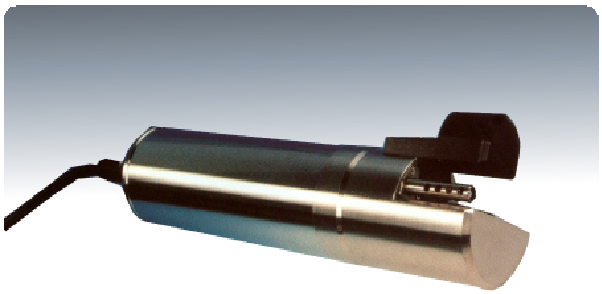
Fact Sheet

UV AQUA*tracka*

In-situ PMT Fluorimeter

The UV AQUA*tracka* is a highly sensitive in-situ fluorimeter designed to monitor concentrations of hydrocarbons (360nm) & Gelbstoff (440).

The UV AQUA*tracka* is easy to use and gives accurate and repeatable measurements. It can be used in towed vehicles or interfaced to CTD monitors. The housing is constructed in titanium and the instrument is rated to 600m (option 6000m) and incorporates an optional ambient light baffling cowl.



UV AQUA*tracka* shown with optional ambient light baffling cowl

OVERVIEW

The UV AQUA*tracka* (Figure No. 1) is a compact lightweight submersible fluorimeter using a photomultiplier detector for the detection of Hydrocarbons (360nm) or Gelbstoffe (440nm), each application uses a common pulsed Xenon light source but requires a unique set of optical filters in both the excitation and emission (detection) paths.

The UV AQUA*tracka* has been designed to use the same body size as the Mk III AQUA*tracka* so there is a considerable reduction in size from the previous Mk 2 PMT AQUA*tracka*. Using a standard grade 5 titanium casing the instrument may be deployed down to a depth 600 metres (option 6,000) for the Hydrocarbons (360nm) and Gelbstoffe (440nm) variants.

The instrument is of modular design with an analogue output logarithmic scaled. Provision has also been made for the inclusion of a fast response (300ms) platinum resistance Pt 100 Temperature Probe option.

The UV AQUA*tracka* may be mounted on a towed vehicle such as Chelsea Technologies Group's AQUA*shuttle* III, NνShuttle or SeaSoar, it can be deployed on buoys, on a mooring , or vertically in a profiling mode.

VARIANTS	360nm HYDROCARBON	440nm GELBSTOFF	DIGITAL O/P	2Mb LOGGING	ANALOGUE LOG O/P	TEMP PROBE
1	✓				✓	✓
2	✓				✓	
3		✓			✓	✓
4		✓			✓	

Table 1 – UV AQUA*tracka* Variants

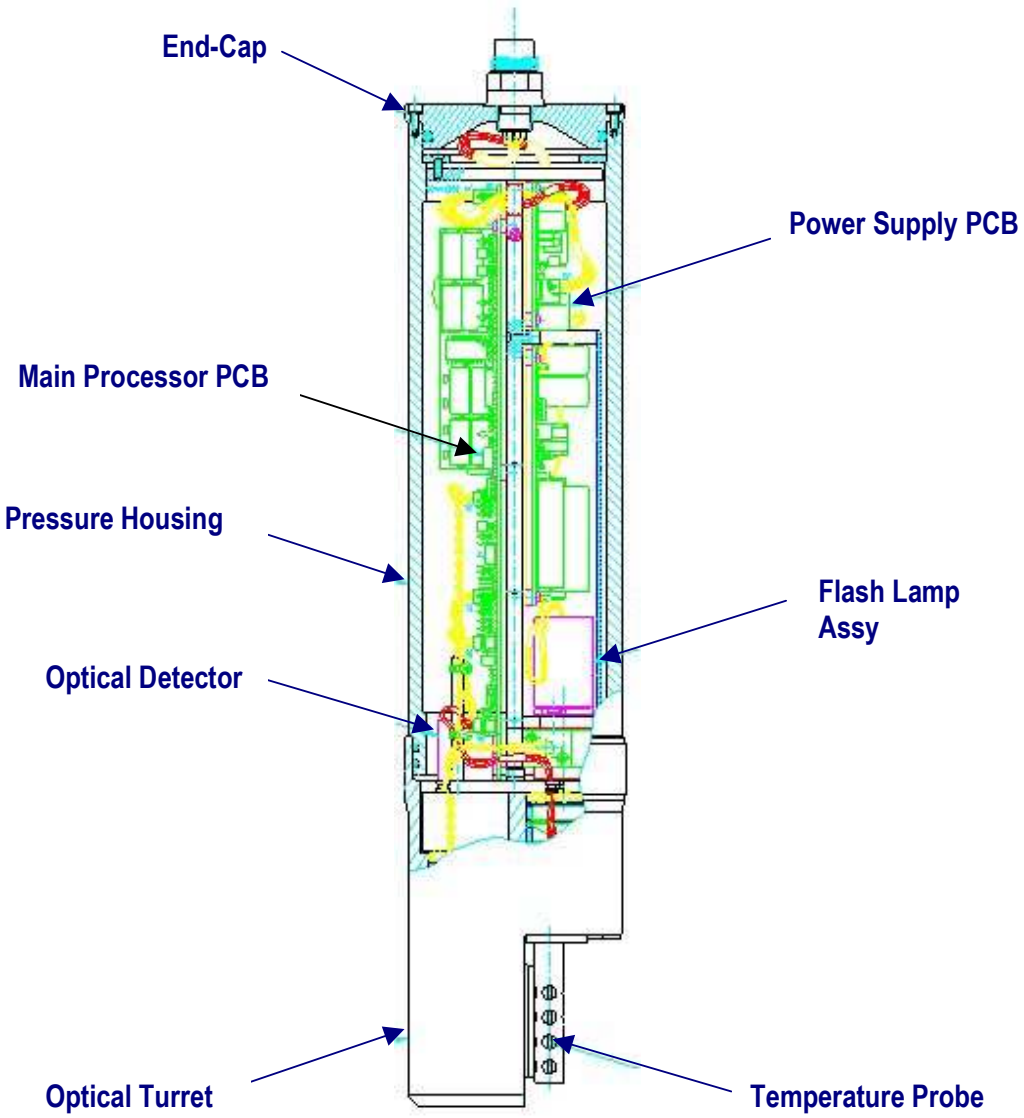


Figure 1 – UV AQUA*tracka*

PRINCIPLES OF OPERATION

The fluorimeter uses a pulsed light double beam technique, which improves performance in a number of ways.

The functional block schematic is shown in Figure 2 and the internal layout of the instrument in Figure 1.

The pulsed technique allows virtually perfect discrimination to be achieved against 'steady' ambient light signals since the light pulse is only two microseconds long, variations in ambient intensity due to wave glitter, etc. are considered 'steady' as far as the high speed processing circuits are concerned and are effectively rejected by the AQUA*tracka*; this is a major operational advantage. A small arc source also allows more efficient optics to be used and together with the pulsed excitation improves the signal to noise ratio, compared to DC excitation.

The double beam system allows the light intensity of the optical beam(X) returned from the specimen to be compared with the light intensity of the reference beam(Y) generated from the same pulsed light source. The outputs are then ratioed(X/Y) so that they are not affected by any variations in the flash lamp strength due to lamp ageing. Since the lamp life exceeds some 10^8 flashes it can be considered to be 'indefinite' unless the instrument is more or less continuously powered thus extending the calibration life of the instrument.

Among the special features is the use of a 'rugged' pulsed light source. Such a lamp emits copiously at visible and ultra-violet wavelengths, giving excellent fluorescence excitation of many substances, while efficiently converting electrical energy to optical output.

NOTE: The light source of the fluorimeter is small, very intense and produces copious emissions of ultra-violet, which can cause eye damage. DO NOT expose eyes to the direct beam of the light source.

Light from the flash lamp takes two paths, the reference beam and the detection beam. The reference beam takes a direct path to the reference photo diode without any lenses or filters. The detection beam from the flash lamp is optically filtered and focused out through the excitation port window to illuminate a volume of liquid specimen just above the detection port window, which is situated on the turret at 90 degrees to the excitation port. Light scattered or fluorescing from the specimen and passing through the detection(emission) port is directed via a prism, lens and optical filter onto the detection photo multiplier tube(PMT).

The bias voltage for the PMT detection amplifier is derived from the ambient light compensating circuit, which compensates for some ambient light that falls on the detector. If the ambient light is excessive the PMT supply voltage is disabled to protect the PMT.

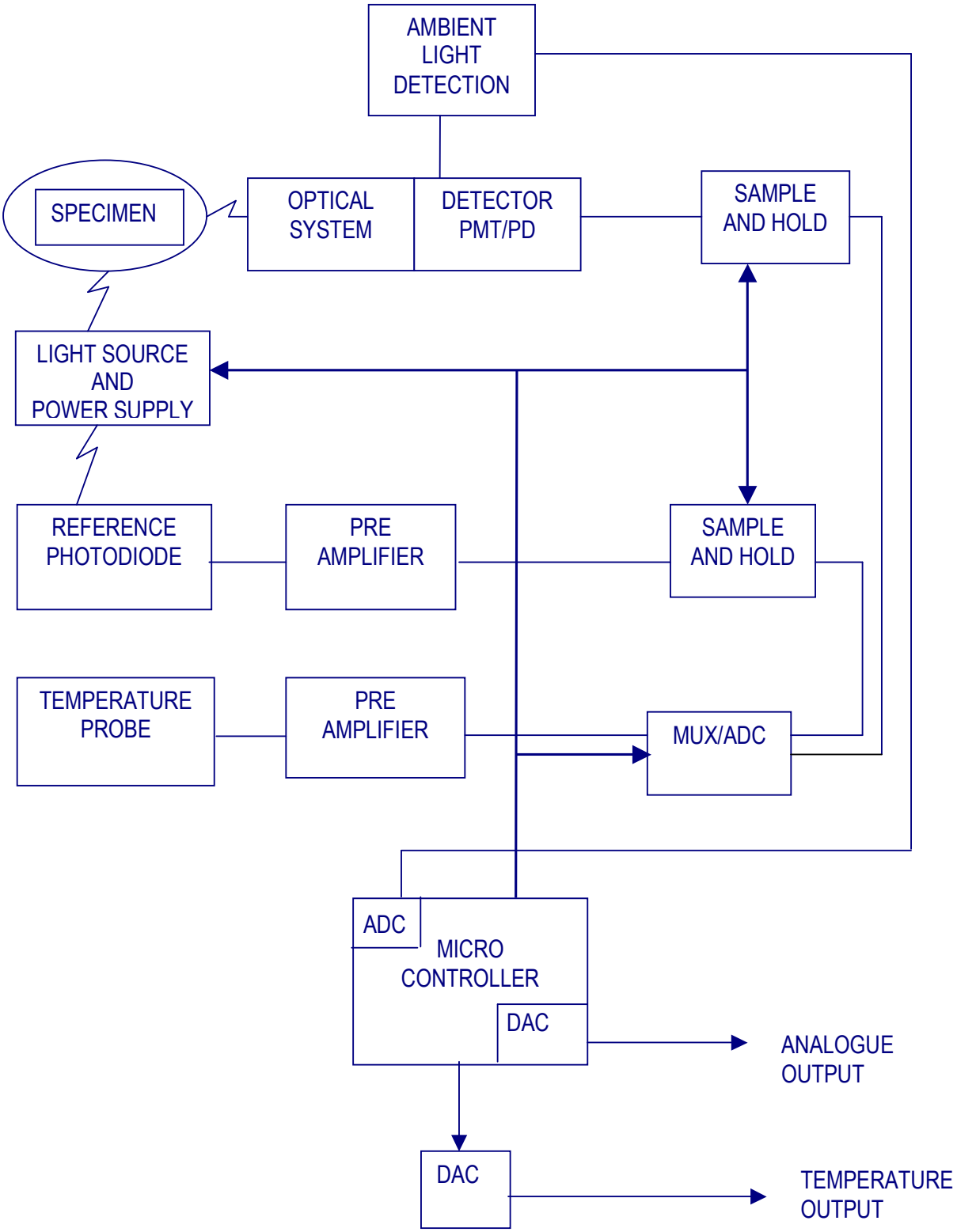


Figure 2 - Functional Block Diagram

SPECIFICATION

Electrical Specification

Input Voltage		10.5 to 72V d.c. (nom. 220mA at 12V d.c.)
Inrush Current		495mA at 12V d.c.
Outputs	**Analogue**	0 to 4V Logarithmic (1V per decade)
Light source		Xenon Lamp
	Pulse Rate	4Hz
	Life	10^8 flashes
Photomultiplier Detector		Hamamatsu H5783 Series
Warm-Up Time		10 seconds
Sampling rate		4Hz (nominal) Extend to 10 Hz (optional contact CI)

Optical Specification

360nm Fluorescence (Hydrocarbon)

Detector	Photomultiplier Tube (PMT)
Range	0.001 to 10 µg/l Carbazole
Min. Discernible Signal	0.001 µg/l Carbazole
Resolution	1% of reading or Min. Discernible Signal which ever is greater.

Excitation Filter Characteristics

Peak wavelength	239 ± 4nm
Full Width Half Maximum (FWHM)	26 ± 4nm
FW at 1% TPK	55 ± 9nm
FW at 0.1% TPK	85 ± 13nm
Spectral Rejection	Better than 10^{-4} to infrared Additional rejection between 300-400nm provided by gas cell

Emission Filter Characteristics

Peak wavelength	360 ± 6nm
Full Width Half Maximum (FWHM)	70 ± 10nm
FW at 1% TPK	150 ± 20nm
Spectral Rejection	Better than 10^{-4} to X-ray and 10^{-3} to infrared

440nm Fluorescence (Gelbstoffe)

Detector	Photomultiplier Tube (PMT)
Range	0.001 to 10 μg/l Perylene
Min. Discernible Signal	0.001 μg/l Perylene
Resolution	1% of reading or Min.Discernible Signal which ever is greater.

Excitation Filter Characteristics

Peak wavelength	239 ± 4nm
Full Width Half Maximum (FWHM):	26 ± 4nm
FW at 1% TPK	55 ± 9nm
FW at 0.1% TPK	85 ± 13nm
Spectral Rejection	Better than 10^{-4} to infrared

Emission Filter Characteristics

Peak wavelength	430 ± 6nm
Full Width Half Maximum (FWHM):	110 ± 17nm
FW at 1% TPK	160 ± 25nm
FW at 0.1% TPK	230 ± 35nm
Spectral Rejection	$<10^{-4}$ X-ray to infrared

Mechanical Specification

Size	89mm dia. by 406mm long
Weight In air	5.5kg
In water	3.5kg
Life Expectancy	8 years
Operating Temperature range	-2 to +40°C
Storage Temperature range	-40 to +70°C
Deployment Depth	600 metres (Hydrocarbon/Gelbstoffe) (option 6,000)

Temperature Probe (Optional for 600m unit only)

Type	Platinum resistance
Range	-2 to +32 °C
Accuracy	0.01 °C
Resolution (Analogue)	10°C/V
Response Time	300 ms (nominal)

TECHNICAL DESCRIPTION

Mechanical

The UV AQUA*tracka* pressure housing/casing comprises three assemblies manufactured from grade 5 Titanium, the Optical Turret Assembly; Pressure Housing and the End-Cap Assembly. The main component layout is shown in Figure 1.

The general assembly consists of four major sub-assemblies:

1. The turret assembly that houses the optical components and windows and makes up the front cap of the pressure housing. The assembly has two plain bores machined parallel with the length of the body, for the excitation and detection (emission) optics. The optical layout is shown in Figure 3. The optical components consist of a series of lens and filters on the excitation side and lens, filters and a prism on the emission side. These are held in their correct axial positions by a set of spacers.

2. An electronics chassis that contains:

    - The photomultiplier Tube(PMT) assembly
    - The xenon flash lamp and its drive circuit pcb.
    - The flash lamp high voltage power supply pcb.
    - The fluorimeter and temperature measuring circuits pcb.
    - The power supply regulator circuitry pcb.

    The chassis is fitted with front and rear bulkheads. The front bulkhead provides the chassis to turret mounting point and when secured to the turret retains the optical components by pre-loading two waveform washers.

3) The cylindrical pressure housing assembly that encloses the electronics chassis.

4) The rear end cap assembly that seals the pressure housing and holds the interface connector.

Electrical

Most of the electrical components of the circuits of the UV AQUA*tracka* are mounted on three pcb's. These pcb's. are:

- A signal processing pcb, which contains the analogue processing components, the microcontroller and the external analogue interface.
- A power supply pcb, which contains the components that convert the incoming 10.5 to 72 V.d.c. supply from the Sea Cable to ± 12V and +5V supplies for the various electronic circuits.
- A lamp supply pcb, which provides the high voltage (700 to 750 V d.c.) required by the Xenon lamp.

The pcb's are linked by plug/socket to related off-board components as are the connections between the Rear End Cap and Electronics Chassis.

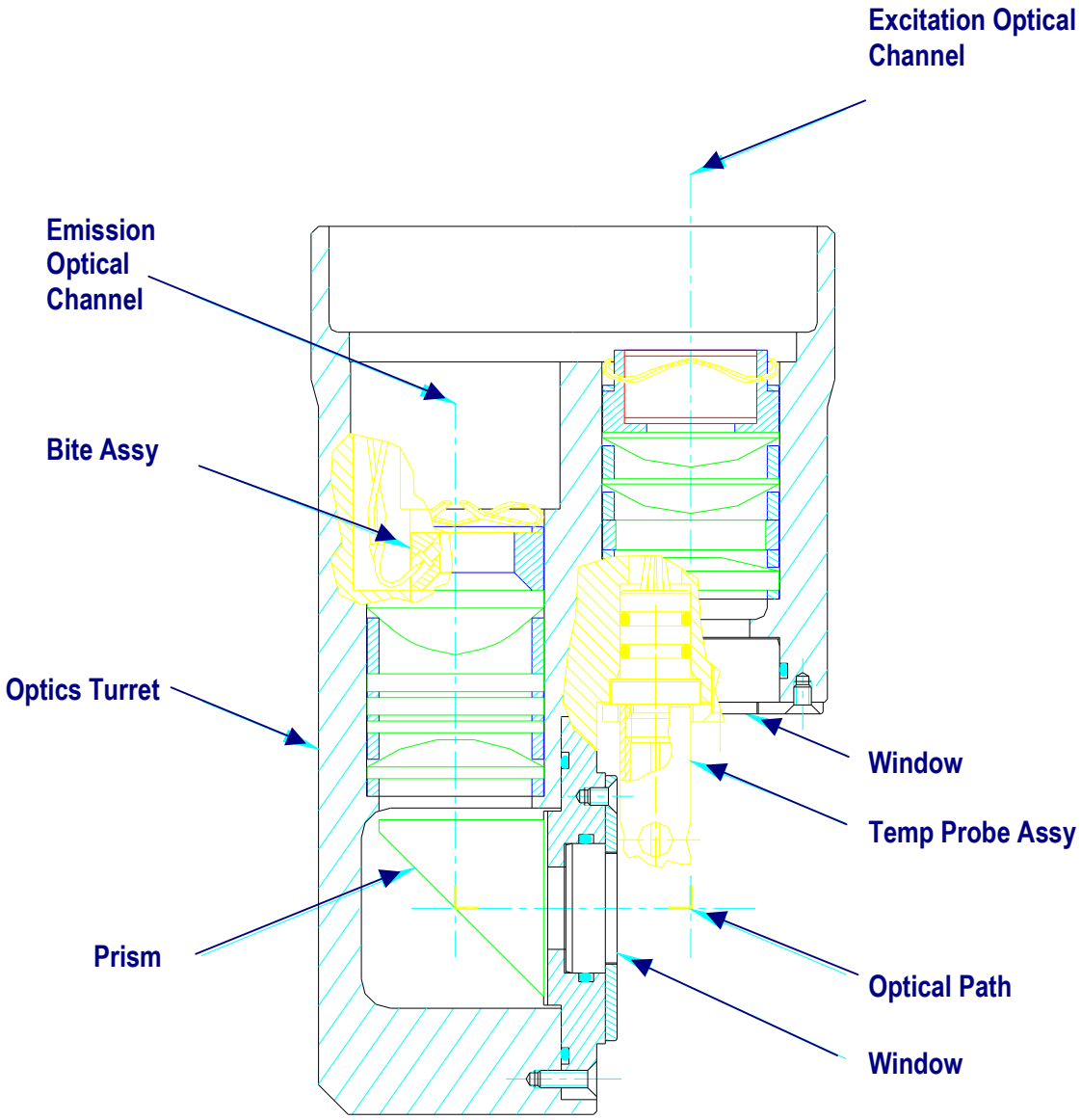


Figure 3 - Optical Layout

Functional Description

A functional block diagram of UV AQUA*tracka* is shown in Figure 2. Functionally, the instrument comprises seven sections:

- Sample signal measurement.
- Reference signal measurement
- Data Acquisition Microcontroller.
- Light source
- Logic control
- Power supplies.
- Temperature probe

Sample Signal measurement

Consider the sample signal measurement section first.

The transmitted light from the light source is optically filtered and focused into a cone. This cone of light is targeted into the sample liquid, via the excitation port, to illuminate the sample immediately above the detection port.

The detection port is mounted in the turret so that it is orthogonal to the excitation port.

Light fluorescing or scattered from the sample liquid and passing through the detection port is directed via a prism, lens and optical filter onto the PMT in the signal measurement section.

An ambient light compensation circuit is included which provides some compensation against ambient light that falls on the detector. If the ambient light striking the detector becomes excessive, the output from AQUA*tracka* is driven beyond the normal full scale value, providing a warning that this condition is occurring and the PMT supply is disabled until the ambient light level is reduced into the operating band.

The output from the PMT is applied to a pre-amplifier which is in turn applied to a sample and hold circuit.

Approximately 40 μs after the flash unit is triggered, the amplified and electronically filtered version of the PMT output signal reaches its peak value at the input of the sample and hold circuit. At this point, the value of the input of the sample and hold circuit is transferred to the storage capacitor.

The output of the sample and hold circuit, which is effectively the voltage across the storage capacitor, is applied to an input channel of the 20 bit analogue to digital converter (ADC). This is subsequently processed and output via a 12 bit DAC for analogue output.

Reference Signal Measurement

The reference photo diode measures the output light source directly, with no lenses in the beam path. The reference photo diode signal is amplified and passed through a sample and hold circuit to the ADC.

Data Acquisition Microcontroller

The data acquisition/communications microcontroller is responsible for power management, control of the flash lamp and sampling timing.

The signal processing pcb incorporates the following sections ;

- Microcontroller and associated circuitry
- Digital controls, including BITE
- Analogue measurement system interface and sample and hold circuitry

Light Source

The light source is triggered by the logic control circuit at a frequency of 4Hz. When the light source is triggered, a capacitor is discharged via the resistance provided by the light source path, creating a flash of light having a high ultra-violet content.

Because the period of the flash generated by the light source is very short (approximately two microseconds), the variations of ambient light intensity caused by water wave glitter are negligible as far as the signal processing circuits are concerned. This pulsed light technique also enable almost total discrimination to be achieved against steady ambient light pick-up.

Logic Control

The logic control circuits of the instrument are used to:

- trigger the light source
- control the sample and hold circuits in the two signal processing sections.

The operation of these circuits is automatic and starts when the instrument is switched on via the Deck Unit.

Power Supplies

The incoming 10.5 to 72 V supply from the Sea Cable is routed to a d.c. to d.c. converter that produces output voltages of + 12 V and - 12 V d.c. These +12 V and - 12 V supplies are then distributed to the appropriate circuits in the instrument.

The + 24 V supply required by the power supply unit that provides the high voltage output (700 to 750 V d.c.) for the light source lamp is derived from the ± 12 V d.c. to d.c. converter, by effectively connecting these outputs in series.

DEPLOYMENT

The UV AQUA*tracka* may be mounted on a towed vehicle such as Chelsea Technologies Group's AQUA*shuttle* III, NνShuttle or SeaSoar, it can be deployed on ROVs, buoys, on a mooring, or vertically in a profiling mode.

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