E-2320 C

Installation & User Manual

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Copyright notice

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Table of Contents

Preface

Notice

Although every attempt has been made to achieve technical accuracy in this document, we assume no responsibility for errors that may be found. Our goal is to provide you with the most accurate and usable documentation possible; if you discover errors, please let us know.

The specifications of BarcoView products are subject to change without notice.

Trademarks

FCC notice (display)

This equipment has been tested and found to comply with the limits of a Class A digital device, pursuant to Part 15 of the FCC rules. These limits are designed to provide reasonable protection against harmful interference when the equipment is operated in a commercial environment. This equipment generates, uses and can radiate radio frequency energy and, if not installed and used in accordance with the instruction manual, may cause harmful interference to radio communications. Operation of this equipment in a residential area is likely to cause harmful interference in which case the user will be required to correct the interference at his own expense.

Canadian notice

This Class A digital apparatus complies with Canadian ICES-003.

Cet appareil numérique de la Classe A est conforme à la norme NMB-003 du Canada.

Disposal Information

The lamps inside the display contain mercury. Do not throw the display in the trash. Dispose of it as required by local ordinances or regulations.

Safety Instructions

General Recommendations

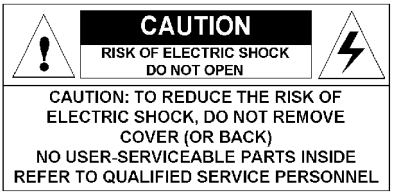
Read the safety and operating instructions before operating the display.

Retain safety and operating instructions for future reference.

Adhere to all warnings on the display and in the operating instructions manual.

Follow all instructions for operation and use.

Electrical shock



Type of protection (electrical):

Class I equipment

Degree of safety (flammable anesthetic mixture):

Equipment not suitable for use in the presence of a flammable anesthetic mixture with air or with oxygen or nitrous oxide.

Power connection

- Power requirements: The display must be powered using the 12 VDC power supply that is supplied with the display.
- The 12 VDC power supply must be powered by the AC mains voltage.
- Power cords:

Power cord with CEE 7 plug: The colors of the mains lead are colored in accordance with the following code: Green-and-yellow: Earth (safety earth), Blue: Neutral, Brown: Line

Power cord with ANSI 73.11 plug: The wires of the power cord are colored in accordance with the following code: Green/yellow: ground, White: neutral, Black: line (live)

- Do not overload wall outlets and extension cords as this may result in fire or electric shock.
- Mains lead protection (U.S.: Power cord): Power cords should be routed so that they are not likely to be walked upon or pinched by items placed upon or against them, paying particular attention to cords at plugs and receptacles.

Water and moisture

Never expose the display to rain or moisture.

Never use the display near water - e.g. near a bathtub, washbasin, swimming pool, kitchen sink, laundry tub or in a wet basement.

Ventilation

Do not cover or block the ventilation openings in the cover of the set. When installing the display in a cupboard or another closed location, heed the necessary space between the set and the sides of the cupboard.

Installation

Place the display on a flat, solid and stable surface that can bear the weight of at least 3 displays. If you use an unstable cart or stand, the display may fall, causing serious injury to a child or adult, and serious damage to the equipment.

More warnings in the Installation chapter.

Operating precautions

Continuous operation of the display with the same image may result in some image sticking on the LCD panel. Over 10 hours operation with the same image content is not recommended.

Switching on DPMS on display and PC and activating a good screen saver may decrease the risk of image sticking (image retention).

This apparatus conforms to:

CE (LVD 73/23/EEC), IEC 60950-1, UL 60950-1,
CAN/CSA C22.2 No. 60950-1 (c-UL), EN 60950-1 DEMKO,
CCC GB4943-1995

National Scandinavian Deviations for Cl. 1.7.2 :

Finland: "Laite on liitettävä suojamaadoituskoskettimilla varustettuun pistorasiaan"
Norway: "Apparatet må tilkoples jordet stikkontakt"
Sweden: "Apparaten skall anslutas till jordat uttag"

Explanation of symbols

Symbols on the display and / or power supply

On the display or power supply, you may find the following symbols:

Indicates the display is approved according to the CE regulations

Indicates the display is approved according to the UL regulations

Indicates the display is approved according to the c-UL regulations

Indicates the display is approved according to the DEMKO regulations

Indicates the display is approved according to the CCC regulations

Indicates the USB connectors on the display

Indicates this apparatus must not be thrown in the trash but must be recycled, according to the European WEEE (Waste Electrical and Electronic Equipment) directive

Symbols used throughout the manual:


Warning


Caution


Important notice or remark


Note


Hint, tip


Additional information

Introduction

Overview

Thank you for choosing Barco.

Single display or complete system?

This manual describes installation and usage of the display only. However, if you have purchased a complete system, the packaging contains the additional sources of information:

- display controller quick install card
- display controller manual on the driver CD-ROM

E-2320 C display

The E-2320 C is a 20.1-inch color LCD display with a native resolution of 1600 x 1200.

Its high-brightness, combined with image crispness and excellent viewing angle, makes it an ideal solution for a multitude of medical applications and environments.

Long-term stabilization

The display contains a Backlight Output Stabilization system (BLOS©), which continuously stabilizes the luminance output of the LCD's backlight. This improves the overall optical efficiency and provides long-term image confidence.

NioWatch

In Nio systems, the display comes standard with NioWatch, a user-friendly software tool that optimizes the LCD panel for DICOM-compliant viewing.

Power saving

The display is equipped with a power saving system. When left idle for a certain time, the computer connected to the display, will power down the display.

The power saving system can be switched on or off using the on-screen menus. Barco recommends to let the power saving system switched on to prevent image sticking.

Tilt & swivel base

The versatile tilt & swivel foot allows to use the display for viewing portrait or landscape image resolutions.

The user can easily change the panel height and viewing angle, allowing to use the display in the optimal viewing conditions.

Package contents

System package

In case you have purchased a complete system, the system contains one or more display boxes (see below) and a system accessory box containing the following items:

- Display controller(s)
- Display controller quick install card
- Driver CD-ROM containing drivers and display controller manual

Display box

Each display box includes one display and a display accessory box containing the following items:

- Calibration software CD-ROM containing NioWatch software and display manual
- Plastic cover of the tilt & swivel foot
- Power supply

- Digital video (DVI) cable (25-pins)
- Analog video (VGA) cable (15-pins)
- USB cable
- Two velcro strips to bind the cables
- European power cord
- UK power cord
- American power cord
- Chinese power cord
- This manual
- Quick install card

If some of the items are missing, please contact the reseller from whom you have purchased the unit.

Parts, controls and connectors

Front

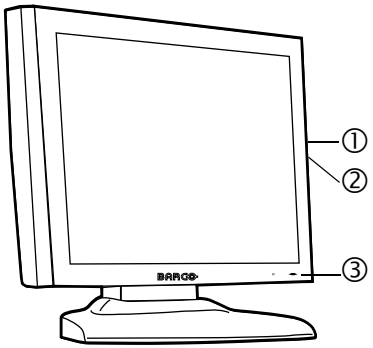


Figure 1

1. Control wheel

   The control wheel can be pressed like a push button and rotated like a knob.

   It allows to put the display in stand-by, navigate through the on-screen display (OSD) menus and change values in the OSD.

2. USB downstream port. See also item “6.” on page 17

3. Power LED

   The LED is **off** when the display is disconnected from the power. The LED is also off when the LED function is disabled in the on-screen display (OSD).

   The LED is **green** when the display is on (when enabled in the on-screen menus).

   The LED is **orange** when the display is in Stand-by power-saving mode.

Rear

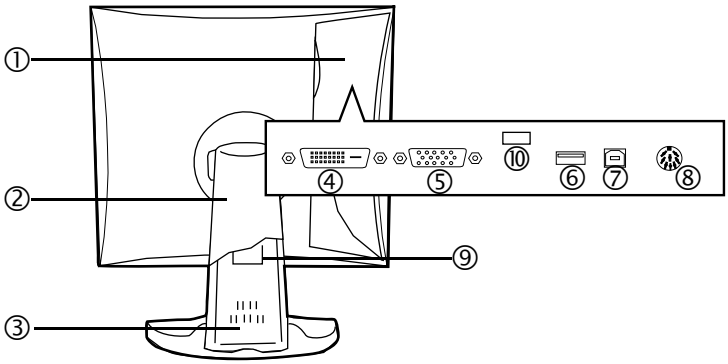


Figure 2

1. Connector compartment cover

   To get access to the connectors, remove the cover by pulling down the 2 clips at the top of the cover.

2. Tilt & swivel foot cover

   This cover is packed in a separate box when the display is shipped to the customer.

3. Tilt & swivel foot
4. DVI (digital) video input
5. D-Sub 15 (VGA) video input
6. USB downstream port

   USB 1.1 standard is supported.

   When the display is connected to the PC USB bus, you can connect USB devices, such as keyboard, mouse, digital camera, to this connector.

7. USB upstream port

   USB 1.1 standard is supported.

   Connect this connector to the PC USB bus if you wish to connect USB devices to the display's USB downstream port.

8. DC power input

   Connect the external power supply, delivered with the display, to this connector.

   Use supplied power supply only.

9. Tilt & swivel foot clip

   The display is shipped with this clip in the foot to protect the tilt & swivel mechanism during transport. After unpacking, you should remove this clip.

   Do not throw the clip away! Should the display have to be packed and shipped later, the clip must be applied to the foot again.

10. Slot for security cable (e.g., Kensington lock)

Installation

Precautions

- Keep your original packaging. It is designed for this display and is the ideal protection during transport.
- Avoid reflections in the flat panel to reduce eye strain.
- Place the display on a strong and stable table or desk.
- Keep the display away from heat sources and provide enough ventilation around the display.
- Do not use the display in direct sunlight.
- Do not scratch or apply pressure to the LCD panel. This may damage the panel permanently.

Display installation

After unpacking the display

Important:

In the factory, the height-positioning system in the display foot is blocked with a red clip to prevent damage during transportation.

Before installing the display, you must remove this clip.

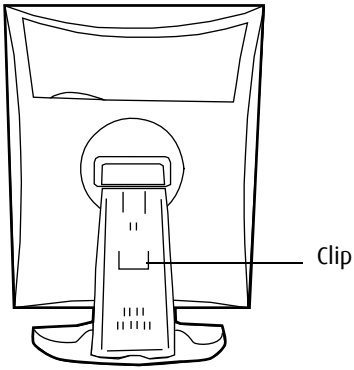


Figure 3

To remove the clip:

1. Position the display with its rear side facing you.
2. Pull the red clip out of the fixation holes in the foot.
3. Keep the clip in case the display needs to be shipped later.

Adjust the panel orientation

You can change the orientation of the panel at any time, but it is more convenient to select landscape or portrait orientation before connecting the cables.

To change the panel orientation:

1. Stand at the front side of the panel and take the panel at both sides.

2. Very important: Tilt the panel before changing the orientation.

   Should you change the panel orientation without tilting it first, you might irreversibly damage the tilt & swivel mechanism.

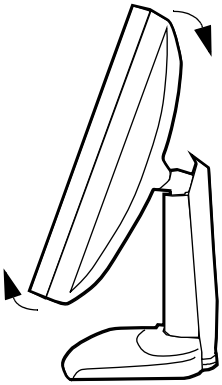


Figure 4

3. To change from landscape to portrait, turn the panel clockwise.

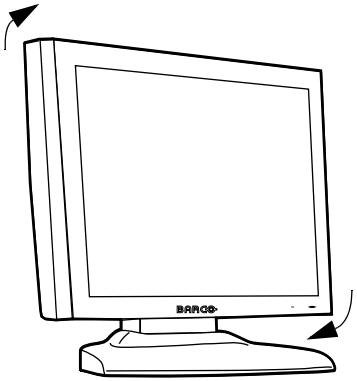


Figure 5

4. To change from portrait to landscape, turn the panel counterclockwise.

Power connection

To connect the power:

1. To get access to the connectors, remove the connector compartment cover by pulling down the 2 clips at the top of the cover.
2. Connect the output of the supplied 12V DC power supply to the DC input of the display.

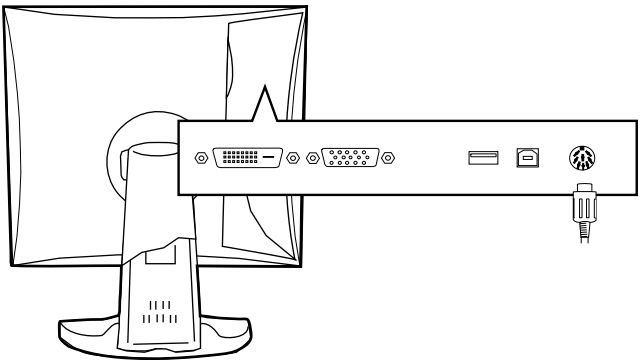


Figure 6

3. Connect one end of the proper power cable to the AC input of the 12V DC power supply.

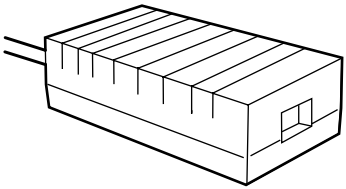


Figure 7

4. Connect the other end of the power cord to a **grounded** power outlet.

   We recommend to use an additional surge protector between the power supply unit and the power outlet to protect the equipment against sudden power variations.

Video connection

The display has 2 different video inputs: Digital (DVI) and VGA (Sub-D 15).

You can connect one or more of these inputs. The best and easiest connection is DVI.

If several video inputs are connected (meaning the display is connected to different video controller boards) you can switch inputs by using the display's on-screen display.

Connecting DVI signals: One display:

1. Connect one end of the DVI cable to the DVI input of the display.
2. Connect the other end of the DVI cable to the DVI connector of the display controller. If this board has 2 video heads (2 video outputs), connect to Vid 1 (Head A).

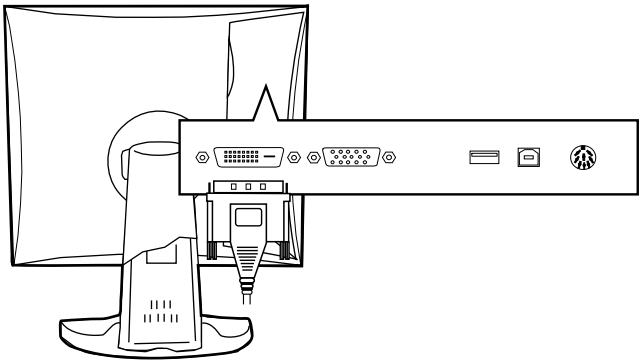


Figure 8

Connecting DVI signals: Two displays:

1. Connect the left display (when looking at the front side) to Vid 1 as described above.
2. Connect the second display to Vid 2 (Head B).

Connecting analog video

Proceed as follows:

1. Connect one end of the VGA cable to the D15 input of the display.
2. Connect the other end of the VGA cable to the analog video output of your computer.

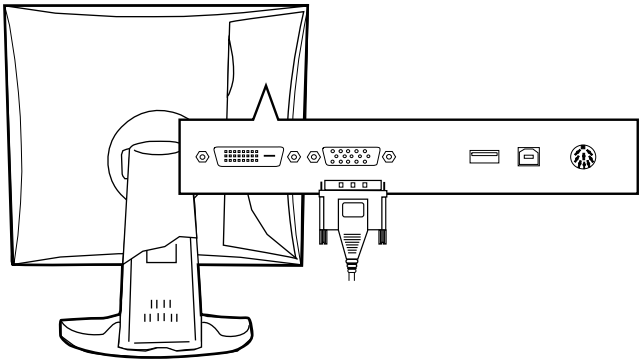


Figure 9

USB connection

If the display receives video from a Barco-supported display controller, it is not necessary to establish a USB connection to use the nioWatch software.

If this is not the case, you must connect the USB cables if you wish to use the nioWatch software.

Moreover, the USB connection allows you to use the display as USB hub, to which you can connect USB devices, such as a keyboard, mouse or digital camera.

To connect the USB cable:

1. Connect the display's USB upstream connector to the USB port of the PC by means of a USB cable.
2. Connect any USB device to any of the display's USB downstream connectors.

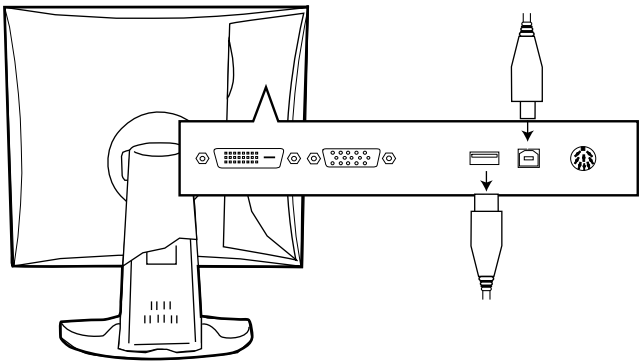


Figure 10

Cable routing

Routing the signal cables

- Bind the cables in the connector compartment together with the cable tie inside the connector compartment.

- Put the connector compartment cover back on the display. Pay attention that the signal cables are positioned under the bulge in the cover.
- Push the cables into the clips on the rear of the tilt & swivel foot.
- Bind the cables together above and under the foot, by means of the 2 velcro strips attached to the inside of the foot cover (packed inside the accessory box).
- At last, put the foot cover back in place.

To put the foot cover in place:

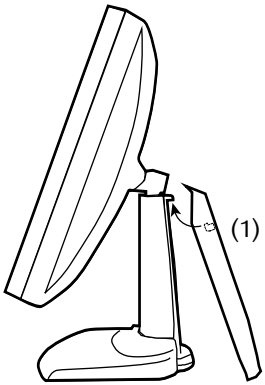


Figure 11

1. Push the upper side of the cover onto the foot, so that the hooks inside the cover are positioned right under the bulges at the rear of the foot.
2. Slide the cover upward while moving the lower side of the cover towards the foot.
3. Press the cover to the foot so that it makes a clicking sound.

Attaching the display to an arm

The panel, standard attached to the tilt & swivel foot, is compatible with the VESA 100 mm standard. So it can be used with an arm stand according to the VESA 100 mm standard.

Therefore, the tilt & swivel foot must be removed from the panel.

Important:

- Use an arm that is approved by VESA (according to the VESA 100 mm standard).
- Use an arm that can support a weight of at least 13 kg (28.66 lbs).

To attach the display to an arm stand:

1. Put the display face down on a clean and soft surface. Be careful not to damage the panel screen.
2. Remove the tilt & swivel foot cover.
3. Remove the small screw (A) fixing the small plastic cover on top of the foot. Next, remove the small cover itself.

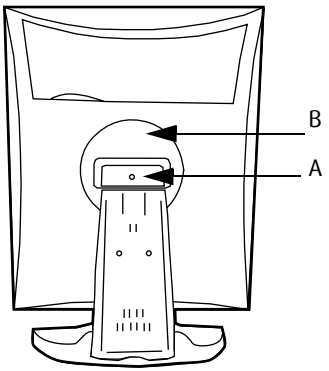
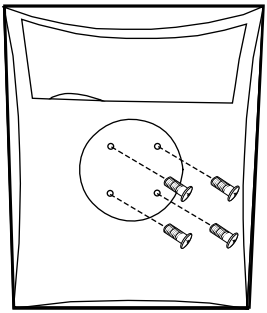


Figure 12: Display with tilt & swivel foot cover removed

4. Unscrew the 2 screws fixing the round plastic cover (B).
5. Lift up the round plastic cover.

6. Remove the four screws fixing the foot while supporting the foot.
7. Attach the arm stand **firmly** to the panel using 4 screws M4 x 8 mm.



4 screws M4 x 8mm

Figure 13

NioWatch installation

NioWatch installation

1. Insert your NioWatch CD into your computer's CD drive. If the NioWatch installation start screen doesn't appear within one minute, browse the contents of your NioWatch CD and double click on the file: **"Setup.exe"**.
2. Click **"Install Now"** on the start screen to begin the installation.

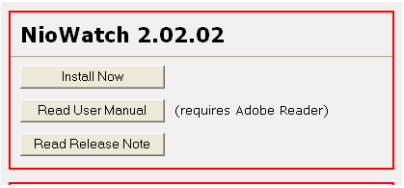


Figure 14: NioWatch installation start screen

3. Click **"Next"** on the Installshield Wizard welcome screen.

4. After reading the Software License Agreement on the next screen, click **"I accept..."** and **"Next"** to continue.
5. Enter your customer information and click **"Next"** to continue.
6. On the Setup Type screen, select **"Complete"** to install NioWatch in the default location, or **"Custom"** to select a different location. Click **"Next"** to continue.
7. In case you selected custom installation, you can now select a location to install NioWatch. Click **"Next"** to continue.
8. On the Ready to Install the Program screen, click **"Install"** to start the installation.

   While the wizard is installing NioWatch, it will display a Setup Status screen.
9. On the Installation Finished screen, check the appropriate selections and click **"Finish"** to complete the installation.

Operation

Display operation

Operating precautions

Continuous operation of the display with the same image may result in some image sticking on the LCD panel. Over 10 hours operation with the same image content is not recommended.

Switching on DPMS on display and PC and activating a good screen saver may decrease the risk of image sticking (image retention).

Stand-by switching

When the display is on and no on-screen display is visible, push the control wheel at the front for a few seconds to switch the display in stand-by. The LED turns orange.

When the display is in stand-by, push and hold the control wheel to switch it back on. The LED turns green.

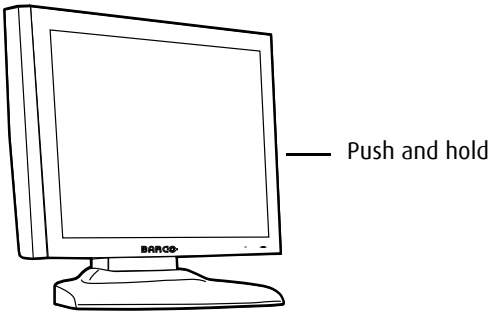
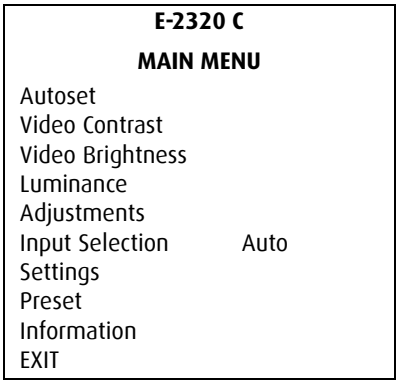


Figure 15

On-screen display

About the on-screen display

The on-screen display (OSD) has a hierarchical structure, with several levels. The top level is the “Main Menu”.



A number of functions are directly accessible from the main menu. Others are grouped in sub-menus.

The content of the on-screen menus depends on the selected video input: The following functions are present in analog mode but are not present in digital (DVI) mode:

- Autoset
- Video Contrast
- Video Brightness
- Preset

This is indicated throughout this manual.

How to navigate through the on-screen display

1. To display the on-screen menus, rotate the control wheel.

2. To enter into a menu or move to a lower level of the menu structure, rotate the control wheel to select the desired menu. Next, press the wheel shortly.
3. To exit from a menu or return to a higher level of the menu structure, rotate the control wheel to select EXIT. Next, press the control wheel shortly.

   If you do this when you are in the Main Menu, you exit the menu system.
4. To change an adjustment value, rotate the control wheel to select the adjustment and press the wheel shortly. The adjustment name appears, as well as the current adjustment value. Rotate the wheel to change the value. When done, press the wheel shortly to confirm the change and return to the menu.

How to save changes

When you have changed something and you wish to exit from the main menu, the display asks if you wish to save the changes.

Save Changes?
Yes
No

1. Rotate the control wheel to select Yes (to save the changes) or No (if you do not wish to save the changes).
2. Press the control wheel to confirm the choice.

Using the Autoset function

* Not available in DVI mode

When do you need to use the Autoset function?

- The first time you use the display with analog video connected.
- After connecting or selecting another analog video source (e.g., changing the PC resolution).

- In case you notice the image geometry or positioning is not as desired.

Required test pattern

To obtain good results, the image on screen during the Autoset function should meet the following requirements:

- The edges of the image should have an intensity of at least 15% video amplitude. E.g., a Windows desktop pattern would be a good image, provided the background is not too dark.
- The image should contain sharp black-white transitions, like a line pattern or characters.
- The image should contain parts that are completely black (0% video amplitude) and parts that are full white (100% video amplitude).

To perform Autoset:

1. Rotate the control wheel to display the on-screen display. The Main Menu appears. The **Autoset** menu is selected.
2. Press the control wheel to enter the Autoset menu.

AUTOSET
Full Autoset
Automatic Geometry
Automatic Phase
Automatic Gain
EXIT

3. Rotate the control wheel to select **Full Autoset**.
4. Press the control wheel to execute the function.

Adjusting Geometry

To perform geometry adjustments:

1. Rotate the control wheel to display the on-screen display. The Main Menu appears.

2. Rotate the control wheel to select **Adjustments**.
3. Press the control wheel to enter the Adjustments menu.
4. Rotate the control wheel to select **Geometry**.
5. Press the control wheel to enter the Geometry menu.

You can perform the following adjustments:

Automatic Geometry *	This is the same function as in the Autoset menu. Please refer to the description of the Autoset functions above. After Automatic Geometry, the image is centered inside the active video window. Its size depends on the video resolution and the Scaling setting.
Hor Pos *	Rotate the control wheel to position the image horizontally inside the active video window
Vert Pos *	Rotate the control wheel to position the image vertically inside the active video window
Scaling	Click to select the desired scaling option: **None**: The image is not scaled **Best Fit**: The image is scaled proportionally to obtain the best fit **Full Screen**: The image is scaled non-proportionally to fill the screen both horizontally and vertically

* Not available in DVI mode

Contrast adjustment

This adjustment is not necessary (and not available) when digital video (DVI) is connected and selected.

By default, the contrast is set in calibrated (CAL) position.

To adjust Contrast:

1. Rotate the control wheel to display the on-screen display. The Main Menu appears.
2. Rotate the control wheel to select **Video Contrast**.
3. Press the control wheel to enter the Video Contrast menu.

VIDEO CONTRAST
Contrast CAL Pos
Man Contrast adj
EXIT

4. Rotate the control wheel to select **Man Contrast adj**.
5. Press the control wheel to execute the function.
6. Rotate the control wheel to change the Video Contrast value.
7. Press the control wheel to confirm the change of the value and return to the Video Contrast menu.

To return to calibrated position:

1. Proceed as described above to enter the Video Contrast menu.
2. Rotate the wheel to select **Contrast CAL Pos**.
3. Press the wheel to switch to calibrated position.

Additional information

If you change Contrast manually, the changed value is saved in the memory.

Brightness adjustment

This adjustment is not necessary (and not available) when digital video (DVI) is connected and selected.

By default, the brightness is set in calibrated (CAL) position.

To adjust brightness:

1. Rotate the control wheel to display the on-screen display. The Main Menu appears.
2. Rotate the control wheel to select **Video Brightness**.
3. Press the control wheel to enter the Video Brightness menu.

VIDEO Brightness
Brightness CAL Pos
Man Brightness adj
EXIT

4. Rotate the control wheel to select **Man Brightness adj**.
5. Press the control wheel to execute the function.
6. Rotate the control wheel to change the Video Brightness value.
7. Press the control wheel to confirm the change of the value and return to the Video Brightness menu.

To return to calibrated position:

1. Proceed as described above to enter the Video Brightness menu.
2. Rotate the wheel to select **Brightness CAL Pos**.
3. Press the wheel to switch to calibrated position.

Additional information

If you change brightness manually, the changed value is saved in the memory.

Color temperature selection

To modify a color temperature definition:

1. Rotate the control wheel to display the on-screen display.

   The Main Menu appears.
2. Rotate the control wheel to select **Settings**.

3. Press the control wheel to enter the Settings menu.
4. Rotate the control wheel to select **Color Temp**.
5. Press the control wheel to enter the Color Temp Definition menu.
6. Rotate the control wheel to select the color temperature you wish to change to.
7. Click the control wheel to confirm the selection.

   The color temperature changes instantly.
8. Exit the menus.

Locking and unlocking user controls

The User Controls function allows to disable or enable the control wheel functions.

When user controls are disabled, you cannot:

- display and use the on-screen display
- switch the display in stand-by mode

To disable user controls:

1. Rotate the control wheel to display the on-screen display. The Main Menu appears.
2. Rotate the control wheel to select **Settings**.
3. Press the control wheel to enter the Settings menu.

SETTINGS	
DPMS	On
Power LED	On
User Controls	On
Automatic Menu Exit	On
EXIT	

4. Rotate the control wheel to select **User Controls**.
5. Press the control wheel to switch from “On” to “Off”.

6. Exit the menus and save the changes.

To enable user controls:

1. Do not use the control wheel for at least 3 seconds.
2. Rotate the control wheel 1 step clockwise.
3. Press the control wheel 2 times.
4. Rotate the control wheel 1 step counterclockwise. The on-screen display appears.

   Note: Steps 2 to 4 must be performed in maximum 3 seconds.
5. Rotate the control wheel to select **Settings**.
6. Press the control wheel to enter the Settings menu.

SETTINGS	
DPMS	On
Power LED	On
User Controls	Off
Automatic Menu Exit	On
EXIT	

7. Rotate the control wheel to select **User Controls**.
8. Press the control wheel to switch from “Off” to “On”.
9. Exit the menus and save the changes.

Complete OSD overview

Main menu

Name	Description	Present in DVI mode
Autoset	Allows to perform automatic image adjustments	No
Video Contrast	Adjust contrast of the image	No
Video Brightness	Adjust brightness of the image	No
Luminance	Adjust the target luminance to which the display will be stabilized.	Yes
Adjustments	Perform Geometry and Phase adjustments	Yes
Input Selection	Select which video signal will be displayed: Digital (DVI) or analog (D-Sub)	Yes
Settings	Change settings for DPMS, Power LED, User Controls, Color Temperature and Automatic Menu Exit	Yes
Preset	Rename the current Preset or select another Preset that matches the characteristics of the selected video signal	No
Information	Read information about the display and the selected video signal	Yes

Autoset

The Autoset menu is not available in DVI mode.

Name	Description
Full Autoset	Perform all Autoset functions (below) one after another
Automatic Gain	Adjust the video levels (black and white) automatically
Automatic Geometry	Adjust the image geometry automatically. This function displays the complete active video in the center of the screen. If the video resolution is smaller than the native panel resolution and no scaling is selected (see further), it puts black borders around the active video window. If the video resolution is larger than the native panel resolution and no scaling is selected, the edges of the image will be lost.
Automatic Phase	Adjust the video sampling phase and frequency automatically. This is necessary when you notice vertical or horizontal banding or noise in the image.

When do you need to use the Autoset function?

- The first time you use the display with analog video connected.
- After connecting or selecting another analog video source (e.g., changing the PC resolution).
- In case you notice the image geometry or positioning is not as desired.

Required test pattern

To obtain good results with the autoset functions, it is necessary to have a good image on which to perform the functions.

E.g., a maximized Windows Explorer window would be a good image.

- Automatic Geometry: The edges of the image should have an intensity of at least 15% video amplitude. .
- Automatic Phase: The image should contain sharp black-white transitions, like a line pattern or characters.
- Automatic Gain: The image should contain parts that are completely black (0% video amplitude) and parts that are full white (100% video amplitude).

Video Contrast

This menu is not available in DVI mode.

Name	Description
Contrast CAL Pos	Switch to calibrated position of contrast
Man Contrast adj	Manually adjust contrast

Video Brightness

This menu is not available in DVI mode.

Name	Description
Brightness CAL Pos	Switch to calibrated position of brightness
Man Brightness adj	Manually adjust brightness

Luminance

Name	Description
Luminance Target	Manually adjust the luminance The calibrated luminance is indicated as 100%

Caution: Increasing the luminance setting to a value higher than 100% may significantly decrease the lifetime of the display backlight.

Adjustments: Geometry

Name	Description	Available in DVI mode
Automatic Geometry	This is the same function as in the Autoset menu	No
Hor Pos	Position the image horizontally inside the active video window	No
Vert Pos	Position the image vertically inside the active video window	No
Scaling	Select the desired scaling option. **None**: The image is not scaled. **Best Fit**: The image is scaled proportionally to obtain the best fit. **Full Screen**: The image is scaled non-proportionally to fill the screen completely.	Yes

Adjustments: Phase

This menu is not available in DVI mode

Name	Description
Automatic Phase	This is the same function as in the Autoset menu
Frequency	Adjust the video sampling frequency manually. However, we recommend you use the Automatic Phase function (Autoset menu).
Man Phase adj	Adjust the video sampling phase manually. However, we recommend you use the Automatic Phase function (Autoset menu).

Input Selection

Name	Description
Auto	Automatically selects the input to which a video signal is connected. If more than one video signal is connected, priority is given to DVI.
DVI	Select the digital input. Consequently, the Automatic setting will be switched off.
DB15	Select the analog input. Consequently, the Automatic setting will be switched off.

Settings

Name	Description
DPMS	Switch on/off the automatic power saving system (DPMS)
Power LED	Switch the power LED on/off. Note: The LED's orange DPMS state is not influenced by this setting. So, when the display goes into power-saving mode, the LED will turn orange, even if it was switched off by this setting.
User Controls	Disable the control wheel functions
Color Temp.	Select a color temperature
Preferred Input Freq.	Click the control wheel to select the desired vertical frequency of the input video signal. Select the best frequency corresonding to your graphic board (see the documentation of your graphic board). After changing this setting you must reboot the PC so that the graphic board changes the vertical frequency of the video signal.

Name	Description
Automatic Menu Exit	Switch the automatic menu exit feature on/off. When switched on, the OSD menus automatically close when left idle for some time.

Information - General Information:

Name	Description
Product	The display type
Serial No	Indicates the display serial number
SW Version	Displays the current internal software version
Display Lifetime	Indicates the total time the display has been operating, including the time in stand-by
Backlight Lifetime	Indicates the total time the display has been operating, excluding the time in stand-by

Information - Current Input Format:

Name	Description
Input Source	Displays the currently selected input
Preset	Displays the currently selected memory Preset
Preset Name	The name of the current memory Preset
Hor Frequency	The currently measured horizontal sync frequency
Vert Frequency	The currently measured vertical sync frequency
Resolution	Displays the actual video signal resolution

NioWatch software

Introduction

To use NioWatch

The NioWatch application resides in the Windows systray. To use one of the NioWatch functions, right-click on the NioWatch systray icon and select the appropriate option:

- Display settings: Allows to view information about your display(s) and display controller. Also allows to select a display function, control display luminance and calibrate display(s)
- Test patterns: Allows to select test patterns to show
- Application settings: Allows to change NioWatch application settings, such as the Equalization option for calibration or MediCal Administrator connection
- Help: Allows to consult the online help
- About: Allows to view information about this version of NioWatch
- Exit: Allows to close NioWatch and remove it from the systray

Figure 16: NioWatch systray icon

Note: After installation, a shortcut "NioWatch Client" is installed in the NioWatch installation directory. You can copy this shortcut to another location (e.g., desktop) if desired.
After double-clicking this shortcut, the NioWatch console appears, allowing you to execute the NioWatch functions.

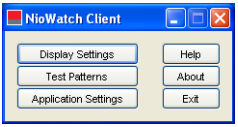


Figure 17: NioWatch console

Display settings

General

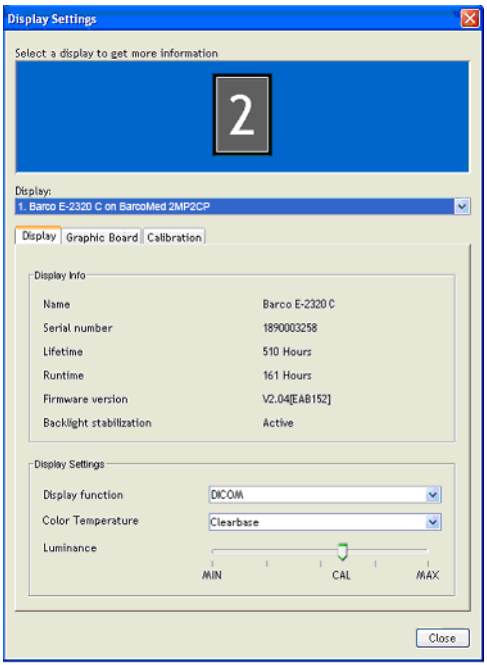


Figure 18: Display Settings dialog

The numbered icons in the upper part of the dialog represent the display controller heads supported by NioWatch.

The display controller heads are also listed in the **Display** drop-down box.

If you wish to control a display in a multi-head system, you must select the display controller head to which the display is connected. You can do this by clicking on the corresponding numbered icon or by selecting the corresponding display controller head from the **Display** drop-down box.

Tip: If you click on a numbered icon, the corresponding number appears for a few seconds on the display connected to that

display controller head. In that way you can easily see which display is connected to which head.

The Display tab allows to view information about the display.

The Graphic board tab allows to view information about the display controller.

The Calibration tab allows to calibrate the display(s) or view the result of the last calibration.

Display tab

Display Info

In the **Display Info** section, you can view the name and serial number of the selected display.

For Nio displays, you can also view:

- Lifetime: Operation time including time in stand-by
- Runtime: Operation time excluding time in stand-by
- Firmware version: Version of internal display software
- Backlight Stabilization: Status of the backlight stabilization in the display.

Display Settings

- To select another display function, select an item from the **Display Function** drop-down box.

  If the selected display has been calibrated to the selected display function in the past, the display will be set according

to this calibration. If no former calibration was found, default factory settings are selected.

When you restart NioWatch, the last selected display function is automatically selected.

The following display functions are available:

Name	Description
DICOM	Select a DICOM display function for most medical viewing applications. The DICOM function results in more visible grayscales in the images.
Dynamic Gamma 2.47	This gamma function best matches the behavior of a grayscale CRT display. The 'dynamic' gamma function is shifted to take into account the non-zero luminance of an LCD panel when driven with a "black" signal.
Dynamic Gamma 2.2	This gamma function best matches the behavior of a color CRT display. The 'dynamic' gamma function is shifted to take into account the non-zero luminance of an LCD panel when driven with a "black" signal.
Gamma 2.2	Select this display function in case the display is to replace a CRT display with a gamma of 2.2
Gamma 1.8	Select this display function in case the display is to replace a CRT display with a gamma of 1.8
Linear	If you select Linear, the native panel behavior will not be corrected.

- To select another color temperature, select an item from the **Color Temperature** drop-down box. This function is available for E-2320 C displays only.

  After selecting another color temperature it may be necessary to recalibrate the display. Therefore, check the Calibration tab to see if calibration is necessary: In case the display is still in calibrated position, the text in the calibration tab will say 'The selected display is calibrated ...'. In case the display is no longer in calibrated position, the text will say 'The selected display uses the factory settings ...'.

- To adjust display luminance manually, adjust the **Luminance** slider. This function is not available for MFCD/MFGD 1218 and MFCD 1219 displays.

  The luminance setting is saved when the system is shut down.

  If the slider is positioned above the CAL mark, the luminance is in calibrated position, as determined during the latest calibration. If the slider is not above the CAL mark, the luminance is not in calibrated position.

Important notices about DICOM compliance:

- If you want the system to be DICOM compliant, you must select the DICOM display function and calibrate the display. After calibration, the luminance must remain in calibrated position to maintain DICOM compliance.
- When you have used NioWatch to calibrate the display to the DICOM display function, it is the NioWatch application that ensures DICOM compliance. Be aware that if you use the display without NioWatch afterwards, the display is no longer DICOM compliant. In that case, please consult Barco MIS service to reset the display function to DICOM.

Graphic Board tab

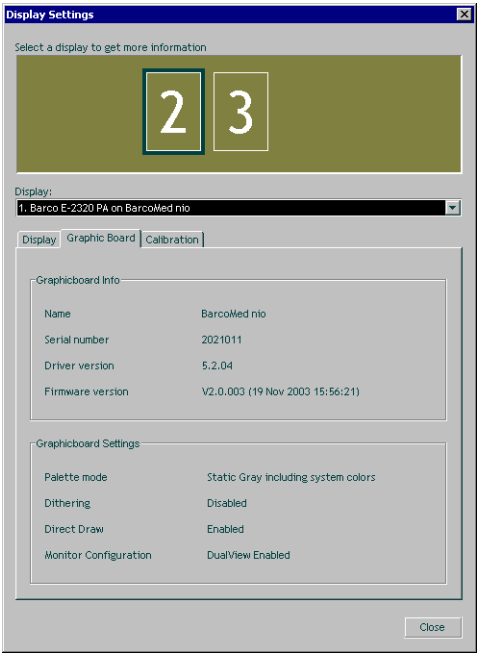


Figure 19: Graphic Board tab

Here you can see information about the installed display controller: Name, serial number, driver version and firmware version.

Calibration tab

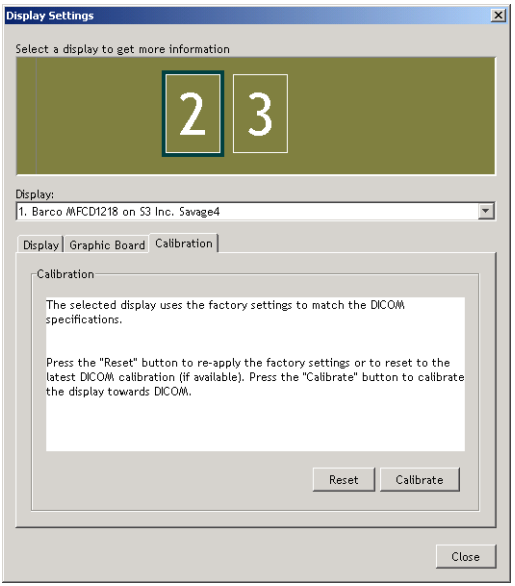


Figure 20: Calibration tab

Here you can calibrate display(s), revert to the latest calibration, revert to default factory settings and view the result of the latest calibration. The possible options are explained below.

Things to consider before starting calibration:

1. If you control color displays and wish all grayscale levels on the display have the same chroma or color temperature, make sure the option “Use Constant Chroma Calibration for color displays” in the **Application Settings** dialog is set. See “Calibration tab” in the description of the Application Settings dialog.

2. If you have multiple Nio displays of the same type connected (multi-head system), consider if you wish to **equalize** the display you calibrate to a reference display.

   The first calibrated display in the system is the reference display.

Equalization means the luminance of the display you are calibrating will be matched to the luminance of the reference display.

If you wish to equalize the display, you must close the Display Settings dialog and make sure the **Equalization** option in the **Application Settings** dialog is set. See "Calibration tab" in the description of the Application Settings dialog.

To calibrate the display using the Barco LCD sensor:

1. If you have multiple displays connected (multi-head system), select the display you wish to calibrate by clicking on the corresponding numbered icon in the Display Settings dialog.
2. Click the **Calibrate** button.
3. A message appears, showing the different calibration options.

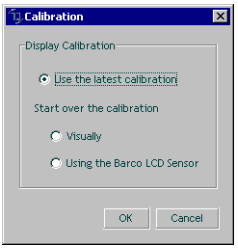


Figure 21: Calibration choices

4. Select "Using the BARCO LCD sensor" and click **OK**.

   This option is grayed in case NioWatch does not find a connected Barco LCD sensor.

5. Follow the guidelines on the screen to complete the calibration successfully.

Note:

If the Equalization option is set in the Application Settings and NioWatch finds at least one other display of the same type that is calibrated, the “Match with reference” page appears during the calibration process.

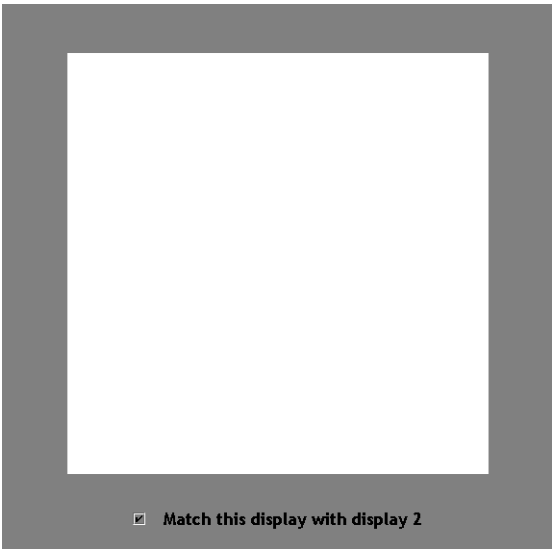


Figure 22: Match with reference

To equalize the display, check the option “Match this display with display....” and click **Next**. The display number that appears in this option, refers to the reference display, which is the first calibrated display in the system.

Manual calibration

1. Follow step 2 and 3 of the calibration with Barco LCD sensor (see page 51).

2. In the Calibration dialog (see step no. 3. in the description of the calibration with sensor), check the option **Visually** and click the **OK** button.

   The DICOM Optimizer dialog appears.

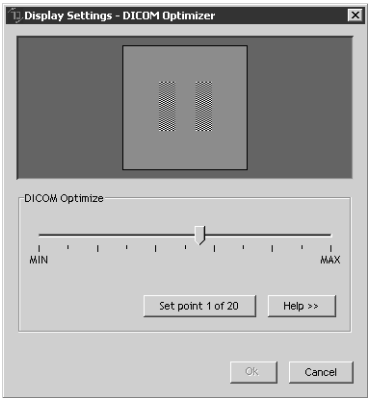


Figure 23: DICOM Optimizer dialog

3. Adjust the slider until there is almost no visible difference between the background of the image above the slider and the bitmap inside this image.
4. When done, click button **Set point 1 of 20**.
5. Repeat this procedure until the button is grayed. This indicates the last point is set.
6. Click **OK** to finish.

To reset to the latest calibration:

1. If you have multiple displays connected (multi-head system), select the display you wish to reset to the latest calibration.
2. Click the **Reset** button.

3. In the next dialog box, select option **Reset to the latest user calibration** and click **OK**.

   The calibration and the luminance will be reset to the latest calibrated position.

Note:

When you start up the system, the calibration is also reset to the latest calibrated position. The luminance, however, is kept at the latest value.

To view a graph showing the result of the latest calibration:

1. In the Calibration tab dialog, click on **Show calibration chart**.

   This button is available only if the display has been calibrated with a sensor before.

2. A graph is shown displaying the applied display function (to which the display is calibrated) compared to the native panel behavior.

To revert to the default factory settings:

1. If you have multiple displays connected (multi-head system), select the display you wish to reset to the default settings.
2. Click the **Reset** button.
3. In the next dialog box, select option **Reset to the factory default calibration** and click **OK**.
4. As a result, the settings are restored to the default factory values.

Test patterns

Test Patterns

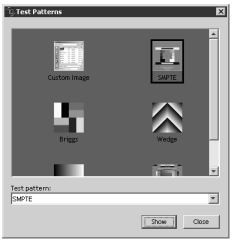


Figure 24: Test Patterns dialog

1. Select the desired test pattern by clicking on the corresponding thumbnail or selecting a pattern by name from the Test pattern drop-down box.
2. Click **Show** to display the pattern.

   If you have selected **Custom Image**, you can select a bitmap image (e.g., saved on the hard disk) as test pattern.
3. To hide the test pattern again, click inside the pattern.

Note:

The test pattern Auto Adjust can be used as test pattern for the Auto Adjust functions in the display OSD.

Application settings

General tab

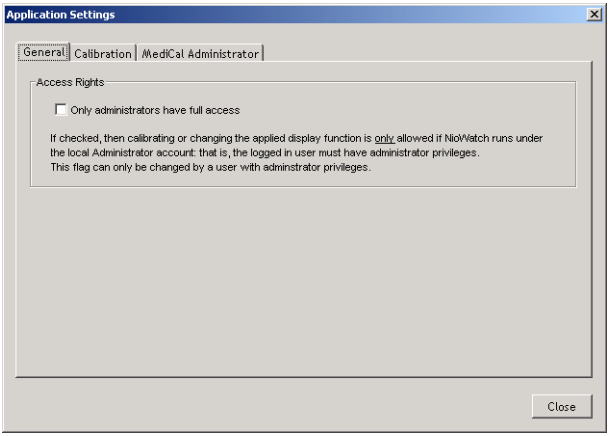


Figure 25

Here you can check the option “Only administrators have full access”.

When this option is checked, calibrating, resetting calibration and selecting another display function can be performed only by users with administrator rights on this workstation.

This option can be checked and deselected only by users with administrator rights on this workstation.

Calibration tab

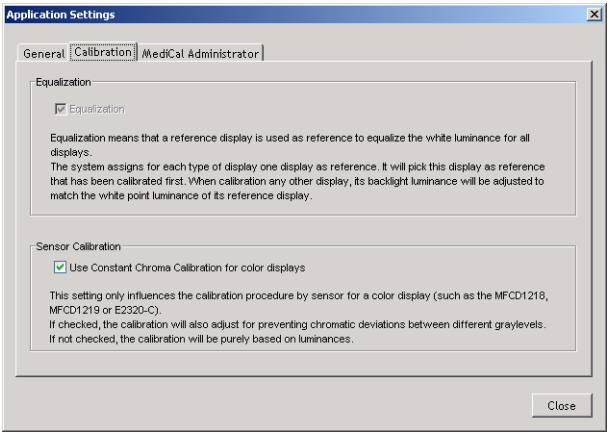


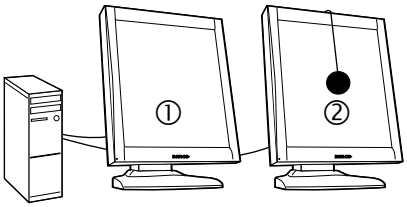
Figure 26: Calibration tab

Equalization

Here you can check the Equalization option, allowing you to match all the displays from a multi-head system to the luminance of the first calibrated display of the system.

Suppose you work with a system containing 2 Nio displays of the same type, and you wish display (2) to have the same output luminance as display (1). Therefore first calibrate display (1). Next, calibrate display (2) while the Equalization option is checked.

The first calibrated display in the system is the reference display.



(1) Reference display
(2) Calibrated display: Luminance automatically matched to reference display

Figure 27: Dual-head equalization

Note: The Equalization option will be available only if the system contains at least two Nio displays of the same type.

To equalize the displays:

1. Be sure the reference display is calibrated to the desired luminance.
2. Set the Equalization option in the Application Settings dialog.
3. Close the Application Settings dialog.
4. Open the Display Settings dialog and calibrate display (2).

   The display will be calibrated and additionally the display luminance will be matched to the luminance of the reference display (1).

Sensor calibration

Here you can check the Constant Chroma Calibration option.

When this option is checked, the next calibration with sensor will give all grayscale levels on the display the same chroma or color temperature, which is the panel native white chroma.

This option has effect only when calibrating color displays with the Barco LCD sensor.

MediCal Administrator tab

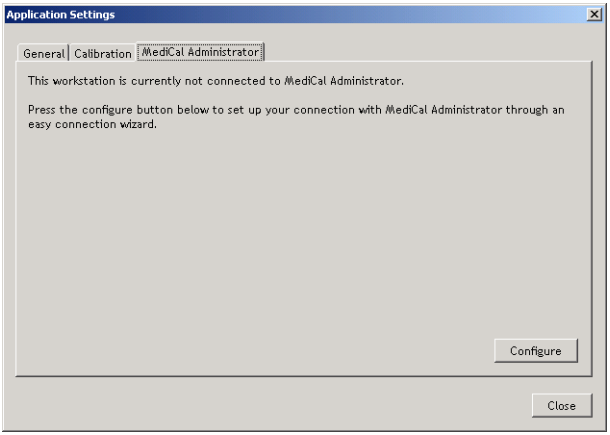


Figure 28: MediCal Administrator tab

Here you can connect to MediCal Administrator, if present.

To connect to MediCal Administrator, click the **MediCal Administrator** button. As a result, the MediCal Administrator connection wizard starts. Please follow the guidelines from the wizard.

The MediCal Administrator software is a hospital-based softcopy image quality management system that keeps the consistency data of every connected display system in a central database. Via the user-friendly web interface, accessible from any client, users have access to all the information of the installed display base.

For more information about MediCal Administrator, please contact Barco Medical Imaging Systems or consult our web site.

Update NioWatch

In the Windows Start menu, the Update NioWatch application is installed during installation of NioWatch.

To update NioWatch:

Select **Update NioWatch** from the Start > Programs > Barco NioWatch menu.

The application will search via the Internet if NioWatch updates are available. If so, you will get the option to install them.

Cleaning

Precautions

- Take care not to damage or scratch the glass or LCD panel.
- Do not apply pressure on the glass or LCD panel.
- Do not apply or spray liquid directly to the glass, panel or cabinet as excess liquid may cause damage to internal electronics. Instead, apply the liquid to the cleaning cloth.
- DO NOT USE:

  - Lye or cleaning solutions containing lye*
  - Acid
  - Detergents with fluoride
  - Detergents with ammonia
  - Detergents with abrasives
  - Steel wool
  - Sponge with abrasives
  - Cloth with thread made of steel
  - Other coarse tools

*(Lye is a strong caustic alkaline solution of potassium salts.)

Proceed as follows:

- Clean the cabinet using a soft cotton cloth, lightly moistened with a recognized cleaning product for medical equipment.
- Repeat with water only.
- Wipe dry with a dry cloth.
- The cabinet has been tested for resistance to the following products:

  Cidex, Betadine, Alcohol (Isopropyl and Ethyl), Ammonia-based cleaners (Windex) and Aquasonic Gel.

To clean the LCD panel:

- Dust particles on the LCD panel may be blown away by using a dust remover. E.g., DUST OFF 67 (KONTAKT Chemie).

  A dust remover is composed of a blend of compressed liquid gases functioning as propellant. They provide a jet of dry inert gas that acts like compressed air for a quick and safe removal of dust particles and other dry contaminants on the surface of the lcd panel or the glass panel.

  Attention: The dust remover contains a liquid gas. If you shake the can or move the can too fast while spraying, you may blow drops of liquid on the panel surface!

  If this is the case, clean the panel as described below.

- If the LCD panel is dirty or wet, clean the panel using a lint-free, nonabrasive cloth, lightly moistened with a solution of 25% Isopropyl Alcohol (IPA) and 75% de-ionized or distilled water. E.g.: Cleareen, a product of Certified Laboratories.
- Take another clean, dry, soft, lint-free cloth and gently wipe the glass dry.

Troubleshooting

General tips

- If one display from a multi-head system exhibits problems, try to eliminate the problem by switching video cables or power supplies. In that way you can find out if the problem resides in the display or not.

Problems and solutions

Problem description	Possible tests or solutions
Screen remains black	• Please check the installation procedure in this manual • If the LED at the front is orange, the display is in stand-by • Check in the Windows Display Properties if the display controller video heads are attached. If not, there will be no image on the screen. • The graphic board resolution may bee too low. See note below. • The external power supply may be defective
Image exhibits noise or interference	• The video cable may be of poor quality • DVI video cable may not be firmly connected to the PC or to the display • Display may need Phase and Frequency adjustments (if analog video is selected)
Image contains missing pixels	• A number of missing pixels is normal (inherent in LCD technology)

Problem description	Possible tests or solutions
Image contains not enough grayscales	• Adjust the Display Function to DICOM by means of the NioWatch software • You may have installed the driver software with an inappropriate selection of Palette Settings. Install the driver software again and set Palette Settings to 24/32 bit color.
The PC does not start up	• Check the CMOS settings in the PC BIOS • The display controller may not be firmly seated in the connector
No image during PC start-up	• Check the CMOS settings in the PC BIOS
Nothing happens when you press or turn the control wheel	• The User Controls may be disabled. Please read the paragraph about the “User Controls” function.
The image is non-proportionally spread out over the screen	• Select another resolution in the Windows “Display Properties” control panel • Switch the “Scaling” function (Geometry menu) in the display OSD to “None” or “Best Fit”
The image on the screen is rotated 90°	• Rotate the image using the display controller control panel. See the display controller manual

Problem description	Possible tests or solutions
The previous image remains slightly visible on the screen	• This phenomenon, called "image sticking" is normal if the same image has been on the screen for a long time. The ghost image will disappear after some time. Over 10 hours operation with the same image content is not recommended. Switching on DPMS on display and PC and activating a good screen saver may decrease the risk of image sticking (image retention). • A slight case of image sticking can be solved by continuously displaying a full white image during a number of hours.
On a dual-head system, the images on the left and right display seem to be switched	• Switch the video cables at the display controller or at the display video inputs

Note: What if the graphic board resolution is too low

Some non-Barco graphic boards (e.g., single-link boards) may have an insufficiant resolution to drive the display. You can solve this problem by forcing the graphic board to operate on a lower vertical frequency. Therefore, proceed as follows:

1. Shut down the PC.
2. In the display OSD, browse to the Settings menu.
3. Select the function **Preferred Input Freq.**
4. Select **45 Hz** as vertical frequency.
5. Exit the OSD.

6. Reboot the computer.

   After reboot, the signal from the graphic board should now be visible on the display.

Technical Information

Technical specifications

E- 2320 C:

Item	Specification
Picture panel	20.1-inch diagonal viewable screen TFT (thin film transistor) active matrix, color liquid crystal display
Resolution	Native: 1600 x 1200
Display area (H x V)	408 x 306 (mm)
Viewing angle (typical, @ 10/1 contrast)	Vertical: 176º Horizontal: 176º
Pixel Pitch	0.255 mm (H) x 0.255 mm (V)
Native color resolution	24 bit color
Luminance	180 cd/m² (calibrated)
Contrast ratio	700/1 (on/off in dark environment)
Response time	8 ms typical (@ 25° C after 30 min warm-up)
Controls	Push / turn control wheel for stand-by switching and OSD controls
Input connectors	DVI single link, D-Sub15 pin
Signal systems	DVI Digital, RGB Analog Video on DVI: Complying to DVI Rev 1.0 specifications Sync on DVI: Complying to DVI Rev 1.0 specifications

Item	Specification
Input signals	Possible resolutions: • 640 x 480 @ 60, 75, 85, 100 Hz • 800 x 600 @ 60, 75, 85, 100 Hz • 1024 x 768 @ 60, 75, 85, 100 Hz • 1152 x 864 @ 75 Hz • 1152 x 870 @ 60, 85, 100 Hz • 1280 x 1024 @ 60, 75, 85 Hz • 1600 x 1200 @ 59, 60 Hz (*)
USB standard supported	USB 1.1
Power source	Input for 12 VDC power supply unit: 90 ~ 264 VAC Input for display: 12 VDC. (The supplied 12VDC power supply must be used)
Power consumption	64 watts (max., at 90 VAC, maximum backlight, USB load)
Dimensions (W x H x D)	In perpendicular vertical position, highest position, tilt = 0°, swivel = 0°: 385 x 585 x 250 mm
Net weight	12 kg
Operating Temperature	0°C to 40°C, 15°C to 35°C within specs
Storage Temperature	-20°C to 60°C
Humidity	8% - 80% (non-condensing) for operation 5% - 95% (non-condensing) for storage
Altitude	7500 m storage 3000 m operation

Connector pin assignments

DVI connector:

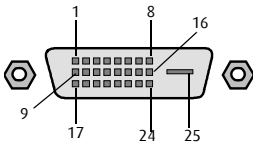


Figure 29: DVI connector pin layout

Pin no.	Signal	Pin no.	Signal
1	TMDS DATA 2-	14	+5V POWER
2	TMDS DATA 2+	15	GND
3	GND	16	HOT PLUG DETECT
4	NC	17	TMDS DATA 0-
5	NC	18	TMDS DATA 0+
6	DDC CLOCK	19	GND
7	DDC DATA	20	NC
8	NC	21	NC
9	TMDS DATA 1-	22	GND
10	TMDS DATA 1+	23	TMDS CLOCK-
11	GND	24	TMDS CLOCK+
12	NC	25	GND
13	NC		

D-Sub 15 connector:

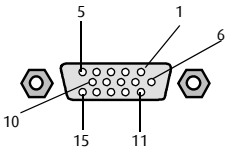


Figure 30: D-Sub 15 pin layout

Pin no.	Signal	Pin no.	Signal
1	Red in	9	DDC 5V IN
2	Green in	10	VGA PRES
3	Blue in	11	NC
4	NC	12	DDC SDA
5	GND	13	HS IN
6	GND	14	VS IN
7	GND	15	DDC SCL
8	GND		

Glossary

Calibration

Each display is calibrated in the factory before it is sent to the customer. After this calibration, black and white luminance are set to the ideal level.

A stabilization routine, constantly active when the display is on, keeps these levels constant using the built-in sensor.

Display Function

A Display Function describes how a display device converts the video signals at the inputs into light.

In the context of a medical viewing station, a display device is the combination of display controller (graphics board) and display.

The display function is a graph that shows how the light from the display panel evolves from minimum to maximum luminance while the data levels at the input of the display controller go from 0 to maximum.

Display Controller head

A display controller (graphics board) converts the digital data from the computer into digital or analog video voltages.

Most of the common display controllers contain just one set of video and sync outputs. However, some high-end boards, like some of the BarcoMed boards, contain two sets of video and sync outputs. This is called a dual head display controller. It is like two complete display controllers implemented on one single unit.

A dual head board in the computer behaves exactly as if two separate boards were installed.

DICOM

DICOM stands for Digital Imaging and Communications in Medicine. It is a standard developed by the American College of Radiology (ACR) and the National Electrical Manufacturers Association (NEMA).

The standard specifies how digital image data can be moved from system to system.

In addition, Supplement 28 Part 14 specifies a function that relates pixel values to displayed Luminance levels and is called Grayscale Standard Display Function.

Presets and Internal memory system

The memory of the display contains maximum 200 fixed and 28 programmable Presets.

When you connect a video signal, the display checks in the memory for a matching Preset.

If it finds one, it selects the corresponding settings and parameters from the memory. If it does not find a matching Preset, the display uses default settings to display the image.

When you make adjustments and save the changes, the current Preset is saved as programmable Preset. If this happens while all programmable Presets are occupied, the oldest programmable Preset is overwritten automatically.

Warranty Statement

ARTICLE 1: SERVICES

BarcoView warrants that the equipment will be free of defects in workmanship or material for the warranty period.

Notwithstanding the provisions of clause 2, repair and replacement of defects in material and/or workmanship under this warranty shall be accomplished in our works in the following manner:

1.1 The Customer, upon the occurrence of any equipment failure, shall contact BarcoView Customer Support Center (or an authorized service center) by telephone, fax or e-mail and shall provide the applicable Customer Support person with a complete description of the problem being encountered, including the model and serial number of the equipment in which the problem has arisen.

1.2 The Customer Support person shall diagnose the problem experienced by the Customer and shall advise the Customer on how to proceed. Customer Support may ask to return the faulty equipment or faulty subassemblies to the BarcoView Customer Support Center (or an authorized service center) for repair activities. The Customer shall ask for a RMA or RAN number to a BarcoView Customer Support Center (or an authorized service center).

1.3 The Customer shall return, freight prepaid, the defective equipment or subassemblies for repair to the BarcoView Customer Support Center (or an authorized service center).

1.4 Replacement parts used shall be new or equivalent to new parts for the revision level of the equipment. The warranty period for the replacement parts will expire at the same moment as the original warranty period of the equipment. All parts replaced hereunder and returned to BarcoView (or an authorized service

center) shall become the property of BarcoView (or the authorized service center).

1.5 The repaired equipment shall be returned to the Customer, by regular freight, at BarcoView's charge.

ARTICLE 2: ITEMS EXCLUDED FROM WARRANTY

The warranty described herein shall not include the following:

2.1 Any hardware or software item procured from a source other than BarcoView or their official agent or distributor and integrated by Customer or a third party into BarcoView supplied equipment.

2.2 Any host configuration not explicitly supported by BarcoView.

2.3 All software installed on the system, whether they are acquired from BarcoView or third party. An exception is made for software delivered by BarcoView that would prove to be a cause for the malfunctioning of the hardware covered under this Agreement.

2.4 Normal wear and tear, use under circumstances exceeding specifications, abuse, unauthorized repair or alternation, lack of proper maintenance.

2.5 Any failures resulting from an accident, negligence (such as but not limited to removing or deleting system files & licensed software product files), misuse, circuit failure or any change, damage due to fire, water, thunder or lightning, power failure or fluctuation, disruption of communication lines or due to force majeure, or any reason foreign to the equipment.

2.6 Any specific services or procedures, asked for by Customer, related to verification of repaired equipment.

ARTICLE 3: OBLIGATIONS OF THE CUSTOMER

Customer hereby assumes the following obligations as partial consideration for BarcoView performance of its requirements under the warranty condition; failure by Customer to meet its

obligations under this paragraph shall excuse BarcoView's performance hereunder:

3.1 Customer shall not expose BarcoView personnel to any unsafe working conditions.

3.2 Repairs to equipment under warranty resulting from improper maintenance or repair performed by the Customer, or its officers, agents, employees, or representatives, shall be borne by the Customer at its additional cost and expense.

3.3 The customer is responsible for installing the BarcoView equipment in an environment for which it was intended. If there is an indication that the equipment was used - even temporary - outside its specifications, BarcoView is entitled not to perform warranty repairs and terminate the warranty agreement. Any actions that have been taken by BarcoView in this respect, may be invoiced to the Customer at normal pricing.

ARTICLE 4: MODIFICATIONS OR CHANGES TO THE EQUIPMENT

Customer may make additions to the equipment only with explicit written consent of BarcoView.

Any attempt to do so, voids the warranty.

ARTICLE 5: DISCLAIMER OF WARRANTIES

Barcoview disclaims all warranties, expressed or implied, including all implied warranties of merchantability and fitness for a particular purpose.

ARTICLE 6: LIMITATION OF LIABILITY

Barcoview shall not under any circumstances be liable to customer or any third party for direct, indirect, incidental, special or consequential damages, such as but not limited to, damage to or loss of tangible or intangible property or equipment, loss of profits or revenues, cost of capital, cost of purchase of replacement goods, or claims of customers of user for service interruptions. The liability of BarcoView for manufacturing, sale, delivery, resale, installation, operation or suitability for use of any

products or services covered by or furnished under this warranty condition, whether arising out of contract, negligence, strict tort, warranty or otherwise, shall not exceed the price of the item or items of goods or services upon which such liability is based.

ARTICLE 7: FORCE MAJEURE

Either party shall be released from performance of its obligations under this agreement to the extent, and for so long as, the performance of this agreement is impeded by reason of force majeure. For the purposes of this clause the expression “force majeure” means, but shall not be limited to, industrial dispute, fire, mobilization, requisition, embargo, currency transfer prohibitions, insurrection, lack of means of transport, restrictions of the use of energy, and generally any circumstances which are beyond the control of the parties and hinder performance by one party of his obligations.

ARTICLE 8: GENERAL

8.1 Customer acknowledges its understanding that all software and electronic devices, including BarcoView products are subject to possible error, mechanical or electrical failure, and should not be relied upon in inappropriate applications or without proper backup and/or other safety precautions whenever personal injury or property damage may result from failure or error of the product.

8.2 BarcoView shall not be responsible for machine failure and/or its failure to render service or maintenance due to causes beyond its reasonable control.

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