



New Fluorometer Technology for Industrial Control Applications

Introduction

The fluorometer architecture used in process control has remained stagnant for the past two decades. Manufacturers continue to produce fluorometers based on technology that was available long ago. Recent advances in optical and electronic technology have opened the door to new innovations that can provide more accurate measurements, greater reliability, enhanced functionality, and easier maintenance.

The AXC-PT201 PTSA fluorometer was designed to surpass the shortcomings of existing products and provide users with higher accuracy and usability. It achieves this by utilizing current technology coupled with a patent-pending optical system that enables superior accuracy and detection levels. The fluorometers that are currently available were designed for low cost and high profitability. These designs are subject to increased interference from turbid water, light scatter, and interfering fluorescent signals. The AXC-PT201 fluorometer has a superior optical configuration that uses multiple components and a single light pathway to provide a highly selective and focused measurement.

Current industrial process control fluorometers use an open-face or flow-through configuration to measure fluorescence. Although inexpensive, these designs are sometimes susceptible to interference from light scatter and stray fluorescence. The open-face design uses a less-than-optimal measurement angle to capture as much fluorescence as possible; however, it can generate a significant amount of light scatter due to the angle of light excitation versus the measurement angle. A 90-degree (right-angle) configuration minimizes direct scattering, but angles $<90^\circ$ (e.g., front-face setups at $22\text{--}60^\circ$) are used for opaque or scattering samples to capture fluorescence. The flow-through configuration measures fluorescence through a glass or quartz tube, and the angle of measurement is usually close to 90° ; however, this configuration is susceptible to its own unique set of issues, such as light scatter that can inflate fluorescence measurements in high-flow systems, inaccuracy due to inner filter effects, trapped air bubbles, and excessive clogging and fouling that require additional maintenance cycles.

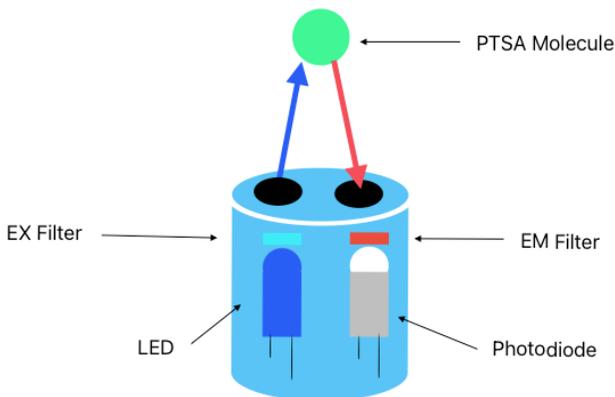


Figure 1: Open-Face Fluorometer Design

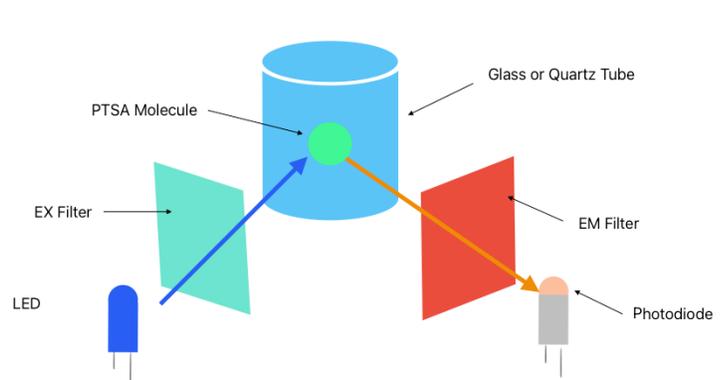


Figure 2: Flow-Through Fluorometer Design



The AXC-PT201 PTSA Fluorometer Advantage

The AXC-PT201 fluorometer utilizes a new patent-pending optical configuration that was developed to minimize interference from light scatter and enhance low-level detection capability. It uses a small-form-factor optical head that creates a single light pathway used by both the excitation light and emission fluorescence. This configuration also uses a dichroic mirror and lens to assist in focusing the excitation light and directing the emission light to the detector. In fluorescence detection setups where the excitation light is directed through a single pathway directly to the sample molecule—rather than at an oblique angle—several key advantages emerge. Below are the primary benefits:

- **Improved Suitability for Turbid Samples:** The excitation light has a highly focused point and avoids the scatter associated with fluorometers that use angled measurement techniques. The fluorescence emitted directly from the PTSA molecule travels in a straight path back to the detector. This minimizes effects from light bouncing off nearby particles, where a photon may be absorbed, reflected, or transmitted, and its energy converted into other forms, potentially resulting in erroneous measurements.
- **Enhanced Sensitivity:** The lens used in this design has a dual purpose: it focuses the excitation light on the sample and condenses fluorescent emissions, sending them directly to the photodiode. The condensed signal captures more fluorescence than would be possible without it. While the lens adds cost to the design, it provides significant detection capabilities that are lacking in other designs. Additionally, measurement in the same light path allows capture of a larger sample of emitted light, boosting overall sensitivity without requiring high excitation intensities that could cause photobleaching.
- **Minimized Light Reabsorption:** Emitted fluorescence is collected immediately from the same path, reducing the possibility of reabsorption by the sample. This is especially useful in concentrated or absorbing media, leading to more accurate measurements and higher signal fidelity.
- **Sophisticated Design in a Small Package:** Until now, this type of optical configuration was only available in much larger and more expensive laboratory-based systems. This advanced and compact design allows for high sensitivity and accuracy in a small form factor.

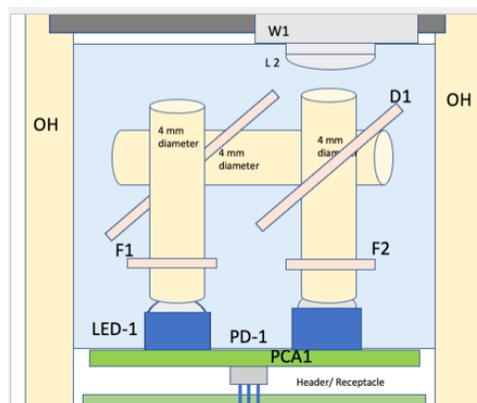


Figure 3: AXC-PT201 PTSA Fluorometer Configuration