# lightSTUDIO

User Manual

19 December 2014

**Image Engineering GmbH & Co. KG** · Augustinusstraße 9d · 50226 Frechen · Germany
T +49 2234 9955950 · F +49 2234 995595-10 · www.image-engineering.de

# CONTENT

# 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 BASIC lightHEAD and the LED lightHEAD. The basic version contains six light sources: F11 (3800 K), F12 (2800 K), D50 (5000 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 spetroradiometer 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.

MOVING lightSTUDIO 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 LG2 ligth boxes can hold different transparent test charts, which can produce a contrast ratio of 10.000:1 when the surrounding illumination is dimmed.

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 BASIC lightHEAD is also adjustable via a control panel on the front side.

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

# 2 ADDITIONAL HARDWARE

Depending on the equipment of the lightSTUDIO some additional hardware is delivered. The MOVING lightSTUDIO includes also a timecode display and a mechanical finger.

## 2.1 DIGITUS


DIGITUS is a mechanical finger. It is used to press the release button of a camera in a reproducible way. DIGITUS is shipped with a hydraulic adjustment arm that holds the DIGITUS 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 DIGITUS 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 DIGITUS until the magnet is locked, then screw off the finger and replace it with the other one. Untighten the knulred 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 DIGITUS 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. DIGITUS is controlled with the software (chapter 4.5.2.3).

## 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 adaption of the camera to rapid light changes with the LED lightHEAD. The timer also has a counter mode to enumerate different capture scenes.

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 current flashing LED during running time code denotes the progress in terms of 1/100 s, thus all 100 LEDs are illuminated subsequently 10 times 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 computer (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 Start/Stop [8] toggles between running and pausing. In counter mode the button is used for counting up one digit. In both modes the display can be resetted with the built-in reset button [4] or the external reset button [7].

# 3 USAGE WITHOUT SOFTWARE

Depending on the chosen combination, some parts of the lightSTUDIO can be used without the software. The BASIC lightHEAD is 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 MOVING lightSTUDIO and the LED ligthHEAD are only accessable by means of the software. However, the timecode Display is also a stand-alone device (chapter 2.2).

## 3.1 BASIC LIGHTHEAD


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 intensity in order to achieve color temperatures of 2100 K (10 lx), 2800K (100 lx), 3100 K (400 lx) and one for 10.000 K (with blue filtering, 400 lx). 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 %.

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.

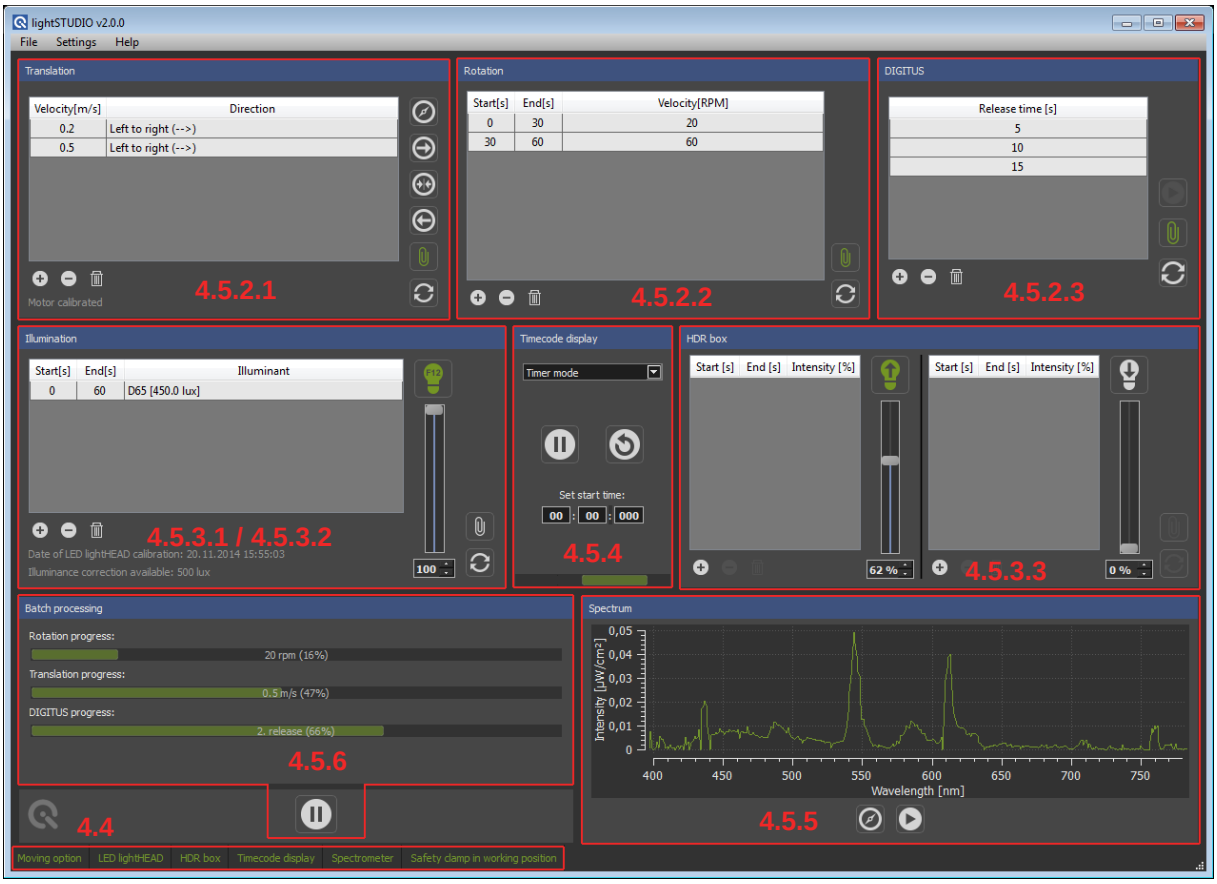
With the knob “LCD backlight” [5] you can adjust the display panel backlighting.

**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.**

# 4 SOFTWARE DOCUMENTATION

## 4.1 INTRODUCTION

The lightSTUDIO software is a Windows software and is designed to control the lightSTUDIO and its components (MOVING option, BASIC or LED lightHEAD, HDR option, timecode display and DIGITUS). Each part can be accessed and controlled separately. Moreover, batch lists can be created for comprehensive batch 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 numbers in the image denote the corresponding chapter.

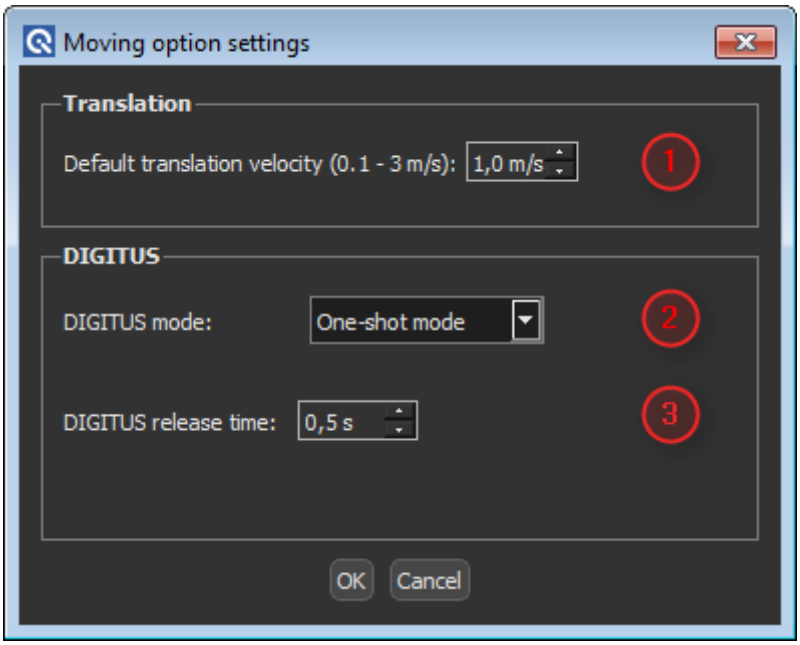
## 4.2 INSTALLATION

Choose the proper installer (32 or 64 bit) for your Windows operating system and run it. During installation three 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
- Microsoft Visual C++ Redistributable
- Java 7 Runtime

## 4.3 SETTINGS

### 4.3.1 MOVING OPTION SETTINGS




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 while processing the batch lists.

The *DIGITUS mode* menu [2] offers three options for the behaviour of the DIGITUS:

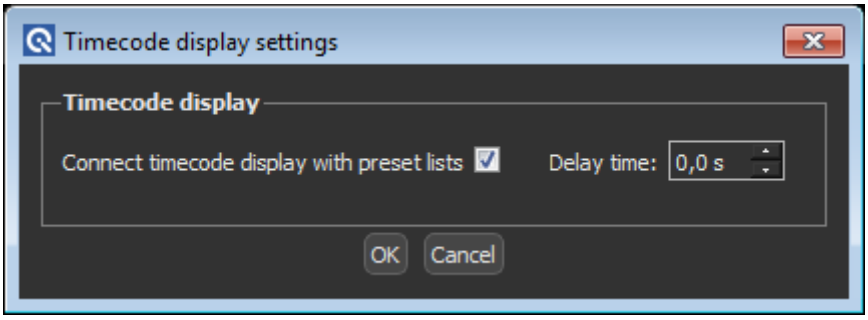
*One-shot mode*: DIGITUS is triggered once with the *start/stop* button and stays pressed with a predefined duration time as edited in the corresponding field below.

*Toggle mode*: DIGITUS is triggered by clicking the *start/stop* button and stays pressed until next click on the button.

*Continuous mode*: DIGITUS is triggered by pressing the *start/stop* button and stays pressed until button is released.

The *DIGITUS release time* [3] denotes the duration of DIGITUS when the *one-shot mode* is selected. The minimal value is 0.5 s.

### 4.3.2 TIMECODE DISPLAY SETTINGS




The *Connect timecode display with batch lists* option allows the time code display to start simultanously with processing start. The delay time defines a time lag after which the display starts. The starting time is the value entered in the fields in the corresponding module (see chapter 4.5.4).

## 4.3.3 LED LIGHTHEAD SETTINGS


With the LED lightHEAD more functionality and flexibility is available in comparison to the BASIC 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 and at least one illuminant to be created. All steps described below must be undertaken in absolute dark surrounding so no stray light can enter the

light box. A dark cloth that is put to the front side may be helpful. Thereby the aperture of the built-in spectrometer in the bottom plate (the round translucent glass) must not be covered

1) The first step is to **calibrate** the **spectral characteristics** of the LED lightHEAD. This procedure is obligatory for the function of the LED lightHEAD. Click the *Calibrate* button [1] for the spectral calibration and confirm the following dialogs. The calibration procedure takes about one minute. If the calibration was successful the calibration date is displayed. It is also displayed in the corresponding module of the software (see chapter 4.5.3.2). This procedure may be repeated at any time. Reasons for a failure of the calibration may be too much incident light or a spectrometer integration time, which is too low.
2) The **illuminance correction** is optional. It is used to correct for the deviation of the illuminance measurement at the aperture of the spectrometer, which is placed behind the transparent glass in the bottom plate of the light box (see image). The maximum achievable lux value in the data sheet of the lightSTUDIO however is defined in the center and at the level of the bottom plate (approx. 25 cm from front side, see image on the left). These two factors, the geometrical deviation and the loss of light caused by the glass, can be corrected by measuring the illuminance with a luxmeter.

An initial illuminance measurement is performed at Image Engineering with every delivered LED lightHEAD at this position and the result file can be found on the CD (“Illuminance Calibration.txt”). Import this file by clicking the button “Import illuminance file…” [5].
If you want to do the illuminance calibration by yourself at a dedicated position follow these steps:
The procedure must be undertaken in absolute dark surrounding. Place the measurement head of a luxmeter at the position at any position inside the lightbox. Click the *lamp button* [4] to turn on a specified illumination. Read the illuminance value (in units of lux) and type it into the corresponding field [3]. Turn off the measurement illumination by clicking the button [4] again. Click the Calibrate button [2] and confirm the following dialog. The measurement takes a few seconds. If the calculation was successful the result is displayed. It is also displayed in the corresponding module of the software (see chapter 4.5.3.2). This procedure may be repeated at any time.

**Illuminants:**

1) Illuminants (see note below) can be imported for the use in the lightSTUDIO software. Click *Import…* button [6] and select *.iqilluminant* files to import. For the creation of a new illuminant select a desired standard illuminant with selection menu [7] or open a text file [8] which contains a spectral distribution in the following formatting:

```
BEGIN_HEADER
NAME=D55
TYPE=Daylight
START_WAVELENGTH=300
END_WAVELENGTH=830
INCREMENT_WAVELENGTH=10
END_HEADER
BEGIN_DATA
300      0.024*
…        …
830      68.336*
END_DATA
```

*The values in the second column can have absolute or relative intensity values.

2) Enter a desired illuminance value [9]. The value refers to the position defined in the lux measurement described above.
3) Click *Test illuminant creation*. 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*. This procedure takes several seconds and saves the illuminant into the program directory: <path to lightSTUDIO software>/illuminants. The illuminants are available for use in the corresponding module (chapter 4.5.3.2).

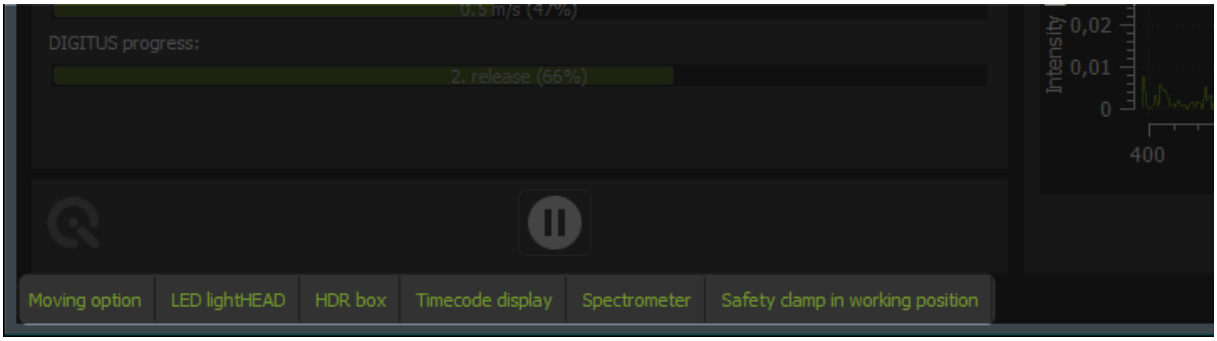
**Note:**
**The term illuminant in the context of the lightSTUDIO is used in the following manner: The combination of a relative spectral response curve (predefined or measured) and an illumination value in lux, which is achieved at a selected position in the light box. This information is saved in a proprietary file format .iqilluminant. These files can be exchanged between different software solutions by Image Engineering. An individual illuminant created with the iQ-LED software may be imported in the lightSTUDIO software for example. Illuminants must be generated before using LED lightHEAD controlled by batch processing.**

**Spectrometer settings:**

The *spectrometer integration time* [12] denotes the integration time for the calibration. The default value should not be changed unless the calibration procedure fails. A longer integration time may help in this case.

The Spectrum measurement repeat interval [13] denotes the repetition interval in the live spectral measurement (chapter 4.5.5). The value cannot be smaller than 150 ms.

## 4.4 HARDWARE STATUS BAR




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

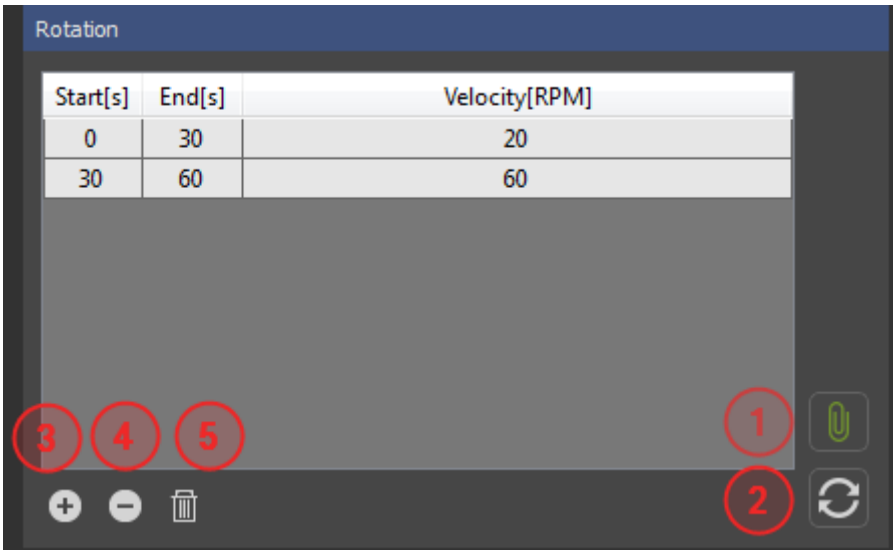
**Note:**
**If the safety clamp is pushed, the internal control unit stops the power supply to the motors immediately. In the software, all buttons for the translation or rotation functions are disabled. Pull the clamp out until it reaches the stop position in order to enable usage of the translation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

## 4.5 MODULE OVERVIEW

Every component of the 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 (e.g. the timecode display) during runtime the module appears in the GUI.

**Note:**
**The term *module* in the context of the lightSTUDIO software denotes a part of the GUI that enables the user to control the corresponding device comprehensively and exclusively.**

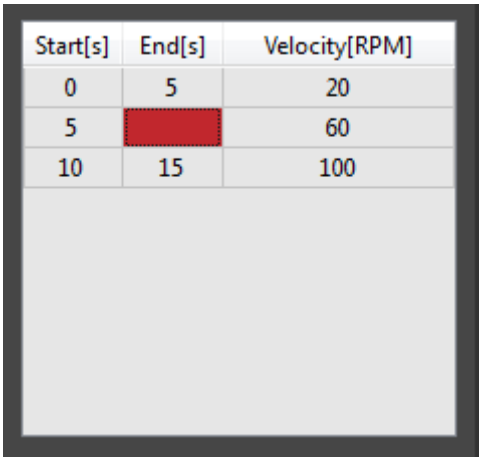
### 4.5.1 BATCH PROCESSING




Each module in the software, except the timecode display, has five buttons and a table for batch processing. Tables for sequences of movements, rotations, DIGITUS releases, and illumination (lightHEAD and HDR option) can be edited, modified and saved for reuse. All batch tables can be executed simultaneously.

When the *"add to batch"* button [1] is activated the batch is started by clicking the *batch start* button (chapter 4.5.6). As long as the *"add to batch"* button is activated none of the control items in each module can be used in order to avoid disturbance of the processing. If the button *loop* [2] is activated, the complete batch table is repeated infinitely until the user stops the process.

For editing the table there are three buttons: a new row is added to the table for free editing of one period with the "+" button [3]. The "-" button [4] deletes a selected row and the *trash* button [5] clears the whole table.

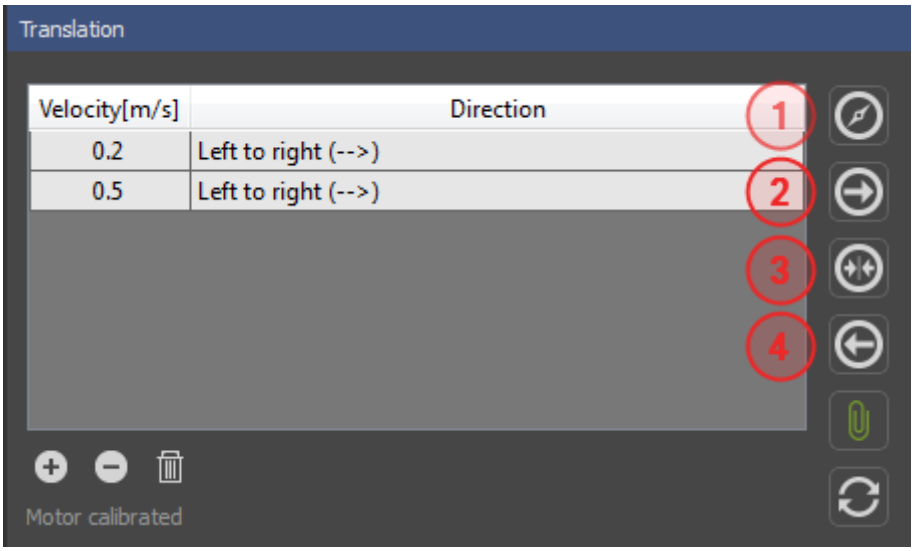



While editing the fields of a table, the values are validated for wrong input. Velocities in rotation and translation are verified for applicability (see data sheet for limits) and times are checked for overlapping ranges. The numbers entered may have a decimal notation using a '.' or a ','. Missing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

### 4.5.2 Modules for Moving option

The MOVING lightSTUDIO incorporates three functionalities: the translation chart, the rotation chart and the DIGITUS. Thus three modules are displayed in the software for controlling these devices.

#### 4.5.2.1 Translation



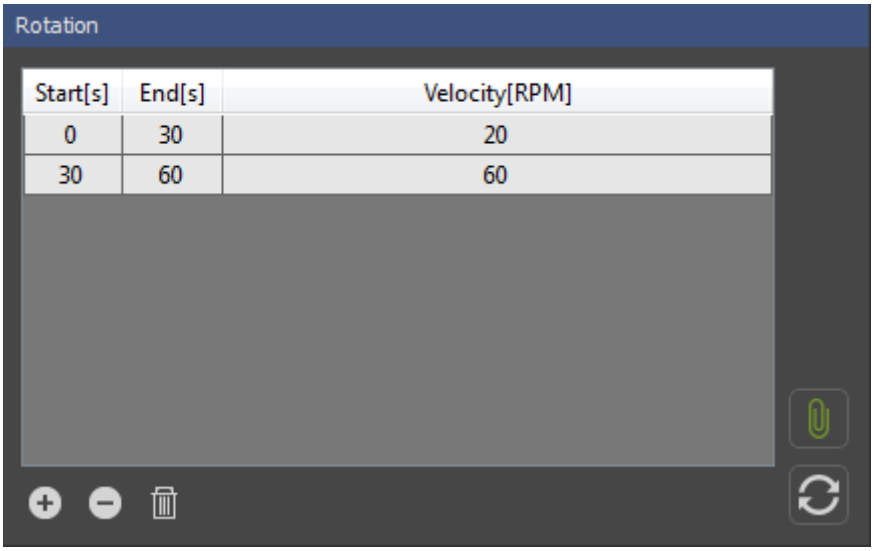
Each time the program starts, a calibration movement of the (translational) chart must be performed in order to calibrate a defined position for the motor control. Click the *calibrate* button [1] to start the calibration: the chart moves to the center and then to final destination on the right side.
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
- The emergency stop switch on 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 positions with the default velocity defined in the settings (chapter 4.3.1).
In the batch table, subsequent 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 are equal, a return movement is inserted with a default velocity as defined in the settings (chapter 4.3.1).

**Note:**
**In comparison to the illumination table (chapter 4.5.3.1) or the rotation table (chapter 4.5.2.2), 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 (chapter 4.5.6) for the translation gives you a hint of how long it lasts.**

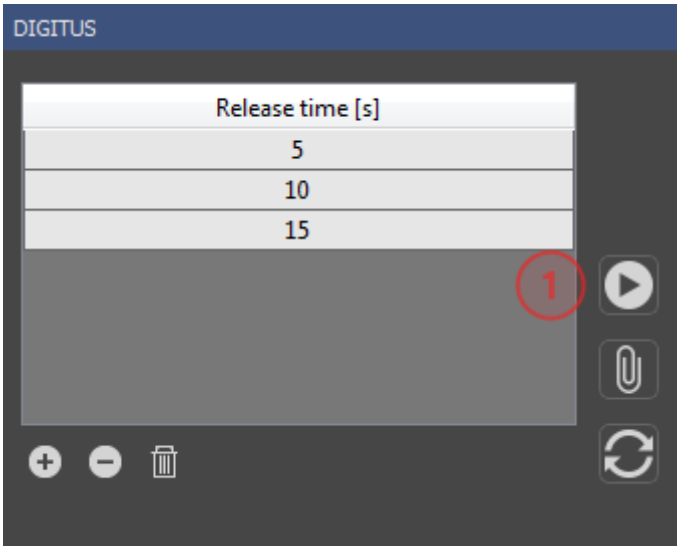
### 4.5.2.2 ROTATION




In the batch table, sequences for the rotating chart can be edited. There are three columns available, the first sets a start-time, the second the end-time 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 and a period of time has the same effect.

#### 4.5.2.3 DIGITUS

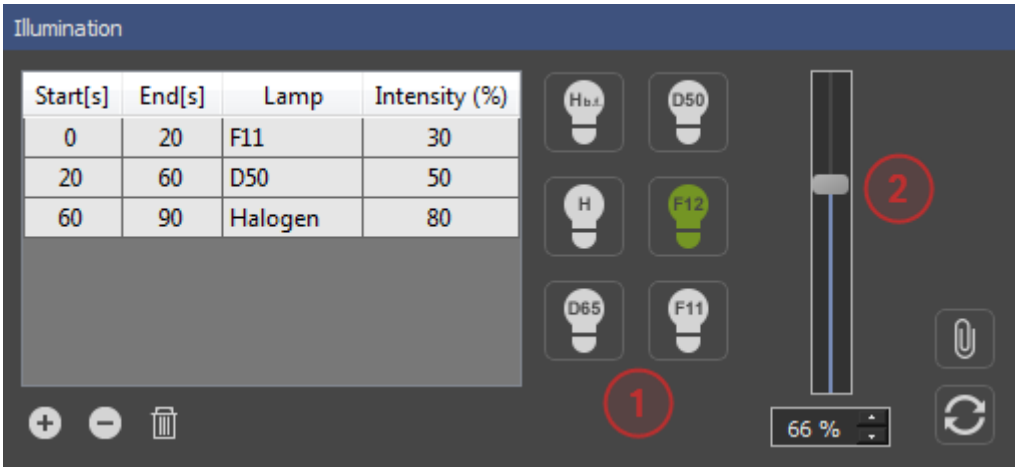



The DIGITUS device allows you to release your camera button with the software. You can release DIGITUS with the *play/stop* button [1] depending on the settings in the options menu (chapter 4.3.1) in one-shot, toggle or continuous mode. A status bar at the bottom displays the continuation of the DIGITUS in released state. During batch processing, the *play/stop* button is disabled.
In the batch table time stamps for the release of DIGITUS can be edited. At each time stamp DIGITUS is released
for a release time as defined in the settings (chapter 4.3.1).

### 4.5.3 MODULES FOR ILLUMINATION

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

#### 4.5.3.1 BASIC LIGHTHEAD

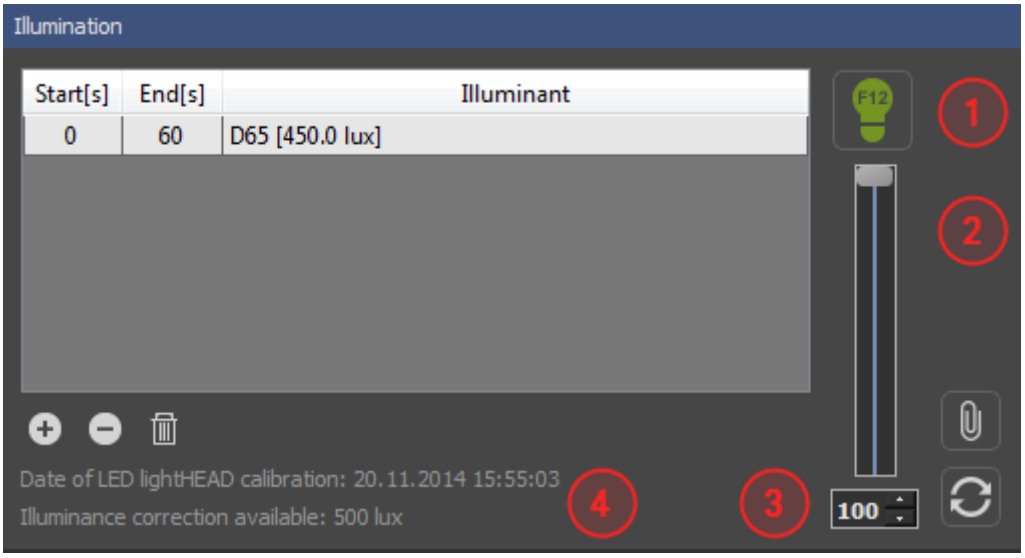



If a BASIC lightHEAD head is delivered with your lightSTUDIO, the corresponding module enables you to switch the lamps on and off [1] and to set the intensity [2]. Only one lamp type can be illuminated at one time, that means switching one lamp type on, turns all others off. There are 6 types of lamps: 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 batch table shows four columns. The first and second column defines the start- and end-times for 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 batch processing, 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 some minutes until the color temperature and illuminance is reliably stable for all lamp types.**

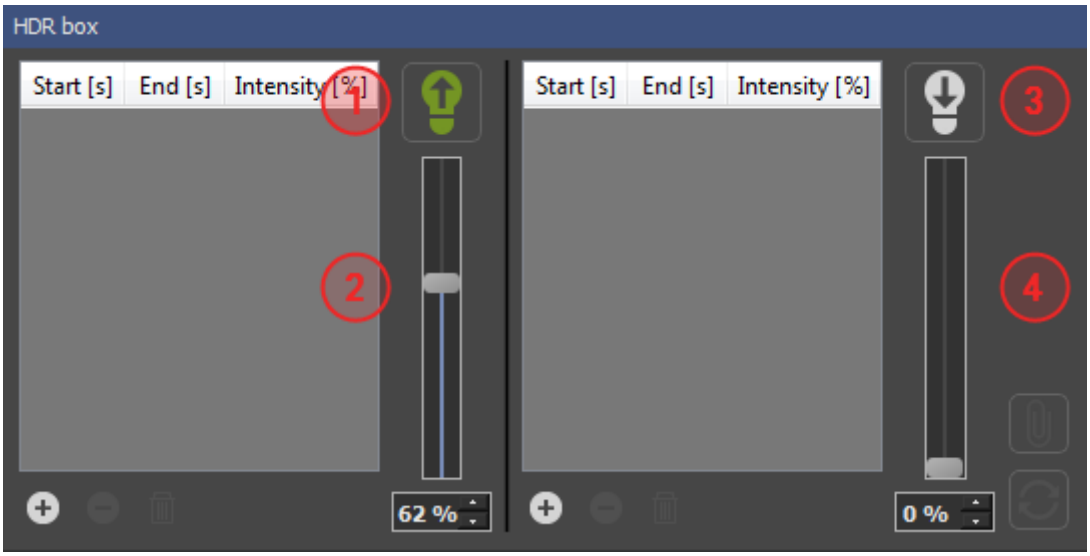
### 4.5.3.2 LED LIGHTHEAD




Besides the iQ-LED technology there is also a F12 lamp mounted into the LED lightHEAD. Thus this lamp can be switched on and off with button *F12* [1] and varied in intensity with a slider [2] and an input field [3]. During processing a batch this lamp is turned off in order to attain the selected spectrum and illuminance (in the example above D65 and 450 lux).

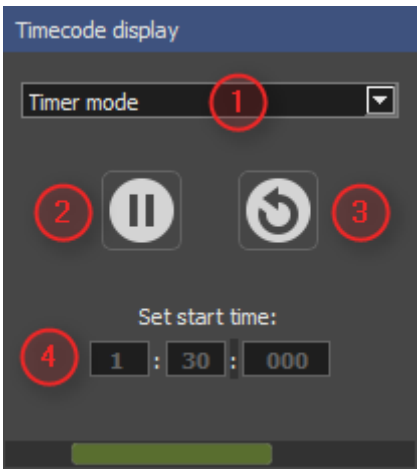
For batch processing all illuminants created in the illumination settings panel (chapter 4.3.3) are available in the third column of the batch table. Add a start and end time to complete one illumination period. Since switching time bewtween illuminants is very fast periods down to 50 ms are possible. Underneath the batch table information about existing spectral calibration and illuminance correction is displayed [4] (chapter 4.3.3).

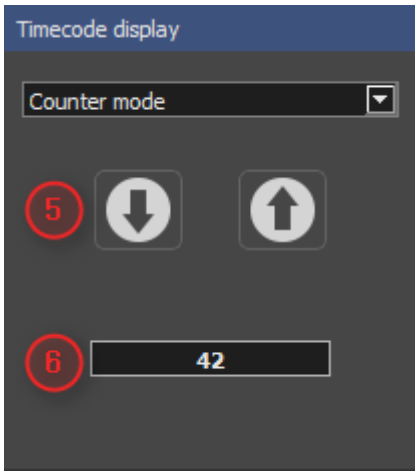
### 4.5.3.3 HDR OPTION




The HDR option module in the software enables you to control both LG2 lamps of the HDR box. The upper lamp is switched on with the *up* button [1] and the intensity controlled with a slider or an input field [2]. The same applies to the lower lamp [3, 4].
For both lamps batch tables are available. Activating the batch processing or looping (chapter 4.5.1) applies for both lamps. Enter start and end times as well as the intensity from 0…100 %
Take into account that switching on the LG2 lamps takes 1…2 s, thus periods below this level in batch processing are not advisable.

## 4.5.4 MODULE TIMECODE DISPLAY



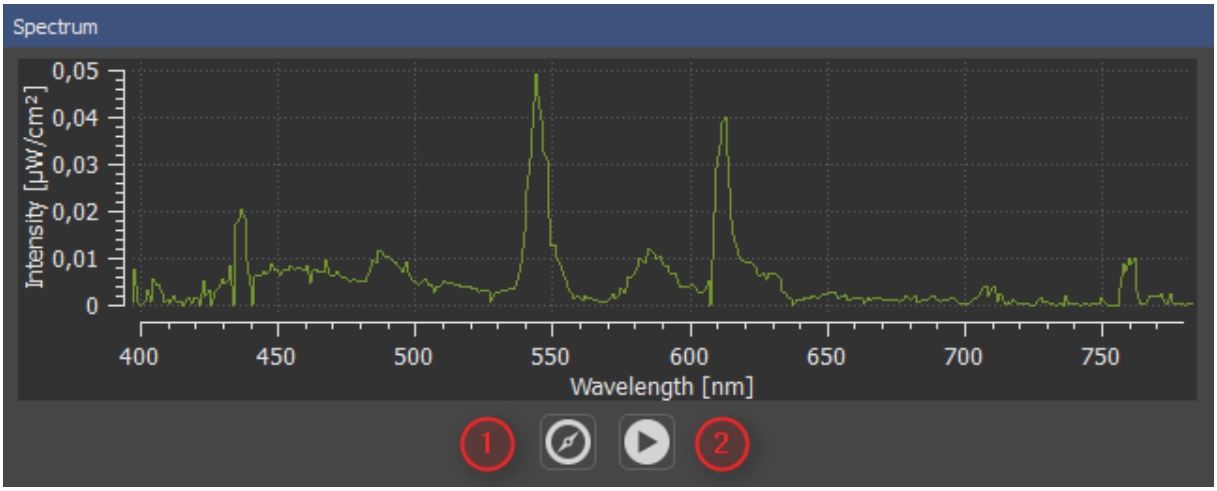




The module for the timecode display (chapter 2.2) offers two operating modes: timer and counter. Switch between the modes with menu [1].

*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 time code. 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 batch lists"* is activated in the settings (chapter 4.3.2) the time code display starts with the entered start time.

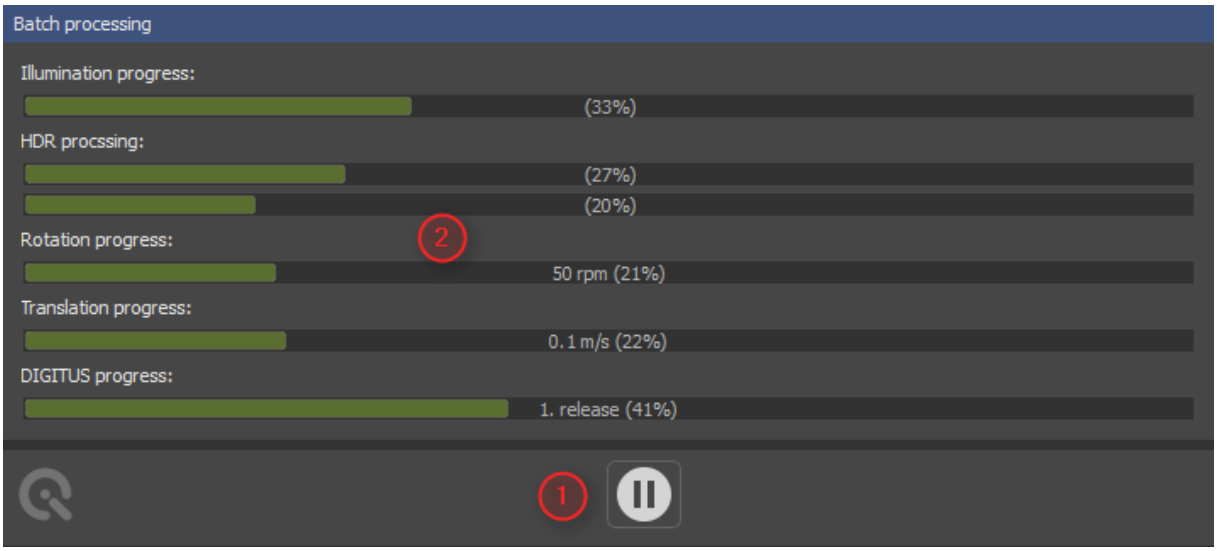
*Counter mode*: The display works as a counter. With the up- and down buttons [5] you may count up and down one digit. Or enter a number from 0 to 65535 in the text field [6].

### 4.5.5 MODULE SPECTRAL MEASUREMENT




The spectrum measurement functionality is only available with the LED lightHEAD. A spectrometer is built into the bottom plate of the light box in the horizontal center behind the transparent glass. Click button *calibrate* [1] to make a dark measurement. Therefore the aperture of the spectrometer must be covered thoroughly. Click button *play/stop* [2] for switching permanent spectral measurement on and off. The measurement is repeated with the time entered in the settings (chapter 4.3.1).
During running a batch with LED lightHEAD (chapter 4.5.3.2) both buttons [1, 2] are disabled and the current measured spectrum and the target spectrum are displayed. The target spectrum is stored in each illuminant that was created with the illumination settings panel (chapter 4.3.3).

### 4.5.6 MODULE BATCH PROCESSING




If at least one batch table is activated, the process is started by clicking the *play/stop* button [1]. Clicking the *play/stop* button again immediately stops all processing after confirmation.

Progress bars display the advance of all batch tables of translation, rotation, illumination and DIGITUS.

# 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).

## 5.2 COPYRIGHT INFORMATION

By installing this software, you accept and agree to be bound by the terms of the software license agreement that appears below.



The software furnished under this agreement is provided on an ‘as is’ basis, without any warranties or representations express or implied, including, but not limited to, any implied warranties of merchantability or fitness for a particular purpose. It is solely the responsibility of the consumer to determine the software's suitability for a particular purpose or use. Image Engineering GmbH & Co. KG, and anyone else who has been involved in the creation, production, delivery, or support of this software, will in no event be liable for direct, indirect, special, consequential, or incidental damages resulting from any defect, error, or omission in the diskette or software or from any other events, including, but not limited to, any interruption of service, loss of profits or good will, legal action or any other consequential damages. the user assumes all responsibility arising from the use of this software, for which Image Engineering GmbH & Co. KG shall have no liability, regardless of whether such use is lawful or forseeable. Image Engineering GmbH & Co. KG shall have no liability for any data or programs stored by or used with this software, including the costs of recovering such data or programs. Image Engineering GmbH & Co. KG reserves the right to make corrections or improvements to the information provided and to the related software at any time, without notice.