# ROBOT VISION iVY RCX240

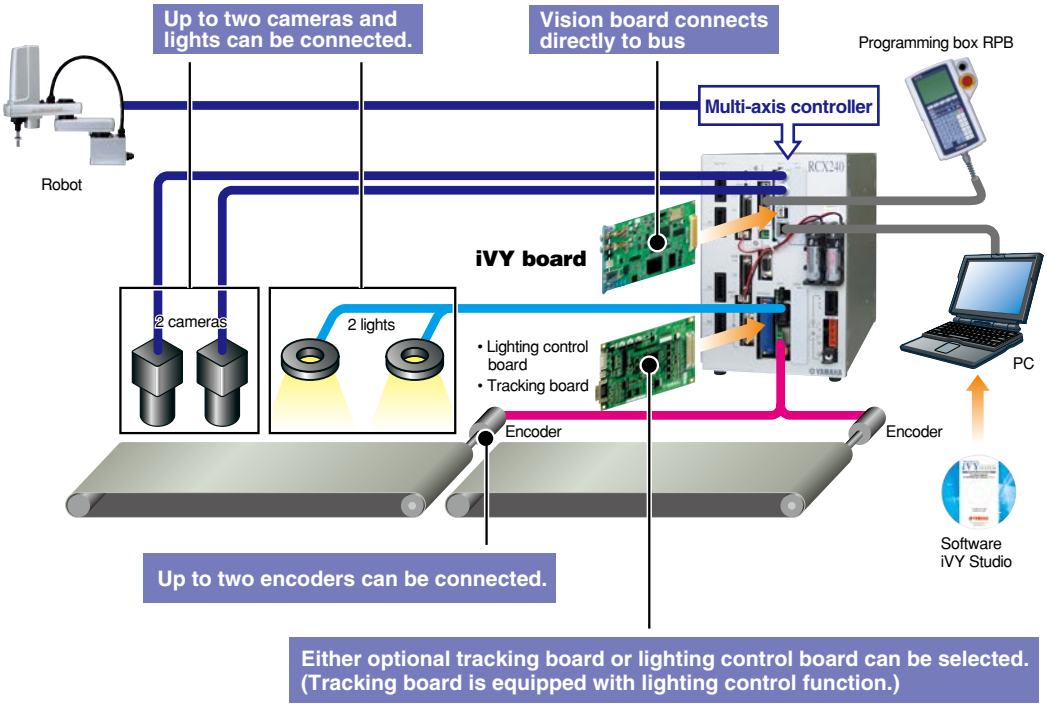
## Easy to use and reduction of work steps.

## "Finds and Picks up" and "Pursues and Picks up" without teaching.

Many robot users might think, "We tried vision recognition, but it seemed to take a lot of work" or "we tried it before, but making adjustments was a tough job".
But YAMAHA iVY system solves these problems.
Anyone can make the setup easily to contribute to reduction of work steps.

# iVY system layout

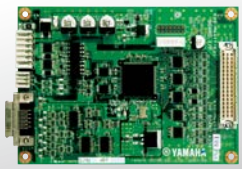
A robot controller with an image processing function is completed only by setting the iVY board in the 4-axis controller RCX240 or RCX240S. As "eye" is put in the robot, the robot finds and takes workpiece, checks deviations in workpiece position, and makes correction if the workpiece deviates largely. This expands the range of applications.



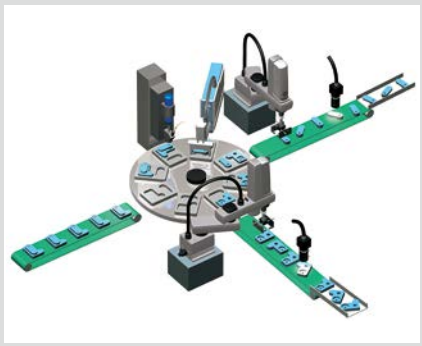

■ Options

- Lighting control board
- Tracking board
- CCD camera
- LAN cable (Shielded cross-cable)
- Camera cable
- Lens
- Close-up ring

Lens　CCD camera

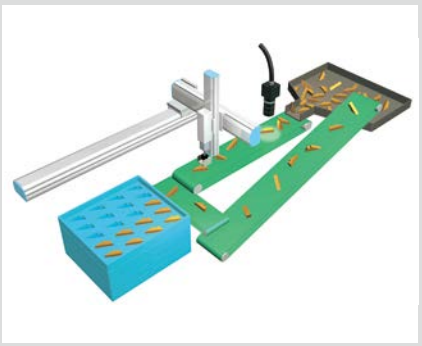


Tracking board



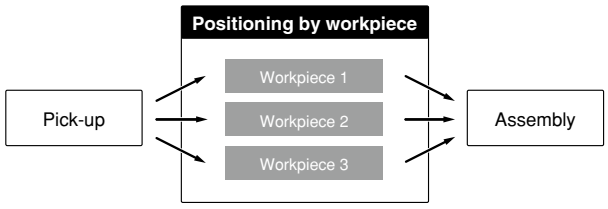
■ Positioning by searching for workpiece

■ Automatic correction even if the camera moves



■ Applicable to conveyor tracking

**Conventional system without robot vision**




When the workpiece is changed, the positioning jig replacement work is needed.
In particular, when using a small lot of workpieces, the setup costs or jig manufacture and management costs are needed.

**System with robot vision**


Even when the workpiece is changed, it is flexibly supported only by changing the part type data.
Since no mechanical positioning is needed, cost reductions, such as equipment down-sizing or jig cost reduction become possible.

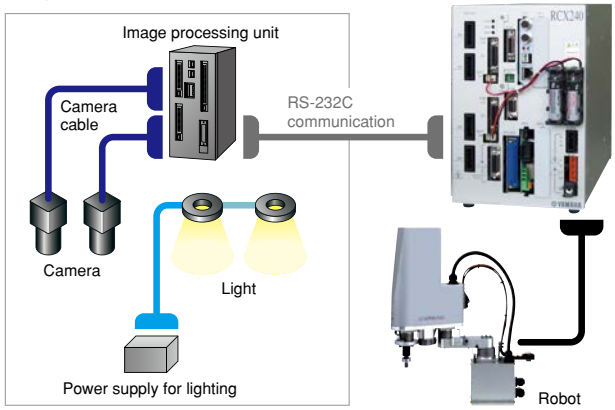
POINT 1

## Easy for anyone to use, applicable to a wide variety of applications

When the system was upgraded by combining the robot with a generally available image processing unit, it took a long time conventionally to adjust the robot controller and image processing unit, and perform the correction calculation. In YAMAHA "iVY system", the vision board is integrated into the robot controller and the functions are limited to the positioning and position correction so as to greatly simplify the operability. This makes the system incredibly easy to use when compared to conventional vision systems. YAMAHA aimed at "a vision system that anyone can easily use". Please try to use YAMAHA's new robot vision.

### Conventional robot vision

① Alignment with robot coordinates is difficult.
② Correction calculation is needed when the camera moves.
③ Operation deviation between the camera and robot due to comunication time.
④ Adjustment of communication format is needed.




✕ • Difficult to handle.
• Hard to actually operate.
• Installation and setup costs are high.
• Difficult to know emergency contact address.

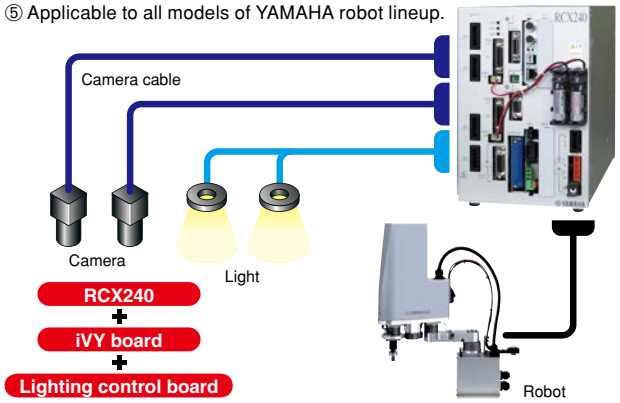
**Special skills are required and many work steps are needed.**

Connecting an external camera to the robot controller requires tasks such as coordinate alignment (calibration), and correction programs are needed, so the startup work is difficult. When using for simple applications, many work steps are needed. So, possible applications are limited.

### iVY system

① Simple calibration function is incorporated.
② Coordinates are corrected automatically even when the camera moves.
③ High-speed connections through dedicated bus line.
④ Controller is incorporated to provide the central operation.
⑤ Applicable to all models of YAMAHA robot lineup.

Point




○ • Easy to use
• Various applications are supported using easy operation.
• Cost reduction by reducing work steps.
• YAMAHA gives you total support.

**Easy operation extends applications**

YAMAHA iVY system can be calibrated very simply
Furthermore, the coordinates are corrected automatically when a camera is installed on the robot. As iVY system can be used, it can be applied to various applications.

POINT 2

## Easy workpiece registration only with 3 steps

YAMAHA aimed at "a vision system that anyone can easily use". But, image recognition itself has been around for a long time. However, conventional image recognition required complex tasks such as coordinate matching (calibration) or coordinate correction during camera movement, and it never became very popular. YAMAHA vision iVY System can be operated by anyone including machine designers or actual machine operators.

### STEP. 1

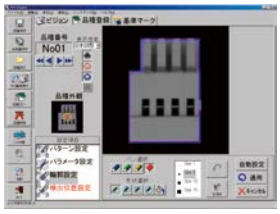
**Capture images.**

Put the workpiece within the camera field-of-view and specify an image capturing range.

### STEP. 2

**Set the contour.**

Contour is automatically extracted. Paint the necessary contour with a pen tool.

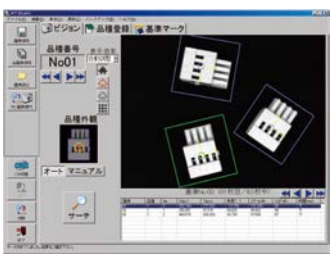


### STEP. 3

**Register the detection position.**

Specify the detection position with the mouse. Desired positions can be set.

### Search results



POINT 3

## Dedicated software "iVY Studio" included

The iVY system includes dedicated software "iVY Studio". All operations related to the vision, such as registration of fiducial marks used for the calibration or workpieces (edge setting, various parameter setting, and image capturing range setting, etc.), backup, restore, and operation monitor can be performed only with this software.

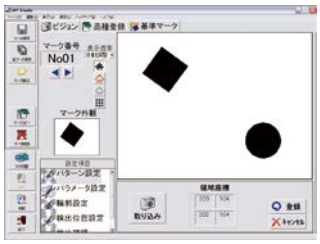
**Support software iVY Studio**

- Search trial-run, part type registration
- Reference mark registration (for calibration)
- Up to 40 workpiece types can be registered.
- Workpiece can also be added easily.
- Up to 40 workpieces can be detected at once.
- Data backup
- This software functions as a monitor during program operation.

POINT 4

## Simple calibration function (coordinate matching alignment work) incorporated

Conventional equipment combining "image processing unit + robot" requires many steps in "calibration" that aligns the camera coordinates with the robot coordinates. In the iVY system, the operation is completed easily in a short time only by following interactive instructions using the programming box. Additionally, the coordinate values are corrected automatically even when the robot installation position is changed, such as upward clamping, downward clamping, robot Z-axis clamping, or SCARA robot Y-arm clamping.



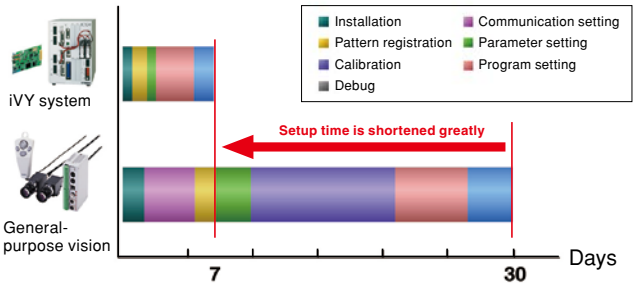
Just follow instructions on Wizards

POINT 5

## Setup time reduced greatly

When using a general vision, a coordinate conversion program needs to be created in the robot controller since the robot coordinate data differs from the vision format.
Since the robot controller is integrated into the iVY system, the robot coordinate data can be stored into the robot point data using single process. This ensures very simple operation. Additionally, the unified control of the camera control and light control can be performed using the robot program. The control becomes easy and the number of start-up steps can also be reduced.

### Comparison of setup time




POINT 6

## Free selection from YAMAHA robot lineup

This robot vision is applicable to all YAMAHA robots that can be operated by the RCX controller.
According to the applications, an appropriate robot can be selected from the single-axis robots FLIP-X series, linear single-axis robots PHASER series, Cartesian robots XY-X, and SCARA robots YK-XG. A low-cost and easy-to-use robot vision system can be constructed with an optimal model suitable for applications.

■ Cartesian robots XY-X

■ SCARA robots YK-XG

■ Linear motor single-axis robots PHASER

■ Single-axis robots FLIP-X

POINT 7

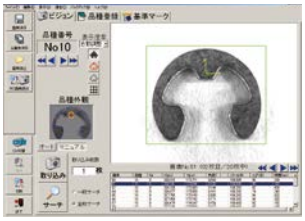
## Workpiece handling without teaching

When the robot handles a workpiece, the teaching work to the correct position is absolutely required. If the workpiece position deviates, the correct handling cannot be performed.
Use of iVY system makes it possible to detect the correct position through the image recognition after coarse positioning. The workpiece can be transferred without teaching, so the start-up steps are reduced and workpiece can be changed or added flexibly.

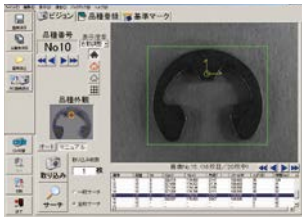
POINT 8

## Edge search engine with excellent stability

The gray search (normalized correlation search) that was frequently used for conventional visions is vulnerable to adverse effects, such as lighting conditions, or workpiece chipping or contamination. The environments and applications are restricted.
The iVY system incorporates an "edge search engine" that performs the search process using information on contour shape. This contour search is resistant to effects on external environment and the range of applications is extended.



Search is made with good lighting.

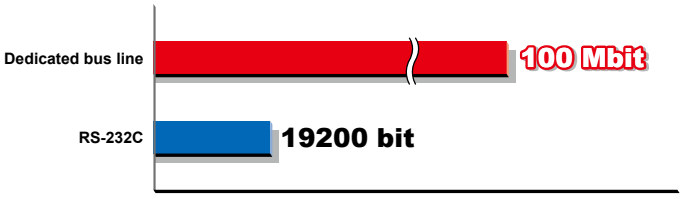


Search is correct even with insufficient lightning.

POINT 9

## High-speed connections through dedicated bus line

By directly connecting the robot controller and CPU board through the bus, a data communication speed approximately 5,000 times higher than that of the serial communication speed with general vision is achieved.
Programming also becomes easy since the time lag due to communication does not need to be considered. Additionally, this robot vision supports the conveyor tracking that requires high-speed processing.

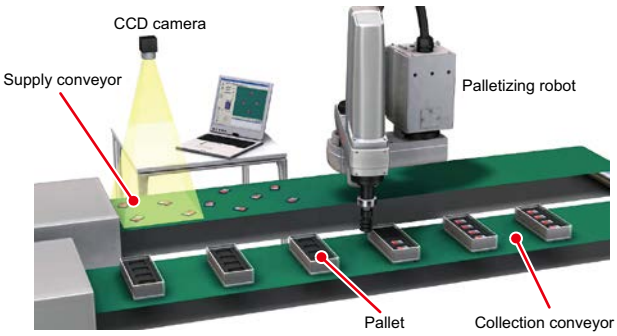



Data transmission volume per second

POINT 10

## Applicable to conveyor tracking

The iVY system is applicable to the conveyor tracking only by adding the tracking board. As the pulses (AB-phase) are taken from the encoder installed on the conveyor, the workpiece that is flowing can be picked up without stopping the conveyor.
As up to two encoders for the camera, lighting, and conveyor can be connected, the iVY system is applicable to movement between the conveyors.



POINT 11

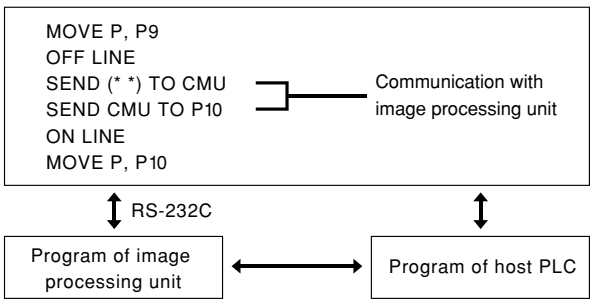
## Vision is also controlled easily with robot programs.

The robot program executes all vision controls including camera switching, image capturing, and workpiece search.
Program creation is simple when compared to general vision systems since the operations from the robot movement to the camera control are performed consistently.
Furthermore, the debug work can be performed efficiently to greatly reduce the total number of work steps.

■ Example of robot vision language

| Command name | Function |
|---|---|
| VCAPTURE | Captures images from the camera. |
| VSEARCH | Searches for the specified part type. |
| VMONITOR | Switches the monitor mode between on and off. |
| VGETCNT | Acquires the number of parts that were found. |
| VGETPOS | Acquires the position data. |
| VGETTIME | Acquires a period of time used for the search command that was executed. |
| VGETSCR | Acquires judgment values for the detected workpiece. |
| VSAVEIMG | Saves images in BMP format. |

**Conventional robot vision**




**Controls using different programs**

**iVY system**

```
MOVE P, P9
VSEARCH 1,2,0     ——— Searches for workpiece.
P10=VGETPOS(0)    ——— Reads the point.
MOVE P, P10       ——— Moves to this point.
```

MERITS

- No communication time lag
- Controllable only with the robot program.
- Needs only few command lines.
- Simple and easy to understand

**Centralized controls using robot programs**

## So, the iVY system can solve such problems.

### Number of teaching steps needs to be reduced.

Robot teaching work requires a lot of labor and time. The iVY system acts as "robot eye". The final fine positioning can be automated to greatly reduce the teaching time that was required for the conventional models.

### Positioning mechanism needs to be simplified.

In the current trend toward small-lot production of multiple models, a larger number of models means that positioning and other aspects of setup will require more time and trouble. Use of the iVY system makes it possible to greatly reduce costs necessary for manufacture, management, and replacement of positioning jigs.

### Random workpieces need to be handled.

Use of a position detection function of the iVY system makes it possible to simply construct operations, such as "workpiece is directly placed from the parts feeder" and "workpiece in the pallet is gripped and transferred".

### Workpiece flowing on the conveyor is picked up.

The iVY system is applicable to conveyor tracking. The position of the flowing workpiece is continuously recognized according to the signals from the encoder. The workpiece can be picked up without stopping the conveyor.

### Consultation destination is not found if a trouble occurs.

When a generally available image processing unit is combined with the robot, various problems such as being unable to capture images, unable to write data, or position deviation occur. YAMAHA iVY system will solve such troubles. The iVY system delivers total support for tasks ranging from capturing of images from the camera to operating the robot.

# iVY System

**Applicable controllers ▶ RCX240/RCX240S**

## ● Robot with image processing functions

**"SEARCH and TAKE" "CHECK POSITION and ASSEMBLE"**
**YAMAHA offers a whole new production line concept that eliminates time-consuming teaching and positioning tasks with "iVY-system".**

**Main functions ▶ P.72**

## ■ Ordering method

**RCX240** – [ ] – [ ] – [ ] – [ ] – [ ] – [ ] – [ ] – [ ]

| Controller | Usable for CE | Regenerative unit | Option I/O | Network Option | iVY System Option board | Light/Tracking | Gripper | Battery |
|---|---|---|---|---|---|---|---|---|
| | | | | | No entry: None<br>VY: iVY (VISION) | No entry: None<br>TR: Light+Tracking<br>LC: Light | | |

Note. For details on the various selection items, refer to P.533

## ■ Basic specifications

### ● iVY board

| Item | | iVY board |
|---|---|---|
| Basic specifications | Applicable controllers | RCX240 / RCX240S |
| | Pixels | 640 (H) × 480 (V) (300,000 pixels, VGA) |
| | Settable part types | 40 part types |
| | Connectable cameras | Maximum 2 units<br>Note. Note. If connecting 2 units, then must be the same model |
| | Camera types | Double speed compatible analog camera |
| | Memory | 128MB SDRAM, 256MB miniSD card |
| | External I/F | Ethernet (100BASE-TX) |
| Search method | | Edge search (Correlative edge filter, Sobel filter) |
| Image input | Trigger | S/W trigger, H/W trigger, Camera internal synch |
| | External trigger input | 2 points |
| Functions | Search function | Position offset, Auto registry of point data |
| | ID recognition (usage planned) | QR-Code [Model2], DataMatrix |
| Setup support functions | | Calibration, image save function, model registration[Note], fiducial mark registration[Note], monitor function[Note] |

Note. Requires Windows PC.

### ● Lighting control board (option)

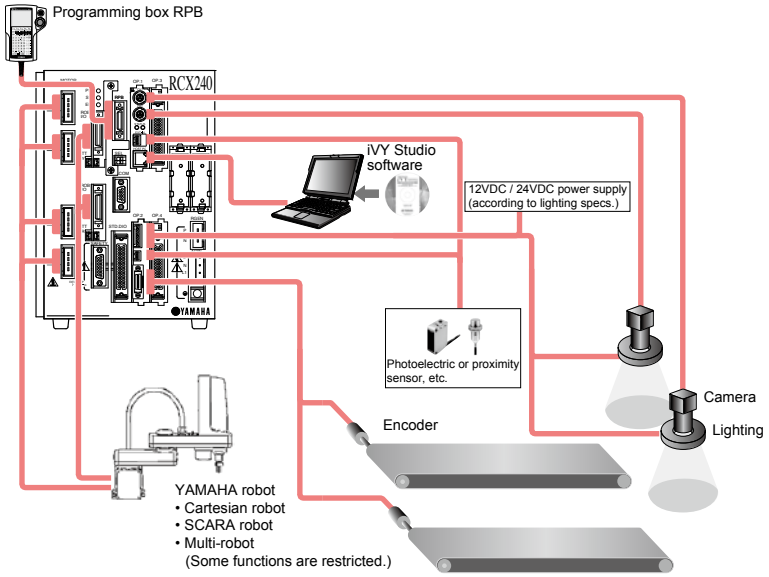
| Item | | Lighting control board (option) |
|---|---|---|
| Basic specifications | Applicable controllers | RCX240 / RCX240S |
| | Number of lighting connected units | Up to 2 units |
| | Light adjusting system | PWM control (0 to 100%) (Cycle 60kHz)<br>Stroboscopic light (10 to 33000us) |
| | Trigger | S/W trigger, H/W trigger |
| | External trigger input | 2 points |
| | Lighting power input | 12VDC or 24VDC (Supplied from outside commonly to 2 channels) |
| | Lighting output | When DC12V is supplied:<br>Less than 30W with 2 channels totaled<br>When DC24V is supplied:<br>Less than 60W with 2 channels totaled |

### ● Tracking board (Options)

| Item | | | Tracking board (option) |
|---|---|---|---|
| Basic specifications | Applicable controllers | | RCX240 / RCX240S |
| | Lighting control section | Light adjusting system | Up to 2 units |
| | | Light adjusting system | PWM control (0 to 100%) (Cycle 60kHz)<br>Stroboscopic light (10 to 33000us) |
| | | Trigger | S/W trigger, H/W trigger |
| | | External trigger input | 2 points |
| | | Lighting power input | 12VDC or 24VDC (Supplied from outside commonly to 2 channels) |
| | | Lighting output | When DC12V is supplied:<br>Less than 30W with 2 channels totaled<br>When DC24V is supplied:<br>Less than 60W with 2 channels totaled |
| | Pulse input section | Number of encoder connected units | Up to 2 units |
| | | Encoder power source | DC5V (Less than 500mA with 2 channels totaled) (Supplied from controller) |
| | | Applicable encoder | Line driver equivalent to 26LS31 / 26C31 (Conforming to RS-422) |
| | | Input phase | A, $\overline{A}$, B, $\overline{B}$, Z, $\overline{Z}$ |
| | | Maximum response frequency | 2MHz |
| | | Counter / Step-up multiplication | 0 to 65535 / Double, quadruple |
| | | Other | Provided with broken wire detect function |

Note. The tracking board is required when using the tracking function.

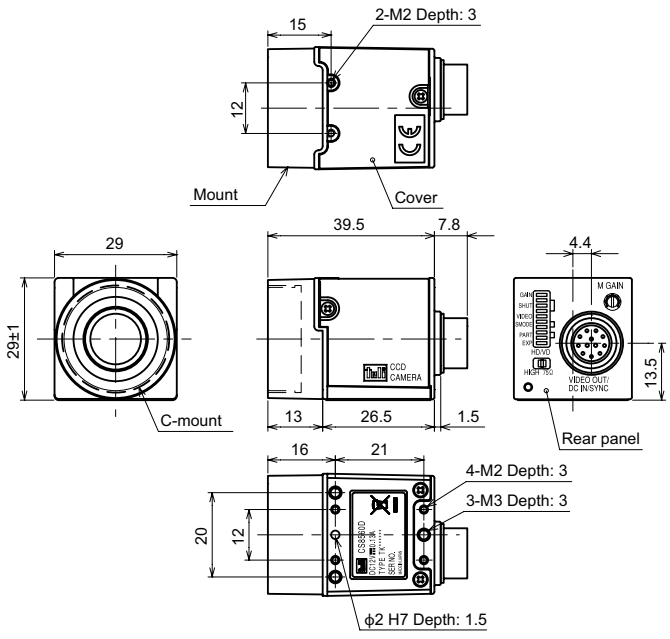
## System configuration illustration




* The above configuration example shows a system where the iVY board and tracking board are used.
* Connections to the STD.DIO, ACIN, and SAFETY connectors is not shown in the above illustration.

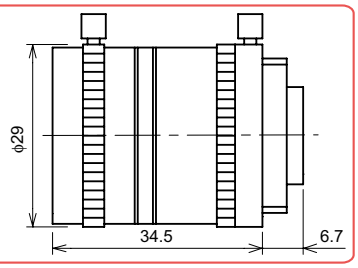
## Dimensional outlines CCD camera

**●CCD camera dimensions**
**(Model No. : KX0-M7913-00)**

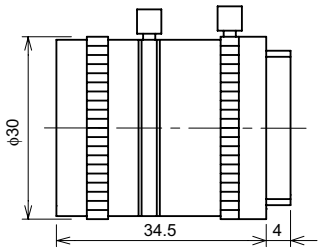


## Lenses

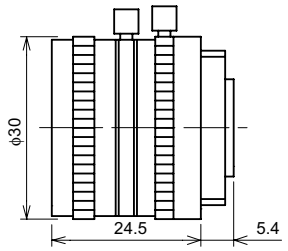
**8mm lens [ML-0813]**
**(Model No. : KM7-M7214-60)**



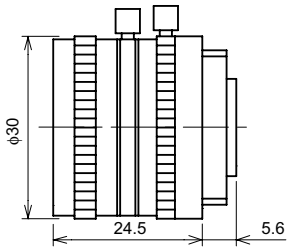

**12mm lens [ML-1214]**
**(Model No. : KM7-M7214-40)**




**16mm lens [ML-1614]**
**(Model No. : KM7-M7214-30)**




**25mm lens [ML-2514]**
**(Model No. : KM7-M7214-20)**




### Standard lens angle-of-view table

| | Focal length (mm) | Aperture value (F No.) | Angle-of-view (degrees) | | Closest approach distance (m) |
|---|---|---|---|---|---|
| | | | Vertical | Horizontal | |
| 8mm lens [ML-0813] | 8 | F1.3-CLOSE | 45.0 | 57.8 | 0.2 |
| 12mm lens [ML-1214] | 12 | F1.4-CLOSE | 21.9 | 29.0 | 0.3 |
| 16mm lens [ML-1614] | 16 | F1.4-CLOSE | 23.0 | 30.4 | 0.4 |
| 25mm lens [ML-2514] | 25 | F1.4-CLOSE | 21.6 | 28.5 | 0.5 |

Note. Field-of-view table for our standard lenses. As the field-of-view widens, distortion on image edges may increase.

### Viewing angle, WD, and magnification when using close-up ring

| Close-up ring (mm) | 8mm lens [ML-0813] | | | | 12mm lens [ML-1214] | | | |
|---|---|---|---|---|---|---|---|---|
| | Viewing angle (mm×mm) | | WD (mm) | Magnification | Viewing angle (mm×mm) | | WD (mm) | Magnification |
| | Vertical | Horizontal | | | Vertical | Horizontal | | |
| None | 72 | 96 | 148 | 0.05 | 77 | 103 | 248 | 0.05 |
| 0.5 | 32 | 43 | 59 | 0.11 | 41 | 55 | 125 | 0.09 |
| | 57 | 77 | 115 | 0.06 | 89 | 119 | 289 | 0.04 |
| 1 | 21 | 27 | 34 | 0.18 | 28 | 38 | 80 | 0.13 |
| | 29 | 38 | 52 | 0.13 | 45 | 59 | 136 | 0.08 |
| 1.5 | 26 | 34 | 22 | 0.24 | 21 | 29 | 57 | 0.17 |
| | 19 | 26 | 31 | 0.19 | 30 | 40 | 85 | 0.12 |
| 2 | – | – | – | – | 17 | 23 | 42 | 0.21 |
| | – | – | – | – | 22 | 30 | 59 | 0.16 |
| 5 | – | – | – | – | – | – | – | – |
| | – | – | – | – | – | – | – | – |

| Close-up ring (mm) | 16mm lens [ML-1614] | | | | 25mm lens [ML-2514] | | | |
|---|---|---|---|---|---|---|---|---|
| | Viewing angle (mm×mm) | | WD (mm) | Magnification | Viewing angle (mm×mm) | | WD (mm) | Magnification |
| | Vertical | Horizontal | | | Vertical | Horizontal | | |
| None | 82 | 109 | 358 | 0.04 | 65 | 87 | 458 | 0.06 |
| 0.5 | 48 | 64 | 206 | 0.07 | 48 | 64 | 338 | 0.08 |
| | 117 | 156 | 515 | 0.03 | 181 | 242 | 1270 | 0.02 |
| 1 | 34 | 45 | 143 | 0.11 | 38 | 50 | 269 | 0.10 |
| | 58 | 78 | 252 | 0.06 | 91 | 121 | 637 | 0.12 |
| 1.5 | 26 | 35 | 108 | 0.14 | 31 | 42 | 223 | 0.12 |
| | 39 | 52 | 164 | 0.09 | 60 | 81 | 425 | 0.06 |
| 2 | 22 | 29 | 86 | 0.17 | 27 | 36 | 191 | 0.13 |
| | 29 | 39 | 120 | 0.12 | 45 | 60 | 320 | 0.08 |
| 5 | 10 | 14 | 35 | 0.35 | 14 | 19 | 103 | 0.25 |
| | 12 | 16 | 42 | 0.31 | 18 | 24 | 130 | 0.20 |

Notes
- This table shows viewing angles when using the standard lens and close-up ring. (If no close-up ring this is closest approach.)
- If not using a close-up ring, then a WD smaller than the value in this table cannot be used.
- If using a close-up ring, then only a WD close to this value can be used.
- The values in this table are at most only a reference and do not signify an absolute index.
- To find viewing angle and WD other than for our standard lens, visit our website at: http://www.moritex.co.jp/products/.

# Accessories and part options

## iVY System

## Standard accessories

| Model | | |
|---|---|---|
| | Without power supply harness | KX0-M4402-10 |
| | With power supply harness | KX0-M4402-00 |

Note. If newly adding an iVY, choose the model with harness.

### iVY board

### iVY board accessories

| Name | Single unit model | Set Model |
|---|---|---|
| Camera trigger input cable connector | KX0-M657L-00 | KX0-M657K-00 |
| Custom tool | KX0-M657M-00 | |

### Support software for PC iVY Studio

iVY Studio is support software for the iVY 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.

### Environment

| | |
|---|---|
| Software model | KX0-M4988-00 |
| OS | Microsoft Windows 2000 / XP / Vista<br>Note. The 64 bit version is not subject to the operation warranty. |
| CPU | Exceeding the environment recommended by the OS being used |
| Memory | 64MB or more (Recommend) |
| Hard disk | Vacant capacity of more than 40MB in the installation destination drive<br>Note. Besides the above, also requires memory space for storing images and data. |
| Display | 800 × 600 dots or more, 32768 colors (16bit High Color) or more (recommended) |
| Network | TCP/IP Ethernet port × 1 |

## Options

### Lighting control board

| Model | KX0-M4400-G0 |
|---|---|

**Required options for the lighting control board**

| Name | Single unit model | Set Model |
|---|---|---|
| Lighting power cable connector | KX0-M657L-10 | KX0-M657K-10 |
| Wiring lever | KX0-M657M-10 | |
| Lighting input trigger cable connector | KX0-M657L-00 | KX0-M657K-00 |
| Custom tool | KX0-M657M-00 | |

### Tracking board

| Model | KX0-M4400-E0 |
|---|---|

**Required options for the tracking board**

| Name | Single unit model | Set Model |
|---|---|---|
| Lighting power cable connector | KX0-M657L-10 | KX0-M657K-10 |
| Wiring lever | KX0-M657M-10 | |
| Lighting input trigger cable connector | KX0-M657L-00 | KX0-M657K-00 |
| Custom tool | KX0-M657M-00 | |
| AB phase input cable connector | KX0-M657L-20 | KX0-M657K-20 |
| AB phase input cable connector case | KX0-M657M-20 | |

### Camera cable

Cable for connecting the camera to the iVY board.

| Model | 3.5m | KX0-M66F3-00 |
|---|---|---|
| | 6m | KX0-M66F3-10 |
| | 9.5m (relay 3.5m+6m) | KX0-M66F0-20 |
| | Relay cable 3.5m | KX0-M66F4-00 |
| | 7m (relay 1m+6m) | KX0-M66F0-30 |
| | Relay cable 1m | KX0-M66F4-10 |

Note. When installing a camera cable in a moving section, use a relay cable so that it can be easily replaced if needed.

### CCD camera

| Model | KX0-M7913-00 |
|---|---|

### Lens

| Model | 8mm | KM7-M7214-60 (ML-0813) |
|---|---|---|
| | 12mm | KM7-M7214-40 (ML-1214) |
| | 16mm | KM7-M7214-30 (ML-1614) |
| | 25mm | KM7-M7214-20 (ML-2514) |

### Close-up ring

| Model | 0.5mm | KX0-M7215-00 |
|---|---|---|
| | 1.0mm | KX0-M7215-10 |
| | 2.0mm | KX0-M7215-20 |
| | 5.0mm | KX0-M7215-30 |

### LAN cable with shield cloth (5m)

| Model | KX0-M55G0-00 |
|---|---|

### Tracking encoder cable (10m)

| Model | KX0-M66AF-00 |
|---|---|