c. Data Format of the output data will be a complete scan of timestamped, comma-separated data:
  - 2023/12/07, 08:27:17, 10307, 0, 8375901, 3087, 0, 0, 0, 0, 0, 0, 0
    - ❖ First two fields – time in ISO 8601 format without milliseconds
    - ❖ Raw data for conductivity. Note: the first two scans of every interval will be the reference values (denoted by a negative sign. The value is not actually negative). This value is output every (10\*output Rate Value+1). If OR = 1 than the first scan would be the reference value, then next eleven scans would be conductivity and then the next scan would be a reference value again. It would continue in that manner until a new interval started.
    - ❖ Raw data for temperature
    - ❖ Raw data for pressure
    - ❖ Raw data for temperature of the pressure transducer.
    - ❖ Eight fields dedicated to future add-on peripherals, currently unused.

## 3. Converting Raw data to computed values

NOTE: Values are :

**BOLD** : to be calculated

**BLUE** : Calibration constants found in EEPROM

**BROWN** : counts taken from instrument

### a. Conductivity

Two reference values are necessary for conductivity to be calculated. When the instrument first turns on, the references are sampled until an appropriate set of values have been found. There is some initial circuit throughput that must settle for the references to be correct.

If the instrument is set to “Set continuous on power up” and “Raw counts on power up”, the output streams the low and the high values of the references it encounters. When references are output to the terminal, there is a negative sign in front of the number but the number is not negative. All values are positive whole numbers in raw mode. If “raw counts on power up” is not selected, there is a short delay, as the references are established before data will be streamed.

There is a phenomenon when the cell is in air that the conductivity raw count is lower than the reference value. This will produce negative conductivity values which are not valid so we cut negative values off as zero point zero.

Step 1 :  $\text{CompCond} = \text{RawCondCounts} - \text{Low Reference}$

Step 2 :  $\text{CompRef} = \text{High Reference} - \text{Low Reference}$

Step 3 :  $\text{CompCondRation} = (\text{RR} - \text{CompRef}) * \text{TR} * \text{compCond} / \text{CompRef} + \text{CompCond}$

Step 4 :  $\text{PRECONDUCTIVITY} = \text{C0} + (\text{C1} * \text{CompCondRation}) + (\text{C2} * \text{CompCondRation}^2) + (\text{C3} * \text{CompCondRation}^3)$

Step 5:  $\text{TEMPERATURE} = \text{T0} + (\text{T1} * \text{RawTempCounts}) + (\text{T2} * \text{RawTempCounts}^2) + (\text{T3} * \text{RawTempCounts}^3) + (\text{T4} * \text{RawTempCounts}^4) + (\text{T5} * \text{RawTempCounts}^5) + (\text{T6} * \text{RawTempCounts}^6)$

Step 6:  $\text{deltaP} = \text{RawPTempCounts} - \text{PT}$

Step 7:  $A = \text{P1} + (\text{P2} * \text{deltaP}) + (\text{P3} * \text{deltaP}^2)$

Step 8 :  $B = \text{P4} + (\text{P5} * \text{deltaP}) + (\text{P6} * \text{deltaP}^2)$

Step 9 :  $C = \text{P7} + (\text{P8} * \text{deltaP}) + (\text{P9} * \text{deltaP}^2)$

Step 10:  $\text{PRESSURE} = A + (B * \text{RawPressureCounts}) + (C * \text{RawPressure Counts}^2) + \text{PA}$

Step 11:  $\text{FINALCONDUCTIVITY} = \text{PRECONDUCTIVITY} / (1 + (\text{TC} * \text{TEMPERATURE}) + (\text{PC} * \text{PRESSURE}))$

## 8.0 OPTIONS

Please Consult D-2 Inc. for the full list of available options. These are constantly being updated, and added to. See D-2.com for more details.

Standard Options Currently Include:

Part Numbers:

OC-CTD-AL = Aluminum CTD's 3000 M Depth Rating

OC-CTD-SS = Stainless Steel CTD's 7000 M Depth Rating

OC-CTD-TI = Titanium CTD for Deepest Ocean Depths 11,500 meters or deeper.

These All can be configured into Ultra Low Power as well.

OC-CTD-ULP-AL

OC-CTD-ULP-SS

OC-CTD-ULP-TI

Battery Packs:

OC-BP-AL Aluminum Shallow Water CTD Battery Pack

OC-BP-SS Stainless Steel Depth CTD Battery Pack

OC-BP-TI Titanium CTD Battery Pack



### **! IMPORTANT**

***NOTE: There are no user-serviceable components inside the D-2 OC-CTD Sensor. There are NO Electronic adjustments inside the sensor. Opening the instrument will damage the cover and will void the instrument warranty.***

***DO NOT OPEN THE SENSOR IN THE FIELD.***

## **APPENDIX A: LIMITED WARRANTY**

One year from date of shipment, D-2 Incorporated, guarantees its products to be free of defects in materials and workmanship. In the event a product malfunctions during this period, the company obligation is limited to repair of the defective item at our factory, or the defective item may be replaced at our option. Instruments found defective should be returned to the factory prepaid and carefully packed, as customer will be responsible for freight damage. D-2 will pay return shipping on any warranty repairs.

Repairs or replacements under warranty will be at no cost to the customer for parts, labor, or return shipment from our factory to the customer. This warranty is void if in our opinion the instrument has been damaged by accident, mishandled, altered or repaired by the customer where such treatment has affected its performance or reliability. In the event of such abuse by the customer, all costs for repairs plus freight costs will be borne by the customer. All equipment supplied by D-2 that is designed for use under hydrostatic loading has been certified by actual pressure testing prior to shipment.

The customer will be charged a diagnostic fee plus all shipping costs if an instrument is returned for warranty repair and no defect is found by the factory. Incidental or consequential damages or costs incurred as a result of product malfunction are not the responsibility of D-2 Incorporated.

Equipment not manufactured by D-2 Incorporated, is supported only to the extent of the original manufacturer's original warranties. All OEM sensors which utilize electrodes (oxygen cartridges, pH, ORP, etc.) is warranted at the time of shipment, and shall perform upon initial installation within stated specifications. If the product proves to be defective within the OEM's warranty we will replace the product or defective part with a similar model, product or part, but only to the extent that the OEM will warrant.

All returned products must be accompanied by a Returned Material Authorization (RMA) number issued by D-2 Incorporated. Shipments will not be accepted without the RMA number. An RMA number can be obtained by calling Customer Service Department at 508-329-2046 or by emailing [sales@D-2inc.com](mailto:sales@D-2inc.com).

The following information should accompany any instrument being returned to the factory:



Return Authorization Number  
Model/Serial Number  
Brief Description of the Problem  
Customer Contact/Telephone Number

#### CALIBRATION SERVICE POLICY

A calibration only service is available for OC-CTD Sensors.

The service is limited to instruments requiring only calibration and minor adjustment. Instruments that are not operating properly and require repair or replacement parts will not be covered. If repair is necessary, the customer will be contacted and apprised of the additional cost. The customer will be charged the standard repair cost, which includes repair and calibration. If the customer does not approve repair, the unit will be returned in "as received" condition and the teardown and inspection charge will be invoked.

The customer will be required to obtain a return authorization number from Customer Service at D-2 Incorporated prior to the return of the instrument. This number should be displayed on the outside of the container, preferably on the shipping label, and included on the shipping documentation sent with the instrument.

If possible, the following information should accompany the instrument:

Return Authorization Number  
Model/Serial Number  
Customer Contact/Telephone Number