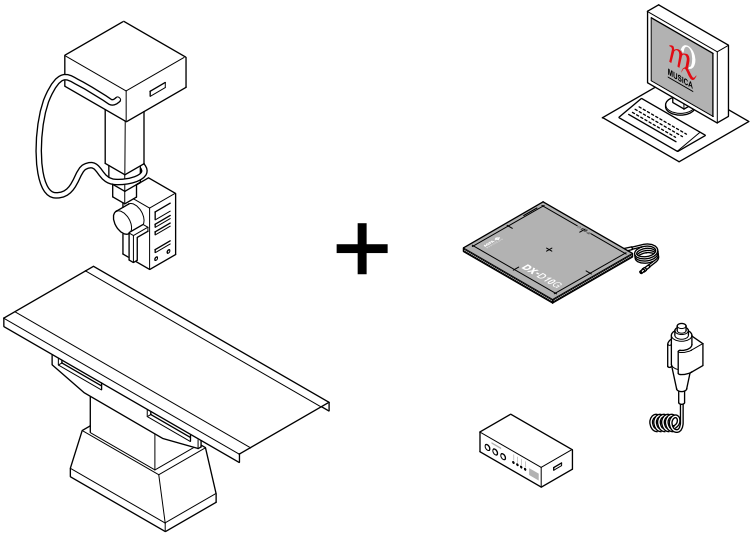
DR Retrofit Solution

5400/526

User Manual



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Legal Notice

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UK RP Agfa HealthCare UK Limited, 6-9 The Square, Stockley Park, Uxbridge, Middlesex UB11 1FW, UK

Agfa NV, Septestraat 27, 2640 Mortsel - Belgium

For more information on Agfa products, please visit medimg.agfa.com.

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Introduction to this Manual

Scope of this Manual

This manual contains information for safe and effective operation of the DR Retrofit Solution, further referred to as the system.

Warnings, Cautions, Instructions and Notes

The following samples show how warnings, cautions, instructions and notes appear in this document. The text explains their intended use.

Warnings are directions which, if they are not followed, can cause fatal or serious injuries to a user, engineer, patient or any other person or can lead to a mistreatment.

Cautions are directions which, if they are not followed, can cause damage to the equipment described in this manual or any other equipment or goods and can cause environmental pollution.

This sign is typically used in combination with the warning sign when providing a specific instruction. If it is followed exactly, it should avoid the subject of the warning.

Note Notes provide advice and highlight unusual points. A note is not intended as an instruction.

Disclaimer

Agfa assumes no liability for use of this document if any unauthorized changes to the content or format have been made.

Every care has been taken to ensure the accuracy of the information in this document. However, Agfa assumes no responsibility or liability for errors, inaccuracies or omissions that may appear in this document. To improve reliability, function or design Agfa reserves the right to change the product without further notice. This manual is provided without warranty of any kind, implied or expressed, including, but not limited to, the implied warranties of merchantability and fitness for a particular purpose.

Note In the United States, Federal law restricts this device on order of a physician for prescription use only.

Introduction

Intended Use

The DR Retrofit Solution is indicated for use in general projection radiographic applications to capture for display diagnostic quality radiographic images of human anatomy for adult, pediatric and neonatal examinations. The DR Retrofit Solution converts the screen-film or CR system into a DR system.

The DR Retrofit Solution is not indicated for use in mammography.

Intended User

This manual is written for trained users of Agfa products. Users are considered as the persons who actually handle the equipment as well as the persons having authority over the equipment. Before attempting to work with this equipment, the user must read, understand, note and strictly observe all warnings, cautions and safety markings on the equipment.

Configuration

The DR Retrofit Solution consists of the following components:

- DR Detector
- MUSICA Acquisition Workstation
- DR Generator Sync Box (optional)

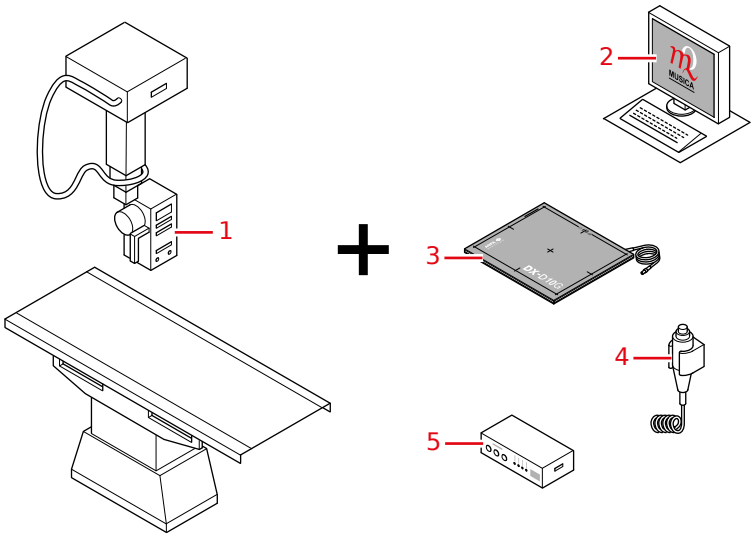
The DR Retrofit Solution supports two levels of integration with the X-ray system.

1. Integration of the exposure signal.
2. Integration of X-ray exposure parameters.

The DR Generator Sync Box synchronizes the exposure signal between the DR detector, the MUSICA Acquisition Workstation and the generator.

The Software Console is available on the MUSICA Acquisition Workstation and synchronizes the X-ray exposure parameters between the MUSICA Acquisition Workstation and the generator.

Note Integration of X-ray exposure parameters is only supported on specific types of X-ray systems. Contact your local service representative for more information about the supported X-ray systems.



1. X-ray system
2. MUSICA Acquisition Workstation with NX application and DR Software Console or DR Detector Switch
3. DR Detector
4. Replacement exposure button (optional)
5. DR Generator Sync Box (optional)

Options and Accessories

The delivery contains a set of labels. When using multiple DR Detectors, on the labels a nickname is written to identify the DR Detector. An identical label is attached to the bucky of the X-ray system to identify the dedicated workspace of each DR Detector.

Operation Controls

The main operation controls are:

- Power switch
- Exposure button
- DR Detector Switch on the MUSICA Acquisition Workstation

The exposure button of the original system should be disabled.

- Exposure button on page 11
- DR Software Console on page 12
- DR Detector Switch on page 13

Exposure button

Preparing for exposure

Press the exposure button down to the first pressure point and hold it for approximately 0.5 s to 2 s.

The X-ray tube is prepared for performing an exposure.

Caution: Wear of X-ray tube due to prolonged preparing of the X-ray tube.

Starting the exposure

Before starting the exposure:

1. Check if the exposure settings displayed on the console are suitable for the exposure.
2. Check the Ready for Exposure status.

Press the exposure button down fully and keep it pressed until the exposure has ended.

The radiation indicator on the control console lights up and a signal sounds to indicate the exposure.

Caution: Releasing the exposure button ends the exposure immediately and the image can be underexposed.

DR Software Console

The DR Software Console is available to support X-ray exposure parameter control on the MUSICA Acquisition Workstation. It is displayed on the MUSICA Acquisition Workstation next to the NX application.

The DR Software Console is used to control the X-ray exposure settings.

The DR Software Console contains the DR Detector Switch.

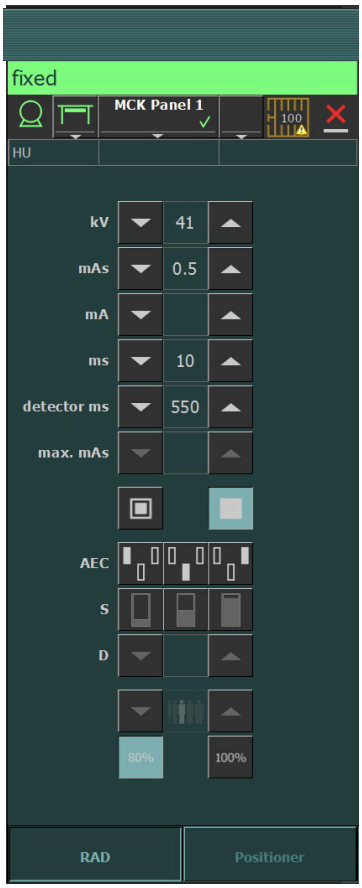


Figure 1: DR Software Console

Related information

Software Console on page 32

DR Detector Switch

The DR Detector Switch is available in the title bar of the NX application or in the device status frame of the DR Software Console.

The DR Detector Switch shows which DR Detector is active and shows its status. The DR Detector Switch can be used to activate another DR Detector.

Figure 2: DR Detector Switch

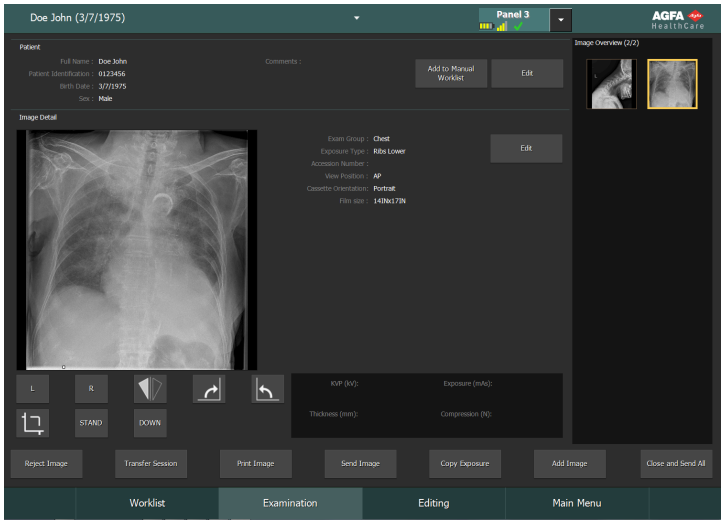


Figure 3: DR Detector Switch in the title bar of the NX application

DR Detector Status

Battery status icon				
Meaning	Full	Medium	Low	Empty

Connection status icon (wifi/wired)				
Meaning	Good	Low	Bad	Wired DR Detector

Panel status icon		(blinking)	(blinking)		
Meaning	Ready	Initializing exposure	Starting up	Error	Sleep

System Documentation

The DR Retrofit user documentation consists of

- MUSICA Acquisition Workstation User Documentation CD (digital media)
- User documentation for the supported DR Detectors (digital media)

Depending on the configuration, a Generator Sync Box is part of the configuration.

- DR Generator Sync Box, DR Retrofit Solution User Documentation CD (digital media)

Training

The user must have received adequate training on the safe and effective use of the system before attempting to work with it. Training requirements may vary from country to country. The user must make sure that training is received in accordance with local laws or regulations that have the force of law. Your local Agfa or dealer representative can provide further information on training.

The user must note the following information in the system documentation:

- Intended Use.
- Intended User.
- Safety Directions.

Product Complaints

Any health care professional (for example a customer or a user) who has any complaints or has experienced any dissatisfaction with the quality, durability, reliability, safety, effectiveness, or performance of this product must notify Agfa.

For a patient/user/third party in the European Union and in countries with identical regulatory regimes (Regulation 2017/745/EU on Medical Devices); if, during the use of this device or as a result of its use, a serious incident has occurred, please report it to the manufacturer and/or its authorised representative and to your national authority.

Contact address:

Agfa Service Support - local support addresses and phone numbers are listed on www.agfa.com

Agfa - Septestraat 27, 2640 Mortsel, Belgium

Agfa - Fax +32 3 444 7094

Compatibility

The system must only be used in combination with other equipment or components if these are expressly recognized by Agfa as compatible. A list of such equipment and components is available from Agfa service on request.

Changes or additions to the equipment must only be carried out by persons authorized to do so by Agfa. Such changes must comply with best engineering practice and all applicable laws and regulations that have the force of law within the jurisdiction of the hospital.

Compliance

General

- The product has been designed in accordance with Regulation (EU) 2017/745 on medical devices (MDR)

Installation

Installation and configuration is performed by an Agfa trained and authorized service engineer. Contact your local support organization for more information.

On a configuration with multiple DR detectors of the same type, it is required to apply labeling to the DR detector containing a unique nickname for each DR detector. The nicknames must be configured on the MUSICA Acquisition Workstation. The **DR Detector Switch** shows which DR detector is active and shows its status, by means of the nickname of the DR detector.

An identical label is attached to the bucky of the X-ray system to identify the dedicated workspace of each DR detector.

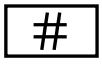
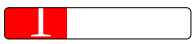
Messages

Under certain conditions the system shows a dialog box in the middle of the screen containing a message, or a message is displayed in a fixed message area in the user interface. This message informs the user that either a problem has occurred or that a requested action cannot be performed. The user must read these messages carefully. It will provide information on what to do from then on. This will be either performing an action to resolve the problem or to contact the service organization. Details on the contents of messages can be found in the service documentation which is available to service personnel.

Related information

Messages on the software console on page 34

Labels

	Date of manufacture
	Country of origin. The two character code on the actual label contains the country code defined in ISO 3166-1.
	Manufacturer
	Medical device
	Serial number
	Unique device identifier, in text format and in machine readable format
	Type and subtype number
	The most recent version of this document is available on http://www.agfahealthcare.com/global/en/library/index.jsp
	If the exposure button of the original system is visible, this label is attached. The user manual (this document) instructs not to use the exposure button of the original system.
	Writable label to identify and dedicate a DR Detector to an X-ray system bucky.

- Consulting the About box on page 21

Consulting the About box

1. Click **About the solution** in the Tools section of the **Main Menu** window on the MUSICA Acquisition Workstation.

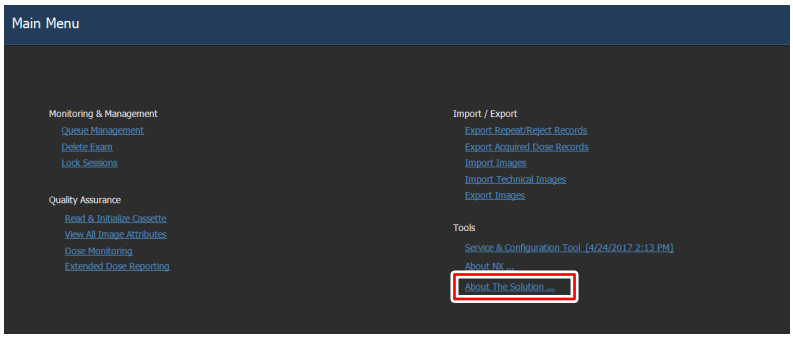


Figure 4: Main Menu window.

This will open the About box showing the current release and version details of the DR Retrofit solution.

Figure 5: DR Retrofit About box (Displayed data may be different).

Note Always quote these details when you discuss any issues with Agfa service personnel.

2. Click on the dialog to close it.

Patient data security

The user must ensure that the patients' legal requirements are met and that the security of the patient data is guarded.

The user must define who can access patient data in which situations.

The user must have a strategy available on what to do with patient data in case of a disaster.

• Requirements on the operating environment on page 22

Requirements on the operating environment

These operating environment requirements for information security and privacy (ISP), set in compliance with point 17(4) and 18(8) of Annex I of the EU Medical Device Regulation 2017/745, must be implemented and used in connection with the use of the Agfa medical device by the Customer (User). These are minimum requirements and designed to protect against unauthorised access that could hamper the device from functioning as intended.

Although Agfa has defined these ISP Operating Environment Requirements for implementation by the Customer, Agfa makes no warranties, expressed or implied regarding those ISP Operating Environment Requirements.

Agfa disclaims all liability if a security incident would occur despite the implementation of these ISP Operating Environment Requirements by the Customer.

Agfa reserves the right to revise these ISP Operating Environment Requirements and to make changes to them at any time. Possible revisions of the ISP Operating Environment Requirements will only be available in an electronic form, on request, via our website, by using the user documentation request form http://www.agfahealthcare.com/global/en/library/index.jsp.

The information presented herein is sensitive and is company confidential. Without written authority from Agfa, further distribution outside the company is not allowed.

- Perimeter firewalls shall be in place and appropriately configured in order to ensure that communications between medical devices and external resources are either denied or restricted to just the communications that are essential for the medical devices to properly function.
- Network Intrusion Detection/Prevention Systems (NIDS/NIPS) shall be in place at the perimeter and appropriately configured, in order to provide early warning of an attack attempt or successful compromise of a medical device as well as to attempt to prevent compromise of medical devices.
- A Network Time Protocol Server shall be configured in the medical devices in order to synchronize the time in the audit logs with the time on the NTP server.
- Medical devices shall be on an isolated network segment that restricts communication of the medical devices to the systems that are required for the device to function.
- Internal firewalls shall be put in place to improve upon network segmentation and to further restrict communications of medical devices to the systems (internal and external) that they need to interact with.
- Medical device configurations shall be backed up in a secure separate device.
- Security controls shall be put in place to ensure that physical access to medical devices is limited only to authorized individuals and that physical theft of the device is prohibited.
- An incident response plan detailing responsibilities and how to react and recover from incidents, shall be in place. Staff involved in the incident response plan shall be trained to respond appropriately and effectively.
- A formal user provisioning and de-provisioning process shall be implemented to enable the appropriate management of access rights to medical devices.
- Users shall be assigned unique accounts to medical devices.

- User access rights to medical devices shall be reviewed for appropriateness and corrected as needed, at regular intervals not exceeding once a year.

Maintenance

Complete maintenance schedules are available in the Agfa service documentation for consultation by an Agfa trained and authorized service engineer.

Maintenance of the DR Detector

The DR Detector requires regular calibration. Calibration instructions are described in the DR Detector Calibration Key User Manual (doc 0134).

Safety Directions

Warning: Safety is only guaranteed when an Agfa certified field service engineer has installed the product.

Warning: Improper changes, additions, maintenance or repair of the system can lead to personal injury, electrical shock and damage to the equipment. Safety is only guaranteed when changes, additions, maintenance or repairs are carried out by an Agfa certified field service engineer. A non certified engineer performing a modification or service intervention on a medical device, acts on his own responsibility and makes the warranty void.

Warning: If the equipment is modified, appropriate inspection and testing is required to ensure continued safe use of the equipment.

Warning: Ionizing radiation can lead to radiation injuries if handled incorrectly. When radiation is applied, the required protective measures must be complied with.

Warning: The operator and end-user must take precautions to protect themselves against dangerous X-ray exposure when using the DR Detector or CR cassette in the X-ray beam path of an X-ray source.

Caution: The DR Detector or CR cassette are not intended to be used as a primary barrier to X-rays. The user is responsible for ensuring the safety of the operator, bystanders, and the subjects being radiographed.

Caution: Strictly observe all warnings, cautions, notes and safety markings within this document and on the product.

Caution: All Agfa medical products must be used by trained and qualified personnel.

Caution: Avoid unnecessary dose by checking before exposure if the DR Detector Switch displays the name of the DR Detector that is being used and if the status of the DR Detector is ready for exposure.

Warning: Avoid unnecessary dose by checking the workstation selection on the X-ray generator console before exposing.

Caution: Excessive ambient temperature may impact performance of DR Detectors and cause permanent damage to the equipment. Refer to the related user manual for environmental conditions for the DR detector. If ambient temperature and humidity is outside the specified range, do not operate the system or use air conditioning. Frost due to low temperatures can damage internal circuits. Warranty will be void if it is obvious that operating conditions are not met.

Getting started

Starting

1. Power on the DR detector.

   For detailed information about powering on the DR detector, refer to the DR detector user manual.
2. Start the MUSICA Acquisition Workstation.

   For detailed information about starting up the MUSICA Acquisition Workstation, refer to the MUSICA Acquisition Workstation User Manual, document 4420.

   The NX application and the software console are available on the MUSICA Acquisition Workstation workstation.
3. In a configuration with a Generator Sync Box, power on the Generator Sync Box.

Basic Workflow

This section describes the workflow which will be followed when using the system for acquiring radiographic images.

Step 1: retrieve the patient info

At the MUSICA Acquisition Workstation:

1. When a new patient comes in, define the patient info for the exam.
2. Start the exam.

If the workstation is connected to a second monitor that is positioned outside the operator room, make sure that the patient data is not exposed to unauthorized persons.

Step 2: select the exposure

In the operator room:

1. At the NX workstation, select the thumbnail for the exposure in the Image Overview pane of the Examination window.

   The selected DR Detector is activated.

   The DR Detector Switch shows which DR Detector is active and shows its status.

   - Red (flashing): starting up
   - Green (constant): ready for exposure
2. At the X-ray generator console or on the DR Software Console, select the exposure settings suitable for the exposure.

   On systems with integration of X-ray exposure parameters, the default X-Ray exposure parameters for the selected exposure are sent to the modality and displayed on the DR Software Console.

Step 3: prepare the exposure

In the examination room:

1. Position the DR Detector.

   When using the bucky, check that the identification labels on the DR Detector and on the bucky match. Do not use a DR Detector that is dedicated to another bucky.
2. Position the patient.

   Apply radiation protective measures for the patient if needed.
3. Check if the X-Ray system position is suitable for the exposure.
4. Position the X-Ray tube with respect to the DR Detector and the patient.
5. Set the correct distance between DR Detector and X-Ray tube.
6. Switch on the light on the collimator. Adapt collimation if required.

   Take care that the collimated area is not larger than the detector.

Warning: Monitor the patient position (hands, feet, fingers, etc.) with special care to avoid injury to the patient caused by unit movements. Patient hands must be kept away from mobile components of the unit. Intravenous tubing, catheters and other patient connected lines should be routed away from moving equipment.

Step 4: check the exposure settings

On the DR Detector Switch:

1. Check if the DR Detector Switch displays the name of the DR Detector that's being used
2. If a wrong DR Detector is displayed, select the right DR Detector by clicking the drop down arrow on the DR Detector Switch.
3. Check if the status of the DR Detector is ready for exposure.

On a DR Detector that has a status indicator:

Check if the status of the DR Detector is ready for exposure. If the status is not ready for exposure, the DR Detector cannot be used for making an exposure.

In the operator room at the X-ray generator console or on the DR Software Console:

1. Check if the exposure settings displayed on the console are suitable for the exposure.
2. Check the Ready for Exposure status.

Step 5: execute the exposure

In the operator room:

Press the exposure button to execute the exposure.

Make sure the generator is ready for exposure before you press the exposure button.

The radiation indicator on the control console lights up during exposure release.

Do not select another thumbnail until the preview image is visible in the active thumbnail.

In the operator room at the NX workstation:

- The image is acquired from the DR detector and displayed in the thumbnail.
- On systems with integration of X-ray exposure parameters, the actual X-Ray exposure parameters are sent back from the console to the NX workstation and are shown in the Image Detail pane.
- If collimation is applied, the image is automatically cropped at the collimation borders.

DAP values

The NX displays the DAP in cGy.cm². X-ray systems may use other units to display the DAP.

The NX stores and transmitts the DAP DICOM compliant units: dGy.cm².

Step 6: perform a quality control

At the MUSICA Acquisition Workstation:

1. Select the image on which quality control is to be performed.
2. Prepare the image for diagnosis by using e.g. L/R markers or annotations.
3. If the image is OK, send the image to a hardcopy printer and/or PACS (Picture Archiving and Communication System).

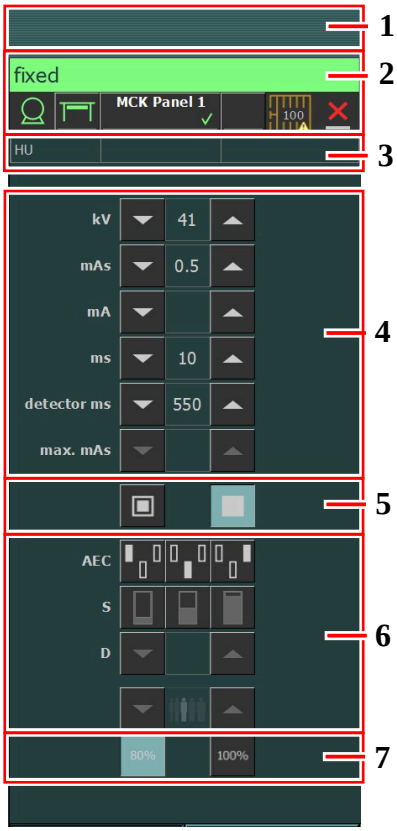
Stopping

1. In a configuration with a Generator Sync Box, switch off the DR Generator Sync Box.
2. Stop the MUSICA Acquisition Workstation.

   For detailed information about stopping the MUSICA Acquisition Workstation, refer to the the MUSICA Acquisition Workstation User Manual, document 4420.
3. Switch off the DR detector.

   For detailed information about switching off the DR detector, refer to the DR detector user manual.

Software Console



1. Title frame
2. Device status frame
3. Heat units and DAP value
4. Radiographic parameters
5. Focal spot indicator
6. AEC buttons
7. X-ray tube load

Figure 6: Operation controls

The graphical user interface consists of several panes and toolbars.

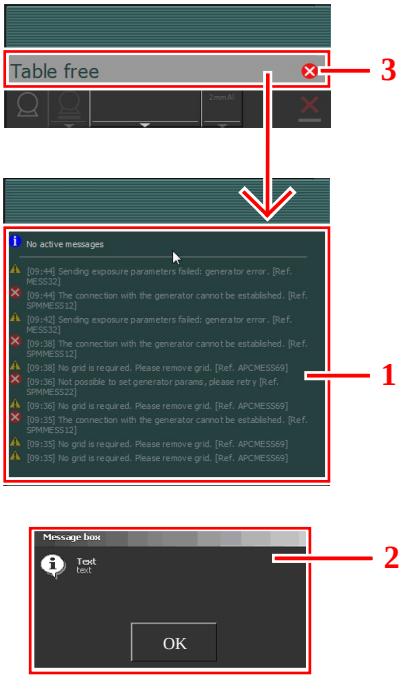
Note The contents of the graphical user interface depends on the configuration of the X-ray system. The screenshots in this chapter are examples.

Messages on the software console

Under certain conditions the software console will show a dialog box in the middle of the screen containing a message. This message will tell that either a problem has occurred or that a requested action cannot be performed.

The user must read these messages carefully. They will provide information on what to do from then on. This will be either performing an action to resolve the problem or to contact the Agfa service organization. If the message has no button, operation is blocked until the problem is resolved.

Other messages are displayed in the message frame in the software console. Click the message frame to view older messages.



1. Message frame
2. Dialog box
3. Device status frame

Figure 7: Example of error code

Depending on the configuration, the message screen can show a button to confirm the error.

Figure 8: Button to confirm errors

The Error Status frame displays warnings, error numbers and error descriptions. If the error has been resolved, the “CONT.” button becomes active. Click the active button to reset the error condition.

A click on the text in the Error Status frame produces a pop-up message that includes the whole text.

Error codes indicate the potential cause of a system failure. Error codes are shown on the software console. Correct the cause of the error and press the “CONT.” button until its indication disappears.

All these error codes will enable the operator to indirectly convey the possible source of error to service personnel. This may prevent the need for a service call or enable service personnel to anticipate corrective actions prior to arriving on site.

- Message types on page 35

Message types

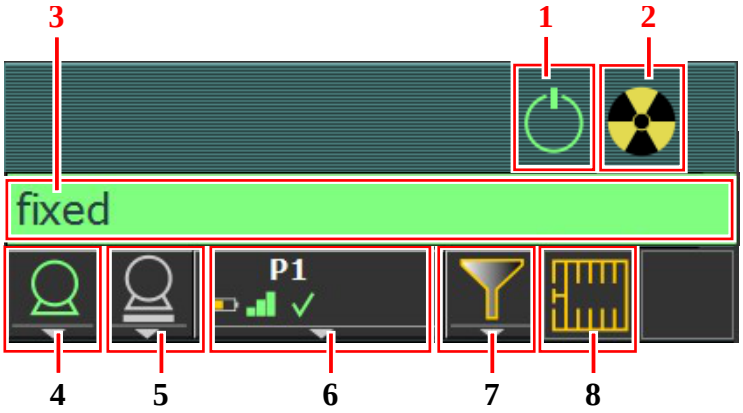
There are different types of messages. The icon in the device status frame shows the message type.

Type of message	Icon	User response
Information		Information messages help to understand the workflow status and do not affect safety or efficiency.
Warning		Warning messages indicate a difference between the actual status of the system and the status expected based on the configuration. Check the message frame for warnings and read the messages carefully. If there's a dialog box, click the button in the dialog box to continue operation.
Error		A dialog box is displayed. Read the message carefully. Click the button in the dialog box to continue operation.
Blocking error		A dialog box is displayed. Read the message carefully. It provides instructions to resolve the problem. Operation is blocked until the problem is resolved. The dialog box is closed automatically when the problem is resolved.

Messages that require no user response disappear automatically.

Warning or error messages may instruct to contact the Agfa service organization if the problem repeats, but by following the instructions in the message, the user can restore the operation of the system.

Device Status Frame



1. Preparation
2. X-Ray On
3. Ready for Exposure Status
4. X-Ray Tube
5. Modality Position
6. DR Detector Switch
7. Filter Status
8. Grid Status

Figure 9: Device status frame

- Preparation on page 37
- X-Ray On on page 38
- Ready For Exposure Status on page 39
- X-Ray Tube on page 40
- Modality Position on page 41
- Filter Status on page 43
- Anti-scatter grid Status on page 44
- Unknown status on page 45

Preparation

Table 1: Preparation

Icon	Description
	The X-ray tube is prepared.
	The examination room door is open.

Press the handswitch halfway (“Prep” position) to prepare the X-ray tube for exposure. The indicator will light up when the X-ray tube is prepared and there are no interlock failures or system faults.

After pressing this push-button, the following functions are activated:

- Anode rotation.
- Filament current switches from stand-by to the selected mA.

X-Ray On

Figure 10: X-ray on

After pressing the handswitch completely, the X-ray exposure is made. The indicator on the console will light up.

Ready For Exposure Status

Table 2: Exposure ready

Color	Description
	Green Exposure ready. Indicates that the selected technique is properly set and there are no interlock failures or system faults.
	Red Exposure not ready. Check the message frame for more information. It is not possible to perform an exposure due to an error. The status will turn to green when problem is solved.
	Gray Exposure not ready. No examination defined.

Beacon light indicator

A beacon light indicator can be connected to the NX workstation to indicate if the system is ready for taking the exposure.

Figure 11: Beacon light indicator

Table 3: Exposure ready

Light	Description
green	Ready for exposure.
off	Not ready for exposure.

X-Ray Tube

An icon indicates whether the X-ray system is ready for taking the exposure.

Table 4: Exposure ready

Icon	Description
	The color of the icon reflects the ready for exposure status.

If multiple tubes can be used, the number of the tube is displayed in the icon.

To select another tube, click the drop-down arrow and select the tube from the list.

Modality Position

The modality position is automatically selected, based on the selected exposure.

To modify the position on the modality where the exposure will be made, click the drop-down arrow and select the modality position from the list.

Table 5: Modality Position

Icon	Description
	The image is planned for the radiographic table using the DR detector.
	The image is planned for the radiographic wall stand using the DR detector.
	The image is planned for the DR detector inserted in the radiographic table bucky.
	The image is planned for the DR detector inserted in the radiographic wall stand.
	The image is planned for the radiographic table using the catapult bucky.
	The image is planned for the radiographic wall stand using the catapult bucky.
	The image is planned as a free exposure using CR.
	The image is planned as a free exposure using the DR detector.
	The image is planned as a free exposure.
	A manual X-ray exposure can be made. No image will be acquired on the NX workstation.

The type and configuration of the X-ray system defines which modality positions are available.

Depending on the configuration, the modality position icon can indicate the status of the DR detector.

Table 6: DR detector status

Icon	Status description
	Grey: the image is planned and the DR detector is in sleep mode.

Icon	Status description
	Green: the DR detector is ready to acquire the exposure on the selected acquisition system. Green flashing: the exposure has been performed and the acquisition is ongoing.
	Red: the DR detector is out of order. Red flashing: the selected acquisition system is starting up.

DR Detector Switch

The DR Detector Switch shows which DR Detector is active and shows its status. The DR Detector Switch can be used to activate another DR Detector. The DR Detector Switch can also be used to switch to CR for making an exposure on a cassette.

DR Detector Status

Battery status icon				
Meaning	Full	Medium	Low	Empty

Connection status icon (wifi/wired)				
Meaning	Good	Low	Bad	Wired DR Detector

DR detector status icon		 (blinking)			?
Meaning	Ready	Initializing exposure	Error	Sleep	One DR detector must be selected

DR Detector exposure synchronization

Automatic exposure detection icon	A	(empty)
Meaning	The active DR Detector is using automatic exposure detection	The active DR Detector is using X-ray generator synchronization

Note Depending on the installed software version, the icon may not be displayed.

Filter Status

Based on the selected exposure, the filter status indicates if a filter is required.

Table 7: Manual filter

(no icon)	Empty: no filter is required.
	Orange: a filter is required. Insert the filter manually.

Anti-scatter grid Status

Based on the selected exposure, the grid status indicates if a grid is required.

Table 8: Grid status

	Empty: no grid is required.
	Orange: a grid is required.

Unknown status

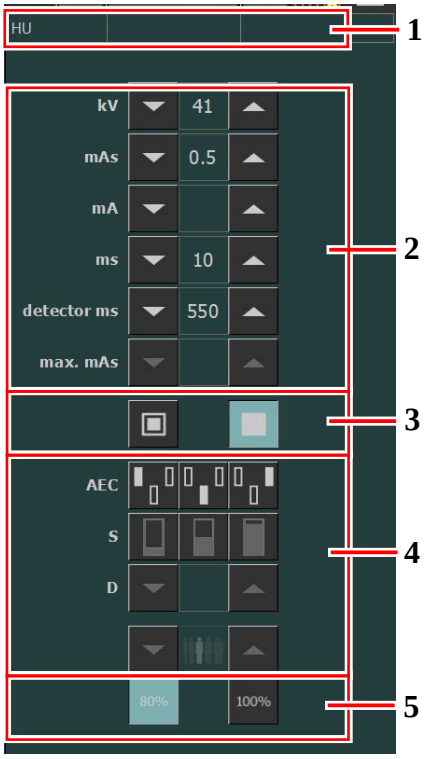
If a status is unknown, a question mark icon is displayed:

Figure 12: Unknown status

Depending on the component for which the unknown status is displayed, an action is required on the component or on the software to provide the system with the missing information.

E.g. to solve the unknown detector status, one DR detector must be selected.

Generator Controls



1. Heat units and DAP value
2. Radiographic parameters
3. Focal spot indicator
4. AEC buttons
5. X-ray tube load

Figure 13: Operation controls

To change a value, use the UP and DOWN arrows. The values increase or decrease step by step each time the corresponding button is touched, and change faster when either of them is touched continuously.

- Radiographic Parameters on page 47
- Focal Spot Indicator on page 48
- X-ray tube load on page 49
- Automatic Exposure Control (AEC) on page 50
- DAP Value on page 53
- Heat Units on page 54

Radiographic Parameters

You can set up following radiographic parameters:

- **kV (kVp)**: shows the radiographic kV value (X-ray tube voltage) selected for the exposure.
- **mAs** can show:
  - The radiographic mAs value selected for the exposure.
  - When an exposure is made, it shows the actual mAs at the end of the exposure.
- **mA**: shows the radiographic mA value (current) selected for the exposure.
- **ms** can show:
  - The time value (in milliseconds) selected for the exposure.
  - When an exposure is made, it shows the actual time at the end of the exposure.
- **Detector ms** shows the integration time of the DR detector. When operating the DR detector, the calculated exposure time (ms) or manual overrides can never exceed the integration time (detector ms) of the DR detector.
- **Max mAs** shows the maximum allowed mAs value for exposures using AEC. The highest allowed setting for max mAs depends on the mA setting and the detector ms setting. Not available in Free Exposure mode using DR or Free Exposure mode using CR.
- **Max ms** shows: the maximum exposure time allowed with DR detector operation (550 ms or 1000 ms). Based upon this, the generator must limit its maximum exposure time. X-rays outside the integration time slot of the DR detector are NOT allowed. This makes that with AEC, the exposure is terminated even if the target dose is not reached. Not available in Free Exposure mode using DR or Free Exposure mode using CR.

When using AEC, the exposure is terminated by the detector ms or max mAs settings, even if the target dose is not reached.

Related information

One Point Mode (1P) on page 56
Two Point Mode (2P) on page 57
Three Point Mode (3P) on page 58

Focal Spot Indicator

A focal spot indicator shows the selected focal spot of the X-ray tube: “Small” or “Large”.

Table 9: Focal Spot Indicator

	Small
	Large

If you change the focal spot, the kV and mAs are kept constant. When changing from a large to smaller focal spot, exposure time may increase as the mAs is kept constant but the mA may be reduced automatically according to the performance of the tube.

Note You can do the focal spot change whenever the present conditions of the X-ray tube allow it. The mA station set for the focal spot change is configured by the field engineer during the installation.

X-ray tube load

Table 10: X-ray tube load

80%	As a way to increase the tube life cycle, the power percentage of the tube is reduced to a 80% by default.
100%	If a specific technique requires 100% of the X-ray tube power, touch the 100% button.

Depending on the status of the heat units, the system may limit the X-ray tube load, even when the X-ray tube load is set to 100%.

Automatic Exposure Control (AEC)

Automatic Exposure Control (AEC) produces consistent detector dose regardless of the radiographic technique selected and of the patient size. The AEC module comprises the controls for the selection of the exposure detector fields (ionization chamber), S-value and density compensation.

To activate AEC mode, touch any of the three AEC field buttons.

To deactivate AEC mode, touch all the selected AEC field buttons until none of them is selected.

If the message “Wrong AEC Selection” is shown on the software console before the exposure, it means that the selected kVp value, AEC density and/or sensitivity set a technique that is out of the operative range with AEC and the next exposure will be inhibited. Change any parameter (kVp value, AEC density or sensitivity) in order to obtain a technique enabled for AEC.

Related information

One Point Mode (1P) on page 56

AEC field selection

Each button indicates its related physical location of the selected field in the AEC exposure detector, and you may select or deselect it by touching it.

Any combination of fields can be selected and the color of the buttons changes (highlighted) when active. The exposure is ended if any of the selected fields measures the AEC cut-off dose.

Table 11: AEC field selection

	Left field
	Middle field
	Right field

Sensitivity (S-value)

Each of these buttons allows adjustment of the AEC cut-off dose (low dose, middle dose and high dose: depending on configuration at installation time). Each time a button is selected (highlighted), the others are automatically deselected.

Table 12: Automatic filter

S	
	low dose
	middle dose
	high dose

Density

These buttons are used to adjust the AEC cut-off dose (and patient entrance dose accordingly).

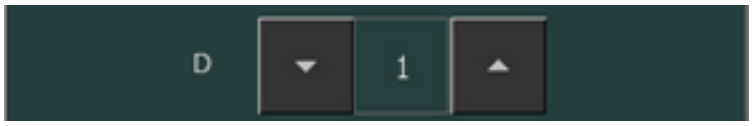


Figure 14: Density

Density can be increased and decreased in a range of -4 to +4. Each step increases or decreases the dose by a fixed ratio. When disabled, the density range number appears in black.

This table shows densities when each step gives a difference of 25% in dose. The exact value of the ratio depends on the generator type and configuration.

Table 13: Density scale variation over reference dose (0)

	Density
-4	rd x 0.41
-3	rd x 0.51
-2	rd x 0.64
-1	rd x 0.80
0	Reference dose (rd)
+1	rd x 1.25
+2	rd x 1.56
+3	rd x 1.95
+4	rd x 2.44

Patient Size

The size of the patient is classified in five categories: Extra Small, Small, Medium, Large and Extra Large.

Press one of the buttons to select the desired patient size.

In one point mode, the patient size affects the values of kV.

In two point mode, the patient size affects the values of mAs. Depending on the configuration, the patient size buttons can be disabled for two point mode.

The default values for adjusting kV and mAs are listed in the following tables.

Table 14: kV variation over patient size

	Patient size	**kV**
	Extra Small	normal kV * 0.9

	Patient size	**kV**
	Small	normal kV * 0.95
	Medium	normal kV
	Large	normal kV * 1.05
	Extra Large	normal kV * 1.1

Table 15: mAs variation over patient size

	Patient size	**mAs**
	Extra Small	normal mAs * 0.25
	Small	normal mAs * 0.5
	Medium	normal mAs
	Large	normal mAs * 2
	Extra Large	normal mAs * 4

AEC dose failure

In AEC mode the exposure is interrupted automatically, when there is not enough dose detected within a certain time (e.g. when the AEC chamber is defect or covered with lead foil) or when there is too much dose detected within a certain time (e.g. when no patient is in front of the AEC).

DAP Value

The DAP value shows the radiation value of the last exposure. The radiation measure is read as DAP value (Dose Area Product) in cGy*cm^2 (for example: DAP 12.22). This measurement unit is configurable.

A new exposure resets the DAP value.

Heat Units

The status of the heat units is displayed below the X-ray icon.

During exposures, the heat units are calculated and totalled. The heat units display shows the percentage of the thermal capacity of the X-ray tube that is used. For example, a display of “HU 0” (0%) would indicate that all the heat units capacity of the X-ray tube remains. A display of "HU 100" (100%) would indicate that maximum heat capacity of the X-ray tube is reached and no exposures can be made until the tube has cooled down.

Radiographic Working Modes

You can select following radiographic working modes according to the parameters to be controlled and the degree of automation:

- One Point Mode (1P), by selecting kV. The exposure is controlled by AEC.
- Two Point Mode (2P), by selecting kV and mAs. AEC is disabled.
- Three Point Mode (3P), by selecting kV, mA and exposure time independently. AEC is disabled.

- One Point Mode (1P) on page 56
- Two Point Mode (2P) on page 57
- Three Point Mode (3P) on page 58

One Point Mode (1P)

By selecting one of the AEC field buttons, the one point mode is activated.

The value of kV, mA, max ms, max mAs, the setting of focal spot, density, S-value, patient size and the selected AEC fields can be adjusted.

The value for mAs and ms is not available.

For accurate AEC operation it may be needed to lower the mA value in order to obtain longer exposure times. The smallest exposure step is 1 ms.

Disabling all AEC fields will switch to two point mode.

After exposure all values reflect the settings actually used by the generator.

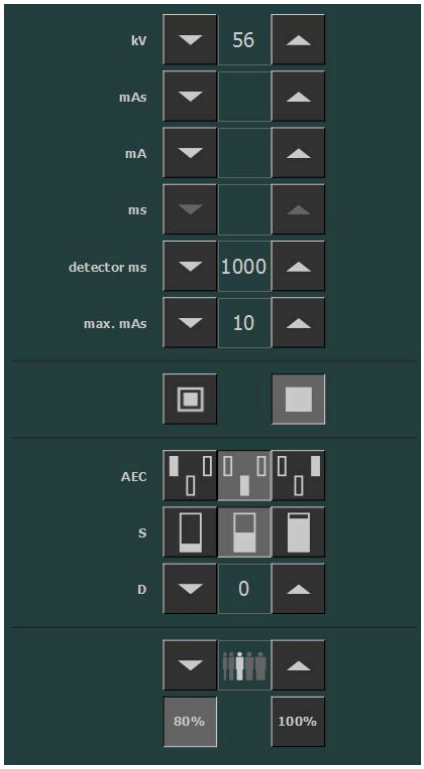


Figure 15: 1P working mode

Related information

Automatic Exposure Control (AEC) on page 50

Two Point Mode (2P)

The value of kV, mAs, max ms, the setting of focal spot and X-ray tube load can be adjusted.

The value of mA and ms are adjusted automatically to keep the mAs value constant, within the boundaries of generator or X-ray tube limitations.

The setting of density, S-value and patient size is not available.

By selecting one of the AEC field buttons, the one point mode is activated.

By adjusting the value of mA or ms, the three point mode is activated.

After exposure all values reflect the settings actually used by the generator.

Figure 16: 2P working mode

Related information

Radiographic Parameters on page 47

Three Point Mode (3P)

The value of kV, mA and ms can be adjusted. The other values are adjusted automatically to keep the mAs value constant.

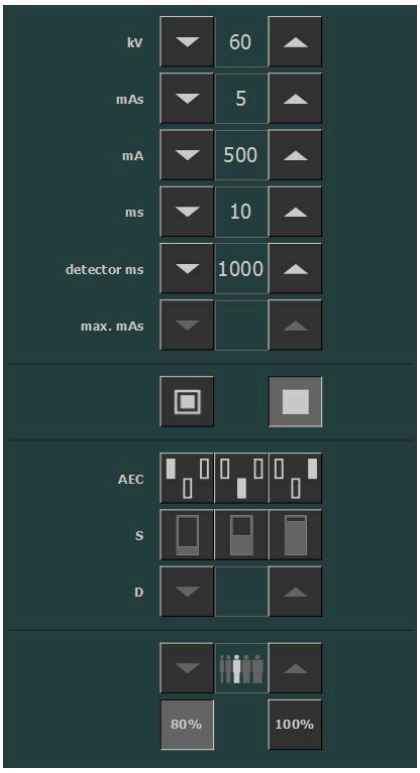


Figure 17: 3P working mode

Problem solving

Radiographic Parameter Limits

Switching between small focus and large focus may have a delay of a few seconds to enable the filament to warm up before switching.

The settings of kV and mAs or of mA and ms are defined by an algorithm. The highest mA setting is used for which the kV can be reached by the system and the exposure time is not lower than 1 ms or the mAs value is not lower than 0.5 mAs. When the kV setting is changed, the value of mA and ms are adjusted automatically to keep the mAs value constant, within the boundaries of generator or X-ray tube limitations.

If the radiographic parameters limits are reached, a value of a radiographic parameter cannot be increased or decreased, or another value can be automatically adjusted:

- **Radiographic Parameters Limit**. A maximum or minimum radiographic parameter limit is reached. The value cannot be increased or decreased.
- **Generator Power Limit**. The generator power limit (kV x mA) is reached. The value of the selected parameter cannot be increased. When increasing the value of the other parameter, the value of the first parameter will automatically be decreased to keep the mAs value constant.
- **Space Charge**. The space charge limit in the selected X-ray tube is reached by changing the kV or mA values. An information message is displayed.
- **Instantaneous Power**. The instantaneous power limit of the X-ray tube (ratings limit or the X-ray tube is momentarily overheated) is reached by selecting some technique. An information message is displayed.

Problem solving

- Radiographic Parameter Limits on page 59
- NX receives black or underexposed DR image due to repeatedly pushing the exposure button on page 60
- NX receives black DR image when X-ray system not ready for exposure on page 61
- Wrong modality position selected on page 62
- Exposure blocked after switching to CR on page 63
- Panel status remains in error on page 64

NX receives black or underexposed DR image due to repeatedly pushing the exposure button

Details	A black or underexposed image is arriving on the NX workstation.
Cause	The exposure button was pushed to the first pressure point and released without making an exposure. Directly afterwards, the exposure button was pushed down fully. The X-ray system may need a longer preparation time directly after an interrupted preparation cycle. This prevents the DR Detector to synchronize with the X-ray system. Depending on the X-ray system, two situations can occur: • The X-ray system will not make the exposure and the DR Detector acquires an image without exposure. • The X-ray system will start the exposure with a delay and the DR Detector cannot acquire the complete dose.
Brief Solution	To repeat the exposure workflow: **1.** On the NX workstation, click **Copy Exposure** to create a new thumbnail. **2.** Repeat the steps described in the Basic Workflow.

Related information

Basic Workflow on page 26

NX receives black DR image when X-ray system not ready for exposure

Details	A black image is arriving on the NX workstation.
Cause	On a system without DR Software Console, the exposure button was pushed while the X-ray system was not ready for exposure.
Brief Solution	To repeat the exposure workflow: **1.** On the NX workstation, click **Copy Exposure** to create a new thumbnail. **2.** Repeat the steps described in the Basic Workflow.

Related information

Basic Workflow on page 26

Wrong modality position selected

Details	The active modality position on the X-ray system does not match the selected modality position on the NX Workstation.
Cause	The modality position has been modified on the generator console. This situation applies only to Siemens generators.
Brief Solution	To use another modality position for a scheduled exposure: **1.** On the NX workstation, click **Edit** in the Image Detail Pane and select an exposure type for the correct modality position. **2.** Continue the exposure workflow.

Exposure blocked after switching to CR

Details	The exposure is set to CR using the DR Detector Switch. Exposure is blocked.
Cause	The X-ray generator console is not automatically set to **free exposure**. This situation applies only to Siemens generators.
Brief Solution	On the X-ray generator console, select **free exposure**. Perform the CR exposure.

Panel status remains in error

Details	The panel status remains in error.
Cause	The generator is in error state. This situation applies only to Siemens generators.
Brief Solution	Restart the generator.

Technical Data

DR Retrofit Solution Technical Data

Technical data is available in the relevant modules of the user documentation.

Fixed DR Detector Technical Data

Manufacturer	
Original manufacturer model name	4343R (part number 7965) 4343R (part number 7964)
Manufacturer DR Detector	Varex Imaging Corporation, 1678 So. Pioneer Rd, Salt Lake City, UT 84104, USA
Electrical connection	
Operating voltage	90-240 V (AC)
Mains fuse protection	6A
Mains frequency	47-63 Hz
Power consumption	
Maximum power consumption	65 W
Environmental conditions (during storage and transport)	
Temperature (ambient)	between -20 °C and +70 °C
Humidity (non condensing)	between 10 % and 90 %
Atmospheric pressure	between 500 hPa and 1100 hPa
Environmental conditions (during normal operation)	
Room temperature	between +15 °C and +35 °C
Humidity (non condensing)	between 30 % and 75 %
Atmospheric pressure	between 700 hPa and 1100 hPa
Warming-up time	
30 minutes	
Throughput	
Maximum number of image acquisitions	150 acquisitions per hour
End of Life	
Estimated product life (if regularly serviced and maintained according to Agfa instructions)	100000 RAD
Pixel Matrix	

Pixel size	139 µm (H,V)
Pixel matrix	3072 (H) x 3072 (V)
Active pixel matrix	3052 (H) x 3052 (V)
Fill factor	100 %
Detector type	Amorphous Silicon
Active area size	42,7 cm (H) x 42,7 cm (V)

	Partnumber 7965	Partnumber 7964
Maximum Linear Dose using RQA5	50 µGy	75 µGy
Minimum Modulation Transfer Function (MTF) using RQA5		
1 lp/mm	0.45	0.45
2 lp/mm	0.15	0.15
3 lp/mm	0.05	0.05
Typical Detective Quantum Efficiency (DQE) using RQA5		
	(at 2.1 µGy dose level)	(at 4.0 µGy dose level)
0 lp/mm	0.59	0.25
1 lp/mm	0.41	0.20
2 lp/mm	0.23	0.10
3 lp/mm	0.11	0.03
3.6 lp/mm	0.06	0.01
Minimum Signal Noise Ratio for 1mR		
SNR	115:1	115:1
Conversion screen	CsI	GOS