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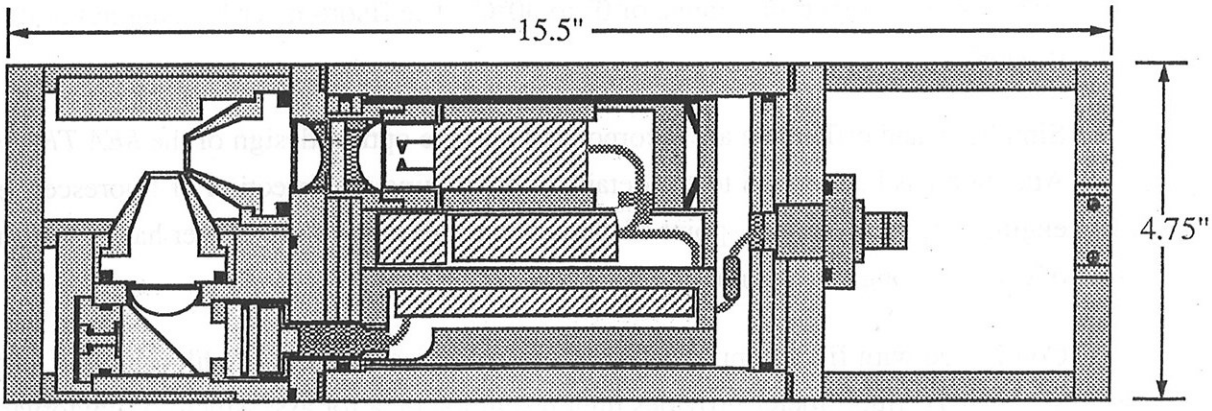
Fluorometer Manual



Fluorometer Cutaway View

Serial # 131S

DEEP SEA. 3000M SBE 911+

SEA TECH FLUOROMETER

AN *IN SITU* INSTRUMENT TO MEASURE CHLOROPHYLL ***a*** FLUORESCENCE.

The *SEA TECH* fluorometer has been designed within challenging constraints of size, weight, and power requirements. The 316 stainless steel housing which is impervious to corrosion by salt water makes the fluorometer ideal for use in a salt water environment. The small size, 4.75" (121 mm) diameter, 15.5" (333 mm) length, and weight of approximately 12 kg in water, allows the *SEA TECH* fluorometer to be installed on most oceanographic data acquisition systems. The power required for operation of the fluorometer is less than two watts. The instrument is very stable over a temperature range of 0° to 30°C . The fluorometer housing has a 3000 meter depth capability.

Simplicity and efficiency are incorporated into the optical design of the *SEA TECH* fluorometer. Attention has been given to the details of optimizing the detection of fluorescence from both an engineering and scientific point of view. The result is this fluorometer has become the instrument of choice among the oceanographic community.

Configured with filters optimized for the *in situ* measurement of chlorophyll ***a*** fluorescence, the *SEA TECH* fluorometer provides high resolution data for assessment of phytoplankton biomass and monitoring of primary productivity in fresh or marine waters. It may be used in highly productive lakes or coastal waters where a wide dynamic range in measurement is sought as well as in oligotrophic environments where a high degree of resolution is most important.

This *SEA TECH* fluorometer is supplied with six ranges permitting the measurement of chlorophyll *a* concentrations from approximately 3 µg/l to 1000 µg/l. These ranges can be selected manually by internal jumpers.

FLUOROMETER SPECIFICATIONS:

NOMINAL RANGE (1,2):	Gain	Chl. *a*
	X330	3µg/l
	X100	10µg/l
	X33	30µg/l
	X10	100µg/l
	X3.3	300µg/l
	X1	1000µg/l
TIME CONSTANT (2):	0.1, 1.0, 3.0 or 10 sec.	
SIGNAL OUTPUT:	0 to 5 VDC	
OPTICAL FILTERS:	Excitation - 425 nm peak, 200nm FWHM	
	Emission - 685nm peak, 30nm FWHM	
POWER SUPPLY:	Voltage	12 VDC
	Power	2 Watts
MATERIAL:	Housing	316 SS
	Windows	Acrylic
WEIGHT:	In air	14.74 kg
	In water	12.04 kg
DIMENSIONS:	Diameter	4.75",121 mm
	Length	15.5", 333 mm
MAXIMUM DEPTH:	3000 Meters	

Notes:

(1) Six internally selectable ranges cover 3 to 1000 µg/l. The fluorometer is designed such that gain programming can be accomplished manually with internal jumpers.

(2) The measurement range values listed above are nominal; calibrations are not performed at the factory and must be done by the user. Spectrophotometric and Fluorometric calibration procedures for the determination of chlorophyll's and phaeo-pigments are described by J. D. H. Strickland and T. R. Parsons (BULLETIN 167 , second edition, A Practical Handbook of Seawater Analysis, FISHERIES RESEARCH BOARD OF CANADA, Ottawa 1972).

(3) One of these four time constants can be internally selected, the recommended time constant is 3 seconds. The fluorometer time constant is set at 3 seconds prior to shipment from the factory.

LIMITED PRODUCT WARRANTY

For a period of one year from the date of shipment Sea Tech, Inc. guarantees its products to be free from 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. Repairs or replacements under warranty will be at no cost to the customer. This warranty is void if, in our opinion, the instrument has been damaged by accident, mishandled, misused, altered or repaired by the customer. The customer should call for Return Authorization before returning the instrument to the factory. Instruments should be returned prepaid and carefully packed in the original shipping container as the customer will be responsible for freight damage if the instrument is improperly packed. The customer will be charged a $100 minimum plus 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 Sea Tech, Inc.

Shipping Address

Items returned to Sea Tech should be shipped to the address below:

Sea Tech, Inc.
825 NE Circle Blvd.
Corvallis, OR 97330

INTRODUCTION

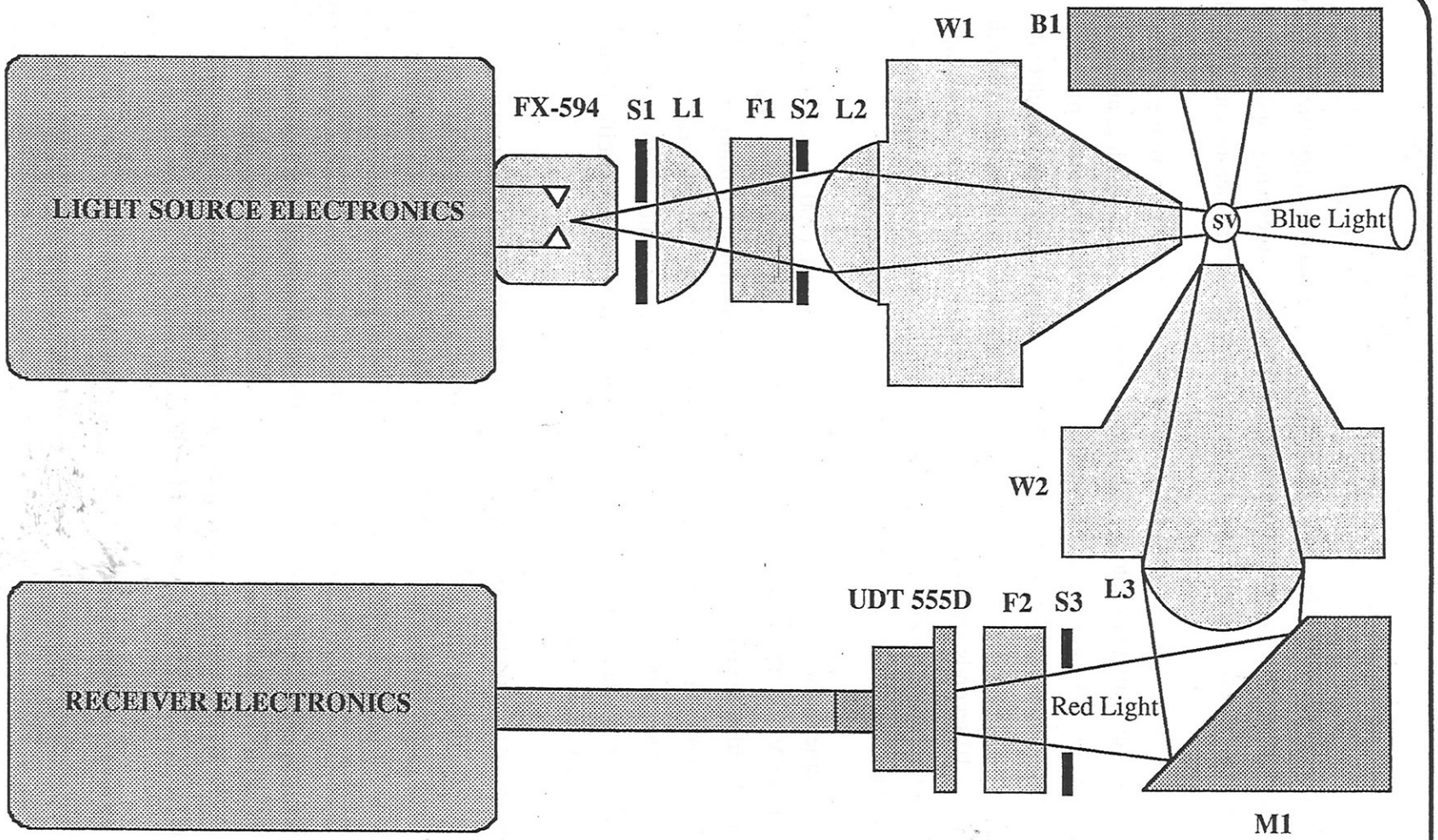
The Sea Tech fluorometer, shown on the front cover and described optically in Figure 1, is an instrument designed for the *in situ* measurement of fluorescence in aquatic environments. While many dissolved substances as well as biopigments exhibit fluorescent properties, the optical filters used in the Sea Tech fluorometer have been selected for optimum measurement of chlorophyll *a*.

The instrument has been designed for use in a moored or profiling mode. It is not sensitive to ambient light, permitting laboratory calibration with normal room lighting, and field measurements to be made at the water surface. The instrument is stable with time and temperature, enabling the user to make accurate and repeatable measurements. Six signal gains are selectable which permit the measurement of chlorophyll *a* concentrations from 0.015 to 1000 µg/l. Four time constants of 0.1, 1, 3, and 10 seconds are provided to smooth the data. Experience has shown that a 3 second time constant is the most useful for profiling applications, and the most appropriate range will depend on the concentration of the fluorescent material in the water column.

Power requirements are nominally 12 VDC at 150 milliamps, (300 ma peak) and the fluorometer output is 0 to 5 VDC. These power requirements and output signal levels allow the fluorometer to be interfaced with most oceanographic data acquisition systems, including those manufactured by Sea-Bird Electronics and Biospherical Instruments, Inc. The interface generally consists of a DC to DC converter to provide 12 VDC @ 300 milliamps and an analog to digital converter to acquire the data. Consult the data acquisition system manufacturer regarding specific details for interfacing the fluorometer to their system.

The fluorometer as supplied from the factory measures the relative fluorescence energy emitted from organic material suspended in the water over a nominal chlorophyll *a* concentration range from 0.015 to 1000 µg/l. Absolute calibration of the instrument must be done by the user in the area where the instrument is deployed because the magnitude of fluorescence energy emitted from different organic materials suspended in the water column can change considerably. Properly calibrated, a good correlation will exist between the relative fluorescence output and chlorophyll *a* if the nature of the particles in the water column does not change significantly. Generally the nature of the particles suspended in the water column does not change significantly in a given area making the fluorometer a very useful tool for the determination of chlorophyll *a*..

Spectrophotometric and Fluorometric calibration procedures for the determination of chlorophyll's and phaeo-pigments are described by J. D. H. Strickland and T. R. Parsons (BULLETIN 167 , second edition, A Practical Handbook of Seawater Analysis, FISHERIES RESEARCH BOARD OF CANADA, Ottawa 1972).



NOTES

1. Light source filter, 425nm peak, 200nm FWHM
2. Receiver filter, 685nm peak, 30nm FWHM
3. Sample volume, approximately 1/2 cc.

FIGURE 1 FLUOROMETER OPTICAL DIAGRAM

OPERATING INSTRUCTIONS

ELECTRICAL WIRING

The wiring diagram for the fluorometer is shown in Figure 2. The power supply used to provide voltage to power the fluorometer must be a nominal 12 VDC supply capable of delivering 300 milliamps. If the instrument is to be battery powered, 4 lithium (D-Cell) batteries connected in series (14.2 VDC) is recommended. *Do not* power the fluorometer with a supply voltage greater than 15 VDC, as ***damage to the unit will result.*** Power is internally regulated in the fluorometer and will perform satisfactory with input voltages between 10 and 15 VDC.

CHECKOUT

Apply power, 12 VDC at 300 milliamps peak, 150 milliamps average, and verify that the unit is emitting blue light. Measure the fluorometer output in air, it should be within about 20 millivolts of zero. Using a fluorescing material in the sample volume, (your finger will do) verify that the signal increases towards the full scale value of 5 VDC (saturation voltage is approximately 6 VDC). This procedure verifies that the unit is functional.

MOUNTING

Figure 3 shows the fluorometer installed in the mounting bracket supplied with the instrument. Four holes are drilled in the base of the bracket for mounting the fluorometer to the user's system. Improper mounting can cause the fluorometer to leak water. If the user does not use the mounting bracket supplied then Sea Tech can not warranty the instrument for water damage. When deployed, the fluorometer should be mounted in a position which permits optimal undisturbed flow of water through the sensing volume.

IN SITU SENSING

With the fluorometer mounted, connected, and checked out, deployment is straightforward. The conical windows should be inspected prior to each use of the instrument. If particles or deposits appear on the windows, a non-abrasive mild detergent may be used with a lint-free damp cloth to lightly cleanse the surfaces. In general a light cleaning of the windows is recommended before each use. The instrument should be washed down with clean fresh water after use to prevent the accumulation of salt deposits and particulate material. Care should always be taken to avoid excessive wiping of the windows, the acrylic material is quite durable but scratches much more easily than glass.

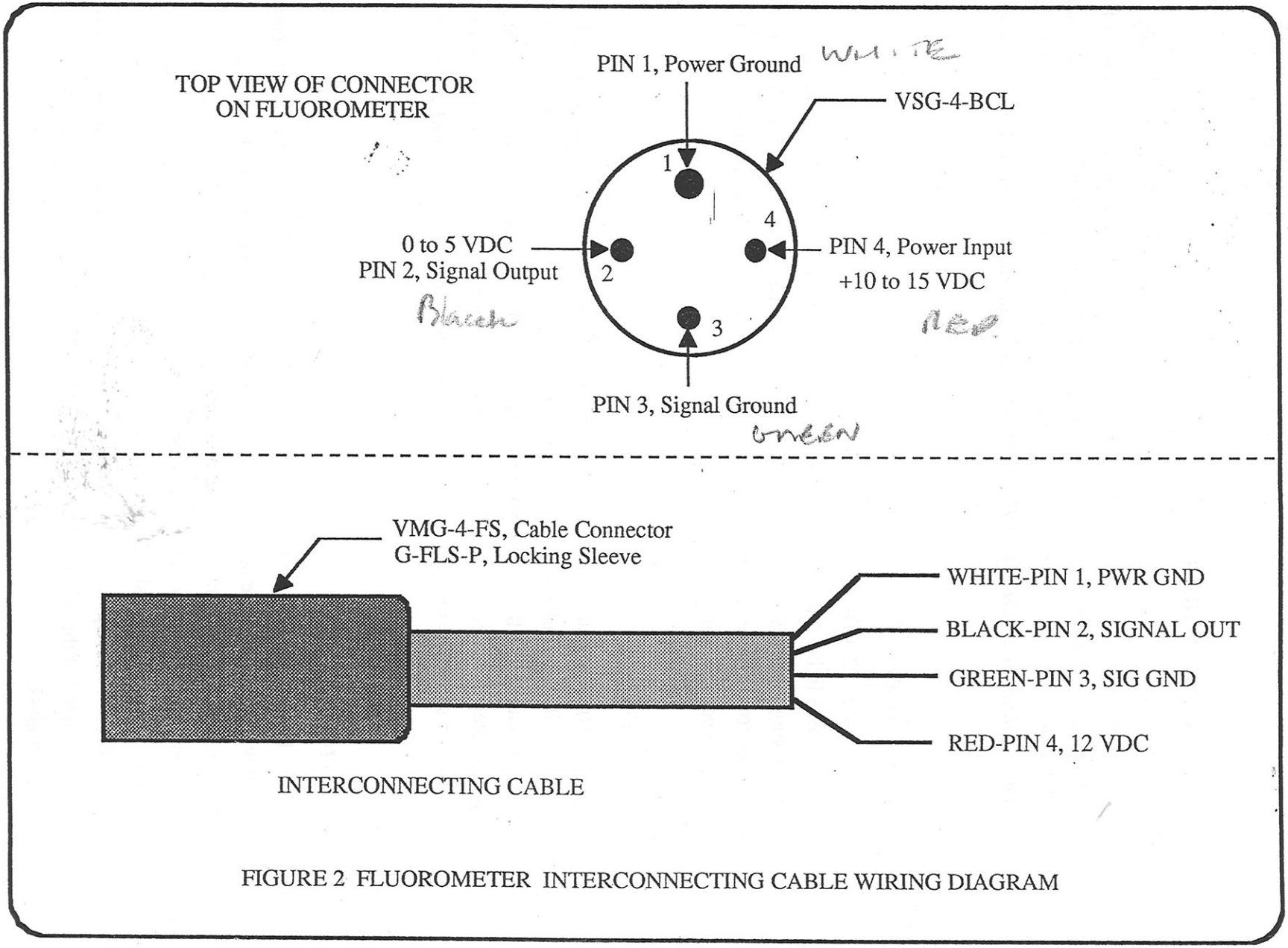


FIGURE 2 FLUOROMETER INTERCONNECTING CABLE WIRING DIAGRAM

CARE

Turn the instrument off after each use because like all light sources the flash lamp degrades with age. According to the manufacturer of the light source, the flash lamp output will decrease to 50% of its initial output in approximately 2 years of continuous operation at 5 HZ (5 HZ is the flash rate used in this instrument). For normal scientific use this means the flash lamp in most applications should last forever.

SELECTING GAIN AND TIME CONSTANT

The gain or time constant can be changed by opening the pressure case of the fluorometer, refer to Figure 5. This is accomplished by removing two screws on the sensor end cap and four screws on the cable end cap. Remove the cable end cap first; two slots are provided which enable the use of two flat blade screwdrivers to be used to pry off the end cap. Use even pressure to remove the end cap, maintaining the same gap at each screwdriver slot when the end cap is being removed to prevent damage to the o-ring seal. Then disconnect the connector to the electronics to allow removal of the pressure case. Remove the pressure case using the screwdriver slots provided, again keep an even gap as the case is being pried off to prevent damage to the o-ring seal. To gain access to the jumpers used to set gain and time constant, remove the four slot screws on the cover plate for the receiver circuit board. ***Do not*** remove the four cross-point screws connecting the receiver assembly to the light source; ***damage to the detector assembly will result.*** Once the jumpers are placed in the appropriate positions, the metal cover should be replaced, all screws checked for tightness, and the pressure case reinstalled. Make sure both end cap o-rings have a light coat of grease (use silicon grease) and are clean and free of debris; if this is not done the pressure case may leak causing severe damage to the fluorometer. The unit should be purged with dry nitrogen prior to closing to prevent a subsequent accumulation of moisture by condensation. Only dry nitrogen should be used because its refractive index is closest to that of air. There are no other user-serviceable components in the fluorometer, and consequently no other sections of the instrument should be opened.

The fluorometer may be configured for any one of six signal gains from 1X to 330X corresponding to a measurement range of 3 µg/l to 1000 µg/l. Signal gain or measurement range can be selected via three jumpers located on the receiver electronics board. To set full scale concentration using these jumpers refer to Figure 5, sensitivity / time constant adjust. Use the truth table in Figure 5 to set the measurement range desired. The time constant may be changed for profiling or moored operations where different response times are desired, four time constants (0.1, 1, 3, and 10 seconds) are selectable via a moveable jumper on the receiver circuit board, again refer to Figure 5. The 3 second time constant is set at the factory and is recommended for both profiling and moored applications.

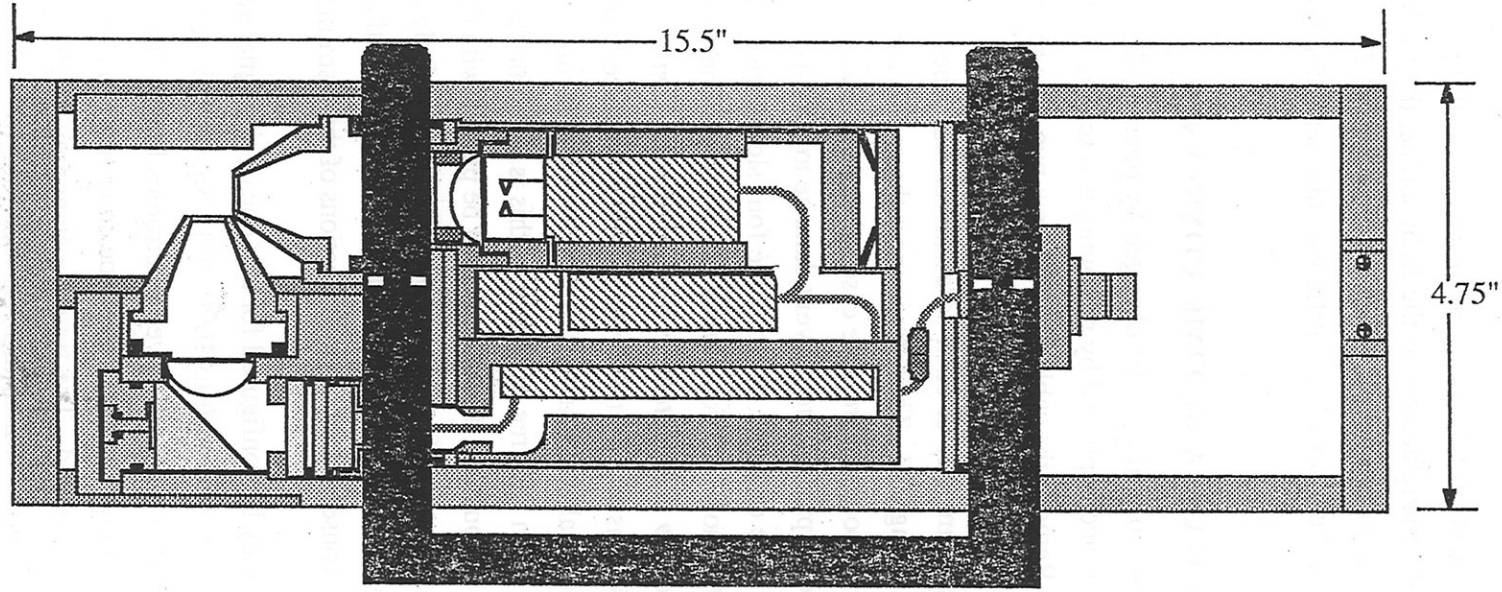


FIGURE 3 FLUOROMETER MOUNTING BRACKET

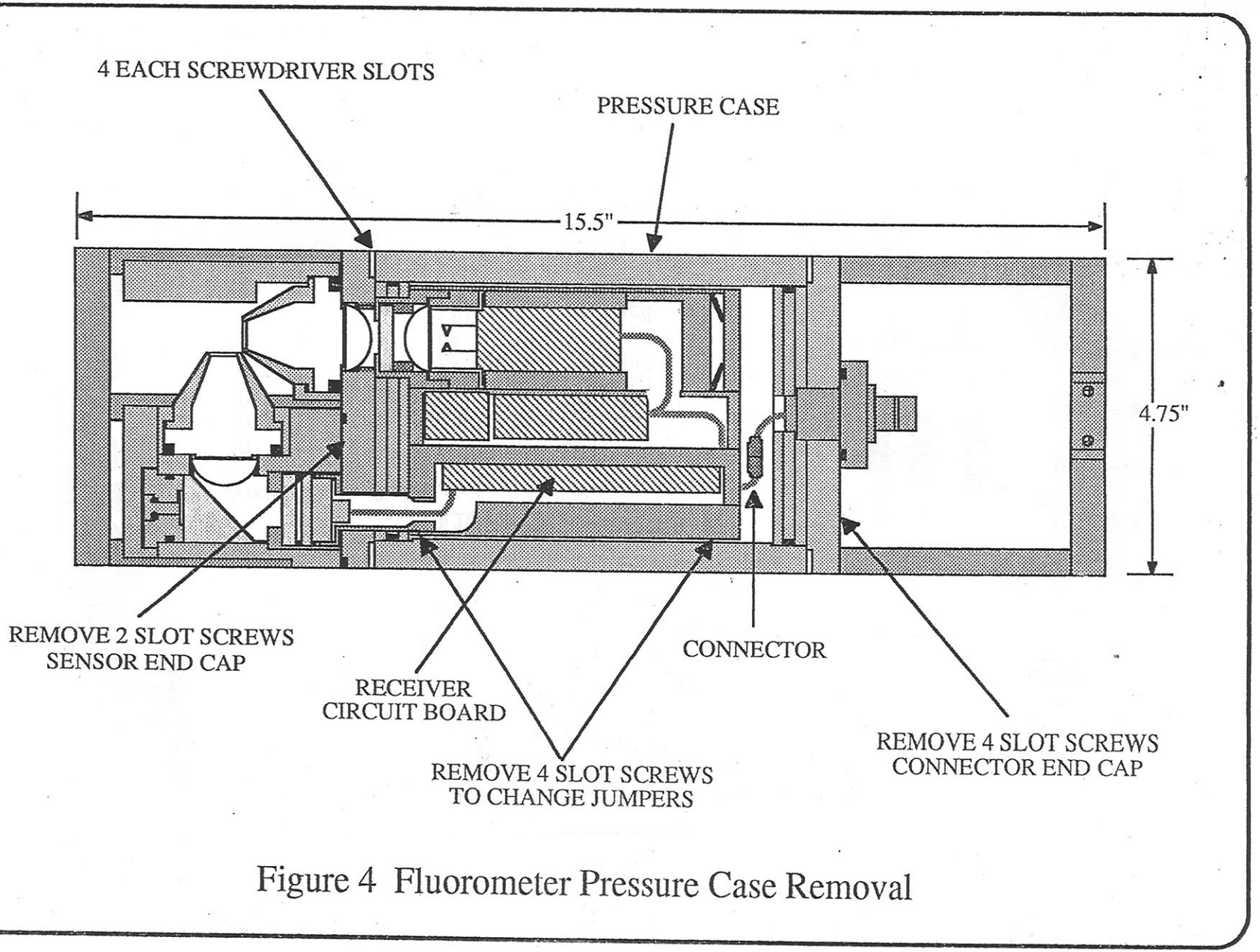
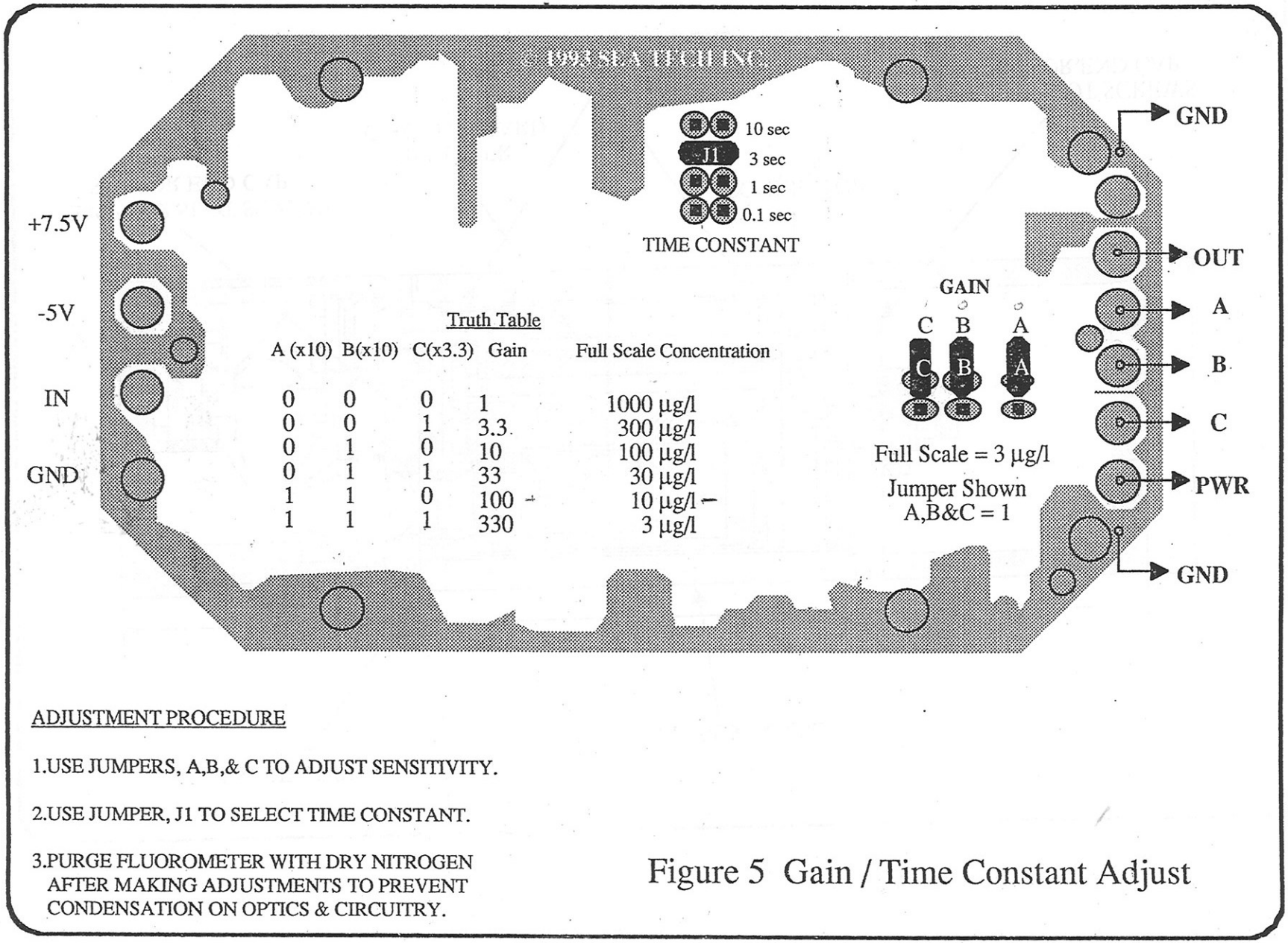


Figure 4 Fluorometer Pressure Case Removal



ADJUSTMENT PROCEDURE

1.USE JUMPERS, A,B,& C TO ADJUST SENSITIVITY.

2.USE JUMPER, J1 TO SELECT TIME CONSTANT.

3.PURGE FLUOROMETER WITH DRY NITROGEN AFTER MAKING ADJUSTMENTS TO PREVENT CONDENSATION ON OPTICS & CIRCUITRY.

Figure 5 Gain / Time Constant Adjust

APPLICATION NOTE NO. 09

Calculating Calibration Coefficients for Sea Tech Fluorometer and WET Labs Flash Lamp Fluorometer (FLF)

Revised August 2001

Some Sea-Bird CTDs can be equipped with a Sea Tech Fluorometer or WET Labs Flash Lamp Fluorometer. For these fluorometers, the CTD configuration file requires the *scale factor* and *offset* to enable the software to calculate the concentration:

Concentration = (voltage * *scale factor* / 5) + *offset*

Sea Tech Fluorometers and WET Labs FLFs have internal, switch-selectable ranges. The *scale factor* is dependent on the fluorometer range:

Fluorometer	Range (milligrams/cubic meter)	Scale Factor
Sea Tech	0 - 3	3
	0 - 10 (factory-set default)	10
	0 - 30	30
	0 - 100	100
	0 - 300	300
	0 - 1000	1000
WET Labs FLF	0 - 100	100
	0 - 300 (factory-set default)	300
	0 - 1000	1000

The *offset* can be calculated by measuring the fluorometer voltage output when its light sensor is completely blocked from the strobe light by an opaque substance such as heavy black rubber:

offset = (-*scale factor* * output voltage) / 5

NOTE: The *scale factor* and *offset* can be adjusted to fit a linear regression of fluorometer responses to known chlorophyll a concentrations.