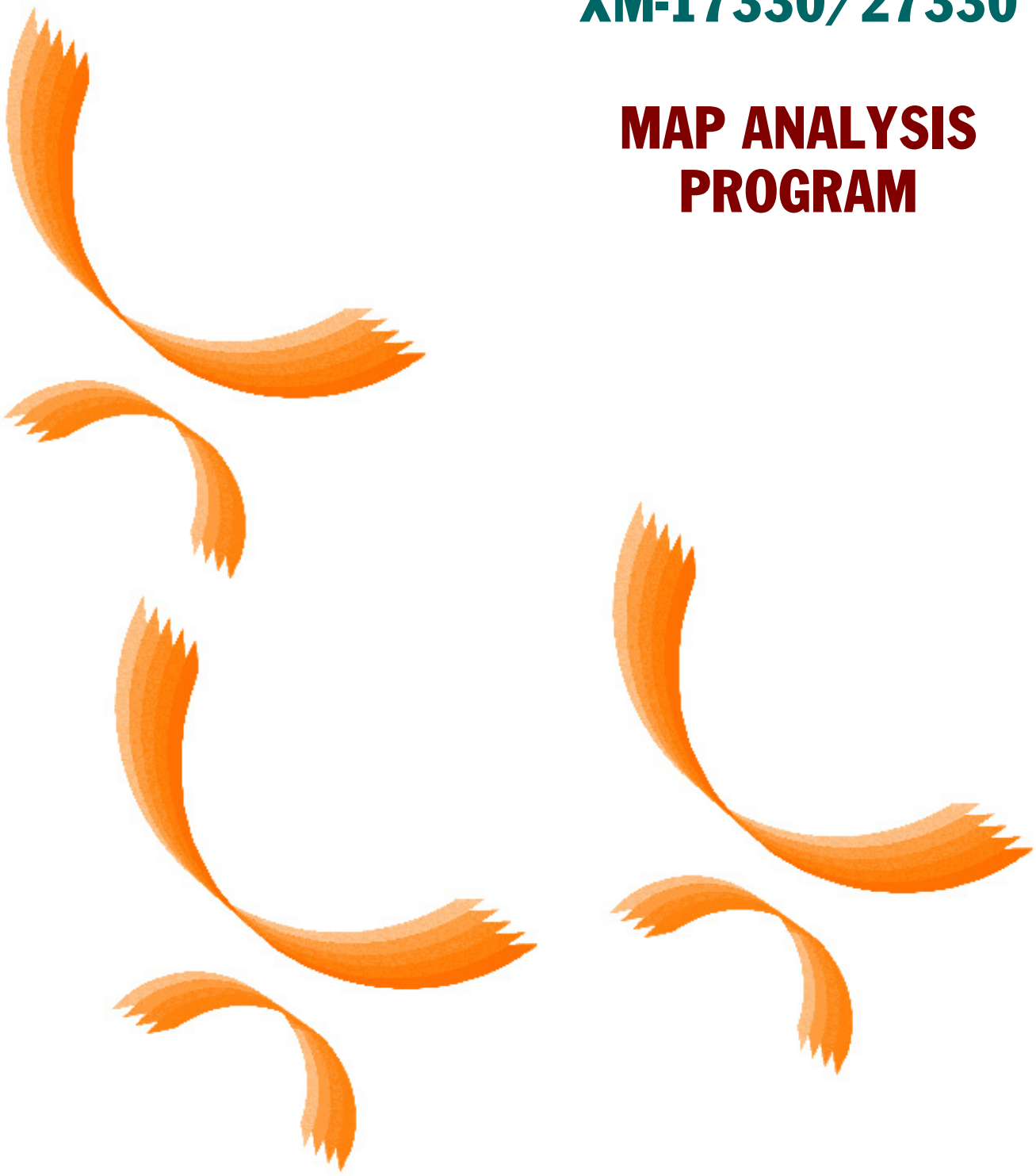
C

CONTENTS

XM-17330/27330

MAP ANALYSIS PROGRAM



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NOTATIONAL CONVENTIONS AND GLOSSARY

General notations

⚠ **WARNING :**	A potentially hazardous situation which, if not avoided, could result in death or serious injury.
⚠ **CAUTION :**	A potentially hazardous situation which, if not avoided, could result in minor injury or material damage. Material damage includes, but is not limited to, damage to related devices and facilities, and acquired data.
– CAUTION – :	Points where great care and attention is required when operating the device to avoid damage to the device itself.
✍ :	Additional points to be remembered regarding the operation.
☞ :	A reference to another section, chapter or manual.
1, **2**, **3** :	Numbers indicate a series of operations that achieve a task.
◆ :	A diamond indicates a single operation that achieves a task.
File:	The names of menus, or commands displayed on the screen, and those of buttons of the instrument, are denoted with **bold** letters.
File–Exit :	A command to be executed from a pulldown menu is denoted by linking the menu name and the command name with a dash (–). For example, **File–Exit** means to execute the **Exit** command by selecting it from the **File** menu.

Mouse operation

Mouse pointer:	An arrow-shaped mark displayed on the screen, which moves with the movement of the mouse. It is used to specify a menu item, command, parameter value, and other items. Its shape changes according to the situation.
Click:	To press and release the left mouse button.
Right-click:	To press and release the right mouse button.
Double-click:	To press and release the left mouse button twice quickly.
Drag:	To hold down the left mouse button while moving the mouse.

CONTENTS

1 GENERAL

This map analysis (area analysis) program is used to examine the two-dimensional distribution of elements on a sample surface.

The program handles two types of signals, X-ray signals and image signals such as SED and BEI, from the Wavelength Dispersive Spectrometer (WDS) and the Energy Dispersive Spectrometer (EDS) for JXA-8200. Up to 30 elements can be specified for measurement on each analysis area. Measurement can be made in two modes, stage scanning and beam scanning.

A raw-data map of X-ray intensity can be converted into a concentration map using calibration curves and displayed on the monitor screen.

Functions available for two-dimensional data include image display, contour display, bird's eye view display, overlay display, simple image processing such as various arithmetic operations and smoothing, line profile display, and analytical functions such as distance measurement.

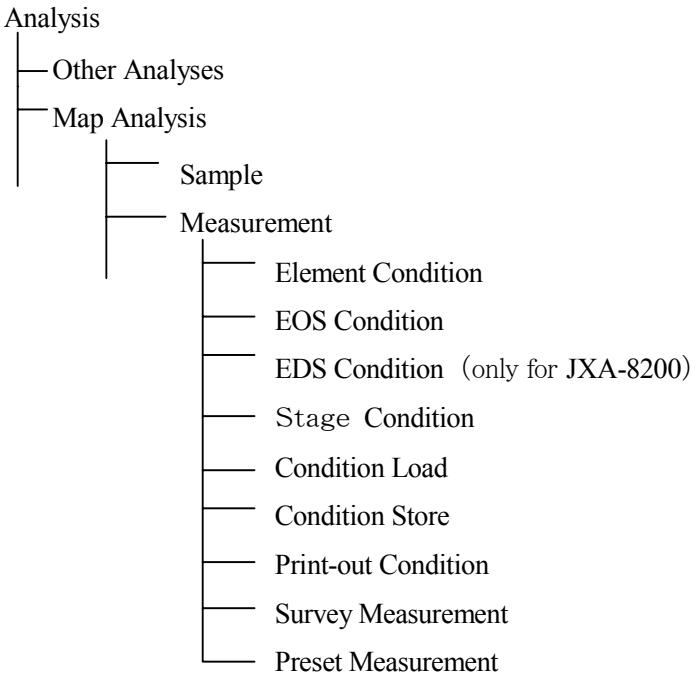
2 SPECIFICATIONS

• Map measurement:	Stage scan and beam scan
• Number of elements per map:	Up to 30.
• Number of measurement points:	10 × 10 to 1,024 × 1,024
• Measurement step interval:	0.5 to 1,000 μm (in the stage scan mode) As low as 0.02 μm possible with micro step driver ✍ The step interval in the beam scan mode is automatically determined by the number of measurement points and the magnification. ✍ The analysis area is to be specified as a multiple of 0.5 μm due to hardware restrictions.
• X-ray measurement time per step:	1 to 100,000 ms
• Preset measurement areas per sample:	1 to 10,000 areas
• Number of accumulations:	1 to 100
• Real-time display during measurement:	Possible
• Concentration map display:	X-ray intensity display and mass concentration display Map enlargement/reduction
• Number of map images to display:	Selectable from 1, 2 (side by side, or up and down), 4 (2 × 2), 9 (3 × 3), and 16 (4 × 4) or user specified up to 16
• Number of map display colors:	2, 4, 8, 16, 32, or 64 colors (selectable)
• Map display mode:	Pseudo-color or gray scale (selectable) Map enlargement/reduction
• Map level change:	Equal-interval division between upper and lower limits, equal-area division, or user specified (selectable)
• Map arithmetic operations:	Dead-time correction; smoothing; edge enhancement; constant addition, subtraction, multiplication and division; and addition, subtraction, multiplication and division of two maps
• Map analyses:	Point analysis, line analysis, and two-point distance measurement

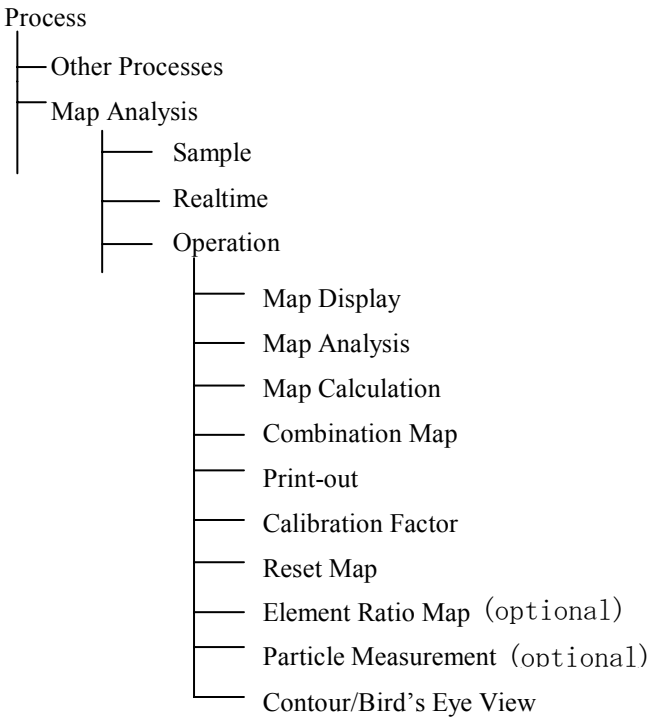
3 PROGRAM STRUCTURE

The structure of this program is shown in the following tree.

■ Measurement



■ Processing



4 MEASUREMENT

This chapter explains the procedure for map analysis. The procedure is divided into three parts: measurement (image-data acquisition), processing (image-data processing) and real-time display (monitoring during measurement).

4.1 Preparation for Measurement

This section explains the general procedure for measurement.

After entering the sample name for the data to be stored, execute measurement by selecting the elements to be measured, the conditions of the electron optical system and the coordinate position to be measured. You can save measurement conditions in advance and recall them when you execute measurement.

The following procedure opens the main window for measurement.

1. Open the EPMA Main Menu on the computer display and then click on the **Analysis** icon to display the **Analysis** menu.

☞ Refer to the instruction manual of the microanalyzer main unit to learn how to open the EPMA Main Menu.

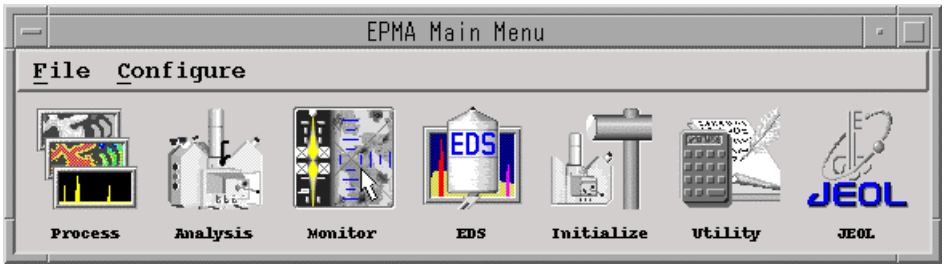


Fig. 1 EPMA Main Menu

2. Select **Map Analysis**.

The Map Analysis function window opens. Proceed to Sect. 4.2.

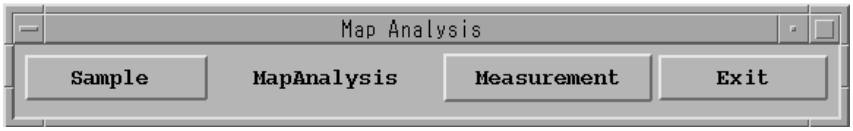


Fig. 1a Map Analysis function window

4.2 Setting Group and Sample Names

Measurement is carried out under the specified sample name, while the data processing and data backup take place after measurement for every sample. Up to 10,000 data can be stored for each sample name. The group name is the name containing a group of samples, and it will be convenient to name it after the property of a series of samples or the operator name for easier arrangement and filing.

1. Click on the **Sample** button of the Map Analysis function window.

The Select Sample window opens as shown in Fig. 2.

This window displays the list of the sample names entered previously, measurement dates and methods of analysis.

The methods of analysis are **Qlw**: qualitative analysis, **Qnt**: quantitative analysis, **Lin**: line analysis, **Map**: map analysis, and **Eds**: EDS analysis.

The amount of disk space (in KB) in use and the amount of free space at present are shown in the window.

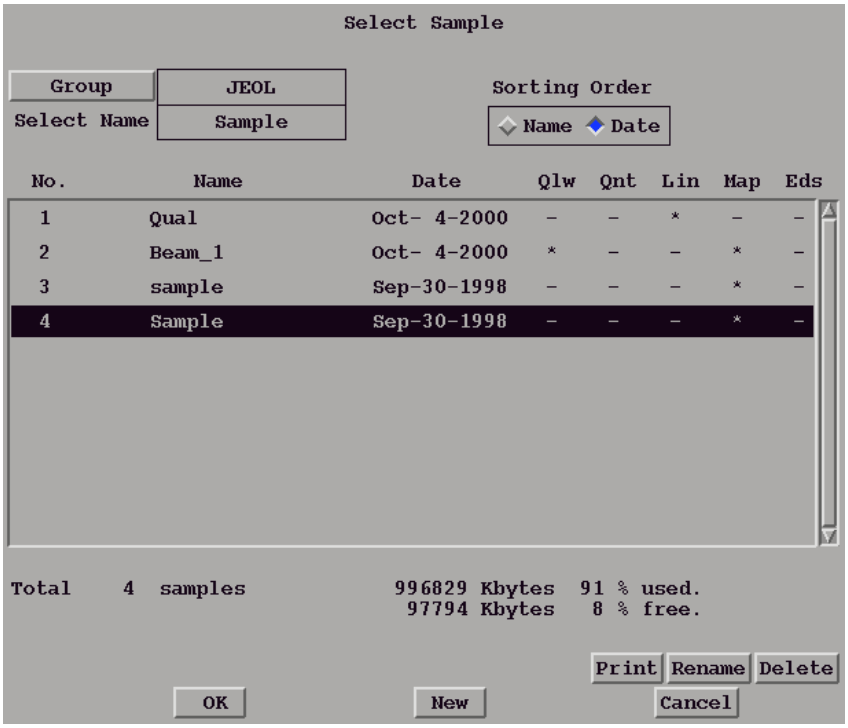


Fig. 2 Select Sample window

2. Confirm the Group name in the top left corner of the Select Sample window.

If you want to create a new group or select an existing group, click on the **Group** button to open the Select Group window; then select the desired group name, or after clicking on the **New** button, enter a new group name. The maximum length is 14 characters.

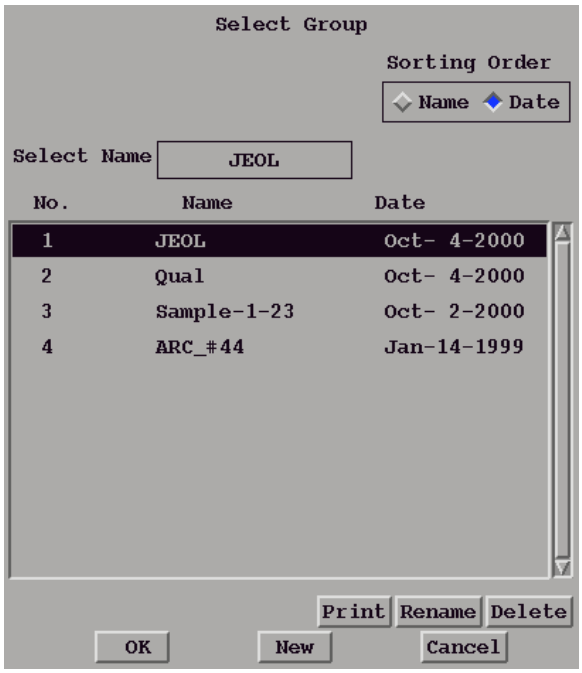


Fig. 3 Select Group window

3. To use a sample name entered previously, click on the desired sample name in the list of sample names, and then click on the **OK** button. To enter a new sample name, click on the **New** button and input the new sample name in the input box. The maximum length is 14 characters.

The remaining buttons in the Select Sample window and the Select Group window have the following functions.

Button	Function
Sorting Order	Clicking on the **Name** button of **Sorting Order** in each window rearranges the Sample names and Group names in alphabetical order. Clicking on the **Date** button of **Sorting Order** rearranges them in chronological order.
Print	Click on the **Print** button in each window to print the list of Group names and Sample names.
Rename	After clicking on the **Rename** button, you can enter new Group and Sample names.
Delete	To delete the Group and Sample names that have been just recorded, specify them in each window and click on the **Delete** button. To delete Group and Sample names that have been already used for measurement, select **Utility–File Utility** from the EPMA Main Menu.
OK	Click on the **OK** button in each window to finalize the Sample name and close the window.
New	After clicking on the **New** button, you can enter new Group names and Sample names. The maximum length is 14 characters. You can use alphanumerics, +, –, _, =, and . (the period cannot be the first character). When a new Group name is recorded, a Sample name also must be recorded using **New** at the same time.

Button	Function
Cancel	Click on the **Cancel** button in each window if you want to cancel the Sample name that was input and close the window.

4.3 Measurement

You set the measurement conditions that you want for the spectrometers.

- Click on the **Measurement** button of the Map Analysis function window.
  The Measurement menu opens.

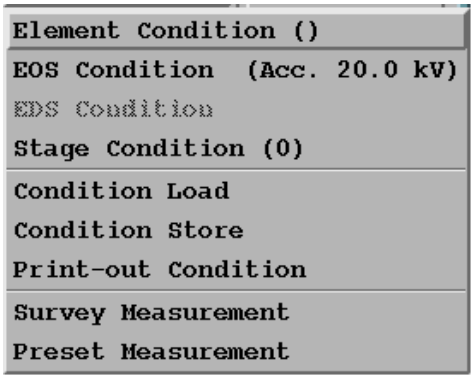


Fig. 4 Measurement menu for Map Analysis

4.3.1 Element Condition

◆ Select **Measurement–Element Condition** from the Map Analysis function window.

The Element Condition window opens as shown in Fig. 5.

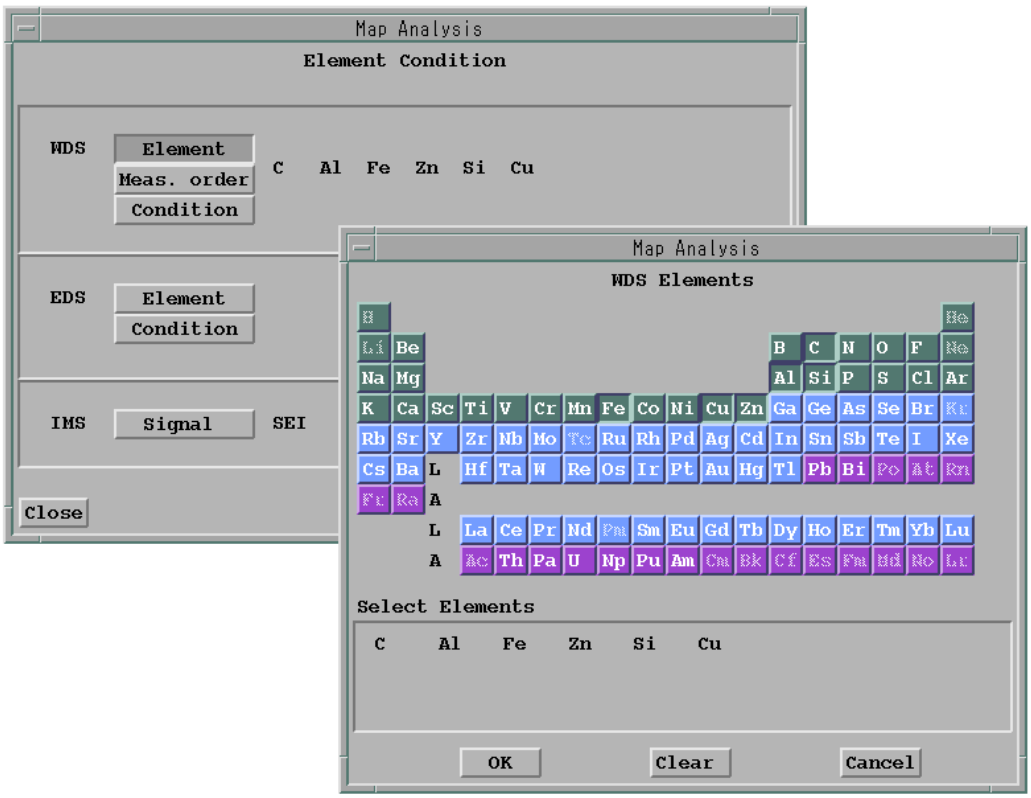


Fig. 5 Element Condition window and WDS Elements window

In this window, you specify elements to be measured for the WDS and the EDS (with JXA-8200 series), and input the spectrometer conditions for the elements to be measured. This can be done separately for the WDS and the EDS.

4.3.2 Specifying elements for WDS

You can specify up to 30 elements to be measured.
An element may be specified more than once.
If the same element is specified twice, for example, the program treats it as two elements.

◆ Select **WDS–Element** from the Element Condition window.

The WDS Elements window displaying the periodic table opens as shown in Fig. 5.

When you select elements from the periodic table, their symbols are displayed in the **Select Elements** box under the periodic table.

Selecting the same element again records it multiple times.

To delete a selected element, click on the label of the selected element to highlight it and click on **Clear**.

To delete selected multiple elements at the same time, drag the mouse to highlight the multiple elements and click on **Clear**.

4.3.3 Setting measurement order

You select a channel to be used and the measurement order for each element. If you make the selection so that measurements are not concentrated in any one specific channel, you can shorten the entire measurement time.

◆ Select **WDS–Meas. order** from the Element Condition window.
The Measurement order window opens.

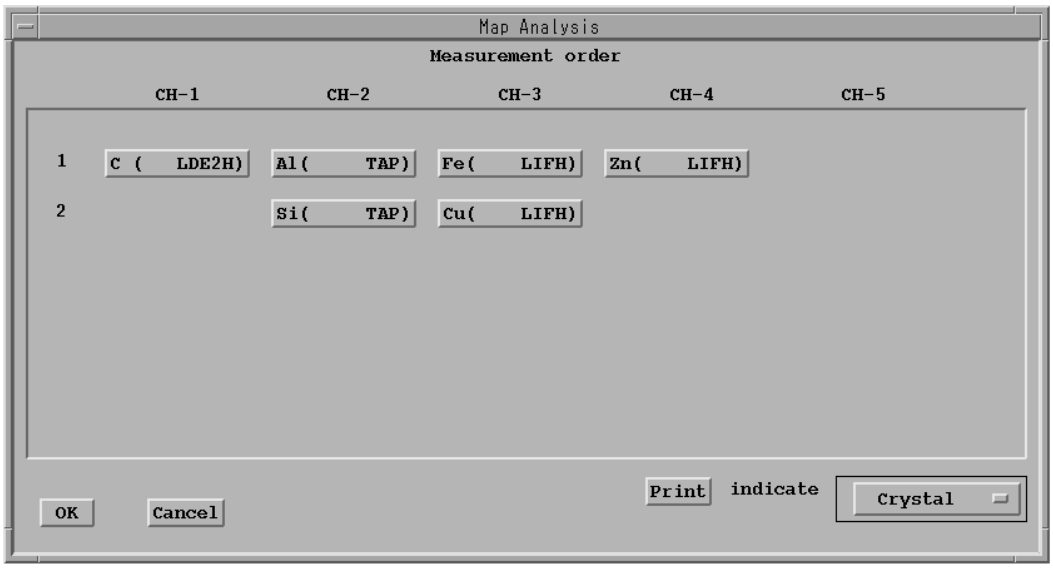


Fig. 6 Measurement order window

Drag an element label using the mouse to set the measurement order. Dragging up and down changes the measurement order and dragging left and right changes the channel number. If the measured X-rays are out of range of spectrometric analysis, the mouse cursor turns to a cross and you cannot select the channel for analyzing the X-rays.

Ordinarily, element name and X-ray analyzing crystal name are displayed in the element label. By selecting **Peak Pos.** for **Indicator** in the Measurement order window, it is possible to display wavelength instead of the crystal name. Doing this allows you to arrange elements in wavelength order. However, since you cannot change X-rays and analyzing crystals in this window, if you need to change them, use the WDS Element Condition window (described later) and set the measurement order there.

4.3.4 Setting measurement conditions

● **How to open the WDS Element Condition window**

◆ Select **WDS–Condition** from the Element Condition window.
The WDS Element Condition window opens as shown in Fig. 7. If elements are recorded, you can see the conditions for the elements to be measured.

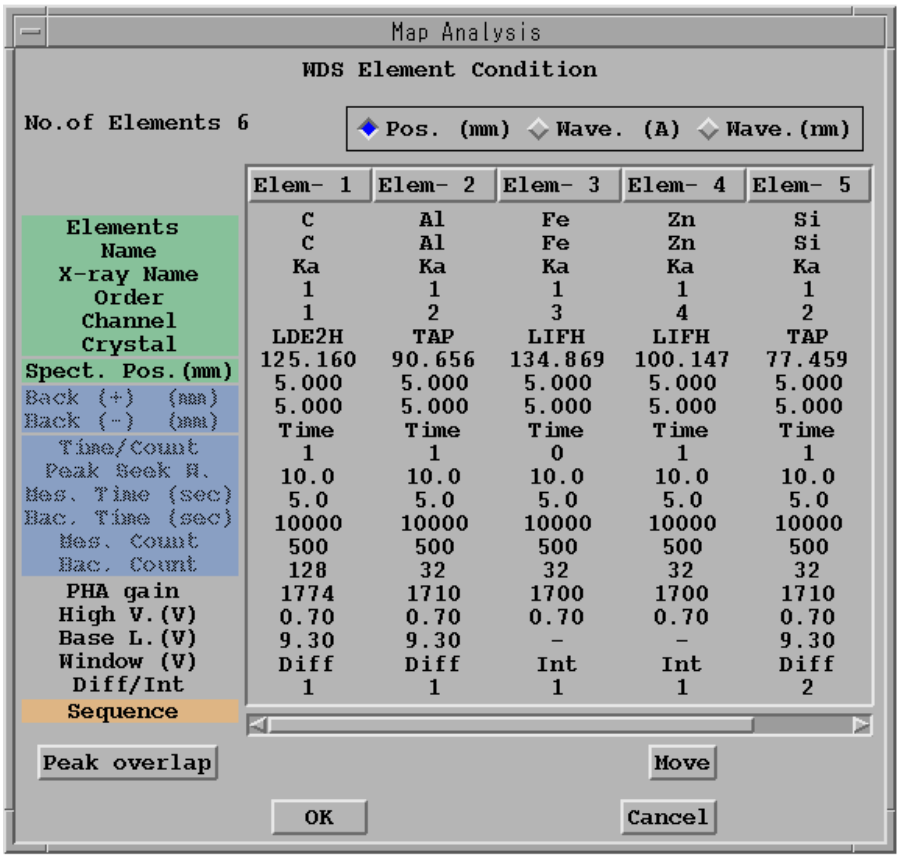


Fig. 7 WDS Element Condition window

- **Back (+) (mm)** to **Bac. Count**

  The eight items from **Back (+) (mm)** to **Bac. Count** are used only for quantitative analysis and standard sample analysis. They are not used for map analysis.

- **Spect. Pos. (mm)**

  The item **Spect. Pos. (mm)** shows the peak positions of characteristic X-rays. These values have been calibrated by executing the **Spectrometer Calibration** menu item in the **Initialize** menu, which is brought up by clicking on the **Initialize** icon in the EPMA Main Menu. The values may be slightly different from those of the actual peak positions, depending on the type of characteristic X-rays and samples. If so, measure the sample of interest and enter the actual peak position obtained.

  When the standard sample is measured, its peak position is automatically updated. Otherwise, to update the peak position, click on the **Peak Search** item in the **Monitor** menu in the EPMA Main Menu. Another way to update the peak position is, after executing the peak search, to click on the **Read** button in the WDS Element Data Table window of Fig. 8.

- **Sequence**

  The item **Sequence** shows the order of measurement, and it will be determined by using the procedure in Sect. 4.3.3.

How to change conditions for an element

◆ Click on the **Elem–n** button for the element concerned in the WDS Element Condition window.

The WDS Element Data Table window opens as shown in Fig. 8.

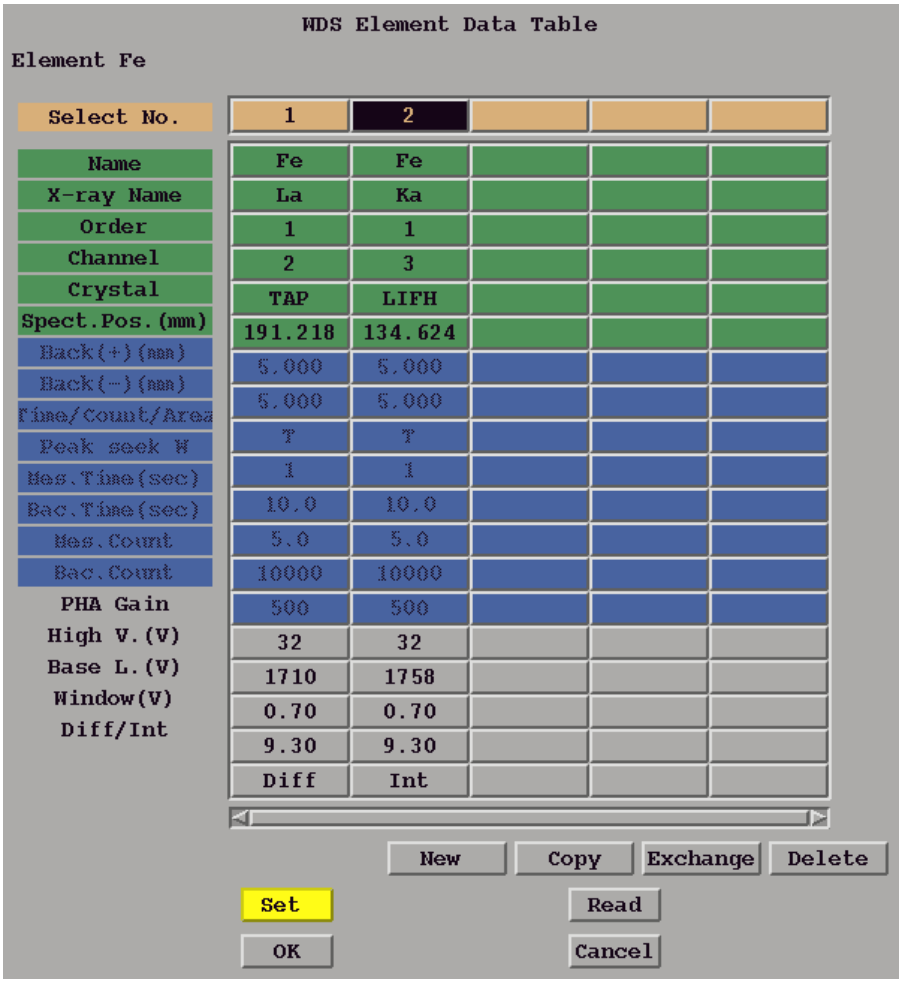


Fig. 8 WDS Element Data Table window

This window shows the conditions for the recorded elements. The number in **Select No.** that corresponds to the present element conditions is shown highlighted.

- To select another displayed measurement item, click on the corresponding **Select No.** button.
- To change the settings for the desired condition item, directly click on an item and type a new setting.
- The settings in the WDS Element Data Table window can be copied, exchanged in order, and deleted, by using the **Copy**, **Exchange**, and **Delete** buttons.
- Clicking on the **Set** button in the WDS Element Data Table sets the spectrometer to the conditions selected by the **Select No.** button.
- Clicking on the **Read** button reads the conditions presently in effect in the spectrometer into the WDS Element Data Table.

4.3.5 Setting JXA-8200 to EDS measurement conditions

The JXA-8200 series permits map analysis using the EDS concurrently with the WDS. Elements that are measured by the EDS can be recorded in the same way as for the WDS (refer to Sect. 4.3.2).

Measurement sequences are automatically set for the elements in the order they were recorded, each for eight elements: the first eight elements are measured in the first sequence, the ninth to sixteenth elements in the second sequence, and so on.

You can determine a ROI (Region of Interest), which is the energy measurement range, by specifying both **Start 1 (keV)** and **End 1 (keV)**, and the default values for map analysis are automatically displayed as shown in Fig. 9.

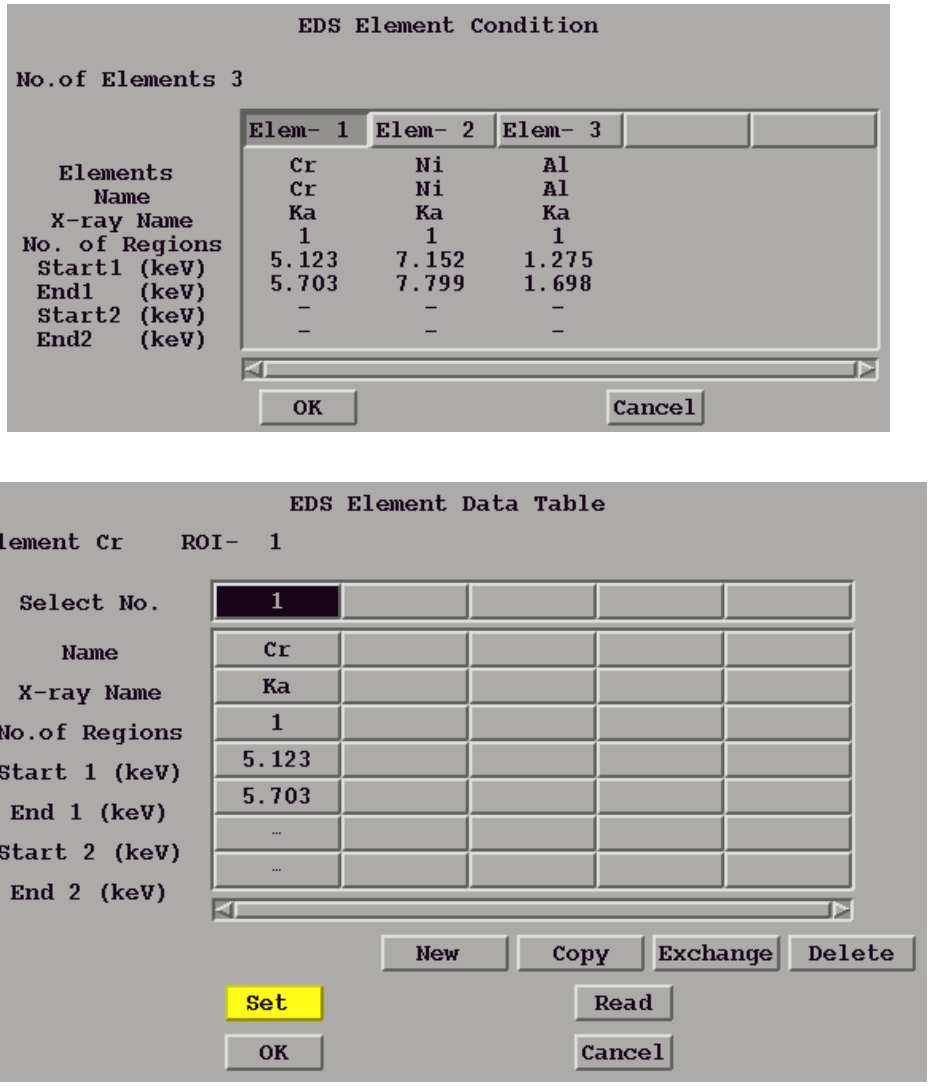


Fig. 9 EDS Element Condition window and EDS Element Data Table window

When specifying EDS measurement conditions, note the following.

- If two characteristic X-ray peak positions are so close that their ROIs may overlap each other, first record the element in the Element Condition window of Fig. 5, then click on the **Condition** button to open the EDS Element Condition window of Fig. 9. Here, the program automatically calculates their ROIs so that they will not overlap and displays them. Then, click on the **Elem-n** button and the EDS Element Data Table window in Fig. 9 will appear. The displayed ROI values in this window may not be identical to those in the EDS Element Condition window, but this is not a problem.

- To change the ROI, directly type numbers in **Start 1 (keV)** and **End 1 (keV)** in the EDS Element Data Table window. Alternatively, display an EDS spectrum and set up a ROI on the spectrum, then click on the **Read** button in the EDS Element Data Table window. At this time, the **ROI** number in the EDS Element Data Table window must be the same as the **Element** number (**Elem-n**) shown in the EDS Element Condition window.

  If you want to restore the default after you have changed the values of **Start 1 (keV)** and **End 1 (keV)**, display an X-ray name listing by clicking on the **X-ray Name** button in the EDS Element Data Table window. Here, click on the X-ray name of interest; then the default values will be displayed at **Start 1 (keV)** and **End 1 (keV)**.

- Usually, you set a ROI at one point for each element. However, you can set it at two points that are separated (e.g., Kα line and Lα line). To do so, set **No. of Regions** in the EDS Element Data Table window to **2** and enter values at **Start 2 (keV)** and **End 2 (keV)**. Then click on the **Set** button. The presently selected ROIs (shown at **Select No.**) will be set up in the EDS screen.

4.3.6 Measuring image signals

1. Click on the **IMS–Signal** button in the Element Condition window of Fig. 5.
The Image Signal window opens as shown in Fig. 10.

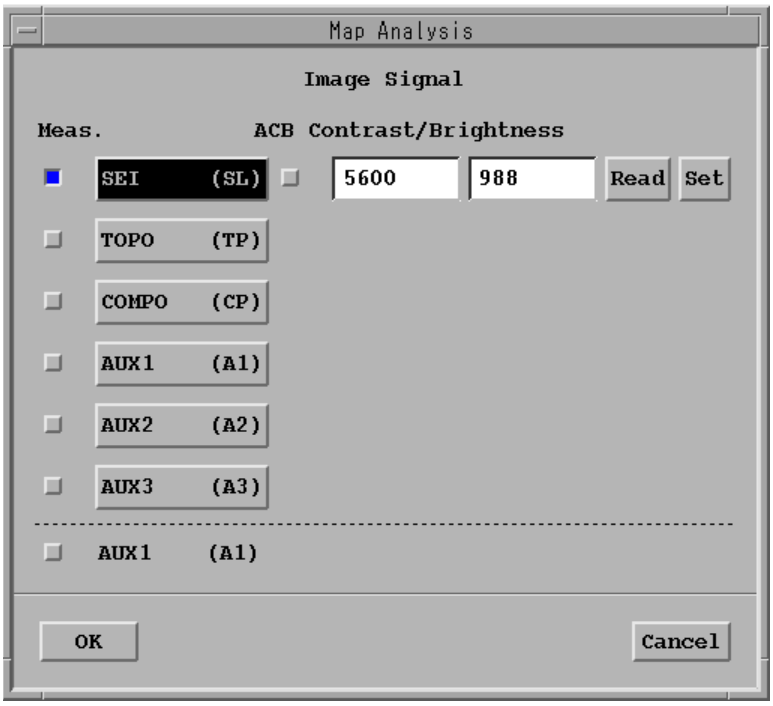


Fig. 10 Image Signal window

2. Click on the desired image-signal measurement (**Meas.**) buttons.
The selected image signals are measured. In the example of Fig. 10, **SEI** is selected.

3. Click on any image signal name button, and then you can use the **Read** and **Set** buttons for **ACB Contrast/Brightness**.
If you select **ACB Contrast/Brightness**, it will be set before measurement.

If you specify multiple image signals, for example, the **SEI** and **TOPO** signals, then the **SEI** signal will be acquired in the first sequence and the **TOPO** signal in the second sequence.

The signal shown under the dashed line in the Image Signal window (**COMPO** signal) is acquired if the optional Second ISD is installed. This selection permits you to acquire two image signals in the first sequence.

4.4 EOS Condition

The EOS Condition window allows you to set the conditions of the electron optical system (EOS). Clicking on the **Read** button reads the present EOS conditions and displays them on the EOS Condition window in which you can input and alter items such as Probe Scan. When **Scan Type–Beam** is selected, **Magnification**, **Probe Scan** and **Scan Mode** are controlled automatically.

◆ Select **Measurement–EOS Condition** from the Map Analysis function window.

The EOS Condition window opens as shown in Fig. 11.

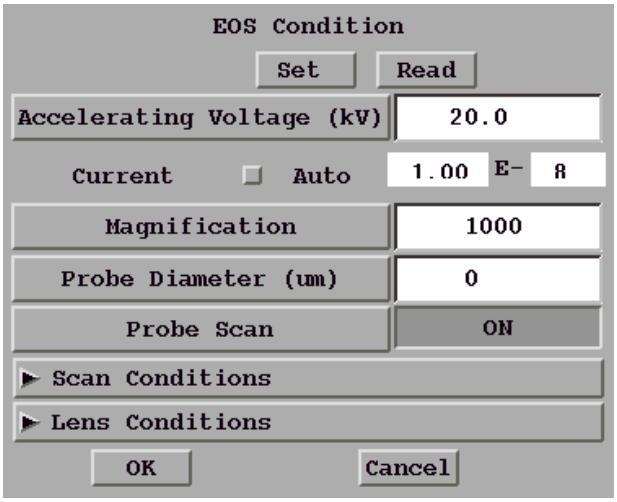


Fig. 11 EOS Condition window

The EOS Condition window has the following objects.

Object	Function
Set	Sets the EOS to the measurement conditions presently displayed.
Read	Reads the present EOS conditions, and displays them in the EOS Condition window.
Accelerating Voltage	Sets the accelerating voltage (in kV).
Current	Displays the beam current. Click on the **Auto** button to specify the current; the specified current will be set automatically before measuring, and the automatic current-setting mode will be applied.
Magnification	Sets the scan magnification for **Scan Type–Stage**. This function is in effect only when the **Probe Scan** is **ON**. When you perform measurement at a very low magnification, the WDS elements will be out of the X-ray collecting conditions, and you cannot obtain good results. When **Scan Type–Beam** is selected, specify a magnification using the Area Input window.
Probe Diameter	Sets the probe diameter (in μm) for measurement. This function is in effect only when the **Probe Scan** is **OFF**.
Probe Scan	Turns the probe scan on or off for measurement.

Object	Function
Scan Conditions	Clicking on the arrowhead of this button opens a pop-up menu, in which you can set the four items below. The items **Scan Mode**, **Scan Speed** and **Auto Focus** are in effect only when the **Probe Scan** is **ON.** However, **Stabilizer** is in effect, even if the **Probe Scan** is **OFF**.
Scan Mode	Specifies the scan mode for measurement. The choices are **Picture**, **Bup**, **Line**, **Spot** and **Area**.
Scan Speed	Selects the scan speed for measurement . The choices are S1 to S12. The larger the number is, the slower the speed is.
Auto Focus	Select automatic focusing (**Auto Focus**) or manual focusing (**Manual Focus**) before measurement.
Stabilizer	Specify whether to use the beam stabilizer (select from **CL & Tilt**, **CL**, and **Tilt**) or not (**Off**).
Lens Conditions	Clicking on the arrowhead of this button opens a pop-up menu for the following two items.
Condenser Lens	Sets the Condenser Lens to Coarse or Fine for measurement.
Object Lens	Sets the value of the Objective Lens for measurement.
OK	Finalizes the input EOS conditions, and closes the EOS Condition window.
Cancel	Cancels the input EOS conditions, and closes the EOS Condition window.

4.5 EDS Condition for JXA-8200

With the JXA-8200 Series EPMA, when you specify the EDS as the spectrometer, you need to set the measurement conditions for the EDS.

◆ Select **Measurement–EDS Condition** from the Map Analysis function window.

The EDS Condition window opens as shown in Fig. 12.

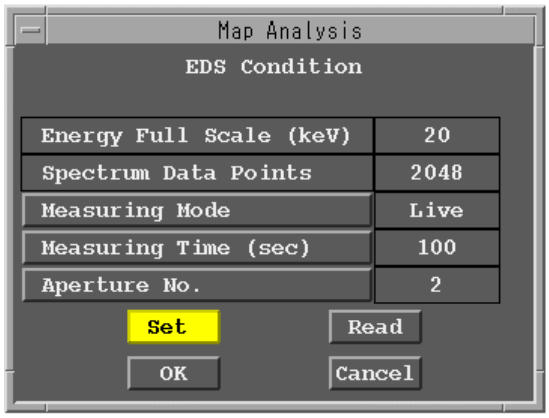


Fig. 12 EDS Condition window

The following items are for controlling the EDS detector.

Button	Function
Energy Full Scale	Is set to 20 kV.
Spectrum Data Points	Is set to 2 K channels.
Measuring Mode	Is not used for the Map Analysis.
Measuring Time	Is not used for the Map Analysis.
Aperture No.	Selects the aperture number from 0 to 5. The value 0 is for open. The larger the number, the smaller the aperture diameter. The value 6 is for closed, and so it cannot be used for measurement.

To select an aperture number, first set the beam current, and then select the appropriate aperture number so that the Dead Time becomes 20 to 30%, while actually collecting EDS spectra.
Select **Live** for **Measuring Mode** and several tens of seconds for **Measuring Time**.
Clicking on the **Set** button sets the EDS to the EDS spectrum-collection conditions that are presently displayed in the EDS Condition window.
Clicking on the **Read** button reads the EDS spectrum-collection conditions that are presently set and display them in the EDS Condition window.
Note that the **Set** and **Read** buttons can be used only when the EDS Home Window is on the screen.

4.6 Stage Condition

The Stage Condition window allows you to specify analysis points before measurement. If the analysis points have been recorded, they are shown when this window opens.

◆ Select **Measurement–Stage Condition** from the Map Analysis function window.

The Stage Condition window opens as shown in Fig. 13.

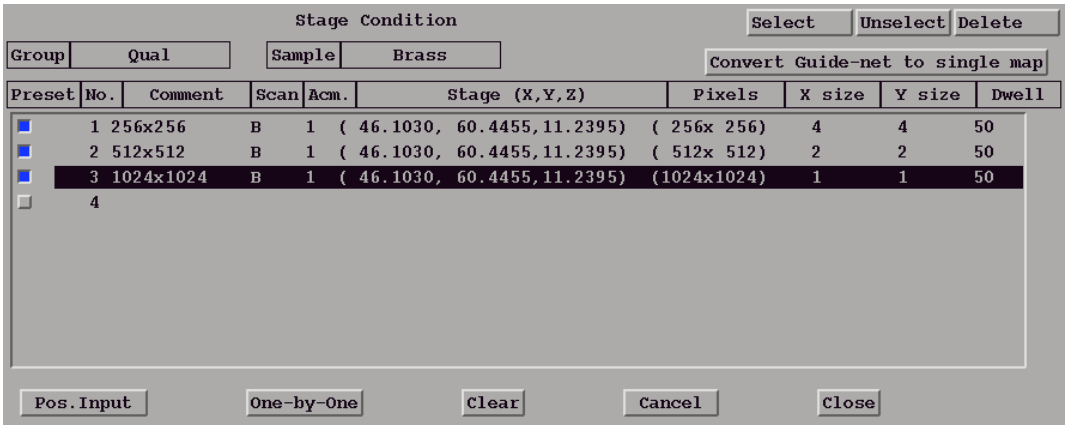


Fig. 13 Stage Condition window

This window allows you to enter and change analysis points using the **Pos. Input** button, or to delete them using the **Clear** button. The window also makes possible executing one-by-one measurement by using the **One-by-One** button.

4.6.1 Specifying analysis positions

You can specify the desired analysis positions using the Area Input/Analysis area Working window.

1. Click on any analysis point number in the Stage Condition window.

The line for that point number will be highlighted.

2. Click on the **Pos. Input** button of the Stage Condition window.

The Area Input/Analysis area Working window opens as shown in Fig. 14.

In this window, specify the analysis position for that point by entering information necessary for the items described in the following pages. Clicking on the arrowhead buttons ▲,▼ on the right side of the Area Input window allows you to move the line of the analysis point number shown in Fig. 13 up or down by one.

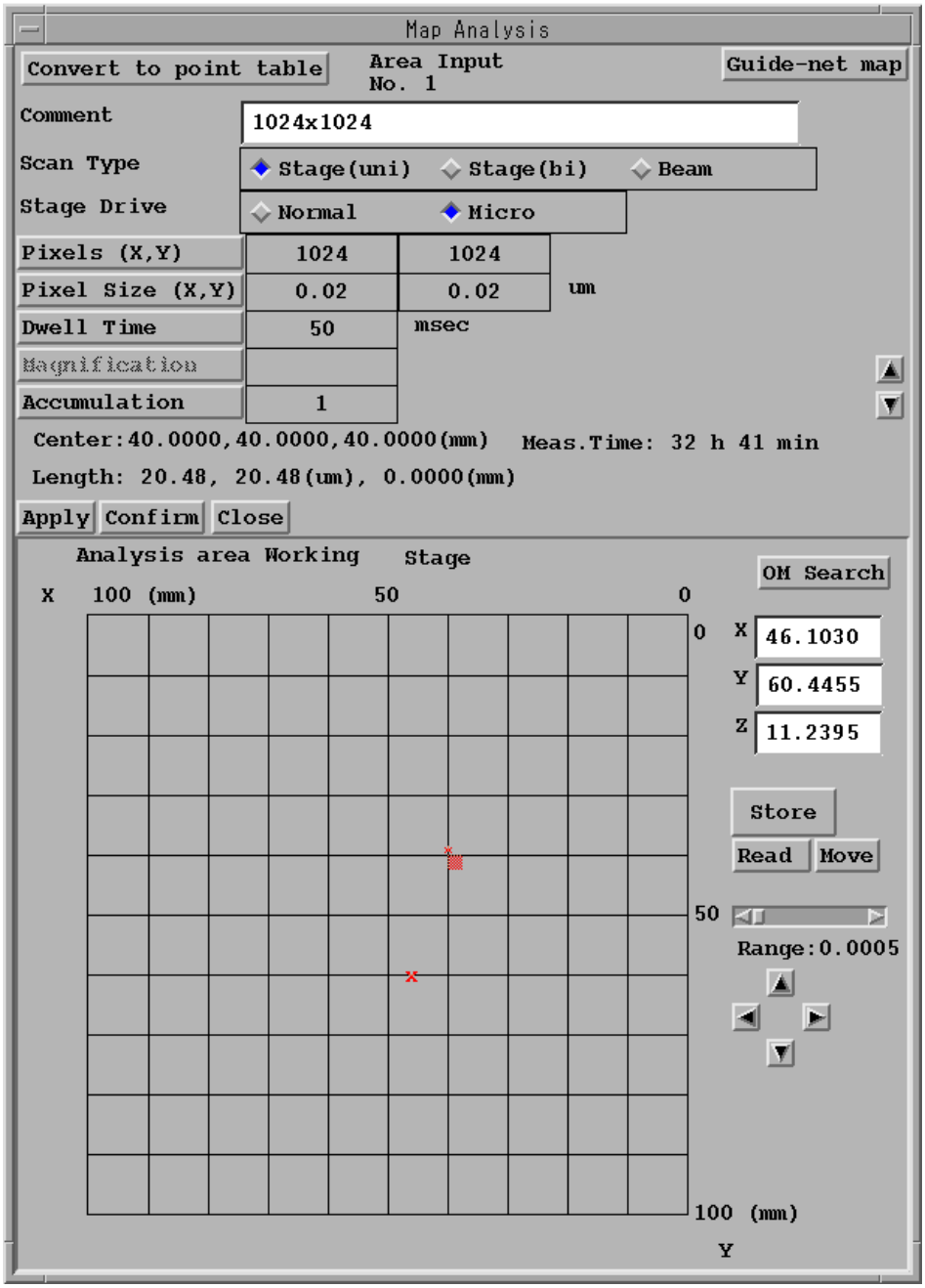


Fig. 14 Area Input/Analysis area Working window

Area Input/Analysis area Working window

Comment

When the pointer is positioned in the input box, you can enter a comment of up to 40 characters.

Scan Type

You select stage scan or beam scan as **Scan Type**. In the stage scan, two modes are available: **Stage (uni)** or **Stage (bi)**.

- **Stage (uni)**

  Stage (uni) stands for unidirectional scan (movement) of the stage during measurement as shown in Fig. 15.

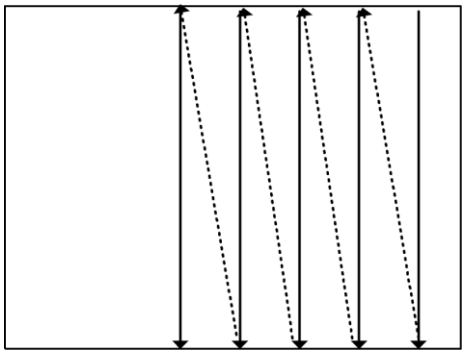


Fig. 15 Stage movement in Stage (uni) mode

This mode is used for the analysis of small area. The interruption of measurement during backward stage movement along the Y-axis will result in a longer measurement time than for **Stage (bi)**, but the influences of stage backlash are reduced.

- **Stage (bi)**

  Stage (bi) stands for bidirectional movement of the stage during measurement as shown in Fig. 16.

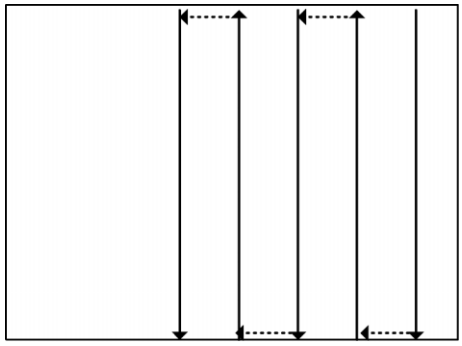


Fig. 16 Stage movement in Stage (bi) mode

In this mode, measurement is not interrupted when the stage moves back along the Y-axis. This mode is used for the analysis of a large area, which will not be affected by stage backlash. A shorter measurement time is an advantage.

- **Beam**

  You can select the beam scan mode when you want to carry out map analysis using the beam scan rather than the stage scan. How to enter an analysis position is explained later.

Stage Drive

When you use the stage scan mode, select the type of the stage driver to be used from the **Normal** step (0.5 μm minimum) and the **Micro** step (0.02 μm minimum).

Pixels (X, Y)

This function allows you to specify the numbers of pixels for the X- and Y-axes. The acceptable range is from 10 to 1024.

Pixel Size (X, Y)

In the stage scan mode, you can specify pixel sizes in μm for the X- and Y- axes. The acceptable range is from 0.5 μm to 1000 μm (minimum of 0.02 μm possible if **Stage Drive** is set to the **Micro** step).

In the beam scan mode, pixel sizes are automatically determined from the magnification and the number of pixels; no values can be entered here.

Dwell Time

This function allows you to specify a measurement time per pixel (in msec). The acceptable range is between 1 msec and 100 sec. However, if the scan speed, which is determined by the pixel size and measurement time, exceeds 5 mm/s, a warning message appears, and you cannot execute the measurement.

Accumulation

This function allows you to specify the number of measurements to be repeated at a specified position. The number can be up to 100 as a maximum. The ordinary setting is 1. If you specify more than 1 for **Accumulation**, the repeated measurements will be executed again after every entire area scan is finished.

Meas. Time (Measurement Time)

This indication allows you to see an approximate measurement time calculated based on the above measurement conditions. Some measurements require more than the indicated time.

Analysis area Working

This two-dimensional display area is used to enter analysis points. Operation in this area differs depending on whether **Scan Type** was set to **Stage** (stage scan) or **Beam** (beam scan) as described earlier.

4.6.2 Specifying analysis area in the stage-scan mode

The two-dimensional display area, shown under **Analysis area Working**, represents the movement area of the stage. The display area contains a rectangular frame as a map-analysis area, and shows the letter **X**. At the right end of the display area are shown the coordinates of the position of the **X**.

A map analysis area is shown in Fig. 17. The analysis area is a rectangle, with point A indicating the measurement start point, C the measurement end point, and O the center of the measurement area.

In the bidirectional scan mode, **Stage (bi)**, point D can be the measurement end point. However, the following discussion assumes point C as the end point.

Each side of the measurement area is determined as (the number of pixels – 1) × (pixel size).

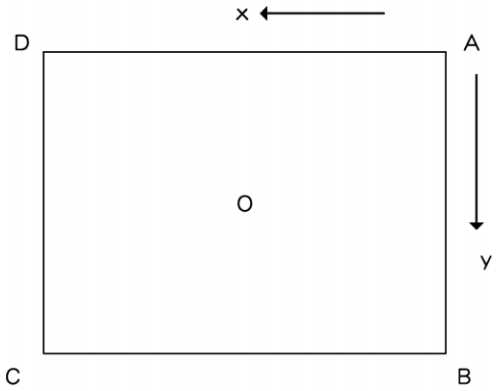


Fig. 17 Specifying map analysis area

■ How to specify an analysis area

1. Select the standard point for a measurement area.

You can specify a measurement area by using one of the three methods given below. Select one that best suits the shape of the sample and other factors.

- Relative to the center point O of the measurement area.
- Relative to the measurement start point A.
- Relative to the measurement end point C.

2. Find an analysis area using the secondary electron image, backscattered electron image, OM image or other images. Then enter the coordinates of the specimen stage corresponding to the standard point selected above in the **X**, **Y**, and **Z** input boxes.

There are four entry methods:

- Typing the coordinates in the X, Y, and Z input boxes using the keyboard.
- Positioning the stage by operating the Joystick Controller of the EPMA basic unit and then clicking on the **Read** button in the **Analysis area Working** display.
- Positioning the pointer on any location in the **Analysis area Working** display and clicking the mouse button; then moving the stage by clicking on the **Move** button, and finally clicking on the **Read** button.

- Finely adjusting the stage position by clicking on four arrow buttons (▲,▼, ◀,▶) at the lower right part of the **Analysis area Working** display, then clicking on the **Read** button.

  You can change the step size given by the arrow buttons using the scroll bar above the arrow buttons.

3. Click on the **Store** button in the **Analysis area Working** display.

The **Store** menu opens as shown in Fig. 18.

Fig. 18 Store menu

4. Select **to Center**, **to Start**, or **to End** from the **Store** menu to finalize the map analysis area.

- **to Center**

  The X, Y, and Z values are specified as the center position (O in Fig. 17) of the map analysis area.

- **to Start**

  The X, Y, and Z values are specified as the start position (A in Fig. 17) of the map analysis area.

- **to End**

  The X, Y, and Z values are specified as the end position (C in Fig. 17) of the map analysis area.

In response, the coordinates of the analysis center point shown as **O** in Fig. 17 are calculated and displayed in **Center** in the Area Input window of Fig. 14.

5. Store the sample surface heights at the four corners of the analysis area for the map analysis by following these steps.

a. Click on the **Confirm** button.

The stage moves to the point A shown in Fig. 17.

b. Move the Z-axis using the Joystick Controller of the EPMA basic unit, and focus the point A through the optical microscope. Then press the **Store** button on the Joystick Controller.

c. Since the stage automatically moves, in sequence, to the points B, C, and D shown in Fig. 17, repeat Step b above at each of these points.

Since the height values for points A to D are given through the above steps, the plane of the analysis area is determined. Consequently, correction for the Z-direction will be made during acquisition of map analysis data.

6. Click on the **Apply** button to finalize the conditions.

These conditions will be displayed on the highlighted line in the Stage Condition window of Fig. 13.

4.6.3 Specifying analysis position in the beam-scan mode

If the basic unit is equipped with the Probe Position Controller (standard on the JXA-8100/8200), you can carry out map-analysis measurement by scanning the electron beam without moving the stage. This analysis method is effective for analyzing very small areas of the order of a few micrometers to several tens of micrometers.

1. Select **Beam** for **Scan Type** in the Area Input/Analysis window of Fig. 14.
2. Type numbers up to 1024 in the **Pixels (X,Y)** input boxes.
   The scan area of the electron beam equals the area that the Beam Monitor window can acquire and display (refer to Fig.19 below).

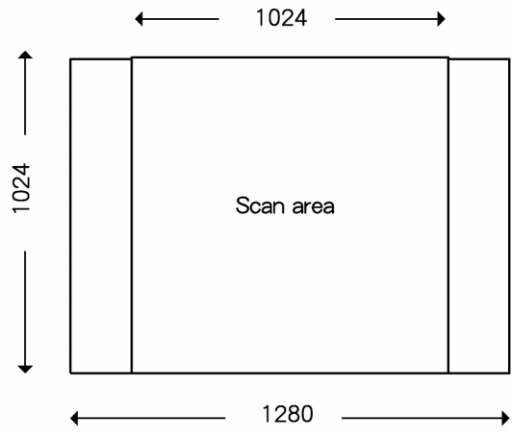


Fig. 19 Scan area of the electron beam

If the number of pixels is smaller than the above value, the **Pixel Size (X,Y)** values will be calculated automatically, and the scan area will be displayed in the **Analysis area Working** display area, as shown in Fig. 20. In the example of Fig. 20, the number of pixels is 200 × 200 and Pixel Size is 4, hence an area of 800 × 800 is displayed as the measurement area. The value of Pixel Size is automatically selected from the maximum value of 1, 2, 4, and 8 which, when multiplied by the Pixel value, results in a value not exceeding 1024. However, in an ordinary measurement, set it to a power of 2 such as 128, 256, 512, or 1024 to make the process after measurement easier.

3. To determine a measurement area, first adjust the position of the stage using the Joystick Controller of the EPMA basic unit; next set the EOS to a suitable magnification; and then use the **Read** and **Store** buttons.
   Alternatively, click on the **Move** button in the Area Input/Analysis area Working window; set the stage to the stage coordinates shown at **Center**; set the magnification to the value shown at **Magnification**; then click on the **Read** button to read in the analysis position and the magnification.
4. If necessary, click on the **Confirm** button and then make fine adjustments to the analysis position.
5. Click on the **Apply** button to finalize the analysis position.

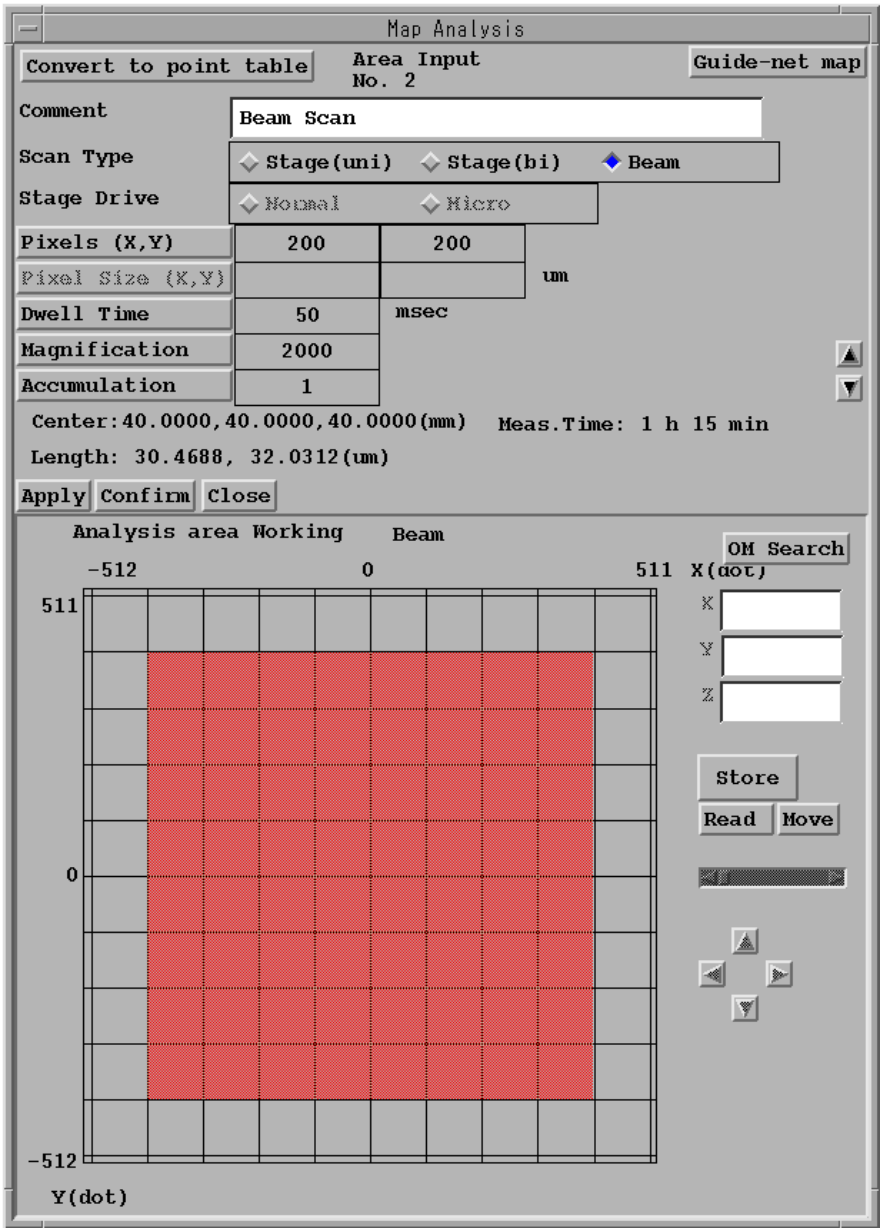


Fig. 20 Area Input/Analysis Area Working window with Beam selected for Scan Type

4.6.4 Conversion to a point table

When performing point analysis, such as quantitative analysis or qualitative analysis, at equal intervals on a map (grid pattern), you can easily determine the coordinates by utilizing the measurement point entry for map analysis. Alternatively, you can do the same by utilizing the coordinates entry window for point analysis.

1. First, specify the measurement area according to the foregoing procedure, and then click on the **Convert to point table** button in the Area Input/Analysis Area Working window (see Fig. 14).

   The Convert to point table window opens as shown in Fig. 21.

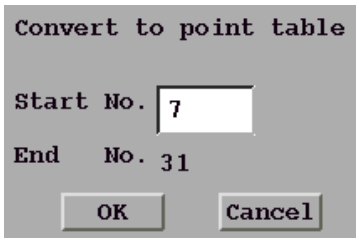


Fig. 21 Convert to point table window

2. Next, enter the desired start number in the **Start No.** Input box; then click on the **OK** button.

Measurement points arranged in a grid pattern will be recorded sequentially in the point table.

✍ To perform measurement, select **Measurement–Survey Measurement** from the Quantitative Analysis function window.

In order to display the quantitative analysis data obtained at the grid points, using the map analysis program, it is necessary to convert the data format by using the Binary/ASCII conversion program. Select **Utility–Ascii Conversion** from the EPMA Main Menu.

4.6.5 Measurement in the one-by-one mode

In the one-by-one mode, only one point is analyzed irrespective of the setting of the measurement.

◆ To execute measurement in this mode, click on the number of the analysis point of interest, highlighting the corresponding line in the Stage Condition window of Fig. 13, and then click on the **One-by-One** button.

4.7 Guide-Net Map

Guide-net map is a technique that allows you to measure automatically contiguous areas and display the results of measurement at the same time. This is used to measure uneven areas in height, or, to measure larger areas than 1,024 × 1,024 pixels.

4.7.1 How to perform guide-net map measurement

The guide-net map measurement method is shown in Fig. 22 and Fig. 23

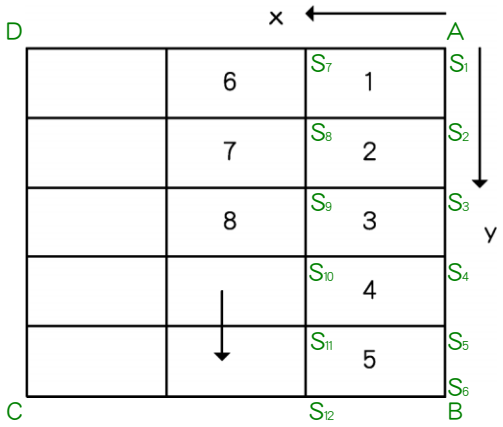


Fig. 22 Schematic diagram for stage-scan mode

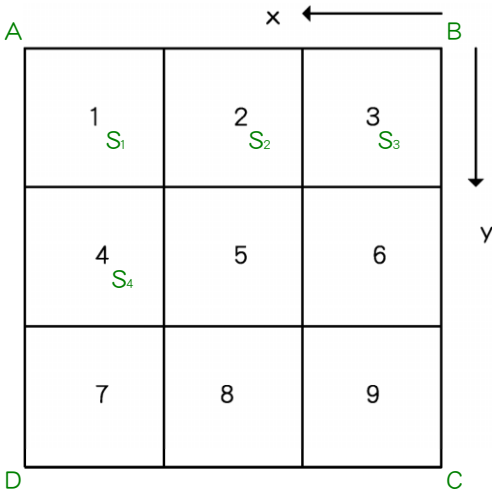


Fig. 23 Schematic diagram for beam-scan mode

The guide-net map method allows you to measure contiguous maps in an orderly sequence. Fig. 22 shows an example in the stage scan mode, and Fig. 23 shows an example in the beam scan mode, which shows analysis areas of a 3 × 3 grid of maps. Each area with a number corresponds to a conventional map.

In the stage-scan mode, scan is executed along the Y-axis of the stage, and the guide-net gives priority to the maps along the Y-axis during measurement.

On the other hand, in the beam scan mode, scan is executed along the X-axis of the beam, and the guide-net gives priority to the maps along the X-axis during measurement.

1. Prepare a guide-net map.

a. Enter map-analysis conditions for one of the guide-net maps in the Area Input/Analysis area Working window (refer to Fig. 14) in the same way as in the ordinary map analysis.

✍ At this time, enter map analysis conditions for map 1 of Fig. 22 or Fig. 23.

2. Specify conditions for guide-net maps.

a. Click on the Guide-net map button in the Area Input/Analysis area Working window.

The Guide-net map conditions entry window opens as shown in Fig. 24.

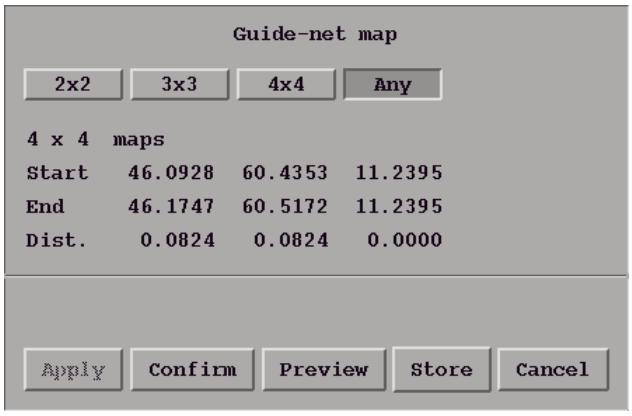


Fig. 24 Guide-net map conditions entry window

b. Click on any of the **2** × **2**, **3** × **3**, **4** × **4** and **Any** buttons.

In this window, you can specify any number of maps for the X- and Y-axes. The maximum number of maps is 10,000. Fig. 25 shows an example of the Any window.

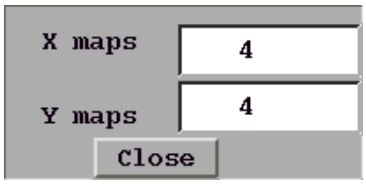


Fig. 25 Any window

3. Confirm the analysis area of the guide-net maps as well as the Z-axis.

You can confirm or change the analysis area of the guide-net maps using the **Confirm**, **Preview** and **Store** buttons (refer to Fig. 24).

Button	Function
Confirm	Confirms the Z-axis coordinates of each map. The order of maps for confirmation is S1, S2, S3, S4 … in Fig. 22 and Fig. 23.
Preview	Moves the stage to the four corners of all the scan area of the guide-net maps in a sequence like A, B, C and D in Fig. 22 and Fig. 23, and waits for you to press the **Store** button of the Joystick Controller. After the final corner, the stage moves to the center of all the guide-net maps.

Button	Function
Store	Allows you to change the scan area of all the guide-net maps. Clicking on the **Store** button opens the **Store** menu that has **To Center**, **To Start**, and **To End**. Then selecting any of the three items sets the center, start, or end position of all the guide-net maps to the present position of the stage and recalculates the coordinate position of each map for storing them.

4. Execute guide-net map analysis.

a. Click on the Apply button in the Any window (refer to Fig. 24).

The conditions for each of all the guide-net maps will be finalized and stored in a file for analysis conditions.

b. Select **Measurement–Preset Measurement** from the Map Analysis function window.

Each map will be measured. The measurement method is the same as in ordinary map analysis.

4.7.2 Displaying guide-net maps

Guide-net maps are displayed by using the Select Sample window in the same way as ordinary map analysis.

1. Select **Process** from the EPMA Main Menu.

The **Process** menu opens.

2. Select **Map Analysis** from the **Process** menu.

The **Map Analysis** menu opens.

3. Select **Sample** from the **Map Analysis** menu.

The Select Sample window opens as shown in Fig. 26.

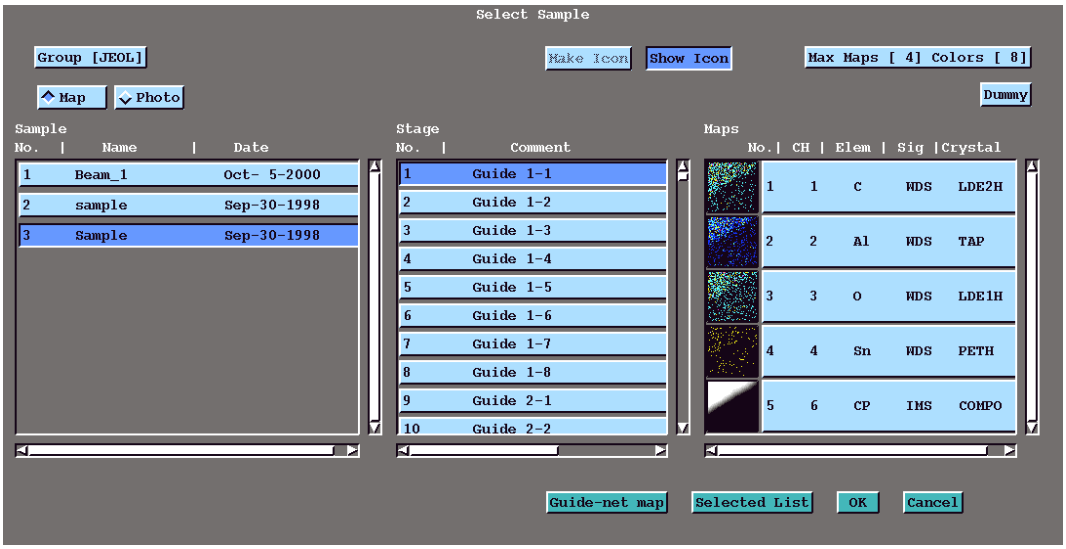


Fig. 26 Select Sample window

4. Click on the **Guide-net map** button in the Select Sample window.
The Guide-net map conditions display window opens as shown in Fig. 27.

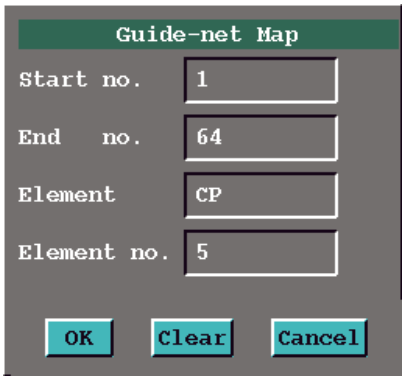


Fig. 27 Guide-net map conditions display window

5. Enter values in the **Start no.**, **End no.**, and **Element** input boxes.

If the same elements have been measured at the same time, enter a number allocated to the desired element in place of element name into the **Element no.** input box. Numbers are allocated in sequence to the elements to be measured.

6. Click on the **OK** button in the Guide-net map conditions display window (refer to Fig. 27).
A guide-net map image will be displayed as shown in Fig. 28. The color bar and micron bar are displayed only in the last map. This is different from an ordinary map that always has them. The level classification is the same for all the maps of the guide-net. Therefore, **Apply to all maps** is selected in the Level Modify window as shown in Fig. 29.

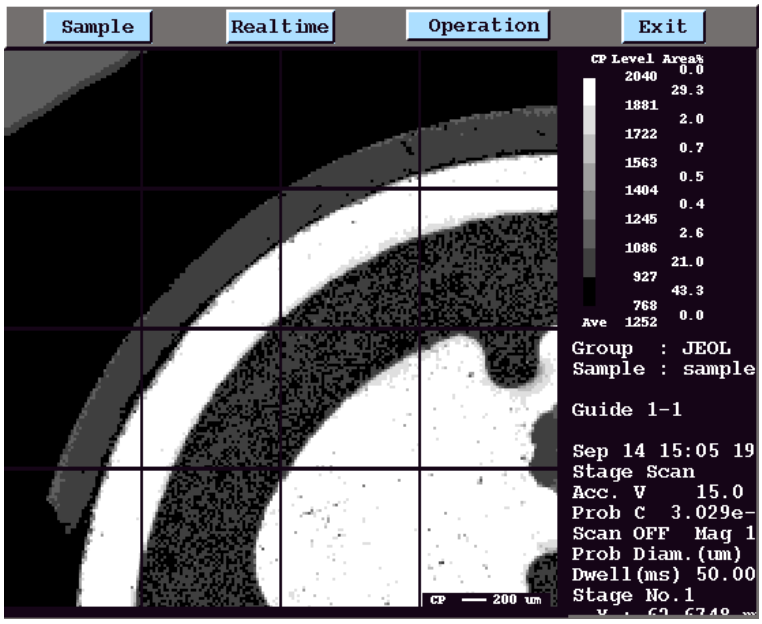


Fig. 28 Example of a guide-net map image

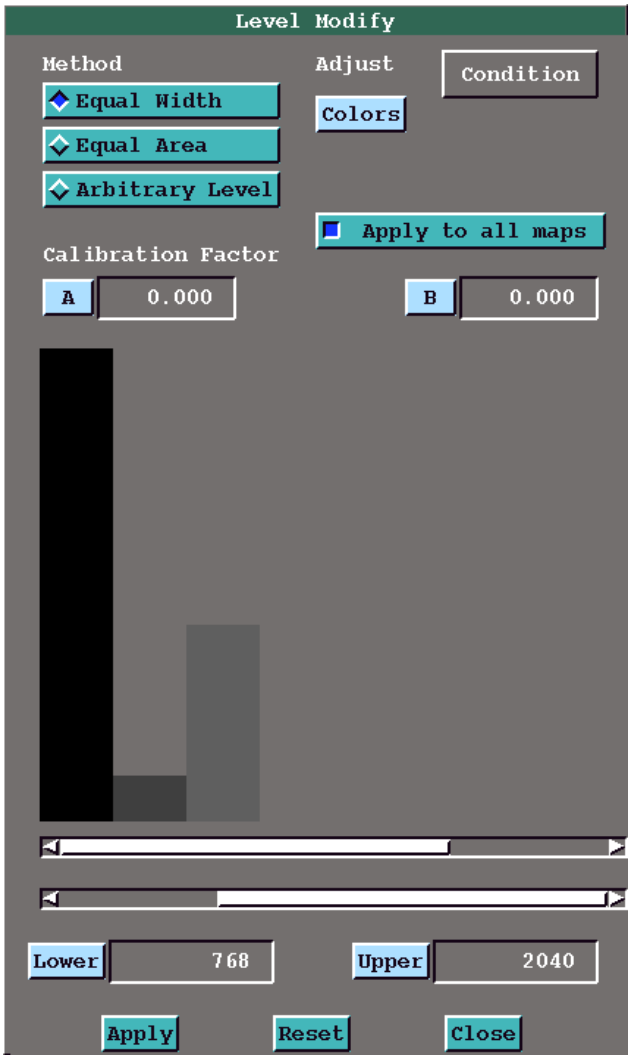


Fig. 29 Guide-net map Level Modify window

4.7.3 Converting guide-net maps to single map

One set of guide-net maps has a large number of maps in total. However, up to 4 × 4 maps can be displayed at the same time. As a result of the system of guide-net maps, maps with more than 1,024 × 1,024 pixels can be collected. In such a case, if you want to see all the maps at the same time, converting them to a single map, then perform the following procedure.

1. After measuring the guide-net maps, click on the **Convert Guide-net to single map** button in the Stage Condition window (refer to Fig. 13).
   The Convert Guide-net to single map window opens as shown in Fig. 30.
   The input boxes of this window show the default values according to the measurement conditions.

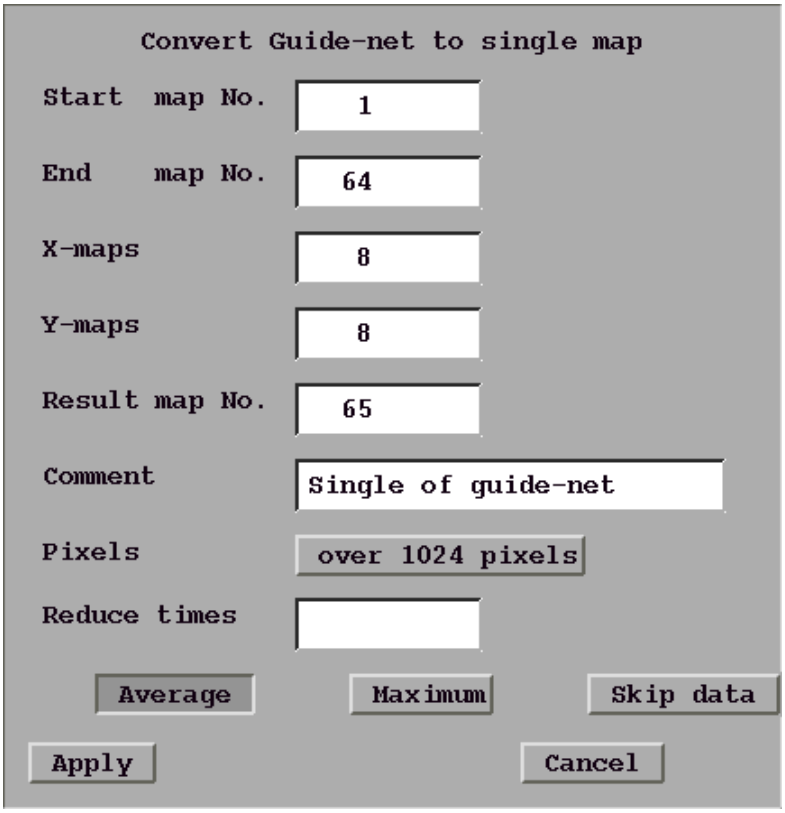


Fig. 30 Convert Guide-net to single map window

2. Type the **Start map No., End map No., X-maps, Y-maps, Result map No. and Comment** input boxes.
3. Click on the **Apply** button.
   The system reads all the guide-net maps and converts them to a single map, and as a result a file of the map with a specified new number will be created.

If the total number of pixels in one set of guide-net maps exceeds 1,024, you can click on the **over 1024 pixels** button. If this button is not clicked on, the number of pixels of the maps will be reduced to 1,024 or less automatically. The reduced scale will be made by a simple integral division, and the scale will be displayed in the **Reduce times** box. For example, if the number of pixels is reduced to 1/2, 2 is displayed in the **Reduce times** box; if the number of pixels is reduced to 1/4, 4 is displayed in the box.

If you want to reduce an image, click on one of the following three buttons.

Button	Function
Average	Adopts the averasge of pixel values as the pixel value for the reduced map.
Maximum	Adopts the maximum pixel value of the pixel values in the reduction range as the pixel value for the reduced map.
Skip data	Picks up the pixel value for each reduction scale, neglecting intermediate pixel values.

4.8 Condition Load

The **Condition Load** function enables you to call up conditions stored for map analysis. The conditions are **Element Condition**, **EOS Condition**, and **EDS Condition** (only for JXA-8200).

1. Select **Measurement–Condition Load** from the Map Analysis function window.

   The Condition File Load window opens.

2. To call up recorded conditions, select the desired file from the list of recorded measurement conditions, and click on the **Load** button.

   The selected analysis conditions will be loaded.

   If you click on the **Check** button before loading, you can check the stored conditions.

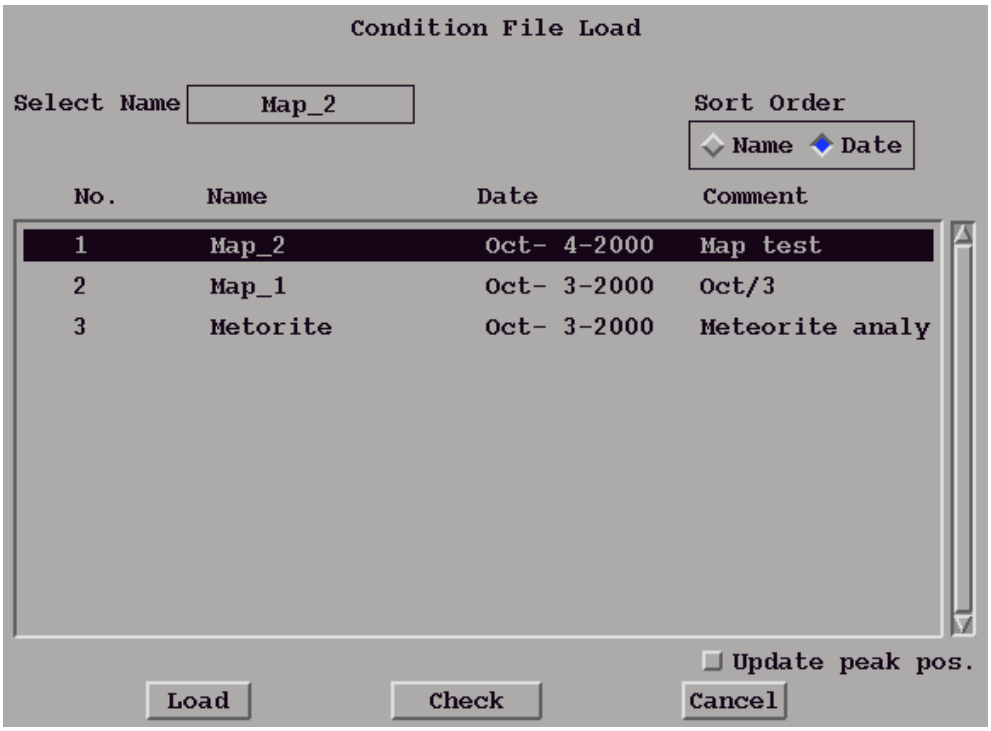


Fig. 31 Condition File Load window

4.9 Condition Store

The **Condition Store** function enables you to store in a file the map analysis conditions you have set. The conditions are **Element Condition**, **EOS Condition**, and **EDS Condition** (only for JXA-8200).

1. Select **Measurement–Condition Store** from the Map Analysis function window.
   The Condition File Store window opens as shown in Fig. 32.
2. Click on the **New** button in the Condition File Store window.
   The Condition File Name window opens as shown in Fig. 32.
3. Enter the desired file name (up to 14 characters) and comment (up to 40 characters) in the Condition File Name window and click on the **OK** button.
   The Condition File Name window disappears.
4. Click on the **Store** button in the Condition File Store window.
   The analysis conditions will be stored.

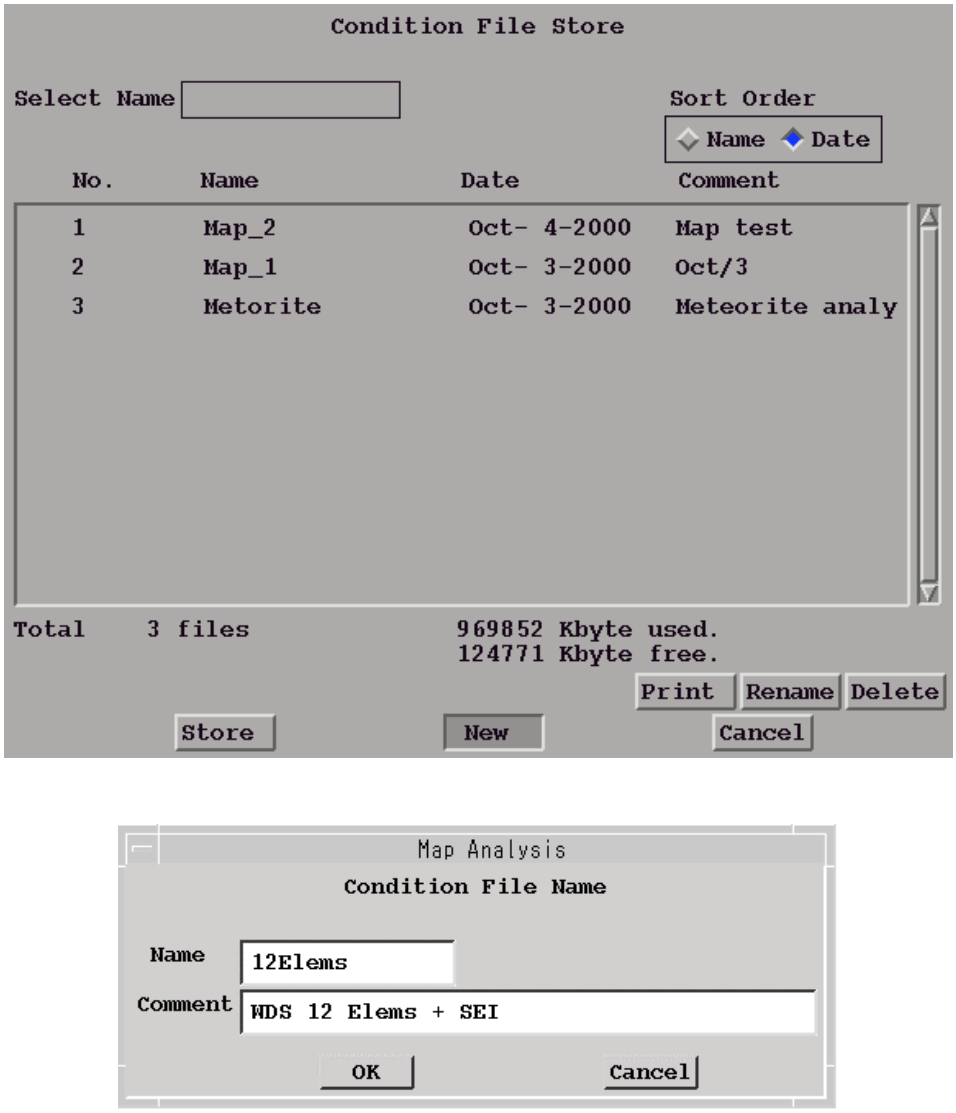


Fig. 32 Condition File Store/Condition File Name windows

4.10 Print-out Condition

1. Select **Measurement–Print-out Condition** from the Map Analysis function window.
   The Print-out Condition window opens.
2. Click on the **Measurement Condition and Results** in the Print-out Condition window.
   The measurement conditions and results will be printed at the end of measurement.

4.11 Survey Measurement

The **Survey Measurement** mode is used to perform preliminary measurement. It has the advantage of reducing the time required to perform condition entry work.

1. Select **Measurement–Survey Measurement** from the Map Analysis function window.
   The Survey Measurement window opens as shown in Fig. 33.

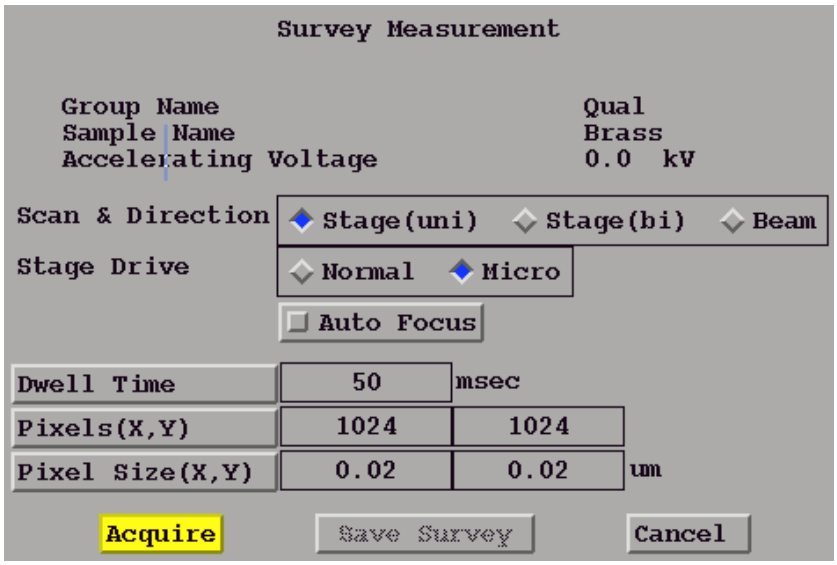


Fig. 33 Survey Measurement window

2. Specify the following items in the Survey Measurement window.

Object	Operation
Scan & Direction	Select **Stage (uni)**, **Stage (bi)**, or **Beam**.
Stage Drive	Select **Normal** or **Micro**.
Dwell Time	Specify a sampling time.
Pixels (X, Y)	Specify pixels.
Pixel Size (X, Y)	Specify pixel size.

3. Click on the **Acquire** button in this window.

Survey measurement will be performed at the present stage position under the present EOS conditions. The data that you obtain are always stored at the stage No. 99999 of the presently selected **Group Name** and **Sample Name**, being overwritten with every measurement.

4. When you wish to store the measurement results as your own in a file after **Survey Measurement**, click on the **Save Survey** button; then enter Position No. and Comment.

The limit of stage number is one more than the number of positions that are already set.

4.12 Preset Measurement

The **Preset Measurement** function allows you to perform measurements in succession by using stored measurement conditions.

1. Select **Measurement–Preset Measurement** from the Map Analysis function window.

The Preset Measurement window opens as shown in Fig. 34.

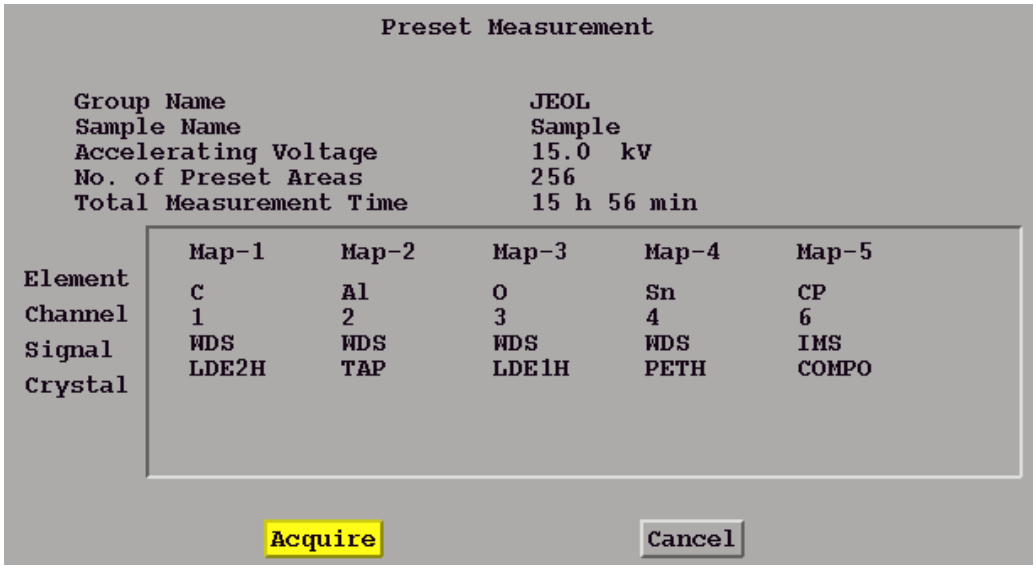


Fig. 34 Preset Measurement window

2. Click on the **Acquire** button in the Preset Measurement window.

The preset measurement conditions and the analysis positions in the list of the Stage Condition window whose **Preset** check boxes are turned on will be loaded. Then the measurement will be carried out in succession at the analysis positions, starting with the smallest number.

Map Analysis Measurement window

During measurement, the Map Analysis Measurement window in Fig. 35 will be displayed, displaying the progress of the measurement being made.

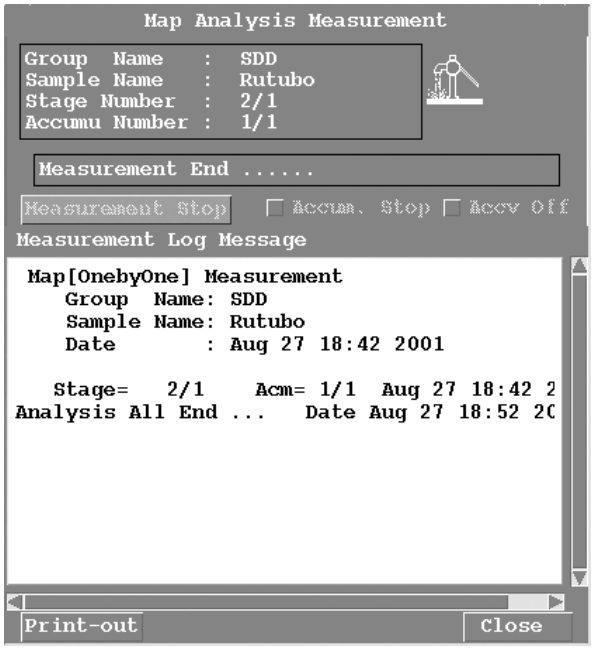


Fig. 35 Map Analysis Measurement window

During the measurement, you can display map analysis data in real time, as detailed in Chapter 6, Realtime Display.

5 PROCESSING

This chapter describes how to process the data obtained from the measurements performed so far.

◆ Select **Process–Map Analysis** from the EPMA Main Menu shown on the Computer Display.

The Area Analysis display and processing function window opens as shown in Fig. 36.

This window allows you to display and process map analysis data.

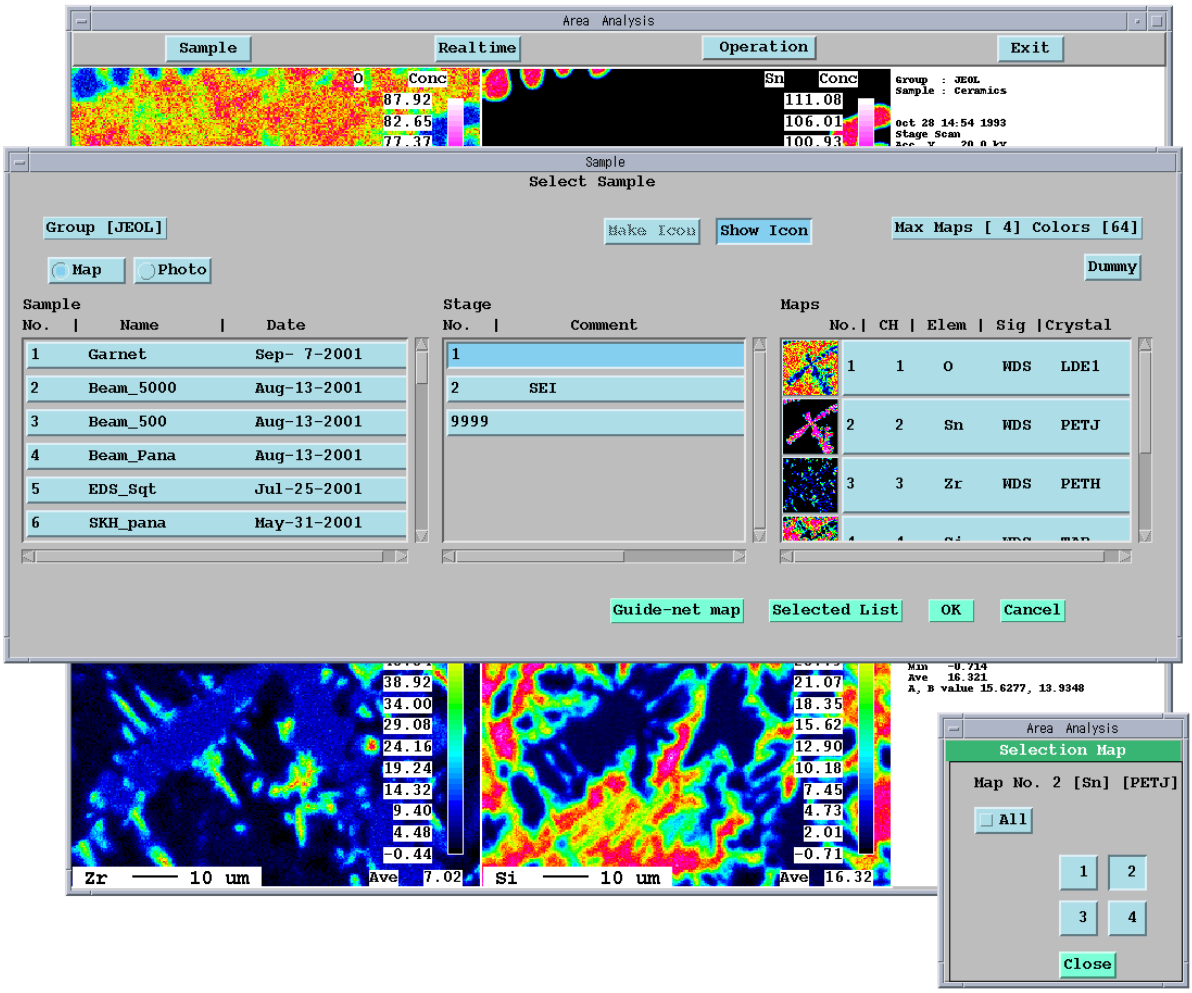


Fig. 36 Area Analysis display and processing function window and Sample window

5.1 Sample

1. Click on the **Sample** button in the Area Analysis display and processing function window shown in Fig. 36.
   The Sample window appears as shown in Fig. 36.
   Here, you can specify the map-analysis data that you measured.
2. Select **Map** or **Photo** in the function window.
   Image icons are displayed on the right side of signal names.
   By default, **Map** is selected, and so if you want to obtain photographic data, click on the **Photo** button.
3. Click on the **Group** button to select a group name, select **Sample** names, select **Stage** number, and spectrometer signal for the data to be displayed.
4. Click on the **OK** button.
   The map-analysis images of the specified data will be displayed in the Area Analysis display and processing function window.

✍ If you want to cancel some items, first click on the **Selected List** button, then click on those items.

✍ If you want to keep a vacant space next to the selected image, click on the **Dummy** button after selecting an image.

- **Max Maps & Colors window**

The **Max Maps [ ] Colors [ ]** button is at the upper right of the Sample window.

◆ Click on the **Max Maps [ ] Colors [ ]** button.
The Max Maps & Colors window opens as shown in Fig. 37.

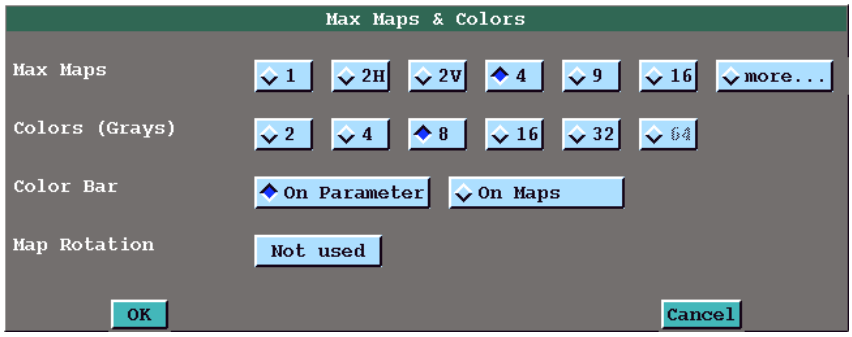


Fig. 37 Max Maps & Colors window

For **Max Maps**, you can specify the number of map-analysis images to display simultaneously. You can select **1**, **2H**, **2V**, **4**, **9**, **16** or **more…**. For example, when **2H** is selected, two map analysis images are simultaneously displayed on the screen: one above and the other below. When **2V** is selected, two map analysis images are simultaneously displayed side by side. If you click on the **more…** button, you can choose any numbers of maps to the horizontal and vertical directions to display up to 16 maps.

For **Colors**, you can specify the number of colors for displaying the images, by selecting **2**, **4**, **8**, **16**, **32**, or **64**.

Furthermore, you can select a place to display the color bar from **On Parameter** (in the parameter-display area) or **On Maps** (on the image). If you select **Map Rotation**, you can display the real image of the stage map.

You can also change the number of colors for displaying the images and place for displaying the color bar using the **Color Bar** and **Colors** functions of the Display Mode window of Sect. 5.3.4.

5.2 Operation

◆ Click on the **Operation** button in the Area Analysis display and processing function window of Fig. 36.

The **Operation Menu** opens as shown in Fig. 38.

Selecting an item from the menu allows the operations described below. The menu items that you use frequently can be selected from the pop-up menu that opens by right-clicking on any position on a displayed spectrum.

To specify the image for operation, select the desired number in the Selection Map window that opens when you click on the **Operation** button. Clicking on a displayed spectrum also specifies the image for operation. If you click on the **All** button in the Selection Map window, all the displayed images will be processed as specified.

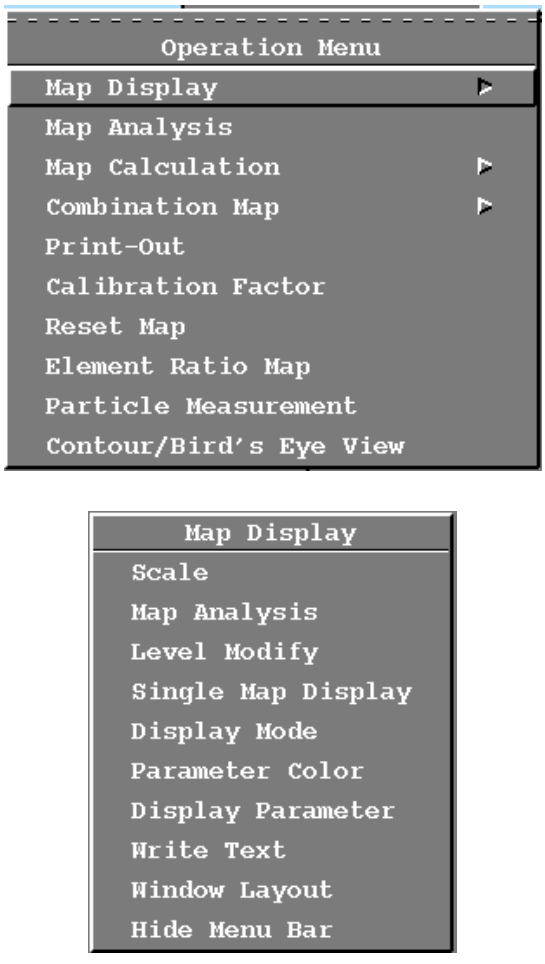


Fig. 38 Operation menu and Pop-up menu

5.3 Map Display

Selecting **Map Display** from the **Operation** menu opens the **Map Display** menu shown in Fig. 39. The following operations are on this menu.

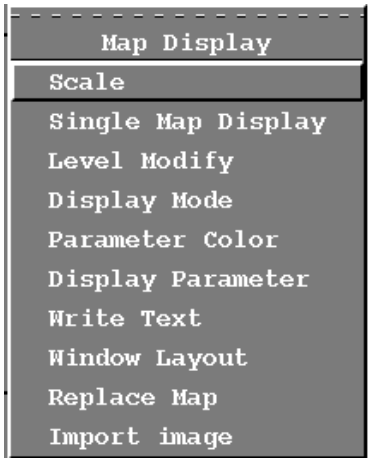


Fig. 39 Map Display menu

5.3.1 Scale

◆ Select **Scale** from the **Map Display** menu.

The Scale window appears as shown in Fig. 40, allowing you to enlarge a map analysis image. There are two methods for enlarging as described below.

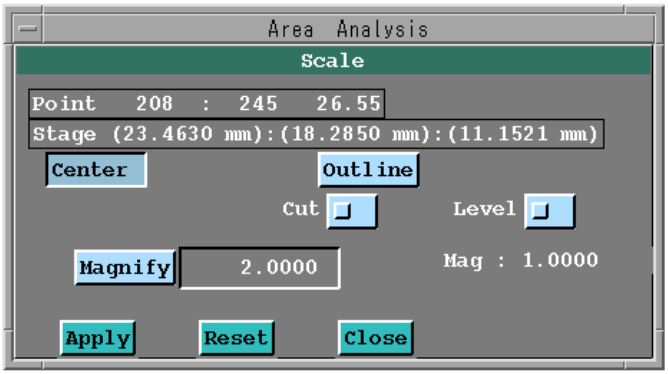


Fig. 40 Scale window

● **Specifying center**

This method enlarges a map analysis image around a point you specify.

1. Click on the **Center** button in the Scale window.
2. Type a scaling value relative to the present image size in the **Magnify** input box.
3. Move the pointer to the point that will be the center of enlargement, click on the point, and then click on the **Apply** button.

   The image will be enlarged and displayed.

4. After the image becomes enlarged, confirm that the scaling value relative to the enlarged image size is shown in the **Mag:** indication area.

- **Specifying frame**

By specifying a frame, you can enlarge any area of a map analysis image.

1. Click on the **Outline** button in the Scale window.
2. Position the pointer at the point A in Fig. 41 to specify on corner of the image area that you want to enlarge.
3. Drag the pointer diagonally to the point B in Fig. 41, and then release the mouse button.

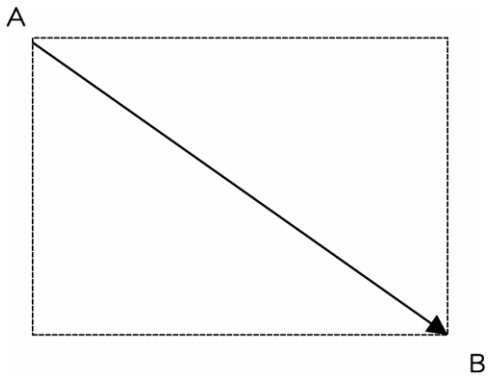


Fig. 41 Specifying an image area (frame)

4. If you do not want to display the data other than the specified image data when the image is enlarged, click on the **Cut** button.
5. Click on the **Apply** button.
   The specified area will be enlarged and displayed.

If you turn on the **Level** button in the Scale window, the color tone will be classified again from the maximum to the minimum in the enlarged area when you specify **Center** or **Outline**.

If you click on any point on a displayed image, the measured position and intensity or concentration of the data will be displayed in the **Point** box, and the stage position in the **Stage** box.

5.3.2 Single Map Display

When multiple analysis images are simultaneously displayed, you can enlarge any desired image to fill the screen by using the **Single Map Display** function.

1. Select **Single Map Display** from the Map Display menu.
   The Single Map Display window opens as shown in Fig. 42.

Fig. 42 Single Map Display window

2. Click on the desired image in the Selection Map window of Fig. 36.
3. Click on the **Apply** button in the Single Map Display window.
   The selected image will be enlarged to fill the screen.
4. If you want to return to the previous display mode, click on the **Reset** button.

5.3.3 Level Modify

The **Level Modify** function allows you to change the levels of a map-analysis image.

1. Select **Level Modify** from the Map Display menu.
   The Level Modify window opens as shown in Fig. 43.

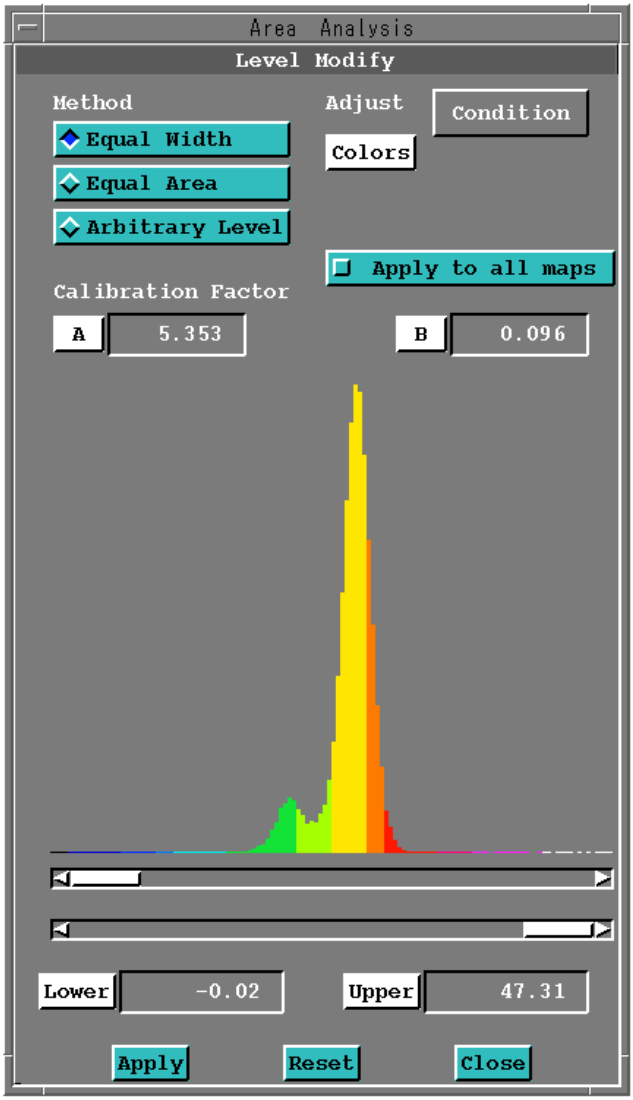


Fig. 43 Level Modify window

The graph in the center of this window is a histogram that represents X-ray intensity or concentration in the horizontal direction and the number of pixels in the vertical direction. Using the buttons in the Level Modify window, you can perform the functions described below.

Object	Function
Equal Widths	Devides the map analysis image in X-ray intensity into equal widths according to the values of **Lower** and **Upper** that you can specify by using the scroll bars or by entering numbers. Then, the histogram after re-calculation and color bar will be redisplayed.
Equal Area	Calculates levels so that each area and color of the histogram become almost equal, based upon the values of **Lower** and **Upper**. Consequently, the map analysis image and color bar are redisplayed.
Arbitrary Level	Clicking on this button opens a level-input window. Enter desired values for levels. The color bar of the map analysis image is redisplayed accordingly, using the input values.
Calibration Factor	Enter a factor for converting the map analysis image from intensity display to concentration display. For details of how to convert, see Sect. 5.8, “Calibration Factor”.
Condition	Clicking on this button stores the present values of **Lower** and **Upper** in a file. You can also call up the previously stored leveling conditions.
Colors	Clicking on this button opens the Leveling Modify window, allowing you to expand the range of the desired level color. Specify the level color you want to expand, using the scroll bar in the Leveling Modify window; then expand the color horizontally using the arrowhead (◀,▶) buttons.
Apply to all maps	Clicking on this button applies the same levels to all the displayed images.

5.3.4 Display Mode

The **Display Mode** function allows you to select a display mode.

◆ Select **Display Mode** from the Map Display menu.

The Display Mode window opens as shown in Fig. 44.

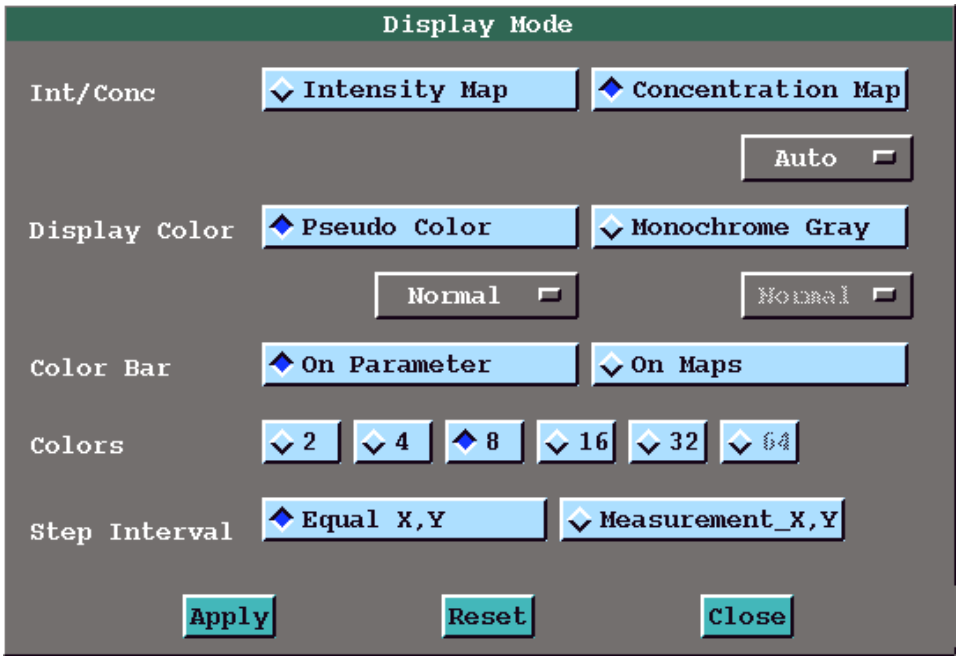


Fig. 44 Display Mode window

Using the buttons in the Display Mode window lets you perform the functions described below.

Button	Function
Int/Conc–Intensity Map	Clicking on this button classifies the measured data for displaying it in different levels according to the intensity.
–Concentration Map	Clicking on this button classifies the measured data (intensity map) for displaying it in different levels according to the concentration, using the **Calibration Factor** A and B (refer to Sect. 5.8).
Display Color–Pseudo Color	Clicking on this button displays measurement data in pseudo-color.
–Monochrome Gray	Clicking on this button displays measurement data in gray.
Color Bar–On Parameter	Clicking on this button displays the color bar in the parameter-displaying area.
–On Maps	Clicking on this button displays the color bar on the map-image display.
Colors–2, **4**, **8**, **16**, **32**, **64**	Clicking on any number button changes the number of colors to use in displaying the data.
Step Interval–Equal X, **Y**	Clicking on this button allows you to specify aspect ratio for displaying the data with pixels.
Step Interval–Measurement X, **Y**	Clicking on this button allows you to specify aspect ratio for displaying the data, keeping the distance ratio between data points.

Pseudo Color

When **Pseudo Color** is selected**,** you can choose **Normal** for displaying data in standard colors or **Specified** for changing the selection of colors. If you select **Specified**, the Specify Pseudo Color window will open as shown in Fig. 45, allowing you to change selected colors.

In this window, you can specify the color of each button of **Color bar** using the **R**, **G** and **B** scroll bars, or by selecting any color name from the **Color Names** list.

You can save the colors specified for **Color bar** in a file by clicking on the **Save** button, load them from the file by clicking on the **Load** button, and delete them from the file by clicking on the **Delete** button.

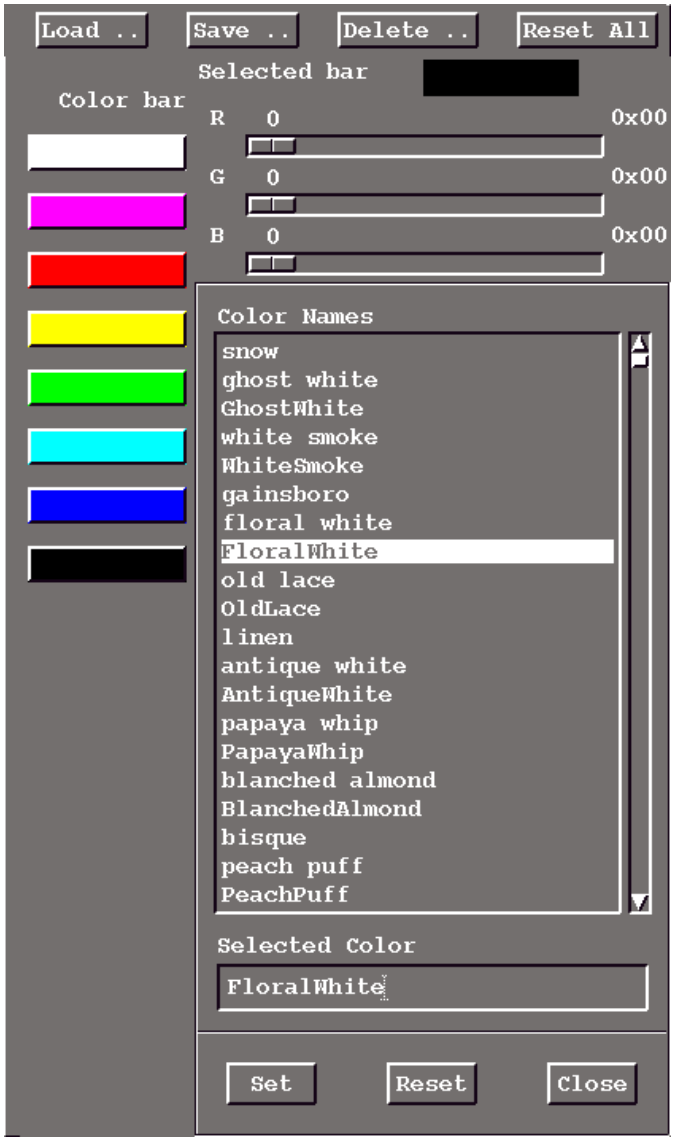


Fig. 45 Specify Pseudo Color window

5.3.5 Parameter Color

Parameter Color allows you to specify the colors of characters, character background, and image background.

1. Select **Parameter Color** from the Map Display menu.
The Parameter Color window opens as shown in Fig. 46.

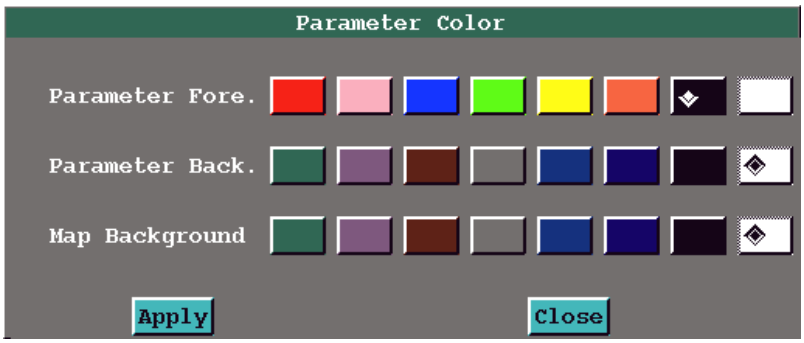


Fig. 46 Parameter Color window

2. Click on each desired color button for **Parameter Fore.**, **Parameter Back.**, and **Map Background** in the Parameter Color window.
3. Click on the **Apply** button.
   The parameters will be displayed in the altered colors.

5.3.6 Display Parameter

Display Parameter allows you to specify information that you want to display together with a map-analysis image in the Area Analysis display and processing function window.

1. Select **Display Parameter** from the Map Display menu.
   The Display Parameter window opens as shown in Fig. 47. You can select the things you want to display.

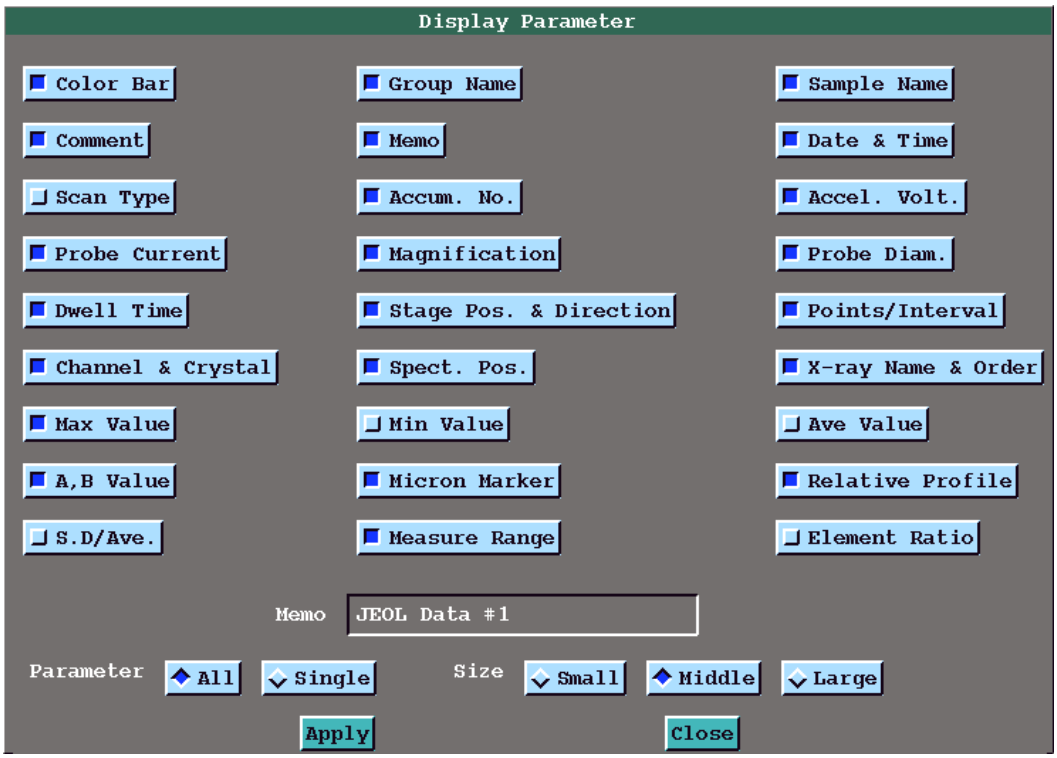


Fig. 47 Display Parameter window

To select the place (**On Parameter** or **On Maps**) to display the color bars, use the Display Mode window of Fig. 44.

2. Click on the buttons for the parameters you want to display together with the map analysis image in the Area Analysis display and processing function window. Then click on the **Apply** button.
   a. If you want to display a memo together with the map analysis image in the Area Analysis display and processing function window, click on the **Memo** button, and type a memo in the **Memo** input box; then click on the **Apply** button.
   b. If you want to display parameters together with all the map analysis images in the Area Analysis display and processing function window, select **All** from the **Parameter** items. If you want to display parameters together with only the map analysis image presently selected in the Area Analysis display and processing function window, select **Single** from the **Parameter** items.
   c. To specify the size of characters, select **Small**, **Middle**, or **Large** from the **Size** buttons.

5.3.7 Write Text

Using **Write Text**, you can display text on a map-analysis image.

1. Select **Write Text** from the Map Display menu.
   The Write Text window opens as shown in Fig. 48. You can then click on the desired buttons.

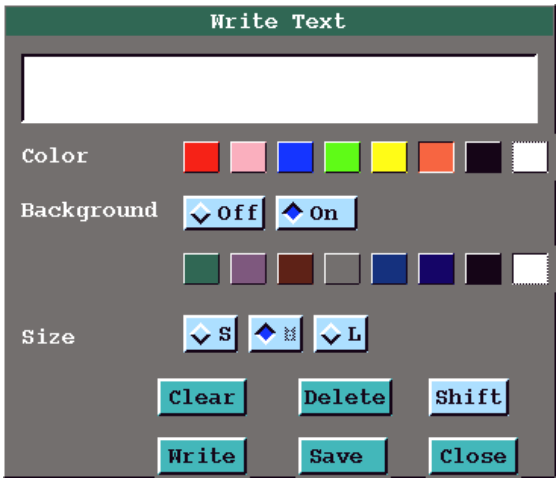


Fig. 48 Write Text window

2. In the input box of the Write Text window, type any text that you want to write.
3. Click on the desired **Color** button, select **On** (and click on the desired color button) or **Off** for **Background**, and specify a size for the characters for text by clicking on a **Size** button (**S**, **M**, or **L**).
4. Click on the position where the text should appear, and then click on the **Write** button.
   The input text will be displayed on the image.
5. If you want to move the displayed text, click on the **Shift** button, and then drag the displayed text to the desired position.

6. If you want to save the text that you input, click on the **Save** button; when you later call up the image, the stored text will be displayed together with it.

5.3.8 Window Layout

You can change the layout of the displayed image by using **Window Layout**.

1. Select **Map Display**–**Window Layout** from the Map Display menu.
   The Window Layout window opens as shown in Fig. 49.

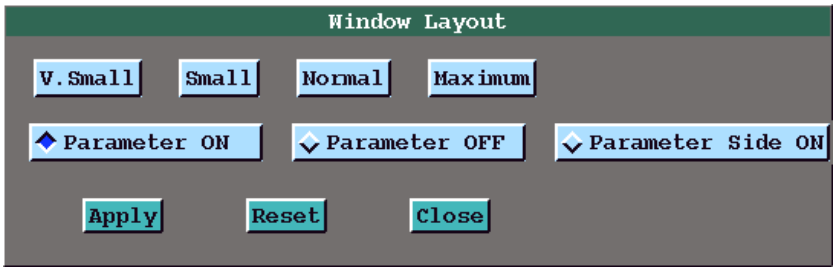


Fig. 49 Window Layout window

2. Select the desired window size from **V. Small**, **Small**, **Normal**, and **Maximum**.
   You can change the size of the Area Analysis display and processing function window by dragging its frame.
3. Choose the desired way to display parameters in the Area Analysis display and processing function window.
   - If you want to display parameters on the right side, select **Parameter ON**.
   - If you do not want to display them, select **Parameter OFF**.
   - If you want to display parameters on the right side of each map image, select **Parameter Side ON**. If you do, you can display up to 4 map images with parameters on the right side.
4. Click on the **Apply** button.

5.3.9 Replace Map

When multiple images are displayed in the Area Analysis display and processing function window, you can replace one of the images with another one.

1. Select the map image to be replaced by clicking on the **1**, **2**, **3**, or **4** button in the Selection Map window of Fig. 36.
2. Select **Map Display**–**Replace Map** from the Map Display menu.
   The Replace map dialog box opens as shown in Fig. 50.

Fig. 50 Replace map dialog box

3. Click on the **Apply** button.
The Sample window of Fig. 36 appears. You can choose the image that you want.

4. Select any map image from the Sample window.

5.3.10 Import Image

You can load FIS images, OM images, or bitmapped images (.bmp) from files.

1. Select **Map Display**–**Import Image** from the Map Display menu.
The Import Image window opens as shown in Fig. 51.
By default, the list of bitmap format files that are stored in the **Images** directory will be displayed.
If you want to change the file type in the filter, click on the **Filter** button, and then change it accordingly.

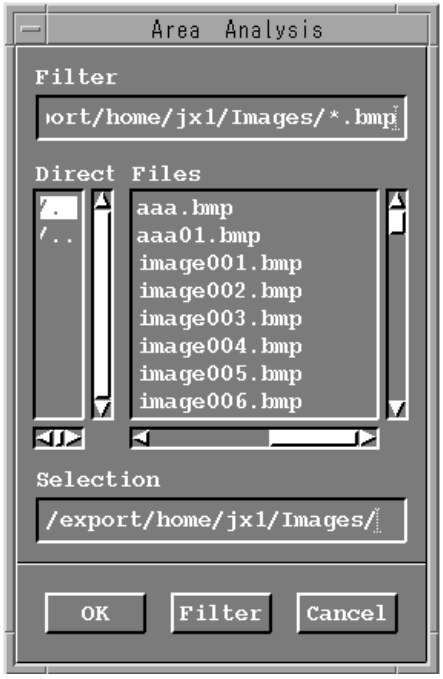


Fig. 51 Import Image window

2. Select a file to display from the **Files** list in the Import Image window.

3. Click on the **OK** button.
The selected image will be displayed. To determine the position for displaying the selected image, use the Selection Map window of Fig. 36.

5.4 Map Analysis

Using **Map Analysis**, you can execute the analyses described below.

◆ Select **Map Analysis** from the Operation Menu.
The Map Analysis window opens as shown in Fig. 52.

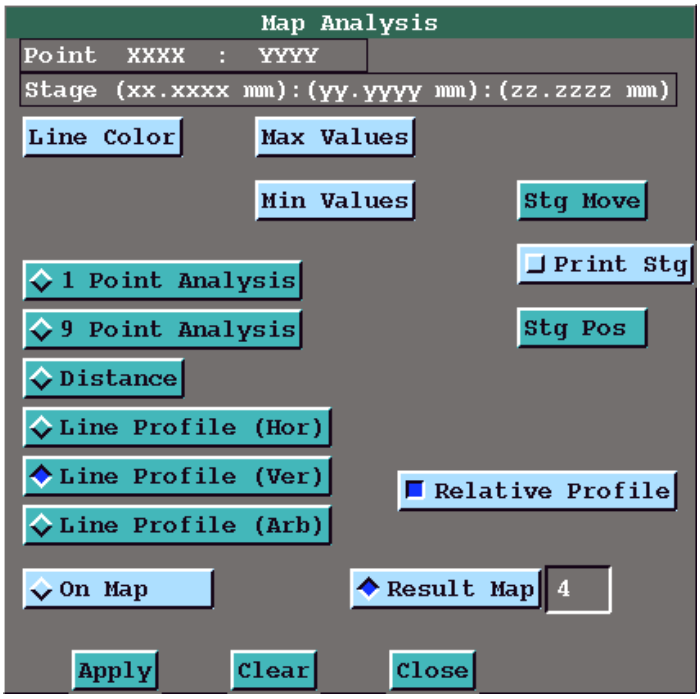


Fig. 52 Map Analysis window

● **1 Point Analysis**

1. Click on the **1 Point Analysis** button in the Map Analysis window.
2. Select the desired image by clicking on the number button corresponding to the image in the Selection Map window shown in Fig. 53.

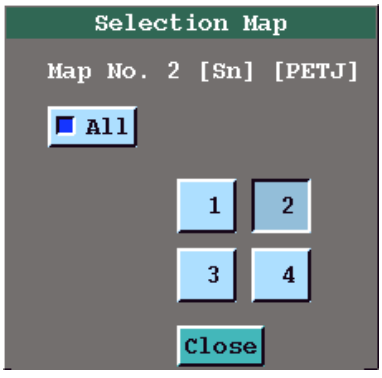


Fig. 53 Selection Map window

3. Position the pointer on the desired point in the selected image, and then click on it.

   The X-ray intensity (or concentration) at the point where you clicked is read out and displayed.

   - If **On Map** in the Map Analysis window is selected, the X-ray intensity (or concentration) is displayed on the image.
   - If **On Map** is not selected, the X-ray intensity (or concentration) is displayed in the parameter display area.
   - If **All** in the Selection Map window is selected, the X-ray intensities (or concentrations) at the same measured position of the simultaneously displayed images are read out and displayed.

4. Click on the **Apply** button in the Map Analysis window.

● 9 Point Analysis

◆ This button is operated in the same way as the **1 Point Analysis** button described above.

The average X-ray intensity at nine points, including the one point you specified and eight points around it, is displayed.

● Distance

Using **Distance**, you can calculate and display the distance between any two points in the map analysis image.

1. Click on the **Distance** button in the Map Analysis window.
2. Position the pointer on one desired point in the selected image, and then drag the mouse to the other desired point.
3. Click on the **Apply** button in the Map Analysis window.

   The distance appears.

✍ Like **Point Analysis**, the place to display the distance can be changed by using the **On Map** button.

● Line Profile (Hor)

Using **Line Profile (Hor)**, you can read out the average data in the horizontal direction at any desired position in the map analysis image and display it as a line profile.

1. Click on the **Line Profile (Hor)** button in the Map Analysis window.
2. To specify the line position for the horizontal data, click the mouse at any point on the image.

   A horizontal line appears (see the line A of Fig. 54).

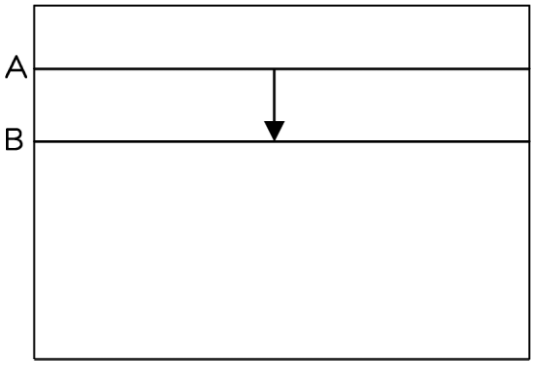


Fig. 54 Specifying the range of a Line Profile

3. To specify a range, drag the mouse downward continuously from Step 2 to the desired point, and release it.
   Another horizontal line appears (see the line B of Fig. 54).
4. Click on the **Apply** button in the Map Analysis window.

The full scale of the line profile will be the maximum value of the image in which the profile is displayed.
To change the scale, click on the **Max Values** or **Min Values** button in the Map Analysis window, and enter the desired value.
Also, to change the color of the display line, click on the **Line Color** button, and select the desired color from the color palette.

- **Line Profile (Ver)**

Using **Line Profile (Ver)**, you can display a vertical line profile in the map analysis image.

- This button is operated in the same way as the **Line Profile (Hor)** button described above.

- **Line Profile (Arb)**

Using **Line Profile (Arb)**, you can read out the data along a line running in any arbitrary direction in the map analysis image and display it as a line profile.

1. Click on the **Line Profile (Arb)** button in the Map Analysis window.
2. Position the pointer at the desired point **A**, drag the pointer to another point **B** that you want, and then release the mouse button.
   This specifies a line **AB** as shown in Fig. 55. The direction of the line is determined.

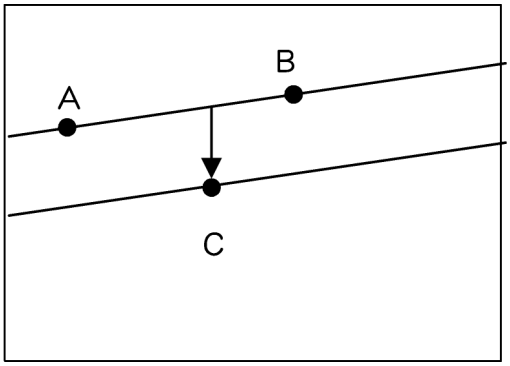


Fig. 55 Specifying a Line Profile range (Lines)

3. To specify a range and display a profile of the average value in that range, after you have released the mouse button at point **B**, press and hold the mouse button again, drag the pointer away from the displayed line, and then release the mouse button.
4. Click on the **Apply** button in the Map Analysis window.

Button	Function
Max Values	Clicking on this button lets you enter a maximum value for a line profile.
Min Values	Clicking on this button lets you enter a minimum value for a line profile.
Stg Move	Click on any point on the image, and click on the **Stg Move** button; then the stage moves to the clicked point on the image.
Print Stg	Keeping this button on prints the values of a line profile.
Stg Pos	Keeping this button on marks the stage position for qualitative and quantitative point analysis with a number on the image.

5.5 Map Calculation

Using **Map Calculation**, you can execute the operations described below.

◆ Select **Map Calculation** from the Operation Menu.
The Map Calculation menu opens as shown in Fig. 56.

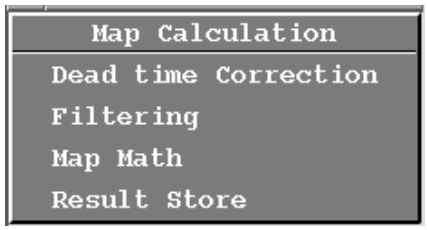


Fig. 56 Map Calculation menu

5.5.1 Dead-time Correction

This menu item provides the dead-time correction of X-ray counting.

◆ Select **Dead time Correction** from the Map Calculation menu.
Dead-time correction will be performed and enhance the accuracy of data that has a high X-ray counting rate (several tens of thousand cps).

☞ For calculations of Dead-time Correction, refer to Chapter 5, “Actual Calculations,” of the instruction manual of the Quantitative Analysis Program.

5.5.2 Filtering

This menu item provides several filtering functions, including smoothing and edge enhancement.

◆ Select **Filtering** from the Map Calculation menu.
The Filtering window opens as shown in Fig. 57. You can perform the filtering tasks listed below by using the various buttons in the Filtering window. These filters are 3 × 3 grids of points.

- **Smoothing**
- **Median**
- **Sharpening**
- **Edge enhancement**
- **User Defined Filter** (filter with user-defined factor)

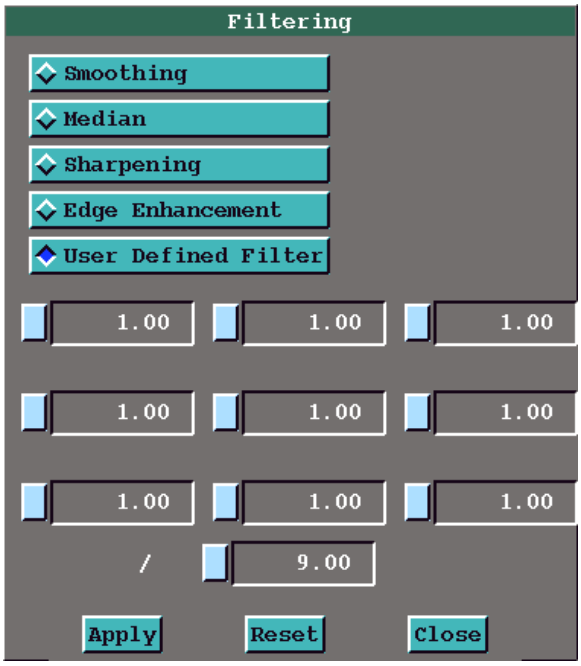


Fig. 57 Filtering window

5.5.3 Map Math

Selecting this menu item lets you process map analysis data by adding, subtracting, multiplying or dividing by a constant (K), or by executing calculations on two sets of map analysis data.

◆ Select **Map Math** from the Map Calculation menu.

The Map Math window opens as shown in Fig. 58. If you use the buttons in the window, you can carry out the arithmetic operations described below. When any one of the operations is executed, its equation is shown in the **Method** display area.

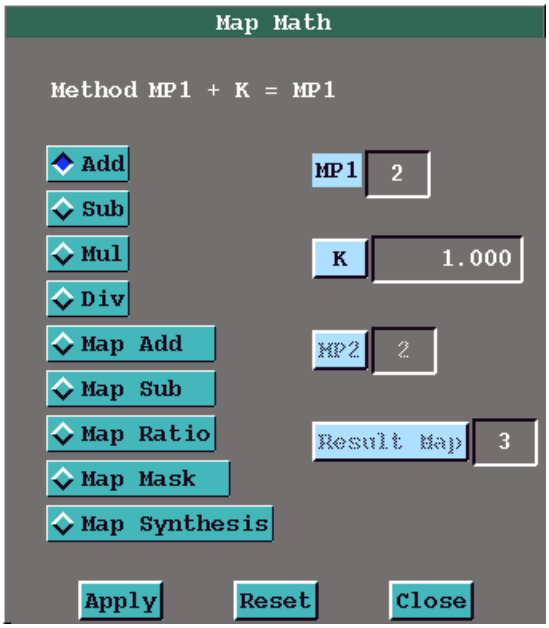


Fig. 58 Map Math window

- **Add**

  Using **Add**, you can add a constant K to a map analysis image.

  1. Click on the **Add** button to turn it on.
  2. Select the number of the desired image using the Selection Map window.
     The selected number is displayed in the **MP1** display box.
  3. Type a constant value in the **K** input box.
  4. Click on the **Apply** button.
     The map analysis image resulting from addition of the constant will be displayed in place of the original image.

- **Sub**

  Using **Sub**, you can subtract a constant K from a map analysis image.

  - The operation is the same as for **Add**.

- **Mul**

  Using **Mul**, you can multiply a map analysis image by a constant K.

  - The operation is the same as for **Add**.

- **Div**

  Using **Div**, you can divide a map analysis image by a constant K.

  - The operation is the same as for **Add**.

- **Map Add**

  Using **Map Add**, you can add two sets of map analysis image data.

  1. Click on the **Map Add** button to turn it on.
  2. Specify two images to add by entering the number of each image in the **MP1** and **MP2** input boxes using the Selection Map window and the map-selection window that opens, respectively.
  3. Specify the number for the added image that results in the **Result Map** input box using the map-selection window that opens.
  4. Click on the **Apply** button.

- **Map Sub**

  Using **Map Sub**, you can subtract two sets of map-analysis image data.

  - The operation is the same as for **Map Add**.

- **Map Ratio**

  Using **Map Ratio**, you ca divide two sets of map analysis image data.

  - The operation is the same as for **Map Add**.

Map Mask

Using **Map Mask**, you can select a common part as a mask, from two sets of map analysis image data.

1. Click on the **Map Mask** button to turn it on.
2. Specify an image to mask by entering the number of the image in the **MP1** input box using the Selection Map window, and also an image to use as a mask by entering the number of the image in the **MP2** input box using the map-selection window that opens.

   After you specify **MP2**, a window for changing levels opens.
3. Create a binarized image from the **MP2** image using the scroll bars.

   The logical calculation will be executed for both the object and mask images, and the created mask image will be shown in the display area with the number that was specified in the **Result Map** box.
4. Click on the **Apply** button.

Map Synthesis

Using **Map Synthesis**, you can create an image from two sets of map analysis image data.

1. Click on the **Map Synthesis** button to turn it on.
2. Specify an image by entering the number of the image in the **MP1** input box using the Selection Map window, and also another image by entering the number of the image in the **MP2** input box using the map-selection window that opens.

   After you specify **MP2**, a window for changing levels opens.
3. Determine the display area using the scroll bars.
   - To determine **Lower Level**, use the upper scroll bar.
   - To determine **Upper Level**, use the lower scroll bar.
4. Click on the **Apply** button in the window for changing levels.

   The new image created with Map Synthesis will be displayed.
5. Click on the **Apply** button in the Map Math window.

   The created image will be shown in the display area with the number that was specified in the **Result Map** box.

5.5.4 Result Store

For the three calculation functions described above, **Dead time Correction**, **Filtering**, and **Map Math**, this button allows you to store the results of calculation on the hard disk. However, the following items cannot be stored together with their correct colors.

- **Map Math**–**Map Mask**, –**Map Synthesis**
- **Combination Map**–**Combination Map** (RGB Synthesis)

1. Select **Result Store** from the Map Calculation menu.
   The Result Store window opens as shown in Fig. 59.

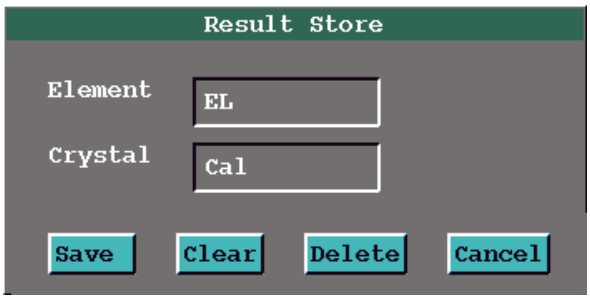


Fig. 59 Result Store window

2. Select a map analysis image that you want to store in the Selection Map window.
3. Enter up to two characters in the **Element** input box and up to eight characters in the **Crystal** input box for the image.
4. Click on the **Save** button.
   The data of the map-analysis image will be stored as a file.
   ✍ Up to 20 maps can be saved for a single map analysis, including the data of maps already measured.

- **How to delete unnecessary image data**

1. Select a map analysis image that you want to delete in the Selection Map window.
   ✍ Instead of using the Selection Map window, if you enter up to two slashes (//) in the **Element** input box and eight slashes (////////) in the **Crystal** input box for the image, the same result will be obtained.
2. Click on the **Delete** button in the Result Store window.
   The selected image will be deleted.

5.6 Combination Map

This software provides two functions under **Map Math**, the **Map Mask** and **Map Synthesis** functions, for overlapping two images. This section introduces the **Combination Map** function, which handles two or three images, and the **Paint Map** function, which handles two or more images.

5.6.1 Combination Map (RGB Synthesis)

This function combines two or three images and displays them as a single image. The map image display area is divided into four, and at least one area must be left available for displaying the resultant image.

◆ Select **Combination Map–Combination Map (RGB Synthesis)** from the Operation Menu.

The Combination Map window opens as shown in Fig. 60.

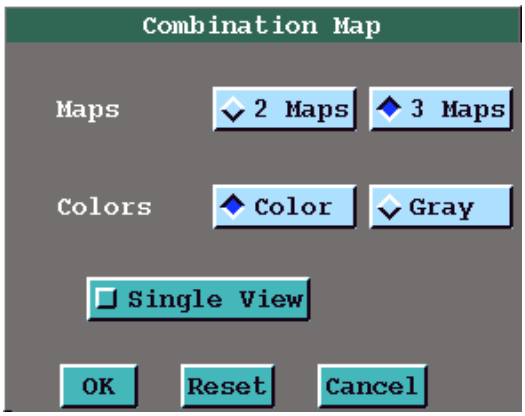


Fig. 60 Combination Map window

The distributions of each element, which are displayed as multilevel red (R), green (G), and blue (B) images, and the combined image are displayed. This results in the display of the distributions of multiple elements in a single screen using the colors of the color bar for displaying the result and the overlapped display for each element next to the color bar. Since a detailed image will not result if 4 or fewer colors are used for the color bar for the resultant map, use 8 or more colors.

If you click on the **OK** button when the **Single View** button in the Combination Map window is on, the resultant image will be displayed on the whole screen. Clicking on the **Reset** button returns the original display.

● Combination Map (RGB Synthesis) Display Color

If **3 Maps** is selected for **Maps** in the Combination Map window, a total of 8 colors will be used for displaying the resultant combined map. If you consider a given point in the map, and if data at that point in the input maps 1, 2, and 3 are displayed in red, green, and blue, respectively, data at the corresponding point in the combined map will be displayed in white. If data at that point in the input maps 1, 2, and 3 are displayed in red, green, and black, respectively, data at the corresponding point in the combined map will be displayed in yellow, which is the color that results from mixing red and green. Fig. 61 shows this graphically.

Data analysis is easier if a color bar is displayed in the combined map by specifying the objects in the Combination Map window as shown in Fig. 60.

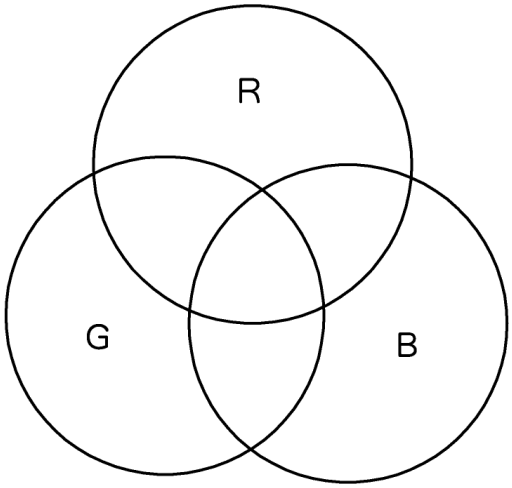


Fig. 61 Color resulting from selecting 3 Maps and Color

If color bars are displayed either in the parameter display area (**On Parameter**) or on the map image area (**On Maps**) while a combined map image created using **3 Maps** (when **3 Maps** in **Maps** in the Combination Map window in Fig. 60 is selected) is displayed, the system will display the name of the element corresponding to each color.

Similarly, when the number of input maps is specified as **2 Maps**, a total of four colors will be used for color display as shown in Fig. 62.

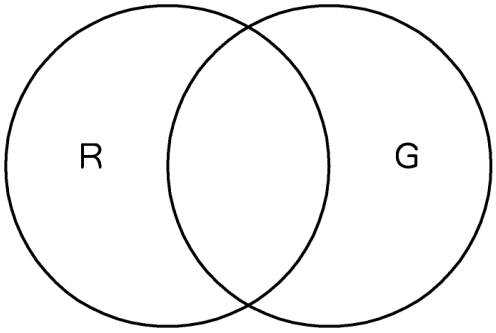


Fig. 62 Color resulting from selecting 2 Maps and Color

We described above the case where 2 colors are used.

Colors (Grays) is set to **2** in the Max Maps & Colors window in Fig. 37.

However, combined maps can be created with more than 2 colors if you specify one of the other number buttons in the Max Maps & Colors window. In these cases, the combined map is limited to 32 colors, and the result will be an approximate color display. That is, each level will be approximated with 4 colors.

5.6.2 Paint Map

This system provides the function that extracts specific sections of an image by using a histogram and overlaps these multiple images in a prioritized order to display them in one image.

◆ Select **Combination Map**–**Paint Map** from the Operation Menu.
The Paint Map window opens as shown in Fig. 63, displaying the histogram for the image specified in the Selection Map window.

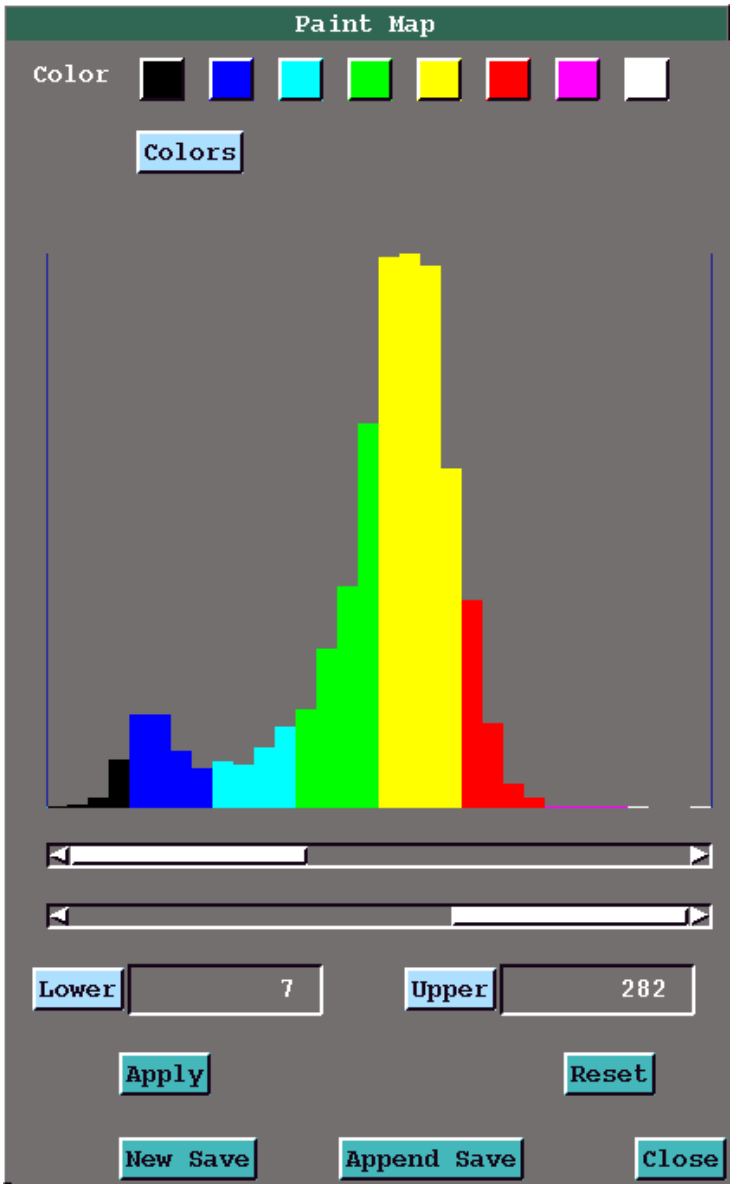


Fig. 63 Paint Map window

1. Manipulate the scroll bars (◀, ▶) in this window to extract the image you want to display.
2. If you want to use a single color, click on the desired **Color** button in the Paint Map window and click on the **Apply** button.

3. Save those conditions by clicking on the **New Save** or **Append Save** button.
Then, the Save Condition window appears as shown in Fig. 64.

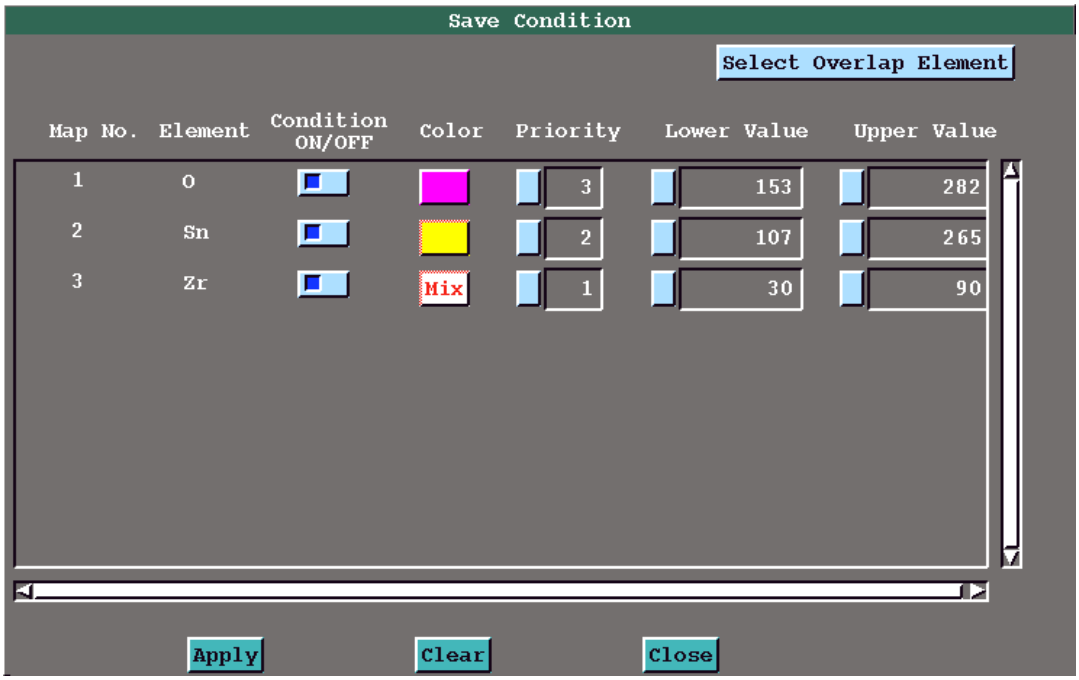


Fig. 64 Save Condition window

4. Set up the display conditions for other images in the same way.

If you want to save the same image multiple times, use the **Append Save** button beginning the second time you save it. If you do not want to save the same image multiple times, only use the **New Save** button.

5. Click on the **Apply** button in the Save Condition window shown in Fig. 64.
You will acquire an overlapped image.

The overlapped colors and the order can be changed using the **Color** and **Priority** buttons.

If you do not want to display some images, turn off the **Condition ON/OFF**.

Clicking on the **Select Overlap Element** button opens the Select Overlap Element window, shown in Fig. 65, where you can specify the color of the overlapped image of elements.

The color button marked **MIX** indicates that the element is displayed not as a single color image, but with the color of the input image unchanged.

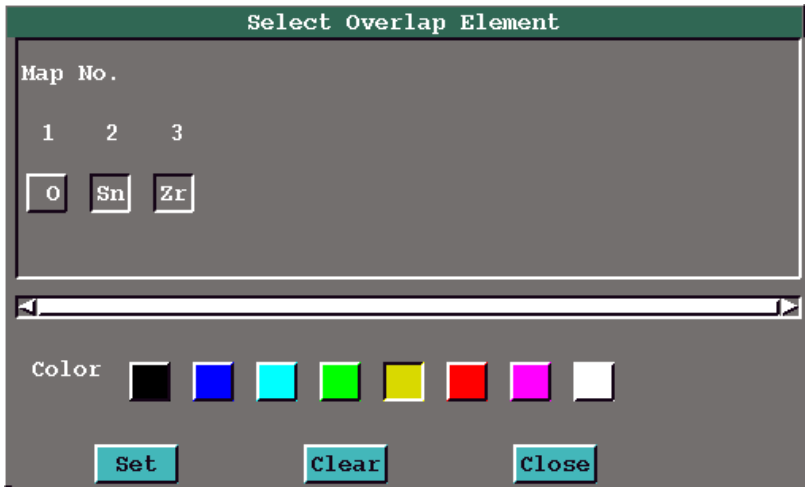


Fig. 65 Select Overlap Element window

5.7 Print-Out

◆ Select **Print-Out** from the Operation Menu.
The Print-Out window opens as shown in Fig. 66.

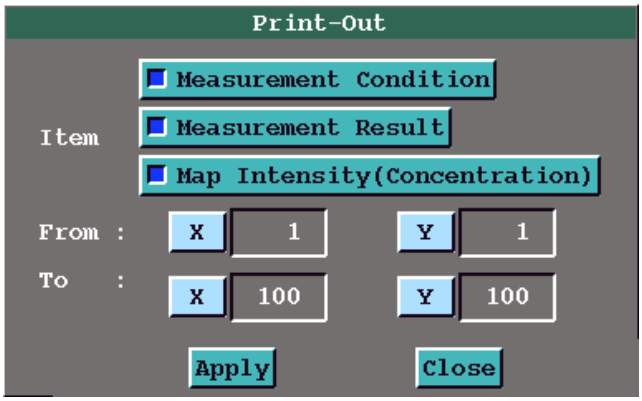


Fig. 66 Print-Out window

Here, data can be printed by clicking on the appropriate item.
This window provides three selections of output information:

- **Measurement Condition**
- **Measurement Results**
- **Map Intensity (Concentration)**

When outputting X-ray intensity (or concentration), specify only the necessary portion of the image data. If all of the image data were specified, the amount of output would be extremely large. To specify an output range, position the pointer on the **X** and **Y** input boxes at the right of **From** and **To**, and enter the X and Y coordinates of the range, as shown in Fig. 67. The X and Y coordinates on the image are defined with the origin (1,1) set at the upper-left corner.
In the stage scan mode, the X direction of image data corresponds to the Y axis of the stage.

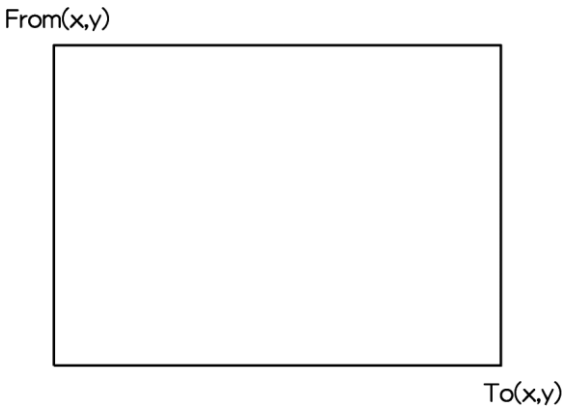


Fig. 67 Specifying an output range

5.8 Calibration Factor

Specify calibration factors A and B to use to convert the map-analysis image data displayed in X-ray intensity to a concentration display.

◆ Select **Calibration Factor** from the Operation Menu.

The Calibration Factor window opens as shown in Fig. 68, displaying a list of calibration factors A and B.

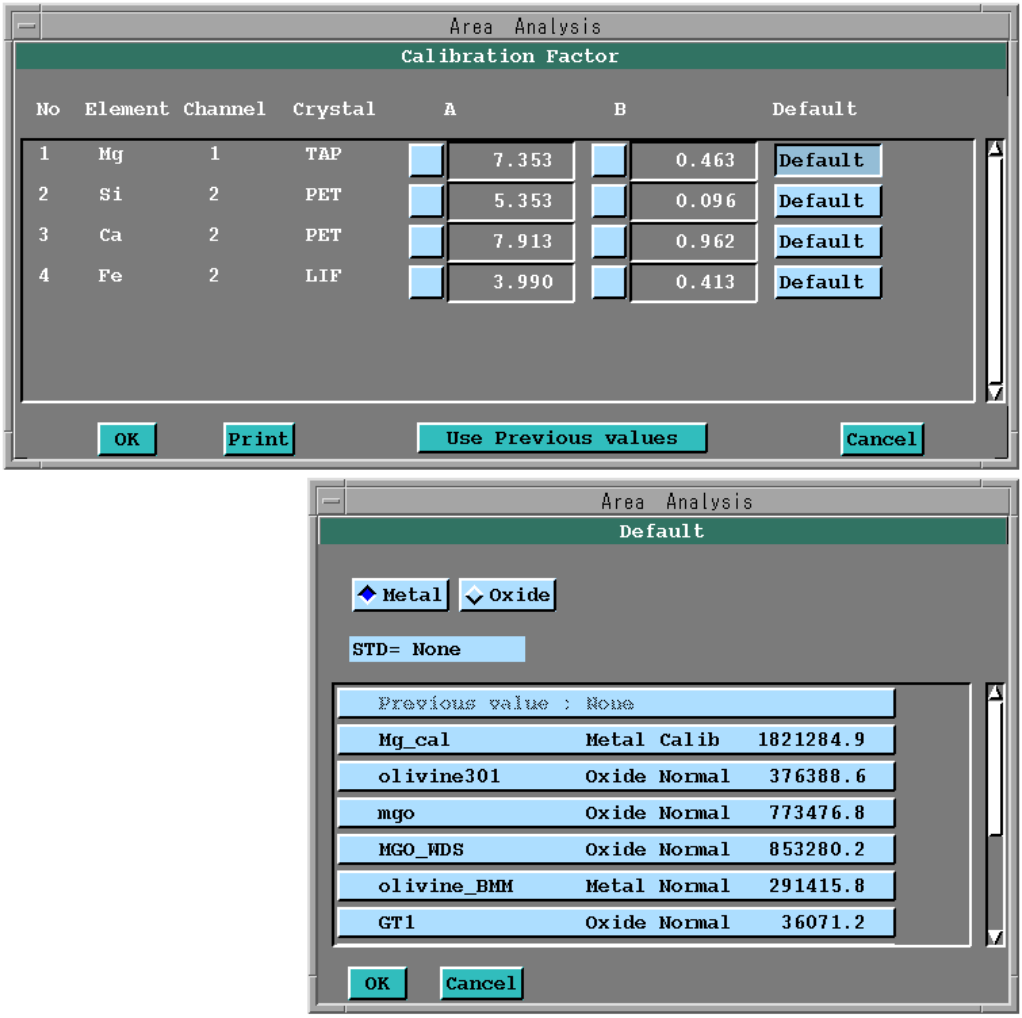


Fig. 68 Calibration Factor window

If you want to change a factor, position the pointer at it, and enter the desired value using the keyboard.

To display the list of standard samples including the specified elements, click on the **Default** button. If you select any standard sample, the factors A and B will be calculated based on the measured data.

If you click on the **Use Previous values** button, the previous values will be applied to each element.

The points in the image are converted from X-ray intensity data to concentration data, as shown in Fig. 69.

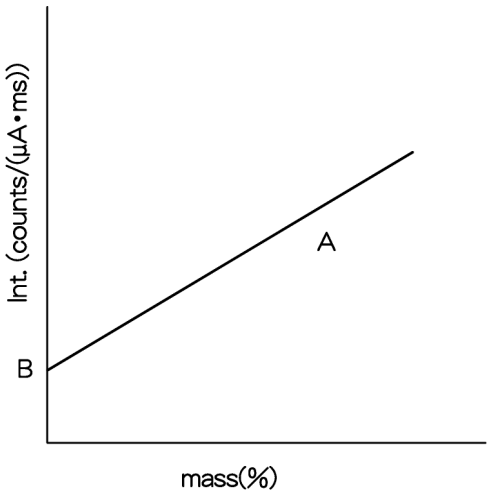


Fig. 69 X-ray intensity and concentration

$$I = A \times C + B$$

where I: X-ray intensity
C: Concentration

A: Slope; X-ray intensity per 1% concentration, in counts/(μA•ms•%)
The current is the probe current measured by PCD.
B: Offset; corresponding to the background, in counts/(μA•ms)

When map data of a backscattered-electron image (composition image) is converted into the mean atomic number data, the factors A and B denote the following:
A: Slope; intensity of backscattered electrons per μA per atomic number
B: Offset; intensity of backscattered electrons per μA

5.9 Reset Map

1. Select **Reset Map** from the Operation Menu.
The Reset Map window opens as shown in Fig. 70.

Fig. 70 Reset Map window

2. Click on the **Apply** button.
All the operations will be cancelled, and the initial image will be displayed.

5.10 Particle Measurement

This is optional software to determine area, shape, ratio, position and other values.

☞ Refer to the instruction manual of the Particle Measurement Program.

5.11 Contour/Bird's Eye View

The **Contour/Bird's Eye View** function lets you convert image data to a contour or bird's eye view.

5.11.1 Contour Map

◆ Select **Contour/Bird's Eye View–Contour Map** from the Operation Menu.
The Contour Map window opens as shown in Fig. 71.

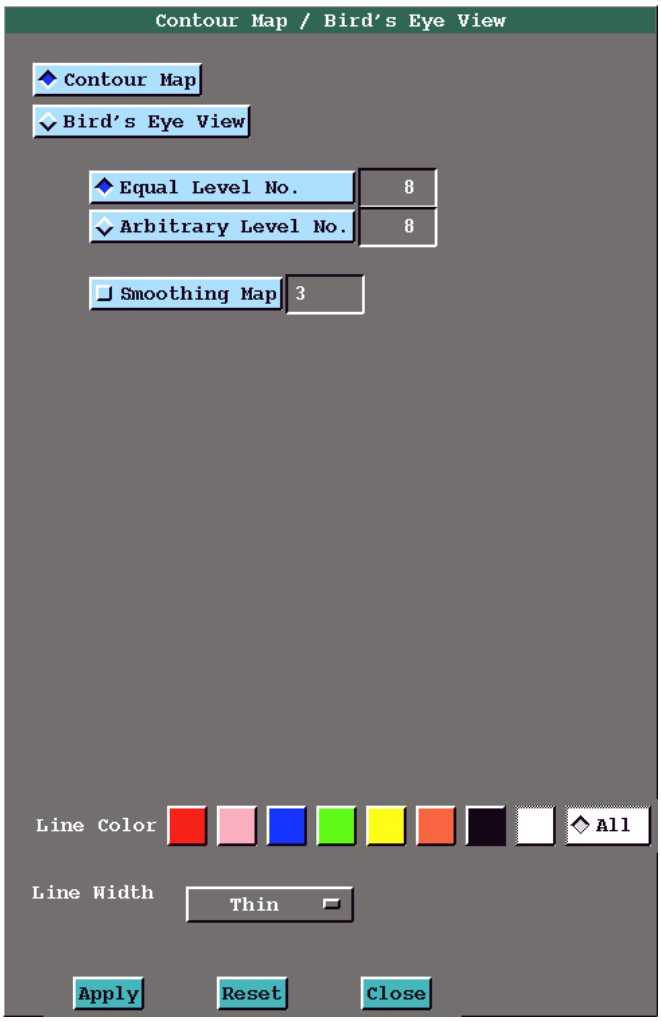


Fig. 71 Contour Map window

Button	Function
Equal Level No.	Number of sections to equally split height (intensity/concentration)
Arbitrary Level No.	Number of sections to arbitrarily split height (intensity/concentration)
Smoothing Map	Odd-numbered order of filter to use to smooth image data. For example, setting it to 3 specifies a 3 × 3 spatial filter.
Line Color	Enables you to select the color of the line. If you select **All**, the color of displayed image will be applied.
Line Width	Enables you to select the line width from **Thin**, **Normal** and **Thick**.

5.11.2 Bird's Eye View

- Select **Contour/Bird's Eye View–Bird's Eye View** from the Operation Menu.

The Bird's Eye View window opens as shown in Fig. 72.

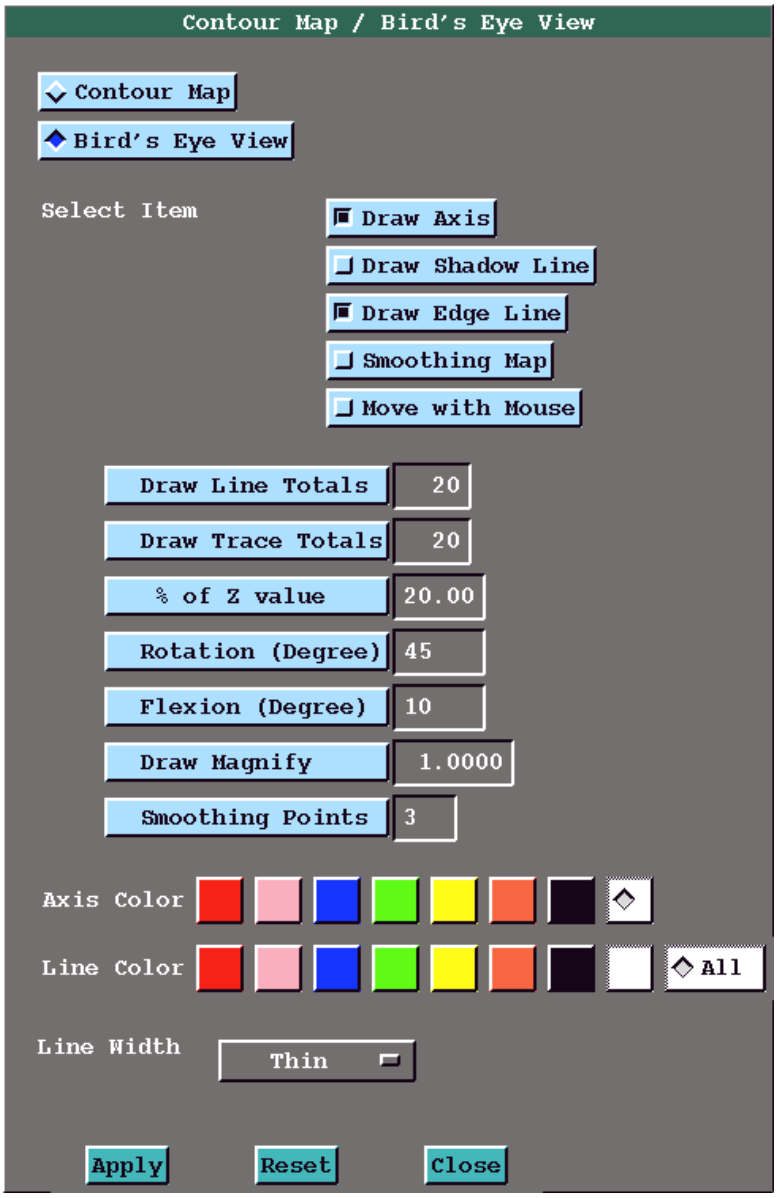


Fig. 72 Bird's Eye View window

Button	Function
Draw Axis	Enables you to draw an axis.
Draw Shadow Line	Enables you to draw a shadow line.
Draw Edge Line	Enables you to draw an edge line.
Smoothing Map	Enables you to draw a bird's eye view after smoothing.
Move with mouse	Allows you to move a bird's eye view using the mouse.
Draw Line Totals	Total number of horizontal lines before rotation.
Draw Trace Totals	The number of lines to trace horizontally.
% of Z value	Height expressed as a percentage. The height of the window is 100%.
Rotation (Degree)	Rotation angle of image data. Angle increases in a counterclockwise direction. You can specify it also by using the mouse. For example, to specify the angle to 45 degrees, drag the image specified in the Selection Map window diagonally (45 degrees) to the upper right and drop it at the desired point.
Flexion (Degree)	Flexion degree of image data. Available from 0 to 89 degrees.
Draw Magnify	Size of bird's eye view. Suppose that original length is 1.0, and then its half-length is 0.5.
Smoothing Points	Odd-numbered order of filter to use to smooth image data. For example, setting it to 3 specifies a 3 × 3 spatial filter.

6 REALTIME DISPLAY

Using **Realtime Display** causes the monitor to display data while they are being acquired during measurement.

1. Click on the **Realtime** button in the Area Analysis display and processing function window (refer to Fig. 36) either before or during measurement.

The Realtime Display window opens as shown in Fig. 73.

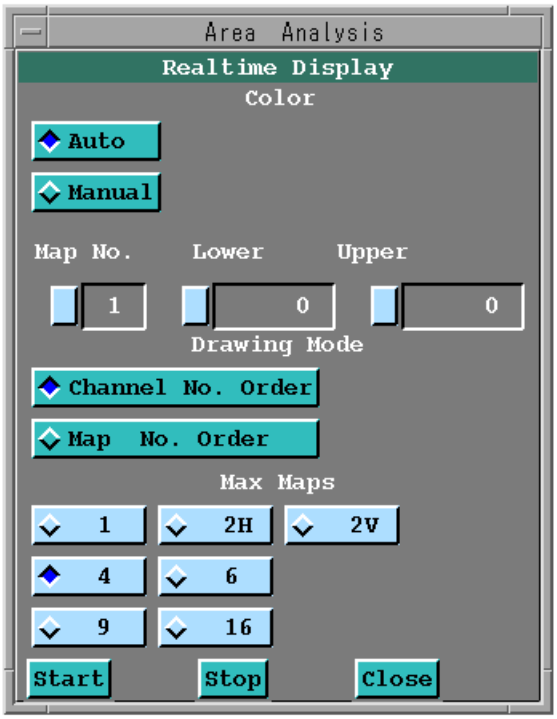


Fig. 73 Realtime Display window

2. Click on the **Start** button in this window.

The image of the map analysis data being acquired during measurement will be displayed in realtime.

● Auto/Manual

- Auto

  Selecting **Auto** in the Realtime Display window allows the displayed maximum value to be automatically updated each time the maximum value is updated during measurement.

- Manual

  Selecting **Manual** enables you to set the upper and lower limits (values for **Lower** and **Upper**) for each displayed map.

After you change from **Auto** to **Manual**, if you click on the **Start** button without entering any numbers, the image will be fixed at the upper and lower limits (for **Lower** and **Upper**) that were in effect when the **Stop** button was clicked on.

You cannot switch between the **Auto** and **Manual** modes during the realtime display after you have clicked on the **Start** button. To switch the mode, click on the **Stop** button.

Channel No. Order/Map No. Order

This function allows you to specify the order in which image data are displayed.

- **Channel No. Order**
  When this button is clicked on, images are displayed in ascending order of the channel number, starting at the upper left of the display frame in the image display area.
- **Map No. Order**
  When this button is clicked on, images are displayed in ascending order of element record, starting at the upper left of the display frame in the image display area.

Max Maps

Clicking on the buttons under **Max Maps** in the Realtime Display window changes the number of maps to be displayed.

During a realtime display, you cannot process the displayed images (see Chapter 5). To process the images, first click on the **Stop** button to stop the realtime display, then carry out the desired processing.