CTD plus

An Autonomous CTD Probe

Version 1.4

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Contents

List of Figures

I GENERAL INFORMATION

I-1 Introduction

The CTD plus 100, 500 and 1000 is a family of CTD "Hang Alone" systems for use in water depth of 100, 500 or 1000 meters respectively. For simple use they are activated by three cursor key buttons to take samples and store them in solid state CMOS RAM, to read out sample values on display, to continuously sample, calculate and display parameters.

They include a serial RS 232 interface with data output in scientific units for direct formatted drive of printers or communication with computers or controllers.

For field analysis and processing the SiS Fieldsoft DOS program is included.

Special features of the instrument are

- high resolution and accuracy
- conductivity and temperature in the same sample volume
- autonomous battery powered system
- LC display
- user programmable by cursor key buttons
- internal calculation of salinity, density and sound speed according to UNESCO tables and standards
- time series sampling for moorings
- spatial series sampling for profiling
- light weight, small size, easy handling and low cost

I-2 Description

The CTD consists of the central pressure housing made of high quality acrylic glass. The case contains the analogue pre-processing, data acquisition, central control, memory, display, magnetic cursor switches and switch mode power supply.

At the lower end the case is closed by the sensor head made of titanium containing the pressure, the temperature and the conductivity sensors. The sensors are protected by a protective cage. The upper end of the pressure housing is closed by a stopper with central communication plug and joint coupling for the standard battery module or other optional modules.

All materials in sealing are anticorrosive (neoprene, acrylic or titanium).

The modules are fastened by three screws secured by locking adhesive.

The battery module contains two batteries of "D" cell type. The total voltage has to be in the range of 1.4 V to 7.5 V. So NC, Alkaline, Lithium or Lithium Thionyl-Chloride batteries may be used.

At the top of the battery module is a traverse - fastening the battery stopper - with a ring of fortifications for fastening the lift wire.

The next page shows a figure of the outline of the instrument.

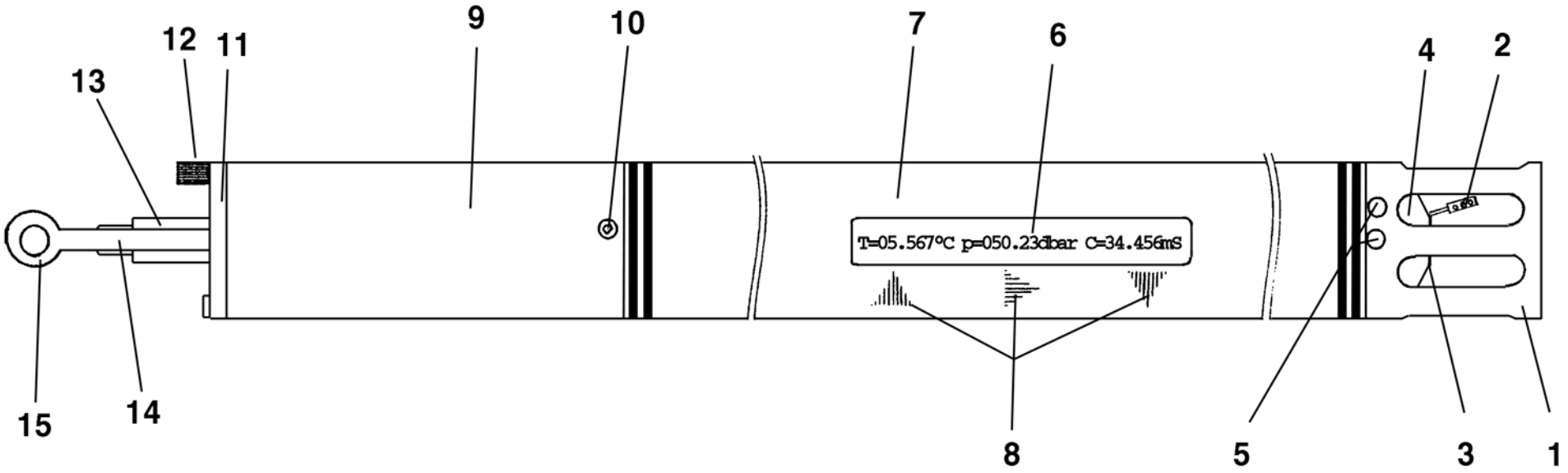


Figure 1.1 Outline of the Instrument

1. Protective Cage
2. Pt - Thermometer
3. Conductivity Sensor
4. Sensor Head
5. Openings to Pressure Sensor
6. Display
7. Central Pressure Housing
8. Cursors
9. Battery Module
10. Fastening Screws
11. Locking Traverse
12. Knurled Fastening Screw
13. Interface Connector
14. Fastening Rod
15. Fastening Eye

I-3 Modes of Operation

The user interface to the instrument consists of the LC display and the cursor buttons. By cursor you can step through user menus.

The main menu corresponds to the mode of operations and consists of "SAMPLE", "READ OUT" and "CONTINUOUS". The "SAMPLE" submenus contain setting of a real-time clock (time, date), parameters for time series sampling (delay time, sampling time increment), for spatial series sampling (initial pressure, sampling pressure increment, end pressure); further you can select sampling activation or abortion.

The "READ OUT" submenus contain selection of displayed parameters pressure, time/date, conductivity, temperature, salinity, sound speed and density. Pressure is obligatory if data is a spatial series; time/date if data is a time series.

Three parameters are displayed simultaneously. By up and down cursor you can step or scroll through the data set. A further mode is "READ OUT P". In this mode in the background the data are send formatted in ASCII over the serial interface to protocol printer or computer.

The last main menu mode is "CONTINUOUS". The instrument operates continuously and updates the display with measured and/or calculated values. In mode "CONTINUOUS P" data are sent in the background via serial interface.

If you don't service a cursor and the instrument is not activated for taking samples it will power down to sleep mode after one minute.

During all operations the instrument controls battery power and switches to low power mode if low battery power is detected. So all sample values are protected against inadvertent loss.

During battery replacement the system is kept alive by backup storage energy.

Figure 1.2 Main Menu

II OPERATING INSTRUCTIONS

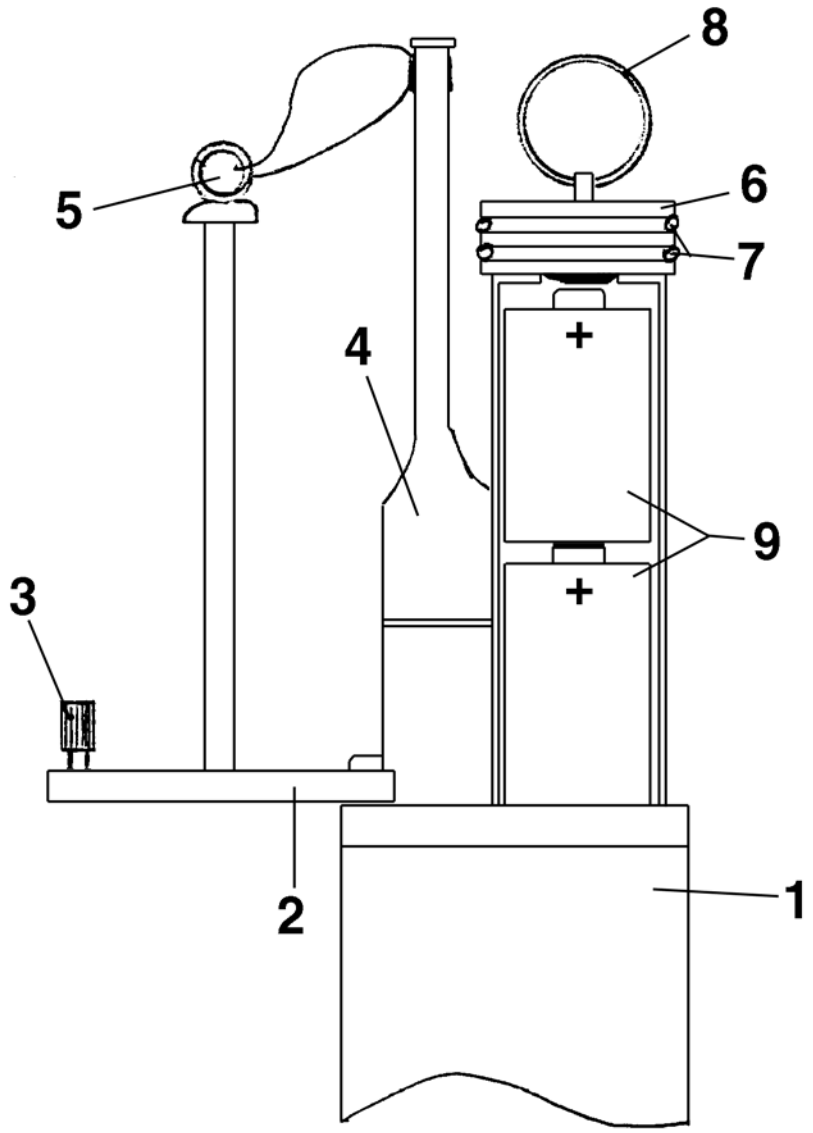
II-1 Insertion of Batteries

The instrument is delivered with two alkali manganese "D" type cells. Please open the stopper of the battery module by unscrewing the knurled fastening screw of the traverse and move out the battery compartment by pulling the opening ring. Insert the batteries into the battery module with plus terminals up, push in the stopper seal and fasten the traverse. The instrument is ready for operation. The battery will last for about twenty hours of continuous operation or for 2000 sampling points during a time series.

According to the type of battery this time will vary. Please calculate the battery life for your special battery. The power consumption of the instrument is about 1.2 watts.

The total voltage of both batteries has to be in the range of 1.4 V to 7.5 V. So NC, Alkaline, Lithium or Lithium Thionyl-Chloride batteries may be used.

Please note that batteries must be removed before supplying the instrument with external power.



1. Battery Module
2. Locking Traverse
3. Knurled Fastening Screw
4. Interface Connector
5. Fastening Eye
6. Stopper with Battery Compartment
7. O-Ring Seal
8. Opening Ring
9. "D" Type Cells

Figure 2.1 Replacement of Batteries

II-2 Operational Elements

The CTD has three cursors, right, up and down respectively. Reaction of the instrument according to the manipulation of cursors is shown on the display. The cursors are indicated as hatched triangles on the central pressure housing just below the LC display window.

By cursors you go through the menu of the program.

The cursors are operated by the delivered triangular magnetic bar. If you near it to the indicated cursor positions, the corresponding switch is activated. Dependent on the actual menu part the up/down cursors have stepping and/or scrolling function.

II-3 Self Test

If the instrument is in power down mode (not sleep mode from continuous) you can switch it on by the right cursor. A self test automatically checks memory and battery condition. If all is okay at the end of test you can go further in the main menu. If the memory is defective or if during last usage an absolute power down for more than 30 minutes (the back up time of the power storage device) occurred, the message "LAST MEMORY LOST - PLEASE SET CLOCK( )!" is displayed. A number in the parentheses specifies the error source (see appendix). If the battery power is insufficient you see the message "!BAT - LOW! Please change batteries!". In that case please go right by cursor to switch off the instrument and replace batteries.

during test

absolute power down for more than 30 minutes

battery power insufficient

Figure 2.2 Results of Self Test

If a low voltage condition occurs during operation, the instrument will show a message and switch to sleep mode.

Figure 2.3 Low Voltage During Operation

II-4 Main Menu

A well finished test phase will lead to the main menu "SAMPLE READ OUT CONTINUOUS". The sample part is blinking. This for the first time indicates the possibility to branch up or down.

Figure 2.4 Main Menu

II-5 Sample Mode and Submenus

In sample mode you can set real-time clock, sample parameters and/or activate the sampling process. By cursor down you first come to real-time clock setting, after a second down you are in the sample parameter setting. By cursor up you come to the activation of sampling process.

II-6 Time/Date

A real time clock with time and date is provided mainly for real time data acquisition in time series sampling and continuous mode.

Figure 2.5 Time/Date Display

Now you can branch further down to the next submenu of sample or you can branch right to get the Time/Date setting submenu.

Figure 2.6 Time/Date Setting Menu

The first hour digit is blinking. In general it is to say, if during your manipulations parts of the display blink it means you can further branch to other submenus and/or you can adjust the value of the blinking digit(s).

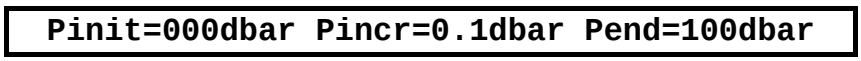
Here you can adjust the digit by stepping or scrolling up or down by up or down cursor respectively (stepping by single service of cursor, scrolling by placing the magnetic bar continuously near the cursor symbol).

Alternatively if you don't want to change this digit you can branch right by service of the right cursor to the next digit. Now you can adjust that digit or branch right again up to the least significant minute.

Further branching right leads to the date. In corresponding manner you can set the date. If you reach the least significant digit of year and branch further right, you are back in the main menu part SAMPLE.

II-7 Selection of Sampling Parameters

Dependent on the last selected sampling mode (spatial series or time series) the depth respectively time setting submenu appears.



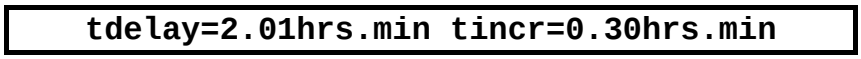


Figure 2.7 Sampling Parameters Submenu

We will begin with the depth sampling procedure. If you have selected it by going down, the display shows the last selected spatial series sampling parameters and by going right the most significant digit of Pinit blinks. Pinit is the initial pressure where the instrument will start sampling the spatial series. By stepping and/or scrolling up or down you can set this digit. By cursor right you come to the less significant digits and set it in equivalent manner.

By stepping further right you come to Pincr setting. Pincr is the pressure increment which gives the width of spatial sampling. During spatial sampling the instrument continuously monitors the pressure. If it reaches the last sampling pressure plus the selected incremental pressure the actual next sample is being taken.

If you leave Pincr setting by going right once again after the least significant digit the instrument will calculate the end depth of sampling procedure according to the available memory.

In case the calculated depth is greater than the depth capability of the instrument, Pend will be set to 100, 500 or 1000 dbar respectively. So the internal formula is Pend = (Pinit + N * Pincr) <= Pmax $\in$ (100, 500, 1000 dbar), N (the number of samples) will be chosen to meet this formula but cannot exceed the memory capacity of 1000 data sets.

In case you don't want to lower the instrument to the calculated Pend, you can decrease that value in equivalent manner to the selection of the other depth parameters. In any case you have to step over the blinking digits of Pend. One step further right from the least significant digit once again leads up to "SAMPLE" of the main menu.

If you don't want to take a spatial series, you can - if no blinking occurs in the depth parameters setting submenu - branch down to the time parameter setting submenu.

The first part is the tdelay time, which is the time from activation of sampling up to the time of first sample. It is a kind of sleep time, which has to elapse before time sampling starts. In case of moorings this is the time for installation and positioning of the mooring.

In equivalent manner as in the depth parameter sampling setting you can select the proper sampling constants.

After selection of the most right parameter digit, with the next right strike you come back to the main menu "SAMPLE READ OUT CONTINUOUS" with blinking "SAMPLE".

Now the sampling parameters have been selected and are kept in memory. You have to go down to sampling parameter setting only if you want to change parameters. If you have selected your standard parameters, the instrument will take it from memory if you start sampling process.

So you don't have to select it manually over and over again if you want your selected parameters.

II-8 Starting the Sampling Process

When you are in the main menu row "SAMPLE READ OUT CONTINUOUS" with blinking "SAMPLE" you can branch to starting the sampling process by cursor up. Now you see the following on the display depending on your last parameter setting.

if you have selected depth parameters

if you have selected time parameters

Figure 2.8 Starting Sampling Process Submenu

First to management of spatial series. If you go down you are back in the main menu. But if you want to start sampling you have to go right and see on the display:

Figure 2.9 Depth Sampling Activated

The instrument will measure air pressure at first and set this value to zero. So the instrument is calibrated relative to the air pressure. Now the instrument monitors actual pressure and if reaching P = Pinit + m * Pincr will take the m th complete set of values in C, T and P.

If you don't lower the instrument to Pinit it will never take samples, but will infinitely - as long as sufficient electrical power is in the batteries - wait for values. In this situation you have to abort the task by cursor down.

If the instrument reaches the last value P = Pinit + N * Pincr (N is the implicitly selected number of samples) it internally switches to the evaluation of derived parameters salinity, density and sound speed.

Then on the instrument you may see - if a diver has gone done with your instrument -:

Figure 2.10 Calculating Derived Parameters

After the calculation time the instrument goes to the main menu and one minute later, after non-service of cursors, switches to the sleep mode. All values - the measured and evaluated - are kept in memory and can be seen in "READ OUT" mode afterwards.

Normally you don't see this part of displayed information because calculation time and the one minute wait in main menu is considerably smaller than heave time from depth corresponding to Pinit + N * Pincr.

If occasionally you have the instrument back on board before elapsing of that time, you have to wait for appearing of the main menu, there is - and must be - no possibility for branching during this part of state, for you might destroy your data set.

But there is one important exception. If you get your instrument back and see "DEPTHS-SAMPLING IN PROGRESS!! Abort:DOWN", the instrument hasn't reached Pinit + N * Pincr - which is Pend - during lowering.

Now you have to abort the task by cursor down and see the message "B U S Y -please wait a moment!", you have to wait till the end of calculation time.

If you started from "TIME-SAMPLING Start:RIGHT Return:DOWN", by cursor right, you see in the display:

Figure 2.11 Time Sampling Activated

This is shown for 30 seconds and - after the selected delay time tdelay - will appear periodically in the selected time interval tincr. Between sampling the instrument calculates derived parameters.

If you get the instrument back on board after tdelay + N * tincr, the instrument will be in sleep mode and you can start it by cursor right with the self test.

If in contrast the total time hasn't elapsed, you can stop time sampling by cursor right and see "TIME-SAMPLING IN PROGRESS! Abort:DOWN". Abort the task by cursor down.

The instrument is back in the main menu. All sampled data and calculated values up to that time are stored in memory for further processing.

For training we advise to select some different small time parameters as one to five minutes, go up to starting the sampling. Observe the actions of the instrument and abort the time sampling task.

II-9 Read Out

When the sampling process has finished, the instrument goes to the main menu part "SAMPLE" for one minute and then branches to sleep mode.

By servicing cursor right for two times you reach the main menu part "READ OUT" (blinking, which once again indicates the possibility to branch within this menu).

Now you can branch by cursor down to your data set. If your data is a spatial series, the first displayed parameter is pressure p and that is obligatory and cannot be changed, because p is the independent variable in a spatial series.

Two other parameters out of conductivity, temperature, salinity, density and sound speed are visible. From the remaining three you can select a choice of two simultaneously.

By cursor down you can step or scroll (continuous service of the cursor) through your data set in increasing pressure steps Pincr. By cursor up you step or scroll in decreasing order.

If you reach the end or the beginning of the data set the instrument returns to the main menu part "READ OUT".

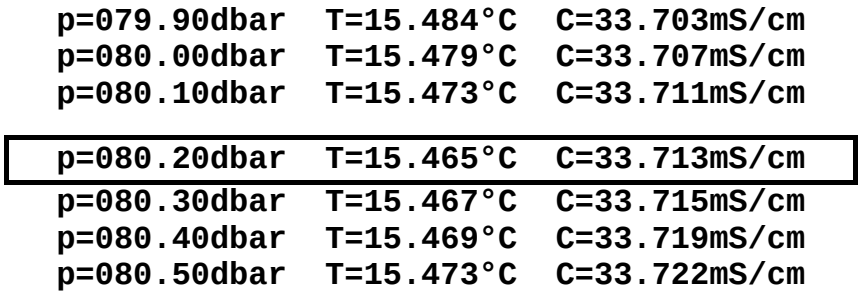


Figure 2.12 Display as Window to the Data Set

The display is like a window which you can shift over your data set.

If you want to finish read out and are far advanced in the data set, you don't want to scroll to the beginning or end of the set. Then you either wait one minute without servicing any cursor, so the instrument switches automatically off, or you go one step right by cursor. Now the display is changed to:

Figure 2.13 Exit to Main menu

By cursor up you can now exit to the main menu.

If your data is a time series, the first displayed parameter is time/date information of your real time series.

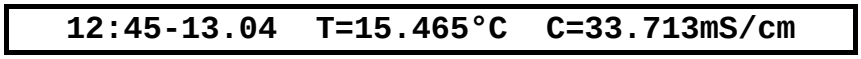


Figure 2.14 Reading Out a Time Series

For space reasons the year is not shown. The procedure of going through the data set is the same as in the case of a spatial series.

II-10 Selection of Displayed Parameters of a Data Set

The displayed parameters of your data set can be selected, if you are in "READ OUT" mode within your data set, by two steps of cursor right (one step - as said before - leads to exit to main menu).

Now the second parameter is blinking. Here you can select the parameters you wish, except pressure if it is a spatial series or time/date if it is a time series, because these are the obligatory independent parameters of a specific series.

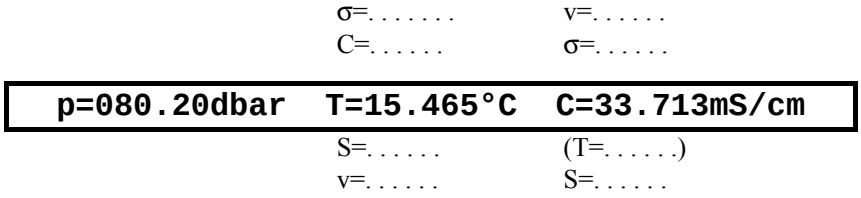


Figure 2.15 Selection of Displayed Parameters

If you selected the actual third parameter, the display gives a hint by showing "?" at the third place. By cursor further right you come to the selection of the third displayed parameter.

The choice by cursor up or down is now restricted to the remaining four parameters. In figure 2.15 the parameter T is not available because it is actually chosen for the second place.

By next cursor right nothing is blinking anymore, so you can now go up or down your data set again by cursor up or down.

II-11 Continuous Mode of Operation

By cursor further right from "READ OUT" in the main menu you come to the "CONTINUOUS" main menu part.

By cursor down you can activate this operational mode. Now the display shows this comment until analogue circuits are stabilised:

Figure 2.16 Starting Continuous Mode

Then the instrument continuously samples data, calculates the derived parameters and displays the selected choice.

All parameters are updated every 0.5 seconds for about one minute. If no further cursor service occurs during this time, the instrument goes to sleep mode.

From sleep mode you can restart "CONTINUOUS" by only one cursor right, the instrument has backed up the former mode.

The selection of displayed parameters is the same as in "READ OUT".

To leave the Continuous mode when not in sleep mode, use cursor up to bring you back to the main menu.

To go back to the "SAMPLE" position from the "CONTINUOUS" position in the main menu you may use cursor up followed by cursor right.

Figure 2.17 Back to Sample

II-12 Data Output via Serial Interface

There are two more sub parts in the main menu. This is "READ OUT P" and "CONTINUOUS P".

One step next to "READ OUT" you will find "READ OUT P", and one step next to "CONTINUOUS" will lead to "CONTINUOUS P".

In "READ OUT P" the complete data set is sent in the background via the serial interface in ASCII and formatted for direct print out. So you only need a printer with serial interface to get a print in tabulated form. Alternatively you can connect the instrument with the provided gender changer to a serial port of your computer and view or save the data using a terminal program or the SiS Fieldsoft. See the Appendix for specification of the serial interface.

The first page is a header page with the serial number of your instrument and space for comments on the specific conditions of the data series.

On the next pages you find the print of the data with header columns for identification of parameters. Figure 2.18 shows a copy of the header page of the following protocol of a spatial series. Figure 2.19 shows a part of the spatial series. Figure 2.20 shows a sample of a continuous mode protocol.

In foreground you can operate the normal "READ OUT" procedure.

If you use the "CONTINUOUS P" mode of operation, display action is as in "CONTINUOUS" and in the background every five seconds an ASCII stream of formatted data is transferred via the serial interface. This restriction is due to printing speed of older printers.

```
                                   S I S
                                CTDplus500



                               Data-Protocol


Serial No. : 23055

Project    :

Station No.:

Profil No. :

Position   :

Date       :

Time       :

Remarks    :
```

Figure 2.18 Header of a Spatial Series

P	C	T	S	SIGMA	v
[dbar]	[ms/cm]	[Cel]	[ppt]	[kg/m3]	[m/s]
0000.0	00.017	15.939	00.015	51.033	1469.2
0000.1	00.013	15.910	00.013	51.030	1469.1
0000.2	20.334	15.863	15.027	10.473	1486.4
0000.3	20.323	15.870	15.015	10.464	1486.4
0000.4	20.331	15.867	15.023	10.470	1486.4
0000.5	20.330	15.867	15.022	10.470	1486.4
0000.6	20.330	15.868	15.021	10.470	1486.4
0000.7	20.336	15.865	15.027	10.475	1486.4
0000.8	20.335	15.865	15.027	10.476	1486.4
0000.9	20.352	15.865	15.040	10.486	1486.4
0001.0	20.349	15.865	15.038	10.485	1486.4
0001.1	20.349	15.865	15.038	10.485	1486.4
0001.2	20.356	15.863	15.044	10.491	1486.4
0001.3	20.348	15.871	15.035	10.483	1486.4
0001.4	20.350	15.871	15.036	10.485	1486.4
0001.5	20.355	15.870	15.041	10.488	1486.4
0001.6	20.353	15.869	15.040	10.489	1486.4
0001.7	20.359	15.871	15.044	10.492	1486.4
0001.8	20.371	15.866	15.055	10.502	1486.4
0001.9	20.394	15.852	15.079	10.523	1486.4
0002.0	20.367	15.853	15.057	10.506	1486.4
0002.1	20.366	15.857	15.054	10.504	1486.4
0002.2	20.391	15.833	15.083	10.531	1486.4
0002.3	20.401	15.831	15.092	10.539	1486.4
0002.4	20.397	15.830	15.090	10.538	1486.4
0002.5	20.414	15.822	15.106	10.552	1486.4
0002.6	20.443	15.809	15.134	10.577	1486.4
0002.7	20.469	15.789	15.163	10.603	1486.3
0002.8	20.438	15.783	15.141	10.588	1486.3
0002.9	20.452	15.771	15.156	10.602	1486.3
0003.0	20.525	15.733	15.229	10.666	1486.2
0003.1	20.492	15.721	15.208	10.652	1486.2
0003.2	20.492	15.715	15.210	10.655	1486.2
0003.3	20.552	15.661	15.279	10.719	1486.1
0003.4	20.553	15.638	15.289	10.731	1486.0
0003.5	20.558	15.624	15.299	10.742	1486.0
0003.6	20.565	15.614	15.308	10.751	1485.9
0003.7	20.603	15.589	15.348	10.787	1485.9
0003.8	20.619	15.521	15.388	10.830	1485.7
0003.9	20.591	15.528	15.362	10.810	1485.7
0004.0	20.625	15.539	15.386	10.826	1485.8
0004.1	20.694	15.481	15.464	10.898	1485.7
0004.2	20.668	15.455	15.453	10.894	1485.6
0004.3	20.683	15.414	15.482	10.925	1485.5
0004.4	20.662	15.426	15.460	10.906	1485.5
0004.5	20.719	15.406	15.514	10.952	1485.5
0004.6	20.750	15.367	15.555	10.991	1485.4
0004.7	20.775	15.326	15.591	11.027	1485.3
0004.8	20.789	15.256	15.630	11.070	1485.1
0004.9	20.788	15.251	15.632	11.073	1485.1
0005.0	20.792	15.246	15.636	11.078	1485.1

Figure 2.19 Part of Printer Protocol of a Spatial Series

* S I S * CTDplus * Sn: 23055 * Continuous Mode Protocol *

TIME [h:m:s]	DATE [d.m.y]	P [dbar]	C [ms/cm]	T [Cel]	S [ppt]	SIGMA [kg/m3]	v [m/s]
12:56:40	11.02.02	0000.4	140.050	21.174	08.849	04.657	1495.8
12:56:45	11.02.02	0000.4	140.050	21.174	08.849	04.657	1495.8
12:56:50	11.02.02	0000.4	140.050	21.174	08.849	04.657	1495.8
12:56:55	11.02.02	0000.4	140.049	21.175	08.848	04.656	1495.8
12:57:00	11.02.02	0000.4	140.050	21.175	08.849	04.656	1495.8
12:57:05	11.02.02	0000.4	140.050	21.175	08.849	04.656	1495.8
12:57:10	11.02.02	0000.4	140.049	21.176	08.848	04.655	1495.8
12:57:15	11.02.02	0000.4	140.050	21.178	08.848	04.655	1495.8
12:57:20	11.02.02	0000.4	140.049	21.179	08.847	04.654	1495.8
12:57:25	11.02.02	0000.4	140.049	21.180	08.847	04.654	1495.8
12:57:30	11.02.02	0000.4	140.048	21.180	08.847	04.653	1495.8
12:57:35	11.02.02	0000.4	140.048	21.179	08.847	04.654	1495.8
12:57:40	11.02.02	0000.4	140.049	21.178	08.848	04.654	1495.8
12:57:45	11.02.02	0000.4	140.049	21.178	08.848	04.655	1495.8
12:57:50	11.02.02	0000.4	140.050	21.178	08.848	04.655	1495.8
12:57:55	11.02.02	0000.4	140.050	21.178	08.848	04.655	1495.8
12:58:00	11.02.02	0000.4	140.049	21.178	08.848	04.655	1495.8
12:58:05	11.02.02	0000.4	140.049	21.180	08.847	04.654	1495.8
12:58:10	11.02.02	0000.4	140.049	21.178	08.848	04.654	1495.8
12:58:15	11.02.02	0000.4	140.049	21.180	08.847	04.654	1495.8
12:58:20	11.02.02	0000.4	140.049	21.179	08.847	04.654	1495.8
12:58:25	11.02.02	0000.4	140.048	21.178	08.847	04.654	1495.8
12:58:30	11.02.02	0000.4	140.048	21.179	08.847	04.654	1495.8
12:58:35	11.02.02	0000.4	140.049	21.179	08.847	04.654	1495.8
12:58:40	11.02.02	0000.4	140.049	21.178	08.848	04.655	1495.8
12:58:45	11.02.02	0000.4	140.048	21.178	08.847	04.654	1495.8
12:58:50	11.02.02	0000.4	140.048	21.178	08.847	04.654	1495.8
12:58:55	11.02.02	0000.4	140.048	21.177	08.847	04.654	1495.8
12:59:00	11.02.02	0000.4	140.048	21.177	08.847	04.654	1495.8
12:59:05	11.02.02	0000.4	140.047	21.176	08.847	04.654	1495.8
12:59:10	11.02.02	0000.4	140.048	21.176	08.847	04.655	1495.8
12:59:15	11.02.02	0000.4	140.048	21.176	08.847	04.655	1495.8
12:59:20	11.02.02	0000.4	140.047	21.177	08.846	04.654	1495.8
12:59:25	11.02.02	0000.4	140.047	21.176	08.847	04.654	1495.8
12:59:30	11.02.02	0000.4	140.047	21.176	08.847	04.654	1495.8
12:59:35	11.02.02	0000.4	140.048	21.176	08.847	04.655	1495.8
12:59:40	11.02.02	0000.4	140.047	21.177	08.846	04.654	1495.8
12:59:45	11.02.02	0000.4	140.047	21.177	08.846	04.654	1495.8
12:59:50	11.02.02	0000.4	140.047	21.176	08.847	04.654	1495.8
12:59:55	11.02.02	0000.4	140.047	21.177	08.846	04.654	1495.8
13:00:00	11.02.02	0000.4	140.048	21.177	08.847	04.654	1495.8
13:00:05	11.02.02	0000.4	140.048	21.177	08.847	04.654	1495.8
13:00:10	11.02.02	0000.4	140.047	21.177	08.846	04.654	1495.8
13:00:15	11.02.02	0000.4	140.047	21.178	08.846	04.653	1495.8
13:00:20	11.02.02	0000.4	140.047	21.178	08.846	04.653	1495.8
13:00:25	11.02.02	0000.4	140.046	21.179	08.845	04.653	1495.8
13:00:30	11.02.02	0000.4	140.047	21.180	08.846	04.653	1495.8
13:00:35	11.02.02	0000.4	140.048	21.181	08.846	04.653	1495.8

Figure 2.20 Continuous Printer Protocol

II-13 Maintenance of the Conductivity Sensor

For cleaning the sensor you will have best results with a saturated Calgon solution. Calgon is a world wide available water softener to prevent limescale build-up in washing machines. Rub off the sensor with a cotton tip applicator soaked with the Calgon solution. Afterwards rinse with distilled water. Subsequently place the sensor in seawater for at least three hours.

Please do not let the sensor fall dry. If the sensor is dry it must be placed in seawater for at least three hours before usage.

III APPENDIX

III-1 Serial Interface Specification

Type : RS 232 C
Data Bits : 8
Stop Bits : 1
Parity : none
Baud Rate : 2400
Data Protocol : XON/XOFF

III-2 Connector Assignment of CTD

The CTD connector on top of the battery module is the central port to the instrument. Relative to top view, supposed the guide hole is in 12 o'clock position, the pin numbers are counted anticlockwise:

12 o'clock guide hole
11 o'clock pin 1
7 o'clock pin 2
5 o'clock pin 3
1 o'clock pin 4

Pin	Description	Direction
1	Signal Ground, Supply Ground	
2	Send Data	to Printer/PC
3	Receive Data	to CTD
4	Supply (-1.5 V to -7.5 V)	to CTD

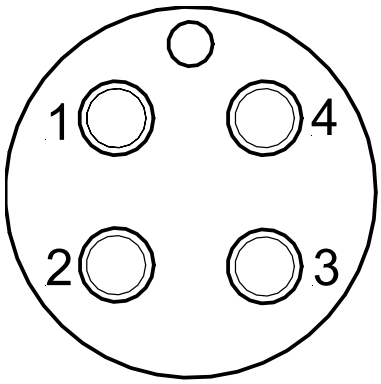


Figure 3.1 CTD Connector

Batteries must be removed before applying external voltage.

III-3 Connector Assignment of Interface D Type Connector

The interface connector for the peripheral devices (printer or computer) is of Sub-D type, 25 pins, male.

Pin	Description	Direction
1	Frame Ground	
2	Receive Data	to CTD
3	Send Data	to Printer/PC
7	Signal Ground	

III-4 Last Memory Lost Error Codes

No.	Power	Critical	Description
1	X		RAM invalid check sum
2		X	RAM read/write error
3	X		Real Time Clock not initialised
4		X	Real Time Clock error
5		X	EEPROM invalid check sum

Power: Error occurs if instrument was not powered for more than 30 minutes.

Critical: Error occurs due to defective hardware. Please send instrument to SiS for service.

III-4 Technical Specification

Parameter	Range	Resolution	Accuracy	Stability	Response Time
conductivity	1 - 65 ms/ cm	1 µS/ cm	10 µS/ cm	2 µS/ cm month	20 ms
temperature	-2 - +40°C	0.001 °C	0.005 °C	0.001 °C/ month	20 ms
pressure	0-100 dbar	0.01 dbar	0.05 %fs	0.01 %/ month	10 ms
	0-500 dbar				
	0-999 dbar				
salinity	2 - 42	0.001	0.019	0.004 / month	-
density	0 - 65 kgm^{-3}	0.001 kgm^{-3}	0.016 kgm^{-3}	0.003 kgm^{-3}/ month	-
sound speed	1392 - 1724 $msec^{-1}$	0.1 $msec^{-1}$	0.02 $msec^{-1}$	0.004 $msec^{-1}$/ month	-

Sampling rate: Spatial mode user selectable > 0.1 dbar
Time mode user selectable 0:00 h:min < t_s < 10:00 h:min
Real time data acquisition 3 msec for a complete CTP cycle of 17 bit resolution

Memory: CMOS solid state with 1000 data sets. Upgrade as option

Power supply: 2 D cells: 10 hours continuous operation (with Alkaline cells)
up to 40 days time sampling (with Alkaline cells)
External supply 1.5 V - 7.5 V, 1.5 W

Outer dimensions: 522 mm (pressure case), 181 mm (battery module), 70 mm diameter

Weight: 4.5 kg in air with battery module and batteries.

III-5 Available Options

- Mounting cage
- Stowage case for CTD without mounting cage
- Stowage case for CTD with mounting cage