EPSON
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EPSON RC+ 7.0 Option

Vision Guide 7.0 Ver.7.5

Hardware & Setup

Rev.4 ENM226S5290F

Original instructions

EPSON RC+ 7.0 Option　Vision Guide 7.0 (Ver.7.5) Hardware & Setup　Rev.4

EPSON RC+ 7.0 Option

Vision Guide 7.0 (Ver.7.5) Hardware & Setup

Rev.4

FOREWORD

Thank you for purchasing our robot products. This manual contains the information necessary for the correct use of EPSON RC+ software.
Please carefully read this manual and other related manuals when using this software.
Keep this manual in a handy location for easy access at all times.

The robot system and its optional parts are shipped to our customers only after being subjected to the strictest quality controls, tests, and inspections to certify its compliance with
our high performance standards. Please note that the basic performance of the product will not be exhibited if our robot system is used outside of the usage conditions and product specifications described in the manuals.

This manual describes possible dangers and consequences that we can foresee. Be sure to comply with safety precautions on this manual to use our robot system safety and correctly.

SOFTWARE LICENSE

For Compact Vision users, please read this software license agreement carefully before using this option.

Appendix A: End User License Agreement for Compact Vision
Appendix B: Open Source Software License for Compact Vision

TRADEMARKS

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Other brand and product names are trademarks or registered trademarks of the respective holders.

TRADEMARK NOTIFICATION IN THIS MANUAL

Microsoft® Windows® 8 Operating system
Microsoft® Windows® 10 Operating system
Throughout this manual, Windows 8, and Windows 10 refer to above respective operating systems. In some cases, Windows refers generically to Windows 8, and Windows 10.

NOTICE

The contents of this manual are subject to change without notice.
Please notify us if you should find any errors in this manual or if you have any comments regarding its contents.

MANUFACTURER

SEIKO EPSON CORPORATION

CONTACT INFORMATION

Contact information is described in “SUPPLIERS” in the first pages of the following manual:

Robot System Safety Manual Read this manual first

SAFETY PRECAUTIONS

Installation of robots and robotic equipment should only be performed by qualified personnel in accordance with national and local codes. Please carefully read this manual and other related manuals when using this software.
Keep this manual in a handy location for easy access at all times.

 WARNING	This symbol indicates that a danger of possible serious injury or death exists if the associated instructions are not followed properly.
 CAUTION	This symbol indicates that a danger of possible harm to people or physical damage to equipment and facilities exists if the associated instructions are not followed properly.

TRAINING

Before using the Vision Guide 7.0, be sure to take our “Vision Guide introduction training”. We provide the training periodically or every time we received your request to help our customers understand our products. The training provides safe and easy operation of the product and helps you to improve productivity of your system. For details of the training, please contact the supplier of your region.

Installation

Hardware

Set Up

Installation

The following chapters contain information to be known before using Vision Guide.
Please be sure to read these chapters.

1. Manuals and On-line Help

1.1 Vision Guide Manual Construction

Vision Guide 7.0 manual consists of three volumes.
Contents of each volume are listed below.

Vision Guide 7.0 Hardware & Setup (this manual)

This section provides general information on this manual. Online help, safety features, and reference cases are also described for understanding of the basic features of the EPSON RC+ 7.0

Hardware

Electrical specification:
This section describes the electrical specification for Compact Vision CV1/CV2 and PC vision PV1.

Cautions for wiring camera cables:
This section describes how to install the camera to the fixed position and mount to the robot.

Optical specification:
This section describes specifications for standard camera lenses and mega-pixel camera lenses.

Option product specification:
This section describes specifications for other optional products. (PoE Injector, PoE switch, robot mounting options, etc.)

Maintenance parts

Setup

How to Install:
This section describes the necessary system, product configuration of the Vision Guide 7.0 and how to install the hardware and software.

Camera configuration

Confirmation of setup

Vision Guide 7.0 Software (separate volume)

Vision Guide Window

This section shows the layout and gives a usage explanation for the Vision Guide window. It also includes information on the Vision Guide 7.0 toolbar, Image Display, Run Panel, the Object, Sequence, and Calibration tabs.

Vision Sequences

This section describes what vision sequences are, how to use and apply them, and also explains about debugging techniques for Vision Guide Sequences.

Vision Objects

This section describes the different types of vision tools available with Vision Guide 7.0 and how to use them.

Histogram and Statistics Tools

This section describes the usage of Histogram for various vision object types including Blob, Correlation, and Polar objects.
It also describes the Vision Guide statistics tools from the Vision Guide window with the Statistics dialog box and from the SPEL+ Language through accessing statistics properties.

Calibration

This section explains the usage for the various calibration types.

Using Vision Guide 7.0 with SPEL+

This section shows how to run vision sequences from the SPEL+ language and how to access vision properties and results. It also explains how to use Vision Guide 7.0 results for robot guidance.

Case Studies: Quick start: First Vision Guide 7.0 Application

This section describes for the users first using the Vision Guide 7.0 how to use it using the sample applications. It thoroughly explains the use of the Vision Guide 7.0, from the creation of a new vision object, calibration of the Vision Guide 7.0 mobile camera, and actual robot motion to the parts detected by Vision Guide 7.0.

Vision Guide 7.0 Properties & Results Reference (separate volume)

This volume contains a complete reference of all the properties and results available for vision sequences and vision objects. It contains detailed information relating to the proper usage, cautions, and warnings for each property and result.

1.2 Related Manuals

Refer to the following related manuals along with the Vision Guide 7.0 manuals for using the Vision Guide 7.0.

EPSON RC+7.0 User's Guide

This manual contains information on using the EPSON RC+ Robot Control System.

SPEL+ Language Reference Manual

This manual contains a complete description of all commands for the SPEL+ language.

Each Robot Manual

Each robot manual contains information on our robots.

1.3 Using On-Line Help

EPSON RC+ 7.0 supports the On-Line Help system. The help system makes it easy to find information than the conventional method using manuals.

There are several ways to refer to the on-line help in EPSON RC+ 7.0:

- Press the F1 function key at any time for context sensitive help. Help will be displayed for the current item you are working with. This is very useful when you need information for a certain item in a screen or dialog box. If you are editing a program, the help information for the SPEL+ keyword at the cursor position will be displayed. You can use the on-line help for referring syntax information to use the SPEL+ language.
- Click the <Help> button in the dialog box, if available.
- To view the table of contents and select topics, select Contents from the Help menu. Topics can be selected by clicking on the underlined text that is highlighted in green. (This causes a jump to the topic of interest.)
- Select Contents from the Help menu, then press <S> or click the <Search> button to search for information on a specific topic.

Once you are in the on-line help you will notice that some items are highlighted in green and underlined. These are hypertext links and when you click on this highlighted text, the system will jump to the area in the Help System that is related to the highlighted text. You will also notice that some text is highlighted in green with dotted underlines. Clicking this type of text will cause a small popup window to appear with a more detailed description of the highlighted text and possibly related information that you can jump to.

Most of the information found in this manual is also available in the Vision Guide 7.0 Help System although it may be arranged a little differently to provide the proper hypertext links and ease of use.

2. Safety

Please read this manual before using the Vision Guide.
Keep this manual handy for easy access at all times and reread it when you find anything unclear.

2.1 Conventions

Important safety considerations are indicated throughout the manual by the following symbols. Be sure to read the descriptions shown with each symbol.

 WARNING	This symbol indicates that a danger of possible serious injury or death exists if the associated instructions are not followed properly.
 WARNING	This symbol indicates that a danger of possible harm to people caused by electric shock exists if the associated instructions are not followed properly.
 CAUTION	This symbol indicates that a danger of possible harm to people or physical damage to equipment and facilities exists if the associated instructions are not followed properly.

2.2 Safety Precautions

 WARNING	■ Do not use this product for the purpose of ensuring safety. ■ The product must be used within the conditions described in this manual. Using the product in an environment that exceeds the specified environmental conditions may not only shorten the life cycle of the product but may also cause serious safety problems.

 CAUTION	■ Purchase cameras and camera cables from our suppliers. Note that cameras and camera cables of other manufacturers are not included in the warranty.

2.3 Robot Safety

Whenever you are working with robots or other automation equipment, safety must be the top priority. The EPSON RC+ 7.0 system has many safety features built in, such as E-Stop and a Safety Guard Input. These safety features should be used when designing the robot cell.

Refer to the *Safety* chapter in this manual for safety information and guidelines.

3. Included Items and Optional Products

3.1 Included Items and Optional Products for Compact Vision CV1

Included Items

Compact Vision CV1 body
Power source connector

Main optional products

NS1044BU (Standard monochrome camera)
NS4133BU (1.3 mega-pixel monochrome camera)
NS4133CU (1.3 mega-pixel color camera)
NS1500BU (5 mega-pixel monochrome camera) *1
NS1500CU (5 mega-pixel color camera) *1
Flexible USB camera cable (5 m)
Standard USB camera cable (5 m)
Flexible USB camera trigger cable (5 m)
Standard USB camera trigger cable (5 m)
Standard camera lens (8 mm, 12 mm, 16 mm, 25 mm, 50 mm)
Megapixel camera lens (8 mm, 12 mm, 16 mm, 25 mm, 50 mm)
1 inch lens (8mm, 12mm, 16mm, 25mm, 35mm, 50mm)
OCR 7.0 license
*1: EPSON RC+ 7.0 Ver. 7.0.2 or later and CV1 firmware Ver. 2.1.0.6 or later are required.

Note:
OCR 7.0 license is setup to the Robot Controller.
When you change the Robot Controller connected to the CV1, the OCR 7.0 license should be setup in the new Controller as well. If the OCR 7.0 license is not setup in the connected Controller, the OCR function is invalid.

3.2 Included Items and Optional Products for Compact Vision CV2

Included Items

Compact Vision CV2 body
Power source connector
Rubber foot (4 pcs)
Mounting bracket (1 set)
Connector covers (2 pcs)

Main optional products

acA640-100gm (Standard monochrome camera)
acA640-120gm (Standard 2 monochrome camera)
acA1300-60gm (1.3 mega-pixel monochrome camera)
acA1600-20gm (2 mega-pixel monochrome camera)
acA1600-20gc (2 mega-pixel color camera)
acA1600-60gm (2 mega-pixel 2 monochrome camera)
acA1600-60gc (2 mega-pixel 2 color camera)
acA2500-14gm (5 mega-pixel monochrome camera)
acA2500-14gc (5 mega-pixel color camera)
acA2500-20gm (5 mega-pixel 2 monochrome camera) *1*2
acA2500-20gc (5 mega-pixel 2 color camera) *1*2
acA3800-10gm (10 mega-pixel monochrome camera) *2
acA3800-10gc (10 mega-pixel color camera) *2
acA5472-5gm (20 mega-pixel monochrome camera) *2
acA5472-5gc (20 mega-pixel color camera) *2
NS1044BU (Standard monochrome camera)
NS4133BU (1.3 mega-pixel monochrome camera)
NS4133CU (1.3 mega-pixel color camera)
NS1500BU (5 mega-pixel monochrome camera)
NS1500CU (5 mega-pixel color camera)
Flexible GigE camera cable (5m, 10m)　CAT5e Ethernet cable (5m, 10m)
Flexible GigE camera trigger cable (5m, 10m)
Flexible USB camera cable (5m)　Standard USB camera cable (5m)
Flexible USB camera trigger cable (5m)　Standard USB camera trigger cable (5m)
Standard camera lens (8 mm, 12 mm, 16 mm, 25 mm, 50 mm)
Megapixel camera lens (8 mm, 12 mm, 16 mm, 25 mm, 50 mm)
Megapixel lens (HF) (8mm, 12mm, 16mm, 25mm, 35mm) *3
1 inch lens (8mm, 12mm, 16mm, 25mm, 35mm, 50mm)
OCR7.0 license

*1: acA2500-20gm (5 mega-pixel 2 monochrome camera), acA2500-20gc (5 mega-pixel 2 color camera), acA5472-5gm (20 mega-pixel monochrome camera), and acA5472-5gc (20 mega-pixel color camera) are cameras equipped with 1-inch sensor. Be sure to use a lens for 1-inch camera. 1 inch lens (optional) is available. If you use other lens, mechanical vignetting may occur.

*2: This is not available for CV2-L.

*3: Megapixel lens (HF) cannot be attached to USB camera.

Note:
OCR 7.0 license is setup to the Robot Controller.
When you change the Robot Controller to be connected, the OCR 7.0 license should be setup in the new Controller as well. If the OCR 7.0 license is not setup in the connected Controller, the OCR function is invalid.

3.3 Included Items and Optional Products for PC Vision PV1

Included Items

Vision Guide 7.0 license (already setup in the Controller)

Main optional products

acA640-100gm (Standard monochrome camera)
acA640-120gm (Standard 2 monochrome camera)
acA1300-60gm(1.3 mega-pixel monochrome camera)
acA1600-20gm (2 mega-pixel monochrome camera)
acA1600-20gc (2 mega-pixel color camera)
acA1600-60gm (2 mega-pixel 2 monochrome camera)
acA1600-60gc (2 mega-pixel 2 color camera)
acA2500-14gm (5 mega-pixel monochrome camera)
acA2500-14gc (5 mega-pixel color camera)
acA2500-20gm (5 mega-pixel 2 monochrome camera) *1
acA2500-20gc (5 mega-pixel 2 color camera) *1
acA3800-10gm (10 mega-pixel monochrome camera)
acA3800-10gc (10 mega-pixel color camera)
acA5472-5gm (20 mega-pixel monochrome camera)
acA5472-5gc (20 mega-pixel color camera)
Flexible GigE camera cable (5 m, 10 m) CAT5e Ethernet cable (5 m, 10 m)
Flexible GigE camera trigger cable (5 m, 10 m)
Standard camera lens (8 mm, 12 mm, 16 mm, 25 mm, 50 mm)
Megapixel camera lens (8 mm, 12 mm, 16 mm, 25 mm, 50 mm)
Megapixel lens (HF) (8mm, 12mm, 16mm, 25mm, 35mm)
1 inch lens (8mm, 12mm, 16mm, 25mm, 35mm, 50mm)
OCR 7.0 license

*1: acA2500-20gm (5 mega-pixel 2 monochrome camera), acA2500-20gc (5 mega-pixel 2 color camera), acA5472-5gm (20 mega-pixel monochrome camera), and acA5472-5gc (20 mega-pixel color camera) are cameras equipped with 1-inch sensor. Be sure to use a lens for 1-inch camera. 1 inch lens series (optional) is available. If you use other lens, mechanical vignetting may occur.

Note:
Vision Guide 7.0 license and OCR 7.0 license are setup in the Robot Controller.
When you change the Robot Controller to be connected, the Vision Guide 7.0 license and the OCR 7.0 license should be setup in the new Controller as well.
If the licenses are not setup in the connected Controller, they are invalid.

4. System Configuration

When connecting the CV1 or CV2 to the RC700-A Controller (Serial Number: R7**03**** or later), be careful for the following:

When connecting the RC700-A Controller and the PC with RC+7.0 software by USB, the following error may occur.

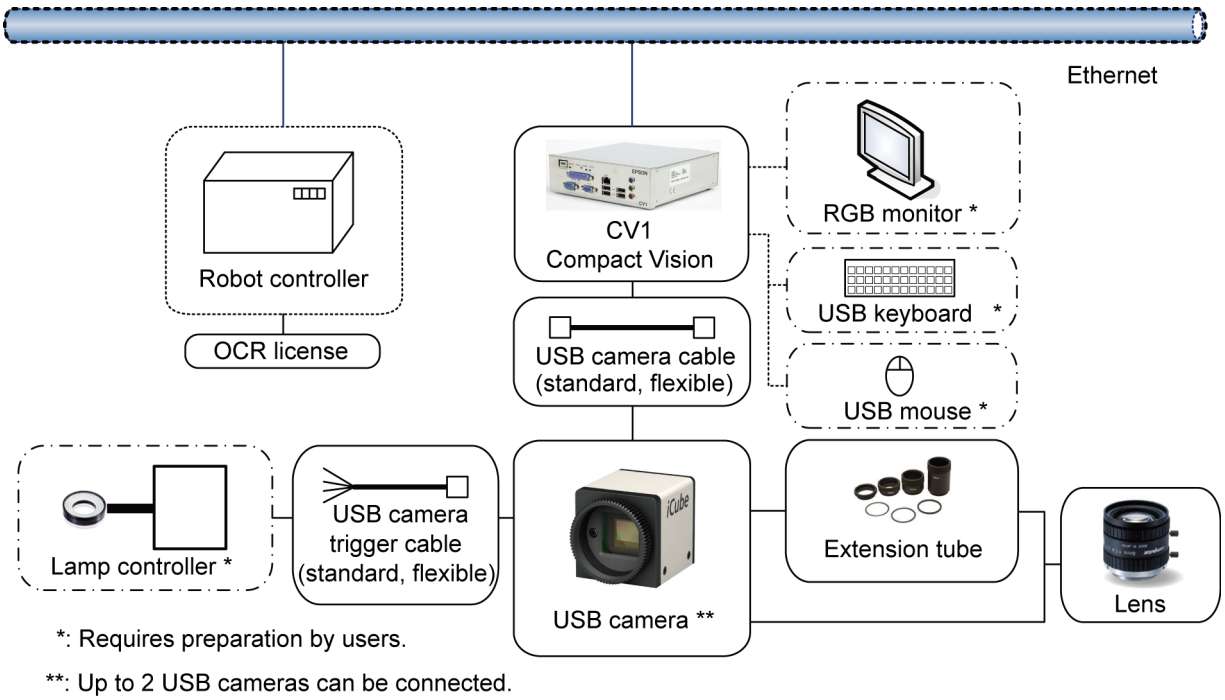
1. When using CV1 or CV2 with RC700DU-A:
   4216: Communication of the main and servo CPU failure. Reboot the Controller. Check for noise. Replace the DMB.
   4233: Servo real time status failure. Communication error with the servo CPU.
   9616: Communication of the main and servo CPU failure. Reboot the Controller. Check for noise. Replace the DMB.
   9633: Servo real time status failure. Servo CPU communication error.

2. When using CV1 or CV2 with Force Sensor I/F Unit:
   5541: Force sensor reception error. Check connection of the force sensor I/F unit (board) and force sensor.

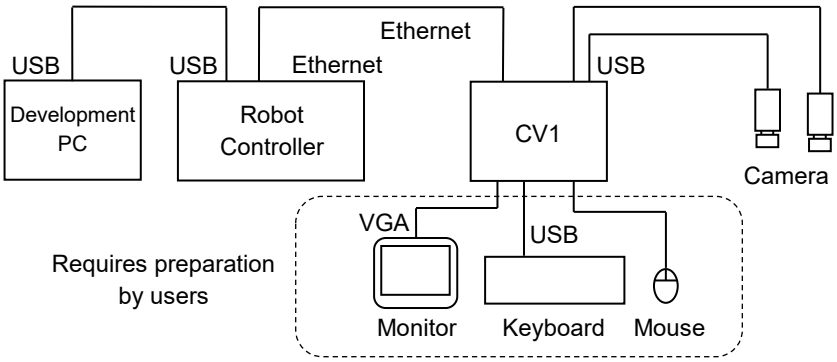
In order to avoid the error, connect the RC700-A Controller and the PC with RC+7.0 software via Ethernet.

4.1 System Configuration for Compact Vision CV1

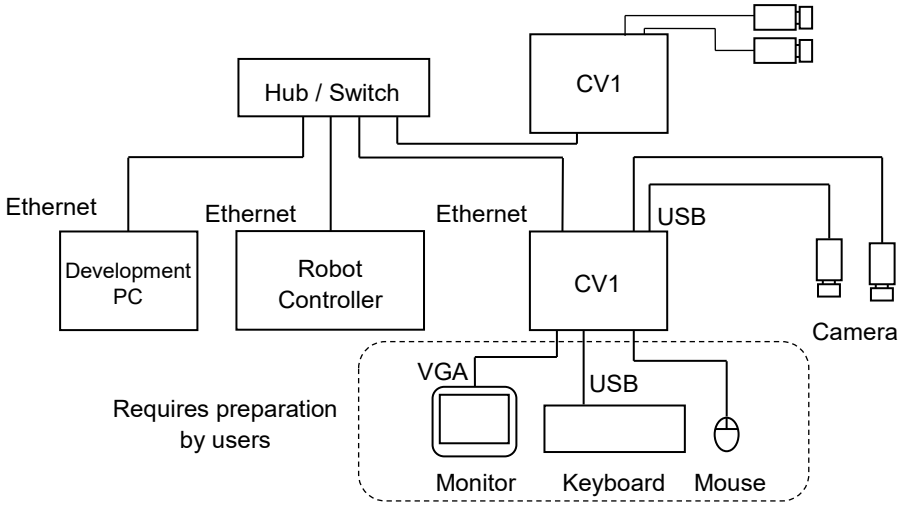
To use the CV1, connect it with the Robot Controller using an Ethernet cable.
Do not use the CV1 continuously while the keyboard and the mouse are connected.
The illustration below shows the system configuration using the CV1.



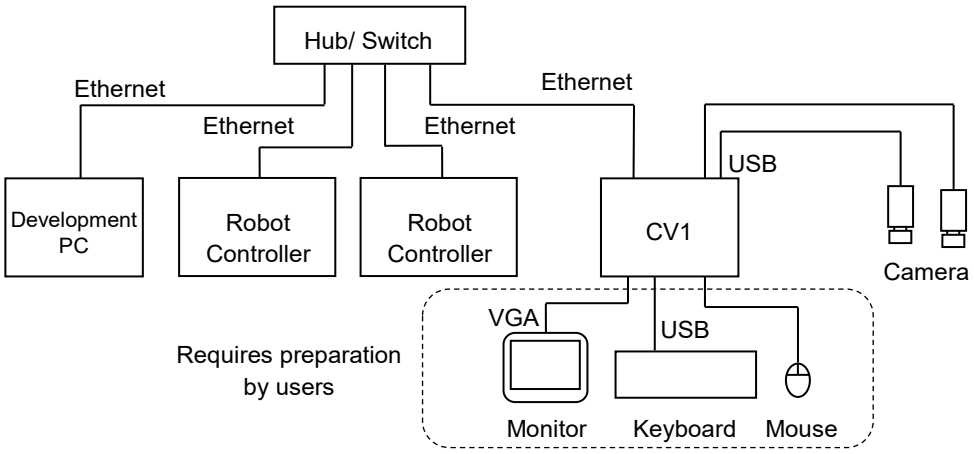
4.1.1 Basic connection configuration (one CV1)



4.1.2 Basic connection configuration (two CV1)



4.1.3 Two Robot Controllers and one CV1



NOTE: The project numbers for the CV1 should be set to the projects transmitted to each Robot Controller without duplication.
For details of setting, refer to the section for the project setting in the *EPSON RC+ User's Guide*.

4.2 System Configuration for Compact Vision CV2

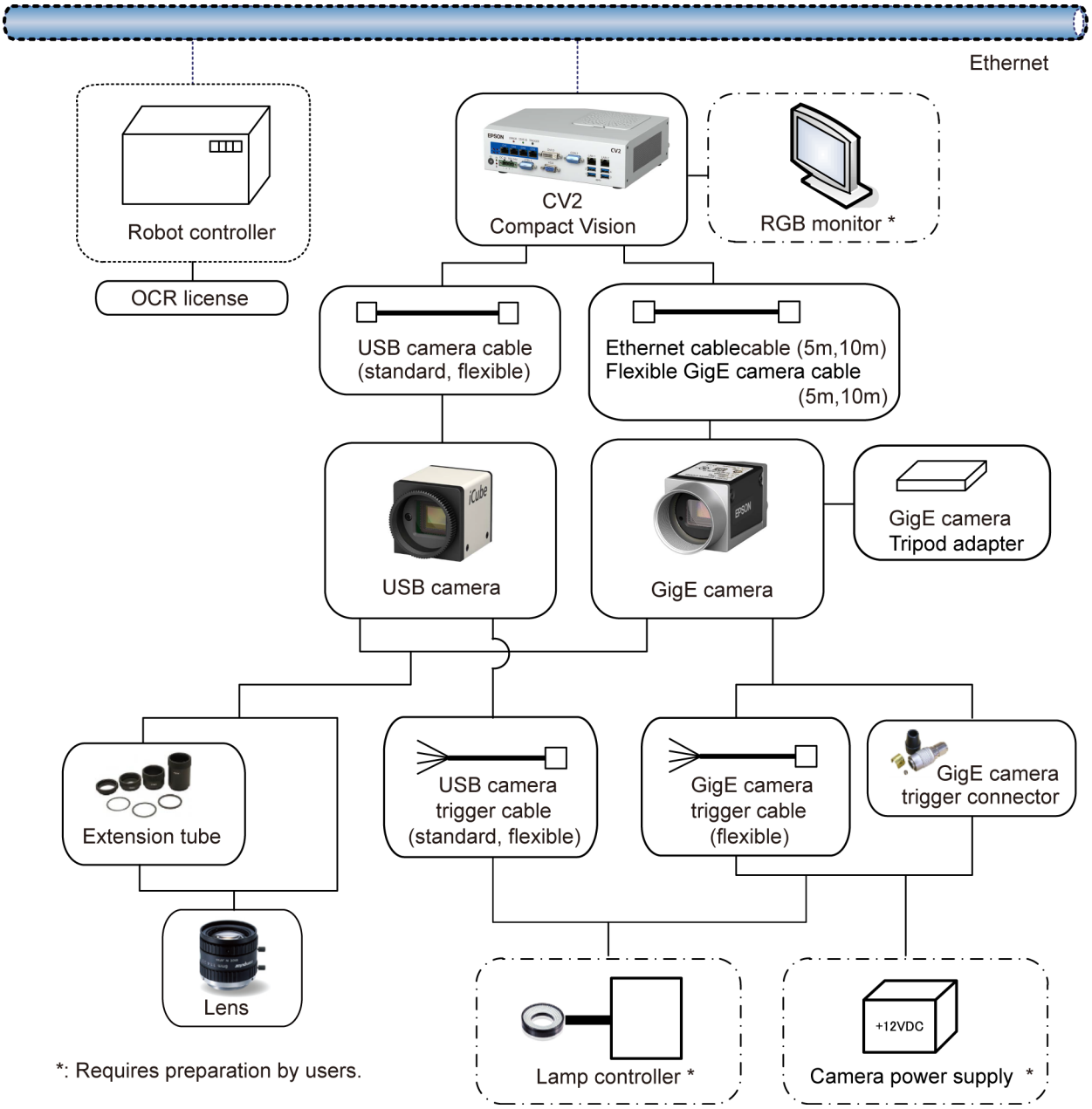
To use the CV2, connect it with the Robot Controller using an Ethernet cable.
Do not use the CV2 continuously while the keyboard and the mouse are connected.
The illustration below shows the system configuration using the CV2.

NOTE

As with our robot system, Compact Vision CV2 is provided on the assumption that customers use it in a closed local area network. Be sure to use an IP address in the following private IP address ranges unless a public (global) IP address is required.

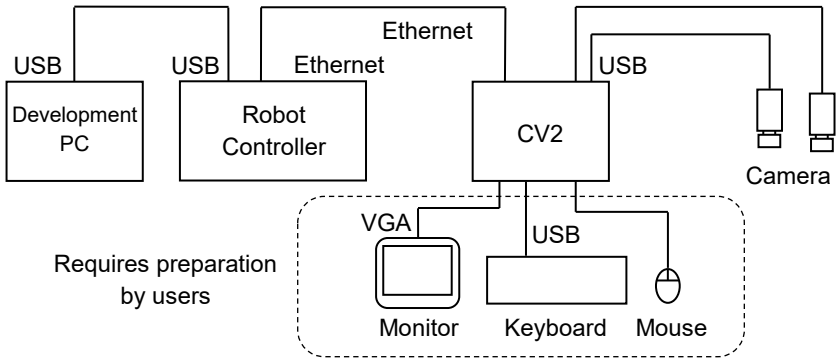
Private IP address ranges

10.0.0.1	～	10.255.255.254
172.16.0.1	～	172.31.255.254
192.168.0.1	～	192.168.255.254

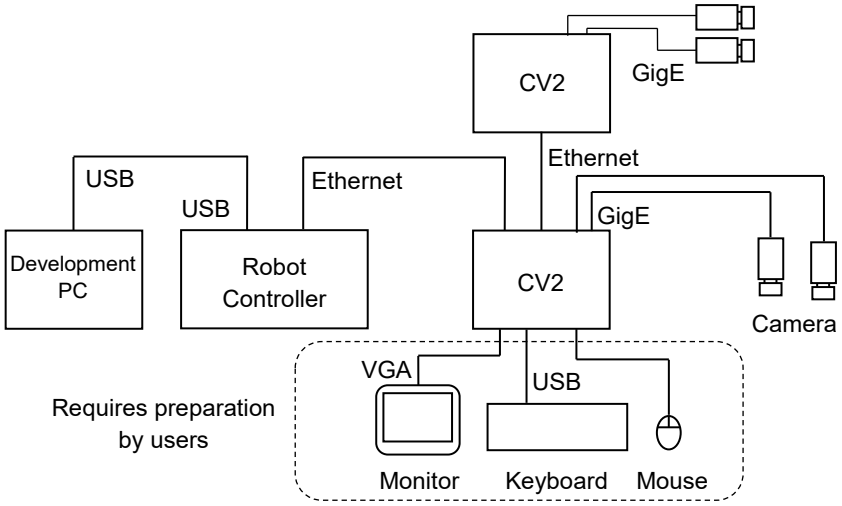


NOTE: To use the CV2, use the EPSON RC+ 7.0 Ver. 7.1.1 or later.

4.2.1 Basic connection configuration (one CV2)



4.2.2 Basic connection configuration (two CV2)



4.3 System Configuration for PC Vision PV1

To use the PV1, connect the computer (user's option) with the GigE camera using an Ethernet cable.
The GigE cameras can be fed by an IEEE802.3af compliant PoE injector or a PoE switching hub. Also, trigger connectors can feed power of 12VDC.

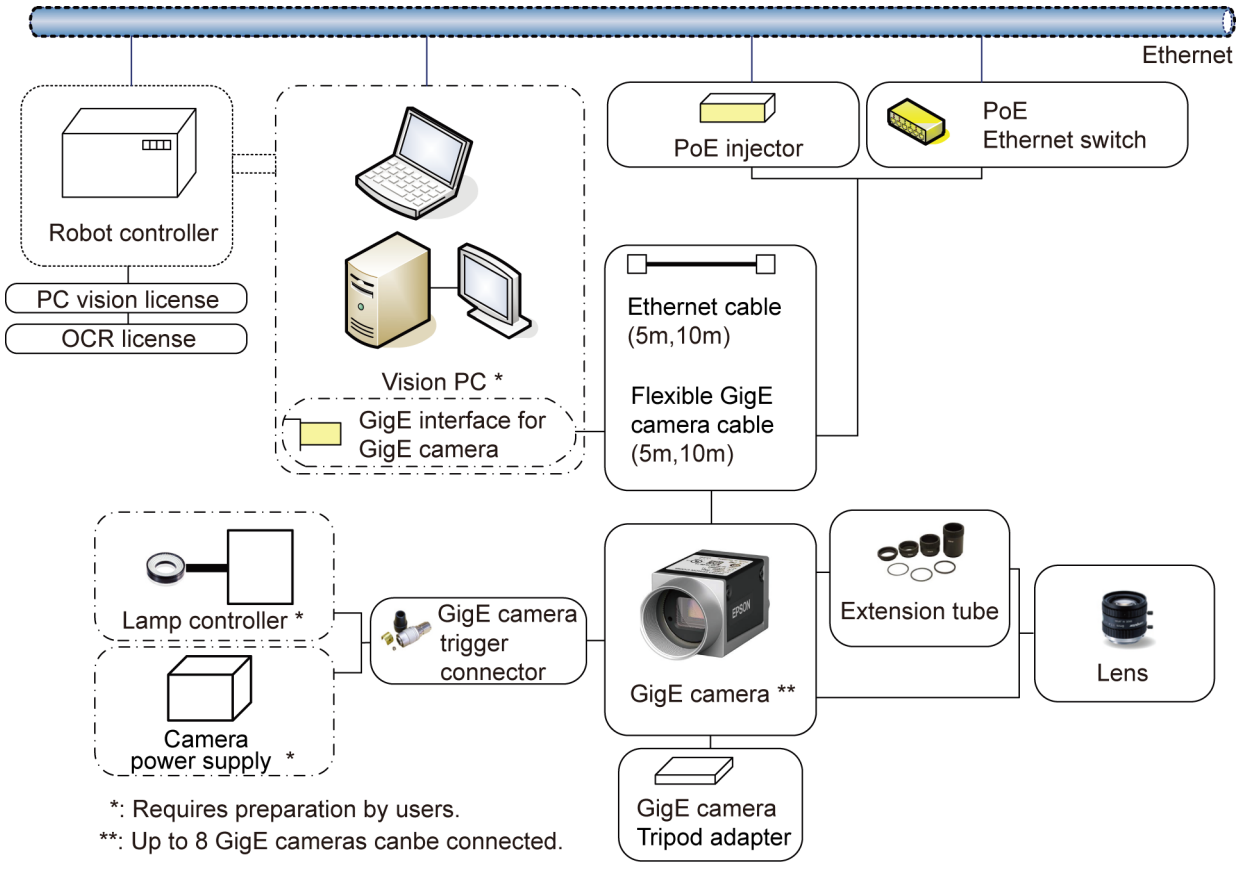
The following illustration shows the PV1 system configuration.

NOTE

As with our robot system, PC Vision PV1 is provided on the assumption that customers use it in a closed local area network. IP address you can set is following range of IP address.

Private IP address ranges

10.0.0.1	～	10.255.255.254
172.16.0.1	～	172.31.255.254
192.168.0.1	～	192.168.255.254



4.3.1 System Requirements

Supported OS

32 bit version	64 bit version
Windows 10 Pro	Windows 10 Pro
Windows 8.1 Pro	Windows 8.1 Pro

For applications which require high-speed image processing using the high-resolution cameras (2 megapixels or more), prepare a PC meets the following specifications.

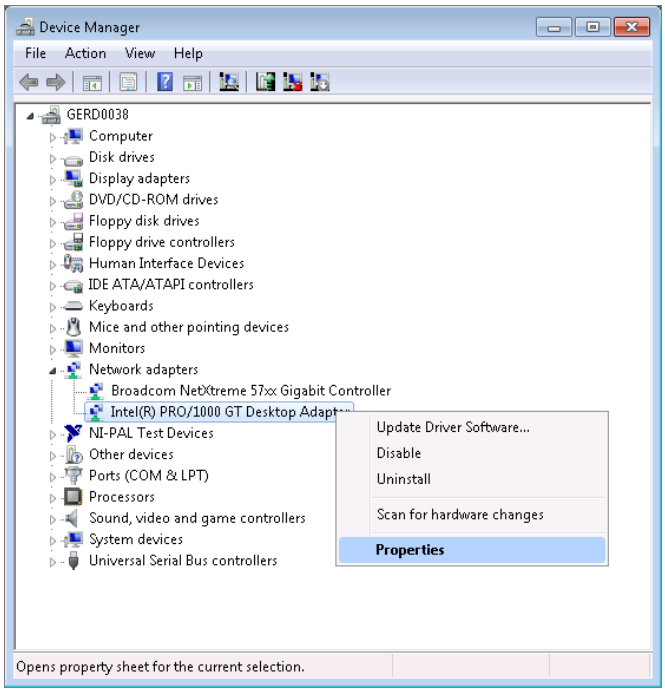
OS	Windows 10 Pro 64 bit version Windows 8.1 Pro 64 bit version
CPU	Core i5 or more
Memory	2 GB (32 bit version) or 4 GB (64 bit version)
Hard disk spare capacity	4 GB or more
Ethernet	Intel Pro 1000 series*1

*1: The following Ethernet adapters are supported.

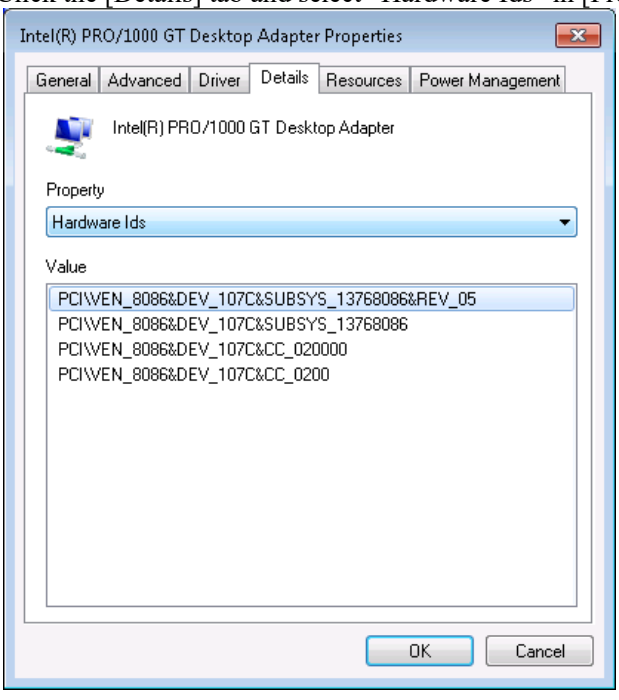
Intel Pro 1000 chipset	Hardware ID
82540EM	PCI\VEN_8086&DEV_100E
82540EP_EL	PCI\VEN_8086&DEV_101E
82541GI/PI	PCI\VEN_8086&DEV_1076
82541GI/LF	PCI\VEN_8086&DEV_107C
82545EM	PCI\VEN_8086&DEV_100F
82545GM	PCI\VEN_8086&DEV_1026
82563EB/80003ES2	PCI\VEN_8086&DEV_1096
82567	PCI\VEN_8086&DEV_1501
82571EB/GB	PCI\VEN_8086&DEV_105E
4-Port (2x82571EB/GB)	PCI\VEN_8086&DEV_10A4
4-Port LP (2x82571EB/GB)	PCI\VEN_8086&DEV_10BC
82572EI/GI	PCI\VEN_8086&DEV_10B9
82572EI/GI-Copper	PCI\VEN_8086&DEV_107D
82573E	PCI\VEN_8086&DEV_108B
82573E-IAMT	PCI\VEN_8086&DEV_108C
82573L	PCI\VEN_8086&DEV_109A
82580 (I340)	PCI\VEN_8086&DEV_150E
I350	PCI\VEN_8086&DEV_1521
I210	PCI\VEN_8086&DEV_1533

To check the Hardware IDs for your network adapter:

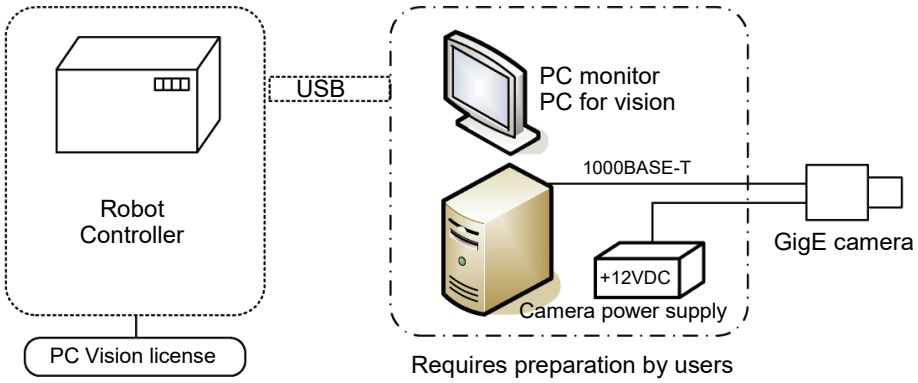
1. Click [Start]-[Run].
2. Enter “devmgmt.msc”.
3. Click the <OK> button to display the [Device Manager].
4. Expand the node for [Network Adapters].



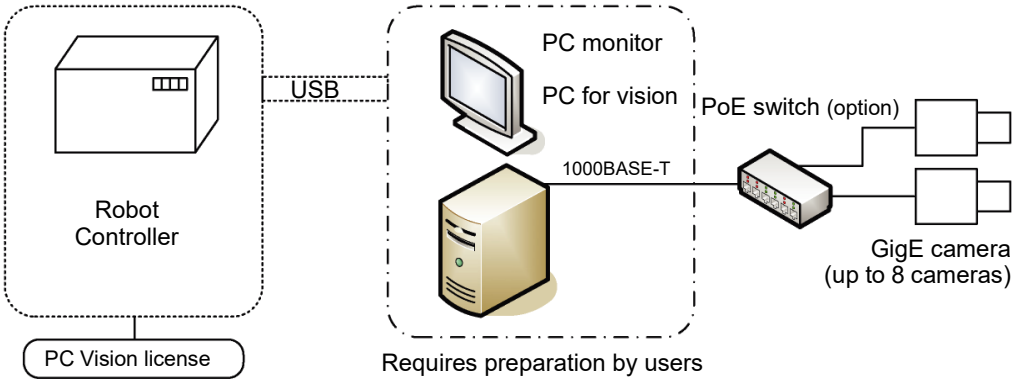
5. Right click the Network Adapter to be checked and select [Properties] from the displayed menu.
6. Click the [Details] tab and select “Hardware Ids” in [Property] list.



4.3.2 Basic connection configuration (1 GigE camera)



4.3.3 Basic connection configuration (using PoE switch, 2 GigE camera)



NOTE1: When using the PC vision, the EPSON RC+ should be run on the PC.

NOTE2: When connecting two or more cameras with the PoE switch, do not capture images simultaneously. If taking images simultaneously, an image defect may occur. When using two or more cameras, connect them with peer-to-peer connection (connect cameras to different NICs).

4.3.4 Available Camera

USB camera

Model name	Model number	CV2-L/S/H	CV2-SA/HA	PV1	
NS1044BU	R12NZ9006A	✓	✓	-	640×480, mono, global shutter, 1/3 in.
NS4133BU	R12NZ9006B	✓	✓	-	1280×1024, mono, global shutter, 1/1.8 in.
NS4133CU	R12NZ9006D	✓	✓	-	1280×1024、color, global shutter, 1/1.8 in.
NS1500BU	R12NZ9006E	✓	✓	-	2560×1920, mono, rolling shutter, 1/2.5 in.
NS4133CU	R12NZ900HB	✓	✓	-	2560×1920, color, rolling shutter, 1/2.5 in.

GigE camera

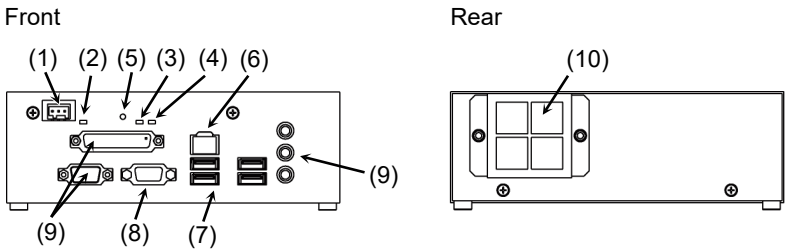
Model name	Model number	CV2-L/S/H	CV2-SA/HA	PV1	
acA640-120gm	-	✓	✓	✓	640×480, mono, global shutter, 1/4 in.
acA1300-60gm	R12NZ900ZV	✓	✓	✓	1280×1080, mono, global shutter, 1/1.8 in.
acA1600-20gm	R12NZ900AL	✓	✓	✓	1600×1200, mono, global shutter, 1/1.8 in.
acA1600-20gc	R12NZ900AN	✓	✓	✓	1600×1200, color, global shutter, 1/1.8 in.
acA1600-60gm	R12NZ900JF	✓	✓	✓	1600×1200, mono, global shutter, 1/1.8 in.
acA1600-60gc	R12NZ900JG	✓	✓	✓	1600×1200, color, global shutter, 1/1.8 in.
acA2500-14gm	R12NZ900AM	✓	✓	✓	2560×1920, mono, rolling shutter, 1/2.5 in.
acA2500-14gc	R12NZ900AP	✓	✓	✓	2560×1920, color, rolling shutter, 1/2.5 in.
acA2500-20gm	R12NZ900Z5	-	✓	✓	2560×1920, mono, rolling shutter, 1 in.
acA2500-20gc	R12NZ900Z6	-	✓	✓	2560×1920, color, rolling shutter, 1 in.
acA3800-10gm	R12NZ900TN	-	✓	✓	3664×2748, mono, rolling shutter, 1/2.3 in.
acA3800-10gc	R12NZ9010E	-	✓	✓	3664×2748, color, rolling shutter, 1/2.3 in.
acA4024-8gm	-	-	✓	✓	4024×3036, mono, rolling shutter, 1/1.7 in.
acA4024-8gc	-	-	✓	✓	4024×3036, color, rolling shutter, 1/1.7 in.
acA5472-5gm	R12NZ9010V	-	✓	✓	5472×3648, mono, rolling shutter, 1 in.
acA5472-5gc	R12NZ9010U	-	✓	✓	5472×3648, color, rolling shutter, 1 in.

Hardware

1. Compact Vision CV1

1.1 Installation Precautions

1.1.1 Part Names and Functions



No	Name	Functions
1	24V Input Connector	This connector is to supply 24V from 24V power source.
2	POWER LED(Green)	This LED indicates the status of 5V generated from 24V.
3	ERROR LED(Red)	This LED indicates the following conditions: From software is turned ON to boot: ON Status is normal after boot: OFF Status is abnormal: ON (OFF in some cases.)
4	STATUS LED(Green)	This LED indicates the following conditions: From software is turned ON to boot: ON Status is normal after boot: Blink (Blinking speed differs according to the CPU's processing state.) Status is abnormal: Not blink (OFF)
5	RESET Switch	Resets the CV1 to restart.
6	Ethernet Connector	A connector for the network hub and the Robot Controller.
7	USB Connector (4 ports)	A connector for the camera(s), the keyboard, and the mouse. Remove the keyboard and the mouse after installing as they may be influenced by the surrounding noise. Up to 2 cameras can be connected.
8	VGA Connector	A connector for the monitor.
9	Parallel Connector COM Connector Audio Terminal	These functions are not available. Do not connect anything to these parts.
10	Fan Filter	A filter for the intake air fan.

Installation environment (CV1/Camera)

In order to optimize the product's performance for safety, CV1 and the camera(s) must be placed in an environment that satisfies the following conditions.

- Install indoors only and place in a well-ventilated area.
- Keep away from direct sunlight and radiation heat.
- Keep away from dust, oily mist, oil, salinity, metal powder or other contaminants.
- Keep away from water.
- Keep away from shocks or vibrations.
- Keep away from sources of electronic noise.
- Prevent the occurrence of strong electric or magnetic field.

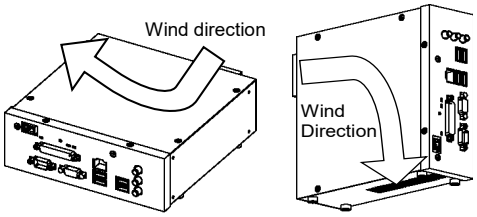
Mounting Direction (CV1)

The CV1 can be installed both horizontally and vertically.

NOTE

Allow at least 50 mm from the wall to prevent blocking the fan filter and the air holes.
Do not install the product near equipment with huge heat value.

Horizontal Mounting Vertical Mounting



- Replace the rubber foot to the left side of CV1. Install CV1 left side down.
- When CV1 is installed vertically, intake air is exhausted from the bottom. Install the product so as not to block ventilation.

1.1.2 CV1 LED Display

STATUS LED and ERROR LED

The STATUS and ERROR LEDs together indicate status and error condition of the CV1.

STATUS LED	ERROR LED	Status
OFF	OFF	No power
ON	ON	Operating system starting
Blinking	OFF	Ready to accept commands
OFF	ON	Critical error has occurred

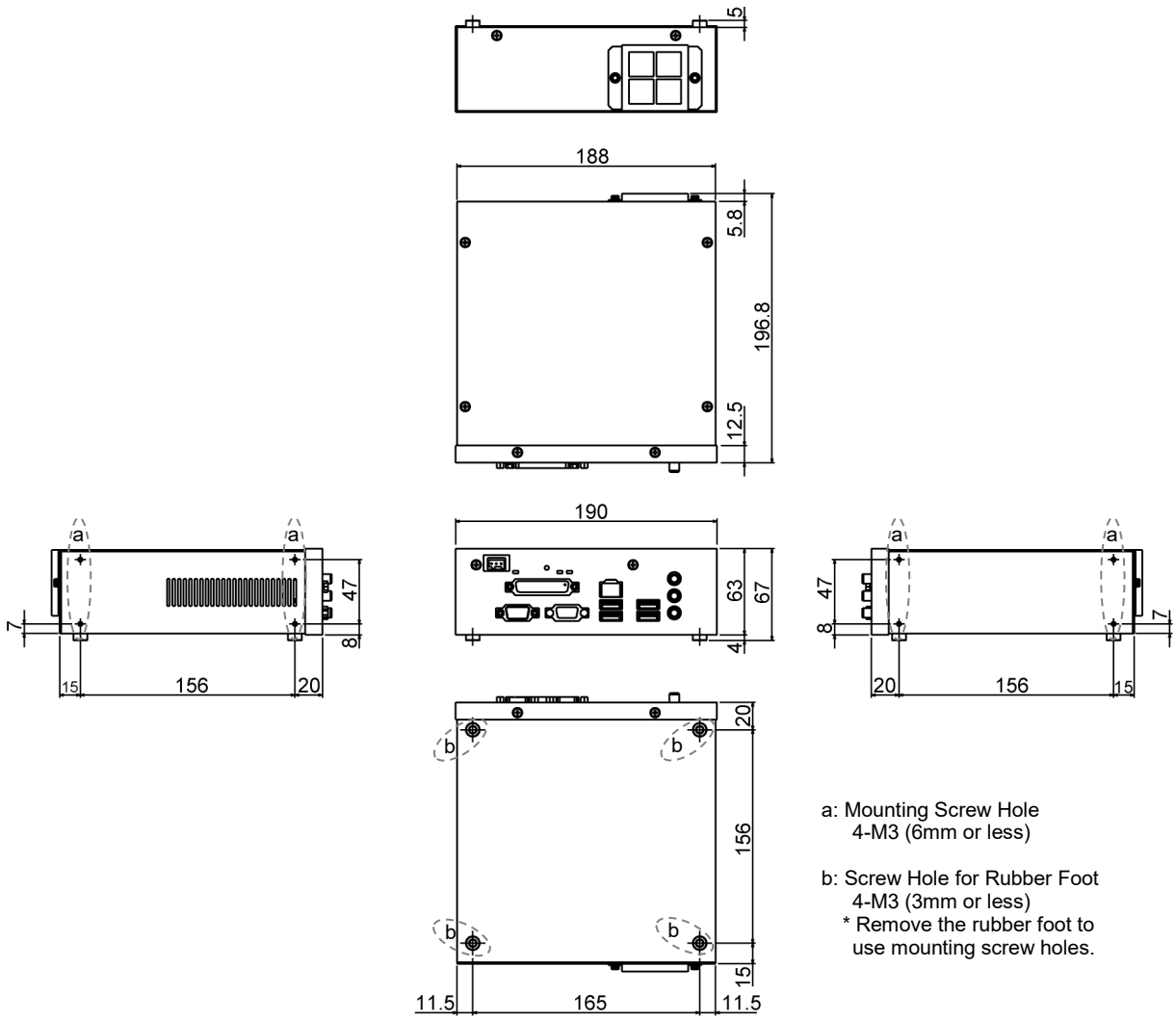
LINK LED

Indicates network connection status as shown in the table below.

LINK LED	Status
OFF	The camera is not connected to the network
ON	Connected to the network
Blinking	Data is being transferred

1.1.3 CV1 Specifications

Item	Specification
Number of Cameras	2 cameras (Only our cameras and cables can be used.)
Power Source Voltage	24VDC±5%
Rated Electric Current	2A or less
Rated Ambient Temperature	5 to 40 °C
Rated Relative Humidity	20 to 80% (with no condensation)
Mass	1.5 kg
Safety standard	CE Marking EMC Directive KC Marking



The CV1 supports five types of USB cameras.

Model	Resolution(color, monochrome)
Standard USB camera	640 × 480 (monochrome)
1.3 mega-pixel USB camera	1280 × 1024 (monochrome)
1.3 mega-pixel USB colorcamera	1280 × 1024 (color)
5 mega-pixel USB camera *1	2560 × 1920 (monochrome)
5 mega-pixel USB colorcamera *1	2560 × 1920 (color)

*1: EPSON RC+ 7.0 Ver. 7.0.2 or later and CV1 firmware Ver. 2.1.0.6 or later are required.

1.2 Wiring of CV1

For details on wiring cameras, refer to *Hadrware 4. Camera*.

1.2.1 Power Supply

Ensure that the power source that supplies 24V to CV1 satisfies the following specifications.

- Voltage: 24VDC ± 5%
- Current Consumption: able to supply 2A or more to CV1
- Satisfies the EMC standards in an industrial setting
- Have a reinforced insulation against the AC power source
- Have an overcurrent protection circuit build-in

It is recommended to use the specialized power source for CV1. When power source is shared with other equipment, ensure not to use the 24V power source connected to the equipments generating electronic noise. Or take adequate measures against electronic noise.

1.2.2 Grounding

For grounding CV1, wire to the FG terminal of the 24V input connector.

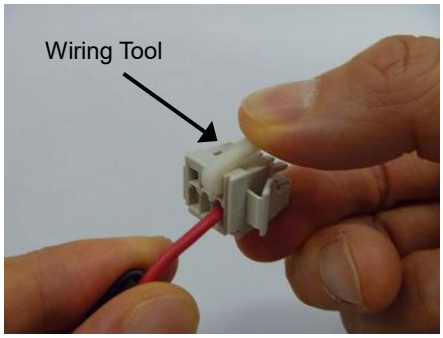
- Use as thick and short a wire as possible.
- Do not share the ground wire with other equipment.
- If the camera is grounded, ground CV1 so as to be equipotential with the camera.

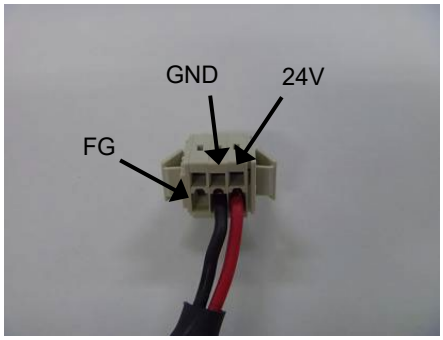
1.2.3 24VDC wiring

Refer to the following and wire the 24VDC power source to the connector.

Pin No.	Signal Name	Description
1	FG	Frame ground
2	GND	Ground (24V ground)
3	24V	24VDC power supply

Connector Model No. : 734-103/037-000 (WAGO)
Wiring Tool Model No. : 734-230 (WAGO)
Appropriate Wire Diameter : 0.25 mm^2 to 1.5 mm^2





CAUTION	■ Be sure to turn OFF the product when wiring the power source. Make sure that wiring and voltage are correct before turning ON the product. ■ Use as thick and short a wire as possible for wiring 24VDC power source. ■ Keep the 24VDC power source cable away from peripheral noise sources as possible. ■ Do not insert and remove the connector while applying current to the 24VDC connector. ON/OFF switch must be installed at AC side of the 24VDC power source. Inserting and removing the connector while applying current to the 24V connector or turning ON/OFF at 24VDC side may cause fusing inside CV1.

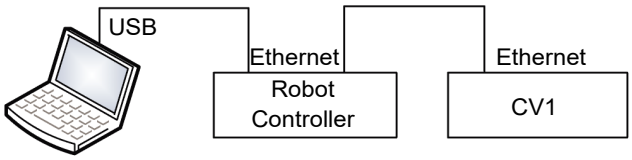
1.2.4 Ethernet Cable

Connect the Ethernet cable for the Ethernet HUB or the Robot Controller to the Ethernet connecter.

- Use Category 5e (with a shield) for the Ethernet cable.
- Install the cable so as not to apply load on the Ethernet connector.
- Put the Ethernet cable as far from the surrounding noise as possible.

Connection example 1:

CV1 and Robot Controller need to be connected in the same subnet. PC network setting does not need to be set as same as Robot Controller.

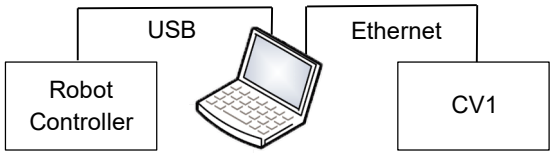


(1) Connect an ethernet cable between the Robot Controller (LAN) and the CV1. Both straight and crossing cables can be used.

(2) Connect a USB cable between Robot Controller and PC.

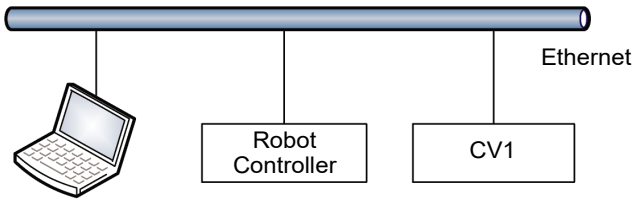
NOTE

The following connection cannot be used.



Connection example 2:

CV1, PC, and Robot Controller need to be connected in the same subnet using a switch or hub.



(1) Connect an Ethernet cable between the camera and the hub.

(2) Connect an Ethernet cable between the Controller and the hub.

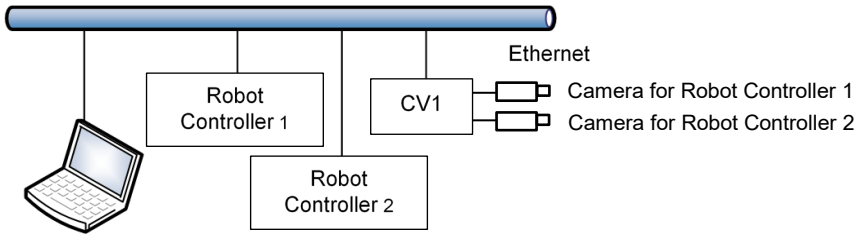
(3) Connect an Ethernet cable between the PC and the hub.

* When the image of the camera is not monitored while operating the robot system, you do not have to connect the EPSON RC+7.0 PC to use the Vision Guide 7.0.

CAUTION	■ You can use the general Ethernet hub or Ethernet switch for connection. However, be sure to use products complying with the industrial standards or noise resistant Ethernet cable (STP cable). If you use office use products or UTP cable, it may cause communication error and may not offer the proper performance.

Connection example 3:

CV1 can be used with multiple Robot Controllers.



(1) Connect an Ethernet cable between the camera, the Controller, and the PC.

Note: The project numbers for the CV1 should be set to the projects transmitted to each Robot Controller without duplication.
One camera cannot be shared by two robot controllers. In this example, you need to connect two cameras for each controller.
For details of setting, refer to the section for the project setting in the *EPSON RC+ User's Guide*.

1.3 Maintenance

1.3.1 Fan Filter

Inspect the fan filter periodically and clean it when needed. The temperature inside the CV1 may get too high and it may not operate properly if the filter is not kept clean.

(1) Turn OFF the power supply for CV1.
Turn OFF at the AC side of the 24VDC power source.

(2) Remove two screws on the rear side filter cover.

(3) Remove the filter from the cover and clean it using a (vacuum) cleaner.

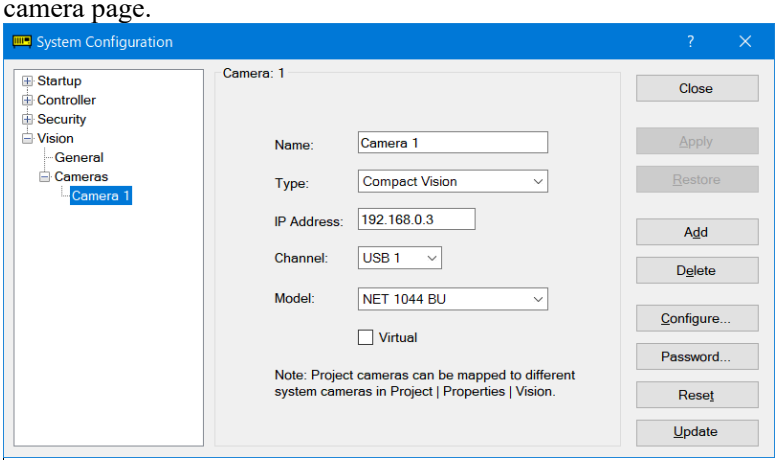
(4) Put the filter back on the filter cover and secure the cover to CV1 with screws.

1.3.2 Updating CV1 Firmware

Sometimes the firmware (non-volatile software) in the camera may need to be updated.

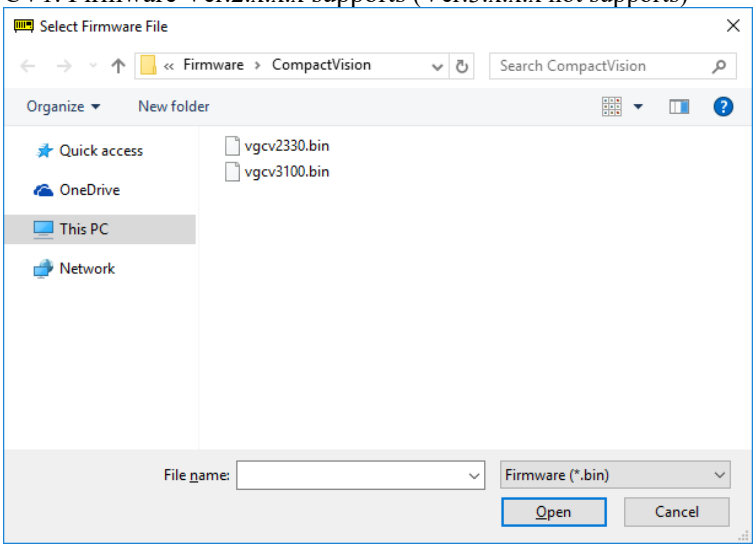
(1) Start EPSON RC+.

(2) Select [System Configuration] from the [Setup] menu and navigate to the desired camera page.



(3) Click the <Update Firmware...> button.

(4) Navigate to the firmware file. The default directory is:
\EpsonRC7.0\Vision\Firmware\CompactVision.
Firmware files have the BIN extension.
Note that you must select the correct firmware file for the camera you are upgrading.
For CV1 cameras, the filename is vgcvxxxx.bin, where xxxx is the version number.
CV1: Firmware Ver.2.x.x.x supports (Ver.3.x.x.x not supports)



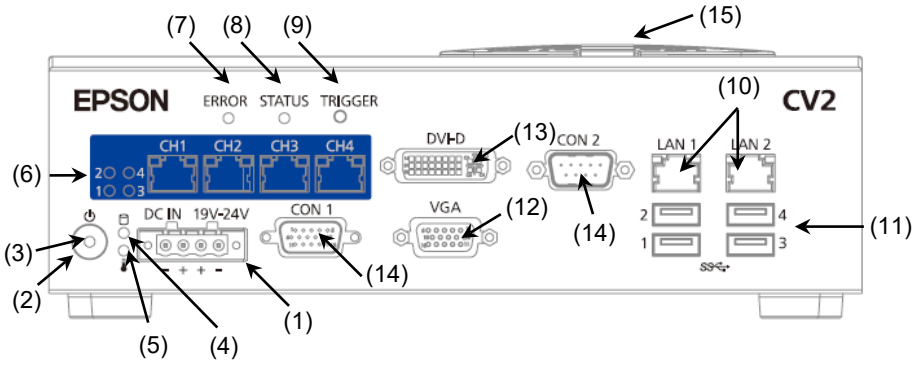
(5) Click the <Open> button.
The firmware update process will start. After the firmware is updated, the camera will be restarted. The firmware update is complete.

2. Compact Vision CV2

Note:
To use CV2, EPSON RC+ 7.0 Ver. 7.1.1 or later is required.

2.1 Installation Precautions

2.1.1 Part Names and Functions



No	Name	Functions
1	24V Input Connector	This connector is to supply 24V from 24V power source.
2	Power Switch	CV2 automatically starts up when 24V power source is applied. However, it does not turn ON automatically when the battery voltage is low. In this case, you can turn ON the CV2 by pressing this button.
3	Power LED	Refer to *Hardware 2.1.2 CV2 LED Display*
4	CFast Access LED	Refer to *Hardware 2.1.2 CV2 LED Display*
5	Temperature Warning LED	Refer to *Hardware 2.1.2 CV2 LED Display*
6	PoE LED (1 to 4)	Refer to *Hardware 2.1.2 CV2 LED Display*
	PoE Connector (4 ports)	Connectors for GigE cameras. Connect one GigE camera for each port. Up to four GigE cameras can be connected. Note: Do not connect the Ethernet hub or switch to the PoE port.
7	ERROR LED	Refer to *Hardware 2.1.2 CV2 LED Display*
8	STATUS LED	Refer to *Hardware 2.1.2 CV2 LED Display*
9	TRIGGER Switch	Refer to *Hardware 2.1.3 CV2 TRIGGER Switch*
10	LAN Connector (2 ports)	Connectors for network hub and Robot Controllers GigE cameras cannot be connected.
11	USB Connector (4 ports)	Connectors for cameras, keyboard, and mouse. Remove the keyboard and mouse after installing as they may be influenced by the surrounding noise. Up to 2 cameras can be connected.
12	VGA Connector	A connector for the analog monitor. Same screen image is displayed for this connector and DVI-D connector (mirroring)

No	Name	Functions
13	DVI-D Connector	A connector for the monitor which is compatible with DVI-D The monitors which only supports DVI-I cannot be connected to this connector. Same screen image is displayed for this connector and VGA connector (mirroring)
14	CON1 CON2	These functions are not available. Install the attached connector cover.
15	Fan Filter	A filter for the intake air fan.

Installation environment (CV2/Camera)

In order to optimize the product's performance for safety, CV2 and the camera(s) must be placed in an environment that satisfies the following conditions.

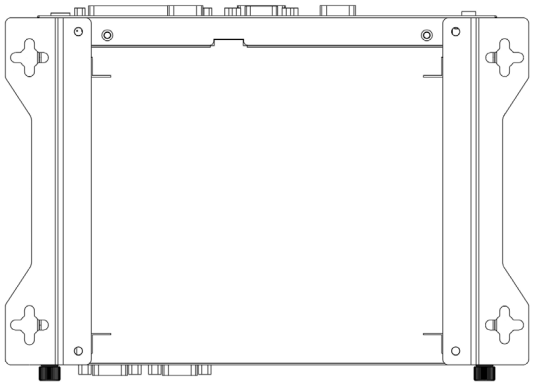
- Install indoors only and place in a well-ventilated area.
- Keep away from direct sunlight and radiation heat.
- Keep away from dust, oily mist, oil, salinity, metal powder or other contaminants.
- Keep away from water.
- Keep away from shocks or vibrations.
- Keep away from sources of electronic noise.
- Prevent the occurrence of strong electric or magnetic field.

Mounting Direction (CV2)

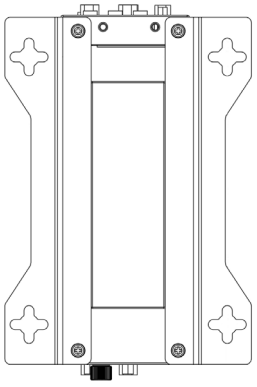
The CV2 can be installed both horizontally and vertically (using the fixing brackets).

For fixing the CV2, use the attached fixing brackets and screws. Internal board may get damages if fixing the CV2 with the screws other than the attached ones.

Brackets installed on the bottom



Brackets installed on the side



NOTE

- Allow at least 50 mm from the wall to prevent blocking the fan filter and the air holes.
- When installing the CV2 vertically, install it so as not to block ventilation of the air holes on the side where the fixing brackets are mounted.
- Do not install the product near instruments with huge heating value.

2.1.2 CV2 LED Display

Each LED of CV2 indicates conditions as follows.

Power LED

Power On	Green
Power off (current applied)	Orange
Power off (current not applied)	OFF

CFast access LED

Access	Orange
No Access	OFF

Temperature warning LED

Warning (CPU temp.: exceeding 105 °C)	Red
No warning (CPU temp.: less than 105 °C)	OFF

PoE LED

Power supplied	Red
Power not supplied	OFF

ERROR/STATUS LED

	ERROR LED (Red)	STATUS LED (Green)
Power ON	ON	ON
OS/ firmware running	ON	ON
After normal startup of OS	OFF	OFF
After normal startup of firmware	OFF	Blink
Error	ON	OFF
Warning	Blink	OFF
Power OFF	OFF	OFF

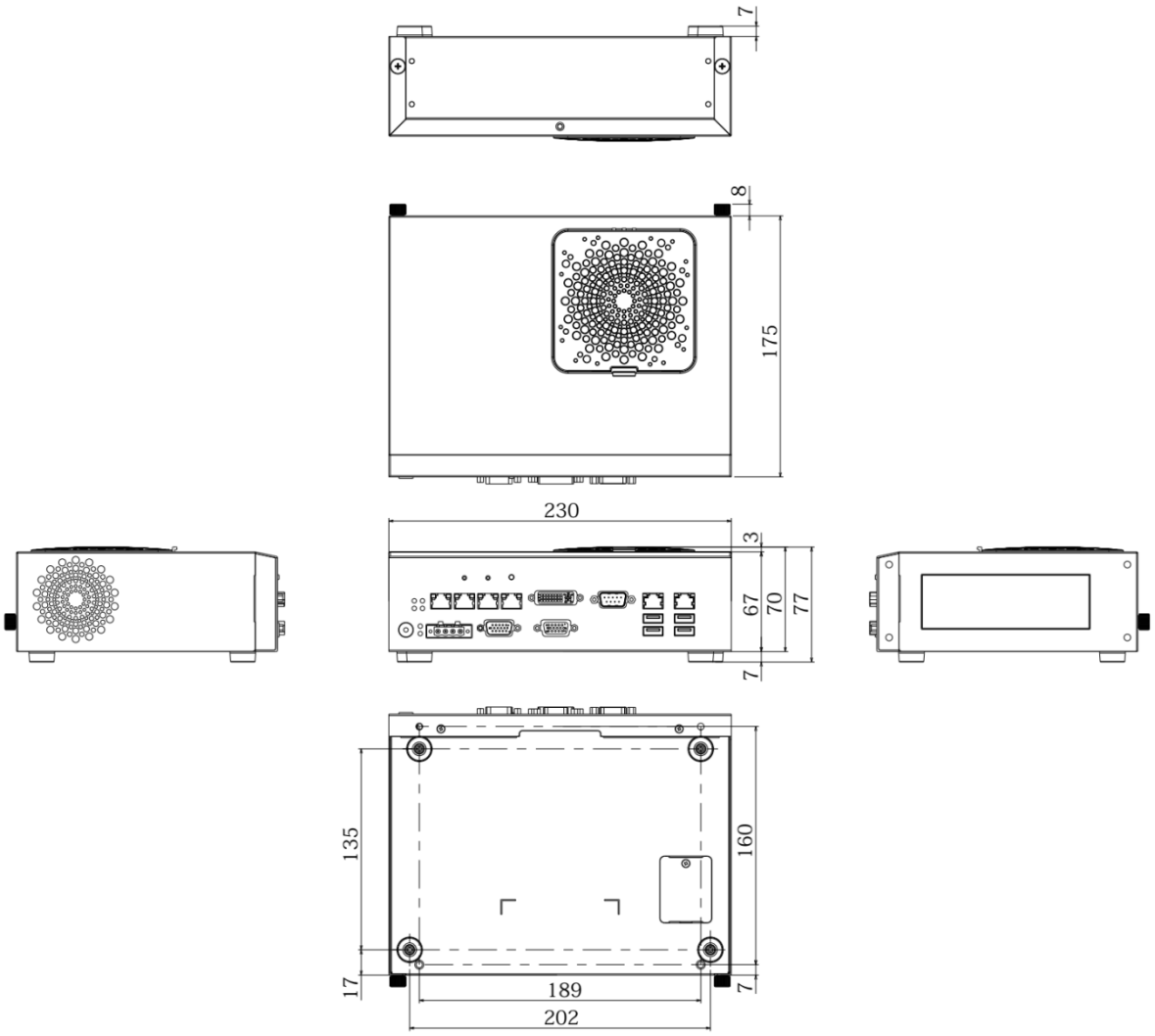
2.1.3 CV2 TRIGGER Switch

CV2 can be reset to factory default by pressing the TRIGGER switch.
(IP address initialization, project deletion, local monitor setting initialization)

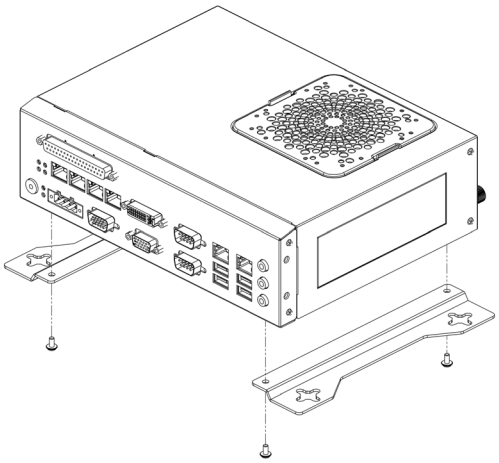
By pressing the switch after normal startup, status data of CV2 can be saved to the USB flash memory. Saved data is available when end user sends data to us or SIer to solve a problem. (A compressed file that name is “Compact Vision model name serial number date/time” after “S_” is output. It is date and time notation in UTC that does not depend on time zone.)

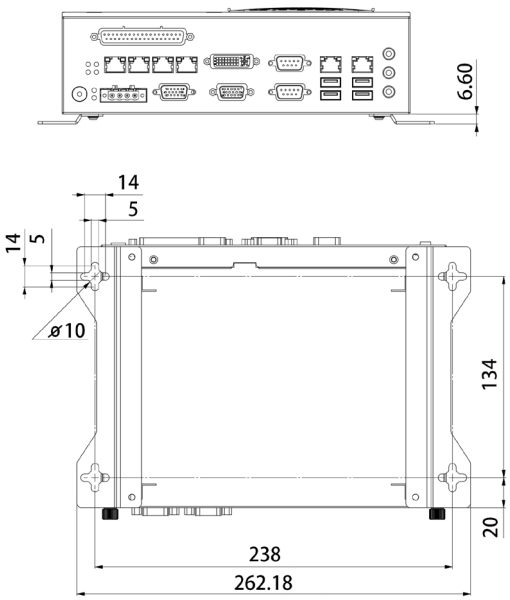
2.1.4 CV2 Specifications

Item	Specification
Number of Cameras	4 GigE cameras (Only our cameras and cables can be used.) 2 USB cameras (Only our cameras and cables can be used.)
Power Source Voltage	19 to 24 VDC
Rated Electric Current	11.57 A (at 19V DC) to 9.16 A(at 24 VDC) or lower
Rated Ambient Temperature	5 to 40 °C
Rated Relative Humidity	20 to 80% (with no condensation)
Mass	2.1 kg
Safety standard	CE Marking EMC Directive KC Marking

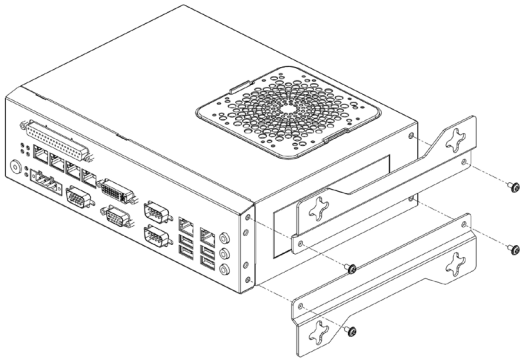


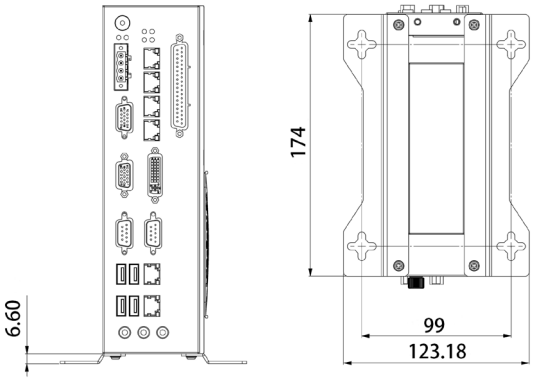
Brackets installed on the bottom





Brackets installed on the side





The CV2 supports eight types of GigE cameras and five types of USB cameras.

For detailed specifications of each camera, refer to *Hardware 4. Camera*.

Model	Resolution(color, monochrome)
Standard GigE camera	640 × 480 (monochrome)
Standard 2 GigE camera	640 × 480 (monochrome)
1.3 mega-pixel GigE camera	1280× 1024 (monochrome)
2 mega-pixel 2 GigE camera	1600 × 1200 (monochrome)
2 mega-pixel 2 GigE color camera	1600 × 1200 (color)
2 mega-pixel GigE camera	1600 × 1200 (monochrome)
2 mega-pixel GigE color camera	1600 × 1200 (color)
5 mega-pixel GigE camera	2560 × 1920 (monochrome)
5 mega-pixel GigE color camera	2560 × 1920 (color)
5 mega-pixel 2 GigE camera*	2560 × 1920 (monochrome)
5 mega-pixel 2 GigE color camera*	2560 × 1920 (color)
10 mega-pixel GigE camera*	3664 × 2748 (monochrome)
10 mega-pixel GigE color camera *	3664 × 2748 (color)
20 mega-pixel GigE camera*	5472 × 3648 (monochrome)
20 mega-pixel GigE color camera *	5472 × 3648 (color)

*: This is not available for CV2-L.

Model	Resolution(color, monochrome)
Standard USB camera	640 × 480 (monochrome)
1.3 mega-pixel USB camera	1280 × 1024 (monochrome)
1.3 mega-pixel USB colorcamera	1280 × 1024 (color)
5 mega-pixel USB camera	2560 × 1920 (monochrome)
5 mega-pixel USB colorcamera	2560 × 1920 (color)

When using USB storage for CV2, following format required.

CV2-L/S/H	FAT32
CV2-SA/HA	FAT32(~32GB), exFAT, NTFS

2.2 Wiring of CV2

For details for wiring cameras, refer to *Hardware 4. Camera*.

2.2.1 Power Supply

Ensure that the power source for CV2 satisfies the following specifications.

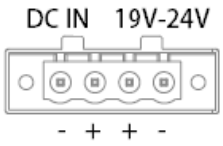
- Voltage: 19 VDC (11.57 A or less) to 24VDC (9.16 A or less)
- Satisfies the EMC standards in an industrial setting
- Have a reinforced insulation against the AC power source
- Have an overcurrent protection circuit build-in

It is recommended to use the specialized power source for CV2. When power source is shared with other equipment, ensure not to use the power source connected to the equipments generating electronic noise or take adequate measures against electronic noise.

2.2.2 24VDC wiring

Refer to the following and wire the 24VDC power source to the connector.

Indication on CV2	Description of signal
-	24V power source ground
+	24V power source input
+	24V power source input
-	24V power source ground



Appropriate Wire Diameter :AWG14 to AWG24

CAUTION	■ Be sure to turn OFF the product when wiring the power source. Make sure that wiring and voltage are correct before turning ON the product. ■ Use as thick and short a wire as possible for wiring 24VDC power source. ■ Keep the 24VDC power source cable away from peripheral noise sources as possible. ■ Do not insert and remove the connector while applying current to the 24VDC connector. ON/OFF switch must be installed at AC side of the 24VDC power source. Inserting and removing the connector while applying current to the 24V connector or turning ON/OFF at 24VDC side may cause fusing inside CV2.

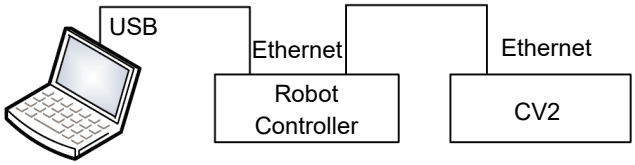
2.2.3 Ethernet Cable

Connect the Ethernet cable for the Ethernet HUB/switch or the Robot Controller to the LAN1 or LAN2 connecter.

- Use Category 5e (with a shield) for the Ethernet cable.
- Install the cable so as not to apply load on the Ethernet connector.
- Put the Ethernet cable as far from the surrounding noise as possible.

Connection example 1:

CV2 and Robot Controller need to be connected in the same subnet. When connecting by the USB, PC network setting does not need to be set as same as Robot Controller.

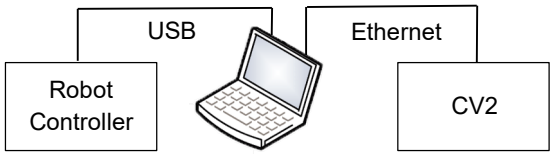


(1) Connect an ethernet cable between the Robot Controller (LAN) and the CV2. Both straight and crossing cables can be used.

(2) Connect a USB cable between Robot Controller and PC.

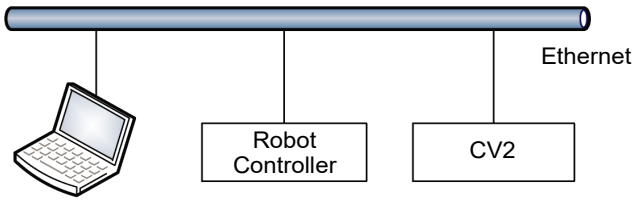
NOTE

The following connection cannot be used.



Connection example 2:

CV2, PC, and Robot Controller need to be connected in the same subnet using a switch or hub.



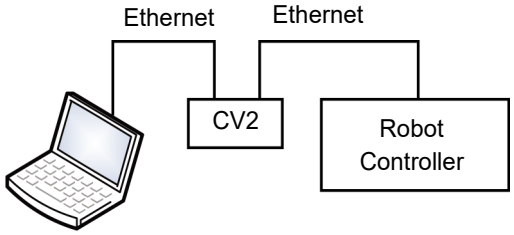
(1) Connect an Ethernet cable between the CV2 and the Ethernet hub/switch.

(2) Connect an Ethernet cable between the Controller and the Ethernet hub/switch.

(3) Connect an Ethernet cable between the PC and the Ethernet hub/switch.

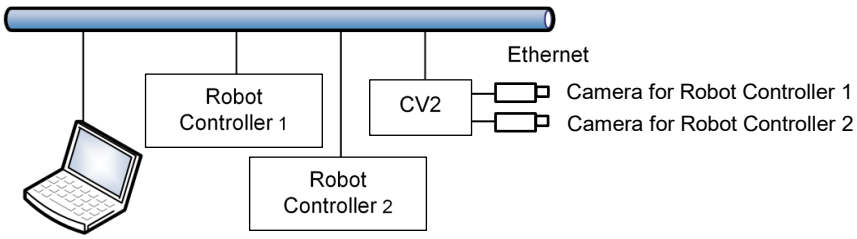
* When the image of the camera is not monitored while operating the robot system, you do not have to connect the EPSON RC+7.0 PC to use the Vision Guide 7.0.

Tips:
LAN1 and LAN2 of the CV2 can be functioned as Ethernet switches. In this connection example, the PC and the Robot Controller can be connected to LAN1 and LAN2 for each.



CAUTION	■ You can use the general Ethernet hub or Ethernet switch for connection. However, be sure to use products complying with the industrial standards or noise resistant Ethernet cable (STP cable). If you use office use products or UTP cable, it may cause communication error and may not offer the proper performance.

Connection example 3:
CV2 can be used with multiple Robot Controllers.



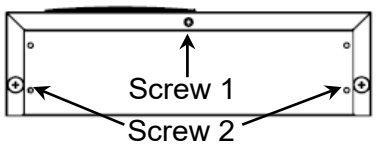
(1) Connect an Ethernet cable between the camera, the Controller, the PC, and the Ethernet hub/switch.

Note: The project numbers for the CV2 should be set to the projects transmitted to each Robot Controller without duplication. The two projects controlled by CV2 must use different cameras.
One camera cannot be shared by two robot controllers. In this example, you need to connect two cameras for each controller.
For details of setting, refer to the section for the project setting in the *EPSON RC+ User's Guide*.

2.3 Maintenance

2.3.1 Internal Structure of CV2

How to remove the top cover



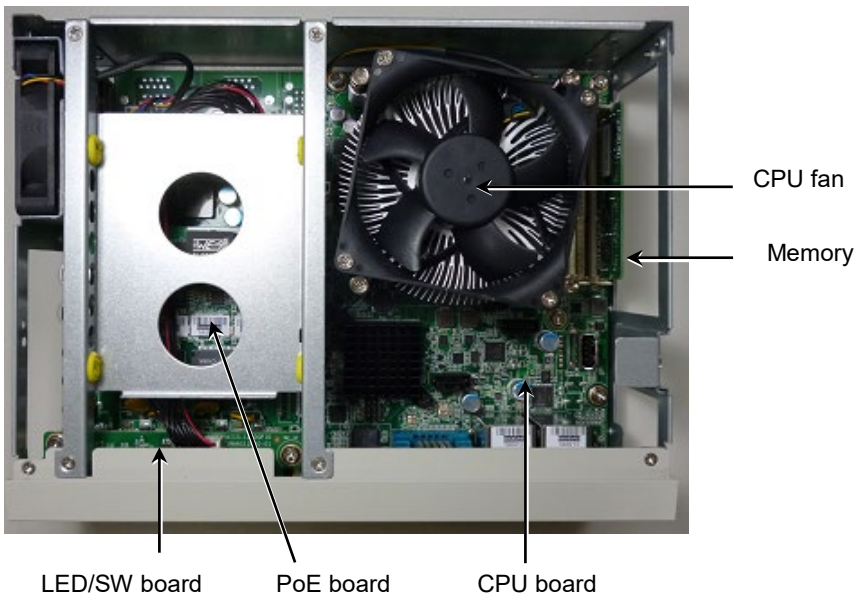
(1) Remove the screw 1 on the CV2 rear face.

(2) Loosen the screw 2 on the CV2 rear face.

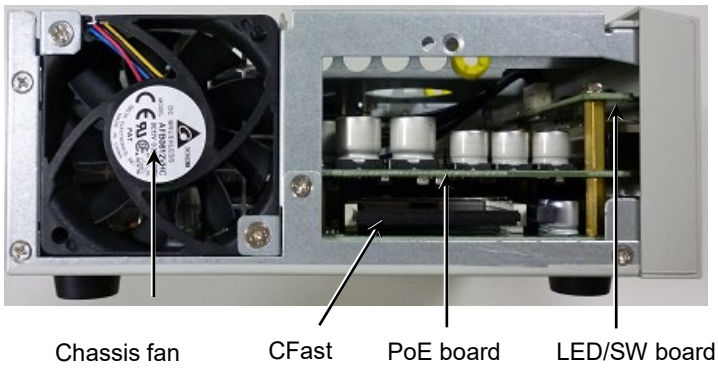
(3) Slide the top cover toward the rear side while slightly lifting it up.

Internal structure of CV2

CV2 Top side



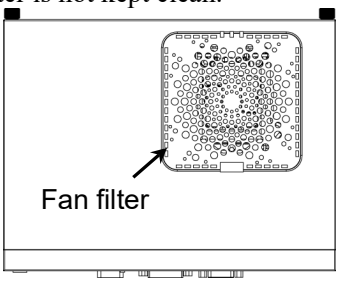
Left side when facing the front side of CV2



2.3.2 Fan Filter

Inspect the fan filter periodically and clean it when needed. The temperature inside the CV2 may get too high and it may not operate properly if the filter is not kept clean.

(1) Turn OFF the power supply for CV2.
Be sure to turn OFF at the AC side of the 24VDC power source.
(2) Remove the filter on the top face of CV2.
(3) Clean the filter using a vacuum cleaner.
(4) Install the filter.



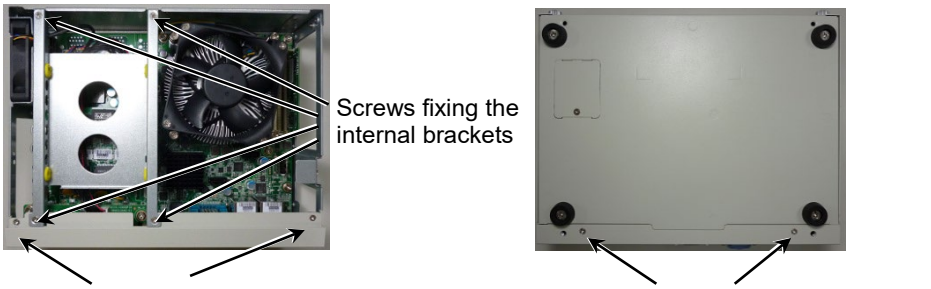
2.3.3 LED / SW Board

To replace the LED/SW board, follow the steps below.

(1) Remove the top cover. (Refer to *Hardware 2.3.1 Internal Structure of CV2*)

(2) Remove four screws fixing the internal brackets.

(3) Remove four screws fixing the front cover. (2 screws on the top face, 2 screws on the bottom face.)



(4) Remove the fitting screws on the both ends of following connectors using a nut driver.

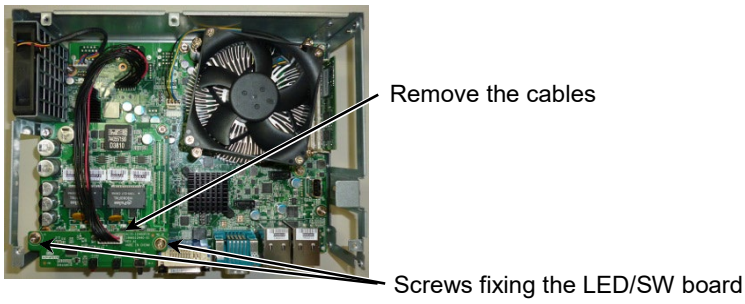
VGA / DVI-D / CON1 / CON2

(5) Remove the front cover.

(6) Remove the cables connected to the LED/SW board.

(7) Remove two screws fixing the LED/SW board and remove the board.

(8) Set the new LED/SW board and fix it in the reverse order to removal.

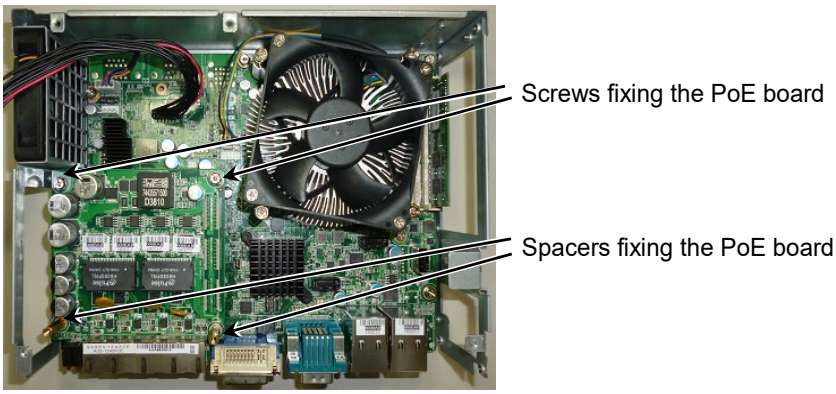


2.3.4 PoE Board

To replace the PoE board, follow the steps below.

(1) Follow the steps (1) through (7) in *2.3.3 LED/SW Board*.

(2) Remove two spacers and two screws fixing the PoE board.



(3) Slide the PoE board up straight and slowly.

The back side of the PoE board is connected to the CPU board by connectors. When removing the PoE board, be careful not to apply excessive force.

(4) When removing the PoE board, the spacers on the CPU board may get loose. In this case, retighten the spacers.

(5) Install the new PoE board.

Be careful not to apply excessive force to the connectors for the CPU board.

(6) Fix the board in the reverse order to removal.

When the PoE board is replaced, choose the one referring to the following table.

	Firmware version	The replaced board
CV2-S/H/L	2.3.3.2 or before or The version is unclear	PoE board (Code 2168503)
	2.3.3.3 or later	PoE board-A (Code 2204519)
CV2-SA/HA		

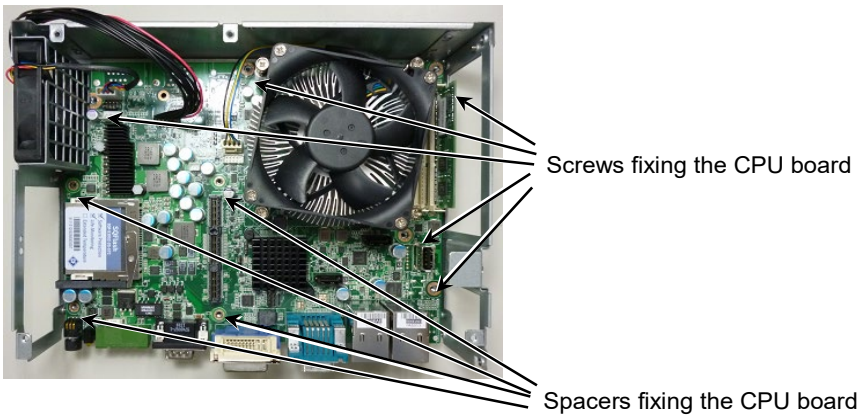
2.3.5 CPU board

To replace the CPU board, refer to the steps below.

(1) Follow the steps (1) through (3) in *2.3.4 PoE Board*.

(2) Remove the chassis fan cable and the LED/SW board connection cable on the CPU board.

(3) Remove four spacers and five screws fixing the CPU board.



(4) Remove the CPU board.

Lift the board carefully not to hitch to the chassis plate.

(5) Remove the CFast and memory on the removed CPU board.

(6) Install the CFast and memory to the new CPU board.

(7) Install the new CPU board to the bottom of the chassis while aligning to the screw holes.

(8) Fix the board in the reverse order to removal.

Be careful of the direction of the LED/SW cables.
(The red cable of the LED/SW cables must be on the right side when facing the front face of the CV2.)

2.3.6 Backup Battery

To replace the battery, follow the steps below.

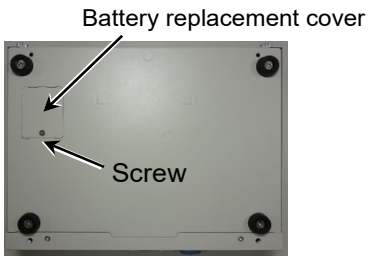
(1) Remove a screw of the battery replacement cover on the bottom and remove the cover.

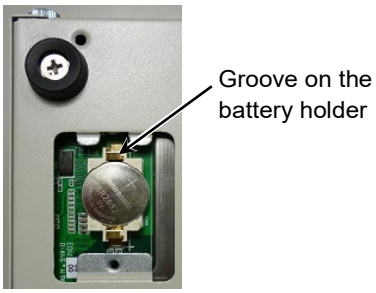
(2) Insert a small flat-head screwdriver to the groove on the battery holder and lift up the battery slowly.

The battery may jump by the spring of the battery holder.

(3) Set the new battery while the + side facing the front.

(4) Fix the cover.





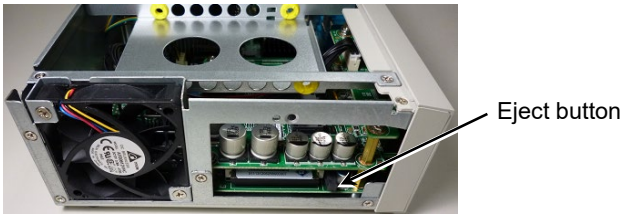
2.3.7 CFast

To replace the CFast, follow the steps below.

(1) Remove the top cover. (Refer to *Hardware 2.3.1 Internal Structure of CV2*)

(2) Press the eject button to remove the CFast.

(3) Install the new CFast.



(4) Install the top cover.

2.3.8 Memory

To replace the memory, follow the steps below.

(1) Remove the top cover. (Refer to *Hardware 2.3.1 Internal Structure of CV2*)

(2) Remove the memory while gently opening the clips on each of the memory socket outside.

(3) Remove the memory from the memory socket.

(4) Insert the new memory to the memory slot obliquely and fix it with the tabs on the memory socket by pushing the memory lightly toward the CPU.

(5) Install the top cover.

2.3.9 Chassis Fan

To replace the chassis fan, follow the steps below.

(1) Remove the top cover. (Refer to *Hardware 2.3.1 Internal Structure of CV2*)

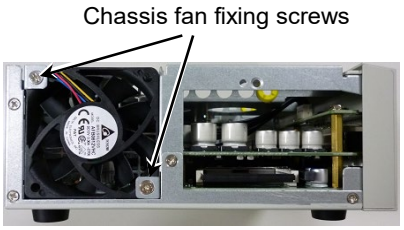
(2) Remove four screws of the internal brackets and remove the brackets.

(3) Remove the chassis fan cables connected to the CPU board.

(4) Remove two screws fixing the chassis fan.

(5) Slide up the chassis fan and remove it.

(6) Install the new fan and fix it in the reverse order to removal.

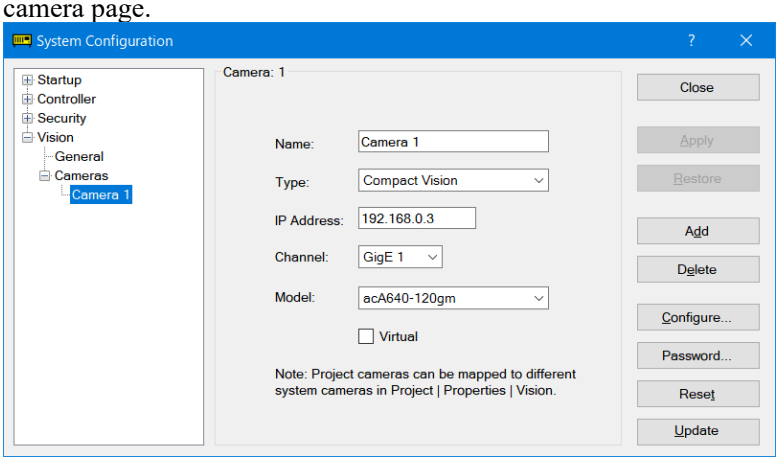


2.3.10 Updating CV2 Firmware

Sometimes the firmware in the camera may need to be updated.

(1) Start EPSON RC+.

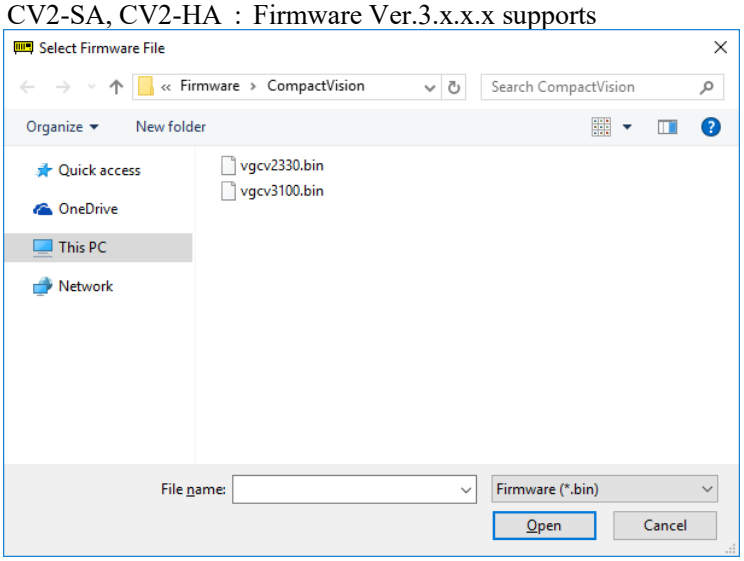
(2) Select [System Configuration] from the [Setup] menu and navigate to the desired camera page.



(3) Click the <Update Firmware...> button.

(4) Open the firmware file. The default directory is as follows:
\EpsonRC7.0\Vision\Firmware\CompactVision
Firmware files have the BIN extension.
Select the correct firmware file for the camera you are upgrading.
The file name for the CV2 camera is “vgcvxxxx.bin”. “xxxx” indicates the version number.

CV2-S, CV2-H	:	Firmware Ver.2.3.x.x supports
CV2-L	:	Firmware Ver.2.3.3.x supports
CV2-SA, CV2-HA	:	Firmware Ver.3.x.x.x supports



(5) Click the <Open> button.
Firmware update will start. After the firmware is updated, the camera will be restarted. Now, the firmware update is completed.

2.3.11 Resetting to the Factory Default

Settings for the CV2 can be reset to the factory default.

Following settings are reset by this function.

- IP address setting
- Local monitor setting
- Setting for projects saved to the CV2

For instance, if you lost the IP address which you previously changed, you can check it by connecting the PC monitor to the CV2. If there is no problem to reset the setting, you can also restore the IP address to "192.168.0.3" by resetting the CV2 to the factory default.

To initialize the CV2 to the factory default, follow the steps below.

(1) Turn OFF the CV2.
(2) Turn ON the CV2 while pressing the TRIGGER switch on the front side of the CV2 (refer to *Hardware 2.1.1 Part Names and Functions*).
(3) Release the TRIGGER switch when the STATUS LED on the front side of the CV2 starts blinking quickly (approx. 3 times/sec).
(4) The CV2 automatically restarts after the STATUS LED stops blinking and the STATUS LED blinks five times quickly.
(5) After the CV2 is restarted, initialization completes.

3. PC Vision PV1

3.1 Installation Precautions

PV1 supports eight types of GigE cameras.

Model	Resolution (color, monochrome)
Standard GigE camera	640 × 480 (monochrome)
Standard 2 GigE camera	640 × 480 (monochrome)
1.3 mega-pixel 2 GigE camera	1280 × 1024 (monochrome)
2 mega-pixel 2 GigE camera	1600 × 1200 (monochrome)
2 mega-pixel 2 GigE color camera	1600 × 1200 (color)
2 mega-pixel GigE camera	1600 × 1200 (monochrome)
2 mega-pixel GigE color camera	1600 × 1200 (color)
5 mega-pixel GigE camera	2560 × 1920 (monochrome)
5 mega-pixel GigE color camera	2560 × 1920 (color)
5 mega-pixel 2 GigE camera	2560 × 1920 (monochrome)
5 mega-pixel 2 GigE color camera	2560 × 1920 (color)
10 mega-pixel GigE camera	3664 × 2748 (monochrome)
10 mega-pixel GigE color camera	3664 × 2748 (color)
20 mega-pixel GigE camera*	5472 × 3648 (monochrome)
20 mega-pixel GigE color camera *	5472 × 3648 (color)

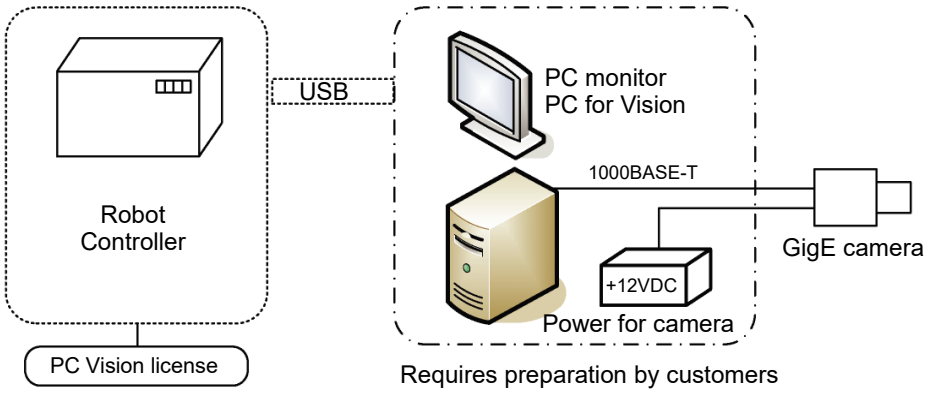
For detailed specifications of each camera, refer to *Hardware 4. Camera*.

For details of available network Controllers, refer to *Installation 4.3.1 System Requirements.*

3.2 Wiring of PV1

The figure below is an example of the system configuration.

In this example, the Robot Controller and the PC are connected by the USB cable. The Ethernet cable also can be used for connection of the Robot Controller and PC.



3.2.1 Ethernet Cable

Connect the Ethernet cable for the Ethernet HUB or Robot Controller to the Ethernet connector.

- Use Category 5e (with a shield) for the Ethernet cable.
- Install the cable so as not to apply load on the Ethernet connector.
- Put the Ethernet cable as far from the surrounding noise as possible.

 CAUTION	■ You can use the general Ethernet hub or Ethernet switch for connection. However, be sure to use products complying with the industrial standards or noise resistant Ethernet cable (STP cable). If you use office use products or UTP cable, it may cause communication error and may not offer the proper performance. ■ For connection of the GigE camera and PC, PoE injector, PoE switching hub, use the dedicated camera cable. ■ When connecting two or more cameras with the PoE switch, do not capture images simultaneously. If taking images simultaneously, an image defect may occur. ■ When using two or more cameras, connect them with peer-to-peer connection (connect cameras to different NICs).

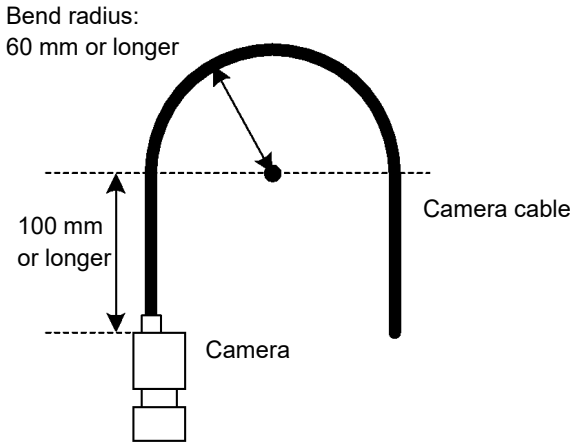
4. Camera

4.1 USB Camera

4.1.1 Camera Cable Wiring

When wiring the USB and trigger cables, be sure to satisfy the following:

- Do not bend the cable within 100 mm from the camera connector.
- Bend radius must be 60 mm or longer.
- Install the cable so as not to apply load on the connector.
- Put the USB camera cable as far from the surrounding noise as possible.



The CV1/CV2 system uses USB cameras that connect via standard USB cables to the front panel of the CV1/CV2 Controller. You can connect one or two cameras. Connect the cameras to any USB receptacle on the front panel.

You can only use the USB cameras provided by EPSON. The system was specifically designed for use with these cameras.

Cables for connecting cameras differ depending on the working condition: installing the camera as a fixed camera or as a mobile camera. Select the cable based on your working condition.

It is recommended that you use a camera bracket supplied by EPSON for mounting the remote camera head to the robot.

Connect the USB camera cable to any of USB1 to USB4 connectors of CV1/CV2.

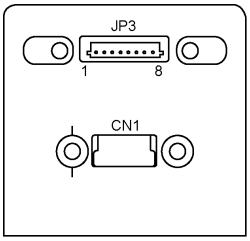
- Do not use USB hubs or USB repeaters.
- Install the cable not to apply load on the USB connector.
- Keep the USB camera cable as far away from surrounding noise source as possible.
- Use our designated flexible cable when installing the camera on a movable part.

NOTE

- Ensure that the following cables are not bound together when installing the camera. Otherwise, distortion of an image may occur due to the noise.
  Cable for connecting the camera head and the body (camera unit)
  Cable that could be noise sources such as the power cable
- Do not use the cable for fixed cameras at moving parts.
  Otherwise, it may cause problems such as a breaking of cable in a short time.

CAUTION	■ Do not use the USB hub, USB repeater or USB extender cable. It may causes problem on your system.

4.1.2 Part Names and Functions



No	Name	Function
CN1	USB connector	A USB connector to connect the CV1 with the camera
JP3	Trigger connector	A connector to receive trigger inputs from the external device or output control signals to the strobe device

4.1.3 External Wiring

Signal alignment for USB camera cables

CN1 USB 2.0 High Speed

Mini USB Type B

Signal alignment for trigger cables

The picture above shows the rear panel of the USB camera. The trigger and strobe are connected to the JP3 receptacle.

Pin #	Color	Name	Description
1	Purple	T+	Trigger signal input
2	Blue	T–	Trigger signal input
3	Green	S+	Strobe signal output
4	Yellow	S–	Strobe signal output
5	Orange	-	Not in use
6	Red	-	Not in use
7	Brown	-	Not in use
8	Black	GND	

JP3 trigger connector

JST: BM08B-SRSS-TB (Compatible plug: JST 08SR-3S)

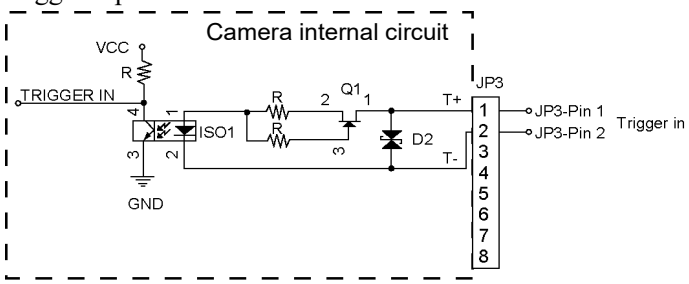
Power Specifications for Trigger and Strobe

Strobe Output : Output Voltage: 4V to 24V
Output Current: Max. 500 mA

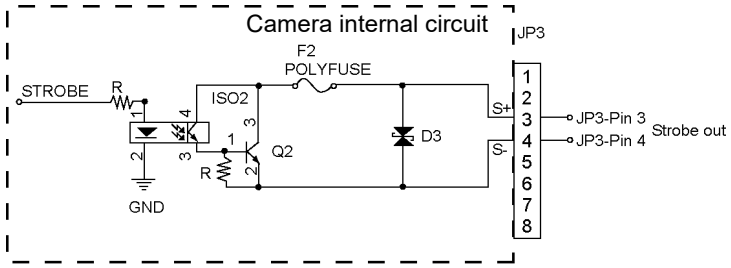
Trigger Input : 3 to 24 V

Internal Circuit Diagrams for Trigger and Strobe

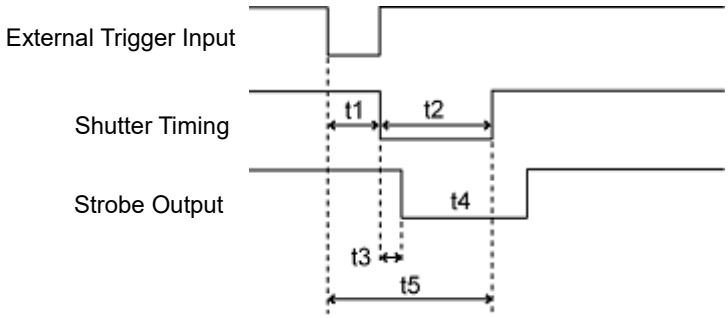
Trigger Input Circuit



Strobe Control Output Circuit



Trigger Timing



t1 ExposureDelay: Min. 70 microseconds [Unit of t1 to t4: microsecond]
t2 ExposureTime
t3 StrobeDelay Min 70 microseconds
t4 StrobeTime Min 140 microseconds
t5 External trigger prohibited zone

Note:

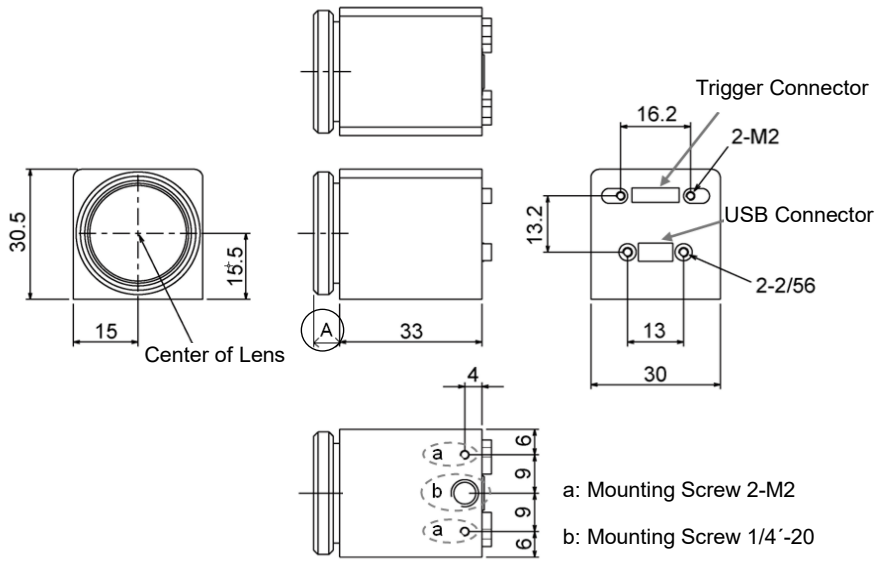
- To use a NS1500BU/CU camera in “Strobe” mode (external trigger mode), an external strobe lighting is necessary.
- If the strobe is not used, the camera works in the rolling shutter mode and cannot recognize moving objects correctly.

4.1.4 USB Camera Specifications

Item	Specification		
Model Name	NS1044BU	NS4133BU/CU	NS1500BU/CU *1
Resolution	640 × 480	1280 × 1024	2560 × 1920
Pixel size[µm]	6.0 × 6.0	5.3 × 5.3	2.2 × 2.2
Valid pixel range [mm]	3.84 × 2.88	6.784 × 5.427	5.632 × 4.224
Sensor size	1/3 in.	1/1.8 in.	1/2.5 in.
Ambient Temperature	5 to 40 °C		
Relative Humidity	20 to 80% (with no condensation)		
Size	Refer to the diagram		
Mass	50 g (without lens)		

*1: EPSON RC+ 7.0 Ver. 7.0.2 or later and CV1 firmware Ver. 2.1.0.6 or later are required.

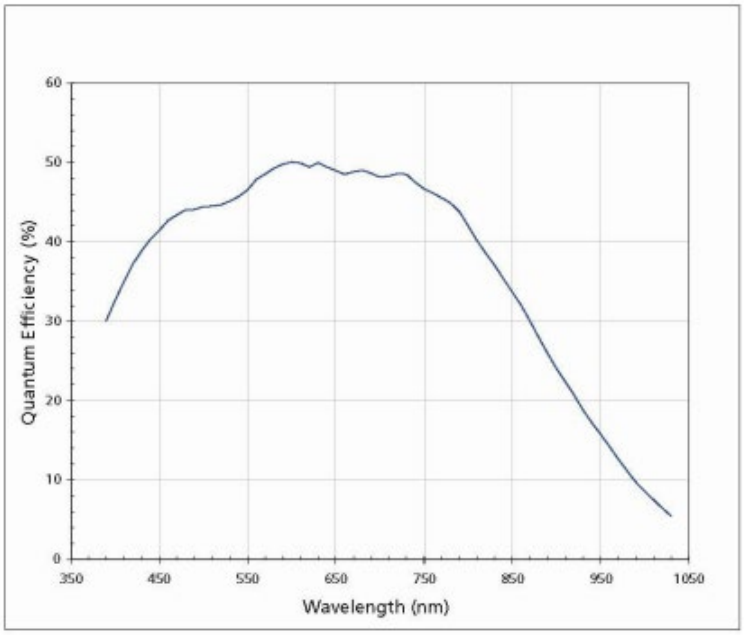
Outline Drawing of Camera (common to all USB cameras)



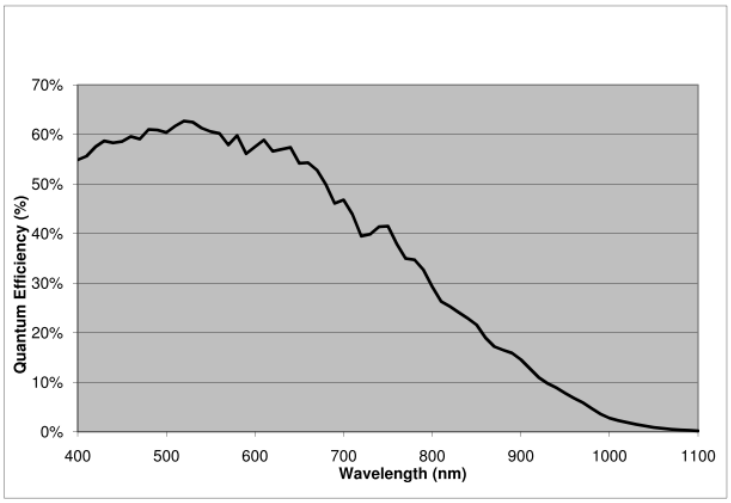
Camera Model	Dimension of A
NS1044-BU	6.1
NS4133BU / CU	5.8
NS1500BU / CU	5.4

4.1.5 Spectral Characteristics of Monochrome Camera

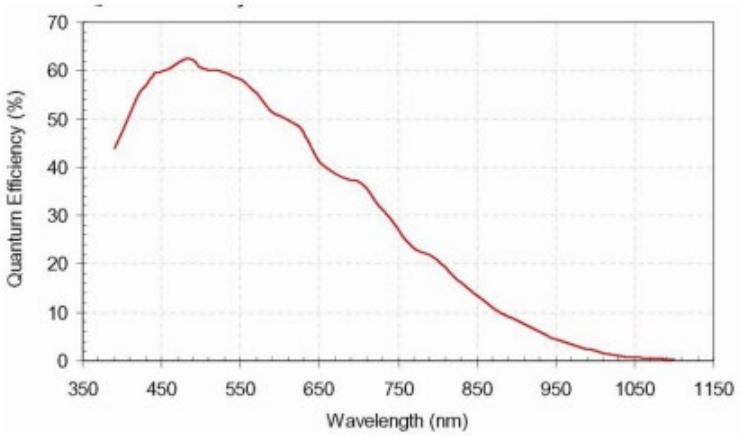
NET 1044 BU



NET 4133 BU



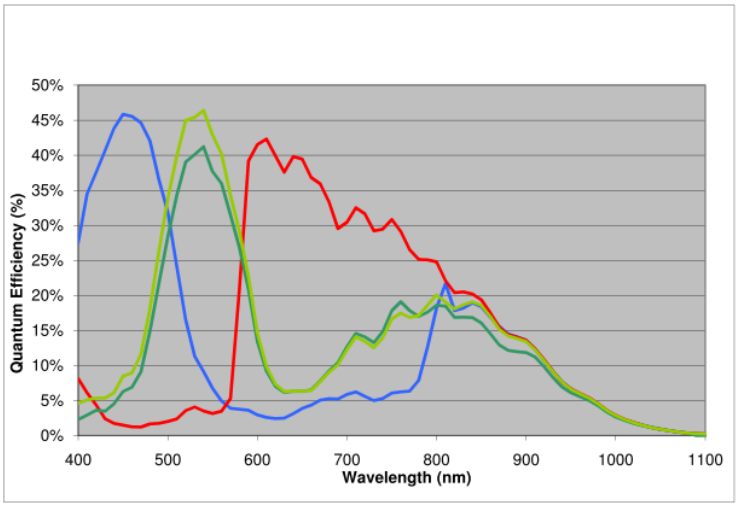
NET 1500 BU



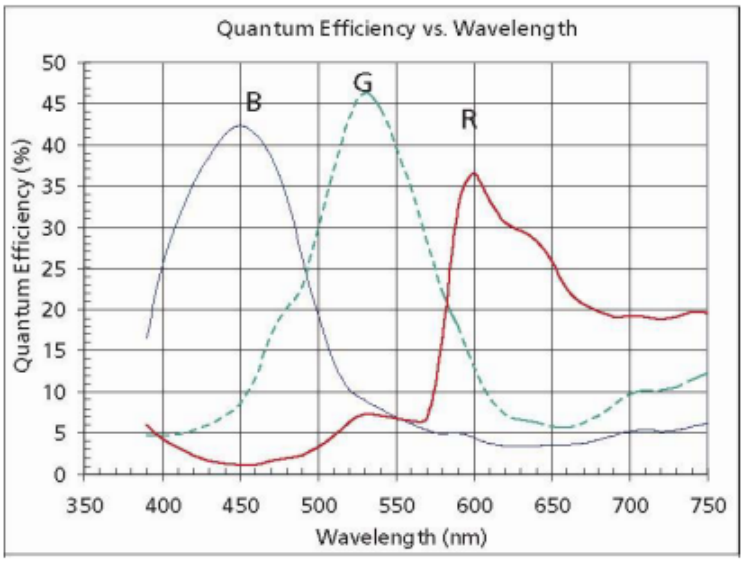
(*1: EPSON RC+ 7.0 Ver. 7.0.2 or later is required.)

4.1.6 Spectral Characteristics of Color Camera

NET 4133 CU



NET 1500 CU



(*1: EPSON RC+ 7.0 Ver. 7.0.2 or later is required.)

4.2 GigE Camera

Installation Precautions

CAUTION	■ Camera's operation is guaranteed up to 50 degree of surface temperature of the camera chassis. If the camera is operated in the temperature exceeding this limit, it may result in damage to the camera.

Fix the camera to a chassis or similar product with as small thermal resistance as possible. Use the formula below to calculate thermal resistance necessary for the installation position.

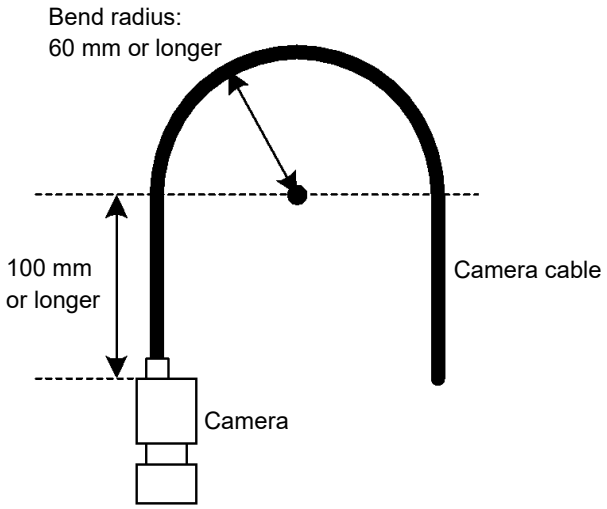
Thermal Resistance (°C /W)
= (50°C – ambient temp.) / Power Consumption of camera (W)

Camera model	Power consumption (PoE feeding)	Power consumption (Trigger connector feeding)
acA640-100gm acA640-120gm	2.5W	2.0W
acA1300-60gm	2.6W	2.0W
acA1600-20gm/gc	3.6W	2.9W
acA1600-60gm/gc	2.7W	2.1W
acA2500-14gm/gc	2.7W	2.2W
acA2500-20gm	3.9W	3.6W
acA2500-20gc	4.1W	3.6W
acA3800-10gm/gc	3.7W	3.3W
acA4024-8gm/gc	2.9W	2.5W
acA5472-5gm	3.0W	2.6W
acA5472-5gc	3.1W	2.8W

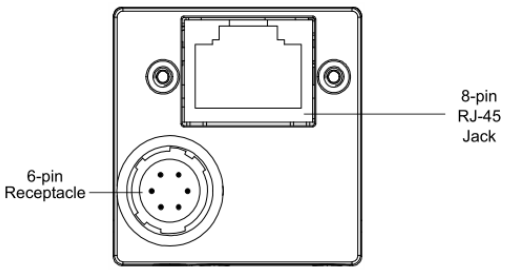
4.2.1 GigE Camera Cable, Trigger Cable

When wiring the GigE camera cable or the trigger cable, be sure to satisfy the following:

- Do not bend the cable within 100 mm from the camera connector.
- Bend radius must be 60 mm or longer.
- Install the cable so as not to apply load on the connector.
- Put the GigE camera cable as far from the surrounding noise as possible.
- Install the GigE camera cable within 40 m.



4.2.2 Part Names and Functions



No	Name	Function
1	Camera cable connector	Ethernet connector for connecting with PC for Vision
2	External trigger connector	Connector for external trigger input, strobe output, and 12VDC input

4.2.3 External Wiring

Camera cable wiring

Use our optional ethernet cable.

Ethernet cables of category 5e STP are available. To avoid EMI, it is recommended to use the shielded cables. As a general rule, use higher category cables for applications with longer cables or applications require EMI countermeasures.

Either a straight or a crossing cable can be used to connect the GigE camera directly to a network adapter or to a network switch.

When installing the cables, cable length should be within 40 m.

When installing the cables, avoid close proximity to strong magnetic fields.

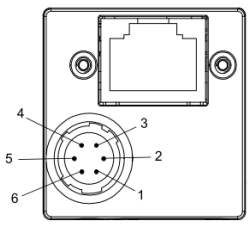
External Trigger Cable Wiring

Trigger input, strobe output, and 12VDC power supply for the GigE camera can be connected from the external trigger connector of the camera. Cable length should be shorter than 10 m.

Tip : GigE camera can be fed through the ethernet cable (PoE) as well as through the external trigger connector. Supply the power either through the external trigger connector or PoE. For details, refer to the following section.

Hardware 4.2.5 Power Specification

Pin assignment of the external trigger connector is shown below.



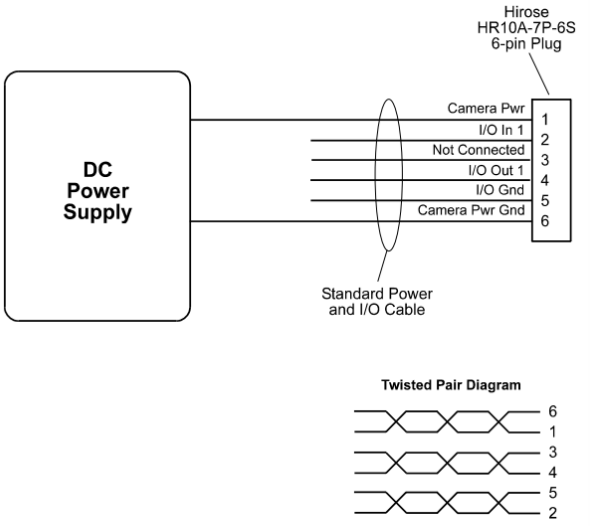
Pin #	Name	Description
1	+12VDC	Camera + 12VDC power supply
2	T+	Trigger input
3	-	Not connected
4	S+	Strobe output
5	IO-GND	Trigger, strobe signal GND
6	DC-GND	Camera power suply GND

Mating connector: HR10A-7P-6S(74) (Hirose)

CAUTION

- Voltage outside of the specified range may cause damage.
  If the voltage of the power to the camera exceeds +13.2VDC, the camera will be damaged. If the voltage is less than +11.3V, the camera operation becomes unstable.

  Use our optional connector or an equivalent product for triger cable wiring. Also, use the twisted pair cables for each cable. (See below)

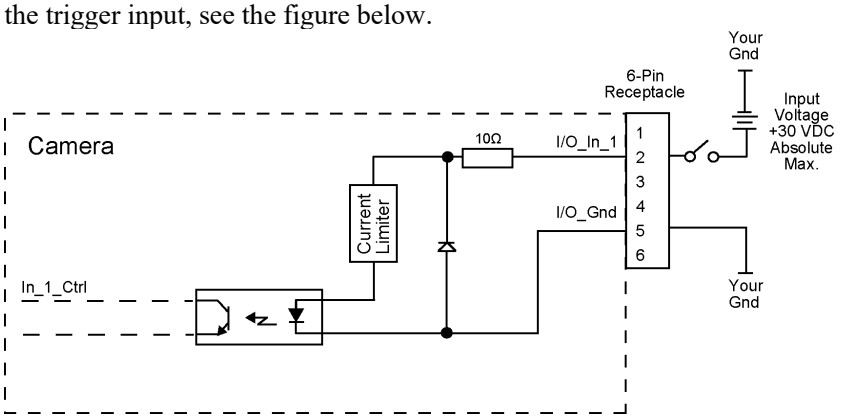


Tip:
To use an acA2500-14gm/gc camera in “Strobe” mode (external trigger mode), an external strobe lighting is necessary.

If the strobe is not used, the camera works in the rolling shutter mode and cannot recognize moving objects correctly.

Internal Circuit of Trigger Input

Triggers can be input via the external trigger connector. For details on internal circuit of the trigger input, see the figure below.

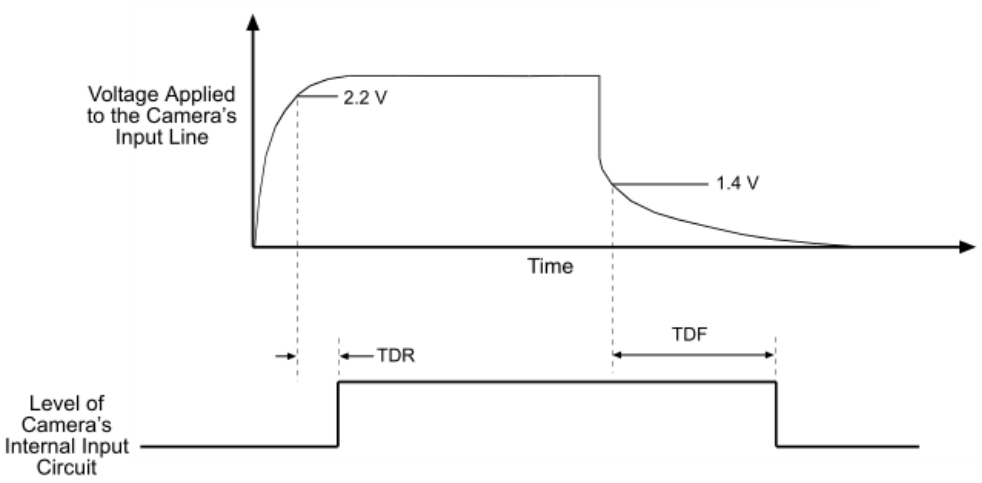


The inside is insulated by a photocoupler. Refer to the table below for the range of input voltage.

Voltage	Significance
+ 0 to + 24 VDC	Recommended operating voltage.
+ 0 to + 1.4 VDC	The voltage indicates a logical 0.
> + 1.4 to + 2.2 VDC	Indeterminate logical value.
> + 2.2 VDC	The voltage indicates a logical 1.
+30.0 VDC	Absolute maximum; the camera may be damaged when the absolute maximum is exceeded.

Response Speed of Trigger Input

Response speed with respect to the trigger input is as below:

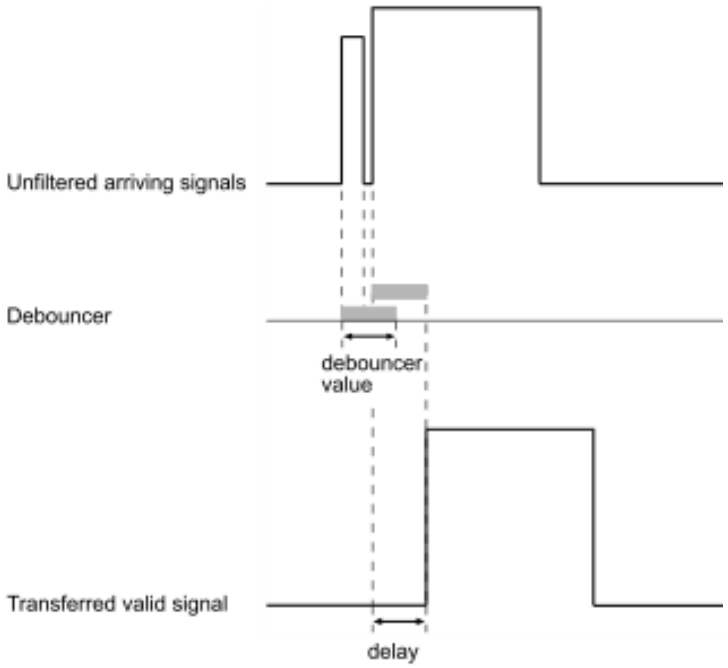


Time Delay Rise (TDR) = 1.3 µs to 1.6 µs

Time Delay Fall (TDF) = 40 µs to 60 µs

Trigger Input Bounce Prevention

The GigE camera has a bounce prevention function to the trigger input. In order to use this function, set the time between 1 and 20000 micro seconds to TriggerDebounce property of the sequence properties (0: invalid). Note that the trigger input delays when this function is enabled.

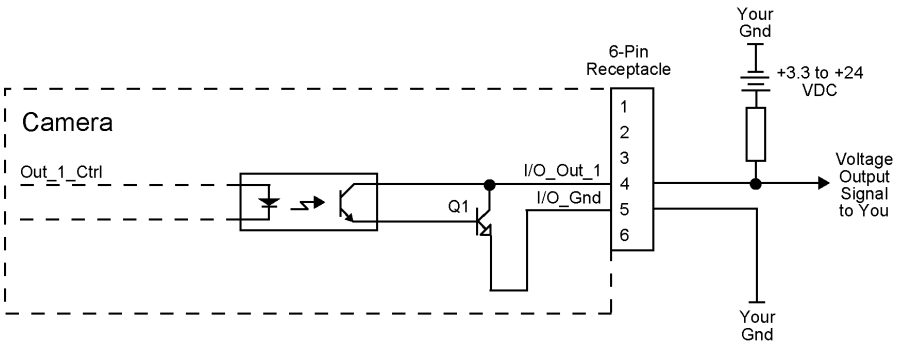


Note: This function is supported only for the GigE cameras. This is not available for the USB cameras.

Internal Circuit of Strobe Output

Strobe timing can be output via the external trigger connector. For details on internal circuit of the strobe output, see the figure below.

Outout circuit and the inside of the camera are insulated by a photocoupler.



The following table shows the range of controlable voltage to the strobe output line. The maximum sink current is 50 mA.

Voltage	Significance
< + 3.3 VDC	The I/O output may operate erratically.
+ 3.3 to + 24 VDC	Recommended operating voltage.
+ 30.0 VDC	Absolute maximum; the camera may be damaged if the absolute maximum is exceeded.

Response Speed of Strobe Output

Response speed to the strobe output is as follows.

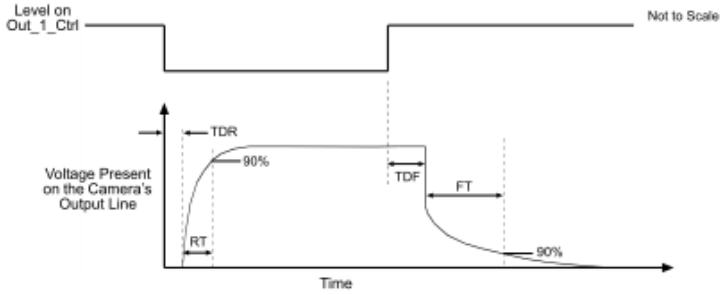
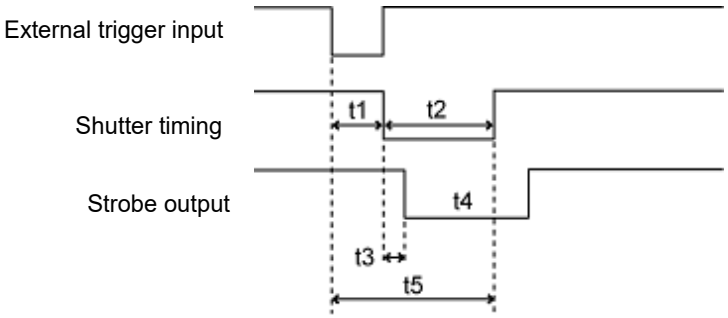


Fig. 40: Output Line Response Times

Time Delay Rise (TDR) = 40 µs
Rise Time (RT) = 20 µs to 70 µs
Time Delay Fall (TDF) = 0.6 µs
Fall Time (FT) = 0.7 µs to 1.4 µs

Trigger Timing



t1 ExposureDelay setting value (Unit for t1 to t4 : micro sec.)
t2 ExposureTime setting value
t3 StrobeDelay setting value
t4 StrobeTime setting value
t5 External trigger prohibition period

Note:
Above response delay is added to each input and output.
Time is added to t1(ExposureDelay) as shown in the table below.

When using the acA2500-14gm/gc camera in “Strobe” mode (external trigger mode), an external strobe light is necessary.

If the strobe light is not used, the camera cannnot recognize moving objects properly since it operates in the rolling shutter mode.

Camera model	t1(ExposureDelay) addition time
acA640-100gm	17.62 micro sec.
acA640-120gm	17.62 micro sec.
acA1300-60gm	43 micro sec.
acA1600-20gm / gc	45.54 micro sec.
acA1600-60gm / gc	41.50 micro sec.
acA2500-14gm / gc	848.00 micro sec.
acA2500-20gm / gc	5 to 43 micro sec.
acA3800-10gm	2900 micro sec.
acA3800-10gc	2550 micro sec.
acA4024-8gm/gc	2031 micro sec.
acA5472-5gm / gc	3185 micro sec.

4.2.4 GigE Camera Specification

Item	Specification	
Model	acA640-100gm acA640-120gm	acA1300-60gm
Resolution	640 × 480	1280 × 1080
Pixel size	5.6 × 5.6	5.3 × 5.3
Valid pixel range [mm]	3.584 × 2.688	6.784 × 5.724
Sensor size	1/4 in.	1/1.8 in.
Shutter	Global shutter	Global shutter
Power consumption	PoE: 2.5W DC 12V: 2.0W	PoE: 2.6W DC 12V: 2.0W
Ambient temperature	0 to 40 °C (Surface temp. of camera chassis must be below 50 °C)	
Ambient relative humidity	20 to 80% (with no condensation)	
Size	Refer to the diagram	
Mass	90 g (without lens)	

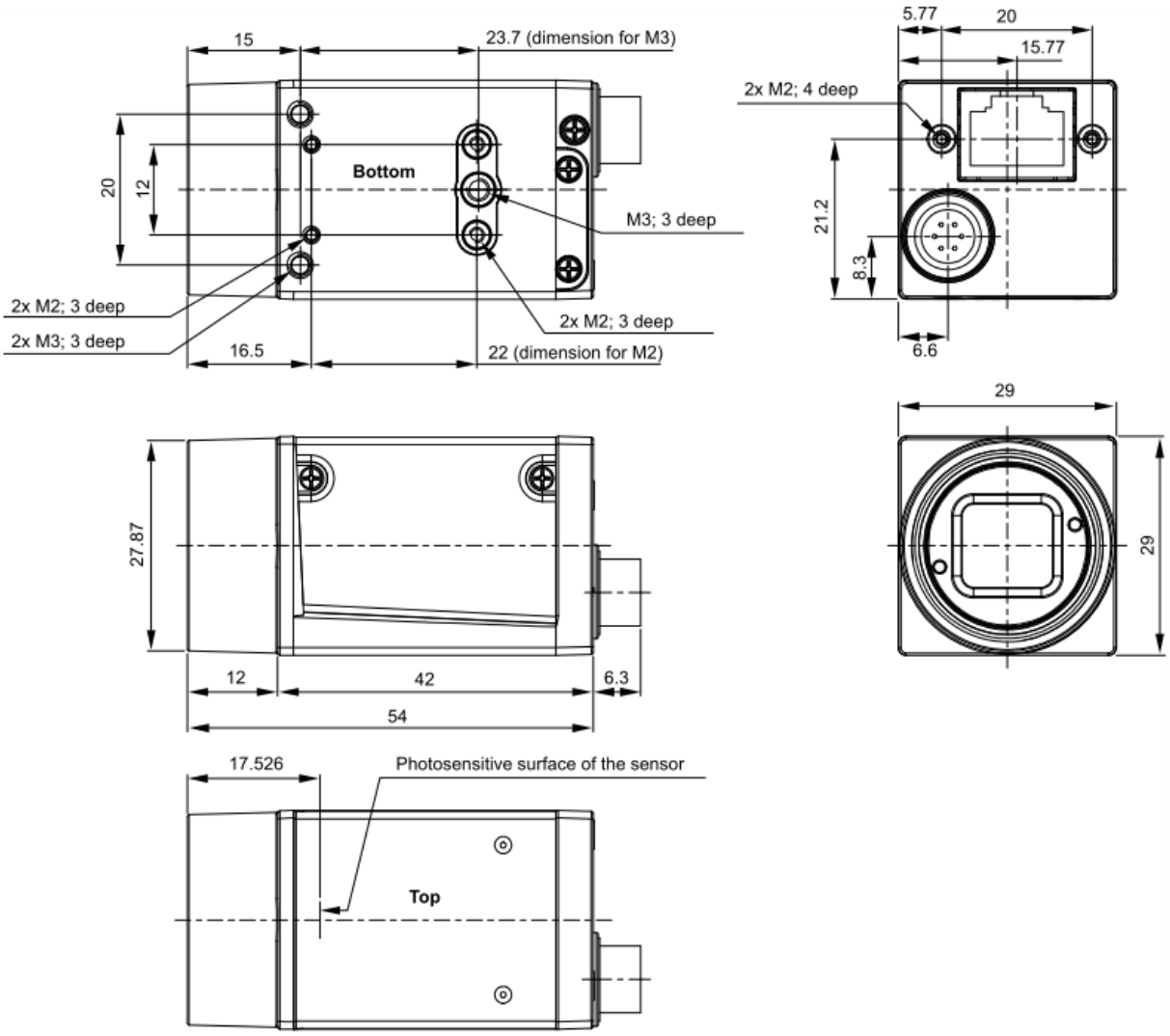
Item	Specification	
Model	acA1600-20gm/gc	acA1600-60gm/gc
Resolution	1600 × 1200	1600 × 1200
Pixel size	4.4 × 4.4	4.5 × 4.5
Valid pixel range [mm]	7.040 × 5.280	7.200 × 5.400
Sensor size	1/1.8 in.	1/1.8 in.
Shutter	Global shutter	Global shutter
Power consumption	PoE: 3.6W DC 12V: 2.9W	PoE: 2.7W DC 12V: 2.1W
Ambient temperature	0 to 40 °C (Surface temp. of camera chassis must be below 50 °C)	
Ambient relative humidity	20 to 80% (with no condensation)	
Size	Refer to the diagram	
Mass	90 g (without lens)	

Item	Specification	
Model	acA2500-14gm/gc	acA2500-20gm/gc
Resolution	2560 × 1920	2560 × 1920
Pixel size	2.2 × 2.2	4.8 × 4.8
Valid pixel range [mm]	5.632 × 4.224	12.288 × 9.216
Sensor size	1/2.5 in.	1 in.
Shutter	Rolling shutter	Global shutter
Power consumption	PoE: 2.7W DC 12V: 2.2W	gm:PoE: 3.9W DC 12V: 3.5W gc:PoE: 4.1W DC 12V: 3.6W
Ambient temperature	0 to 40°C (Surface temp. of camera chassis must be below 50 °C)	
Ambient relative humidity	20 to 80% (with no condensation)	
Size	Refer to the diagram	
Mass	90 g (without lens)	

Item	Specification		
Model	acA3800-10gm/gc	acA4024-8gm/gc	acA5472-5gm/gc
Resolution	3664 × 2748	4024×3036	5472 × 3648
Pixel size	1.67 × 1.67	1.85um×1.85um	2.4 × 2.4
Valid pixel range [mm]	6.119 × 4.589	7.444mm×5.617mm	13.1328 × 8.7552
Sensor size	1/2.3 in.	1/1.7 in.	1 in.
Shutter	Rolling shutter	Rolling shutter	Rolling shutter
Power consumption	PoE: 3.7W DC 12V: 3.3W	PoE: 2.9W DC12V: 2.5W	gm: PoE: 3.0W DC 12V: 2.6W gc: PoE: 3.1W DC 12V: 2.8W
Ambient temperature	0 to 40 °C (Surface temp. of camera chassis must be below 50 °C)		
Ambient relative humidity	20 to 80% (with no condensation)		
Size	Refer to the diagram		
Mass	90 g (without lens)		

* Up to four GigE cameras for the CV2 and up to eight GigE cameras for PV1 can be connected.

Outline Drawing of Camera (common to all GigE cameras)



4.2.5 Power Specification

There are following two power supplying methods for the camera.

- PoE: Power over Ethernet
- Via the external trigger connector

CAUTION	■ If the power is supplied via both PoE and the external trigger connector, the camera will be damaged. Do not supply the power simultenously via both PoE and the external trigger connector. ■ When the camera is connected with CV2, do not supply the battery via the external trigger because the power is supplied via PoE.

Power supply via PoE

To supply power to the camera via PoE, PoE injector (PoE power feeding equipment) to be used should comply wih IEEE802.3af.

For details on power consumption of cameras, refer to *4.2.4 GigE Camera Specifications*.

A camera which is connected with CV2, the power is supplied via PoE.

Power supply using External Trigger Connector

To supply power to the camera using the external trigger connector, supply 12VDC (+11.3V to +13.2V) for power voltage.

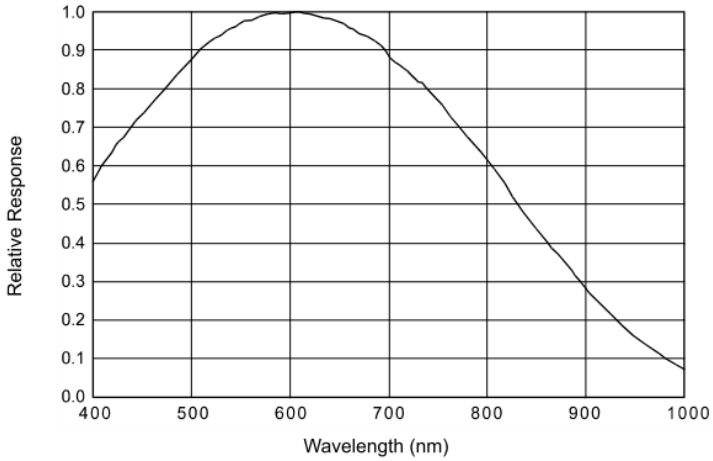
For details on power consumption of cameras, refer to *4.2.4 GigE Camera Specifications*.

When installing the cables, avoid close proximity to strong magnetic fields.

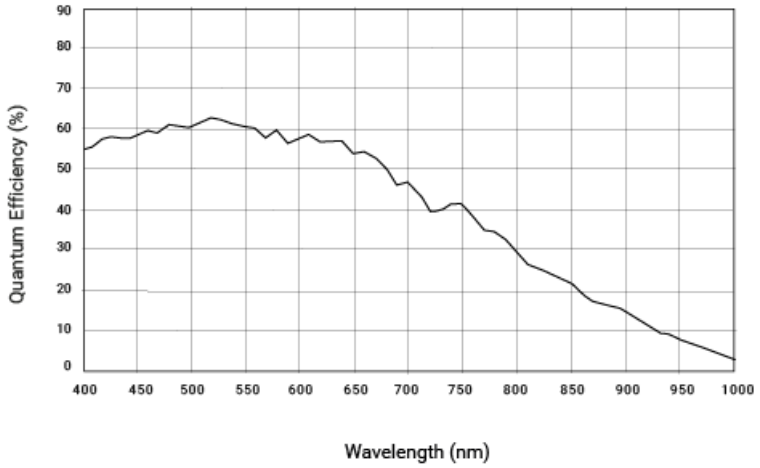
CAUTION	■ Voltage outside of the specified range may cause damage. If the voltage of the power to the camera exceeds +13.2VDC, the camera will be damaged. If the voltage is less than +11.3V, the camera operation becomes unstable. Use our optional connector or an equivalent connector for jointing the external triger connector. Use of other connectors may result in damage to the camera.

4.2.6 CCD/CMOS Spectral Characteristics of Monochrome Camera

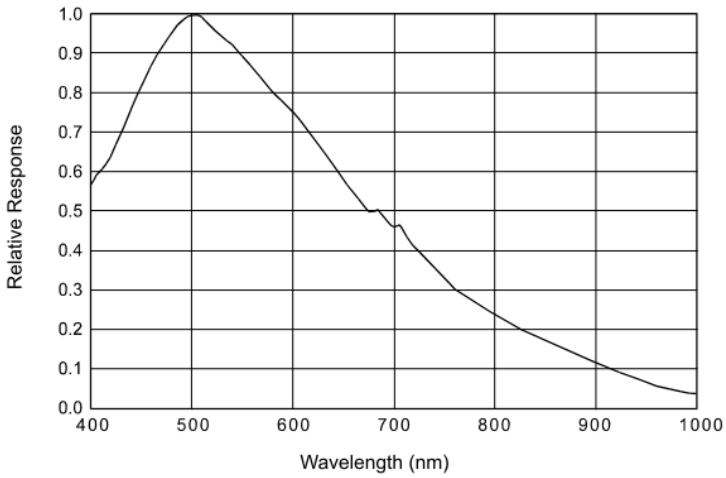
acA640-100gm/acA640-120gm Spectral Response (From Sensor Data Sheet)



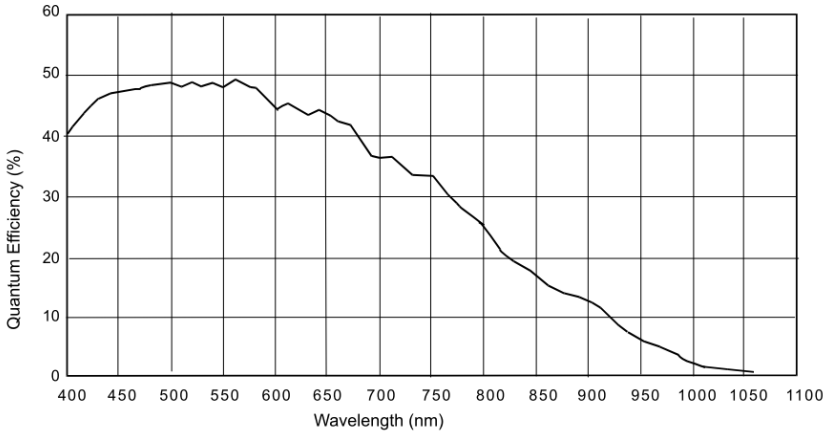
acA1300-60gm Spectral Response (From Sensor Data Sheet)



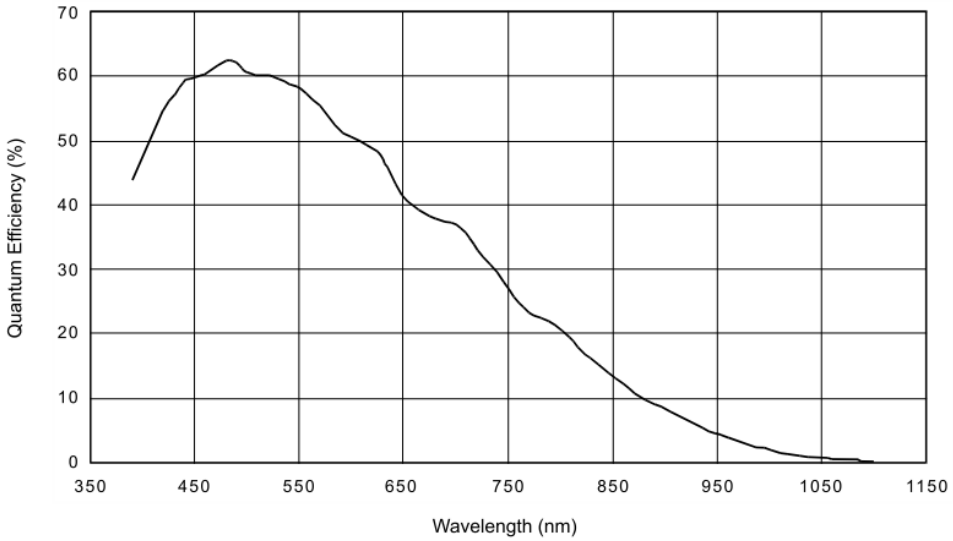
acA1600-20gm Spectral Response (From Sensor Data Sheet)



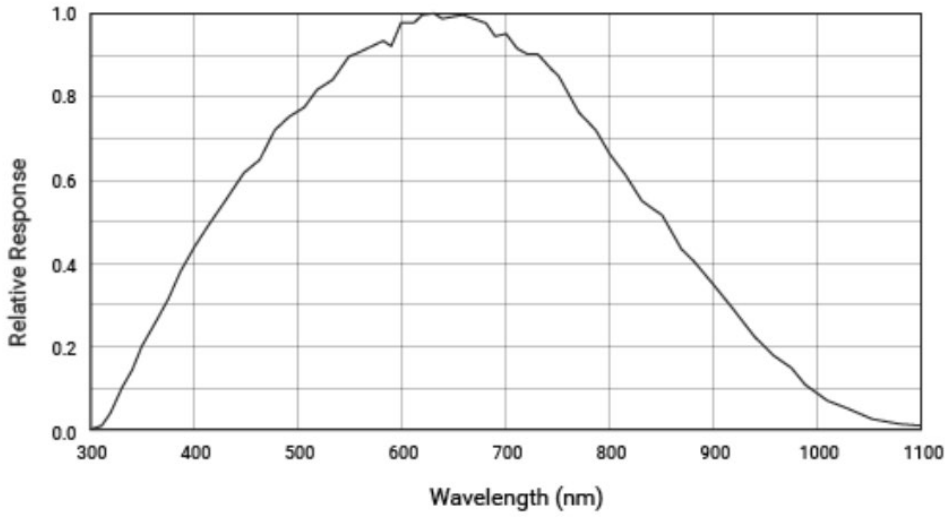
acA1600-60gm Spectral Response(From Sensor Data Sheet)



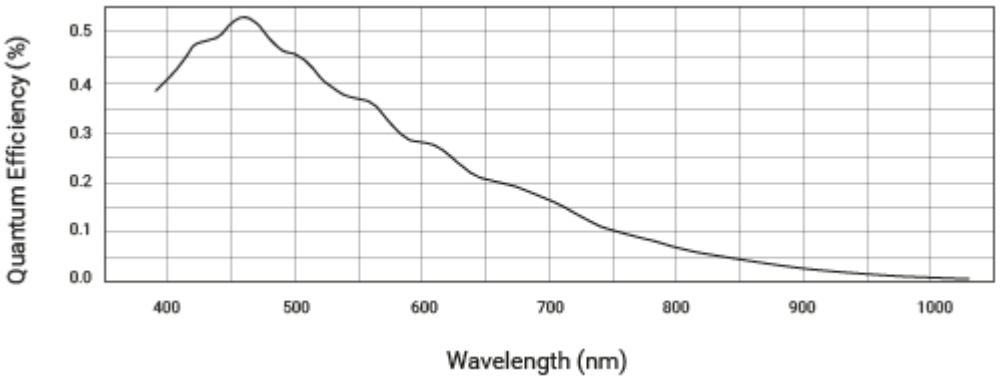
acA2500-14gm Spectral Response(From Sensor Data Sheet)



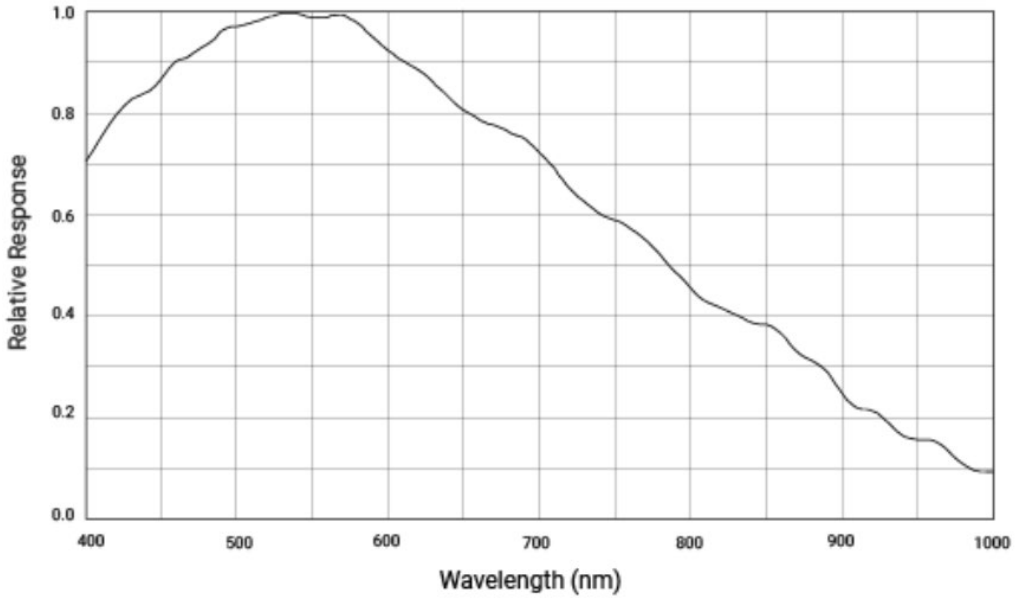
acA2500-20gm Spectral Response(From Sensor Data Sheet)



acA3800-10gm Spectral Response(From Sensor Data Sheet)

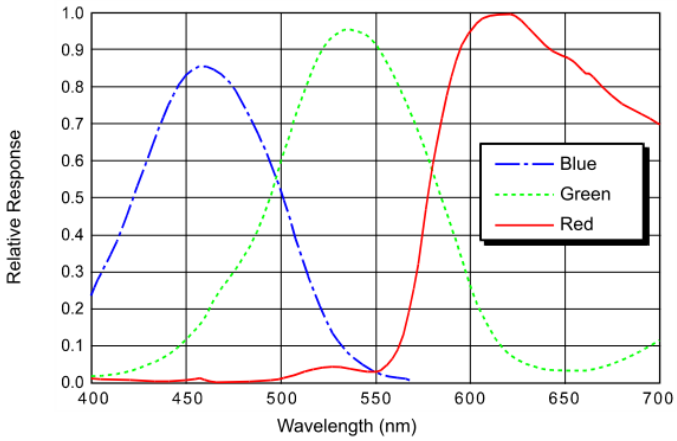


acA5472-5gm Spectral Response(From Sensor Data Sheet)

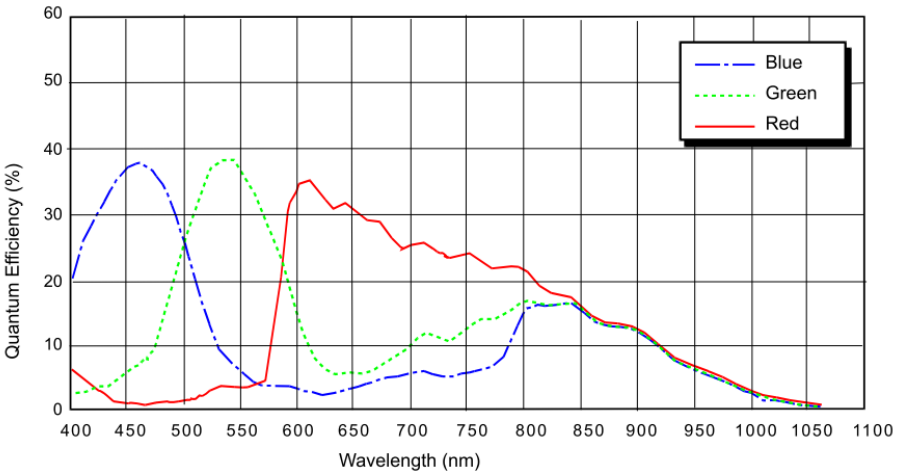


4.2.7 CCD/CMOS Spectral Characteristics of Color Camera

acA1600-20gc Spectral Response(From Sensor Data Sheet)

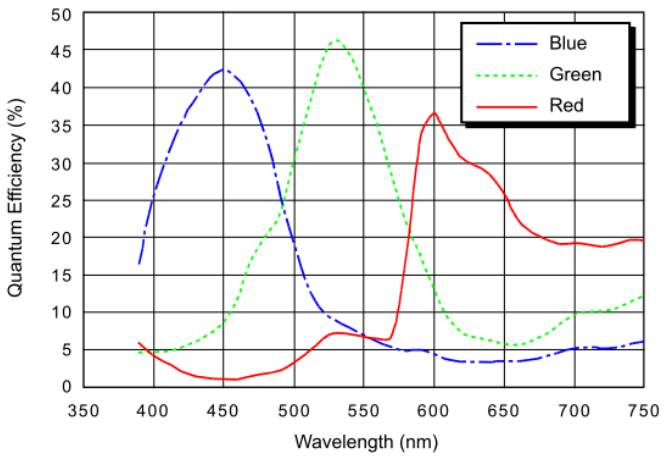


acA1600-60gc Spectral Response(From Sensor Data Sheet)

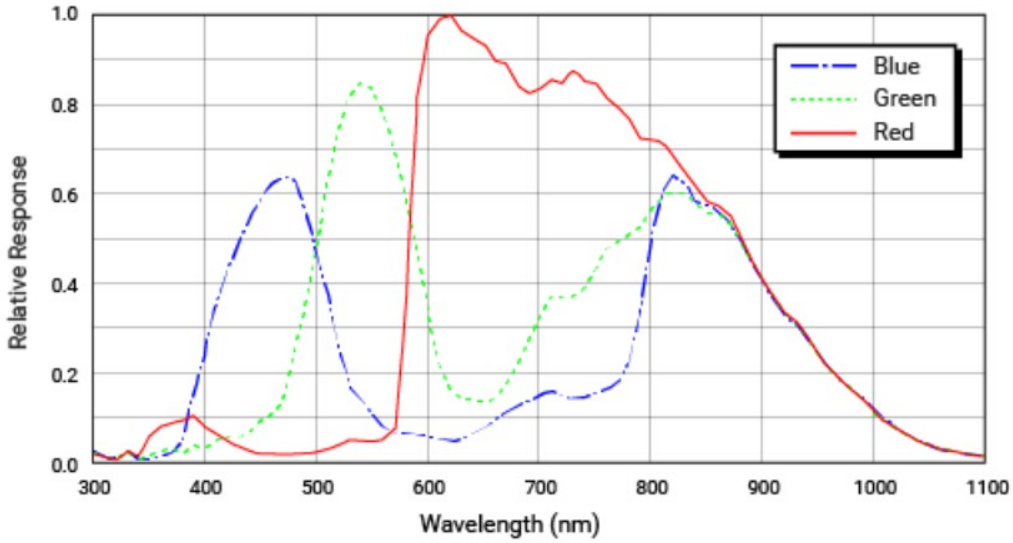


(*EPSON RC+ 7.0 Ver.7.1.1 or later is required.)

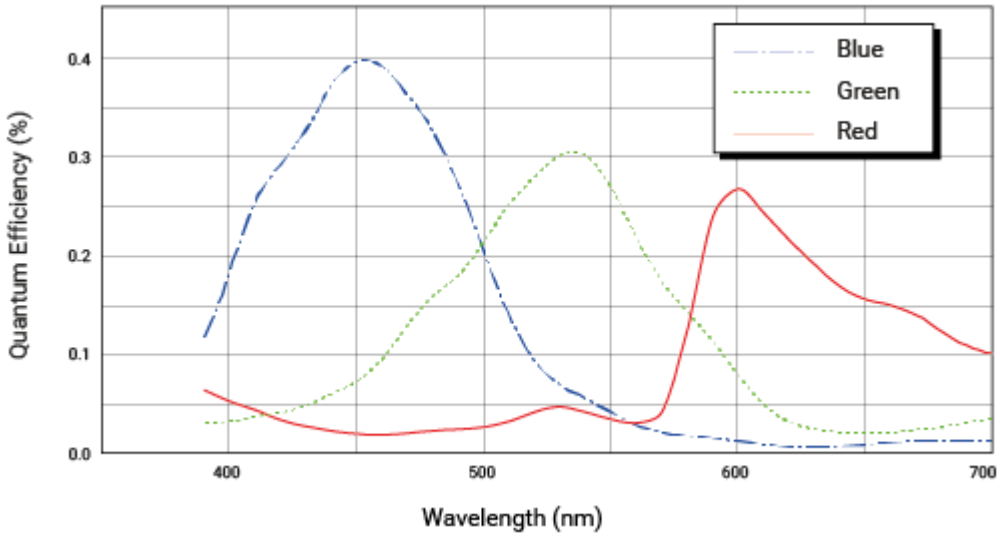
acA2500-14gc Spectral Response(From Sensor Data Sheet)



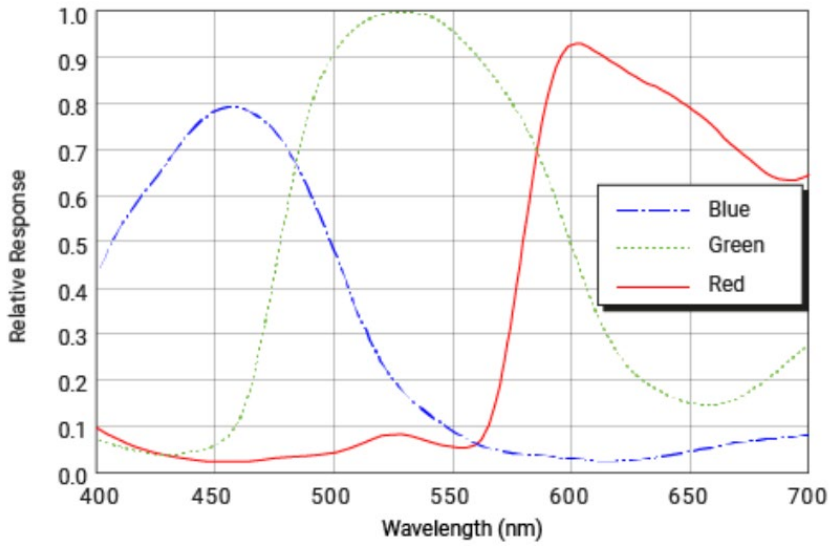
acA2500-20gc Spectral Response(From Sensor Data Sheet)



acA3800-10gc Spectral Response(From Sensor Data Sheet)



acA5472-5gc Spectral Response(From Sensor Data Sheet)



5. Camera Lens

5.1 Standard Camera Lens

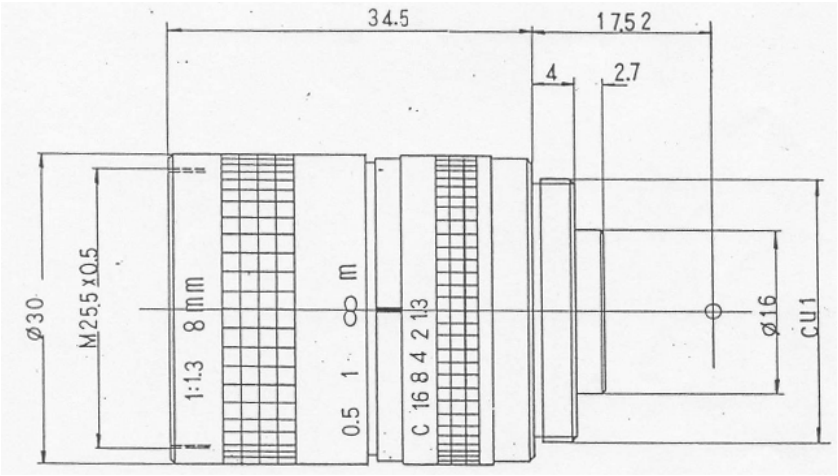
5.1.1 Lens specification

Item	Unit	Specification				
Focal length	mm	8	12	16	25	50
Closest approach distance	m	0.2	0.3	0.4	0.5	1.0
Filter screw diameter	mm	M25.5 × P0.5	M27 × P0.5	M27 × P0.5	M27 × P0.5	M30.5 × P0.5
External dimensions	mm	ø 30 × 34.5	ø 30 × 34.5	ø 30 × 24.5	ø 30 × 24.5	ø 32 × 37
Mass	g	55	56	40	40	55

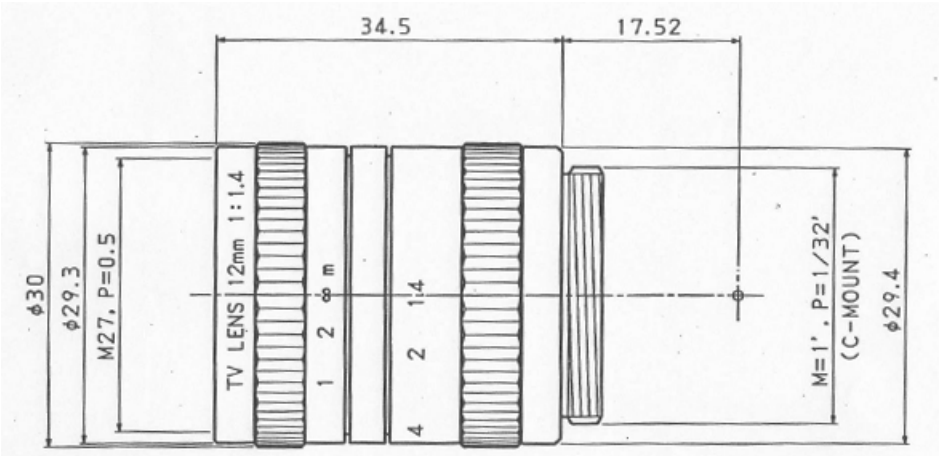
P0.5: Screw pitch0.5 mm

5.1.2 Outline Drawing

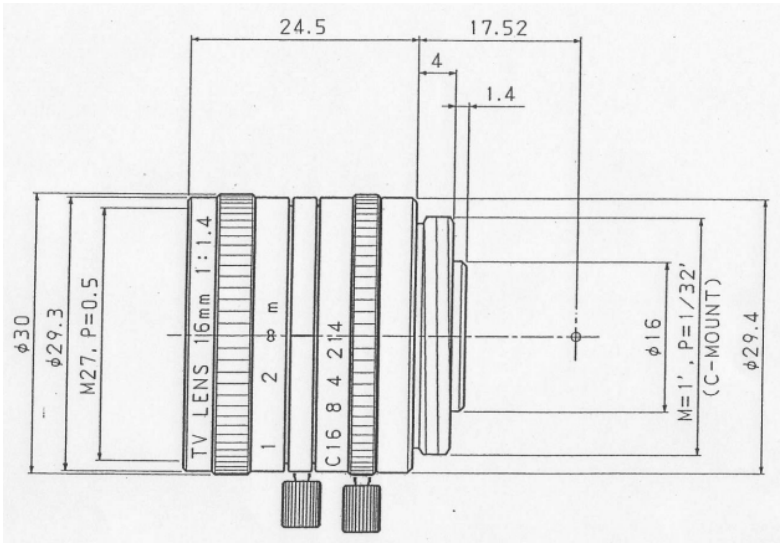
8 mm



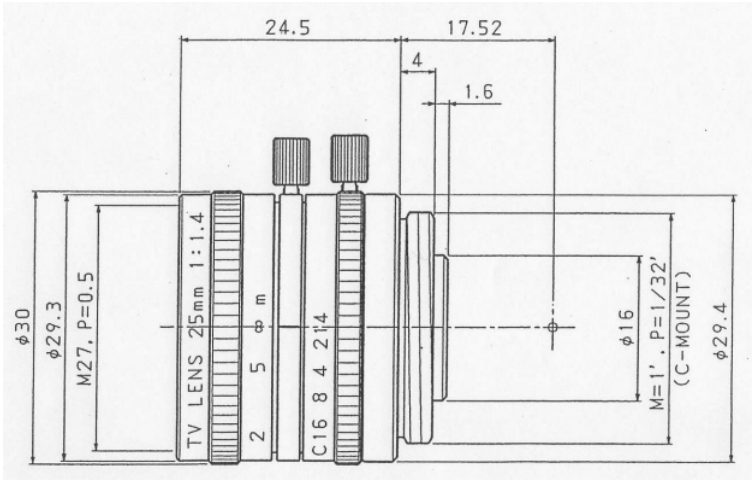
12 mm



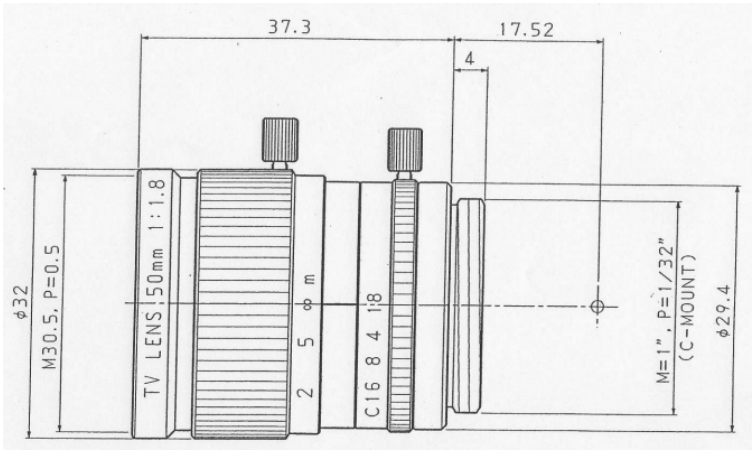
16 mm



25 mm



50 mm



5.2 Megapixel Camera Lens

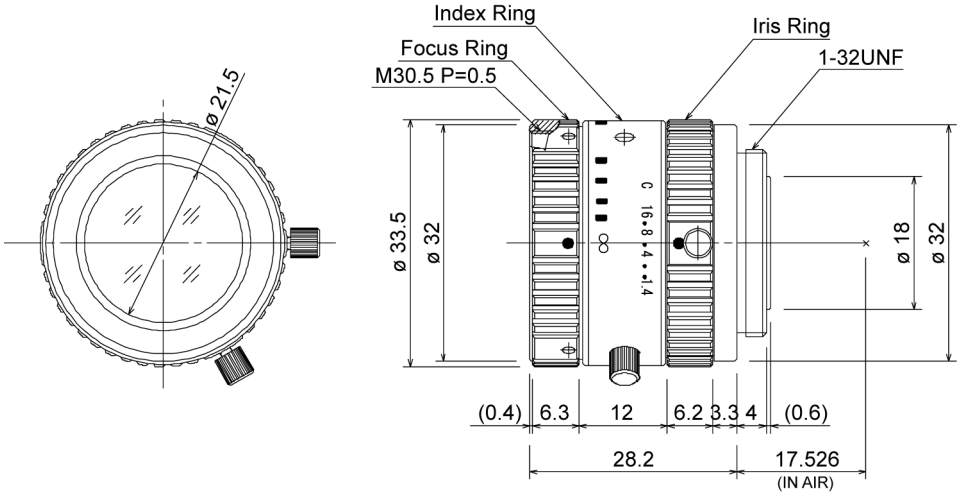
5.2.1 Lens Specification

Item	Unit	Specification				
Focal length	mm	8	12	16	25	50
Closest approach distance	m	0.1	0.15	0.3	0.3	0.5
Filter screw diameter	mm	M30.5 × P0.5	M30.5 × P0.5	M30.5 × P0.5	M30.5 × P0.5	M30.5 × P0.5
External dimensions	mm	ø 33.5 × 28.2	ø 33.5 × 28.2	ø 33.5 × 28.2	ø 33.5 × 36.0	ø 33.5 × 38.2
Mass	g	62.6	61.9	60	71.2	85

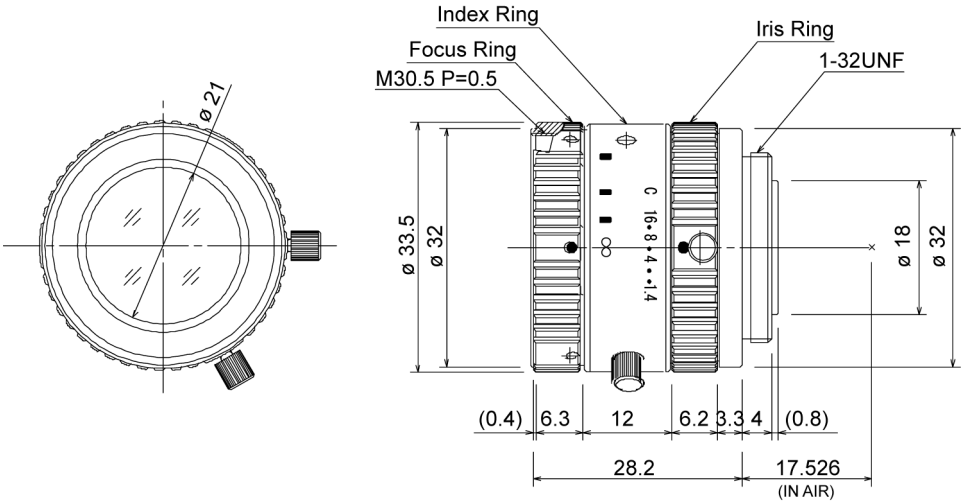
P0.5: Screw Pitch 0.5 mm

5.2.2 Outline Drawing

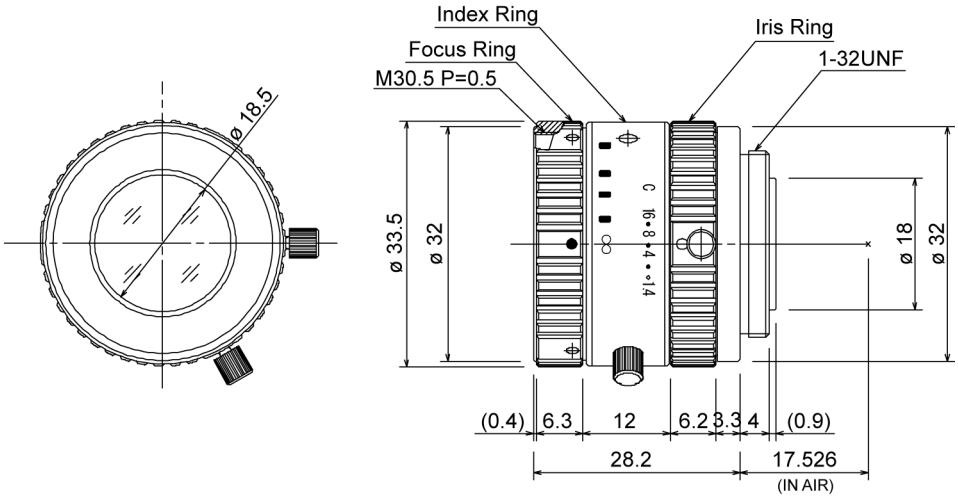
M814-MP2



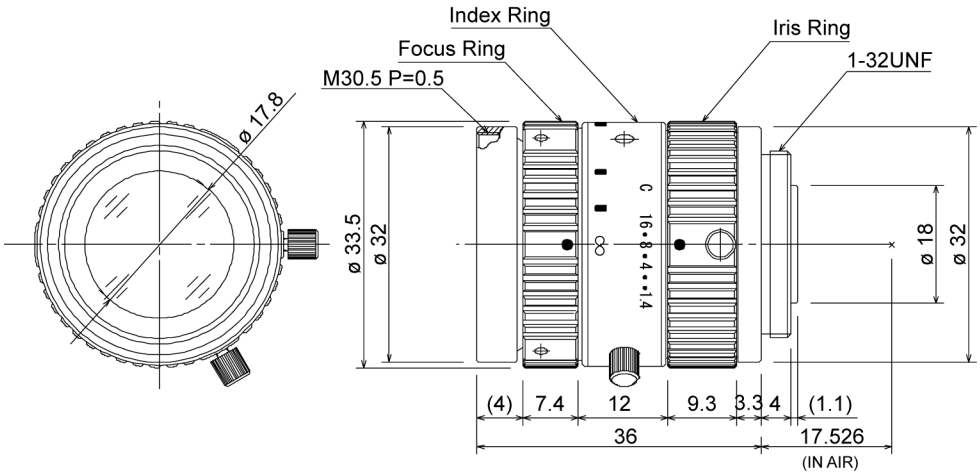
M1214-MP2



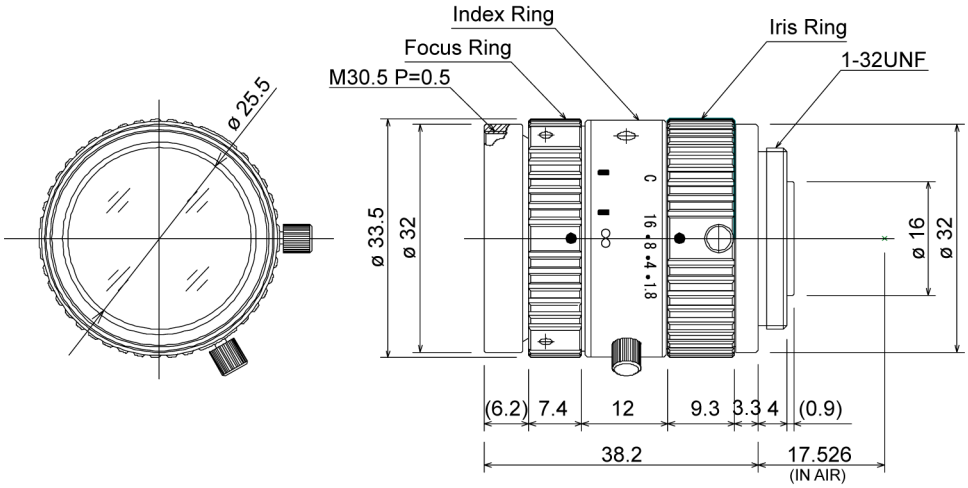
M1614-MP2



M2514-MP2



M5018-MP2



5.3 Megapixel Lens (HF)

5.3.1 Lens Specification

Item	Unit	Specification				
Focal length	mm	8	12	16	25	35
Closest approach distance	m	0.1	0.1	0.1	0.1	0.2
Filter screw diameter	mm	M30.5 × P0.5	M30.5 × P0.5	M30.5 × P0.5	M30.5 × P0.5	M30.5 × P0.5
External dimensions	mm	ø 33 × 48.5	ø 33 × 52.5	ø 33 × 52.5	ø 33 × 53.1	ø 33 × 53.1
Mass	g	95	85	90	85	85

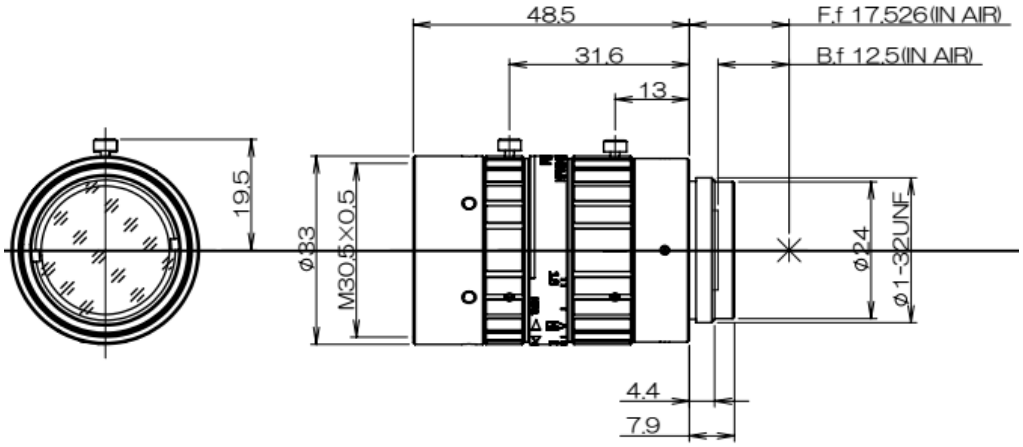
P0.5: Screw Pitch 0.5 mm

The lenses cannot be attached to USB camera.

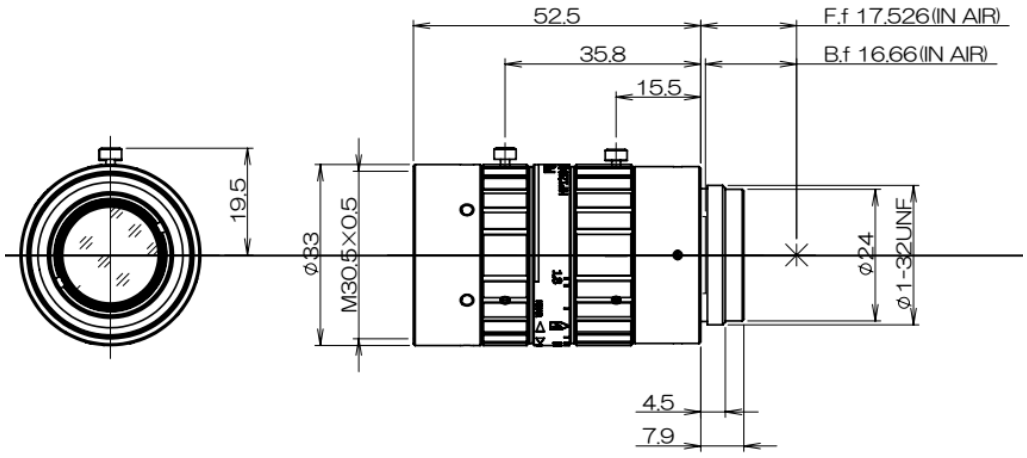
If the thickness of the extension tube is 5 mm or more, it cannot be installed.

5.3.2 Outline Drawing

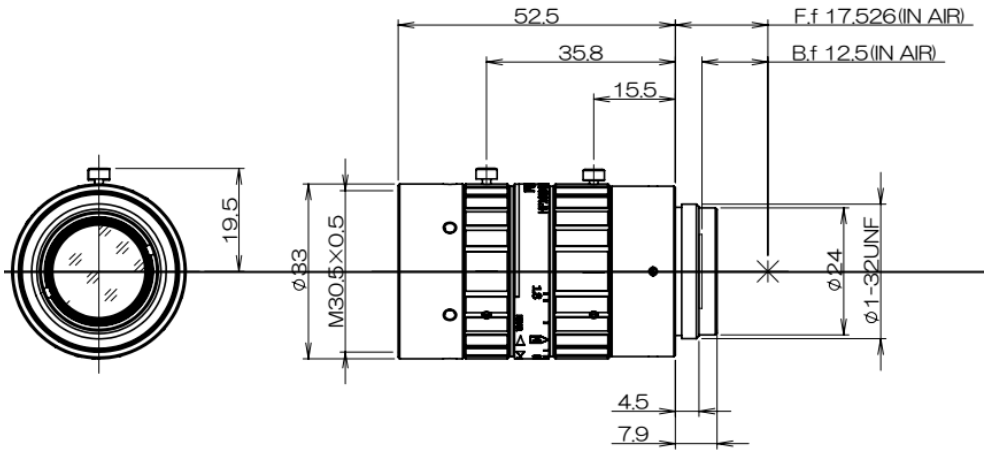
HF818-12M



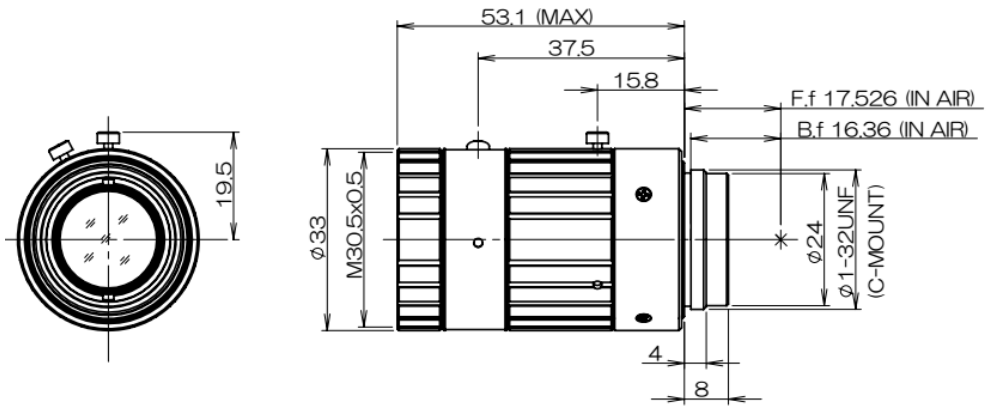
HF1218-12M



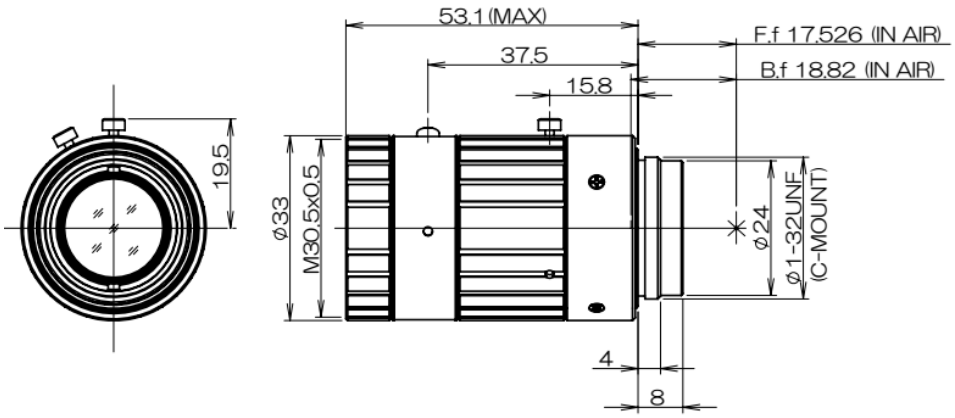
HF1618-12M



HF2518-12M



HF3520-12M



5.4 1 inch Lens

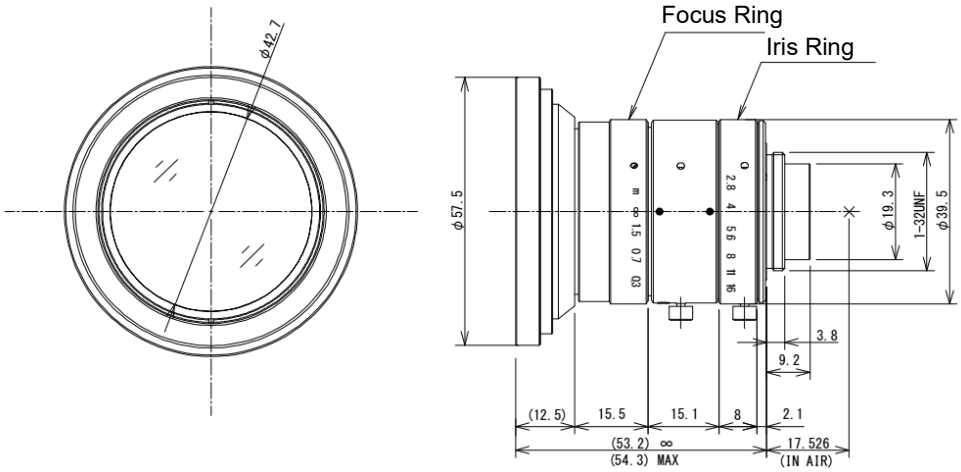
5.4.1 Lens Specification

Item	Unit	Specification					
Focal length	mm	8	12	16	25	35	50
Closest approach distance	m	0.2	0.3	0.3	0.3	0.3	0.5
Filter screw diameter	mm	—	M40.5 × P0.5	M34 × P0.5	M34 × P0.5	M34 × P0.5	M34 × P0.5
External dimensions	mm	ø 57.5 × 53.2	ø 42 × 36.1	ø 39.5 × 35.2	ø 39.5 × 34	ø 39.5 × 45.2	ø 39.5 × 45.2
Mass	g	164.8	102.8	94.4	78.6	103.0	107.0

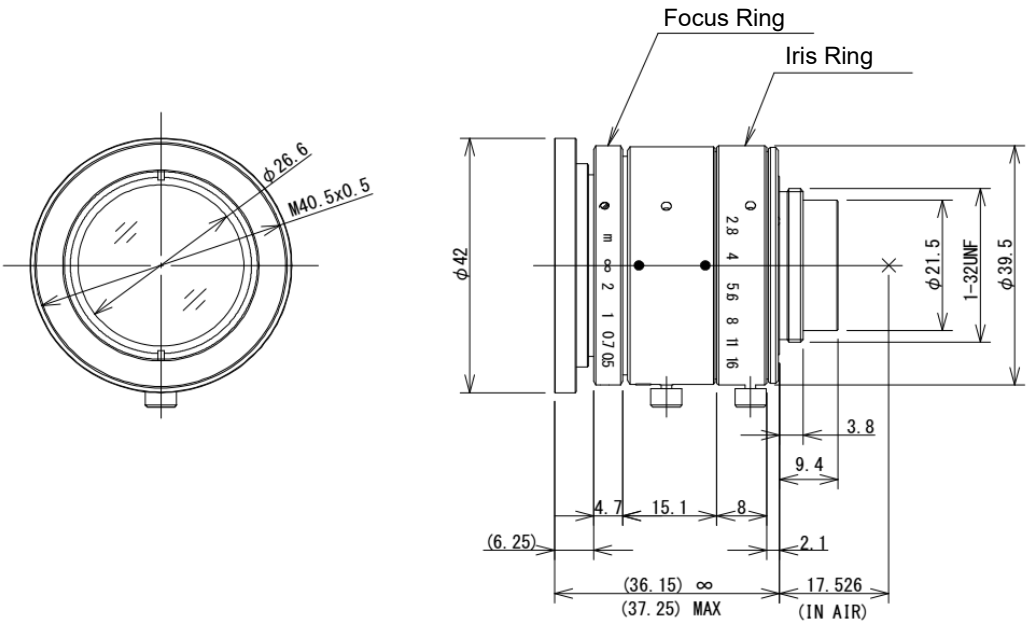
P0.5: Screw Pitch 0.5 mm

5.4.2 Outline Drawing

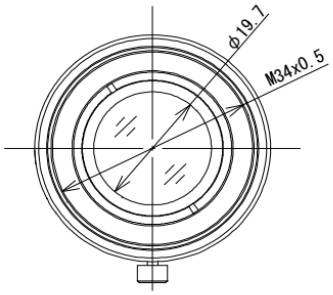
V0828-MPY2

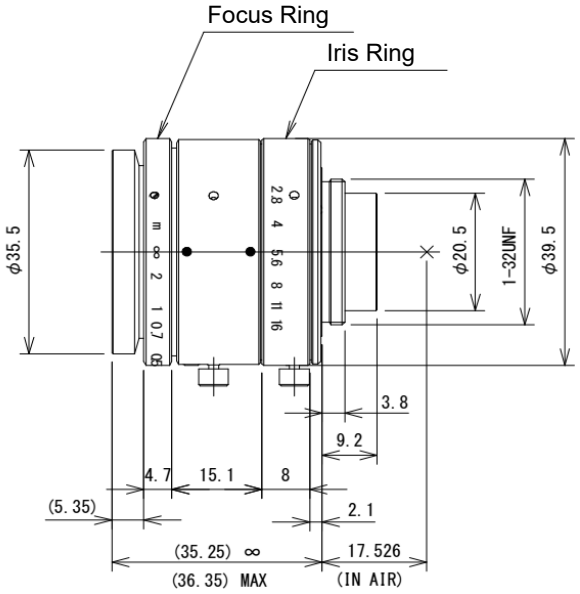


V1228-MPY2

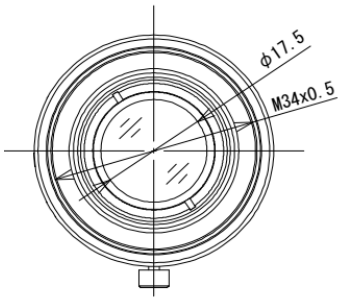


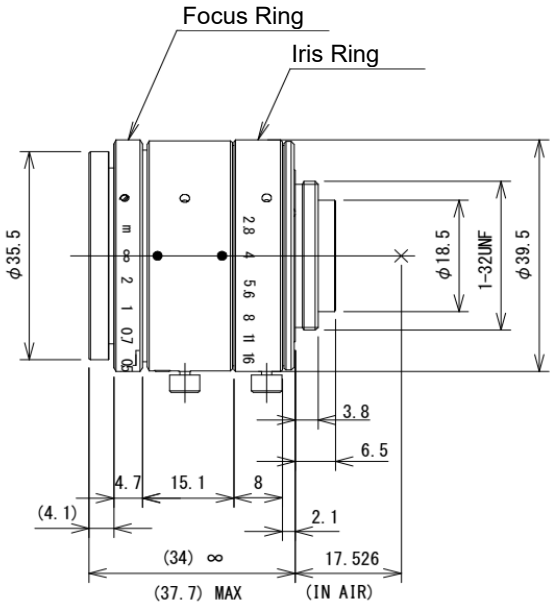
V1628-MPY2



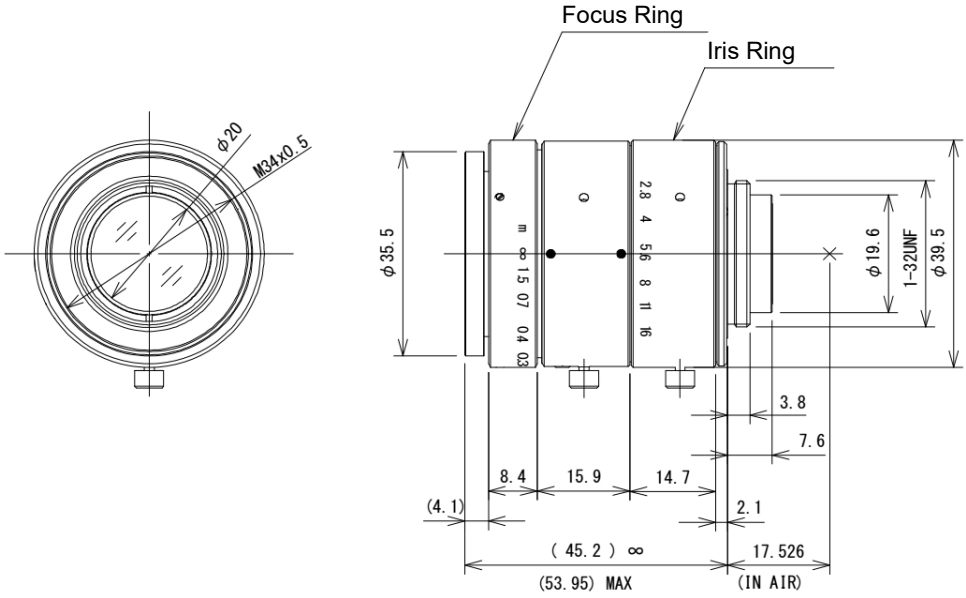


V2528-MPY

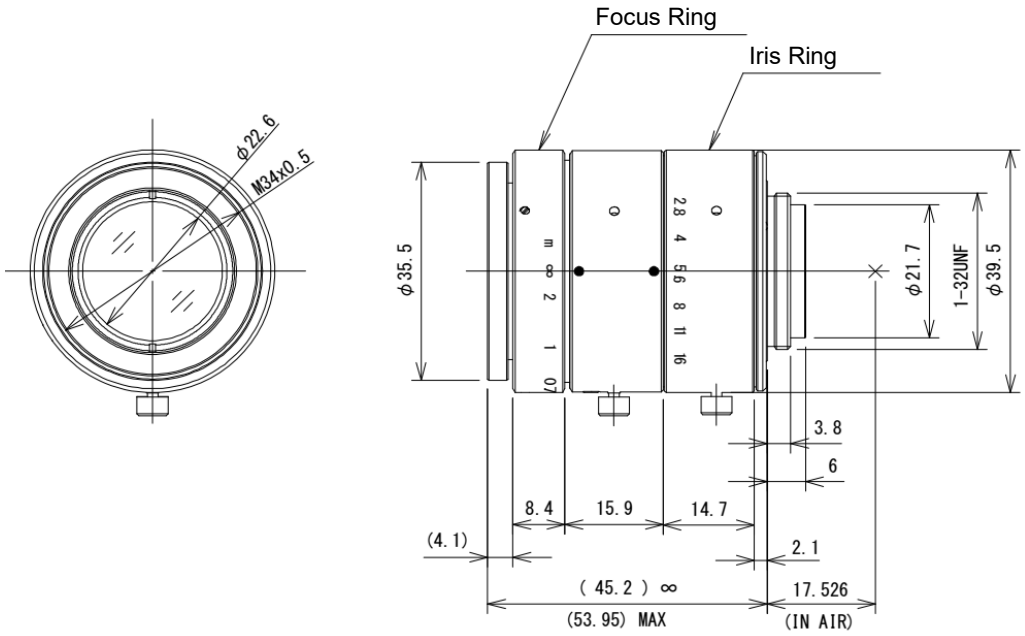




V3528-MPY



V5028-MPY



5.5 Extension Tube

5.5.1 Extension Tube Work Distance

The values in the tables below are for the camera lens kit of EPSON under LED lights. When the environment is different or using other cameras, values are different. The WD and FOV may change according to the individual variability.

Tip: Rough calculation methods are described in Appendix C.

You can select proper camera, lens, and extension tube from FOV and WD by using Optical Selection Tool.
(EPSON RC+ installation folder \Tools\CamSelectTool\CamSelectTool.exe)
For combinations which do not described in this manual, select by using Optical Selection Tool.

Standard Camera Lens

		Lens Focal Length				
		f = 8 mm	f = 12 mm	f = 16 mm	f = 25 mm	f = 50 mm
Extension Tubes	0.0 mm	174 to 1500	258 to 1500	335 to 1500	458 to 1500	907 to 1500
	0.5 mm	67 to 134	130 to 311	207 to 579	338 to 1207	775 to 1500
	1.0 mm	36 to 55	78 to 131	139 to 247	263 to 607	683 to 1500
	1.5 mm	23 to 32	58 to 84	106 to 167	219 to 415	604 to 1500
	5.0 mm			35 to 42	102 to 129	344 to 502
	10.0 mm			15-16	60 to 67	224 to 274
	15.0 mm				43-45	175 to 198
	20.0 mm					145 to 160
	40.0 mm					97 to 101

[unit: mm]

Megapixel Camera Lens

		Lens Focal Length				
		f = 8 mm	f = 12 mm	f = 16 mm	f = 25 mm	f = 50 mm
Extension Tubes	0.0 mm	100 to 1500	150 to 1500	300 to 1500	300 to 1500	500 to 1500
	0.5 mm	65 to 210	110 to 290	200 to 700	260 to 1500	480 to 1500
	1.0 mm	35 to 65	70 to 140	140 to 260	210 to 680	440 to 1500
	1.5 mm	25 to 40	50 to 85	100 to 160	180 to 430	400 to 1500
	5.0 mm			30 to 35	80 to 110	265 to 490
	10.0 mm				40 to 50	185 to 260
	15.0 mm				25 to 30	145 to 180
	20.0 mm					120 to 140
	40.0 mm					75 to 80

[unit: mm]

5.5.2 Extension Tube FOV Table

The values in the table below are for the camera lens kit of EPSON under LED lights. When the environment is different or using other cameras, values are different. The WD and FOV may change according to the individual variability.

USB camera (for CV1)

NS1044BU (Resolution: 640 × 480) + Standard camera lens

		Lens Focal Length				
		f = 8 mm	f = 12 mm	f = 16 mm	f = 25 mm	f = 50 mm
Extension Tubes	0.0 mm	85×64 to 736×553	82×62 to 468×352	82×62 to 358×270	69×52 to 229×172	69×52 to 116×87
	0.5 mm	38×28 to 70×53	45×34 to 100×75	51×38 to 140×105	51×38 to 184×139	59×44 to 116×87
	1.0 mm	23×17 to 32×24	29×22 to 45×34	35×26 to 61×46	39×29 to 92×69	51×38 to 116×87
	1.5 mm	16×12 to 21×16	23×17 to 31×23	27×20 to 42×31	33×25 to 63×42	45×34 to 116×87
	5.0 mm			11×8 to 12×9	15×11 to 19×14	24×18 to 37×27
	10.0 mm			6×5	8×6 to 10×7	14×11 to 18×14
	15.0 mm				6×5	10×8 to 12×9
	20.0 mm					8×6 to 9×7
	40.0 mm					4×3 to 5×4

[unit: mm]

USB Camera (for CV1)

NS1044BU (Resolution: 640 × 480) + Megapixel camera lens

		Lens Focal Length				
		f = 8 mm	f = 12 mm	f = 16 mm	f = 25 mm	f = 50 mm
Extension Tubes	0.0 mm	49×36 to 696×520	51×38 to 482×361	75×55 to 362×271	47×35 to 229×171	36×27 to 115×86
	0.5 mm	35×26 to 101×76	39×28 to 96×72	51×38 to 169×125	40×30 to 229×171	35×26 to 116×87
	1.0 mm	22×16 to 36×26	26×20 to 49×36	36×27 to 65×49	33×24 to 105×78	32×24 to 116×86
	1.5 mm	16×11 to 23×17	20×15 to 31×23	27×20 to 41×31	28×21 to 66×50	28×21 to 115×86
	5.0 mm			10×7 to 11×8	13×9 to 18×13	19×13 to 36×26
	10.0 mm				8×5.5 to 9×6.5	12×9 to 18×13
	15.0 mm				5×4 to 6×4.5	9×6.5 to 11.5×9
	20.0 mm					6.5×5 to 8.5×6
	40.0 mm					3.5×2.5 to 4×3

[unit: mm]

USB camera (for CV1)

NS4133BU/CU (Resolution: 1280 × 1024) + Standard Camera Lens

		Lens Focal Length				
		f = 8 mm	f = 12 mm	f = 16 mm	f = 25 mm	f = 50 mm
Extension Tubes	0.0 mm	161×121 to 1322×1052	150×114 to 828×662	144×109 to 632×506	122×92 to 406×305	122×97 to 206×165
	0.5 mm	68×51 to 126×95	80×60 to 179×136	91×69 to 247×187	90×68 to 326×261	103×82 to 205×164
	1.0 mm	40×30 to 57×42	51×39 to 81×61	62×47 to 108×82	69×53 to 163×123	90×72 to 205×164
	1.5 mm	29×21 to 37×28	40×30 to 54×41	48×37 to 74×56	58×44 to 111×84	78×60 to 205×164
	5.0 mm			19×14 to 22×16	26×20 to 34×26	42×32 to 65×49
	10.0 mm			10×7 to 11×8	15×11 to 17×13	25×19 to 32×25
	15.0 mm				10×8 to 11×9	18×14 to 22×17
	20.0 mm					14×11 to 16×12
	40.0 mm					8×6

[unit: mm]

USB Camera (for CV1)

NS4133BU/CU (Resolution: 1280 × 1024) + Megapixel camera lens

		Lens Focal Length				
		f = 8 mm	f = 12 mm	f = 16 mm	f = 25 mm	f = 50 mm
Extension Tubes	0.0 mm	87×68 to 1230×981	90×72 to 851×680	132×104 to 639×510	83×66 to 405×323	64×52 to 204×163
	0.5 mm	62×50 to 179×143	70×54 to 170×137	90×72 to 299×236	71×56 to 405×323	62×50 to 206×165
	1.0 mm	39×30 to 64×50	47×38 to 87×68	64×52 to 115×92	58×46 to 185×147	56×46 to 206×163
	1.5 mm	28×20 to 41×32	35×28 to 54×44	49×38 to 73×58	51×40 to 117×94	51×40 to 204×163
	5.0 mm			18×14 to 20×16	24×18 to 32×26	34×26 to 64×50
	10.0 mm				14×11 to 16×13	21.5×17 to 32×25
	15.0 mm				9×8 to 11×9	16×13 to 20.5×17
	20.0 mm					12×10 to 15×12
	40.0 mm					6.5×5 to 7.5×6

[unit: mm]

USB Camera (for CV1)

NS1500BU/CU (Resolution: 2560 × 1920) + Megapixel camera lens

		Lens Focal Length				
		f = 8 mm	f = 12 mm	f = 16 mm	f = 25 mm	f = 50 mm
Extension Tubes	0.0 mm	72×53 to 1021×763	75×56 to 707×529	110×81 to 531×397	69×51 to 336×251	53×40 to 169×127
	0.5 mm	51×39 to 149×111	58×42 to 141×106	75×56 to 248×183	59×44 to 336×251	51×39 to 171×128
	1.0 mm	33×23 to 53×39	39×29 to 72×53	53×40 to 95×72	48×36 to 154×114	47×36 to 171×127
	1.5 mm	23×17 to 34×25	29×22 to 45×34	40×29 to 61×45	42×31 to 97×73	42×31 to 169×127
	5.0 mm			15×11 to 17×12	20×14 to 26×20	28×20 to 53×39
	10.0 mm				11.5×8.5 to 13×10	18×13 to 26.5×19.5
	15.0 mm				7.5×6 to 9×7	13×10 to 17×13
	20.0 mm					10×7.5 to 12.5×9
	40.0 mm					5.5×3.5 to 6×4.5

[unit: mm]

GigE Camera (for PV1)

acA640-100gm, acA640-120gm (Resolution: 640 × 480)
+ Megapixel Camera Lens

		Lens Focal Length				
		f = 8 mm	f = 12 mm	f = 16 mm	f = 25 mm	f = 50 mm
Extension Tubes	0.0 mm	46×34 to 650×486	48×36 to 450×337	70×52 to 338×253	44×33 to 214×160	34×26 to 108×81
	0.5 mm	33×25 to 95×71	37×27 to 90×68	48×36 to 158×117	38×28 to 214×160	33×25 to 108×82
	1.0 mm	21×15 to 34×25	25×19 to 46×34	34×26 to 61×46	31×23 to 98×73	30×23 to 108×81
	1.5 mm	15×11 to 22×16	19×14 to 29×22	26×19 to 39×29	27×20 to 62×47	27×20 to 108×81
	5.0 mm			10×7 to 11×8	13×9 to 17×13	18×13 to 34×25
	10.0 mm				7.5×5.5 to 8.5×6.5	11.5×8.5 to 17×12.5
	15.0 mm				5×4 to 6×4.5	8.5×6.5 to 11×8.5
	20.0 mm					6.5×5 to 8×6
	40.0 mm					3.5×2.5 to 4×3

[unit: mm]

GigE Camera (for PV1)

acA1600-20gm/gc, acA1600-60gm/gc (Resolution: 1600 × 1200)
+ Megapixel Camera Lens

		Lens Focal Length				
		f = 8 mm	f = 12 mm	f = 16 mm	f = 25 mm	f = 50 mm
Extension Tubes	0.0 mm	90×66 to 1276×954	94×70 to 883×661	137×102 to 663×496	86×64 to 420×314	66×51 to 212×159
	0.5 mm	64×49 to 186×139	72×53 to 176×133	94×70 to 310×229	74×55 to 420×314	64×49 to 214×161
	1.0 mm	41×29 to 66×49	49×37 to 90×66	66×51 to 119×90	60×45 to 192×143	58×45 to 214×159
	1.5 mm	29×21 to 43×31	37×27 to 56×43	51×37 to 76×56	53×39 to 121×92	53×39 to 214×159
	5.0 mm			19×13 to 21×15	25×17 to 33×25	35×25 to 66×49
	10.0 mm				14.5×10.5 to 16.5×12.5	22.5×16.5 to 33×23.5
	15.0 mm				9.5×7.5 to 11.5×8.5	16.5×12.5 to 21.5×16.5
	20.0 mm					12.5×9.5 to 16.5×11.5
	40.0 mm					6.5×4.5 to 7.5×5.5

[unit: mm]

GigE Camera (for PV1)

acA2500-14gm/gc (Resolution: 2560 × 1920) + Megapixel Camera Lens

		Lens Focal Length				
		f = 8 mm	f = 12 mm	f = 16 mm	f = 25 mm	f = 50 mm
Extension Tubes	0.0 mm	72×53 to 1021×763	75×56 to 707×529	110×81 to 531×397	69×51 to 336×251	53×40 to 169×127
	0.5 mm	51×39 to 149×111	58×42 to 141×106	75×56 to 248×183	59×44 to 336×251	51×39 to 171×128
	1.0 mm	33×23 to 53×39	39×29 to 72×53	53×40 to 95×72	48×36 to 154×114	47×36 to 171×127
	1.5 mm	23×17 to 34×25	29×22 to 45×34	40×29 to 61×45	42×31 to 97×73	42×31 to 169×127
	5.0 mm			15×11 to 17×12	20×14 to 26×20	28×20 to 53×39
	10.0 mm				11.5×8.5 to 13×10	18×13 to 26.5×19.5
	15.0 mm				7.5×6 to 9×7	13×10 to 17×13
	20.0 mm					10×7.5 to 12.5×9
	40.0 mm					5.5×3.5 to 6×4.5

[Unit: mm]

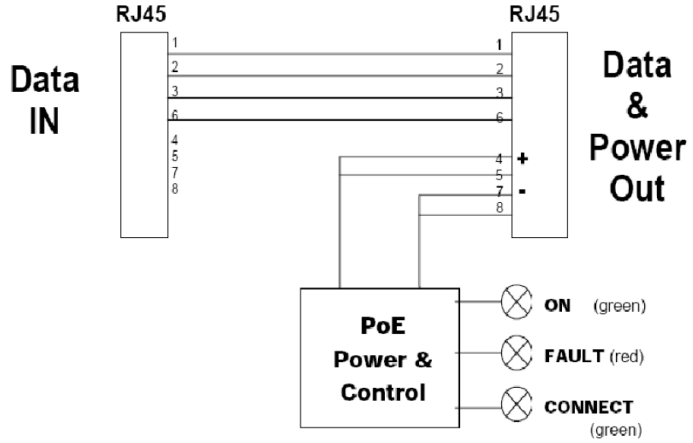
6. Option Product Specifications

6.1 PoE Injector

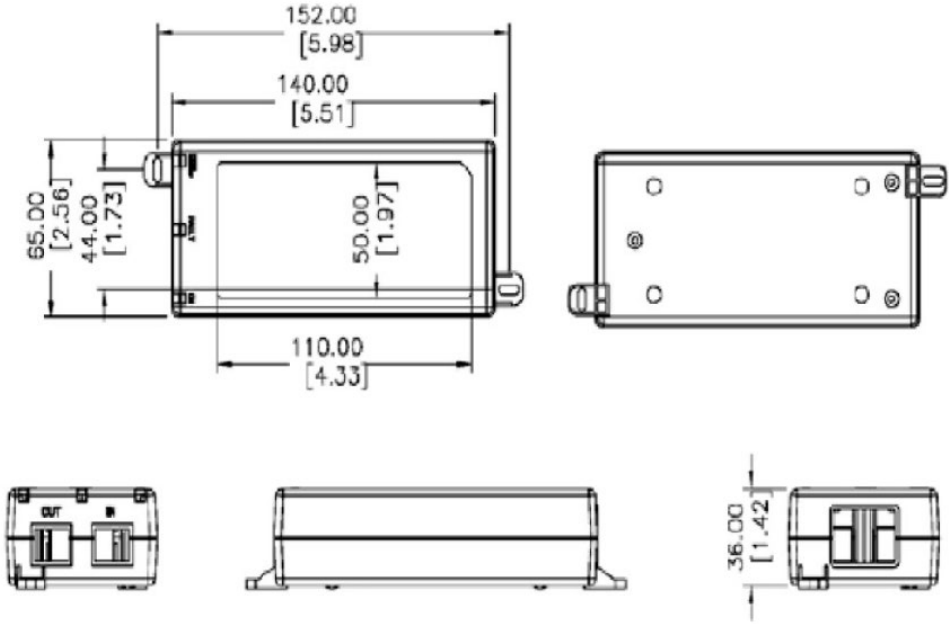
6.1.1 Specifications

External dimensions	W 140 mm × H 65 mm × D 36 mm
Mass	0.2 kg
Power voltage	100 - 240 V
AC input current	Max. 0.5A (RMS) at 90V Max. 0.35A (RMS) at 240V
Operating temperature	0 to 40 °C
Operating humidity	5 to 90 %
EMC	FCC Class B, EN55022 Class B

Internal block diagram



6.1.2 External Dimensions

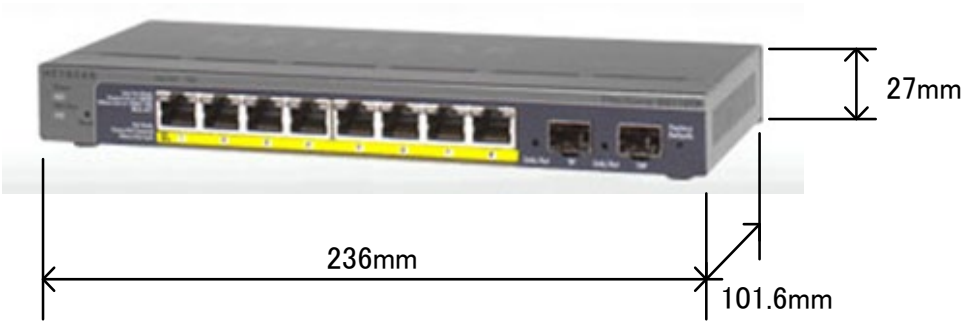


6.2 PoE Switching Hub

6.2.1 Specifications

External dimensions	W 236 mm × H 101.6 mm × D 27 mm
Mass	0.7 kg
Power voltage	100 - 240V (AC adapter: 48VDC)
Power Consumption	Max.59.3 W
Operating temperature	0 to 50 °C
Operating humidity	10 to 90%
Connection configuration	Automatic negotiation, automatic crossover, PoE support
Transfer rate	10, 100, 1000 Mbit/s (RJ45)
Port count, PoE	8, Max. 46W
Jumbo frame	Supported
Electromagnetic compatibility	CE Class B, FCC Class B, VCCI Class B
Noise emission	EN55022 (CISPR 22)
Interference immunity	EN55024, EN50082-1
UL	UL / cUL (UL 1950) / cUL IEC950 / EN60950)

6.2.2 External Dimensions

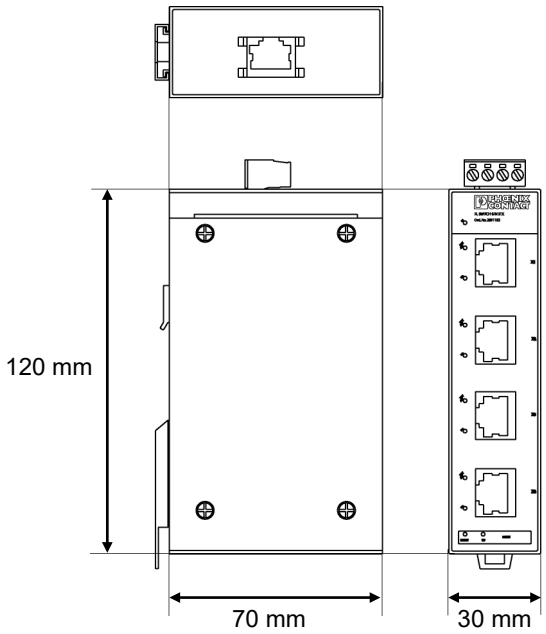


6.3 Ethernet Switch FL SWITCH SFN 5TX

6.3.1 Specifications

External dimensions	W 30 mm × H 120 mm × D 70 mm
Mass	265 g
Power voltage	18.5 VDC to 30.2VDC
Power consumption	90 mA
Operating temperature	0 to 60 °C
Operating humidity	10 to 95%
Connection configuration	Automatic negotiation, automatic crossover, QoS support
Transfer rate	10, 100 Mbit/s (RJ45)
Protection code	IP20
Electromagnetic compatibility	CE Marking EMC directive
Noise emission	EN61000-6-4
Interference immunity	EN61000-6-2

6.3.2 External dimensions



6.4 Camera Mounting Unit

Mounting a mobile Camera to the end of the robot arm is easy if you use a camera mounting unit. The brackets provide the necessary hardware to mount a camera to the end of the arm close to the end effector.

NOTE

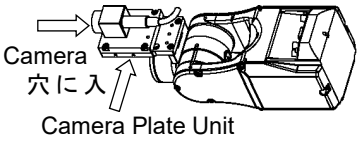

When you mount the camera head to a moving part such as the robot arm, make sure to secure the cable properly to keep the camera head connector and the cable from all the stress and shake. If the cable is not properly secured, it may have a cable disconnection and/or loose connection.

6.4.1 6-Axis Robot

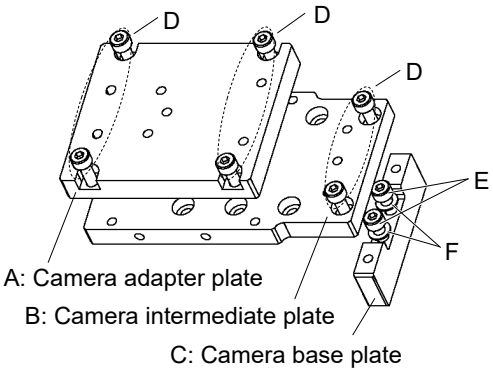
Use C4 as an example to describe the following installation procedures.
For other 6-axis robots, refer to the each manual.

To mount a camera to the Manipulator, you need to mount the camera plate unit first.

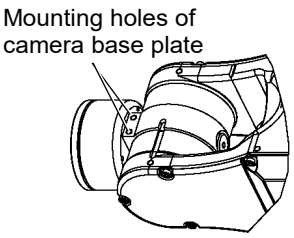
End effctor fitted with a camera



Parts List		Qty.
A	Camera adapter plate	1
B	Camera intermediate plate	1
C	Camera base plate	1
D	Hexagon socket head boltsM4×12	6
E	Hexagon socket head boltsM4×20	2
F	Plain washer for M4 (small washer)	2



(1) Mount the camera base plate to the Manipulator.
2-M4 × 20 + Plain washer for M4 (small washer)



(2) Mount the camera mid plate to the base plate.
2-M4×12

NOTE


The motion range and dimension of the Manipulator with the camera installed may vary depending on the mounting hole of camera mid plate. The details are described in the table below.

(3) Mount the camera to the camera adapter plate.

NOTE

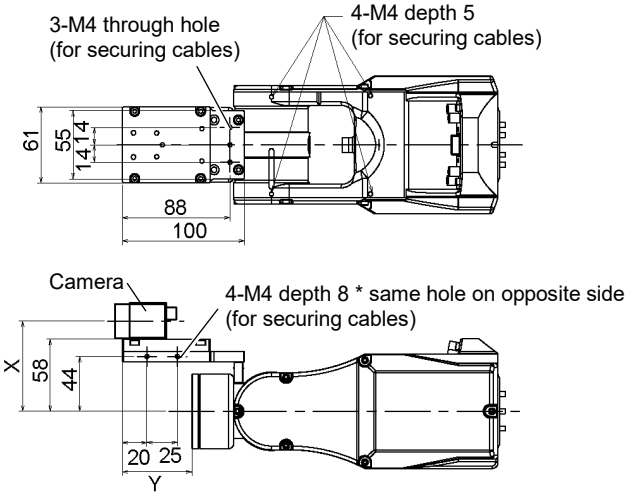

According to the camera, the available mounting hole of adapter plate will be different. The details are described below.

(4) Mount the camera adapter plate and camera to the camera mid plate.
4-M4×12

(5) Secure the cables at the position where they donot interfere with the Manipulator motion.

NOTE When securing the cables, check if the cables bend radius is big enough and the cables are not rubbing against each other while the Manipulator moves. Otherwise, the cables will be disconnected.

Dimension of the camera with the plate unit

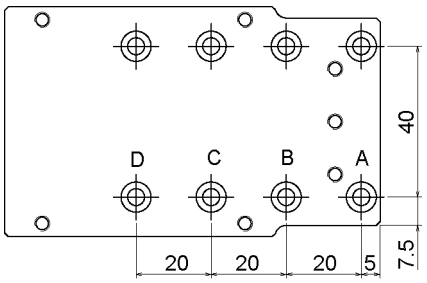


Dimensions of X and Y change depending on the position of the camera mid plate and the camera size. Refer to the table below for the values.

Camera intermidiate plate

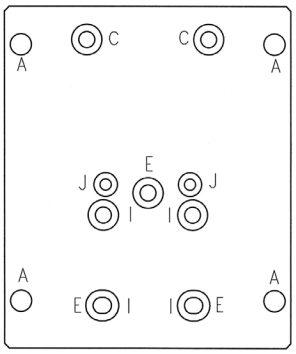
The camera mid plate uses the mounting holes A to D.

By using the different mounting holes, it can be mounted to the camera base plate in the different four positions.

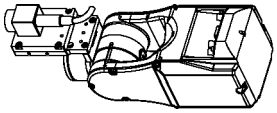


Camera adapter plate

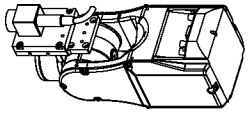
Each camera uses the different mounting holes.
USB camera : J (two)
GigE camera : E (three)



Mounting example



Using the mounting hole A



Using the mounting hole C

Camera and Joint #5 motion range (reference values)

The Joint #5 motion range varies depending on the mounting position of camera mid plate and the camera you are using.

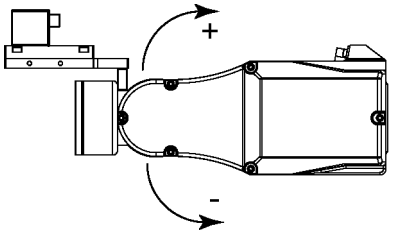
The table below shows the motion range (reference values) based on the available cameras for this option and the mounting positions of the camera mid plate. The values in the table may vary depending on how to secure the cables.

By changing the Y position, you can extend the distance from the end effector mounting surface to the camera. Also, you can attach the larger end effector. However, be careful about the Joint #5 motion range that will be limited in this case.

	A	B	C	D	X
USB camera, GigE camera	–135 to +60°	–135 to +50°	–135 to +35°	–135 to +25°	72.5 mm

	A	B	C	D
Y	57 mm	37 mm	17 mm	7 mm

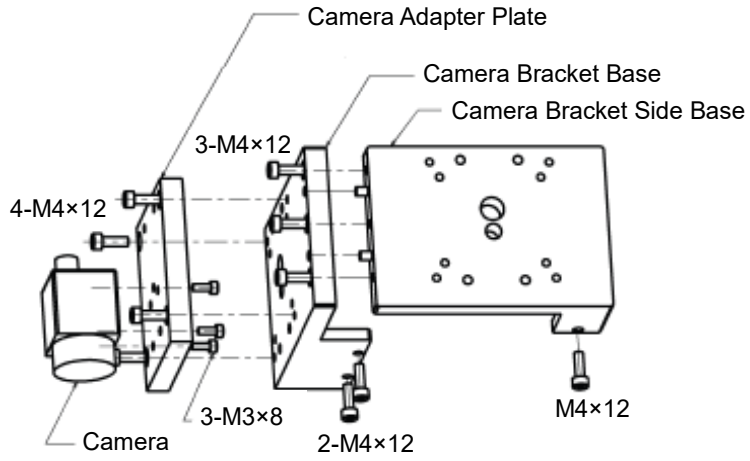
Direction of the Joint #5 motion



6.4.2 SCARA Robot

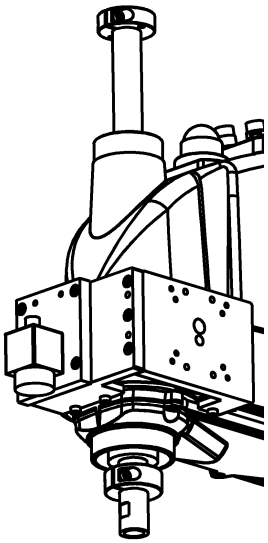
Parts List

Camera adapter plate:	1	
Camera bracket base:	1	
Camera bracket side base:	1	
Hexagon socket head bolts M3 × 8:	3	Tightening torque 245 N·cm (25kgf·cm)
Hexagon socket head bolts M4 × 12:	10	Tightening torque 280 N·cm (29kgf·cm)

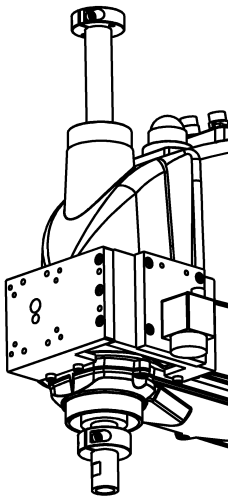


Installation

Install the camera mounting unit to the Arm #2. (See the figure below.)



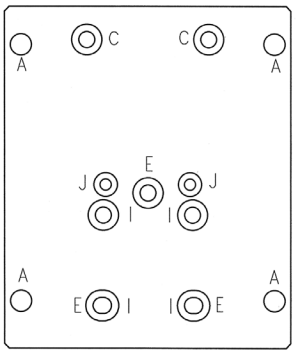
Arm #2 End



Arm #2 Side

Camera adapter plate

Each camera uses the different mounting holes.
USB camera : J (two)
GigE camera : E (three)



Setup

1. Vision Guide 7.0 Software Installation

Vision Guide 7.0 is included in the EPSON RC+ 7.0.

Follow the instructions in *the EPSON RC+ 7.0 User's Guide* for installing the EPSON RC+ 7.0.

When installing the PV1, make sure to enable the GigE camera driver option.

1.1 Software Option Key

To use the following functions of the Vision Guide, software option key should be enabled.

- PV1
- OCR function

For details on the option key, refer to *Options Command (Setup Menu)* in the *EPSON RC+ 7.0 User's Guide*.

1.2 PV1 Software Option Key

This is a software option key for using the PV1.

The option key will be stored in the Robot Controller. Therefore, enable the option key after connecting to the Controller.

Tip:
This software option key is not necessary when you use the CV1/CV2.

1.3 OCR Option Key

This is a software option key for using the OCR function.

The option key will be stored in the Robot Controller. Therefore, enable the option key after connecting to the Controller.

2. Software Configuration

Before you can use the Vision Guide 7.0 with the EPSON RC+ 7.0, you need to configure the camera settings. The cameras indicated here are each camera of the CV1/CV2 and GigE cameras of the PV1.

To use the cameras with your Controller and the EPSON RC+ 7.0, you need to configure the TCP/IP settings of the cameras for communicating with the Controller and PC via Ethernet.

The cameras use static IP addressing. You must configure the IP address, IP Mask, and optionally the IP Gateway of the camera so that the PC and Controller can communicate with it.
For example, the table below shows typical IP address assignments for the PC, Controller, and camera on subnet 192.168.0.

Device	IP Address
Development PC	192.168.0.10
Controller	192.168.0.1
Camera	192.168.0.3

To change the TCP/IP settings of the CV1/CV2 camera, you must run the EPSON RC+ 7.0 on the PC with the same subnet as the camera.

Tips:

The TCP/IP settings of the CV1/CV2 can be changed by connecting the monitor and the USB mouse.

IP address which is in the same subnet as the Controller and the development PC should be set at camera configuration.

Default IP setting of the GigE camera is unconfigured. If the DHCP server does not exist on the network in the DHCP mode, IP address of 169.254.xxx.xxx will be automatically set. Since this automatically set IP address changes each time the Vision Guide is started, it is necessary to set a static IP address before using the Vision Guide. When setting the IP address of the GigE camera, it is not necessary to set the same subnet as the GigE camera (169.254.xxx.xxx) before starting the Vision Guide.

2.1 Network Configuration of Development PC and Vision PC

Following configuration is necessary when connecting the development PC with the Robot Controller using the Ethernet (refer to *Setup: 4. Connection*).

When using the PC as the Vision PC, configure the setting in the next chapter after completing setting in this chapter.

2.1.1 LAN setting

(1) Open the Windows Control Panel.

(2) Click <Network Connections>.

(3) Click< Local Area Connection>.

(4) Select [Internet Protocol (TCP/IP)] and click <Properties>.

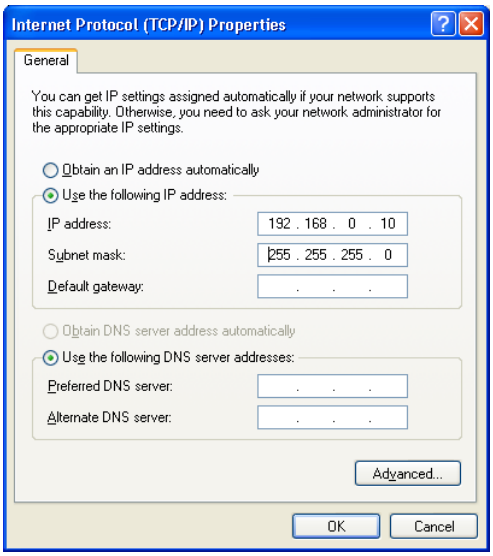
(5) Record the current settings.

(6) Select [Use the following IP address].

(7) Enter the following:

IP address: 192.168.0.10

Subnet mask: 255.255.255.0



(8) Click <OK> to save the changes.

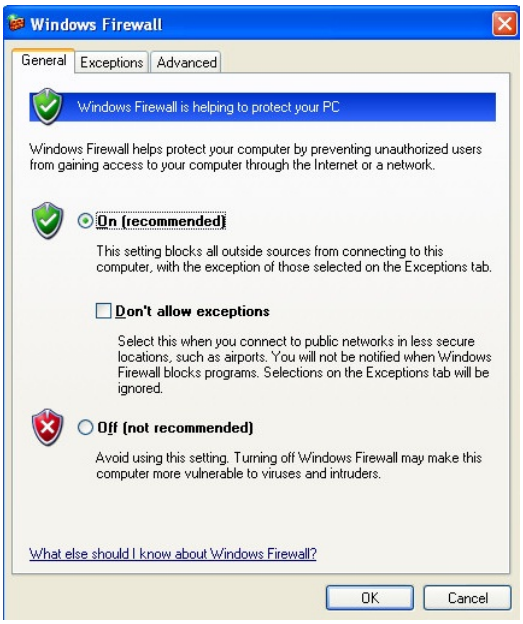
NOTE

The Robot Controller, the CV1/CV2, and the GigE camera do not support the internet protocol version 6 (TCP/IPv6). When connecting via the Ethernet, make sure to use the internet protocol version 4 (TCP/IPv4).

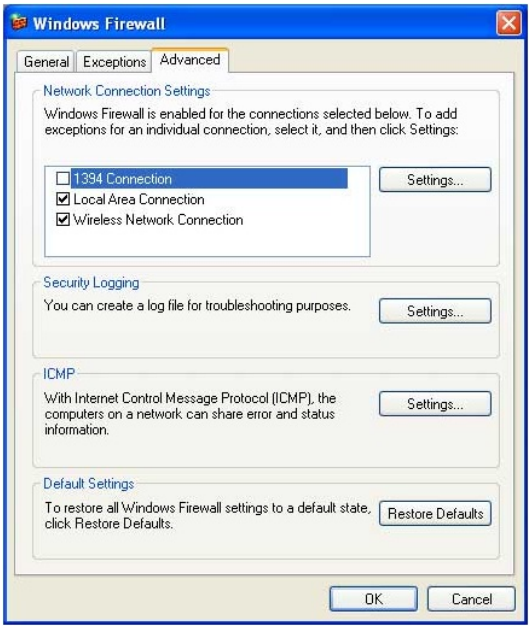
2.1.2 Disabling the Firewall

This section describes how to disable the firewall. This step is necessary since the firewall judged the packets sent from the Robot Controller, Compact Vision, and GigE camera as attacks and block out them. Setting of the firewall can be done in the [Windows Firewall] in the Control Panel.

First, select the [General] tab. Select the <Enable> button to enable the firewall.



Then, select the [Advanced] tab and uncheck the network cards to which the Robot Controller, Compact Vision, and GigE camera are connected.



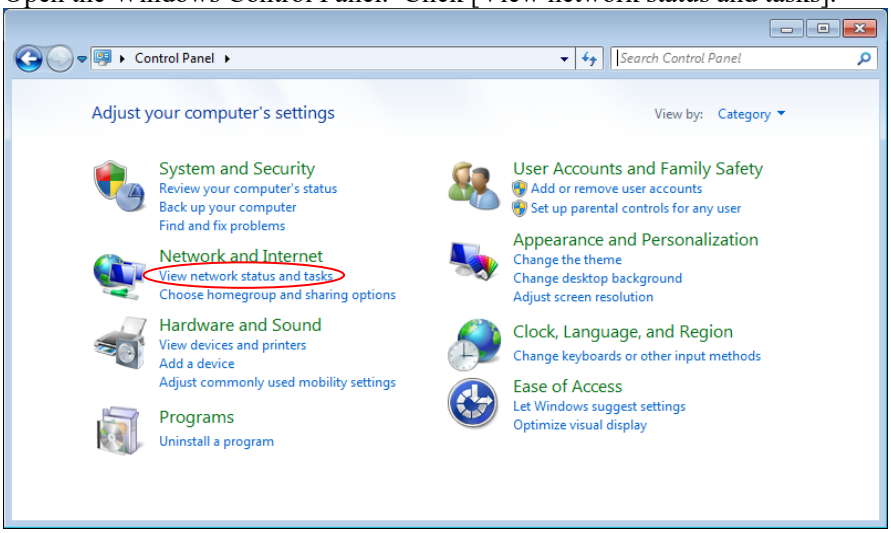
Click <OK> and close the dialog box.

2.2 Network Configuration of Vision PC

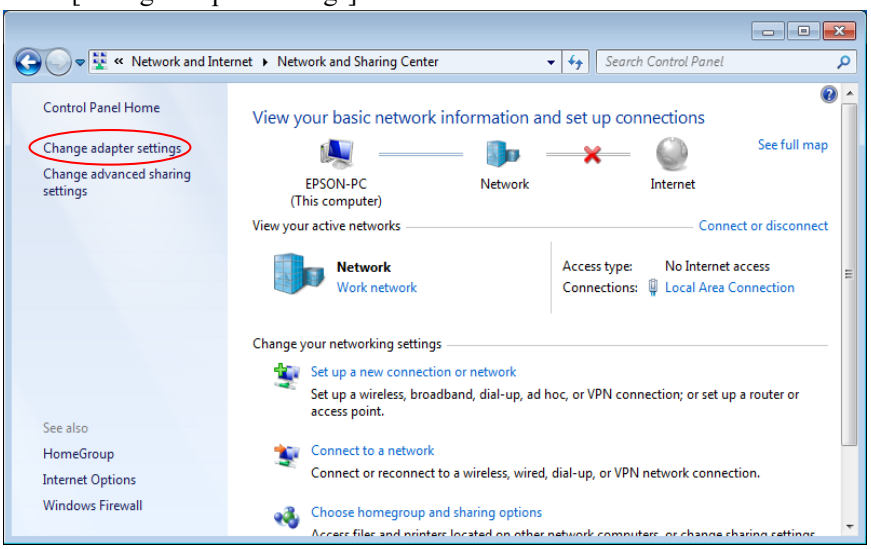
2.2.1 Network Driver Setting Confirmation

To set the computer as the Vision PC, follow the instructions below to set the network driver after installing the EPSON RC+ 7.0.

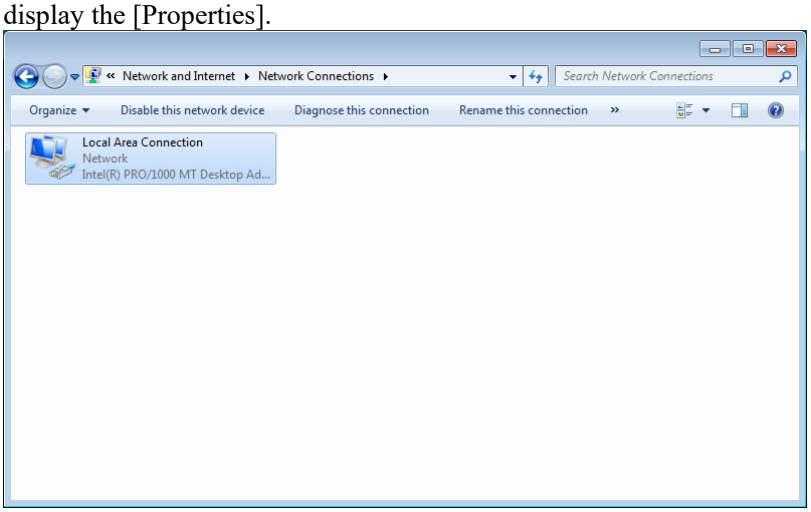
(1) Open the Windows Control Panel. Click [View network status and tasks].



(2) Click [Change adapter settings].



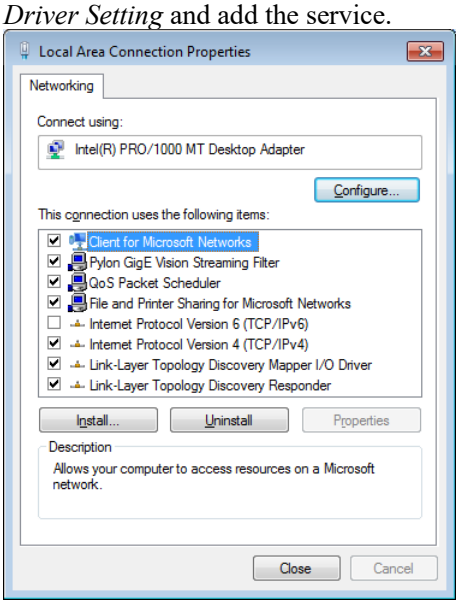
(3) Select the adapter to which the GigE camera is connected by double-clicking and display the [Properties].



(4) When “Pylon Performance Driver” is used, “Pylon GigE Vision Adapter” is shown in [Connect using:].

Tip:
If NIC of Intel PRO 1000 series is used, “Pylon Performance Driver” will be used. If other NIC are used, “Pylon Performance Driver” cannot be used. In this case, Pylon Filter Driver needs to be used.

(5) Check that “Pylon GigE Vision Streaming Filter” is registered and the checkbox is checked.
If “Pylon GigE Vision Streaming Filter” is not registered, refer to *Setup2.2.2 Filter Driver Setting* and add the service.

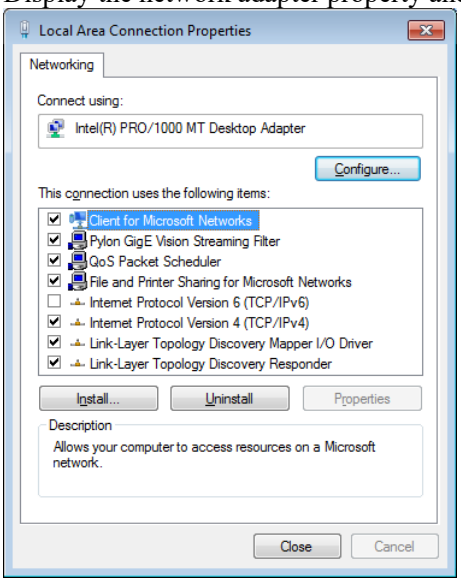


Tip: If the image loading error occurs

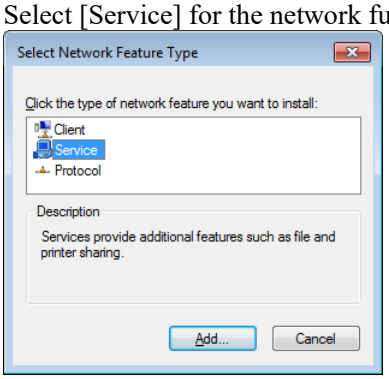
Check for TCP/IP offload setting in the network driver setting. If TCP checksum offload and UDP checksum offload are enabled, communication error may occur.

2.2.2 Filter Driver Setting

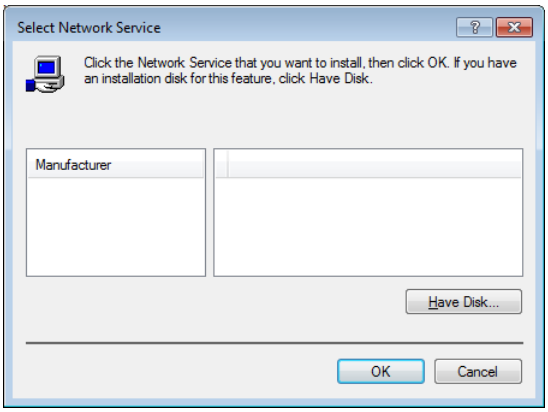
(1) Display the network adapter property and click the <Install> button.



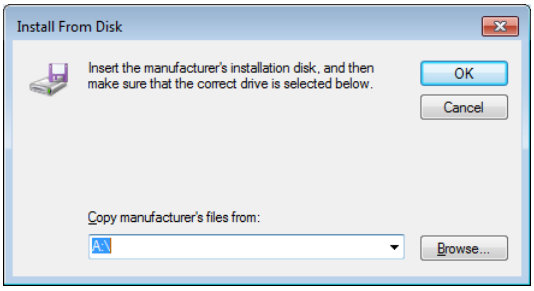
(2) Select [Service] for the network function type and click <Add>.



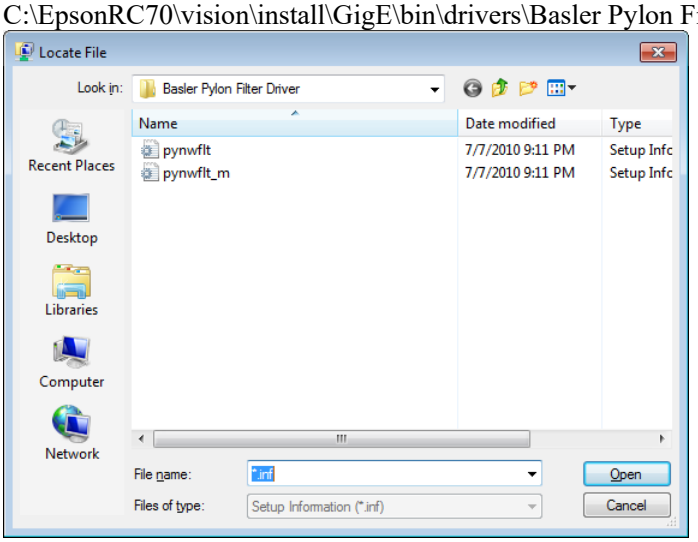
(3) Click <Have Disk…>.



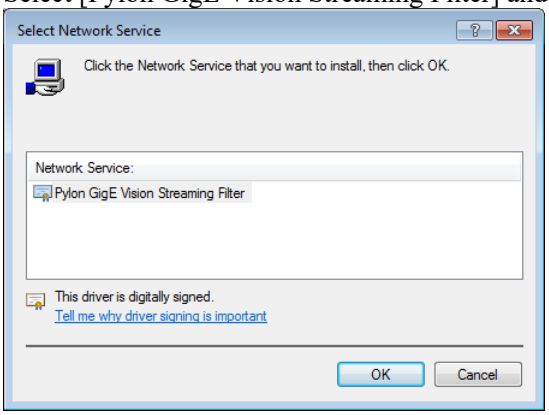
(4) Click<Browse…>.



(5) Specify the following path in the file selection dialog box.
C:\EpsonRC70\vision\install\GigE\bin\drivers\Basler Pylon Filter Driver



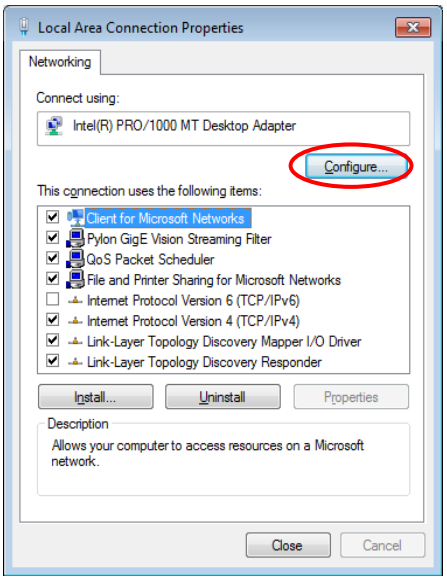
(6) Select [Pylon GigE Vision Streaming Filter] and click <OK>.



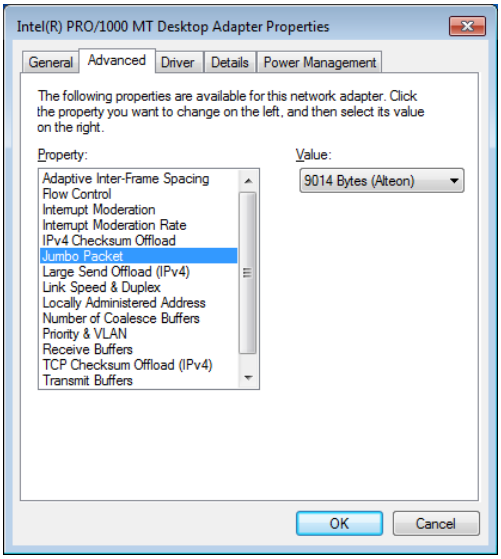
(7) If the dialog box asking whether to shutdown and restart the computer appears, click <Yes>.

2.2.3 Jumbo Frame Setting

(1) Display the network adapter property and click the <Configure> button.



(2) Select "Jumbo Packet" in the [Advanced] tab.
Set the frame size according to the system network configuration.
(GigE camera support up to 8 KB.)



2.2.4 Precautions for Vision PC

When using multiple network adapters

Make sure to set each network adapter to different subnets.

All GigE cameras connected to each adapter should be assigned to the same subnet.

If a network card has multiple Ethernet ports, each network port should be considered as independent “multiple network adapter”.

Available network adapters

GigE cameras must be used with the network adapters which have Intel PRO 1000 series NIC (and which must be supporting Gigabit Ethernet (1000Mbps)).

For details of available network adapters, refer to *Installation 4.3.1 System Requirements*.

Recommended Network Configuration

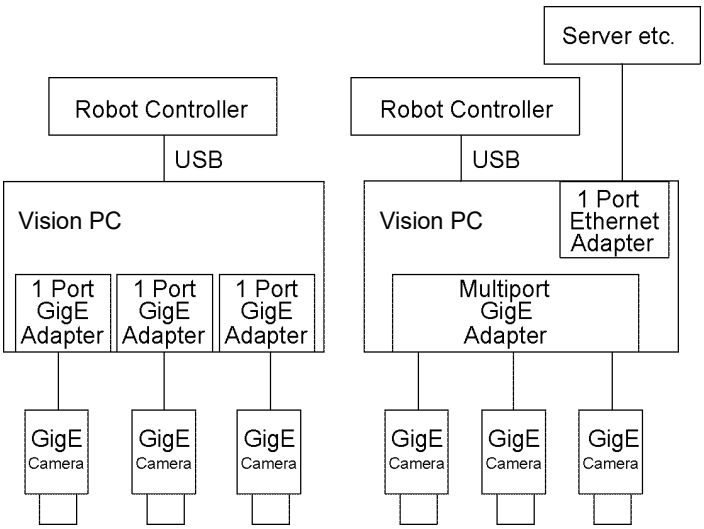
GigE camera network and other Ethernet communications for Windows network should be separated.
For example, configure the network between the Robot Controller and the Vision PC using the USB do that it does not disturb the communication between Vision PC and the GigE camera.
It is also effective to install multiple network adapters to separate the informational network for Windows from the GigE camera network for the sake of system performance improvement.

NOTE

Use the Gigabit Ethernet (1000Mbps) network adapter for the GigE camera. The 100Mbps network adapters cannot be used.

Peer-to-peer Network Architecture

For a network configuration, it is strongly recommended to employ “peer-to-peer connection” which connects cameras directly to each adapter. (See the figure below)



The main advantage of the peer-to-peer connection is that it can make full use of the network bandwidth for transfering captured images from each camera due to independent network. This allows you to get great performance of each camera and to design the system easily. The peer-to-peer connection is particularly effective when using multiple cameras in the external trigger mode.

However, it is recommended to employ the “network switch connection” described in the following when not using the external trigger or when connection a lot of cameras.

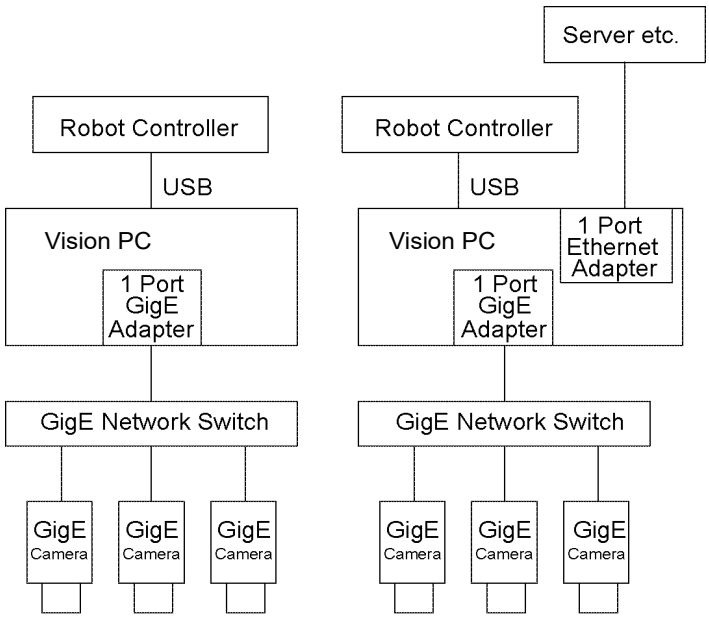
Note:
When using the peer-to-peer connection, each camera can occupy each network bandwidth. However, when installing multiple network adapters to the Vision PC, or when using the multiport network adapter, be careful of the bus baud rate.

For usual PCI bus, the baud rate is 133M bytes/ seconds. Since PCI bus transmission is shared with various inter-device communications within the CPU, it is unsuitable as a GigE camera adapter bus.

Network Switch Connection

For most robot systems, consider employing the “network switch connection”. Example of the network switch connection configuration is shown below.

CAUTION	■ Although any Ethernet standard compliant GigE switch supporting Gigabit Ethernet (1000Mbps) can be used, use our optional GigE switch.



This network configuration is effective for systems where there are a lot of cameras or where GigE cameras are set away from the Vision PC. However, this configuration may not be able to improve the system performance because the imaging timings must not be overlapped.

Note:
Do not input triggers for several cameras at the same time when the network is configured by the “network switch connection”. If triggers are inputted at the same time, image data may be partially lost, or an error may occur. In such a case, the network must be configured by the “peer-to-peer connection”.

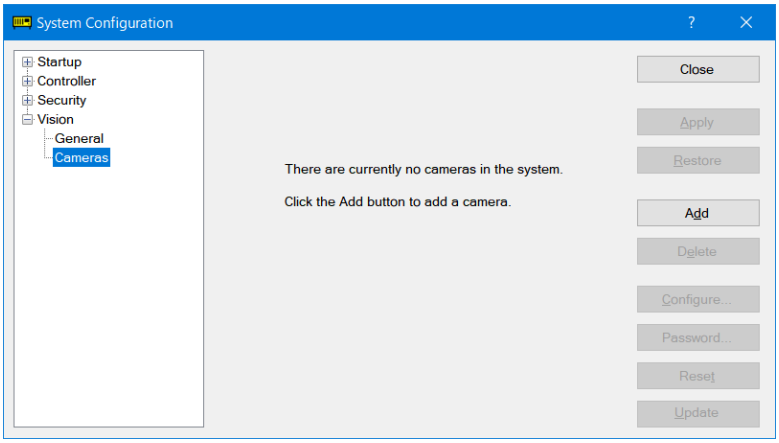
2.3 Camera Configuration

2.3.1 PV1 Camera Configuration

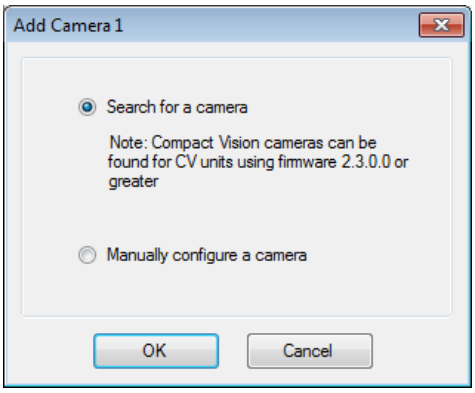
(1) Start the EPSON RC+ 7.0.

(2) Select [System Configuration] from the Setup menu.

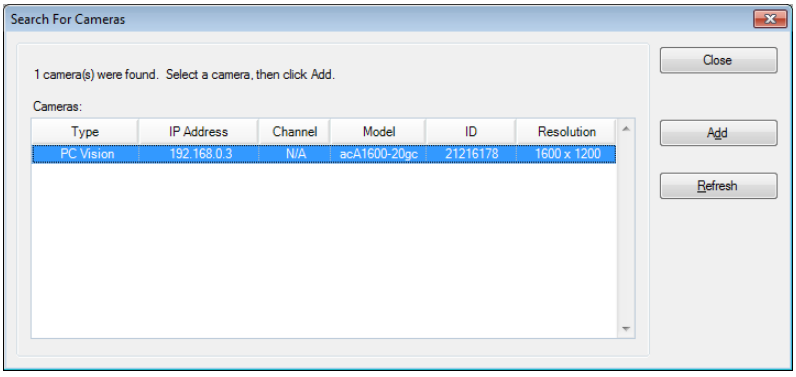
(3) Click [Vision]-[Cameras] from the tree.



(4) Click the <Add> button to add a camera.



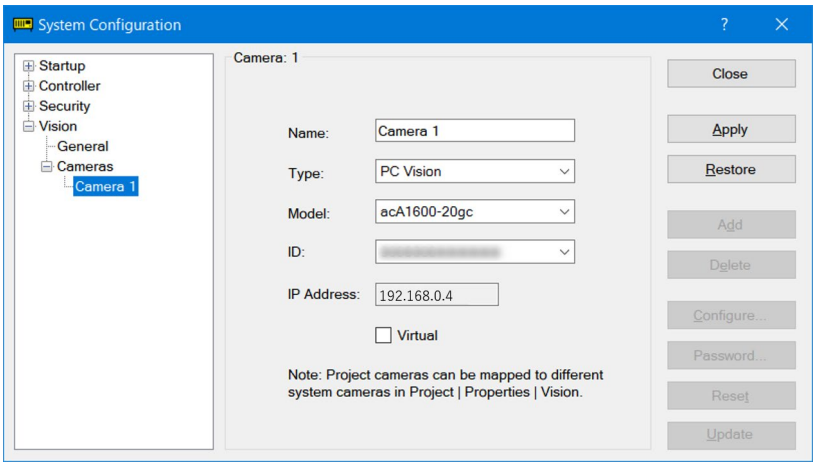
To search the cameras on the network, select “Search for a camera” and click <OK>. The following dialog box appears if the camera is found on the network. Select the camera to add and click the <Add> button.



Note: For Compact Vision, camera search is available only when using the firmware Ver. 2.3.0.0 or later.

If you have information of the camera required for setting such as IP address, select “Manually configure a camera”.

(5) Select the camera model and ID as necessary.
For the GigE camera, select the ID after selecting the camera model. The ID is a serial number of the camera.
Selecting the ID displays the IP address set to the camera.



(6) If you changed settings after adding the camera, click the <Apply> button.

(7) Repeat steps (4) through (6) to add cameras.

TIP

Up to 16 cameras (8 CV1/CV2 cameras and 8 PV1 cameras) can be configured.

When starting more than one EPSON RC+ 7.0 by one PC, PV1 camera is only available in the first session.

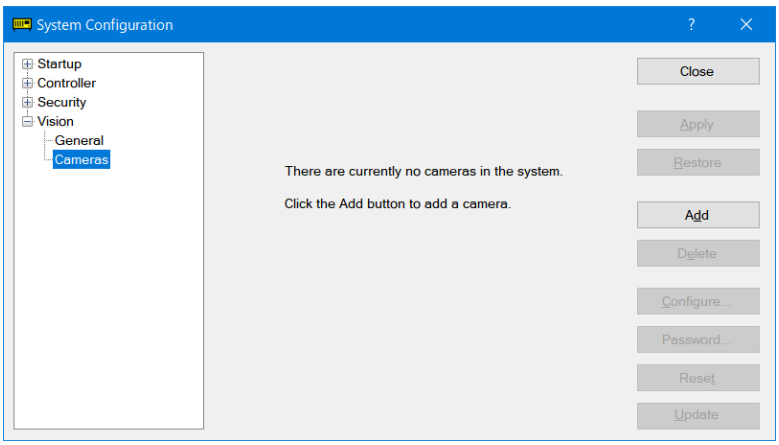
Item	Description
Name	This is the name of the camera. The maximum length is 16.
IP Address	This is the IP address of the GigE camera. Refer to section *Setup 2. Software Configuration* for details.
Type	Sets the type of camera.
Model	Sets the model of camera.
Add	Adds a camera. It is also possible to search and add the cameras on the network.
Delete	Delete the currently selected camera.
Apply	Set current values after changes have been made. For CV1/CV2: When this button is clicked, RC+ attempts to connect with the camera to verify the IP address and determine the camera type.
Restore	Revert back to the previous values.
Configure…	Click this button to open the [Camera configuration] dialog box.
Reset	For CV1/CV2 only. Resets the currently selected CV1/CV2. All project files are cleared and the CV1/CV2 is restarted. Restart takes approximately one minute.

Item	Description
Update Firmware…	For CV1/CV2 only. Updates the CV1/CV2 firmware. For more details, refer to the following section. *Hardware 1.3.2 Updating CV1 Firmware* *2.3.10 Updating CV2 Firmware*

2.3.2 CV1/CV2 Camera Configuration

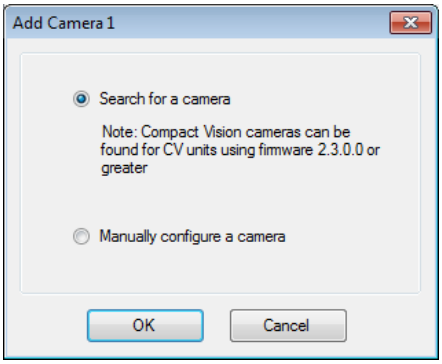
(1) Ensure that the CV1/CV2 and the Controller are connected to the same network and that the Controller TCP/IP subnet is same (192.168.0). See the previous section.

(2) Start EPSON RC+ 7.0 and select [Setup]-[System Configuration]-[Vision]-[Cameras].



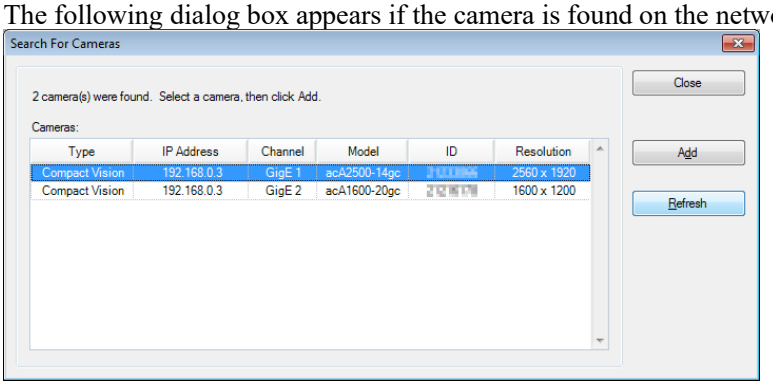
(3) Click the <Add> button.

(4) [Add Camera 1] is displayed.



To search the cameras on the network, select “Search for a camera” and click the <OK> button.

The following dialog box appears if the camera is found on the network.

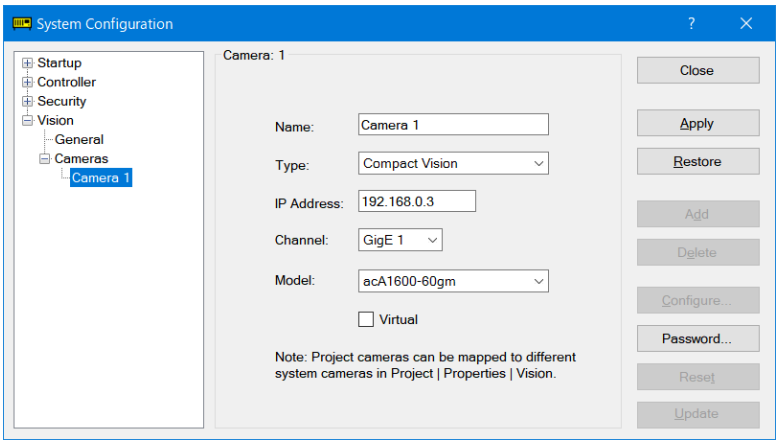


Select the camera to add and click the <Add> button.

Note: For Compact Vision, camera search is available only when using the firmware Ver. 2.3.0.0 or later.

When adding the Compact Vision with the firmware Ver.2.2.x.x or earlier, or if you have information of the camera required for setting such as IP address, select “Manually configure a camera”.

The following dialog box will be displayed

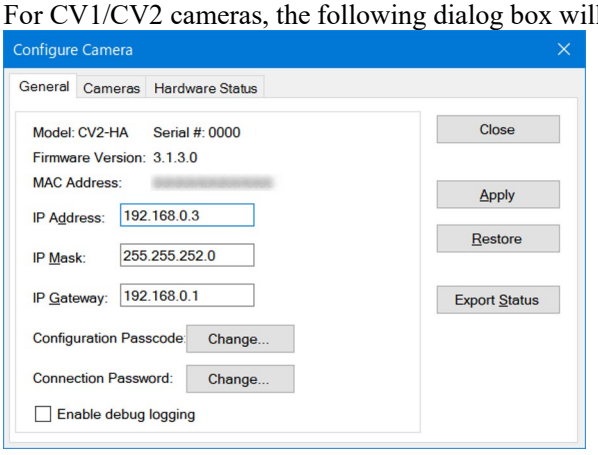


The default camera type is “PC Vision”. Therefore, you need to select “Compact Vision”.

Tip: The default address for Compact Vision is 192.168.0.3 (CV1/CV2 camera).

(5) Click the <Apply> button to save any changes. EPSON RC+ will attempt to connect with the camera to identify the camera type. The camera type will be automatically displayed in the dropdown list. If a message is displayed stating that the connection password is invalid, then click the <Password> button to change the connection password, then click the <Apply> button again.

(6) Click the <Configure...> button to open the [Configure Camera] dialog box.
For CV1/CV2 cameras, the following dialog box will be displayed.



NOTE

If a communication error occurs after clicking the <Configure...> button, check that your Controller TCP/IP is configured properly as described in the previous section. Also check that the PC and camera are physically connected to the same network subnet.

(7) Change the IP Address, IP Mask, and IP Gateway to the desired settings.

(8) Click the Configuration Passcode <Change…> button if you want to set the configuration passcode for the CV Monitor.

(9) For CV2-A units using firmware version 3.1.3.0 or greater, click the Connection Password <Change…> button if you want to change the connection password in the CV unit. The Connection Password is used to prevent unauthorized connections to the CV unit.

When using a public (global) IP address, you must provide a connection password. When using a private (local) IP address, the connection password is optional.

If a password is configured, then all RC+ clients must be configured with the same connection password. Controllers connecting to the CV will also be provided with the CV connection password when the project in RC+ is built.

Private (local) IP address ranges are shown below. All other IP address ranges are public (global) and require a connection password.

Private IP Address Ranges

10.0.0.1	to	10.255.255.254
172.16.0.1	to	172.31.255.254
192.168.0.1	to	192.168.255.254

After changing the password on the CV unit, the RC+ connection password is automatically updated to use the same password to connect with the CV unit. You can also change the CV connection password at the CV unit itself with a monitor, mouse, and optional keyboard connected.

NOTE

If the CV connection password is lost, you must change the password using the CV Monitor or by performing a factory reset on the CV unit.

(10) For CV2-A units, if the firmware version is 3.1.2.0 or greater, the [Enable debug logging] checkbox will appear. Debug logging is used for when Epson technical support needs more information to troubleshoot a problem. This checkbox should be unchecked for normal production operation. When it is checked, the system is run until a problem occurs.
When the <Export Status> button is clicked, the status is exported from the CV2-A. Please send it to Epson technical support.

(11) Click the <Apply> button to change the settings in the camera.

(12) Click the <Close> button. The dialog box will close and the new IP address for the camera will automatically be set in the [Setup]-[System Configuration]-[Vision]-[Camera] page.

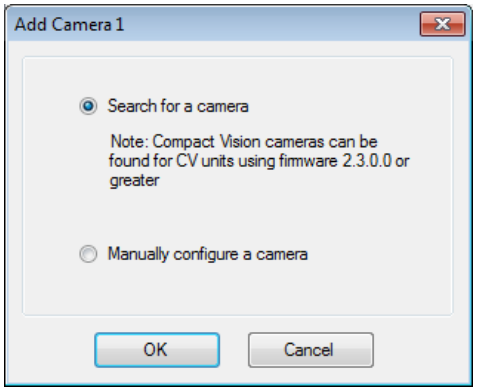
TIP

Up to 16 cameras (CV1/CV2: eight cameras and PV1: eight cameras) can be configured.

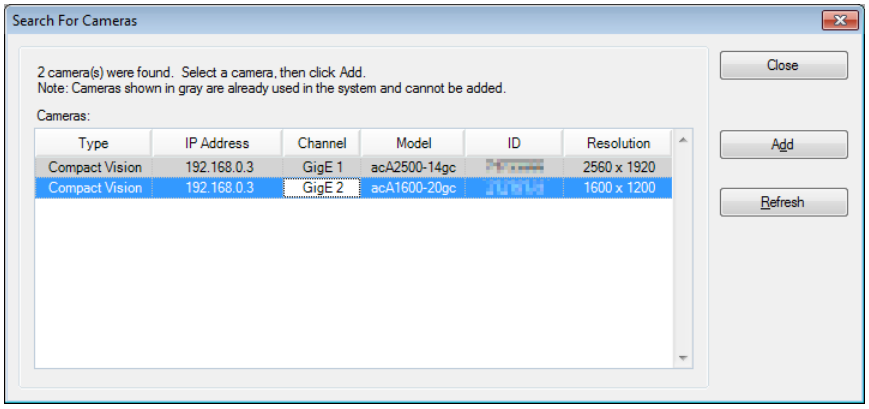
2.3.3 Using Multiple CV1/CV2 Cameras

The CV1 system supports up to two cameras (two USB cameras) and the CV2 supports up to six cameras (four GigE cameras and two USB cameras). Each camera is referenced from RC+ by a system camera number. A system camera number is assigned to each camera connected to the CV1/CV2 Controller by camera configuration in RC+.

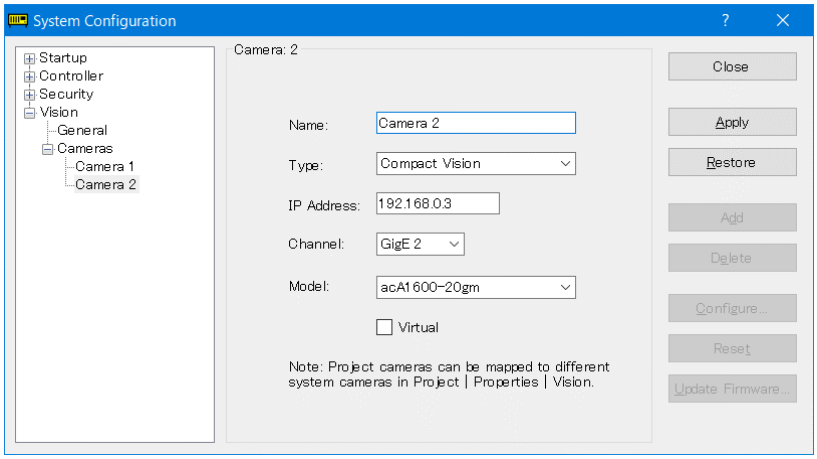
When you add the first camera to the CV1/CV2 system, the [Channel] is set to 1. To add a second camera to the same CV1/CV2 system, click the <Add> button, and add the searched camera.



Click the <OK> button to search the cameras on the network and display them on the list.

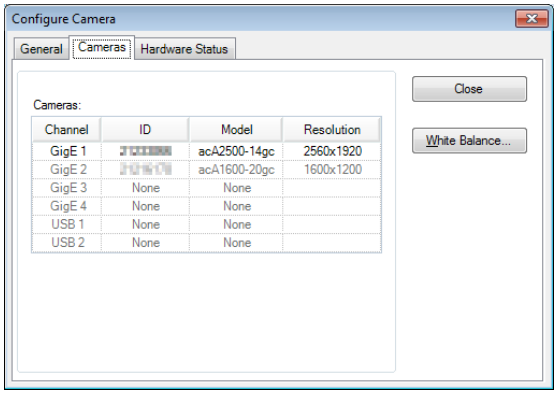


A camera can be registered to the system by selecting the camera and clicking the <Add> button.



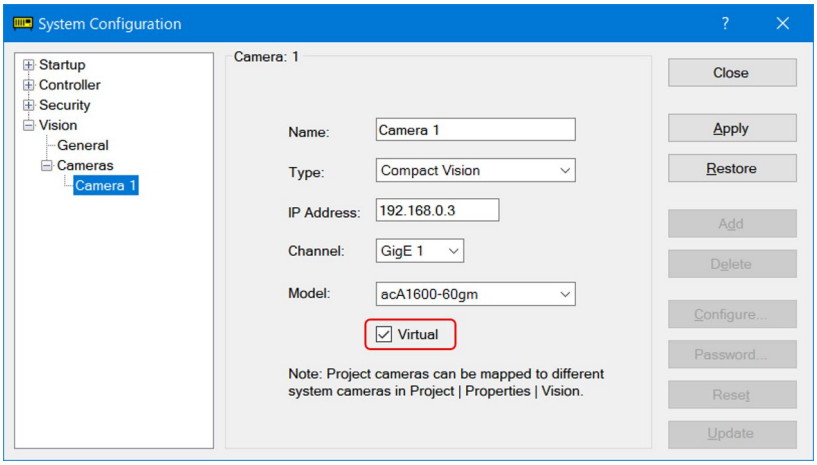
Click the <Apply> button to complete.

To see the camera configuration in the CV1/CV2 Controller, select the camera and click the <Configure…> button to show the [Configure Camera] dialog box. This will show the GigE camera and USB camera that are assigned for each channel. The camera ID is printed on the label of the camera.



2.3.4 Virtual Camera Function

Checking the [Virtual] checkbox in the camera configuration dialog box enables the camera to work in the virtual mode.



In this mode, the image processing functions on the development PC, whether a camera is actuallty installed.

(Although the actual connection of the caera is not necessary, it requires the image file for the image processing.)

When starting more than one EPSON RC+ 7.0 by one PC, virtual camera is only available in the first session.

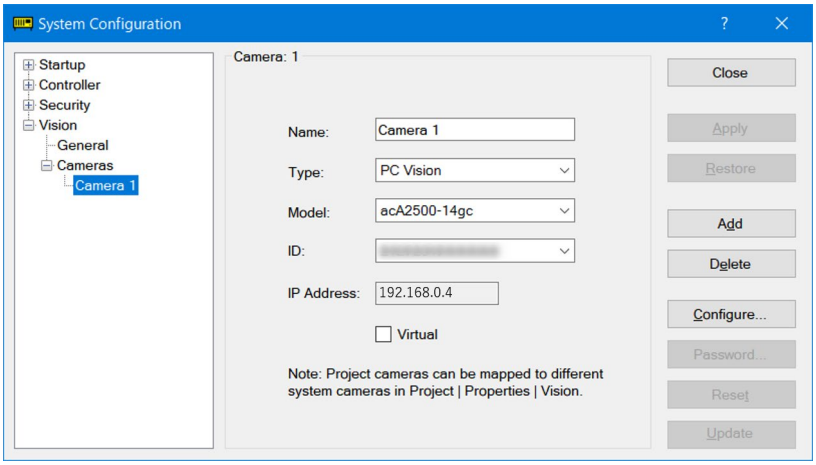
2.3.5 Adjusting White Balance

The shades of the image to be aquired by the color camera can be changed by using the white balance adjustement function. Refer to the following steps to adjust the shades.

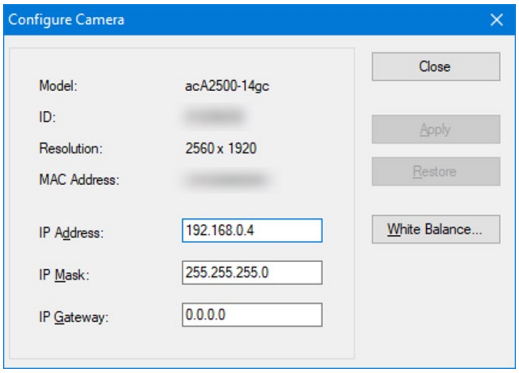
For PV1

(1) Start EPSON RC+ 7.0 and select [Setup]-[System Configuration].

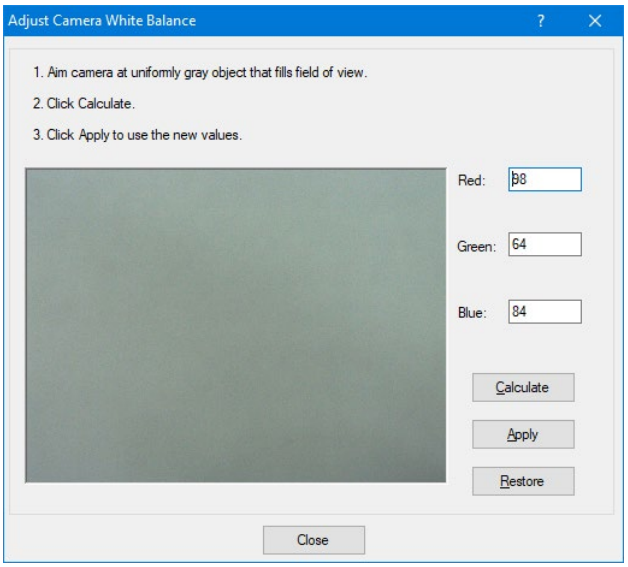
(2) Click [Vision]-[Cameras] from the tree and select the color camera to be adjusted. Click the <Configure…> button.



(3) The [Configure Camera] dialog box is displayed. Click the <White Balance…> button.



(4) The [Adjust Camera White Balance] dialog box is displayed.
Set a white or gray object shown on the full view. When the image is overexposed, adjust the aperture to control the brightness.



(5) Click the <Calculate> button.

(6) Click the <Apply> button. The results are reflected to the camera.
It can be adjusted by entering values manually in [Red], [Green], and [Blue] boxes.

(7) Click the <Close> button. Finish the white balance adjustment.

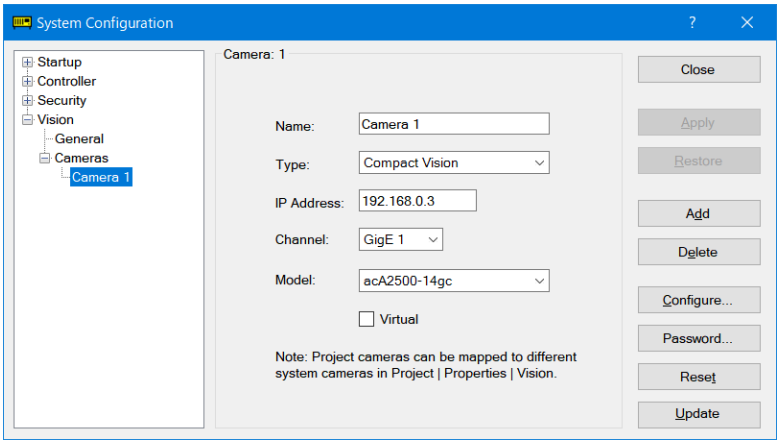
For CV1/CV2

(1) Create a new project whose sequence uses the color camera for the target of adjustment and open the project. For details, refer to the following section.

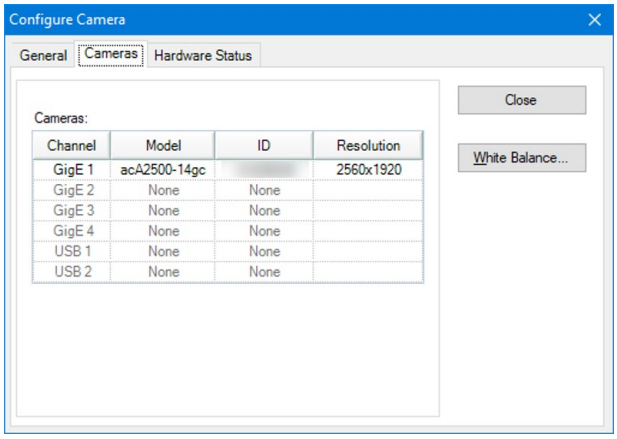
Setup 4.2 Operation Check of Vision Guide 7.0

(2) Start EPSON RC+ 7.0 and select [Setup]-[System Configuration].

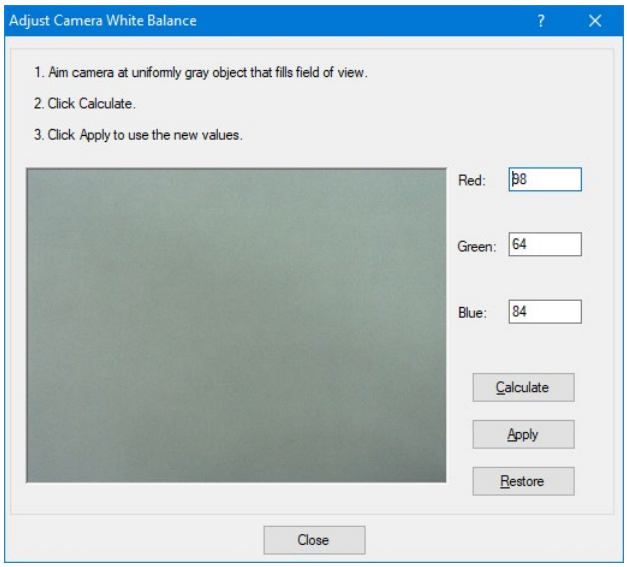
(3) Click [Vision]-[Cameras] from the tree and select the color camera to be adjusted. Click the <Configure…> button.



(4) The [Configure Camera] dialog box is displayed.
Select the [Cameras] tab. Click the <White Balance…> button.



(5) The [Adjust Camera White Balance] dialog box is displayed.
Set a white or gray object shown on the full view. When the image is overexposed, adjust the aperture to control the brightness.



(6) Click the <Calculate> button.

(7) Click the <Apply> button. The results are reflected to the camera. It can be adjusted by entering values manually in [Red], [Green], and [Blue] boxes.

(8) Click the <Close> button. Finish the white balance adjustment.

2.3.6 System Cameras and Project Cameras

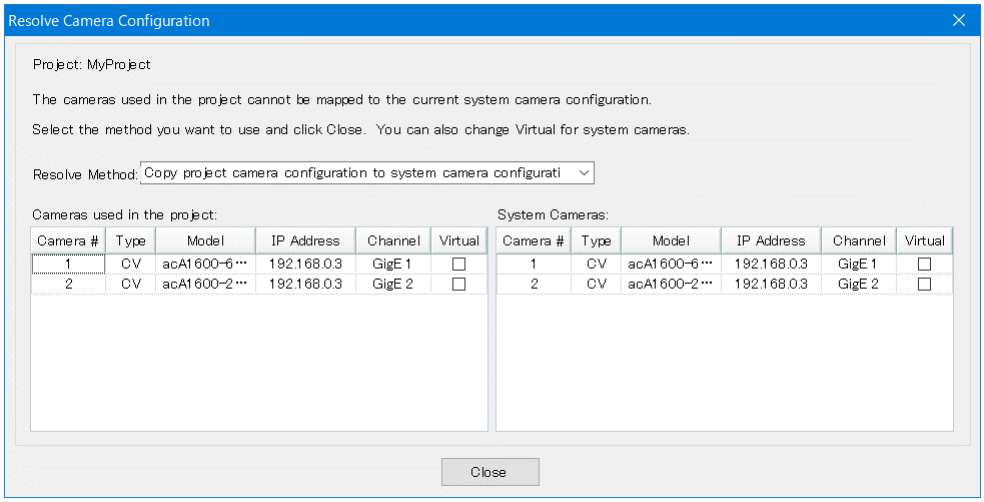
EPSON RC+ system cameras are configured in [Setup]-[System Configuration]-[Vision]. EPSON RC+ project cameras are mapped to the system cameras

When a new project is created, the project cameras are mapped one on one with the current system cameras.

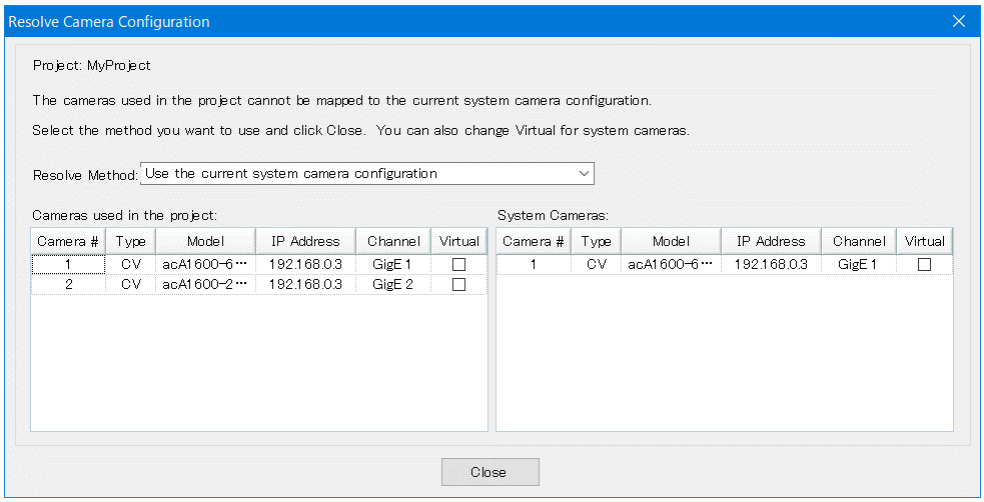
When a project is opened, EPSON RC+ attempts to automatically map the project cameras with the current system cameras. For example, if project camera 1 matches system camera 2, then project camera 1 is mapped to system camera 2. You can view the project camera mapping in [Project]-[Properties]-[Vision].

If one or more project cameras cannot be mapped to system cameras during project open, a [Resolve Camera Configuration] dialog box is displayed that allows the user to copy the "project camera configuration" to the "system camera configuration", or keep the current system camera configuration.

If the "Copy project camera configuration to system camera configuration" in the [Resolve Method] box is selected, then the project camera configuration is copied to the system camera configuration as shown below.



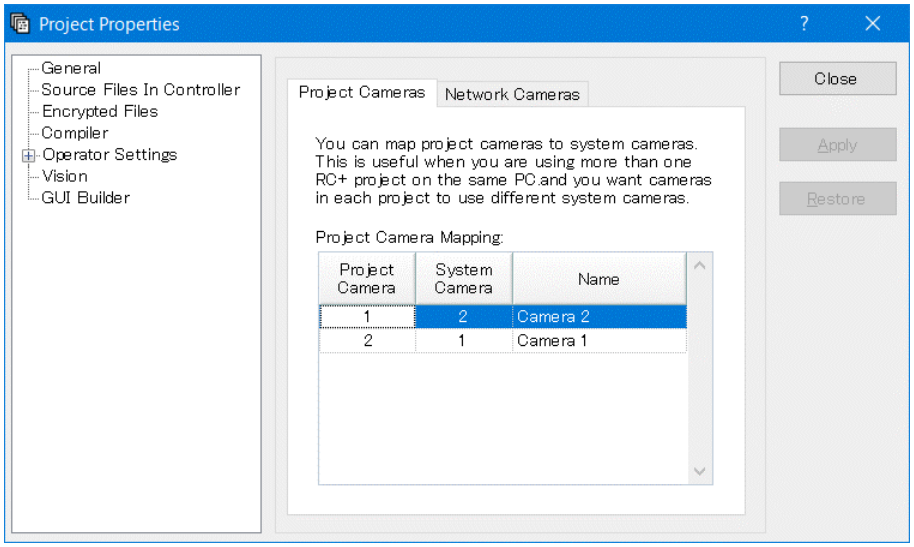
If the "Use the current system camera configuration" in the [Resolve Method] box is selected, then the current system cameras are not changed, as shown below.



For the system cameras in the [Resolve Camera Configuraiton] dialog box, you can change if a camera is virtual or not using the [Virtual] checkbox in the [System Cameras] grid.

For users that use multiple projects from one PC, the project cameras can be mapped to the system cameras in [Project]-[Properties]-[Vision].

For example, say there are two projects being used on the same PC: Project A and Project B. The projects have two system cameras. Project A project camera 1 uses system camera 1, and Project B project camera 1 uses system camera 2. In this way, both projects use project camera 1.



2.4 Configure Controller LAN Port TCP/IP

The Controller needs to communicate with the camera when vision commands are executed. The TCP/IP settings in the Controller must be configured to communicate on the same subnet as the camera and PC.

To configure the Controller TCP/IP settings, refer to the Robot Controller manual.

3. How to Use the Compact Vision Monitor

The CV1/CV2 system supports local monitoring of video and graphics, and basic configuration. To use the monitor, you will need to connect a display monitor. To configure the monitor software, you must temporarily connect a USB mouse and/or keyboard.

3.1 Connecting Monitor, Mouse, Keyboard

To use the monitor feature, you will need to connect a display monitor. To configure the monitor settings or network settings, you will need a mouse and/or keyboard.

Connecting a Display Monitor

For CV1:
Connect a monitor that supports 1024 × 768 or greater resolution to the VGA receptacle on the front panel of the CV1 Controller. The video is output at 1024 × 768 resolution.

For CV2:
Connect a monitor that supports 1280 × 1024 or greater resolution to the VGA receptacle or DVI-D receptacle on the front panel of the CV2 Controller. The video is output at 1280 × 1024 resolution.

Connecting a Mouse and Keyboard

A USB mouse or a USB keyboard is required to make configuration changes.

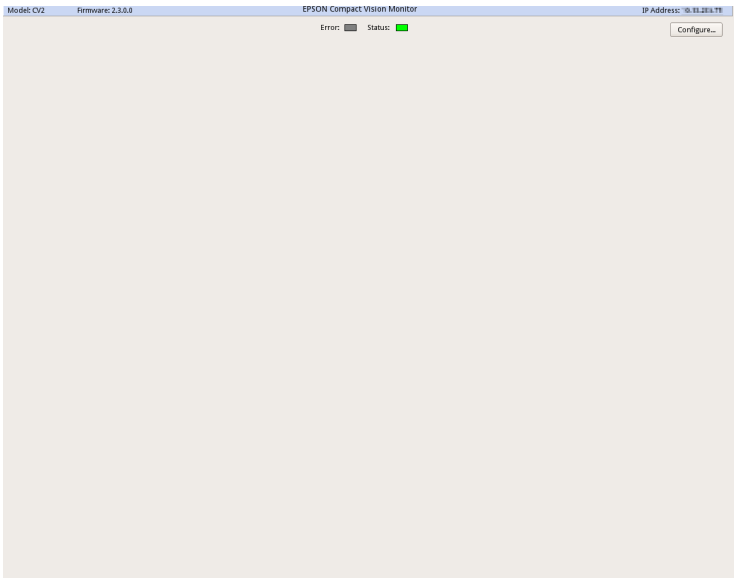
Connect the mouse and/or keyboard to the USB receptacles on the front panel of the CV1 Controller.

After completing the screen setting, disconnect the mouse and keyboar from the computer.

3.2 Monitor Main Screen

Main Screen Layout

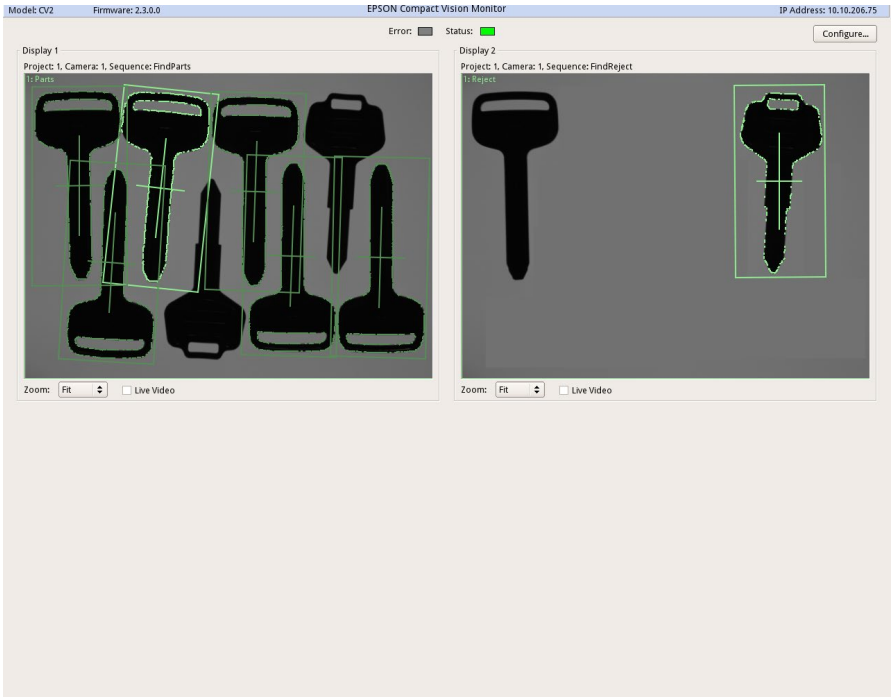
The main screen is displayed after the system is started . It fills the entire monitor display area. The title bar displays the model, firmware version, and IP address. By default, the Display Mode is set to “None”.



The states of the STATUS and ERROR LEDs located on the front panel are shown under the title bar.

By clicking the <Configure...> button, setting of IP address and screens for the Compact Vision system is available.

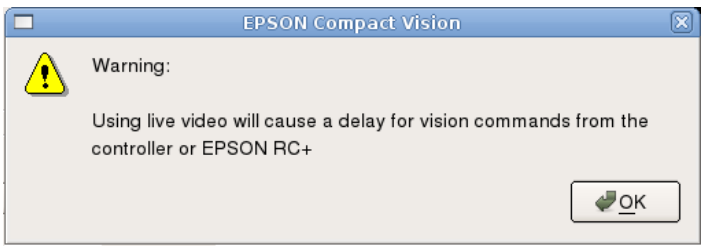
Following is the example when setting to display two windows (setting [Number of Video Displays], which is explained later, to “2”).



If the window is configured to display the windows like the above example, the upper part of the image display area shows the selected project and camera setting, and the bottom shows the Zoom setting and Live Video checkbox. Details of the Zoom setting and Live Video checkbox function are as follows.

Zoom — This dropdown list has selections for the zoom value. If the selection is not Fit to Window, then scroll bars will appear to allow horizontal and vertical panning.

Live Video — Check this checkbox to display the live image of the camera. The [Live Video] checkbox can be checked whichever project is selected. Also, while the sequence execution result is displayed when the sequence is selected and executed, the live image is displayed after the execution result when the [Live Video] is checked.
When the [Live Video] is checked, Vision command execution from the Robot Controller or the EPSON RC+ delay (a warning dialog box will be displayed). Be careful when selecting [Live Video].



Note:
If there is no project in the CV1/CV2 when it is turned ON, [Number of Video Displays] will be set to “None”.

Displaying Video

When the EPSON RC+ or a Robot Controller is connected to the camera, and a project is selected on the monitor main screen, then the video is updated only when a sequence is run from the EPSON RC+ or the Controller.

In this case, the video is not a live image unless it is configured as a live image in the EPSON RC+. If you want to see the live video, check the [Live Video] check box, then select the desired camera.

The sequence image is also displayed like the EPSON RC+. For example, when the sequence is executed in the Vision Guide window of the EPSON RC+, the same image will be displayed on the monitor when the related projects, camera, sequence are selected.

 CAUTION	■ If you display a live video on the monitor (check the [Live Videl] checkbox) while a client (RC+ and/or a Controller) is also using the system, then vision processing will be slower since the video is being grabbed by both the monitor and the client. Checking the [Live Video] checkbox is intended to be used for checking a camera from the monitor without connecting RC+. For best performance, select one or two projects that you want to monitor and save the settings. If you will not be using the monitor display, set the display mode to None, then save the settings.

3.3 Configuration Dialog Box

[General] tab

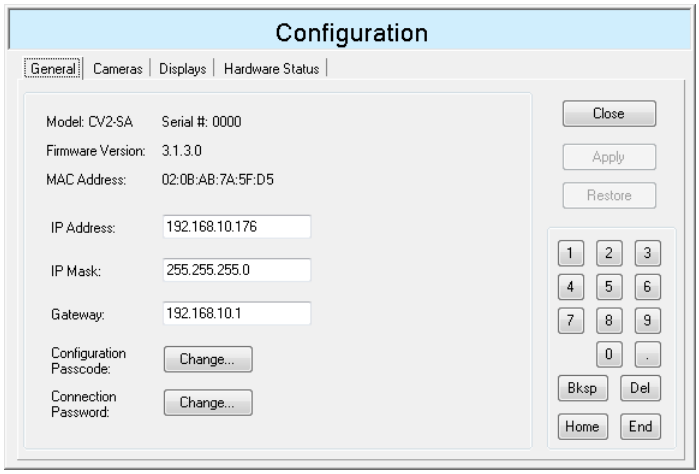
The Genaral page shows the model, firmware version and MAC address of the CV unit.

The following settings can be changed:

Network configuration: IP address, subnet mask, and gateway

Configuration passcode

Connection password



Network Configuration

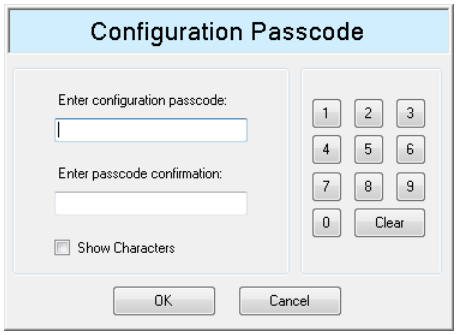
Enter the IP address, IP mask, and Gateway. If using a global IP address, then there must be a connection password configured.

Configuration Passcode

The Configuration Passcode is used to allow only users with the passcode to change the CV configuration settings.

Clicking the Configuration Passcode <Change...> button of the [Configuration] dialog box displays the following dialog box. The assignable number of digits for the passcode is from 1 to 8 digits. You can use the mouse to click on the numbers in the keypad buttons on the dialog, or you can use a keyboard connected to the CV. Use the [Show Characters] checkbox to show the password digits or only asterisks.

To clear the passcode, click the <OK> button while leaving the passcode fields empty.



Connection Password

The Connection Password is used to prevent unauthorized connections to the CV unit.

When using a public (global) IP address, you must provide a connection password. When using a private (local) IP address, the connection password is optional.

If a password is configured, then all RC+ clients must be configured with the same connection password. Controllers connecting to the CV will also be provided with the CV connection password when the project in RC+ is built.

Private (local) IP address ranges are shown below. All other IP address ranges are public and require a connection password.

Private IP Address Ranges

10.0.0.1	to	10.255.255.254
172.16.0.1	to	172.31.255.254
192.168.0.1	to	192.168.255.254

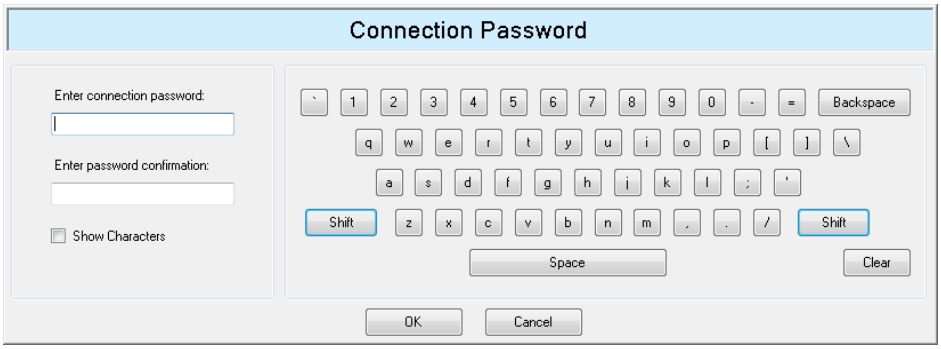
Clicking the Configuration Password <Change...> button of the [Configuration] dialog box displays the following dialog box.

Assignable passcode is 8 to 32 characters.

You can use the mouse to click on the characters in the keypad buttons on the dialog, or you can use a keyboard connected to the CV. Click either Shift key to change between lower and uppercase, and numbers or symbols.

Use the [Show Characters] checkbox to show the password characters or only asterisks.

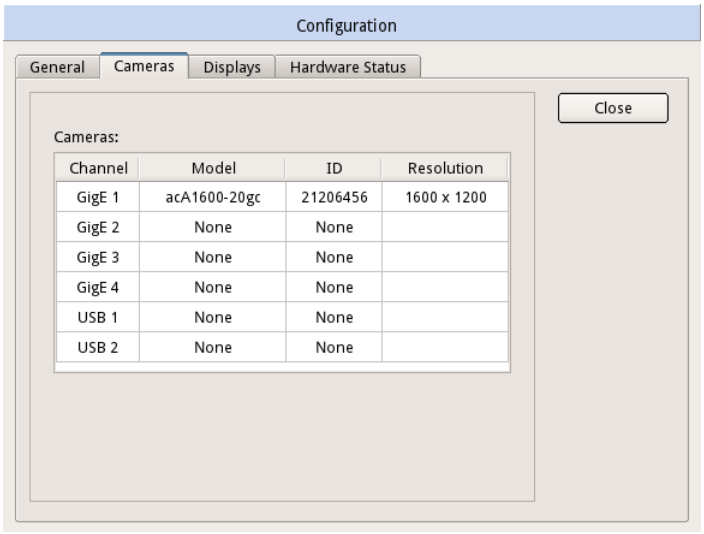
To clear the password, click the <OK> button while leaving the password fields empty.



When you click the <OK> button and the current IP address is public and the password fields are empty, you will see a message stating that the password cannot be empty for a public (global) IP address.

[Cameras] tab

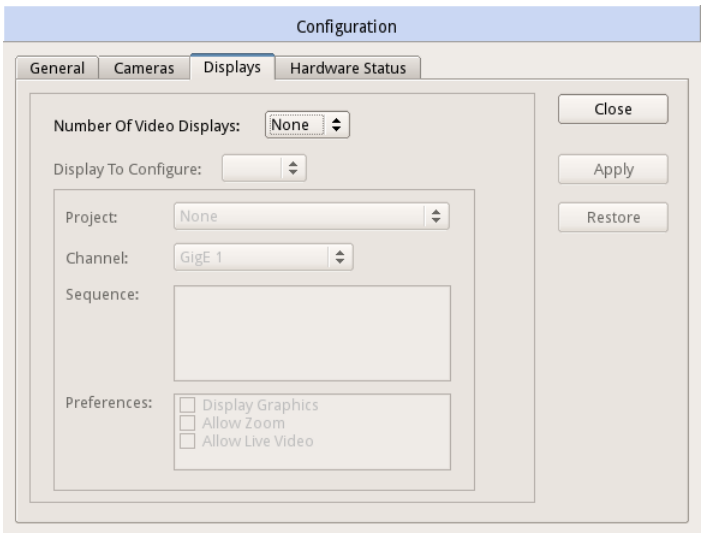
You can check the ID and resolution for the cameras connected to the Compact Vision.



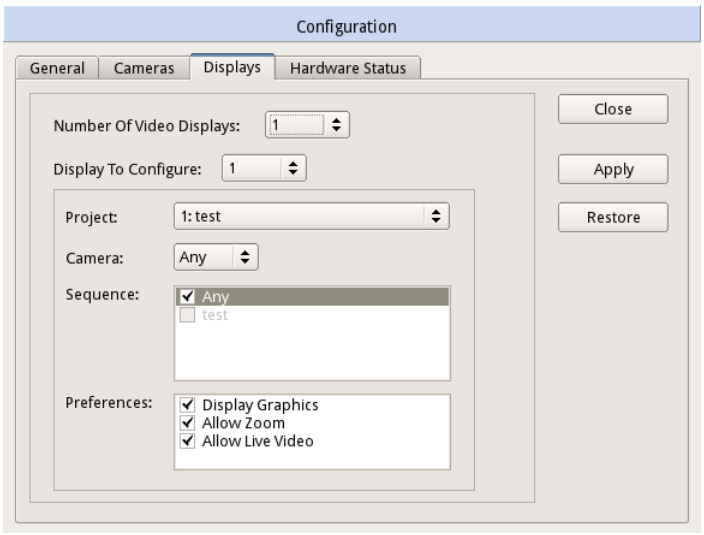
[Displays] tab

You can configure the windows to be displayed on the main screen.

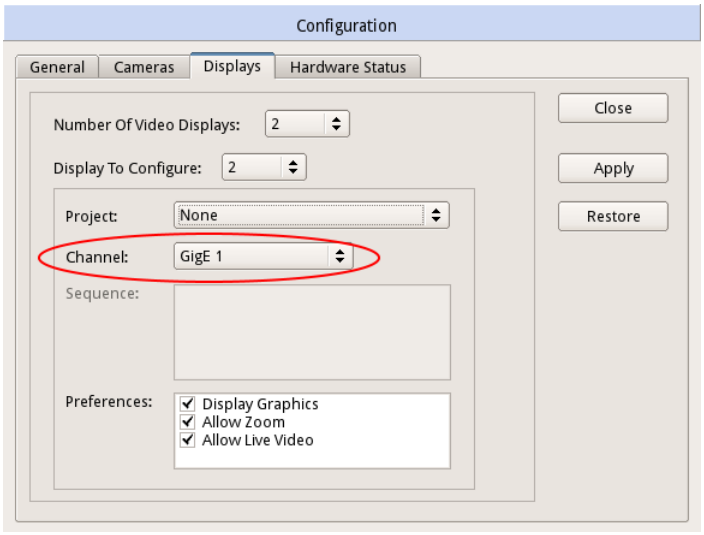
As a default, [Number of Video Display] is set to “None”.



By setting the value larger than “1” to [Number of Video Displays], each screens to be displayed become configurable. [Number of Video Displays] can be up to “6”.



When [Project] is set to None, the channel number is shown in the display captions.



Each display area has the following settings:

Project — This is a dropdown list of projects in the system. In addition to each project, you can also select None. When None is selected, you can see live video from the selected camera.

Note:
If you display a live video on the monitor (with Project set to None) while a client (EPSON RC+ and/or a Controller) is also using the system, then vision processing will be slower since the video is being grabbed by both the monitor and the client. Setting [Project] to None is intended to be used for checking a camera from the monitor without connecting the EPSON RC+.

For best performance, select one or two projects that you want to monitor and save the settings. If you will not be using the monitor display, set the display mode to None, then save the settings.

Camera
This is a dropdown list of project cameras. Note that the camera numbers are the ones used in the EPSON RC+ vision configuration. For example, if the Channel 1 camera is camera 3 in the EPSON RC+ vision configuration, then you will see camera 3 in this list.
If more than one camera is used in a project, then the choices in the list are Any, Camera<1>, Camera<2>. Only sequences using the current camera will be displayed.

Channel
This is a dropdown list of the channel numbers of CV1.
Channel setting is available only when [Project] is set to None.
Channel number of each camera connected to CV1 can be checked by clicking the <Configure...> button.

Sequence
This is a dropdown list of the sequences in the selected project. If there is more than one sequence, then the Any choice is also added. When Any is selected, then the video and graphics for any sequence in the specified project using the specified camera are displayed.

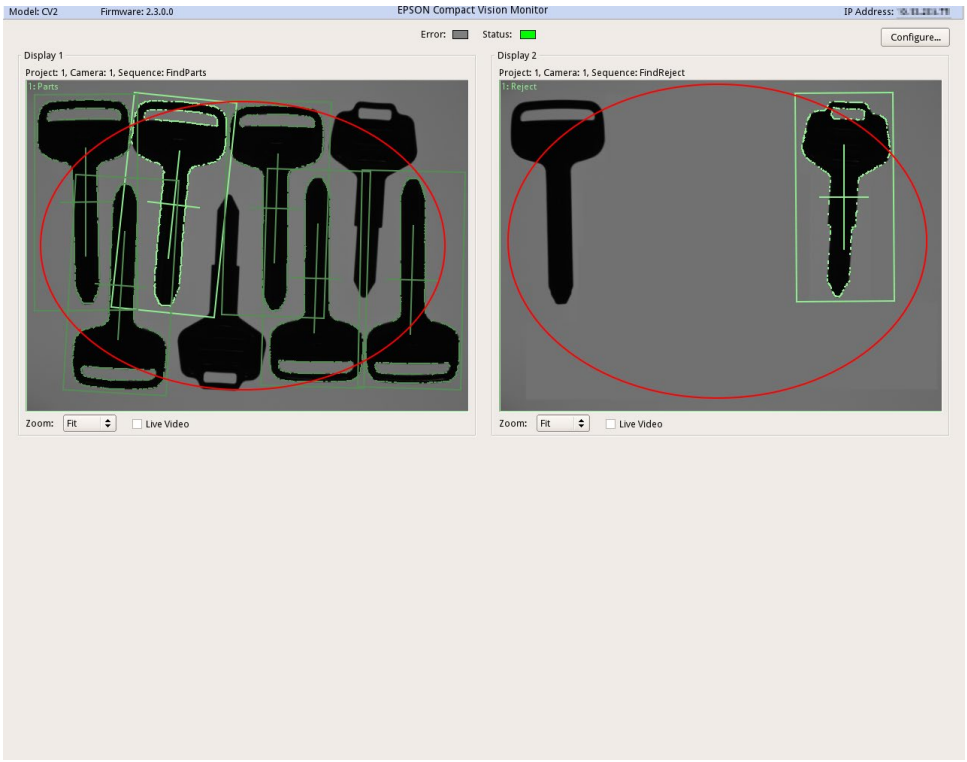
Preference
You can enable and disable functions of Display Graphics, Allow Zoom, and Allow Live Video. Results of the setting will be reflected to the main screen.

Display Graphics

You can set whether to layer the image processing result over the image.

Following image is the example of the display when setting [Number of Video Displays] to "2".

The [Displays] tab for each window can be opened by double-clicking the display area on the main screen.



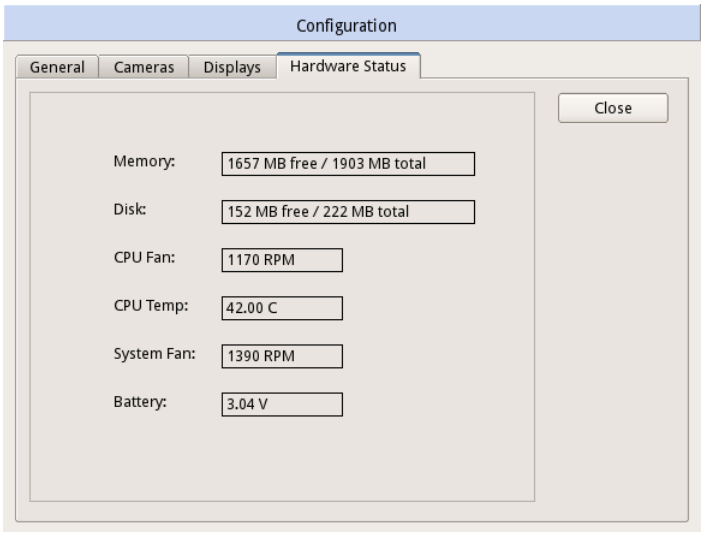
After making changes, you can click the <Apply> button to make the changes permanent. If the system is restarted, the settings will be restored to the saved settings.

Note:

If there is no project in the CV1/CV2 when it is turned ON, [Number of Video Displays] will be set to “None”.

[Hardware Status] tab

You can check the hardware status in the Compact Vision.



4. Connection

4.1 Testing the Vision System

Initial Setting

1. Wiring, IP address setting
   Connect the PC, the Controller, and the camera via Ethernet and configure all IP addresses.
   *IP address assignment example

Device	IP address
PC	192.168.0.10
Controller	192.168.0.1
Camera	192.168.0.3

2. Select the lens and the extension tube.
   Select the lens and the tube based on the size of the viewing field and distance between the part and the camera.
3. Confirm the image
   Click the  <Vision> button to open the dialog box. Then, create a sequence to display the camera image.

Vision sequence

Click the  <New Sequence> button and create a Vision sequence.

4.2 Operation Check of Vision Guide 7.0

After the installation is complete, check that the software works properly. Follow the steps below to confirm the operation.

4.2.1 Start EPSON RC+ 7.0 and create a new project

(1) Double click the <EPSON RC+ 7.0> icon on the Windows desktop to start EPSON RC+ 7.0.

(2) Click the [Project] menu on the EPSON RC+ 7.0 menu bar.

(3) Click the [New Project] menu entry of the [Project] menu. The [New Project] dialog box will appear.

(4) Type a name for the new project. You can use any name. We suggest that you use the name “vastest” since this will be our test project to make sure everything is working OK.

(5) After you type a name in the name field, click the <OK> button. You have just created a new project.

4.2.2 Checking of Input Image from Camera

(1) Once you have created a new EPSON RC+ 7.0 project, many of the toolbar icons are shown with color. Click the  <Vision> button to open the Vision Guide window. If the vision button is not displayed, this means the Vision Guide was not installed. Run the EPSON RC+ 7.0 installer and select Vision Guide option in the install setting.

(2) Before using the Vision Guide window, a vision sequence should be created. Clicking the  <New Sequence> button creates a new vision sequence. (This button is located on the Vision Guide window toolbar and not on the EPSON RC+ 7.0 menu toolbar.) The New Sequence dialog box will be displayed.

(3) Enter the name "vistest" for the new vision sequence and click the <OK> button.

(4) Look for the area called Properties in the [Sequence] tab. You can see a property called Camera. This property is used to select the camera that will be used with the sequence. The Camera property is set to 1 as default, and this will be used for the newly create sequence.

(5) If you are using a camera number other than 1, click the value field of the Camera property to display a down arrow. Click the down arrow to display a select list. The number of cameras available depends on the number of cameras in the system.

(6) Look at the image display of the Vision Guide window. You can see a live image from the camera. If so, go on to *Checking and Adjusting for Proper Focal Distance*

(7) If the image display of the Vision Guide 7.0 is shown black, open the diaphragm of the camera lens. This allows more the light into the image and makes the image display brighter. If the object of the camera is black, however, move the aperture upward to check if color in the image display changes. When doing so, use the lighting equipment to get a lot of light into the camera. After checking the change of color in the image display by opening/closing the diaphragm, go on to *Checking and Adjusting for Proper Focal Distance*.

(8) If you cannot see any difference in the color of the image display by opening/closing the aperture, point the light directly to the lens to make sure that enough light is getting into the camera. If you still see no difference in the image display, you should install the software again.

4.3 Checking and Adjusting for Proper Focal Distance

(1) Define a target to adjust a focal distance of the camera. Position your camera above the area where you are going to search for parts, and place an object within the camera's field of view.

(2) Now, you can see the object that you put under the camera in the image display of the Vision Guide window. If not, move the part manually in front of the camera. Then, check if you can see the target feature. (it does not matter if the it is out of focus) If you cannot see the target, you may have selected the lens not suitable for the distance between part and the camera. Try a different size lens.

(3) For mobile cameras, the 16 or 25 mm lens are usually used. Therefore, when you are testing a Mobile camera, try to start with a 16 mm lens.

(4) At this point, you can see at least the target feature on the work surface. Adjust the focus of the lens to bring the part into a good focus. If you cannot bring the part into focus, add an extension tube between the lens and the camera. This will change the work distance of the lens. To adjust the work distance of the camera lens, the extension tube with a proper length should be selected.

(5) After installing the extension tube, adjust the focus of the camera lens. You may need to try some extension tubes with different lengths to get proper focus.

Refer to *Hardware 5.5.1 Extension Tube Work Distance* for a list of the common lens and extension tube configurations for various focal lengths.

Now the installation is completed. Go on to *Software 10.1 Quick Start: A Vision Guide 7.0 Tutorial*. This chapter describes how to position the parts and how to carry them by the robot using the Vision Guide.

5. Parts List

5.1 Maintenance Parts List

5.1.1 Compact Vision CV1

Part Name	Code
Compact Vision CV1	2195001
Fan Filter	1653513

5.1.2 Compact Vision CV2

Part Name		Code
CPU Board	For CV2-S/L/SA	2175329
	For CV2-H/HA	2175328
PoE Board *		2168503
PoE Board-A *		2204519
LED/SW Board		2168504
Memory	For CV2-S/H/L (2GB)	2208280
	For CV2-SA/HA (4GB)	2182048
CFast	For CV2-S/H (2GB)	2168501
	For CV2-L (2G)	2194001
	For CV2-SA/HA (8GB)	2182047
Battery		2168507
Chassis Fan		2168505
Fan Filter		1653513
Power Supply Connector		2168506
Mounting Bracket		1653498

* When the PoE board is replaced, choose the one referring to the following table.

	Firmware version	The replaced board
CV2-S/H/L	2.3.3.2 or before or The version is unclear	PoE board (Code 2168503)
	2.3.3.3 or later	PoE board-A (Code 2204519)
CV2-SA/HA		

5.2 Option Parts List

5.2.1 Common

Part Name		Code	Old Code
OCR 7.0 License		R12NZ900H3	R12N798011
Camera Lens	8 mm	R12NZ900BC	R12R500VIS018
	12 mm	R12NZ9006C	R12B120361
	16 mm	R12NZ900BD	R12R500VIS019
	25 mm	R12NZ900BE	R12R500VIS020
	50 mm	R12NZ900BF	R12R500VIS021
Megapixel Camera Lens	8 mm	R12NZ900AU	R12N7C3091
	12 mm	R12NZ900AV	R12N7C3101
	16 mm	R12NZ900AW	R12N7C3111
	25 mm	R12NZ900AX	R12N7C3121
	50 mm	R12NZ900AY	R12N7C3131
Megapixel Lens (HF)	8 mm	R12NZ9010F	-
	12 mm	R12NZ9010G	-
	16 mm	R12NZ9010H	-
	25 mm	R12NZ9010J	-
	35 mm	R12NZ9010K	-
1 inch Lens	8 mm	R12NZ9010L	-
	12 mm	R12NZ9010M	-
	16 mm	R12NZ9010N	-
	25 mm	R12NZ9010P	-
	35 mm	R12NZ9010Q	-
	50 mm	R12NZ9010R	-
Camera Extension Tube Kit		R12NZ900BG	R12R500VIS022
Camera Mounting Unit (Plate, Bracket)	SCARA robot (3kg)	R12NZ9003D	R12B031913
	SCARA robot (6kg)	R12NZ90039	R12B031907
	SCARA robot (10, 20kg)	R12NZ9003A	R12B031908
	6-Axis robot	R12NZ9003F	-
	RS series	R12NZ9003K	R12B031929
	VT series	R12NZ900ZZ	-
USB Camera	Standard	R12NZ9006A	R12B120359
	1.3 mega-pixel	R12NZ9006B	R12B120360
	5 mega-pixel	R12NZ9006E	R12B120363
USB Color Camera	1.3 mega-pixel	R12NZ9006D	R12B120362
	5 mega-pixel	R12NZ900HB	R12B120364
USB Camera Cable (5 m)	Standard	R12NZ9001X	R12B020226
	Flexible	R12NZ9001Y	R12B020227
Trigger Cable for USB Camera (5 m)	Standard	R12NZ9001V	R12B020224
	Flexible	R12NZ9001W	R12B020225
GigE Camera	1.3 mega-pixel	R12NZ900ZV	-
	2 mega-pixel	R12NZ900AL	R12N7C3021
	2 mega-pixel 2	R12NZ900JF	-
	5 mega-pixel	R12NZ900AM	R12N7C3031
	5 mega-pixel 2	R12NZ900Z5	-
	10 mega-pixel	R12NZ900TN	-
	20 mega-pixel	R12NZ9010V	-

Part Name			Code	Old Code
GigE Color Camera		2 mega-pixel	R12NZ900AN	R12N7C3041
		2 mega-pixel 2	R12NZ900JG	-
		5 mega-pixel	R12NZ900AP	R12N7C3051
		5 mega-pixel 2	R12NZ900Z6	-
		10 mega-pixel	R12NZ9010E	-
		20 mega-pixel	R12NZ9010U	-
GigE Camera Cable	5 m	Flexible	R12NZ9009Y	R12N722051
	10m	Flexible	R12NZ900EA	R12N722061
Trigger Cable for GigE Camera	5 m	Flexible	R12NZ900A3	R12N722111
	10 m	Flexible	R12NZ900HC	R12N722121
Trigger Connector for GigE Camera			R12NZ900AB	R12N767021
GigE Camera Tripod Adapter			R12NZ900AT	R12N7C3081
Ethernet Switch			R12NZ9005Q	R12B120201
Ethernet Cable		5 m	R12NZ900A4	R12N722131
		10 m	R12NZ900HA	R12N722141
Calibration Plate		L	R12NZ900SR	-
		M	R12NZ900ST	-
		S	R12NZ900SU	-
		XS	R12NZ900SV	-

5.2.2 Compact Vision CV2

Part Name		Code
Compact Vision CV2	CV2-H	R12NZ900JR
	CV2-S	R12NZ900JT
	CV2-L	R12NZ900ZU
	CV2-HA	R12NZ900TU
	CV2-SA	R12NZ900TV

5.2.3 PC Vision PV1

Part Name	Code	Old Code
Vision Guide 7.0 License	R12NZ900AC	R12N790011
PoE Switching Hub	R12NZ900AR	R12N7C3071
PoE Injector	R12NZ900AQ	R12N7C3061
Power Cable (U.S.) *1	R12NZ9009Z	R12N722071
Power Cable (Europe) *1	R12NZ900HD	R12N722081
Power Cable (China)*1	R12NZ900A1	R12N722091
Power Cable (Singapore) *1	R12NZ900A2	R12N722101

*1: The power cables are for PoE switching hubs and PoE injectors.

6. Trouble Shooting

Initialization Error Occurred at EPSON RC+ Startup

If Windows Firewall (or equivalent security software) is activated, an initialization error may occur at EPSON RC+ startup.

Error 6519 Occurred After the GigE Camera Configuration

If the error 6519 occurred after configuring the GigE camera to the system, it is thought to be due to the improper network driver configuration.

Refer to *Setup 2.2.1 Network Driver Setting Confirmation* and *2.2.2 Filter Driver Setting*.

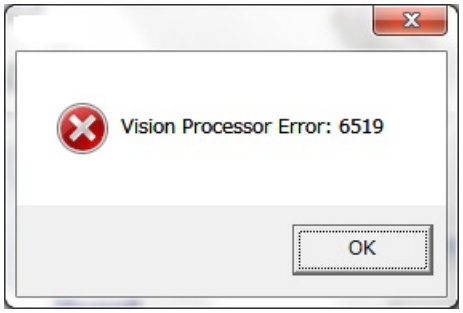


Image Loading Error Occurred

Check for TCP/IP offload setting in the network driver setting.

If TCP checksum offload and UDP checksum offload are enabled, communication error may occur.

In addition, an error may occur when the packet size of the Ethernet is default (1500 bytes). In this case, the error may be avoided by setting the jumbo frame.

“FilterDriver” Installation Error Occurred

A message "Filters currently installed on the system have reached the limit" appears when “FilterDriver” installation is started.

Windows 10 may limit the number of filters to be installed by specification. If the number of filters reaches the limit, above error message appears. In this case, the error can be avoided by either of the following countermeasures.
- Uninstall unnecessary software
- Change registry to change the limiting value

Note:

This countermeasure requires the change of the registry using the registry editor. Incorrect use of the registry editor causes critical problems and may result in re-installation of Windows. Use the registry editor on your own responsibility and at your discretion. Also, make sure to edit the registry after creating backup of the registry file.

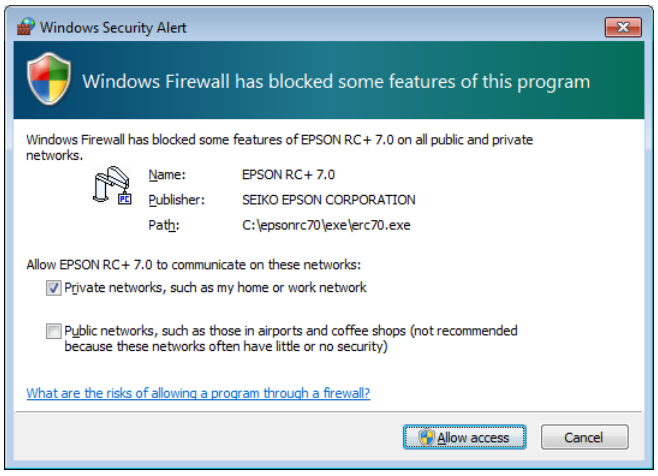
(1) Open the following directory from the registry editor.

HKEY_LOCAL_MACHINE\SYSTEM\CurrentControlSet\Control\Network

(2) Click “MaxNumFilters” in the above folder.

(3) Select “Decimal”and change the number to“14”, and then click <OK>.
(Note: the default is “8”, and the maximum value is “14”)

Firewall Error (warning) Occurred at EPSON RC+ Startup



If “Windows Security Alert” appears when starting the EPSON RC+ or adding the Compact Vision:

Click “Allow access” to permit the network communication for the EPSON RC+.

Appendix A: End User License Agreement

(for Compact Vision CV1/CV2)

1. Definition

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Compact Vision System CV2

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Appendix B: Open Source Software License

(for Compact Vision CV1/CV2)

(1) The Compact Vision product includes open source software programs listed in Section 6) according to the license terms of each open source software program.

(2) We provide the source code of the Open Source Programs (each is defined in Section 6) until five (5) years after the discontinuation of same model of this option product. If you desire to receive the source code above, please contact the "SUPPLIER" in the first pages of the Safety manual. You shall comply with the license terms of each open source software program.

(3) The open source software programs are WITHOUT ANY WARRANTY; without even the implied warranty of MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE. See the license agreements of each open source software program for more details, which are described on \usr\shared\copyrights in the Installer DVD.

(4) OpenSSL toolkit

The Compact Vision product includes software developed by the OpenSSL project for use in the OpenSSL Toolkit (http://www.openssl.org/).

This product includes cryptographic software written by Eric Young (eay@cryptsoft.com).

(5) Info-ZIP

This is version 2009-Jan-02 of the Info-ZIP license. The definitive version of this document should be available at ftp://ftp.info-zip.org/pub/infozip/license.html indefinitely and a copy at http://www.info-zip.org/pub/infozip/license.html.

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(6) The license terms of each open source software program are described on \usr\shared\copyrights in the Installer DVD.

(7) The list of open source software programs which the Compact Vision product includes are as follows.

CV1

adduser	base-files	base-passwd	bash
bsdmainutils	bsdutils	busybox	console-common
console-data	console-tools	coreutils	cpio
cpp	cpp-4.3	cron	dbus
dbus-x11	debconf	debconf-i18n	debian-archive-keyring
debianutils	defoma	dhcp3-client	dhcp3-common
diff	dmidecode	dpkg	e2fslibs
e2fsprogs	file	findutils	fontconfig
fontconfig-config	gcc-4.2-base	gcc-4.3-base	gnupg
gpgv	grep	groff-base	grub
grub-common	gzip	hostname	ifupdown
initramfs-tools	initscripts	iproute	iptables
iputils-ping	jwm	klibc-utils	libacl1
libattr1	libaudio2	libblkid1	libbz2-1.0
libc6	libc6-i686	libcomerr2	libconsole
libcwidget3	libdb4.6	libdbus-1-3	libdevmapper1.02.1
libdrm2	libedit2	libexpat1	libfakekey0
libfontconfig1	libfontenc1	libfreetype6	libfs6
libgcc1	libgcrypt11	libgdbm3	libgl1-mesa-dri
libgl1-mesa-glx	libglib2.0-0	libglib2.0-data	libglu1-mesa
libgmp3c2	libgnutls26	libgpg-error0	libhal1
libice6	libjpeg62	libkeyutils1	libklibc

libkrb53	liblcms1	liblocale-gettext-perl	liblockfile1
libmagic1	libmng1	libmpfr1ldbl	libncurses5
libncursesw5	libnewt0.52	libpam0g	libpam-modules
libpam-runtime	libpci3	libpcre3	libpixman-1-0
libpng12-0	libpopt0	libqt4-assistant	libqt4-dbus
libqt4-designer	libqt4-gui	libqt4-network	libqt4-opengl
libqt4-qt3support	libqt4-script	libqt4-sql	libqt4-svg
libqt4-xml	libqtcore4	libqtgui4	libreadline5
libsasl2-2	libselinux1	libsepol1	libsigc++-2.0-0c2a
libslang2	libsm6	libss2	libssl0.9.8
libstdc++6	libtasn1-3	libtext-charwidth-perl	libtext-iconv-perl
libtext-wrapi18n-perl	libtiff4	libusb-0.1-4	libuuid1
libvolume-id0	libwrap0	libx11-6	libx11-data
libxapian15	libxau6	libxaw7	libxcb1
libxcb-xlib0	libxcursor1	libxdamage1	libxdmcp6
libxext6	libxfixes3	libxfont1	libxft2
libxi6	libxinerama1	libxkbfile1	libxmu6
libxmuu1	libxpm4	libxrandr2	libxrender1
libxt6	libxtrap6	libxtst6	libxv1
libxxf86dga1	libxxf86misc1	libxxf86vm1	linux-image-2.6.26-2
locales	lockfile-progs	login	logrotate
lsb-base	lzma	makedev	man-db
manpages	matchbox-keyboard	mawk	mktemp
module-init-tools	mount	ncurses-base	ncurses-bin
netbase	netcat-traditional	net-tools	openssh-blacklist
openssh-blacklist-extra	openssh-client	openssh-server	passwd
perl	perl-base	perl-modules	procps
qt4-qtconfig	readline-common	rsyslog	sed
ssh	sysvinit	sysvinit-utils	sysv-rc
tar	tcpd	traceroute	ttf-dejavu
ttf-dejavu-core	ttf-dejavu-extra	tzdata	ucf
udev	unzip	update-inetd	usbmount
usbutils	util-linux	wget	whiptail
x11-apps	x11-common	x11-session-utils	x11-utils
x11-xfs-utils	x11-xkb-utils	x11-xserver-utils	xauth
xbitmaps	xfonts-100dpi	xfonts-75dpi	xfonts-base
xfonts-encodings	xfonts-scalable	xfonts-utils	xinit
xkb-data	xorg	xserver-xorg	xserver-xorg-core
xserver-xorg-input-evdev	xserver-xorg-input-kbd	xserver-xorg-input-mouse	xserver-xorg-input-synaptics
xserver-xorg-video-vesa	xterm	zip	zlib1g

CV2 (Firmware ver.2.3.x.x)

acpi	acpi-support-base	acpid	adduser
apt	apt-utils	base-files	base-passwd
bash	bridge-utils	bsdmainutils	bsdutils
busybox	console-common	console-data	console-setup
console-setup-linux	coreutils	cpio	cpp
cpp-4.7	cron	dash	dbus
debconf	debconf-i18n	debian-archive-keyring	debianutils
desktop-base	diffutils	discover	discover-data
dmidecode	dmsetup	dpkg	e2fslibs
e2fsprogs	findutils	fontconfig	fontconfig-config
gcc-4.7-base	gettext-base	gnupg	gpgv
grep	groff-base	grub-common	grub-pc
grub-pc-bin	grub2-common	gzip	hostname
ifupdown	initramfs-tools	initscripts	insserv
iproute	iptables	iputils-ping	isc-dhcp-client
isc-dhcp-common	jwm	kbd	keyboard-configuration
klibc-utils	kmod	krb5-locales	less
libacl1	libapt-inst1.5	libapt-pkg4.12	libasprintf0c2
libattr1	libaudio2	libaudit0	libblkid1
libboost-iostream1.49.0	libbsd0	libbz2-1.0	libc-bin
libc6	libc6-i686	libcairo2	libcap2
libclass-isa-perl	libcomerr2	libcroco3	libcwidget3
libdatrie1	libdb5.1	libdbus-1-3	libdevmapper1.02.1
libdiscover2	libdrm-intel1	libdrm-nouveau1a	libdrm-radeon1
libdrm2	libedit2	libept1.4.12	libexpat1
libfakekey0	libffi5	libfontconfig1	libfontenc1
libfreetype6	libfribidi0	libfs6	libfuse2
libgcc1	libgcrypt11	libgdbm3	libgdk-pixbuf2.0-0
libgdk-pixbuf2.0-common	libgl1-mesa-dri	libgl1-mesa-glx	libglapi-mesa
libglib2.0-0	libglib2.0-data	libglu1-mesa	libgmp10
libgnutls26	libgpg-error0	libgssapi-krb5-2	libice6
libidn11	libjasper1	libjbig0	libjpeg62
libjpeg8	libk5crypto3	libkeyutils1	libklibc
libkmod2	libkms1	libkrb5-3	libkrb5support0
liblcms1	liblocale-gettext-perl	liblockfile-bin	liblockfile1
liblzma5	libmng1	libmount1	libmpc2
libmpfr4	libncurses5	libncursesw5	libnewt0.52
libnfnetlink0	libp11-kit0	libpam-modules	libpam-modules-bin
libpam-runtime	libpam0g	libpango1.0-0	libpcap0.8
libpci3	libpciaccess0	libpcre3	libpipeline1
libpixman-1-0	libpng12-0	libpopt0	libprocps0
libqt4-assistant	libqt4-dbus	libqt4-designer	libqt4-gui
libqt4-network	libqt4-opengl	libqt4-script	libqt4-svg
libqt4-xml	libqtcore4	libqtgui4	libreadline6
librsvg2-2	librsvg2-common	libselinux1	libsemanage-common
libsemanage1	libsensors4	libsepol1	libsigc++-2.0-0c2a
libslang2	libsm6	libsqlite3-0	libss2
libssl1.0.0	libstdc++6	libswitch-perl	libsystemd-login0
libtasn1-3	libtext-charwidth-perl	libtext-iconv-perl	libtext-wrapi18n-perl
libthai-data	libthai0	libtiff4	libtinfo5
libudev0	libusb-0.1-4	libusb-1.0-0	libustr-1.0-1
libutempter0	libuuid1	libwrap0	libx11-6
libx11-data	libx11-xcb1	libx86-1	libxapian22
libxau6	libxaw7	libxcb-dri2-0	libxcb-glx0
libxcb-render0	libxcb-shape0	libxcb-shm0	libxcb-util0
libxcb1	libxcomposite1	libxcursor1	libxdamage1
libxdmcp6	libxext6	libxfixes3	libxfont1
libxft2	libxi6	libxinerama1	libxkbfile1

libxml2	libxmu6	libxmuu1	libxpm4
libxrandr2	libxrender1	libxt6	libxtst6
libxv1	libxvmc1	libxxf86dga1	libxxf86vm1
linux-image-3.2.57-7	lm-sensors	locales	lockfile-progs
login	logrotate	lsb-base	matchbox-keyboard
mawk	module-init-tools	mount	multiarch-support
nano	nct6776	ncurses-base	ncurses-bin
ncurses-term	net-tools	netbase	netcat-traditional
openssh-blacklist	openssh-blacklist-extra	openssh-client	openssh-server
passwd	pciutils	perl	perl-base
perl-modules	plymouth	plymouth-drm	pmount
procps	read-edid	readline-common	rsyslog
sed	sensible-utils	sgml-base	shared-mime-info
sudo	sysv-rc	sysvinit	sysvinit-utils
tar	task-ssh-server	tasksel	tasksel-data
tcpd	traceroute	ttf-dejavu-core	ttf-wqy-microhei
tzdata	ucf	udev	unzip
usbmount	usbutils	util-linux	vim-common
vim-tiny	wget	whiptail	x11-apps
x11-common	x11-session-utils	x11-utils	x11-xfs-utils
x11-xkb-utils	x11-xserver-utils	xauth	xbitmaps
xfonts-100dpi	xfonts-75dpi	xfonts-base	xfonts-encodings
xfonts-scalable	xfonts-utils	xinit	xkb-data
xml-core	xserver-common	xserver-xorg	xserver-xorg-core
xserver-xorg-input-evdev	xserver-xorg-input-mouse	xserver-xorg-video-intel	xterm
xz-utils	zip	zlib1g	

CV2 (Firmware ver.3.x.x.x)

libjpeg62	libtiff4		

Appendix C: Approximate Calculation Formulas for Lenses

When WD is longer than approx. 200 mm:

Distance to the object: *L* [mm]

Focal distance: *f* [mm]

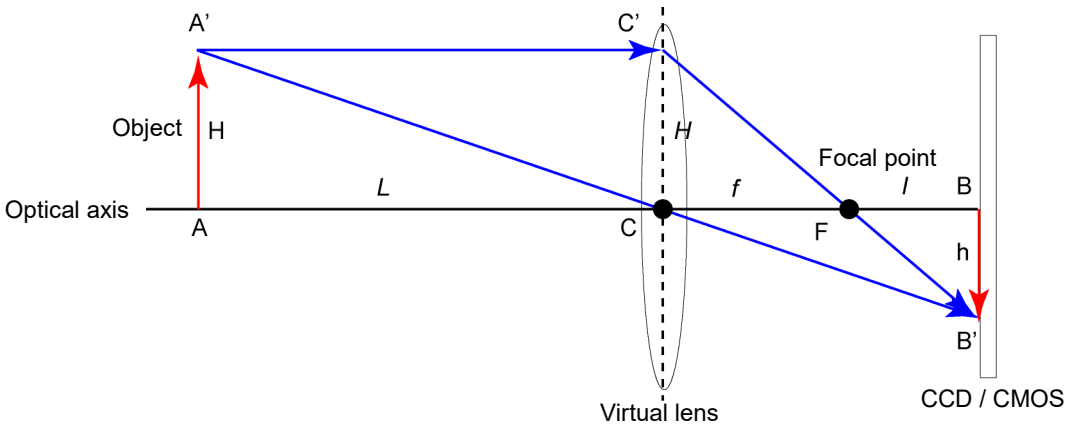
Field of View (Height) Approximate Calculation Formula

H = L × CCD vertical dimension / (f+l)

* CCD vertical dimension = Pixel size × number of pixels

* For the pixel size, refer to the specification of each camera.

When WD is roughly shorter than approx. 200 mm:



Distance to the object: *L*

Focal distance: *f*

Distance from the focal point to the imaging element: *l*

Distance from the virtual lens to the imaging element (CCD/CMOS): *(f+l)*

Tip:

"Distance to the object: *L*" in the above figure differs from the work distance.

"Distance to the object: *L*" is a distance from the "position of the virtual lens", while a work distance is a distance from the "lens end".

Therefore, a relation ship of *L*, *(f+l)* and *WD* in the above figure is as follows:

L + (f+l) = WD + Lens length + 17.526mm

Distance from the virtual lens to the imaging element (CCD/CMOS) *(f+l)*

$(f+l) = (L \times f) / (L - f)$

***L* including the extension tube (*t*)**

$L = f \times ((f+l) + t) / (((f+l) + t) - f)$

Field of View (Height) Approximate Calculation Formula

$H = L \times$ *CCD vertical dimension* $/ (f+l)$

* CCD vertical dimension = Pixel size × number of pixels

* For the pixel size, refer to the specification of each camera.