



Industrial Sensing

Particulate Matter Measurement

High quality VCSEL solutions for sensors in demanding industrial environments

Particulate Matter (PM) 2.5 refers to particles in the air that have a diameter of 2.5 micrometers or smaller. These particles are of particular concern because they can be inhaled deep into the lungs, potentially causing serious health issues. Monitoring PM 2.5 levels is important for assessing air quality and its impact on public health.

Optical sensing with Vertical-Cavity Surface-Emitting Laser (VCSEL) technology is one method used to measure PM 2.5 concentrations. VCSELs are semiconductor-based lasers that emit light vertically from their surface. They are compact, efficient, and offer advantages for sensing applications due to their stable output and precise control.

Which application fields?

In the field of industrial sensing there are various applications. Some examples for the particulate matter measurement solutions are indoor air quality monitoring, environmental pollution control and workplace safety assessments.

Why TRUMPF?

TRUMPF Photonic Components is a family-owned global leader in VCSEL technology. We design, manufacture and sell VCSEL-based light sources. Our solutions support the growing demand of 3D sensing application. With over 20 years of VCSEL technology development and offering VCSEL products to the market, being the leading VCSEL supplier to smartphone customers, TRUMPF has proven to be your VCSEL partner for 3D sensing applications.

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Principle of operation:

- VCSELs emit light at a specific wavelength that is absorbed or backscattered by particles in the air
- Light scattering and absorption properties change based on the particle concentration.
- By measuring how much light is absorbed or scattered, the device can estimate the concentration of PM 2.5 particles.

Steps in the measurement process

01

Light emission

- The VCSEL emits light at a specific wavelength, typically in the near-infrared range, at 850 nm.
- This light passes through the air containing suspended particles.

03

Detection

- A photodiode can be used to monitor the transmitted power, which depends on the concentration of absorbing particles in the beam path.
- In a similar way, VCSELs with integrated photodiode allow the detection of backscattered light in a very compact design.

02

Interaction with particles

- As the light travels through the air, it interacts with PM 2.5 particles.
- Some of the light is absorbed by the particles, and some is scattered.

04

Signal processing

- The detector converts the light intensity into an electrical signal.
- Signal processing techniques are applied to this electrical signal to filter out noise and extract the relevant information about PM 2.5 concentration

Advantages of VCSEL Technology for PM 2.5 Sensing:

- **Compact size:** VCSELs are small and can be integrated into portable and handheld devices for on-site monitoring.
- **Precise wavelength control:** VCSELs emit light at a specific wavelength, which improves accuracy in particle detection.
- **Low power consumption:** They are energy-efficient, making them suitable for continuous monitoring applications.
- **Fast response time:** VCSELs can switch on and off rapidly, allowing for real-time monitoring of PM 2.5 levels.

In summary, optical sensing with VCSEL technology for PM 2.5 measurement offers a promising approach due to its accuracy, speed, and suitability for portable and continuous monitoring applications.

Product Specifications

Product	Part number*	Description	CW optical output power	Emission wavelength	Number of emitters
VCSEL chip	TVT-014-850-A	single-mode, bare die	2 mW	850 nm	1
VCSEL with integrated photodiode	TVP-001-850-A	single-mode, bare die	0.75 mW	850 nm	2

For more information visit
www.trumpf.com/s/VCSEL-solutions



Safety information:

- Invisible laser radiation / avoid beam exposure / class 3B laser product
- Electrostatic sensitive devices / observe precautions for handling

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