



Instruction sheet 200 320

Lab Docs Editor (200 320)

Lab Docs Editor 365 (200 323)

Lab Docs Viewer

1 Introduction

Lab Docs are editable HTML experiment manuals that can be displayed in a platform-independent manner on any up to date internet browser and that automatically adapt to the size of the utilised device (smartphone, tablet, PC). No additional software is required to use Lab Docs.

Lab Docs are interactive:

- Answers can be typed in and sketches or photographs from observations can be added,
- Measured values can be entered in tables, wherein the values are automatically transferred into diagrams,
- Diagrams can be evaluated directly in the document with many fixed curve fittings and any number of free evaluations.
- The results can be stored in the browser and reloaded again for later processing.

Lab Docs can connect directly with CASSY hardware:

- Simple connection of up to three terminal devices with one CASSY by entering the PIN from the CASSY display,
- Automatic setting of the CASSYs, sensors and measurement ranges via the Lab Doc,
- Control of the CASSYs from the Lab Doc and
- Automatic transmission of the measured values from the CASSYs into tables and diagrams in the Lab Doc.

- Currently, Mobile-CASSY 2 WIFI (524 005W), Power Analyser CASSY (727 100) and Power Analyser CASSY Plus (727 110) are supported.

However, even without CASSY, Lab Docs enrich digital learning because measured values, images and experiment results can also be manually recorded and evaluated by the student in a Lab Doc.

Lab Docs can be edited with the Lab Docs Editor:

- Adapt all content to the respective lesson,
- Create new Lab Docs.

Many Lab Docs are available as a literature collection (e.g. [Science Lab Physics](#), [Chemistry](#) or [Biology](#)).

2 Technical Data

File format:	*.html, images and resources in separate files
Exchange format:	*.labdoc (all required files in one container file)
Export format:	*.pdf (teacher and student version, Internet access required for export)
Typesetting of formulae:	Optionally with LaTeX syntax (incl. mhchem package)
Lab Docs Visibility Settings:	Teacher and Student Version Offline and Online Mode
Saving of student data:	Locally on the student's terminal device
Supported measured value server:	Mobile-CASSY 2 WIFI (524 005W) Power Analyser CASSY (727 100) Power Analyser CASSY Plus (727 110)
Virtual instruments:	Multimeter, measurement data tables, diagrams, evaluations, vector diagrams*, powermeter* and more than 10 more for controlling the recording of measured values (* only Power Analyser CASSY and Power Analyser CASSY Plus)
System requirements for Lab Docs Editor:	PC with Windows from Windows 7, Internet access recommended
System requirements for Lab Docs Viewer:	PC with Windows from Windows 7, private network or work network
System requirements for Lab Docs:	Terminal devices with iOS, Android, Windows, Linux or MacOS with WiFi capability, local WiFi network (with or without Internet access)

3 Lab Docs Visibility Settings

3.1 Teacher and student version and student data

Each Lab Doc contains a teacher and a student version. The teacher version shows a model solution. When first opened, the student version does not display any student answers or measured values from the sample solution. Instead, the user administration menu is shown in the top right of the header line (see Fig. 1 top right).

The data entered by the student (student answers and measured values) are stored in the browser until the browser tab is closed. If the student logs in via user administration with their chosen username and password, the data is stored in the browser for 4 weeks. The data is encrypted, so only the student can access it with their name and password combination. This means they can continue to work on the Lab Doc on the same tablet the next day, for example. If the student wants to continue working on another terminal device, or if they want to take a longer break, they must download the file with their data via the user administration menu (*.labd file). The data can be loaded again via the same menu. This also allows the students to transfer their results to the teacher.

*Notes: The student data from a *.labd file can only be loaded back into an identical Lab Doc. If you have changed the Lab Doc in the meantime, the student data can no longer be displayed in it. The integrated user administration runs locally in the browser and the content is not transmitted over the Internet.*

In order that students do not have access to the teacher version, a Lab Doc normally displays the student version when it is opened in an Internet browser. The teacher version can only be opened via LeyLab, the Lab Docs Viewer or the Document Center (see Section 8).

3.2 Offline and Online Mode

If a Lab Doc can control a CASSY and display its measured values live, elements to enable a connection with a CASSY are displayed in the centre of the header line of the Lab Doc (see Fig. 1). There are always two modes: Offline if a connection to a CASSY does not currently exist, and online if a CASSY is currently connected. In Offline mode, the teacher version shows a sample solution and the student version shows the last measured values of the student. Therefore, the student version initially contains no measured values. In Online mode, the current measured values of the CASSY are displayed and the CASSY can be controlled.



Fig. 1: A Lab Doc with virtual instruments can connect with a CASSY and thus bring the virtual instruments to life. The connection is established by clicking on **Offline** in the upper illustration and entering the PIN for the CASSY that is to be connected into the lower illustration.

4 Download and Activation

The Lab Docs Editor is only available as a download of the installation package:

<https://www.ld-didactic.de/software/labdocseditor.msi>.

Before using the Lab Docs Editor, this must be activated via a licence import. Otherwise no file operations such as loading, saving, importing and exporting will be available. For the initial activation, an unused product key for

- Lab Docs Editor (200 320, licence with unrestricted validity) or
- Lab Docs Editor 365 (200 323, annual subscription licence)

is required. This product key must be activated via [LeyLab](#) (Internet access required).

All activated licences are managed in a LeyLab account. If you already have a LeyLab account, please log in with your login details before or during activation. You can view your licences in LeyLab under Licences → **My Licences** and use them on all of the school's or institution's terminal devices.

If neither you nor your school have a LeyLab account, a free LeyLab account can be created during activation. Please use the same LeyLab account for any licences you acquire in future.

The licence code created here must be either automatically imported by the Lab Docs Editor from LeyLab (Internet access required) or manually entered into the Lab Docs Editor (possible without Internet access, see Fig. 2). You can find the licence import in Lab Docs Editor under **View** → **About ...**

Important: You can only activate the product key once. When re-installing the software, the software can import the activation from your LeyLab account. But if you delete the LeyLab account, you must manage the obtained licence code for new installations yourself.

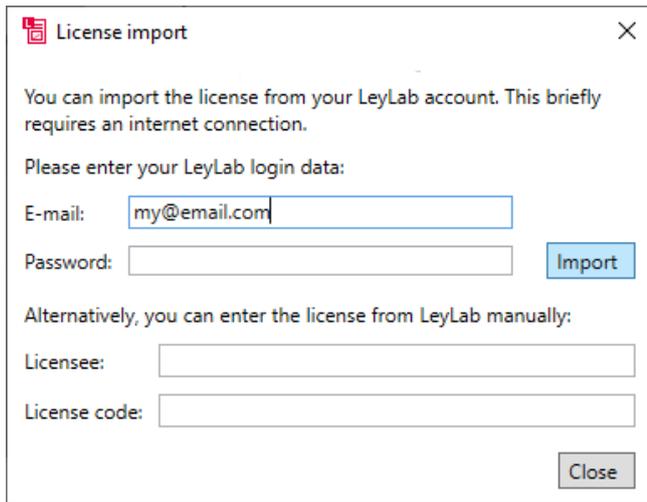


Fig. 2: Activating the Lab Docs Editor.

Updates to the Lab Docs Editor are available for free from the download link specified. If the Lab Docs Editor has an Internet connection, information about updates is automatically displayed when updates become available.

5 Lab Docs Editor and Lab Docs Viewer

During the installation, two links are automatically created in the start menu: Lab Docs Editor and Lab Docs Viewer. Lab Docs are edited using the Lab Docs Editor. Here, the Lab Docs Editor displays the Lab Doc in an editor view that differs from the format in which the Lab Doc is presented in an Internet browser. The Lab Docs Viewer displays the Lab Doc in the same format as in an Internet browser and offers some additional functions (see Section 7).

The Lab Docs Editor always also launches the Lab Docs Viewer, because this shows the final appearance of the Lab Doc and can also switch between the teacher and student version of a Lab Doc. Its window can, for example, be moved to a second monitor or separately resized to test how the Lab Doc would look on the narrow display of a smartphone.

The Lab Docs Viewer can also be launched on its own in order to view a Lab Doc or to distribute it in the local network, e.g. to a school class wherein the students cannot access the Internet (see Section 8).

6 Using the Lab Docs Editor

The Lab Docs Editor is used in a similar manner to other text editors, but has one fundamental difference: content and layout are strictly separated. You can only edit content – the layout is automatically created.

Therefore, in all cases, only the **contextual meaning** and **not the appearance** is specified. Only values such as information, variables and titles are set, whereas stylistic information such as bold, italics or font size is not. For you as the author, this offers the advantage that you no longer have to be concerned about the layout if you have allocated the right values to the text passages.

The actual layout is specified and is the same as LD DIDACTIC GmbH's student experiment manuals. If you change existing student experiment manuals, the LD logo and the copyright information will be replaced by your logo and your copyright information. The administrator of your LeyLab account can set your logo in LeyLab under **Settings** → **School**.

*Note: Keyboard shortcuts are also available for many of the operation options via the tabs described in following text. The shortcuts start with the **Alt** key and are displayed if you hold down the **Alt** key for a longer period or release it without pressing another key. For example, **Alt+V** denotes a variable.*

6.1 File Formats and File Menu

*.html files

The file format of the Lab Docs and the Lab Docs Editor is *.html (HTML5). Such HTML files can be displayed and controlled using all current Internet browsers (see Section 8). Fundamentally, the content of such files can be edited using any text editor. However, we recommend to exclusively use the Lab Docs Editor. If an HTML file links to images or other files, these automatically link in a subdirectory (img or res) when saving with the Lab Docs Editor. Links to other Lab Docs are also possible if these are in the same directory or in subdirectories.

*.labdoc files for exchange

The HTML file is only conditionally suitable for exchange with colleagues, for example, because the linked files and images are also required. For this, we recommend the *.labdoc export under **File** → **Export**. This creates a *.labdoc file that contains all files required for the Lab Doc. This *.labdoc file is also used to add a Lab Doc to an experiment created in LeyLab (see Section 8).

*.pdf files for printing

A Lab Doc can be exported as a PDF file for printing the instructions. Exported PDF files have a printing layout that is adapted to the paper size and are no longer interactive.

If you add a Lab Doc to one of your experiments in LeyLab, the associated PDF files are also automatically offered there for the teacher and student version. Alternatively, you can also export a PDF of the teacher version or the student version directly in Lab Docs Editor under **File** → **Export**. To do this you will need an Internet connection because the PDF export is performed by LeyLab.

If the Lab Doc contains chapter headings (**Heading 1**) with specific keywords, additional page breaks are inserted that divide the document into several parts:

Part of the document	Chapter heading starts with...
Instructions	Introduction Additional break only if Introduction is not the first visible heading.
Worksheet	Observation To be printed out and copied for each student. It always starts on the right-hand page and a name field is automatically added.
Appendix	Appendix or Risk assessment

This action is controlled by the option **Optimise work sheet for printing**. This option guarantees that student worksheets automatically have a name field and can be printed in a manner that saves paper wherever possible. If the entire document is to be printed on the fewest possible pages, however, **Optimise work sheet for printing** can be switched off. This affects both the PDF export of Lab Docs Editor and the automatic PDF generation of *.labdoc files imported into LeyLab.

Document Properties

The properties of the current document can also be set in the file menu. In particular, these include the title and the language of the Lab Doc. A number is prefixed to the title that enables the experiment to be assigned to categories with several breakdown levels. Each point in the number denotes a further level. The titles of the categories used can be specified under the title entry and are displayed in the header of the Lab Doc under the title.

The set language determines the language on non-editable displays in the document (e.g. in the numbering of image captions) and the language profile of the voice that can be switched on in the browser to read the Lab Doc aloud. The read-aloud function is not supported by Lab Docs Viewer and Internet Explorer.

6.2 Start Tab



Fig. 3: The **Start** tab contains all contextual meanings and visibility settings.

Paragraph Format Group

The paragraph types define the contextual meaning of separate paragraphs that lie between paragraph marks (set with the Enter key). The start and end of a paragraph can be identified by the coloured bands on the left-hand side of the text. Paragraph types are available for normal text, 3 heading levels and bulleted as well numbered lists.

The contextual meaning of the current paragraph can be recognised both by the highlighted item in the tab group **Paragraph format** and also on the left in the footer of the editor.

Text Format Group

Both an entire paragraph and a part of a paragraph can have additional meanings. For example, the text can be defined as an instruction or as a variable in a student answer.

To apply such a text format to an entire paragraph, first highlight the paragraph by clicking on the coloured band on the left or highlight the entire text of the paragraph and then select the desired text format. The active text formats can be identified by the colours of the band on the left, by the tooltip when hovering the mouse over the band and by the highlighted items in the Text format tab group.

There are several options for applying a text format to part of a paragraph:

- Highlight the text and then select the desired text format.
- First select the desired text format, type the text that is to be formatted and then switch off the text format again.
- If the cursor is placed within a word, a text format is automatically applied to the entire word.

The active text formats can be identified by the colour of the text, by the tool tip when hovering the mouse over the text and by the highlighted items in the Text format tab group.

Note: For example, some text formats cannot be applied to entire paragraphs and vice versa. It is not logical to set an entire paragraph as superscript or to apply a safety instruction to just one part of a paragraph.

Student Answers

Paragraphs or parts of paragraphs that are highlighted as student answers are displayed as an input field in the student version. The text visible in the editor is displayed as a sample

solution in the teacher version. If entire images are highlighted as a student answer, the students are given the option of integrating their own images in the student version.

Links

The Link text format allows web pages or other documents (*.html or *.pdf) that are opened by clicking on the link to be linked to in a Lab Doc. Linked documents must be saved in the same directory as the Lab Doc or in a subdirectory.

Formulas Group

On the one hand, formulas can be entered using the text formats **Variable**, **Superscript**, **Subscript** and **Break**, e.g. $s = \frac{1}{2}a \cdot t^2$. On the other hand, they can be set using LaTeX syntax, e.g. with the LaTeX text format, $s = \frac{1}{2}a \cdot t^2$ becomes: $s = \frac{1}{2} a \cdot t^2$.

Various special characters are available to be entered as normal text via **Insert** → **Special character**. It is easiest for the Variable text format to be subsequently applied to a formula: Highlight the entire formula and activate **Variable**. Each letter sequence is automatically highlighted as a variable with consideration of arithmetic operators, numbers and indices. The **Break** text format recognises a colon as a separator between numerators and denominators. Hence **1:2** simply becomes $\frac{1}{2}$.

The LaTeX formatting uses the MathJax package with the mhchem expansion. Since the font differs between the direct formulas and the MathJax package and the loading time of a Lab Doc is slightly increased by MathJax, we only recommend the use of MathJax for complex formulas or for formulas that require formula numbering. Formula numbering is active as standard for all LaTeX formulas that occupy an entire paragraph:

$$s = \frac{1}{2} a \cdot t^2 \quad (1)$$



Automatic numbering can be individually deactivated by switching off **Number equation** (right mouse button). You can easily find further information and online formula editors for LaTeX on the Internet.

Visibility Group

The **Teacher's version** and **students' version** visibility modes restrict the visibility of text but do not change the functionality of the text (unlike **Student answer**). This means that it can be used to add text (or images) that only the students or only the teacher should be able to see (student or teacher version, see Section 3.1).

The **Online mode** or **Offline mode** visibility modes behave in a similar manner in Lab Docs that can connect with a CASSY (see Section 3.2). **Online mode** text is then only visible when a connection to a CASSY exists or is established. **Offline mode** text is then only visible when the **Online mode** text is not visible. It is only relatively rare that it is necessary to explicitly set these visibility restrictions yourself, because the virtual instruments (see Section 6.4) already provide expedient offline annotation.

6.3 Insert Tab

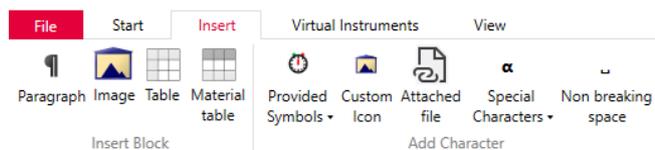


Fig. 4: A Lab Doc can be expanded with images, simple tables, symbols and links to attached files in the **Insert** tab.

Paragraph

A new paragraph can be inserted underneath the current position using **Paragraph**. This is also possible in the text using the **Enter** key. Using this button, a paragraph can also be inserted after an illustration or a table.

Images

Images can be easily inserted with **Image**. Here, an image caption appears automatically. This can also be removed by deselecting **Display caption** (right mouse button). In addition, the size of the image can be changed and the image file can be replaced using the right mouse button. Furthermore, additional images for the same figure can be added so that they have a common image caption.

Upon saving the Lab Doc, the inserted image files are stored in the img subdirectory of the Lab Doc. Here, large *.jpg files are reduced to an expedient size.

Small images can also be inserted as symbols in tables or in body text (see below).

Tables

Tables can be inserted via **Table**. They can have a header line and/or a header column at the top and/or left (right mouse button). The context menu (right mouse button) also permits various other manipulation options for the table. In addition, individual table cells can be highlighted as **Student answer** so that the students can make an entry at this point.

If a table should also contain measured values, the virtual instrument **Measurement data table** is more suitable (see Section 6.4) because these values can then be shown in a diagram or taken into consideration in an evaluation.

Material Tables

The material table is a special table with special functionality. It is intended for devices, chemicals and additionally-required materials. Clicking on the item name displays an image of the item, provided that an Internet connection exists and an image is available. Furthermore, links to the Web Shop are automatically created in the teacher version.

The creation of material tables is easier if an Internet connection exists. To automatically receive a name suggestion for the item as well as any hazard symbols, you only need to enter the LD catalogue number.

Additional options are available via the right mouse button in the **Catalogue number** and **Info** columns. With these, you can assign attributes to catalogue numbers or specify whether the material is only required for each class (e.g. scales) or even for each student (e.g. safety glasses).

Icons

Small images can be inserted directly into the text as symbols here. A range of icons (e.g. safety icons) are available under **Provided icons**. **Custom icon** permits any image to be inserted as an icon.

Attached Files

This function allows additional files, to which a Lab Doc should refer, to be attached. If you click on the file name in the text of a Lab Doc, the file is downloaded and can then be opened on the terminal device. These files are stored by the editor in the **res** subdirectory. This is expedient for providing files for measurement and evaluation with other programs or linking *.labm files with CASSY settings that the student can use to set up a CASSY via USB if there is no direct connection between Lab Doc and CASSY (offline mode).

If you would like to link to other documents or web pages, use **Link** in the **Start** tab.

Special Characters

Here, the Lab Docs Editor offers the option of easily inserting special characters (e.g. Greek letters).

6.4 Virtual Instruments Tab



Fig. 5: The **Virtual instruments** tab shows interactive elements for displaying and controlling measurements.

Virtual instruments enable a large degree of interactivity in a Lab Doc. They are interactive elements for displaying and entering measured values and controlling measurements. Each virtual instrument is linked with a so-called measurement series that has a unique name and contains the definition of the measured variables and their measured values. Therefore, all virtual instruments for a measurement series draw upon the same measured values. The virtual instruments in the group **With CASSY** (see Fig. 5) are only expedient with Lab Docs that establish a connection with a CASSY.

Measurement Series

Measurement series are the basic prerequisite for being able to display virtual instruments. When creating a virtual instrument, this can be linked with an existing measurement series or a new measurement series can be created. If no measurement series have yet been defined, this takes place compulsorily when a virtual instrument, measurement data table, diagram, multimeter, vectorscope or powermeter is created.

There are two types of measurement series:

- **Measurement series with CASSY** (green background) enables the connection to a CASSY. This measurement series is created by importing a *.labm file. Carry out the measurement with the CASSY, store the measured values as a *.labm file and transfer the file to the PC using the Lab Docs Editor. The Editor takes over all settings of the experiment, the list of utilised measured variables and the measured values that are displayed as the sample solution in the teacher version from the *.labm file.

*Note: The CASSY saves a *.labm file via the menu item  → **Save values** → ***.labm**.*

The virtual instruments, multimeter, vectorscope or powermeter require a measurement series with CASSY as mandatory. If a measurement series with CASSY becomes active when loading a Lab Doc for the first time, the associated settings such as measured variables, measurement ranges and measurement interval are automatically transmitted to the CASSY.

- **Measurement series without CASSY** (brown background) only contains measured values by typing into measurement data tables in the Lab Doc (see below). This measurement series is created by specifying the

number of measured variables. All designations of measured variables, units, measurement ranges and measured values for the sample solution must be manually entered by the author.

Measurement series are not directly visible in the document via the virtual instruments but are indirectly visible, e.g. via a measurement data table. You can select **View** → **Measurement series** to get an overview of the available measurement series. Any number of diagrams and measurement data tables can access a measurement series and display or change its measured values within a Lab Doc.

If several measurement series are used in a Lab Doc, when a new measurement series is first used, the virtual instruments switch over to this. In doing so, the respective settings are also transferred to the CASSY. You can recognise which measurement series is currently active from the number after the # in the header line of the Lab Doc.

Measurement data table

If no measurement series had yet been created when compiling a measurement data table, such as with the first virtual instrument, then firstly the first measurement series is created (with or without CASSY, see above). If a measurement series had already been created, this can be selected as an alternative. After this, the measurement data table belongs firmly to this measurement series. When compiling the table, the measured variables that are to be displayed can be preselected. This selection can still be changed later as desired.

The content of the table can be directly edited in Lab Docs Editor. In the editor view, the table has three header lines for name, symbol and unit of the measured variables. In Lab Doc these are consolidated in a formatted header line. The body section contains the values of the sample solution. Since several measurement data tables display the same data for the same measurement series, all changes in the editor have an immediate effect on all of these measurement data tables in the document.

In the case of a **Measurement series with CASSY** (green background), the table already knows most properties of the measured variables such as symbol, unit, measurement range and number of significant decimal places. These can also no longer be changed, to ensure that the values correspond with the CASSY display. It is only the name of the measured variable that is not a component of the *.labm file and which has to be manually entered into the first line of the table.

In the case of a **Measurement series without CASSY** (brown background), all of these properties and values must be manually defined. This is affected directly in the table. The measurement ranges (display ranges for a diagram) and the number of significant decimal places of the measured variables are specified in the properties of the respective **Measured variable** (right mouse button on the column).

The **Table settings** can also be accessed via the right mouse button. Here, for example, it is possible to switch off the standard behaviour, wherein a measurement data table automatically extends if more measured values are entered than the minimum length of the table (also configurable).

You can always add additional measured variables without CASSY to a measurement series with CASSY, wherein these must then also be defined purely manually. This is affected either in the settings of the **Measurement series** (right mouse button of the table) or via the **Insert column on the right** → **Add measured variable (without CASSY)**. Here, you can also alternatively add pure text columns that are independent of the measurement series and therefore cannot also be displayed in a diagram or another table.

Angle difference	Illuminance
$\Delta\alpha$	E_A
°	lx
0	447
10	430
20	389
30	342
40	266

Fig. 6: Measurement data table with 3 header lines with the definition of the measured variable and the measured values. The right column originates from a measurement series with CASSY. The left column is a subsequently defined measured variable without CASSY in the same measurement series.

Diagram

If no measurement series had been created when creating a diagram, such as with the first virtual instrument, then the first measurement series is first created (with or without CASSY, see above). If a measurement series had already been created, this can be selected as an alternative. The diagram then firmly belongs to the selected measurement series. When compiling the diagram, the measured variables that are to be displayed can be preselected. This selection can still be changed later as desired.

In the case of a **Measurement series with CASSY** (green background), no measurement data table is required to completely define the diagram because the settings are already contained in the measurement series.

In the case of a **Measurement series without CASSY** (brown background), a measurement data table is vital in order to define the measured variables and the values of the sample solution and to give the students a table in which they can enter the measured values that are then to appear in the diagram.

In **Settings** (⚙️ or right click on the diagram), the suggested title, the axis assignment, the axis ranges and the appearance of the diagram can be changed. Additionally, curves with further measured variables can be added later and their order (colours) can be changed.

The instruments **Evaluation**, **Zoom axes** and **Marker** can be used to modify a diagram interactively. Therefore, the buttons to insert these instruments can be found via the arrow next to the **Diagram** button.

Evaluations

Evaluations are linked to a specific measured variable of a specific diagram in the Lab Doc and are also shown in this diagram. A button to switch the evaluation on and off appears in the place at which the virtual instrument **Evaluation** is inserted in the body text. If it is switched on, the results of the evaluation are also displayed there and, in the case of free evaluation, the evaluation is controlled. The virtual instrument **Evaluation** can also contain several different evaluations. In this case, the user can later select one of the evaluations. There are two types of evaluations:

- Default evaluations are automatically carried out during selection and the result is displayed. A limited selection of evaluations are available such as average value or balance line.
- Free evaluations are set manually via sliders. Any mathematical functions are possible here.

The button for inserting an evaluation can be found via the arrow next to the **Diagram** button.

When creating an evaluation, its settings open automatically and these can be accessed again later at any time via their context menu (right click). Here, right at the top, the diagram and the measured variable that are to be evaluated are selected. These can be changed at any time. Among these, any number of default evaluations and one free evaluation can be activated. Under all active evaluations, the user must later select an evaluation that they want to carry out. If multiple evaluations are to be active at the same time, several separate **Evaluation** virtual instruments must be added to the document.

If the predefined evaluation contains parameters, the symbols of the parameters below the list can be adapted to the names of the respective Lab Docs. This is not possible if there are multiple evaluations to choose from, because their parameters most likely have different meanings. For specified evaluations, the units are automatically determined from the units of the measured variables.

Further settings are required for the free evaluation:

- The name of the evaluation that is displayed in the Lab Doc.
- The formula of the evaluation that is displayed in the Lab Doc. Here, variables should be written so as to be enclosed with \$, set as superscript with ^ and set as subscript with _. If this is not sufficient, the complete HTML syntax with <var>, <sub> and <sup> can also be used.
- The **formula as JavaScript** is the JavaScript source code that is executed to calculate the evaluation in the diagram. Questions about the notation are answered in the help text that is concealed behind the ? button.
- **Symbol, Unit, Range and Step** with configure the sliders for each parameter of the formula. The corresponding lines appear automatically when a parameter is entered in the formula in JavaScript.

The sample solution can be transferred from the Lab Docs Viewer so that an evaluation that is suitable for example measured values is displayed in the teacher version. To do this, the settings of the evaluation must be opened, then the evaluation must be activated in Lab Docs Viewer and (in the case of the free evaluation) optimised, and then **Take over from preview** must be clicked in the open settings window.

Zooming the axes

This instrument is a slider for zooming in the measured variables in a diagram.

When inserting this instrument, the settings open automatically and can be accessed later at any time via its context menu (right click). At the very top, the diagram and the measurement type to be zoomed are selected. These can be changed at any time. Underneath, a slider can be enabled for the upper and lower range limits of the axis of the measurement type. If the **Symbol** field is filled, it is displayed to the left of the slider. Symbols with subscript can be achieved by entering _ and superscript by entering ^.

Marker

This instrument is a slider for placing markers on a curve in diagrams. That makes it possible to read individual measurement values or intervals (by using two markers) from one diagram.

The settings open automatically when inserting this instrument and afterwards they can always be accessed via the context menu (right click). At the very top, the diagram and curve to be marked can be selected. These can be changed at any time. Below that one or two markers can be activated, which can be moved horizontally or vertically with the corresponding slider. With two markers, both intervals (two markers in the

same direction) and points (one horizontal and one vertical marker) can be read. If the **Symbol** field is filled, it is displayed in the Lab Doc to the left of the slider. Symbols with subscript characters are possible by entering _ , superscript characters via ^.

If more than two markers are needed, multiple marker instruments can be inserted.

Setting parameters

This instrument consists of a slider and text field for entering a single measured value of a measurement variable - like a measurement table consisting of only one cell. This is particularly useful as a parameter of a calculated measurement type (see below, in the section Calculator).

When creating this instrument, it is assigned to a measurement series and then to a measurement type of this measurement series. The slider then sets the first measured value of this measurement type. Measurement series, measurement type and measurement value number can be changed later at any time in the **Settings** (context menu).

Multimeter

This virtual instrument displays the current measured value of a measurement variable of the connected CASSY in real time. It is therefore only useful when connected to a CASSY and can only be linked to **Measurement series with CASSY** (green background). The measurement type to be displayed is selected when creating the multimeter and can be changed later at any time in the **Settings** (right click).

Alternatively, the multimeter can always display the current measured value of the currently active measurement series. Then the instrument remains active even when switching between measurement series. To do this, select the **Always switch to the active measurement series** option when creating the multimeter. In the **Settings** of the multimeter (right click) you must then specify the number of measurement types to be displayed from which input of the CASSY, because the name and meaning of the measurement type may change when switching to another measurement series (and thus the settings of the CASSY).

In Offline mode, it shows in the student version no value and in the teacher version the last measured value of the measurement series as standard. In **Settings** (right click), the title of the virtual instrument and the value displayed in offline mode can be changed.

Vectorscope, Powermeter

The vector display and the power meter are only available when using the Power Analyser CASSY (727 100) or the Power Analyser CASSY Plus (727 110) and can be found under the menu item **Power Analyser CASSY**. This virtual instrument is similar to the multimeter, but displays the current measured values of several fixed measurement types. Apart from that the settings correspond to those of the multimeter.

Virtual Instruments for Controlling the CASSY

All virtual instruments for controlling the CASSY require a measurement series that has already been created by one of the aforementioned virtual instruments. They are inserted as buttons directly into the text of a Lab Doc.

After the virtual instrument has been created, its **Settings** can be changed via the right mouse button.

If several students are connected to the same CASSY, only one student may operate the virtual instruments.

Icon	Function
	Start / stop measurement
	Delete last measured value
	Delete all measured values
	Tare the measured value for measured variables that also support this in CASSY
	Manually switch on / off measured variable
	Manually switch measuring range
	Slider for the frequency or amplitude of the Hearing Threshold Adaptor
	The measured variable is multiplied by a factor that the user enters into the Lab Doc.
	The offset that the user enters into the Lab Doc is added to the measured variable.
	First value of a two-point calibration that determines a factor and an offset. If no second calibration point is defined, only the offset is determined.
	Second value of a two-point calibration that determines a factor and an offset, if no first calibration point is defined, only the factor is determined.
	Deletes the calibration in the connected CASSY.

Calculator: Combining measurement series and calculated measurement variables

A calculator is a special type of measurement series that adds two functions to Lab Docs:

- Via a calculator, measured variables of different measurement series can be displayed together in a measurement data table or a diagram.
- Calculated measurement variables can be created in a calculator, the measured values of which the Lab Doc automatically determines using any formulas from other measured variables. These measurement variables, called formulas, can be displayed in measured data tables and diagrams.

Measured data tables and diagrams can be linked to a calculator instead of an ordinary measurement series when creating them. A new calculator is created via **New measurement series**. Here a calculator can be created instead of a measurement series with CASSY or without CASSY. This opens a window with the calculator settings, which can be opened later at any time via **View** → **Measurement series** or a virtual instrument linked to the calculator.

The settings window of a calculator shows a list of all **Measured variables of this calculator** in the centre, which is initially empty. From the list above, any measurement variables of other measurement series can be added to the calculator by dragging them into the lower list while holding down the left mouse button. This way you can add measurement variables from different measurement series. Measured data tables and diagrams which are linked to the calculator can then display these measured variables together. The measurement variables remain in their original measurement series. The calculator only refers to them - recognisable by the name of the original measurement series in the lower list. Changes to the properties or measured values of these measurement variables also affect the original measurement series. If such a

measurement variable is removed from the calculator, it remains in the original measurement series.

In addition to these references to other measurement series, a calculator can also contain its own measured variables: In particular, **New formulas** can be added using the buttons below the list **Measurement variables of this calculator**. If you mark a formula in the list of measurement variables, the formula can be edited in the area below the list. In particular, the formula that is used to calculate the measured values is specified here as JavaScript source code. In the formula, the measured values of all other measurement variables of the calculator can be used. The easiest way to do this is to drag a measurement variable from the list into the formula while holding down the left mouse button. The measurement variables are written in the formula as $a[i]$, where i is the index of the measurement variable in the list. These designations are also shown on the left-hand side of the list.

Note: If the list of measured variables of a calculator changes, the designations $a[i]$ in the formulas must be adapted.

Further questions about the syntax of the formulas are answered by the help text which can be found behind the ? button.

6.5 View Tab



Fig. 7: The preview can be controlled and various menus opened via the View tab.

Preview

Opens the Lab Docs viewer if it has been closed in the meantime or switches it to the current document and brings it into the foreground.

Help

Opens these instructions for use in the Lab Docs Viewer. A second click switches back to the preview.

Validator

The validator helps you to create an appealing and well-functioning Lab Doc. It checks the Lab Doc and indicates content that should not be used in this way. The messages are divided into faults and warnings. When the message is clicked, the affected paragraph is highlighted in the editor view, insofar as an assignment is possible.

The validator checks the saved file. The messages are therefore only updated when the Lab Doc is saved.

Comments

A Lab Doc can be provided with comments in the Lab Docs Editor that can help the author when processing the Lab Doc. Comments are not visible in the Lab Doc (Lab Docs Viewer, Internet browser), but they are visible in the source text of the HTML file.

A comment always relates to one or more paragraphs or to text within a paragraph. A new comment can be set for the selected text or paragraph via the tab **Start**, group **Edit** – such as a text format (see Section 6.2).

If you select a comment in the list, the associated text or paragraph is highlighted in the editor view. Furthermore, the com-

ment can be subsequently changed or deleted there. Responses to comments simplify the joint creation of a Lab Doc with several persons.

Search and Replace

The search function searches through the text of the Lab Doc and can also be launched using **Ctrl+F**. You can click on the individual hits in the list. You can go to the next hit by clicking on search again or by pressing the **Ctrl+F**, **Enter** or **F3** keys.

Measurement Series

An overview of the measurement series of the Lab Doc is shown here (see Section 6.4). The settings of each measurement series can be opened via the list; these are alternatively also available via each virtual instrument that is linked with the measurement series.

About...

Shows the version information and the licence status of the Lab Docs Editor.

7 Using the Lab Docs Viewer

When the Lab Docs Viewer is launched with the Lab Docs Editor, it shows the current Lab Doc of the Editor and thus enables an automatically updated preview. Furthermore, the Viewer offers other advantages in comparison with a normal Internet browser:

- You can switch between the teacher and student version of the same Lab Doc at any time via the buttons **Teacher's version** and **Students' version**.
- Instead of the preview, the Viewer can also display a QR code of the current Lab Doc, which enables this Lab Doc to be used easily on other devices in the local network as long as the Lab Docs Viewer is running. This means that when processing with the Editor, the Lab Doc can, for example, be quickly tried out on a smartphone or distributed to an entire class in a lesson from the teacher's PC (see Section 8).

If the Lab Docs Viewer has been launched directly via the Start menu and not via the Editor, a Lab Doc can be opened via 📄 or via drag & drop.

8 Distributing Lab Docs

A Lab Doc must be distributed to all student devices so that students can experiment using the Lab Doc on their terminal devices. Since Lab Docs are Web pages, it is reasonable that they should not be copied onto all student devices, but rather that a web server should be used that makes the Lab Doc accessible to all devices via a local network or via the Internet.

The students merely have to enter the address of the Lab Doc on the web server in the Internet browser. This is even easier if the address is coded as a QR code. Mobile terminal devices can scan these codes with their cameras and can then open the web page (the Lab Doc) automatically.

In principle, Lab Docs can be distributed via any web server. We offer three solutions that are described below. All three also allow easy access to the teacher version of the Lab Doc.

8.1 LeyLab

A web server that can be reached via the Internet is necessary if the student is also to be able to access the Lab Doc from home. This can be the school's own server or LeyLab.

LeyLab gives you access to all Lab Docs in the literature package purchased and allows these to be distributed to students via a temporary link. After activating the purchased literature package, you can find these in LeyLab under **LD Experiments**. Open the desired experiment. Teacher and student versions of the associated Lab Doc are listed as two separate documents in the **Documents** tab. With the student version, click on **Share** and copy the link or the QR code for the students. Please note that you will only be able to share time-limited document links with your students.

Even the free access to LeyLab also offers the option of creating your own experiments and uploading and distributing your own Lab Docs. These Lab Docs must be exported from the Editor as *.labdoc files and added to one of your own experiments in LeyLab. To do this, create an experiment in LeyLab under **My Experiments** and click on **Edit** at the top. You can then upload a Lab Doc in the **Documents** tab. After clicking on **Save**, the student version can be distributed in exactly the same way as an LD document.

Note: For licensing reasons, it is not permitted to grant the students their own access to LeyLab or to share teacher access with students. You must also ensure that you own the rights to the distributed documents. This is, however, the case with the documents from the literature package purchased from LD DIDACTIC, even if you have changed the files.

URL: <https://www.leylab.de>

8.2 Lab Docs Viewer

If a PC with Lab Docs Editor installed is available, the Lab Docs Viewer can be used to distribute your own Lab Docs. Launch the Lab Docs Viewer via the Start menu and move the HTML file into the Viewer via drag & drop. Ensure that the **Student** view is selected in the menu bar at the top. The students can use the QR code displayed to open the Lab Doc (QR code button in the menu bar).

The Lab Docs Viewer distributes the HTML file via the local network (private network or workplace network, not public network). No Internet access is required for this. However, this also has the disadvantage that students can only open the Lab Doc within the local network, i.e. not from home.

Firewall

During installation of the Lab Docs Editor, the Windows firewall was configured in such a way that the distribution of Lab Docs in the local network only functions if this network is a private network or a workplace network. If it is a public network, the distribution of Lab Docs only works within your computer – but not to another terminal device on the same network. If you use another firewall, you may have to configure this yourself.

8.3 Document Center

If you have activated a purchased literature package in LeyLab, this literature licence can also be imported into the Document Center Software on a PC. After this, the literature will also be available on this PC without permanent Internet access and you can distribute the individual Lab Docs to students in the local network via a QR code (QR code button in the menu bar, private network or workplace network, not public network) from the PC. You can switch between the student and teacher version of the Lab Doc via the button **Show information for teachers**.

Your own Lab Docs can also be distributed via the Document Center (from version 1.14 onwards). To do this, a directory for your own Lab Docs can be specified in the Document Center. Each Lab Doc within this directory can be displayed by the

Document Center and can also be distributed to the class via the QR code.

Download: <https://www.ld-didactic.de/dc>

9 Examples

The following examples show how the various functions of the Lab Docs are created with the Lab Docs Editor. To familiarise yourself with the Lab Docs Editor, open the examples one after the other directly in the Lab Docs Editor. They can be found directly on the Start page or under **File** → **Open** → **Examples**. You can then reproduce the described functions directly in the Editor view and in the preview and can then try to replicate these in your own Lab Doc.

9.1 Example 1: Visibility and formulas

In this example, text is given different values so that it is only visible in the teacher version of the Lab Doc or it is formatted as a mathematical formula, for example.

9.2 Example 2: Measurement series without CASSY

In this example, a measurement data table is created that is populated by entering measured values and a diagram that automatically displays these measured values.

9.3 Example 3: Measurement series with CASSY

In this example, a Lab Doc is created that establishes a connection to a Mobile CASSY 2 and transmits settings for voltage and current measurement to the Mobile CASSY 2. A multimeter is created that displays the measured voltage of the Mobile CASSY 2 in real time. Furthermore, a button is added to record measured values as well as a table and a diagram that display the recorded values.

9.4 Example 4: Two measurement series with CASSY

In this example, a Lab Doc is created that establishes a connection to a Mobile CASSY 2 and contains two measurement series for two separate parts of the experiment with different settings for the Mobile CASSY 2. The currently active measurement series is indicated by the number behind the # in the title bar of the Lab Doc. Various options are shown for switching the active measurement series.

9.5 Example 5: Calculated measured variables

In this example measured variables are calculated via formulas from measured values and parameters and are displayed in tables and diagrams.

9.6 Other examples

Many Lab Docs are available as a literature package (e.g. [Physics](#), [Chemistry](#) or [Biology Science Lab](#)). If their product keys have been activated in LeyLab, the examples can be viewed there and also downloaded as a *.labdoc file and processed with the Editor.

10 Software libraries used

Lab Docs Editor and Lab Docs Viewer use the following open source software, that is covered by the [MIT licence](#):

- [CommandLineParser](#) © 2019 gsscoder, nemec, ericnewton76.
- [ControlzEx](#) © 2019 Jan Karger, Bastian Schmidt, James Willock.
- [Fluent.Ribbon](#) © 2018 batzen.
- [Gu.Wpf.NumericInput](#) © 2017 Johan Larsson.
- [HtmlAgilityPack](#) © 2019 ZZZ Projects, Simon Mourrier, Jeff Klawiter, Stephan Grell.
- [Newtonsoft.Json](#) © 2019 James Newton-King.