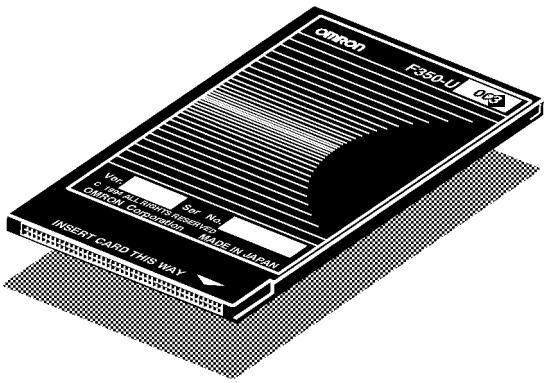
F350-U003E
Positioning Software 1

Operation Manual

Produced August 1995



Notice:

OMRON products are manufactured for use according to proper procedures by a qualified operator and only for the purposes described in this manual.

The following conventions are used to indicate and classify precautions in this manual. Always heed the information provided with them. Failure to heed precautions can result in injury to people or damage to the product.

⚠ DANGER! Indicates information that, if not heeded, is likely to result in loss of life or serious injury.

⚠ WARNING Indicates information that, if not heeded, could possibly result in loss of life or serious injury.

⚠ Caution Indicates information that, if not heeded, could result in relatively serious or minor injury, damage to the product, or faulty operation.

OMRON Product References

All OMRON products are capitalized in this manual. The word “Unit” is also capitalized when it refers to an OMRON product, regardless of whether or not it appears in the proper name of the product.

The abbreviation “PLC” means Programmable Controller (Programmable Logic Controller) and is not used as an abbreviation for anything else.

Quick BASIC is a registered trademark of Microsoft Corporation.

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Visual Aids

The following headings appear in the left column of the manual to help you locate different types of information.

Note Indicates information of particular interest for efficient and convenient operation of the product.

1, 2, 3... 1. Indicates lists of one sort or another, such as procedures, checklists, etc.

Symbols

The following symbols appear at the bottom of each page in *Section 4 Functions and their Operation* and indicates which Application Program(s) is effective for a particular menu operation. The symbols and their corresponding Application Program are shown below.

Positioning 1 — Positioning Program 1

Positioning 2 — Positioning Program 2

The following example indicates that both Positioning Programs 1 and 2 are effective.

Positioning 1 Positioning 2

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About this Manual:

This manual describes the operation of the F350-U003E Positioning Software 1 and includes the sections described below.

Please read this manual carefully and be sure you understand the information provided before attempting to operate the F350-U003E Positioning Software 1.

Section 1 provides a general introduction to the F350 Positioning Software 1.

Section 2 describes the system configuration, starting and stopping the Application Program, and basic menu operation.

Section 3 describes two application programs, each used for different input devices. While each program is used with different input devices, the functions and operation sequence are identical for each. The program functions and the sequence of operations are described by using typical inspections as examples.

Section 4 provides detailed explanation of the functions and their operation.

Section 5 provides a list of error messages, and the causes and remedies of them.

The **Appendix** provides a menu hierarchy diagram for this software.

⚠WARNING Failure to read and understand the information provided in this manual may result in personal injury or death, damage to the product, or product failure. Please read each section in its entirety and be sure you understand the information provided in the section and related sections before attempting any of the procedures or operations given.

SECTION 1
Introduction

This section provides a general introduction to the F350 Positioning Software 1.

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1-1 Before Using this Manual

Copyright

The copyright of this software (the stored and written contents of the system memory card and manual) belongs to OMRON.

Copying and Modifications

This software may not be copied in whole or in part, except for the purposes of storage or for changes or modifications for the customer's own use.

This software may only be changed or modified for the customer's own use. However, OMRON accepts no responsibility for problems or damages arising from a customer's changes or modifications to the software.

Handling the System Memory Card

Do not leave the card in a dusty or wet place as this may lead to connection errors. To prevent destruction of system program data or deformation of the card, avoid high temperatures, high humidity, and direct sunlight. Also, do not bend, scratch or apply shocks to the card.

1-2 Applicable Manuals

The manuals applicable to the F350 Visual Inspection System are shown in the table below, according to the procedures used. There are three kinds of F350-series manuals:

- F350 Setup Menu Operation Manual: Included with the F350-C10E IMP Unit.
- F350 Application Software Operation Manual: Included with the F350-U□□□E Application Software.
- F350 OVL Reference Manual: Included with F350-L100E OVL Unit.

Procedure		Software	
		Application Programs	OVL program
System design	Consider the lighting environment, I/O devices, and so on, and arrange the system configuration. Design the system carefully, taking into account variations in conditions and the objects that are to be inspected.	F350-series catalog	
Assembly/Installation	Install the F350 Visual Inspection System by assembling the hardware and wiring the power supply and peripheral devices.	F350 Setup Menu Operation Manual	
Environmental settings	Start up the software and make the settings related to the F350 Visual Inspection System and the settings for starting, communicating with I/O devices, and so on.	Make the settings using the Setup Menu which is standard with F350-C10E IMP Unit. (Refer to the F350 Setup Menu Operation Manual.)	Mount the F350-L100E OVL Unit and program using OVL, a specialized BASIC programming language. (Refer to the F350 OVL Reference Manual.)
Inspection condition settings	Start up the software and make the settings related to inspection. Set the criteria for determining the inspection area and the acceptability of the inspected products.	Make the settings using the F350-U□□□E Application Programs. Do the actual testing according to the conditions that have been set. (Refer to the relevant F350 operation manual.)	Mount the F350-L100E OVL Unit and program using OVL, a specialized BASIC programming language. Do the actual testing according to the conditions that have been set. (Refer to the F350 OVL Reference Manual.)
Testing/Inspection	Do the actual testing according to the conditions that have been set. If adjustments are required, change the settings.		
Maintenance	Carry out periodic inspections. This is essential in order to maintain the F350 Visual Inspection System in optimum condition.	F350 Setup Menu Operation Manual	

1-3 Features

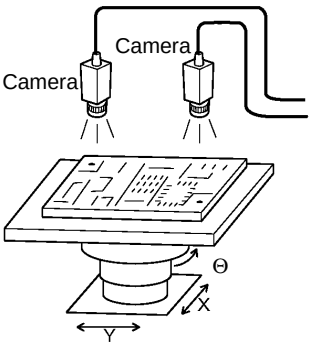
This software allows accurate positioning of parts and printed circuit boards.

- The unique gray processing detects positions to sub-pixel accuracy.
- Calibration settings allow measurements to be obtained in the actual coordinate system.
- Distortion compensation for lens distortion achieves high-accuracy positioning.

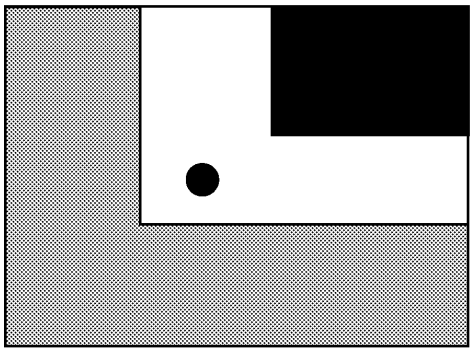
Positioning Program 1 For the Console and RS-232C Unit as I/O devices.

Positioning Program 2 For the Console and Parallel I/O Unit as I/O devices.

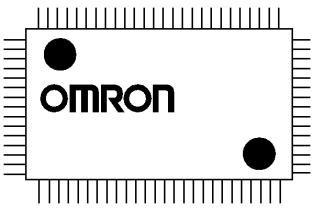
2-camera Positioning



1-model Positioning



2-model Positioning



SECTION 2
Preparation for Operation

This section describes the system configuration, starting and stopping the Application Program, and basic menu operation.

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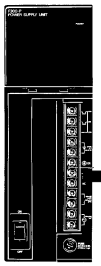
2-1 System Configuration

The number of cameras and I/O devices that can be used depends on the application software. Check that the system is correctly configured for the application software.

Basic System Configuration (Must be used.)

F300-P Power Supply Unit

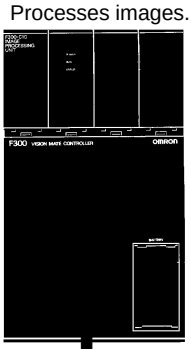
Supplies power to the entire system.



(Note: The F200-P Power Supply Unit cannot be mounted.)

F350-C10E IMP Unit

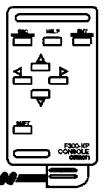
Processes images.



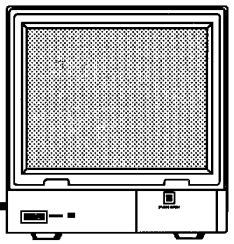
F300-FM MMI Unit

Provides Memory Card functions and menu operations via a Video Monitor and Console.

F300-KP Console

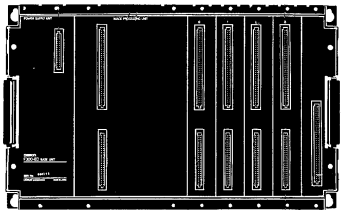


F300-M09 Video Monitor (100 VAC)



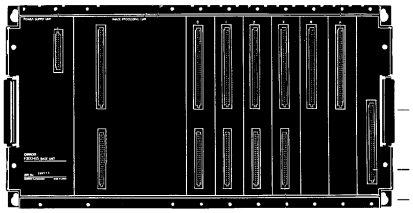
F309-VM Monitor Cable

F300-B3 (3 slots)



or

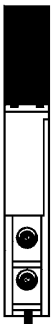
F300-B5 (5 slots)



Camera I/F Units (use four maximum)

F300-A20 Normal Camera I/F Unit

For measuring stationary objects or moving objects using a strobe.

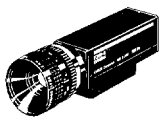


F300-A20S Normal Simultaneously Camera I/F Unit

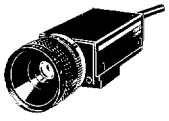
For measuring stationary objects or moving objects using a strobe, and for measuring two places simultaneously using two cameras.

F309-VS Camera Cable

F200-S Camera



F300-S Camera



Cameras (use eight maximum)

Lens

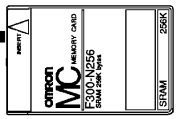
Note: An incorrect image may be read if different types of cameras and I/F Units are used together.
Do not mix different types of cameras and I/F Units.
Only one F200-S Standard Camera can be used.

F350-U003E Positioning Software 1
Demonstration software
Positioning program 1
Positioning program 2

Note
The demonstration software is provided for training. It cannot be used for actual inspections. Use this software with the basic configuration only.

Peripheral Devices

F300-N256/N512 Memory Card
Use to store scene data.



I/F Units (Use one that matches the peripheral devices connected.)

F300-E RS-232C I/F Unit
Use to input instructions from the measurement screen and output measurement results through the RS-232C interface.

Note
Use only for positioning program 1.

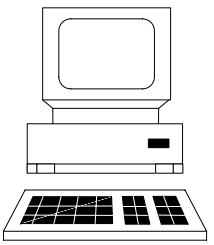
F300-DC Parallel I/O Unit
Use to input instructions from the measurement screen and output measurement results through the parallel I/O interface.

Note
Use only for positioning program 2.

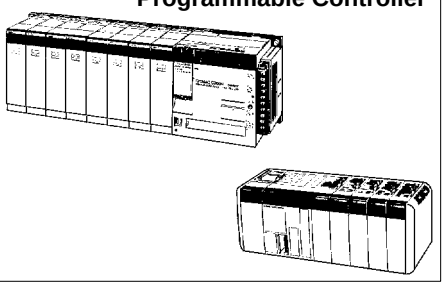
F300-G Dummy Unit
For inserting into empty slots to protect and strengthen connectors.

F309-VR
RS-232C Cable

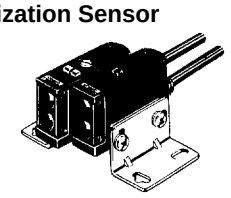
IBM PC/AT or Compatible



C200H or CQM1 Programmable Controller



Synchronization Sensor



2-2 Starting and Stopping

2-2-1 Starting

The application software contains three different Application Programs. Select one Application Program and start it.

The three Application Programs are described below.

Application Program		Description	File name
Demonstration Software		This software allows the user to experience search processing, which is the basic F350 technology. Two modes are included: the 12-pattern search mode which simultaneously searches for 12 different model patterns and displays the correlation value for each pattern, and the rotating pattern search, which searches for 1 pattern and displays the correlation value in the optimal search position. The rotating pattern search can handle the rotation of a workpiece. The 12-pattern search is displayed when the software is started. Follow the instructions displayed on the screen.	DEMO0001.DEF
Positioning programs		These programs measure positions to allow positioning of printed circuit boards and other parts. Two programs are available for different I/O devices.	
	(1)	For the Console and RS-232C Unit as I/O devices.	U003POS1.DEF
	(2)	For the Console and Parallel I/O Unit as I/O devices.	U003POS2.DEF

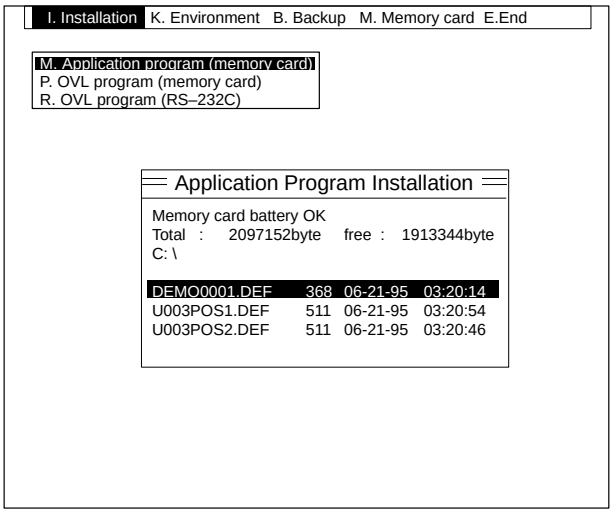
The Setup Menu is used to install and run the Application Programs. Operate the Setup Menu by referring to *3-1 Starting the Setup Menu* in the *F350 Setup Menu Operation Manual*.

Note When an Application Program is installed, previously installed software and set data are deleted from memory. Save this data, if it is required. Refer to *5.3 B.Backup* in the *F350 Setup Menu Operation Manual*.

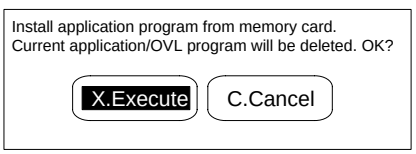
Procedure

1, 2, 3...

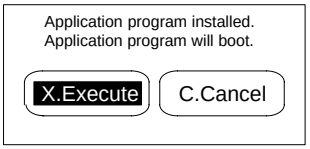
1. Select “I.Installation.”
2. Select “M.Application program (memory card).” The Application Program directory is displayed.



3. Select the file name. A confirmation message is displayed.

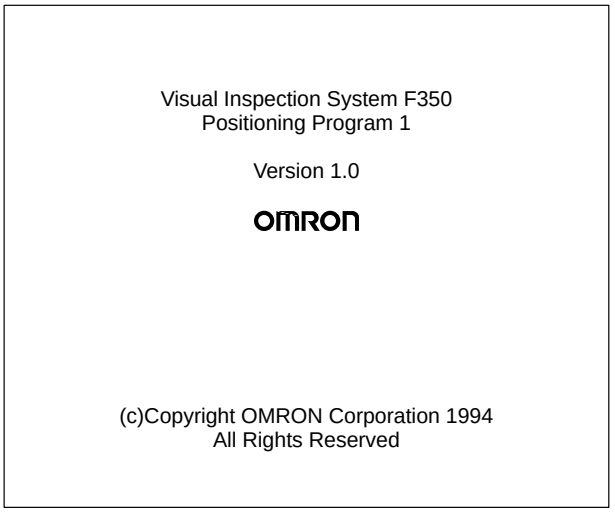


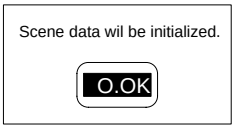
4. Select “X.Execute.” The Application Program is installed. A confirmation message is displayed when installation is complete.



5. Select “X.Execute.” The Application Program runs. A confirmation message asks if the scene data should be initialized.

   Example of Initial Screen for the Positioning Program 1:

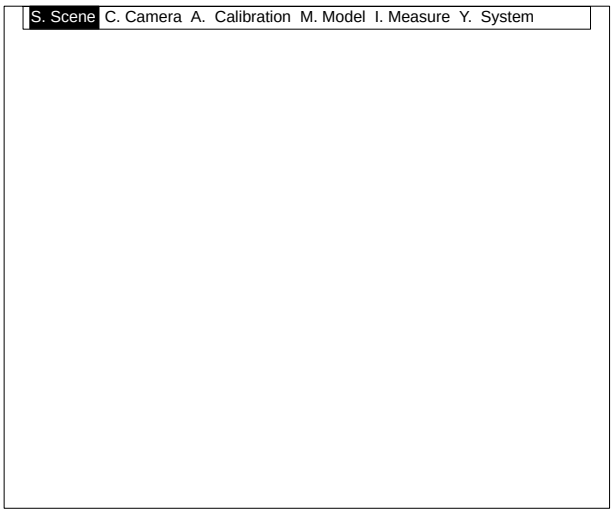




6. Select “O.OK.”

   The Application Program Basic Screen and the image from the connected camera 0 are displayed. Adjust the image focus.

   Basic Screen:



   If multiple cameras are connected, select the image from the camera number to be adjusted. Refer to *4-2-1 Select the Camera Number: C.Camera*.

Note Do not turn off the power during menu installation or the F350 memory contents may be destroyed and the Unit will malfunction when it is turned on again.

When an Application Program is installed, it runs each time the power is turned on. Select “K.Environment” and “M.Initial Mode” in the Setup Menu to change the Application Program which runs initially. Refer to *5-2-1 Designating Startup Operations: M.Initial mode* in the *F350 Setup Menu Operation Manual*.

2-2-2 Stopping

Ensure the following points before stopping the program:

- Data is not being saved, loaded, or copied.
- The orange memory card access indicator on the MMI Unit is not lit.

Procedure

1, 2, 3...

1. Turn off the F350 power.
2. Turn off the video monitor power.

   The setting data is stored when the F350 is turned off.

Note

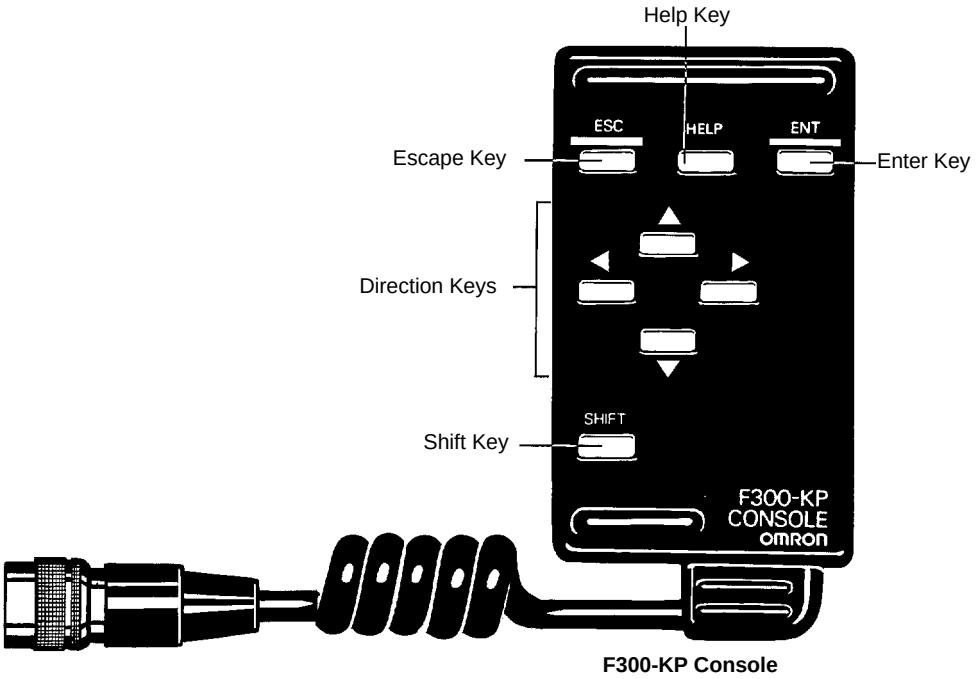
1. The Setup Menu and OVL system cannot be started using an application program. Quit the application program before starting the Setup Menu or OVL system.
2. To run the Setup Menu, turn on the power while holding down the Enter Key. Refer to *3-1 Starting the Setup Menu* in the *F350 Setup Menu Operation Manual*.
3. To start the OVL system, run the Setup Menu, change the “K.Environment/ M.Initial Mode” to “OVL prompt,” and restart the F350. Refer to *2-2-1 Starting Up* in the *F350 OVL Reference Manual*.

2-3 Basic Menu Operation

The Application Programs are operated from the Console.

2-3-1 About the Console

The names of the various Console parts and their functions are described below. Only the basic key functions are described here. Some of them are assigned special functions in some of the menus. In this case, the key function is described in the comment line of the screen.

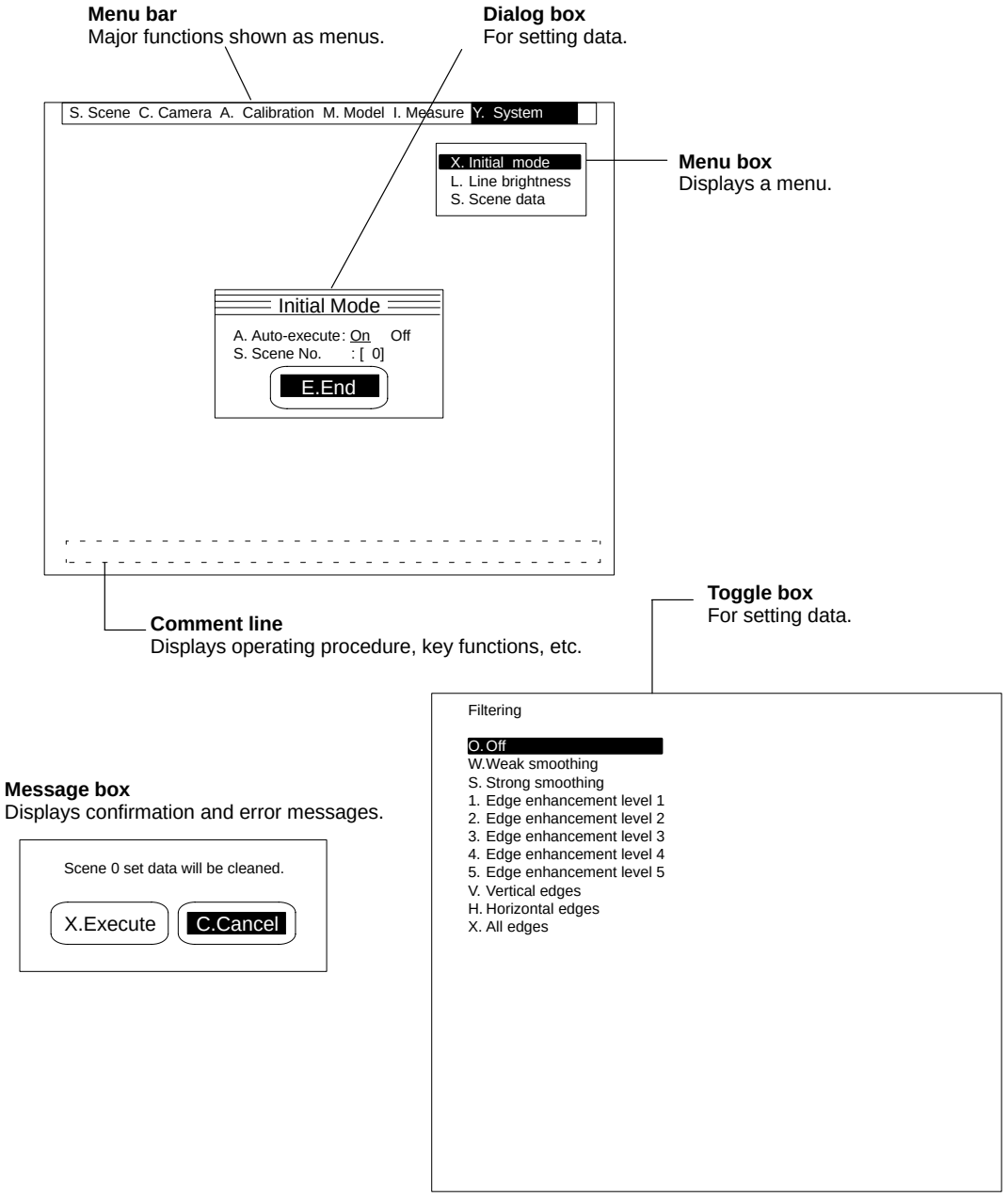


F300-KP Console

Marking	Name	Function
ESC	Escape Key	Interrupts processing and displays previous menu level.
HELP	Help Key	Assigned a different function in each menu. For example, it switches modes for the demonstration software.
ENT	Enter Key	Executes the function at the cursor position. If a menu is displayed, the next menu level of the cursor position is displayed. Set input data during data input.
▲ ▼	Direction Keys	Move the cursor up and down. In numerical input mode, the Direction Keys increase or decrease a number by 1. In character input mode, the Direction Keys change the character in ascending or descending order of character code.
▶ ◀		Move the cursor left and right.
SHIFT	Shift Key	Has no effect when pressed alone but changes the function of other keys when pressed simultaneously. The menus assign functions to combinations of the Shift Key with other keys.
Example: SHIFT+ESC		Displays the extended menu, if any exist.

2-3-2 Key to the Screens

The menus and their functions are described below.



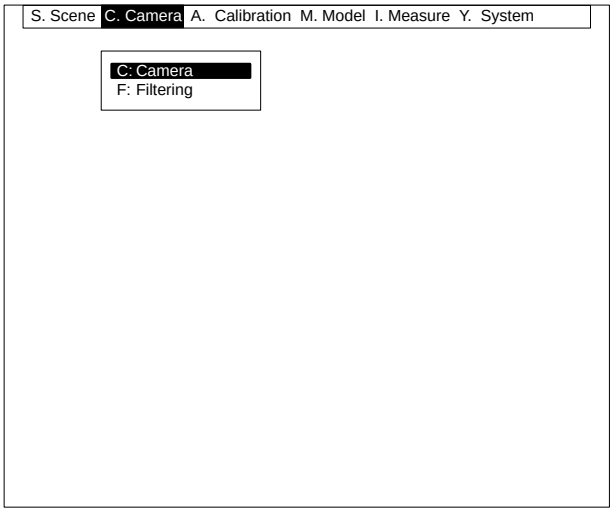
2-3-3 Selecting a Menu

The Application Programs are hierarchical and it is necessary to select related menus to set the data. Select the appropriate menu for operations such as setting data or conducting inspections. Refer to the menu hierarchical diagram to determine the overall menu hierarchy.

Procedure

1, 2, 3... 1. Move the cursor to the required menu item and press the Enter Key. The next level in the menu hierarchy is displayed. Repeat the procedure to move down another level.

2. Press the Escape Key. The previous level in the menu hierarchy is displayed. Press the Escape Key again to move up another level.



2-3-4 Setting Data

Dialog boxes and toggle boxes are both used on data setting screens. Dialog boxes allow multiple data settings to be made simultaneously when “E.End” is selected. Toggle boxes, however, allow one setting to be selected from several possibilities.

All settings are set to the initial values at the factory. Change the settings as required.

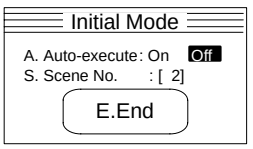
Setting Data in a Dialog Box

The current settings are underlined when a dialog box is displayed.

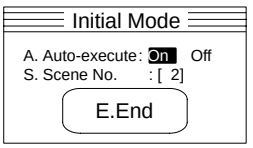
Procedure

1, 2, 3...

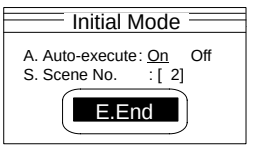
1. Press the Up/Down Keys to move the cursor to the setting to be changed. The cursor moves to the current setting.



2. Press the Up/Down Keys to move the cursor to the required new data setting.



3. Move the cursor to “E.End” and press the Enter Key. The selected data is set.

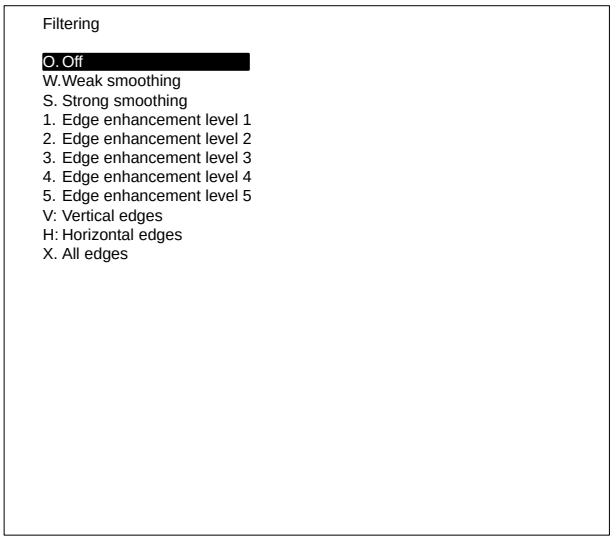


Setting Data in a Toggle Box

The cursor is at the current data setting when a toggle box is displayed.

Procedure

1, 2, 3... 1. Move the cursor to the required new data setting and press the Enter Key. The selected data is set.

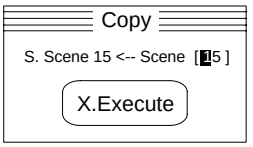


2-3-5 Inputting Numbers

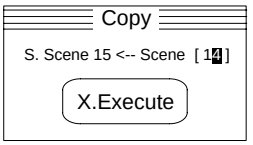
The method of inputting numbers to set scene numbers and coordinates is described below. All settings are set to the initial values at the factory. Change the settings as required.

Procedure

1, 2, 3... 1. Move the cursor to the item for which a number is to be input and press the Enter Key. The number input mode is selected.



2. Move the cursor to the digit to be changed.

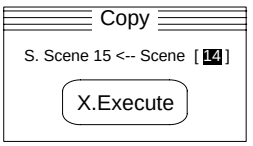


3. Press the Up/Down Keys to increase or decrease the number.

   Entering a Minus Sign (–)
   Move the cursor to the extreme left position and press the Up/Down Keys to display the minus sign.

   Repeat steps 2 and 3 above to input multiple values.

4. Press the Enter Key. The values are input.



A convenient method exists for fine adjustment of a number. Move the cursor to the number to be changed and press the Direction Keys shown in the table below.

Key	Action
▶	Increases the least-significant digit by one.
◀	Decreases the least-significant digit by one.

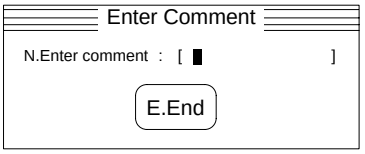
2-3-6 Inputting Characters

The method of inputting characters for scene comments or file names is described below.

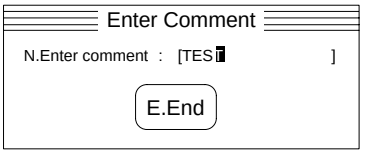
Procedure

1, 2, 3...

1. Move the cursor to the item for which a character is to be input and press the Enter Key. The character input mode is selected.

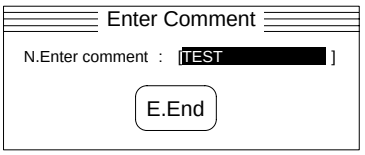


2. Move the cursor to the position where the character is to be input.



3. Press the Up/Down Keys to sequentially display the characters. The available characters are displayed in order of character code.

   Repeat steps 2 and 3 above to input multiple characters.



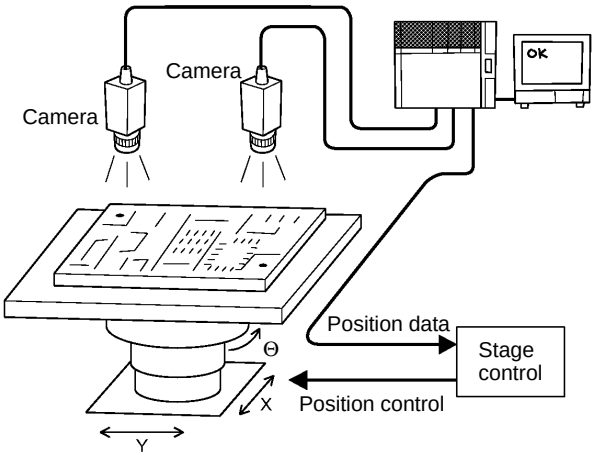
4. Press the Enter Key.

SECTION 3
Procedure for Using the Menus

This section describes two application programs, each used for different input devices. While each program is used with different input devices, the functions and operation sequence are identical for each. The program functions and the sequence of operations are described by using typical inspections as examples.

3-1 Positioning Programs 18

3-1 Positioning Programs



Procedure

1, 2, 3... 1. **Select Scene Number**

Select scene 0. Subsequent data settings will apply to scene 0. Refer to *4-1-1 Selecting Scene Number: S.Scene*.

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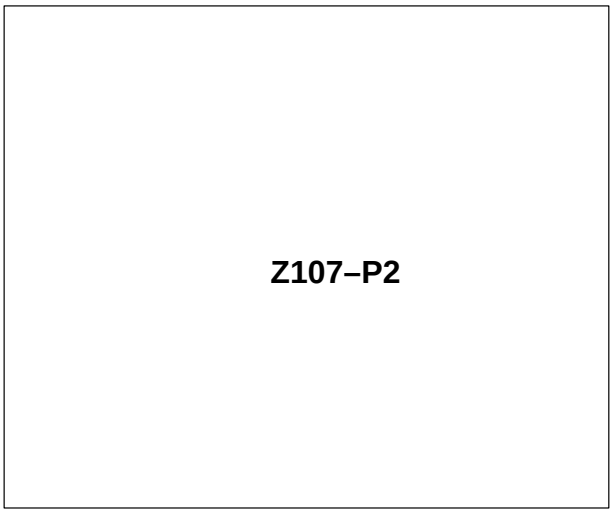
Setting Camera 0 Measurement Items

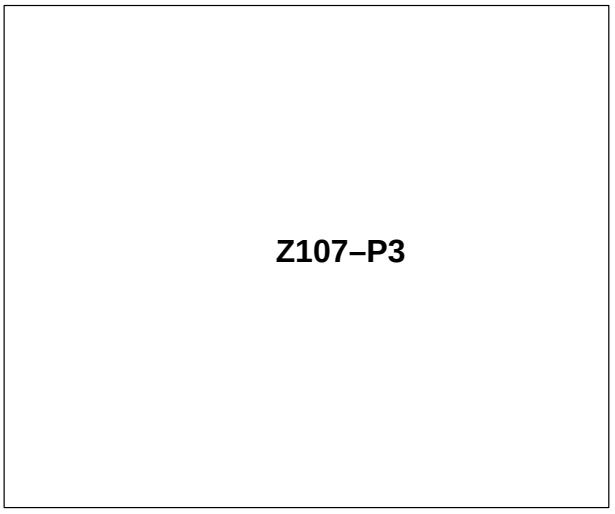
2. **Select the Camera Number**

   Select camera 0. Select the camera number for which the data is set. In this case, camera 0. Refer to *4-2-1 Select the Camera Number: C.Camera*.



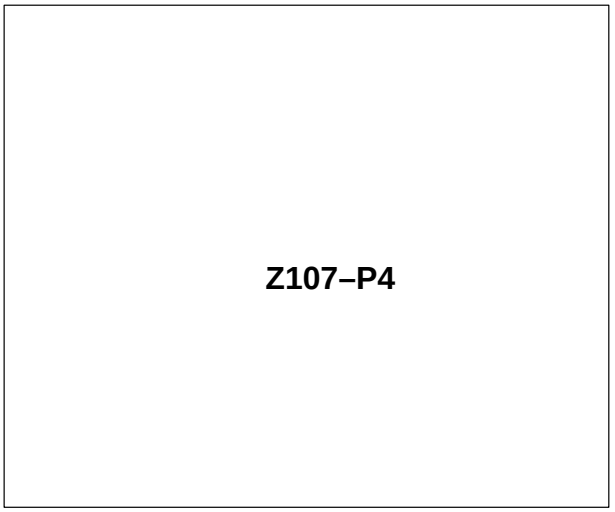
3. **Select the Filtering**

   Select edge enhancement level 3. Reinforces and stabilizes the edges of the image. Refer to *4-2-2 Selecting the Filtering: F.Filtering*.



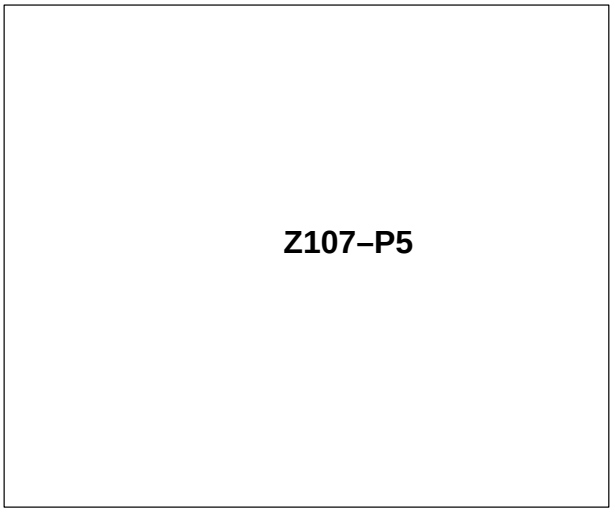
4. **Set the Calibration**

   Register the calibration model. Register as the model any mark for which the actual coordinates are known. Refer to *4-3-1 Registering a Calibration Model: M.Model registration*.



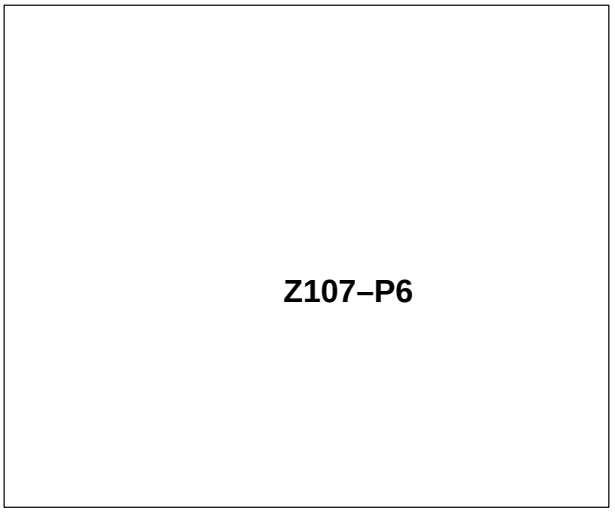
5. **Run the Calibration**

   Move the mark to a number of positions and enter the actual coordinates of the position. The calibration data is automatically generated after actual coordinate input is complete at each position. Refer to *4-3-2 Setting the Calibration Data: X.Execute*.



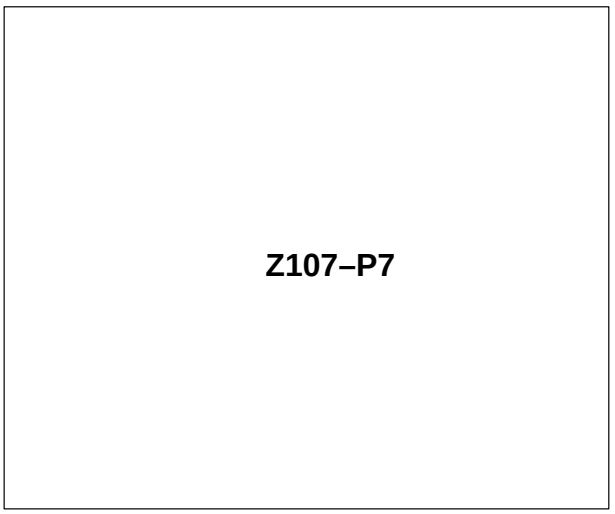
6. **Register the Measured Items**

   Register the measurement models. Register the images at the positions to be measured as measurement models. Refer to *4-4-1 Registering a Measurement Model: M.Measure model*.



7. **Register the Search Regions**

   Register the regions where the models can be found as the search regions. Refer to *4-4-3 Modifying a Search Region: S.Search region*.

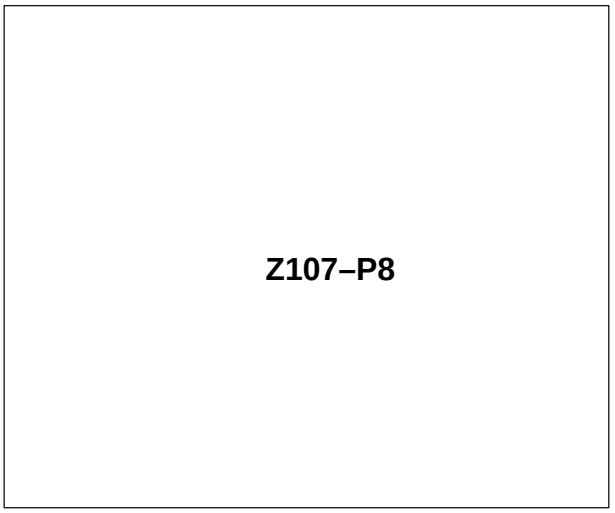


Setting Camera 1 Measurement Items

8. **Select the Camera Number**

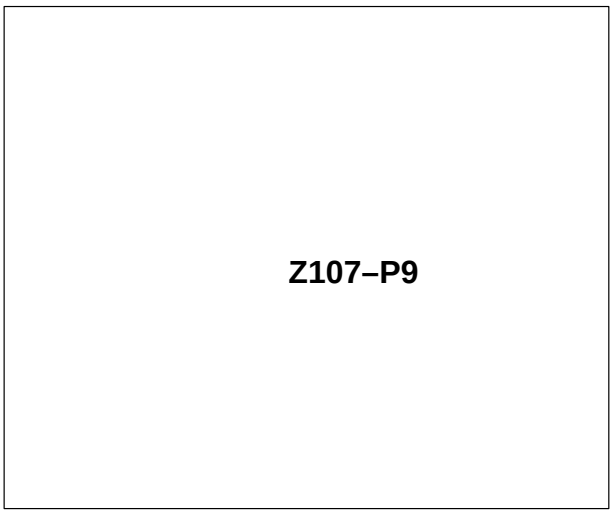
   Select camera 1. Select the camera number for which the data is set. In this case, camera 1. Refer to *4-2-1 Select the Camera Number: C.Camera*.

   Repeat steps 3 to 7 for camera 1.



9. **Run the Measurement**

   Run the measurement using the measure instructions. The measurement results are output to each output device. Solid boxes are displayed on the video monitor at the positions the measurement models were found. Refer to *4-5-2 Measuring: I.Measure*.



SECTION 4
Functions and their Operation

This section provides detailed explanation of the functions and their operation.

4-1 S.Scene 24
4-1-1 Selecting Scene Number: S.Scene 24
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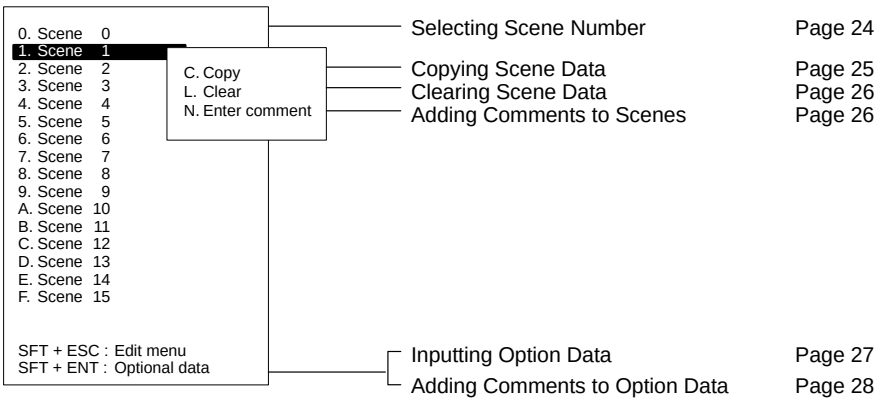
4-1 S.Scene

Positioning software 1 allows 16 measurement conditions (scenes) to be set and stored. This data is known as scene data and is identified by a scene number.

Set measurement conditions can be stored as a scene. Refer to *4-6-3 Saving and Loading Scene Data: S.Scene data*.

The S.Scene functions allow switching of scene numbers and editing of scene data.



4-1-1 Selecting Scene Number: S.Scene

Select the scene number to display.
The measurement conditions can be set for this scene number and the measurement conducted according to the set measurement conditions.

Scene Number Displayed at Start Up

The scene number displayed after start up is the same scene number displayed when the application program was previously shut down.

The factory setting is Scene#0 and this scene number is displayed when the unit is first started.

If “A.Automatic execution” is turned on using “Y.System/M.Initial Mode,” the measurement screen is displayed for the set scene number.

Refer to *4-6-1 Automatic Measurement: M.Initial mode*.

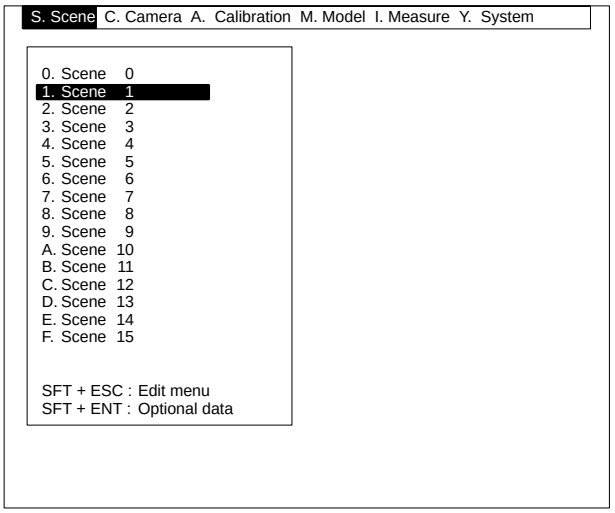
Display of Scene Comments

If a comment is input for a scene, the comment is displayed instead of the scene number.

Refer to *4-1-4 Adding Comments to Scenes: N.Enter comment*.

Procedure

Select the scene number. The selected scene is displayed.



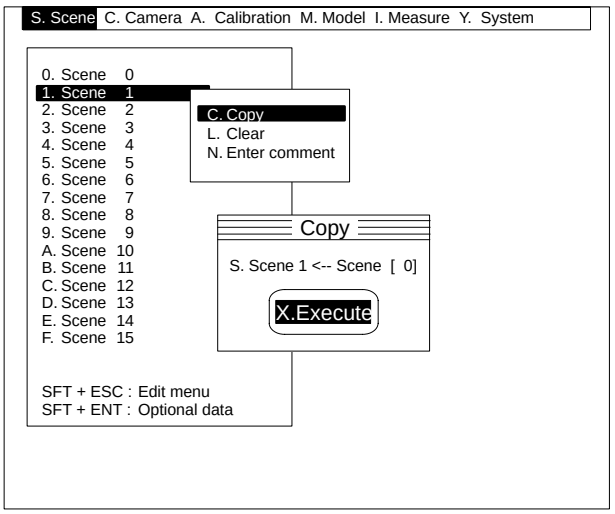
4-1-2 Copying Scene Data: C.Copy

Write the scene data of the selected scene number to a different scene number. This function provides a convenient method of re-using existing data when scenes have many conditions in common.

Procedure

1, 2, 3...

1. Move the cursor to the copy source scene number and press the Shift and Escape Keys.
2. Select “C.Copy.”
3. Input the copy destination scene number.



4. Select “X.Execute.” The scene data is copied from the copy source scene number to the copy destination scene number.

Note Copying scene data can take a long time if many measurement models are registered or if the model regions are large. However, do not turn off the power during a copy operation as this may destroy the data. If this occurs, clear the set data and restart the system.

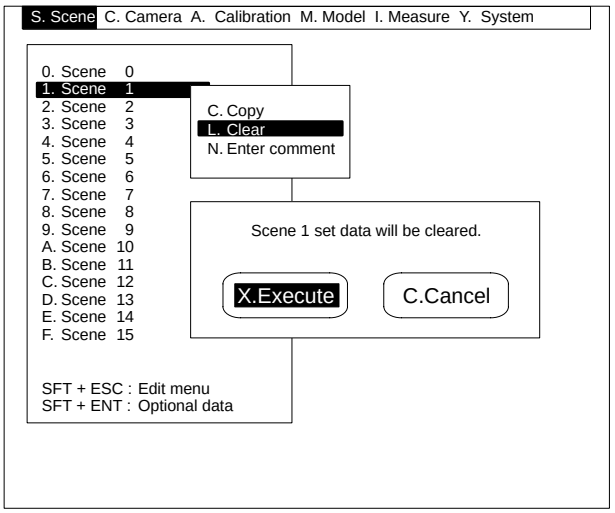
4-1-3 Clearing Scene Data: L.Clear

Set the scene data for the selected scene number to the initial (default) data. Clearing existing data with this instruction is recommended before setting new scene data.

Procedure

1, 2, 3...

1. Move the cursor to the scene number to be cleared and press the Shift and Escape Keys.
2. Select “L.Clear.” A confirmation message is displayed.



3. Check that the correct scene number is highlighted and select “X.Execute.” All scene data for the selected scene number reverts to the initial data.

4-1-4 Adding Comments to Scenes: N.Enter comment

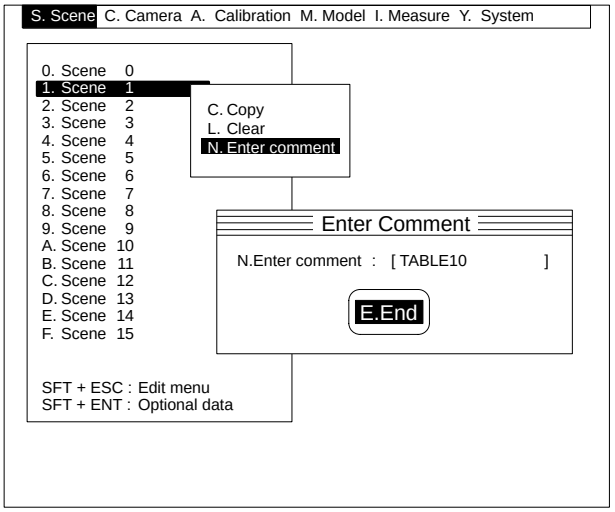
Add comments to scenes. Inspection details or the inspection line name input as a comment can be used as a scene title.

The length of a comment must be a maximum of ten normal characters.

Procedure

1, 2, 3...

1. Move the cursor to the scene number for which a comment is to be entered and press the Shift and Escape Keys.
2. Select “N.Enter comment.”
3. Enter the comment.



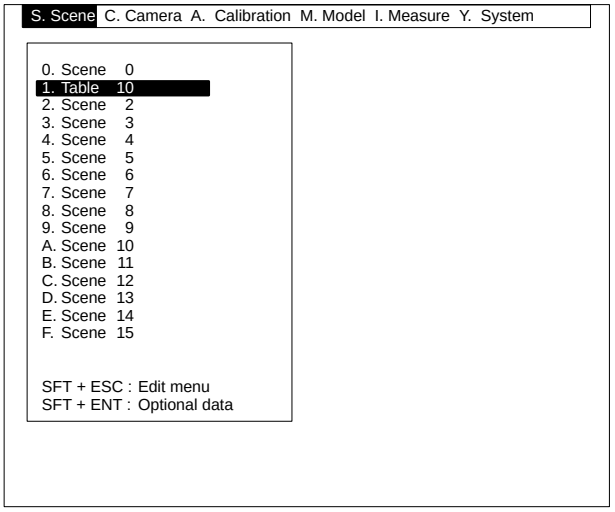
The following characters can be used in comments.

Least significant bits

Most significant bits	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
3	0	1	2	3	4	5	6	7	8	9	:	;	<	=	>	?
4	@	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
5	P	Q	R	S	T	U	V	W	X	Y	Z	[	¥	]	^	_
6	`	a	b	c	d	e	f	g	h	i	j	k	l	m	n	o
7	p	q	r	s	t	u	v	w	x	y	z	{	¦	}	~	

Character codes $30 to 7E.

4. Select “E.End.” The comment is displayed instead of the scene number.



4-1-5 Inputting Option Data: I.Data input

Option data is set for future function expansion. The data can be input but has no effect on measurements.

Sixteen items of option data can be set for each scene.

Note Option data is for future function expansion and is not supported as of 1 October, 1995. The set data has no effect on measurements.

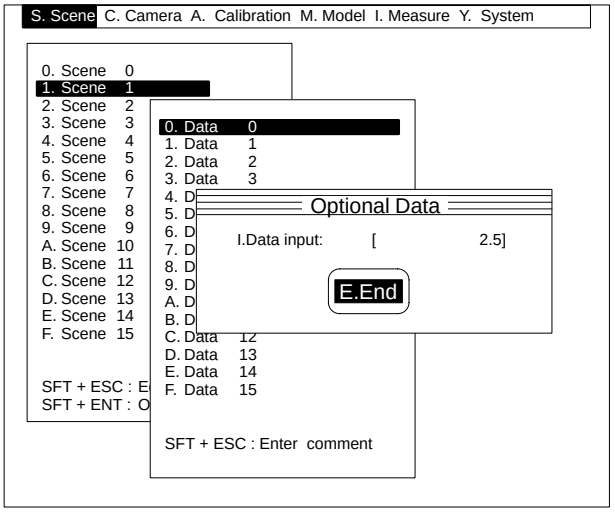
Display of Option Data Comments
If a comment is added to option data, the comment is displayed instead of the option data number. Refer to *4-1-6 Adding Comments to Option Data: N.Enter comment*.

Procedure

1, 2, 3...

1. Move the cursor to the scene number for which the option data is to be input and press the Shift+Escape Keys.
2. Select the option data number.

3. Input the option data.



4. Select “E.End.” The option data is set.

4-1-6 Adding Comments to Option Data: N.Enter comment

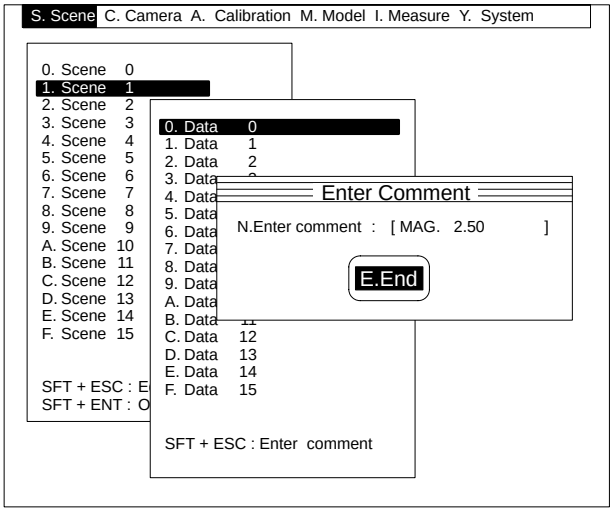
A comment, such as the distribution of a variable, can be added. This comment appears as the option data title. The length of a comment must be a maximum of ten normal characters.

Note Option data is for future function expansion and is not supported as of 1 October, 1995. The set data has no effect on measurements.

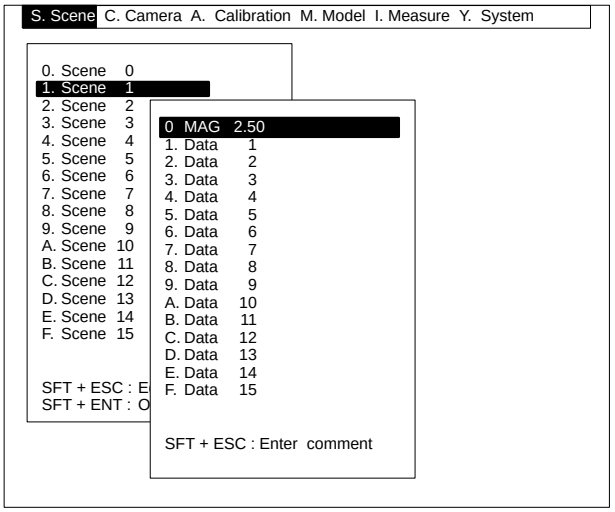
Procedure

1, 2, 3...

1. Move the cursor to the option data number for which the comment is to be input and press the Shift+Escape Keys.
2. Enter the comment.



3. Select “E.End.” The comment is displayed instead of the option data number.



4-2 C.Camera

Use “C.Camera” to select the camera number and set the data related to the displayed image of the measured object.

C. Camera — Select the Camera Number Page 29
F. Filtering — Selecting the Filtering Page 30

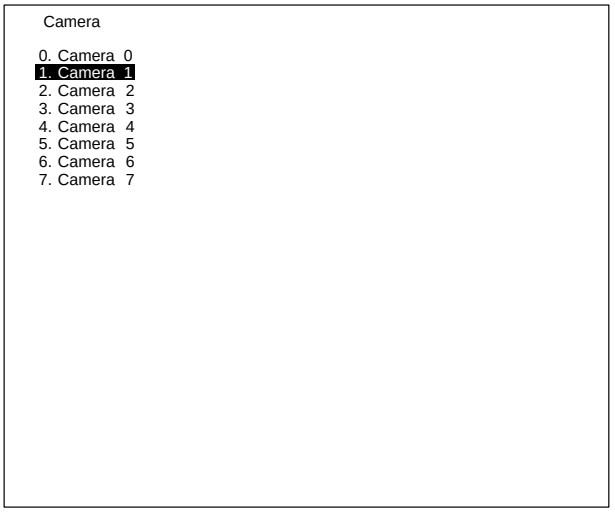
4-2-1 Select the Camera Number: C.Camera

The C.Camera/F.Filtering, A.Calibration, and M.Model registration data must be set for each camera number if multiple cameras are used. The data can be set for the currently displayed camera number.

Procedure

1, 2, 3...

1. Select “C.Camera.”
2. Select the camera number. The image from the selected camera number is displayed.



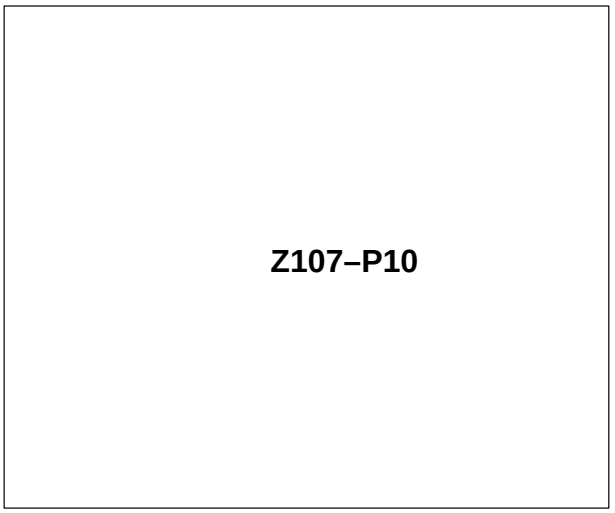
4-2-2 Selecting the Filtering: F.Filtering

The F.Filtering functions process the camera image into an image more suitable for inspection. Select the filtering function to match the environment and inspection.

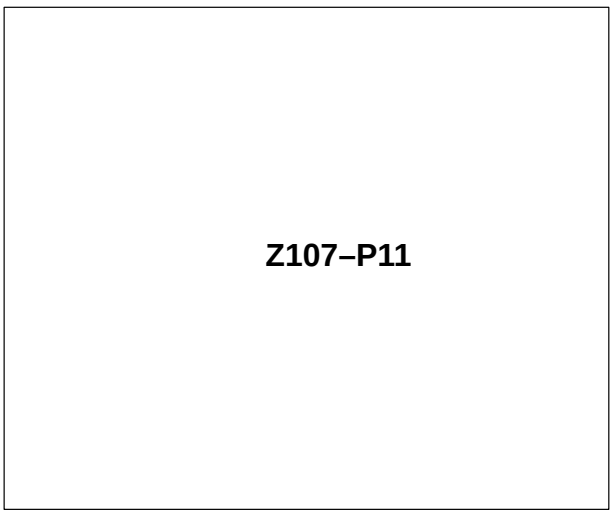
If filtering is specified for a particular camera number, the filtered image is always displayed for that camera number.

Note Correct measurement is not possible if different filtering is selected during measurement than at the time the model data was registered. Do not change the filtering after registering the models.

OFF No filtering. The raw image is displayed.

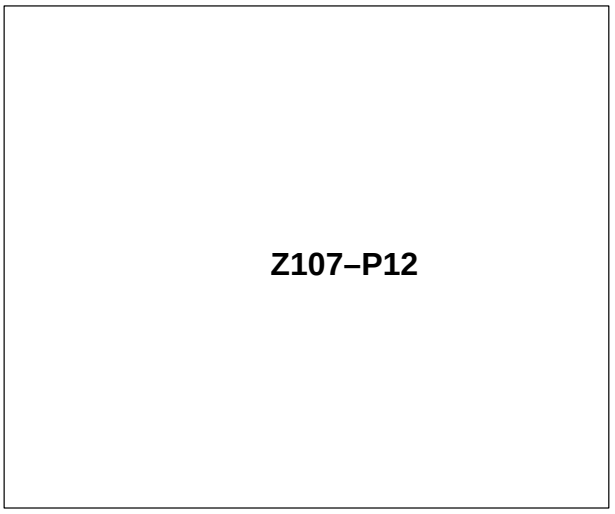


Smoothing Displays a smoothed image with noise suppressed. Smoothing allows suppression of the effects of uneven lighting due to scratches, patterns, or roughness of the surface. Select either weak or strong smoothing.



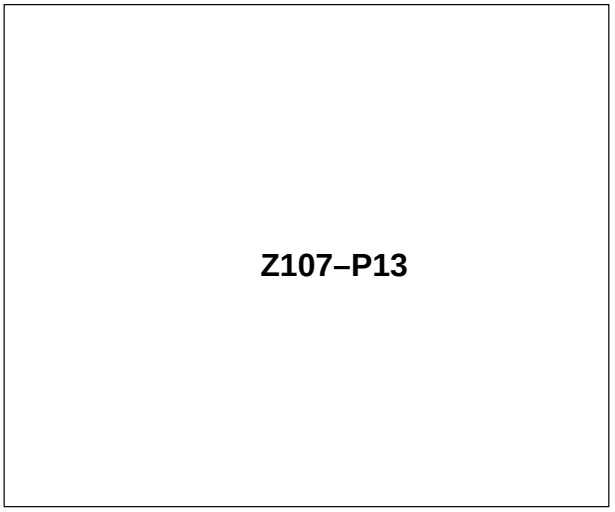
Edge Enhancement

Displays an image with enhanced edges between bright and dark regions. Select the degree of edge enhancement from 1 to 5. Edge enhancement 5 is stronger than edge enhancement 1.



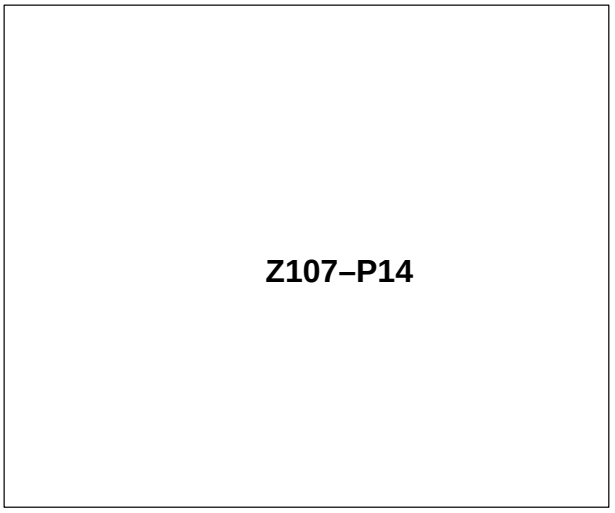
Vertical Edges

Displays an image of the vertical edges between bright and dark regions.



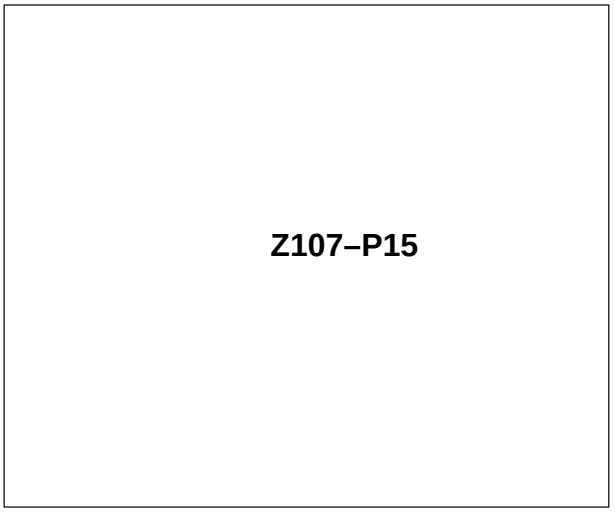
Horizontal Edges

Displays an image of the horizontal edges between bright and dark regions.



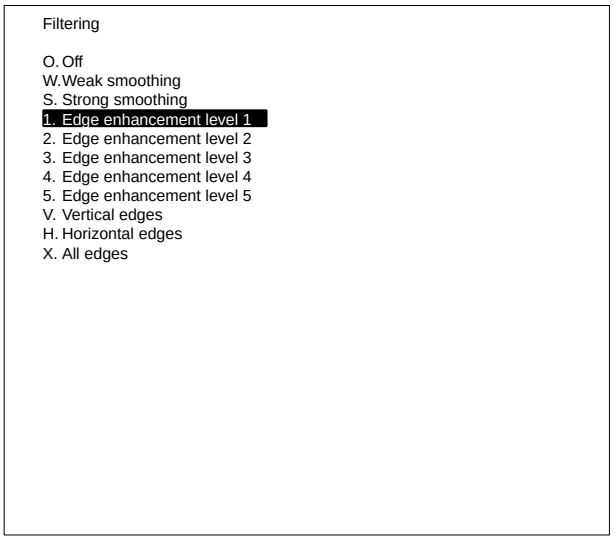
All Edges

Displays an image of all edges between bright and dark regions.



Procedure

Select “F.Filtering.” The image is displayed using the filtering at the cursor position. Set the filtering for the displayed camera number.



4-3 A.Calibration

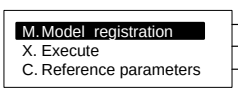
Positioning software 1 converts the measured results for output as actual dimensions. The calibration function converts these results.

Use “A.Calibration” to set the conversion data required for the conversion to actual dimensions. Register the calibration model before setting the conversion data.

The initial values of the calibration data are shown in the table below.

Field of view	Origin in actual coordinates (0,0)	Enlargement
512 W x 484 H (mm)	Screen coordinates (0,0)	1 (1 mm = 1 pixel)

If multiple cameras are used, calibration data can be set to match the field of view of each camera. Select the camera number before setting the calibration data. Refer to *4-2-1 Select the Camera Number: C.Camera*.



Registering a Calibration Model Page 33
Setting the Calibration Data Page 35
Checking the Calibration Data Page 40

4-3-1 Registering a Calibration Model: M.Model registration

Move the mark to a number of positions and enter the actual coordinates of the positions.

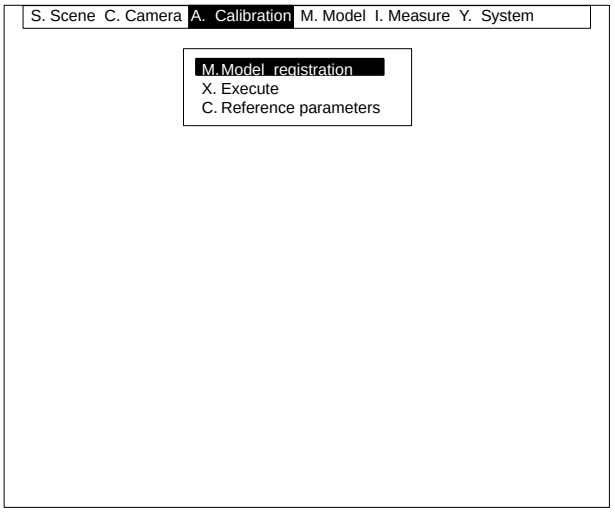
Set the calibration model as a mark for which the actual coordinates are known contained in rectangular regions.

Registering the Calibration Model

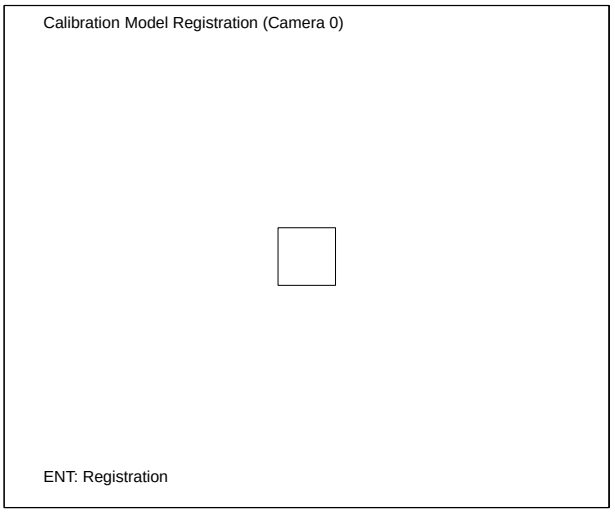
Procedure

1, 2, 3...

1. Select “M.Model registration.” A rectangle displayed in broken lines and an arrow cursor appear.



2. Set the top-left corner coordinates of the rectangle to be registered as the model.
3. Set the bottom-right corner coordinates of the rectangle to be registered as the model.
4. Press the Enter Key. The image in the set rectangle is registered as the calibration model.

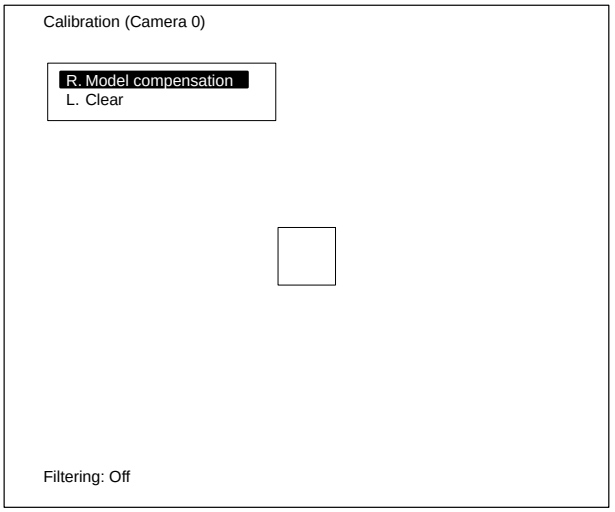


Modifying the Calibration Model

The editing menu is displayed if “M.Model registration” is selected after a calibration model has been registered and when a new model is registered. Display and use this editing menu to modify a calibration model.

Procedure

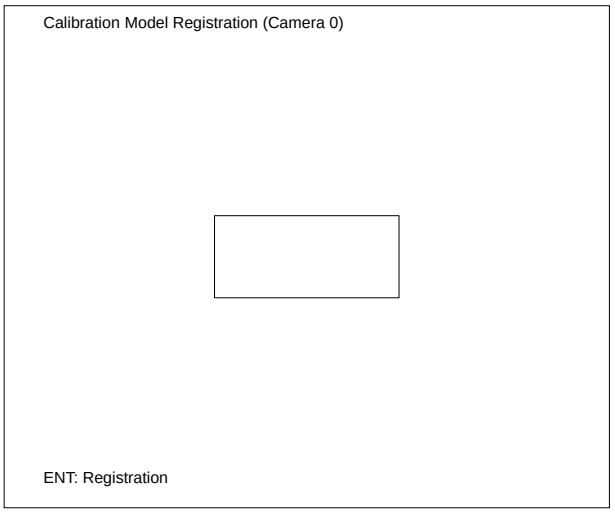
1, 2, 3... 1. Select “R.Model compensation.” A rectangle displayed in broken lines and an arrow cursor appear in the registered calibration model region.



2. Set the top-left corner coordinates of the rectangle to be registered as the model.
3. Set the bottom-right corner coordinates of the rectangle to be registered as the model.

Note Do not set a region smaller than 23 mm wide x 19 mm high.

4. Press the Enter Key. The image in the set rectangle is registered as the calibration model.

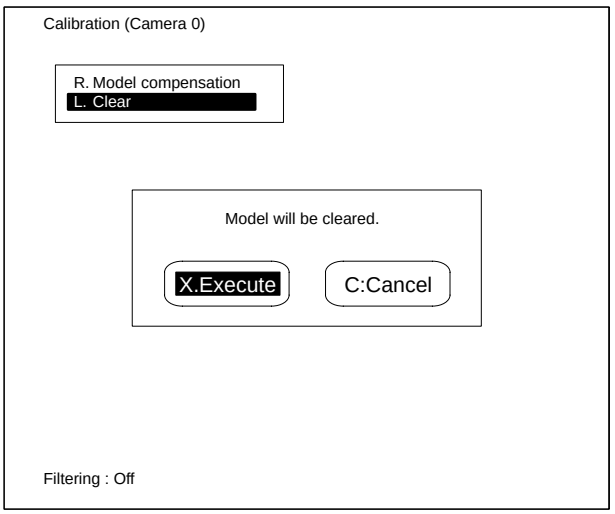


Clearing the Calibration Model

The editing menu is displayed if “M.Model registration” is selected after a calibration model has been registered and when a new model is registered. Display and use this editing menu to clear a calibration model.

Procedure

1, 2, 3... 1. Select “L.Clear.” A confirmation message is displayed.



2. Select “X.Execute.”

4-3-2 Setting the Calibration Data: X.Execute

Set the calibration data. To set the calibration data, move the mark registered as the calibration model to a number of positions on the screen and enter the actual coordinates of the positions.

The actual method of setting the calibration data differs according to whether distortion compensation is selected.

Distortion Compensation
If “D.Distortion compensation” is selected, the lens distortion is taken into consideration when the calibration data is created. Select “D.Distortion compensation” to generate more accurate calibration data.

Note Correct measurement is not possible if different filtering is selected during measurement than at the time the model data was registered. Do not change the filtering after registering the models.

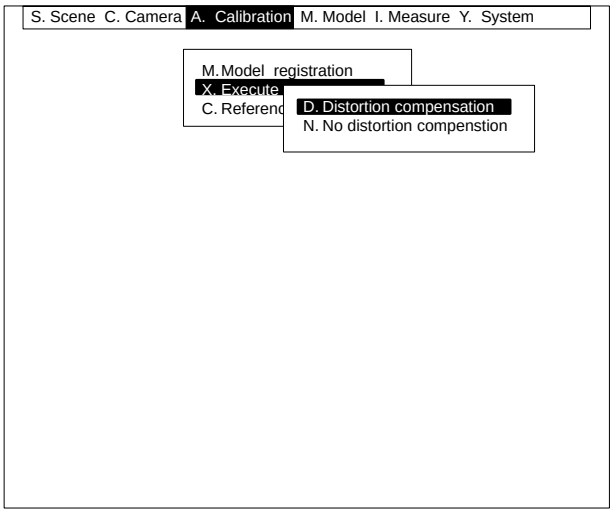
D.Distortion compensation

Move the mark to 25 positions in the image and input the actual coordinates.

Procedure

1, 2, 3... 1. Select “X.Execute.”

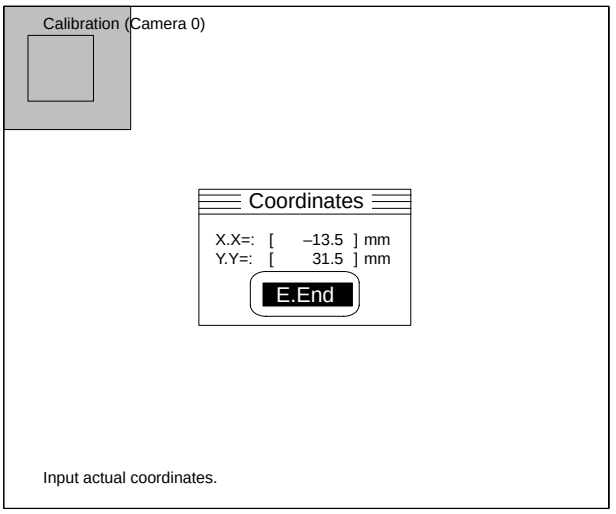
2. Select “D.Distortion compensation.” A rectangular region is displayed at the top-left of the screen.



3. Move the workpiece so that the mark is displayed inside this rectangular region.

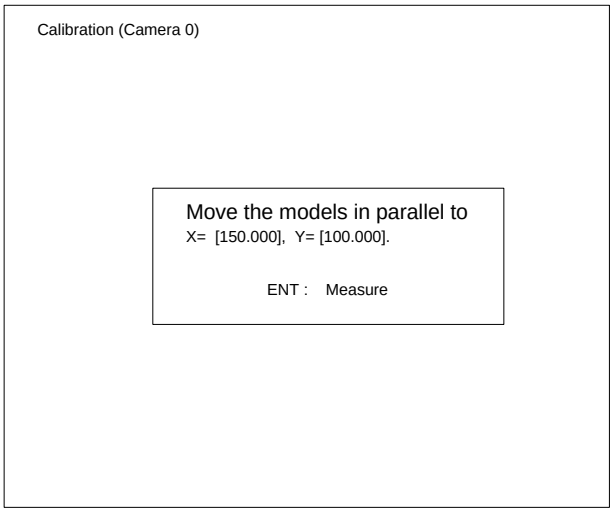
Note Move the workpiece horizontally and vertically only. Incorrect calibration data will result if the workpiece is rotated.

4. Press the Enter Key. A menu is displayed to input the actual coordinates.

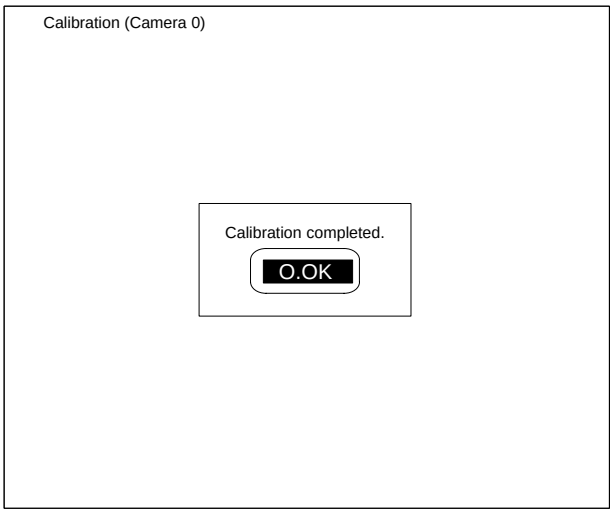


5. Set the coordinates of the mark. Select “E.End.” Similar rectangular regions are displayed at the top-right and bottom-left of the screen. Repeat steps 3 to 5. A message is displayed when the operation is complete.

6. The mark moves to the specified actual coordinate position.



7. Press the Enter Key. Messages are displayed. Repeat steps 6 and 7 as instructed in the messages. A confirmation message is displayed when input of all 25 positions is complete.



8. Select “O.OK.”

N.No distortion compensation

Move the mark to 5 positions in the image and input the actual coordinates.

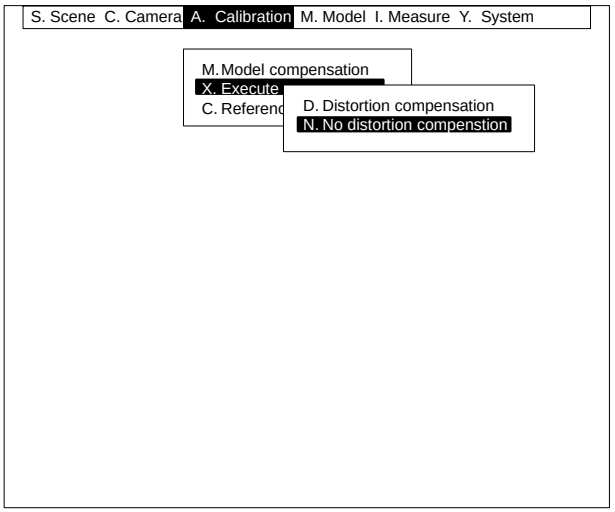
Procedure

1, 2, 3...

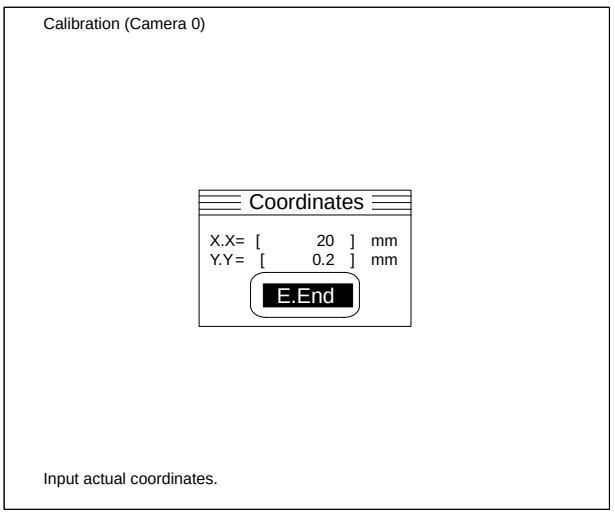
1. Select “X.Execute.”
2. Select “N.No distortion compensation.” A rectangular region is displayed in the center of the screen.

3. Move the workpiece so that the mark is displayed inside this rectangular region.

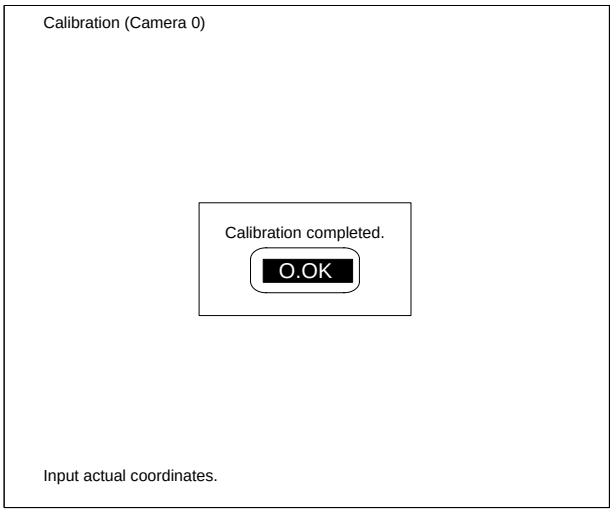
   Note Move the workpiece horizontally and vertically only. Incorrect calibration data will result if the workpiece is rotated.



4. Press the Enter Key. A menu is displayed to input the actual coordinates.



5. Set the coordinates of the mark. Select “E.End.” Similar rectangular regions are displayed at the top-left, top-right, bottom-left and bottom-right of the screen. Repeat steps 3 to 5. A message is displayed when input of all 5 positions is complete.



6. Select “O.OK.”

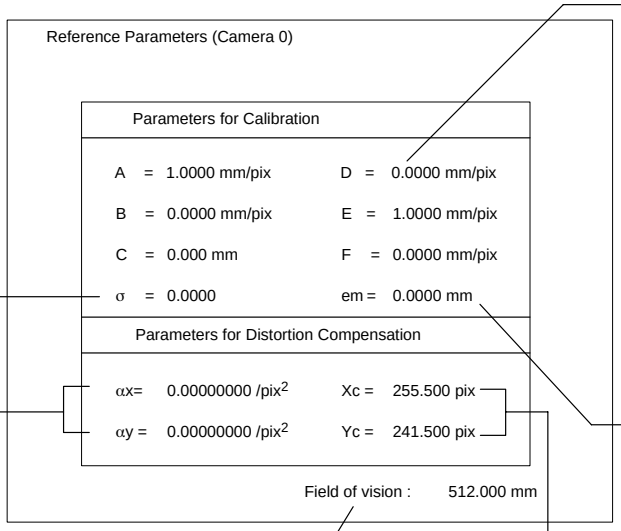
4-3-3 Checking the Calibration Data: C.Reference parameters

Check the set calibration data.

σ is the standard deviation of the errors. This standard deviation is calculated from the errors between the actual coordinates input when the calibration data was set and the coordinates converted using the conversion factors A to F.
The standard deviation is calculated using the following formula.

$$\sigma = \sqrt{\left[\sum_{i=1}^{N} \{(RXi - X'i)^2 + (RYi - Y'i)^2\}/N\right]}$$

Where,
Rxi, Ryi: the input actual coordinates (for i = 1 to N)
X'i, Y'i: the actual coordinates converted using the conversion factors (for i = 1 to N)
N: number of data points (no distortion compensation = 5, distortion compensation = 25)



A to F are the calculated conversion factors which are used to convert the camera coordinates to actual coordinates.
The converted coordinates are calculated using the following formula.

$$X' = A * X + B * Y + C$$
$$Y' = D * X + E * Y + F$$

Where,
X, Y: measured position in camera coordinate system (units: pixels)
X', Y': converted position in actual coordinate system (units: mm)

"em" is the maximum error.
The maximum error between the actual coordinates input when the calibration data was set and the coordinates converted using the conversion factors A to F.
The maximum error is calculated using the following formula.

$$em = MAX\left(\sqrt{(RXi - X'i)^2 + (RYi - Y'i)^2}\right)$$

Where,
MAX: function to output the maximum value achieved from 1 to N.
Rxi, Ryi: the input actual coordinates (for i = 1 to N)
X'i, Y'i: the actual coordinates converted using the conversion factors (for i = 1 to N)
N: number of data points (no distortion compensation = 5, distortion compensation = 25)

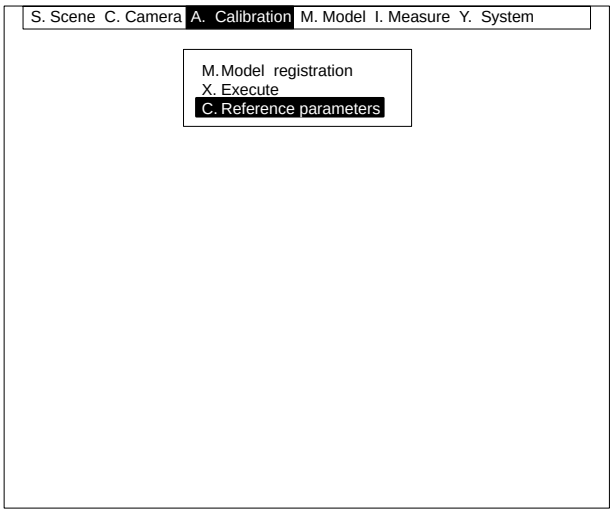
Xc: X coordinate of lens center
Yc: Y coordinate of lens center

αX is the distortion coefficient in the X direction.
αY is the distortion coefficient in the Y direction.

The actual dimensions in the X direction of the field of view in millimeters (mm).

Procedure

1, 2, 3... 1. Select “C.Reference parameters.” The parameter table of calibration data for the currently displayed camera is displayed.



4-4 M.Measure Model

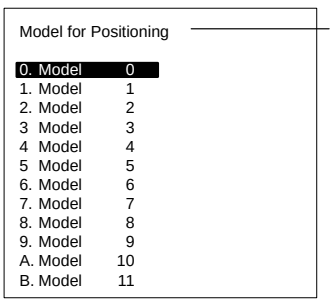
Use “M.Measure model” to set the measurement model and the search region. Positioning software 1 searches for the measurement model in the search region and measures the position of the measurement model.

Register an image whose position is to be measured as the measurement model.

Set the search region to enclose the measurement model if the measured object position deviates. The initial setting of the search region is a rectangle with corner coordinates (20,20) and (491, 456).

Note Incorrect measurement results if the measurement model does not exist inside the search region. If a measurement results in a correlation value of under 70, the measurement model is assumed not to exist and an error is output. Refer to *4-5-2 Measuring: I.Measure*.

If multiple cameras are used, a measurement model can be set for each camera. Select the camera number before setting the measurement model. Refer to *4-2-1 Select the Camera Number: C.Camera*.



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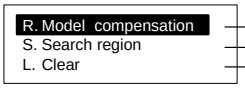


Modifying a Measurement Model Page 43
Modifying a Search Region Page 44
Clearing a Measurement Model Page 45

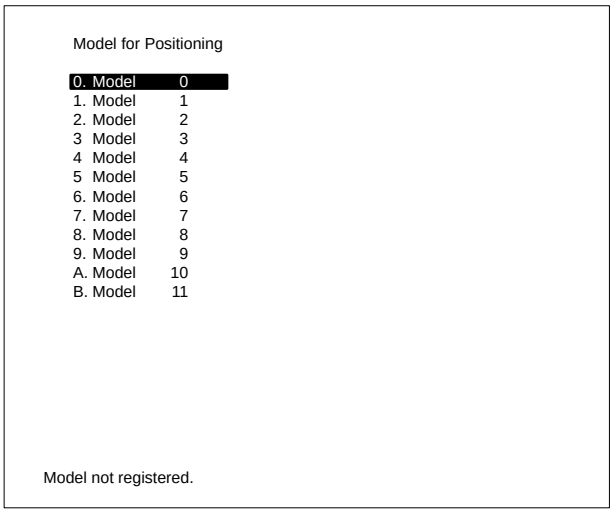
4-4-1 Registering a Measurement Model: M.Measure model

One camera can measure up to 12 positions. Register each measured position as a measurement model.

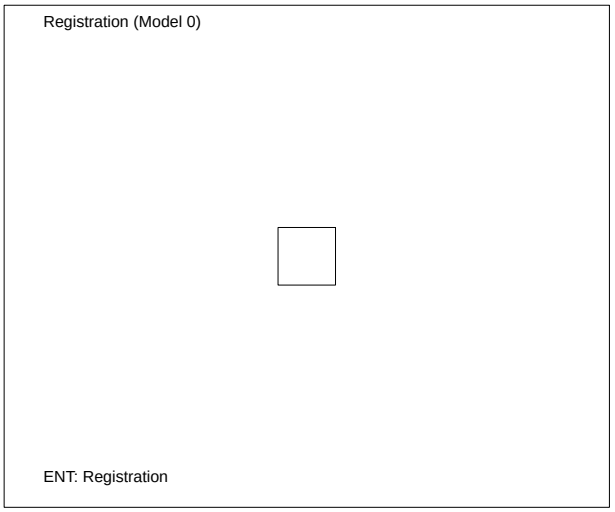
Note Correct measurement is not possible if different filtering is selected during measurement than at the time the model data was registered. Do not change the filtering after registering the models. Before starting the measurement, make sure that the displayed filtering is the same as that selected at the time the model data was registered.

Procedure

1, 2, 3... 1. Select the model number. A rectangle displayed in broken lines and an arrow cursor appear.



2. Set the top-left corner coordinates of the rectangle to be registered as the model.
3. Set the bottom-right corner coordinates of the rectangle to be registered as the model.



4. Press the Enter Key. The image in the set rectangle is registered as the measurement model.

4-4-2 Modifying a Measurement Model: R.Model compensation

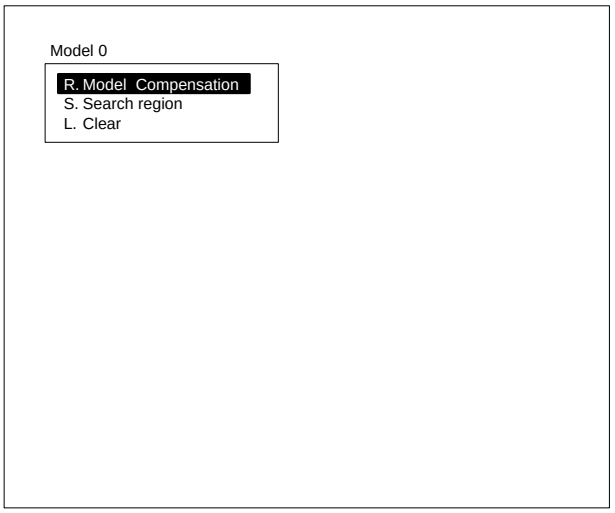
Modifies a registered model. The registered model data is displayed when the cursor is moved to the model number. The measurement model is displayed in solid lines and the search region in broken lines.

Always register a measurement model again after the measurement model filtering is changed.

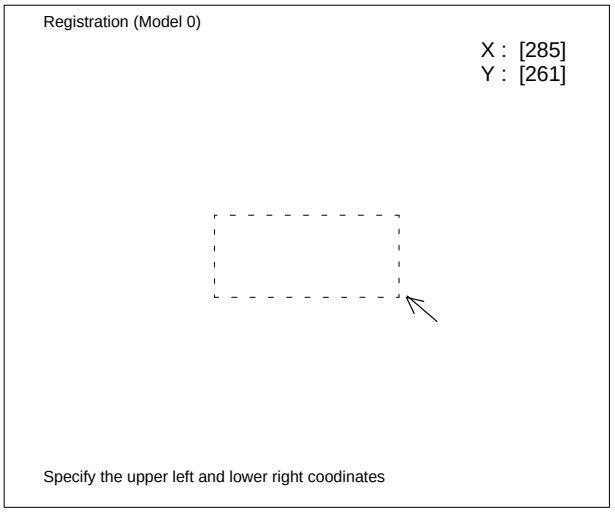
Procedure

1, 2, 3...

1. Select the model number. The editing menu is displayed.
2. Select “R.Model compensation.” The registered measurement model is displayed in broken lines.



3. Set the top-left corner coordinates of the rectangle to be registered as the model.
4. Set the bottom-right corner coordinates of the rectangle to be registered as the model.



5. Press the Enter Key. The image in the specified rectangle is registered as the measurement model.

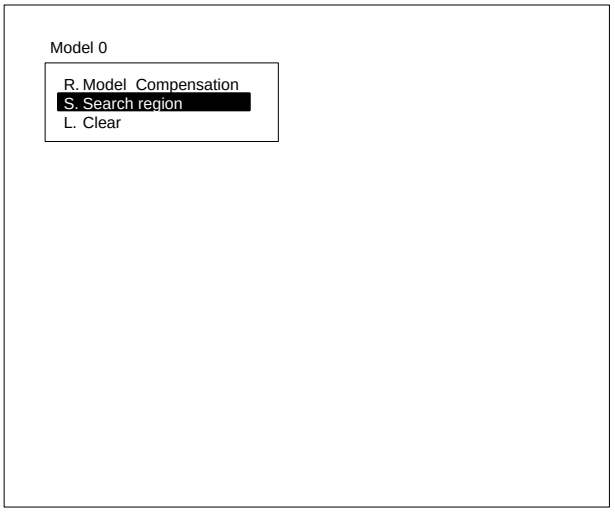
4-4-3 Modifying a Search Region: S.Search region

Modifies the registered search region. When a measurement model is registered, the search region is automatically registered as a rectangular region with corner coordinates (20, 20) and (491, 456). Change this search region to the region where the measurement model is to be searched for. Incorrect measurement results if the measurement model does not exist inside the search region.

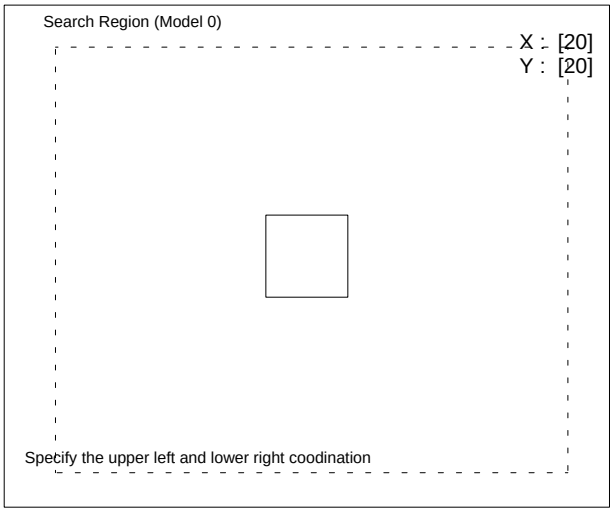
Procedure

1, 2, 3...

1. Select the model number. The editing menu is displayed.
2. Select “S.Search region.” The registered search region is displayed in broken lines.



3. Set the top-left corner coordinates of the rectangle to be registered as the search region.
4. Set the bottom-right corner coordinates of the rectangle to be registered as the search region.



5. Press the Enter Key. The specified rectangle is registered as the search region.

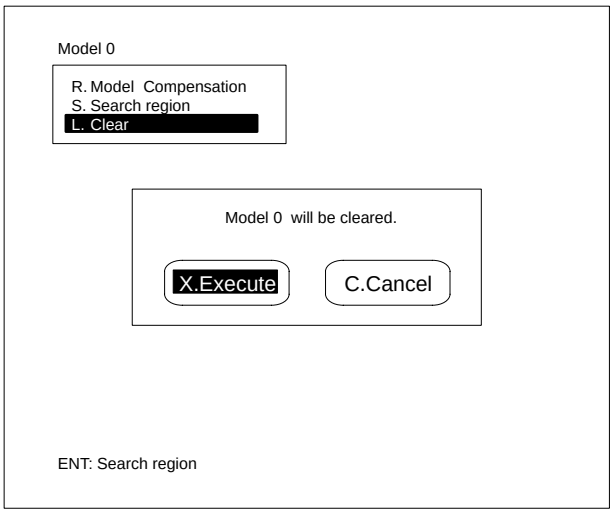
4-4-4 Clearing a Measurement Model: L.Clear

Clears measurement models. Clear measurement models which do not need to be measured.

Procedure

1, 2, 3... 1. Select the model number.

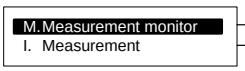
2. Select “L.Clear.” A confirmation message is displayed.



3. Select “X.Execute.”

4-5 I.Measure

Searches for the set models and measures their positions.



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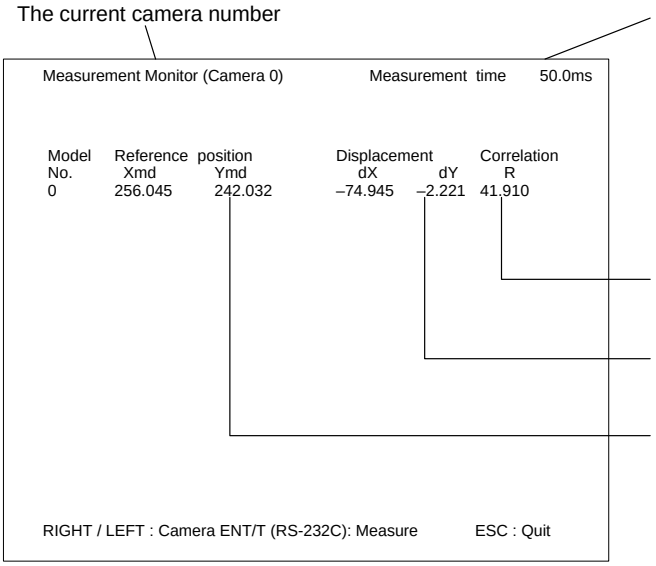
Measuring Page 47

4-5-1 Checking the Measured Results: M.Measurement monitor

This function allows the positions of the models and their correlation values to be checked before the actual measurement is started.

When the measure instruction is executed, the measurement is run for the currently displayed camera number and the results are displayed on the video monitor. If multiple cameras are used, switch from one camera to the next to complete all measurements.

The measurement results are output to the video monitor only, and not to any Parallel I/O Unit or RS-232C Unit which is mounted.



The measurement time for the current camera. This is the time between instruction input and completion of measurement. The total tact time is the measurement time + data output time + α (16.7 ms max.). The data output time depends on the amount of data. Check it for your system. Do not input the next measure instruction during measurement or data output. If a Parallel I/O Unit is mounted, the Busy signal remains ON during measurement and output of the measured results. If multiple cameras are used, the total measurement time is the sum of the measurement time for each camera.

Correlation with the measurement model.

Displacement of measurement model from reference position.

The position of the measurement model at registration is displayed as the reference position.

Applicable Instructions

Console

Instruction	Key	Action
Measure	ENT	Runs the measurement once for the currently displayed scene.
Select camera	◀ / ▶	Increases or reduces the displayed camera number.

RS-232C

The following instructions can be input via the RS-232C for positioning program 1. Add delimiters to the following input ASCII codes.

Note

1. Match the communications specifications of the F350 and external device. Set either CR+LF as the delimiter. Refer to *5-2-3 Setting the RS-232C Communications Specifications: R.RS-232C* in the *F350 Setup Menu Operation Manual*.
2. Only use channel 0. The F300-E RS-232C Unit channel 1 cannot be used.

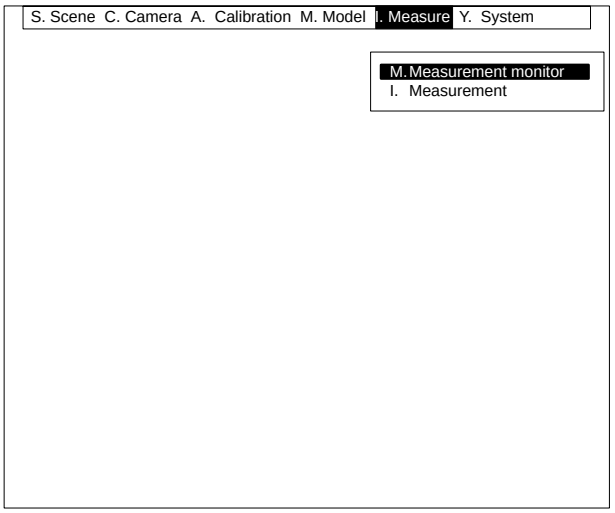
Instruction	Code	Action
Measure	T	Runs the measurement once for the currently displayed scene.

STEP Signal Input

The STEP signal can be input via the Parallel I/O for positioning program 2. The measurement runs once for the currently displayed scene each time the STEP signal turns from OFF to ON.

Procedure

1, 2, 3... 1. Select “M.Measurement monitor.” Shows the measurement monitor screen for the lowest camera number of the currently displayed scene. The measurements are made for the currently displayed camera number only. If multiple cameras are connected, select the image from the camera number to be measured.



2. Press the Enter Key. The measurement results are displayed.

4-5-2 Measuring: I.Measure

Runs the measurement based on the set data. Follow the instructions displayed on the measurement screen. Make all connections with the input devices if a Parallel I/O Unit or RS-232C I/F Unit is used.

Incorrect measurement results if the measurement model does not exist inside the search region. If a measurement results in a correlation value of under 70, the measurement model is assumed not to exist and an error is output.

The measurement screen is displayed after the power supply is turned on and the system waits for an instruction to be input. Refer to *4-6-1 Automatic Measurement: M.Initial mode*.

Inputting Instructions from the Measurement Screen

RS-232C

The following instructions can be input via the RS-232C for positioning program 1. Add delimiters to the following input ASCII codes.

Note

1. Match the communications specifications of the F350 and external device. Set either CR+LF as the delimiter. Refer to *5-2-3 Setting the RS-232C Communications Specifications: R.RS-232C* in the *F350 Setup Menu Operation Manual*.
2. Only use channel 0. The F300-E RS-232C Unit channel 1 cannot be used.

Instruction	Code	Action
Measure	M	Runs the measurement once for the cameras selected by the select camera instruction. If no camera is selected when the measure instruction is executed, the measurement is run for all cameras for which measurement models are registered.
Select camera	R | Start camera# | , | End camera#	Selects the cameras used for the measurement. Execute the camera select instruction before the measure instruction.
Switch scene	S | Scene # 0 to 15	Displays the selected scene number. Set the scene number between 0 and 15.

Parallel I/O

The following instructions can be input via the Parallel I/O for positioning program 2. For the bit statuses in the table below, 1 represents OFF, 0 represents ON, and * represents either OFF or ON.

Instruction	Input data DI: 7 6 5 4 3 2 1 0	Action
Switch scene	0 1 * * (Scene#)	Switches the number of the displayed screen. Set the scene number with DI0 to DI3 and turn DI6 ON after 1 ms. Set the scene number from 0 to 15.
Select camera	1 0 (Start camera#) (End camera#)	Selects the cameras used for the measurement. Set all cameras for which measurement models are registered between the start camera # and end camera #. All cameras for which measurement models are registered are selected after the switch scene instruction is executed or after the measurement screen is displayed, therefore always select the cameras required for the measurement before executing the measure instruction. Set the camera numbers in the range 0 to 7, with the end camera number greater than the start camera number. Set the start camera number with DI3 to DI5 and the end camera number with DI0 to 2, then turn DI7 ON after 1 ms.

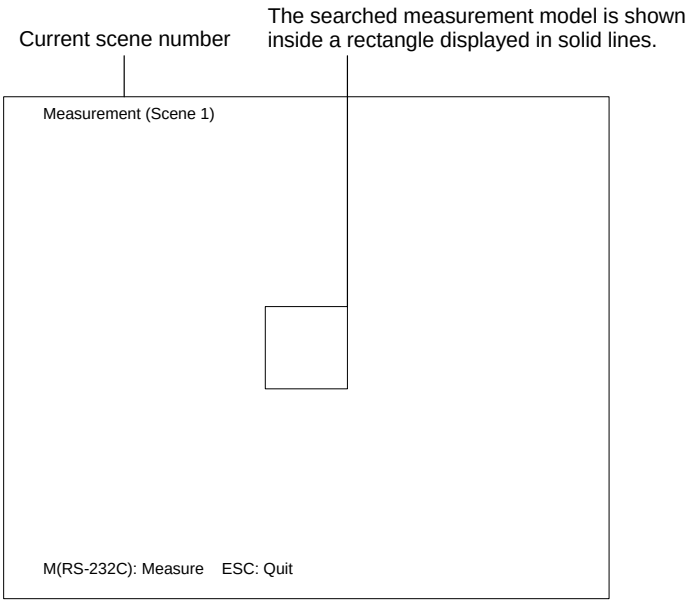
STEP Signal Input

The measurement runs once for the currently displayed scene each time the STEP signal turns from OFF to ON. The measurement runs using the cameras set with the select camera instruction. If the STEP signal is turned ON before the select camera instruction is executed, the measurements are run for all cameras for which measurement models are registered.

Outputting Measured Results

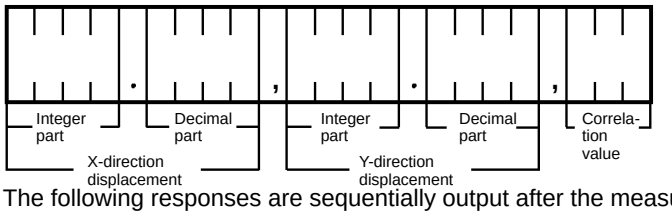
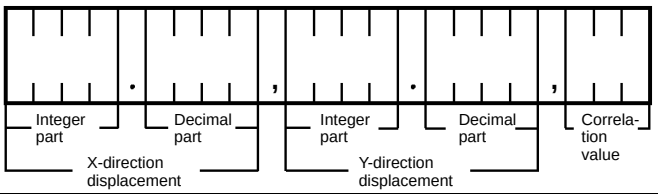
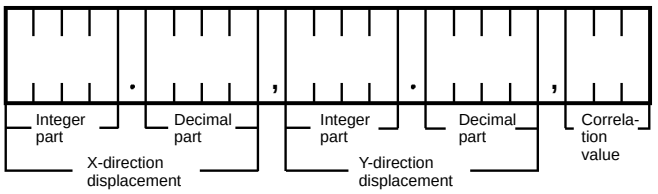
Video Monitor

The measurement result is displayed on the video monitor in the format shown below.



RS-232C

Positioning program 1 outputs responses to the following instructions input via the RS-232C. Delimiters are inserted in the output format.

Input instruction	Output format
Measure	The following responses are sequentially output after the measurement is complete. O K  The following responses are sequentially output after the measurement is complete. **Note** If the integer part is 3 digits or less, the most significant digits are filled with space characters ($20).
	The following responses are sequentially output if the correlation value is under 70. E R 
	The following responses are sequentially output if the measured value overflows the display. E R  Data is output between 999.999 and –999.999.
Switch scene	If the scene was switched normally. O K
	The following responses are sequentially output if an illegal scene number was used (not between 0 and 15). E R Input instruction
Illegal instruction input	The following responses are sequentially output if the camera number was not specified between 0 and 7 or if the start camera number was specified greater than the end camera number. E R Input instruction

Parallel I/O

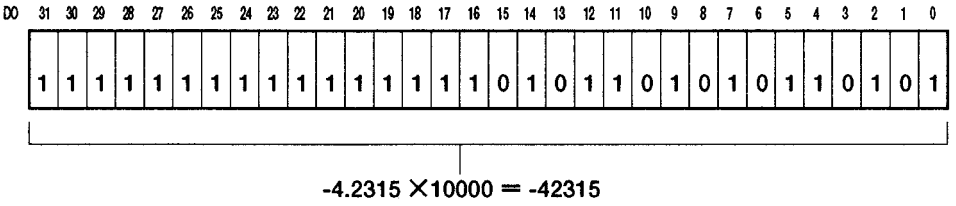
Positioning program 2 outputs measured results via the parallel I/O. The measured X-direction displacement, Y-direction displacement, and the correlation value are output sequentially in increasing order of camera number and increasing order of model number.

Each item is output as 32 points of binary data. Set the number of output bits according to the *F350 Setup Menu Operation Manual*. Refer to *5-2-4 Setting the Output Specifications for Parallel Data: P.I/O Unit* in the *F350 Setup Menu Operation Manual*.

Note that the X-direction displacement and Y-direction displacement are output as 10,000 times the measured value.

The most significant bit or bits are discarded if the measured value exceeds the set number of output bits.

32 output bits, X-direction displacement = –4.2315 mm

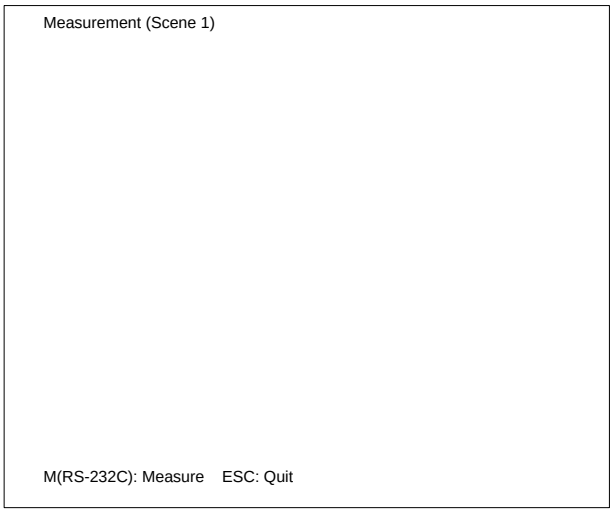


Note

1. The Power Supply Unit ERROR terminal turns ON if the measurement model does not exist inside the search region (the correlation value is under 70). The ERROR terminal turns OFF when the next instruction is input.
2. The Power Supply Unit ERROR terminal turns ON if the measured value cannot be output because of an overflow. The ERROR terminal turns OFF when the next instruction is input. The upper limit on the data values which can be expressed as 32 bits is 7FFFFFFF and the lower limit is 80000000.

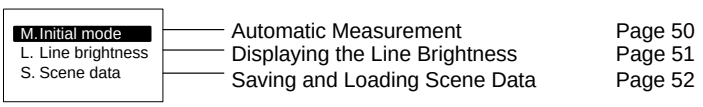
Procedure

Select “I.Measure.” The measurement screen is displayed for the currently displayed scene. Follow the instructions displayed on the screen.



4-6 Y.System

Save the set scene data and set the environment data. The data set using “Y.System” does not directly affect the measurement conditions.



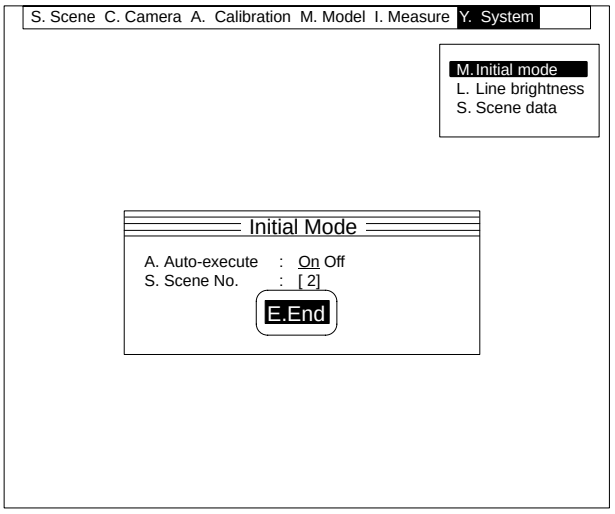
4-6-1 Automatic Measurement: M.Initial mode

The automatic measurement function displays the measurement screen and inputs the measure instruction to start the measurement when the application program is started. Use this function to start measurement after all the measurement conditions are set as scene data.

Procedure

1, 2, 3...

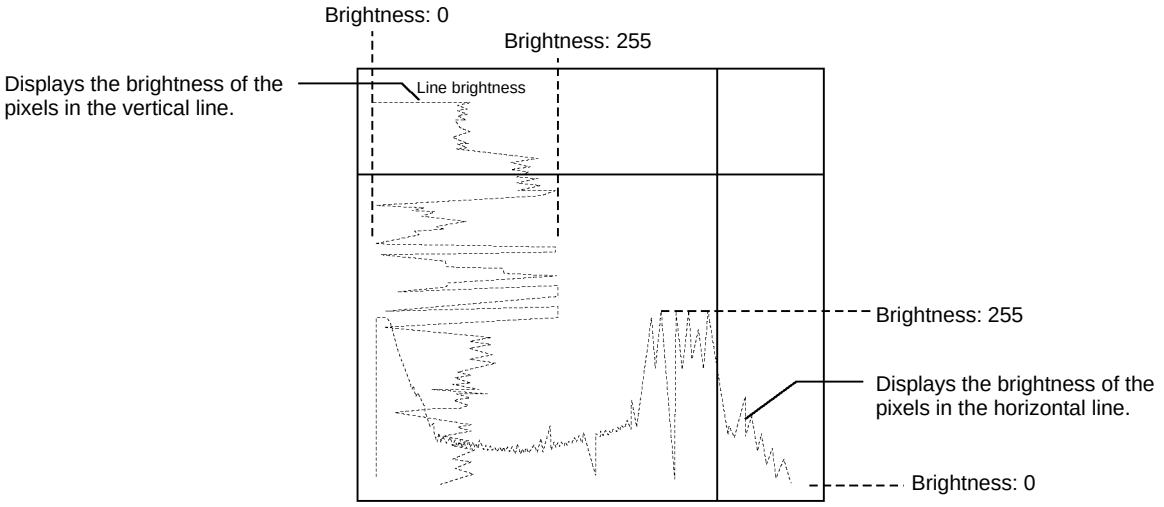
1. Select “M.Initial mode.”
2. Set “A.Automatic execution” ON.
3. Set the scene number in “S.Scene.” The measurement screen for the specified screen number is automatically displayed the next time the system is started.



4. Select “E.End.”

4-6-2 Displaying the Line Brightness: L.Line brightness

Line brightness is the name given to a graph which indicates the brightness distribution along a line through the image. The line brightness can be displayed for any arbitrary vertical or horizontal lines through the image.

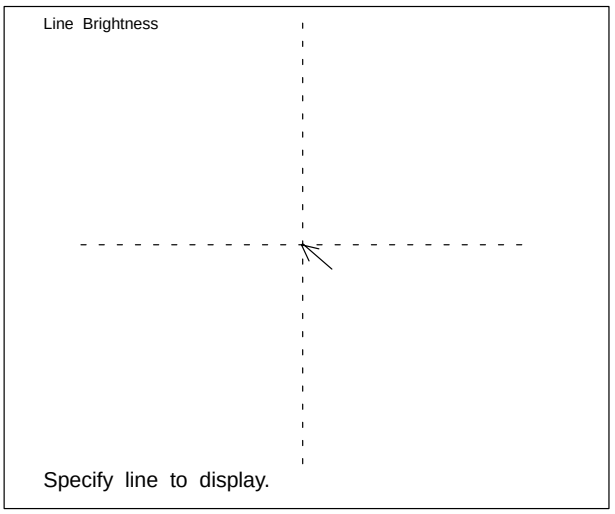


Procedure

1, 2, 3... 1. Select “L.Line brightness.”

Dotted lines are displayed vertically and horizontally through the cursor.

Note A static (freeze) image is displayed when “L.Line brightness” is selected. If “D.Display/F.Freeze” is set to “U.Unfreeze” display the required image before selecting “L.Line brightness.”



2. Select the line. Move the cursor to the line and press the Enter Key. The line brightness is displayed for the selected vertical and horizontal lines.
3. Press the Enter Key or the Escape Key. Returns to the menu.

4-6-3 Saving and Loading Scene Data: S.Scene data

Loads and saves data to and from the memory card. Scene data comprises of data set using: S.Scene, C.Camera, A.Calibration, M.Measure model, and Measure.

Saving Scene Data

Saves scene data to a memory card. The extension “.SCN” is automatically appended to the saved file name.

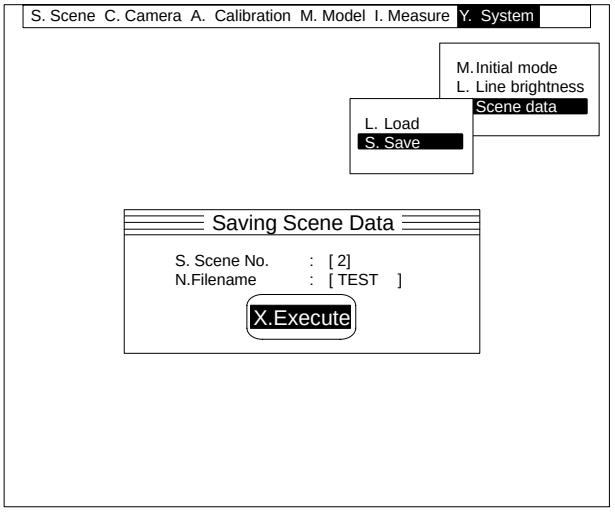
When using a new memory card for the first time, initialize it using the Setup Menu. Refer to *5-4-1 Initializing Memory Cards: F.Format* in the *F350 Setup Menu Operation Manual*.

Procedure

1, 2, 3... 1. Select “S.Scene data.”
2. Select “S.Save.”
3. Input the save source scene number for “S.Scene No.”

4. Input the save destination file name for “N.Filename.”

   Only the upper-case characters A to Z can be input (character codes: $41 to $5A).



5. Select “X.Execute.” The data from the specified scene number is saved in the memory card under the specified file name.

Loading Scene Data

Loads saved scene data from a memory card. Insert a memory card containing saved scene data. When the scene data is loaded, it overwrites the scene data for the currently displayed scene number. Display the load destination scene number before loading.

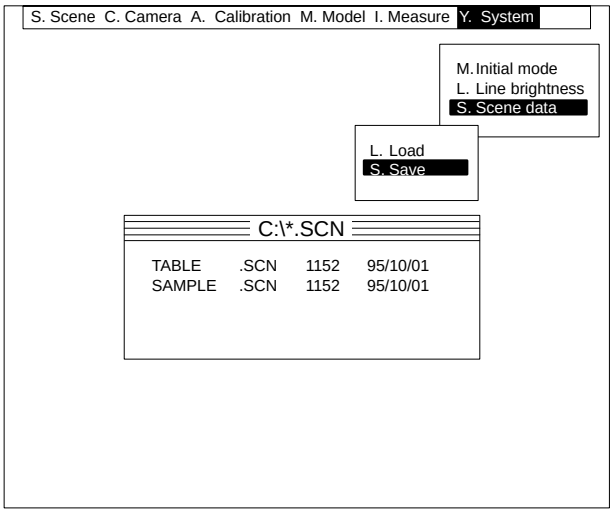
Compatibility of Scene Data Between Menus

The scene data is fully compatible between positioning programs. Scene data created with positioning program 1 or positioning program 2 can be loaded into either program.

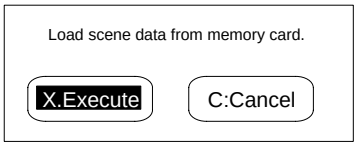
Procedure

1, 2, 3...

1. Select “S.Scene data.”
2. Select “L.Load.” A directory is displayed of the scene data file names in the root directory. The names of any existing sub-directories are also displayed.



3. Select the file name. A confirmation message is displayed.



4. Select “X.Execute.” The selected scene data is loaded to the currently displayed scene number.

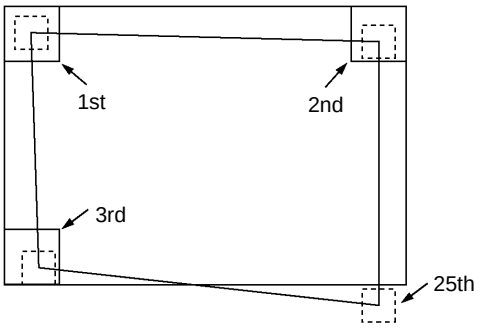
SECTION 5
Troubleshooting

This section provides a list of error messages, and the causes and remedies of them.

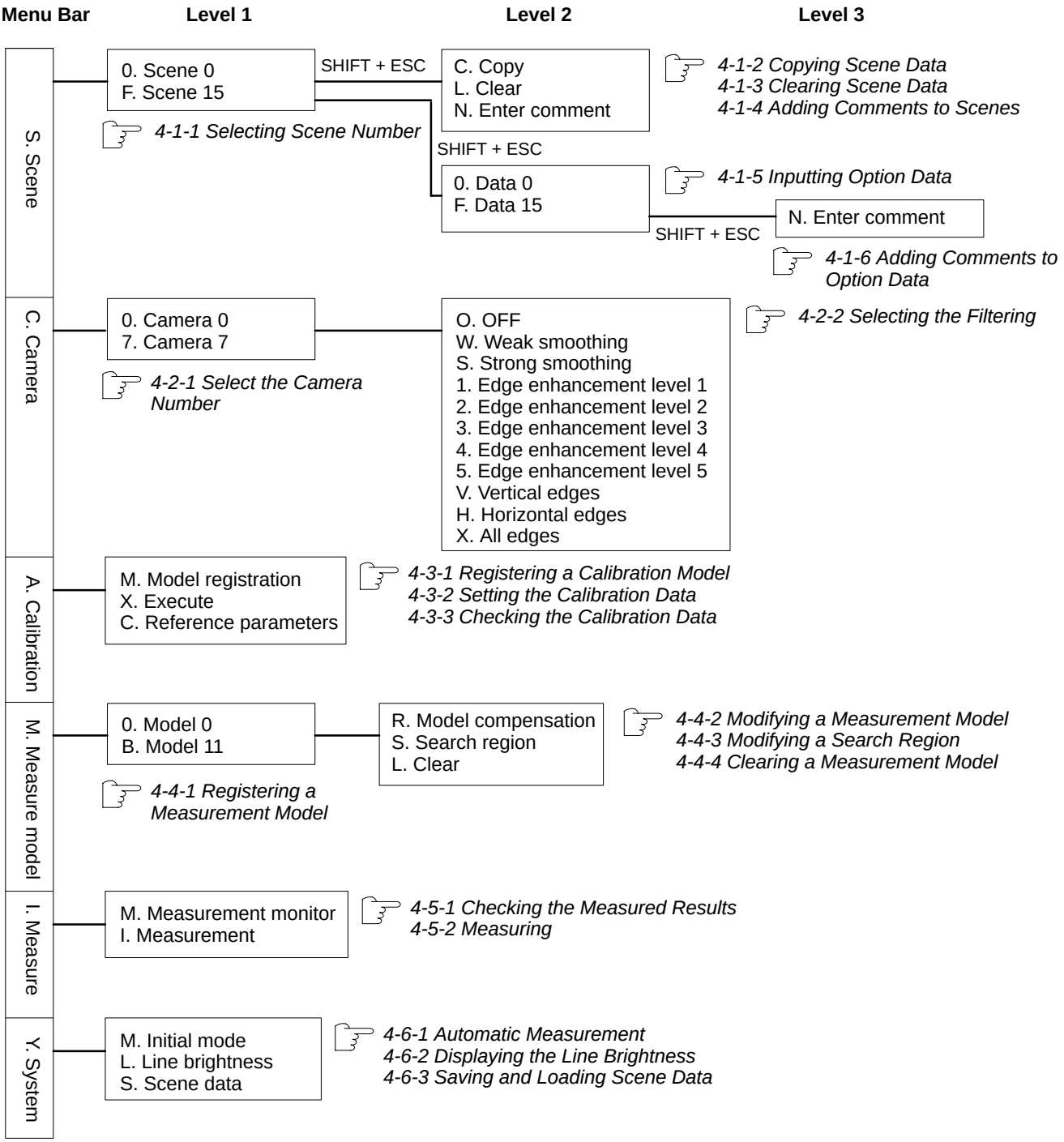
5-1 Troubleshooting 56

5-1 Troubleshooting

The error messages and corresponding remedies for Positioning Programs 1 and 2 are displayed in alphabetical order. Refer to this table for an explanation of the error messages.

Error message	Cause and remedy
Calibration failed.	Calibration could not be registered because the 25th measurement model was outside the screen. Input the first three measurement models such that the 25th measurement model lies approximately in the center of the screen. 
Cannot be registered. No space in model registration region.	No more space exists in the model registration region. No more models can be registered or loaded.
Cannot copy to the same scene number.	The copy source and copy destination are the same scene number. Select different scene numbers.
Cannot save to memory card. Not sufficient space.	The memory card does not have enough free space to save to. Insert a memory card with sufficient free space and try again.
File does not exist.	No file exists in the inserted memory card. Insert a memory card containing files and try again.
Incorrect filename. Input again.	Either no filename is input or an incorrect filename is input. Input a correct filename and and try again.
Measurement results in error.	Correct measurement values cannot be output because the model correlation value is too small. Make sure that the measurement object is normal.
No models registered for calibration.	The calibration parameters could not be set because no calibration model is registered. Register a calibration model.
No memory card inserted.	The operation is not possible because no memory card is inserted. Insert a memory card and try again.
No model is registered.	The measurement cannot be run because no model is registered. Register a model.
Not scene data for the positioning program.	Scene data saved with another program cannot be used with a positioning program. Load scene data saved with a positioning program.
Scene data initializing.	Initializing the scene data to start the installed Application Menu. All scene data will revert to the initial values.
	Initializing the scene data because exiting scene data is destroyed. All scene data will revert to the initial values.
Scene data loading cancelled due to an error. Scene data will be cleared.	Loading was cancelled because the memory card was not correctly inserted. Insert the memory card correctly and load the scene data again.
	The loaded scene data has the wrong format. The data is destroyed, or an attempt was made to load incorrect data. Load scene data with the correct format.
Scene data saving cancelled due to an error.	Saving was cancelled because the memory card was not correctly inserted. Insert the memory card correctly and save the scene data again.
	Saving not possible because the memory card is not initialized. Save the scene data again using an initialized memory card.
	Saving not possible because the memory card is write-protected. Cancel the write protection and save the scene data again.
Too many models. No more can be registered.	You have tried to register more than the maximum number of models. No more models can be registered or loaded.
Wrong model image.	The image is completely white or completely black and is unsuitable for registration as a model.

Appendix A
Menu Hierarchy Diagrams



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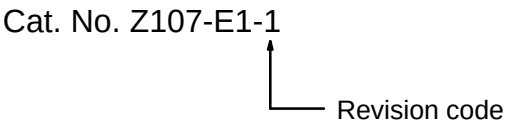
Revision History

A manual revision code appears as a suffix to the catalog number on the front cover of the manual.



The following table outlines the changes made to the manual during each revision. Page numbers refer to the previous version.

Revision code	Date	Revised content
1	August 1995	Original production