Canon

CXDI Control Software NE

Version 1.20

Setup Guide

Before using this software, be sure to read this manual and the separate Operation Manual thoroughly.
Also, read the Digital Radiography CXDI series User's Manual.
Keep the manual where it is easily accessible.

To the Customers

Thank you for purchasing the Canon CXDI Control Software NE (hereinafter called this product).
Operating instructions are divided into two volumes: the Operation Manual and the Setup Guide.
Before using this product, be sure to read these manuals thoroughly in order to utilize this product more effectively.

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Third Party Software

Third-party software will be installed on the image-capture computer when the control software is being installed by the service engineer. For details on the third-party software and its license agreements, consult your service engineer.

Safety Summary

Before using this product, read this safety summary thoroughly. This information will prevent the users and persons involved from sustaining physical harm and/or property damage.
Read the separate Operation Manual and the Digital Radiography CXDI series User's Manual as well.

Safety Notices

The following safety notices are used to emphasize certain safety instructions. This manual uses the caution symbol along with a caution message.

⚠ **CAUTION**	**This notice is used to identify conditions under which improper use of the product may cause minor personal injury.**

Safety Precautions

Follow this safeguard and use the application software properly to prevent injury and equipment/data damage.

While conducting Calibration and Performance Test

⚠ **CAUTION**
Be sure to confirm that there is no person in the radiology room during Calibration and Performance Test to prevent the possibility of any persons exposing themselves to X-ray exposure.

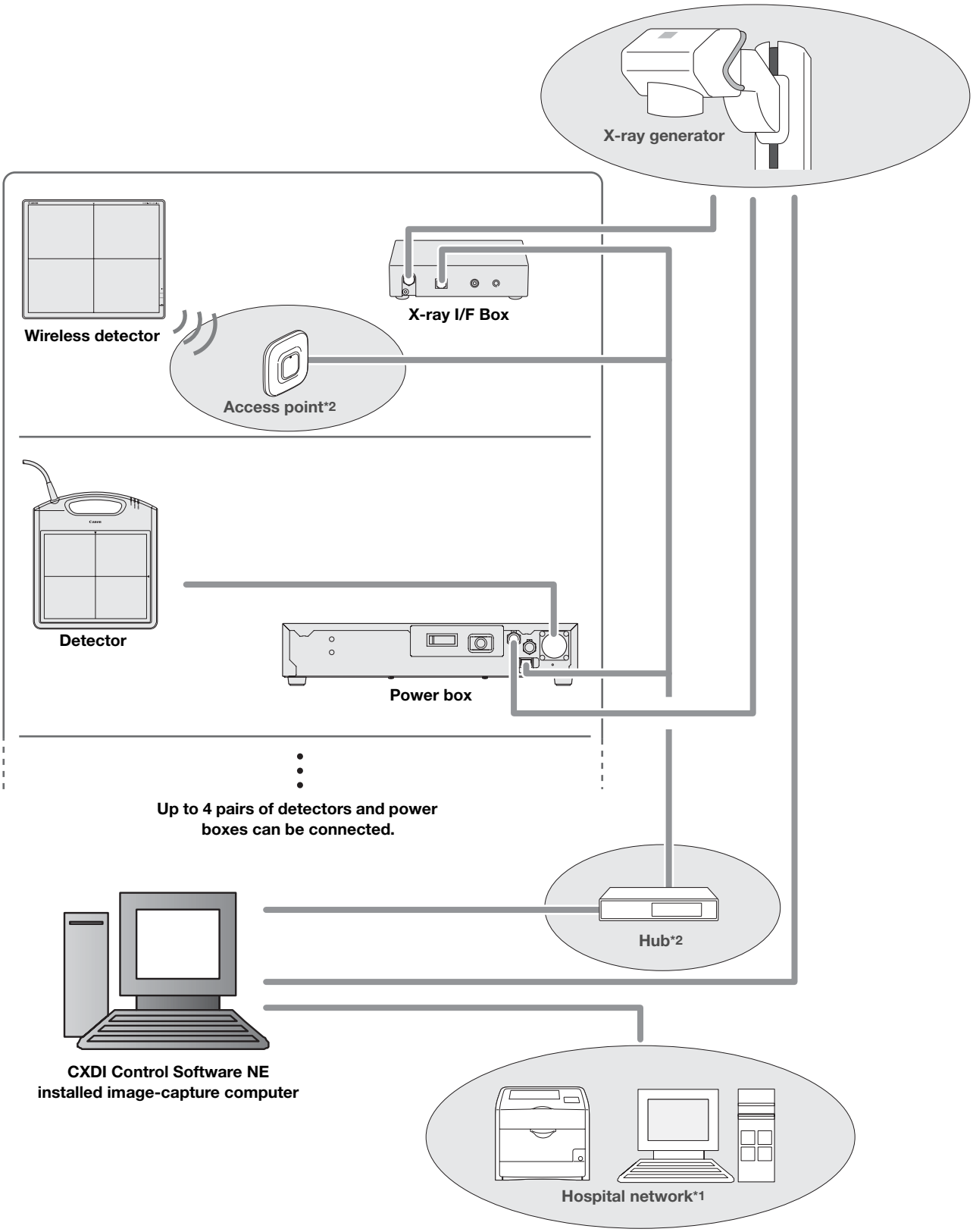
Contents

3 System Tools

Appendix

1 System Configurations and Requirements

1.1 Hardware configuration



*1 Consists of DICOM standard compatible equipment (HIS/RIS, PACS, printer, storage device, etc).

*2 Recommended commercially available items

1.2 Hardware requirements

Image-capture computer

- Intel® Core™2 Duo 2.0 GHz or faster processor
- 4 GB of RAM
- 50 GB of available hard-disk space

Display

- XGA (1024×768), SXGA (1280×1024)
- WXGA++ (910×804), WSXGA+ (1680×1050), WUXGA (1920×1200)
- DICOM GSDF or DICOM P-value LUT compatible
- Touch operation compatible

Video card

- Graphic board
- Screen resolution corresponding to that of the display
- Full color (24 bits or more)

Ethernet

- More than 3 ports (For a detector control, X-ray generator control, and Local Area Network)
  A port for a detector requires Intel Pro/1000 PT (PCI Express)

Detector

- Static flat-panel detector (Ethernet connection available)
- Wireless flat-panel detector
- Maximum number of detectors that can be configured: 10
- Maximum number of detectors that can be simultaneously connected: 4

UPS (Uninterruptible Power Supply) (optional)

Bar-code reader (optional)

- USB interface
- USB bus power

Magnetic card reader (optional)

NOTE: For details about hardware requirements, consult your service engineer.

1.3 Software requirements

Operating System

- Microsoft Windows Vista Business Edition SP1 or later (×64)
- Microsoft Windows Vista Ultimate Edition SP1 or later (×64)
- Microsoft Windows 7 Professional Edition (×64)
- Microsoft Windows 7 Ultimate Edition (×64)

Additional software

- .Net Framework 3.5 SP1 or later
- Microsoft Windows Vista Security Patch
- Microsoft Windows 7 Security Patch
- SQL Server 2005 Express Edition
- DirectX Runtime
- VC++ 2005 redistributable package
- VC++ 2008 redistributable package

NOTE: For details about software requirements, consult your service engineer.

2 System Setup Screen

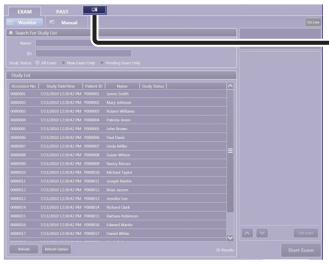
2.1 Using the system setup screen

Fundamental system setup options (user administration, screen appearance, and so on) are organized through the setup option tabs on the system setup screen. First learn basic operation in 2.1.1, and then access the necessary setup options as explained by the setup option finder in 2.1.2.

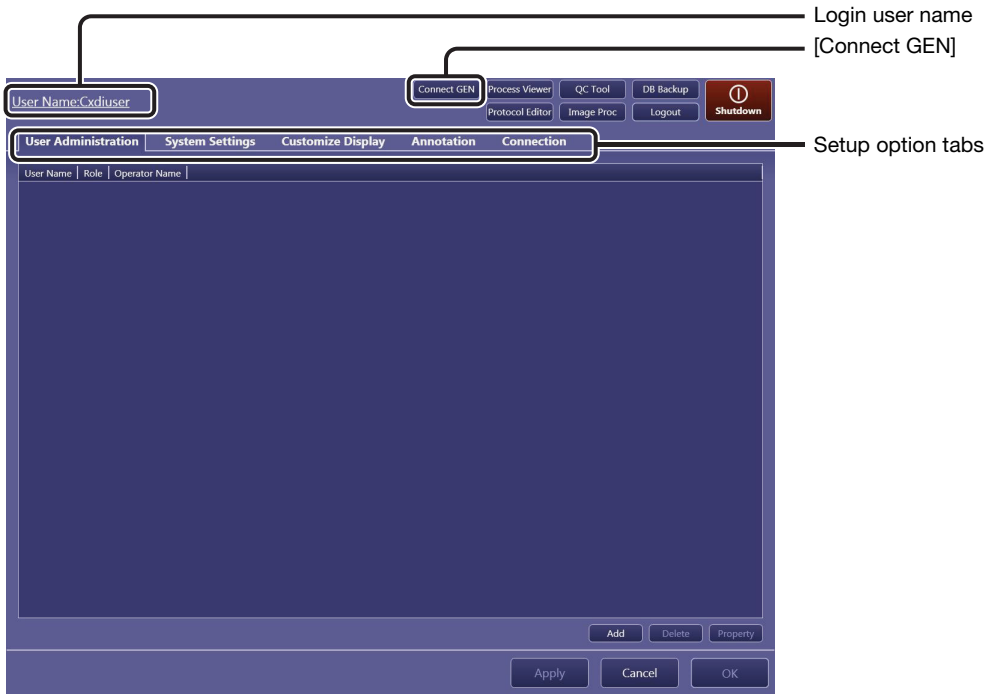
2.1.1 Basic operations

1 Show the system setup screen.

Click  on the [EXAM] or [PAST] screen.



[EXAM] or [PAST] screen



System setup screen

When [Connect GEN] appears

The image-capture computer and the X-ray generator have been functionally disconnected. Click [Connect GEN] to resume connection.

Note: [Connect GEN] appears only when the communication with the X-ray generating device is enabled. See 2.6.5 for details on operation.

2 Select a setup option.

Click the target setup option tab. For the Annotation and Connection tabs, a further click of a sub-tab is required.

NOTE: The User Administration tab is not available during examination.

To change the settings

See 2.2 thru 2.6.

To save the changes that have been made and continue with other settings

Click [Apply].

To save the changes and return to the previous [EXAM] or [PAST] screen

Click [OK]. The screen shown before clicking  returns.

To cancel the changes and return to the previous [EXAM] or [PAST] screen

Click [Cancel]. The screen shown before clicking  returns.

NOTE: After [Apply] is clicked, the changes cannot be canceled.

2.1.2 System setup option finder

The following system setup option tabs are available:

User Administration tab (See 2.2)

Addition, deletion, and modification of the user account

System Settings tab (See 2.3)

CXDI Control Software NE:
Software Version, **Character Set**, and **Device Info**
Screen Saver: **Wait Time** and **Auto-Logout**
Process Viewer: **Refresh Interval**
Essential Input Setting:
Essential items selection for the Patient/Study information pane
Institution: **Institution Name**
Monitor Gamma: Confirmation of the monitor gamma adjustment using test patterns

Customize Display tab (See 2.4)

GUI Color Taste Selection:
Two options are available.
Examination Screen:
Automatic Next Protocol Selection, **Show Code Meaning**, **Input Reject Reason**, **Show Stitch Screen automatically after ending every Exam**, **Patient Info Input Mode**, **Help Display**, and **Measurement Object**
Column Headers: For both the Worklist/Pendinglist and the Past List
Description List Items:
Description list management for Referring Physician, Reading Physician, and Reject Reason

Annotation tab

The following sub-tabs are available.

Preview Annotation tab (See 2.5.1):
Display item layout for single view mode, **Font**, and font size

Free Annotation/Laterality Marker tab (See 2.5.2):
Font, font size, and **Free Annotation** list for Free Annotation Laterality marker selector, **Font**, font size, and **Position** for the laterality marker

Film Annotation tab (See 2.5.3):
Embedded item layout, **Font**, and font size for each film/image
(This tab is separated into **Film Box Annotation** and **Image Box Annotation** sub-tabs in accordance with the intended annotation object.)

Connection tab

The following sub-tabs are available.

Storage tab (See 2.6.1):
Storage selection and communication tests, **Storage List** management, and **Common Output Setting**

Printer tab (See 2.6.2):
Printer selection and communication tests, **Printer List** management, **Common Output Setting** and **Layout Template** selection (see 2.6.6)

MWL tab (See 2.6.3):
MWL settings and communication tests, and **Search Condition** settings

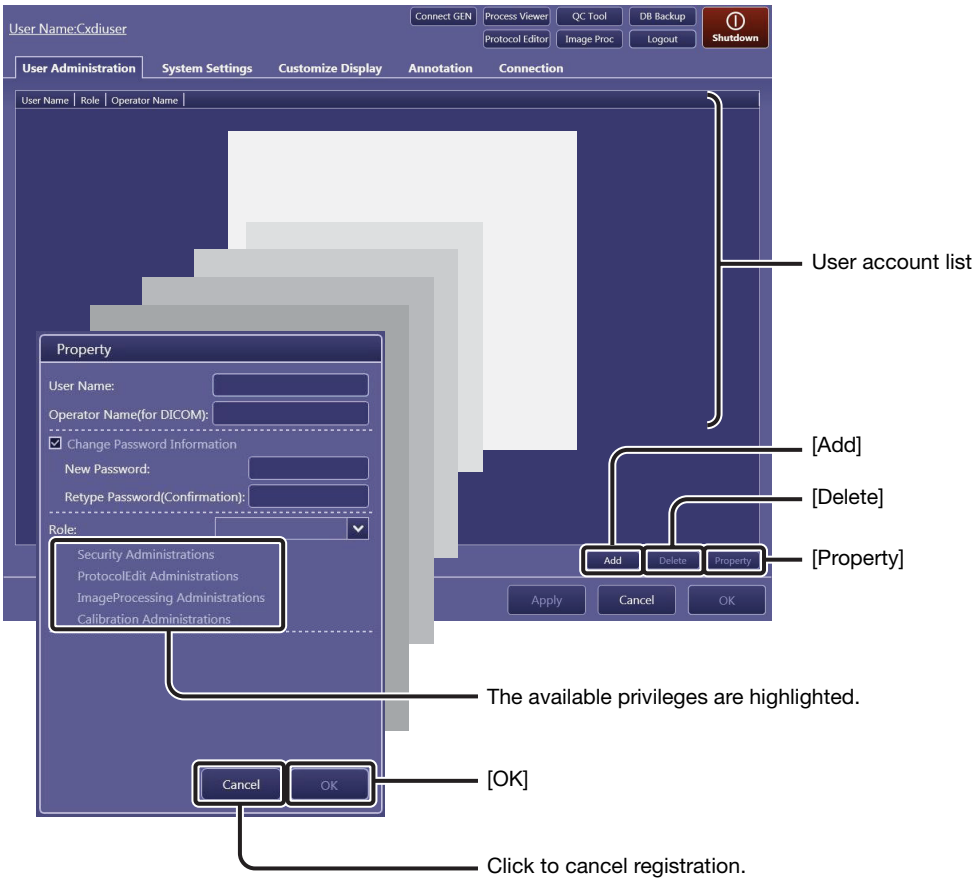
MPPS tab (See 2.6.4):
MPPS settings and communication tests

GenCom (See 2.6.5):
X-ray generator communication selection

2.2 User Administration tab

To ensure the security of personal information and enable authenticated operation, the CXDI Control Software NE (hereinafter referred to as “Control Software”) provides a login dialog box on the start screen. The User Name for the user account created with this tab appears in the User Name selector on the start screen. A user without Security Administrations privileges can only modify his/her own user account settings.

NOTE: New user account registration requires the **Security Administrations** privilege (see step 2). Consult your service engineer.



1 Register an user account to the User account list.

Click [Add] to create a new user account.

To modify an existing user account

Click the target user in the user account list, and then click [Property].

2 Enter or modify the user account properties.

User Name: Identifies users.
Operator Name (for DICOM):
This entry is optional.
Change Password Information:
Select this option before entering a new password.
New Password: Enter the same password in the Retype Password (Confirmation) field as well.
Role: According to the role, advanced operations are permitted. The following privileges can be granted to a role: **Security Administrations** (this section), **ProtocolEdit Administrations** (see 3.3), **ImageProcessing Administrations** (see 2.3.2 and 3.5), **Calibration Administrations** (see 3.4).

NOTE: In addition to **Administrator** and **Standard User**, the roles registered by the service engineer can be selected. For details, consult your service engineer.
NOTE: For User Name and Operator Name options, up to 64 alphanumeric characters can be used. For the New Password option, 4 to 64 alphanumeric characters can be used. Avoid use of blank character at the beginning of the name and password.
NOTE: The current login user cannot change his/her own Role option.

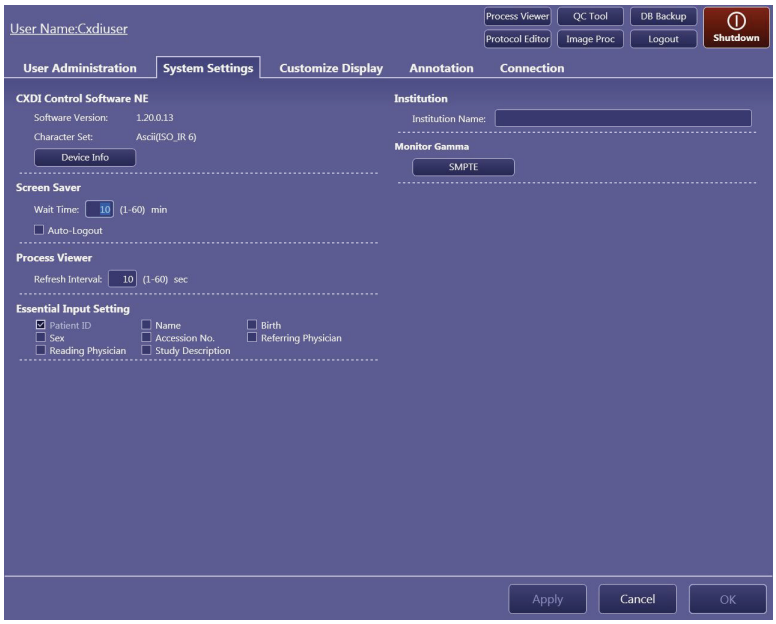
3 Set the user account.

Click [OK] in the Property dialog box.

To delete a user account

Click the target user in the user account list, click [Delete], and then click [OK] in the confirmation dialog box that appears.

2.3 System Settings tab



2.3.1 System options

CXDI Control Software NE

Software Version: Shows the version of the Control Software.
Character Set: Shows the value of the character set for DICOM information.
Device Info: Click to show the information dialog box for a connected detector and power box. If two or more detectors are connected, a target detector selection is required on the Detector Name drop-down list of the dialog box. Click [OK] to close the dialog box.

Screen Saver

Wait Time: Specify the amount of time after the last operation until the screen saver becomes active (within a range of 1 to 60 minutes).
Auto-Logout: Select this option to automatically log out of the Control Software and activate the screen saver.
This option may not be available depending on the Control Software setting. Consult your service engineer for the setting.

Process Viewer (See 3.2)

Refresh Interval: Specify the refresh interval for the process viewer (within a range of 1 to 60 seconds).

Essential Input Setting

Select the items required for the patient/study information pane. “*” appears at the left of the selected items in the patient/examination information pane, which indicates items that need to be entered before an examination is started. (refer to 3.2.1 in the Operation Manual).

Patient ID*, **Name**, **Birth** (birthday), **Sex**, **Accession No.**, **Referring Physician**, **Reading Physician**, **Study Description**

* Required items that cannot be cleared.

Institution

Institution Name: Enter or modify the institution name to output as a film box annotation (see 2.5.3).

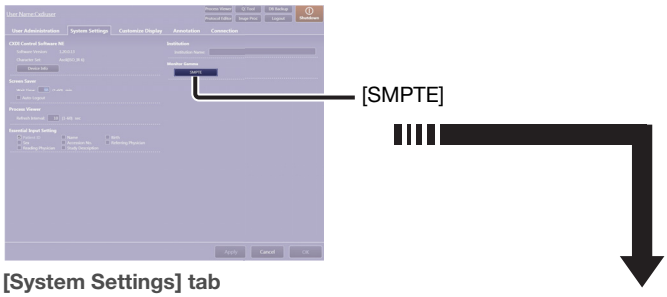
2.3.2 Monitor gamma

To maintain a uniform screen appearance, regularly check whether the monitor gamma is properly adjusted using the SMPTE test pattern.

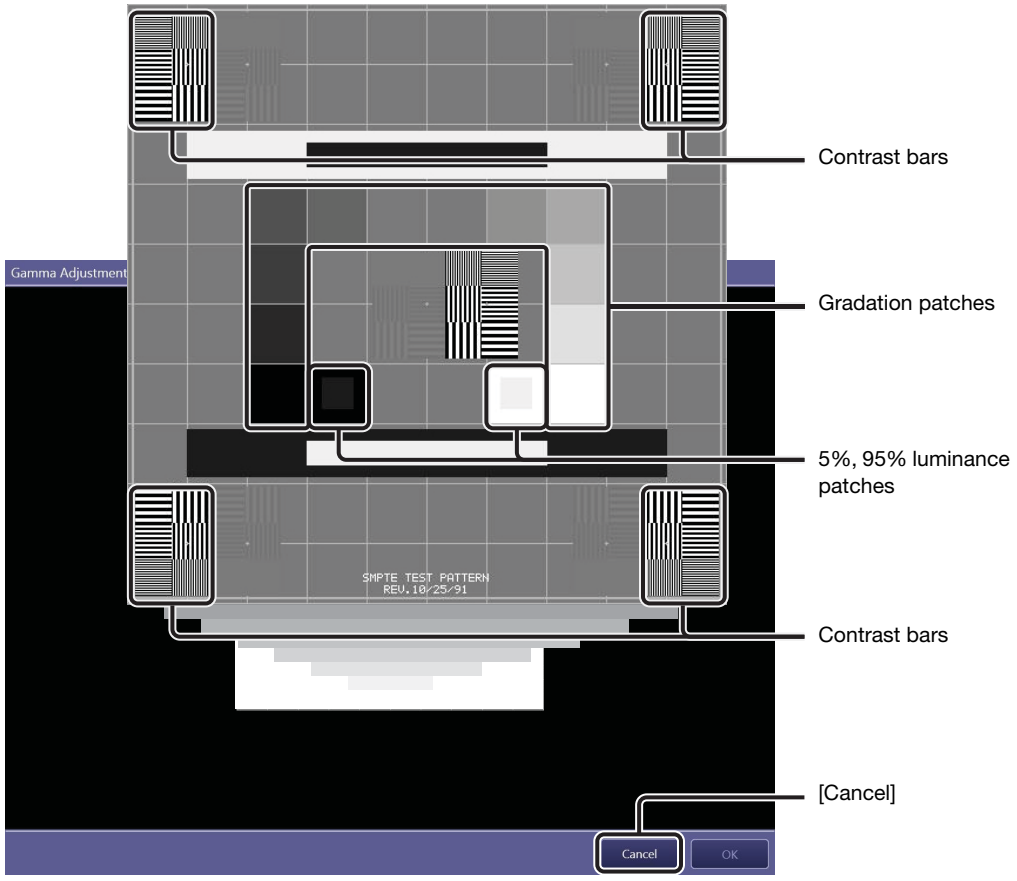
1 Start monitor gamma confirmation.

Click [SMPTE].

NOTE: Operations for the Monitor Gamma option require the ImageProcessing Administrations privilege (see step 2 in 2.2).



[System Settings] tab



SMPTE screen

2 Check the screen appearance for the current monitor gamma.

Check whether the monitor gamma is properly adjusted using the three kinds of patches below.

To confirm the 5% and 95% luminance patches

Confirm that the squares inside each of the two luminance patches are clearly and equally defined.

To confirm the gradation patches

Confirm that the gradation patches are clearly defined.

To confirm the contrast bars

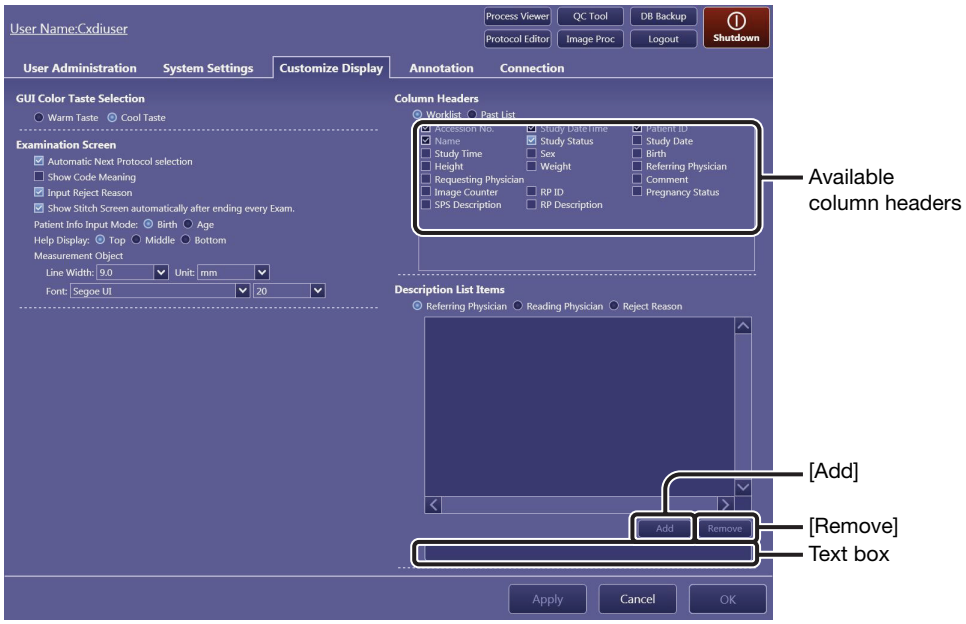
Confirm that the black and white strips are clearly defined.

3 End monitor gamma confirmation.

Click [Cancel] to return to the [System Settings] tab.

NOTE: Depending on the current software configuration, users can adjust the monitor gamma and save the adjustment result (see 7 in Appendix for details) in addition to confirming the monitor gamma using the SMPTE test pattern.

2.4 Customize Display tab



2.4.1 GUI Color Taste Selection, Examination Screen, and Column Headers options

GUI Color Taste Selection

Select either **Warm Taste** (when using in a dimly-lit room such as a radiology room) or **Cool Taste** (when using in a well-lit room such as a hospital ward in which X-ray exposure is available using a mobile system).

Examination Screen

Automatic Next Protocol Selection:
Select the check box to automatically prepare the next available protocol for exposure. Clear the check box to manually select the next protocol to be conducted.

Show Code Meaning:
Select the check box to use Code Meaning for the protocol title (except for protocols created on the Protocol Editor screen).

Input Reject Reason:
Select the check box to enable entry of a Reject Reason.

Show Stitch Screen automatically after ending every Exam:
Select the check box to automatically show the stitch screen when the number of images required for stitch protocol have been captured.

Patient Info Input Mode:
Select either **Birth** (uses a birthday for the patient information) or **Age** (uses an age for the patient information).

NOTE: Even when Age is selected for the Patient Info Input Mode option, the information is not shown in the Patient List as it does not accurately specify the patient age.

Help Display: Select the position of the help display in the image view pane during image processing operations from among **Top**, **Middle**, or **Bottom**.

Measurement Object:
Specify the details of objects embedded in Measurement mode.
Line Width (of the distance/angle object), **Unit** (select from among “mm”, “cm” and “inch”) (refer to 6.3 in the Operation Manual), **Font** (font name), and Size (font size)

Column Headers

Select **Worklist** or **Past List**, and then select column headers to show for the selected list. Available column headers for each list are as follows:

Worklist: **Accession No.***, **Study DateTime*** (of the ordered examination), **Patient ID***, **Name***, **Study Status**, **Study Date**, **Study Time**, **Sex**, **Birth** (birthday), **Height**, **Weight**, **Referring Physician**, **Requesting Physician**, **Comment**, **Image Counter**, **RP ID** (requested procedure ID), **Pregnancy Status**, **SPS Description** (scheduled procedure step description), and **RP Description** (requested procedure description)

Past List: **Accession No.***, **Study DateTime***, **Patient ID***, **Name***, **Birth***, **Print Result**, **Store Result**, **Study Date**, **Study Time**, **Image Counter**, **Sex**, **SC** (storage commitment), and **Reject**

* Required items that cannot be cleared.

2.4.2 Description List Items option

The descriptions of reject reasons are preset in this option, as are the names of the referring physicians and reading physicians.

1 Select the target option.

Select **Referring Physician**, **Reading Physician**, or **Reject Reason**.

2 Add a new description to the list.

Enter a new name or description in the text box, and then click [Add].

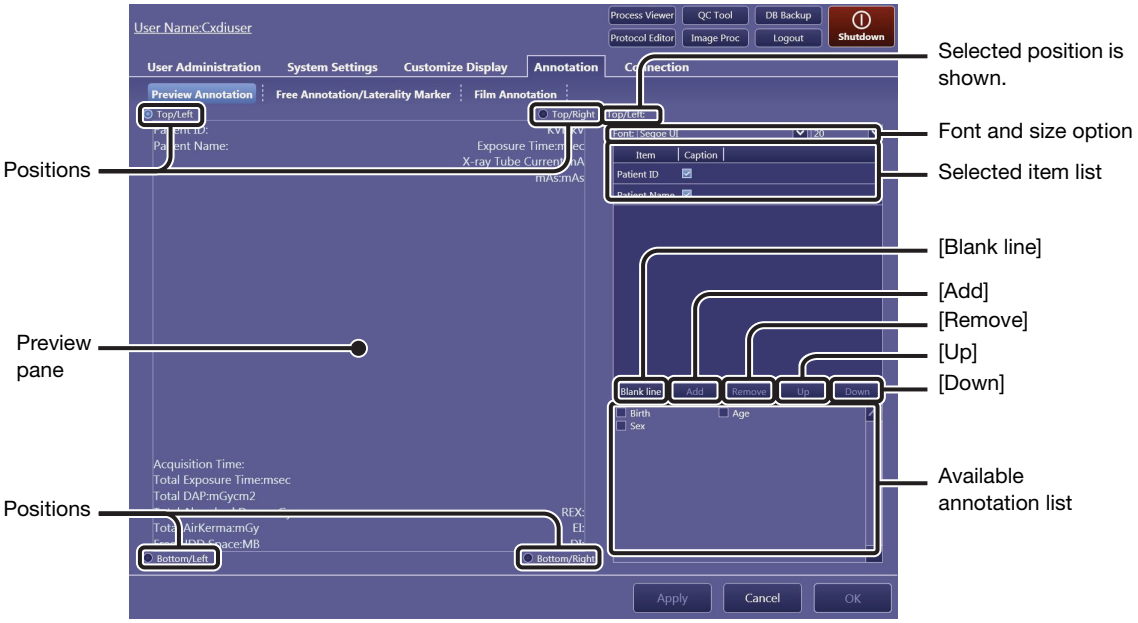
To delete an description from the list

Click a name or description in the list to select it, and then click [Remove].

2.5 Annotation tab

2.5.1 Preview Annotation tab

Annotations superimposed on a preview image are selected and arranged on the Preview Annotation tab.



[Annotation > Preview Annotation] tab

NOTE: The user can choose to have annotations always displayed on the screen, independent of the Info status. For details, consult your service engineer.

1 Select the position of the annotations.

Select **Top/Left**, **Bottom/Left**, **Top/Right**, or **Bottom/Right** at the corners of the preview pane.

2 Specify the Font and the size option.

Perform this procedure while checking the preview pane.
Click the Font drop-down arrow, and then select an option from the list.
Click the size drop-down arrow, and then select an option from the list.

3 Reserve the target annotations for the selected position.

Select from among the available annotation list, and then click [Add]. The selection appears in the selected item list.

Available annotations for each position (Preview Annotation tab)

Top/Left:	**Patient ID***, **Patient Name***, **Birth** (birthday), **Age**, **Sex**
Bottom/Left:	**Acquisition Time***, **Total Exposure Time***, **Total DAP*** (Dose Area Product), **Total Absorbed Dose***, **Total Air Kerma***, **Free HDD Space***, **Acquisition Date**, **Study Description**
Top/Right:	**KVP*** (kilo-voltage peak), **Exposure Time***, **X-ray Tube Current***, **mAs***, **SID** (Source image receptor distance), **SOD** (Source object distance)
Bottom/Right:	**REX*** (Reached Exposure value), **EI*** (Exposure Index), **DI*** (Deviation Index), **EIt** (See step 3 in 3.5 for details on EI, DI, and EIt.)

* Shown by default.

NOTE: Because the same annotation cannot be used twice, previously selected annotations are excluded from the available annotation list.

To remove annotations from the selected item list

Click the target annotations to highlight them, and then click [Remove]. Clicking on a highlighted annotation unselects it.

To add blank annotations

Click [Blank line] to add a blank annotation to the selected item list.

To show only the value without the annotation title

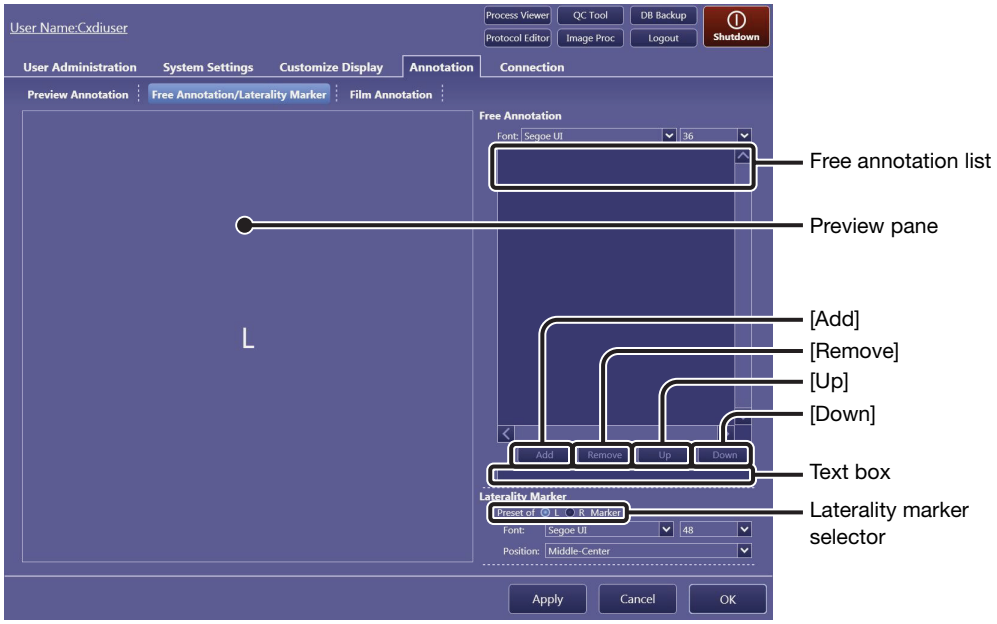
Clear the check box for the target annotation on the selected item list.

4 Change the order of annotations.

Click the target annotation to highlight it, and then click [Up] or [Down].

2.5.2 Free Annotation/Laterality Marker tab

In addition to the annotations preset in the Preview Annotation tab and the Film Annotation tab, custom annotations can be created ahead of time for the Annotation dialog box; they are embedded on both the screen preview and film sheet images (refer to 6.4 in the Operation Manual).
Furthermore, the font type and font size of the free annotations and the laterality marker can be selected in this tab. The position of the laterality marker can also be specified (refer to 6.1.2 in the Operation Manual).



[Annotation > Free Annotation/Laterality Marker] tab

1 Enter a free annotation.

Enter a free annotation in the text box, and then click [Add]. The annotation appears in the free annotation list.

NOTE: Make sure that the length of annotations is as short as possible so that they do not overlap each other and overflow the preview pane.

To remove annotations from the free annotation list

Click the target annotation to highlight it, and then click [Remove]. A click of a highlighted annotation unselects it.

2 Specify the Font and size options (only for free annotations).

Perform this procedure while checking the preview pane.
Click the Font drop-down arrow, and then select an option from the list.
Click the size drop-down arrow, and then select an option from the list.

3 Change the order of annotations in the free annotation list.

Click the target annotation to highlight it, and then click [Up] or [Down]. The order arranged in this tab will be reflected in the list in the Annotation dialog box.

4 Select the target laterality marker.

Select a marker in the laterality marker selector.

5 Specify the Font and size options (only for laterality markers).

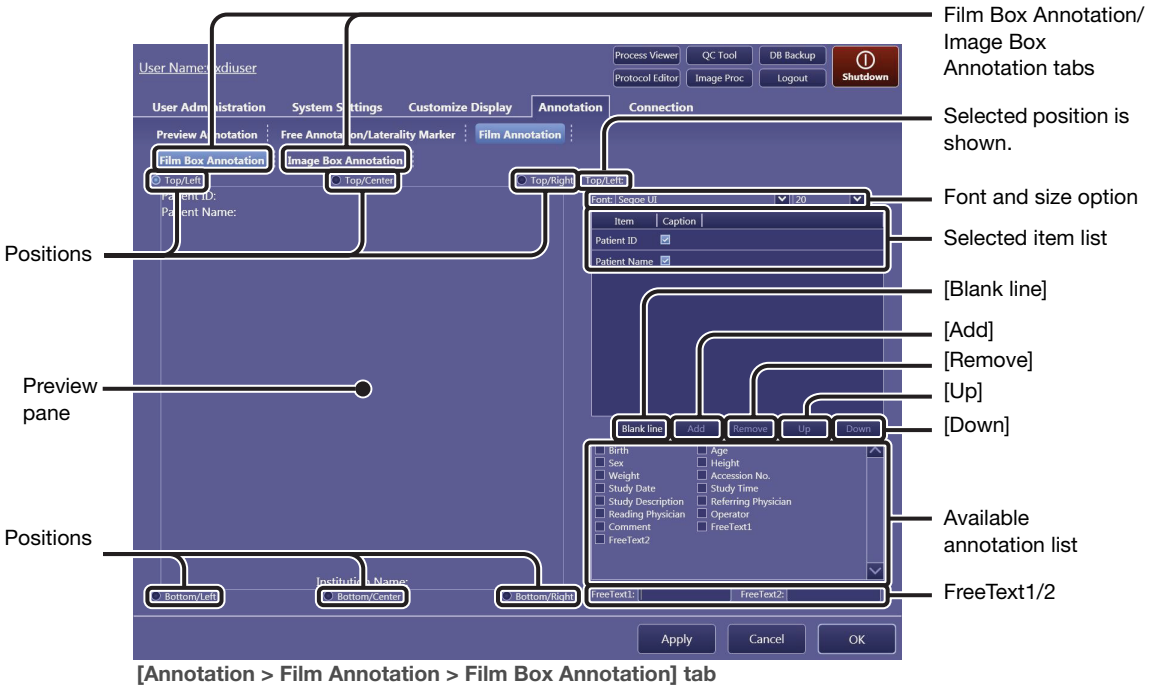
Perform this procedure while checking the preview pane.
Click the Font drop-down arrow, and then select an option from the list.
Click the size drop-down arrow, and then select an option from the list.

6 Specify the position of the laterality marker.

The position of a laterality marker applied by clicking [L] or [R] in the toolbar can be specified (refer to 6.1.2 in the Operation Manual).
Click the Position drop-down arrow, and then select an option from the list.

2.5.3 Film Annotation tab

Annotations embedded on each printed image and margin on a film are selected and arranged on the two sub-tabs under the Film Annotation tab. The annotations to be set on the Film Box Annotation tab are applied on each film margin, and those to be set on the Image Box Annotation tab are applied on each image.
Although the Image Box Annotation tab differs from the Film Box Annotation tab in the position and number of available annotations, operations on these sub-tabs are the same. In this section, the Film Box Annotation tab is used for explanation.



[Annotation > Film Annotation > Film Box Annotation] tab

1 Select the position of the annotations.

Select **Top/Left**, **Bottom/Left**, **Top/Right**, or **Bottom/Right** at the corners of the preview pane. Additionally, **Top/Center** and **Bottom/Center** options are available for the Film Box Annotation.

2 Specify the Font and the size option.

Perform this procedure while checking the preview pane.
Click the Font drop-down arrow, and then select an option from the list.
Click the size drop-down arrow, and then select an option from the list.

NOTE: For image box annotations, each font size of the annotation is reduced depending on the layout partition.

NOTE: The actual size of the annotations cannot be previewed on the preview pane of the Film Annotation tab.

3 Reserve the target annotations for the selected position.

Select from among the available annotation list, and then click [Add]. The selection appears in the selected item list.

To add free annotations

Select the FreeText1/2 text box and enter/modify a text before selecting FreeText1/2 from the available annotation list.

To add blank annotations

Click [Blank line] to add a blank annotation to the selected item list.

Available annotations for each position (Film Box Annotation tab)

The following items can be superimposed at all corners and Top/Center and Bottom/Center of a film.
Patient ID*, **Patient Name***, **Birth** (birthday), **Age**, **Sex**, **Height**, **Weight**, **Accession No.**, **Study Date**, **Study Time**, **Study Description**, **Referring Physician**, **Reading Physician**, **Operator**, **Institution Name***, **Comment**, **FreeText1**, **FreeText2**

Available annotations for each position (Image Box Annotation tab)

The following items can be superimposed at all corners of an image.
Patient ID, **Patient Name**, **Birth** (birthday), **Age**, **Sex**, **Height**, **Weight**, **Accession No.**, **Study Date**, **Study Time**, **Study Description**, **Referring Physician**, **Reading Physician**, **Operator**, **Institution Name**, **Comment**, **IP Parameter**, **FreeText1**, **FreeText2**, **Detector Name**, **Protocol Name**, **Body Part**, **View Position**, **Series Description**, **KVP***, **Exposure Time***, **X-ray Tube Current***, **mAs***, **Series Date***, **Series Time***, **Acquisition Date**, **Acquisition Time**, **Grid**, **Focal Spot Size**, **Code Meaning**, **SID**, **SOD**, **Absorbed Dose***, **DAP***, **AirKerma***, **REX**, **EI***, **DI***, **EIt**

* Shown by default.

The IP Parameter option available for Image Box Annotation
If the IP Parameter option is selected, the values and options for image processing parameters that are applied to the image will be printed on the printed film.
For details on the meaning of the printed values, see 6 in Appendix.

NOTE: Because the same annotation cannot be used for two or more positions, previously selected annotations are excluded from the available annotation list.

To remove annotations from the selected item list

Click the target annotations to highlight them, and then click [Remove]. Clicking on a highlighted annotation unselects it.

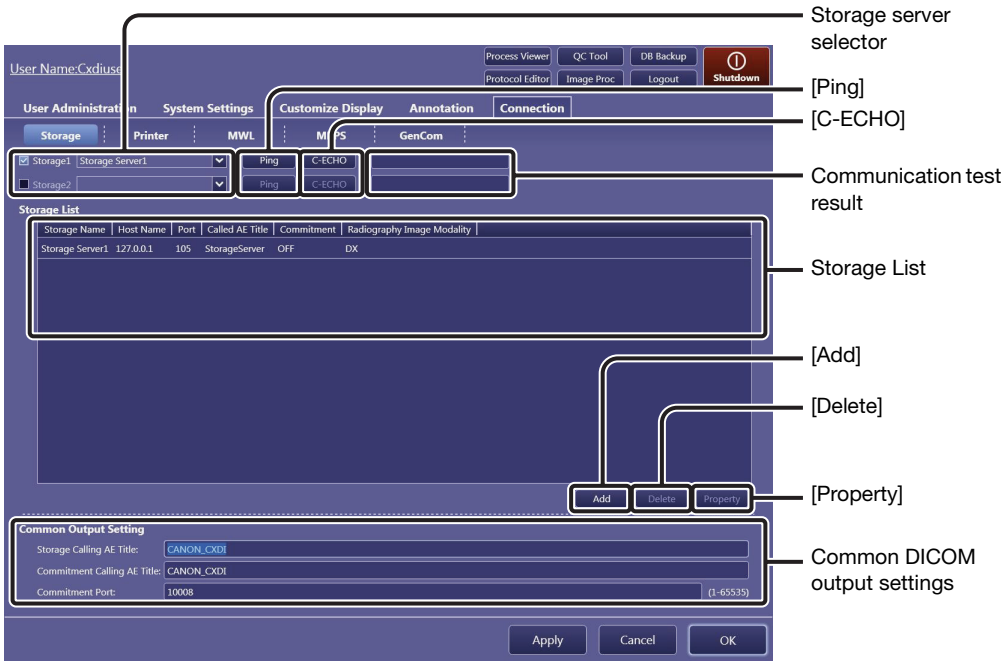
To show only the value without the annotation title

Clear the check box for the target annotation on the selected item list.

2.6 Connection tab

2.6.1 Storage tab

Storage (PACS) servers for archiving captured image data can be specified and managed using this tab. Communication test between the Control Software and the storage server can be performed using the Ping or C-ECHO command.

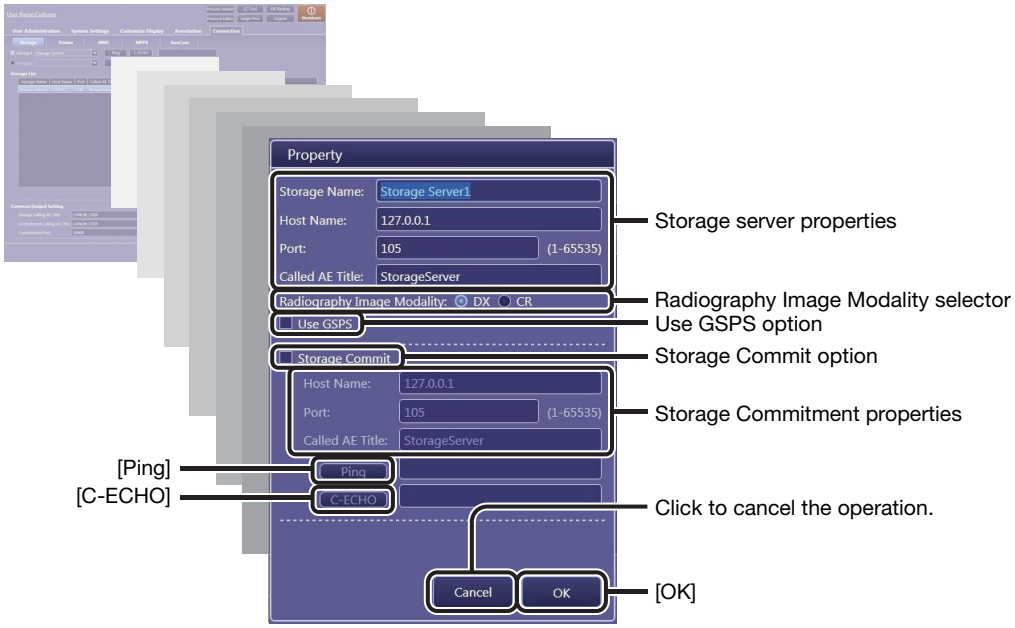


1 Register a storage device in the Storage List.

Click [Add] to show the Property dialog box for registration.

To modify an existing storage server

Click the target storage server in the Storage List, and then click [Property].



2 Enter or modify the storage server properties.

Storage Name: Arbitrary name that identifies the storage server
Host Name: The IP address or the host name of the storage server
Port: Port number for the storage server
Called AE Title: Application entity title assigned to the storage server necessary for DICOM communication
Radiography Image Modality:
Select the modality of the images to be transmitted to the storage server.
Use GSPS: GSPS (Grayscale Softcopy Presentation State) service provides the consistency in the presentation of every screen and printed images. Select this option for the use of GSPS service.

To ensure image data storage using the storage commitment function

The Control Software can request the storage (PACS) server to securely store the image data. To do so, select the Storage Commit option, and then enter the properties as in step 2 above.
After the function is enabled, when “Committed” is displayed for the SC status on the Study List in the [PAST > Past List] screen, the image data has been secured.
Note that storage commitment setting needs to be enabled on both the Control Software and the destination storage server to use this function.

Continued

SC (storage commitment) status on the Study List in the [PAST > Past List] screen
The result for the storage commitment status can be confirmed by checking the SC status on the Study List in the [PAST > Past List] screen. To show the SC column header, select SC for the Past List under the Column Headers option (see 2.4.1).

To test communication between the Control Software and the storage server being registered

Click [Ping] to test the TCP/IP connectivity.
Click [C-ECHO] to test the DICOM communication.
The result of the test will be shown to the right of each test button.

3 Set the properties.

Click [OK]. If required, repeat steps 1 thru 3 for another registration. Up to five storage devices can be registered in the Storage List.

To change the order of header items in the Storage List

Drag a header item and drop it in the target position.

To delete storage server data in the Storage List

Click the target data to select, and then click [Delete].

4 Select the storage server to be used.

Select the storage server selector check box, click on the drop-down arrow, and select an option from the list (the storage servers registered in the Storage List are listed). Up to two storage servers can be used simultaneously.

To disable the storage server in use

Clear the target storage server selector check box.

To test communication between the Control Software and the storage server in use

Click [Ping] to test the TCP/IP connectivity.
Click [C-ECHO] to test the DICOM communication.
The results of both [Ping] and [C-ECHO] tests will be shown to the right of [C-ECHO].

NOTE: If the Called AE Title or the Port setting is modified during the commitment process, the process may fail.
NOTE: Even if some images are transmitted or an examination is in operation, modification or deletion of the registered storage server does not affect the current operation.

5 Modify the DICOM storage service properties.

Storage Calling AE Title:
Application entity title assigned to the Control Software necessary for the DICOM storage service

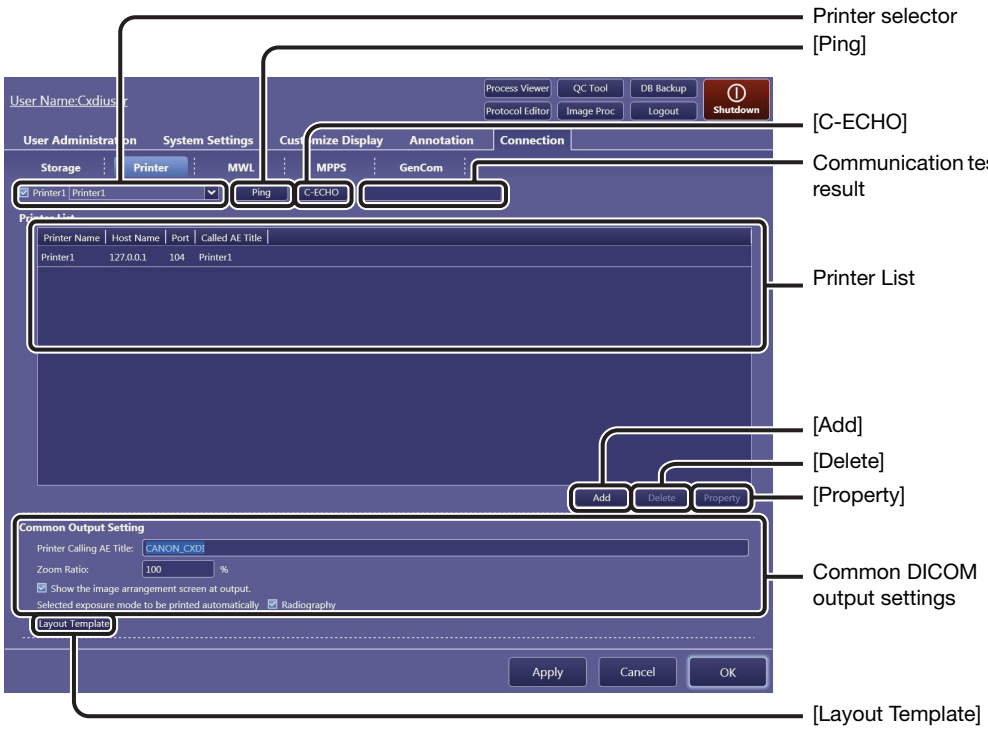
Commitment Calling AE Title:
Application entity title assigned to the Control Software necessary for the DICOM storage commitment service

Commitment Port:
Port number for the DICOM storage commitment service

NOTE: If the Storage Calling AE Title or the Commitment Calling AE Title setting is modified during image data transmission, the process may fail.

2.6.2 Printer tab

Printers can be specified and managed using this tab. Communication test between the Control Software and the printer can be performed using the Ping or C-ECHO command. Custom layout templates for printout image can be created. See 2.6.6 for details on operation.



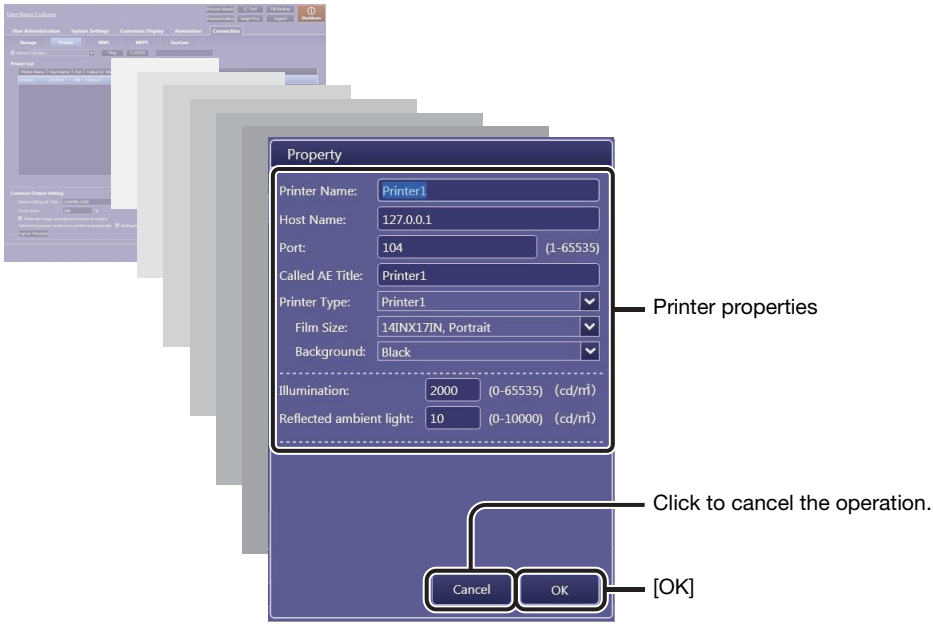
Continued

1 Register a printer to the Printer List.

Click [Add] to show the Property dialog box for the registration.

To modify an existing printer

Click the target printer in the Printer List, and then click [Property].



2 Enter or modify the printer properties.

Printer Name: Arbitrary name that identifies the printer

Host Name: The IP address or the host name of the printer

Port: Port number for the printer

Called AE Title: Application entity title assigned to the printer necessary for DICOM communication

Printer Type: Click on the drop-down arrow, and select an option from the list. **Film Size** and **Background** (specifies the color of the area outside the cropped image from **White** and **Black**) options are available after the Printer Type property is specified.

Illumination: A DICOM attribute that represents the luminance of lightbox illuminating a piece of transmissive film, or for the case of reflective media, the luminance obtainable from diffuse reflection of the illumination present. When this field is left blank, the value set on the receiving printer will be used.

Reflected ambient light: A DICOM attribute that represents the luminance contribution for the transmissive film image appearance due to reflected ambient light. When this field is left blank, the value set on the receiving printer will be used.

3 Set the properties.

Click [OK]. If required, repeat steps 1 thru 3 for another registration. Up to five printers can be registered to the Printer List.

To change the order of header items in the Printer List

Drag an item and drop it in the target position.

To delete a printer from the Printer List

Click the target printer to select, and then click [Delete].

4 Select a printer to be used.

Click the drop-down arrow, and then select an option from the list (the printers registered in the Printer List are listed).

To disable a printer in use

Clear the printer selector check box.

To test communication between the Control Software and the printer in use

Click [Ping] to test the TCP/IP connectivity.
Click [C-ECHO] to test the DICOM communication.
The results of both [Ping] and [C-ECHO] tests will be shown to the right of [C-ECHO].

NOTE: Even if some images are transmitted or an examination is in operation, modification or deletion of the printer does not affect the current operation.

5 Modify DICOM print service properties and other options.

Printer Calling AE Title:
Application entity title assigned to the Control Software necessary for the DICOM print service

Zoom Ratio: Specify the actual image size in %. A change made for this option reflects the setting of the Zoom Ratio option in the image arrangement screen. Refer to step 3 in 7.1.1 in the Operation Manual.

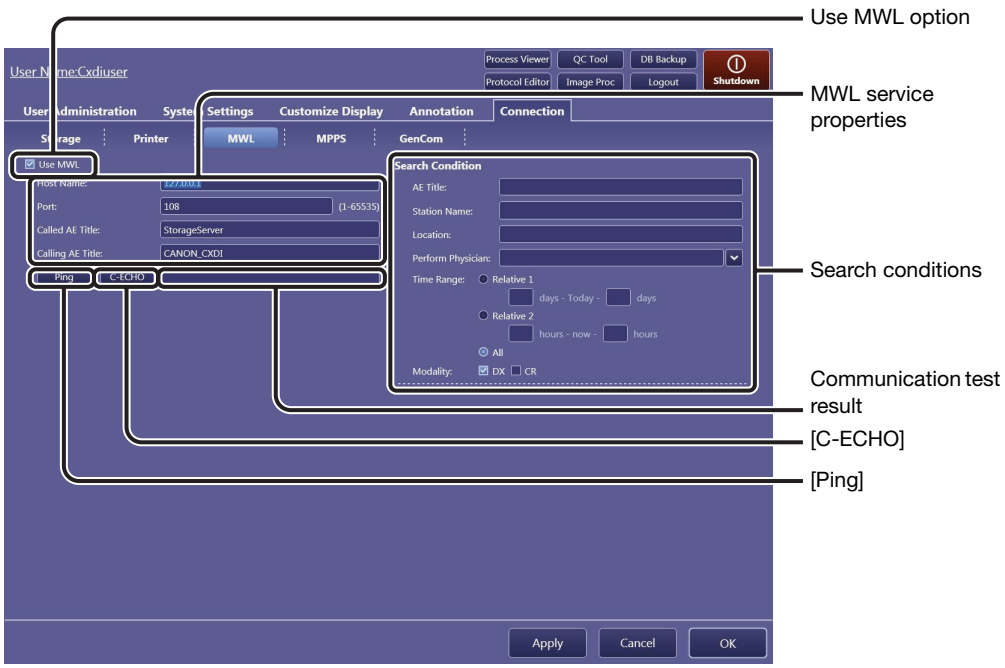
Show the image arrangement screen at output:
Select this option to show the image arrangement screen before printing images on film sheets. Refer to 7.1.1 in the Operation Manual.

Selected exposure mode to be printed automatically:
Select the Radiography check box to use the automatic arrangement feature. Refer to 7.1.1 in the Operation Manual.

2.6.3 MWL tab

The Modality Work List (MWL) service provides central data entry (ordering and scheduling of examinations) and management features. The HIS/RIS database server, which provides the MWL service, can be specified using this tab. Communication test between the Control Software and the database can be performed using the Ping or C-ECHO command.

NOTE: To show the MWL tab, start the Control Software after connecting the control PC to the HIS/RIS database.



1 Specify a database server for the MWL service.

Select the Use MWL check box, and then enter the following properties:

Host Name: The IP address or the host name of the server
Port: Port number for the server
Called AE Title: Application entity title assigned to the server necessary for DICOM communication
Calling AE Title: Application entity title assigned to the Control Software necessary for the DICOM MWL service

To disable the server in use

Clear the Use MWL check box.

To test communication between the Control Software and the server

Click [Ping] to test the TCP/IP connectivity.
Click [C-ECHO] to test the DICOM communication.
The results of both [Ping] and [C-ECHO] tests will be shown to the right of [C-ECHO].

2 Specify preset narrowing conditions during study order acquisition.

The narrowing conditions below are applied every time the worklist is refreshed. Enter or select any narrowing conditions under the Search Condition title.

AE Title: Application entity title assigned to the study necessary for DICOM communication

Station Name: An institution defined name for the modality on which the ordered study is to be performed

Location: The location at which the ordered study is to be performed

Perform Physician: Name of the physician scheduled to administer the ordered study

Time Range: **Relative 1** and **Relative 2** refer to the period relative to the current day or time in which the study orders are to be conducted. **Relative 1** and **Relative 2** are specified by days and hours respectively in the past/future. To clear the Time Range condition, select **All**.

Modality: **DX** refers to digital X-ray radiography, and **CR** to computed radiography. To cancel the condition, clear the check box.

NOTE: The Time Range option can be temporarily changed. Refer to 3.1.1 in the Operation Manual.

2.6.4 MPPS tab

The Modality Performed Procedure Step (MPPS) service provides a communication feature between the modality and the HIS/RIS database server that exchanges the status of ordered studies, such as in progress, completed, and so on to refresh the related information, including the worklist. The HIS/RIS database server, which provides the MPPS service, can be specified using this tab. Communication test between the Control Software and the database can be performed using the Ping or C-ECHO command.

NOTE: To show the MPPS tab, start the Control Software after connecting the control PC to the HIS/RIS database.

1 Specify a database server for the MPPS service.

Select the Use MPPS check box, and then enter the following properties:

Host Name: The IP address or the host name of the server
Port: Port number for the server
Called AE Title: Application entity title assigned to the server necessary for DICOM communication
Calling AE Title: Application entity title assigned to the Control Software necessary for the DICOM MPPS service

To disable a server in use

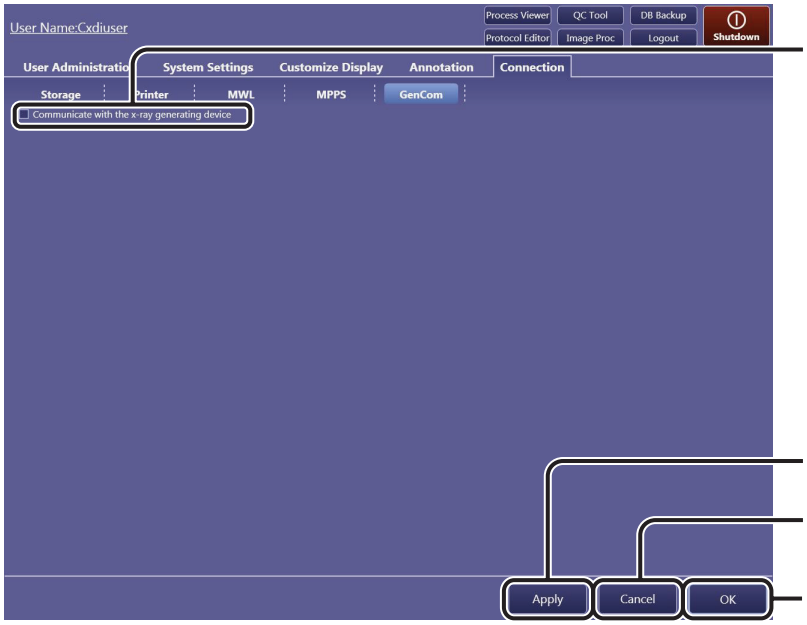
Clear the Use MPPS check box.

To test communication between the Control Software and the server

Click [Ping] to test the TCP/IP connectivity.
Click [C-ECHO] to test the DICOM communication.
The results of both [Ping] and [C-ECHO] tests will be shown to the right of [C-ECHO].

2.6.5 GenCom tab

Communication between the Control Software and the X-ray generating device can be set using this tab.
Detector settings are indicated on the examination screens by the communication (refer to 4.1 in the Operation Manual).



1 Enable the communication with the X-ray generating device.

Select the Communicate with the x-ray generating device check box.

To disable the communication with the X-ray generating device

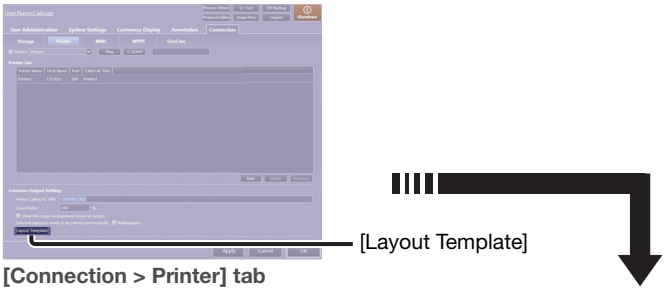
Clear the Communicate with the x-ray generating device check box.

2.6.6 Layout Template button

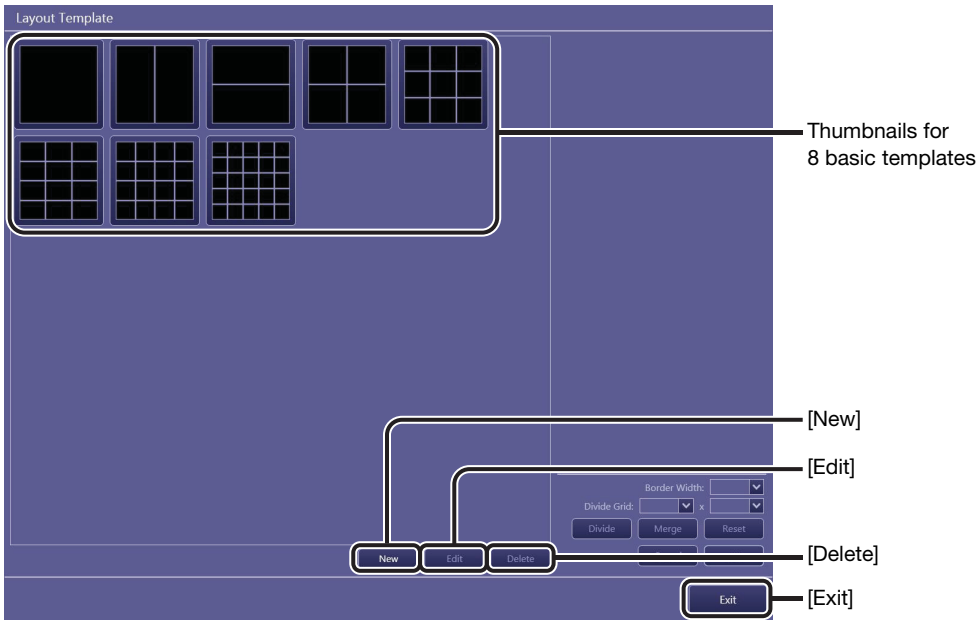
Custom templates can be created on this screen in order to arrange images on a film sheet.

1 Show the Layout Template screen.

Click [Layout Template] (see also step 5 in 2.6.2).



[Connection > Printer] tab



NOTE: The 8 basic templates cannot be selected, modified, or deleted.

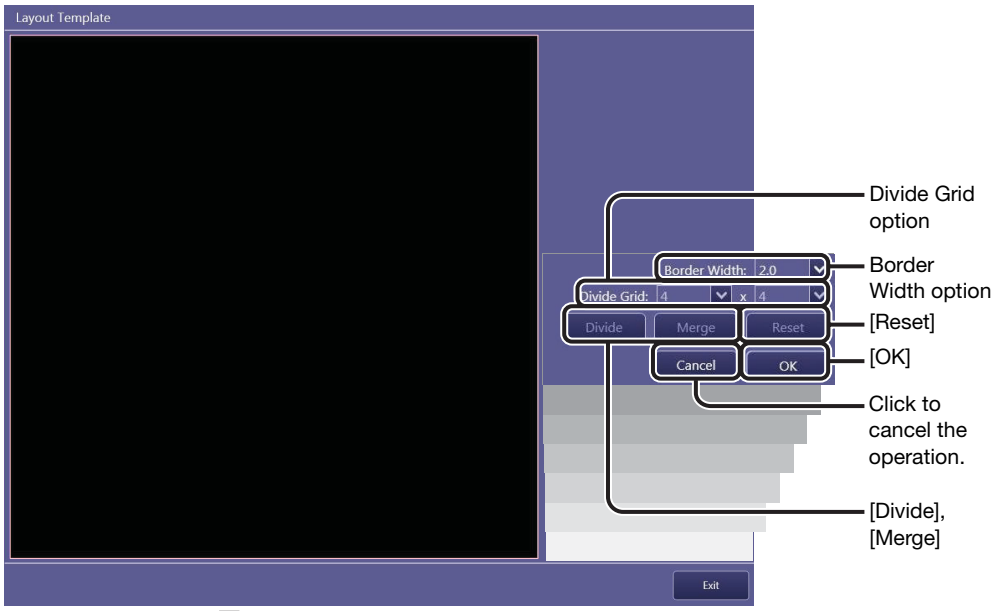
2 Enable template edit mode.

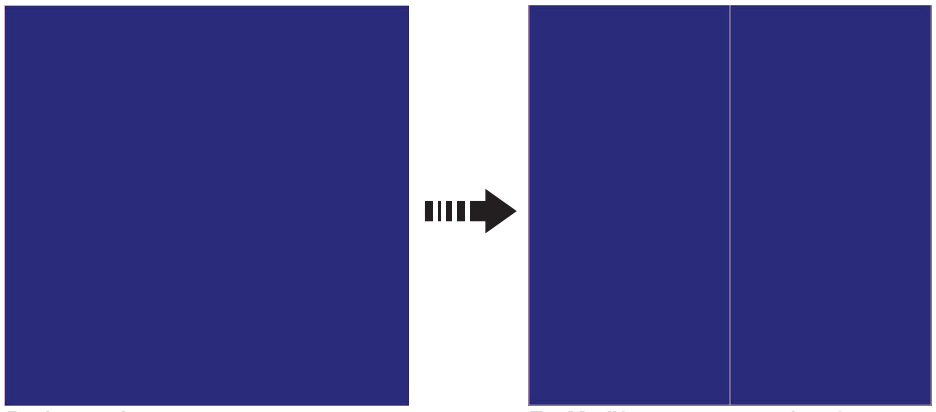
To create a custom template

Click [New]. The basic template 1×1 (horizontal × vertical) appears in place of the template thumbnails.

To modify an existing custom template

Click the target custom template to highlight it, and then click [Edit].





Basic template 1x1

Ex: Modify to create template 2x1

3 Select the target segment(s) to be modified.

To divide the segment

Click a single segment to highlight it in blue.

Continued

To merge the segments

Click the target and the neighboring segment to highlight them in blue. Note that a third click cancels the selection.

4 Modify the segment(s).

To divide the segment

Specify the number of segments to be created in the target segment, and then click [Divide].
Click on the drop-down arrow of the Divide Grid option, and select an option from the list.
The number of horizontal divisions can be set using the left-hand drop-down arrow, and the number of vertical divisions using the right-hand drop-down arrow.

To merge the segments

Click [Merge].

To modify the border width

Click on the drop-down arrow for the Border Width option, and select an option from the list.

To restore the original template

Click [Reset].

5 Continue modifications.

If necessary, repeat steps 2 thru 4.

6 Set the newly created or modified custom template.

Click [OK]. The newly created template thumbnail is added to the list. When an existing custom template is modified, the changes are reflected in the original template.

To delete an existing custom template

Click the target custom template to highlight it, click [Delete] and then click [OK] in the confirmation dialog box that appears.

7 Return to the [Connection > Printer] screen.

Click [Exit].

3 System Tools

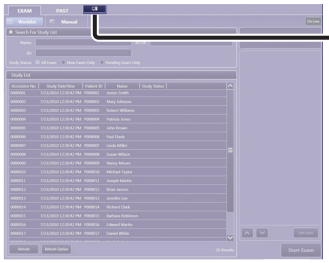
3.1 Using the system tools

The technical system setup options (for modification of protocols, image quality assurance, and so on) can be accessed from the system tool buttons. First learn basic operation in 3.1.1, and then access the necessary setup options guided by the system tool option finder in 3.1.2.

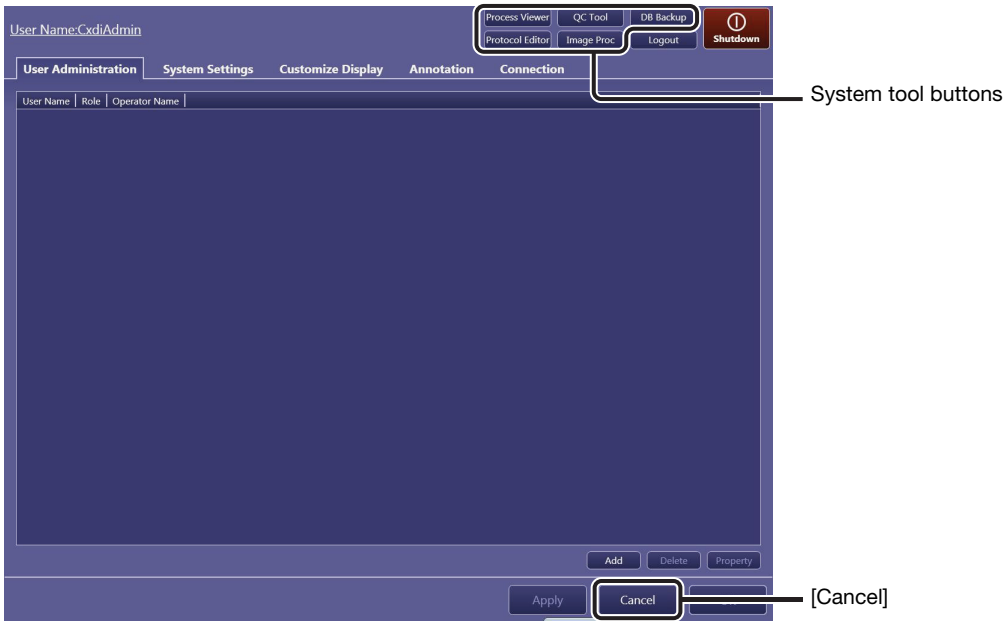
3.1.1 Basic operations

1 Show the system setup screen.

Click  on the [EXAM] or [PAST] screen.



[EXAM] or [PAST] screen



System setup screen

2 Access the target system setup tool.

Click the target system tool button.

NOTE: The available system tool buttons vary depending on the privileges granted to a user (see step 2 in 2.2). [QC Tool] is disabled during examination, and [Protocol Editor] and [Image Proc] are disabled during examination and image review.

To use the tools

See 3.2 thru 3.6.

To return to the previous [EXAM] or [PAST] screen

Click [Cancel]. The screen shown before clicking  returns.

3.1.2 System tool option finder

Process Viewer button (See 3.2)

Confirmation of the status of the data transmission process

Protocol Editor button (See 3.3)

Addition, modification, bundled selection and deletion of protocols, and configuration of the protocol list

Protocol Settings:
Protocol Name, **Comment**, **Code Value**, **Code Meaning**, **Laterality Marker**, **Body Part**, **Patient Orientation**, **Laterality** (Marker Placement, DICOM Attribute), **Default Workspace**

Protocol Workspace Settings:
Flipping and Rotation, **Grid Name, Printable area of an oversized image**

APR Editor: **Exposure type**, **Source object distance(SOD)**, **Source imaging receptor distance(SID)**, **APR ID**

QC Tool button (See 3.4)

Calibration: Creation of detector correction data for securing image quality. During Calibration, X-ray exposure is required.

Performance Test:
Check of the detector and image quality. During the Performance Test, X-ray exposure is required.

Self-diagnosis: Check of the detector and image quality using test patterns and other images. During Self-diagnosis, X-ray exposure is not required.

Image Proc button (See 3.5)

Modification of the image processing parameters included in the protocol

Continued

DB Backup button (See 3.6)

Database Backup, **Output Exam Log**

Logout button (Refer to 2.2 in the Operation Manual)

Logout from the Control Software.

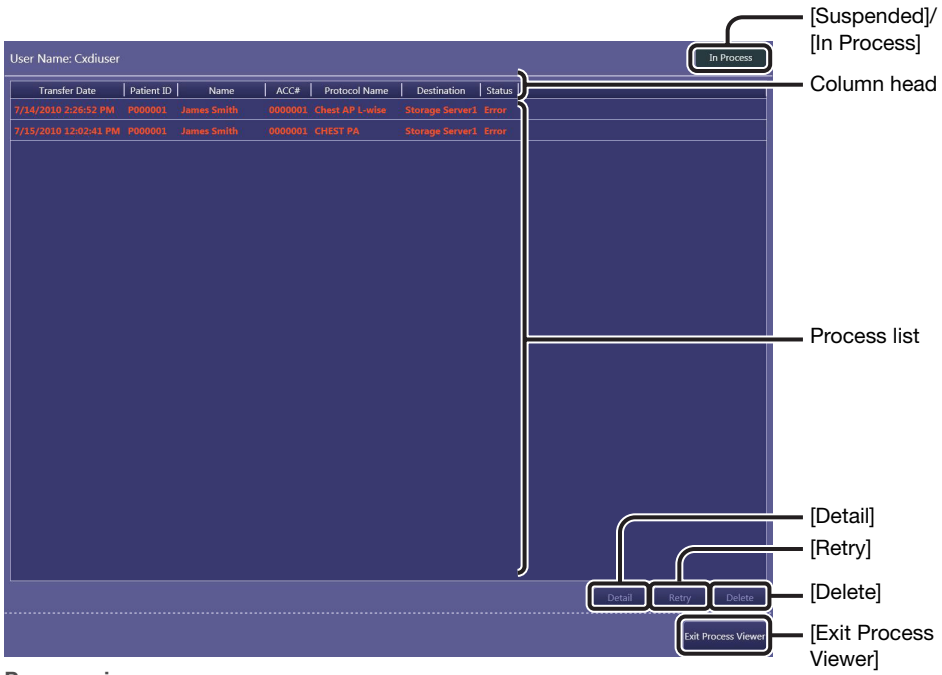
Shutdown button (Refer to 2.2 in the Operation Manual)

Shutdown the image-capture computer.

3.2 Process Viewer button

The current status and result of an image/arranged images (film sheet)/study/PPS data transmission can be confirmed in the process viewer. Users can manually resend data that was not transmitted and can also stop or cancel data being processed. See also 2.3 for details on the refresh interval for the process list.

Performed Procedure Step (PPS)
The data to be transmitted to the RIS database that indicates the completion of the ordered study. This data is used for updating the worklist and so on.



Process viewer

1 Utilize the process list.

To sort the listed data

Click a sort item in the column head. To switch between ascending and descending sort order, click the same item again.

To rearrange the order of the column head items

Drag an item and drop it in the target position.

Classification of processes
The following appear in the Status column;
Idling: The data is waiting to be transmitted.
Processing: The data is being processed.
Sending: The data is being transmitted.
Error: The data transmission failed.

To select the target data

Click the target data to highlight it. To unselect the data, click it again.

2 Check the details of the target data.

Click the target data in the list, and then click [Detail].

To delete the target data

Click the target data, and then click [Delete].

3 Resend the target data.

Click the data with an Error indication in its Status column, and then click [Retry].

4 Suspend target data by study.

Click the data with a Processing or Sending indication in its Status column, and then click [Suspended].

To restart suspended process

Click the suspended data, and then click [In Process].

5 Exit the process viewer.

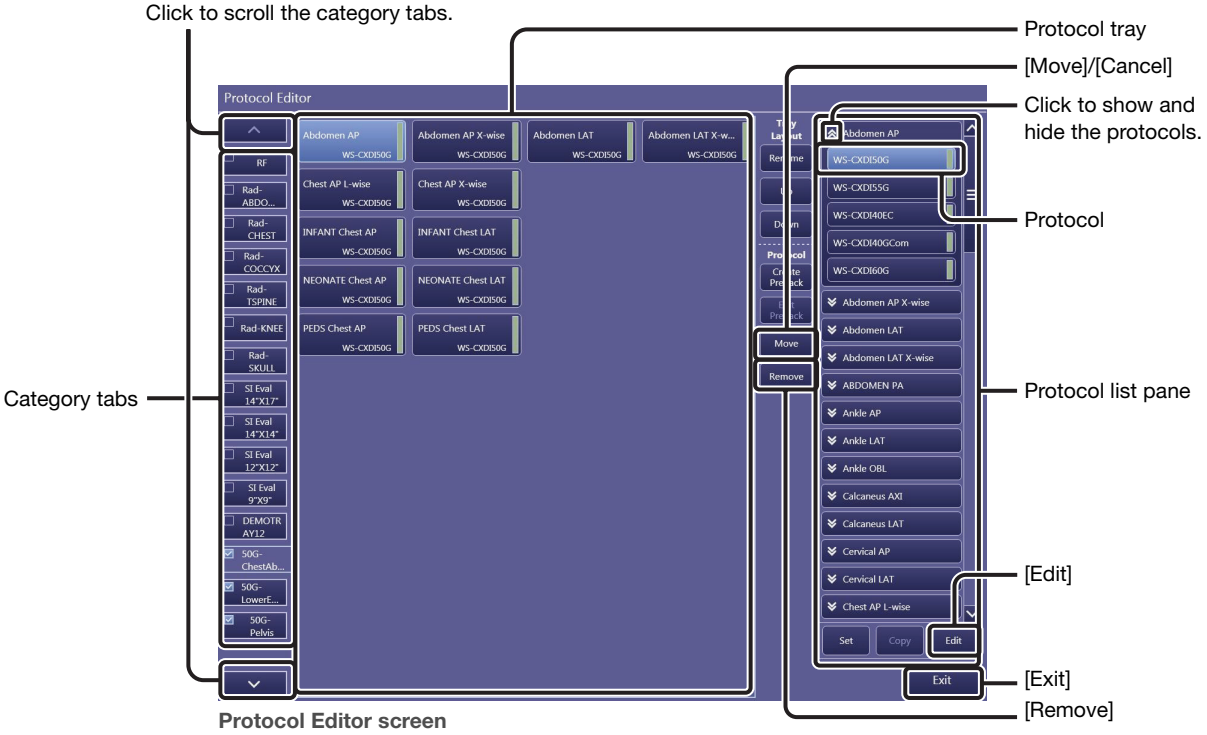
Click [Exit Process Viewer].

3.3 Protocol Editor button

Preset protocols are organized on the protocol tray (refer to 3.1.5 in the Operation Manual) and users can create and modify study orders using the tray. When new protocols or new trays are required for suite on-site operations, follow the steps below.

NOTE**:** Operations for this tool require the ProtocolEdit Administrations privileges (see step 2 in 2.2).

3.3.1 Modifying the protocol



Protocol Editor screen

1 Select the target protocol.

Click the target tab and then a protocol in the protocol tray. The protocol for the corresponding protocol listed in the protocol list pane are highlighted.

To change the position of the protocol in the protocol tray

While the target protocol is selected in the protocol tray, click [Move]. [Move] changes to [Cancel] and available destinations indicated by blank rectangles appear in the protocol tray. Click the target destination.
To cancel the modification, click [Cancel] before clicking the target destination.

NOTE: Protocols can be moved to other trays as well as the current tray. In such cases, select the target tab before selecting the target destination.

To delete the protocol in the protocol tray

While the target protocol is selected in the protocol tray, click [Remove], and then click [OK] in the confirmation dialog box that appears.

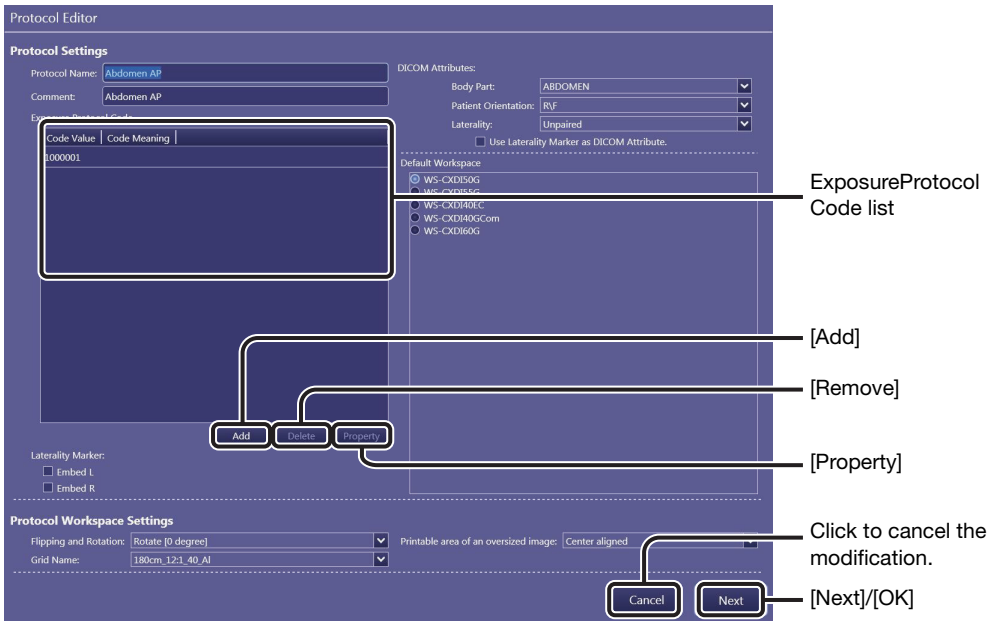
2 Modify the protocol/protocol group properties.

Click [Edit] while in workspace edit mode, and then modify the properties.

NOTE: Protocols in the protocol list pane have the following two modes. Available operations for the protocol varies depending on the mode.

Workspace edit mode **Protocol group edit mode**

Protocols that have the same conditions but different workspaces are displayed as a protocol group.
To enter workspace edit mode, click the protocol. To enter protocol group edit mode, click the area outside the protocol.



Protocol property screen 1

Continued

Protocol Settings

Protocol Name: Arbitrary name that identifies the protocol

Comment: Arbitrary comment

Exposure Protocol Code:
See “To modify a protocol code meaning” below for details.

Laterality Marker:
Select the **Embed L** (shows the L marker at the preset position) or **Embed R** (shows the R marker at the preset position) check box. For details on the preset position, see 2.5.2.

Body Part*: Click on the drop-down arrow, and select an option from the list.

Patient Orientation*:
Click on the drop-down arrow, and select an option from the list.
L (left), **R** (right), **H** (head), **F** (foot), **P** (posterior), **A** (anterior), and a combination of these are available.

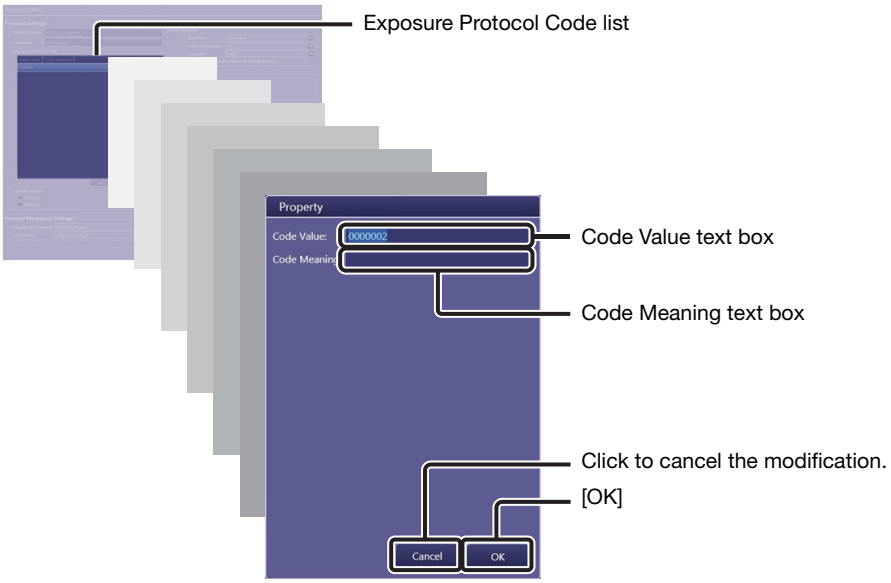
Laterality*: Select the Laterality attribute from **L** (left body part), **R** (right body part), **Both L and R** (left and right body parts), **Unpaired** (body part without laterality attribute).
To associate the Laterality Marker option defined marker with a DICOM attribute in the event of transmission, select the **Use Laterality Marker as the DICOM Attribute** option. Refer to 6.1.2 in the Operation Manual for details on embedding laterality markers.

Default Workspace:
Select a target workspace from those available.

* DICOM Attributes

To modify a protocol code meaning

When Show Code Meaning under the Examination Screen option (see 2.4.1) is selected, the code meaning specified below serves as the protocol name instead of that acquired from the HIS/RIS database. To modify an existing code meaning, click a target item in the Exposure Protocol Code list and click [Property].



Modify the description in the **Code Meaning** text box and then click [OK].
To create a new code meaning, clear any selections in the Exposure Protocol Code list, click [Add], enter both the **Code Value** and **Code Meaning**, and then click [OK]. Up to ten code meanings can be registered.
To delete an existing code meaning, select an item in the Exposure Protocol Code list and click [Delete].

Protocol Workspace Settings

Flipping and Rotation:
Click on the drop-down arrow, and select an option from the list depending on the patient posture and the direction of the detector.

Grid Name: Click on the drop-down arrow, and select an option from the list.

Printable area on an oversized image:
Click on the drop-down arrow, and select an option from the list depending on the cutout area in the oversized image for printing.

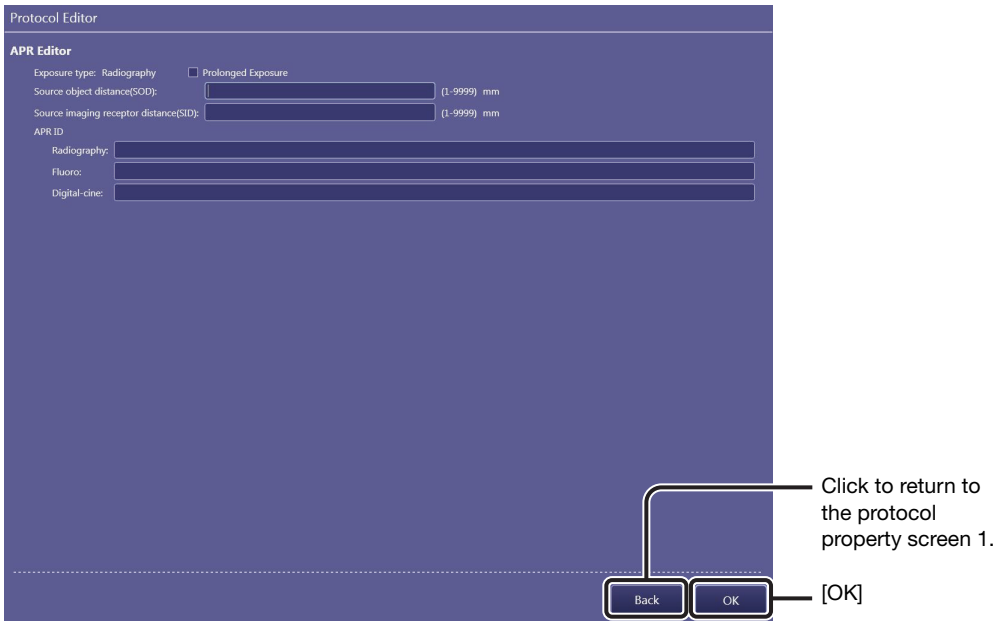
NOTE: While in protocol group edit mode (see the first NOTE in step 2 in 3.3.1), Protocol Workspace Settings are not shown.
NOTE: Users cannot create a workspace. Consult your service engineer.

Continued

To confirm the exposure summary of the X-ray generator

Click [Next] in the protocol property screen 1.

NOTE: If [Next] is not shown, click [Cancel] or [OK] to go back to the Protocol Editor screen, and then enter workspace edit mode (see step 2).



Protocol property screen 2

APR Editor

When the anatomical program (APR) is used for the communication with the X-ray generator, the exposure summary is displayed in the system status bar, and the following properties can be confirmed.

Exposure type: **Radiography** refers to digital X-ray radiography.
Select **Prolonged Exposure** option to turn on the prolonged exposure feature.

Source object distance(SOD):
Enter the distance between the X-ray tube and the patient.

Source imaging receptor distance(SID):
Enter the distance between the X-ray tube and the detector.

APR ID: The IDs are specified for exposure summary.

3 Set the properties.

Click [OK] in the protocol property screen 1 or 2.

4 Exit the Protocol Editor.

Click [Exit] in the Protocol Editor screen.

3.3.2 Creating new protocols

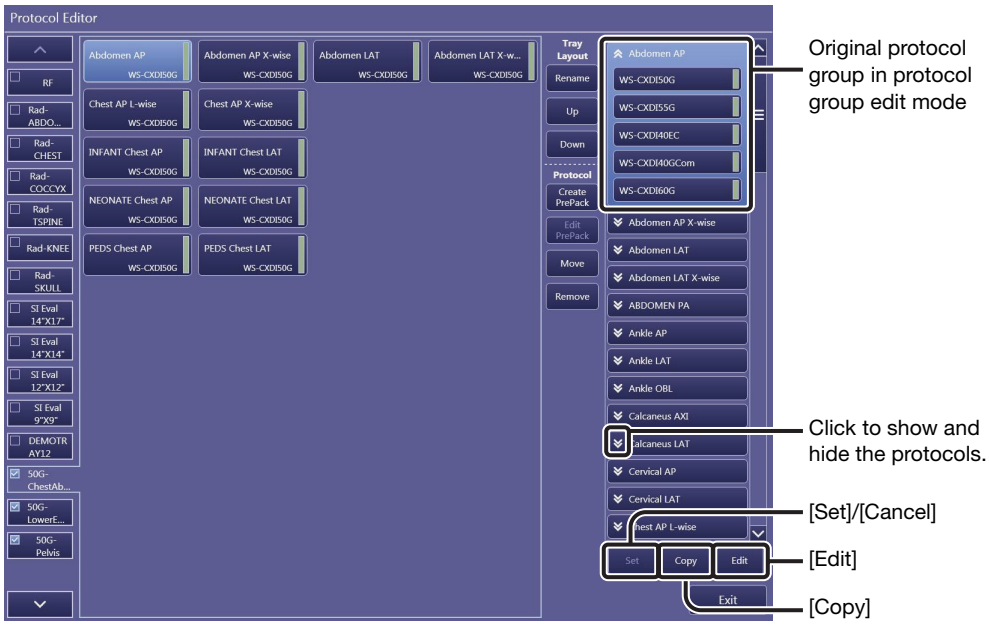
A new protocol is created by editing an existing protocol. Be sure to select an existing protocol with appropriate parameter configurations to use in creating the new protocol.

1 Select an original protocol.

See step 1 in 3.3.1 for details on operation.

2 Duplicate the original protocol.

Click [Copy] while in protocol group edit mode (see the first NOTE in step 2 in 3.3.1).
A copy protocol group appears below the original one. “Copy1” at the end of the copy protocol group name distinguishes the copy from the original.



3 Set the copy protocol to workspace edit mode.

Click the arrow for the copy protocol group, and then click the protocol.

4 Modify the copy protocol to create a new protocol.

See 3.3.1 for details on operation.

5 Arrange the new protocol in the protocol tray.

Click [Set]. [Set] changes to [Cancel] and available destinations indicated by blank rectangles appear in the protocol tray. Click the target destination.
To cancel the arrangement, click [Cancel] before clicking the target destination.

3.3.3 Modifying the category tabs

The category tab controls the use of the protocol tray labeled with the tab. When the tab is disabled, the protocols categorized in the protocol tray are not available.

1 Select the target category tab.

Click a category tab.

2 Enable the target category tab.

Select the check box on the tab.
To disable the tab, clear the check box.

3 Modify the name of the tab.

Click [Rename], modify the name in the Tab Name text box, and then click [OK] in the Rename Tab dialog box.

4 Change the order of the tab.

Click [Up] or [Down].

3.3.4 Packaging a set of protocols in a single protocol

The PrePack feature, which enables a single click selection of a set of protocols required for a specific examination, streamlines study order creation in the radiology room.

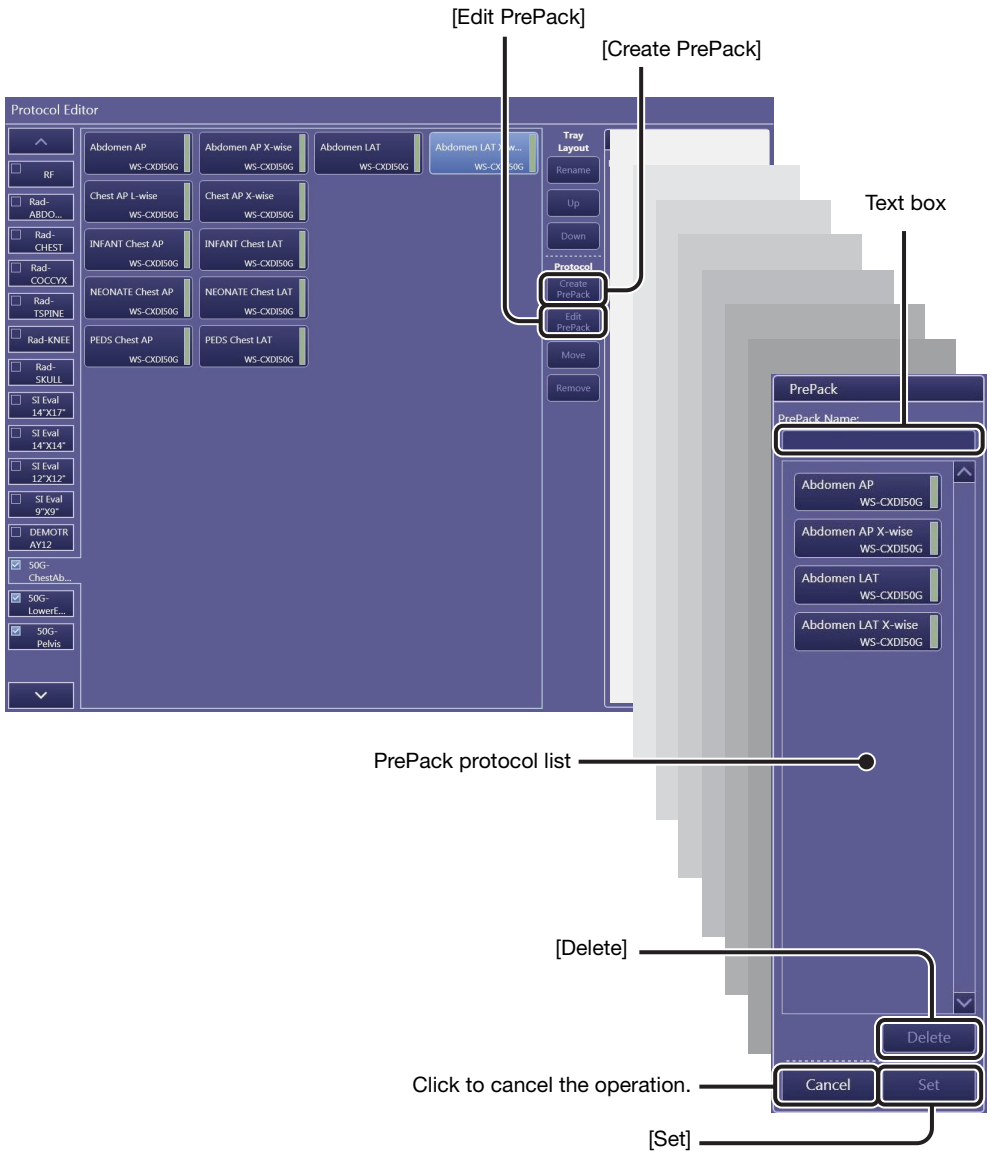
1 Show the PrePack dialog box.

To create a PrePack protocol

Click [Create PrePack]. A PrePack protocol is prepared in which a set of protocols are to be packaged.

To modify an existing PrePack protocol

Select a target PrePack protocol (see step 1 in 3.3.1 for details on operation), and then, click [Edit PrePack].



Continued

2 Label the PrePack protocol.

Enter the name of the PrePack protocol in the Prepack Name text box.

3 Select target protocols from the protocol tray.

See step 1 in 3.3.1 for details on operation. Selections are added to the PrePack protocol list.

To remove a protocol from the PrePack protocol list

Select a target protocol from the list, and then click [Delete].

4 Arrange the PrePack protocol in the protocol tray.

Click [Set]. Available destinations indicated by blank rectangles appear in the protocol tray. Click the target destination.

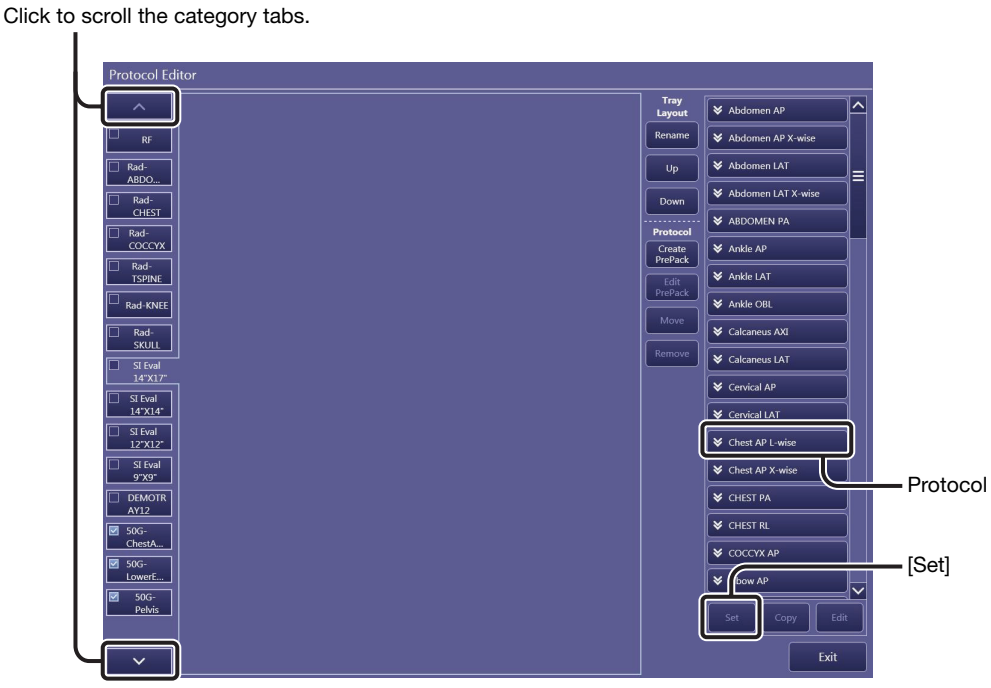
NOTE: PrePack protocols can be moved to other trays as well as the current tray. In such cases, select the target tab before selecting the target destination.

3.3.5 Creating new protocol trays

A new protocol tray is created by editing a preset protocol tray with no protocol set.

1 Select a blank protocol tray.

Click [∨] on the Protocol Editor screen to scroll down the category tabs, and select a protocol tray with no protocol set.



2 Select a protocol.

Click the arrow for the Protocol group on the protocol list, and click the target protocol so that the selected protocol is highlighted in workspace edit mode (see step 2 in 3.3.1).

3 Arrange the protocol in the protocol tray.

Click [Set]. Available destinations indicated by blank rectangles appear in the protocol tray. Click the target destination.

4 Continue arranging protocols.

Repeat steps 2 and 3.

To add new protocols

See 3.3.2 for details on operation.

5 Modify the name of the category tab.

See 3.3.3 for details on operation.

To change the order of category tabs

See 3.3.3 for details on operation.

3.4 QC Tool button

⚠ **CAUTION**	**Be sure to confirm that there is no person in the radiology room during Calibration and Performance Test to prevent the possibility of any persons exposing themselves to X-ray exposure.**

To assure the strict image quality required for medical imaging systems, calibration measures for the connected detector are provided for the Control Software.

NOTE: This tool require the Calibration Administrations privileges for operation (see step 2 in 2.2).

NOTE: Be sure to remove the grid from the detector before conducting the following steps.

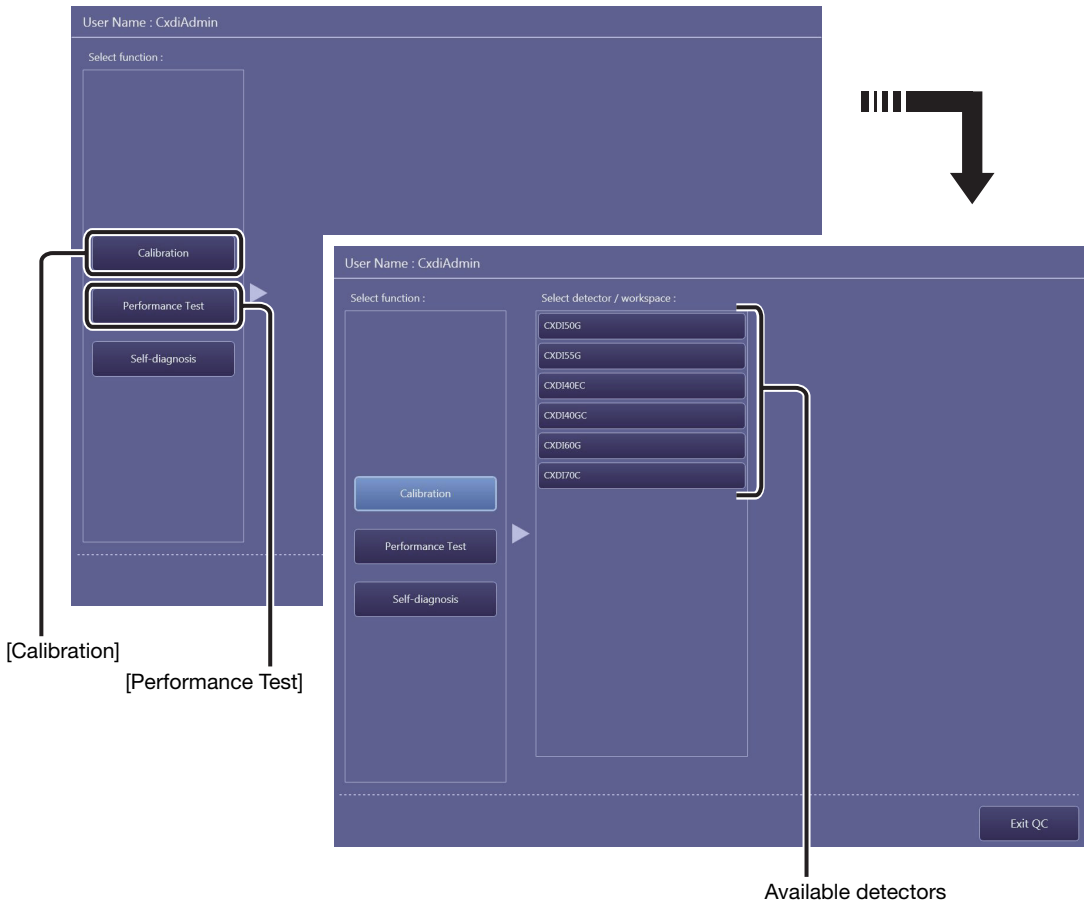
3.4.1 Calibrating the detector

A combined performance of a Calibration (for the detector correction data generation) and a Performance Test (for the detector inspection) that was conducted when the system was set up, is required regularly (approximately once a year). The steps for operation of both the Calibration and Performance Test are almost the same. First conduct the Calibration, and then the Performance Test for confirmation.

NOTE: Screens in Calibration mode are used for the following steps.

1 Enter calibration/performance test mode and select the target detector.

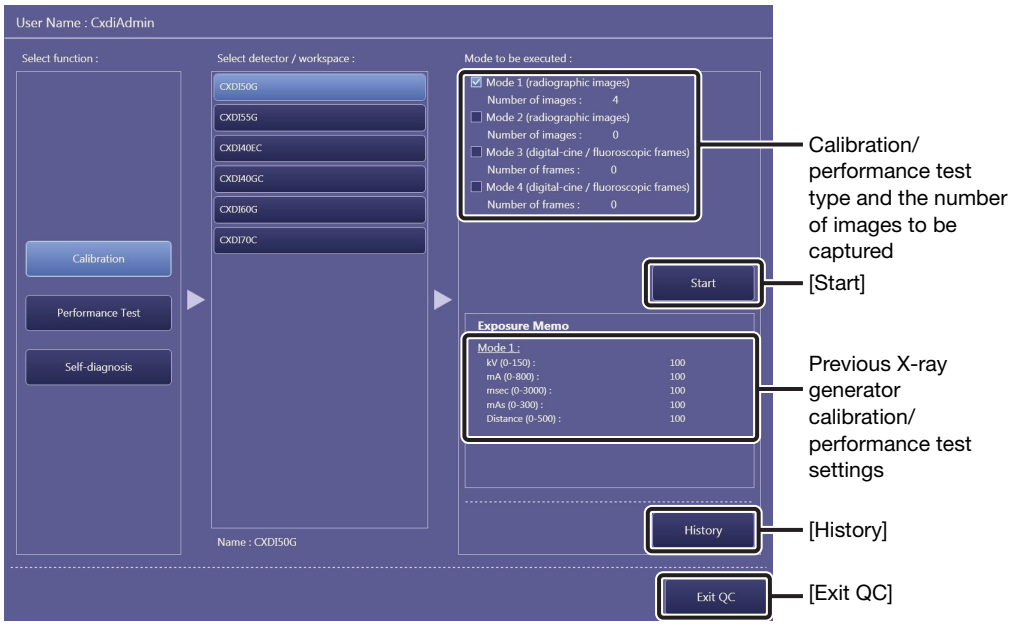
Click [Calibration] or [Performance Test], and then select a detector.



Continued

2 Start the calibration/performance test.

Click [Start].

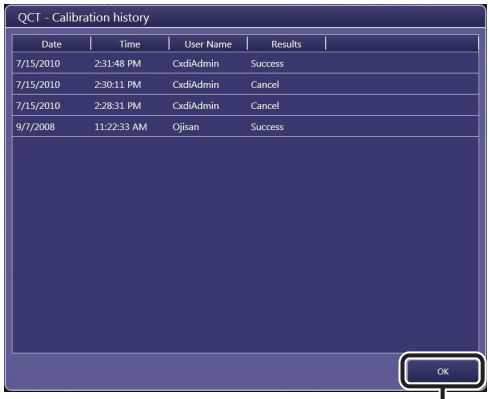


Calibration start screen

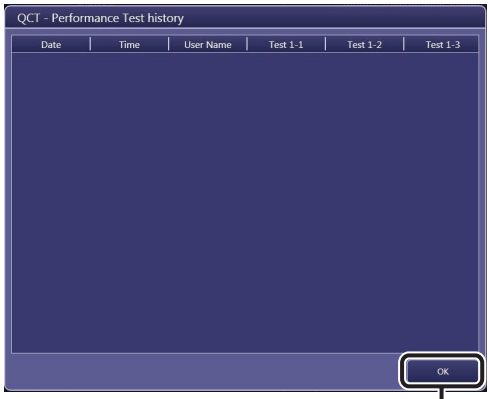
NOTE: Selection of the calibration/performance test type and the number of the images to be captured cannot be modified. For details, consult your service engineer.

To confirm the calibration/performance test history

Before clicking [Start], click [History]. To close the dialog box, click [OK].

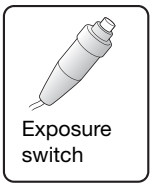


Calibration history dialog box

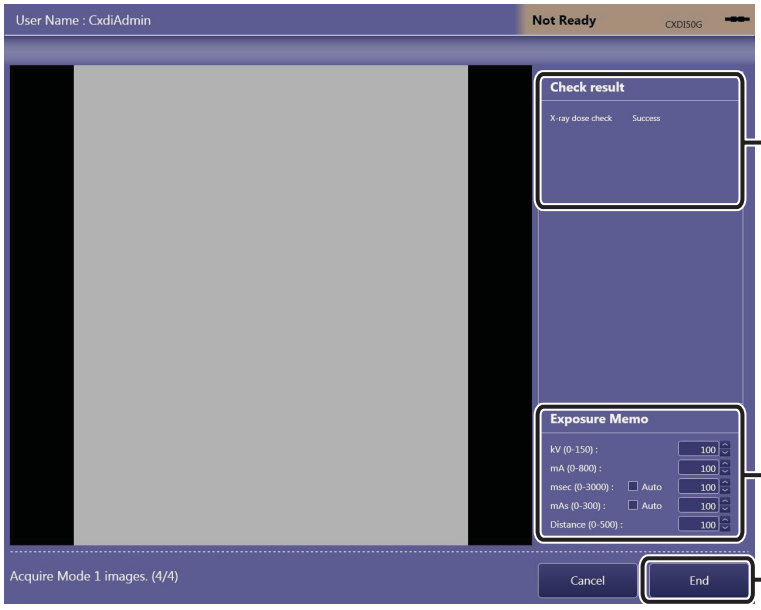


Performance test history dialog box

3 Start exposure.



Confirm that the **Ready** indicator appears in the system status bar, and then press and hold the exposure switch of the X-ray generator.



To record the exposure conditions used for the current calibration

For further reference, enter the exposure conditions in the Exposure Memo. These text boxes are available when all the calibrations are complete.

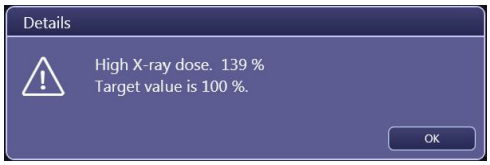
Continued

To automatically calculate the msec/mAs value in the Exposure Memo

After entering the mA (X-ray tube current) value, if one of the values for msec (exposure time) and mAs (current-time product) is entered, the other value will automatically be calculated. Select one of the Auto (calculation) check boxes for msec or mAs to enable the auto calculation feature.

When an error occurs during calibration

To confirm the details of a calibration result, click [Details] in the Check result list. After confirming the results, click [OK] to close the dialog box. Change the X-ray generator settings based on the results of the failed calibration, and then click [Retry].



4 Set the detector and X-ray generator to ready status.

Click [Next].

5 Repeat calibration/performance test.

Repeat steps 3 and 4 until all the calibrations/performance tests are complete.

6 Exit the QC Tool.

Click [Exit QC] in the calibration/performance test start screen.

3.4.2 Inspecting the detector (Performance Test)

A Performance Test by itself can also be conducted to maintain the detector. In accordance with the medical site guidelines, the test should be performed on a regular basis. If problems are detected, perform calibration. See 3.4.1 for details on operation.

NOTE: Before conducting a performance test, be sure to adjust the X-ray generator settings based on the Exposure Memo data recorded during previous calibration.

NOTE: Be sure to inform your service engineer of the error code that appears during a performance test.

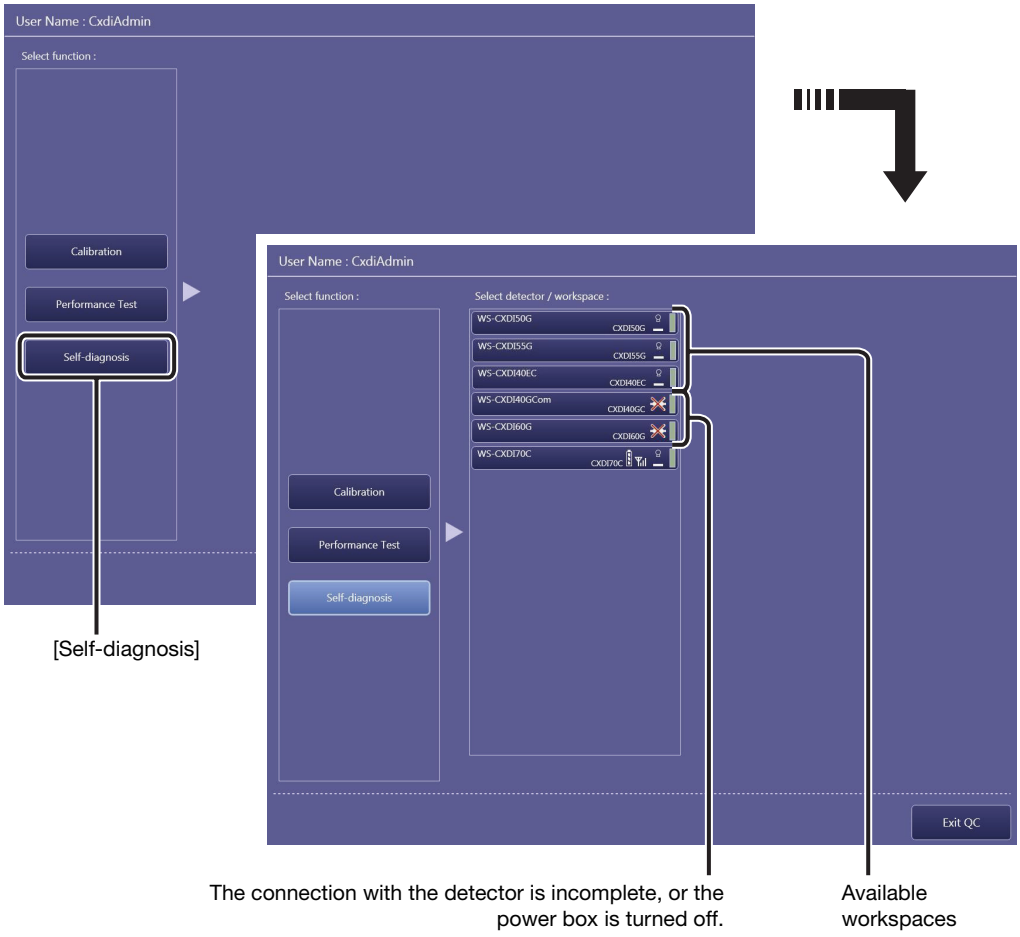
3.4.3 Inspecting the detector/power box (Self-diagnosis)

The Control Software inspects the connected detector/power box using test pattern images and so on. This inspection is required to be conducted once a month.

NOTE: Be sure to inform your service engineer of the error code that appears during a self-diagnosis.

1 Enter Self-diagnosis mode and select the target workspace.

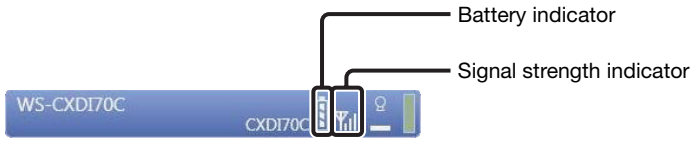
Click [Self-diagnosis], and then select a workspace.



Continued

NOTE: A battery indicator and a signal strength indicator are shown on the workspace for wireless detectors.

Example of Workspace Indicator for wireless detectors



The remaining battery charge is indicated as follows:

- : 60–100% charge
- : 9–59%
- : 5–8%
- : 4% or less

When the indication changes to or , a warning/error dialog box appears to prompt a battery recharge.

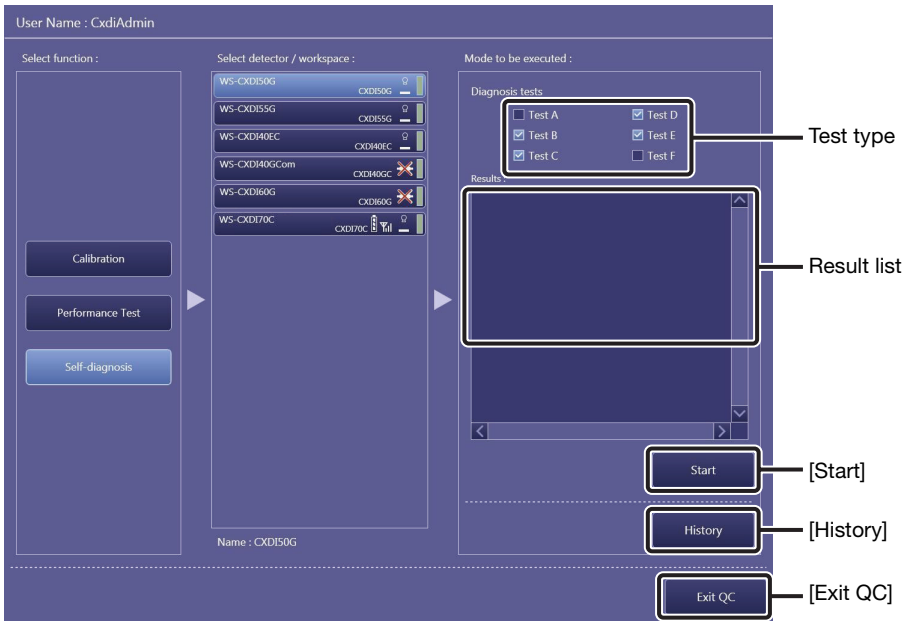
Signal strength is indicated as follows:

- : Strong
- : Medium
- : Poor
- : No signal

For the wireless detector, refer to the Digital Radiography CXDI series User's Manual.

2 Start the self-diagnosis.

Click [Start]. The Control Software starts self-diagnosis, and the results appear in the Result list.



Self-diagnosis start screen

NOTE: Selection of the test type cannot be modified. For details, consult your service engineer.

To confirm the self-diagnosis history

Before clicking [Start], click [History]. To close the dialog box, click [OK].

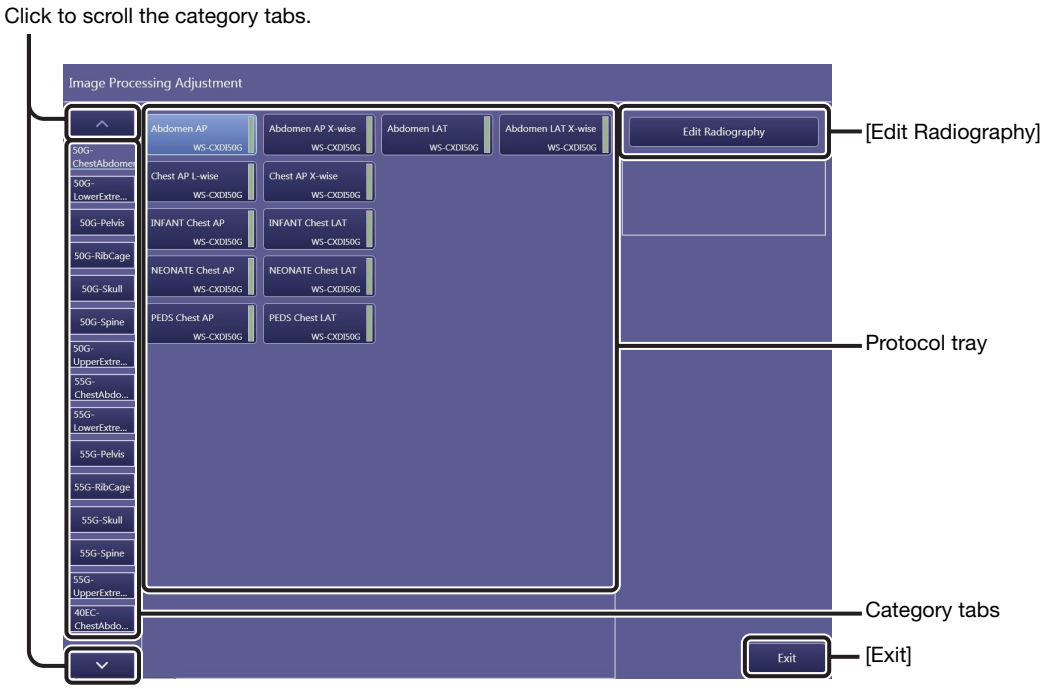
3 Exit the QC Tool.

Click [Exit QC] in the Self-diagnosis start screen.

3.5 Image Proc button

Image processing parameters included in the protocol can be modified while simulating the processing parameter settings using the sample image that was previously captured.

NOTE**:** Operations for this tool require the ImageProcessing Administrations privileges (see step 2 in 2.2).



Protocol selection screen

1 Select the target protocols in the protocol tray.

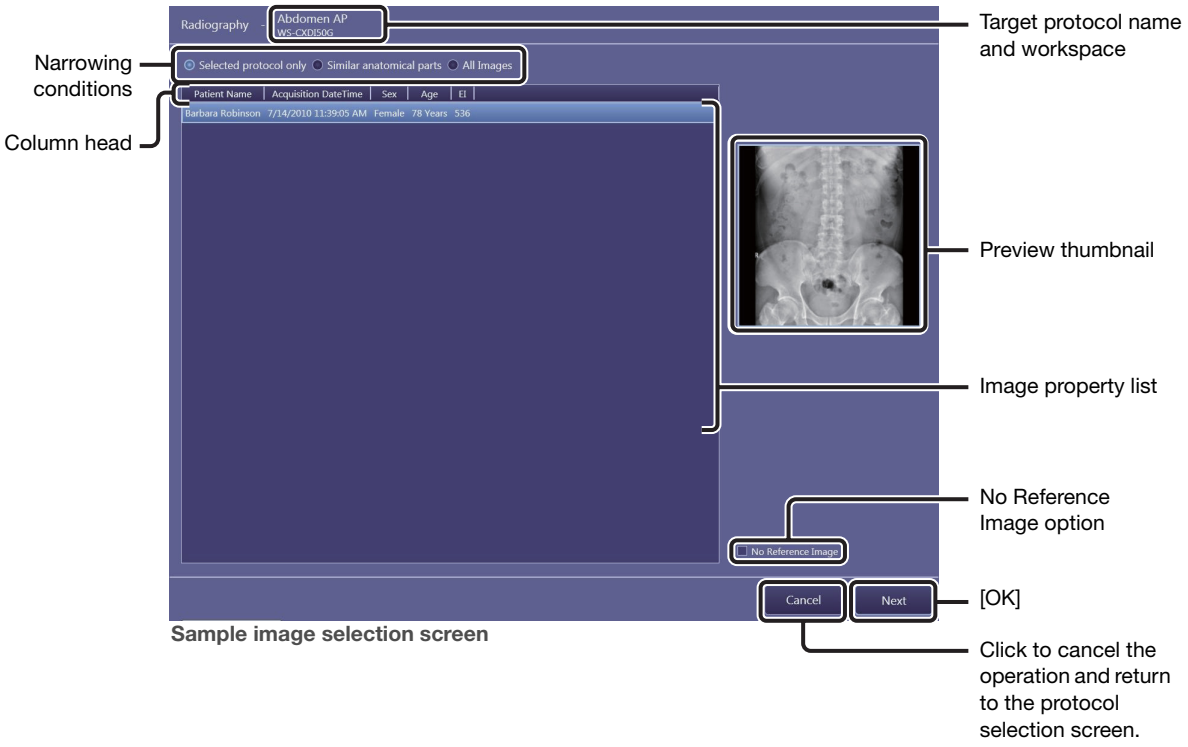
Click the target tab and then click a protocol from the protocol tray.
The selected protocol is highlighted. Click [Edit Radiography] to show the sample image selection screen.

2 Select a target sample image.

Select an image property from the list while checking the preview thumbnail, and then click [OK].
The processing parameter edit screen appears.

NOTE: Up to 100 of the most recent images can be available for simulations.

If a sample image is not required
Select the No Reference Image option, and then click [OK].



Sample image selection screen

To change the narrowing conditions for the image property list

Select one of the following options; **Selected protocol only** (shows only images captured using the same protocols as the target protocol), **Similar anatomical parts** (shows only images captured using protocols whose anatomical parts are similar to the target protocol), and **All Images** (all available images).

To sort the image property

Click a sort item in the column head. To switch between ascending and descending sort order, click the same item again.

Continued

3 Modify the image processing parameters.

Refer to 6.2, and 7.3 in the Operation Manual for details on operation.

To set the EIt value

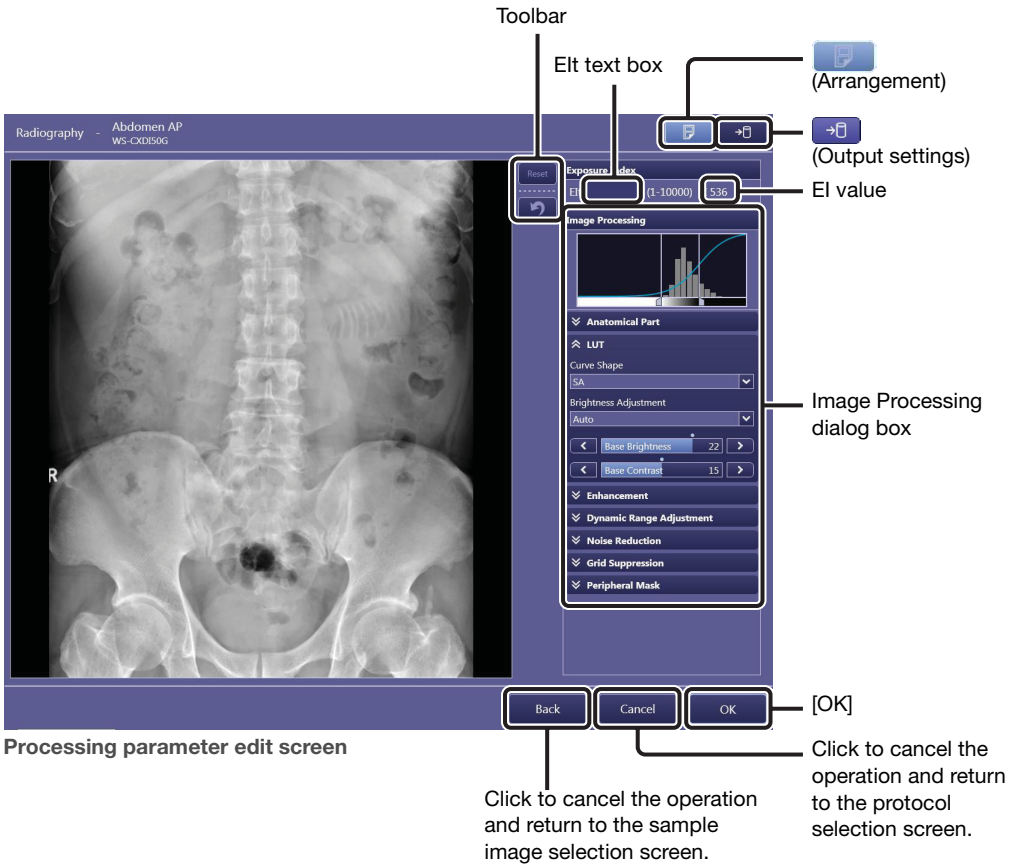
Enter a value in the EIt text box referring to the current EI value. If the text box is left blank, DI cannot be calculated.

NOTE: The values of EI, EIt, and DI can be embedded on both the preview screen and film sheet images. See 2.5.1 for details on operation.

EI (Exposure Index)
EI is an approximative indicator of the dose that reaches the detector, as calculated per IEC 62494-1 standards from the captured images.
Under the same exposure conditions, the indicator and the dose are proportional. Depending on the exposure conditions, the indicator may vary on a 10 percent basis up to several 100 percent larger. For details, refer to IEC 62494-1.

EIt (Target Exposure Index)
EIt is the target EI level. Set the appropriate EIt using EI obtained from previous captured radiographic images as feedback.

DI (Deviation Index)
DI is a logarithmic index indicating the difference between the EI and EIt. When the EI value is the same as EIt, the DI is calculated as 0. The bigger the difference between EI and EIt, the larger the DI absolute value becomes. A positive DI value is calculated when EI is bigger than EIt, and a negative value is calculated when EI is smaller than EIt.



Processing parameter edit screen

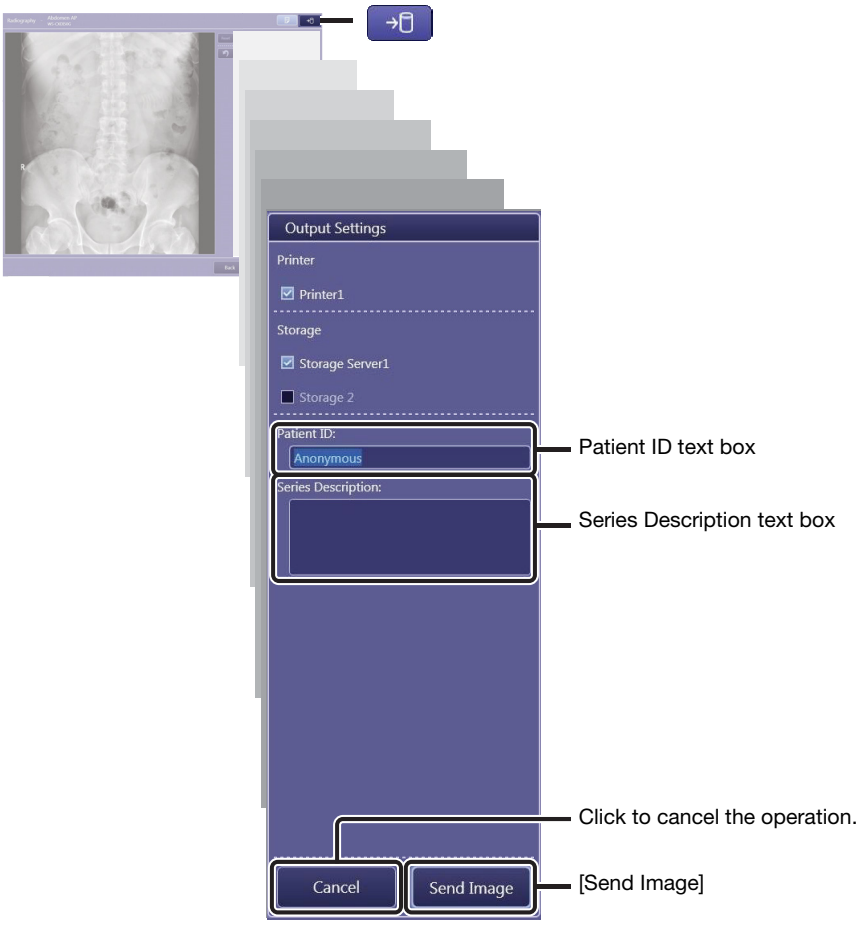
NOTE: The result of the Grid Suppression control is not reflected in the preview image. However, the result can be confirmed solely in the printed image. If required, proceed to step 4.

NOTE: The result of the Peripheral Mask control is not reflected in the preview image. However, the Peripheral Mask result can be confirmed in the [EXAM > Examination] or [PAST > View] screen. Refer to Chapter 5 in the Operation Manual.

4 Transmit the resulting image, if required.

Click  , select the destination, and then click [Send Image].
Refer to 7.2 in the Operation Manual for details on operation.

Saving or printing the resulting images for strict image evaluation
To evaluate the resulting image quality, it is recommended to check the images on the DICOM viewer or on printed film sheet. In such cases, the Patient ID and Series Description options are provided in the Output Settings dialog box. For example, enter a title that indicates that the image is not for examination in the Patient ID text box, and also enter a summary of the parameter modifications in the Series Description text box.



Continued

When the image arrangement screen appears

Refer to “7.1.1 Arranging images automatically” in the Operation Manual.

5 Set image processing parameter.

Click [OK] in the processing parameter edit screen.

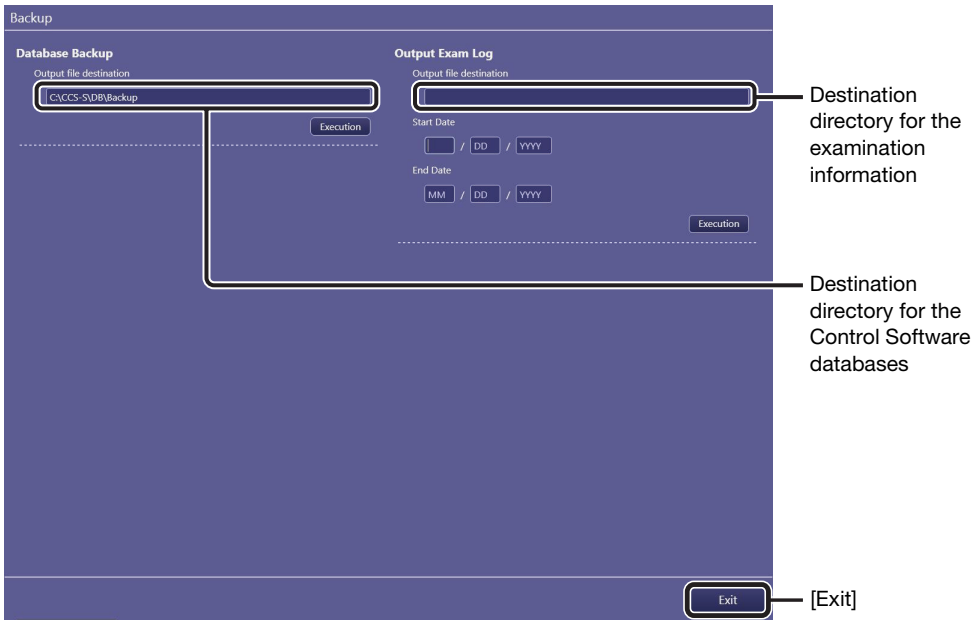
6 Exit image processing parameter edit mode.

Click [Exit] in the protocol selection screen.

3.6 DB Backup button

On the Backup screen, all of the Control Software databases or specific examination information can be manually backed up to a preset destination directory. Be sure to back up the database before performing any major modification of the Control Software.

NOTE: Users cannot change the destination directories for both options. For details, consult your service engineer.



To exit backup mode

Click [Exit].

3.6.1 Database Backup option

1 Perform backup for all of the Control Software databases.

Click [Execution] for this option.

3.6.2 Output Exam Log option

The following information can be backed up in a CSV format file: Image capture date, image capture time, accession number, exposure mode, protocol name, body part, patient orientation, operator name, image rejection date, image rejection time, reason for image rejection, and name of operator who rejected the image.

1 Specify target examinations by period of time.

Enter the year, month, and date for both the Start Date and End Date option.

NOTE: When the Start Date and End Date are not specified, log data of all examinations are output.

2 Perform backup for the examination information.

Click [Execution] for this option.

Appendix

Introduction

This appendix gives instructions for user adjustment to imaging parameters for captured images from Canon digital radiography system CXDI series and CXDI Control Software NE (hereafter “the control software”) systems. For details on operating procedure, refer to the chapter 1 thru 3 of this Setup Guide and the separate Operation Manual. The control software includes image processing functions to produce optimal images. Site-specific adjustments are made during installation by service engineers.
For questions or technical issues when using imaging parameters to adjust captured images, contact your service engineer.

NOTE: Before adjusting imaging parameters, calibrate the output devices, such as local preview monitors, PACS, HD DICOM monitors, and film printers, to ensure consistent image appearance. Insufficient calibration will make adjustment of interrelated imaging parameters complex and prevent optimal image quality from being obtained easily.

NOTE: If you find undesirable artifacts on adjusted images or realize any loss of details necessary for diagnosis, attenuate the effect of adjustments or cancel them. Be sure to check that the adjusted images are acceptable.

1 Imaging Parameters

1.1 Overview of Imaging Parameters

The control software incorporates a variety of image processing to enable consistently optimal imaging.
Settings have already been configured to leverage this processing for optimal rendering (in each study, each anatomical part, and each patient). It is also possible to fine-tune imaging by altering the intensity or level of processing through customization of imaging parameters.

1.2 Classification of Imaging Parameters

Imaging parameters are classified into three levels (1–3).

Level 1: General imaging parameters that are occasionally applied to specific patients.
Level 2: Imaging parameters that are rarely applied to specific patients.
In general, there is no need to adjust these parameters.
Level 3: Global parameters, not restricted to specific patients.

1.3 Access Privileges

Whether or not users can access imaging parameters depends on two levels of authorization, based on their image processing privileges. In this appendix, users authorized for advanced adjustment of image processing parameters are called imaging administrators. Users without this authorization are simply called regular users.

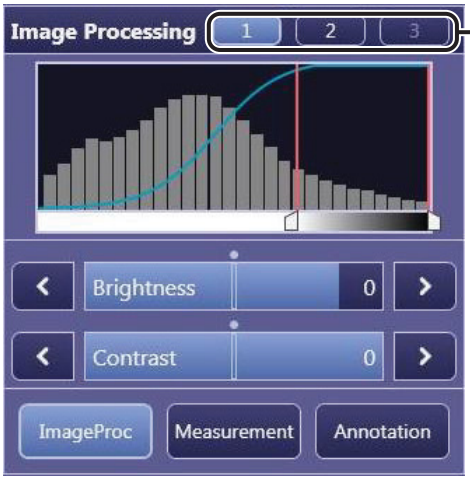
Regular users:
Users who can edit level 1 parameters.
Imaging administrators:
Administrators who can edit all parameters (levels 1–3).

However, regular user privileges (for level 1 image adjustment) are sufficient in most workflows. When regular users attempt to access level 2 or 3 image adjustment parameters, the Authorization dialog box is displayed indicating insufficient privileges.

When the Authorization dialog box is displayed
Entering the login name and password of a user with higher-level authorization in this dialog box grants provisional access to level 2 and 3 parameters.
This provisional access is valid only until the current study is finished. After the current study, even if users attempt to access level 2 or 3 parameters for multiple studies of the same patient, the login name and password of an imaging administrator is required.

1.4 How to Access Imaging Parameters

To access level 2 parameters, click indicator 2 in the access level selector/indicator in the Image Processing pane. To access level 3 parameters, when level 2 parameters are displayed, click indicator 3 in the access level selector/indicator.



2 Saving Imaging Parameters

This chapter gives overview of saving imaging parameters. Parameters are saved per-protocol basis* and per-study basis.
The categories, parameters (functions), and levels of image adjustment are as follows. The table also indicates whether adjusted parameters can be saved as the default parameters. See also 2.1 Adjustment and Saving of Default Parameters.
* Default (per-protocol basis) parameters are automatically applied to the captured images as default setting.

Category	Parameter	Level			Can be Saved as Defaults
		1	2	3	
Generals	Rotate Clockwise	✓	✓	✓	Yes
	Rotate Counterclockwise	✓	✓	✓	Yes
	Flip Horizontal	✓	✓	✓	Yes
	Flip Vertical	✓	✓	✓	Yes
Analysis	Dynamic Range	✓	✓	✓	No
	ROI	✓	✓	✓	No
Anatomical Part	Category			✓	Yes
	Anatomical Part			✓	Yes
	Direction			✓	Yes
LUT	Curve Shape			✓	Yes
	Brightness Adjustment			✓	Yes
	REX*1			✓	Yes
	Base Brightness*2			✓	Yes
	Base Contrast			✓	Yes
	Brightness	✓	✓	✓	No
	Contrast	✓	✓	✓	No
Enhancement	Edge Enhancement		✓	✓	Yes
	Edge Frequency			✓	Yes
	Contrast Boost		✓	✓	Yes
Dynamic Range Adjustment	Dark Region		✓	✓	Yes
	Bright Region		✓	✓	Yes
Noise Reduction	Effect		✓	✓	Yes
Grid Suppression	Grid Suppression			✓	Yes
	Grid Name			✓	Yes
Peripheral Mask	Mask			✓	Yes

*1 Only when REX is selected for Brightness Adjustment
*2 Only when Auto is selected for Brightness Adjustment

2.1 Adjustment and Saving of Default Parameters

2.1.1 Adjustment

Among default imaging parameters, level 3 parameters are global and not restricted to specific patients. When configuring these parameters, use values that represent the optimal average values across multiple subjects. The adjustment procedure is described in the next chapter.

Interfaces enabling editing of default parameters

Interface	Adjustment Scenario	Notes
Image Proc button	Adjustment after specifying a protocol	The protocol name must be known in advance.
EXAM tab	Adjustment during a study	Parameters are saved during level 3 adjustment by clicking [Save As Default].
PAST tab	Adjustment after selecting a patient who has already been imaged	

When adjusting settings on the Image Processing Adjustment screen, also see Chapter 3.5 of this Setup Guide.

2.1.2 Saving

Default parameters can be saved on a per-protocol basis. These parameters can be edited in the above three interfaces, but saving requires imaging administrator privileges. Default parameters cannot be saved with regular user privileges.

2.2 Adjustment and Saving of Study Parameters

2.2.1 Adjustment

Essentially, adjustment is only possible for level 1 imaging parameters. However, if additional fine-tuning is desired, adjust level 2 imaging parameters. Adjustment of level 3 imaging parameters is not necessary. The adjustment procedure is described in the next chapter.

Interfaces enabling editing of study parameters

Interface	Adjustment Scenario	Notes
EXAM tab	Adjustment immediately after image capture	-
PAST tab	Adjustment after a study is finished	-

2.2.2 Saving

Study parameters can be saved, as needed. These parameters can be edited in the above two interfaces and be saved with regular user privileges. The same applies to users with imaging administrator privileges.

3 Details of Imaging Parameters

This chapter gives explanations of each parameter function and operating procedures for these parameters.

NOTE: If you find undesirable artifacts on adjusted images or realize any loss of details necessary for diagnosis, attenuate the effect of adjustments or cancel them. Be sure to check that the adjusted images are acceptable.

NOTE: To confirm the results of effects in the imaging parameters, check images after transfer to storage or output to film.

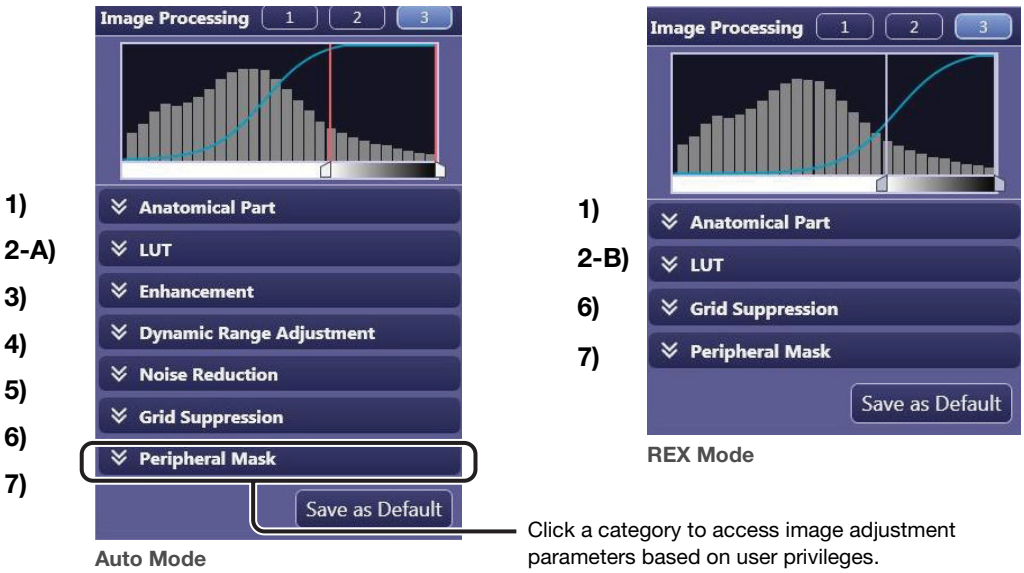
3.1 Main Parameters

The number of parameters varies depending on the Brightness Adjustment setting. Two Brightness Adjustment settings are available: Auto and REX.

NOTE: Auto: Mode for automatic tone curve adjustment, for uniform brightness in the region of examination regardless of X-ray dose

REX: Mode for tone curve adjustment to change brightness of the region of examination based on X-ray dose

Top Screen of Image Processing Pane*

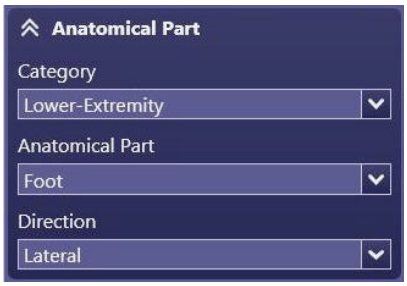


* This pane appears in [EXAM > Examination] and [Past > View] screens.

3.2 Description of Parameters

1) Anatomical Part

Functions for automatic adjustment of image tone after exposure. Complete the Anatomical Part and Direction settings according to study objectives and the anatomical part involved. For example, specify Chest in Anatomical Part for automatic tone adjustment after exposure suited to chest diagnosis.



Category and Anatomical Part
The anatomical parts are categorized as follows.

Category	Anatomical Part
Contrast-Medium	Upper Gastrointestinal
	Lower Gastrointestinal
	Hepato Billiary Pancreatic
	Urinary
	Myelo
Skull	Skull
	Ear
	Nose Sinus
	Nose
	Mandible
Chest/Abdomen	Chest
	Child Chest
	Infant Chest
	Abdomen
Spine	Cervical Spine
	Thoracic Spine
	Lumbar Spine
Rib Cage	Clavicle
	Shoulder
	Scapula
	Rib
	Sternum

Category	Anatomical Part
Pelvis	Pelvis
	Sacrum
	Ilium
	Coccyx
	Pubis
Upper-Extremity	Humerus
	Elbow
	Forearm
	Wrist
	Hand
Lower-Extremity	Hip Joint
	Femur
	Knee
	Leg
	Ankle
	Foot
Other	Unknown
Stitch*	Whole Spine
	Full leg
	Unknown

* Only for stitch protocol

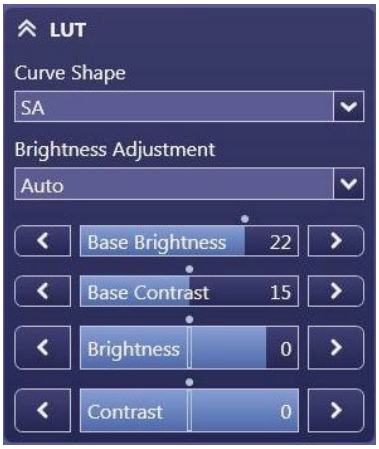
Direction
Imaging directions (orientations) are as follows.

Front
Lateral
Other

Continued

2-A) LUT (Auto mode)

Adjusts tone curve parameters.



Curve Shape
Specify the tone curve. Select one of the following four tone curves.

- **SA:** S-shaped tone curve equivalent to standard radiographic film.
- **SB:** S-shaped tone curve with higher contrast in bright regions.
- **SC:** S-shaped tone curve with higher contrast in dark regions.
- **LN:** Uniform contrast throughout all brightnesses.

Brightness Adjustment
Select Auto.
In Auto mode, the tone curve will automatically be adjusted so that the brightness of the overall examination region of all images wil be almost the same regardless of the X-ray dose.

Base Brightness (1 to 29)
Specify the standard brightness.
Set the value higher for brighter images. Conversely, set it lower for darker images.
Choose values that represent optimal average values across multiple subjects.

Base Contrast (1 to 29)
Specify the standard contrast.
Set the value higher for more overall contrast. Conversely, set it lower for less contrast overall.
Choose values that represent optimal average values across multiple subjects.

Brightness (-10 to +10)
Used to fine-tune brightness. Adjust the brightness in a range of -10 to +10 relative to the Base Brightness value.
Set the value higher for brighter images. Conversely, set it lower for darker images.
The supported adjustment range depends on the Base Brightness value. In some cases, the range may be narrower than -10 to +10.

Contrast (-10 to +10)
Used to fine-tune contrast. Adjust the contrast in a range of -10 to +10 relative to the Base Contrast value.
Set the value higher for more overall contrast. Conversely, set it lower for less contrast overall.
The supported adjustment range depends on the Base Contrast value. In some cases, the range may be narrower than -10 to +10.

2-B) LUT (REX mode)

Adjusts tone curve parameters.

NOTE: REX mode is used for manual studies (when the X-ray dose was intentionally controlled to achieve a specific image brightness) or in follow-up exams when imaging is based on film density*1, for example.
*1 Or on brightness, in display-based diagnosis.

Curve Shape
See 2-A) LUT (Auto mode).

Brightness Adjustment
Select REX.
In REX mode, the brightness of the overall examination region of an image varies depending on the X-ray dose (images are darker at higher X-ray doses and brighter at lower doses).

REX (0 to 65535)
Specify the standard brightness in REX mode.
Set the value higher for brighter images. Conversely, set it lower for darker images.

NOTE: The REX (Reached Exposure Index) value is equivalent to that of the output from the image sensor pixels that are included in a region, where the referential density of 0.75D is applied, in a diagnostic image captured using the CXDI system.
If the applied imaging parameters are the same in Auto mode, the REX value varies depending on the X-ray dose that reaches the image sensor, and provides an indication of the X-ray dose radiated from the generator.

Base Contrast (1 to 29)
See 2-A) LUT (Auto mode).

Brightness (-10 to +5)
Used to fine-tune brightness. Adjust the brightness in a range of –10 to +5 relative to the Base Brightness.
Set the value higher for brighter images. Conversely, set it lower for darker images.

Contrast (-10 to +10)
See 2-A) LUT (Auto mode).

Continued

3) Enhancement

Adjusts image enhancement parameters.

Select the check box to activate enhancement. The following three parameters are available.

Edge Enhancement (0 to 20)
Set the value higher to emphasize image edges, making images sharper.

Edge Frequency (1 to 7)
Adjust the frequency range for edge enhancement.
Set the value lower for edge enhancement in low-frequency regions. This is suitable for large structures such as organs and bones.
Set the value higher for edge enhancement in high-frequency regions. This is suitable when imaging blood vessels, trabecular bones, or other small structures.

Contrast Boost (0 to 20)
Set the value higher to enhance local contrast. This increases sharpness in thicker areas of the body, as in trunk imaging.

4) Dynamic Range Adjustment

Adjusts the dynamic range adjustment parameters.

Select the Dark Region check box to activate dynamic range adjustment of dark regions. Conversely, select Bright Region to activate dynamic range adjustment of bright regions.

Dark Region (1 to 20)
Set the value higher to brighten dark image areas. If dark image areas are too dark, increase the value. If they are too bright, decrease the value.

Bright Region (1 to 20)
Set the value higher to darken bright image areas. If bright image areas are too bright, use a large value. If they are too dark, use a low value.

5) Noise Reduction (1 to 10)

Reduces graininess in image areas of low X-ray exposure.

Select the check box to activate noise reduction. Set the value higher to reduce graininess. However, images will be somewhat less sharp.

6) Grid Suppression (On/Off)

Reduces the appearance of grid lines in captured images.

When this check box is selected, grid suppression is applied to images at the time of transfer to storage or film output. If a grid other than the one set at the parameter configuration is used, select the check box to activate grid suppression, and then the name of the grid that is attached.

NOTE: In order to check the effect of this image processing, examine images transferred to storage or output to film. Results of grid suppression cannot be seen in images as displayed.

7) Peripheral Mask (On/Off)

Peripheral masking is a function to conceal areas outside the region of examination.

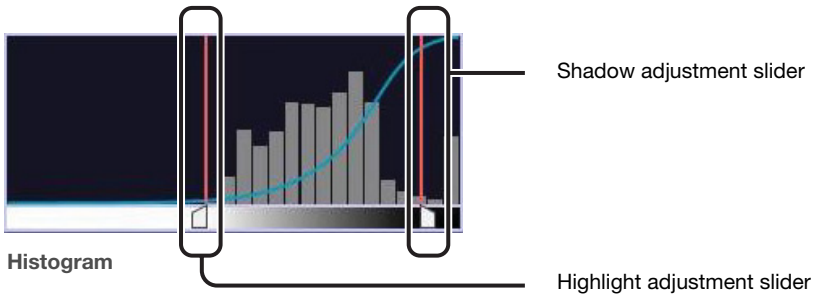
When this check box is selected, [Mask] is displayed in the toolbar and the masking appears. Refer to 6.1.5 in the separate Operation Manual.

NOTE: The masking is not applied to images shown in the preview image on the processing parameter edit screen during modification of a protocol (see 3.5 in this Setup Guide). Masking is translucent on EXAM and PAST screens. At the time of output, an opaque black mask conceals peripheral images.

3.3 Other Parameters

Dynamic Range

In the figure, the subject's dynamic range is bounded by Shadow/Highlight adjustment sliders. However, because the optimal dynamic range is normally set after automatic analysis, avoid moving the sliders.



Determining if the Dynamic Range is Suitable
Examine both the image preview and the histogram to determine suitability. Determine the exact histogram range that corresponds to the subject's dynamic range. This range does not include peripheral areas, metal objects, or blank, transparent areas. Accurate judgment requires some experience. For function details, see 5.2.3 Dynamic Range Analysis and 5.3.2 Dynamic Range Adjustment in this appendix.

ROI

For specifying the region of interest. If there are overexposed highlights or underexposed shadows, click this button and specify the ROI.

4 Adjustment Procedure

This chapter gives instructions for adjusting exposure images through various parameters. Before adjusting imaging parameters, calibrate the output devices, such as local preview monitors, PACS, HD DICOM monitors, and film printers, to ensure consistent image appearance. Insufficient calibration will make adjustment of interrelated imaging parameters complex and prevent optimal image quality from being obtained easily.

NOTE: If you find undesirable artifacts on adjusted images or realize any loss of details necessary for diagnosis, attenuate the effect of adjustments or cancel them. Be sure to check that the adjusted images are acceptable.

4.1 Default Parameters

For image adjustment involving default parameters, perform adjustment on multiple exposure images of various physiques and specify the average values as default parameters.
The process first involves refinement of the overall/bright area/dark area image appearance by adjusting the tone curve and dynamic range, followed by refinement of image details by adjusting noise reduction and image enhancement.
Figure 4.1 presents a flowchart of the procedure for adjusting default parameters. Table 4.1 describes each step in this process.

Continued

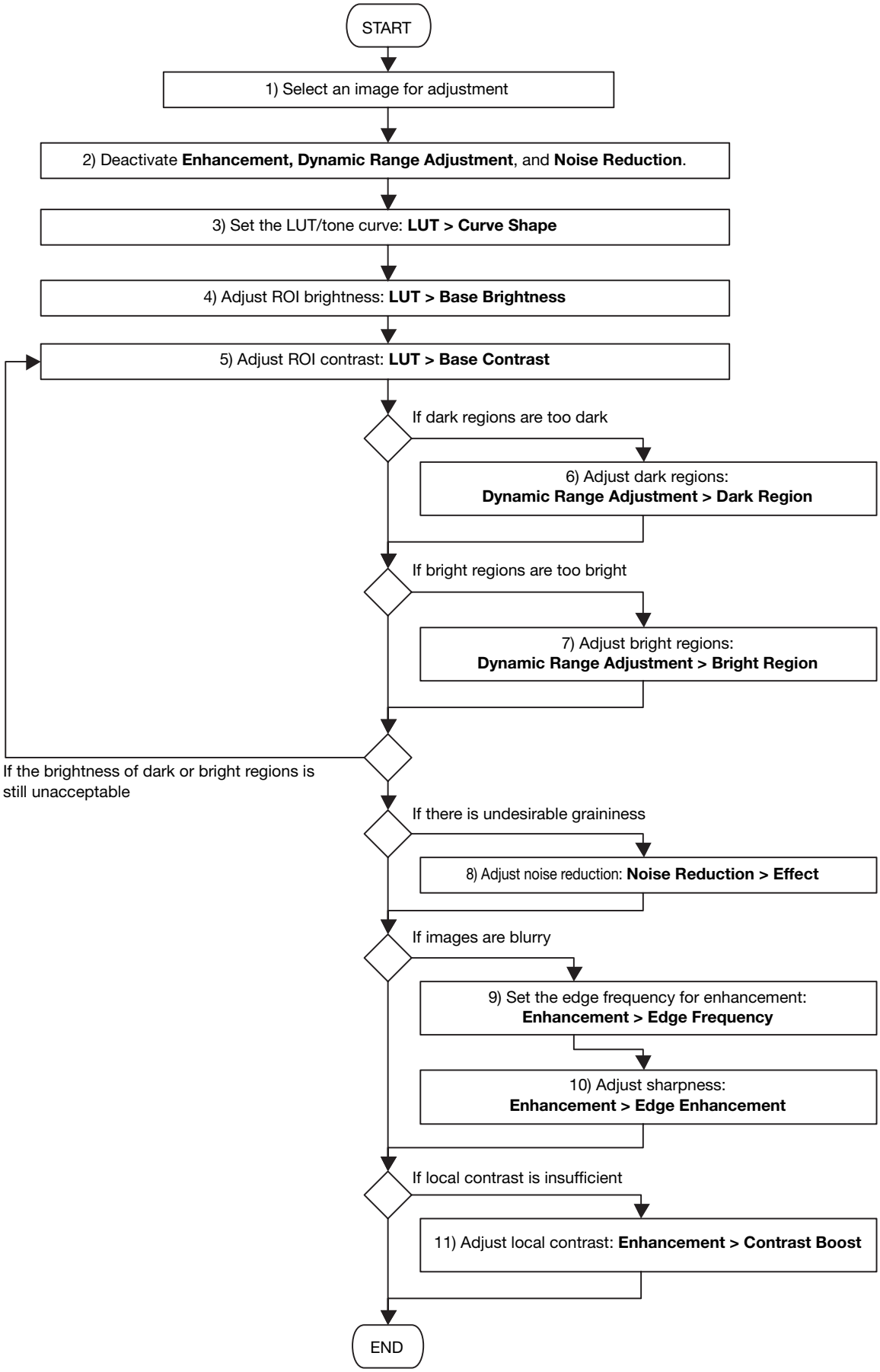


Figure 4.1. Flowchart of the Adjustment Procedure for Default Parameters

No.	Description
1)	Select images for parameter adjustment. At this time, avoid images for which automatic analysis failed.
2)	Deactivate image enhancement, dynamic range adjustment, and noise reduction.
3) to 5)	Adjust tone curve parameters (curve shape, base brightness, and base contrast). At this time, adjust the settings for optimal ROI brightness and local contrast. Note that you can specify a high value in the base contrast parameter, even if this causes underexposed shadows in dark areas and overexposed highlights in bright areas. You can correct this later by adjusting the dynamic range.
6)	If dark areas are too dark compared to the brightness of the ROI, activate dark region control and adjust the value.
7)	Similarly, if bright areas are too bright compared to the brightness of the ROI, activate bright region control and adjust the value.
5) to 7)	If the base contrast parameter is set too high relative to the image's dynamic range, steps 6) and 7) may not be effective in achieving optimal brightness in dark and bright areas. In this case, set the base contrast parameter lower and repeat steps 6) and 7). If the base contrast parameter is set low, local contrast of the ROI will be low, but you can correct local contrast later in the enhancement parameter.
8)	Check image areas of low X-ray exposure. If there is undesirable graininess, activate noise reduction and adjust the value. Note that it may be difficult to verify effect processing on local computers used for previewing images. Refer to a printed film image or HD DICOM monitor to verify effect processing as you adjust the parameters.
9) and 10)	Check image sharpness. If images are blurry, activate enhancement and edge frequency and adjust the value. Note that it may be difficult to verify effect processing on local computers used for previewing images. Refer to a printed film image or HD DICOM monitor to verify effect processing as you adjust the parameters.
11)	Check the local contrast of images. If contrast is too low, activate contrast boost and adjust the value.

Table 4.1. Flowchart Description for Default Parameters

4.2 Study Parameters

Image quality is automatically optimized to account for individual variation in X-ray dose, physique, and other factors. For this reason, no fine-tuning of parameters is generally necessary. However, the effect of tone curve and dynamic range adjustment will be inconsistent if automatic analysis fails, and in this case, the parameters must be fine-tuned.

NOTE: Enhancement and noise reduction parameters, on the other hand, need not be adjusted after default parameters are determined because the results of automatic analysis are not applicable to this image processing.

Figure 4.2 presents a flowchart of the procedure for fine-tuning study parameters. This procedure involves changing tone curves and dynamic range to adjust the brightness. Table 4.2 describes each step in this process.

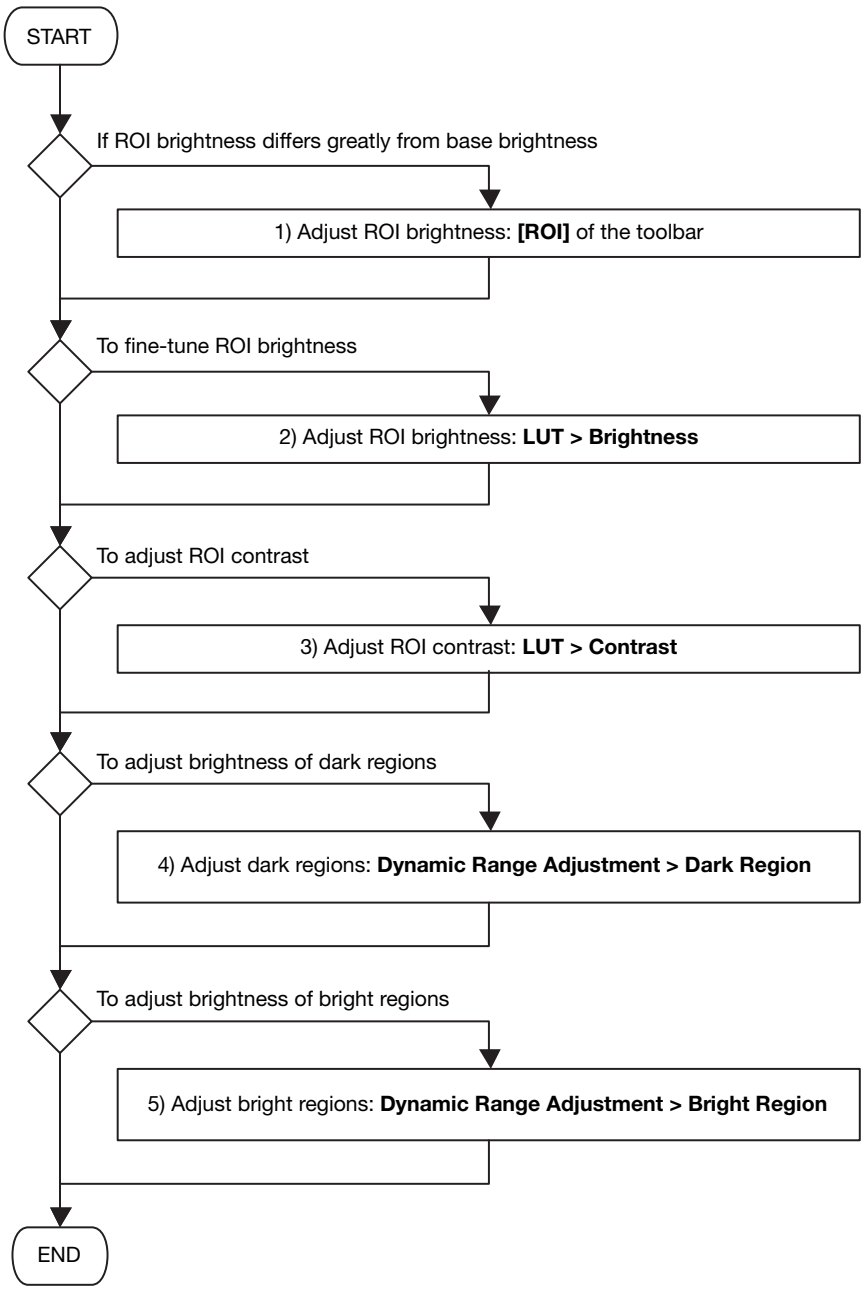


Figure 4.2. Flowchart of Adjustment Procedure for Study Parameters

No.	Description
1)	Automatic analysis may fail if the ROI brightness differs significantly from the base brightness, or if there are overexposed highlights or underexposed shadows. Adjust the ROI image manually to make sure it is suitable.
2)	To fine-tune ROI brightness, adjust the brightness parameter of tone curves. Correct inconsistent automatic analysis of patients, and fine-tune ROI adjustment results as needed.
3)	To change local contrast in the ROI, adjust the contrast parameter of tone curves.
4)	If dark areas are too dark relative to ROI brightness, use a higher value for dark region control. If areas are too bright, on the other hand, reduce the value.
5)	If bright areas are too bright relative to ROI brightness, use a higher value for bright region control. If areas are too dark, on the other hand, reduce the value.

Table 4.2. Adjustment Flowchart Description for Study Parameters

5 Technical Overview of Image Processing

This chapter presents a technical overview for users of image processing by the control software.

5.1 Overview of Image Processing

Image processing by the control software can be broadly classified into three stages of image processing: pre-processing, automatic analysis, and processing images for use in diagnosis as shown in Figure 5.1. In each case, after conversion to digital signals, image from the FPD (at this point, the images are referred to as “raw image.”*1) is pre-processed for uniformity. After pre-processing (at which point images are referred to as “pre-processed image”), automatic analysis is conducted to determine image features or characteristics. This is followed by processing to prepare images suitable for diagnosis. At this stage of image processing, multiple imaging parameters*2 can be adjusted interactively to provide diagnosis images tailored to a variety of requirements. Also at this stage, the results of analysis are applied in optimal image processing for the X-ray dose and patient physique involved.

*1 Raw images produced by the LANMIT system are irrelevant to end users.
*2 Details on configurable parameters are given in 3 Details of Imaging Parameters.

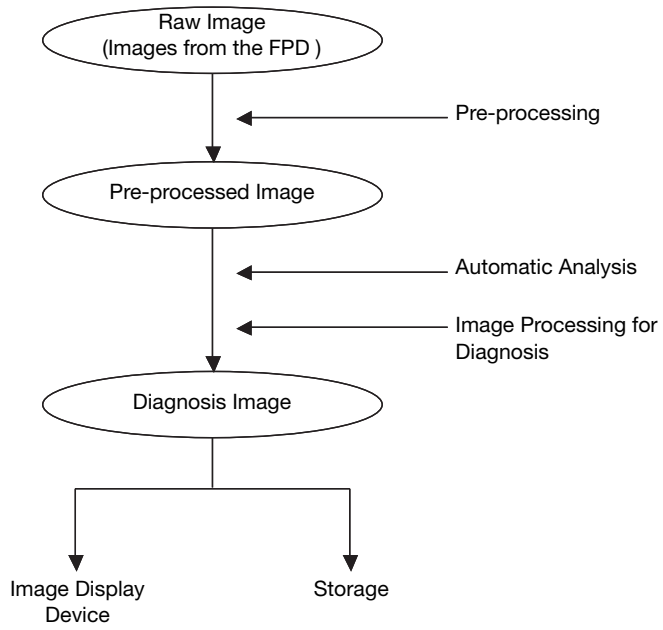


Figure 5.1. Image Processing Sequence

5.2 Automatic Analysis

Images produced by the digital radiography system CXDI series and control software have a wide dynamic range (extending to about four digits). For this reason, automatic analysis must be conducted to determine which part of the dynamic range will be useful in diagnosis and adjust the density (brightness) accordingly to prepare effective images for diagnosis. Automatic analysis must also detect what image areas were exposed to X-rays, because the area of exposure varies by study. Another role of the control software in automatic analysis is to calculate the Reached Exposure index and analyze a variety of image characteristics in other ways. This section describes the typical process of automatic analysis.

5.2.1 Detection of Irradiated Fields

Although the CXDI detector has a large effective area, the actual exposure area may be limited to an area smaller than this, depending on the study. The area is therefore detected automatically, by isolating the irradiated field. A schematic diagram of detection is shown in Figure 5.2. To detect this area, original, pre-processed images are analyzed to extract the edges of the irradiated field from multiple edge components in the image based on position, intensity, and other criteria. The area bounded by these edges is determined to be the area of exposure. Although this technique enables accurate detection of irradiated fields even when X-rays strike the detector at an angle, it cannot be used to detect multiple exposure areas.

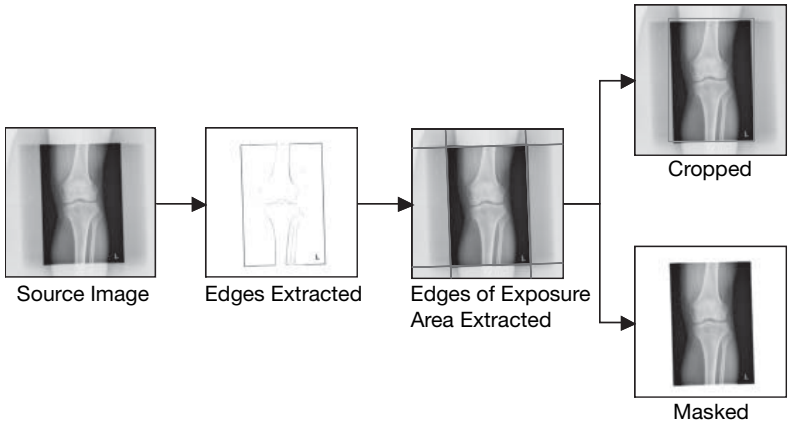


Figure 5.2. Schematic diagram of detection of irradiated fields

Operators can save time in imaging setup and improve throughput by using the area detected as the initial value in cropping and peripheral masking (which masks areas outside the field).
If detection fails, the area for cropping and peripheral masking must be set manually. For details on cropping and peripheral masking, refer to 6.1.4 and 6.1.5 in the separate Operation Manual.

5.2.2 Image Feature Analysis

Generally consistent density (brightness) in the region of interest (ROI) is maintained for all subjects and X-ray doses by the control software through tone conversion*3. This processing requires a representative pixel value (the “reference pixel value”) of the ROI to be determined from captured images. The reference pixel value is calculated automatically through image feature analysis. A schematic diagram of analysis is shown in Figure 5.3 and Figure 5.4. Because the reference pixel value sought varies depending on the anatomical part studied, anatomically specific algorithms are used for image feature analysis. Analysis accuracy is enhanced through various means. For example, after the ROI is determined directly from irradiated image areas, the average ROI value is used as the reference pixel value (as shown in Figure 5.3). Alternatively, the ROI is determined from a histogram of irradiated image areas and its center of mass is used as the reference pixel value (as shown in Figure 5.4). Both methods are also used together.*3 Tone conversion is described in greater detail in 5.3.1 Image Tone Transformation.

*3 If analysis fails, the ROI must be set manually. For instructions on manual configuration, refer to 6.1.3 in the separate Operation Manual.

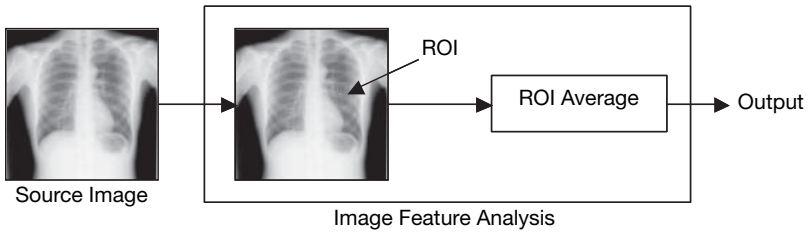


Figure 5.3. Schematic diagram of image-based image feature analysis

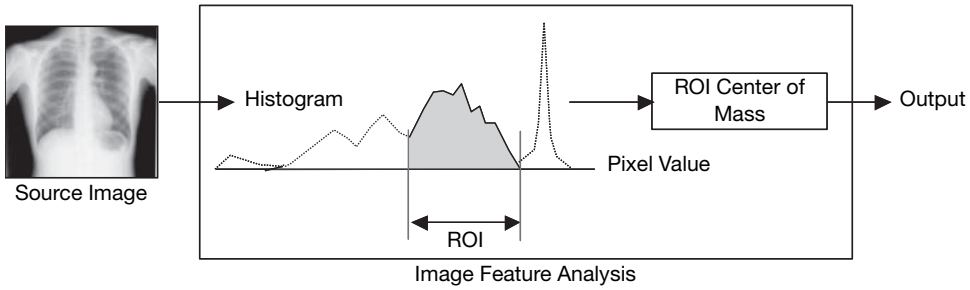


Figure 5.4. Schematic diagram of histogram-based image feature analysis

5.2.3 Dynamic Range Analysis

To enable dynamic range adjustment, the control software uses the subject's dynamic range as the density (brightness) range in settings, regardless of subject physique. This processing requires an understanding of how the available dynamic range corresponds to the specific dynamic range of the subject (that is, what part of the dynamic range should be used for the subject). This part is calculated automatically through dynamic range analysis. A schematic diagram of analysis is shown in Figure 5.5. Analysis involves extracting the region that remains after areas other than the subject (such as X-ray shielding or areas of direct exposure on the FPD) are subtracted from the irradiated field. The range between minimum and maximum values in this area is then calculated*4, which represents the dynamic range of the subject. Dynamic range adjustment is described in greater detail in 5.3.2 Dynamic Range Adjustment.

*4 If analysis fails, the subject's dynamic range must be set manually by referring a histogram. For details, refer to Dynamic Range in 3.3. Other Parameters in this appendix and 6.2.1 in the separate Operation Manual.

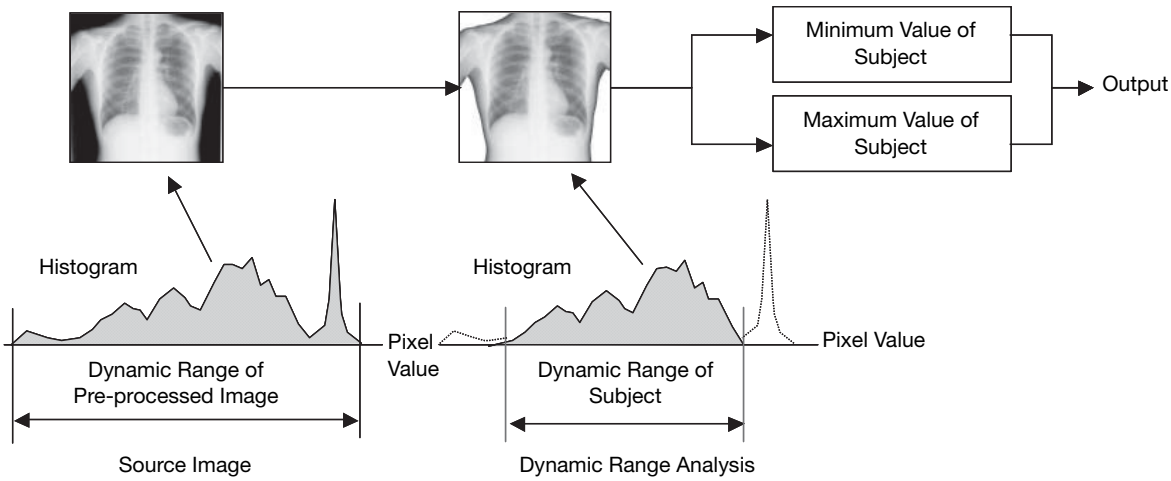


Figure 5.5. Schematic diagram of dynamic range analysis

5.3 Image Processing for Diagnosis

Pre-processed images are not always sufficient for use in diagnosis. For this reason, they must be converted to suitable images. Some parameters to prepare images for diagnosis can be adjusted in the control software. This section describes typical image processing in preparation for diagnosis.

5.3.1 Image Tone Transformation

Images produced by the digital radiography system CXDI series and control software have a wide dynamic range (extending to about four digits). For this reason, to prepare images suitable for diagnosis, the part of the dynamic range that will be useful in diagnosis must be determined and suitable shading assigned. Additionally, because conventionally produced images are standard in diagnosis, image shading must also match that of conventional images. This processing is referred to as tone transformation. Figure 5.6 shows a relevant schematic diagram.

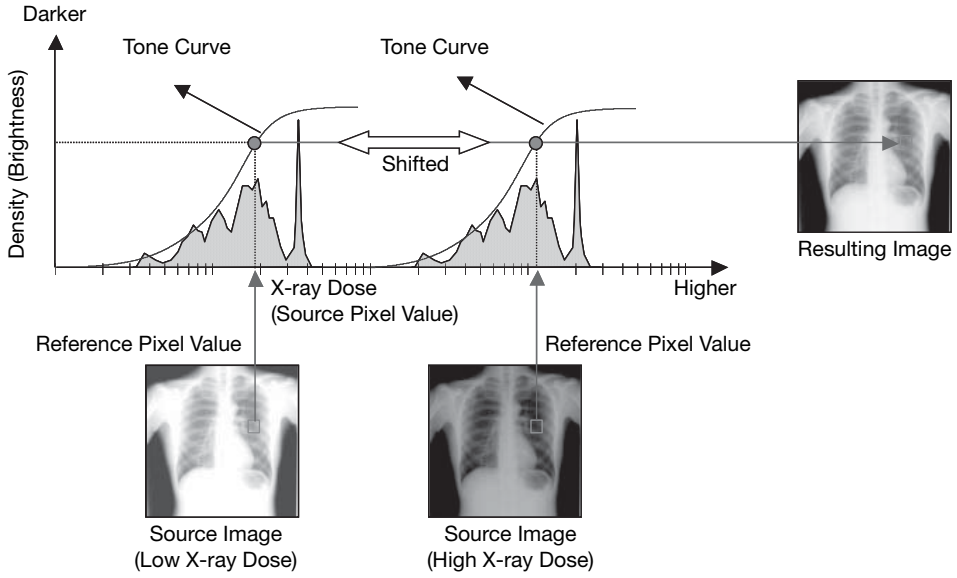


Figure 5.6. Schematic diagram of image tone transformation

In logarithmically transformed pre-processed image, representing higher or lower X-ray doses can be done simply by shifting the tone curve laterally. Thus, as shown in Figure 5.6, tone curves are shifted laterally depending on the dose so that the reference pixel value is at the desired density (brightness). As mentioned in the context of image feature analysis, the reference pixel value is calculated from the same, region-specific ROI regardless of the subject or dose. In this way, image tone transformation automatically adjusts the ROI to the desired density (brightness) regardless of the subject or dose. Moreover, because tone curves resembling the characteristic curves of conventional systems are used, this system provides diagnosis images equivalent to conventional images.

5.3.2 Dynamic Range Adjustment

As described, image tone transformation yields diagnosis images equivalent to conventional images, regardless of the subject or dose. However, with this processing alone, it is difficult to represent the entire subject while maintaining sufficient contrast. This is due to the subject's wide dynamic range, particularly in regions where subject depth varies significantly. For this reason, the entire subject is represented while maintaining sufficient contrast through dynamic range adjustment. Specifically, as shown in Figure 5.7, tone curves established in image tone transformation ("reference tone curves") are adjusted to keep the subject's dynamic range within the desired range of visibility. This adjustment of reference tone curves maintains visibility even in regions of the subject that would normally be affected by overexposed highlights or underexposed shadows. The adjustment also maintains the correlation between reference pixel values and desired density (brightness) and maintains tone curve gradients around reference pixel values. Thus, the subject's dynamic range can be kept within the desired range of visibility without changing the density (brightness) or local contrast (difference between the local contrast of structures) of the ROI. Because the subject's dynamic range is calculated automatically through dynamic range analysis, reference tone curves are also adjusted automatically to suit the subject's dynamic range.

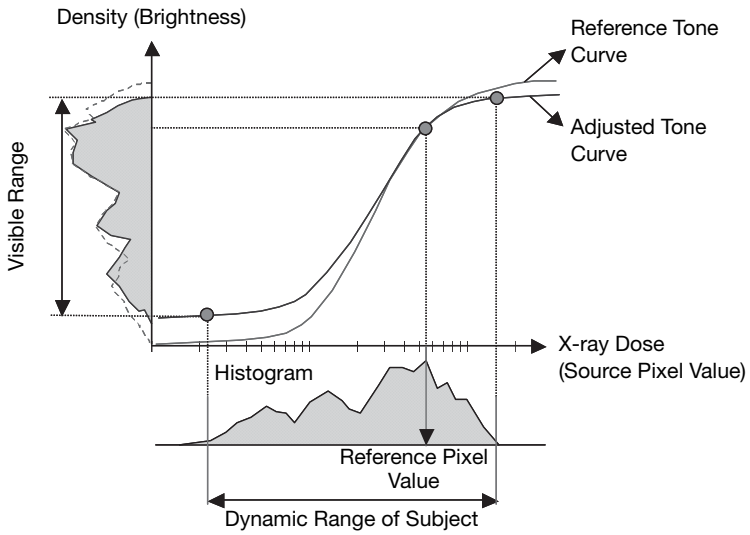


Figure 5.7. Tone curve adjustment

However, merely adjusting tone curves this way causes low local contrast where the tone curve gradient is slight, as in the profile signals shown in Figure 5.8, which obscures these structures. For this reason, the dynamic range adjustment performed compensates for local contrast, keeping the subject's dynamic range within the range of visibility without reducing local contrast of main structures in the subject, as shown in Figure 5.9.

Continued

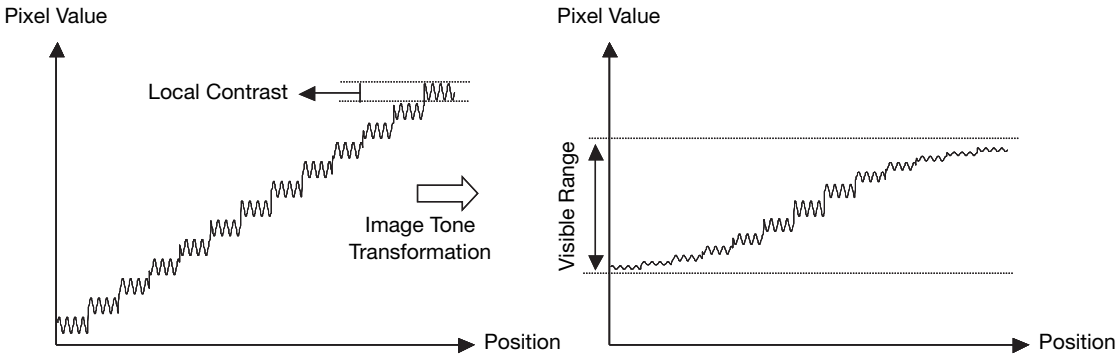


Figure 5.8. Alteration of local contrast

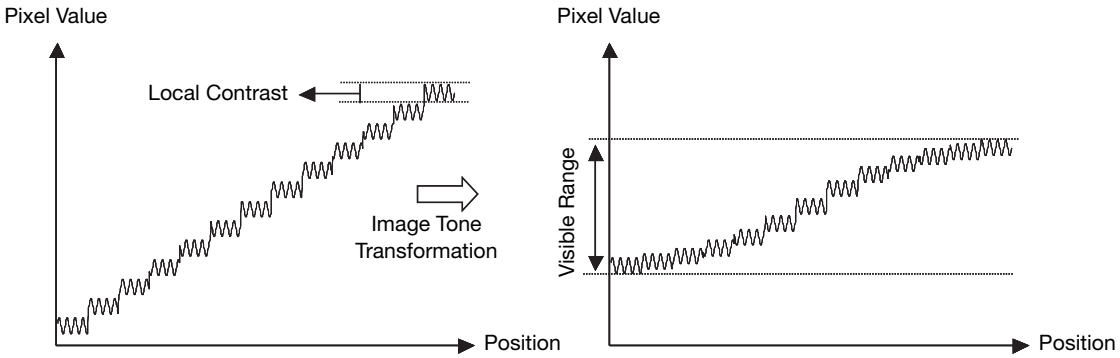


Figure 5.9. Compensation for local contrast

Figure 5.10 shows a schematic diagram of dynamic range adjustment. As mentioned, this adjustment compensates for local contrast relative to images after tone transformation. Local contrast compensation is performed by adding tone-transformed images to images resulting from compensation for local contrast, which are created by extracting main structural components in each frequency band from images produced by breaking down source images into multiple frequency bands.

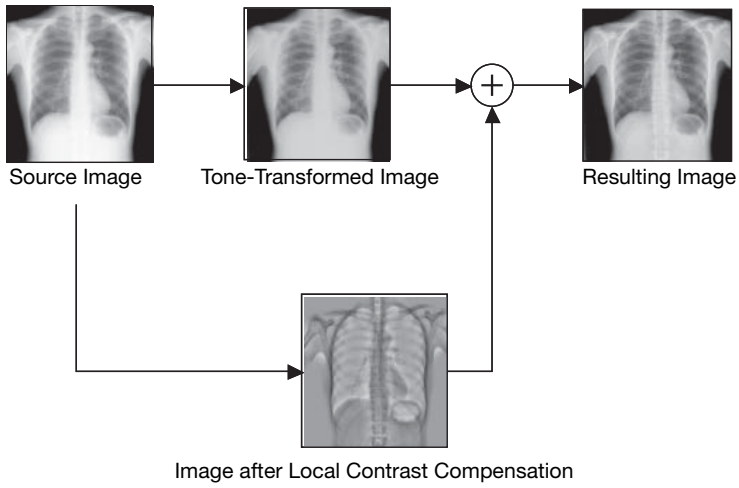


Figure 5.10. Schematic diagram of dynamic range adjustment

5.3.3 Image Enhancement

A variety of factors including X-ray and light scattering may cause blurriness in the raw image actually captured. Blurry images are made clearer and easier to see through image enhancement. A schematic diagram of enhancement is shown in Figure 5.11. After source images are broken down into multiple frequency bands, enhanced images are produced by extracting structures for enhancement in each frequency band. Image enhancement is then performed by adding enhanced images to source images.

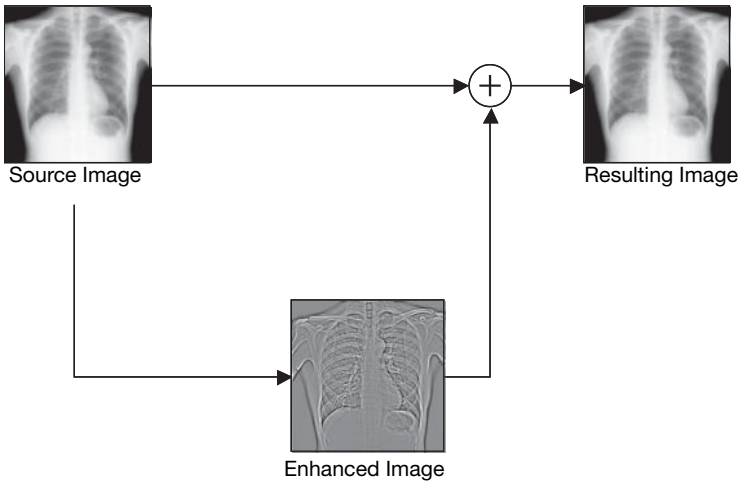


Figure 5.11. Schematic diagram of image enhancement

In enhancement, edges and local contrast are emphasized by changing the structures subject to enhancement. To enhance edges, the edges of the structures are emphasized by generating overshoot and undershoot along edges, as is shown in Figure 5.12. Local contrast is enhanced by amplifying local differences between structures, as shown in Figure 5.13.

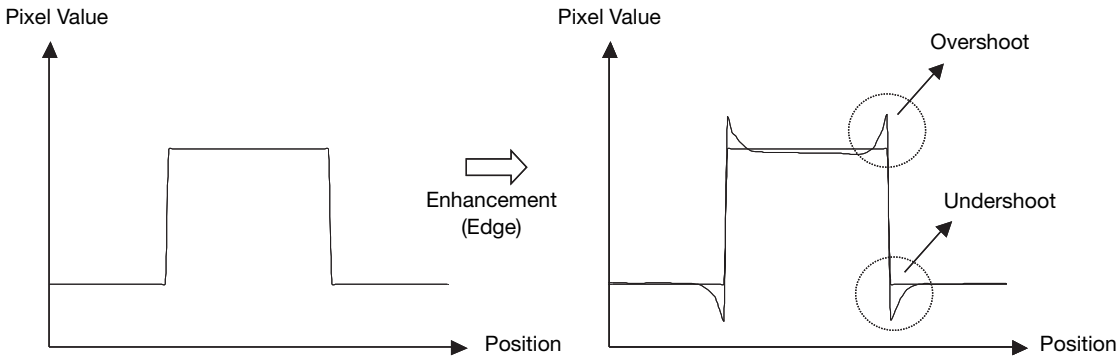


Figure 5.12. Schematic diagram of edge enhancement

Continued

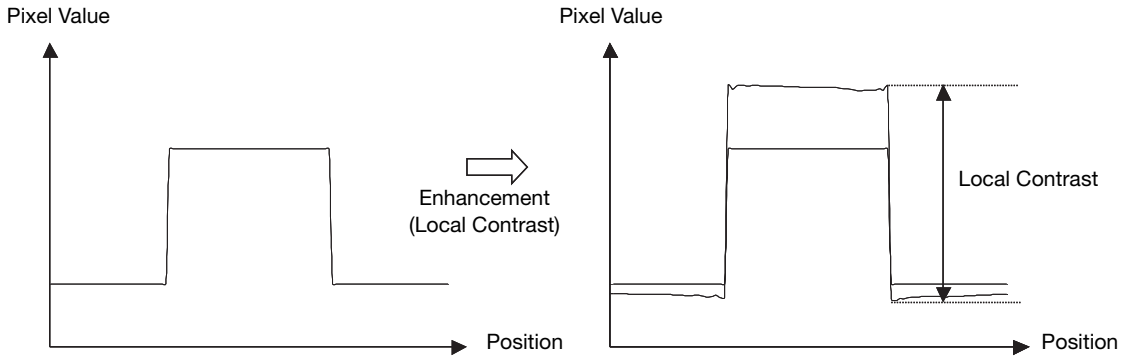


Figure 5.13. Schematic diagram of local contrast enhancement

5.3.4 Noise Reduction

The raw image captured may also be affected by system noise, X-ray quantum noise, and various other types of noise superimposed onto the images. In this case, noise and image graininess is reduced through noise reduction. A schematic diagram of noise reduction is shown in Figure 5.14. Here, a noise image is created by extracting the noise superimposed in each frequency band from images obtained by breaking down source images into multiple frequency bands. The noise image is subtracted from source images, for adaptive noise reduction according to the X-ray dose.

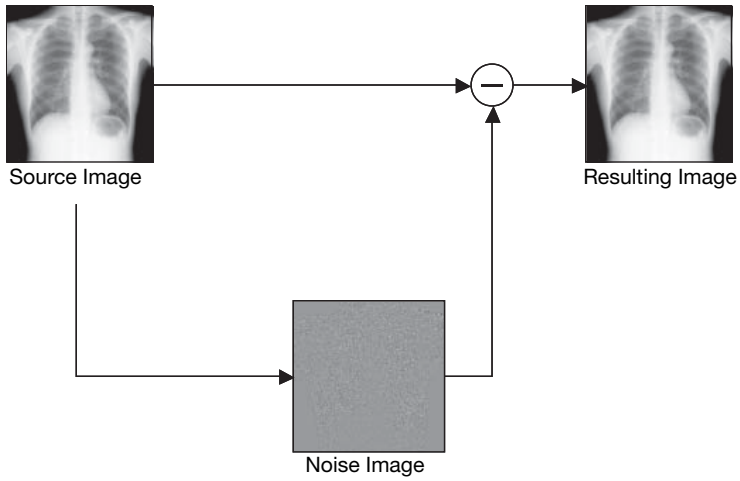
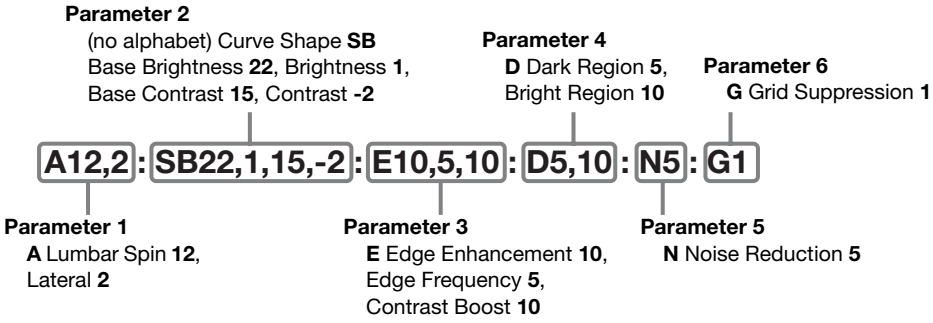


Figure 5.14. Schematic diagram of noise reduction

6 Printing IP Parameter Values on printed images

If the IP Parameter option is selected on the Film Annotation tab (see 2.5.3), the values for image processing parameters that are applied to the image will be printed on the film output in the following format.
Parameters are segmented into six groups by colons, and they consist of group or option identifying alphabets or numbers, and parameter values.



For details on the meaning of the printed values, see the table below.

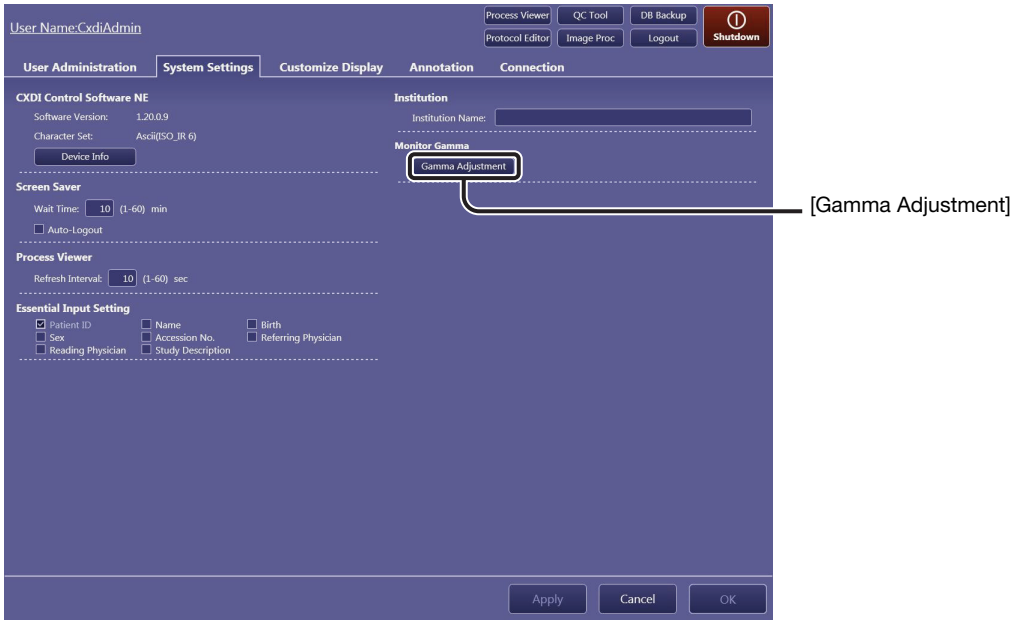
Continued

Group	Alphabet	Corresponding Image Processing Parameter	Indication
Parameter 1	A	Anatomical Part	0: Unknown 1: Skull 2: Ear 3: Nose Sinus 4: Nose 5: Mandible 6: Chest 7: Child Chest 8: Infant Chest 9: Abdomen 10: Cervical Spine 11: Thoracic Spine 12: Lumbar Spine 13: Clavicle 14: Shoulder 15: Scapula 16: Rib 17: Sternum 18: Pelvis 19: Sacrum 20: Ilium 21: Coccyx 22: Pubis 23: Humerus 24: Elbow 25: Forearm 26: Wrist 27: Hand 28: Hip Joint 29: Femur 30: Knee 31: Leg 32: Ankle 33: Foot 34: Upper Gastrointestinal 35: Lower Gastrointestinal 36: Hepato Billiary Pancreatic 37: Urinary 38: Myelo 100: Unknown (Stitch) 101: Whole Spine 102: Full leg
		Direction	0: Other 1: Front 2: Lateral

Group	Alphabet	Corresponding Image Processing Parameter	Indication
Parameter 2	None	Curve Shape	SA/SB/SC/LN
		Base Brightness	When the Auto option is selected for Brightness Adjustment, a value between 1 and 29 will be printed. When the REX option is selected for Brightness Adjustment, “*” will be printed.
		Brightness	-10 to 10
		Base Contrast	1 to 29
		Contrast	-10 to 10
Parameter 3	E	Enhancement	When the Edge Enhancement check box is selected, values for Edge Enhancement, Edge Frequency, and Contrast Boost will be printed. When the Edge Enhancement check box is not selected, “*” will be printed.
		Edge Enhancement	0 to 20
		Edge Frequency	1 to 7
		Contrast Boost	0 to 20
Parameter 4	D	Dark Region	When the Dark Region check box is selected, a Dark Region value (1 to 20) will be printed. When the Dark Region check box is not selected, “*” will be printed.
		Bright Region	When the Bright Region check box is selected, a Bright Region value (1 to 20) will be printed. When the Bright Region check box is not selected, “*” will be printed.
Parameter 5	N	Noise Reduction	When the Noise Reduction check box is selected, a Noise Reduction value (1 to 10) will be printed. When the Noise Reduction check box is not selected, “*” will be printed.
Parameter 6	G	Grid Suppression	When the Grid Suppression check box is selected, 1 will be printed. When the Grid Suppression check box is not selected, “*” will be printed.

7 Monitor Gamma Adjustment

If [Gamma Adjustment] appears on the [System Settings] tab, users can adjust the monitor gamma and save the adjustment result.



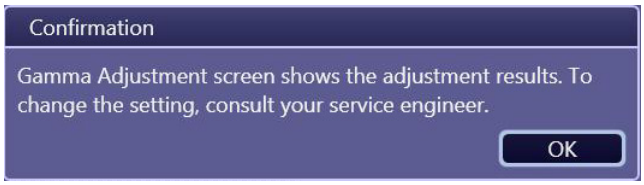
[System Settings] tab

1 Start monitor gamma adjustment.

Click [Gamma Adjustment].

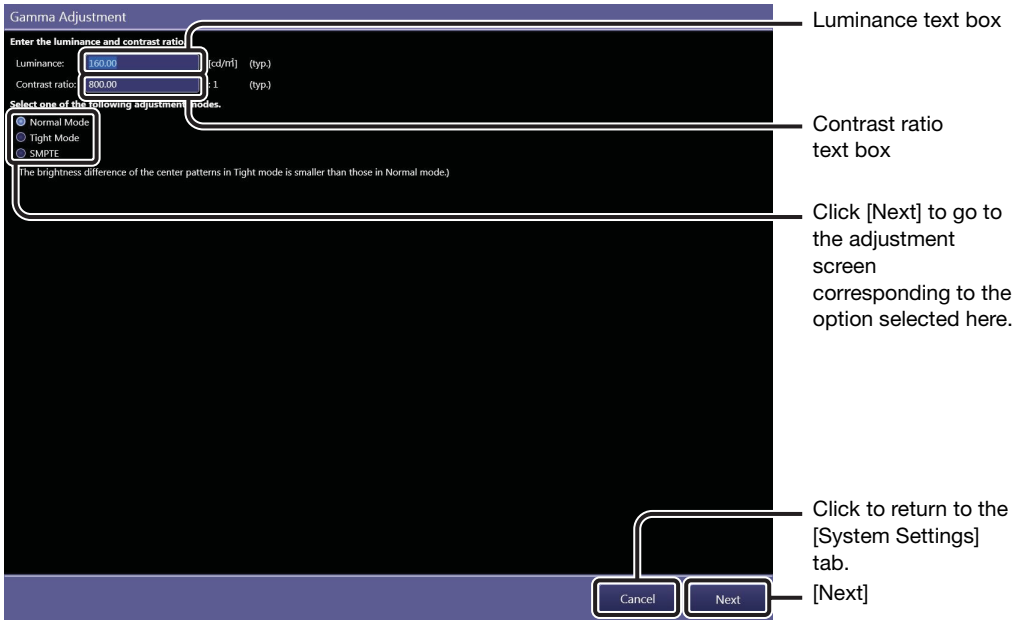
If a confirmation dialog box appears

Click [OK] and go to step 2. In such cases, users can confirm the adjustment results but cannot save the result. If there is a 0.4 or greater difference in the monitor gamma value before and after the adjustment, the adjustment result should be saved. Consult a service engineer for details.



If the value entry screen appears

Enter values in the Luminance and Contrast ratio text box (both values may be found in a catalog or user's manual for the monitor display), click [Next], and go to step 2. In such cases, users can adjust the monitor gamma and can save the adjustment result.



Value entry screen

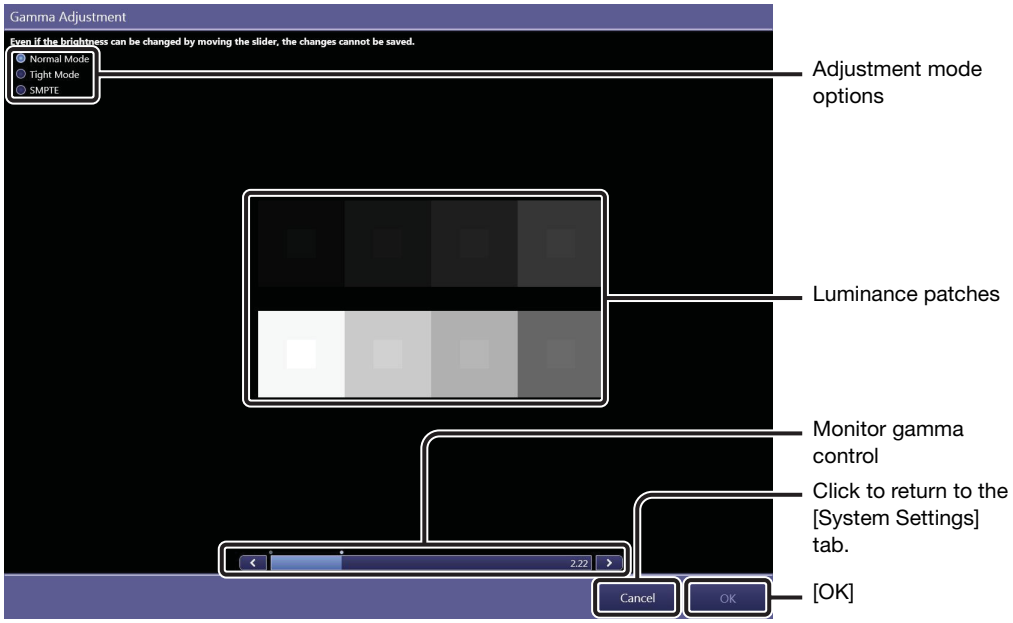
Continued

2 Adjust the monitor gamma using luminance patches.

NOTE: Eight different luminance patches have a square at their center whose brightness can be adjusted by the use of the monitor gamma control. Adjust the monitor gamma so that all the eight squares inside each of the luminance patches are clearly and equally defined.

Point the monitor gamma control and rotate the scroll wheel on the mouse or click the arrows of the control.
To brighten the center squares of the luminance patches, move the slider to the right.
To darken the center squares of the luminance patches, move the slider to the left.

NOTE: It is recommended to lower the monitor gamma value if adjustment is performed in a darker room. On the other hand, raise the monitor gamma value if adjustment is performed in a brighter room.



Normal mode screen

NOTE: While the screens for Normal Mode and Tight Mode appear almost the same, lower contrast around the border of the center square of the luminance patch in tight mode is suited to fine-adjust the monitor gamma.

3 Confirm the adjustment result using the SMPTE test pattern.

Select the SMPTE mode option from among the adjustment mode options. See step 2 in 2.3.2 for details on confirmation method.

NOTE: If required, monitor gamma can also be adjusted in this mode using the monitor gamma control.

4 End monitor gamma adjustment.

Click [OK]. The adjustment result is saved and the screen will return to the [System Settings] tab.

NOTE: If a confirmation dialog box appears in step 1, [OK] will be disabled and the adjustment results cannot be saved. In such cases, click [Cancel] to return to the [System Settings] tab, and consult your service engineer.

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