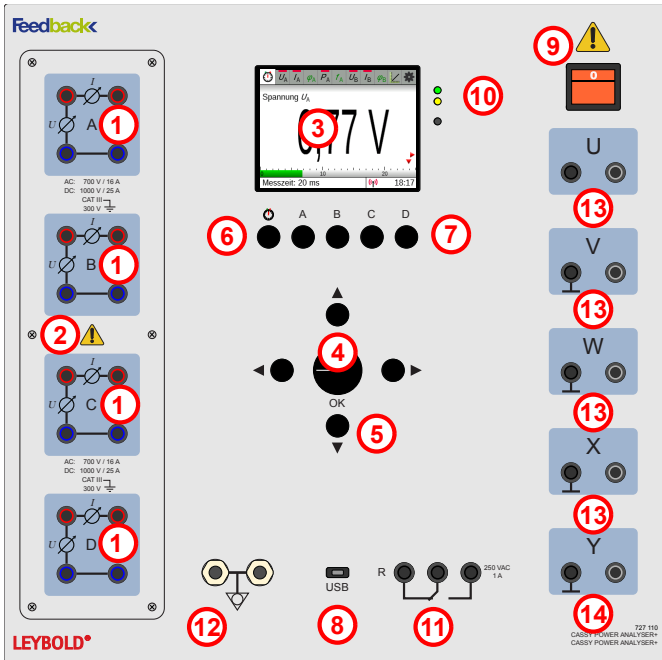


Instruction sheet 721 100

Power Analyser CASSY (727 100) Power Analyser CASSY Plus (727 110)



1	Measuring channels U and I
2	Mask
3	Display
4	Rotary selector and OK button
5	Cursor buttons
6	Start button
7	Channel selection
8	USB-C connector
9	Power switch
10	LEDs
11	Relay
12	Potential equalisation connection
13	Output channels (only 727 110)
14	Output, function generator output (only 727 110)

1 Safety notes



Please read first

This device has been designed for use in LD Didactic experiments, and is therefore only intended for use in dry rooms. If the device is used for other measurements, the user is responsible for the risk assessment and must take the necessary safety precautions.

All users should be instructed about the risk of electric shock. The user of the measuring instrument must ensure compliance with the guidelines of the trade association or other insurance carriers, country-specific requirements, as well as regulations for schools and universities.

The Power Analyser CASSY meets the following standards:

EC/EN61010-1-2001

- Safety regulations for electrical equipment for measurement, control, and laboratory use, Part 1: General requirements
- Rated voltage range: 700 V AC and 1000 V DC
- CAT III 300 (see table of permitted types of mains).
- Pollution degree 2.

- Use the analyser and accessories only as specified in the operating instructions. Failure to follow these instructions may affect the protective functions provided by the analyser.

Warning!

A "Warning" indicates circumstances and actions that represent one or more sources of risk to the user.

Warning!

- To avoid electric shock and fire hazard:
- Read this entire manual carefully before using the analyser and accessories.
- Read all instructions thoroughly.
- Do not work alone.
- Do not use the product near explosive gases, vapours, or in humid or wet environments.
- Use the product only as intended. Otherwise, the protection offered by the product may be affected.
- Only use safety leads that are approved for the maximum values of the Power Analyser CASSY.
- If measuring tips are used, keep your fingers behind the finger guards on the measuring tips.
- Inspect the analyser, voltage probe heads, measurement leads, and accessories for any mechanical damage before use, and replace them if necessary. Check for cracks in the insulation (housing, cable sheath) or if parts are missing. Pay special attention to the insulation on the plugs.
- Check the function of the measuring device by measuring a known voltage.

- Remove all unused probe heads and measuring tips, test leads, and accessories.
- Always first connect the Power Analyser CASSY to the mains socket before connecting it to the test setup.
- Do not touch voltages > 25 V AC, effective, or 60 V DC.
- Use potential equalisation only for grounding the Power Analyser CASSY. Make sure that no voltage is present here.
- The voltages to be measured must not exceed the maximum value of 1000 V DC and 700 V AC, and the currents must not exceed the maximum value of the current of 16 A AC and 16 A DC, continuous, or pulses of 24 A.
- The voltages used must not exceed the specified rated data of the probe heads and measuring tips, test leads, and accessories.
- When measuring, only use the correct measurement category (CAT), voltage and current-tested test leads and adapters.
- Never exceed the rated values of the measurement category (CAT) for the lowest rated individual component of a product, test lead, or accessory.
- Follow the local and national safety regulations.
- Use personal protective equipment (approved rubber gloves, face shield, and flame-retardant clothing) to prevent electric shock and burn injury in case dangerous live electrical conductors are exposed.
- Do not work with the device if the covers are removed or the case is open. You might make contact with dangerous voltages.
- Do not use bare metal BNC or banana plugs.
- Never insert any metal objects into the connectors.

2 Description

Power Analyser CASSY and the Power Analyser CASSY Plus are measuring devices for use in experiments in electrical engineering, in the areas of drive technology, power electronics, electrical machines, and power engineering.

Measurements are performed in 4 isolated channels, according to CAT III 300. The channels are marked by the letters A, B, C, and D. They can each measure the current or the voltage, or current and voltage at the same time.

2.1 Voltage and current U, I

- Instantaneous values: U, I
- Mean values: U_{AV}, I_{AV}
- RMS values (AC+DC): U_{TRMS}, I_{TRMS}
- RMS values (AC): U_{TRMSAC}, I_{TRMSAC}

The measuring methods can freely choose for all channels.

2.2 Phase shift 1

The phase shift φ (channel), indicates the angle between the effective power and the apparent power of the fundamental wave. This function is only active if voltage and current are selected and the measurement method is set to RMS value.

2.3 Active power

Measures the effective power. This function is only active if voltage and current is selected.

2.4 Frequency

Frequency of the voltage for waveforms that pass through the zero axis. This frequency measurement is suitable for measuring the mains frequency in energy grids.

2.5 Phase shift 2

The phase shift φ (channel A / channel X), measures the angle between channel A and the selected channel, e.g., $\varphi_{AA}, \varphi_{AB}$.

3 Technical Specifications

- Graphic display: 9 cm (3,5"), QVGA, colour, high brightness (adjustable up to 400 cd/m²)
- Operation: Push-button and rotary selector with push-button
- Inputs: 4 isolated measuring channels, each with U and I measurement (max. 8 usable simultaneously)
- Input A-D : U and I connection
- Output U-X: Voltage outputs ± 10 V, 200 mA (only for 727 110)
- Output Y: Voltage output as function generator, 0.01 Hz to 20,000 Hz (only for 727 110)
- Sockets for U and I : 4-mm safety sockets
- Voltage ranges U : 25.0/70/250/700 V_{RMS}
 $\pm 36/\pm 100/\pm 360/\pm 1000$ V_{AV}
- Current ranges I : 0.7/1.6/7/16 A_{RMS}
 $\pm 1/\pm 2.4/\pm 10/\pm 16$ A_{AV}
- Sampling rate: Max. 1,000,000 values/s per channel, for U and I , max. 500,000 values/s

Rated voltage of power supply systems					
Three-phase 4-conductor systems with grounded neutral conductor	Three-phase 3-conductor systems ungrounded	Three-phase 3-conductor systems phase grounded	Single-phase 2-conductor system, AC or DC voltage	Single-phase 3-conductor system, AC or DC voltage grounded	Voltage conductor to neutral conductor, taken from rated AC voltage or rated DC voltage up to and including
V	V	V	V	V	V
			12,5 bis 48	30 / 60	50
66 / 115	66	100	60	100 / 200	100
120 / 208	110, 115		110, 115	110 / 220	150
127 / 220	120, 127		120, 127	115 / 230	
				120 / 240	
220 / 380	220, 230, 240	200	220	220 / 440	300
230 / 400	260, 277, 347		230	240 / 480	
240 / 415	380, 400, 415		240		
260 / 440	440, 480				
277 / 480					
347 / 600	500		480	480 / 966	600
380 / 660	577				
400 / 690	600				
417 / 720					
480 / 830					
	660, 690		1000		1000
	720, 830				
	1000				

Fig. 1: Voltages and types of mains for CAT.

Resolution of the analogue inputs and outputs:	16 bits
Loudspeaker:	Error message when the measuring ranges are exceeded
Data memory:	10,000 values for each set of measurements, built-in Micro-SD card (4 GB) for more than a thousand measurement files and screenshots
WLAN	802.11 b/g/n as access point or client (WPA/WPA2) – A client connection to an Internet-enabled router/hotspot also enables the Internet connection of connected tablets or smartphones
HTTP server:	integrated (display of multimeter, table, and diagram in a browser)
WebSocket server:	integrated (distribute current measurement data to up to three clients)
VNC server	integrated (remote operation by transmitting the display content to a client)
USB ports:	Connection of a USB-C
Mains voltage:	230 V, 50-60 Hz
Dimensions:	300 mm x 300 mm x 185 mm
Weight:	2700 g

3.1 Equipment included

- Power Analyser CASSY (727 100) or Power Analyser CASSY Plus (727 110)
- Power cord DE and GB

4 Assembly description

4.1 Measuring channels (1)

- Each channel can measure the voltage U and the current I .
- Each channel is isolated against every other channel and against the control unit in accordance with CAT III.
- The measuring resistors in the circuit are designed as specified on the imprint of the screen.
- The polarity of voltage U and current I is arranged such that the power P is positive (consumption) if the power flows from left to right.
- When voltage measurement of an AC voltage is activated, its frequency f can also be measured.
- When the voltage and current measurement is activated, the power P and for alternating values (RMS value), the load angle φ and the frequency f can also be measured.
- For alternating values (RMS value), if more than one channel has been activated, the shift angle can be measured with respect to the reference value of channel A.

4.2 Mask (2)

- Each channel is protected by a 16 A gR, which can be replaced by removing the mask.
- It can only be replaced after all test leads have been removed and the device has been switched off (see safety note).
- The fuses can be pried out by using a screwdriver in the slot on the side.
- The device must not be operated with an open mask.

4.3 Display (3)

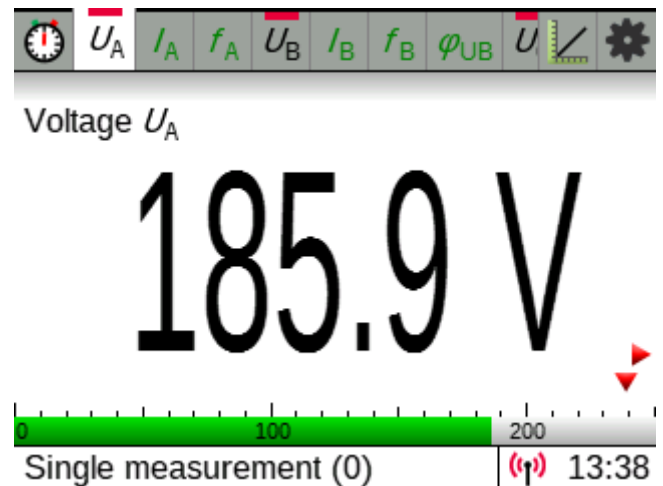



Fig. 2: Display for manual measurement.

Menu bar

Contains all sub-menus that have been activated (27 maximum). The selection is made with the rotary selector , and activated with **OK**.

Display field

- Individual measured values and settings of the output channels
- All measured values of a measuring channel A to D with the settings of the associated output
- All measured values (no more than 24 values)
- Vector diagram
- Table
- Diagram

Status bar

- Information about the measurement
- WiFi status
- Time of day

4.4 Rotary selector and OK button (4)









Turn the rotary selector  to make a selection in

- the menu bar (move left – right),
- the settings menus (move up – down),
- the range menus (move up – down),
- value lists (move up – down).


In some settings menus, it is necessary to move to the right. This can only be done with the cursor buttons (e.g., trigger menu).

- Only the rotary selector can activate a selection by pressing **OK**. A setting is saved or opened in a sub-menu.

4.5 Cursor buttons (5)

- The buttons   cannot be used in the menu bar as they can only select the display field in normal view.
- The buttons   are only active in a few settings menus.
- The buttons   can jump from the menu bar to the settings menu and back.
- The buttons   can make a selection in the settings menu, area menu, or value list, but cannot activate it.

4.6 Start button (6)

Starts and stops the measurement and simultaneously jumps to  in the menu bar.

4.7 Channel selection (7)

Jumps directly to the first active value of the selected channel in the menu bar. If the selected channel is not yet active, the voltage U is automatically activated.

4.8 USB-C plug (8)

Connection for the supplied USB cable or a suitable USB stick.

4.9 Power switch (9)

Switches the device on and lights up when it is switched on and mains voltage is present.

4.10 LEDs (10)

Lights up during start-up, firmware update, and saving.

4.11 Relay (11)



Allows measuring of switch-on and switch-off processes.

4.12 Potential equalisation sockets (12)



- Enables the meter to include potential equalisation in measurements that may require it, such as in frequency converter circuits.
- The user is responsible for setting up potential equalisation as it depends on local conditions.

5 Operation

5.1 On first use

- Switch on the Power Analyser CASSY with the power switch.
- On delivery, the display shows the language selection menu in the tab . After the language has been selected, the display shows the activated channel U_A as it will after each subsequent start-up.
- If the language has been set incorrectly, use the rotary selector or the cursor button to go to , and press the rotary switch **OK**. Select the language with rotary selector and activate it with **OK**.

5.2 Selecting and configuring values to measure

- Use the buttons A to D to select a channel. If not yet active, the voltage measurement of the selected channel is activated at the same time.
- If the desired measurand is not displayed automatically, select the measurand in the displayed menu bar and activate or deactivate it with **OK**. An activated measured variable is marked with a small red bar in its list entry (see fig. 3).
- Press **OK** or  to open the menu of the measurand. The selection is preferably made via the rotary selector .
- The setting options depend on measurand:
 - Measuring range (including automatic)
 - Acquisition of instantaneous values, mean values, and RMS values
 - Tare ($\rightarrow 0 \leftarrow$) to zero the measured value

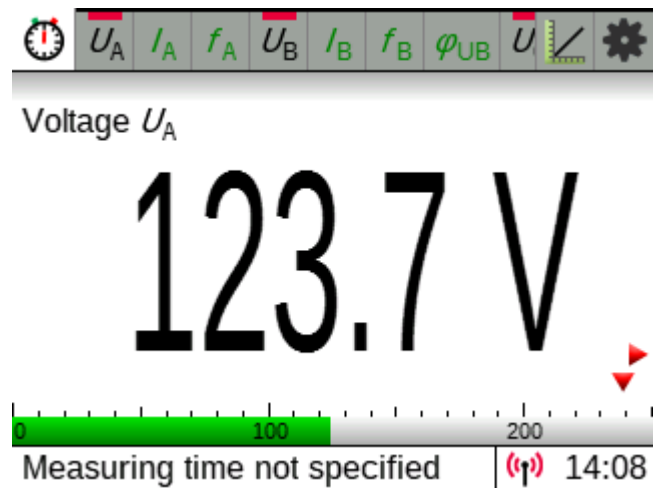


Fig. 3: Display with measured variables switched on.

- Zero point left, centre, or right for analogue display and diagram scale for current values and mean values
- Correction (for special applications)

Notes regarding displayed values

By default, values to be displayed are averaged over 100 ms. This can be modified by setting the recording mode to instantaneous values or RMS values, if necessary. Values in red indicate that the configured measuring range has been exceeded.

Notes on power measurements



Power Analyser CASSY is optimised for the simultaneous measurement of U , I , P , and f . In particular, the measuring range setting for P is always automatic and only depends on the measuring ranges of U and I .

If U and I are active and display RMS values, the phase shift angles φ may be activated as well.


For the frequency measurement f the measurement quantity U must be activated. It requires an AC voltage that runs through the zero line.

5.3 Switching between measured quantities


The quantities which have been activated for measurement are indicated by a small red bar above their listing and all of them are measured simultaneously. It is not necessary to switch back and forth between them.

For demonstrations and for the control of the measured values, the display of the measured values may, however, be switched over. That's possible only via the   buttons. By pressing the buttons in the desired direction, you can switch between the side-by-side displays (see fig. 5).

5.4 Starting a set of measurements

Once all the quantities to be measured have been activated, selecting  is sufficient to start the measurements and to stop them when you are finished. Standard settings for duration of measurement (measuring time) and measuring interval are used. These can be altered before measurements are started.

5.5 Setting measurement parameters

Fig. 4 shows a typical configuration of measurement parameters. Measurements recorded can be saved or deleted via the  menu (see section 5).

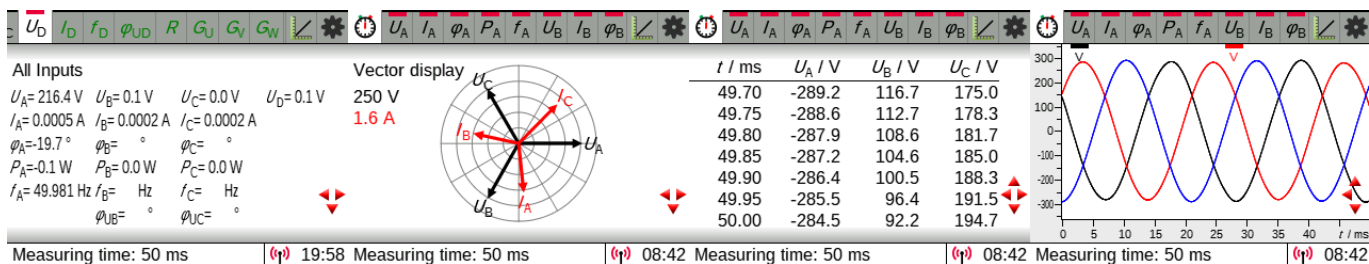


Fig. 5: To the right of the displayed measurement, there may be other displays indicating any other quantities that are activated, as well as a table of the measurements and, on the far right, a plot of those measurements. You can switch between the various displays with the keys ◀ and ▶.

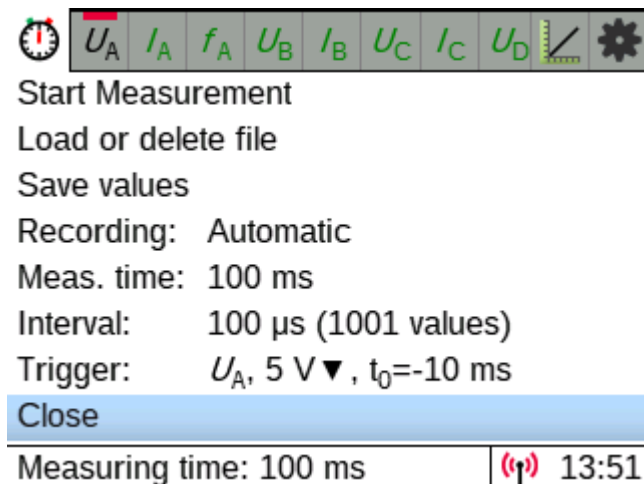


Fig. 4: Typical measurement parameters of an automatic voltage measurement with trigger (here 0 V rising) and possibly pre-trigger (here start of the measurement 10 ms before the trigger).

The recording of measurements can either be controlled manually or automatically:

- Manual: when → **Start Measurement** is activated, one set of measurements only is recorded with the present measurement values.
- Automatic: measurements are recorded over a pre-set duration at pre-set intervals. It is possible to configure trigger and (pre-trigger) settings for this. It is not essential to stipulate a measurement duration. If no duration is configured, the measurement will continue until it is stopped manually or until the internal memory for the set of measurements in question is full (10,000 values).
- Repeating: This is similar to automatic mode but the measurements are repeated continuously. A duration must be stipulated for this mode.

Notes regarding measurement intervals

For rapid measurements made at an interval of less than 100 ms, please take the following into account:

- Even if the display is showing average or RMS values, the actual measurements in the set are still instantaneous. The same settings can then be used for evaluating the results (e.g. RMS values and curves). Averages and RMS values are only measured and displayed before or after such rapid measurements.
- Automatic setting of measuring ranges is disabled during rapid measurements to ensure that no values are omitted.

Notes regarding measuring times

The unit selected for the duration of the measurement (measuring time) will also be used as the unit for the time axis. If the duration is given in hours, then the time axis will also be scaled in hours. In such cases, though, the time axis will not start from 0 but from the time of day when the measurements starts. When making measurements, for example, this means it is possible to see the time of day when the measurements were recorded. If this is not what is wanted, it is possible to reset the measurement time to minutes after the measurement has been made, from where it can then be set back to hours.

Notes regarding automatically deleted measurements

Measurements are not usually deleted without a confirmation prompt being displayed. When a new measurement is started, there is also a prompt asking whether the existing measurement values should be deleted.

But: If a USB cable is plugged in or a WiFi connection to CASSY Lab 2 or the CASSY App is established, all measured values already recorded will be lost in the process because the data acquisition will then be completely taken over by CASSY Lab 2 or the CASSY App.

5.6 Evaluations within the table

The table is shown to the right of the displayed measurements and can be accessed with the arrow keys ◀ and ▶ (see fig. 5).

The menu for the table is always selectable via (View: Table) or from the table view itself by pressing ▲.

All activated measured values are stored internally. However, a maximum of 4 measured values and the time axis can be displayed. The columns can be freely selected via the table menu. To scroll in large tables, you need to set **Scrolling** to **manual** in the table menu set; you will then immediately jump into the table where you can scroll in the table with ▲ ▼. For **Scrolling** set to **automatic**, the last measured line is always displayed as the bottom line.

5.7 Evaluations within the diagram


A diagram showing a plot of the values is displayed to the right of the table and can be accessed with the arrow key ▶ (see fig. 5).

Normally, values of all quantities activated for measurement will be shown on the diagram. This can, however, be modified with the help of the diagram menu.

The diagram menu is always selectable via (View: Diagram) or from the diagram view itself by pressing ▲.

The menu contains various evaluation functions which may be selected (e.g. zoom, line fitting, integrals). These are applied to the currently selected region of the plotted curve.

By default, the selected region is the full length of the first (black) curve. This can be altered by selecting **Range** and then selecting the desired curve.

After this range function has been selected from the diagram menu, the start and end of the range can be selected via the rotary knob  and **OK**, either until both ends of the range have been defined or a cursor key has been clicked to cancel the action.

If more than one curve is to be displayed at once, a second y-axis will automatically be displayed if the display range of the second curve differs from that of the first. The colour of the scale divisions for that axis will match the colour of the curve to which they belong.

Notes on evaluation functions

As long as no ranges have been selected, the zoom function will zoom into all of the y-axes but not the x-axes. You can only zoom in on the x-axes as well by selecting a range.


Multiple subsequent evaluations can be made without deleting any previous ones. The most recent result of any evaluations will be displayed in the status bar at the bottom of the diagram.

5.8 Switching off

The Power Analyser CASSY and the Power Analyser CASSY Plus are switched on and off via the power switch.

When the device is switched off, the current set of measurements and the present settings are erased. Any sets of measurements which have been saved are, of course, retained.

6 Save

Once a set of measurements has been recorded, it can be saved via the  menu (see fig. 4). The filename specified will be displayed.

The file can either be saved to a USB memory stick with FAT formatting or to the internal SD card to the Examples sub-folder (*.labm) or to the Data sub-folder (*.txt). It is only possible to write to the internal SD card when the Power Analyser CASSY unit is NOT connected to a computer.

If the Power Analyser CASSY is connected to a computer via USB, then it is possible to read and write to the SD card from the computer.

If the file has been saved as *.labm, then besides the measurement data the file also contains all the settings and can be read by a Power Analyser CASSY 2 again. If the subdirectories exist for the examples directory, these can be selected in the first level. Furthermore, using Mobile Edit (see section 9.2) an experiment instruction sheet can be integrated.

If the file has been saved as *.txt, then it can be read using multiple commonplace programs. The simplest way is to drag and drop it onto CASSY Lab 2 (see section 9.7) while that software is running. Even the demo version of CASSY Lab 2 is equipped for this, meaning that no activation code is required.

7 Meaning of LEDs

The LEDs beside the display indicate various operating states.

Green: Displayed briefly when switching on.




Flashing green: During the course of an actual measurement (see section 4.6) or a firmware update (see section 10).


Yellow: The internal SD card or an external USB stick is being accessed.




8 WiFi settings

In order for Power Analyser CASSY to be found more easily in WiFi, it has a name. The standard name for this is "PA-XXX", where "XXX" is replaced by the last three numbers of the serial number. This name can be modified with Mobile Config (see section 9.1) and is used by Power Analyser CASSY e.g. as the name of the access point, as the DHCP host name and as the name in the apps (see section 9).

Power Analyser CASSY supports three different WiFi modes:

- Disabled
- Access point as the standard default setting. A different name for the access point and a password can be entered using Mobile Config (see section 12.1). The three operating modes can be distinguished between by the displayed symbol:
 - : No connection established to access point.
 - : A device is connected.
 - : An app is connected (see section 9).

Connecting to a Power Analyser CASSY access point is particularly easy:  → **Show QR code** → **AP data**. However, a terminal then always has connection to exactly one Power Analyser CASSY and usually no more Internet access.

- Client for connection to a router. The access data of the router (SSID and password) can be entered using Mobile Config (see section 9.1). The three operating modes can be distinguished between by the displayed symbol:
 - : The connection to the router is being established or has failed. If a connection to the router has not been signalled after 30 seconds, check the SSID and password of the router.
 - : The connection to the router has been established. The better the reception is, the more bars displayed.
 - : An app is connected (see section 9). The better the reception is, the more bars are displayed.

For security reasons, the Power Analyser CASSY will not reveal the connection data to the router via a QR code.

8.1 Server

The Power Analyser CASSY runs several servers, some of which support multiple simultaneous connections.

Note: These servers provide unencrypted connections, which, for security reasons, should therefore only be used within a local network.

TCP server



A TCP client, such as the CASSY App (see section 9.6) and CASSY Lab 2 (see section 9.7), control the measurement recording of a Power Analyser CASSY and display the results. Only one connection is possible simultaneously, and only if there is no USB connection.



HTTP server

For the delivery of the Power Analyser CASSY Web App (see section 9.4) to a browser, e.g., on a smartphone. In this case, the Power Analyser CASSY controls the measurement itself.

WebSocket server

For the distribution of the measured values of the Power Analyser CASSY to up to three WebSocket clients. A WebSocket client is often embedded in a web page, such as Mobile Control or the Power Analyser CASSY Web App (see sections 9.3 and 9.4). Our Lab Docs of the Student Experimental Literature also include WebSocket clients that allow up to three students to collaborate on a Power Analyser CASSY experiment, using their tablets (see sections 9.5 and 9.6).

To simplify a WebSocket connection, a PIN that can be found to the left of the  or , which can be entered instead of the IP address or the CASSY name in the address field of a Lab Doc. This PIN can be modified or disabled in Mobile Config (see section 9.1).

To keep track of the number of WebSocket connections, they are counted to the right of the green  or . It counts all connections to the Power Analyser CASSY Web App, to Mobile Control, and to a Lab Doc. When all three connections are established, the display of the PIN disappears since no further connection is possible.

VNC server

A VNC client connected to the VNC server transmits the screen content and enables remote control of the Power Analyser CASSY (see section 9.5). Only one VNC client can be used at a time.

8.2 MAC address

For some networks, the MAC address must be specified before Power Analyser CASSY can connect to the network. There are different ways to obtain the MAC address of a Power Analyser CASSY:

- Mobile Config (see section 9.1) displays the MAC address in the status line when the Power Analyser CASSY is connected via USB.
- The Power Analyser CASSY Web App (see section 9.4) shows the MAC address in the System menu.
- The Bonjour Discovery App on a smartphone or tablet displays the MAC addresses of all Power Analyser CASSYs on the same network under the HTTP services in the form, CASSY-name-XXXXXXXXXXXX. This is useful for determining the MAC addresses of several Power Analyser CASSYs at the same time.

9 Additional settings

The settings can be modified in the menu or can be temporarily or permanently configured using Mobile Config (see section 9.1) on the computer.

9.1 Activate screenshots

If screenshots are activated, these can be made by touching the **OK** button for 2 seconds.


A screenshot can either be saved to a USB memory stick with FAT formatting or to the Screenshots sub-folder on the internal SD card. It is only possible to write to the internal SD card when the Power Analyser CASSY unit is NOT connected to a computer.

A successful screenshot is indicated by an audible signal identical to a normal key tone. An unsuccessful screenshot (e.g. when the internal SD card is currently being accessed by a computer) is indicated by a higher pitched and longer tone.

If a Power Analyser CASSY unit is connected to a computer via USB, then it is possible to read and write to the SD card from the computer.

The saved bitmap file (*.bmp) can be read using multiple commonplace programs.

9.2 Diagram available

If the diagram is disabled, then with the key  you are only able to toggle to the table. Depending on what the object of the lesson is, work on the diagram can be postponed until a later point in time.

9.3 Clock visible

If the clock display is disabled, then there is more space for evaluation results in the status bar.

9.4 Additional settings

There are some settings which cannot be set using the menu of Power Analyser CASSY. This includes a welcome screen during switch-on, a preset subdirectory for experiment examples, the name of the Power Analyser CASSY, the WiFi configuration and default experiments.

Furthermore many individual menu items of the Power Analyser CASSY can be disabled so that these menu items can no longer be selected.

These settings can be carried out with Mobile Config (see section 9.1).

10 Apps for Power Analyser CASSY



For those who are not yet satisfied by Power Analyser CASSY's features, these can be supplemented using apps.

10.1 Mobile Config (contained in scope of delivery)

Mobile Config is a tool used by the instructor or the system administrator to configure Power Analyser CASSY or to restrict its functionality (see fig. 6).

The configuration is stored in the hidden configuration file MOBILE.CFG on Power Analyser CASSY.

A welcome screen, the name of the Power Analyser CASSY, its WiFi access data, automatic switchover to daylight savings time and a default experiment can be defined.

In addition to the WiFi access information, this is where you can change the PIN, which is displayed to the left of the green  or  and simplifies the connection to the interactive Lab Docs. For this purpose, this PIN is transmitted anonymously to our discovery service, along with the local IP address, where it is stored for a maximum of one day. If this is not desired, the PIN can be disabled, thus disabling this service in Mobile Config.

It is also possible to enter values for many existing menu items or to disable these menu items altogether.

Particularly helpful is the automatic configuration of several Power Analyser CASSYs with the same configuration file, if the first option **Copy changed configuration to CASSY automatically** is selected and the configuration file is copied to a USB stick. Then all you need to do is briefly insert this USB stick for the configuration of a Power Analyser CASSY.

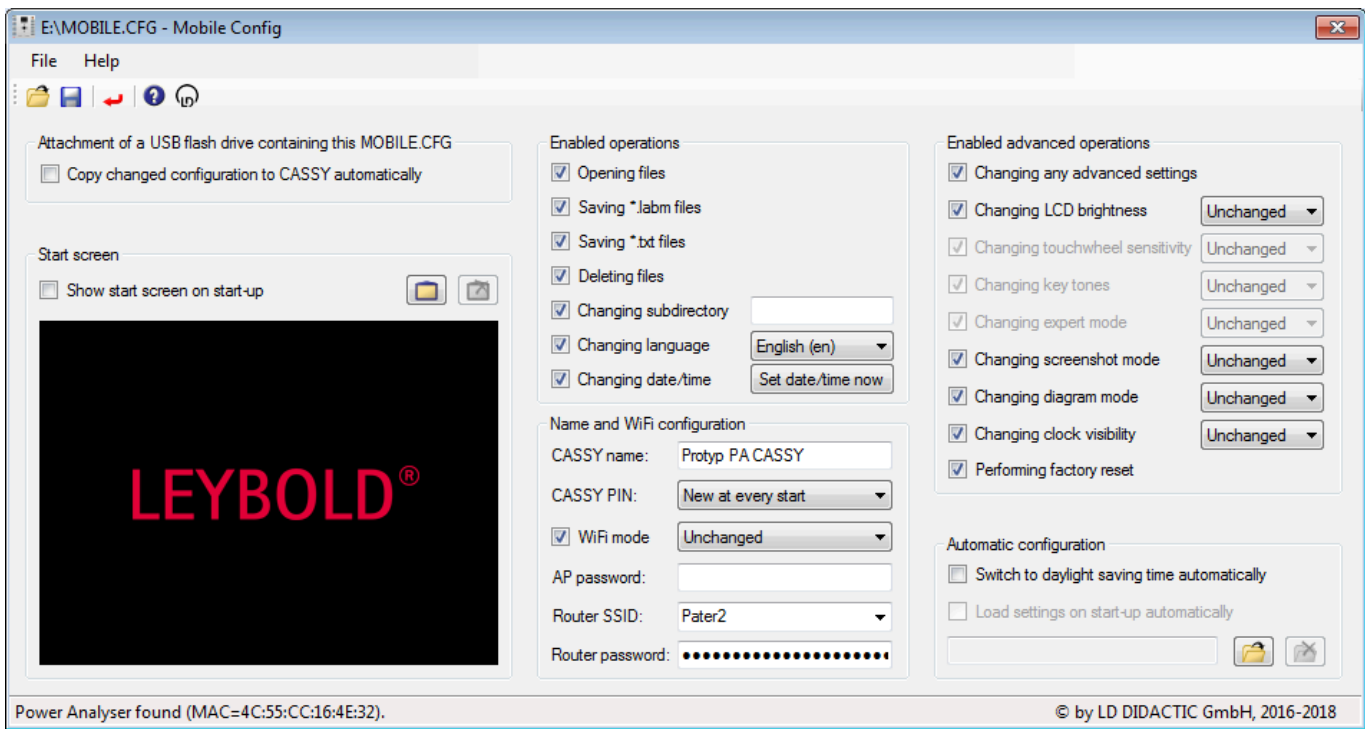


Fig. 6: Mobile Config configures a Power Analyser CASSY by editing its hidden configuration file MOBILE.CFG.

In the default operating state of the Power Analyser CASSY, MobileConfig.exe is located on its SD card and can be started directly from there without any installation as soon as the Power Analyser CASSY is connected via USB to a Windows computer.

The user interface of Mobile Config is only available in the German and English language. The help texts provide additional information on how to use Mobile Config.

Download: <https://www.leybold-shop.de/727100>

10.2 Mobile Edit (contained in scope of delivery)

Mobile Edit is a tool used by the instructor or author to add experiment descriptions in one or more languages to the measurement files of Power Analyser CASSY (see fig. 7).


In addition to the experiment descriptions, an image and the name can be specified for each language, under which the experiment example should be displayed in the file selection tree in Power Analyser CASSY.

In the default operating state of the Power Analyser CASSY, MobileEdit.exe is located on its SD card and be started directly from there without any installation as soon as the Power Analyser CASSY is connected via USB to a Windows computer.

The user interface of Mobile Edit is only available in the German and English language. The help texts provide additional information on how to use Mobile Edit.

Download: <https://www.leybold-shop.de/727100>

10.3 Mobile Control (contained in scope of delivery)

Mobile Control is a tool for teachers who can use it to survey the measurement data of all student groups. For this purpose, a WebSocket connection to the selected Power Analyser CASSYs is established, and thus the group is also displayed by a small digit to the right of the green . In addition, Mobile Control can transfer control settings to all or individual stu-


dent groups in the form of a *.labm file, using the menu or drag&drop (see fig. 8).

Since Mobile Control is a tool for multiple Power Analyser CASSYs, its use makes sense only in a router infrastructure. However, this router does not need to have internet access.

The user interface of Mobile Control is only available in the German and English language. The help texts provide additional information on how to use Mobile Control.

Download: <https://www.leybold-shop.de/727100>

10.4 Power Analyser CASSY Web App (contained in scope of delivery)

The Power Analyser CASSY Web App is a website which is delivered by Power Analyser CASSY (see fig. 9). The URL of the web app can be reached via  → **Show QR Code**. The Web App is useful for having measured values, tables, diagrams,

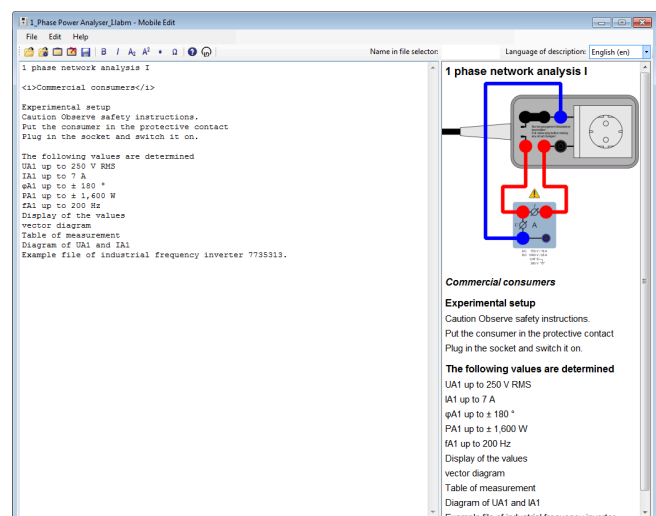


Fig. 7: Mobile Edit supplements the measurement data by providing descriptions..

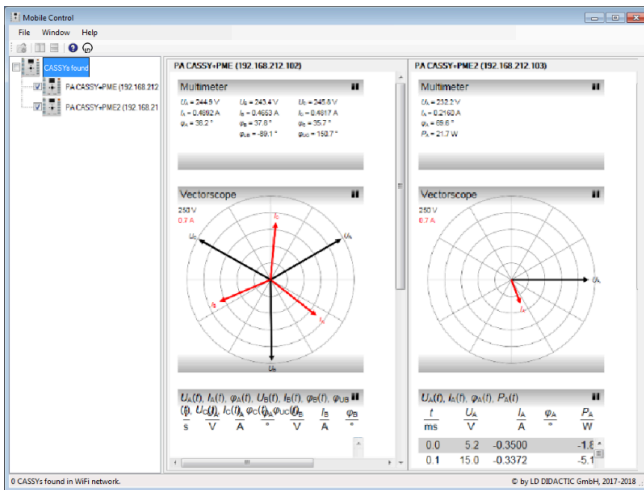


Fig. 8: Mobile Control gives a clear summary of the measurement data of several Power Analyser CASSYs in the network and can transfer settings to the various Power Analyser CASSYs.

and evaluations that are displayed by Power Analyser CASSY displayed by other devices on the same network as well. The Power Analyser CASSY Web App is only intended for display, and not for controlling the recording of measured values.

10.5 VNC Viewer (free of charge)

Power Analyser CASSY has an integrated VNC server. For easy use we recommend the VNC Viewer from RealVNC, which is available free of charge for Windows, Linux, OS X, Android and iOS (see fig. 10).

The respective name of the Power Analyser CASSY is to be entered as the VNC server, just as it is specified in ① menu. Any blank spaces need to be replaced by hyphens. Alternatively, the IP address indicated in the ① menu can be entered instead.

Alternatively operation of the Power Analyser CASSY can also be carried out using the VNC Viewer. There is of course no touch wheel available for operation on the VNC Viewer. Instead equivalent mouse actions can be used (click and drag).

Important note

The default settings of the VNC Viewer have to be modified.

VNC Viewer: Display all available colours (maximum compression), as otherwise the colours are displayed incorrectly.

VNC Viewer app: Switch picture quality from automatic to high as otherwise no connection is established.

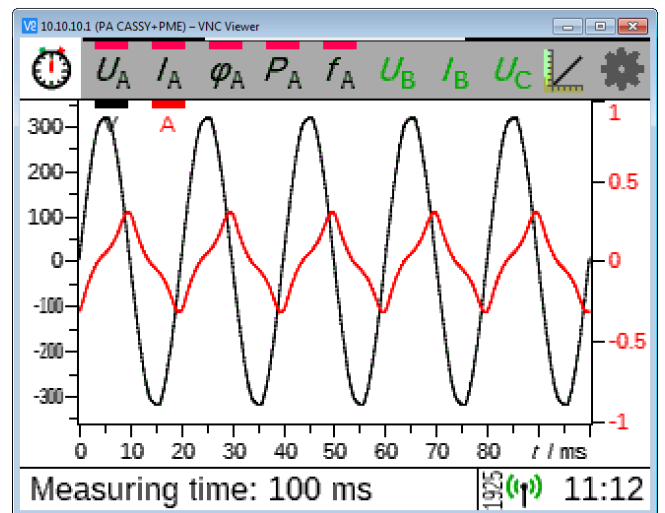


Fig. 10: A Power Analyser CASSY screen in the window. A VNC Viewer is ideal for presentations on a projector.

10.6 CASSY App (free of charge)

The CASSY App is available for all conventional operating systems (Android, iOS and Windows). It reproduces the functional environment of the Power Analyser CASSY on a tablet with the additional possibility of being able to export measurement values and diagrams to other apps or to the cloud.

10.7 CASSY Lab 2 (524 220)

Power Analyser CASSY is fully supported by CASSY Lab 2. If only Power Analyser CASSY files (see section 5) are to be read, the demo version without activation code suffices.

Download: https://www.ld-didactic.com/software/cassylab2_en.msi

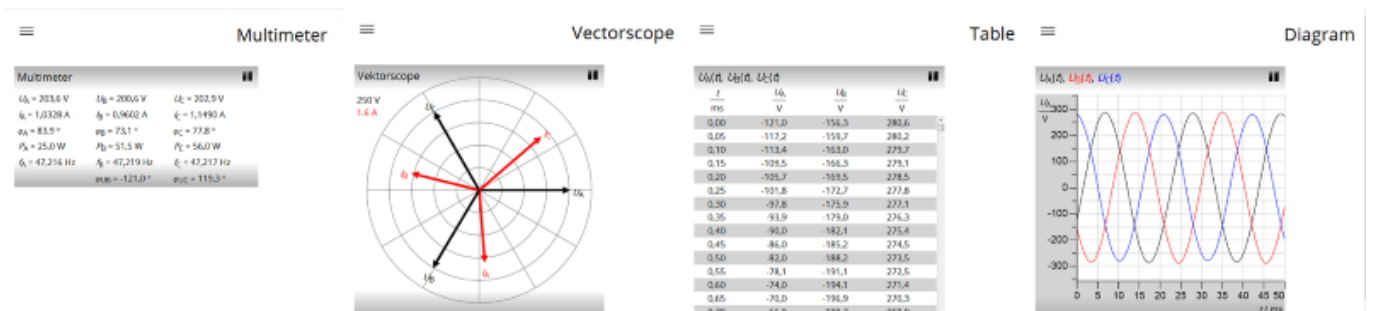


Fig. 9: In addition, the Power Analyser CASSY Web App displays the measurement data, tables, diagrams, and evaluations of a Power Analyser CASSY in up to three browsers.


11 Firmware updates

It is advisable to update the Power Analyser CASSY firmware from time to time.

There are various ways by which an update can be carried out:

- Download the firmware file FIRMWARE.LD from the internet, copy it to the Power Analyser CASSY SD card, then turn the unit off and back on again. When you have switched it back on, wait for the update procedure to be carried out, i.e. while the green LED is flashing.
Download: <https://www.leybold-shop.de/727100>
- Download the firmware file FIRMWARE.LD from the internet and copy it to the root directory of a FAT-formatted USB stick. Plug the USB stick into the Power Analyser CASSY unit, and take it out again once the update procedure has started (i.e. when the green LED is flashing). This method is particularly useful if you need to update the whole set of Power Analyser CASSY units for a class.
Download: <https://www.leybold-shop.de/727100>
- Download the current version of CASSY Lab 2 from the internet and install it. Connect the Power Analyser CASSY to a computer and carry out the firmware update from CASSY Lab (this requires a licence for CASSY Lab 2).
Download: https://www.ld-didactic.com/software/cassylab2_en.msi

11.1 WiFi update

The WiFi module of the Power Analyser CASSY includes firmware and the Power Analyser CASSY Web App (see section 9.4). Updating this firmware is only possible if Power Analyser CASSY is connected to the Internet. If a WiFi update is available, it can be applied via  → **WiFi update**. In order to offer this option, Power Analyser CASSY automatically downloads the version number of the current firmware from the Internet at each start-up and compares it with the installed version.

12 Examples of the connection of the measuring channels

12.1 Current measurement

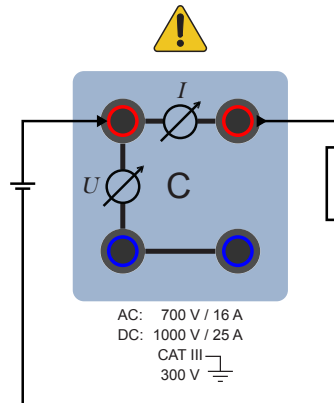


Fig. 11: Measures the current of a channel.



Attention

The connections of current paths should never be interrupted unless the system or the experiment is switched off. There is a possibility of the formation of arcs in case of disconnections and short circuits. The safety leads used must be rated for the expected current value.

12.2 Voltage and frequency measurement

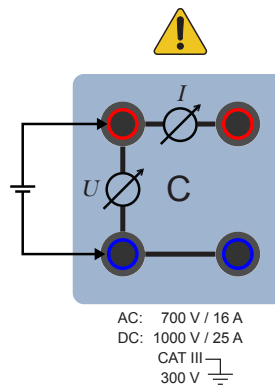


Fig. 12: Measures the voltage and frequency of a channel.



Attention

The safety leads used must be rated for the expected voltage value.

12.3 Phase shift angle between U and I of a channel

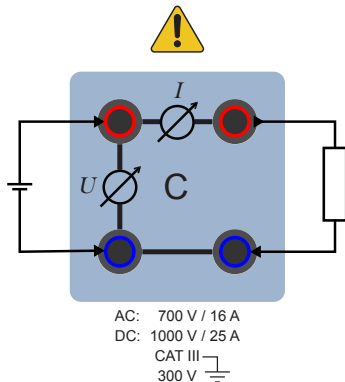



Fig. 13: Measures the phase shift angle between U and I of a channel.

The phase shift angle can only be selected if U and I has been selected in the channel.



Attention

The connections of current paths should never be interrupted unless the system or the experiment is switched off. There is a possibility of the formation of arcs in case of disconnections and short circuits. The safety leads used must be rated for the expected voltage and current values.

12.4 Effective power

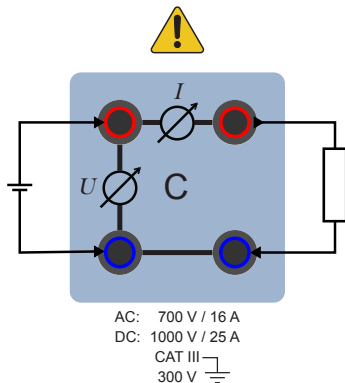



Fig. 14: Measuring the effective power with voltage and current.

Effective power can only be selected if U and I has been selected in the channel.



Attention

The connections of current paths should never be interrupted unless the system or the experiment is switched off. There is a possibility of the formation of arcs in case of disconnections and short circuits. The safety leads used must be rated for the expected voltage and current values.

12.5 Phase shift between U_A and the voltage U_B to U_D of the other channels

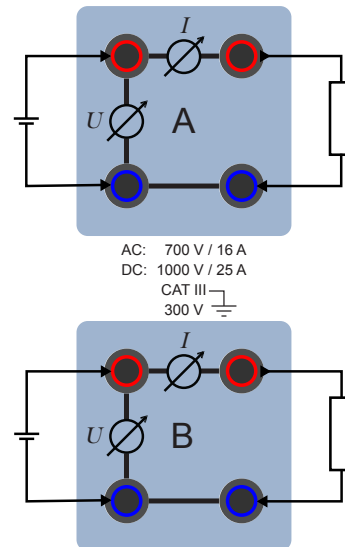


Fig. 15: Measures the phase shift between channel A and another channel.

The phase shift angle can only be selected if at least the voltage U_A has been selected in channel A, and another voltage U_B to U_D has been selected in another channel.

12.6 3 phase networks with connected star point

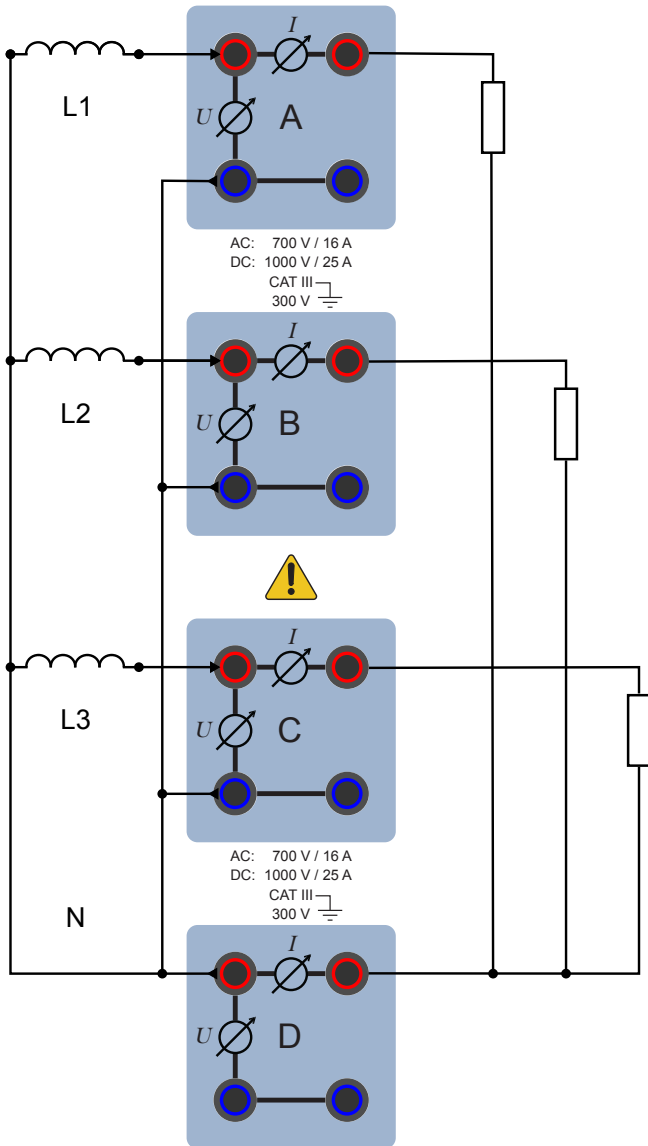


Fig. 16: Measurement in 3 phase networks with neutral conductor and grounded star point.

In this application, only the current I_D is active in channel D. It corresponds to the current in the neutral conductor.



Attention

The connections of current paths should never be interrupted unless the system or the experiment is switched off. There is a possibility of the formation of arcs in case of disconnections and short circuits. The safety leads used must be rated for the expected voltage and current values.

12.7 3 phase networks with open star point

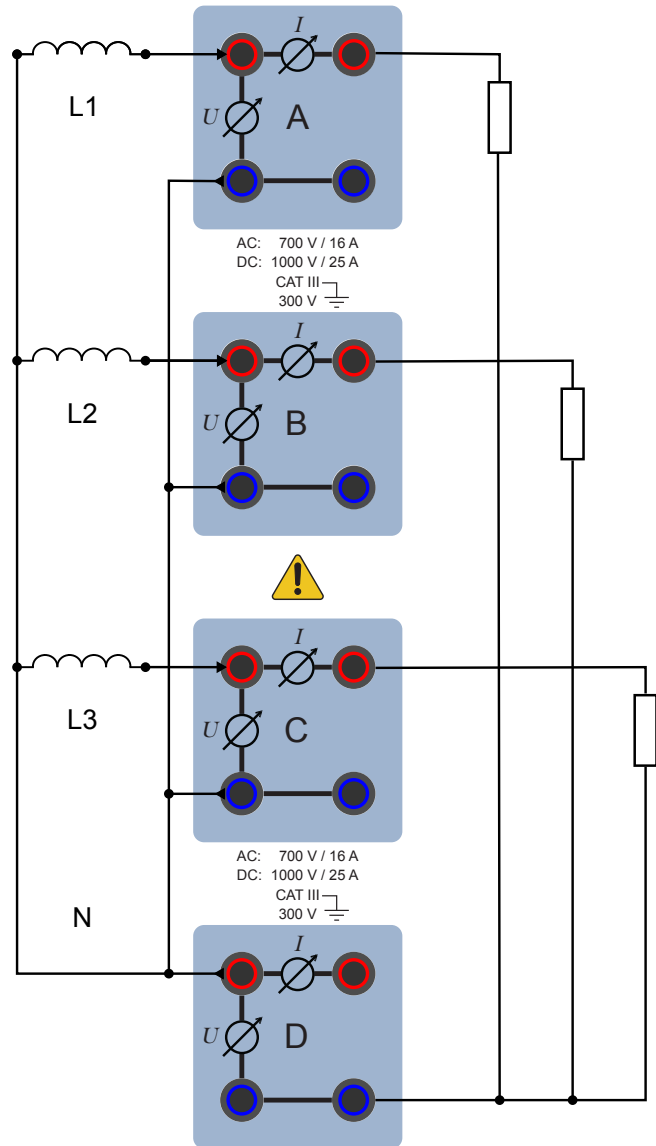


Fig. 17: Measurement in 3 phase networks with star point without neutral conductor.

In this application, only the voltage U_D is active in channel D, corresponding to the voltage between the 2 disconnected start points.



Attention

The connections of current paths should never be interrupted unless the system or the experiment is switched off. There is a possibility of the formation of arcs in case of disconnections and short circuits. The safety leads used must be rated for the expected voltage and current values.

12.8 3 phase networks without star point

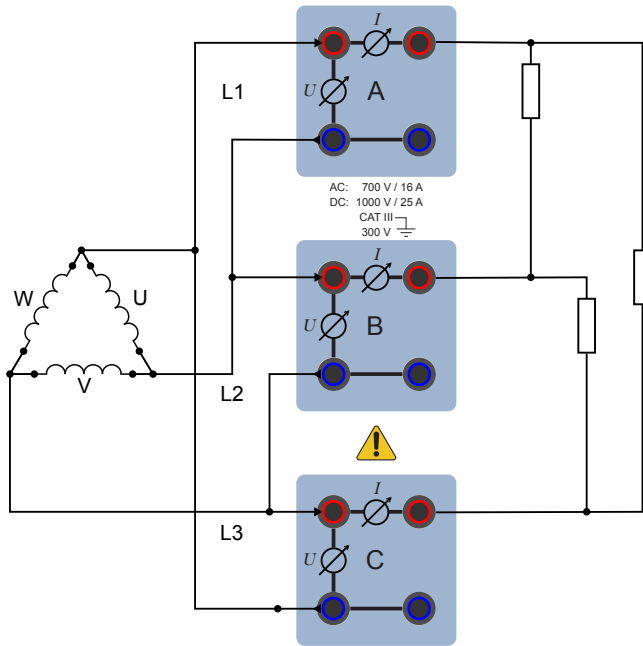


Fig. 18: Measurement in 3 phase networks without star point.

Attention

The connections of current paths should never be interrupted unless the system or the experiment is switched off. There is a possibility of the formation of arcs in case of disconnections and short circuits. The safety leads used must be rated for the expected voltage and current values.

13 Additional functions of the Power Analyser CASSY Plus (727 110)

13.1 Isolation amplifier

At the analogue outputs U to X, the signals of the inputs A to D or calculated signals for the connection of an oscilloscope or other control devices with a maximum output voltage of ±10 V are output.

The analogue outputs are permanently assigned to the measuring channels, e.g., channel A to analogue output U. With the activation of a measuring channel, they become visible as measurand G_U to G_X and can then be activated like a measurand.

All Inputs

$U_A = 216.7 \text{ V}$	$\varphi_B = \text{ }^\circ$	$U_D = 0.1 \text{ V}$
$I_A = 0.1656 \text{ A}$	$\varphi_{UB} = \text{ }^\circ$	$G_U = 0.01 \text{ V/V}$
$\varphi_A = 84.0 \text{ }^\circ$	$U_C = 0.06 \text{ V}$	$G_V = 0.25 \text{ V/V}$
$f_A = 50.012 \text{ Hz}$	$I_C = 0.0003 \text{ A}$	$G_W = 0.25 \text{ V/V}$
$U_B = 0.05 \text{ V}$	$\varphi_C = 99.2 \text{ }^\circ$	$G_X = 0.025 \text{ V/V}$
$I_B = 0.0002 \text{ A}$	$\varphi_{UC} = 75.9 \text{ }^\circ$	

Measuring time: 50 ms | 12:47

Fig. 19: Activation of the output channels.

Measured signals

The signals U_x , I_x , and P_x of the measuring channel can be delivered to the output. The gain associated with the measurement is displayed as a measured value in the display and in the menu selection.

The conversion is calculated as $U_A = \frac{U_U}{G_U} = \frac{5.75 \text{ V}}{0.025 \text{ V/V}} = 230 \text{ V}$

Gain G_U

Input: Voltage $U_A(t)$

Gain: x 1 (0.025 V/V)

Close

Measuring time not specified | 07:21

Fig. 20: Display of the gain in the output menu.

Calculated signals

It is possible to add, subtract, or multiply the signals from adjacent channels. With these functions, the gain is displayed as a measurand as well.

Output	+	-	x
U	$U_A + U_B,$ $I_A + I_B$	$U_A - U_B,$ $I_A - I_B$	$U_A \times U_B,$ $I_A \times I_B$
V	$U_B + U_C,$ $I_B + I_C$	$U_B - U_C,$ $I_B - I_C$	$U_B \times U_C,$ $I_B \times I_C$
W	$U_C + U_D,$ $I_C + I_D$	$U_C - U_D,$ $I_C - I_D$	$U_C \times U_D,$ $I_C \times I_D$
X	$U_D + U_A,$ $I_D + I_A$	$U_D - U_A,$ $I_D - I_A$	$U_D \times U_A,$ $I_D \times I_A$

Tab. 1: Table of possible assignments.

13.2 Function generator

The function generator output, Y, can only be addressed via CASSY Lab 2 (see section 9.7).

Functions

The output of the function generator can be actively limited to the actual measuring time **while a measurement is active (single shot)**.

The output waveform, frequency f (in Hz), amplitude A (in Vp), DC voltage offset O (in V) and duty factor (in %) can be set in specific ranges (see Tab. 2).

Negative amplitudes of A are allowed and mirror the signal through 0. The duty factor determines the ratio between the rising and falling wave sections. Thus, e.g. it is easy to convert a triangular signal (50 %) into a sawtooth signal (100 %).

In addition to the usual waveforms, the CASSY also offers a user-programmable waveform. To generate this, you need to enter a formula $f(x)$ that describes that waveform. To determine the waveform, this function is evaluated in the variable x in the interval $[0,1]$ and output with the specified frequency f , amplitude A and offset O . Formula entry is governed by the standard rules.

The formula input box is relatively small. You can use any standard text editor to generate longer formulas and then cut and paste these into the input box (right mouse button).

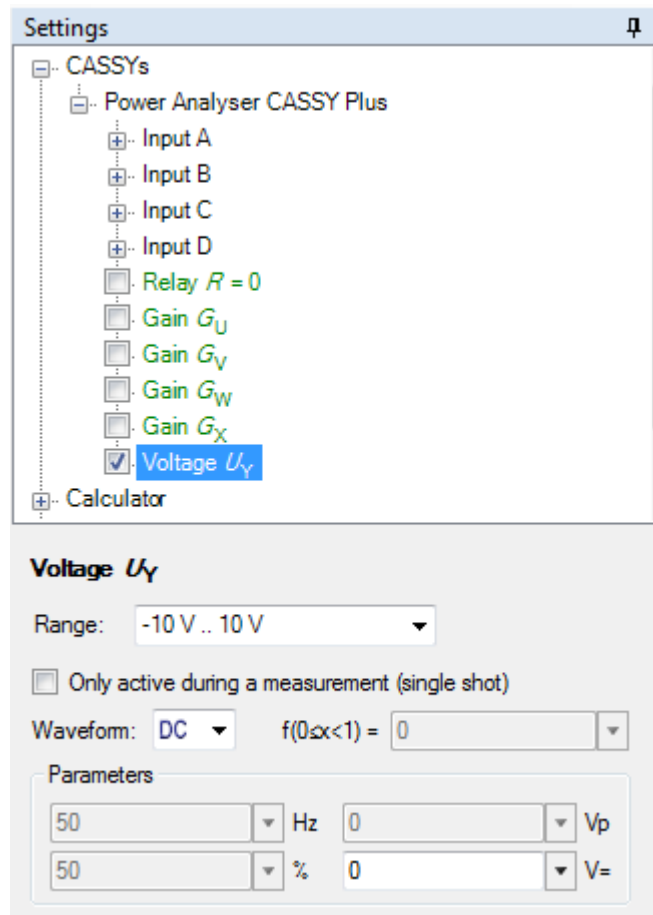


Fig. 21: Settings in CASSY Lab 2.

Waveform	Frequency range $\frac{f}{\text{Hz}}$	Amplitude $\frac{A}{\text{V}_p}$	Offset $\frac{O}{\text{V}=\}$	Duty cycle $\frac{\tau}{T}$
DC	-	-	0 ... ± 10	-
Sine	0.01 ... 20.000	0 ... ± 10	0 ... ± 10	0 ... 100
Square sym.	0.01 ... 20.000	0 ... ± 10	0 ... ± 10	0 ... 100
Square asym.	0.01 ... 20.000	0 ... ± 10	0 ... ± 10	0 ... 100
Triangle sym.	0.01 ... 20.000	0 ... ± 10	0 ... ± 10	0 ... 100
Ramp	0.01 ... 20.000	0 ... ± 10	0 ... ± 10	0 ... 100
Free function $f(x)$	0.01 ... 20.000	0 ... ± 10	0 ... ± 10	-

Tab. 2: Table with setting ranges for the function generator.