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C-Star Calibration Sheet

Date:	**05/01/02**
Customer:	**OSU/Linda Fayler**
Serial Number:	**CST-590DR**
Job Number:	**0204013**
Work Order:	**001**

V_d = V dark	**0.058**
V_{air} = V out in air	**4.891**
V_{ref} = V out in water	**4.771**
Calibration Temperature of water	**21.5**
Ambient Temperature	**24.4**

% Transmission = $(V_{sig}-V_d)/(V_{ref}-V_d)$
$Tr = e^{-cx}$
To solve for the attenuation coefficient **c** in units of m^{-1} use the following equation.
$c = -1/x\ (\ln(V_{sig}-V_d)/(V_{ref}-V_d))$
For further information on these calculations please see C-Star User's Guide, Section 2.

Temperature Error: 0.02% F.S./°C

NOTES

- **(V_d)**—analog output of the instrument with the beam blocked. This is an instrumental offset.
- **(V_{air})**—analog output voltage of the instrument with a cleared beam path.
- **(V_{ref})**—analog output voltage of the instrument with clean H_2O in the path.
- **(Calibration Temperature of water)**—temperature of the clean water used to obtain V_{ref}.
- **(Ambient Temperature)**—temperature of the instrument during the calibration procedures.
- **(V_{sig})**—measured signal voltage of the C-Star.

degrade over a long electrical wire due to the electrical resistance of the cable. For best results, the analog signal should be fed directly into an A/D converter with a high impedance input through a short cable (1–2 meters) and the digital signal should be sent up the sea cable.

2.5 Data Analysis

C-Star's output voltage increases linearly with increasing transmittance over the instrument's measurement range. The output voltage is proportional to the amount of light received by the detector over a given pathlength. With the instrument in water, the output voltage (V_{sig}) should vary from a minimum value equaling the dark voltage (obtained by a blocked beam reading) to a maximum signal equal to the clean water reference voltage (V_{ref}). The ratio of the signal voltage to the reference voltage is known as Transmittance (**Tr**) and will vary from 0 to 1 or 0 to 100 percent. Transmittance is related to **c** by the relationship

$$\mathbf{Tr} = e^{-cx} \quad (1)$$

where x is the pathlength through the water volume.

Since the C-Star transmittance can be expressed as

$$\mathbf{Tr} = (V_{sig} - V_{dark}) / (V_{ref} - V_{dark}) \quad (2)$$

where:

- V_{sig} is the measured analog signal
- V_{dark} is the dark voltage offset for the instrument (factory supplied). V_{dark} is obtained by blocking the C-Star's receiver and obtaining a "dark" reading of output voltage. This is an instrument offset that needs to be subtracted.
- V_{ref} is the factory supplied clean water offset.

To obtain the beam transmittance we then solve for

$$c = - 1/x * \ln(\mathbf{Tr})$$
$$= - 1/x * \ln((V_{sig} - V_{dark}) / (V_{ref} - V_{dark})) \quad (3)$$

2.6 Upkeep and Maintenance

C-Star is a very compact instrument and its maintenance can be easily overlooked. However, the transmissometer is a precision instrument and does require a minimum of routine upkeep. After each cast or exposure of the instrument to natural water, flush the instrument with clean fresh water, paying careful attention to the pressure windows. Soapy water will cut any grease or oil accumulation. Do not get water into the open sockets of the bulkhead connector. Be careful not to scratch the pressure windows when cleaning. Use lint-free tissues such as Kimwipes® for wiping the lenses.

Note that the power supply ground signal is internally connected to the Analog Return signal. There is only one ground internal to the C-Star instrument. The C-Star mechanical case is floating, and is not connected to the internal C-Star power supply ground or Analog Return signal.

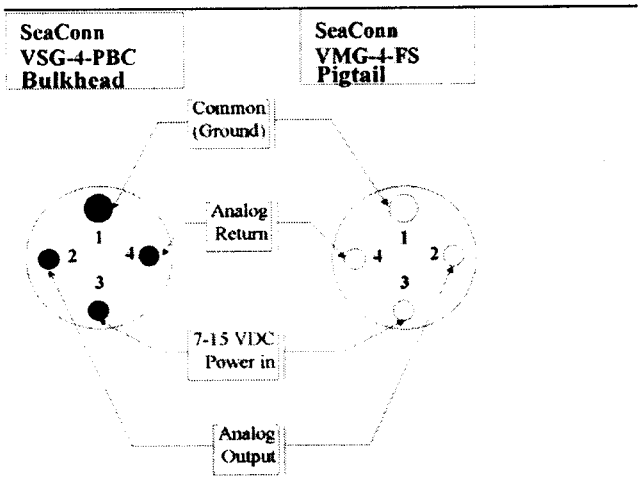

Figure 4. C-Star connectors

3.2.2 Analog Output Circuitry

The equivalent analog output circuitry is shown in Figure 5. The C detector photodiode signal is amplified, using analog gain circuitry. The resulting signal is then connected to a single pole, low pass filter, with an equivalent RC time constant of 0.167 msec. The reciprocal of this time constant produces the instrument data sample rate of 6 Hz. Note that the low-pass filter roll-off is 20 dB per decade of increased frequency.

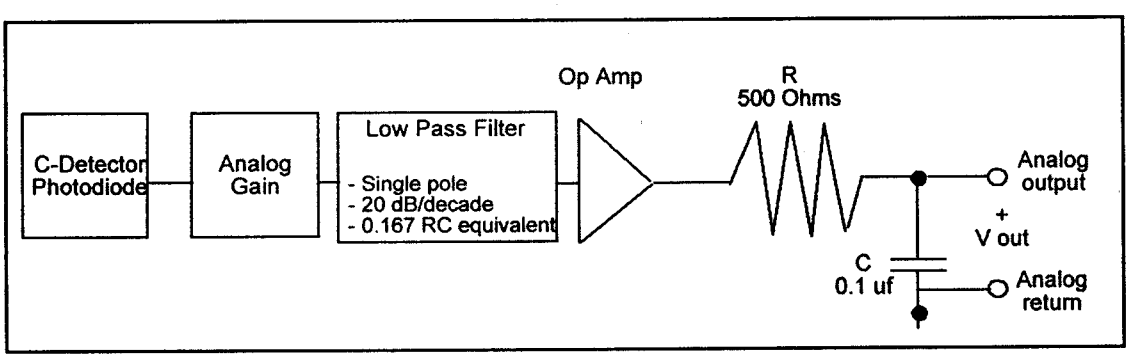

Figure 5. C-Star equivalent analog output circuitry

The output of the 6 Hz low pass filter is then buffered by an Op Amp. The output of the Op Amp has 500 ohms in series with the Analog Out signal. When the Op Amp output voltage is 5 Volts, the series resistor limits the worst case output current to 10 mAmps, when the Analog Out signal is accidentally shorted to the Analog Return signal, due to a system wiring error.

The Analog Out signal has a 0.1uF ceramic capacitor connected to the Analog Return signal. The 500-ohm resistor and the 0.1uF capacitor create a low pass filter with a time

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Packing List

To:

OSU
Attn: Linda Fayler

Date: May 2, 2002

PO# S0432A
Job# 0204013
Serial# CST-590DR

ITEM	Description	Qty.
1.	C-Star Transmissometer (25 cm 660 nm 6000 meters)	1
2.	Pigtail with Lock Collar	1
3.	Manual with Calibration Sheet	1