3D Data Processing Software

RANGE VIEWER

Reference Manual
Safety Symbols

The following symbols are used in this manual to prevent accidents that may occur as a result of incorrect use of the instrument.

- Indicates information that contains safety warnings or notes. Read the information carefully to ensure safe use.
- Indicates a prohibited act. Never commit such acts.
- Indicates an instruction. Adhere to the instruction.
- Indicates safety information concerning the laser. Read the information carefully to ensure safe use.

Official Names for Application Mentioned in This Manual

(Indication in this manual)  (Official name)
Windows, Windows Vista  Microsoft ® Windows ® Vista ® Business Operating System
Windows, Windows XP  Microsoft ® Windows ® XP Professional Operating System
Windows, Windows 7  Microsoft ® Windows ® 7 ® Professional Operating System

Trademarks

- Microsoft, Windows, Windows 7, Windows Vista and Windows XP are registered trademarks of Microsoft Corporation in the United States and other countries.
- Other product names and company names are the registered trademarks or trademarks of their respective owners.

Notes on This Manual

- It is strictly prohibited to copy or reproduce any of the content in this manual without the expressed permission of KONICA MINOLTA.
- The contents of this manual are subject to change without notice.
- Every effort has been made in the preparation of this manual to ensure the accuracy of its content. However, should you have any questions or find any mistakes, please contact the place of purchase.
- KONICA MINOLTA assumes no responsibility whatsoever for accidents or other consequences arising from the use of this software in disregard of the content of this manual.

About This Manual and Related Documents

This manual explains RANGE VIEWER commands in the sequence they appear in the menu bar. RANGE VIEWER is 3D scanning software created specifically for KONICA MINOLTA RANGE7/5.

The following manuals are related to the information contained herein.

<table>
<thead>
<tr>
<th>Title</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RANGE VIEWER User's Guide</td>
<td>Explains basic operation of RANGE VIEWER.</td>
</tr>
<tr>
<td>RANGE7/RANGE5 Instruction Manual</td>
<td>Explains the functions, operating procedures and warnings of the RANGE7/5 that acquires 3D profile data of diverse kinds of industrial products at high speed and to a high degree of accuracy.</td>
</tr>
<tr>
<td>RANGE VIEWER Installation Guide</td>
<td>This sheet explains how to install or uninstall RANGE VIEWER.</td>
</tr>
</tbody>
</table>
Safety Precautions

When using RANGE VIEWER, observe the following precautions to ensure correct safe use. Also, read this manual carefully and keep it in a handy place for future reference.

<table>
<thead>
<tr>
<th>WARNING</th>
<th>Failure to observe the indicated information may result in serious injury or even death.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Failure to observe the indicated information may result in fire or electric shock. Before using this system, carefully read the manuals provided with the RANGE7/5 and computer together with this manual to ensure correct safe use.</td>
</tr>
<tr>
<td></td>
<td>Do not look directly into the laser emission window of the RANGE7/5.</td>
</tr>
<tr>
<td></td>
<td>Keep lenses, objects with mirror-like surfaces and optical elements out of the optical path of the RANGE7/5 laser. These objects can focus the laser beam, resulting in damage to eyes, fire and burns. Also, to prevent inadvertent accidents, situate works in front of a wall or other structure that shields the laser beam.</td>
</tr>
</tbody>
</table>

Package Contents

- RANGE VIEWER Install CD-ROM x 1
- Installation Guide

Software Restrictions

The terms and conditions for using this software are provided in the Software User’s Agreement window that appears online during installation. This software may only be installed by agreeing to those terms and conditions.

Notes on Use

- This software is application software for Windows Vista, Windows XP or Windows 7. Neither the package nor product includes an OS.
- One of these operating systems must be installed in the computer before this software may be installed.
- Load the CD-ROM into the CD-ROM drive with the correct side up. Keep level and do not force into the slot.
- Do not dirty or scratch the CD-ROM. Dirt on the recording surface and scratches in the label may cause read errors.
- Be careful of sharp temperature changes and condensation.
- Keep the CD-ROM away from direct sunlight, heaters and other sources of heat.
- Do not subject the CD-ROM to strong impacts or drop it.
- Keep water, alcohol, thinner and other chemicals away from the CD-ROM.
- Turn ON power to the computer to eject the CD-ROM.

Notes on Storage

- After use, return the CD-ROM to its case and store with care.
- Keep the CD-ROM away from direct sunlight, heaters and other sources of heat.
- Do not store the CD-ROM in highly humid environments.

Every effort has been made in the preparation of this product. However, should you have any questions or find any mistakes, please contact the place of purchase or a customer service center.
Introduction

RANGE VIEWER is newly developed 3D scanning software capable of controlling RANGE7/5 scanning and registering, merging and editing scanned data. It adopts a new GUI that enables seamless scanning and editing of scanned data. Moreover, it runs on Windows 7, Windows Vista or Windows XP and can handle large volumes of data. It is equipped with a navigator for showing operating methods and procedures in a large navigation window, making it possible for anyone from skilled engineers to beginners to easily and speedily operate.

Main Functions

Data input
Original format: .rgv (1 shot data set) .rvm (multiple data sets),
Marker information: .rmk, .txt

Data output
ASCII, STL, original format: .rgv and .rvm, Marker information: .rmk

Scanning support
Monitored images, preview, AF and AE, scanning and rotational stage control

Editing
Data registration, data merging, point deletion

Drawing
Point shading

Required Operating Environment

OS
Windows Vista Business SP2 (64bit),
Windows XP Professional x64Edition SP2 (64bit)
Windows 7 Professional (64bit)

CPU
Core2Duo, Xeon or faster

RAM
4GB or more

Display
1280 x 1024 or higher resolution graphics

Graphic board
OpenGL board (It is recommended to use boards tested and proven by KONICA MINOLTA.)

Interface
USB 2.0 port

Installation and Uninstallation

Install and uninstall RANGE VIEWER in a computer as explained in the RANGE VIEWER Installation Guide.

(Added/Changed functions in Ver. 2.0)

1. Compatible with Windows7 Professional 64bit.
2. From the viewpoint of improvement in operability and data visibility, the GUI design was modified. 3D view of the Scanning mode screen was changed from 3 screens to 2 screens.
3. [Edit marker holes] was added to the editing function. The marker part became capable of being hole-filled by RANGE VIEWER.
4. By means of the paired points initial registration, selected data can be moved not just immediately after scanning but at other moments.
5. By means of the paired points initial registration, registration can be performed based on the plural number of data.
6. Background colors and scanned data color scheme (surface, back side) of windows were changed. Linkage of scanned data and an un-shot part can be identified easily.
7. Changed the marker display color of 2D view. A marker can be displayed at the time of contour display as well.
8. A selection screen is zoomed in while monitoring is being executed. A position during scanning became easy to confirm.
9. Rotary movement of a viewing position followed by 3D view provides more intuitive mouse operation.
10. Extensively speeded up the function to select point groups.
12. Automatically deletes groups of very small points at the time of scanning. Editing labor can be saved.
13. Strengthened the data noise deletion function, and improvement was made with the data quality of edge part.
How to Use this Manual

This Reference Manual explains RANGE VIEWER features and functions by focusing on the commands selected from menus and buttons. As in the Users Guide, explanations follow the sequence of the menu bar to elucidate the details of setting items, etc.

The screen picture in this document is the display example of Windows 7 in use.
# Table of Contents

Safety Symbols ................................................................. Cover 2  
Official Names for Application Mentioned in This Manual  
Trademarks  
About This Manual and Related Documents  
Safety Precautions .............................................................. 1  
Package Contents  
Software Restrictions  
Notes on Use  
Notes on Storage  
Introduction ................................................................. 2  
Main Functions  
Required Operating Environment  
Installation and Uninstallation  
(Added/Changed functions in Ver. 2.0)  
How to Use this Manual ...................................................... 3  
RANGE VIEWER Startup ...................................................... 6  
Startup ............................................................................. 6  
Exit .................................................................................. 7  
Window Configuration ...................................................... 8  
Scan Window .................................................................. 8  
Editing Window ................................................................. 10  
1. File .............................................................................. 12  
1.1 New ................................................................. 12  
File Formats .................................................................. 12  
1.2 Open ........................................................................ 13  
1.3 Save ........................................................................ 14  
Cautions for saving data by different file formats. .............. 14  
1.4 Save As ............................................................... 15  
1.5 Export ........................................................................ 16  
A. Exporting Files .......................................................... 16  
STL Files ........................................................................ 16  
ASC Files ........................................................................ 16  
B. Exporting Directing to Other Software with the IPC function 17  
Exporting with the IPC function (File Transfer) ................. 17  
1.6 Preferences ............................................................... 18  
1.7 Exit ........................................................................... 21  
2. Edit ............................................................................. 22  
2.1 Undo ......................................................................... 22  
2.2 Redo ......................................................................... 22  
2.3 Select ......................................................................... 23  
A. Rectangle ................................................................. 23  
B. Bezier .......................................................................... 24  
Bezier Curves .................................................................. 25  
C. Point Selection Invert ................................................... 26  
D. Element Boundary Point Select ..................................... 27  
E. Front Facing Points ..................................................... 28  
F. All Elements/Unselect All Elements ......................... 29  
G. Select All Points on Selected Elements/ Unselect All Points on Selected Elements ...................................................... 30
RANGE VIEWER Startup

When you start RANGE VIEWER, the software will attempt to recognize the RANGE7/5. When the device is recognized, measurement becomes possible. Therefore, check that the RANGE7/5 is connected correctly to the computer before starting RANGE VIEWER. However, when only editing will be performed, it is not necessary to have the RANGE7/5 connected to the computer.

Startup

Operating Procedure

1. From the Windows start menu, open [All Programs] – [KONICA MINOLTA] – [RANGE VIEWER], and select [RANGE VIEWER Ver.*.*].
   The opening window appears for 3 sec as RANGE VIEWER starts up.

   **Supplement**
   • Windows open at the maximum size when the application starts up.
   • A warning appears if the display resolution is too low.
   • You can also start directly by double clicking a RANGE VIEWER data file. (The splash screen is not displayed when you start directly from a file.)

2. Scanning status is shown in the status bar.
   • Whether properly connected to the instrument or not
   • Scanning lens
   • A warning appears until instrument temperature stabilizes.
     • A sensor icon appears when connection has been achieved.
     • A warning mark appears over the sensor icon until temperature stabilizes.
     • A warning mark appears over the sensor icon if the temperature changes (approx. ±1.5°C) from the last calibrated temperature.
     • The sensor icon is ghosted if the instrument is not connected.

   **Supplement**
The RANGE7/5 requires time to warm-up. RANGE VIEWER displays a warning for a short time after power is turned ON based on the internal temperature of the RANGE7/5.
Exit

Operating Procedure


RANGE VIEWER quits.

The message to confirm saving data will appear, if there are any elements that were changed after scanning or the last time that data was saved.
- When you click the [Yes] button, the measured and edited data are saved and the RANGE VIEWER is exited.
- When you click the [No] button, the RANGE VIEWER is exited without the measured and edited data being saved.

Supplement

“Element” is the 3D data unit used by RANGE VIEWER. Normally, one element is generated and edited from scanning.
Window Configuration

Scan Window
RANGE VIEWER has a “scan window” for scanning and an “editing window” for editing. These windows can be opened by clicking the scan and edit tabs at the top of the window.

Common GUI

A Title bar
Displays the name of the software.

B Menu bar
Contains various functions for operating RANGE VIEWER. Clicking a header opens a drop-down menu from which functions can be selected.

C Menu buttons
Buttons for executing often-used functions of the menu bar.

D Scan tab
Switches to the scanning mode for controlling the RANGE7/5 and acquiring 3D data. Click to switch the screen to the “Measurement Screen”.

E Edit tab
Switches to the editing mode for viewing and editing acquired 3D data using editing tools. Click to switch the screen to the “Edit Screen”.

F Status bar
Displays the connection status of the RANGE7/5 and information such as operation and procedure hints.

G Navigation message
Displays hints and messages on upcoming operations according to selected operations and status.

H Element list
List of registered elements. Elements can be selected/unselected as well as shown/hidden by checkbox operation.

*The element list for the "scan window" is different from that of the "editing window", and only a single element can be selected in the "scan window" element list.

*Selected elements only can be displayed by selecting the elements while pressing the Alt key.
Scan Window GUI

1 Scan settings
The current settings of the scan parameters are displayed. Scan parameters can be changed. If the data reduction ratio setting is changed, data can be re-duced when they are scanned.

2 Monitor button
Clicking projects the FOV (Field Of View) indicator on the work and displays a 2D image of the work in the monitor window.

3 AE/AF buttons
Starts AE/AF, AF only or AE only based on scan settings.

4 Spot AF button
When you press the point AF button and then specify the focus point on the monitor screen by clicking on the point you want to focus on, the RANGE7 focuses automatically on the specified point.

5 Preview button
The object is prescanned.

6 Scan button
Scans the work based on scan settings.

7 Monitor window
Perform monitoring of the object by the monitor button, and display the zoomed out monitor screen. You can check and adjust the FOV (field of view = measurement area). The green vertical line indicates the center of the lens, while the black vertical line is for adjusting scanning distance and focus.

8 Selection screen
Displays only the data selected from the element list. Scanned objects prescanned by the preview button or the data scanned by the scanning button are selected and displayed in this screen. The paired points registration is done by the 3D image on this screen and the 3D image on the measured screen. When the scanned data are selected, the letters on the upper left indicate [Selection] and if previewed data are selected, then the display becomes [Preview].

9 Previous window
This is the window to confirm scanned data as 3D image. Shows setting of Display/Non-Display of the element list, and elements selected from the element list are shown in selected colors while the rest are in a non-selected color. Paired points are performed in 3D image of this screen and selected (preview) screen of 3D image.
Editing Window

RANGE VIEWER has a “scan window” for scanning and an “editing window” for editing. These windows can be opened by clicking the scan and edit tabs at the top of the window.

Common GUI

A Title bar
- Displays the name of the software.

B Menu bar
- Contains various functions for operating RANGE VIEWER. Clicking a header opens a drop-down menu from which functions can be selected.

C Menu buttons
- Buttons for executing often-used functions of the menu bar.
  - Viewpoint rotate button
  - Viewpoint move button
  - Zoom button
  - Zoom selected area button
  - Fit to window button
  - Show points button
  - Show shaded points button

D Scan tab
- Switches to the scanning mode for controlling the RANGE7/5 and acquiring 3D data. Click to switch the screen to the “Measurement Screen”.

E Edit tab
- Switches to the editing mode for viewing and editing acquired 3D data using editing tools. Click to switch the screen to the “Edit Screen”.

F Status bar
- Displays the connection status of the RANGE7/5 and information such as operation and procedure hints.

G Navigation message
- Displays hints and messages on upcoming operations according to selected operations and status.

H Element list
- List of registered elements. Elements can be selected/unselected as well as shown/hidden by checkbox operation.
**Point** This window is for editing scanned data. Preview data cannot be edited. Also, reference markers are not shown.

### Editing Window GUI

#### 1 Editing tool buttons
For editing 3D images. The selected button is highlighted.

- **Rectangle select**
  Draws a rectangular area for selecting/unselecting points.
- **Bezier select**
  Draws a Bezier curve for selecting/unselecting points.
- **Point selection invert**
  Inverts points between selected/unselected.
- **Element boundary point select**
  Selects only boundary points of elements.
- **Front facing points**
  Enables selecting points having the normal facing towards the camera
- **Point delete**
  Deletes the selected points.
- **Undo**
  This cancels the last edit operation and returns the software to the state just before that operation.
- **Redo**
  This redoes the edit operation canceled with the “Undo” button.
- **Element registration**
  Registers the selected elements.
- **Edit marker holes**
  Edit data of the market part.
- **Element merge**
  Merges the selected elements.
- **Open**
  Opens files.
- **Save**
  Saves files.
- **Export**
  Exports elements to other applications.

#### 2 3D view
Displays a 3D view of works as they are edited.

To delete an element, select the element to delete from the element list and then click the [Delete Element] button. Multiple elements may be selected at a time.

#### 3 Element delete button
To delete an element, select the element to delete from the element list and then click the [Delete Element] button. Multiple elements may be selected at a time.
1. File

1.1 New

When selected, the currently open file is discarded and a new file is created in rvm format. If opened files need to be saved, save them before selecting [New].

<table>
<thead>
<tr>
<th>Operating Procedure</th>
<th>Shortcut</th>
<th>Ctrl+N</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select [New] from the [File] menu.</td>
<td>—</td>
<td>—</td>
<td>—</td>
</tr>
</tbody>
</table>

The currently open file closes and a new file is created.

Files can be created in rvm and rgv formats. See below.

---

File Formats

RANGE VIEWER uses two file formats: rvm that groups all elements into a single file and rgv that creates one file for each element.

**rvm format**

Multiple elements are grouped into a single file.

**rgv format**

Each element has its own file.
1.2 Open
This command opens files. You can select whether to open rvm or rgv files.

Operating Procedure | Shortcut | Ctrl+O | Edit Button |
---|---|---|---|
1 Select [Open] from the [File] menu.

The Open File dialog box appears. Files can be opened from the editing window by clicking [Open] button.

2 This specifies the file type.

Files of the selected format appear.

Supplement

rvm: The currently opened file is discarded and a new file is opened. To keep the currently opened file, save the file and then select “Open”.

rgv: Elements are added to the currently open file.

3 Select a file and click [Open] button.

When having selected rvm file, only one file can be opened at a time.

Supplement

Only files of rvm or rgv format can be opened. For details on the file format, see the column on the bottom row of Page 12.
1.3 Save

When you select [Save], the file that is currently open and being worked on is saved with its current name, overwriting the older version of the file. Only rvm file format can be saved.

Operating Procedure

1. Select [Save] from the [File] menu.

   If the file has been newly created, the Save As dialog box appears.
   If an existing file has been edited, the file is overwritten and saved.
   Files can be saved from the editing window by clicking [Save] button.

   ![Operating Procedure Image]

   Supplement
   1. For details on the file format, see the column on the bottom row of Page 12.
   • You can set automatic save as described in “1.6 Preferences” on Page 18.
   • Only rvm files can be overwritten and saved.

Cautions for saving data by different file formats.

   • rvm format files can be saved with [Save] button, but “rgv” files can not.
   • Even when saving an “rgv” file with its current name, you must use [Save As].
   • The path for saving a new file is the default file path set in the environmental settings (Page 20).
   • When you save a file in rgv format, the file name becomes Input file name + "- (Hyphen)" + Element Name + ".rgv" (extension). As many files will be created as the number of the elements.

   ![Cautions for saving data by different file formats Image]
1.4 Save As

Selecting [Save As] allows you to rename open files and save them under different names.

**Operating Procedure**

<table>
<thead>
<tr>
<th>Operating Procedure</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Select [Save As] from the [File] menu.</td>
<td></td>
</tr>
<tr>
<td>2 Select a file format and input a file name.</td>
<td></td>
</tr>
<tr>
<td>3 Click the [Save] button.</td>
<td></td>
</tr>
</tbody>
</table>

The Save As dialog box appears.

File names must conform to Windows restrictions.

![Save As dialog box](image)

**Supplement**

For both rvm files and rgv files, you can save with the current name by selecting [Save As]. For details on the file format, see the column on the bottom row of Page 12.
1.5 Export

Scanning data and editing data can be exported to other 3D point processing software from other manufacturers. Data can be exported for use with other programs either by saving the 3D data in a file or by directly exporting the 3D data to external software using IPC function.

A. Exporting Files

Memo

The method of exporting to a file is generally called “Exporting”.

This converts from the unique formats (rvm and rgv) used as the standard with this software into other file formats and saves the file in that format.

Operating Procedure


   The Save As dialog box appears.

2. Select a file format for export and input a file name.

   Data can be exported in STL or ASC format.

3. Click the [Save] button.

   The file is saved in the selected (STL or ASC) format.

Supplement

For details on STL (binary) and ASC formats, see below.

To read rgv files on other 3D point processing software, select [File] - [Export] and save the file in rgv format. See “When Saving rvm and rgv Files” on p. 14.

STL Files

This file format is specifically for SLA CAD software by 3D Systems. It is supported by a wide range of analysis software and allows 3D data to be directly input in STL format for use with prototyping machines. The recorded 3D modeling data forms a polygon of the surface normal vectors and coordinates for three vertexes of a triangle. STL files can be ASCII or binary format, but RANGE VIEWER exports only the binary format. Merged data is exported to a single STL file without connections between the merged elements.

ASC Files

Exported ASC (ASCII) files contain 3D point data without normal (Normal line) information.
B. Exporting Directing to Other Software with the IPC function

**Memo**
- The method of directly exporting to external software is generally called “File Transfer”.

**Note**
- When exporting directly to external software, it is necessary to first start the external software that will receive the export and prepare it to be able to import.
- For details on how to prepare the external software for import operation, see the user’s manual for the external software.

### Operating Procedure

<table>
<thead>
<tr>
<th>Steps</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check that the external software that will receive the export has started and that it is ready to import.</td>
</tr>
<tr>
<td>2</td>
<td>Select [Export] – [To Application] from the [File] menu. Files can be exported from the editing window by clicking [Export] button. * “Application” sub menu of Export will be activated when the third-party software is ready to import the 3D data from RANGE VIEWER. At this time, “Application” menu name will be changed to the name that set by the third-party software.</td>
</tr>
<tr>
<td>3</td>
<td>Click [Export] button. The file is sent to the connected software. The transfer is monitored by the progress bar. The time required to transfer the file varies according to the amount of data and number of scanned points.</td>
</tr>
</tbody>
</table>

### Exporting with the IPC function (File Transfer)

Exporting with [File] – [Export] – [Application Software *] uses the IPC function. Compared to exporting through a file (Export), the file transfer export method is simpler and faster because it eliminates the need to save the file or read in the file. Confirm that the external software supports the IPC function.

* “Application Software” is enabled when preparations are complete on the external software side for receiving the export from RANGE VIEWER, and shows the name set by the external software.
1.6 Preferences

The preferences allow you to set 3D image viewing, file saving operations and more.

<table>
<thead>
<tr>
<th>Operating Procedure</th>
<th>Shortcut</th>
<th>Shift+F1</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. To set display settings, click the [Display] tab. To set file settings, click the [File] tab.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. After making settings, click the [OK] button.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Preferences are immediately applied. To default the settings, click the [Default] button.

About parameters in [Preferences Dialog Box]

**[DISPLAY] tab**

**Element display reduction ratio**

Only while the viewpoint is rotating or moving, the display ratio is reduced.

Sets the display ratio of points to elements for element views. Make a selection from the drop-down list.

Selectable ratios: 1/1, 1/4, 1/9, 1/16

Note: Only the display ratio is reduced; points of the original element are not deleted.
Shading color of selected elements  
Sets the shading color of selected elements and all elements of the scan tab. 
Clicking the button of the currently selected color opens the Color Setting dialog box where colors can be freely selected.

![Color Setting Dialog]

- **Auto**
  - When a checkmark is placed in the checkbox, the color select button is hidden and shading colors for selected elements are automatically set.

Shading color of unselected elements  
Sets the shading color of unselected elements. The currently selected color appears in the button. Clicking the button opens the Color Setting dialog box where colors can be freely selected.

Size of shaded points  
Sets the size of shaded points. Setting range: 1 ~ 10

Color of selected points  
Sets the color of selected points. The currently selected color appears in the button. Clicking the button opens the Color Setting dialog box where colors can be freely selected.

Color of unselected points  
Sets the color of unselected points. The currently selected color appears in the button. Clicking the button opens the Color Setting dialog box where colors can be freely selected.

Size of points (1 - 10)  
Sets the size of points. Setting range: 1 ~ 10

Background color of 3D view  
Sets the background color of 3D views. The currently selected color appears in the button. Clicking the button opens the Color Setting dialog box where colors can be freely selected.

- **Display title of 3D view**  
  - Sets whether to show/hide the title of the 3D view. The title appears in the 3D view when a checkmark is placed in the checkbox.

- **Display axis**  
  - Sets whether to show/hide the 3D coordinate axes. The axes appear in the 3D view when a checkmark is placed in the checkbox.

**OK button**  
When you click the [OK] button, the contents set in the [Environmental Settings] dialog are applied and the dialog is closed.

**Cancel button**  
When you click the [Cancel] button, the changes made in the [Environmental Settings] dialog are discarded and the dialog is closed.

**Default button**  
Returns the settings to the default values.
[FILE] tab

Default file path

This displays the default file path. The file path displayed here is the default file path for the dialog for opening/saving a file. If Preferences ends with the default file path being empty, the folder that was previously opened will open when the file is saved, exported or opened.

Browse button

For browsing file paths. When clicked, the Browse Folder dialog box appears whereby enabling you to select the default file path. The selected path appears in the [Default file path] box.

Auto Save

☑ Data is saved at the input time interval when a checkmark is placed in the checkbox. Automatic saves are executed only if an element is changed. Files are saved in the rvm format.

Intervals (1 – 60)

Sets the time interval at which data is automatically saved. Setting range: 1 ~ 60 min.

OK button

When you click the [OK] button, the contents set in the [Environmental Settings] dialog are applied and the dialog is closed.

Cancel button

When you click the [Cancel] button, the changes made in the [Environmental Settings] dialog are discarded and the dialog is closed.

[DISPLAY] tab

[FILE] tab
1.7 Exit

This command quits RANGE VIEWER.

Operating Procedure


   RANGE VIEWER quits.

   The message to confirm saving data will appears, if there are any elements that were changed after scanning or the last time that data was saved.
   • When you click the [Yes] button, the measured and edited data are saved and the message is closed.
   • When you click the [No] button, the message is closed without the measured and edited data being saved.
2. Edit

2.1 Undo

This command cancels the last editing operation on the editing window.

**Note**
Only the last operation is undone. Moreover, merging cannot be reversed.

<table>
<thead>
<tr>
<th>Operating Procedure</th>
<th>Shortcut</th>
<th>Ctrl+Z</th>
<th>Edit button</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Click [Undo] button or select [Undo] from the [Edit] menu.</td>
<td></td>
<td>Ctrl+Z</td>
<td></td>
</tr>
<tr>
<td>The last editing operation executed on the editing window is reversed. Only the last operation can be undone.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• If elements were merged, merging cannot be reversed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• If scanning imported another element after editing was done, the last editing operation can still be undone.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

2.2 Redo

This command reexecutes the last editing operation on the editing window that was undone by the [Undo] command.

**Note**
Only the last undone operation can be reapplied.

<table>
<thead>
<tr>
<th>Operating Procedure</th>
<th>Shortcut</th>
<th>Ctrl+Y</th>
<th>Edit button</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Click [Redo] button or select [Redo] from the [Edit] menu.</td>
<td></td>
<td>Ctrl+Y</td>
<td></td>
</tr>
<tr>
<td>The last undone operation executed on the editing window is reapplied. Only the last undone operation can be redone.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• If scanning imported another element after editing was done, the last undone operation can still be reapplied.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
2.3 Select

When you want to erase unnecessary data, such as a background shot when the measurement is done, you can select the section you want to erase and invert the selected section. To use these commands, the edit tab must be selected and at least one element must be registered. Points can be selected using rectangles, Bezier curves, element boundaries or as all points, and reversed between selected/unselected. Only the points of selected elements in the element list are selected. However, if front point selection is ON, only points facing to the front are selected. And, both points of elements selected in the element list and points of unselected elements appear in the 3D view.

A. Rectangle

This command selects/unselects all points lying within rectangles drawn with the mouse.

---

Operating Procedure  | Shortcut | Shift+R | Edit Button |
--- | --- | --- | --- |
1 Click the [Rectangle select] button or select [Select] – [Rectangle] from the [Edit] menu. |  |  |  |
2 While holding down the left mouse button, drag to enclose the area you want to select (deselect) with a rectangle. Rectangle is set when left mouse button is released. |  |  |  |
3 When you click the right mouse button inside the area enclosed by the rectangle, a pop-up menu is displayed. |  |  |  |
4 When you click the right mouse button inside the area enclosed by the curved line or at the end of drawing the curved line, a pop-up menu is displayed. The selected area appears in the color set for [Color of selected points] on the Preferences dialog box. • To redraw the target area, click [Undo] button and reselect the area. • To add more target areas, repeats steps 2 ~ 4. • Selecting [Cancel] in the pop-up window cancels the drawn rectangle. |  |  |  |
5 Edit the selected areas as needed. • Delete selected points. • Invert selected points between selected/unselected. • Unselect selected points. |

Supplement
All selected elements in the element list are subject to this operation.
### B. Bezier

This command selects/unselects all points lying within Bezier curves drawn with the mouse.

<table>
<thead>
<tr>
<th>Operating Procedure</th>
<th>Shortcut</th>
<th>Shift+B</th>
<th>Edit Button</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong> Click the [Bezier curve select] button or select [Select] – [Bezier] from the [Edit] menu.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>2</strong> While holding down the left mouse button, draw a line to enclose the area you want to select (deselect) with a curved line. For instructions on enclosing areas in Bezier curves, see “Bezier Curves” on the next page.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>3</strong> When you click the right mouse button inside the area enclosed by the curved line or at the end of drawing the curved line, a pop-up menu is displayed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>4</strong> Select [Close] from the pop-up menu to close the encompassed area.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>5</strong> Select [Select] ([Unselect]) from the pop-up menu to include (exclude) the selected area.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• To redraw the target area, click [Undo] button and reselect the area.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• To add more target areas, repeats steps <strong>2</strong> ~ <strong>5</strong>.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Selecting [Cancel] in the pop-up window cancels the drawn curve.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>6</strong> Edit the selected areas as needed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Delete selected points.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Invert selected points between selected/unselected.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Unselect selected points.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To Change the Color of a Selected Area

Change the color in the preferences. See “1.6 Preferences” on p.18.

Supplement

All selected elements in the element list are subject to this operation.
**Bezier Curves**

Left-clicking the mouse creates control points.

Holding and pressing the left mouse button and dragging the pointer creates a continuous line from the last control point.

Targeted areas are drawn by a combination of control points and continuous lines from them. Repeat these operations to enclose the targeted areas in a Bezier curve.

**Note**
- You cannot undo the last operation when drawing a Bezier curve.

Lastly, as stated in the procedure of the previous page, right-click the mouse to open the pop-up menu and, select [Close] to close the drawn area.
- Selecting [Cancel] in the pop-up window cancels the draw curve.
- Pressing the [ESC] key on the computer cancels the Bezier curve mode.

**Fine-Adjusting Bezier Curves**

After a Bezier curve has been closed, the curve can be moved by placing the center of the + pointer on the yellow points of the Bezier curve, pressing and holding the left mouse button and dragging the pointer. Release the left mouse button when the point is at the desired position.

The length of the continuous line represents the amount of pulling force, therefore that force can be increased or decreased. This changes the curvature of the line.

As when moving curves, the curve can be reshaped by placing the center of the + pointer on the yellow point at the end of a continuous line on the curve, pressing and holding the left mouse button and dragging the pointer. Release the left mouse button when the point is at the desired position.

**Supplement**

You cannot undo to return to the previous point during outlining of a selection area with a Bézier curve. When the area has been outlined to some extent, it is more efficient to continue outlining as is and after the outline is completed, revise with the method above.
C. Point Selection Invert
Inverts the selected / unselected status of the selected element points.

<table>
<thead>
<tr>
<th>Operating Procedure</th>
<th>Shortcut</th>
<th>Ctrl+R</th>
<th>Edit Button</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Select points using either a rectangle or Bezier curve, and click [Point selection invert] button or select [Select] – [Invert] from the [Edit] menu.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2. Invert points between selected and unselected. When there is no element selected partially with the rectangle or Bezier curve, the points in all elements selected in the element list are inverted between selected and unselected.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Click [Point selection invert] button to invert the area back.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4. Edit the selected areas as needed.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Delete selected points.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Invert selected points between selected/unselected.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>• Unselect selected points.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

To Change the Color of a Selected Area
Change the color in the preferences. See “1.6 Preferences” on p.18.

Supplement
All selected elements in the element list are subject to this operation.
D. Element Boundary Point Select

This button automatically selects boundary points (circumference of holes) of elements. With merged elements, the boundary points of all merged elements are selected.

Operating Procedure


2. Select boundary points of the element.

   Of all the points that compose the element, only the boundary points are selected.

3. Edit the selected areas as needed.
   - Delete selected points.
   - Invert selected points between selected/unselected.
   - Unselect selected points.

Supplement

All selected elements in the element list are subject to this operation.
### E. Front Facing Points

This button automatically selects only the points that compose polygons in the current view of the selected elements (rectangle or Bezier curve used) that are facing front and visible.

### Operating Procedure

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1    | **Click [Front facing points] button to highlight it or select [Select] – [Front facing points] from the [Edit] menu.**  
![Front facing points selection ON when the front point select button is highlighted.](image) |
| 2    | **Select the desired areas using a rectangle or Bezier curve, while the front point select button is highlighted.**  
Only the points facing front in the current view of the elements in the selected areas are selected.  
![Select desired areas](image) |
| 3    | **Edit the selected areas as needed.**  
- Delete selected points.  
- Invert selected points between selected/unselected.  
- Unselect selected points.  
![Edit selected areas](image) 
(Example: When deleting by Points, only surfaces with holes facing the front are deleted.) |

### Shortcut

**Shift+F**

### Edit Button

- Select all Elements  
- Unselect All Elements  
- Select all points on selected elements  
- Unselect all points on selected elements

### Supplement

All selected elements in the element list are subject to this operation.
F. All Elements/Unselect All Elements

These commands select and unselect all elements, respectively. The commands apply only to elements, therefore point selection does not change.

<table>
<thead>
<tr>
<th>Operating Procedure</th>
<th>Shortcut</th>
<th>Alt+A/ Shift+Alt+A</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Select [Select] – [Select all Elements] from the [Edit] menu. To unselect all elements, select [Unselect all Elements].</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 All elements in the element list are selected and displayed in the [Shading color of selected elements] set in the Preference dialog box. Selected points remain the color set for selected points.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Supplement

All selected elements in the element list are subject to this operation.
G. Select All Points on Selected Elements/ Unselect All Points on Selected Elements

These commands select and unselect all points of selected elements, respectively.

<table>
<thead>
<tr>
<th>Operating Procedure</th>
<th>Shortcut</th>
<th>Edit Button</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>1</strong> Select the desired elements and select [Select] – [Select all points on selected elements] from the [Edit] menu.</td>
<td>Ctrl+A/ Ctrl+Shift+A</td>
<td></td>
</tr>
</tbody>
</table>

To unselect all points of the selected elements, select [Unselect all points on selected elements].

| **2** All points of the selected elements are selected and displayed in the [Color of selected points] set in the Preference dialog box. | | |
| All points of the selected elements are selected and displayed in the [Color of selected points] set in the Preference dialog box. | | |

With [Unselect all points on selected elements], all points are unselected and displayed in the [Shading color of selected elements] set in the Preference dialog box.

Supplement

All selected elements in the element list are subject to this operation.
2.4 Delete

A. Deleting Selected Points

This command deletes selected points of elements.

Operating Procedure


2. The selected points are deleted.

To restore the deleted points, click the [Undo] button.

B. Deleting Selected Elements

This command deletes elements selected in the element list.

Operating Procedure

1. Select the desired elements from the element list.


To restore the deleted elements, click the [Undo] button.

Supplement

All selected elements in the element list are subject to this operation. Before dealing with the operation, an alert warning message is displayed.
## 2.5 Registration

This function should be used for more precise registration of elements for which initial registration has already been completed. This command is for positioning two or more elements in the element list. When executed, the selected element of the highest position serves as the reference for positioning the other elements. A dialog box appears with the results.

<table>
<thead>
<tr>
<th>Operating Procedure</th>
<th>Shortcut</th>
<th>Alt+Shift+R</th>
<th>Edit Button</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Select the desired elements from the element list.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Click [Element registration] button or select [Registration] from the [Edit] menu.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Registration calculations begin. Once ended, a dialog box appears with the calculated Mean Error and Standard Deviation.

- To continue registration, click [Repeat]. Calculations start again.
- Selecting [Quit] ends the registration.

To cancel registration elements, click [Undo] button.

### Supplement
Recalculate the mean error and standard deviation until the values no longer change.

### Mean Error and Standard Deviation
The mean error and standard deviation are reference values for registration results. Both are indicated in units of mm: mean error giving the average amount of error in the registration result and the standard deviation giving the variance of that error. Normally, as the values approach “0”, the closer the position matches the reference position.

### Registration with marker information
If there are markers, registration can be performed with the marker information.
If registration is performed, the dialog at right is displayed. To perform registration with the marker information, select [Yes]. If registration is performed with the marker information, each position is adjusted finely so that the shapes of the other parts will match while matching of the marker positions is maintained. Positions can be adjusted finely after [Initial registration] is performed with markers.
2.6 Edit marker holes

When registration is performed by using a marker, editing is done for data around the marker which is pasted to the scanned object. In case scanned data (rvm, rgv file) and a reference marker (rmk file) are read out, editing can be done for data around the marker in the same way.

The function to keep points on the marker selected (selection of points on the marker) and the function to replace point groups around the marker with the shape calculated based on point groups around the marker can be executed.

### Operating Procedure

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1    | Selects elements which need to be edited on the element list.  
Selected elements |
| 2    | Click the [Edit marker holes] button.  
Or select [Edit marker holes] on the [Edit] menu. |
| 3    | Select functions to be executed.  
• By clicking [OK], the selected function is executed.  
• By clicking [Cancel], the dialog is closed without executing the selected function. |

#### [Edit marker holes] dialogue

**[Selection of points on markers]**

Select all the points near the reference marker in the form of a discus. By deleting in the [Edit Mode] screen, a hole is formed.

**Supplement**

After executing selection of points on the marker, points which were selected before the execution become non-selected. Only the points on the marker are selected. This operation can return the condition to the original state by cancelling.

**[Marker hole-filling]**

Replace points on the reference marker with the shape calculated based on the point around the reference marker. By means of [Hole-filling level], the acceptance level of a hole-filling result can be set. By increasing the number, markers pasted to a round surface can be hole-filled.

**Supplement**

When the number of selected elements around a reference marker is few, the points around the reference marker are selected. Selected points before the execution are not selected, and only the points which failed to perform hole-filling are selected. This operation can return to the original state by cancelling.
2.7 Merge

This command merges two or more registered elements from the element list. When executed, unless saved under another name, the original elements are deleted and only the resulting merged element remains.

>Note
Element combination cannot be undone with the [Undo] button.

**Operating Procedure**

<table>
<thead>
<tr>
<th></th>
<th>Shortcut</th>
<th>Alt+Shift+M</th>
<th>Edit Button</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Select the desired elements from the element list.

2 |          |             |             |
Click [Merge] button or select [Merge] from the [Edit] menu.

3 |          |             |             |
Select whether to save the original data or not, before merging the elements.

If [Yes] is selected, the Save As dialog box appears for you to save the current scanned data. After inputting a file name and clicking the [Save] button, the data is saved before the elements are merged.
Selecting [No] merges the elements without saving their original data.
Selecting [Cancel] cancels merge processing.

4 |          |             |             |
When the merge command is executed, a confirmation message appears.
• Selecting [OK] merges the elements.
• Selecting [Cancel] cancels merge processing.

5 |          |             |             |
The merged elements are deleted from the element list and appear as a single merged element.
The file name is “Merged-x” (x being an integer from 0 up).
3. View

3.1 Viewpoint

Change the viewpoint direction of the 3D data by selecting the command from the mouse right-click pop-up menu or from the menu bar.

Operating Procedure

1. Click the right mouse button to open a pop-up menu of commands and select [Viewpoint] - [Front], [Back], [Top], [Bottom], [Right] or [Left], or select [Viewpoint] and select a viewpoint from the [View] menu.

3D data are displayed from the direction selected.

3D Orthogonal Coordinates

The position of a point in a 3D space is represented by coordinates in a 3D orthogonal coordinate system. The coordinate system here uses a point near to the center of the RANGE7/5's receiver lens. The Z direction extends from directly behind the light receptor along the optical axis to the front, the Y direction is above the receiver and the X direction is to the right.

* In the output 3D data, specific offsets are applied respectively along the XYZ axes.

Viewpoint

RANGE VIEWER lets you view elements from the front, back, top, bottom, right or left, or in most any orthogonal projection.
3.2 Rotate/Zoom

The viewpoint can be rotated, moved, zoomed in/out and matched to the display size. Selected areas can be zoomed in/out, as well. The commands can be executed from menu buttons or the menu bar. You can also perform this operation from the pop-up menu displayed by clicking the right mouse button menu.

Operating Procedure

1. Click a menu button or select [Rotate/Zoom] – [Rotate], [Pan], [Zoom], [Area Zoom] or [Fit to window] from the [View] menu.

The selected command is activated. See the following for command details.

Menu Button Functions

**Viewpoint rotate**

The viewpoint can be rotated by pressing and holding the left mouse button and dragging the mouse. Left-clicking on a point above the scan data while holding down the [Ctrl] key will switch the center of rotation to the position of the point.

The viewpoint can be moved by pressing and holding the center mouse button (wheel) and dragging the mouse. While the button is depressed, the cursor appears as.

The viewpoint can be zoomed in/out by spinning the mouse wheel.
**Viewpoint move**
The viewpoint can be moved by pressing and holding the left mouse button and dragging the mouse to move the cursor up and down on the screen.

**Zoom**
You can zoom in/zoom out the display range by pressing and holding the left mouse button, and dragging the pointer up/down in the screen.

**Zoom selected area**
A rectangle target area appears over the view while pressing and holding the left mouse button. The mouse can be dragged to enlarge/reduce the area.

When the left mouse button is released, the rectangle area is set.

Clicking the right mouse button opens a pop-up menu with [Zoom In], [Zoom Out] and [Cancel] commands. Operations are executed by selecting those commands.

**Fit to window**
Clicking the button automatically zooms the image so that all elements appear in the view.
3.3 Display Mode

3D data views can be switched between shaded images and images made up of points. The commands can be executed from menu buttons. You can also perform this operation from the pop-up menu displayed by clicking the right mouse button menu.

<table>
<thead>
<tr>
<th>Operating Procedure</th>
<th>Shortcut</th>
<th>Ctrl+Space</th>
<th>Edit Button</th>
</tr>
</thead>
<tbody>
<tr>
<td>Click either [Show points] button or [Show shaded points] button, or select [Display mode] – [Points] or [Shading] from the [View] menu.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>The 3D data view appears in the selected display mode.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Points and Shades Display Modes

**Show points**
Displays 3D data as a set of points. The points image does not calculate the 3D shading used in shaded images, therefore it can be drawn more quickly than shaded views. Processing goes faster with the points image when deleting unnecessary points and other editing operations. The size of the points can also be set from 1 to 10. See “1.6 Preferences” on p. 18.

**Show shaded points**
Displays 3D data with shading. A sense of volume is created by calculating shadows from the location of the light source and reflected light.
3.4 Element Information

Element information is recorded in scanned data. To make it easier to view and edit this information, elements can be selected from the element list and commands executed from the menu bar or a pop-up menu opened by right-clicking the mouse.

Operating Procedure

1a Select an element from the element list, right-click the mouse to open the pop-up menu and select [Element information]. The Element Information dialog box appears.

1b Select [Element information] from the [View] menu.

- The Element Information dialog box appears.

Select an element from the [Element name] combo box.

2 Set element information, color when selected and whether to show or hide the element.

In the [Measurement Environment], the contents recorded during measurement are displayed. [Number of points] indicates the number of points that compose the 3D data.
### Element Information Dialog Box

<table>
<thead>
<tr>
<th>Element name</th>
<th>Displays the element name. Element information differs according to the element selected in the combo box. The name in the combo box may also be changed.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Scan environment</td>
<td>Displays parameters used in element scanning.</td>
</tr>
<tr>
<td>Date</td>
<td>The date of measurement of the selected element is displayed.</td>
</tr>
<tr>
<td>Scanning instrument type</td>
<td>Displays the type of the instrument used to scan this element.</td>
</tr>
<tr>
<td>Instrument serial number</td>
<td>The serial number of the measurement device used to measure the element is displayed.</td>
</tr>
<tr>
<td>Lens type</td>
<td>Displays “TELE/WIDE” as the type of lens used to scan the element. “---” appears with merged elements if different types of lenses were used to scan the individual elements.</td>
</tr>
<tr>
<td>Ambient temperature (deg.)</td>
<td>Displays the temperature of the instrument at the time the element was scanned.</td>
</tr>
<tr>
<td>Number of scans</td>
<td>Displays the number of times the selected element was scanned. “+1” is displayed if the element was created through a Dark Surface mode.</td>
</tr>
<tr>
<td>Data reduction ratio</td>
<td>Select a data reduction ratio from [1/1], [1/4], [1/9] and [1/16]. Since the number of data in the original element is deleted for scanning, the data reduction ratio of the scanned data cannot be changed.</td>
</tr>
<tr>
<td>Scan distance (mm)</td>
<td>Displays the distance from the selected element in scanning.</td>
</tr>
<tr>
<td>Laser power</td>
<td>Displays the exposure level used in element scanning.</td>
</tr>
<tr>
<td>Temperature at calibration (deg.)</td>
<td>Displays the instrument temperature after calibration.</td>
</tr>
<tr>
<td>Calibration time</td>
<td>Displays the date and time that the instrument was calibrated.</td>
</tr>
<tr>
<td>Number of points</td>
<td>Displays the effective number of points of the element.</td>
</tr>
<tr>
<td>Color of selected element</td>
<td>Displays the color used when the element is selected. Although the shading color of selected elements is set in the Preferences dialog box, this shading color can be individually set for each element. The color in the element list is that selected here.</td>
</tr>
</tbody>
</table>

Clicking the color button opens the [Color] dialog box where colors can be freely selected.

<table>
<thead>
<tr>
<th>Display status of element</th>
<th>Displays whether the element is shown or hidden. The setting can be changed. This item is linked to the checkbox in the element list.</th>
</tr>
</thead>
<tbody>
<tr>
<td>3D image</td>
<td>Displays the 3D image of the element in two dimensions. The XY points are the horizontal and vertical edges of the image, while the Z coordinate is displayed on a grey scale. “Merged” is displayed for merged elements.</td>
</tr>
</tbody>
</table>
4. Measure

WARNING

Do not look directly into the laser emission window.
Keep lenses, objects with mirror-like surfaces and optical elements out of the optical path. These objects can focus the laser beam, resulting in damage to eyes, fire and burns. Also, to prevent inadvertent accidents, situate works in front of a wall or other structure that shields the laser beam.

4.1 Monitor

This command monitors the work and displays it in the monitor window so that you can position the scanning area. A vertical green line representing the center of the lens to aid positioning, and a vertical black line to help you adjust the stand-off distance and focus will appear.

Operating Procedure

1. Click [Monitor] button or select [Monitor] from the [Measure] menu. The image obtained from monitoring appears in the monitor window.

While watching this image, you can adjust the location and posture of the work and RANGE7/5 so that the targeted scan areas fits inside the monitor window and straddles the green vertical line marking the lens center at the center of the window.

Supplement

• Monitoring automatically ends 10 min after being started.
• If another button is clicked while monitoring is in progress, monitoring ends and the software transitions to the processing of the clicked button.
Scan Position Adjustment

The location and posture of the work and RANGE7/5 can be adjusted so that the two are appropriately positioned for scanning. These adjustments are made by activating the monitoring feature and watching the work in the monitor window.

<table>
<thead>
<tr>
<th>Distance to work and work size</th>
<th>(Unit: mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lens</td>
<td>TELE lens</td>
</tr>
<tr>
<td>Distance</td>
<td>450</td>
</tr>
<tr>
<td>X × Y</td>
<td>79 × 99</td>
</tr>
<tr>
<td>Z</td>
<td>54</td>
</tr>
</tbody>
</table>

**Memo** For RANGE5, please refer to the WIDE lens data.

Distance to work and work size in Multi focus mode (Unit: mm)

<table>
<thead>
<tr>
<th>Lens</th>
<th>TELE lens</th>
<th>WIDE lens</th>
</tr>
</thead>
<tbody>
<tr>
<td>Distance</td>
<td>462</td>
<td>781</td>
</tr>
<tr>
<td>X × Y</td>
<td>81 × 102</td>
<td>138 × 172</td>
</tr>
<tr>
<td>Z</td>
<td>54</td>
<td>97</td>
</tr>
</tbody>
</table>

**Memo** For RANGE5, please refer to the WIDE lens data.

FOV Indicator

A FOV (field of view) indicator projects the pattern of light shown at right on the work to make it easier to identify the scan area. The FOV indicator is synchronized with motor operation to continuously project the light. (Note: FOV indicator updates slow while RANGE VIEWER windows are being operated.)

Multi focus

In the Multi focus mode, scanning is performed twice by changing the focal point. When the Multi focus mode is active, the data of the area closer to the focal point is selected for calculation. Depending on the work, the effects may differ. However, when you want to obtain results with less data noise, set Multi focus to "Enable." Compared to when Multi focus is set to "Disable," it takes more time to display the results.

Multi focus is enabled and disabled from the Scan settings dialog box. See “4.6 Scan settings” on p. 67.
4.2 AE/AF

Automatic exposure (AE) and automatic focusing (AF) are available to accurately scan works. To use AE/AF and spot AF, it is necessary to select [AF only], [AE only] or [AE/AF] under [AE/AF configuration] on the Scan settings dialog box. See “4.6 Scan settings” on p. 67.

AE/AF

<table>
<thead>
<tr>
<th>Operating Procedure</th>
<th>Shortcut</th>
<th>AE/AF Button</th>
</tr>
</thead>
<tbody>
<tr>
<td>Click [AE/AF] button or select [AE/AF] from the [Measure] menu.</td>
<td>F3</td>
<td></td>
</tr>
<tr>
<td>The laser will scan the object several times and AE and/or AF will be performed according to the settings in [AE/AF configuration].</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

1. A vertical black line appears on the monitor window while AF is being performed. The work is in focus when the vertical black line of the monitor window is aligned with the vertical green line indicating the center of the lens.

2. AE (Auto Exposure) and AF (Auto Focus)

AF (Auto Focus) is a mechanism for automatically setting the focal distance to the work. AE (Auto Exposure) is a mechanism for automatically setting image exposure conditions.
Spot AF

If the target area is out of focus or outside of the scan area after AF, the spot AF feature can be used to bring it into focus.

With point AF, line up the mouse cursor with the location you want to focus on in the monitor screen, and then click the left mouse button. Scanning for spot AF begins when the mouse is left-clicked. When the targeted area is brought into focus, the scanning parameter settings of RANGE VIEWER are updated to the results obtained in spot AF. Spot AF ends when monitoring operations start.

**Operating Procedure**

1. **Click [Spot AF] button.**
   
   The icon in the monitor window changes to [Spot AF button].

2. **Left click at the position where you want to execute point AF.**
   
   Click target point.

3. **Spot AF begins and the clicked location is brought into focus.**

   **Note**
   
   It is not a problem if spot AF results in the lens center (green) line at the window center and the black line not being aligned.
Manual Focusing and Exposure Level Setting

The focus and exposure level can be adjusted manually for works that are hard to focus on with AE/AF or spot AF.

### Operating Procedure

<table>
<thead>
<tr>
<th>Step</th>
<th>Description</th>
</tr>
</thead>
</table>
| 1    | Set the measurement distance by clicking the ▲ or ▼ button at the side of the [Measurement Distance] list box or inputting the number directly.  
The stand-off distance can be set between 450 and 800 mm. In the Multi focus mode, this range is 462 ~ 781 mm for TELE and 475 ~ 766 mm for WIDE. For correlations between stand-off distance and work size, see “Scan Position Adjustment” on p. 42.  
![Distance list box](image)
|     | Shortcut – |
| 2    | Slide the [Exposure] slider left and right to set the exposure level.  
Adjust the exposure level according to the brightness of the work. A low percentage (%) is effective for scanning bright works. Inversely, a setting a higher ratio is effective for scanning dark works.  
![Exposure slider](image)
|     | – |
| 3    | Select the number of scans from the [Number of scans] list box.  
The number of scans can be selected from 1 to 5.  
The slider width varies with the number of measurements set.  
Each measurement covers 20% of the entire size. Setting 5 measurements gives a size of 100%.  
![Selected number of scans](image)
|     | – |

### Supplement

- The Scanning time displays the estimated time required for scanning. It is based on the Distance, Exposure level and Number of scans.
### 4.3 Dark Surface mode setting

Measurement of objects with ultra-low reflectivity (the dark surface with 2.5% reflectivity), until now considered difficult using camera-type non-contact 3D digitizer, is now made easy using this industry-pioneering function.

**NOTE**
The Dark Surface mode setting screen is unavailable in RANGE7 models which do not have the Dark Surface mode function. Please warm up the sensor before use it. Low temperature may result in problems such as incomplete data.

<table>
<thead>
<tr>
<th>Operating Procedure</th>
<th>Shortcut</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Tick the Dark Surface mode checkbox under the “Exposure” slider. The “Exposure” slider is automatically set to maximum. At the same time, the number of scans to be performed increases by 1 from the preset value.</td>
<td></td>
</tr>
<tr>
<td>2 The exposure level can be adjusted by moving the “Exposure” slider sideways. Depending on the amount of light, you can manually adjust the exposure slider to get your desired exposure for measuring objects.</td>
<td></td>
</tr>
<tr>
<td>* Adjusting the “Exposure” slider will cancel the Dark Surface mode setting; the indicator will change from to and the “+1” icon in the “Number of scans” field will disappear.</td>
<td></td>
</tr>
<tr>
<td>To return to the Dark Surface mode, reset the “Exposure” slider to maximum.</td>
<td></td>
</tr>
<tr>
<td>* The Dark Surface mode indicator will restore from to and the “+1” icon in the “Number of scans” field will reappear.</td>
<td></td>
</tr>
<tr>
<td>3 Select the number of scans from the “Number of scans” list box. The number of scans can be selected from 1 to 5. The number of scans automatically increases by 1 in the case of a Dark Surface mode. The slider width varies with the number of measurements set in the same way as when you scan a work without ticking out the Dark Surface mode checkbox.</td>
<td></td>
</tr>
</tbody>
</table>

**Supplements**
- You may tick or not tick the Dark Surface mode checkbox as you go along depending on the condition of the work surface to be scanned.
- The checkbox will not be displayed while the sensor is disconnected.
- The Dark Surface mode will carry through to the next startup if remained it on at the end of the session; when you want to carry out a regular scan next time, please do not tick the Dark Surface mode checkbox.
- When a change is made to the number of scans while the Dark Surface mode is on, and if the exposure is set to maximum before the change, then it is automatically set to maximum after the change.
- When the Dark Surface mode is switched on, there will be 8 seconds more than the time cost for the regular scan displayed in the “Scanning time” field.
AE/AF in Dark Surface mode

Using the AE function when scanning a dark surface will result in the exposure being set so that bright areas of the work are scanned.

In order to scan a black work, you are advised to set the scan setting to “AF only” using the “Scan settings” dialog, so that the AE function can be switched off.

Set the AE/AF configuration to “AF only”

Preview in Dark Surface mode

A dark surface preview (approx. 0.8 seconds / scan) is carried out when the Dark Surface mode checkbox is ticked and the exposure is set to maximum.

Element information in Dark Surface mode

In the “Element information” dialog, for an element created using a scan in Dark Surface mode, the “Number of scans” field will display a “+1” in addition to the preset number of scans, for example, “4+1”. 
4.4 Preview

The measurement results can be forecast with the 3D preview function. This makes it possible to predetermine the depth in the measurement area and any blind spots before the actual measurement takes place, and it can greatly reduce measurement mistakes.

**Operating Procedure**

<table>
<thead>
<tr>
<th>1</th>
<th>Click the [Preview] button or select [Preview] from the [Measure] menu.</th>
<th>Shortcut</th>
<th>F4</th>
<th>Preview Button</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>The work is scanned at high speed and a preview of it is displayed in the preview window. The captured image can be checked using the menu buttons and mouse.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

“Data-pre” appears in the element list when the preview feature is executed.

- The data obtained in the preview is shown just for checking beforehand.

---

**Supplement**
- You can check the preview results with two types of 2D images on the monitor screen.

- **Monochrome image display**
  - You can check the entire image for a main scan as a monochrome image.

- **Contour image display**
  - You can check the data by looking at the color distribution, which corresponds to the measurement distance.
  - The color bar displays the correspondence between the colors displayed in the contour image and the measurement distances.
  - If the display colors are extremely biased, good 3D data cannot be obtained in the measurement scan.
  - The data is displayed as a distribution of colors, which correspond to the measurement distances.

Viewing mode is changed by these buttons.
3 Preview data is deleted by clicking Delete last data button.

Monitor Window

Show monochrome view button
Displays the scanned data in a monochrome view.

Show contours button
The data is displayed as a distribution of colors, which correspond to the measurement distances.

Show color bar checkbox
When a checkmark ✓ is placed in the checkbox, a bar is displayed giving the correspondence between the colors and the distances shown on the contour display.

Data close to the RANGE7/5 appears red and that far away is blue. The scale is evenly spaced across the distance from the RANGE7/5 to the focal point. Auto scaling is not performed according to depth.

Images with little change in distance change little in color.

Delete last data button
Deletes previews and the last scanned element.

Supplement
• Switching of monitor screens can be executed by the shortcut below as well.

- Monochrome image display button: Shift + M
- Contours display button: Shift + C
- Color bar display check button: Shift + V
4.5 Measure

Clicking the [Scan settings] button opens the Scan settings dialog box with the [Initial registration method] selected as the registration mode. During scanning, scanning time is monitored on a progress bar. There are three registration modes: [Paired points], [Rotating stage] and [Marker]. Their features are outlined below:

<table>
<thead>
<tr>
<th>[Initial registration method]</th>
<th>Description</th>
<th>Advantages</th>
<th>Other</th>
</tr>
</thead>
<tbody>
<tr>
<td>Paired points</td>
<td>The position of a work is registered by left-clicking corresponding points of two scanned 3D images in order to interpolate their positions in 3D space.</td>
<td>Scanning is easy as special instruments and markers are unnecessary.</td>
<td>–</td>
</tr>
<tr>
<td>Rotating stage</td>
<td>The work is set on a rotating stage and automatically scanned to register its position in 3D space.</td>
<td>The axis of rotation requires simple calibration. The position of a work can be registered automatically.</td>
<td>SHOT-602* and SHOT-202 are applicable control boxes for the rotating stage.</td>
</tr>
<tr>
<td>Marker</td>
<td>Markers are affixed to works and their positions are registered when they overlap in differing scan shots. Marker registration is performed by the correspondence relationship between the markers in the scanned shots and those in the read file.</td>
<td>This mode is more accurate than [Paired points] and operability is improved because the marker information basically automates registration work.</td>
<td>Set marker size for the type of lens being used. Use [Small] for TELE and [Large] for WIDE.</td>
</tr>
<tr>
<td>Marker (Fixed)</td>
<td>Markers are affixed to the work and the file containing the 3D coordinate values of the affixed markers is read in. Marker registration is performed by the correspondence relationship between the markers in the scanned shots and those in the read file.</td>
<td>The 3D coordinate values of the markers are given in the file. Accordingly, errors do not accumulate with repeated registration compared to the normal marker registration.</td>
<td>Set the marker size according to the lens currently used. Small (for TELE lens), Large (for WIDE lens). When scanning with markers (fixed), select [Marker] from the initial registration and check [Not adding new ref.]. Determine the 3D coordinate value of each marker by means of photogrammetry etc. before scanning and then save it in the file. To record the 3D coordinate values of markers, rmk and TXT files can be used. The markers scanned during scanning with markers (fixed) are not added to the reference markers.</td>
</tr>
</tbody>
</table>

Scan Flow by Registration Mode  *All examples rotate the work 90˚ and take 4 scan shots.

![Scan Flow by Registration Mode](image_url)
Before Scanning

Before scanning, it is necessary to set up scanning, registration mode and other parameters. For details, see “4.6 Scan settings” on p. 67.

A. Registration by [Paired points] Mode

Operating Procedure

1. Click [Scan settings] button to open the Scan settings dialog box, and select [Paired points] under [Initial registration method].

2. Click [Monitor] button and adjust the location and posture of the RANGE7/5 and work while monitoring the work. See “4.1 Monitor” on p. 41.

3. Click [AE/AF] button to set the stand-off distance and exposure. See “4.2 AE/AF ” on p. 43.

4. Click [Preview] button to check the preview image. See “4.4 Preview” on p. 48.

5. Click [Scan] button or select [Scan] from the [Measurement] menu.

6. The Scanning dialog box appears and scanning starts.
7 Scanning ends as per settings.
Displays the measured 3D images on the selected screen and measured screen.
A name appears in the element list for the acquired data.

8 Rotate the work to another angle and adjust location and posture while monitoring.

9 Click [Scan] button or select [Scan] from the [Measure] menu.
The Scanning dialog box appears and scanning starts.

10 Scanning ends as per settings.
The second scanned data are displayed on the selected screen.
The second scanned data name is displayed in the element list as selected.
In addition, scanned data after the second data are not displayed on the scanned screen until registration is complete.
However, checking the check box manually enables the data to be displayed on the scanned screen.
Click  Set registration points button.

The pointer changes to  when preparations for selecting points are complete.

Click sequentially on the corresponding points in the two images.

Perform the registration by designating the corresponding positions of the second measured data (left) and the first measured data (right). Click as close to the same point as possible in the left and right images.

When the pointer looks like  right-clicking the mouse opens a pop-up menu of the following commands.

Selecting [Undo] deletes clicked points in backwards order from the most recent.

Selecting [Pause] pauses clicking and enables you to rotate and zoom the 3D images. To start again, select interruption from the popup menu again. In addition, interruption and restarting can be done by pressing the [Space] key.

Selecting [Cancel] cancels the selected points registration mode regardless if any points have been selected or not.

You can select points sequentially in either of the images first and then in the other image. Marker colors change sequentially with each click.

Once one or more pairs of corresponding points have been selected, select [Done] from the pop-up menu opened by right-clicking the mouse, to register the points.

Scanned data finished with registration are automatically displayed in the scanned window.

Supplement

- If positions do not align properly, add a pair of corresponding points and register the positions again.
- Preview data obtained by clicking the preview button can be aligned with already scanned elements.
- If scanning is executed immediately after positioning preview data, the preview data is automatically registered with the scanned element.
  Because registration is complete even though it is immediately after scanning, a checking mark is put in the check box and the element is displayed on the scanned screen.
- Rotate works to a profile that makes it easy to select corresponding points.
- After the measurement, in case preview or measurement is done without paired points registration, the message "Trying to preview (measure) without paired points registration, do you continue to preview (measure)?" is displayed. Press the [No] button, and stop preview or measurement. By pressing the [Yes] button, preview or measurement continues.
Continue and repeat scanning from different directions.

Click [Paired Points Registration] button.

The icon becomes , and corresponding points can be selected.

Click corresponding positions of the data displayed on the selection screen and scanned screen, then register.

At this stage, paired points can be performed to all the plural number of data displayed on the scanned screen.

When clicking more than one pair in corresponding positions, registration is executed by selecting [Execution] in the pop-up menu provided by the right mouse click.

Scanned data finished with registration are automatically displayed in the scanned window.

With regard to element information, if colors of elements change, registration results become easier to see. ("3.4. Element information" p. 39 – 40)
The data which was registered once can be registered again by selecting them in the element list. Displays data selected from the element list are displayed in the Selection screen.

By clicking [Paired Points Registration] in this condition, registration can be done again for the data [Data-1] which was registered once.

Note: Data obtained by preview cannot be used as the bases for registration even though they are displayed on the scanned screen. Selected data themselves are not used as bases of registration. Therefore, these data automatically become [Non-display] to avoid displaying them on the Scanned screen (to disable clicking of corresponding points) during the work of paired points.

Data moved by registration
Data scanned in review
Start paired points registration
Check is turned off so as not to display data in the scanned screen automatically while registration.
B. Initial Registration with Use of a Rotating Stage

Using the rotating stage to measure the object and determining the rotation axis with the calibration chart results in 3D data on a specific circle. By using this as the measured data, and repeating the initial alignment with other 3D data on other circles, you can obtain full-circle 3D data with minimal measurement omissions.

Setup for Registration Using a Rotating Stage

This setup is for registering works in 3D space using a rotating stage.

Operating Procedure

1. Click [Scan settings] button to open the Scan settings dialog box, and select [Rotating stage] under [Initial registration method]. This operation activates the [Stage] group of settings.

2. Set the communication port for the controller of the rotating stage. The controller can be selected between [SHOT-602] and [SHOT-202] from the [Model] list box in the [Stage] group of settings. Select the controller connected to the computer. Select a communication port to connect the controller from the [Port] list box in the [Stage] group of settings.

3. Click the [OK] button. The rotating stage is initialized.

   - If the Rotating Stage Is Not Recognized
     An error message appears stating, “Unable to communicate with stage.”
     → In this case, switch the control box power Off, then On again and re-do the operation from the start.

   - If the Rotating Stage Is Recognized and Successfully Initialized
     If the computer does not contain a file of the axis of rotation data, a message appears stating, “No stage axis information exists. Please measure a chart.”
     If the computer has a file of the axis of rotation data, it is automatically read and the information on the registered instrument and lens is checked.
     • If the registered instrument and lens in that axis of rotation data differ from the current instrument and lens, a message appears stating, “Conditions differ from when the chart was scanned.”
     • If the registered instrument and lens in that axis of rotation data are the same as the current instrument and lens, a message appears stating, “Axis of rotation data has been loaded.”
       (Note: This message appears as long as the instrument and lens match the registered data even if calibration is needed because the stand-off distance has changed from when the axis of rotation data was last calibrated. Accordingly, when this message appears, it is not guaranteed that the loaded axis of rotation data is appropriate.)
Rotating Stage Calibration
The axis of rotation data needed to automatically register the scanned data of a work turned on a rotating stage is calculated by scanning the calibration chart. The resulting axis of rotation data is automatically saved as a file in the computer for use the next time that [Use rotating stage as initial registration method] is set.

Operating Procedure

1 Set the calibration chart “S” or “L” on the rotating stage and click [Monitor] button.
Position and posture the instrument and the rotating stage so that the calibration chart appears in the monitor window as shown at right.

(Note: Prior to calibration, if the rotating stage is not at the first angle (0˚), move the [Rotation Angle] slider to 0˚ to return the stage to the 0˚ angle.)

2 Click the AE/AF button to adjust the stand-off distance and exposure.
Adjustments are made as determined by the [AE/AF configuration] setting on the Scan settings dialog box. See “4.6 B. Scan settings for Rotating Stage Registration” on p. 70.

3 Click [Preview] button.
Check the distance image of the calibration chart in the preview window looks like the Good example at right. If it looks like the Bad example, return to step 2.

Good example  Bad example
4 Click [Stage calibrate] button.

When clicked, a message appears asking, “Ready to initialize stage and scan chart?”
Clicking the [Yes] button rotates the stage to the first angle.
• Clicking the [No] button cancels rotating stage calibration.

5 A message appears asking, “Scan chart image?”
Clicking the [OK] button starts calibration chart scanning.
• Clicking the [Cancel] button cancels rotating stage calibration.

6 The calibration chart is scanned.

When scanning has been completed, a message appears asking, “Use this image?”
Clicking the [Yes] button calculates the axis of rotation data and saves it as a file. The saved data is used the next time registration is done using the rotating stage.

If no data was obtained at all, a warning message will appear.

Note: When using the rotating stage by setting RANGE7/5 vertically, place it in the physical relationship where the acceptance lens is above the rotating stage, and the laser projection window is below the stage.
By setting the acceptance lens below, counter-rotated data can be obtained.
Registration Using a Rotating Stage

If scanning is started without any existing scanned data, the full-perimeter data of a work is obtained by rotating the work around the axis of rotation using the acquired axis of rotation data and scanning it at various angles on the rotating stage. This axis of rotation data is calculated as explained in “Rotating Stage Calibration” and loaded as explained in “Setup for Registration Using a Rotating Stage”.

Operating Procedure

1. If you performed the steps in “Rotating Stage Calibration”, remove the calibration chart and set the work on the rotating stage.

2. If you loaded the axis of rotation data as explained in “Setup for Registration Using a Rotating Stage” without calibrating the rotating stage, calibrate the stage to obtain the most recent axis of rotation data in the following cases.

<table>
<thead>
<tr>
<th>Rotating Stage Must Be Calibrated</th>
<th>Comment</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. If the message “Cannot find the corresponding axis of rotation data.” appears</td>
<td>–</td>
</tr>
<tr>
<td>2. If the message “Conditions differ from when the chart was scanned.” appears</td>
<td>–</td>
</tr>
<tr>
<td>3. If the message “Axis of rotation data has been loaded.” appears, but the positional relationship of the rotating stage and instrument differs from when the axis of rotation data was obtained</td>
<td>This message does not guarantee that the axis of rotation data is appropriate. (See step 3 of “Setup for Registration Using a Rotating Stage” p. 56.)</td>
</tr>
</tbody>
</table>

If the message “Axis of rotation data has been loaded.” appears and the positional relationship of the rotating stage and instrument is the same as when the axis of rotation data was obtained, use the loaded axis of rotation data.

Note: Calibrate the rotating stage if any displacement in the [Use rotating stage as initial registration method] data appears when the loaded axis of rotation data are used.

3. Click **[Scan]** button and do the following based on the step angle.

   If Not Using Free Step Angles
   Scan at the current angle, display the scanned result in the 3D view window and turn the stage to the next angle.

   If Using Free Step Angles (*Free step angles cannot be selected in full auto scanning.*):
   Scan at the current angle and display the scanned result in the 3D view window.
   Do not turn the stage. With free stepping, use the slider bar to turn the stage to a specific angle.

   If Using [Auto scan]:
   Start the measurement from the 0˚ angle, and then automatically measure one complete circle according to the step angle.
   When you measure the data for one circle, the rotation stage returns automatically to the 0˚ angle.
Note: Clicking the [Cancel] button that appears on the Scan dialog box during scanning stops scanning and rotating stage rotation. To change the angle, do so from the [Rotation Angle] slider.

(Example of scanning at 90° steps)

When the scanning for one circle is complete, the rotation stage stops and measurement ends.
The scanned 3D image appears in the preview window.
A name appears in the element list for the acquired data.
Setup for Full Auto Scanning
To use full auto scanning, place a checkmark in the [Auto scan] checkbox.
* When full auto scanning is used, at the start of measurement, by just clicking the [Measure] button once, you can measure automatically until the measurement for one circle is complete and the stage is aligned at the initial position.

Operating Procedure

1. **Place a checkmark in the [Auto scan] checkbox on the scan window.**

2. **Click the [Scan] button to open the [Auto scan settings] dialog box.**

   When there are no measured data yet, the [Register by paired points] checkbox is grayed out. If scanned data exists, data scanned at 0˚ can be interpolated to the existing scanned data by placing a checkmark in the [Register by paired points] checkbox.

3. **To use AE/AF for each scan shot, place a checkmark in the [Perform AE/AF] checkbox and select a mode from the list box.**

   AE/AF are not performed if the [Perform AE/AF] checkbox is not checked.
Click the [OK] button.

If a checkmark is not placed in the [Register by paired points] checkbox.

The rotating stage angle is initialized at 0˚ and the full perimeter of the work is scanned automatically at the set step angles. When data has been obtained for the full perimeter, the rotating stage returns to 0˚.

If a checkmark is placed in the [Register by paired points] checkbox.

- The rotating stage angle is initialized at 0˚ and, after obtaining scan data for 0˚, scanning stops so as to interpolate the data by selected points registration.

- Clicking the [Set registration points] button performs paired points registration.

- After selected points registration has been completed, clicking the [Scan] button starts full auto scanning.

- Scanning is automatically performed for the remaining step angles. When data has been obtained for the full perimeter, the rotating stage returns to 0˚.

Note: Clicking the [Cancel] button that appears in the [Scan] dialog shown during full auto scanning stops scanning.
**Registration combining rotating stage registration and measurement from different positions**

Groups of data registered around the axis of rotation can be registered even after changing the RANGE7/5 position by following the specified procedure. Using this feature can provide full-perimeter 3D view results with fewer gaps in the scanned data.

**Method 1: Method in which the rotating stage is not calibrated at each different instrument position**

With this method, repeated registration around the axis of rotation (with the instrument position changed in order to scan the work on the rotating stage from different angles for example) is performed to create a full-perimeter 3D view without calibrating the rotating stage each time the instrument position is changed.

The procedure is as follows:

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Illustration</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Step 1</strong></td>
<td>1. Place the instrument, rotating stage and scanning works in any position (Position1). 2. Start scanning and registration using the rotating stage from a rotating stage angle of 0 degrees without any prior data present. 3. Registration of first series of data is performed. (Data group A)</td>
</tr>
<tr>
<td><strong>Step 2</strong></td>
<td>1. Change the instrument position (Position 2). Do not change the positional relationship between the work and the rotating stage. 2. Scan at a rotating stage angle of 0 degrees. 3. Perform selected points registration of the new data just scanned at an angle of 0 degrees to one of the first 0-degree data scanned in Step 1 (Data group A) as a reference. 4. Scan data at remaining rotating stage angles. Data are registered around the axis of rotation.</td>
</tr>
<tr>
<td><strong>Step 3</strong></td>
<td>Repeat Step 2 as many times as necessary.</td>
</tr>
</tbody>
</table>
Method 1 cannot be used in the following cases.

<table>
<thead>
<tr>
<th></th>
<th>Method 1 Cannot Be Used</th>
<th>Comment</th>
</tr>
</thead>
</table>
| 1 | If the work was moved  
⇒ Use method 2.
Also, use method 2 for all subsequent scan shots until scanning the full perimeter. | Point  
If only the step angle is changed in scanning without repositioning the work on the stage, the stage does not require calibrating. (Selected points registration is unnecessary.) |
| 2 | If another method of registration is used than selected points registration  
⇒ Use method 2.  
Also, use method 2 for all subsequent scan shots until scanning the full perimeter. | Point  
Delete all scanned data from the element list in order to perform registration using method 1 again |
| 3 | If all scanning is done using a rotating stage for registration and existing scanned data from the element list that contains data loaded from rgv or rvm files as reference | Point  
Even if the rgv or rvm file contains data registered using a rotating stage, it cannot be used. |
| 4 | If all scanning is done using a rotating stage for registration after calibrating the rotating stage or loading axis of rotation data when existing scanned data exists in the element list | – |

Method 2: Method in which the rotating stage is calibrated at each different instrument position

With this method, new data can be registered to any existing data. Use this method when registration by Method 1 could not be performed.

The procedure is as follows

<table>
<thead>
<tr>
<th>Procedure</th>
<th>Illustration</th>
</tr>
</thead>
</table>
| **Step 1** | 1. Place the instrument, rotating stage and scanning works in any position (Position1).  
2. Start scanning and registration using the rotating stage from a rotating stage angle of 0 degrees without any prior data present.  
3. Registration of first series of data is performed. (Data group A) |

| **Step 2** | 1. Change the positional relationship between the work and the rotating stage (Position 2). (The instrument position can also be changed.)  
2. Calibrate the rotating stage.  
3. Scan at a rotating stage angle of 0 degrees.  
4. Perform selected points registration of the new data just scanned at an angle of 0 degrees to one of the first 0-degree data scanned in Step 1 (Data group A) as a reference.  
5. Scan data at the remaining angles. Data are registered around the axis of rotation. |

| **Step 3** | Repeat Step 2 as many times as necessary. |
C. Initial Registration with Markers/Markers (Fixed)

The position of a work in 3D space can be automatically registered by affixing markers to the work and identifying where the markers overlap in differing scan shots. Registration is performed by automatically recognizing the markers read out from the file containing the 3D coordinates of the markers and the markers of the scanned shot. The markers scanned during scanning with markers (fixed) are not added to the reference markers.

Operating Procedure

1. Click [Scan settings] button to open the Scan settings dialog box, and select [Marker] under [Initial registration method].
   When scanning with markers (fixed), please check [Not adding new ref.].

2. Affix either large or small markers to the work.
   Space the markers apart so that about 5 ~ 10 appear on the monitor window during scanning. Set marker size according to the type of lens being used.
   [Small]: TELE, [Large]: WIDE
   Before scanning with markers (fixed), determine the 3D coordinates of the stuck markers by means of photogrammetry etc. and save them in an rmk or txt file, and then read the markers out of that file with the [Read out reference] button.

3. Click [Monitor] button and adjust the location and posture of the RANGE7/5 and work while monitoring the work.
   See “4.1 Monitor” on p. 41.

4. Click [Preview] button to check the preview image.
   See “4.4 Preview” on p. 48.
   Check in the 3D view window that preview data from the second and subsequent scan shots can be automatically registered.

5. Click [Scan] button or select [Scan] from the [Measure] menu.
   The Scanning dialog box appears and scanning starts. The recognized markers are captured and collected as reference markers.
Once scanning has been completed, delete unnecessary marker information in the monitor window.

You can specify a range and select markers by either clicking the misrecognized marker or a marker you want to delete with the left mouse button or by dragging the cursor while holding down the left mouse button. When selected, these markers appear red. Left-clicking the selected markers again unselects them.

After selecting a marker to delete, click the right mouse button to display the pop-up menu and then select [Delete Selected Marker] to delete the selected marker. Right-clicking the marker on the 3D view displays the popup menu. Selecting [Delete] deletes the selected marker.

Perform the next scan shot.

Position the work so that at least three (preferably five or more) markers overlap and are common to both the scanned element and upcoming scan shots.

Repeat steps 2–6 to obtain the necessary data.

**Point**

Saving Reference Markers (See p. 71.)

Click the [Save ref.] button in the Scan settings dialog box. The reference markers are saved as a rmk file. Also, you can resume interrupted operations by clicking the [Open ref.] button to recall saved reference markers (rmk file).

Function to read out reference marker (See p. 71.)

Registration can be started again with the interrupted "markers" by reading out the saved rmk file. Also, since the 3D coordinates of each marker affixed to the work can be determined, registration can be performed with "markers (fixed)". The files that can be read out are rmk file and txt file. The rmk file has an original format. In the format of the txt file, the X coordinate value, Y coordinate value and Z coordinate value of the 3D coordinates of the marker are entered in each line. Each coordinate value is separated by commas or tabs.

Creating New Reference Markers (See p. 71.)

To delete all captured reference markers, as might the case when ready to scan a new work, click the [New ref.] button. All reference markers are deleted.
4.6 Scan settings

Scan settings are controlled by the Scan settings dialog box that is opened by clicking the [Scan settings] button, and the (scan) tab of the main window. The number of scans, stand-off distance, exposure level and rotating stage drive settings (This is only displayed when the rotating stage is used.) are set on the scan tab. The exposure is automatically set to the best level for the set conditions (i.e., number of scans, etc.) when AE is executed.

Operating Procedure

1. Click the [Scan settings] button or select [Scan settings] from the [Measure] menu.
   The Scan settings dialog box appears. Scan settings are set on the Scan settings dialog box and scan tab of the main window.

2. Select an AE/AF mode from the [AE/AF configuration] list box.
   - [AE and AF] AE/AF mode
   - [AE only] AE only mode
   - [AF only] AF only mode

   - [Enable]: Automatic scanning using multiple focal points
   - [Disable]: Focal point does not move.

4. Select a data reduction ratio from the [Data reduction ratio] list box.
   Select a reduction ratio from [1/1], [1/4], [1/9] and [1/16]. Since the number of data in the original element is deleted for scanning, the data reduction ratio of the scanned data cannot be changed.

5. Select a registration mode from the [Initial registration method] list box.
   Select a registration mode from [Paired points], [Rotating stage] and [Marker]. Once a mode has been selected, parameters must be set for the selected mode.

6. Click the [OK] button to close the Scan settings box.
   - To save settings, click the [Save settings] button.
   - To cancel settings, click the [Cancel] button.

Supplement
Clicking the [Load settings] button loads the settings saved via the [Save settings] button.
AE/AF

AE and AF configuration must be set to focus and expose works for registration processing. To perform only AF, select [AF only]. AE can be performed in conjunction with AF particularly when working with works that are dark or bright (shiny) so as to automatically set exposure to the best level.

But, using the AE function when scanning a dark surface will result in the exposure being set so that bright areas of the work are scanned. In order to scan a black work, you are advised to set the scan setting to “AF only” using the “Scan settings” dialog, so that the AE function can be switched off.

AF is difficult with the following works.
1. Works of equal size overlapping from front to back
2. Works with fence-like structures at the front

When using AF with these kinds of works, the best focal distance is not always determined. In these cases, spot AF is effective. Clicking the spot AF button starts monitoring and displays the monitored image in the 2D view window, therefore a point for focusing the image can be selected by clicking the mouse pointer somewhere on the image. Monitoring makes it easy to check the image after spot AF.

Cases Where Spot AF Is Unsuccessful
1. If the mouse is clicked on a point off the work
2. If the mouse is clicked on a point at an extremely close distance

If an error message appears, adjust the location and posture of the work.

The focus and exposure level can be adjusted manually for works that are hard to focus on with AE/AF or spot AF. The exposure level can be set to 0 ~ 100% of the brightness of the work. A low percentage (%) is effective for scanning bright works. Inversely, a high setting is effective for scanning dark works.

Scan settings Dialog Box * Other parameters are discussed on p. 69 ~ 71.

[Save settings] button Saves scan settings on the hard disk.
[Load settings] button Loads scan settings from the hard disk.
[OK] button Updates settings changes (applies them to the instrument) and closes the Scan settings dialog box.
[Cancel] button Changing of scan settings is canceled. The settings for scanning are returned to the settings that were in effect at the time the dialog was opened, and the dialog will close.
A. Scan settings for Paired Points Registration

**Operating Procedure**

1. **Click** [Scan settings] button or select [Scan settings] from the [Measure] menu.
   - The Scan settings dialog box appears.

2. **Select** an AE/AF mode from the [AE/AF configuration] list box.
   - **AE and AF** AE/AF mode
   - **AE only** AE only mode
   - **AF only** AF only mode

3. **Select** [Enable] or [Disable] from the [Multi focus] list box.
   - **Enable**: Automatic scanning using multiple focal points
   - **Disable**: Focal point does not move.

4. **Select** a data reduction ratio from the [Data reduction ratio] list box.
   - Select a reduction ratio from [1/1], [1/4], [1/9] and [1/16]. Since the number of data in the original element is deleted for scanning, the data reduction ratio of the scanned data cannot be changed.

5. **Select** [Paired points] from the [Initial registration method] list box.

6. **Click** the [OK] button to close the Scan settings box.

---

**Scan settings Dialog Box**

<table>
<thead>
<tr>
<th>Registration/Stage configuration</th>
<th>AE/AF configuration</th>
<th>Sets AE/AF mode from [AF only], [AE only] and [AE and AF].</th>
</tr>
</thead>
<tbody>
<tr>
<td>Multi focus</td>
<td>Enable/Disable</td>
<td>Enables/Disables automatic scanning with multiple focal points. When enabled, if the stand-off distance in the scan window exceeds the focal range of the Multi focus mode, it is set within this focal range (“Scan Position Adjustment” on p. 42) when the [OK] button is clicked.</td>
</tr>
<tr>
<td>Data reduction ratio</td>
<td></td>
<td>The data can be reduced when they are scanned. Select a reduction ratio from the drop-down list. Selectable items: 1/1, 1/4, 1/9 and 1/16 Note: Since the number of data in the original element is deleted for scanning, the data reduction ratio of the scanned data cannot be changed. [Related item: [Element display reduction ratio] p. 18] For 1/4 deletion, the algorithm which leaves the edge part as much as possible is applied.</td>
</tr>
<tr>
<td>Initial registration method</td>
<td>Sets the registration mode between [Paired points], [Rotating stage] and [Marker].</td>
<td></td>
</tr>
</tbody>
</table>
B. Scan settings for Rotating Stage Registration

Operating Procedure

1. Click [Scan settings] button or select [Scan settings] from the [Measure] menu.
   The Scan settings dialog box appears.

2. Select an AE/AF mode from the [AE/AF configuration] list box.
   - [AE and AF] AE/AF mode
   - [AE only] AE only mode
   - [AF only] AF only mode

   - [Enable]: Automatic scanning using multiple focal points
   - [Disable]: Focal point does not move.

4. Select a data reduction ratio from the [Data reduction ratio] list box.
   Select a reduction ratio from [1/1], [1/4], [1/9] and [1/16]. Since the number of data in the original element is deleted for scanning, the data reduction ratio of the scanned data cannot be changed.

5. Select [Rotating stage] from the [Initial registration method] list box.

6. Select items from the [Model], and [Port] list boxes under [Stage].
   For parameter details, see "Scan settings" Dialog Box below.

7. Click the [OK] button to close the Scan settings box.

Scan settings Dialog Box

<table>
<thead>
<tr>
<th>Registration/Stage configuration</th>
</tr>
</thead>
</table>

For AE/AF setting, Multi focus and data sub-scanning rate, see "A. Scan setting for scanning by paired point registration"

<table>
<thead>
<tr>
<th>Initial registration method</th>
<th>Select the initial registration method for scanning from [Paired points registration], [Rotary stage] and [Markers].</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stage</td>
<td>Available only when [Rotating stage] is selected for [Initial registration method]. Selects the rotating stage controller. Selection can be made from SHOT-602, SHOT-202.</td>
</tr>
<tr>
<td>Model</td>
<td>Sets the RS communication port that connects to the rotating stage. Available settings vary according to the PC environment.</td>
</tr>
</tbody>
</table>
C. Scan settings for scanning with Markers/Markers (Fixed)

Operating Procedure

1. Click [Scan settings] button or select [Scan settings] from the [Measure] menu.
   The Scan settings dialog box appears.

2. Select an AE/AF mode from the [AE/AF configuration] list box.
   - [AE and AF] AE/AF mode
   - [AE only] AE only mode
   - [AF only] AF only mode

   - [Enable]: Automatic scanning using multiple focal points
   - [Disable]: Focal point does not move.

4. Select a data reduction ratio from the [Data reduction ratio] list box.
   Select a reduction ratio from [1/1], [1/4], [1/9] and [1/16]. Since the number of data in the original element is deleted for scanning, the data reduction ratio of the scanned data cannot be changed.

5. Select [Marker] from the [Initial registration method] list box.

6. Select items from the [Marker size] list box under [Marker].
   For parameter details, see "Scan settings Dialog Box" below.

7. Click the [OK] button to close the Scan settings box.

Scan settings Dialog Box

Registration/Stage settings

For AE/AF setting, Multi focus and data subscanning rate, see "B. Scan setting for scanning on rotary stage".

<table>
<thead>
<tr>
<th>Initial registration method</th>
<th>Select the initial registration method for scanning from [Paired points registration], [Rotary stage] and [Marker].</th>
</tr>
</thead>
<tbody>
<tr>
<td>Marker</td>
<td>Available only when [Marker] is selected for [Initial registration method]. Sets the marker size.</td>
</tr>
<tr>
<td>Marker size</td>
<td>Creates new reference markers. All reference markers in memory are discarded and the reference marker list is cleared.</td>
</tr>
<tr>
<td>[New ref.] button</td>
<td>Loads reference markers from the file. All reference markers in memory are discarded and the reference markers saved as a rmk file are read from the file to memory.</td>
</tr>
<tr>
<td>[Open ref.] button</td>
<td>Saves the reference markers as a file. The reference markers in memory are saved as a rmk file.</td>
</tr>
<tr>
<td>[Save ref.] button</td>
<td>If there is a file containing 3D coordinates of markers determined by photogrammetry etc., check the box. If the box is checked, registration with &quot;markers (fixed)&quot; is performed. The markers scanned during scanning with markers (fixed) are not added to the reference markers.</td>
</tr>
</tbody>
</table>

Memo Only the large one (for WIDE lens) can be used for RANGES.
5. Instrument

**WARNING**

- Do not look directly into the laser emission window.
- Keep lenses, objects with mirror-like surfaces and optical elements out of the optical path. These objects can focus the laser beam, resulting in damage to eyes, fire and burns. Also, to prevent inadvertent accidents, situate works in front of a wall or other structure that shields the laser beam.

### 5.1 Calibration

Calibration reduces errors caused by environmental changes or changes over time.

Calibration should be performed if ambient temperature has changed since the last time the instrument was calibrated. If temperature changes ±1.5°C from the time of calibration, RANGE VIEWER displays a warning to prompt you to perform calibration.

When scanning is executed while a warning mark is ON, a warning dialog is displayed before starting to scan.

To avoid the display of the warning dialog, check when warming up is complete in the condition where no temperature change takes place in the environment at a certain temperature. Make sure to scan in the same temperature environment.

Calibration is unnecessary when lenses are interchanged. (Calibration is required after interchanging lenses if temperature has changed since the last time the instrument was calibrated with the newly mounted lens.)

**Before Calibration (Calibration Set)**

The calibration set includes the following.

<table>
<thead>
<tr>
<th>Calibration sheet</th>
<th>Calibration chart</th>
<th>Calibration stand</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="calibration-sheet.png" alt="" /></td>
<td><img src="calibration-chart.png" alt="" /></td>
<td><img src="calibration-stand.png" alt="" /></td>
</tr>
</tbody>
</table>

- 1280 x 430 (mm) plastic sheet. Sufficient space to spread out the calibration chart is required.
- Do not touch the front side of the chart with bare hands.
- Supports the RANGE7/5.

**RANGE7/5 position**

- For calibration with WIDE lens
- For calibration with TELE lens

The chart can be tilted to three set angles by pulling the knob on the left face of the chart stand. The stand makes it easy to establish the angles shown in the RANGE7/5 Calibration Wizard.

**How to use**

- *Calibration setup*

  - The RANGE7/5 can be calibrated on its scanning stand without using the calibration stand.
Prepare the RANGE7/5 and calibration sheet.

Calibration with Only the RANGE7/5

- Spread the calibration sheet out on a table.
- Set the calibration stand on the sheet where indicated by the picture. Position the stand’s legs in the three circles.
- Set the RANGE7/5 on the stand.

Calibration with the RANGE7/5 on the Scanning Stand

Spread the calibration sheet out on a table.

- Spread the sheet out so that the edge of the RANGE7/5’s body comes to the edge of the table.

Hold the RANGE7/5 level and adjust the height so that the bottom of the scanning stand pan head almost contacts the tabletop.

- Anchor the RANGE7/5 securely to the pan head with the bottom of the pan head above the tabletop.
- Loosen the stand pan head enough that it can rotate around the optical axis. Then, lower the stand arm with the RANGE7/5 mounted on it until the bottom of the pan head is flush with the tabletop. Determine the direction and height of the RANGE7/5 and lock in place.

Fine-adjust the position of the RANGE7/5.

- Move the stand so that the RANGE7/5 is on the picture on the calibration sheet.
  (Note: Be careful not to contact the stand legs with the table legs.)

Prepare the calibration chart.

The chart can be titled to three set angles by pulling the knob on the left face of the chart stand.

The stand make it easy to establish the angles shown in the RANGE7/5 Calibration Wizard.
Select [Calibration] from the [Instrument] menu.

The Calibration Wizard appears.

Set the calibration chart in a position suitable for the type of lens. For a WIDE lens, the chart should be placed in position ① nearest the RANGE7/5. For a TELE lens, it goes in position ② farther from the RANGE7/5.

Once the calibration chart has been set, click the [Next] button.

Fine-position the chart.

While watching the monitor screen, finely adjust the position of the calibration chart and RANGE7/5 so that 24 O's fit into the outermost side of the area sandwiched between the two red box lines. Make sure the outside dots do not cross the outside red frames.

Using the Stand Pan Head
Adjust the stand in the height direction from the tilt lever, and lock in place.
In the horizontal direction, either fine-adjust the stand’s position or reposition the calibration chart.

Using the RANGE7/5 and Calibration Stand
Adjust the calibration stand in the height direction from the tilt lever.
In the horizontal direction, either fine-adjust the stand’s position or reposition the calibration chart.

Note: As long as the outside rows of dots fit between the two red boxes, problems are not caused by the calibration chart being slightly displaced from the picture on the calibration sheet.
OK

NG (Outside row of dots cross outside red frame.)

Once positions have been set, click the [Next] button.

4 Scan at position 1.

Check that the angle of the calibration chart surface is like the picture in the Calibration Wizard. If OK, click the [Scan] button.

Verify results on the check screen.

The [Monitor screen] on the check screen shows the scan results. Compare these results with the [Sample results].

Memo

About the dots on the "Monitor Screen".
• Is not the dot notched?
• If the color is same colors as that shown in the "Sample" on the right side, the position is correct.

If there is no problem, click the [Next] button. Position 1 scan data will be made valid.

If there is a problem, click the [Retry] after the position is adjusted.

Note

For the possible problem and the solution method, refer to the column in page 76-77.

• When the [Retry] button is clicked, a message requesting confirmation of whether or not to discard the most recent measurement data will be displayed.
• Click the [OK] button to perform a retry.
• [Cancel] button to cancel the retry and return to the previous screen.
Possible problem and the corresponding solution method

Example 1)
State: Several dots are missing.
Cause: Exposure level problem.
Action: Readjust exposure level and perform retry.

Example 2)
State: 3 colors of dots are shown.
Cause: Calibration chart is at an angle instead of directly facing the RANGE7/5.
Action: Adjust the positions of the RANGE7/5 and calibration chart so that they directly face each other and perform retry.
**Example 3)**

**State:** The color is different than the dot colors of the sample.

**Cause:** Improper distance. The direction of distance shift is different according to the color of dots.
- Almost all dots are red: Range7/5 is too close to calibration chart.
- Almost all dots are red: Range7/5 is too far from calibration chart.

**Action:** Handle the problem according to the direction of distance shift as follows
- Almost all dots are red.
  - Move RANGE7/5 from its current position to 3 to 5mm further away from the calibration chart and perform retry.
- Almost all dots are yellow
  - Move RANGE7/5 from its current position to 3 to 5mm closer to the calibration chart and perform retry.

- Almost all dots are red

![Image of red dots with instructions]

- Almost all dots are yellow

![Image of yellow dots with instructions]

**Point**
If the RANGE7/5 is repositioned in position ① and the problem is solved, the instrument is calibrated for other position (②-⑦) as well. If you proceed to the next step without solving the problem by performing Retry, correct calibration may not be possible. Be sure to solve the problem before proceeding to the next step.
Scan at position ③.

Set the calibration chart to position ③. Check that the angle of the calibration chart surface is like the picture in the Calibration Wizard.

If OK, click the [Scan] button.
• If the chart is displaced, fine-adjust its position before clicking the [Scan] button.

Check scan results on the monitor window.
Check scan results in the same way as with position ①.
If there are no problems, click the [Next] button.
If there is a problem, click the [Retry] button.

Scan at position ③.

Set the calibration chart to position ③. Check that the angle of the calibration chart surface is like the picture in the Calibration Wizard.

If OK, click the [Scan] button.
• If the chart is displaced, fine-adjust its position before clicking the [Scan] button.

Check scan results on the monitor window.
Check scan results in the same way as with position ①.
If there are no problems, click the [Next] button.
If there is a problem, click the [Retry] button.
7 Scan at position ③.

Set the calibration chart to position ④. Check that the angle of the calibration chart surface is like the picture in the Calibration Wizard.

If OK, click the [Scan] button.
• If the chart is displaced, fine-adjust its position before clicking the [Scan] button.

Check scan results on the monitor window.
The bottom left monitor window shows good scan results. Compare them to those on the bottom right. In the NG example, there are two and five colors, meaning the chart is tilted. If dots are missing or notched, the exposure is incorrect. If there are no problems, click the [Next] button. If there is a problem, click the [Retry] button.

8 Scan at position ⑤.

Set the calibration chart to position ⑤. Check that the angle of the calibration chart surface is like the picture in the Calibration Wizard.

If OK, click the [Scan] button.
• If the chart is displaced, fine-adjust its position before clicking the [Scan] button.

Check scan results on the monitor window.
Check scan results in the same way as with position ④. If there are no problems, click the [Next] button. If there is a problem, click the [Retry] button.
Scan at position 9.

Set the calibration chart to position 6. Check that the angle of the calibration chart surface is like the picture in the Calibration Wizard.

If OK, click the [Scan] button.
- If the chart is displaced, fine-adjust its position before clicking the [Scan] button.

Check scan results on the monitor window.
The bottom left monitor window shows good scan results. Compare them to those on the bottom right.
In the NG example, the color sequence and pattern steadfast differ, meaning the chart direction and tilt are wrong. If dots are missing or notched, the exposure is incorrect.
If there are no problems, click the [Next] button. If there is a problem, click the [Retry] button.

Scan at position 10.

Set the calibration chart to position 7. Check that the angle of the calibration chart surface is like the picture in the Calibration Wizard.

If OK, click the [Scan] button.
- If the chart is displaced, fine-adjust its position before clicking the [Scan] button.

Check scan results on the monitor window.

Check scan results in the same way as with position 6.
If there are no problems, click the [Finish] button. If there is a problem, click the [Retry] button.
Data has been scanned in seven positions.
To cancel calibration halfway through, click the [Cancel] button. The confirmation message at right appears. To cancel calibration, click the [OK] button.
• If calibration is canceled, previous calibration data will continue to be used.

Execute calibration calculations.
These calculations use the seven sets of data to minimize error. Click the [Perform calculation] button.

Once calibration calculations have been completed, the residual error and result evaluation are displayed.
Perform the below operations according to the displayed result evaluation.

<table>
<thead>
<tr>
<th>Displayed Result Evaluation</th>
<th>Meaning</th>
<th>Operation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calibration ended successfully.</td>
<td>Calibration results are good.</td>
<td>Click the [Close] button to end calibration.</td>
</tr>
<tr>
<td>CAUTION</td>
<td>Caution is needed with calibration results.</td>
<td>Click the [Close] button to end calibration.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Be careful of the ambient temperature. To recalibrate the instrument, click the [Return to Beginning] button. If the same evaluation results after recalibration, contact Konica Minolta.</td>
</tr>
<tr>
<td>Calibration failed.</td>
<td>There is a problem with calibration results.</td>
<td>Click the [Return to Beginning] button and reperform calibration.</td>
</tr>
</tbody>
</table>
5.2 Instrument information

Information on the connected instrument can be displayed as a list. The information includes the type of model, the serial number of the sensor, type of lens, date of calibration, sensor temperature and residual error.

### Operating Procedure

1. **Select [Instrument information] from the [Instrument] menu.**
   
   The Sensor Information dialog box appears.

2. **Information on the connected sensor appears as a list.**

---

**Sensor Information Dialog Box**

- **Connected Instrument information**: Displays information on the connected sensor.
- **Instrument Type**: Displays the type of the connected instrument.
- **Serial number**: Displays the serial number of the connected sensor.
- **Firmware number**: Displays the firmware number of the connected scanning device.
- **Lens type**: Displays "TELE/WIDE" as the type of lens used by the connected sensor.
- **Calibration date/time**: Displays the date and time that the connected sensor was calibrated.
- **Residual error**: Displays the residual error calculated during the calibration.
- **Temperature at calibration**: Displays the instrument temperature when calibration was performed.
- **Instrument temperature**: Displays the current temperature of the connected sensor.
- **Warning contents**: Displays whether the connected sensor is ready for scanning or not.
  - **Ready**: The sensor is ready for scanning.
  - **Wait**: The sensor is not ready for scanning.

- **Display warning message when instrument status has changed**: Displays a warning message about sensor status changing when a checkmark is placed in the checkbox.
6. Help

6.1 Tool Tips

Tool tips are a function that displays a description of the operation which would be performed by a button that you bring the mouse cursor close to (for example a menu button or edit button).

<table>
<thead>
<tr>
<th>Operating Procedure</th>
<th>Shortcut</th>
<th>Ctrl+T</th>
<th>—</th>
</tr>
</thead>
<tbody>
<tr>
<td>Select [Tool tips] from the [Help] menu.</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

A checkmark appears next to [Tool tips] and the tool tips feature is activated. To hide the tool tips, select [Help] – [Tool tips] from the menu bar again. This removes the checkmark.

Example tool tip display
6.2 User's Guide

This command calls pdf files of the RANGE VIEWER user's guide and reference manual (this manual).

<table>
<thead>
<tr>
<th>Operating Procedure</th>
<th>Shortcut</th>
<th>F1</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Select [Instruction Manuals] from the [Help] menu.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The table of contents pages for the respective manuals are displayed in PDF format.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

6.3 About RANGE VIEWER

This command displays the version of the installed RANGE VIEWER as well as the version of the firmware used in the connected sensor.

<table>
<thead>
<tr>
<th>Operating Procedure</th>
<th>Shortcut</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>1 Select [About RANGE VIEWER] from the [Help] menu.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>The same opening window seen when the software is started up appears.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>If the instrument is not connected, &quot;--------&quot; will be displayed in place of the firmware version.</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
(Appendix)

Error Messages .................................................. 86
Menu Items ......................................................... 88
Glossary ............................................................. 90
Index ................................................................. 92
## Error Messages

The following error messages appear if RANGE VIEWER is incorrectly operated or trouble occurs with it. Take the measures as explained in “Action”. When a message not indicated in the list is displayed, please contact our Service Department.

<table>
<thead>
<tr>
<th>Error Messages</th>
<th>Cause</th>
<th>Action</th>
<th>ref. page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Memory allocation error.</td>
<td>There is not enough memory space for the operation.</td>
<td>Use a PC equipped with the recommended or higher (4 GB) memory capacity.</td>
<td>2</td>
</tr>
<tr>
<td>Could not export for memory was insufficient.</td>
<td></td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>Export was canceled because there were many exports of data.</td>
<td></td>
<td></td>
<td>17</td>
</tr>
<tr>
<td>Available memory is low. Save elements?</td>
<td></td>
<td></td>
<td>14</td>
</tr>
<tr>
<td>Instrument is still initial unstable status.</td>
<td>Little time has passed since the instrument was started up. The instrument is unstable.</td>
<td>Wait until the error message disappears.</td>
<td>6</td>
</tr>
<tr>
<td>Instrument temperature has changed since calibrating.</td>
<td>The temperature of the instrument changed since the last time it was calibrated.</td>
<td>Recalibrate the instrument to ensure accuracy.</td>
<td>6</td>
</tr>
<tr>
<td>LD safety circuit has worked.</td>
<td>Trouble occurred in the laser circuit.</td>
<td>Shut power to the instrument OFF, wait at least 10 sec and turn it back ON. If the error message appears again, the instrument may be damaged, therefore contact a customer service center listed in “Authorized Service Facility”.</td>
<td>–</td>
</tr>
<tr>
<td>LD safety circuit error had occurred.</td>
<td></td>
<td></td>
<td>–</td>
</tr>
<tr>
<td>LD safety circuit has been disabled.</td>
<td></td>
<td></td>
<td>–</td>
</tr>
<tr>
<td>AE failure.</td>
<td>Exposure could not be measured because the distance to the work was improper.</td>
<td>Check the status of the work and reperform AE.</td>
<td>–</td>
</tr>
<tr>
<td>AF failure.</td>
<td>The difference between the set standoff distance and actual distance is too large.</td>
<td>Change the stand-off distance setting so that it matches the actual distance to the work.</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>The work is not suited for auto focusing.</td>
<td>Scan the work in the manual mode or try using spot AF.</td>
<td>43-45</td>
</tr>
<tr>
<td>Unable to communicate with the stage.</td>
<td>The wrong rotating stage was selected.</td>
<td>Select the correct model number.</td>
<td>56</td>
</tr>
<tr>
<td>Unable to finish the stage.</td>
<td>The communication cable is not connected to the rotating stage.</td>
<td>Check that the communication cable is correctly connected. If not, connect it correctly.</td>
<td>–</td>
</tr>
<tr>
<td>Unable to control the stage.</td>
<td>Power to the rotating stage is OFF.</td>
<td>Turn ON power to the rotating stage.</td>
<td>–</td>
</tr>
<tr>
<td>Connection error</td>
<td>Communications with the instrument cannot start.</td>
<td>Shut power to the instrument OFF, wait at least 10 sec and turn it back ON. If the error message appears again, the instrument may be damaged, therefore contact a customer service center listed in “Authorized Service Facility”.</td>
<td>–</td>
</tr>
<tr>
<td>Timeout error while transmitting</td>
<td>An error occurred during communications with the instrument.</td>
<td>Shut power to the instrument OFF, wait at least 10 sec and turn it back ON. If the error message appears again, the instrument may be damaged, therefore contact a customer service center listed in “Authorized Service Facility”.</td>
<td>–</td>
</tr>
<tr>
<td>Timeout error (while obtaining error code)</td>
<td></td>
<td></td>
<td>–</td>
</tr>
<tr>
<td>Timeout error (while obtaining device list)</td>
<td></td>
<td></td>
<td>–</td>
</tr>
<tr>
<td>USB API error</td>
<td>Trouble occurred with the USB API.</td>
<td>Shut power to the instrument OFF and shut down the RANGE VIEWER application. Then, turn power to the instrument back ON and start up RANGE VIEWER.</td>
<td>–</td>
</tr>
<tr>
<td>Error Messages</td>
<td>Cause</td>
<td>Action</td>
<td>ref. page</td>
</tr>
<tr>
<td>------------------------------</td>
<td>-------------------------------------------------</td>
<td>------------------------------------------------------------------------</td>
<td>-----------</td>
</tr>
<tr>
<td>I/O error</td>
<td>An I/O error occurred.</td>
<td>Shut power to the instrument OFF, wait at least 10 sec and turn it back ON. If the error message appears again, the instrument may be damaged, therefore contact a customer service center listed in &quot;Service Support&quot;.</td>
<td>–</td>
</tr>
<tr>
<td>USB instrument not connected</td>
<td>Communications with an active instrument were interrupted.</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Communication error</td>
<td>An error occurred during communications with the instrument.</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Lens not attached</td>
<td>A lens is not mounted on the instrument or the lens is not securely mounted.</td>
<td>Mount a lens. Choose a lens according to the size of the work and the distance to it. Mount the lens as instructed.</td>
<td>–</td>
</tr>
<tr>
<td>AF motor error</td>
<td>Trouble occurred with the AF motor.</td>
<td>Shut power to the instrument OFF, wait at least 10 sec and turn it back ON. If the error message appears again, the instrument may be damaged, therefore contact a customer service center listed in &quot;Service Support&quot;.</td>
<td>–</td>
</tr>
<tr>
<td>Shutter motor error</td>
<td>Trouble occurred with the shutter motor, preventing the shutter from opening and closing correctly.</td>
<td>–</td>
<td>–</td>
</tr>
<tr>
<td>Could not perform measurement. Please check that lens cap is removed and check the measurement environment.</td>
<td>Measurement was performed with the lens cap attached.</td>
<td>Remove the lens cap.</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>The difference between the set standoff distance and actual distance is too large.</td>
<td>Change the stand-off distance setting so that it matches the actual distance to the work.</td>
<td>–</td>
</tr>
<tr>
<td></td>
<td>Exposure could not be measured because the distance to the work was improper.</td>
<td>Check the status of the work and reperform AE.</td>
<td>42</td>
</tr>
</tbody>
</table>
## Menu Items

Each window has buttons to facilitate operations in line with scanning and editing procedures. The following list outlines the functions of those buttons, their location in the menu bar and their shortcuts.

<table>
<thead>
<tr>
<th>Menu</th>
<th>Main Header</th>
<th>Sub Header</th>
<th>Shortcut</th>
<th>Button</th>
<th>Operation</th>
<th>Ref. Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>File</td>
<td></td>
<td></td>
<td>Ctrl+N</td>
<td>–</td>
<td>Creates a new file.</td>
<td>12</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ctrl+O</td>
<td>–</td>
<td>Opens an existing file.</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Ctrl+S</td>
<td>–</td>
<td>Saves the opened file.</td>
<td>14</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>–</td>
<td>–</td>
<td>Saves the opened file under another name.</td>
<td>15</td>
</tr>
<tr>
<td>Export</td>
<td></td>
<td>To File</td>
<td>–</td>
<td>–</td>
<td>Exports elements to files.</td>
<td>16</td>
</tr>
<tr>
<td></td>
<td></td>
<td>To Application</td>
<td>Ctrl+E</td>
<td>–</td>
<td>Exports elements to other applications.</td>
<td>17</td>
</tr>
<tr>
<td>Preferences</td>
<td></td>
<td>Shift+F1</td>
<td>–</td>
<td>–</td>
<td>Accesses settings for 3D view displays, file saving processing, etc.</td>
<td>18</td>
</tr>
<tr>
<td>Exit</td>
<td></td>
<td></td>
<td>–</td>
<td>–</td>
<td>Quits RANGE VIEWER.</td>
<td>21</td>
</tr>
</tbody>
</table>

**Edit**

<table>
<thead>
<tr>
<th>Button</th>
<th>Operation</th>
<th>Ref. Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undo</td>
<td>Reverses the last editing operation.</td>
<td>22</td>
</tr>
<tr>
<td>Redo</td>
<td>Reapplies the last undone editing operation.</td>
<td>22</td>
</tr>
<tr>
<td>Select Rectangle</td>
<td>Selects/unselects all points lying within drawn rectangles.</td>
<td>23</td>
</tr>
<tr>
<td>Select Bezier</td>
<td>Selects/unselects all points lying within drawn Bezier curves.</td>
<td>24</td>
</tr>
<tr>
<td>Invert</td>
<td>Inverts points between selected/unselected.</td>
<td>26</td>
</tr>
<tr>
<td>Boundary</td>
<td>Selects only boundary points of elements.</td>
<td>27</td>
</tr>
<tr>
<td>Front facing points</td>
<td>Enables selecting points having the normal facing towards the camera.</td>
<td>28</td>
</tr>
<tr>
<td>Select all Elements</td>
<td>Selects all elements.</td>
<td>29</td>
</tr>
<tr>
<td>Unselect all Elements</td>
<td>Unselects all elements.</td>
<td>29</td>
</tr>
<tr>
<td>Select all points on selected elements</td>
<td>Selects all points of selected elements.</td>
<td>30</td>
</tr>
<tr>
<td>Unselect all points on selected elements</td>
<td>Unselects all points of selected elements.</td>
<td>30</td>
</tr>
<tr>
<td>Delete Points</td>
<td>Deletes selected points.</td>
<td>31</td>
</tr>
<tr>
<td>Delete Elements</td>
<td>Deletes selected elements.</td>
<td>32</td>
</tr>
<tr>
<td>Registration Shift+Alt+R</td>
<td>Registers selected elements.</td>
<td>32</td>
</tr>
<tr>
<td>Edit marker holes Shift+Alt+K</td>
<td>Edit data near markers.</td>
<td>33</td>
</tr>
<tr>
<td>Merge Shift+Alt+M</td>
<td>Merges selected elements.</td>
<td>34</td>
</tr>
<tr>
<td>Menu</td>
<td>Main Header</td>
<td>Sub Header</td>
</tr>
<tr>
<td>------------</td>
<td>------------------</td>
<td>--------------</td>
</tr>
<tr>
<td><strong>View</strong></td>
<td>Viewpoint</td>
<td>Front</td>
</tr>
<tr>
<td></td>
<td>Right</td>
<td>Ctrl+2</td>
</tr>
<tr>
<td></td>
<td>Back</td>
<td>Ctrl+3</td>
</tr>
<tr>
<td></td>
<td>Left</td>
<td>Ctrl+4</td>
</tr>
<tr>
<td></td>
<td>Top</td>
<td>Ctrl+5</td>
</tr>
<tr>
<td></td>
<td>Bottom</td>
<td>Ctrl+6</td>
</tr>
<tr>
<td><strong>Rotate/Zoom</strong></td>
<td>Rotate</td>
<td>F9</td>
</tr>
<tr>
<td></td>
<td>Pan</td>
<td>F10</td>
</tr>
<tr>
<td></td>
<td>Zoom</td>
<td>F11</td>
</tr>
<tr>
<td></td>
<td>Area zoom</td>
<td>F12</td>
</tr>
<tr>
<td></td>
<td>Fit to window</td>
<td>Ctrl+F</td>
</tr>
<tr>
<td><strong>Display mode</strong></td>
<td>Points</td>
<td>Ctrl+Space</td>
</tr>
<tr>
<td></td>
<td>Shades</td>
<td>Ctrl+Space</td>
</tr>
<tr>
<td><strong>Element Information</strong></td>
<td>Alt+I</td>
<td>–</td>
</tr>
<tr>
<td><strong>Measure</strong></td>
<td>Monitor</td>
<td>F2</td>
</tr>
<tr>
<td></td>
<td>AE/AF</td>
<td>F3</td>
</tr>
<tr>
<td></td>
<td>Preview</td>
<td>F4</td>
</tr>
<tr>
<td></td>
<td>Scan</td>
<td>F5</td>
</tr>
<tr>
<td></td>
<td>Scan settings</td>
<td>F6</td>
</tr>
<tr>
<td><strong>Instrument</strong></td>
<td>Calibration</td>
<td>F8</td>
</tr>
<tr>
<td></td>
<td>Instrument information</td>
<td>F7</td>
</tr>
<tr>
<td><strong>Help</strong></td>
<td>Tool tips</td>
<td>Ctrl+T</td>
</tr>
<tr>
<td></td>
<td>Instruction Manuals</td>
<td>F1</td>
</tr>
<tr>
<td></td>
<td>About</td>
<td>–</td>
</tr>
</tbody>
</table>

**Shortcut List (items not in the menu bar)**

<table>
<thead>
<tr>
<th>Ref. Page</th>
<th>Shift Ultimate Function</th>
</tr>
</thead>
<tbody>
<tr>
<td>9, 49</td>
<td>Monochrome image display button</td>
</tr>
<tr>
<td>83</td>
<td>Contours display button</td>
</tr>
<tr>
<td>82</td>
<td>Color bar display check button</td>
</tr>
<tr>
<td>84</td>
<td>(Current scanning element) Delete</td>
</tr>
</tbody>
</table>

89
Glossary

rvm format
Multiple elements are grouped into a single file.

rgv format
Each element has its own file.

STL Files
This file format is specifically for SLA CAD software by 3D Systems. It is supported by a wide range of analysis software and allows 3D data to be directly input in STL format for use with prototyping machines. The recorded 3D modeling data forms a polygon of the surface normal vectors and coordinates for three vertexes of a triangle. STL files can be ASCII or binary format, but RANGE VIEWER exports only the binary format. Merged data is exported to a single STL file without connections between the merged elements.

ASC Files
Exported ASC (ASCII) files contain 3D point data without normal information.

rmk Files
Reference marker information is processed in this format.

txt Files
Files in the ordinary text format. RANGE VIEWER can read in the X coordinate value, Y coordinate value and Z coordinate value of the marker in each line. The X, Y and Z coordinate values are separated by commas or tabs.

IPC Export
IPC (Inter Process Communication) uses available internal memory space to transfer data scanned by RANGE VIEWER to other software at high speed. Compared to normal file transfers, transmission is easier and faster because it does not require operations to save or read files.

3D Orthogonal Coordinates
The position of a point in a 3D space is represented by coordinates in a 3D orthogonal coordinate system. The coordinate system here uses a point near to the center of the RANGE7/5’s receiver lens. The Z direction extends from directly behind the light receptor along the optical axis to the front, the Y direction is above the receiver and the X direction is to the right.
* In the output 3D data, specific offsets are applied respectively along the XYZ axes.

Viewpoint
RANGE VIEWER lets you view elements from the front, back, top, bottom, right or left, or in most any orthogonal projection.
**FOV Indicator**

A FOV (field of view) indicator projects the below pattern of light on the work to make it easier to identify the scan area. The FOV indicator is synchronized with motor operation to continuously project the light. (Note: FOV indicator updates slow while RANGE VIEWER windows are being operated.)

![FOV Indicator Diagram](image)

**Multi focus**

In the Multi focus mode, scanning is performed twice by changing the focal point. When the Multi focus mode is active, the data of the area closer to the focal point is selected for calculation. Depending on the work, the effects may differ. However, when you want to obtain results with less data noise, set Multi focus to "Enable". Compared to when Multi focus is set to "Disable", it takes more time to display the results.

![Multi focus Diagram](image)

Multi focus is enabled and disabled from the Scan settings dialog box.

**AE (Auto Exposure) and AF (Auto Focus)**

AE (Auto Exposure) is a mechanism for automatically setting image exposure conditions. AF (Auto Focus) is a mechanism for automatically setting the focal distance to the work.

**Polygon**

Polygons refer to areas (surfaces) enclosed by lines (edges) connecting vertices.

**Element**

“Element” is the 3D data unit used by RANGE VIEWER. Normally, one element is generated and edited from scanning.
# Index

3D Orthogonal Coordinates 35, 90  
3D view 11  

**A**  
About RANGE VIEWER 84  
AE 91  
AE/AF 43, 68  
AE/AF buttons 9  
AF 91  
All elements 29  
ASC files 16, 90  

**B**  
Bezier 24  
Bezier curves 25  
Bezier select button 11  
Boundary 27  

**C**  
Calibration 72  
Calibration chart 57, 72  
Calibration sheet 72  
Calibration stand 72  
Color bar 9  

**D**  
Dark surface mode 46, 47  
Data subsampling rate 69  
Delete 31  
Delete last data button 9  
Deleting selected elements 31  
Deleting selected points 31  
Display mode 38  

**E**  
Editing tool buttons 11  
Edit tab 8, 10  
Element 7, 91  
Element boundary point select button 11, 27  
Element delete button 11  
Element Information 39  
Element list 8, 10  
Element merge button 11  
Element registration button 11  
Exit 7, 21  
Export button 11  
Exposure level setting 45  

**F**  
Firmware version 84  
Fit to window button 8, 37  
FOV Indicator 42, 91  
Front facing points button 11, 28  
Full auto scanning 61  

**H**  
Help 83  

**I**  
Instrument 72  
Instrument information 82  
Invert 26  
IPC export 17, 90  

**M**  
Manual focusing 45  
Marker 65  
Marker registration 71  
Marker size 71  
Mean error 32  
Measure 41, 50  
Menu bar 8, 10  
Menu buttons 8, 10  
Merge 34  
Monitor 41  
Monitor button 9  
Monitor window 9  
Move viewpoint button 8  
Multi focus 42, 91  

**N**  
Navigation message 8, 10  
New 12  

**O**  
Open 13  
Open button 11  

**P**  
Paired points 50, 51, 69  
Point delete button 11  
Point selection invert button 11, 26  
Polygon 91  
Registration with marker information 32  
Preferences 18  
Preview 48  
Preview button 9  
Preview current scan window 9  
Previous window 9  

92
### R

<table>
<thead>
<tr>
<th>Item</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rectangle</td>
<td>23</td>
</tr>
<tr>
<td>Rectangle select button</td>
<td>11</td>
</tr>
<tr>
<td>Redo</td>
<td>22</td>
</tr>
<tr>
<td>Redo button</td>
<td>11</td>
</tr>
<tr>
<td>Registration</td>
<td>32</td>
</tr>
<tr>
<td>Residual error</td>
<td>81, 82</td>
</tr>
<tr>
<td>rgv</td>
<td>13, 14</td>
</tr>
<tr>
<td>rgv format</td>
<td>12, 90</td>
</tr>
<tr>
<td>Rotate/Zoom</td>
<td>36</td>
</tr>
<tr>
<td>Rotating stage</td>
<td>50, 56</td>
</tr>
<tr>
<td>Rotating stage registration</td>
<td>70</td>
</tr>
<tr>
<td>rvm</td>
<td>12, 13, 14</td>
</tr>
<tr>
<td>rvm format</td>
<td>90</td>
</tr>
</tbody>
</table>

### S

<table>
<thead>
<tr>
<th>Item</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Save</td>
<td>14</td>
</tr>
<tr>
<td>Save as</td>
<td>15</td>
</tr>
<tr>
<td>Save button</td>
<td>11</td>
</tr>
<tr>
<td>Saving reference markers</td>
<td>66</td>
</tr>
<tr>
<td>Scan button</td>
<td>9</td>
</tr>
<tr>
<td>Scan position adjustment</td>
<td>42</td>
</tr>
<tr>
<td>Scan settings</td>
<td>9, 67</td>
</tr>
<tr>
<td>Scan tab</td>
<td>8, 10</td>
</tr>
<tr>
<td>Select</td>
<td>23</td>
</tr>
<tr>
<td>Select all elements</td>
<td>29</td>
</tr>
<tr>
<td>Select all points on selected elements</td>
<td>30</td>
</tr>
<tr>
<td>Sensor icon</td>
<td>6</td>
</tr>
<tr>
<td>Set registration points button</td>
<td>9</td>
</tr>
<tr>
<td>SHOT-202</td>
<td>56, 70</td>
</tr>
<tr>
<td>SHOT-602</td>
<td>56, 70</td>
</tr>
<tr>
<td>Show color bar button</td>
<td>9</td>
</tr>
<tr>
<td>Show contours button</td>
<td>9</td>
</tr>
<tr>
<td>Show monochrome view button</td>
<td>9</td>
</tr>
<tr>
<td>Show points button</td>
<td>8, 38</td>
</tr>
<tr>
<td>Show shaded points button</td>
<td>8, 38</td>
</tr>
<tr>
<td>Spot AF</td>
<td>44, 68</td>
</tr>
<tr>
<td>Spot AF button</td>
<td>9</td>
</tr>
<tr>
<td>Stage calibrate</td>
<td>58</td>
</tr>
<tr>
<td>Standard deviation</td>
<td>32</td>
</tr>
<tr>
<td>Start up</td>
<td>6</td>
</tr>
<tr>
<td>Status bar</td>
<td>6, 8, 10</td>
</tr>
<tr>
<td>STL Files</td>
<td>16, 90</td>
</tr>
</tbody>
</table>

### T

<table>
<thead>
<tr>
<th>Item</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Title bar</td>
<td>8, 10</td>
</tr>
<tr>
<td>To application</td>
<td>17</td>
</tr>
<tr>
<td>To file</td>
<td>16</td>
</tr>
<tr>
<td>Tool tips</td>
<td>83</td>
</tr>
<tr>
<td>TXT</td>
<td>66</td>
</tr>
</tbody>
</table>

### U

<table>
<thead>
<tr>
<th>Item</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Undo</td>
<td>22</td>
</tr>
<tr>
<td>Undo button</td>
<td>11</td>
</tr>
<tr>
<td>Unselect all elements</td>
<td>29</td>
</tr>
<tr>
<td>Unselect all points on selected elements</td>
<td>30</td>
</tr>
<tr>
<td>Users Guide</td>
<td>84</td>
</tr>
</tbody>
</table>

### V

<table>
<thead>
<tr>
<th>Item</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>View</td>
<td>35</td>
</tr>
<tr>
<td>Viewpoint</td>
<td>35, 90</td>
</tr>
<tr>
<td>Viewpoint move button</td>
<td>8, 10, 37</td>
</tr>
<tr>
<td>Viewpoint rotate button</td>
<td>36</td>
</tr>
</tbody>
</table>

### Z

<table>
<thead>
<tr>
<th>Item</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Zoom button</td>
<td>8, 10, 37</td>
</tr>
<tr>
<td>Zoom selected area button</td>
<td>8, 10, 37</td>
</tr>
</tbody>
</table>