AANDERAA INSTRUMENTS

DATA COLLECTING INSTRUMENTS FOR LAND SEA AND AIR

S/T - C/T - S/T/D and C/T/D Sensors

Sensors for direct measurement of salinity, conductivity, temperature and depth. Designed for use with Aanderaa Dataloggers or Display Units.

- **Salinity / Temperature Sensor 3210/3210D**
- **Conductivity / Temperature Sensor 3211/3211D**
- **Salinity /Temperature / Depth Sensor 3230**
- **Conductivity /Temperature / Depth Sensor 3231**

These sensors measure the salinity, conductivity, temperature of sea-water as well as the sensor depth depending on which model is used. They can be used separately or in conjunction with other sensors to monitor the suitability of the sea-water for aquaculture and other purposes.

All four types of sensors have the same external design. The sensor's upper and lower parts are made of titanium. A conductivity cell, a temperature sensor, a pressure sensor and the associated electronics are all molded in polyurethane (Durotong) forming a cylindrical shaped sensor. At the lower end, the sensor is furnished with an endpiece with eyelet for fastening purposes. The sensor is furnished with a 10-pin receptacle that makes a watertight connection to the Aanderaa Sensor cable 3282. Several standard cable lengths are available.

When a reading is to be taken, the absolute conductivity is measured by an electrodeless induction cell based on two toroidal windings. The primary toroid induces a current in the sea-water loop. The current, which is determined by the conductivity of the water, is then measured by the secondary toroid. The effect of water temperature on the conductivity is compensated for by a thermistor circuit to provide an accurate measure of salinity for the S/T and S/T/D sensors.

The signal in the secondary winding is converted to Aanderaa SR10 digital code by an A/D converter. The signal can further be clocked in serial form into reading units such as Aanderaa Dataloggers, Display or Sensor Scanning Units.

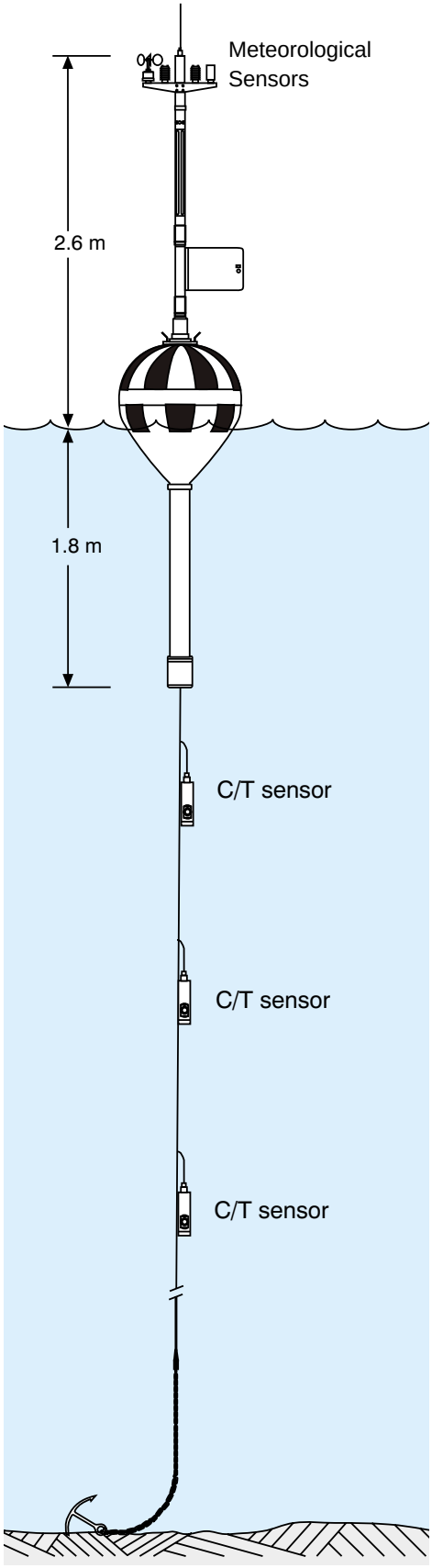
Water temperature is sensed by a thermistor in a half-bridge configuration, and the output is the Aanderaa VR-22 analog signal format. The sensor depth is measured by an absolute pressure sensor in the VR-22 half-bridge configuration.

Cables up to 300 meters in length can be used for connecting the sensor to the reading unit. To avoid erratic readings, do not install the sensor closer to an object than 10cm.

Note:
The reading of this sensor may be erratic if marine fouling builds up in the bore of the cell or in its vicinity. The sensor should be inspected regularly and cleaned when necessary.

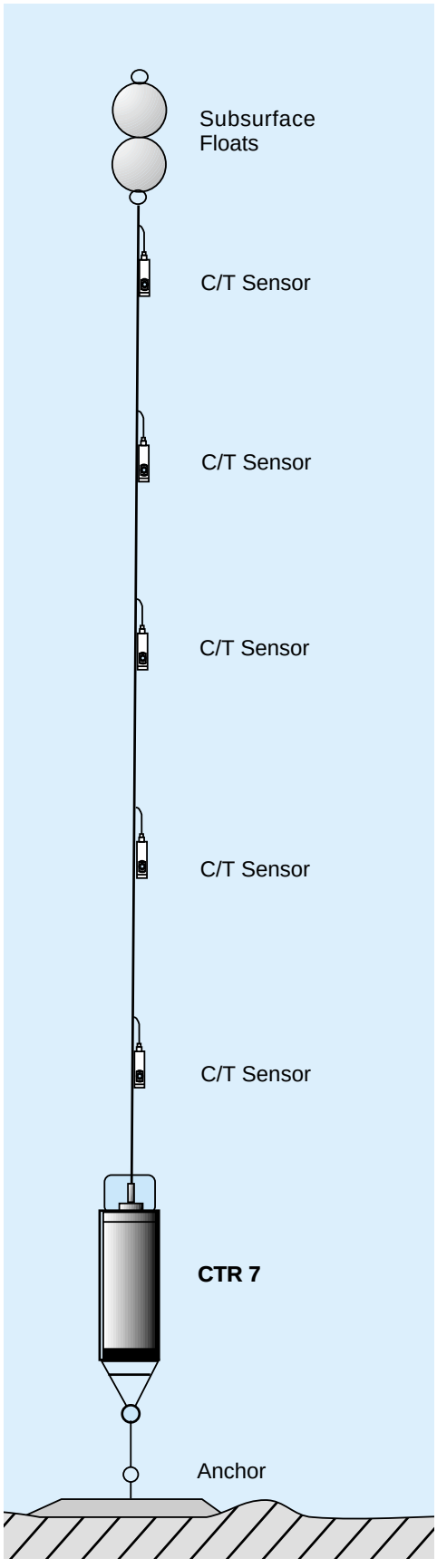
APPLICATIONS

These sensors can be used in various ways. Two main fields of application are shown in the illustrations below. One can use any of the four types of sensors in the examples shown. In each case it is recommended that the sensors are used in combination with Aanderaa recorders, scanning or display units to take full advantage of their design, technical solution and accuracy.

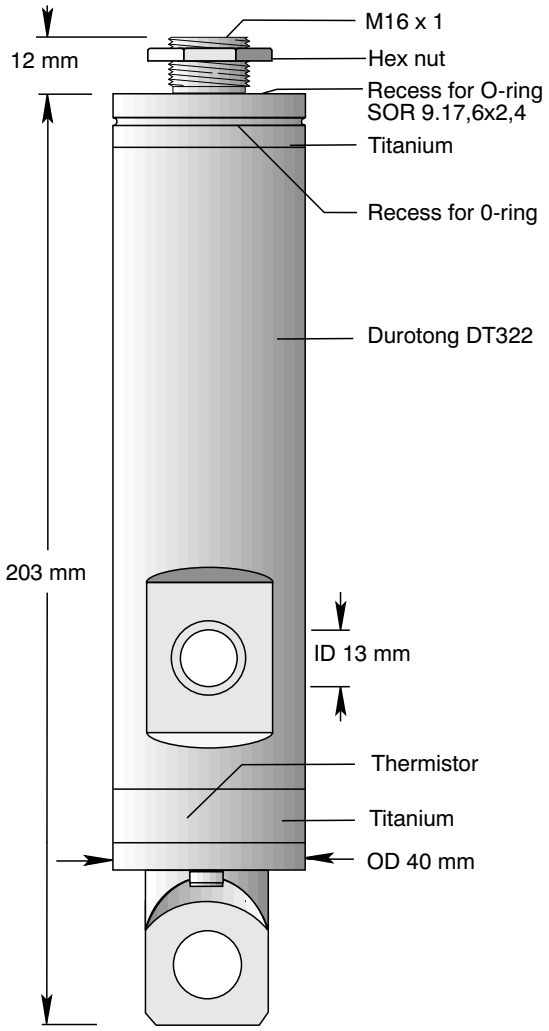


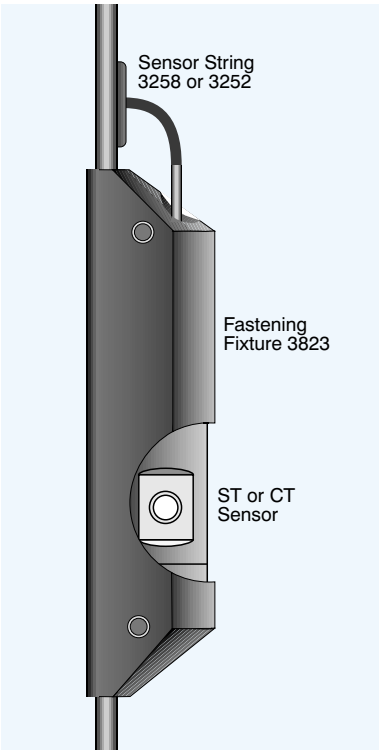
The example to the left shows a moored databuoy equipped with a string with 3 C/T sensors hanging underneath. The string can be up to 300m long and the sensors are scanned successively at fixed time intervals controlled by the sensor scanning unit in the buoy. Data can either be stored at site or transmitted to the user in real-time by VHF radio. The buoy can also be equipped with meteorological sensors as shown here.

The illustration to the right shows the sensors used together with the 11 channel CT recorder, CTR 7. which is normally placed on the seabed. The string, fastened to the top of the recorder, is lifted by a subsurface float. Up to 5 S/T or C/T sensors can be used.
Data are stored in the recorder at user selectable intervals.
The standard Data Storage Unit DSU 2990 is used in both examples.



SPECIFICATIONS FOR S/T, C/T, S/T/D AND C/T/D SENSORS





Fastening Fixture 3823 for fastening the sensor to Sensor String 3258 or to Sensor String for Buoy 3252

S/T SENSOR 3210/3210D

Salinity:	Sensor Output: SR10
- Range:	0–40 ppt
- Accuracy:	± 0.2 ppt
- Resolution:	0.04 ppt
- Operating Depth:	
3210	300 meters
3210D	1500 meters
	Maximum cable length is 300m
Temperature:	See below

C/T SENSOR 3211/3211D

Conductivity:	Sensor Output: SR10
- Range:	0–75 mS/cm
- Accuracy:	±0.15 mS/cm
- Resolution:	0.075 mS/cm
- Operating Depth:	
3211	300 meters
3211D	1500 meters
	Maximum cable length is 300m
Temperature:	See below

S/T/D and C/T/D SENSORS 3230 and 3231

The salinity and conductivity specifications are the same as for the S/T and C/T sensors

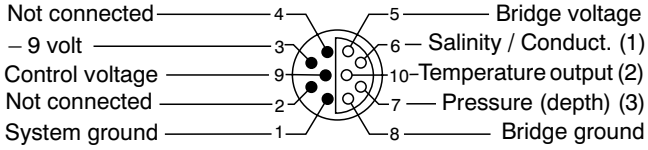
Pressure (Depth):	Sensor Output:VR-22
- Range:	0–1100 kPa Abs. (other ranges available on request)
- Accuracy:	0.2 % of range
- Resolution:	0.1% of range
Temperature:	See below

COMMON FOR ALL SENSORS

Temperature:	Sensor Output: VR22
- Range:	–7.5 to +41°C
- Accuracy:	±0.1°C
- Resolution:	0.05°C
- Time Constant (63%)	
S/T & C/T sensors:	35 seconds
S/T/D & C/T/D sensors:	60 seconds
Current Drain:	2.5 mA
Operating Temperature:	–5 to +40°C
Operating Depth:	Limited by the pressure sensor range
Electrical Connection:	Cable 3282. Specify length. With Datalogger 3660, 3634 or SSU 3010, split cable 3218 or 3219 is also needed
Materials:	Titanium and Polyurethane (Durotong DT322)
Net Weight:	400 grams
Warranty:	Two years against faulty materials and workmanship

PIN CONFIGURATION

Receptacle, exterior view; pin = ●; bushing = ○



CALIBRATION

The calibration of each sensor is carried out at the factory and the calibration is valid for all following data handling. The form below is filled in only where necessary, depending upon which type of sensor it concerns.

Type:.....Model No.:..... Serial No...... Pressure range:..... kPa A

Conductivity / Salinity		**Temperature**		**Pressure**	
(mS/cm-PPT)	Reading N	(°C)	Reading N	(kPa)	Reading N

Coefficients (mS/cm-PPT)		Coefficients (°C)		Coefficients (kPa Absolute)	
A		A		A	
B		B		B	
C		C		C	
D		D		D	

Formula for converting Pressure in kPa to Water Level in meters:

$$\text{Water Level} = \frac{(A + BN + CN^2 + DN^3) - P_{atm}}{d \times g}$$

A, B, C, D = coefficients for water level in meters given in the sensor's calibration sheet.

N = raw data value measured by the datalogger.

d = density of water (gram pr. cm^3). Depending on its salinity and whether it is fresh or salt water.

g = gravity.(m/s^2) Depending on where the measurements are taken .

P_{atm} = atmospheric pressure (kPa)

How to calculate an A_m coefficient for a specific location (m)

In our example the density is 1 and the gravity is set to 9,80665 m/s^2 (the international standard). Referring to the calibration sheet for a specific sensor the A coefficient (in kPa) is -2.842 E - 01

$$A_m \text{ coeff. in meters} = \frac{A}{d \times g} = \frac{\text{-2.842 E - 01}}{9{,}80665} = \text{-2,898 E - 02}$$

The same procedure applies for the B, C and D coefficients.

The general formula for converting the different parameter's raw data (N) to engineering units is: $A + BN + CN^2 + DN^3$

Loop Reading for C/T sensor:

for 1000 ohm resistor:.....

for 100 ohm resistor:.....

The Cell factor,K =..... cm^{-1}

Date:..... Signature:.....

Representative's Stamp