

SHARP®

Instruction Manual

Image sensor camera

Controller **IV-S51M**

Version 1.0

Produced in Jan. 2004

Thank you for purchasing the SHARP IV-S51M image sensor camera. The specifications and other details of IV-S51M are explained in this user's manual. Read this introductory user's manual carefully to thoroughly familiarize yourself with the functions and proper procedures for operation.

Although IV-S51M is designed to create an objective measurement program by simply selecting and setting necessary parameters in accordance with the instruction given on the screen. In addition to this manual, a supplementary manual is provided to explain functions and settings. Ask our sales department (refer overleaf) for this supplementary manual.

Notes

- This manual was written with the utmost care. However, if you have any question or inquiries concerning the product, please feel free to contact our dealers or service agents.
- Copying all or part of this booklet is prohibited.
- The contents of this manual may be revised or modified for improvement without prior notice.


Components of IV-S51M

The components of IV-S51M are as follows.


One(1) Controller IV-S51M	
Accessories	<ul style="list-style-type: none">• Two (2) Main housing angle brackets (for the bottom/backside)• Two (2) Main housing angle brackets (for the side)• Four (4) Securing screws• Two (2) D sub-connector (9-pin, D-sub, male, M2.6 lock screw for serial interface of IV-S51M)• One (1) 17-pin terminal connector• One (1) 23-pin terminal connector• One (1) Instruction manual

Safety Precautions



Read this user's manual and the attached documents carefully before installing, operating, or performing any maintenance, in order to keep the machine working correctly. Make sure you understand all of the equipment details, safety information, and cautions before using this machine. In this user's manual, the safety precautions are divided into "Dangers" and "Cautions" as follows.



 **Danger** : Improper handling is likely to lead to death or serious injury.

 **Caution** : Improper handling may lead to injury or damage to equipment.

Even when only a  **Caution** is given, serious results may occur depending on the circumstances. In all cases, important points are described. Be sure to follow the advice given.

The following symbols are used to prohibit or explain required action.

 : This means do not do what is described. For example, prohibited disassembly is shown as .

 : This means an action you must take. For example, a ground connection that must be made is shown as .

(1) Installation

Caution

- Use only in the environments specified in the catalog, instruction manual, or user's manual. Electric shock, fire or malfunction may result if used in high temperature, high humidity, dusty or corrosive environments, or if excessive vibration or impact occurs.
- Install the equipment only as described in the manual.
An improper installation may cause the equipment to fail, breakdown, or malfunction.
- Never leave wire cuttings or any other foreign matter lying about.
A fire, breakdown or malfunction may result from inappropriate objects left near the equipment.

(2) Wiring

Caution

- Connect only to the specified power source.
Connection to the wrong power source may cause a fire.
- Wiring should be performed by a qualified electrician.
Improper wiring may lead to a fire, machine failure or electric shock.

(3) Use

Danger

- Do not touch the terminals while the power is turned ON or you may receive an electric shock.
- Assemble an external emergency stop circuit and interlock circuit (external to the IV-S51M compact image sensor camera). Otherwise a breakdown or damage to the other equipment may occur due to a problem with the IV-S51M.

Caution

- Take special care to follow all safety guidelines if you are changing the parameters for the operating conditions or performing an "enforced output," "run," or "stop" during operation. Misoperation may damage the machine or cause an accident.
- Turn ON the power supplies in the specified sequence. Turning ON the supplies in the wrong order may lead to a machine breakdown or cause an accident.

(4) Maintenance

 **Warning**

- The IV-S51M controller contains a lithium battery. Do not expose the IV-S51M directly to flames as the battery may explode and seriously injure people nearby.

 **Prohibit**

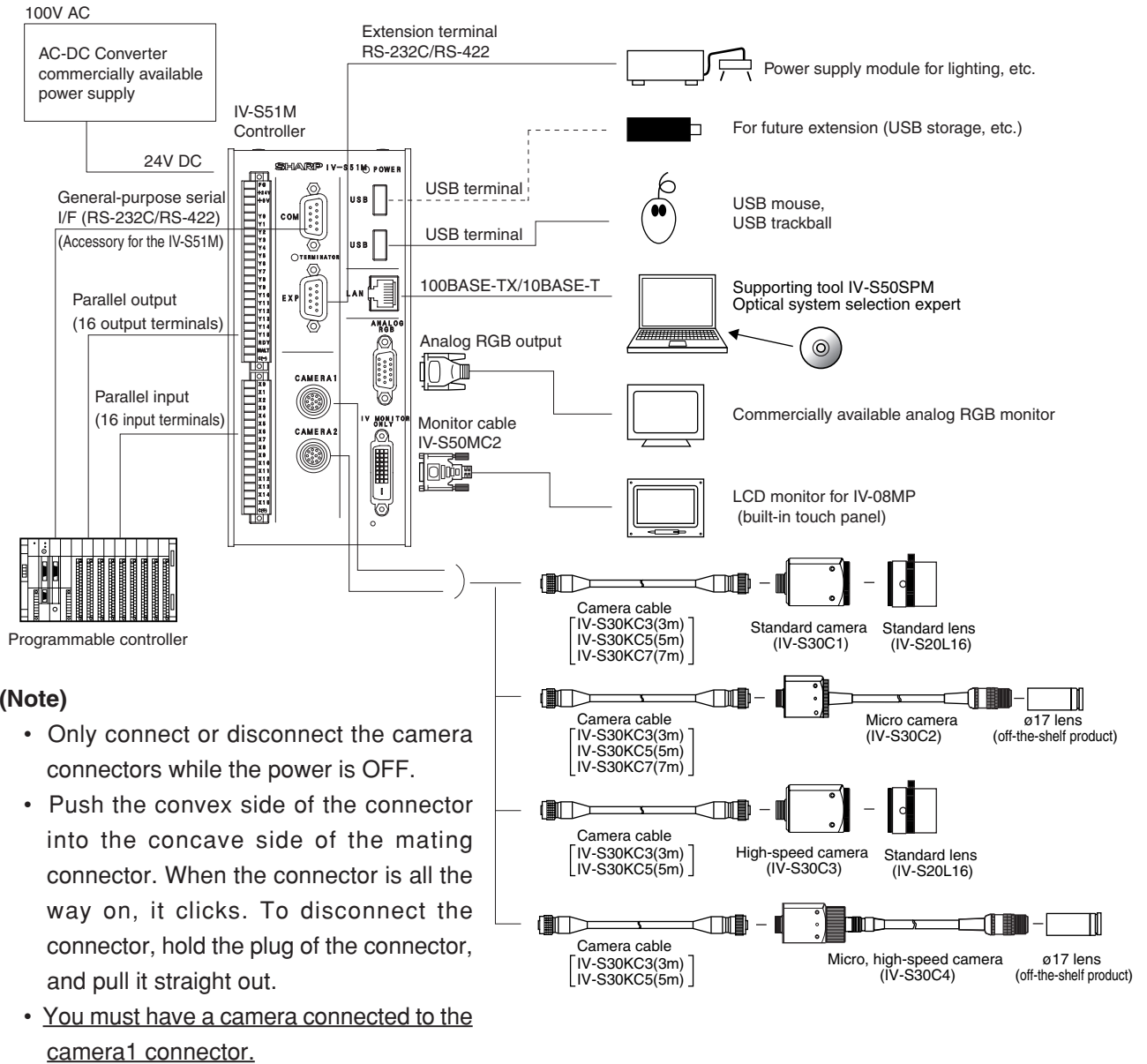
- Do not disassemble or modify the camera.
Fires, breakdowns or malfunctions may occur, if the camera is disassembled.

 **Caution**

- Turn OFF the power source before connecting or disconnecting the IV-S51M.
If you don't, electric shocks, malfunctions or breakdown may occur.

1. System Configuration

■ When an IV monitor is not directly connected

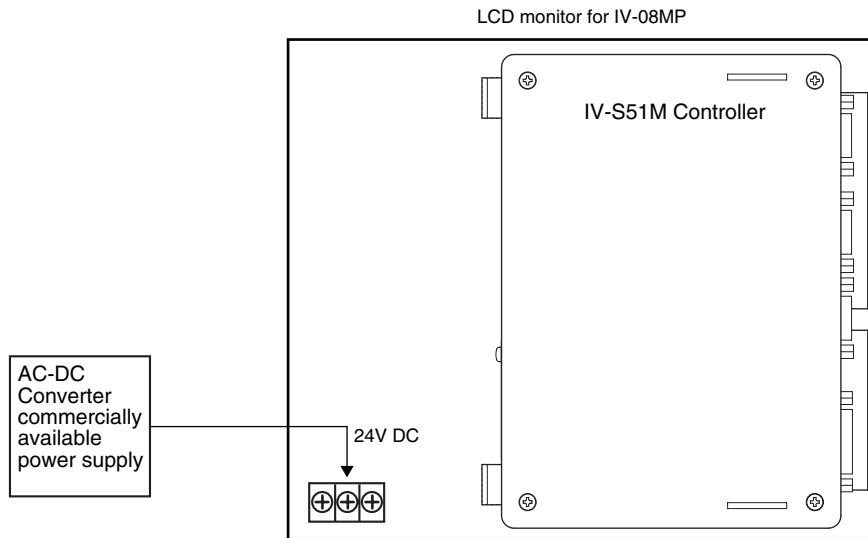


(Note)

- Only connect or disconnect the camera connectors while the power is OFF.
- Push the convex side of the connector into the concave side of the mating connector. When the connector is all the way on, it clicks. To disconnect the connector, hold the plug of the connector, and pull it straight out.
- You must have a camera connected to the camera1 connector.

■ **When an IV monitor is connected**

When an IV monitor is connected, the configuration of peripheral equipment is equal to the one when an IV monitor is not directly connected.



■ **When camera is connected**

- A maximum of two cameras can be connected to the IV-S51M.
- Mixed use of different camera types (IV-S30C1/C2 and IV-S30C3/C4) is not supported.

Camera mode	Camera port	Connectable camera
High-speed camera	CAMERA1	IV-S30C3/C4
	CAMERA2	IV-S30C3/C4
Standard camera	CAMERA1	IV-S30C1/C2
	CAMERA2	IV-S30C1/C2

■ **Product lines**

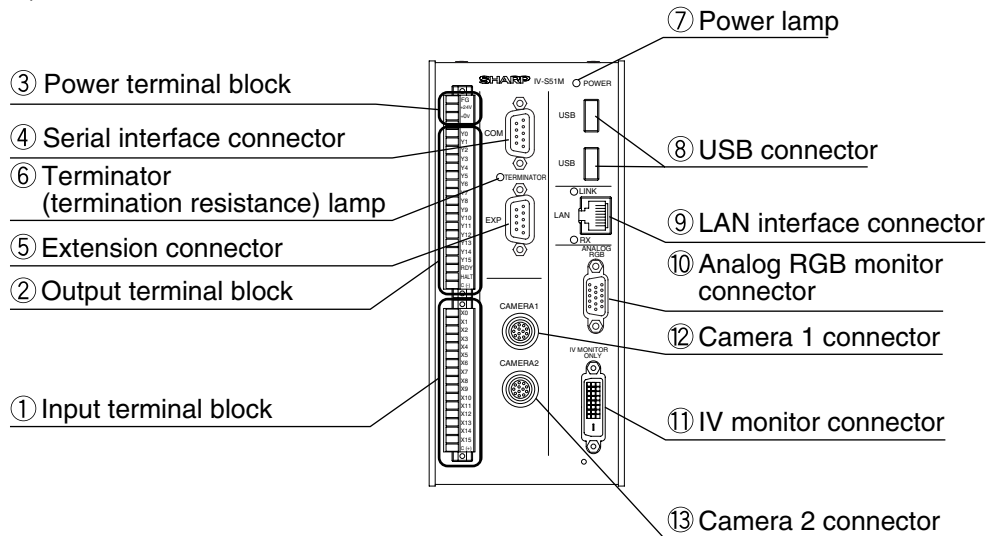
Item name		Model name	Specification or details
Camera	Standard	IV-S30C1	Camera main housing (without lens or camera cable)
	Micro	IV-S30C2	Camera main housing (without lens or camera cable)
	High-speed	IV-S30C3	Camera main housing (without lens or camera cable)
	Micro, high-speed camera	IV-S30C4	Camera main housing (without lens or camera cable)
Camera cable		IV-S30KC3	Cable for IV-S30C1/C2/C3/C4 camera, 3m
		IV-S30KC5	Cable for IV-S30C1/C2/C3/C4 camera, 5m
		IV-S30KC7	Cable for IV-S30C1/C2 camera, 7m
Camera lens		IV-S20L16	C mount lens with a 16mm focal length
Parameter setting support software		IV-S50SPM	Runs on Windows2000/XP
Exclusive LCD monitor		IV-08MP	TFT LCD 8.4-inch monitor with touch panel

- For the details about the IV-S50SPM and IV-08MP, see the individual instruction manuals attached to the products.
- For the details about the IV-S30C1/C2/C3/C4, IV-S30KC3/KC5/KC7, and IV-S20L16, see the individual instruction manuals attached to the products.

2. Part Names and Functions

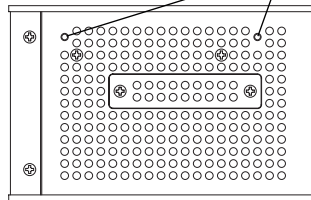
This section describes the names and functions of the IV-S51M Controller.

(Front)

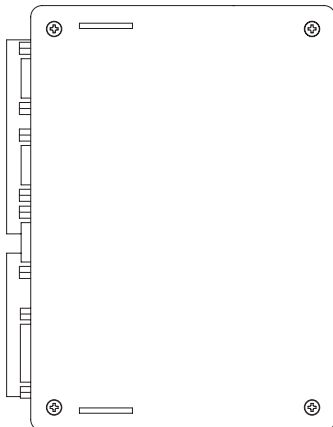


(Top)

⑭ Mounting hole for angle bracket (for mounting on side)



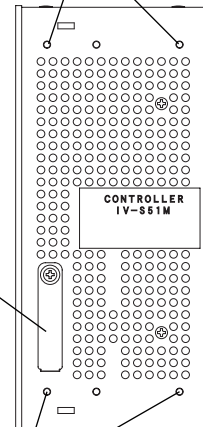
(Side)



(Backside)

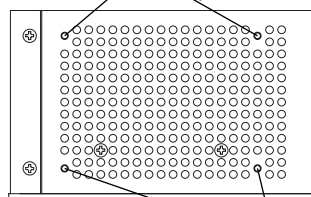
⑭ Mounting hole for angle bracket (for mounting on backside)

⑮ Connector cover



(Bottom)

⑭ Mounting hole for angle bracket (for mounting on bottom)



⑭ Mounting hole for angle bracket (for mounting on side/bottom)

	Name	Function	
①	Input terminal block (INPUT: X0 to X15)	This block has 16 input terminals. • External devices are connected to these terminals for input (parallel I/F).	
②	Output terminal block	OUTPUT : Y0 to Y15	This block has 16 output terminals. • External devices are connected to these terminals for output (parallel I/F).
		RDY(READY)	This will turn ON when the measurement start input is enabled.
		HALT	This turns OFF when the image processing is halted. This turns ON when image processing is running.
③	Power terminal block (+24V, 0V)	Commercially available constant-voltage power supply (24V DC \pm 10%, 2A or more) is connected here.	
④	Serial interface connector (RS-232C/RS-422)	This connector is used to connect a personal computer for communications (general-purpose serial I/F) or to connect programmable controller for a computer link.	
⑤	Extension connector (RS-232C/RS-422)	This connector is used to connect external devices (power supply module for lighting, etc.) for communications (general-purpose serial I/F).	
⑥	Terminator (termination resistance) lamp	When terminating resistance at RS-422 input of general-purpose serial port (COM) is ON, this lamp will be lit. When IV-S51M is connected to several peripheral devices at RS-422, turn ON the terminating resistance of IV-S51M or the peripheral devices which are located at the both ends of the cable. ON/OFF will be set for the termination resistance of IV-S51M in "Setting up system parameters".	
⑦	Power lamp (POWER)	When power is supplied to the IV-S51M, this lamp will light green.	
⑧	USB connector (x2)	USB mouse or USB trackball are connected here. Use the devices with 100mA or less. The upper connector is for future extension to be used for USB storage or other purposes.	
⑨	LAN interface connector (10 BASE-T/100 BASE-TX)	Ethernet cable is used when IV-S51M is connected to LAN (runs on 10 BASE-T/100 BASE - TX)	
⑩	Analog RGB monitor connector (ANALOG RGB)	Commercially available analog RGB monitor with SVGA display function is connected here.	
⑪	Connector for IV monitor (IV MONITOR ONLY)	Monitor cable (IV-S50MC2:to be sold separately) is connected to here when the LCD monitor (IV-08MP) is separately used. This will be not used when a monitor and IV-S51M are directly connected.	
⑫	Camera 1 connector (CAMERA 1)	The camera cable connector is connected here. • The camera connected to the CAMERA 1 position is camera 1, and the camera connected to the CAMERA 2 position is camera 2.	
⑬	Camera 2 connector (CAMERA 2)		
⑭	Mounting hole for angle bracket	This is the hole to mount angle bracket to IV-S51M. There are two types of angle brackets which are the angle bracket for the side mount and the angle bracket for backside/bottom mount (common).	
⑮	Connector cover	This cover is removed, when IV-S51M and LCD monitor (IV-08MP) are directly connected.	

3. Connection and Installation Method

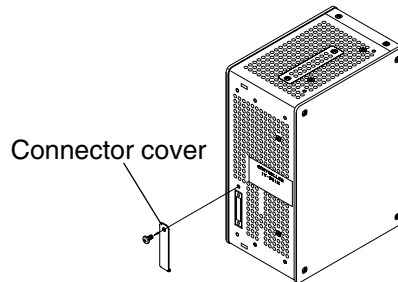
This section describes how to connect IV-S51M and LCD monitor. IV-S51M and LCD monitor can be directly connected or connected using the monitor cable.

[1] When IV-S51M is directly connected to LCD monitor (IV-08MP)

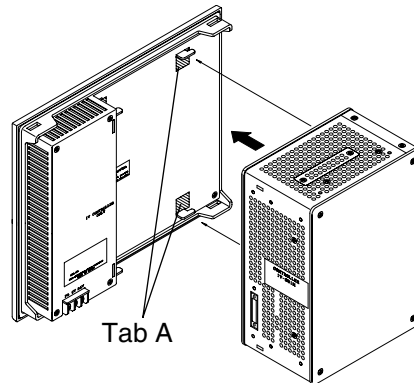
When IV-08MP is directly connected, follow the instructions below to connect the monitor to IV-S51M.

(Note) When IV-08MP and IV-S51M are not directly connected and used separately, the work explained here are not be required.

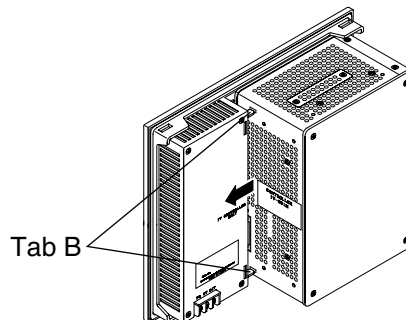
- ① Remove the connector cover from the main housing of IV-S51M.



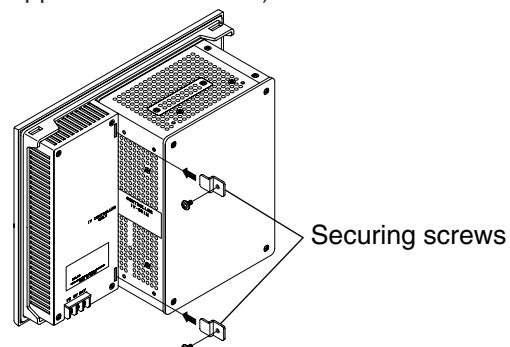
- ② Fit the tab A of the IV-08MP in the notch part of the IV-S51M.



- ③ To connect them, press the IV-S51M in place in the direction of the arrow so that the tab B is fit into the notch part. Make sure that the connectors of both units are firmly connected.



- ④ Insert two (2) main housing angle brackets (supplied with IV-08MP) as indicated below and fix them with two (2) securing screws (supplied with IV-08MP).



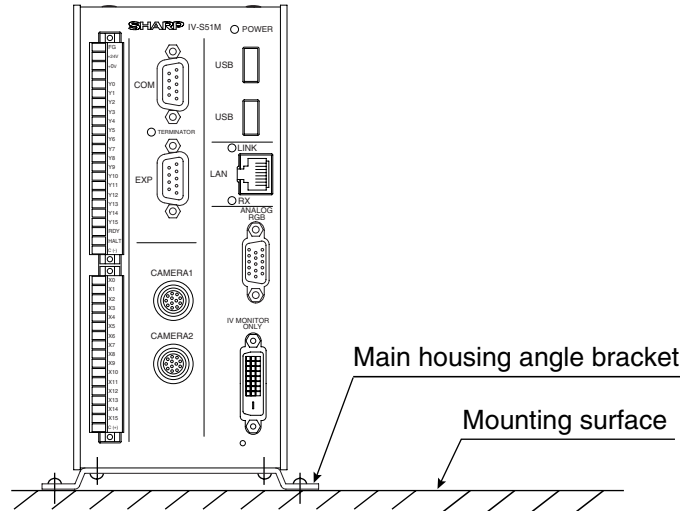
[2] When IV-S51M is connected to LCD monitor (IV-08MP) using the monitor cable

When IV-S51M is connected to the IV-08MP using the monitor cable, secure the IV-S51M to the mounting surface with main housing angle brackets (accessory). IV-S51M can be mounted on the surface either at the bottom (when vertically placed), the side (when horizontally placed), or the backside.

(Note) When the IV-S51M and the IV-08MP are directly connected, main housing angle brackets will not be used.

(1) Attachment at the bottom surface (when vertically placed)

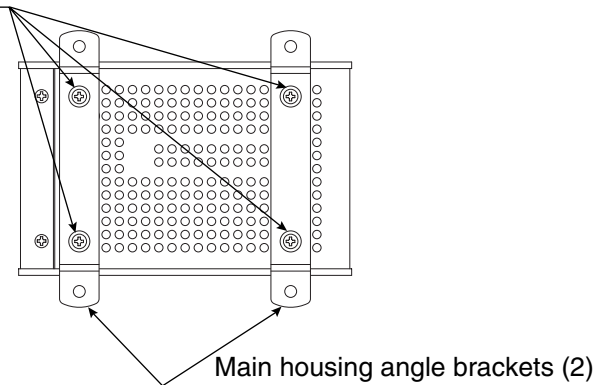
IV-S51M is vertically placed and its bottom surface is secured to the mounting surface.



- ① Attach two (2) main housing angle brackets (for the bottom/backside) to the bottom surface of the IV-S51M with securing screws (accessory, two each: M3×8)

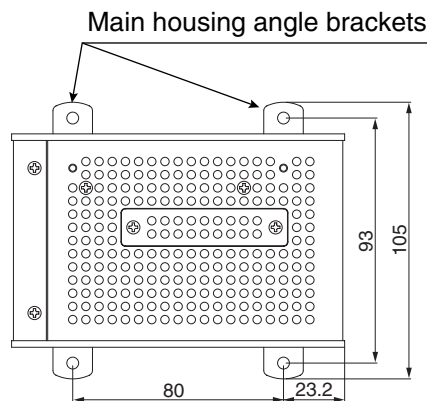
(The bottom view of the IV-S51M)

Securing positions of screws (4)



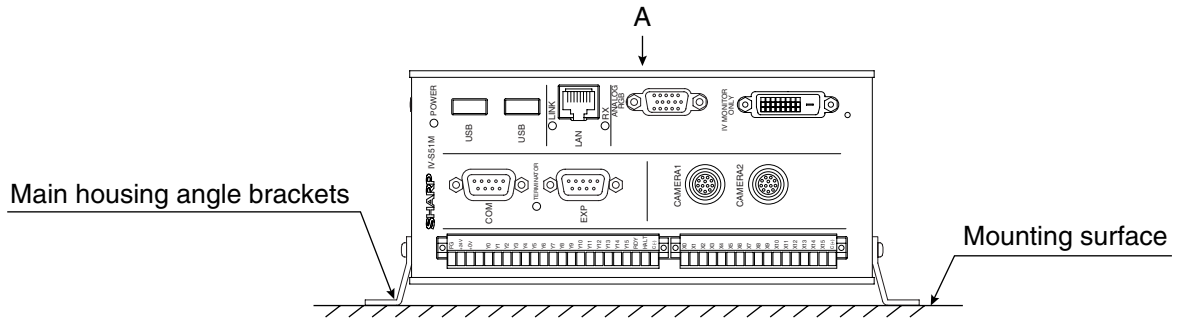
- ② Secure the IV-S51M to the mounting surface using four (4) mounting holes of main housing angle brackets.

(Top view)

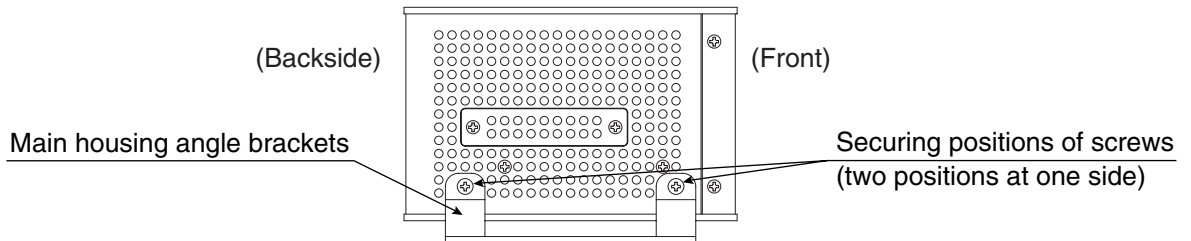


(2) Attachment at the side surface (when horizontally placed)

IV-S51M is horizontally placed and its side surface is secured to the mounting surface.

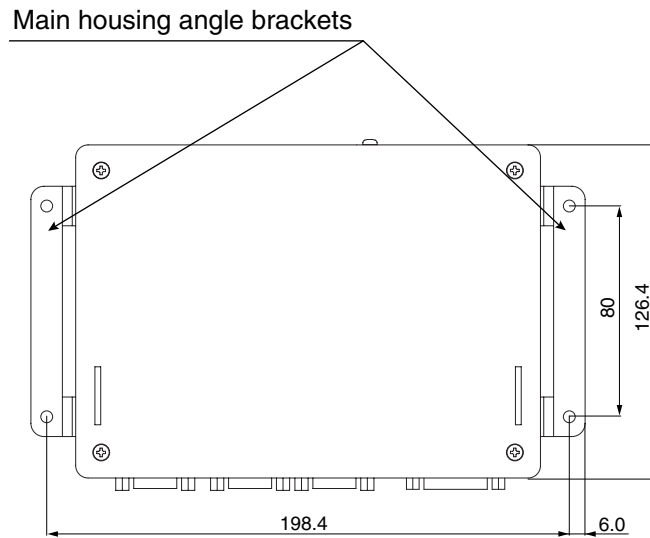


- ① Attach two (2) main housing angle brackets (for the side) to the side surface of the IV-S51M with securing screws (two each: M3×8).



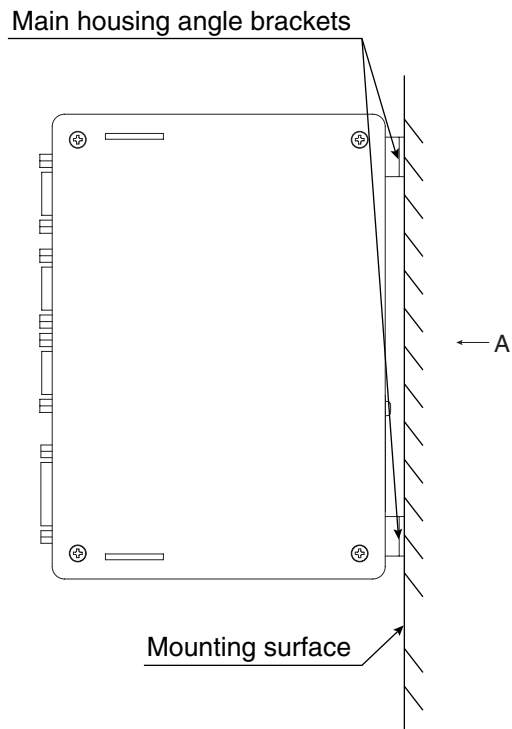
- ② Secure the IV-S51M to the mounting surface using four (4) mounting holes of main housing angle brackets.

(A view on arrow)



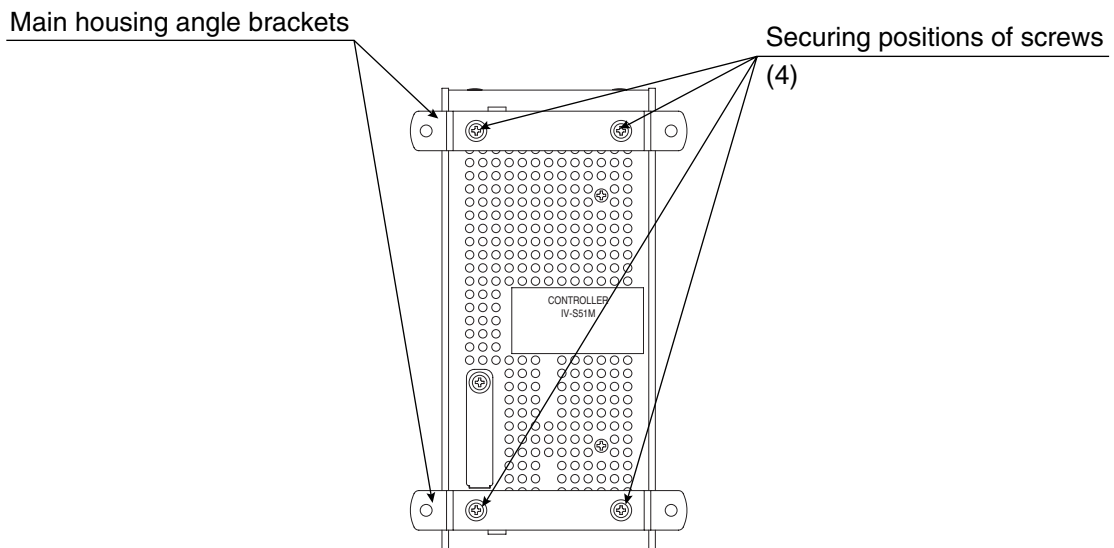
(3) Attachment at the backside surface

The backside surface of IV-S51M is secured to the mounting surface.

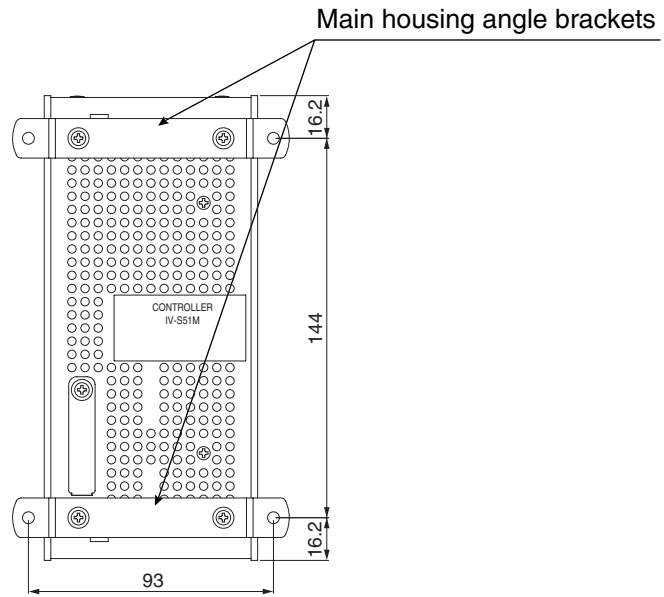


- ① Attach two (2) main housing angle brackets (for the bottom/backside) to the backside surface of the IV-S51M with securing screws (two each: M3×8)

(A arrow diagram)

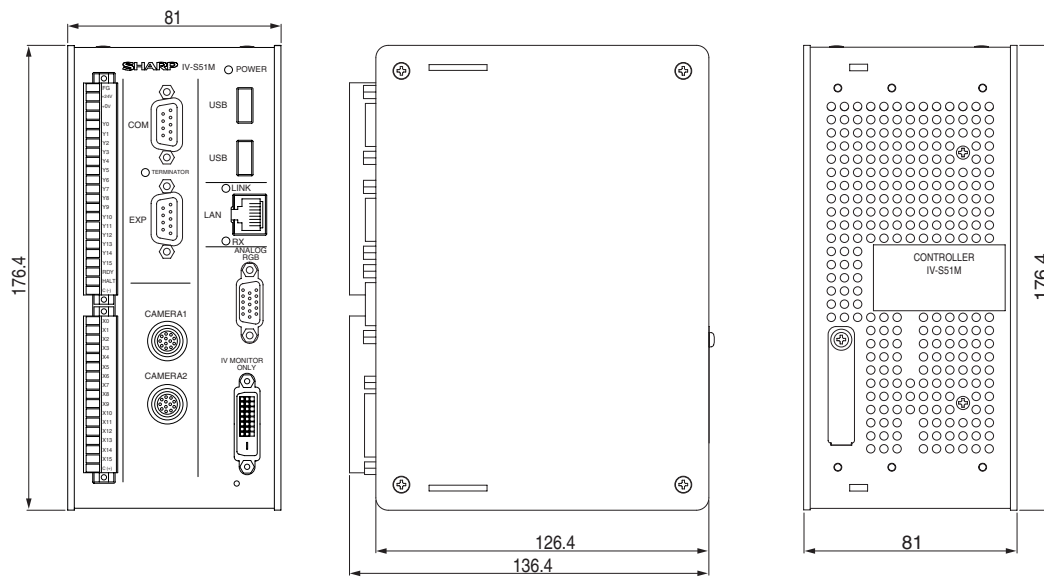


- ② Secure the IV-S51M to the mounting surface using four (4) mounting holes of main housing angle brackets.



● External dimension of the IV-S51M

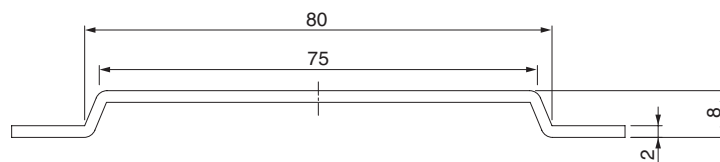
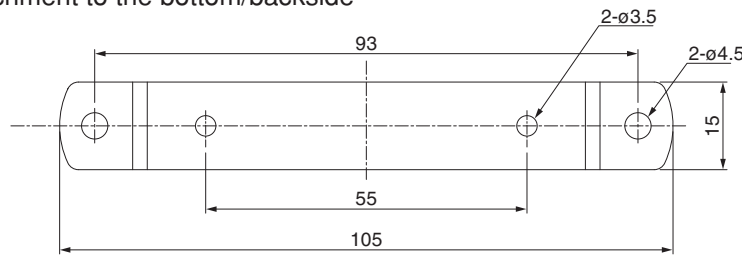
(Unit: mm)



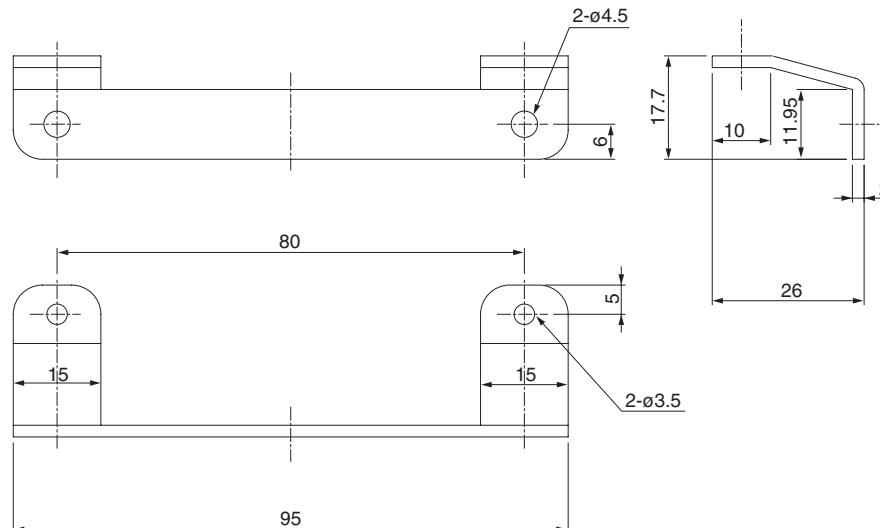
● External dimension of main housing angle bracket

(Unit: mm)

- For the attachment to the bottom/backside

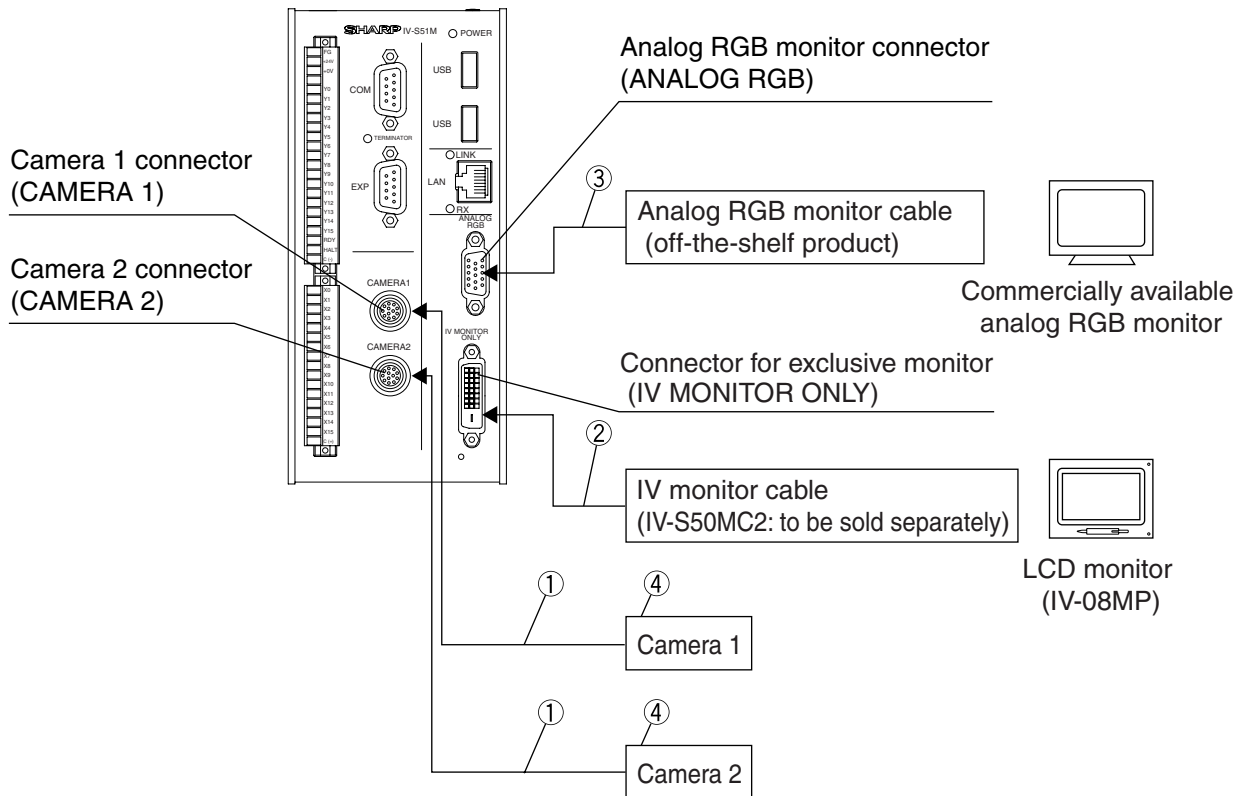


- For the attachment to the side



[3] Connecting the peripheral equipment to the IV-S51M

Connect the camera (up to 2 cameras), the LCD monitor, and commercially available analog RGB monitor to the IV-S51M.



① Connect the camera cable (IV-S30KC3/KC5/KC7) or the camera conversion cable (IV-S30HC) to the camera 1 connector (CAMERA 1) and camera 2 connector (CAMERA 2) on the IV-S51M.

(Note) Only connect or disconnect the peripheral equipment including the camera while the power is OFF.

- Push the convex side of the connector into the concave side of the mating connector. When the connector is all the way on, it clicks.
- To disconnect the connector, hold the plug of the connector and pull it straight out.
- A camera connected to the camera 1 connector (CAMERA 1), is treated as camera 1 by this system, and a camera connected to the camera 2 connector (CAMERA 2) is treated as camera 2.
- It is possible to connect only one camera. In this case, you must have a camera connected to the camera 1 connector.

- ② When the LCD monitor IV-08MP and the controller are separately used, connect the IV monitor cable (IV-S50MC2: to be sold separately) to the connector for IV monitor (IV MONITOR ONLY).
(Note) When the LCD monitor and the controller are directly connected, the work described here is not required.
- ③ When other commercially available analog RGB monitor with SVGA display function are connected other than the LCD monitor, connect the monitor cable to the analog RGB monitor connector (ANALOG RGB).
- ④ See the individual manual for each camera for details about connection/installation of the camera.

■ **Leave enough space around the IV-S51M**

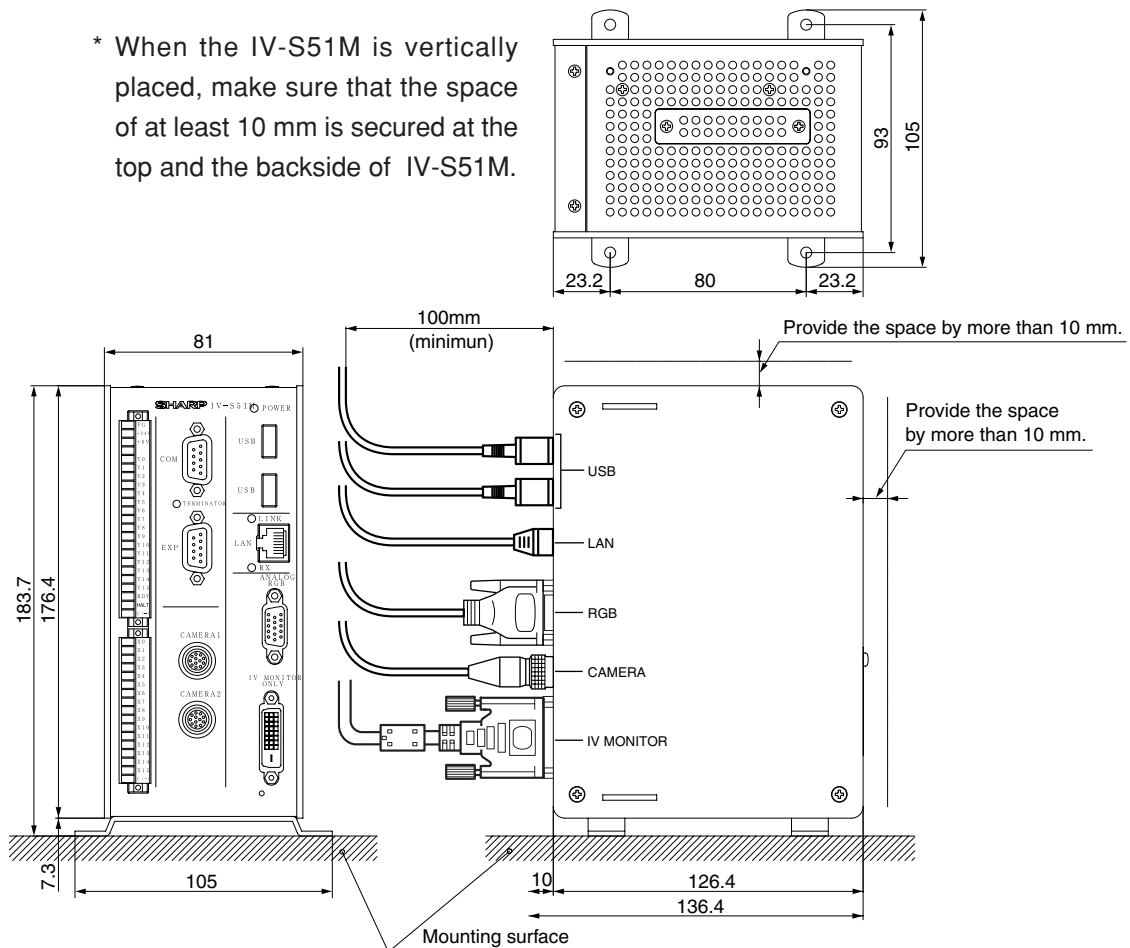
In order to connect camera cables, the IV monitor cable, RGB monitor cable and Ethernet cable to the IV-S51M, the following space (min.) is required.

(Note)

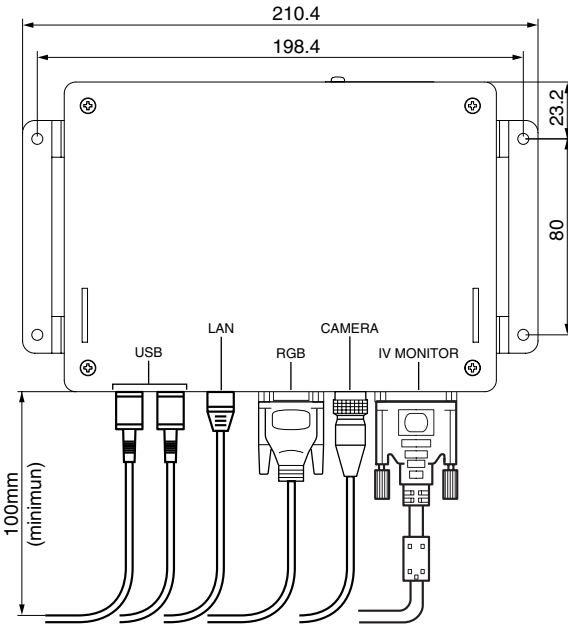
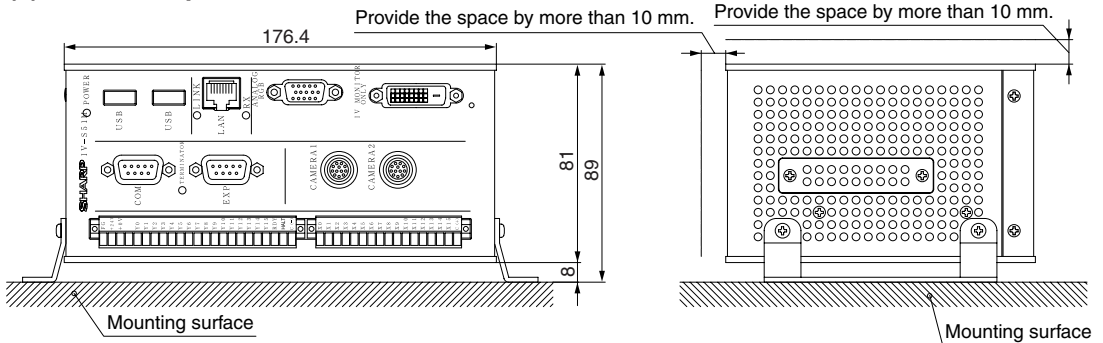
- Do not bend the camera cables repeatedly.
- Make sure the installation location allows the enough space for the input/output wires going to the I/O terminal block and the power terminal block on the IV-S51M.

(1) Vertical placement

* When the IV-S51M is vertically placed, make sure that the space of at least 10 mm is secured at the top and the backside of IV-S51M.



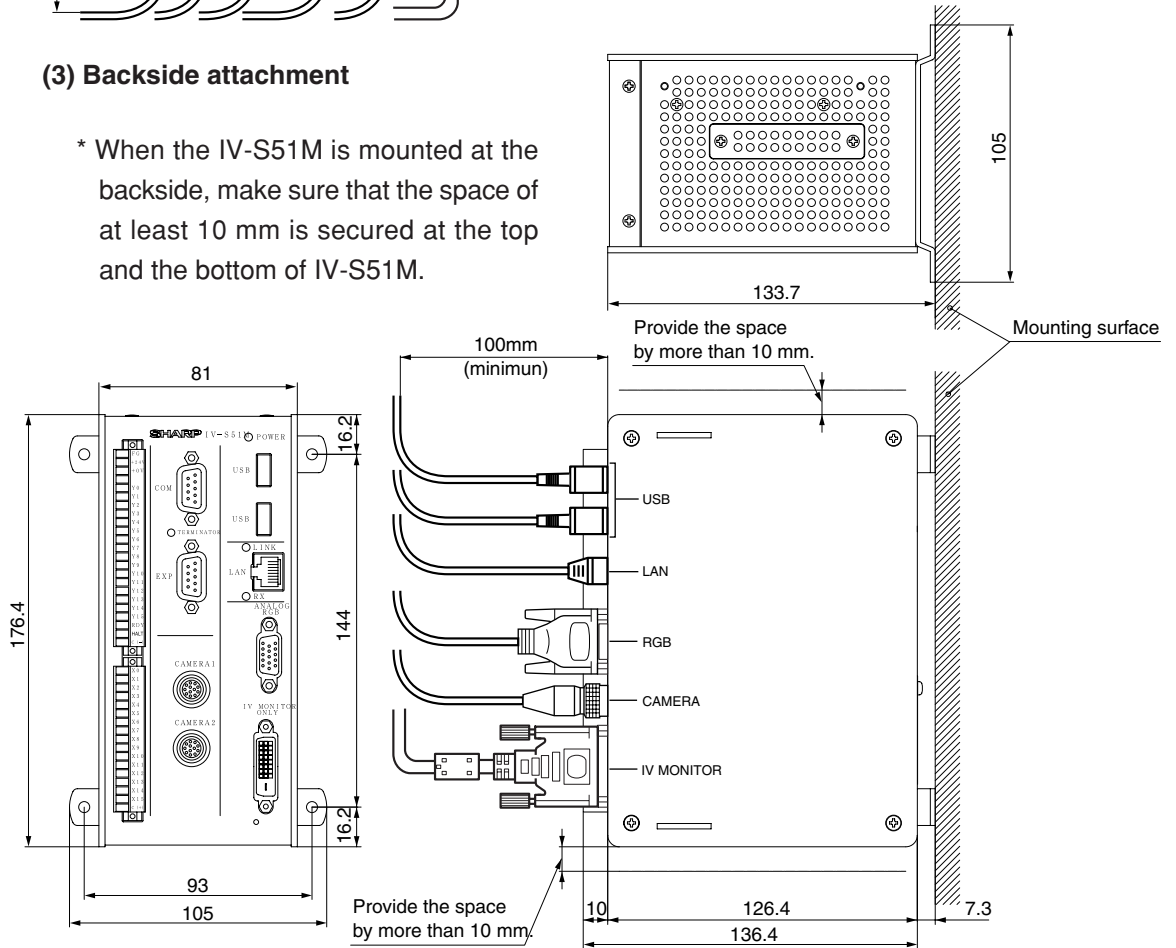
(2) Horizontal placement



* When the IV-S51M is horizontally placed, make sure that the space of at least 10 mm is secured at the top and the backside of IV-S51M.

(3) Backside attachment

* When the IV-S51M is mounted at the backside, make sure that the space of at least 10 mm is secured at the top and the bottom of IV-S51M.

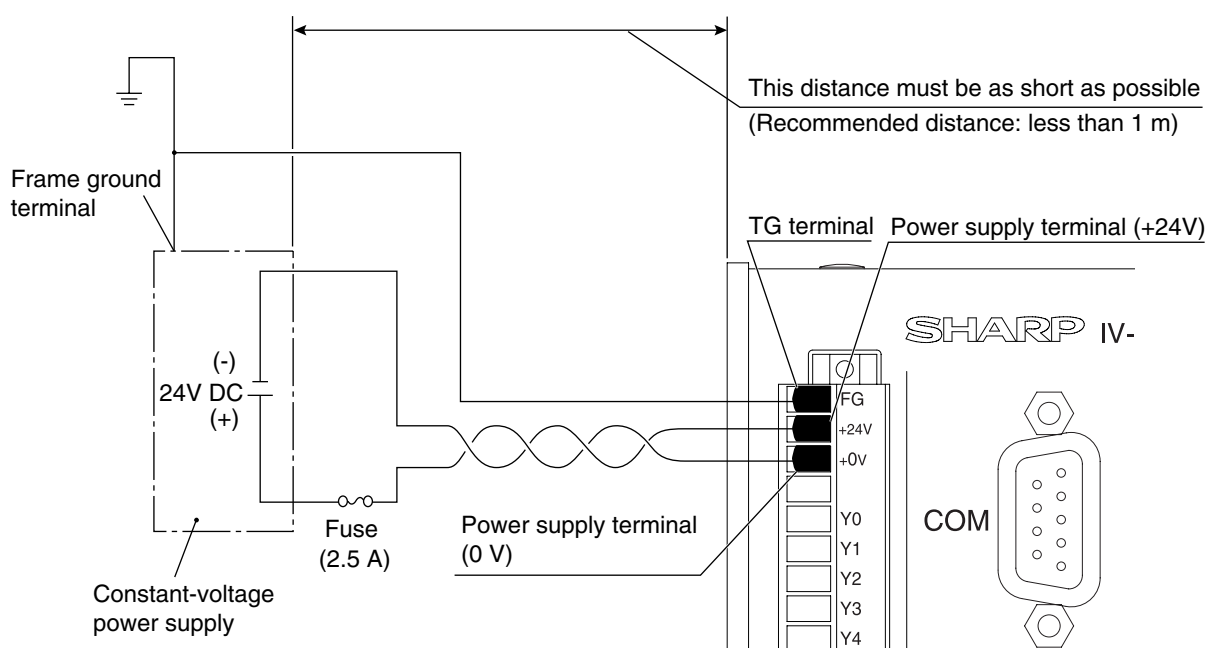


4. Wiring

[1] Connecting a power supply

Connecting a commercially available constant-voltage power supply to the power terminal (POWER: +24V, 0 V) on the IV-S51M. Use a 24 VDC \pm 10%, 2A or more constant-voltage power supply.

- Use an individual power supply to supply power to the IV-S51M. If the power supply is used to power other equipment, measurement error may occur.
- Check the polarity of the power supply terminals, +24 V and 0 V. If power is supplied with the polarity inverted, the IV-S51M may be damaged.
- Only connect or disconnect the camera cable and other equipment while the power is OFF.



(Note) To improve the noise resistance of the constant-voltage power supply to the IV-S51M, observe the following precautions.

- Ground the FG terminal of the constant-voltage power supply according to the class D (class 3) grounding.
- The power line between the IV-S51M and the constant-voltage power supply must be as short as possible. (Recommended distance: less than 1 m)
Do not run the power supply line near any noise generating sources, such as electric motor lines.
- Use twisted-pair wire for the power supply line.
- Connect the power/output terminal block and the input terminal block while they are detached. If they are connected while they are attached, damage may occur.
- Only insert each terminal into the controller after all the wiring is completed.

[2] Connecting to the input/output terminals (parallel I/F)

16 input terminals and 16 output terminals are available on the input/output terminal block on the IV-S51M.

The input terminal block has INPUT terminals X0 to X15, C(+), and the output terminal block has OUTPUT terminals Y0 to Y15, RDY, HALT and C(-).

● Conditions for connection

Size of the wire	AWG22 to 16 (0.33 to 1.65mm ³)
Type of the wire	Single wire, twisted wire
Terminal treatment	Peel off the wire cover by 7mm
Screw torque	0.25Nm

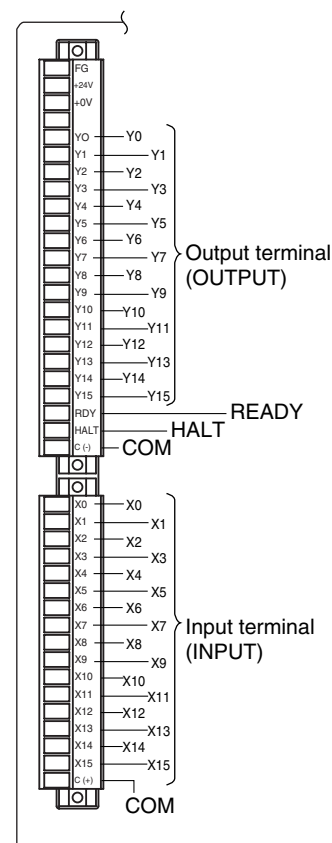
● Wiring procedure

- ① Remove the terminal block from the IV-S51M by loosening two screws at the both end (flange), which secure the terminal block.
- ② Loosen the screw of the terminal by turning it anti-clockwise with slotted screw driver.
- ③ Insert the peeled wire into the terminal and screw it up.
- ④ After all the wiring is done, fit the terminal block in place on the IV-S51M, and secure it by tightening the screws at the flange.

(Note)

- Soldered wire may cause a loose connection.
- Connect only one wire to one terminal. If more than one wire is connected, it may cause a loose connection.
- Do not plug in or unplug the terminal block while it is energized.
- Do not plug in or unplug the terminal block by pulling the wire.

● Input/output terminal block on the IV-S51M



Terminals for input	X0	Measurement start trigger
	X1 to X6 (7 points)	Type change (64 types)
	X7 to X8	Execution for individual camera (camera 1/camera 2)
	X9	Standard image registration
	X10 to X15	General-purpose input for micro PLC
	C(+)	Common for input
	Terminals for output	Y0 to Y15 (15 points)	Result of logical calculation output
RDY		This will turn ON when the measurement start trigger is enabled.
RUN		This will turn OFF when a problem occurs.
C (-)		Common for output

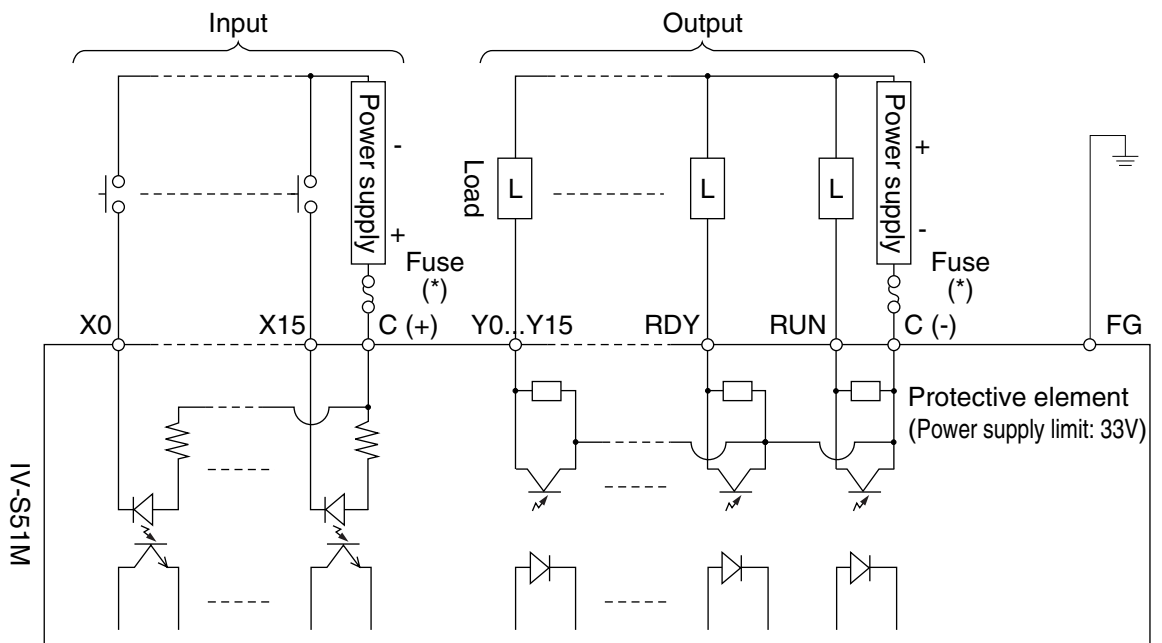
(Note) Only connect the terminal block while the connector terminal block is detached from the main housing.

● I/O port

The input/output terminals are isolated by photocouplers, to prevent malfunctions caused by noise. Use them within the rated range. The specifications of the input/output ports are listed below.

Item		Rating
Input	Rated input voltage	12/24V DC
	Input voltage range	10.8V to 26.4V DC
	Input voltage level	ON: 10.5V or less, OFF: 5V or more
	Input current level	ON: 3mA or less, OFF: 1.5mA or more
	Input impedance	3.3KW
	Response time	1 ms or less (OFF to ON, ON to OFF)
Output	Rated output voltage	12/24V DC
	Load voltage range	10.8V to 26.4V DC
	Rated max. output current	80mA DC
	Output type	Photocoupler open connector
	ON voltage drop	1.2V or less (80mA)
	Isolation method	Photocoupler isolation
	Response time	1 ms or less (OFF to ON, ON to OFF)

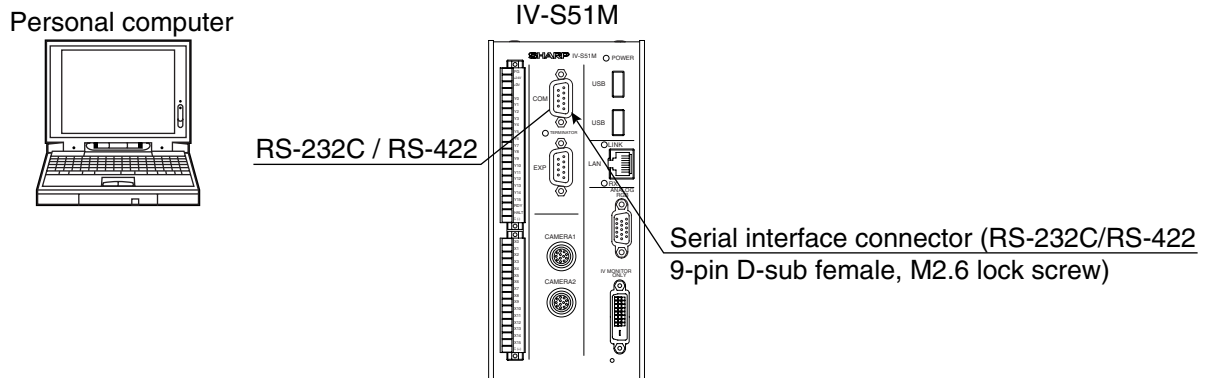
● Wiring to the IV-S51M



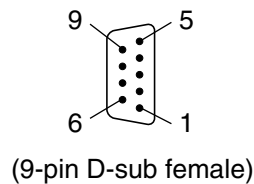
*Use the capacity appropriate to the load.

[3] Connection for communication with personal computer (general-purpose serial I/F)

Connect a personal computer to the serial interface connector (RS-232C/RS-422) on the IV-S51M. A 9-pin D-sub, male connector is included with the IV-S51M.

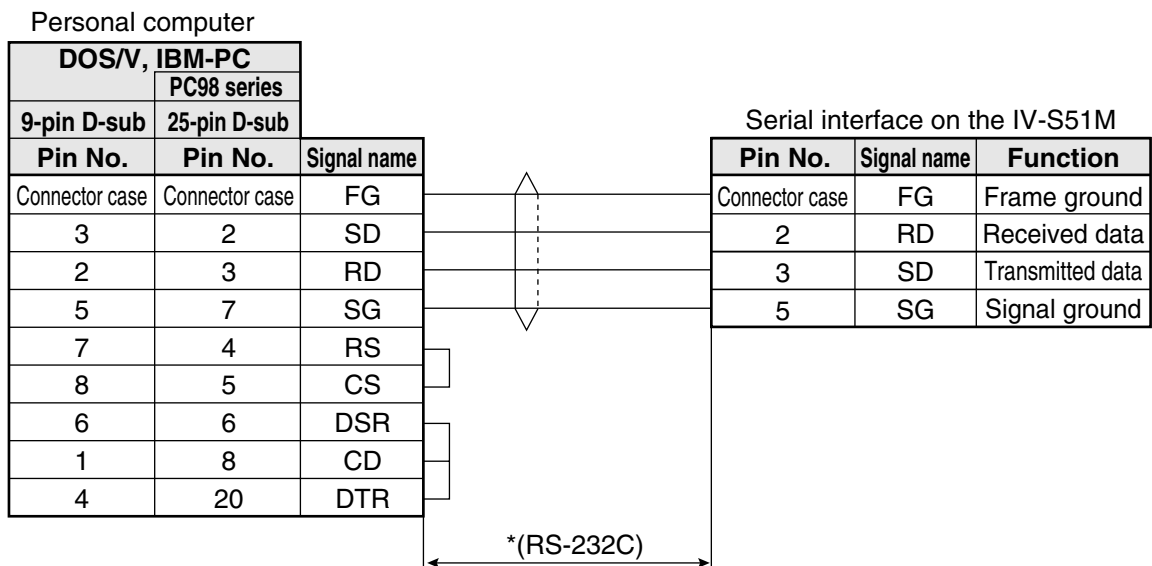


● Pin arrangement of serial interface connector (RS-232C/RS-422)



Communication standard	Pin No.	Signal name	Details	Direction
RS-232C	2	RD	Received data (personal computer → IV-S51M)	input
	3	SD	Transmitted data (IV-S51M → personal computer)	output
	5	SG	Signal ground	—
RS-422	4	TA	Transmitted data (IV-S51M → personal computer)	output
	7	TB		
	8	RA	Received data (personal computer → IV-S51M)	input
9	RB			
Connector case		FG	Frame ground	—

(1) When communicating through the RS-232C port



* The maximum length of the communication cable depends on the communication speed.

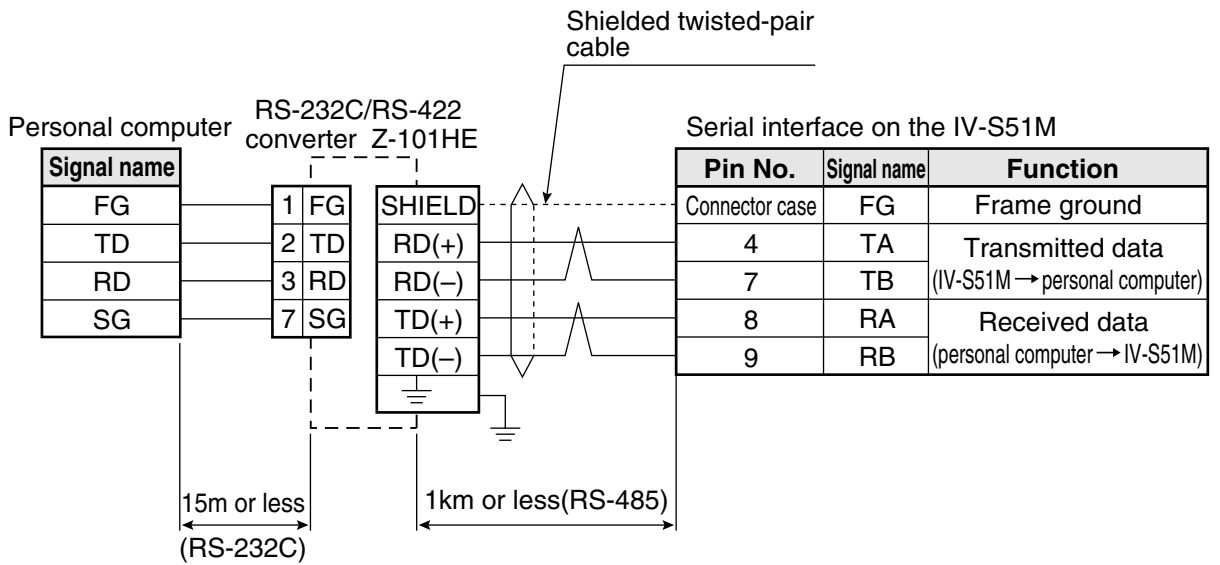
Communication speed	Cable length
9.6, 19.2	15m or less
38.4, 57.6, 115.2	2 to 3m

• Conduct a communication test before using the devices for measurements

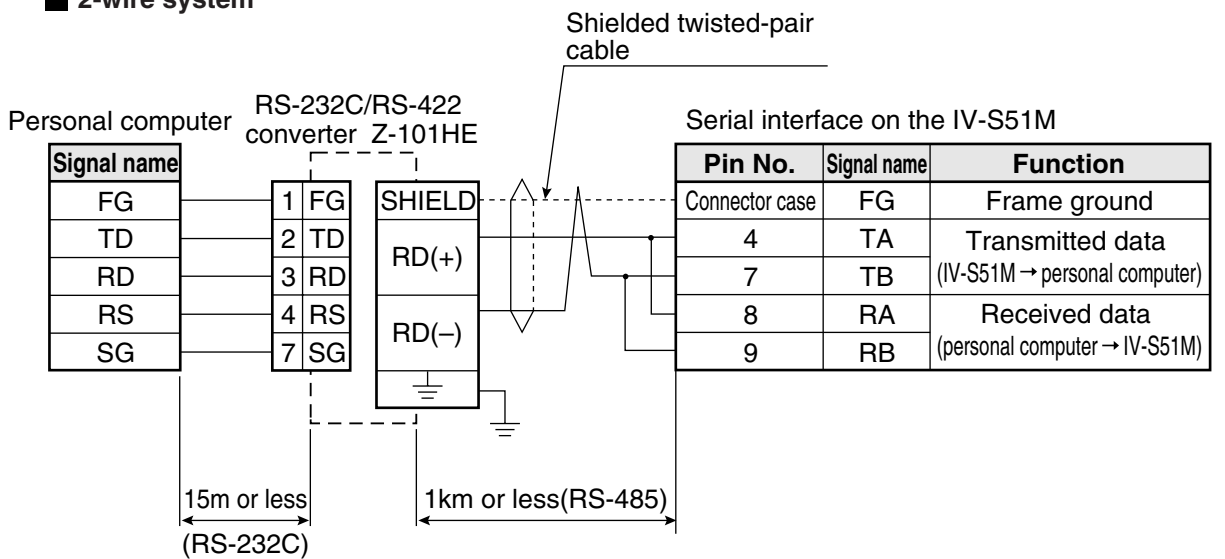
(2) When communicating through the RS-422 port

Specify the 4-wire or 2-wire on the [Serial Communication Parameters] menu from the [System Conditions] menu of IV-S51M in accordance with the actual wiring system.

■ 4-wire system



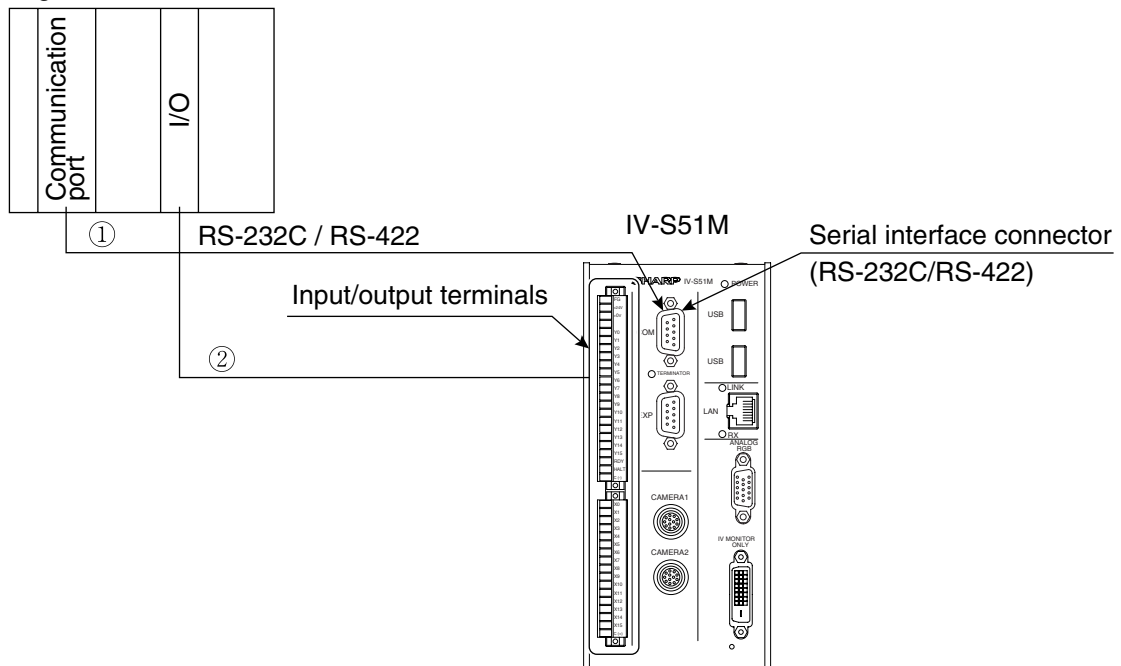
■ 2-wire system



[4] Connecting a programmable controller using the computer link function

Connect a programmable controller to the serial interface connector (RS-232C/RS-422) and the input/output terminals on the IV-S51M.

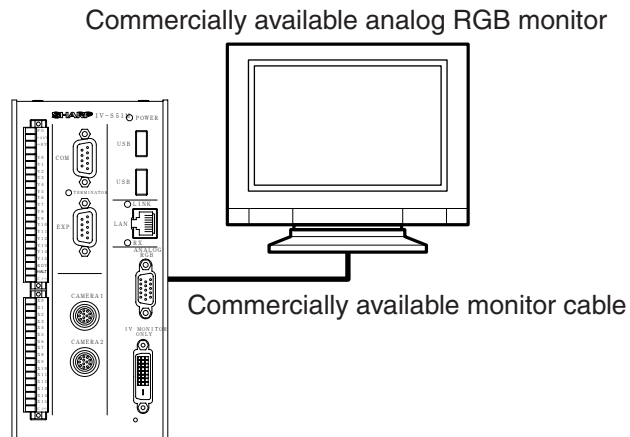
Programmable controller



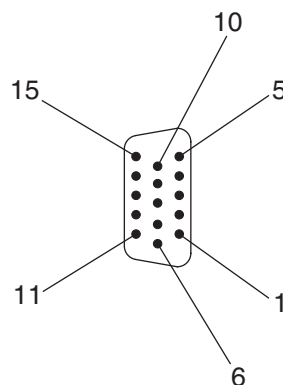
- ① Connect the computer link connector (RS-232C/RS-422) of a programmable controller to the serial interface connector (RS-232C/RS-422: 9-pin D-sub, female) on the IV-S51M.
 - In the case of RS-232C, the maximum communication cable length depends on the communication speed. → See item [3] for details.
- ② Connect the input/output terminals of the programmable controller to the input/output terminals on the IV-S51M. → See item [2] for details.

[5] Connecting to the analog RGB monitor connector

Connect an analog RGB monitor and the analog RGB monitor connector on the IV-S51M with a commercially available RGB monitor cable.



● Pin arrangement of RGB monitor connector



Pin No.	Signal name
1	R
2	G
3	B
4	—
5	GND
6	RGND
7	GGND
8	BGND
9	—
10	GND
11	—
12	DDAT
13	H_SYNC
14	V_SYNC
15	DDCK

[6] Connecting to the extension connector

Pin alignment of the extension is equal to the one of the serial interface connector.

The details of the communication vary from the equipment to be connected.

Termination resistance of RS-422 is always ON.

5. Specifications

Item		Specifications
Image sampling system		Monochrome 256 level
No. of pixel	Analog camera	512×480
Image memory		Shared with image processing memory
No. of assignable object type		64 object types
No. of camera to be connected		Up to 2 cameras
Image processing		Gray, binary conversion
Image capture time	Standard camera	33.3ms
	High-speed camera	16.7ms (full mode), 8.3ms (half mode)
Gray search time		8ms (model: 64×64, search area: 256×256, when the speed is prioritized)
Gray search, edge detection precision		Sub-pixel
Gray image pre-processing	Gray level change	Histogram widening
	Noise elimination	Smoothing (average/ center)
	Outline extraction	Edge extraction (primary differentiation, secondary differentiation), horizontal edge, vertical edge
Binary threshold value		Fixed and threshold value correction (variation difference/variation rate)
Binary noise elimination		Expansion, contraction, area filter
Positional correction method		X/Y correction, rotation correction
Window shape		Rectangle, circle, oval, polygon, and free shape

Item		Specifications
Inspection program	Position detection	Object: ① single workpiece, ② multiple workpieces can be processed simultaneously Output: coordinate
	Position & attitude angle	Object: ① single workpiece, ② multiple workpieces can be processed simultaneously Output: coordinate, angle
	Shape degree of match inspection	Object: ① single workpiece, ② multiple workpieces can be processed simultaneously Output: Degree of match
	Point sensor	Output: yes or no
	Existence of work/size inspection	Measurement: ① no individual workpiece ② individual workpiece Output: area
	Workpiece counting	Object: ① all the workpieces ② designated workpieces Output: number of object detected
	Detecting the number of projected parts and the width, interval, etc. of the alignment	The number of projected parts, interval, width (point alignment)
	Distance & angle measurement	Object: ① single workpiece, ② multiple workpieces can be processed simultaneously Output: distance (between 2 points/X coordinate/Y coordinate), angle (3 points/2 points against vertical line/2 points against horizontal line)
	Workpiece dimension measurement	Output: number of workpieces, total area, area for each workpieces, diameter of the projection width, circumference length, main axes angle
Image processing procedure automatic generating expert (binary processing)	Object: position detection, position & attitude angle, existence of work / size inspection, workpiece count inspection, distance & angle measurement, and workpiece dimension measurement	
Number of inspection program		Maximum 8 inspections/type (inspection item 0 - camera 1, inspection item 0 - camera 2, and inspection item 1 to 6)
Arithmetic operation		Four basic operations (+, -, ×, /), root, absolute value, TAN, ATAN, maximum, minimum, average, and total
NG image memory function		Maximum 128 images (8 whole scenes)
Calendar timer		Year, month, day, hour, and minute
Optical system configuration setting	Image adjustment 1	① Focus adjustment ② contrast adjustment
	Image adjustment 2	① Image distortion diagnosis & compensation ② calibration
Optical system maintenance	Lighting adjustment	Adjustment of light volume
	Light level automatic adjustment	Monitoring illuminance→shading diagnosis→optical system automatic adjustment (① light volume ② shutter speed)
Other functions		Displaying measuring time, monitoring illuminance, crosshair cursor display, switching language between Japanese and English, Running screen lock function, and change image display (through/freeze)
Micro PLC	Input relays	16 points (X0 to X15)
	Output relays	16 points (Y0 to Y15)
	Auxiliary relays	Internal auxiliary 1024 points (C0 to C1023), system auxiliary 64 points (S0 to S63)
	Timer	16 points (TM0 to TM15), timer setting (0.01 to 9.99 seconds), (down counter)
	Counter	16 points (CN0 to CN15), counter setting (1 to 999), (up counter)

Item		Specifications
IPU external interface	Parallel interface	Input 16 points (X0 to X15) 12/24V DC 7mA (24V DC) Output 16 points (Y0 to Y15) 12/24V DC 80mA (open corrector)
	Serial interface	RS-232C/RS-422 (2-wire system/4-wire system) (2.4 to 115.2kbps) upward calculator, PLC
	Extension terminal	RS-232C/RS-422 (2-wire system only) used for lighting control
Measurement start input	Internal trigger	CCD trigger
	External trigger	Trigger input (parallel interface), serial trigger, and manual trigger (for testing)
Power supply input		+24V, 0V
		FG
Parallel interface		Input common 1 point
		Interrupt input (trigger) 1 point
		Input 15 points
		Output common 1point
		READY 1 point
		HALT output 1 point (interlocking with watchdog timer)
		Output 16 points
Lighting control	Control function	Dimmer function, lamp ON/OFF (LED), shutter ON/OFF (halogen)
	Number of control	4 systems, 2 controls/1 system
	Control port	RS-232C/RS-422
Power supply voltage / power consumption		24V DC ($\pm 10\%$) 30W
Operation ambient temperature / atmosphere		0 to 45°C / 35 to 95% RH (no condensation)**
Storage ambient temperature / atmosphere		-20 to 70°C / 35 to 95% RH (no condensation)
Outside dimension/weight		81mm (W) \times 176.4mm (H) \times 126.4mm (D) (protruding portions are not included)
HMI External interface	USB host	USB 1.1 specification, 2 channel (power supply capacity 100mA / ch)
	LAN	10/100 base-TX
	Image output	VGA output port 1 point, IV LCD monitor output 1 point
Operation input		Touch panel, and commercially available USB mouse (*)
Image output		SVGA (800 \times 600 \times 24bpp) analog output IV LCD monitor (800 \times 600 \times 18bpp) digital output
Cameras to be connected		IV-S30C1, IV-S30C2, IV-S30C3, and IV-S30C4

* Both can be used at the same time, but touch panel overrides the USB mouse.

**When this is used with the IV-08MP LCD monitor as one unit, temperature should be 0 to 40°C.

■ Communication (General Purpose Serial Interface)

The IV-S51M can communicate with a personal computer that transmits commands and receives responses to process measurement execution commands.

List of processing function

1. Outline

- The following functions and commands are supported by IV-S51M.

Item	Functions	Communication port
① Measurement execution	Executes measurement programs for specified object types and outputs the numeric value results.	COM
② Result data reading	<ul style="list-style-type: none"> • Outputs the numeric value result of the last measurement (measurement is not executed). 	COM
③ Lighting control	<ul style="list-style-type: none"> • Monitoring illuminance • Light level automatic adjustment 	COM
	Control lighting power source <ul style="list-style-type: none"> • Setting up lighting control system • Lighting ON / OFF • Reading / writing light volume • Reading / writing EEPROM light volume 	I/O Link
④ Self-diagnosis	Diagnosing hardware of image processing board	COM

2. List of commands

Category	Item	Code	Functions
Executing measurement	Measurement execution 1	0010	<ul style="list-style-type: none"> • Outputs the numeric value result of the executed measurement. • Maximum 512 bytes
	Measurement execution 2	0011	<ul style="list-style-type: none"> • Outputs the numeric value result of the executed measurement. • If the volume of the data exceeds 512 bytes, it will be divided into packets.
	Measurement execution 3	0012	<ul style="list-style-type: none"> • Outputs the numeric value result of the last measurement. • If the volume of the data exceeds 512 bytes, it will be divided into packets.
Reading measurement data	Measurement data reading 1	0110	<ul style="list-style-type: none"> • Outputs the numeric value result of the last measurement. • Maximum 512 bytes
	Measurement data reading 2	0111	<ul style="list-style-type: none"> • Outputs the numeric value result of the last measurement. • If the volume of the data exceeds 512 bytes, it will be divided into packets.
	Measurement data reading 3	0112	<ul style="list-style-type: none"> • Outputs the arithmetic result (double precision floating decimal point) of the last measurement. • If the volume of the data exceeds 512 bytes, it will be divided into packets.
Controlling lighting	Illuminance monitor	0118	Executes illuminance monitor to provide the measured light level and the evaluation result.

(COM * 1)	Illuminance reading	0119	Reads the amount of illuminance measured by the illuminance monitor function and the evaluation result.
	Light level automatic adjustment	011A	When the illuminance monitor is NG, adjust the light volume and the shutter speed.
Controlling lighting (I/O link * 2) self-diagnosing		02XX 0300	Checks for abnormalities of hardware at the image board.

*1: The functions are described in "Optical system control function".

*2: Command specification and other details are described in "Optical system control function".

3. Data flow

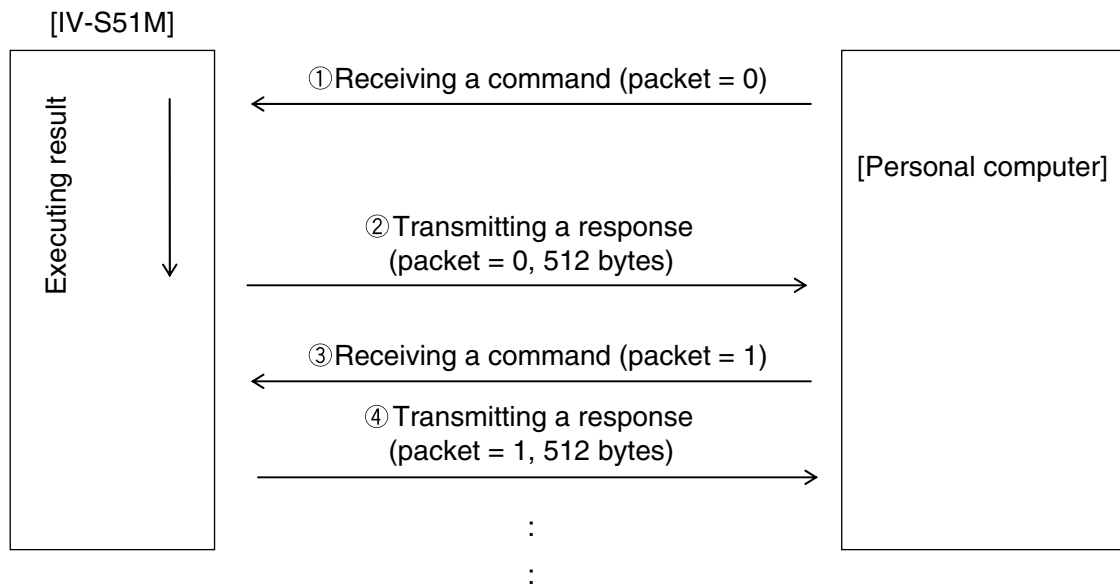
The data flow between the IV-S51M and a personal computer is shown below.

1) Measurement execution

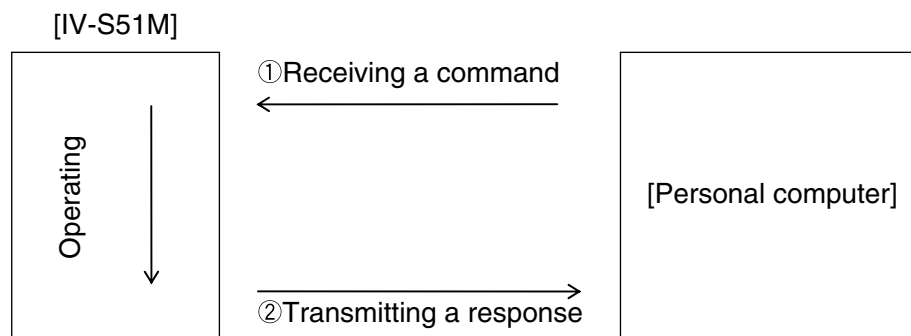
See "1. Outline 3. General Purpose Serial Data Flow".

2) Processing other than measurement execution processing

- Reading the result data by dividing into packets



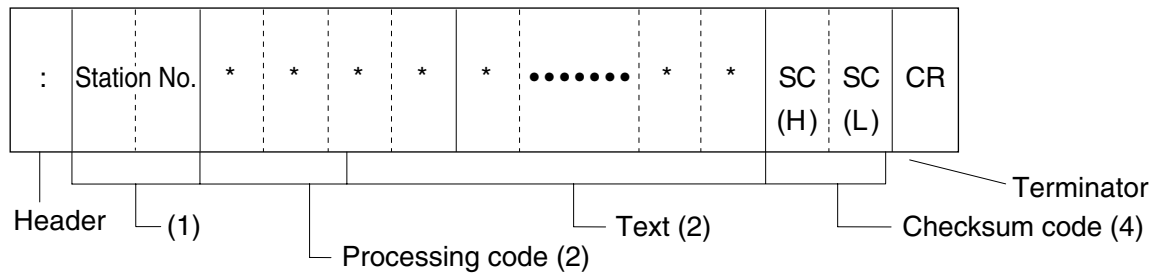
- Processing other than the above processing



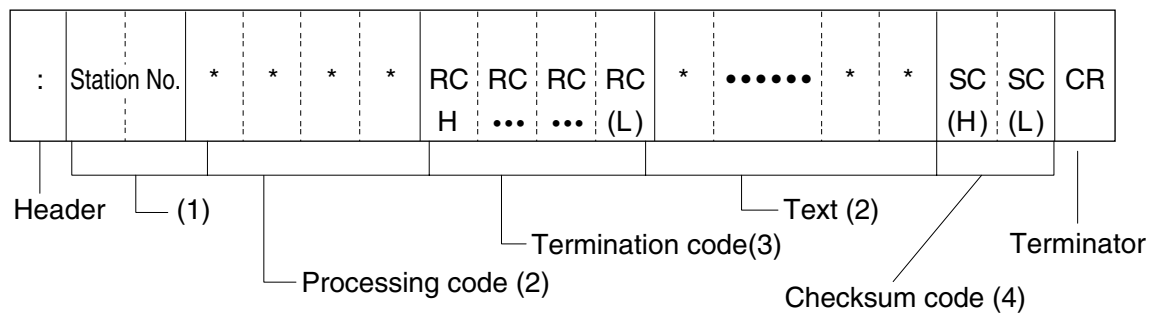
4. Communication format

The communication formats of the commands and responses between IV-S51M and a personal computer are outlined below.

■ Command



■ Response



(1) Station No.: 00 to 7F(H)

(2) Processing code and text

- They depend on the contents of processing
- On abnormal termination, no text is provided.

(3) Termination code

- The termination code is a 4-digit hexadecimal number.
- When an output is sent through the general purpose serial I/F, 0000(H) is sent on normal termination.
- On abnormal termination, a code is more than 0001 (H). (The errors are described in the separate page.)

(4) Checksum code (SC(H), SC(L))

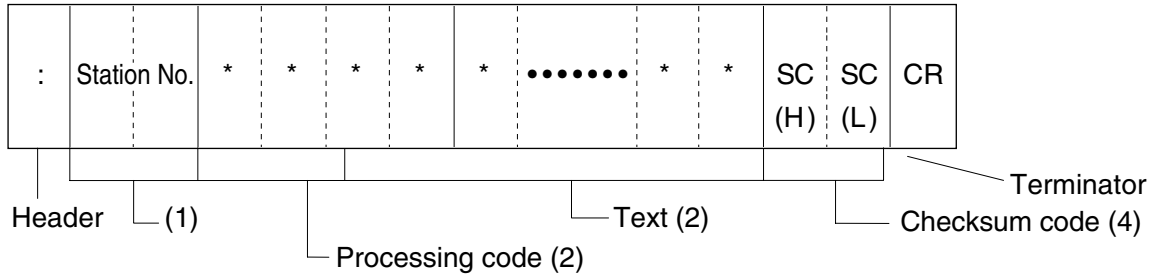
- To improve the reliability of the transmitted data, in addition to a parity check, error detection by checksum is used for error detection.

1) Error detection using a checksum

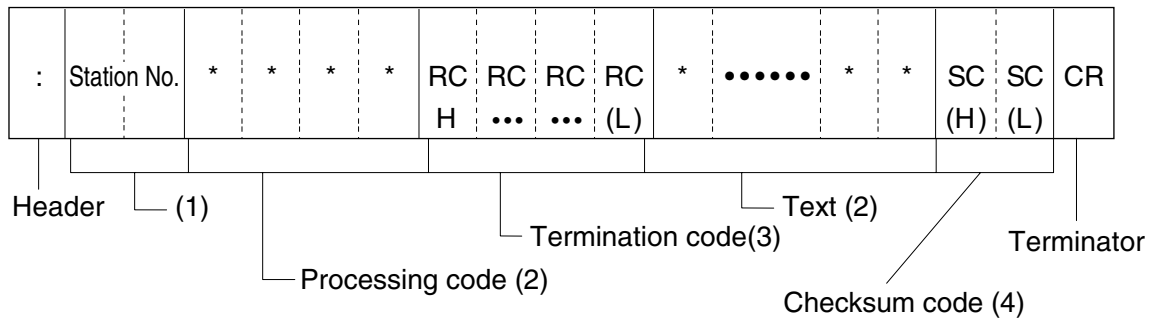
[Detection procedure]

- ① The ASCII code for each data byte, from the processing code to the end of text (prior to the checksum code), is added.
- ② The final value of "①" is compared to the checksum code which is treated the same way. If the two values are identical, the command is considered to be valid. If not, it is considered that an error has occurred during transmission.

[Command]



[Response]



2) Creating a checksum code

- ① The ASCII code for each data byte, from the processing code to the end of text (prior to the checksum code), is added.
- ② The lower 1 byte of this sum is divided into the upper 4 bits and the lower 4 bits. The hex character (0 to F) is converted to the ASCII code for that character.

Note: When detection using checksum is not required at IV side, set @(ASCII:40(H)) in the command's checksum code (SC(H), SC(L)).

5. Public command format

1) Measurement execution function: code 0010H

- This command will cause the IV-S51M to execute all of the measurement program for a specified object type or the corresponding measurement program for a specified camera.
- 512 bytes of the result data (from the beginning) of the measurement program will be sent back as the response.
- In the case of "Measurement start input = CCD trigger or parallel input, serial output = general purpose serial", result will be sent back to the host as a response of this command.

[Command]

:	Station No.	0	0	1	0	Object type	Execution camera	SC	SC	CR
						(H) (L)	No.	(H)	(L)	

[Response]

:	Station No.	0	0	1	0	RC	RC	RC	RC	Object type	Execution camera	Numeric value result		SC	SC	CR
						(H)	...	...	(L)	(H)	(L)	No.	data	(H)	(L)	

- Object type: Object Type to measure (maximum 0 ~ FF(tentatively))
- Execution camera No.: 0 = executing all the cameras, 1 = Camera 1 only, 2 = Camera 2 only
- Numeric value result data (see (4) Output data chart for the details of the output data)

- Ex. 1 Measurement 1: Position detection measurement (single workpiece, Number of registration 2), Measurement 2: Size inspection (no individual workpiece)

Coordinate X (Registration 0)	Coordinate Y (Registration 0)	Coordinate X (Registration 1)	Coordinate Y (Registration 1)	Total area (Registration 0)
----------------------------------	----------------------------------	----------------------------------	----------------------------------	--------------------------------

[Example of HMI]

[Output data (general purpose serial)]				F C1 BRT
Packet 0	Measurement 1	Registration 0	Coordinate X	2 bytes
			Coordinate Y	2 bytes
		Registration 1	Coordinate X	2 bytes
			Coordinate Y	2 bytes
	Measurement 2	Registration 0	Total area	4 bytes

Note: Preset the maximum number of detection for the measurement where the amount of output data is variable until the measurement is executed, and when the actual detection is less than the maximum number of detection, output a dummy data.

When the actual detection is more than the maximum number of detection, exceeded data will not be output.

Measurement is executed on: Position detection (multiple/circle center), Position and attitude angle (multiple), Shape degree of match inspection, Size inspection (individual workpiece), Distance angle measurement (multiple), and Workpiece dimension measurement

- Ex. 2 Measurement 1 Workpiece dimension measurement (Number of registration 1)
 - Maximum number of detection 3 = output as much as 2 labels, output data = total area, Number of workpiece, area for each workpiece, barycenter, and midpoint

Total area (Registration 0)	Number of workpiece (Registration 0)
--------------------------------	---

Area for each workpiece Registration 0 Label 0	Center of gravity X Registration 0 Label 0	Center of gravity Y Registration 0 Label 0	Midpoint X Registration 0 Label 0	Midpoint Y Registration 0 Label 0
--	--	--	---	---

Area for each workpiece Registration 0 Label 1	Center of gravity X Registration 0 Label 1	Center of gravity Y Registration 0 Label 1	Midpoint X Registration 0 Label 1	Midpoint Y Registration 0 Label 1
--	--	--	---	---

Area for each workpiece Registration 0 Label 2	Center of gravity X Registration 0 Label 2	Center of gravity Y Registration 0 Label 2	Midpoint X Registration 0 Label 2	Midpoint Y Registration 0 Label 2
--	--	--	---	---

[Example of HMI]

[Output data (general purpose serial)]	F C1 BRT
Packet 0 Measurement 1 Registration 0 Total area	4 bytes
Number of workpiece	2 bytes
Label 0 Area for each workpiece	2 bytes
Label 0 Center of gravity X	2 bytes
Center of gravity Y	2 bytes
Label 0 Midpoint X	2 bytes
Midpoint Y	2 bytes
Label 1 Area for each workpiece	4 bytes
Label 1 Center of gravity X	2 bytes
Center of gravity Y	2 bytes
Label 1 Midpoint X	2 bytes
Midpoint Y	2 bytes
Label 2 Area for each workpiece	4 bytes
Label 2 Center of gravity X	2 bytes
Center of gravity Y	2 bytes
Label 2 Midpoint X	2 bytes
Midpoint Y	2 bytes

● Ex. 3 Measurement 1 Point sensor

- 8 points are handled by 1 byte.
- Black & white = FA_(H)

	F				A			
	1	1	1	1	1	0	1	0
Point No.	P7	P6	P5	P4	P3	P2	P1	P0
Black & white	White	White	White	White	White	Black	White	Black

0 = Black, 1 = White

[Example of HMI]

[Output data (general purpose serial)]	F C1 BRT
Packet 0 Measurement 1	Registration 0 ~7 1 bytes
	Registration 8 ~ 15 1 bytes

2) Measurement execution 2: code 0011H

- Execute all of the measurement programs for a specified object type or corresponding measurement program for the specified camera.
- The result data of the measurement program will be divided into packets by each 512 bytes (128 data × 4 bytes) from the beginning, and sent as the response.

[Command]

:	Station No.	0	0	1	1	Object type (H) : (L)	Execution camera No.	①	SC (H) :	SC (L)	CR
---	-------------	---	---	---	---	--------------------------	----------------------------	---	-------------	-----------	----

- ① The first measurement execution command is specified as "0" for the specified packet No.

[Response]

:	Station No.	0	0	1	1	RC : RC (H) : ...	RC : RC ... (L)	Object type (H) : (L)	Execution camera No.	②	③
---	-------------	---	---	---	---	----------------------	--------------------	--------------------------	----------------------------	---	---

- ② Current packet No., ③ Final packet No.

Numeric value result data	SC (H) :	SC (L)	CR
------------------------------	-------------	-----------	----

3) Measurement execution 3: code 0012H

- Execute all of the measurement programs for a specified object type or corresponding measurement program for the specified camera.
- The arithmetic result of the measurement program will be divided into packets by each 512 bytes (64 data × 8 bytes, double precision floating decimal point) from the beginning, and sent as the response.

[Command]

:	Station No.	0	0	1	2	Object type (H)	Camera (L)	① No.	SC (H)	SC (L)	CR
---	-------------	---	---	---	---	--------------------	---------------	----------	-----------	-----------	----

- ① The first measurement execution command is specified as "0" for the specified packet No.

[Response]

:	Station No.	0	0	1	2	RC (H)	RC ...	RC ...	RC (L)	Object type (H)	Camera (L)	Execution Camera No.	②	③
---	-------------	---	---	---	---	-----------	-----------	-----------	-----------	--------------------	---------------	----------------------------	---	---

- ② Current packet No., ③ Final packet No.

Numeric value result data									C (H)	SC (L)	CR
------------------------------	--	--	--	--	--	--	--	--	----------	-----------	----

4) Result data reading 1: code 0110H

- Reads the numeric value result of the last measurement.
- The result data of the measurement program will be divided into packets by each 512 bytes (128 data × 4 bytes) from the beginning, and sent as the response.

[Command]

:	Station No.	0	1	1	0	SC (H)	SC (L)	CR
---	-------------	---	---	---	---	-----------	-----------	----

[Response]

:	Station No.	0	1	1	0	RC (H)	RC ...	RC ...	RC (L)	Object type (H)	Camera (L)	Execution Camera No.	Numeric value result data			SC (H)	SC (L)	CR
---	-------------	---	---	---	---	-----------	-----------	-----------	-----------	--------------------	---------------	----------------------------	------------------------------	--	--	-----------	-----------	----

5) Result data reading 1: code 0111H

- Reads the numeric value result of the last measurement.
- The result data of the measurement program will be divided into packets by each 512 bytes (128 data × 4 bytes) from the beginning, and sent as the response.

[Command]

:	Station No.	0	1	1	0	SC	SC	CR
						(H)	(L)	

- ① The first measurement execution command is specified as "0" for the specified packet No.

[Response]

:	Station No.	0	1	1	0	RC	RC	RC	RC	Object type	Camera	Execution	Numeric value result data	SC	SC	CR
						(H)	...	...	(L)	(H)	(L)	No.		(H)	(L)	

- ② Current packet No., ③ Final packet No.

:	Station No.	0	1	1	1	①	SC	SC	CR
							(H)	(L)	

6) Result data reading 1: code 0112H

- Reads the arithmetic result of the last measurement.
- The result data of the measurement program will be divided into packets by each 512 bytes (64 data × 8 bytes, double precision floating decimal point) from the beginning, and sent as the response.

[Command]

:	Station No.	0	1	1	2	Object type	camera	Execution	①	SC	SC	CR
						(H)	(L)	No.		(H)	(L)	

- ① The first measurement execution command is specified as "0" for the specified packet No.

[Response]

:	Station No.	0	1	1	1	RC	RC	RC	RC	Object type	camera	Execution	②	③
						(H)	...	...	(L)	(H)	(L)	No.		

- ② Current packet No., ③ Final packet No.

Numeric value result data	SC	SC	CR
	(H)	(L)	

9) Light level automatic adjustment

- When the illuminance monitor is executed and it turns out as "NG", automatically adjusts the light level using one of the following methods, and reads the result of the last illuminance monitor.

- ① Lighting automatic dimmer function ② Shutter speed automatic adjustment

[Command]

:	Station No.	0	1	1	8	Camera No.	SC (H)	SC (L)	CR
---	-------------	---	---	---	---	------------	--------	--------	----

[Response]

:	Station No.	0	1	1	8	RC (H)	RC	RC	RC (L)	Object type	Result	Illuminance			
							...	...				10 ²	10 ¹	10 ⁰	10 ⁻¹

Result	Illuminance 2 pt				SC (H)	SC (L)	CR
	10 ²	10 ¹	10 ⁰	10 ⁻¹			

10) Self-diagnosing: code 0300h

- Checks for abnormalities of hardware at the image processing of IV-S51M.
- Diagnosis
RAM related (read after light), FROM related (system program checksum)

[Command]

:	Station No.	0	3	0	0	SC (H)	SC (L)	CR
---	-------------	---	---	---	---	--------	--------	----

[Response]

:	Station No.	0	3	0	0	RC (H)	RC	RC	RC (L)	SC (H)	SC (L)	CR
---	-------------	---	---	---	---	--------	----	----	--------	--------	--------	----

- RC = 0 at the normal state, RC ≠ 0 at the abnormal state
- Abnormality code is described in the separate sheet.

6. Private command format

1) Version reading: code F000H

Reads the version of the image processing of IV.

[Command]

:	Station No.	F	0	0	0	SC (H)	SC (L)	CR
---	-------------	---	---	---	---	-----------	-----------	----

[Response]

:	Station No.	F	0	0	0	RC (H)	RC ...	RC ...	RC (L)	① 1 - 1 -10	② 1 - 1 -10	SC (H)	SC (L)	CR
---	-------------	---	---	---	---	-----------	-----------	-----------	-----------	----------------	----------------	-----------	-----------	----

① System program version of the main housing: comply with IVS50

② Boot program version: comply with IVS50

2) Average light level reading: code F001H

[Command]

:	Station No.	F	0	0	1	①	X1	Y1	X2	Y2	SC (H)	SC (L)	CR
---	-------------	---	---	---	---	---	----	----	----	----	-----------	-----------	----

• ① Camera No.: 0 = Camera 1, 1 = Camera 2

• Coordinate designation: X1 = upper left X coordinate (0 ~ 511), Y1 = upper left Y coordinate (0 ~ 479),
X2 = lower right X coordinate (0 ~ 511), Y2 = lower right Y coordinate (0 ~ 479)

[Response]

:	Station No.	F	0	0	1	RC (H)	RC ...	RC ...	RC (L)	Illuminance 10 ² 10 ¹ 10 ⁰	SC (H)	SC (L)	CR
---	-------------	---	---	---	---	-----------	-----------	-----------	-----------	--	-----------	-----------	----

• Illuminance : 0 to 255

3) Parallel input reading: code F003H

• Reads the data of the input terminal block (16 terminals) of IV

[Command]

:	Station No.	F	0	0	3	SC (H)	SC (L)	CR
---	-------------	---	---	---	---	-----------	-----------	----

[Response]

:	Station No.	F	0	0	3	RC (H)	RC ...	RC ...	RC (L)	D0	D1	D15	SC (H)	SC (L)	CR
---	-------------	---	---	---	---	-----------	-----------	-----------	-----------	----	----	-----	-----	-----	-----------	-----------	----

• Input data D0 to D15: 0 = OFF, 1 = ON

4) Parallel input instruction: code F004H

- Output the preset data (ON/OFF) to the parallel I/O terminal block (16 terminals).

[Command]

:	Station No.	F	0	0	4	D0	D1	...	...	D15	SC	CR
											(H)	(L)

- Output data D0 to D15: 0 = OFF, 1 = ON

[Response]

:	Station No.	F	0	0	4	RC	RC	RC	RC	SC	SC	CR
						(H)	...	...	(L)	(H)	(L)	

5) Setting gain/offset: code F005H

- Change the gain (contrast) and the offset (brightness) of the specified camera

[Command]

:	Station No.	F	0	0	5	①	②	Preset value			SC	SC	CR
								10 ²	10 ¹	10 ⁰	(H)	(L)	

- ① Camera No.: 0 = Camera 1, 1 = Camera 2
- ② gain/offset setting: 0 = gain, 1 = offset
- Preset value: 0 to 255

[Response]

:	Station No.	F	0	0	5	RC	RC	RC	RC	SC	SC	CR
						(H)	...	...	(L)	(H)	(L)	