Full Spectrum Illumination and Powerful Algorithms

VISION SYSTEM WITH UNLIMITED FLEXIBILITY
For Colour, Shape, Gloss, and Target Variability

All-In-One Illumination
Outstanding Control

Multi-Spectrum lighting incorporating LEDs in eight colours and a dedicated control circuit.
Synchronised lighting, colour control, segmented lighting, and high-speed image capture without complicated PLC integration.
Accurate Sorting, Even between Slight Colour Differences

MULTI-SPECTRUM MODE ➤ P. 4

Detect Height Changes While Removing Glare

LumiTrax™ MODE ➤ P. 6

Simple Selection of Optimal Lighting

NORMAL ILLUMINATION MODE ➤ P. 7
MULTI-SPECTRUM MODE

Accurate Sorting Even between Slight Colour Differences

Completely New Colour Inspection Algorithm

Using a high-speed monochrome camera in combination with 8-wavelength lighting provides vastly superior capabilities compared with colour inspection with conventional colour cameras (RGB). This allows users to achieve accurate sorting, even of the slightest differences in colour.

Inspection of Various Types of Plastic Caps

With conventional models, distinguishing between similar targets with little noticeable colour difference was difficult. Multi-Spectrum Mode analyses information using eight different wavelengths, allowing for easy distinction between similar colours.

Although some differences are noticeable, the extracted colours are largely the same.

Differences in colour are clearly defined.
Easy Configuration Enables Powerful Colour Differentiation

### Colour-Separation Method

In addition to the conventional "Eyedropper Method", the Multi-Spectrum Mode includes a Colour-Separation Method for analysis of only a specific area and group of specified colours. With this method, users have only to choose the colour required for inspection from the ones automatically separated. This new method of colour-based analysis solves the problem faced with conventional methods for specifying a colour, which leads to varying results depending on who is setting the colour or where the mouse is being clicked.

![Colour-Separation Method](image)

Colour extraction is performed just by clicking the inspection location. The colour information excludes any areas with ambiguous colour differences, such as blown-out highlights or crushed shadows, allowing users to extract only areas where colour differences are clear.

![Registering colours to exclude from detection](image)

Colours that should not be included in detection can be registered as "Excluded Colours". This feature is capable of reliably distinguishing between colours, eliminating the need for complicated fine adjustment of the extracted colour when colours similar to that of the detection target exist, such as similar background colours.
Eliminating the Problems of Conventional Image Creation

LumiTrax™ is a vision system solution where analysis is performed using multiple images taken with lighting from different directions in order to generate shape images and remove glare. This allows users to effortlessly create images that would conventionally require a great deal of time and experience.

CONVENTIONAL IMAGING PROBLEMS

- Various surface conditions
- Influence from surrounding environment (ambient light)
- Target vibration caused by transfer conditions

Difficult imaging conditions require trial and error for selecting the optimum light.

SOLUTIONS WITH LumiTrax™

1. Application examples
   - Stamped Character Inspection on Metal Casting
   - Chip Inspection on Metal Surfaces
   - Printed Character Inspection on Film Surfaces
   - Tape Presence Inspection

2. Application examples
   - Suppressing glare and ambient light to extract only textures (pattern)

Using optimal wavelengths

- Normal Image: A slight difference between the background and the characters is produced, but glare also occurs.
- White LED: Glare is eliminated through LumiTrax™, but no contrast between the background and the characters is produced.
- Infrared LED: Background intensity is reduced and glare is eliminated.
Easy Inspection Stability and Responsiveness Improvement

Multi-Spectrum lighting utilises eight built-in colour LEDs in order to illuminate targets in a variety of colours for inspection. With the ability to remember illumination colours for every program or product type, multi-spectrum lighting provides the optimum colour for inspection even with multiple items and various product types.

Optimum Colour Selection from among Multiple Images

When configuring the lighting colour, images for each of the eight lighting colours are displayed allowing for quick determination of which lighting provides the best inspection results.

Appropriate Lighting Colour Usage According to Inspection Items

The combination of multiple images and lighting colours enable the optimum lighting colour for each inspection item.

Excellent Flexibility for Future Inspections

Colours used for lighting are memorised for each set product type, so users need only switch the setting during operation. This eliminates the need for cumbersome external control. The eight coloured LEDs cover both visible and invisible light, providing maximum flexibility even when adding product varieties in the future.
HARDWARE AND SOFTWARE THAT SUPPORTS INSPECTION STABILITY

Stable vision system inspection depends not only on the capabilities of hardware, such as cameras and lighting, but also on software capable of controlling these devices according to the application requirements. By developing both hardware and software, KEYENCE is able to commit fully to inspection stability as only a comprehensive manufacture of vision systems can.

**HARDWARE**

- Built-In Dedicated Illumination Control Circuit
  - Automatic wavelength and directional control according to the inspection settings

- Ultra, High-Speed CMOS camera and Dedicated Control Circuit
  - Multi-capture imaging even on high-speed lines

- Photodiode and Real-Time Intensity Control Circuit
  - Real-time intensity feedback circuit for even brightness between images

- Lighting Equipped with 8 High-Brightness LEDs of Different Wavelengths
  - Powerful LEDs with a wide illumination range (from visible to invisible light) for detecting targets

**SOFTWARE**

Greater Inspection Stability

- P. 10
- 3D Display Function for Registered Colours
- Registration of Multiple Colours
- Brightness/Colour Range Function
- Ambient Light Elimination
Improved Application-Specific Inspection Capabilities

- Colour Distribution
- Fine Colour Processing
- Colour Extraction Guide
- Custom Menu Registration
3D Display Function for Registered Colours

The distribution of registered colours can be displayed in 3D, indicating how different the registered selected and excluded colours are and allowing visualisation of whether the inspection is stable and free from interference from other colours.

Example: Increasing responsiveness to brightness changes without changing the extraction status

Adjust the brightness ranges so that the ovals do not overlap.

The extraction status does not change even if the brightness changes.

Brightness/Colour Range Function

This function adjusts the brightness and colour range for each registered colour. Analysis is performed beforehand using simulations for factors that may cause unstable inspection, such as changes in the surrounding environment and variations in the target, ensuring stable inspection over a longer period within the actual environment. This allows users to obtain the optimal settings for the best results.

Brightness Variation Adjustment Screen

Creation of simulated images with ±20% brightness within the controller allows the device to immediately display multiple colour extraction results using varying brightness parameters.

Simply select the column where the detection location appears the clearest. This eliminates the need to adjust the parameters based on the users’ perception.
Multi-Colour Registration
(Support for Invalidation and Integration)

Registration of up to 32 extracted colours and 32 excluded colours is possible. This makes it possible to handle a variety of inspection targets through added colour extraction without losing existing colour information. In addition, the ability to integrate or invalidate colours later allows for optimisation while always checking results.

Addition And Invalidation

<table>
<thead>
<tr>
<th>Added colour</th>
<th>Existing colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 32 individual colours can be stored. This makes it possible to perform adjustment even during operation without sacrificing colour information.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Added colour</th>
<th>Existing colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Colours can not only be removed but also invalidated. This provides flexible testing without having to redo inspection.</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Added colour</th>
<th>Existing colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Invalidated colours are not used for inspection, but the colour information is saved.</td>
<td></td>
</tr>
</tbody>
</table>

Ambient Light Elimination Function

Ambient light is analysed using an image captured without the use of the lighting (ambient light image) in order to remove the ambient light from the inspection image. This removal is performed for capture, reducing the effects of unexpected ambient light changes that may occur.

Real-Time Intensity Feedback Function

The photodiode and real-time intensity control circuit within the lighting is used for feedback control of the LED light intensity. Setting the current brightness to the regularly used brightness prevents drops in inspection capabilities due to deterioration caused by LED age ing.
Colour Distribution

Registered colours can be combined together as customisable colour groups. These colour groups allow for differentiation of various products according to colour and for inspection of the distribution ratios for each group. Whereas, conventional inspection methods required a combination of multiple tools. Colour Distribution enables inspection with higher accuracy using only a single tool.

<table>
<thead>
<tr>
<th>Colour Sorting</th>
<th>This mode determines which colour group the current inspection target belongs to.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Product</td>
<td>The group to which the current target belongs is displayed.</td>
</tr>
<tr>
<td>Differentiation</td>
<td></td>
</tr>
</tbody>
</table>

Colour Sorting

- Group No. 00
- Group No. 01
- Group No. 02

The distinctive colours from each product type are registered in a colour group (16 groups maximum).

Colour Distribution

- This mode calculates how distributed a colour group is within a target.

Distribution Checking for Air Fresheners

The mixing ratio of an air freshener is determined.

Fine Colour Processing

Fine Colour Processing enables detection of scratches and dirt by measuring grey-level differences within the measurement area using images for each of the eight wavelengths and identifying any differences above the threshold. This function captures changes in background colour, making it effective for cases when the occurrence of scratches and dirt cannot be predicted. In addition, by using an algorithm that captures colour changes that occur within the detection region, this function is also useful for easily identifying changes in background colour.

Colour changes in the background or from defects are analysed to ensure changes in colour are properly ascertained.
With absolutely no numerical adjustment of parameter values, users are able to extract colours intuitively, just by selecting an image.

**Colour Extraction Guide**

A step-by-step guide walks users through the necessary steps for extracting a colour. Simply select the optimal parameters from among multiple screens.

1. **STEP 1**
   - Select the area to extract

2. **STEP 2**
   - Select the optimal setting from the images presented

3. **STEP 3**
   - Click on the colour to be extracted

4. **STEP 4**
   - Select a colour range

**Colour extraction complete**

**Custom Menu Registration**

Custom menus allow users to create shortcuts to a selected area within the tool. This creates a menu with only those items required for operation being registered, providing a way to quickly call up frequently used items.

**Sharing of Extracted Colours**

Information on configured extracted colours can be shared between tools. This enables synchronisation of colour information between shared tools simply by changing the original colour extraction setting.

**Colour information shared as a reference**

Configuration is performed simply by selecting which tool to use as a reference for the colour information.
* Fan units are not included with CV-X400/X420/X450 and XG-X2000/X2200/X2500 products.
The CV-X480 and XG-X2800 have no camera connection port. Use in combination with a camera input unit or similar device.

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**PRODUCT LINEUP/OPTIONS**

<table>
<thead>
<tr>
<th>Multi-Spectrum Lighting</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 mm type CA-DRM5X</td>
</tr>
<tr>
<td>100 mm type CA-DRM10X</td>
</tr>
<tr>
<td>200 mm type CA-DRM20X</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Multi-Spectrum Lighting Dome Attachment</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 mm type CA-DRM5DA</td>
</tr>
<tr>
<td>100 mm type CA-DRM10DA</td>
</tr>
<tr>
<td>200 mm type CA-DRM20DA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Multi-Spectrum Lighting Polarisation Attachment</th>
</tr>
</thead>
<tbody>
<tr>
<td>50 mm type CA-DRM5PA</td>
</tr>
<tr>
<td>100 mm type CA-DRM10PA</td>
</tr>
<tr>
<td>200 mm type CA-DRM20PA</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lighting Power Supply</th>
</tr>
</thead>
<tbody>
<tr>
<td>LED light control expansion unit CA-DC60E</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Lighting Cables</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Lighting cables</strong></td>
</tr>
<tr>
<td><strong>Lighting extension cables</strong></td>
</tr>
<tr>
<td>Cable length (m)</td>
</tr>
<tr>
<td>3</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>10</td>
</tr>
<tr>
<td>5</td>
</tr>
<tr>
<td>10</td>
</tr>
</tbody>
</table>
DIMENSIONS

Multi-Spectrum Lighting (50 mm type) CA-DRM5X

Multi-Spectrum Lighting (100 mm type) CA-DRM10X

Multi-Spectrum Lighting (200 mm type) CA-DRM20X

Unit: mm
**SPECIFICATIONS**

### Multi-Spectrum Lighting

<table>
<thead>
<tr>
<th>Model</th>
<th>CA-DRM5X</th>
<th>CA-DRM10X</th>
<th>CA-DRM20X</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Illumination method</strong></td>
<td>Ring illumination (with support for optional CA-DRM (DA) Series dome attachment and CA-DRM (PA) Series polarisation attachment)*1</td>
<td>Multi-Spectrum lighting / LumiTrax lighting / Normal lighting (single-colour lighting in all directions)*2</td>
<td>Constant current control mode. (1024-step digital gradation: With CA-DC60E connected / Adjustable per wavelength)*3</td>
</tr>
<tr>
<td><strong>Response speed</strong></td>
<td>1 ms or less</td>
<td>1 ms or less</td>
<td>1 ms or less</td>
</tr>
<tr>
<td><strong>LED Peak wavelength</strong></td>
<td>Ultraviolet: 405 nm / Blue: 457 nm / Green: 527 nm / Orange: 600 nm / Red: 660 nm / Far red: 730 nm / Infrared: 860 nm / White: 600 nm (All values approximate)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Controller connection</strong></td>
<td>Dedicated cable (3 m / 5 m / 10 m), Max. 30 m (with extension cables*4)</td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Power consumption</strong></td>
<td>51.4 W (during normal light emission)</td>
<td>71.0 W (during normal light emission)</td>
<td>71.0 W (during normal light emission)</td>
</tr>
<tr>
<td><strong>Environmental resistance</strong></td>
<td>Operating ambient temperature: 0 to 40°C</td>
<td>Operating ambient temperature: 0 to 40°C</td>
<td>Operating ambient temperature: 0 to 40°C</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>Approx. 560 g</td>
<td>Approx. 600 g</td>
<td>Approx. 1080 g</td>
</tr>
</tbody>
</table>

*1 The UV and IR wavelengths cannot be used when the polarisation attachment is attached.
*2 Continuous lighting can only be set during normal lighting when brightness value control is set to ON.
*3 Simultaneous lighting of multiple colours is not supported.
*4 Connection of up to two dedicated extension cables is allowed.

### Lighting power supply

<table>
<thead>
<tr>
<th>Model</th>
<th>CA-DC60E</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Output</strong></td>
<td>Light control method: Constant current control mode.</td>
</tr>
<tr>
<td>Gradation</td>
<td>1024-step digital gradation (switchable settings using controller)</td>
</tr>
<tr>
<td>Connection points</td>
<td>2ch (Dedicated 12-pole connector)</td>
</tr>
<tr>
<td>Synchronisation</td>
<td>Camera trigger and shutter synchronisation*1</td>
</tr>
<tr>
<td>Response speed</td>
<td>1 ms or less</td>
</tr>
<tr>
<td><strong>Display</strong></td>
<td>LED display</td>
</tr>
<tr>
<td><strong>Rating</strong></td>
<td>Voltage: 24 VDC ±10%</td>
</tr>
<tr>
<td>Current consumption</td>
<td>5.1 A (incl. supply to light emitter for lighting)</td>
</tr>
<tr>
<td><strong>Environmental resistance*2</strong></td>
<td>Operating ambient temperature: 0 to 40°C (DIN rail-mounted) / 0 to 40°C (bottom-mounted)</td>
</tr>
<tr>
<td><strong>Weight</strong></td>
<td>Approx. 500 g</td>
</tr>
</tbody>
</table>

*1 Continuous lighting (single-colour lighting in all directions) can only be set when the brightness value control is set to ON.
*2 Environmental resistance for lights includes an operating ambient temperature of 0 to 40°C and an operating ambient humidity of 35 to 65% RH (with no condensation).