### Lens characteristics

- If a close-up ring is used, only WD in the region of this value can be used.
- If a close-up ring is not used, a WD less than the value shown in this table cannot be used.
- The above table shows the field of view when the standard lens and close-up ring are used. (Closest distance value is shown in No Close-up Ring column).

<table>
<thead>
<tr>
<th>Lens</th>
<th>Model</th>
<th>Focal length [mm]</th>
<th>Minimum focus distance (No Close-up Ring) [mm]</th>
<th>WD [mm]</th>
<th>Angle-of-view size X × Y [mm]</th>
<th>Angle-of-view size [degrees]</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 mm</td>
<td>KCX-M7214-30</td>
<td>8</td>
<td>F1.0–CLOSE</td>
<td>12.5</td>
<td>113.6</td>
<td>66.1</td>
</tr>
<tr>
<td>12 mm</td>
<td>KCX-M7214-10</td>
<td>12</td>
<td>F1.0–CLOSE</td>
<td>11.3</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>16 mm</td>
<td>KCX-M7214-16</td>
<td>16</td>
<td>F1.0–CLOSE</td>
<td>9.1</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>25 mm</td>
<td>KCX-M7214-25</td>
<td>25</td>
<td>F1.0–CLOSE</td>
<td>8.1</td>
<td>85.0</td>
<td>85.0</td>
</tr>
<tr>
<td>8 mm (megapixel support)</td>
<td>KCX-M7214-40</td>
<td>8</td>
<td>F1.0–CLOSE</td>
<td>8.1</td>
<td>85.0</td>
<td>85.0</td>
</tr>
<tr>
<td>12 mm (megapixel support)</td>
<td>KCX-M7214-50</td>
<td>12</td>
<td>F1.0–CLOSE</td>
<td>8.1</td>
<td>85.0</td>
<td>85.0</td>
</tr>
<tr>
<td>16 mm (megapixel support)</td>
<td>KCX-M7214-60</td>
<td>16</td>
<td>F1.0–CLOSE</td>
<td>8.1</td>
<td>85.0</td>
<td>85.0</td>
</tr>
<tr>
<td>25 mm (megapixel support)</td>
<td>KCX-M7214-70</td>
<td>25</td>
<td>F1.0–CLOSE</td>
<td>8.1</td>
<td>85.0</td>
<td>85.0</td>
</tr>
</tbody>
</table>

* This table shows the angle-of-view for Yamaha's standard lenses. If the angle-of-view is greater, there might be more distortion at the edge of the image.

<table>
<thead>
<tr>
<th>Lens characteristics</th>
<th>201907-CE</th>
</tr>
</thead>
<tbody>
<tr>
<td>25 mm</td>
<td>F1.4–F16</td>
</tr>
<tr>
<td>16 mm</td>
<td>F1.4–F16</td>
</tr>
<tr>
<td>8 mm</td>
<td>F1.3–CLOSE</td>
</tr>
<tr>
<td>25 mm</td>
<td>F1.4–CLOSE</td>
</tr>
<tr>
<td>16 mm</td>
<td>F1.4–CLOSE</td>
</tr>
<tr>
<td>8 mm</td>
<td>F1.3–CLOSE</td>
</tr>
<tr>
<td>12 mm</td>
<td>F1.4–CLOSE</td>
</tr>
<tr>
<td>16 mm</td>
<td>F1.4–CLOSE</td>
</tr>
<tr>
<td>8 mm</td>
<td>F1.3–CLOSE</td>
</tr>
</tbody>
</table>

**Angle-of-view size, WD, and magnification when close-up ring is used**

- WD is the lens tip reference.

<table>
<thead>
<tr>
<th>Lens</th>
<th>Model</th>
<th>Angle-of-view size [degrees]</th>
<th>WD [mm]</th>
<th>Magnification</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 mm</td>
<td>KCX-M7214-30</td>
<td>46°45'</td>
<td>113.6</td>
<td>0.1</td>
</tr>
<tr>
<td>12 mm</td>
<td>KCX-M7214-10</td>
<td>27°39'</td>
<td>100</td>
<td>0.2</td>
</tr>
<tr>
<td>16 mm</td>
<td>KCX-M7214-16</td>
<td>23°19'</td>
<td>100</td>
<td>0.2</td>
</tr>
<tr>
<td>25 mm</td>
<td>KCX-M7214-25</td>
<td>14°35'</td>
<td>100</td>
<td>0.1</td>
</tr>
<tr>
<td>12 mm (megapixel support)</td>
<td>KCX-M7214-40</td>
<td>23°19'</td>
<td>100</td>
<td>0.2</td>
</tr>
<tr>
<td>16 mm (megapixel support)</td>
<td>KCX-M7214-50</td>
<td>23°19'</td>
<td>100</td>
<td>0.2</td>
</tr>
<tr>
<td>25 mm (megapixel support)</td>
<td>KCX-M7214-60</td>
<td>14°35'</td>
<td>100</td>
<td>0.1</td>
</tr>
<tr>
<td>25 mm (megapixel support)</td>
<td>KCX-M7214-70</td>
<td>14°35'</td>
<td>100</td>
<td>0.1</td>
</tr>
</tbody>
</table>

* This table shows the angle-of-view for Yamaha’s own unique solution. The value shown in this table cannot be used.

Yamaha’s own unique solution for integrated robot vision

YAMAHA MOTOR CO., LTD.
Robotics Operations FA Section
127 Toyota, Kuki-ku, Hamamatsu, Shizuoka 433-8103, Japan
Tel. +81-55-525-4350, Fax. +81-55-525-8378
E-mail robot@yamaha-motor.co.jp

Integrated Robot Vision System with "plug-and-play" simplicity

[Image: Yamaha ROBOT VISION SYSTEM]

RCX340 CONTROLLER YAMAHA ROBOT VISION
dev.YV2 SYSTEM
A robot-integrated vision system that only Yamaha could produce

**Simplicity**
Setup is completed as little at eight minutes after power-on.
Auto-calibration makes setup easy.

**Sophistication**
With up to five million pixels, a variety of workpieces can be supported.
Improve throughput to 100 CPM with conveyor tracking.

**Assurance**
Comprehensive support covers everything from camera image acquisition to the operation of the gripper and robot.
With support that only the robot manufacturer can provide, you can relax.

**Easy to use, and reduces the number of steps**
Adding "eyes" to a robot significantly expands the range of applications.

**Basic specifications** have been dramatically enhanced while retaining the current iVY system's ease of use.

**Labeling device (affixing labels to food packages)**
- Industry: food
- Robot used: YK500TW omnidirectional robot

**Sealant touch-up (engine block sealant)**
- Industry: automotive
- Robot used: SXYX Cartesian robot

**Screw attachment position detection** (television panel screw attachment)
- Industry: electronics
- Robot used: NXY Cartesian robot

**Position compensation with upward-facing camera** (installing irregularly-shaped parts on a circuit board)
- Industry: electronics
- Robot used: YK150XG SCARA robot

- **Camera**
  - Supports from 300,000 to 5 million pixels
  - Increased to 254 types previously 40 types

- **Number of registered types**
  - **50%** less previously 9.5 m

- **Longer cables usable**
  - Cables can be as long as 20 m previously 9.5 m

- **Monitor output is provided**
  - Enables operating status to be monitored without a PC

- **ADVANTAGE**
  - Even if the incoming workpieces are not precisely positioned, labels can be applied at the correct position.

- **ADVANTAGE**
  - Hole position is detected, and screws are fastened accurately.

- **ADVANTAGE**
  - Even if the workpiece is skewed from its correct position, the skew and angle are detected, and the application path is automatically compensated.

Various application examples
**Auto-calibration**

- Easily complete high-precision calibration just by following a wizard! Even if equipment becomes misaligned, execute auto-calibration and resume operation.

**Easy workpiece registration**

- From image acquisition, registration takes just three steps.

**Comparison of setup time**

- Setup time is shortened greatly.
- Setup time reduced by up to 80%.

**MERITS**

- No communication time lag
- Needs only few command lines.
- Simple and easy to understand

**Program of image processing unit**

- Program of host PLC
- Camera and robot have separate programs

**Centralized control using only the robot program**

**Simplicity**

Our goal: "A vision system that anyone can use easily, even for the first time"

**STEP 1**

- Register the desired fiducial mark

**STEP 2**

- Select the camera mounting method
- Mounted on robot
- Fixed downward
- Fixed upward

**STEP 3**

- Align fiducial mark position
- If camera is movable, move the robot
- If camera is fixed, attach fiducial mark to robot, and move it

**Search results**

- Comparison of setup time
- Setup time is shortened greatly
- Setup time reduced by up to 80%
Megapixel camera supports high precision and wide field of vision. Conveyor tracking reaches 100 CPM.

Conveyor tracking
Ideal for high-speed packaging, arrangement, high-speed transport of multiple types of items, such as pharmaceuticals, cosmetics, and food products.

The vision camera detects the position and orientation of parts moving on the conveyor, and the robot picks them up.

Even numerous workpieces can be detected at high speed. The search speed is approximately double that of the previous model. Even a large number of workpieces can be detected at high speed. This can be used for a wide variety of applications, including molded plastic parts or food items.

Support for five-megapixel cameras
(Choose from 300,000 pixel, 1.3 megapixel, and 2 megapixel, and 5 megapixel)

- Stable workpiece detection
- Detailed edge detection is possible even if workpieces are touching each other or have a complex shape.
- Decreased number of search detections
- A single search allows detection even for a large workpiece, improving takt.

254 types can be registered
Setup changes are easy
Setup changes require only that part numbers be changed.

Monitor output is provided
Monitor the operating status
Monitor the search status while making calibration settings or during automatic operation.

Contents of output
- Selected type / Captured image
- Search result (position, score, scale)
- Executed command
- Time required by command

Output method
DVI-I (supports digital monitor or analog monitor)

254 types (0–253) can be registered

High-precision search even under low light
- Edge search engine is built-in
- Supports a variety of applications while being minimally affected by the external environment.

When lighting is sufficient
- Accurate search even if lighting is insufficient

Control multiple robots for even more improvement in production efficiency.

Program allows differentiation by model for even more improvement in production efficiency.

Even numerous workpieces can be detected at high speed.

The search speed is approximately double that of the previous model. Even a large number of workpieces can be detected at high speed.

This can be used for a wide variety of applications, including molded plastic parts or food items.

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(Choose from 300,000 pixel, 1.3 megapixel, and 2 megapixel, and 5 megapixel)

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Output method
DVI-I (supports digital monitor or analog monitor)

High-precision search even under low light
- Edge search engine is built-in
- Supports a variety of applications while being minimally affected by the external environment.
Choose freely from Yamaha's lineup of robots

A low-cost and convenient robot vision system can be constructed using the models that are optimal for the customer’s application.

- XY-X Cartesian robots
- YK-XG SCARA robots
- YK-TW orbit type robots
- FLIP-X single-axis robots

* The YA series is not supported.

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You have the assurance of support that can be provided only by Yamaha, the robot manufacturer.

You can rely on us both before installation and after installation.

Preparatory evaluation and advice give you peace of mind

We borrow the workpiece from you, evaluate it, and submit an evaluation report.

In addition, we draw on our wealth of experience and evaluation results to provide advice and training regarding selection and installation of robots and peripheral equipment.

Advice regarding camera, lens, and lighting settings

The results of our preliminary evaluation regarding camera, lens, lighting selection, and setup are summarized as a report and submitted.

Training can be performed according to the content of the customer’s application.

Also usable with an analog monitor by using a conversion adaptor.

- Power supply: DC24V±10% 1.5A Max.
- Dimensions: W 45 × H 195 × D 130 (iVY2 unit only)
- Weight: 0.8 kg (iVY2 unit only, when the lighting control board option is selected)

Search method: Edge search (correlated edge filter, Sobel filter)

- Image capturing: Trigger mode, S/W trigger, H/W trigger
- External trigger input: 2 points
- Function: Position detection, automatic point data generation

Camera installation position: Fixed to the fixed camera (up, down) or robot (Y-axis, Z-axis).

- Setting support function: Calibration, image save function, model registration*, fiducial mark registration*, monitoring function*

* iVY2 Studio function (requires a Windows PC)

Lighting control options:

- Number of connectable lighting units: Max. 2 lighting units
- Modulated light format: PWM modulated light control (0 to 100%), PWM frequency switchable 62.5 kHz/125 kHz
- Continuous light, strobe light (follows camera exposure)
- Lighting output power: 12VDC or 24VDC (external supply shared by both channels)

- Setting support function: Number of connectable encoders up to two units
- Encoder power supply: DC5V (less than 500 mA total for two counters) (provided by controller)
- Applicable encoders: 26L531 / 26C31 equivalent line driver (RS422 compliant)
- Input phase: A, B, Z
- Highest response frequency: 2 MHz or lower
- Counter: 0–55535
- Multiplier: 4 times
- Other: disconnection detection function is provided

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Ordering method

- Controller
- No. of connectable axes
- Safety standards
- Controller option A to D (OP.A to D)
- Controller option E (OP.E)
- Additional feature

* Refer to the comprehensive catalog for details on the order format.
The iVY2 unit adds robot vision to the RCX340 robot controller.

- **iVY2 unit**
  - Model: KCX-M4400-V0
  - With lighting: KCX-M4404-L0

- **Standard accessories**
  - iVY2 unit
  - Camera trigger input cable connector
  - 24V power supply connector

- **Options**
  - **Lens**
    - 8 mm: KCX-M7214-00
    - 12 mm: KCX-M7214-10
    - 16 mm: KCX-M7214-20
    - 25 mm: KCX-M7214-30
    - 32 mm (megapixel support): KCX-M7214-40
    - 40 mm (megapixel support): KCX-M7214-50
    - 45 mm (megapixel support): KCX-M7214-60
    - 50 mm (megapixel support): KCX-M7214-70

  - **Close-up ring**
    - 0.5 mm: KX0-M7215-00
    - 1.0 mm: KX0-M7215-10
    - 2.0 mm: KX0-M7215-20
    - 5.0 mm: KX0-M7215-40

- **CMOS camera**
  - Model: KCX-M6541-00
  - 5,000,000 pixel
  - 3009 × 2000 (QVXGA)

- **CCD camera**
  - Model: KCX-M5841-00
  - 1,300,000 pixel
  - 1280 × 966 (SXGA)

- **Camera trigger input cable connector**
  - 2.0 mm: KCX-M4400-L0
  - 5 m: KX0-M657K-00
  - 10 m: KX0-M657K-10
  - 15 m: KX0-M657K-15
  - 20 m: KX0-M657K-20
  - 25 m: KX0-M657K-30
  - 30 m: KX0-M657K-30

- **24V power supply connector**
  - 2.0 mm: KCX-M4400-L0
  - 5 m: KX0-M657K-00
  - 10 m: KX0-M657K-10
  - 15 m: KX0-M657K-15
  - 20 m: KX0-M657K-20
  - 30 m: KX0-M657K-30

- **Camera cable**
  - 2.0 mm: KCX-M6541-00
  - 5 m: KX0-M6541-00
  - 10 m: KX0-M6541-10
  - 15 m: KX0-M6541-20
  - 20 m: KX0-M6541-30

- **Tracking encoder cable**
  - 2.0 mm: KCX-M6541-00
  - 5 m: KX0-M6541-00
  - 10 m: KX0-M6541-10
  - 15 m: KX0-M6541-20
  - 20 m: KX0-M6541-30

- **Support software for PC iVY2 Studio**
  - iVY2 Studio is support software for the iVY2 system that allows registering part types and reference marks as well as monitoring the work search status during automatic robot operation by connecting to the robot controller.

- **Dimensions**
  - **Lenses**
    - 8 mm lens: Model KCX-M7214-00
    - 12 mm lens: Model KCX-M7214-10
    - 16 mm lens: Model KCX-M7214-20
    - 25 mm lens: Model KCX-M7214-30
  - **Camera**
    - 2.0 mm: KCX-M5841-00
    - 5 m: KX0-M657K-00
    - 10 m: KX0-M657K-10
    - 15 m: KX0-M657K-15

- **System configuration illustration**
  - iVY2 unit
  - Camera
  - Lighting
  - Encoder
  - Tracking board

- **iVY2 Studio**
  - Microsoft, Windows XP, Windows Vista, Windows 7, Windows 8, 8.1, and Windows 10 are registered trademarks of Microsoft Corporation, USA.

- **Programming box**
  - PDBK

- **Support software for PC**
  - iVY2 Studio

*Not included.*

[Support software for the IVY2 system that allows registering part types and reference marks as well as monitoring the work search status during automatic robot operation by connecting to the robot controller.]*

*Connections to the STD.DIO, ACIN, and SAFETY connectors are not shown in the left illustration.*

*The illustration left shows an example system with the tracking board and an iVY2 unit (when the lighting control board option is selected).