



ezcəl

USER'S MANUAL

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I. GETTING STARTED

1.1. Introduction

When it comes to medical imaging, the ability to see the whole image is important. With a standard workstation configuration using an uncalibrated display, the user runs the risk of missing fine details. Missing fine details can represent a health risk to the patient, which may lead to a misdiagnosis or an expensive lawsuit. The problem is not the image or the practitioner's eye; it is the ability of the display to represent all information accurately.

EzCal is a software solution which enables the user to modify display output to meet DICOM part 14 GSDF and other key industry standards. After calibration your workstation will allow you to see the finest details of every image displayed. With EzCal medical display calibration software installed on all of your computers, you are assured that no matter which image you are looking at, it will be the same on every display.

EzCal is not only a DICOM calibration tool, but also a medical monitor QA application, that verifies the display's conformance to medical standards AAPM TG18, DIN 6868-57, DIN 6868-157, JESRA X-0093, IEC 62563-1, the New York state Primary Diagnostic Monitor (PDM) Quality Assurance Program and performs acceptance and conformance tests for these standards.

This document provides details on installation and use of the EzCal application.



About EzCal

EzCal is a medical monitor quality assurance tool based on the medical standards NEMA DICOM part 14 GSDF, AAPM TG18, DIN 6868-57, DIN 6868-157, JESRA X-0093, IEC 62563-1 and NY PDM. The medical monitor QA tool performs calibration, acceptance test, conformance test and maintains consistency to all medical workstations. The use of this software enables healthcare professionals to maintain international standards of quality in terms of their displays performance.

EzCal Features

- Calibration of displays to DICOM part 14 GSDF, CIE L*, BT.709 and BT.1886 standard
- Update of video card LUT or display LUT for displays that comply with the DDC/CI standard
- Calibration of multi-head display systems
- White level and black level calibration
- Version 4 ICC profile generation
- Calibration to a certain color temperature and XY coordinates
- Verification of conformance to the major regulations: AAPM TG18, DIN 6868-57, DIN 6868-157, JESRA X-0093, IEC 62563-1 and the New York state Primary Diagnostic Monitor (PDM) Quality Assurance Program
- Automated QA - performing acceptance and conformance tests
- Scheduling conformance test automatically and reminders to perform tests
- Remote quality control
- Convenient and user-friendly calibration and QA reports
- Color measurement capability
- Diversified auto backup
- History log for comparing and checking results of calibrations
- Briggs, SMPTE, AAPM test patterns to visually check calibration results
- Many brands of photometers support
- License supports all users on the installed workstation



1.2. Minimum system requirements

1.2.1. EzCal client is supported on the following operating systems:



- Windows:
 - XP (32-bit and 64-bit)
 - Vista (32-bit and 64-bit)
 - Win 7 (32-bit and 64-bit)
 - Win 8 (32-bit and 64-bit)

Processor: Pentium or AMD K7

Minimum RAM: 512MB.

Minimum free space on hard disk: 150 MB.

1.2.2. EzCal server is supported on the following operating systems:

- Windows hosts:
 - Windows XP, all service packs (32-bit)
 - Windows Server 2003 (32-bit)
 - Windows Vista (32-bit and 64-bit).
 - Windows Server 2008 (32-bit and 64-bit)
 - Windows Server 2012
 - Windows 7 (32-bit and 64-bit)
 - Windows 8 (32-bit and 64-bit)
 - Windows 8.1 (32-bit and 64-bit)
 - Windows 10 (32-bit and 64-bit)



- Mac OS X:
 - 10.7 Lion
 - 10.8 Mountain Lion
 - 10.9 Mavericks
 - 10.10 Yosemite
 - 10.11 El Capitan
 - 10.12 Sierra

- Linux hosts (32-bit and 64-bit). Among others, this includes:
 - Ubuntu 6.06 ("Dapper Drake"), 6.10 ("Edgy Eft"), 7.04 ("Feisty Fawn"), 7.10 ("Gutsy Gibbon"), 8.04 ("Hardy Heron"), 8.10 ("Intrepid Ibex"), 9.04 ("Jaunty Jackalope"), 9.10 ("Karmic Koala"), 10.04 ("Lucid Lynx"), 10.10 ("Maverick Meerkat), 11.04 ("Natty Narwhal"), 11.10 ("Oneiric Ocelot"), 12.04 ("Precise Pangolin"), 12.10 ("Quantal Quetzal"), 13.04 ("Raring Ringtail"), 13.10 ("Saucy Salamander"), 14.04 ("Trusty Tahr")
 - Debian GNU/Linux 3.1 ("sarge"), 4.0 ("etch"), 5.0 ("lenny"), 6.0 ("squeeze"), 7.0 ("Wheezy")
 - Oracle Enterprise Linux 4 and 5, Oracle Linux 6
 - Redhat Enterprise Linux 4, 5 and 6
 - Fedora Core 4 to 20
 - Gentoo Linux
 - SUSE Linux 9, 10 and 11, openSUSE 10.3, 11.0, 11.1, 11.2, 11.3, 11.4, 12.1, 12.2, 12.3, 13.1
 - Mandriva 2007.1, 2008.0, 2009.1, 2010.0 and 2010.1

1.2.3. Your web browser should be one of the following:

- Mozilla Firefox, version 3.5 or higher
- Safari, version 4 or higher



- Google Chrome, version 3 or higher
- Internet Explorer 8 or higher

1.3. Hardware requirements

1.3.1. Displays and Graphic boards:

- All LCD, CRT Displays and Projectors
- All currently commercially available graphic boards



1.3.2. Measurement devices:

Display Front Sensor	Colorimeter	Spectral photometer	Spot Luminance meter
LumiMED MM03A	X-Rite Eye-One display	X-Rite Eye-One Pro	IBA dosimetry / Wellhoefer LX Plus
LumiMED MM05A	X-Rite Eye-One display 2	X-Rite Eye-One Monitor	IBA dosimetry / Wellhoefer LX Can
Olorin VC19012	X-Rite Eye-One display Pro	PhotoResearch PR 670	Pehamed CD mon
Olorin MC20012	X-Rite Monaco OPTIX XR	IBA dosimetry / Wellhoefer LX Chroma	Pehamed CD LUX
Olorin VC21012	X-Rite DTP 94	JETI specbos 1001	Pehamed CD Lux plus
Sony LMD DM20	X-Rite Sequel Gamma 3	JETI specbos 2001	
Sony LMD DM30	X-Rite Sequel Chroma 4	JETI specbos 2101	
Sony LMD DM50	X-Rite Sequel Chroma 5	JETI specbos 4001	
Sony LMD DM20C	Datacolor Spyder3		
Sony LMD DM30C	Datacolor Spyder4		
Sony LMD DM50C	Konica Minolta CS200		
Totoku CCL254i2	Konica Minolta CA210		
Totoku CCL256i2			
Totoku CCL258i2			



1.3.3. Displays with internal LUT:

Beacon C81W+
 Beacon C42W+
 DELL U3011
 DELL U3014
 DELL U2413
 DELL UP2414Q
 DELL U2713H
 DELL U2414
 DELL UP3214Q
 DELL UP3216Q
 DELL UP2715K
 DELL UP3017
 DIVA GET1905CMI
 DIVA RAP2005SM
 DIVA GUP2105NMI
 DIVA RUP2105CMI
 DIVA ROM770AMI
 DIVA RAP1823AMII
 DIVA RON950AM
 DIVA ROM970AMI
 DIVA ROM1900AMI
 DIVA RAP1902AM
 DIVA RAP1922AM
 DIVA RON2000LM
 DIVA ZSP2105CMI
 DIVA ZSP5812CMI
 DIVA GUP2103JMI
 IIYAMA PLH2130-2
 IIYAMA PLH2130-3

LumiMED MM02
 LumiMED MM03
 LumiMED MM05
 LumiMED MM03A
 LumiMED MM05A
 NEC MultiSync LCD 1980
 NEC MultiSync LCD 2180
 Olorin VL211D
 Olorin VL200D
 Olorin VC210D
 Olorin VC19012
 Olorin MC20012
 Olorin VC21012
 Olorin MC210D
 Olorin VC190D
 Olorin MC190D
 Olorin MC200D
 Olorin VC210D
 Olorin MC191D
 Olorin MC221D
 Rein VIEWMEDIC EV-C119
 Rein VIEWMEDIC RV-C219
 Rein VIEWMEDIC RV-C221
 Sony LMD DM20
 Sony LMD DM30
 Sony LMD DM50
 Sony LMD DM20C
 Sony LMD DM30C
 Sony LMD DM50C

Totoku CCL254i2
 Totoku CCL256i2
 Totoku CCL258i2
 Totoku CCL352i2
 Totoku CCL354i2
 Totoku CCL356i2
 Totoku CCL358i2
 WIDE CX20p
 WIDE CX20n
 WIDE MX20s
 WIDE CX30p
 WIDE CX30n
 WIDE MX30s
 WIDE MX30n
 WIDE CX50n
 WIDE MX50p
 WIDE MX50s
 WIDE MX50t
 WIDE MX50n
 WIDE CW60
 WIDE MW100



1.4. Installation Procedure Overview

1.4.1. Pre-installation conditions:

In order to install EzCal client you must have Administrator privileges or Administrator's password if required when installing to the user profile.

Before installing EzCal software in your system:

Power on the workstation with all display(s) attached that you intend to use.

Check if the screen settings are correctly configured:

XP - Go to Settings -> Control panel, and double click on the display icon. Select the "Settings" tab to view screen resolution and color settings.

Vista - Go to Settings -> Control panel and click on "Adjust screen resolution" under the Appearance and Personalisation Icon.

Windows 7 and 8 - Go to Control panel -> Display -> Adjust resolution.

Ensure that the screen resolution is set to the native resolution of the display with color quality of 32 bit "True color" or higher.

Ensure that the correct graphics card display driver is installed.

Repeat these checks for each display attached to your system.

Your system is now ready to start the installation process.

IMPORTANT: Before starting the installation process, please make sure that the USB measurement device is NOT connected. The measurement device will be added later, after EzCal is successfully installed.

EzCal can be operated as a client only or as a client-server combination.

Complete installation consists of several components.

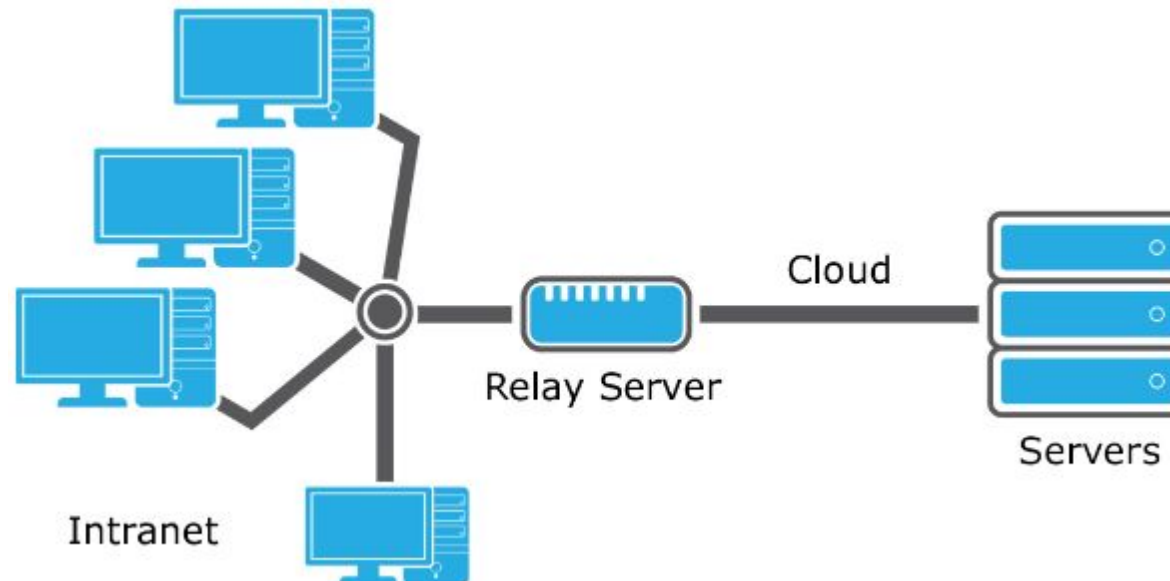


EzCal Client

EzCal Client is the client application that runs on each of the workstations. It provides a number of actions that can be performed locally on the workstations, including calibrating the displays, viewing test patterns or performing full QA (Quality Assurance) and acceptance tests. Even when EzCal Client is not connected to EzCal Remote Server it can still run all QA tasks on the workstation.

EzCal Remote Server

All EzCal clients can be connected to EzCal Remote Server. No special license is required. QA managers can connect to EzCal Remote Server via internet/intranet connection and take full control over the performance of connected workstations from any location at any given time.

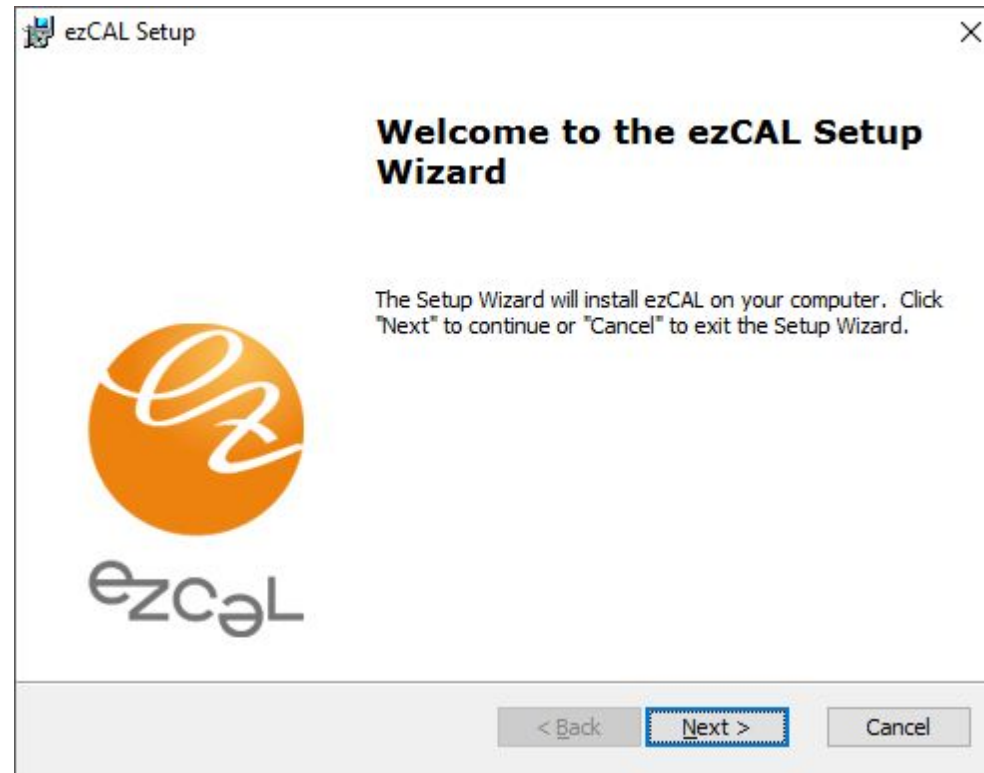




1.4.2. Installation

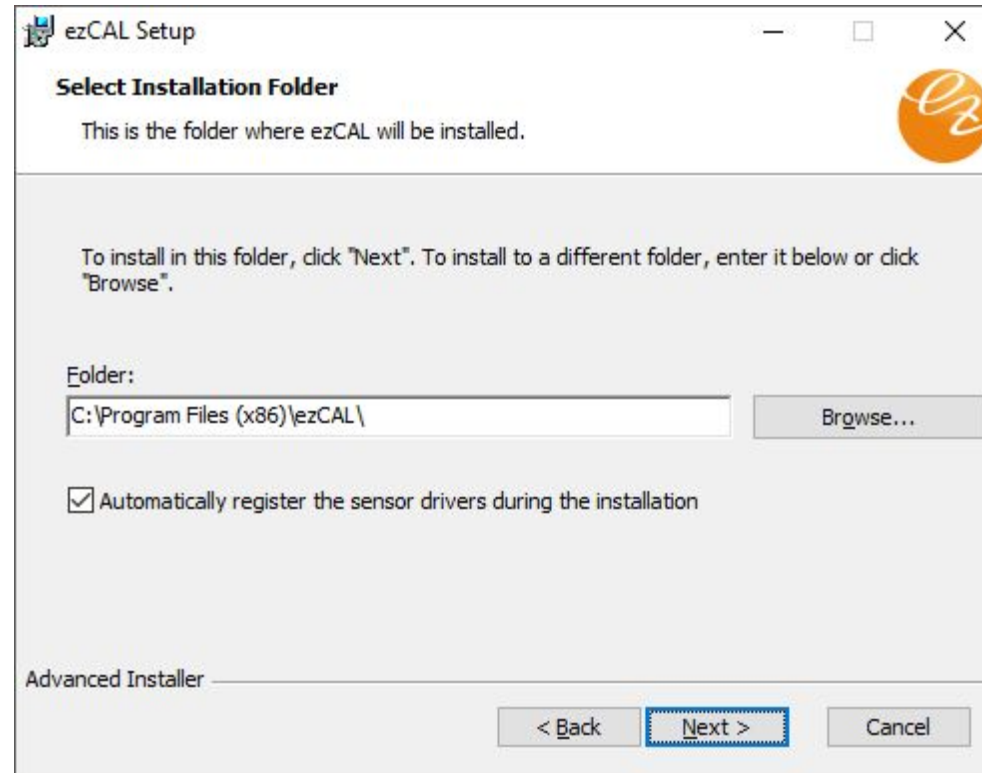
Windows Vista/7/8:

Double click on the installer:





Follow the instructions presented in the installer.



If you don't want to install EzCal into the default directory, browse your computer and choose another one.

Windows will present a driver message for a few times during EzCal installation. This is normal behavior as drivers to support measurement devices are loaded. Please click the „Install this driver software anyway“ button when prompted.

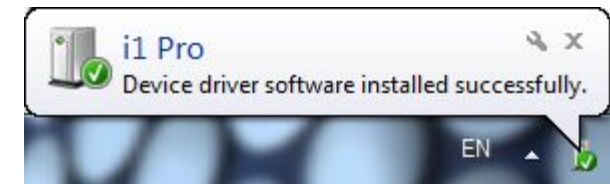


1.4.3. Measurement Device Installation

Now that you have the software installed, it is time to install the measurement device. Plug the device into an unused USB port and refer to the following depending on which OS you have installed the software:

Vista and Windows 7

Vista and Windows 7 will automatically install your device driver. Wait until you receive the "Device driver software installed successfully" message, and jump ahead to the end of this section.





Windows XP:

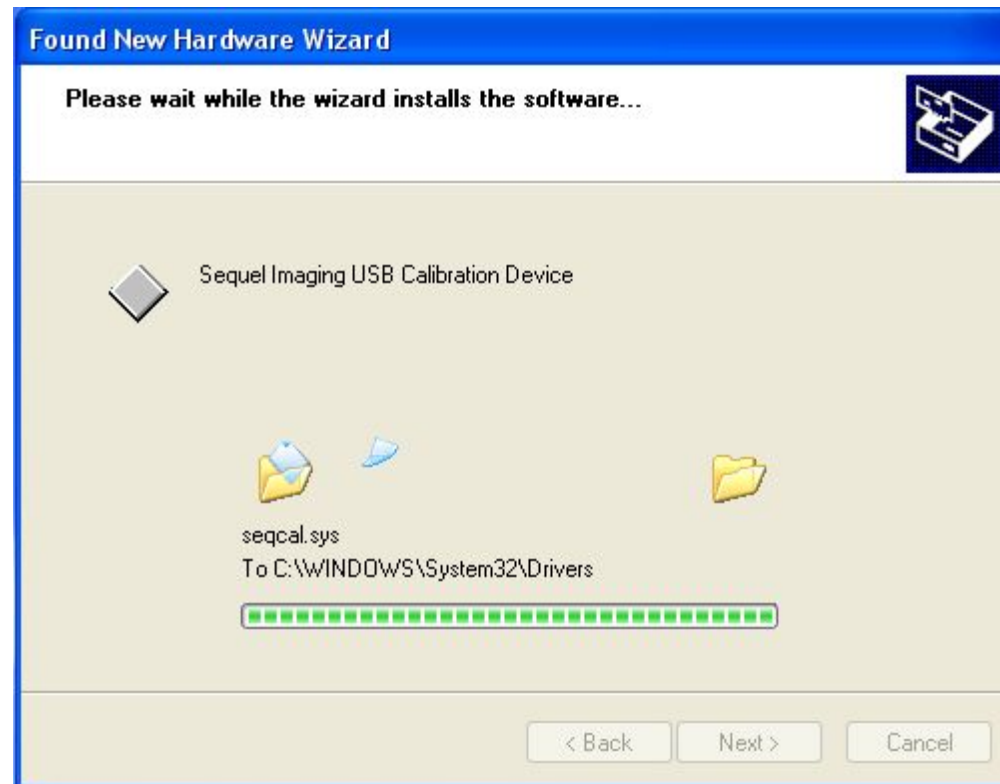
The "Found new Hardware Wizard" will start. Click the "Yes, this time only" radio button followed by "Next".



Check the "Install the Software Automatically (Recommended)" radio button and click "Next".



The software is installed automatically.



When all drivers have been loaded and configured, the wizard will prompt you to click on the "Finish" button.



Windows will notify you when the measurement device is ready to use, by momentarily displaying the "Found New Hardware" message balloon in the lower right corner of the screen.



1.5. The Main Window

Preliminary Conditions:

Before using the software, make sure the following conditions are observed:

- ambient light should be constant;
- ambient light should be as low as possible;
- no direct light should reach the display.

The tasks included in the Main Window:

On the left you can notice a list of displays linked to the PC. EzCal provides visual feedback to help identify your display in a multiple head situation. Double clicking on the selected display icon will identify the selected screen.

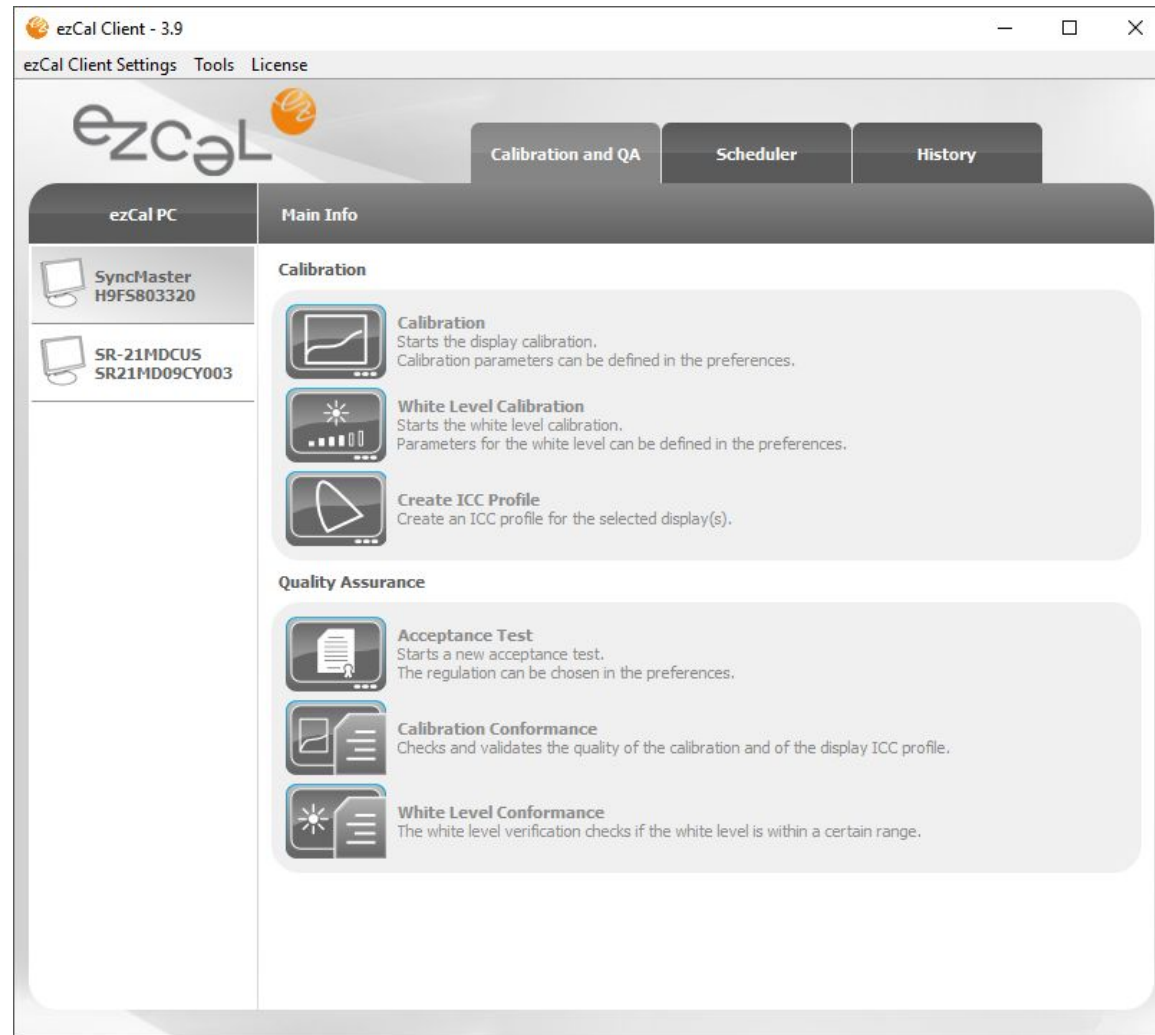
EzCal Main window has 3 Tabs:

- Calibration and QA Tab. Here you can initiate calibrations and QA tasks.
- Scheduler Tab. Here you can manage your scheduled tasks.
- History Tab. Here you can view history data.

In the center of each tab there are buttons or lists of tasks to access all of the functionalities of the software.



1.5.1. Calibration and QA Tab



Calibration: this function allows you to calibrate your display. The software will adjust your monitor based on your selected preferences. First select the display you want to calibrate from the left menu and then click the "Calibration" button.



IMPORTANT: Calibration should always be started on a warmed-up display. Warm-up time is specified by the display manufacturer (minimum 30 minutes).

White Level Calibration: adjusts the white level of your display to the target luminance in candelas.

Create ICC Profile: creates a LUT - based ICC v4 profile of the display with the selected settings of the chromatic adaptation.

Acceptance Test: this task allows you to perform an acceptance test according to one of the following regulations: AAPM TG18, JESRA X, DIN 6868-57, DIN 6868-157, IEC 62563-1 and NY PDM. The function automatically generates schedules for the corresponding conformance tests. You can view the threshold values for each regulation by clicking the "Show Thresholds" button in QA Settings.

If you have already performed the acceptance test(s), you can import it into EzCal with the help of the "Import Acceptance Values" Feature (see section 2.4.2).

Calibration Conformance: The function checks and validates the quality of the calibration and of the display ICC profile according to the preferences you have selected as Calibration targets.

White Level Conformance: verifies the display's luminance level.

All listed above functions (except Create ICC Profile) can also be performed in the demo version, which will be available during 15 days.



1.5.2. Scheduler Tab

Task Type	Device	Scheduled (Date/Time)	Frequency	Last Success
DIN 6868-157 Quater (vis...	SyncMaster H9FS803320	5/24/2017	Quarterly	2/24/2017
DIN 6868-157 Quater (vis...	SR-21MDCUS SR21MD09...	5/24/2017	Quarterly	2/24/2017

In the Scheduler Tab you can see automatically scheduled QA Constancy tasks (depending on the regulation you have selected). It is possible to postpone the scheduled tasks, add, edit and delete locally created tasks.

Constancy test schedules that were created automatically by EzCal software can not be deleted. Also, schedules that were created from the system admin panel on the remote server can be edited and deleted only by the system admin.



ezCal Client

Add Task

Task: Calibration

Display: SR-21MDCUS SR21MD09CY003

Schedule Type: Semiannually

Specify the time and date to launch the task.

Start time: 14:22

Start date: 2/23/2017

Disable Task

Cancel Ok

In order to create a new task click the "Add New Task" button and select the following options: type of task (Calibration, Create ICC Profile, Calibration Conformance, White Level Calibration, White Level Conformance, Display Test Pattern), the display you want to perform the task on, schedule type (Start-up, Once, Daily, Weekly, Monthly, Quarterly, Semiannually, Annually) and the scheduled date and time.

You can also disable tasks - in this case you will not be notified about them by the task notificator. Just check the 'Disable Task' box.

To edit a task, select the task, click the "Edit Task" button or double-click on the task.

To delete a task, select the task and click on the "Delete Task" button.

To launch a new task instantly, select the task and click on "Perform Selected Task Now".

In the search field you can filter task types, displays, dates and frequency.



1.5.3. History Tab

Task Type	Device	Performed (Date/Time)	Result
DIN 6868-157 Acceptance Test	SR-21MDCUS SR21MD09CY003	2/23/2017 2:19 PM	OK
Calibration (DICOM)	SR-21MDCUS SR21MD09CY003	2/23/2017 2:11 PM	OK
Create ICC Profile	SR-21MDCUS SR21MD09CY003	2/23/2017 2:06 PM	OK
Calibration (DICOM)	SR-21MDCUS SR21MD09CY003	2/23/2017 2:00 PM	OK

In the History Tab you can view tasks that were performed in the past. Simply double-click on a task to see the detailed report.



Select a task from the list and click "Perform Selected Task Again" to restart the task.

The search field enables you to filter task types, displays, dates and results.

The 'Show Display Consistency' function indicates white and black levels of a selected display over time on a graph. The graph is shown when enough data is collected (e.g. 2 or more tasks were performed on a display). Note that the data are shown only for connected displays.

"Display Report" shows the option where you can select a time interval and a display for which you want to see a report of all QA tasks performed.

1.6 Do my first calibration:

First select the display you want to calibrate from the menu on the left. After that, click the "Calibration" button. A Wizard will pop up and will guide you in order to customize the calibration process.

Please note that the Wizard will not pop up if you have opened the preferences before.

IMPORTANT: Calibration should always be started on a warmed-up display. Warm-up time is specified by the display manufacturer (minimum 30 minutes).

Select the calibration type by choosing between DICOM, Gamma, CIE L*, BT.709 and BT.1886.

If you want to calibrate the color of the display, check "Adjust Color Temperature" box, select the predefined target value or enter your own value by choosing a "custom" option.

If you want to adjust the white level, check "Set White Level" box and enter the target white level luminance in candelas.

After you customized the calibration settings, place the sensor on the display and start the calibration process. Make sure no ambient light reaches the sensor. After calibration is finished a report will pop up on the screen with the calibration results.



1.7. Do my first QA Acceptance test:

When you perform the first acceptance test a Wizard will pop up. The Wizard will prompt you to select the regulation and the display category. In addition, you have to fill in some information about the location of your workstation and the responsible person. Please note that the Wizard will not pop up if you have opened the preferences before.

The acceptance test consists of two parts: a measurement part and a set of visual tests. The exact tests are determined by the selected regulation. For measurement tests an on-screen or a handheld measurement device can be used. Please refer to the list of supported measurement devices for detailed information.

After the acceptance test was performed, associated Consistency QA Tasks are automatically scheduled.

II. PREFERENCES:

2.1. Application Settings:

2.1.1. Language:

Set the language of the application. Supported languages: English, German, Japanese, Chinese, Korean, French.

2.1.2. Software Update:

Check the "Update Software Automatically" box if you want the software to notify you about new software updates.



2.1.3. Password Protection:

When you check the "Protect Settings by Password" box two fields will appear. Enter a password in the first field and repeat it in the second field.

IMPORTANT: Make sure you note down the password in a secured location for future use, since you can not recover it from the system.

Once the preferences are protected by a password, they can be changed only when the correct password is entered. If the wrong password is entered, the settings are visible, but can not be changed.

2.1.4. Export/Import Common Settings:

Settings of the application can be exported into one file as backup or as "golden" settings. The same settings can be imported into the application from other machines to work with the same settings and to save time during installations.

To export the settings, click on the "Export" button and browse the directory to select the folder where you want to save the settings. To import the settings, click on the "Import" button, browse for the .qbx settings file and click OK.

Please note that the "Display Settings" and the "Remote and Network Settings" will not be recovered. Display settings and serial numbers can differ from each other and the different remote and network settings can be set on different workstations.

2.1.5. Backup/Recover:

This function will back up the entire database with all history data, settings and schedules. Click on the "Backup" button and browse the directory where you want to save the database. Click "Recover" and browse the .qbx database backup file to recover the database.

Please note that the "Display Settings" and the "Remote and Network Settings" will not be recovered. Display settings and serial numbers can differ from each other and the different remote and network settings can be set on different workstations.

Check the "Activate auto backup" box to have the software run an automatic backup every day, week or month. Select the directory where you want the database to be saved.



Note: If the path you've chosen for auto backup is changed (renamed or deleted folder) the path line will become selected with a red frame - choose a correct path for auto backup and save preferences.

2.2. Workstation Settings:

2.2.1. Workstation Name:

The workstation name is read automatically from the system. It can be overwritten to be personalized.

The workstation name can be changed and is used on the remote management server to identify your workstation among the others.

2.2.2. Ambient light:

Ambient Light is the reflection of ambient light on the switched off display panel. Enter a value for ambient light in candelas if you know it, or click the "Measure Ambient Light" button to measure the reflection. During this process the software will switch off the backlight of the panel. You must place the sensor 15 cm away from the display facing the switched off panel. The software will measure the reflection of an ambient light on the display panel.

During the measurement process don't move the mouse and don't hit any keys as it will switch the display back on. Once the measurement is finished the display will be automatically switched back on.

2.2.3. Task Delay:

Check the "Use Scheduler to remind me when Tasks are due" box to program the application to automatically remind you when a task is due. This function can also schedule start tasks automatically. Set the time between 5 and 60 minutes for the display to warm up after the system boot before starting any scheduled tasks.

2.2.4. Sleep Mode:

Check the "Put display to Energy Saving Mode" box to put the display into an energy save mode for a set time period. In the energy save mode the backlight of the display is switched off to save energy and to extend backlight lifetime.



2.3. Calibration Settings:

2.3.1. Calibration Type:

DICOM	Calibrates to NEMA DICOM Part 14 GSDF (Grayscale Display Function)
Gamma	Calibrates towards the gamma function. Enter a value for gamma. Typically Gamma 2.2 is used.
CIE L*	Calibrates to the Color Space Lab of the CIE (Commission Internationale d'Eclairage)
BT.709	Defines the image format parameters and values for HDTV, specifies the opto-electronic transfer characteristics at the source.
BT.1886	Specifies the reference electro-optical transfer function that the displays used in HDTV programme production should follow in order to facilitate consistent picture presentation.

2.3.2. Color Temperature:

Check the “Adjust Color Temperature” box to calibrate the color of the display and to adjust the display to reach target color temperature. You can enter the target color temperature in 3 different ways:

CIE Standard light source color presets	Standard lights between D50 and P93. D65 is the mostly used value and represents daylight.
Color Temperature	Enter a value for color temperature. Color temperature is less precise and doesn't represent a standard like CIE standards.
Advanced settings x and y value	Enter the x and y coordinates of the CIE xyY color space. The values are generally used to match any other device or film.



2.3.3. Gamut:

Check the "Adjust Gamut" box to include a Gamut calibration into the calibration process. Select the predefined color space or enter your own by clicking the "Advanced" button.

2.3.4. White Level:

Check the "Set White Level" box to adjust the white level luminance of the display to a certain value. Enter the target value in candelas into the field.

2.3.5. Black Level:

Check the "Set Black Level" box to adjust the black level luminance of the display to a certain value. Enter the target value in candelas into the field.

2.3.6. ICC/ICM Profile:

If you want to include an ICC Profile creation into the calibration process, check the "Create ICC/ICM Profile" box and select the necessary chromatic adaptation.

2.4. QA Settings:

All information related to the Quality Assurance Regulations is entered in this section.

2.4.1. Regulation:

Select the Regulation you want to use and the Application Category.



Regulation	Category	Application
DIN 6868-57	Mammography	Mammography
	A	Diagnostic
	B	Reviewing
DIN 6868-157	Dental	Dental
	Projection Radiology	Projection Radiology
	Fluoroscopy	Fluoroscopy
	Computer Tomography	Computer Tomography
AAPM TG18	Dental	Dental
	Mammography	Mammography
	Operation Room	Operation Room
	Primary	Diagnostic
	Secondary	Reviewing
JESRA X-0093	Category 1	Diagnostic
	Category 2	Reviewing
IEC 62563-1	Diagnostic	Diagnostic
	Reviewing Monochrome	Reviewing
	Reviewing Color	Reviewing



NY PDM	Mammography	Mammography
	No Mammography	Diagnostic

Click the "Show Tests" button to see QA tests that are part of this regulation.

Click the "Show Thresholds" button to see the thresholds that will be applied during QA tests for this regulation and category.

2.4.2. Import Acceptance Values

Easily import all your previously performed QA tests into EzCal with the "Import Acceptance Values" feature. In order to use this function, please go to Preferences -> QA Settings, select the desired regulation and click the "Import Acceptance Values" button.

Then select a display, date of the test and a name of a tester who performed the test. If the constancy tests have been passed, please set the dates they were performed and check the appropriate boxes. After you have entered the values measured in the imported test(s), click "OK" and wait until the confirmation message appears.



Preferences

ezcal

- Application Settings
- Workstation Settings
- Calibration Settings
- QA Settings**
- Remote and Network Settings
- License and Licensing
- Display Settings

SyncMaster
H9FS803320

SR-21MDCUS
SR21MD09CY003

Quality Assurance Settings (QA)

Used Regulation:

Regulation: Show Tests

Room Class: Show Thresholds ?

Body-region:

Import Acceptance Values

Start daily tests without notification

Workstation Location:

Facility:

Department:

Room:

Responsible Person:

Address:

City:

Email:

Phone Number:

Cancel OK



Import Acceptance Values
✕

Display:

Date of Test:

Tester Name:

Last Constancy Test Execution:

Overall Image Quality 8.2.2 (a, b, c, 1, e, g)	Daily	<input type="text" value="23.02.2017"/> <input type="button" value="📅"/>	<input checked="" type="checkbox"/>
Color impression and uniformity 8.2.4, 8.2.5	Semiannually	<input type="text" value="23.02.2017"/> <input type="button" value="📅"/>	<input checked="" type="checkbox"/>
MultiDisplay Uniformity 8.3.7	Semiannually	<input type="text" value="23.02.2017"/> <input type="button" value="📅"/>	<input checked="" type="checkbox"/>
Maximum, minimum, veiling luminance and maximum luminance ratio 8.3.1, 8.3.2, 8.3.3, 8.3.5	Semiannually	<input type="text" value="23.02.2017"/> <input type="button" value="📅"/>	<input checked="" type="checkbox"/>
Luminance response curve 8.3.8	Semiannually	<input type="text" value="23.02.2017"/> <input type="button" value="📅"/>	<input checked="" type="checkbox"/>
Illumination 8.3.4	Semiannually	<input type="text" value="23.02.2017"/> <input type="button" value="📅"/>	<input checked="" type="checkbox"/>

Values:

Maximum Luminance Ratio ($L_R = L_{max} / L_{min}$)	<input type="text" value="1248"/>
Veiling Luminance (L_{sm})	<input type="text" value="0.3"/>
Maximum Luminance (L_{max})	<input type="text" value="250"/>
Minimum Luminance (L_{min}) (Recommended Performance)	<input type="text" value="0.5"/>
Illumination (lx)	<input type="text" value="10"/>

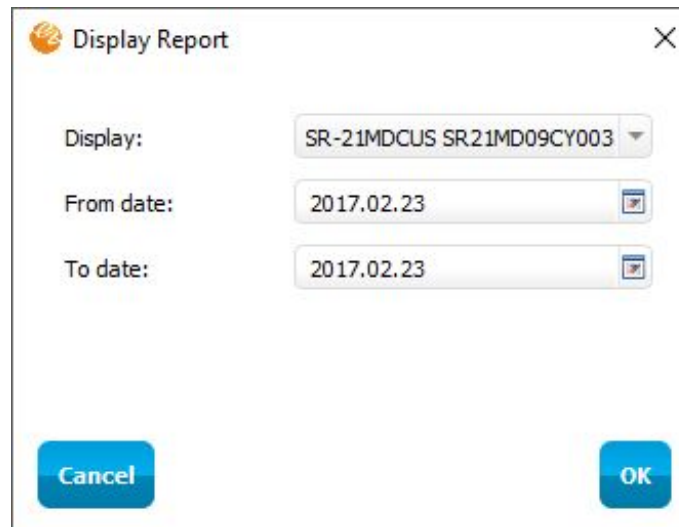
Cancel

OK



In order to view a display report, you need to complete the following steps:

1. Open the "History tab" in the main window of EzCal
2. Click the "Display Report" button
3. Select the display for which you want to get a report
4. Set the time interval and click "OK".





Now you have a report with clear pass/fail indication of test results

Acceptance Test - DIN 6868-157

Test Name	2/23/2017 John
Overall Image Quality 8.2.2 (a, b, c.1, e, g)	Passed
Overall Image Quality 8.2.2 (c.2)	Passed
Overall Image Quality 8.2.2 (d, i)	Passed
Image Geometry 8.2.7	Passed
Grayscale resolution 8.2.3	Passed
Color impression and uniformity 8.2.4, 8.2.5	Passed
Clinical Reference Images 8.2.8	Passed
Pixel Errors 8.2.6	Passed
Pixel Size 8.4-8.5	Passed
Display Resolution 8.4-8.5	Passed
Luminance Uniformity 8.3.6	Passed
MultiDisplay Uniformity 8.3.7	Passed
Maximum, minimum, veiling luminance and maximum luminance ratio 8.3.1, 8.3.2, 8.3.3, 8.3.5	Passed
Luminance response curve 8.3.8	Passed
Illumination 8.3.4	Passed

Note:

If you want to exclude the specific QA or Constancy tests data from the display report, you can click the right button on them in the "History tab" and select the "Disable" option.



2.4.3. Workstation Location:

The workstation location contains the information about the workstation used to perform the tasks (e.g. Display Calibration, QA). Please enter the information regarding your facility, department and room.

Note: this information will be displayed in reports.

2.4.4. Person Responsible:

The person responsible is the person who should be notified if something is wrong with the workstation. Please enter the information into the corresponding fields.

2.5. Remote and Network Settings:

Activate Remote Control for the workstation and connect it to the EzCal Remote Control server.

2.5.1. Enable Remote:

Enter the IP address or the server address like <https://remote.qubyx.com> into the field "Server Address". Enter the username and the password of the EzCal Remote user account and click the "Enable Remote Management" button. When connection is established, a dialog will pop up, asking you to select the workgroup for this workstation. Select the workgroup and click 'Save' - then all the data (schedules, history and preferences) will be immediately synchronized with the remote server.

Note: Remote Admin account needs to be created first on EzCal Remote. In addition to this, you have to create a workgroup, a facility and user accounts on Remote Server in advance.

2.5.2. Remote Database Synchronization:

Select the time interval within which you want to synchronize the databases between the client and the server.

2.5.3. Your Proxy Server:



Check the "Use Proxy" box if you use a proxy server to access the internet. This action is required in order to access EzCal Remote Management server if you do not use it on the intranet and for activating software license automatically via internet.

Note: If the "Use Proxy" box is checked, the license activation will be performed using the given settings.

III. LICENSE AND LICENSING:

3.1. Remote License:

Remote license is included for FREE. You can connect and manage your displays with EzCal Remote server. The following features are also free: Calibration Conformance, White Level Conformance, Display Test Pattern, Measure color.

3.2. EzCal License:

EzCal license is required to perform Calibration and White Level Calibration, QA Acceptance and Constancy tests for AAPM TG18, JESRA X, DIN 6868-57, DIN 6868-157, IEC 62563-1 and NY PDM regulations. In order to activate the license, click the "Add License" button, enter the license code and your email address into the selected fields and click "Activate". The license will be activated if your workstation is connected to the internet. If it is not connected, go to <http://qubyx.com/index.php/register> from any other machine and enter the license code and the ID number from the workstation (visible in the license activation window). You will receive an unlock code. Enter this code into the activation window to activate and unlock the software.

IV. DISPLAY SETTINGS:

The displays connected to the workstation are visible in separate tabs. Select a display to adjust the settings for that specific display.

4.1. Ignore Display:

Check the "Exclude Display from Testing/Calibration" box if you do not want to perform any Quality Assurance tests or calibration on a specified display.



4.2. Calibration Upload:

Calibration upload will select the location where LUT (Look Up Table) will be saved and the exact communication channel that will be used to perform the action.

Note: Calibration upload is detected automatically for each display.

Calibration Upload	Look Up Table is saved in	Used communication channel
Graphics card	Graphics card	Graphics card
DDC/CI	Display	DDC/CI i2c channel
Serial	Display	Serial RS232
USB	Display	USB

4.3. Used Sensor:

Check the "Use Internal Sensor If Possible" box if your display has an internal Front Sensor and you want to use that sensor during calibrations.

Note: The sensor is detected automatically for each display. If this option is missing, that means your display has no Front Sensor available.

4.4. Display Model:

The software will read the model name of the display from its EDID. You can change the model name. The model name will be visible in calibration and QA reports.

4.5. Display Serial Number:



The software will read the serial number of the display from its EDID. You can change the serial number. The serial number will be visible in calibration and QA reports.

4.6. Display Manufacturer:

The software will read the name of the display manufacturer from its EDID. You can change the name. The manufacturer's name will be visible in calibration and QA reports.

4.7. Inventory Number:

You can set an inventory number for the display.

4.8. Type of Display:

Select the type of the display (Color or Gray). Depending on your choice, a different calibration algorithm and a different set of QA tests will be used for this display.

4.9. Display Technology:

Select if the display is a Flat screen, LCD or a CRT screen. Depending on your selection different thresholds in QA regulations will be applied.

4.10. Screen Size:

The software will read the diagonal size of the display automatically.

4.11. Resolution (h/v):

The software will read the horizontal and vertical resolution of the display automatically. The resolution will be documented in QA reports.

4.12. Backlight Stabilization:



Select if the display has integrated backlight stabilization that maintains the white level of the display constant over time. If the display has backlight stabilization the intervals for QA test will be longer.

4.13. Installation Date:

Enter the date when the display was installed.

V. REGISTRATION

5.1. Free and Additional Features:

EzCal has free and additional features. Free features are available as soon as you install EzCal. Additional features can be unlocked by buying the full license.

Free features	Additional features
Calibration Conformance	Display Calibration
White Level Conformance	White Level Calibration
Display Test Pattern	QA Acceptance Tests
Measure Color	QA Constancy Tests
Sync with remote	Create ICC Profiles
3D Gamut Viewer	
History and Reporting	
Task Scheduling	



There are two possibilities to access the licensing part: over Preferences or License section from the main window.

5.2. Licenses Functionality

Function	EzCal Full License	EzCal Demo Period	EzCal Expired Demo Period
Calibrate Display	+	+	-
Hardware calibration and DDC/CI / USB / Serial usage	+	-	-
Adjust White Level	+	+	-
Verify calibration	+	+	+
Verify White Level	+	+	+
Generate Display ICC Profile	+	-	-
Adjust Gamut	+	-	-
Perform Acceptance Test	+	+	-
Perform Constancy Tests	+	-	-
Schedule QA Tasks	+	+	+
Edit Settings	+	+	+
Edit Calibration Settings	+	+	+
Edit QA Settings	+	+	+
Measure Color	+	+	+
Display Test Pattern	+	+	+
Remote Control	+	+	+



Note: Quick access to preferences is Ctrl+P

The screenshot shows the 'Preferences' dialog box with the 'License and Licensing' tab selected. The left sidebar contains a list of settings categories: Application Settings, Workstation Settings, Calibration Settings, QA Settings, Remote and Network Settings, License and Licensing (selected), and Display Settings. Under 'License and Licensing', there are four license options:

- Base License** (Free): License for different kinds of conformance checks, reporting and tools like "Measure Color", "Display Test Pattern", "3D Gamut View".
- Remote License** (Free): Capability of connecting to a remote management web application (Qubyx Remote) for managing a display network easily.
- QA License** (Not Active): License for acceptance tests under different regulations and managing the quality assurance (QA).
- Calibration License** (Not Active): License for different kinds of calibrations.

At the bottom right of the dialog, there is an 'Add License' button. At the bottom left and right of the dialog, there are 'Cancel' and 'OK' buttons respectively.

5.3. License Activation

To activate the Calibration and QA license, click the "License" option in the main window, and select "Registration/Activation". When the Registration/Activation window opens, enter the serial number you obtained when you purchased a license, and choose an activation type.



For automatic online activation, just enter and repeat your e-mail address, and click the "Activate" button.

The screenshot shows the 'Preferences' window for ezCal, specifically the 'Registration/Activation' tab. On the left, there is a sidebar with various settings categories: Application Settings, Workstation Settings, Calibration Settings, QA Settings, Remote and Network Settings, License and Licensing (highlighted), and Display Settings. Under 'License and Licensing', two license entries are listed: 'SyncMaster H9FS803320' and 'SR-21MDCUS SR21MD09CY003'. The main area contains the following steps for activation:


1. Enter Serial Number: LZAU4NFHZZ61
2. Choose Activation Type:
 - Automatic Online Activation
 - Manual Activation
- Email Address: example@qubyx.com
- Retype Email: example@qubyx.com
3. **Activate**

An 'Activate' button is present next to step 3. A smaller dialog box titled 'ezCal Client' is overlaid on the main window, showing a green information icon and the text 'License activated successfully.' with an 'OK' button. At the bottom of the main window, there are 'Cancel' and 'OK' buttons, and a 'Return to License List' button is located near the bottom right.



For manual activation, follow the link and fill out the form that you will find on the website. Enter the generated workstation ID that you see below into the corresponding field of the form. When you submit the form, an activation code will be sent to your e-mail. Enter this code into the field below and click "Activate".

Preferences



Application Settings

Workstation Settings


Calibration Settings


QA Settings

Remote and Network Settings

License and Licensing

Display Settings

 SyncMaster
H9F5803320

 SR-21MDCUS
SR21MD09CY003

Registration/Activation

1. Enter Serial Number:

2. Choose Activation Type:

Automatic Online Activation

Manual Activation

2.1. From any computer go to this link: <http://www.gubyx.com/en/register>

2.2. Enter the below shown ID on the website.

Generated workstation ID:

2.3 An activation code will be sent to your email. Copy that code and paste it here:

Activation code:

3.



When you finish the license activation, all licenses in the Preferences > License and Licensing section will be marked as active.

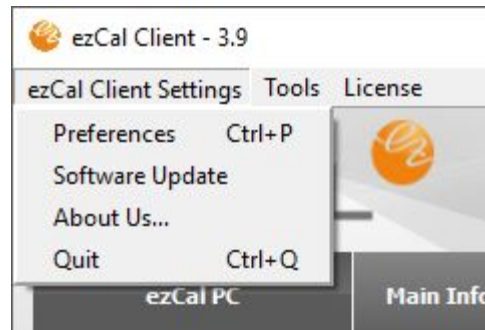
The screenshot shows the 'Preferences' window for ezCəl. The 'License and Licensing' section is active, displaying the following license information:

License Name	Description	Status
<input checked="" type="checkbox"/> Base License	License for different kinds of conformance checks, reporting and tools like "Measure Color", "Display Test Pattern", "3D Gamut Viewer".	Free
<input checked="" type="checkbox"/> Remote License	Capability of connecting to a remote management web application (Qubyx Remote) for managing a display network easily.	Free
<input checked="" type="checkbox"/> QA License	License for acceptance tests under different regulations and managing the quality assurance (QA).	Active
<input checked="" type="checkbox"/> Calibration License	License for different kinds of calibrations.	Active

At the bottom of the window, there are 'Cancel' and 'OK' buttons.



VI. EZCAL MENU ITEMS:



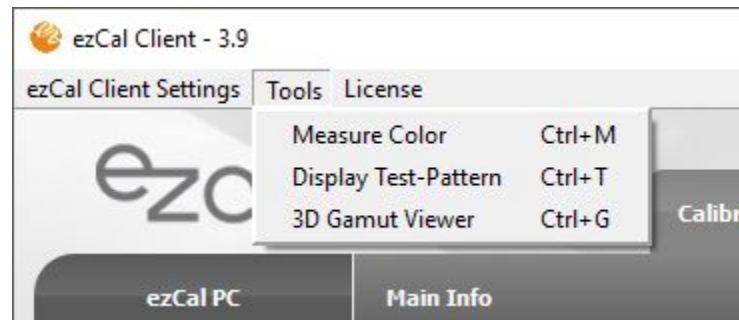
6.1. Software Update

This function checks the server for a new EzCal version. You will get a link to download a new version if there exists one.

6.2. About Us...

The window where you can see our contact information, license agreement, license information and version installed.

Tools:



Tools are accessible in EzCal from the Main Window > Tools

Note: Tools are included for free use.

6.3. Measure Color:

This function will open two windows. In the first window you can start measurement. Mix color and gray levels will be displayed in the second window where measurements are actually performed. First select the RGB color patch with sliders or by entering a number for RGB values. Then place the measurement device on the patch and start measuring. You can perform two measurements, the software will compare them and will display color difference in Delta E with or without L (Luminance).

Note: Quick access to this tool is Ctrl+M

6.4. Display Test-Pattern:

Select the display where you want the test pattern to be displayed and select the test pattern you want to display. Click "View and Check". For displaying a test image that is not in the list, but is available on the system, select "User Image" click View and Check, navigate to your image file and open it. Click on the test pattern or press "Escape" button on your keyboard to close it.

Note: Quick access to this tool is Ctrl+T

6.5. 3-D Gamut Viewer:



This function graphically displays the 3D gamuts of different profiles using the selected color spaces and rendering intents. It is possible to calculate the percentage of Gamut intersection of two profiles.

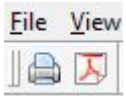
6.6. Notification:

After a task is created, EzCal Task Notification will pop up at the scheduled time provided that the warm up time has expired (see "Use Scheduler to remind me when Tasks are due"). Click the "Perform Scheduled Tasks" button to carry out a scheduled task or "Remind Me In" button to remind the user about the task later. You can also choose the time interval of getting a reminder in the combo box placed near. Closing this window means "Remind Me In" + value that is set in the combo box.

Note: For displays that have Front Sensors, measurement tasks that require no manual interruption (Display Calibration, Display Conformance, White Level Calibration, White Level Conformance and Create ICC Profile) will be started automatically and report will not be shown for the next task to start successfully.

6.7. Report:

After each measurement and QA task you will get a report where you can check your result with more details and graphs, and a summary result (OK or Failed). Reports can also be exported as a .PDF file or printed. Use these two icons:



VII. OTHER

7.1. Matching Multiple Displays

To achieve identical image reproduction on two or more displays connected to one workstation side by side, or several displays connected to different workstations, you will need to adjust such characteristics of the displays as color temperature, white level, and luminance response to the same level.



To match image reproduction on two or more displays, follow this procedure:

1. Make sure all displays are set to the same values over the display OSD. Especially important are the color pre-settings, brightness, and the contrast settings. Doing a factory reset on all displays can be helpful to make sure all of them start from a similar level.
2. Use only one measurement device. Measurement devices, unfortunately, still have considerable deviations when measuring color. So it is recommended to use the same device on all displays.
3. Identify the weakest display. If you want all displays to have the same white level, you need to know which of them has the lowest one and measure it. This white level will become the target value for all displays. It is important to have the same white level on displays that are connected to one workstation and installed side by side.
4. Set your target values for white level, color temperature and luminance response in EzCal Preferences.
5. Perform a display calibration with those same settings on each of your displays.

7.2. Read Me - mass installation of EzCal

Create your "master" settings file

Before performing a mass auto-installation you need to prepare your "master" settings file.

To do this just make ONE usual installation and set all needed configurations in preferences. (**Important:** Do not forget eventual proxy settings if they are used in your network).

Then go again to Preferences > Application and click "Export". The software will create the needed file for auto-configuration. The file extension is .qbx - save the file in your preferred location.

Export/Import Common Settings:

To import settings please push the "Import" button and choose the path.

Import

To export current settings please push the "Export" button and choose the directory.

Export

File name:	Settings_ezCal PC
Save as type:	Settings files (*.qbx)



Installation

On every workstation you will need to:

1. Copy the EzCal installer msi file and the "master" settings file (.qbx) file
2. In console run installation in silent mode (you MUST have administrative rights):

```
msiexec /i [PATH to installer]EzCal_Installer.msi /quiet
```

or if you need specific installation path:

```
msiexec /i EzCal_Installer_v3.0.436.msi /qn INSTALLDIR=D:\Apps\WIDE\EzCal
```

Warning: the installation will not be completely silent - a database will appear for a few seconds. Also the user might be asked to apply drivers installation.

run auto configuration:

```
[PATH]ezcal.exe configure <PATH-to-Settings> [<PATH-to-Log>]
```

Examples:

```
"C:\Program Files\ezCAL\ezCAL.exe" configure default.qbx
```

```
"C:\Program Files(x86)\EzCal\ezCAL.exe" configure default.qbx d:\logs\ezCALlog.log
```

```
"D:\Apps\ezCAL\ezCAL.exe" configure d:\tmp\default.qbx d:\logs\ezCALlog.log
```

run auto registration:

```
[PATH]ezCAL.exe registration <SERIAL> <MAIL> [<PATH-to-Log>]
```

Example:

```
"C:\Program Files\ezCAL\ezCAL.exe" registration 012XERT2ASDF admin@hospital.co.uk d:\logs\ezCALlog.log
```



run auto remote enabling:

```
[PATH]ezCAL.exe remote <SERVER> <LOGIN> <PASSWORD> <GROUP_NAME> [<PATH-to-Log>]
```

Example:

```
"C:\Program Files\ezCAL\ezCAL.exe" remote "http://remote.ezCAL.com" testuser testpassword "our group" d:\logs\ezCALlog.log
```

Notes:

<PATH-to-Log> - is an optional parameter in all commands

<GROUP_NAME> - is the name of a workgroup you want to connect your machine to. Case insensitive, but sensitive to the whitespaces

7.3. EzCal Remote: System Administrator Guide

System Requirements

Virtual Machine (VM) is provided as an OVA package. So, you need virtualization software, which supports OVF (Open Virtualization Format) and .vmdk disk images. Oracle VirtualBox is the preferred choice for running this VM. However, you can also use VMware products.

About 550 Mb of free space is needed for an OVA package and minimum 2 GB needed for VM production use (1.5 GB base system and 500 Mb for database and backups). Note that database and backup images are constantly growing, so you may consider having more free space in advance.

1. Installing and configuring VM

You should use the "Import Appliance" option from the "File" menu of Oracle VirtualBox Manager in order to install VM. All required settings are predefined. However, you may tune some settings, such as amount of memory, to better fit your requirements. We recommend to select the correct network card in virtual machine settings (network tab) before the first start.

After successful installation you may safely start VM. You may log into console when the login prompt appears. You need to do this in order



to check or set up an IP address for VM.

It takes IP address via DHCP by default, but you may want to set a static one.

2. TCP/IP Settings

In order to find VMs current IP address you need to complete following steps:

1. Log in as root (find passwords in "Default Settings" document).
2. Run "ifconfig" command and find "inet addr" for eth0 interface in its output.

Now, when you know the IP address of VM, you may use it to log in via SSH or Webmin. Note, that "root" user is not allowed to log in via SSH, so you should log in as "perfectlum" and then use "su" command with a root password.

In order to set a static IP address or change other network configuration settings you should modify "/etc/network/interfaces" file. You can find a full description of "interfaces" file in "Network Configuration" article from Debian (http://wiki.debian.org/NetworkConfiguration#Setting_up_an_Ethernet_Interface).

The alternative way recommended by us is to change system and network settings is Webmin (check Default Settings document for Webmin URL). You may change boot-time network settings by selecting "eth0" interface at "Network Interfaces" section of "Networking -> Network Configuration" menu.

Both "console way" and "Webmin way" are described for next tasks.

3. Configuring firewall

VM comes up with small set of predefined rules, which are stored at "/etc/iptables/rules" file and executed at boot-time. In order to modify these rules you should edit firewall initialization script "/home/perfectlum/bin/perfectlum-firewall" and then execute it. However, you may edit "/etc/iptables/rules" directly or via Webmin, but "perfectlum-firewall" script is the recommended way to update firewall rules.

Console



```
# nano /home/perfectlum/bin/perfectlum-firewall
```

Modify firewall rules and save changes

```
# /home/perfectlum/bin/perfectlum-firewall
```

Webmin

Use "Linux Firewall" option of "Networking" menu.

4. Mail delivery settings

You may want to provide an SMTP server address if you want to receive email notifications from EzCAL Remote Management. The only way to do this is updating the Exim configuration. Exim is the MTA (Mail Transport Agent) software, which is responsible for mail delivery. Open `/etc/exim4/update-exim4.conf.conf` file in a text editor and set `dc_smarthost` directive value to your SMTP server IP-address or hostname. If your SMTP server uses a non-default port you may define it using `::` (two colons). Example:

```
dc_smarthost='smtp.googlemail.com::587'
```

If your SMTP server requires authentication, you should define credentials in the `/etc/exim4/passwd.client` file. To do this just open `/etc/exim4/passwd.client` in a text editor and add a new line with your credentials using the following format: `smtp_server:login:password`. Example:

```
smtp.googlemail.com:perfectlum@example.com:examplepassword
```

When all changes are done you should run the `update-exim4.conf` script to generate new configuration files and then restart Exim.

Console

```
# nano /etc/exim4/update-exim4.conf.conf
```




Modify configuration files according to your needs

```
# nano /etc/exim4/passwd.client
```

Write credentials here if your SMTP server requires authentication

```
# update-exim4.conf  
# /etc/init.d/exim4 restart
```

Webmin

There is no possibility to do this in Webmin

5. Managing backups

VM is doing automatic database backups every night. Backup starts right after the midnight. Backups older than 7 days from the current date are removed automatically.

Backups are stored at `"/home/perfectlum/backups"` in a separate disk image. So, you can even attach a physical partition or hard drive, if you need more space for backups.

You may use `"perfectlum-restore"` script to restore database backup for particular date. Be careful, because `"perfectlum-restore"` overwrites your current database.

To restore database backup just run `"perfectlum-restore"` with full path to backup the file you want to restore.

Example:

```
/home/perfectlum/bin/perfectlum-restore /home/perfectlum/backups/2011-01-01-perfectlum-mysql-backup
```

Don't forget to restart MySQL when restore is finished. Simply run the following command:

```
/etc/init.d/mysql restart
```



Default Settings

Default System Accounts

System Administrator account

Login: root
Password: vb903lejMPk1

Default unprivileged account

Login: perfectlum
Password: plumadmin2912

MySQL Accounts

MySQL Administrator account

Login: root
Password: bemy349R00t

PerfectLum Database account

Login: perfectlum
Password: elj390g#\$J@ld0289

Use "perfectlum" MySQL database while installing Remote Management.

Firewall Settings



New incoming connections are accepted for the following TCP ports:

20, 21, 22, 80, 443, 11001

New incoming connections are accepted for the following UDP ports:

68

All other new incoming connections which do not satisfy the stated rules are rejected.

All new incoming connections from localhost are accepted.

All outgoing connections are accepted.

Webmin

Webmin is a web-based interface for system administration for Unix. Using any modern web browser, you can setup user accounts, Apache, DNS, file sharing and much more.

Webmin is listening 11001 TCP port. Point your browser to "http:// VM_IP_ADDRESS:11001" and log in using one of default accounts to use it.



EzCal Remote site configuration

Enter the IP address (static IP or DHCP) in your browser.

A setup screen, where you can set the name, password and email of "Super Admin", will appear.

Then click "Install". If the installation was successful, a congratulation screen will show up.

Database settings	
DB Host:	<input type="text" value="localhost"/>
DB User Name:	<input type="text" value="root"/>
DB Password:	<input type="text" value="123123"/>
DB Name:	<input type="text" value="perfectlum"/>
DB Table Prefix:	<input type="text" value="vqr_"/>
Super Admin settings	
Full name:	<input type="text" value="Super Admin"/>
Login:	<input type="text" value="admin"/>
Password:	<input type="text" value="admin"/>
E-mail:	<input type="text" value="admin@192.168.1.9"/>
<input type="button" value="Install"/>	

Before you can connect workstations to Remote, some preparations are necessary:

- In EzCAL Remote, go to the "Setup" tab and then to:
 - Facilities - create a new facility (e.g. NYU Medical Center)
 - Workgroups - create at least one workgroup (e.g. CT, Radiology, etc.)
 - Users - create an admin user
- Now you can connect from client application EzCAL to EzCAL Remote New:
 - open preferences and go to "Remote and Network Settings"



- enter EzCAL Remote IP as "Server Address"
- enter the admin user you have created and the password for this admin user
- click on the "Enable Remote Management" button.

That's it. Now your workstation is connected to EzCAL Remote and will synchronize its data at certain intervals, which are set in the same dialog.

7.4. Acronyms

DICOM	Digital Imaging and Communications in Medicine
GSDP	Gray Scale Display Function
CIE	Commission Internationale d'Eclairage
BT	Broadcasting service (television)
NEMA	National Electrical Manufacturers Association
AAPM	American Association of Physicists in Medicine
DIN	Deutsches Institut für Normung
IEC	International Electrotechnical Commission
NY PDM	the New York state Primary Diagnostic Monitor (PDM) Quality Assurance Program
JESRA	Japanese Engineering Standards of Radiological Apparatus
LUT	Look Up Table
DDL	Digital Driving Levels
JND	Just-Noticeable Difference
OSD	On Screen Display

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