
Manual

Uninterruptible Power Supply

Capacitive UPS PC-0424-017-0



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1. Order Information

The table below shows the order information for the capacitive UPS and capacity modules.

Table 1: Order numbers

Capacitive UPS			
Variant	Input voltage	Output current	Rated capacity
PC-0424-017-0	24 V DC	20 A	1,700 W
Capacity modules			
Variant	Input voltage	Rated output current	Rated capacity
PC-0424-115-0	24 V DC	40 A	11,500 W

2. General Information

2.1 Safety Instructions

Please read these warnings and safety instructions carefully before operating the device. The device may only be installed by qualified competent personnel. In the event of malfunctions or damage, switch off the supply voltage immediately and send the device to BLOCK Transformatoren-Elektronik GmbH to be checked. The device does not contain any service components. When an internal fuse is triggered, there is most likely an internal defect in the device. The data provided are for product description purposes only and should not be construed as legally guaranteed properties.

2.2 Qualified Personnel

The product referred to in this documentation may only be operated by qualified personnel, in compliance with the specific documentation pertinent to the respective task, in particular the safety instructions and warnings contained therein. Qualified personnel can, as a result of their training and experience, help to ensure that the use of the described product meets all safety requirements as well as applicable regulations, provisions, standards, and laws.

2.3 Intended Use

This device is designed for installation within an enclosure and is suitable for use with general electronic devices, such as industrial controls, office equipment, communications equipment, and gages. Do not use this device in control systems for airplanes, trains, or nuclear facilities where a malfunction can result in serious injury or death.

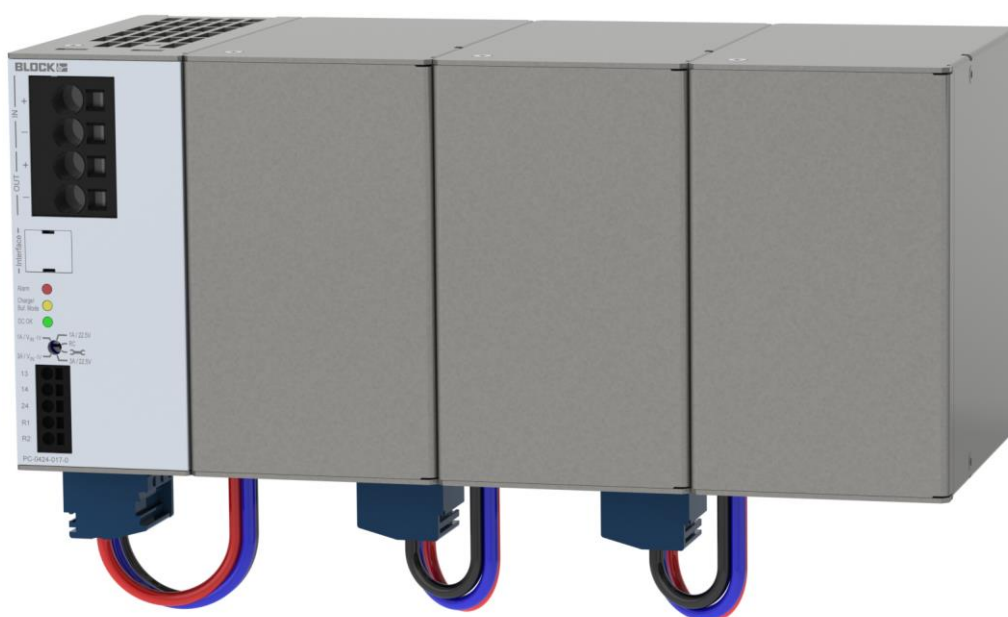
2.4 Disclaimer

The contents of this publication have been checked with great care for concordance with the described hardware and software. Nevertheless, there may be differences between the product and the documentation. Deviations may also arise due to the further development of the product.

For this reason, we cannot guarantee full concordance. Should this documentation contain any errors, we reserve the right to make necessary corrections without prior notice.

3. Product Description

The new ultracapacitor-based UPS provides a long lifetime, including at high ambient temperatures, thereby ensuring increased safety in 24 V networks. Uninterrupted power supplies of up to 20 A are available in the event of a power failure with the basic module. The flexible expansion options mean that the output current can be increased to up to 40 A and the buffer time scaled accordingly to meet requirements by adding up to 3 capacity modules. All relevant data can be accessed at any time via an isolated USB interface.



3.1 Block Circuit Diagram

The block circuit diagram below shows an example of a wiring arrangement.

To ensure good communication with the capacitive UPS, it is essential to use interface, control, and signal cables less than 3 m in length.

It is also important to ensure the control cable does not run parallel with power cables as this may interfere with communication.

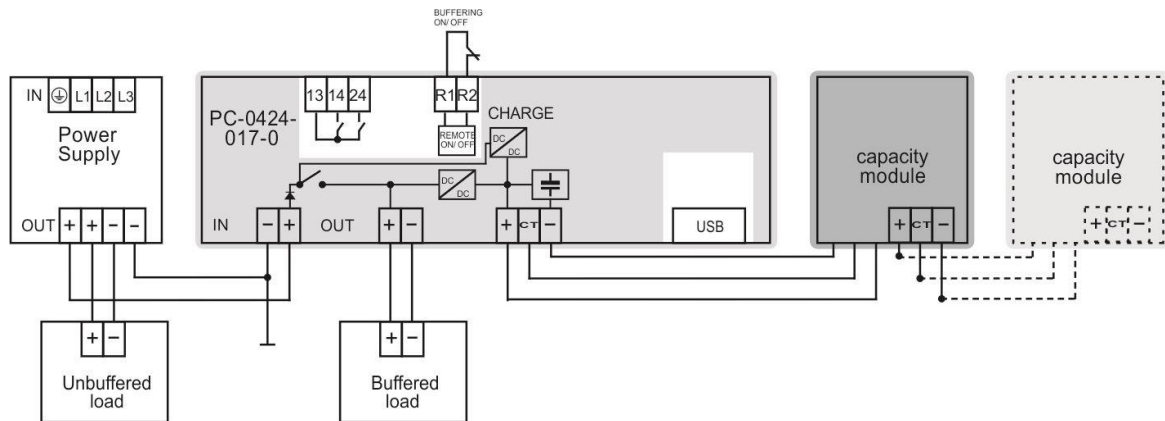


Figure 1: Block circuit diagram of wiring

Maximum power can be achieved by connecting up to 3 capacity modules in parallel. This increases both buffer time and output current (see section 5.1).

3.2 Dimensions

The dimensions for the capacitive UPS and capacity modules can be found in figure 3 and figure 4.

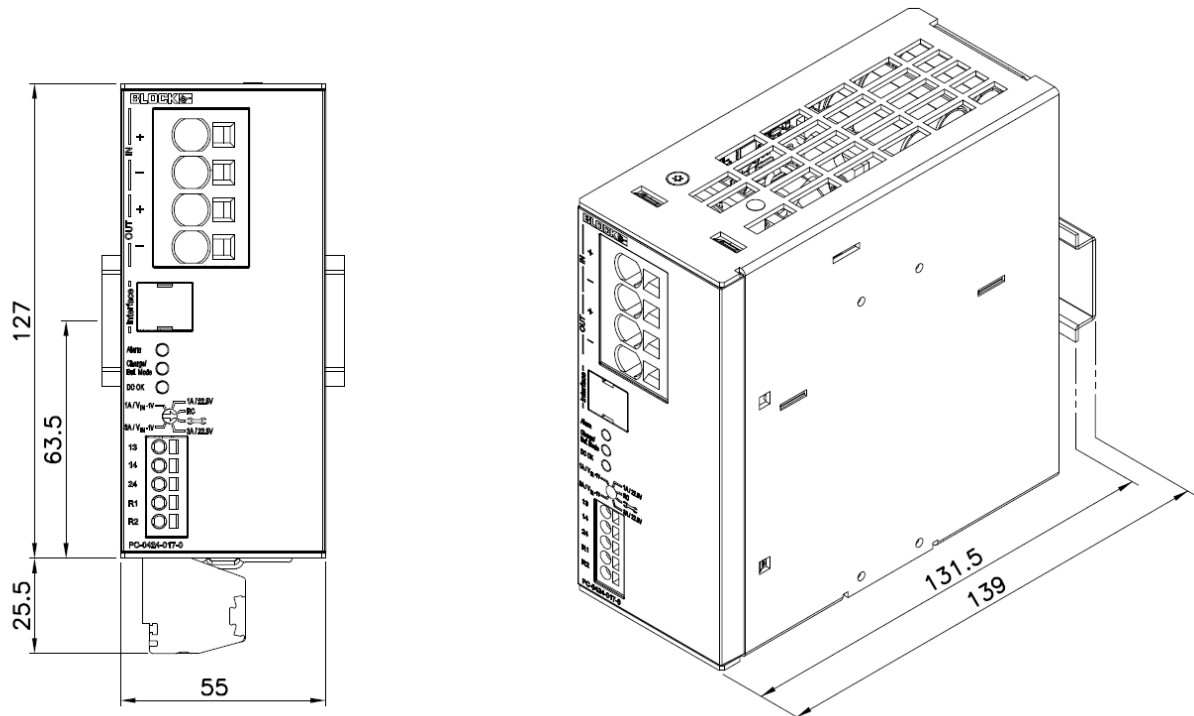


Figure 2: Dimensions for the capacitive UPS

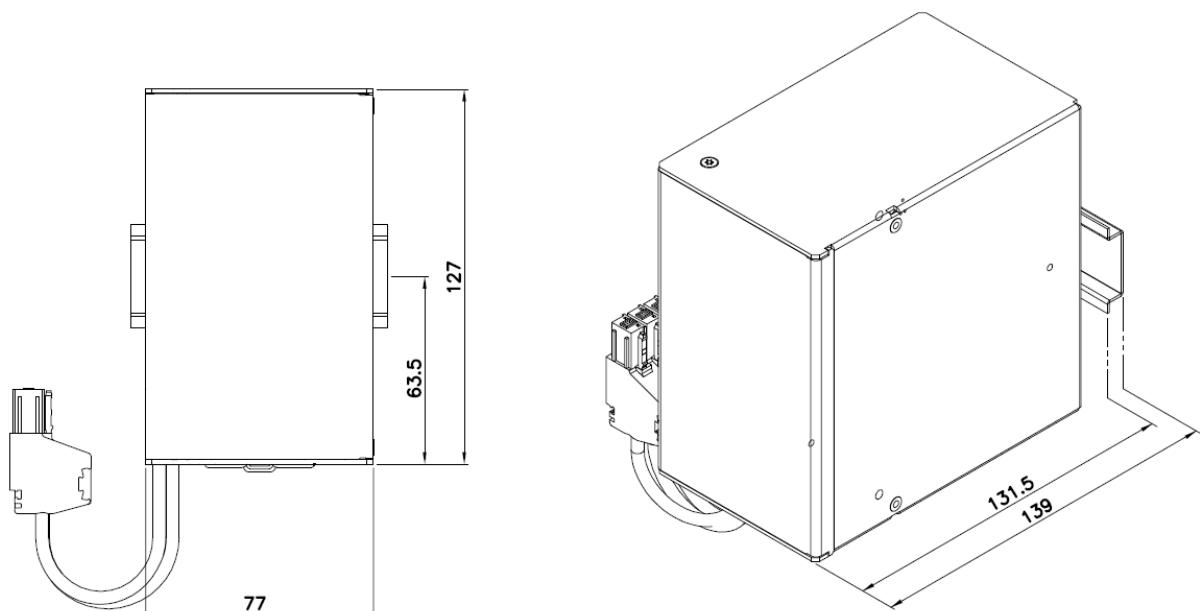


Figure 3: Dimensions for the capacity module

3.3 Assembly

The capacitive UPS and capacity module can be fitted to the supporting rail without tools. First, rotate the front of the device slightly, in an upward direction, and place it on the profile rail. Note that the device slides downward as far as it will go. Once the device is sitting on the profile rail, press the underside against the mounting rail until it engages with the catch on the profile rail (followed by an audible "click"). As a further check, gently shake the device to ensure it is properly locked in place.

To remove the device, you only need an ordinary tool like a slotted screwdriver. If the attachment is pressed, the device can be released by lifting its underside from the profile rail.

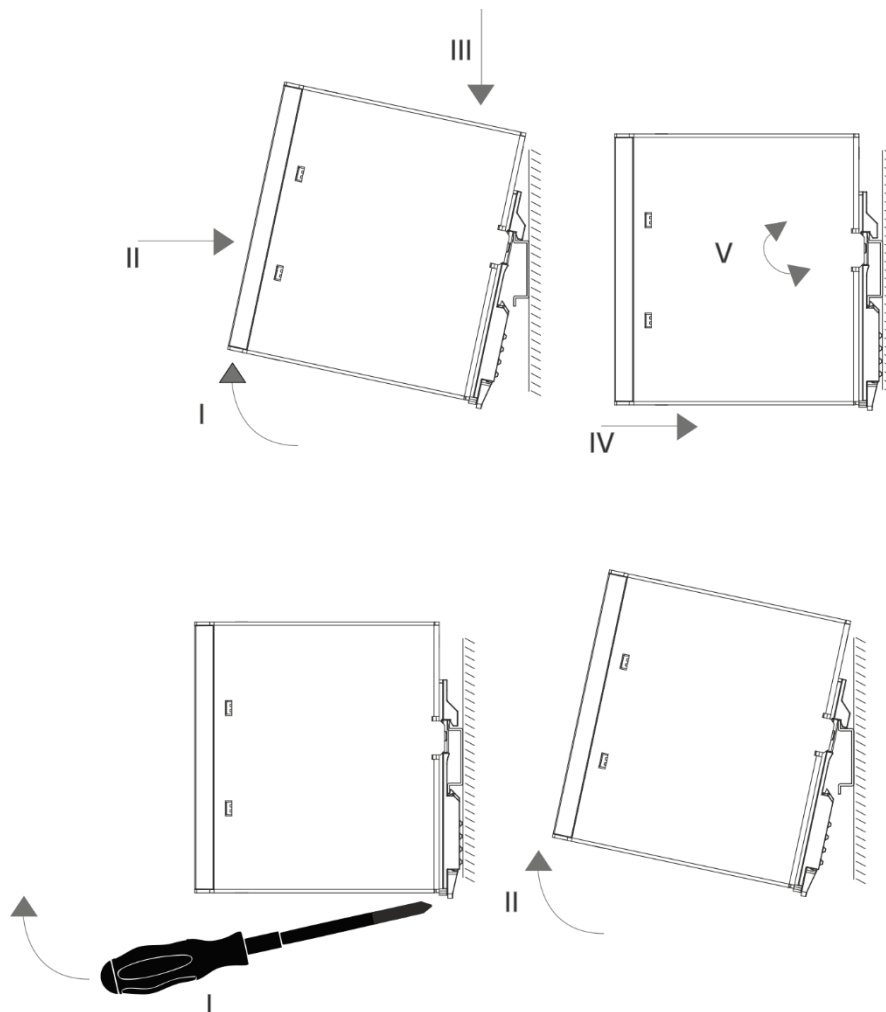


Figure 4: Assembly

Caution:

It is **not** permissible to install the capacitive UPS and capacity modules in a horizontal arrangement or above head height.

To ensure cooling through natural convection, it is important to think about distances from any nearby equipment.

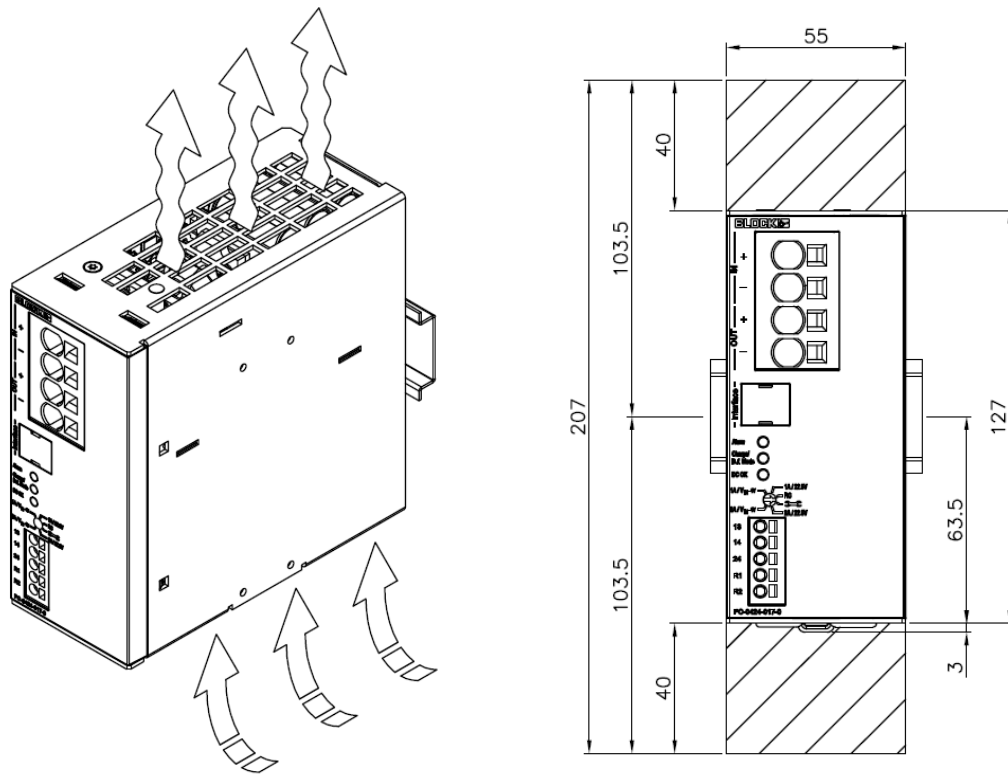
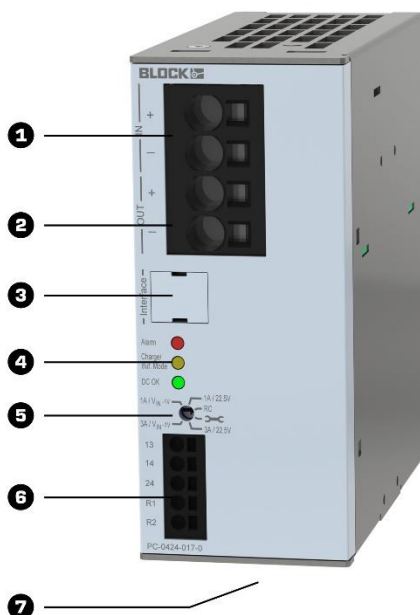


Figure 5: Convection cooling

Caution:

The installation instructions must be followed without exception.

3.4 Connections and Signaling



No.	Function	Note
1	Input terminals for power supply	0.75 - 16 mm ²
2	Output terminals for power supply	0.75 - 16 mm ²
3	PC interface	USB interface connection
4	Signal lights	Red LED: Alarm Yellow LED: Charge / buf. mode Green LED: DC OK
5	Rotary switch for buffer time adjustment	1 A and 3 A at 22.5 V 1 A and 3 A at $V_{in} = -1 V$ Maintenance mode (🔑) Individual (RC)
6	Signaling contacts	13: Potential-free shared input for signal outputs 14/24 14: Freely configurable / Factory setting: UPS in buffer mode 24: Freely configurable / Factory setting: capacitor voltage <85 % R1/R2: Remote shutdown in buffer mode 0.2 - 2.5 mm ²
7	Connection of external capacity modules	Approved modules only

4. Initialization

Following initialization, addressing of the capacity modules is performed automatically. At the time of delivery, the capacitive UPS and capacity modules are not charged, which means they are not yet ready for operation.

Buffer mode is only available once the equipment is 85 % charged. Automatic addressing only begins once the charging voltage reaches 15 V.

4.1 Operating Statuses / Signaling

The capacitive UPS is able to signal current operating statuses, warnings, and faults. There are 3 indicator lights (LED) and 2 potential-free contacts for function monitoring purposes.

At the time of delivery, the signal outputs are configured as follows:

Table 2: Configured signal outputs

Status	Signal output	Function
Buffer mode	13/14	low impedance
Charge <85%	13/24	low impedance

The capacitive UPS is able to detect a number of incidents, which can be individually linked with the 2 signal outputs with the help of the UPS-Control configuration and management software. The logic involved (inverted/not inverted or low/high impedance) can also be amended as required.

Table 3: Detectable statuses

No.	Description
1	Buffer mode
2	Input voltage error
3	Buffer mode not possible
4	Output is switched off
5	Charging very low <15%
6	Charging <85%
7	Fuse mode
8	Hiccup mode
9	End of storage life reached

Input voltage error

The input voltage is not within the relevant range.

Input voltage > 30 V

Input voltage < buffer threshold set

The operating status for the capacitive UPS can also be checked via the LED status indicators. The light signals have the following meanings.

Table 4: Signaling via LED status indicators

Operating status	Green LED	Yellow LED	Red LED
	DC OK	Charge / buf. mode	Alarm
UPS is operating in normal mode Charging is > 85% complete and OK	on	off	off (flashes (1 Hz) during lifetime warning)
UPS is operating in normal mode Storage capacity is being charged (charging <85% of rated capacity)	on	on	off (flashes (1 Hz) during lifetime warning)
UPS is operating in normal mode (remote shutdown R1/R2 active or maintenance mode)	on	off	on
Input voltage too low or too high, output switched off	flashes (1 Hz)	off	off (flashes (1 Hz) during lifetime warning)
UPS is operating in buffer mode, output voltage OK	on	flashes (1 Hz)	off
UPS is operating in buffer mode, device about to switch off, output voltage OK	on	flashes (4 Hz)	off
UPS is operating in buffer mode but current limitation applies, so output voltage not OK	off	flashes (1 Hz)	flashes (1Hz)
UPS has terminated buffer mode due to: - low residual charge - user setting - time passed - overload - remote shutdown - input voltage <10 V - input voltage at time of switching on <10 V DC	off	off	off
UPS is in hiccup mode	off	off	flashes (1 Hz)
UPS is in fuse mode	off	off	flashes (4 Hz)
UPS is blocked: - maintenance mode - output switched off - charge controller switched off	off	off	on
Switch-on phase / Constant current	off	off	on

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The UPS-Control management software offers a choice of 2 switch-on modes following a short circuit or overload.

Hiccup mode

The output cannot be activated within 5 seconds due to a short circuit or a persistent overload. 3 start-up attempts are made with a wait time of 20 seconds each. If there is still no restart, the wait time is extended to 60 seconds from then on.

Fuse mode

The output cannot be activated within 5 seconds due to a short circuit or a persistent overload. The output remains switched off until it is switched on again via UPS-Control.

To quit fuse mode, press the "Reset fuse mode" button. This appears in the UPS-Control software (overload behavior) as soon as fuse mode is activated.

If no restart takes place following resetting of fuse mode, any further attempt may only be initiated after a wait time of 20 seconds.

Note:

As regards the factory settings, the statuses of the LED indicators are also signaled via the signal outputs at the same time. If the signal outputs are assigned on an individual basis, it is possible to have signal statuses that differ from the LED indicator. Make sure that only sensible combinations are signaled.

4.2 Charging and Querying of Capacity Modules

The capacitive UPS performs various checks of the capacity modules, depending on the operating status. If any irregularities are detected, warnings or faults are generated accordingly.

Charging status

In normal mode, the capacity module is charged on a cyclical basis. During charging, the charging status and operating hours of the capacity modules are duly checked.

If the capacity modules are less than 85% charged, the status "Capacity module is charged" is signaled. The yellow LED lights up and the "Charge <85%" signal output is activated (based on the delivery set-up only).

Presence test

The presence test is designed to detect a connected and functional capacity module and is performed every 60 seconds in normal mode. The charging process is briefly interrupted during the detection phase.

Detection of and communication with the connected capacity modules only occur from a charging voltage of 15 V. There is no communication with the capacity modules at lower voltage levels.

Charging voltage/current

The charging behavior of the capacity modules is freely configurable. The charging voltage and current for the capacity modules can be adjusted via the UPS-Control software.

At the time of delivery, the charging current for the capacity modules is set to 3 A.

- 0.5 A – 3 A adjustable

The charging voltage for the capacitive UPS depends on the final charging voltage to be configured for each cell. At the time of delivery, this is set to 2.6 V.

- 2.0 V – 2.8 V adjustable

The maximum final charging voltage for the capacitive UPS is 33.6 V.

The maximum final charging voltage for connected capacity modules reaches 25.2 V.

Capacity modules with no charge at all are unable to support communication, although they do become charged via the capacitive UPS once connected.

Note:

Increasing the cell voltage reduces the lifetime of the capacity modules.

4.3 Buffer Mode

When the line voltage fails, buffer mode kicks in without any interruption. The energy required to maintain the 24 V DC supply voltage is drawn from the store of the capacitive UPS and the connected capacity modules.

Buffer mode is signaled by slow flashing of the yellow LED (approx. 1 Hz).

The capacitive UPS supports both maintenance of the supply voltage for a configurable time and also the controlled shutdown and restart of an industrial PC (IPC). (See the section on buffer mode in IPC mode.)

The "UPS-Control" Windows software is required for software-based shutdown of an IPC. Assuming the capacitive UPS is connected with the IPC, the cyclically transmitted data from the UPS trigger the shutdown after a time that can be adjusted accordingly.

Switch-in threshold for buffer mode

If the input voltage falls below the switch-in threshold, the energy from the capacitive UPS and capacity modules is made available without interruption. The switch-in threshold can be individually set via the rotary knob or via the free UPS-Control configuration software.

- 22.5 V – 28 V adjustable

Buffer mode with adjustable buffer time

At the factory, the module is preconfigured to a minimum buffer time of 2 seconds and a maximum buffer time of 1 hour. The total usable energy from the capacitive store is used, with this configuration, to maintain the 24 V DC supply voltage. The buffer time can be adjusted via the UPS-Control software.

Buffer mode in IPC mode

In IPC mode, the UPS module works on the basis of a time sequence intended to support the controlled shutdown and reliable restart of an IPC. Changeable times can only be adjusted via the configuration software.

The time sequence for "Delay time", "Shutdown time", and "Idle time" is defined in each case. Thanks to the option to switch off the output despite the line voltage returning during battery mode, an IPC can be restarted in a reliable manner after a shutdown.

Delay time

If the line voltage returns during buffer mode while the delay time set is still running, the output for the charging and control unit will not be switched off.

Signal output 13/14 or 13/24 (can be configured via the configuration software) retains its inactive status so that no signal is generated for a shutdown of the IPC.

If the incoming line supply only returns once the delay time set has expired, the output voltage and signal output will be switched as shown in the flow diagram.

- 1 – 1,000 seconds adjustable

Shutdown time

Once the delay time has expired, signal output 13/14 is activated. This signal output retains its active status through the entirety of the time set. This means the IPC is prompted to shut down. Through the entirety of the time set, the IPC continues to be supplied with energy by the capacitive UPS.

- 1 – 600 seconds adjustable

Idle time

Once the shutdown time has expired, the output voltage is switched off assuming the input voltage is present again between the end of the delay time and the start of the shutdown time. As a result, the IPC gets the positive edge required for a restart once the wait time has expired.

If the input voltage is not yet present again after the shutdown time has expired, the capacitive UPS including the output will be switched off permanently. Once the module has been switched off, an automatic restart with activation of the 24 V DC supply only occurs when the input voltage returns.

- 1 – 60 seconds adjustable

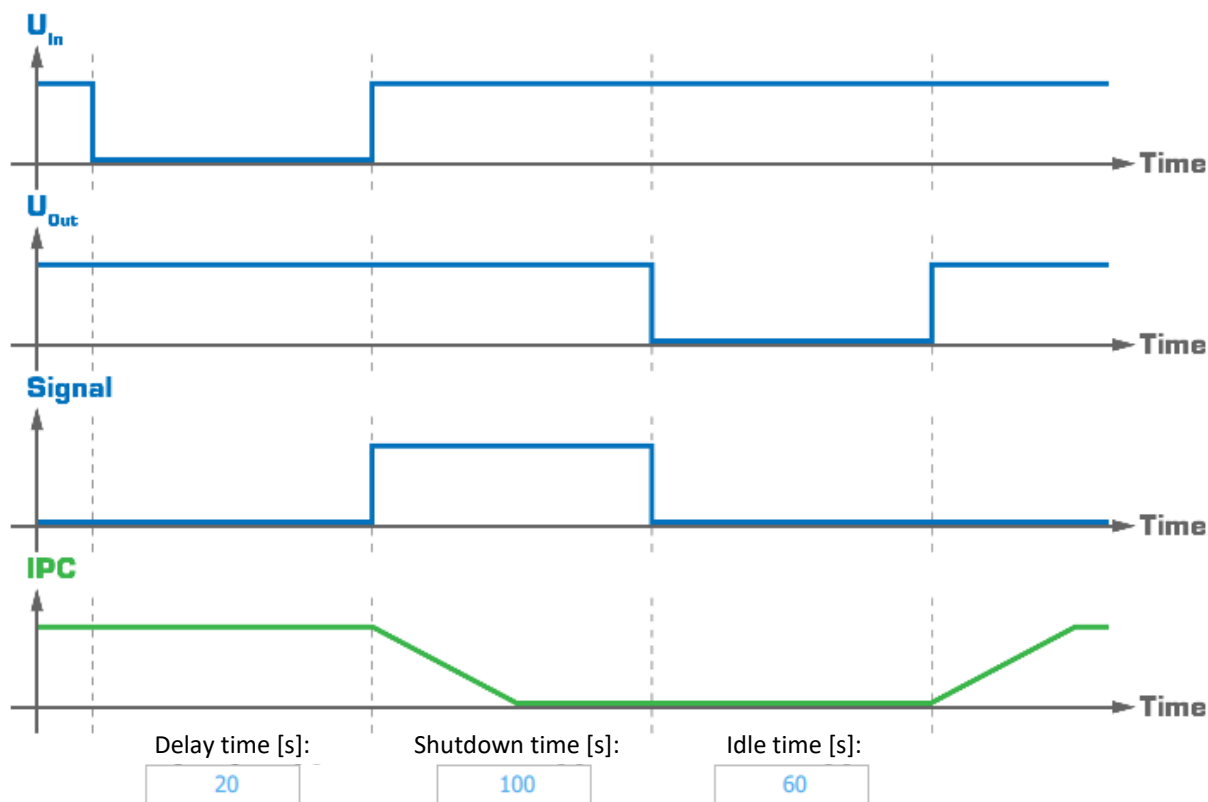


Figure 6: IPC adjustment

Power Boost

In the event of an overload scenario, the capacitive UPS, with the Power Boost feature, makes it possible to supply increased loads for short periods.

- 50 A for 3 s in buffer mode
- 60 A for 5 s in line mode

The Power Boost feature in line mode must be supported by the upstream power unit.

Remote shutdown in buffer mode

If the connected load at the output of the capacitive UPS is no longer to be supplied during buffer mode, e.g. in an "EMERGENCY OFF" scenario, buffer mode can be deactivated. This requires the connection between the 2 contacts R1/R2 for the "remote" input to be interrupted.

If this connection is not present in normal mode, the module signals the fault "Buffer mode not possible". The red LED is permanently lit up. This fault can be linked with a signal output via the UPS-Control software so that the contact is opened.

Shutdown on discharge

Under a load, buffering continues until the capacity modules reach the switch-off threshold. The yellow LED signals that the capacity modules are about to lose their charge or the capacitive UPS is about to switch off.

4.4 Buffer Times

The potential buffer time for the capacitive UPS can be extended with up to 3 capacity modules. The specified buffer times are based on new capacity modules with a cell voltage of 2.8 V once fully charged.

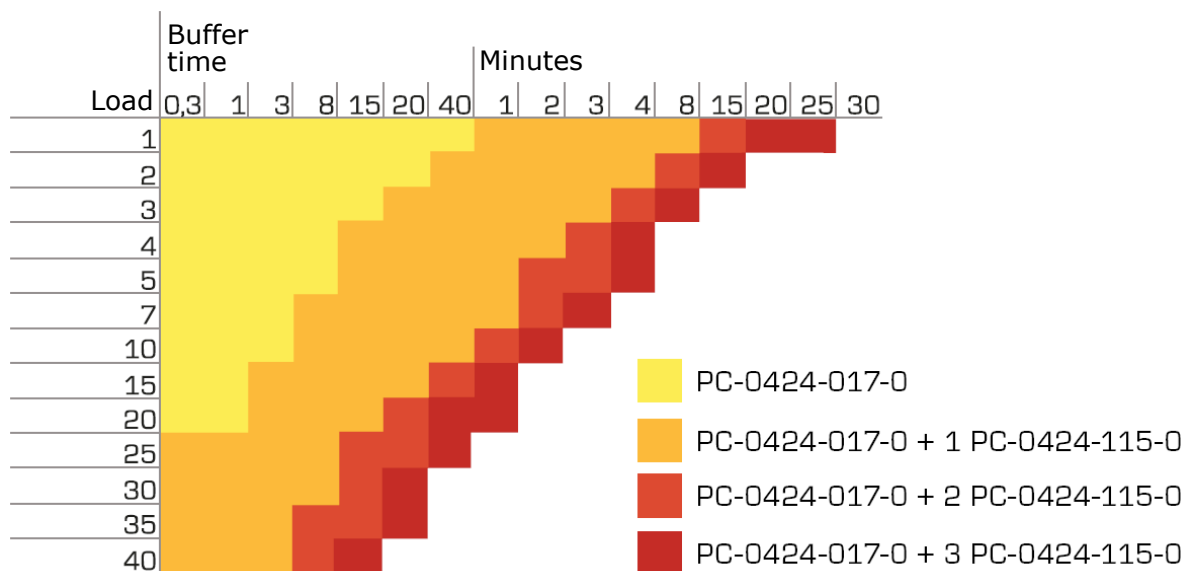


Figure 7: Buffer time based on output current

4.5 Charging Times

The time until charging is complete depends on the charging current set, the final charging voltage set for each cell, and the number of capacity modules.

The charging time for a charging current of 3 A and a final charging voltage for each cell of 2.8 V can be seen below.

Table 5: Time until charging is complete

Modules	Charging time
PC-0424-017-0	approx. 60 s
PC-0424-017-0 + 1 PC-0424-115-0	approx. 410 s
PC-0424-017-0 + 2 PC-0424-115-0	approx. 770 s
PC-0424-017-0 + 3 PC-0424-115-0	approx. 1,100 s

4.6 Derating

The capacitive UPS is designed for a wide temperature range. To protect the UPS, the power level must be reduced when the temperature reaches 55°C or above to prevent the device overheating.

The maximum output current is available up to a temperature of 55 °C. Above this, the rated output current needs to be reduced by 2.5 % per degree Kelvin.

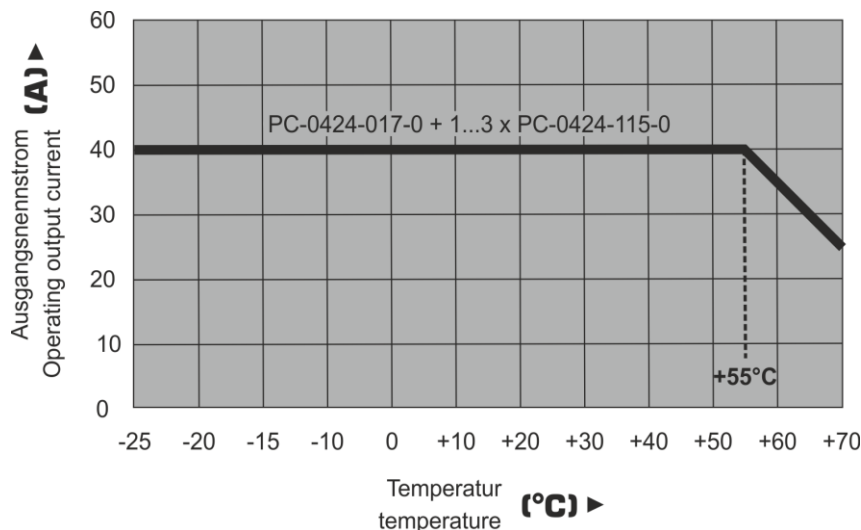


Figure 8: Temperature behavior of the rated output current

The maximum charging current is available up to a temperature of 55 °C. Above this, the charging current is reduced by 3.3 % per degree Kelvin.

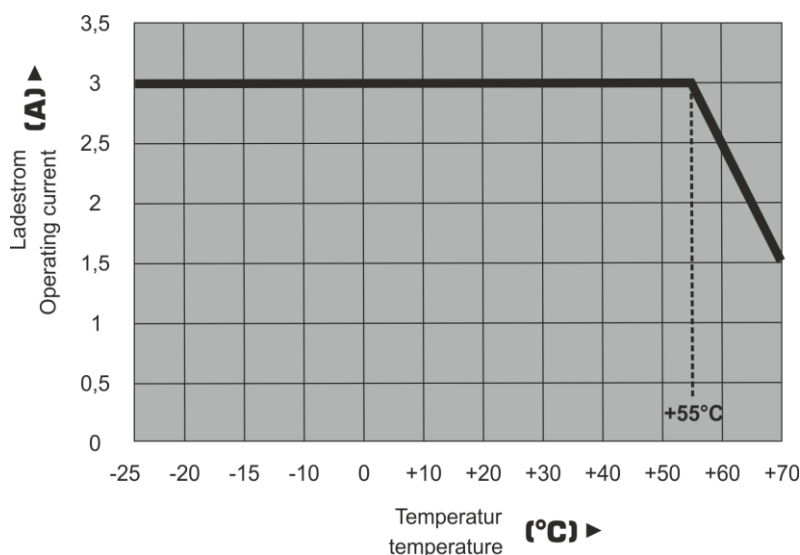


Figure 9: Temperature behavior of the charging current

The maximum buffer time is available up to a temperature of 55 °C. Above this, the buffer time should be reduced as the output current increases.

The maximum buffer time at an output current of 1 A needs to be reduced by 1 % per degree Kelvin when the temperature reaches 55 °C or above.

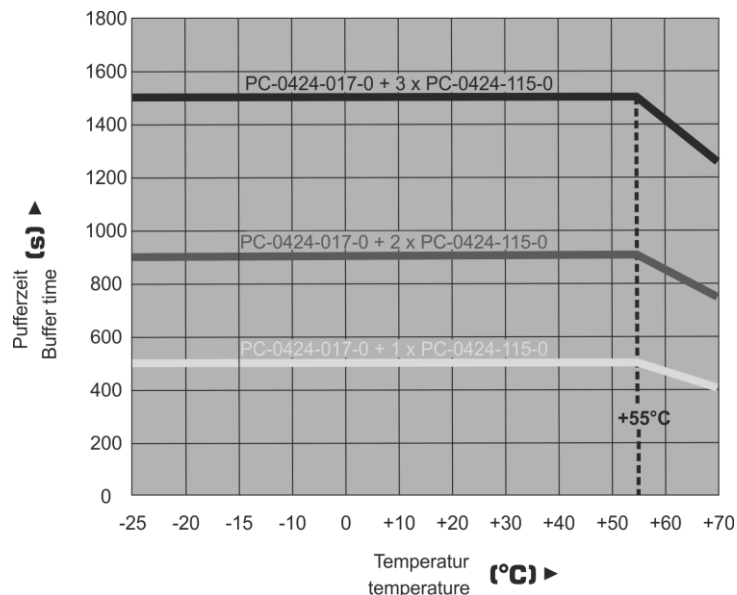


Figure 10: Temperature behavior at 1 A

The maximum buffer time at an output current of 20 A needs to be reduced by 2.1 % per degree Kelvin when the temperature reaches 55 °C or above.

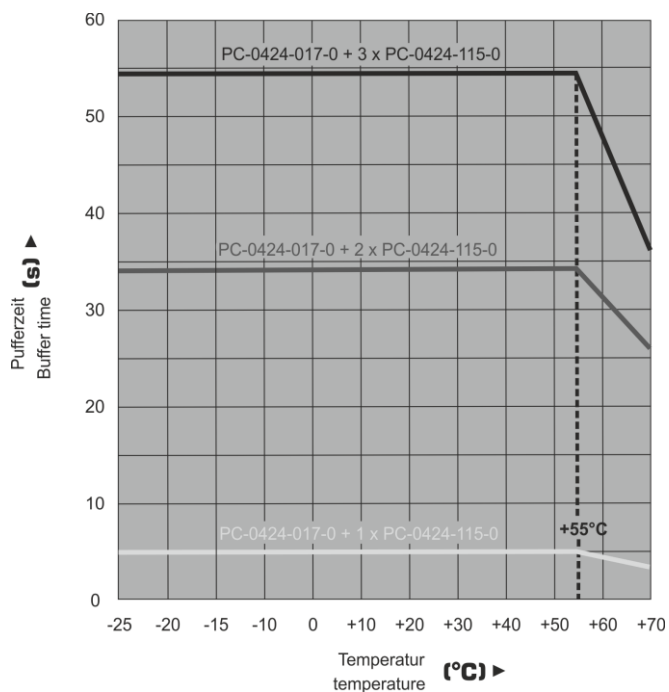


Figure 11: Temperature behavior at 20 A

The maximum buffer time at an output current of 40 A needs to be reduced by 3.3 % per degree Kelvin when the temperature reaches 55 °C or above.

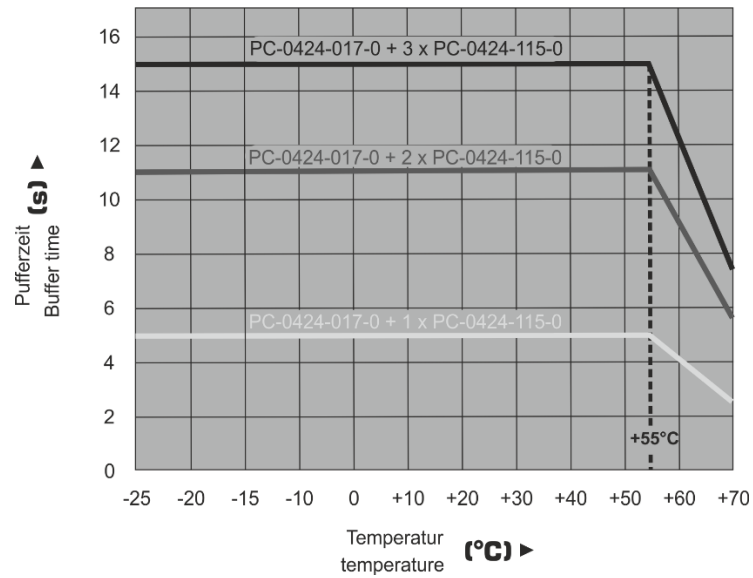


Figure 12: Temperature behavior at 40 A

5. Maintenance

5.1 Expanding the Capacity Modules

The capacitive UPS allows the replacement and expansion of the capacity modules in operation. Prior to any replacement or expansion, the capacitive UPS needs to be switched to maintenance mode (⏏) via the rotary knob. In maintenance mode (⏏), normal mode is actually maintained and the capacity modules can be connected and isolated without any risk. Capacity modules can also be replaced without risk when charged.

Note:

Buffer readiness and charging mode are interrupted when the user switches to maintenance mode. Activation in buffer mode causes buffer mode to be interrupted immediately.

5.2 Lifetime of the UPS and Capacity Modules

The lifetime depends on temperature, the cell voltage set, and current levels. The graphics below show the lifetime of the products based on thermal measurements and calculated in accordance with a theoretical calculation model (these values do not represent a guaranteed lifetime). The lifetime of the capacitors used, as specified by the manufacturer, is a maximum of 15 years and a maximum of 500,000 cycles for double-layer capacitors.

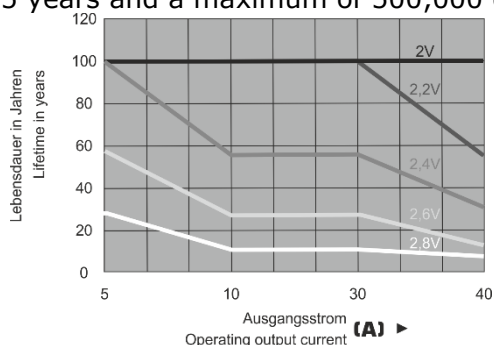


Figure 13: Lifetime at 20 °C

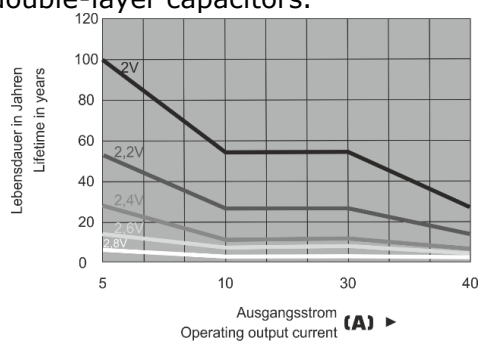


Figure 14: Lifetime at 40 °C

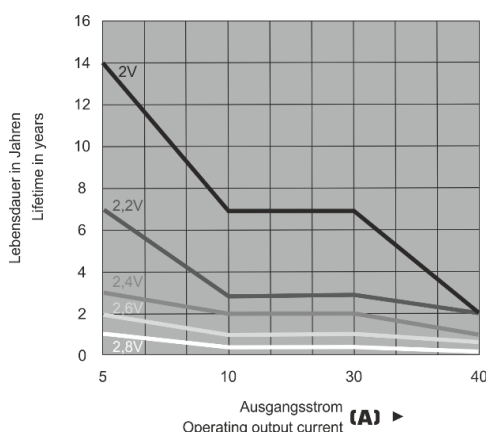


Figure 15: Lifetime at 70 °C

5.3 Storage of Capacity Modules

The capacitive UPS and capacity modules are not charged at the time of delivery.
In this state, storage temperatures must not exceed 70 °C or fall below -30 °C.