Overview
The BM9CL4 LED Color sensor is a revolutionary color sensor that measures any paper grade online with an accuracy of high-grade laboratory color measuring instruments.

Perfect combination of a high brightness white LED and the specially designed spectroscope that is stable in a severe paper machine environment proves accurate and stable color measurement. The light source that irradiates a constant amount of light at all times enables continuous measurement. The LED Color sensor provides high S/N ratio, which is suitable even for measuring dark color grades with high accuracy.

The synergy of an optical system with a deep focal depth and a new-developed ranging correction technology eliminates the effect of the paper fluttering or wrinkles without any mechanical sheet stabilizer. The non-sheet stabilizer structure guarantees imposing no stress on paper and causing no sheet break or paper dust.

A UV LED light source driven by a high-speed pulse enables the LED Color sensor to measure fluorescence effect with high accuracy, which meets the customer's request of evaluating the effect of fluorescent agents arising from the addition of the recovery rate of waste paper.

Features
- **High accuracy**
The combination of the high brightness white LED light source and in-house developed spectroscope achieves the equivalent sensor accuracy and stability as those of high-grade laboratory color measuring instruments.

- **Continuous measurement**
The constant-lighting high brightness white LED light source provides continuous measurement. The conventional xenon lamp light source is equipped with the high-voltage pulse power supply; this white LED light source that is driven by a simple low voltage power supply dramatically improves reliability.

- **Continuous measurement even of fluorescence effect**
The conventional Color sensor operates a UV light cut filter to control UV light.

  For the LED Color sensor during measurement, the high brightness white LED light source always lights up, while the UV LED light source flashes at a very short interval compared to the measurement output cycle. This enables the LED Color sensor to continuously measure fluorescence effect under UV light.

- **Eliminating the effect of the pass line position variation**
The LED Color sensor contains the optical system having the deep focal depth and the new-developed ranging correction function to ensure stable measurement even when paper flutters and wrinkles.

  No sheet stabilizer is required because the cylindrical mirrored optical system detects stable reflection wherever the paper pass line exists in the sensor gap.

- **High reliability and long-life**
The high brightness white and the UV LED light sources have a life more than twice of that of the conventional light source, which reduces the maintenance work load for customers.

  Built-in self-diagnostic circuits that monitor the sensor condition at all times provide quick maintenance.
### Technical points

- **High brightness white LED light source**
  No monitor for the spectral distribution of this LED light source is required because the illuminant whose temperature is precisely controlled always irradiates a constant amount of light. The high brightness white LED light source requires no high voltage pulse power supply, such as a xenon lamp, and generates no flash noise. It continuously and safely lights up at a low voltage.

- **UV LED light source driven by a high-speed pulse**
  It produces light in the UV range only and lights up at a pulse interval of dozens of Hz. This lighting interval is designed so that it is very short compared to the measurement output cycle. The LED Color sensor reads signals when the UV light is ON and OFF in alternate order while synchronizing this interval, thereby allowing comparison of the effect with and without UV light simultaneously at a same spot. This enables fluorescence effect to be not only measured with high accuracy but also continuously measured.

### Specifications

- **Measurement principle:** Spectrophotometry
- **Measurement geometry:** 45° a: 0° (omnidirectional irradiation)
- **Measurement range:**
  - Reflectivity: 0 to 130 %
  - Wavelength: 400 to 780 nm
- **Measurement item:**
  - Color (*1) (*2): Can be selected from CIE L*a*b*, HunterLab, CIE Yxy, or CIE XYZ
  - Brightness (*1) (*3) (*4)
  - Whiteness (*1) (*3) (*5)
  - Reflectivity (*1): Spectrum
- **Fluorescence:** ΔBrightness or ΔWhiteness
- **Light source:** High brightness LED light source and UV LED light source (for fluorescence measurement)
- **Detector:** CCD linear image sensor
- **Dustproof:** Anti-Paper dust accumulation mechanism
- **Ambient temperature (*6):** 0 to 50 °C
- **Ambient humidity (*6):** 20 to 90 %RH (non-condensing)

*1: Simultaneous measurement and display is possible regardless of the presence or absence of the UV light.
*2: Illuminant/Observer can be selected from C/2°, C/10°, D65/2°, D65/10°, A/2°, A/10°, F2/2°, F2/10°, F7/2°, or F7/10°
*3: Can be selected from Brightness or Whiteness
*4: Illuminant/Observer can be selected from C/2° or D65/10°.
*5: Illuminant can be selected from C or D65.
*6: The temperature and the humidity are values measured at 10 cm or more above and below the paper.

### Performance

- **Accuracy:**
  - Color: ±0.1 point or less for CIE L*a*b*
  - Brightness: ±1 % or ±0.5 point whichever is greater
  - Whiteness: ±2 % or ±1.0 point whichever is greater

- **Repeatability:**
  - Color: ±0.05 point or less for CIE L*a*b*
  - Brightness: ±0.1 point or less
  - Whiteness: ±0.2 point or less

- **Resolution:**
  - Wavelength: 1 nm
  - Color: Calculation at 5 nm
  - Brightness: Calculation at 5 nm
  - Whiteness: Calculation at 5 nm

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Yokogawa’s unique spectroscope is installed in the LED Color sensor. It has a light receiving element compensation function, which has only been used for high-grade laboratory color measuring instruments. The spectroscope and a high-accuracy temperature control mechanism offers high stability. The combination of the high brightness white LED light source and the high-performance spectroscope achieves high S/N ratio. This allows the LED Color sensor to measure low reflectance dark color grades with high accuracy.

### Industry's first optical system and pass line correction technology

The industry’s first cylindrical mirror optical system with the deep focal depth focuses light. The formation of the deep focusing zone always maintains the measurement geometry despite the variation of the sheet pass line. In addition, the newly-developed ranging correction function, Wavelength Shifting Method (WSM), has a real-time pass line measurement and correction functions. WSM always offers stable measurement without being influenced by the pass line position variation due to fluttering or wrinkles.
### Model and suffix codes

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<tr>
<th>Model</th>
<th>Suffix Codes</th>
<th>Specifications</th>
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| BM9CL4    | VP           | LED Color Sensor (*)
| Application | VP         | B/M9000 VP      |
| Installation Spec. | ST        | For general atmosphere |
| Sensing Unit Type | S1        | Standard type   |
| Backing Unit Type | B1        | Standard type   |

*1: Can be installed only on the BM9F1-X frame.

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