

UV / Lasers Specifications

This brief description further reveals how a UV reactor/laser can detect contaminants in potable water. Although the chlorine detection forms the basis of the system, an end-user can choose to use these units interchangeably and dependently of one-another. More technicalities to follow below.

It is important to note that, in general, this technology comes out of cation chromatography, whereby inorganic ions absorb the mid-UV more than mobile phase ions, at least indirectly. Therefore, sample ions appear as peaks in the UV absorbing background.

The sensor design concept itself is based on the use of optically transparent sapphire substrates that can be used as windows to separate the laterally configured sensor components from the analyte, if used. One of the main advantages of such a configuration is its use as a flow-through, in-line sensor. In addition, lateral setup of the components allows employment of a totally planar design, which significantly simplifies the process.

(A possible drawback is a possible high background signal resulting from the direct illumination of the photodetector by the LED light transferred by the sapphire substrate. Experiments in this task might be setup to determine the background noise and investigate the sensor prototype ability to measure fluorescence signals above this background.)

Another embodiment as proposed in the UV detection process occurs when a liquid sample is collected into the continuous flow system by means of a tube (line). A pulsed laser (KrF excimer laser) fluoroscope then irradiates that water sample. To detect contaminants, immobilized heavy metals are exposed to the sample and are then monitored using a substrate that fluoresces under illumination by the ultraviolet laser light. A change in activity indicates the presence of a metal.

This process is repeated until the appropriate contaminant levels (~5 ppm) are achieved. Note that heavy metal ions of more than 10 mg/l can cause fouling of the UV sleeves. Contaminant samples are compared to clear water samples on a graph output, in order to distinguish the difference between the two. Any discrepancies are then reported upon. The detector itself working with the substrate, usually a photodiode or PMT-type, ideally converts optical signals into electric ones, which is then electronically processed. All of this information is compared on the computer with pre-existing information on regular clean water.

If more sampling is required, the same water is looped around and sent through the JCN-process again, or perhaps many times until a satisfactory reading is obtained, which can take up to 15 minutes. Frequencies are picked up on a computer graph via proprietary software through (analog converted to digit serial interface) ports.

Trace heavy-metals that are over and above their government ordained threshold levels induce an alarm relay, as indicated on controller circuitry of the wall unit control box. These signals are amplified and sent over a network. At the central monitoring station, a pre-design module is chosen according to signal acquisition technique, i.e., chlorine levels would opt for a more basic signal processing application.

Note that other poisonous particles can potentially be detected as well. To detect these, the system would observe the fluorescence emitted by aromatic amino acids and proteins when excited by the UV light. Some of these are: Ethylenediamine/Tartaric Acid, Bipyridl or Nitric Acid for iron, Sodium diethyldithio-carbamate (lead), Cupric Sulfate, and Tetra...

The fluorescence-based chemistry for the above compounds is currently under development. UV detection can be used for organic contaminant characterization in water (using trace enrichment HPLC). For future R&D projects, UV fluorescence-based chemistry will be experimented in conjunction with 'optical interface coupler technology' to potentially detect man-made spores such as anthrax, etc., not only in liquid applications, but also in the vapour and air! This is a potential military application. Quantum dots (Q-dots) attach to H₂O when zapped by laser then fluoresce according to colour- green, blue, but cadmium selenide is released as a result, therefore, water must drain.

eWatertek Laser Specifications

Temperature changes play an important part in deciding exactly what test should be performed. Process water should be allowed to come to room temperature, 20–25°C, before conducting any tests. When drawing off samples from an outlet pipe such as a tap, allow sample to run for several minutes, rinsing the container several times before taking the final sample. Avoid splashing and introduction of any contaminating material.

Assuming a flow of 1mL/min, if correct nanometer reading is obtained, no customization or tenability is necessary. If this is not feasible for cost purposes, etc., an analyte may be obtained according to well established HPLC chromatography techniques, and applied to the sample, several times if necessary. Pulse wavelength of Visible 510 to 540 nm = ZINC; 355 = LEAD; UV @ 254 to 266 = IRON. The power source is a diode-pumped solid state Q-switched, 800 mW to 20 watt; each pulse has a duration of 10-20 nanoseconds. With a usage of only twice daily, every 12 hours, lifetimes are very long.

This scenario uses approx. 2 watts of green/UV @ >35 kHz, producing a pulse width of 7 nsec; mode = TEM with a beam diameter of >2 mm, preferably. Therefore very little electrical consumption and much cheaper than NASA Mars Probe technology (sensitive to 100 ppb @ 100 Hz pulse frequency) by a significant proportion. Synthetic quartz sleeves should be used because glass will block the UV rays. Each laser is approximately 25 lbs. or 11.5 kg, using external diode module for better beam. It requires water resistance, and a thermo-electric cooling system. Due to tight space constraints, all three lasers must integrate and are placed in a box about 1m high and 0.7m wide.

Electronics: Application: Measured value collector for recording and storing analogue and digital values.

Input: Universal application
Analog: Transmitter must have 0/4 to 20 mA, 0 to 1 V
Output signal or direct Pt100
Digital: potential free contact or 5 V DC TTL peak, no loop power supply: Power supply minus, GND connection (pin 4) of the interface, analog input minus (terminal 1) and terminal 5 of the digital input are internally connected.

Number of inputs: Analog input: 1; Digital input: 1
Analog input 0 to 1 V, $R_i \geq 1 \text{ MW}$
Digital input 1 input using two terminals, $f_{\max} = 25 \text{ Hz}$ on pulses, 1 s on events; for potential free contact

Temperature influence: Temperature drift $\pm 0.25 \%$ / 10 K
Time drift $\pm 50 \text{ ppm}$ ($\leq 30 \text{ min/year}$)

Electrical connection:

- Two wire connection (three wire on Pt100). Connection access using 2 x PG 9 cable glands (optionally 1 x 1/2 " NPT thread instead of 1 x PG9).
- Termination on 2.5 mm 2
- Terminals, 1.5 mm 2 core with ferrule.
- Display LC display, 7 segment, prefix, decimal point, limit symbol, battery status symbol

Mounting: The only way to house such a system that requires fragile handling as well as ventilation, is by incorporating a special fibre-glass screen encasement for transport and protection. This allows air to flow through the laser cooling system, while at the same time, providing a flexible and environment-proof protection. By building this casing into an intrinsic part of the detection system, these units can be transported abroad with little to no extra cost for re-packaging. Size is approximately 3.5 ft (1m) high by 2 ft wide (0.7m).

Those interested in more hardware for the **simulation** of advanced integrated multifunctional optoelectronic sensing should consider: Triax 320 monochromator, SR510 lock-in amplifier, 150W xenon lamp, Kethley 2410 Source Meter, Keithley 485 Picoammeter. These would be used for spectral characterization of the LEDs and photodetectors in the range of 250 and up to 1200 nm. In this scenario, the voltage to the LEDs according to their specifications is supplied, from a Topward 360D stabilized DC power supply. The signal from the photodetectors is measured as a voltage by a Keithley 2410 Source Meter, and as a current by a Keithley 485 Picoammeter.

eWaterTek: *Bringing Advanced Water Monitoring Right To Your Tap!*