

Miniature Chlorophyll/Turbidity Data Logger

COMPACT CLW ACLW-CMP

Fluorescence Turbidity Temperature

Features

- Small size, light weight & large memory capacity
- High resolution
- Non-volatile flash memory
- Built-in calendar / time information
- No interface required
- Programmed calibration factors
- Wiper function provided as standard
- Better stability & longer life span
- No corrosion due to titanium housing
- Easy-to-use data acquisition software (Windows version)



COMPACT-CLW is a miniature and precision data logger with a micro-controller suitable for long-term consecutive deployment. Our updated state-of-the-art technology allows for a compact design capable of storing up to 179,178 sets of 4-channel data, consisting of chlorophyll, turbidity, temperature and battery voltage. This facilitates up to one year of continuous measurement.

The memory media, non-volatile flash memory IC's, protect data from loss resulting from irregular battery voltage. This feature improves reliability.

A circular array of light emitting diodes (LED's) provides the excitation light for the chlorophyll-a fluorescence and the turbidity backscatter sensors. Optical filters in front of the optical receivers separate the backscattered light (turbidity) from the fluorescence signals. The filters also prevent the influence of solar light on the measurements.

A wiper sweeps the optical surface before each sample to remove dirt and residue. This improves the repeatability of the measurements and makes long-term deployments possible.

The turbidity sensor has a superior stability in low concentration areas and the correlation with suspended sediment in high concentration areas has been improved. The instrument, therefore, can be used not only in the marine field but also in river and dam applications.

COMPACT-CLW is controlled through the PC serial port, RS232-C. The main unit records calendar and time information with each sample and the sensors' calibration coefficients are stored in the built-in memory. The basic measurement setup requires only the selections of the start time and the sampling interval.

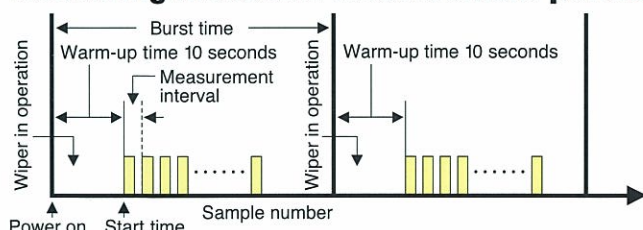
The data transfer after the completion of the deployment is easily accomplished. Information, such as measurement start time and calibration coefficients, are transferred together with the measured data. The user is free from troublesome coefficient control. Data can be processed quickly and effortlessly.

The data processing program offers clear and logical screens for easy operation.

Main Unit Specifications

Measuring items	Chlorophyll	Turbidity	Temperature
Sensor type	Fluorescence light scattering	Infrared back-scattering	Thermistor
Measurement range	0~400 $\mu\text{g}/\ell$ based on Uranine solution concentration	0~1000 FTU based on Formazine solution concentration	-5~40°C
Resolution	0.01 $\mu\text{g}/\ell$	0.03FTU	0.001°C
Accuracy	$\pm 1\%$ of measured value (0~200 $\mu\text{g}/\ell$) Zero drift $\pm 0.1\mu\text{g}/\ell$	$\pm 2\%$ of measured value Zero drift $\pm 0.3\text{FTU}$	$\pm 0.05^\circ\text{C}$
Memory type	2Mbyte flash memory		
Memory capacity	179,178 data		
A/D Converter	16bits digital conversion		
Measuring mode	Continuous, Burst		
Measuring interval	0.5, 1, 2, 5, 10, 15, 20, 30 seconds		
Burst time	1-1440 minutes adjustable per minute		
Sample number	1, 10, 15, 20, 30, 60, 120, 180, 240, 300, 600, 1200		
Battery capacity	Lithium Battery 14 AH		
Power consumption	90mA		
Material of outer case	Titanium		
Dimensions	See below		
Weight	1,080g in air & 560g in water		
Depth rating	200 m		

Measuring mode and Measurement period

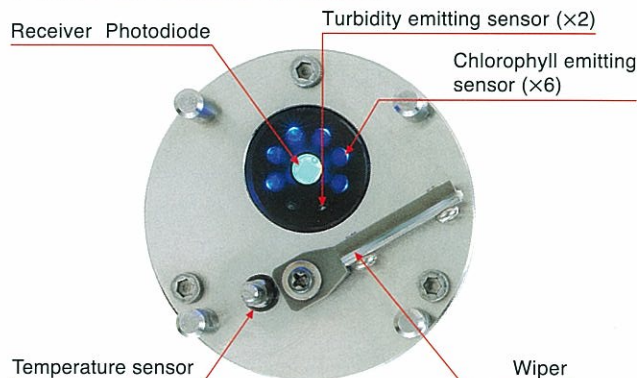


For 1 second measurement interval
Upper: Maximum measuring period Lower: Battery consumption

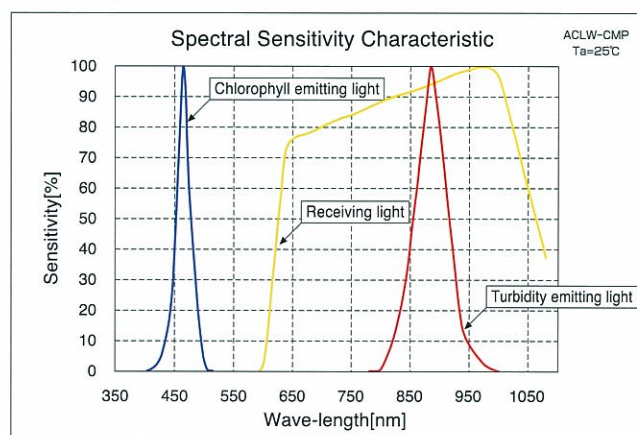
Burst interval		No. of samples				
		10	20	30	60	120
10min	days	115.2	62.2	41.4	20.7	10.3
	Ah	11.2	8.3	7.1	5.8	5.2
20min	days	230.4	124.4	82.9	41.4	20.7
	Ah	11.2	8.3	7.1	5.8	5.2
30min	days	345.6	186.6	124.4	62.2	31.1
	Ah	11.2	8.3	7.1	5.8	5.2
60min	days	365.0	365.0	248.8	124.4	62.2
	Ah	6.0	8.1	7.1	5.8	5.2
120min	days	365.0	365.0	365.0	248.8	124.4
	Ah	3.0	4.1	5.2	5.8	5.2

Remarks: Above table was made with basic calculation by data & battery capacities.
The battery capacity is consider as 5.6Ah maximum with safety rate of 0.8.
Measurement period is limited to be max. 1 year.

Photo of sensor portion



Sensitivity characteristics on chlorophyll/ Turbidity sensors

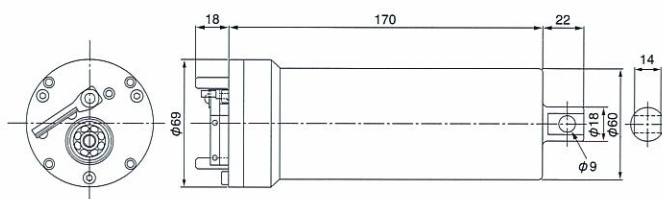


Sensor condition after deployment



One-month deployment under burst interval of 10 minutes

Dimensions



Calibration ALEC JFE fluorescence and turbidity sensors.

The units of the data generated by the sensors are expressed as formazine units. From a lab calibration constants have been determined to transfer these units to suspended matter concentrations of local suspended material and in case of fluorescence to chlorophyll-a concentrations using *isochrysis galbana* as reference algal species.

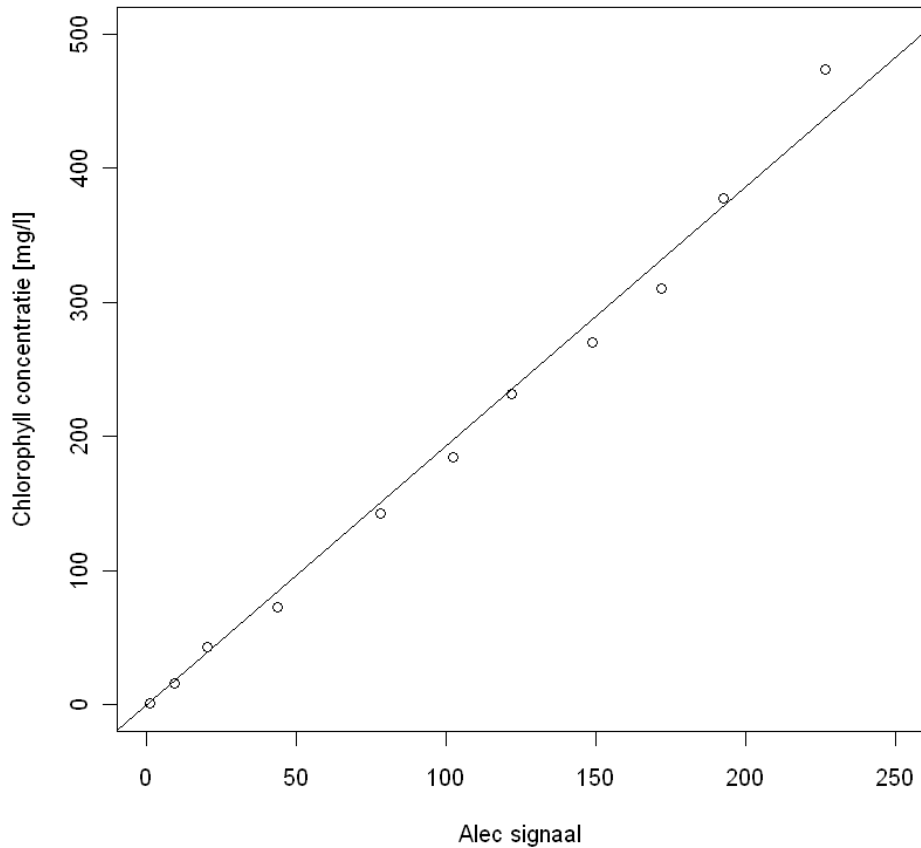
Suspended matter calibration;

Local fine material was collected. A dilution series of this material was made ranging from 6 to 2100 mg/L. Every ALEC sensor measured two bursts of each 10 measurements in each of the concentrations while the solutions were stirred. Afterwards three water samples ranging from 100 ml to 2000 ml from the solution were filtered over pre weighted cellulose acetate filters. After drying for a day at 60°C each filter was weighed again. From the weight difference between the absolute amount of suspended material could be determined. This was back calculated to a concentration using the filtered volume of the sample taken.

Chl-a

A dilution series of the algal culture was made ranging from 0.6 to 444 µ/L. Every ALEC sensor measured two bursts of each 10 measurements in each of the concentrations while the solution was stirred. Afterwards three water samples ranging from 20 ml to 300 ml from the solution were filtered over whatman gff filters. After freeze drying the amount of chlorophyll was determined by the acetone extraction method. The amount of chlorophyll was back calculated to a chlorophyll concentration using the filtered volume of the sample taken.

Chlorophyll-a



$$\text{Chlorophyll } [\mu\text{g/L}] = 1.92950 \cdot \text{Alecsignaal} + 0$$

Residuals:

Min	1Q	Median	3Q	Max
-21.581	-12.600	-3.999	1.426	35.990

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
Average[Type == "Chloro"]	1.92950	0.03797	50.81	2.11e-13 ***

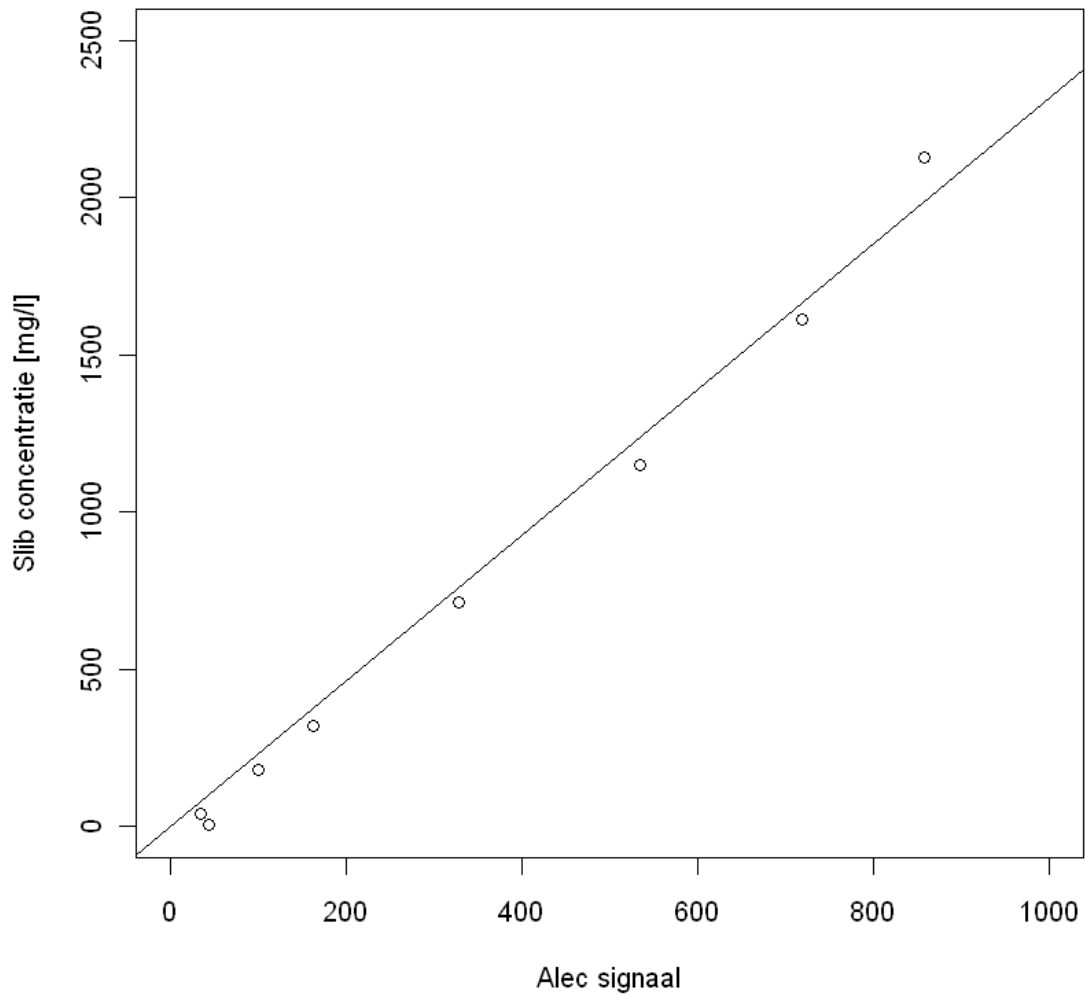
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Residual standard error: 15.84 on 10 degrees of freedom

Multiple R-squared: 0.9961, Adjusted R-squared: 0.9958

F-statistic: 2582 on 1 and 10 DF, p-value: 2.106e-13

Slib ijking.



Slib concentratie[mg/L]= 2.3151*Alecuitlezing+0

Coefficients:

	Estimate	Std. Error	t value	Pr(> t)
Average[Type == "Slib"]	2.3151	0.0629	36.8	2.84e-09 ***

Signif. codes: 0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1

Residual standard error: 81.68 on 7 degrees of freedom

Multiple R-squared: 0.9949, Adjusted R-squared: 0.9941

F-statistic: 1355 on 1 and 7 DF, p-value: 2.841e-09

