lightSTUDIO

User Manual

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1 INTRODUCTION

lightSTUDIO is a light box for the illumination of a scene with different standardized light types.

There are two types of light heads available, the Standard lightHEAD and the LED lightHEAD. The basic version contains six light sources: F11 (4000 K), F12 (3000 K), D50 (5300 K), D65 (6500 K), Halogen, and Halogen with blue filter (~10000 K). All light sources can be dimmed from 1-100% to set an appropriate light level. The LED version uses 20 narrow band and two white LED channels for the creation of almost every desired spectral distribution. A spectroradiometer provides feedback to the control software in order to ensure a reliable reproducibility of spectra and intensities. Spectral distributions can be changed rapidly within 25 ms.

lightSTUDIO-M is an extension with two moving targets, a horizontally moving frame, which can be equipped with any kind of test chart and a rotating plate on the back wall, which can also carry different kinds of round test charts. The velocity of both moving options can be varied over a wide range.

The HDR option adds the capability to generate high contrast scenes in the center part of the back image. Two LG4 light boxes can produce a contrast ratio of up to 10,000:1 when the surrounding illumination is dimmed. They can be equipped with different transparent test charts.

All variants of lightSTUDIO are equipped with interior objects which represent a wide range of real-world situations. Amongst these is, for example, a ColorCecker for measuring the color reproduction and the white balance.

lightSTUDIO can be controlled in all its combinations by a software using a USB connection to a Windows PC. The Standard lightHEAD is also controllable with a panel on its front side.

Notes for reading this manual:
Numbers in square brackets [ ] in the text refer to the red numbers in the images.
Text in italics refers to labels on control elements of the software.

Definition:
The term illuminant in the context of the lightSTUDIO is used as follows: The combination of a relative spectral response curve (predefined or measured) and an illumination value in lux, which is achieved at a dedicated position in the light box. This information is saved in a proprietary file format with file ending .iqilluminant. Illuminants must be generated before the LED lightHEAD can be used.
2 ADDITIONAL HARDWARE

Depending on the equipment of the lightSTUDIO some additional hardware is delivered. The lightSTUDIO-M includes also a timecode display and a mechanical finger, the iQ-trigger.

2.1 iQ-TRIGGER/iQ-TRIGGER-T

iQ-Trigger is a mechanical finger, which can be used to press the release button of a camera in a reproducible way. iQ-Trigger is shipped with a hydraulic adjustment arm that holds the iQ-Trigger and an L-shape holder on a mounting plate (Manfrotto Type 405 mounting plate). The L-shape holder can be mounted to a geared head or a tripod with the Manfrotto RC4 rapid connect system. The adaptor plate has a ¼” screw for compact cameras. The iQ-Trigger comes with two different fingers: A solid finger for general use and a finger with a touch-pen tip. To exchange the fingers, tighten the knurled screw at the back of the iQ-Trigger until the magnet is locked, then screw off the finger and replace it with the other one. Untighten the knurled screw again. When using the touch-pen finger, please keep in mind that the front foam adds some extra delay. Also use the knurled screw on top of the iQ-Trigger to adjust the travel distance of the finger. The further the screw is turned in, the shorter the distance the finger has to move. As a general rule, try to set the travel distance as short as possible. A smaller travel distance implies more power and less delay. iQ-Trigger is controlled with the software (chapter 4.5.2.3).

The iQ-Trigger-T is intended for use with touch screens on mobile devices. Please read iQ-Trigger manual for further information on iQ-Trigger-T usage.

For use with the lightSTUDIO-M, plug the cable of iQ-Trigger or iQ-Trigger-T into the corresponding 6,3 mm port of the electrical control cabinet of the lightSTUDIO.
2.2 TIMECODE DISPLAY

The timecode display is used for tracing movement and illumination scenes over time. For example, the movement of the horizontal test chart in the Moving lightSTUDIO may be scrutinized for artefacts in captured images or videos. Another possible application might be the examination of changes in the adaptation of the camera to rapid light changes with the LED lightHEAD. The timer also has a counter mode to enumerate different capture scenes. For an example see sample video on the Image Engineering website (go to Products -> Equipment -> lightSTUDIO and then at the bottom to “Product video”).

The timecode display shows the time in the format MM:SS.MS [1]. The maximum time is 99 min, 59 s, 999 ms. Bars with each 50 LEDs are placed above and below the digits [2, 3]. The flashing LED ticker denotes the progress in units of 1/100 s, thus all 100 LEDs are illuminated subsequently 1 time per second.

To start operation connect the timecode display with the power supply [9]. With the remote push buttons for resetting and starting/stopping [7, 8], the display can be operated remotely from outside the light box. For use with the software also connect the display with the USB cable to the electrical control cabinet (see chapter 4.5.4).

With the “Mode” button [5] the display can be switched between counter and timer functionality. In timer mode the external push button connected to jack plug “Start/Stop” [8] toggles between running and pausing. In counter mode the button is used for incrementing. In both modes the display can be reset with the built-in reset button [4] or the external reset button connected to jack plug “Reset” [7].

For use with the lightSTUDIO-M, plug the USB cable of the timecode display into the corresponding USB port of the electrical control cabinet of the lightSTUDIO.
3 USAGE WITHOUT SOFTWARE

Depending on the chosen combination, some parts of the lightSTUDIO can be used without the software. The lightHEAD-S and lightHEAD-L are equipped with a control panel on the front side, which comprises the switching of light sources, the adjustment of intensities and the ability to store the intensity value for each light. The translation and rotation of the lightSTUDIO-M is only accessible by means of the software. The timecode display may be also used as a stand-alone device (chapter 2.2).

3.1 STANDARD LIGHTHEAD (LIGHTSTUDIO-S)

For the initial operation, select a light source by using one of the push-buttons [2, 3] after turning the power supply on. Press the button “Light ON/OFF” [1] to illuminate the corresponding light source.

The control panel has eight knobs for switching the lights: four for the fluorescent lamps F12, F11, D50 and D65 [3] and four for the halogen lamps [2]. The latter have different preset values for the intensities of 10 lx, 100 lx and 400 lx and one for 400 lx with blue filtering. The knobs for the three halogen settings use the same lamp type but with different current supply. With the rotary knob [4] the intensity for all light sources can be varied from 0 to100 % in 1% steps.

To store an intensity setting for one type, keep the corresponding knob pressed and press the “Store” knob [1] until the display shows the result.

With the knob “LCD backlight” [5] you can adjust the background lighting of the display panel.

Note:
Only one light source can be illuminated at the same time.
It may take some minutes until the color temperature and illuminance of the lamps are reliably stable. All values measured in the acceptance protocol were measured 3 minutes after switching the lights on.
3.2 LED LIGHTHEAD V2 (LIGHTSTUDIO-L)

The lightHEAD with iQ-LED V2 technique adds more functionality and a wider illuminance range (25 - 2000 lux) to the previous lightHEAD version. See datasheet for more technical information. The lightHEAD incorporates a control panel, which enables the user to use it without connection to a PC.

Usage of control elements:

1. Hold power switch for two seconds to turn LED light on and off.
2. Switch between 44 stored illuminants. Use iQ-LED software > V3.0.0 to generate and store illuminants on the lightHEAD.
3. Plays and interrupts a sequence of illuminants. Use iQ-LED software > V3.0.0 to generate and store a sequence on the lightHEAD. By default there are three illuminants stored at delivery of device: A, D50 and D75 with intensities as noted in the acceptance protocol.
4. Displays the memory slot number of an illuminant. Read the instructions in the manual of the iQ-LED software to see how the number is assigned to an illuminant.
5. The Trigger Out socket can not be controlled with this software. It is automatically triggered when illuminants are switched. The duration of the output signal (short circuit) is 500 ms. A 3.5mm mono jack can be plugged into the socket. An additional iQ-Trigger USB box may be connected here.
6. Power and intensity control knob for fluorescent lamp F11. Press button to turn and off lamp.
4 SOFTWARE DOCUMENTATION

4.1 INTRODUCTION

The lightSTUDIO is a Windows software and is designed to control the lightSTUDIO and its components (Moving target option, Standard or LED lightHEAD, HDR box, timecode display and iQ-Trigger). Each part can be accessed and controlled separately. Moreover, sequence lists can be created for simultaneous processing including test chart movements, illumination with the lightHEADs and HDR box. The graphical user interface (hereinafter referred to as GUI) offers a complete overview of all components at the same time and a quick access to make your workflow with the lightSTUDIO as intuitive as possible. Each component works as a plug-in for the software, which means, that the software switches the corresponding module in the GUI on or off, when a device is connected or disconnected.

The GUI display of a lightSTUDIO-LMH with LED lightHEAD, HDR box, moving test charts, iQ-trigger and timecode display.
4.2 INSTALLATION

Choose the proper installer (32 or 64 bit) for your Windows operating system and run it. During installation some drivers and further software are installed. For proper function of the software allow all drivers and software to be installed. The software installations include:

- Microsoft .NET Framework
- Java 7 Runtime

4.3 SETTINGS

4.3.1 MOVING OPTION SETTINGS (LIGHTSTUDIO-M)

In the Moving option settings dialog, specifications can be modified for some components of the Moving lightSTUDIO.

The default translation velocity [1] defines the transportation speed of the moving test chart in the range between 0.01 and 3.0 m/s. This value is used for the movement when clicking the move left, move home or move right buttons and as speed for the return movements of a sequence.

The iQ-Trigger mode menu [2] offers three options for the behavior of the iQ-Trigger:

- **One-shot mode**: iQ-Trigger is released once with the start/stop button and stays activated with a predefined duration time as edited in the corresponding field below.
- **Toggle mode**: iQ-Trigger is released by clicking the start/stop button and stays activated until next click on the button.
- **Continuous mode**: iQ-Trigger is released by pressing the start/stop button and stays activated until button is released.

The iQ-Trigger release time [3] denotes the duration of iQ-Trigger release when the one-shot mode is selected. Minimum time is 0.1 s.
4.3.2 TIMECODE DISPLAY SETTINGS (LIGHTSTUDIO-M)

The Connect timecode display with sequence tool [1] option allows the time code display to start simultaneously with sequence. The delay time [2] defines a time lag after which the display starts.

4.3.3 LED LIGHTHEAD SETTINGS AND CONTROL

With the LED lightHEAD more functionality and flexibility is available in comparison to the Standard lightHEAD. The iQ-LED technology allows to generate individual illuminants with predefined illumination values and to switch between the different illuminants very rapidly.

Calibration:
Before using the LED lightHEAD, it needs to be calibrated. The procedure described below must be undertaken in a dark surrounding without any stray light entering the light box. Also ensure that the aperture of the built-in spectrometer in the bottom plate is not covered. Both steps, illuminance adjustment and spectral calibration, should always be performed combined and in the same order.

Spectrometer setting: For all lightSTUDIO-L V2 versions the integration time for the spectrometer must be entered here. Take the value from the acceptance protocol and round it to integer number:

| Spectrometer setting (Integration time): | 80,19 ms | (Sample value) |
For all other version the displayed value can be used. It should then only be adjusted to lower values in case the following procedure emits a saturation overflow error.

The **Illuminance compensation** is necessary in order to regulate the deviation of the illuminance measurement of the spectrometer, whose aperture is placed in the bottom plate of the light box. The maximum achievable lux value as noted in the acceptance protocol of your lightSTUDIO however is measured at a different position (see next paragraph).

Follow these steps for adjusting the illuminance:

1. Enter a lux value into field [2]:
   a. The initial measurement from acceptance protocol (example):
      iQ-LED lightHEAD V1:

      | Illuminance calibration value [lx]: | minimum: 300 | 340 lx |

      iQ-LED lightHEAD V2:

      | Measurement head of luxmeter centered in lightStudio: | yes |
      | Illuminance measurement for compensation factor [min. 1000 lx]: | 2090 lx |
      | Compensation factor set: | yes |

   b. An individual lux measurement: Switch specified illumination on with button [3]. Measure the illuminance with a luxmeter at any reasonable position inside the light spectrometer aperture.

   *The initial illuminance measurement was performed at 25 cm distance from front side.*
box. Wait at least 5 seconds before metering the illuminance value (in units of lux). Type the lux value into the corresponding field [2]. Click the Calculate button [4] and confirm the following dialog. The adjustment procedure takes 5 seconds.

**Spectral calibration:**
The second step is to calibrate the spectral characteristics of the LED lightHEAD and the dark level of the spectrometer. Click the Calibrate button [5] for this procedure and confirm the following dialogs. The calibration procedure takes about one minute. If the calibration was successful the calibration date is displayed. The calibration result is also visible in the corresponding module of the software (see chapter 4.5.3.2). Reasons for a potential failure of the calibration may be too much ambient light.

Recommendations for calibration repetition:
During the first 600 working hours of the lightSTUDIO perform a spectral calibration every 50 operating hours.
After the first 600 operating hours a calibration of every 150 working hours is sufficient.

**Illuminant creation:**
Illuminants are the essential basis for illuminating the LED lightHEAD. They consist of a relative power spectral distribution in the visual range from 380 nm to 780nm and an illuminance value (measured in cd/m² or lux) . These illuminants can be saved as files and loaded if they were generated with other Image Engineering software, like iQ-LED . Illuminants can be imported for the use in the lightSTUDIO software. Click Import… [6] and select .iq illuminant files for import.
Individual illuminant creation:
1) For the creation of a new illuminant select a desired standard spectrum[8]. Available are: 3200BB (imitation of black body radiator with 3200 K), A, B, C, D50, D55, D65 D75 and 3200 BB. For more details on standard illuminants see Image Engineering website (go to Library /Technotes/CIE standard illuminants).

It is possible to create individual spectral distribution files. Open a sample file in the directory of the software: C:/Program Files/Image Engineering/lightSTUDIO<Version number>/spectra with a text editor. You may create a text file with the same formatting and you own spectral distribution. The intensity values in the second column may be scaled relative (0…1) or in absolute values. The wavelength values must be scaled in 5 or 10 nm increments in the range 300 – 830 nm, the range may be smaller but not greater. Store the new file in the same directory; after restart of the lightSTUDIO software the new file will be listed in the menu with the name as entered in the tag “NAME”.
The selected spectral distribution is displayed [9].

2) Enter a desired illuminance value [10]. The value refers to the position defined in the lux measurement described above.

3) Click Verify value [11]. The software verifies if the desired illuminance value can be achieved
with the selected spectral distribution. If this aim cannot be reached the maximum achievable illuminance value is returned.

4) Click *Create illuminant* [12]. This procedure takes several seconds and stores the illuminant permanently. The illuminants are available for use in the corresponding module (chapter 4.5.3.2).

### 4.4 HARDWARE STATUS BAR

The status bar gives information about the connected hardware components. If a component is available in your lightSTUDIO configuration it is highlighted in green. The release state of the safety clamp is also displayed.

**Note:**
If the safety clamp is pushed in, the internal control unit stops the power supply to the motors immediately. In the software, all buttons for the translation or rotation functions are disabled. Pull the clamp out until it reaches the stop position in order to enable usage of the translation and rotation functionality.
4.5 **MODULE OVERVIEW**

Each component of the modular lightSTUDIO can be controlled separately. The plug-in mechanism of the software only displays modules that have a connection to the corresponding hardware device. If a device is connected during runtime the module appears in the GUI.

### 4.5.1 SEQUENCE LISTS

Each hardware control module in the software, except the timecode display, has five buttons and a table for sequence editing. Lists for sequences of movements, rotations, iQ-Trigger releases, and illumination (lightHEAD and HDR option) can be edited with a table, modified and saved for reuse. All sequence lists can be executed simultaneously.

When the button [1] is activated the sequence is started by clicking the play button (chapter Sequence player). As long as button [1] is activated none of the control items in each module can be used in order to avoid disturbance of the sequence. If the loop-button [2] is activated, the complete sequence list for this component of the lightSTUDIO is repeated infinitely until the user stops the sequence.

For editing the list there are three buttons: a new row is added to the table with the button “+” [3]. Button [4] deletes a selected row and button [5] clears the whole table. Move mouse cursor over info button [6] in order to display some useful technical data about the corresponding device.

While editing the fields of a table, the values are validated for wrong input. Velocities in rotation and translation are verified for applicability (see data sheet for limits) and times are checked for overlapping ranges. The numbers entered may have a decimal notation using a ‘.’ or a ‘,’. Missing values are highlighted in red. The buttons [1] and [2] are only enabled if the table is complete. All sequences can be added to sequence tool in every desired combination.
All lists can be saved and opened in the File menu or with the keyboard shortcuts \texttt{ctrl + S} and \texttt{ctrl + O}.

4.5.2 MODULES FOR MOVING OPTION

The lightSTUDIO-M incorporates three functionalities: the translation chart, the rotation chart and the iQ-Trigger. Thus three modules are displayed in the software for controlling these devices. The iQ-trigger is connected to the lightSTUDIO directly without the iQ-Trigger USB box, which is part of the lightSTUDIO-M. With the USB box, the iQ-Trigger may be used as a stand-alone device. See the documentation of the iQ-Trigger for further details.

4.5.2.1 TRANSLATION

Each time the program is started, a calibration movement of the (translational) chart must be performed in order to define a so-called home position for the motor control. Click the home button [1] to start the procedure: the chart moves to the center and then to the final destination on the right side. This procedure can be performed at any time; it is obligatory in the following cases:

- The main power of the lightSTUDIO is turned off during runtime of the program
- The safety clamp is released
- One of the emergency stop switches of the lightSTUDIO is released.

Now all other functions are enabled. With the right [2], center [3] or left [4] buttons the chart is moved to the very right, center and very left position with default velocities (see chapter 4.3.1).

In the sequence table, translational movements for the test chart can be edited. In the velocity column, values between 0.001 and 3.0 m/s can be entered. In the direction column movements from left to right or reverse are available. If two subsequent directions in the list are equal, a return movement is inserted with a default velocity as defined in the settings (chapter 4.3.1).

\textbf{Note:}

In comparison to the illumination list or the rotation list, a translation of the test chart is not triggered by start and end times but only by the velocity setting. Due to varying acceleration and deceleration of the motor, the duration for one period can only be estimated. The progress bar for the translation gives you a hint of how long it lasts, but may not be highly exact.
4.5.2.2 Rotation

In the sequence table, movements for the rotating chart can be edited. There are three columns available, the first contains the start times, the second the end times for a period of rotation and the last column the velocity in revolutions per minute (RPM). The velocity must be in the range between -360 and 360 RPM. Positive values let the plate rotate counter-clockwise, negative values clockwise. The periods must not overlap in time and negative times are not allowed, a message dialog is displayed if a time value entered is invalid. In order to insert a break of rotating, enter a later start time for a specific period than the end-time of the precedent period. Inserting a row with velocity 0 has the same effect.

4.5.2.3 iQ-Trigger

The iQ-Trigger device allows you to release your camera button with the software. You can release iQ-Trigger with the play/stop button [1] depending on the settings in the options menu (chapter 4.3.1) in one-shot, toggle or continuous mode. A status bar at the bottom displays the progress of the iQ-Trigger in released state. In the sequence list time stamps for the release of iQ-Trigger can be edited. At each time stamp iQ-Trigger is released for the time defined in the settings (chapter 4.3.1).
Note:
Due to mechanical construction, the mechanical finger of iQ-Trigger is limited in continuous operation:
- Maximum time in released state: 60s
- Shortest release time: 100ms
- For continuous operation the duty cycle must not be longer than 50% (duty cycle = the ratio of release time to period).
The mechanical finger may be heated up or even destroyed if operated for a long time in released state without interruption.

4.5.3 MODULES FOR ILLUMINATION

There are three illumination devices available: the Standard lightHEAD and the LED lightHEAD and optionally there is the HDR kit with two LG2 light boxes available. All three have their own panels in the software.

4.5.3.1 STANDARD LIGHTHEAD

If a Standard lightHEAD head is delivered with your lightSTUDIO, the illumination module enables you to switch the corresponding lamps on and off [1] and to set the intensity [2]. Only one lamp type can be illuminated at one time, hence it follows that switching one lamp type on, turns all others off. There are 6 types of lamps: F11, F12, D50, D65, Halogen (H) and Halogen with blue filter (H_b.f.). Clicking a button for a lamp type at first run of the program turns the respective lamp on with an intensity of 100%. If the intensity is varied with the slider or the input field [2], the value is stored during runtime, thus setting a lamp to this intensity when turned on again.

The sequence list shows four columns. The first and second columns define the start- and end-times of a period. In the third column, the lamp type is selected. In the fourth column the intensity can be varied between 0 and 100%.
Note:
For sequences, operating times of less than 3 seconds are not advised since switching the lamps takes some time (1…3 s depending on lamp type). Thus rapid changes may lead to omitted periods. It is important to keep in mind that it takes a couple of minutes until the color temperature and illuminance is reliably stable for all lamp types. All values measured in the acceptance protocol were measured 3 minutes after switching the lights on.

4.5.3.2 LED lightHEAD

The LED lightHEAD enables you to create individual light types with the built-in iQ-LED technology. Besides the 10 iQ-LED devices there is an additional fluorescent lamp of type F11 mounted into the LED lightHEAD by default. This lamp can be switched on and off with button F11 [5] and its intensity varied with a slider [6] and a value input field [7]. During a sequence play back this lamp is turned off in order to attain the selected spectrum and illuminance.

For sequences all illuminants created in the illumination settings panel (chapter 4.3.3) are available in the third column of the sequence list. Add a start and end time to complete one illumination period. Since switching time between illuminants is very fast periods down to 50 ms are possible.

Underneath the table, information about existing spectral calibration and illuminance adjustment is displayed [2] (see chapter 4.3.3). It is possible to switch the selected illuminants on and off by enabling this functionality with the lamp button [4]. Click on one of the selected illuminants in the list to turn it on.

The temperatures of the iQ-LED modules have impact on the temporal stability of the selected spectra. The optimal operating temperature is between 33 and 36 °C, thus the lightHEAD needs generally be warmed up before usage. In the panel the temperature of the coldest module is displayed [3]. Click the button to the left of the temperature display to show a more advanced view. The thermometer is colored blue, if the
(coldest) module is below the working temperature, green in the working range and red, if the temperature exceeds the working range. To accelerate warm-up click the lamp button to the right of the thermometer – all iQ-LED modules are switched on with all 22 channels set to 100 % illumination. When the lower temperature threshold is reached the modules are switched off. Click the thermometer button to the right in order to view the temperatures of all 10 iQ-LED modules.

4.5.3.3 HDR BOX

The HDR box can be used to generate illumination ratios for measurements of High Dynamic Range scenes. The new generation of the built-in LG4 devices allow to create an illumination ratio of up to 1:65000 inside the lightSTUDIO box.

LG2 DEVICES (UNTIL JANUARY 2018)

The HDR module in the software enables you to control both LG2 lamps of the HDR box. The upper lamp is switched on with button [1] and the intensity controlled with a slider or an input field [2]. The same applies to the lower lamp, buttons [3] and [4].

For both lamps separate sequence lists are available. Activating the sequence or looping functionality applies for both lamps. Enter start and end times as well as the intensity from 0…100 %.

Take into account that switching the LG2 on and off lamps takes 1…2 s, thus shorter periods are not advisable and may be omitted in the sequence player.
LG4 DEVICES (SINCE DECEMBER 2018)

Each LG4 device in the HDR box is equipped with 432 white LEDs with a Color Temperature of approximately 5000K. It has two power modes, “normal” and “low”, which can be switched in the panel. See data sheet of LG4 for further details.

The (upper) LG4 lamp is switched on with button [1] and the intensity can be controlled with a slider or an input field [3] and [4]. The same applies to the lower LG4 lamp on the right side. Switch between low and normal mode of lamp with radio button [2]. In low mode the maximum intensity of the lamp is approximately 10% of the maximum intensity in normal mode. In both cases intensity can be tuned from 1 to 100% in 1% increments.

For both lamps separate sequence lists are available. Activating the sequence or looping functionality applies for both lamps. Enter start and end times as well as the intensity from 0…100 % depending on selected mode.

4.5.4 TIMECODE DISPLAY

The module for the timecode display (chapter 2.2) offers two operating modes: timer and counter. Switch between the modes with menu [1].
**Timer mode:** Start and stop the timecode with the *start/stop* button [2].

Clicking the reset button [3] resets the timecode display to 00:00.000. A status bar at the bottom of the module denotes a currently running timecode display. In the three fields for setting a start time [4] the timer can be set to: minutes from 0…99, seconds from 0…59, milliseconds from 0…999. If option “Connect time code display with sequence player” is activated in the settings (chapter 4.3.2) the timecode display starts with the entered start time.

**Counter mode:** The display works as a counter. With the up- and down buttons [5] you may count up and down one digit. Or enter a number from 0 to 65535 in the text field [6].

### 4.5.5 Module Spectral Measurement

The spectral measurement functionality is only available with the LED lightHEAD. The spectrometer is built into the bottom plate of the light box in the bottom plate. Click button *play/stop* [2] for switching permanent spectral measurement on and off.

During sequence play back of LED illuminants, button [1] is disabled and the current measured spectrum (green) and the target spectrum (red) is displayed. The target spectrum is stored in the illuminant (chapter 4.3.3).

The illuminance value and the Correlated Color Temperature (CCT) are also measured and displayed.
4.5.6 SEQUENCE PLAYER

If at least one component of a lightSTUDIO is enabled for the sequence player, all activated sequences are started by clicking the play/stop button [1]. Clicking the play/stop button again immediately stops the sequence player. Progress bars display the advance of all sequences.
5 COPYRIGHT AND TRADEMARKS

5.1 TRADEMARKS

Windows is a registered trademark of Microsoft Corporation.

The lightStudio software uses open source software:
libusb (www.libusb.org) is an open source project, the code is licensed under the GNU Lesser General Public License version 2.1 or later (www.gnu.org/licenses/old-licenses/lgpl-2.1.html).

Qt (www.qt.io) is an open source framework, the code is licensed under the GNU Lesser General Public License version 3.0 or later (www.gnu.org/licenses/lgpl-3.0).

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