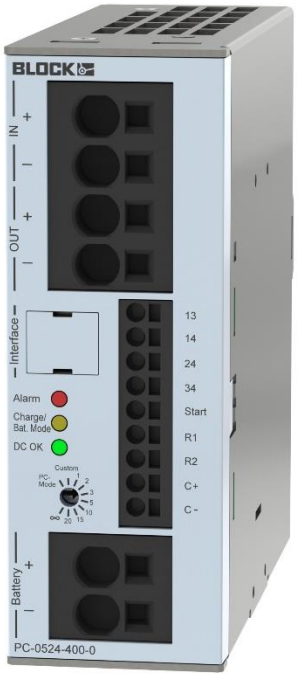
Manual

Uninterruptible Power Supply

Charge and control unit PC-0524-400-0



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1. Order Information

The table below shows the order information for the charge and control unit and the battery modules.

Table 1: Order numbers

Charge and control unit			
Variant	**Input voltage**	**Output current**	
PC-0524-400-0	24 Vdc	40 A	
Battery modules			
Variant	**Input voltage**	**Rated output current**	**Rated capacity**
PVAF 24/0.8 Ah	24 Vdc	max. 5 A	0.8 Ah
PVAF 24/1.2 Ah	24 Vdc	max. 7.5 A	1.2 Ah
PVAF 24/7 Ah	24 Vdc	max. 40 A	7 Ah
PVAF 24/12 Ah	24 Vdc	max. 40 A	12 Ah
PVA 24/3.2 Ah	24 Vdc	max. 20 A	3.2 Ah
PVA 24/7 Ah	24 Vdc	max. 40 A	7 Ah
PVA 24/12 Ah	24 Vdc	max. 40 A	12 Ah
PBAT-1224-025-0	24 Vdc	max. 20 A	2.5 Ah
PBAT-1224-130-0	24 Vdc	max. 40 A	13 Ah

UPS-Control Software

Visualization and configuration software for the charge and control unit.
Free download at www.block.eu.
For depiction and custom configuration of the charge and control unit.

2. General Information

2.1 Safety Instructions

Please read through these warnings and safety notes carefully before using the device. The device must be installed by competent and qualified personnel. In the event of malfunction or damage, switch off the supply voltage immediately and send the device to BLOCK Transformatoren-Elektronik GmbH to be inspected. The device does not contain any service components. If an internal fuse is triggered the device probably has an internal defect. The listed data is provided merely to describe the product and must not be regarded as guaranteed properties in the legal sense.

2.2 Qualified Personnel

The product associated with this document can only be handled by qualified personnel taking the documentation for the respective task into consideration - especially the safety and warning information contained therein. Based on their training and experience, qualified personnel can guarantee that the usage of the described product satisfies all the safety requirements and applicable provisions, specifications, norms and laws.

2.3 Intended Use

This device was designed to be installed in an enclosure and is suitable for usage with general electronic devices, such as industrial control systems, office equipment, communication and measurement equipment. Do not use this device in control systems in airplanes, trains or nuclear facilities, where malfunction could lead to serious injuries or have life-threatening consequences.

2.4 Disclaimer

The content of this publication has been reviewed with the greatest of care to ensure it corresponds with the hardware and software described. Nonetheless, there may be discrepancies between the product and the documentation. Discrepancies can also occur due to the ongoing development of the product.
For this reason, we cannot guarantee absolute conformity. Should this document contain errors, we reserve the right to make the necessary corrections without prior announcement.

3. Product Description

The charge and control unit forms an uninterruptible power supply (UPS) when combined with up to three battery modules and a suitable external power supply. This UPS protects systems and sensitive data against power failures and voltage fluctuations. Depending on the particular application, up to 40 A is available without interruption on 12 V and 24 V grids. The charge and control unit guarantees a reliable supply for industrial PCs.

The intelligent battery management of the UPS combines short charging times with optimized charging management for the longest possible operating life of the battery modules. In addition, ongoing monitoring of the battery modules is provided, which warns users when the remaining operating life of the battery modules is low.

One special feature of the device is the option to change settings using the rotary switch mounted on the front. This rotary switch allows the user to select a defined buffer period setting, custom configuration via the interface (only in combination with the UPS Control Software) or IPC shutdown mode.

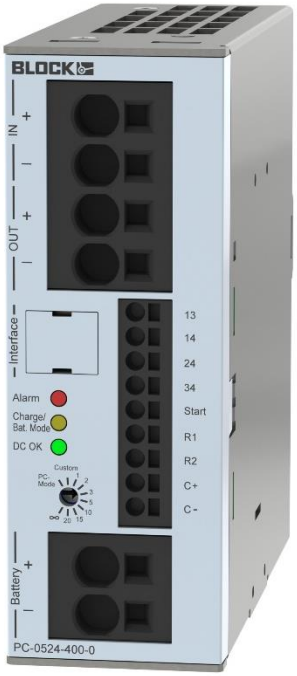


Illustration 1: Charge and control unit

3.1 Block Circuit Diagram

The following block circuit diagram depicts a wiring example.
In order to ensure good communication between the battery module and the charge and control unit, the chosen interfaces, control and signal lines should be < 3 meters.
In addition, ensure that the control line is not routed parallel to the power cables, otherwise there is a likelihood of communication disruptions.

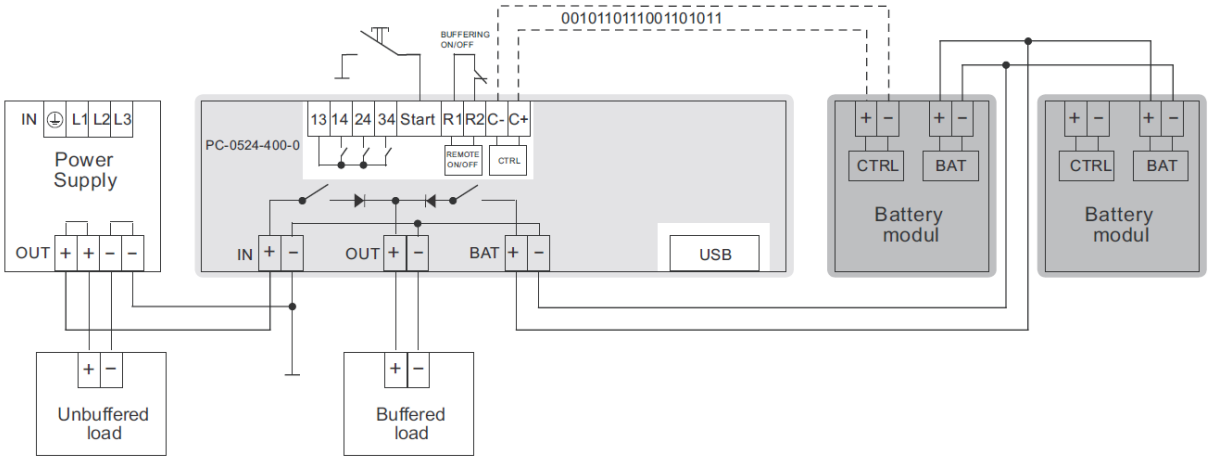


Illustration 2: Block circuit diagram of wiring

To achieve the maximum buffer time, up to 3 battery modules can be installed in parallel (see Chapter 4.5).
When multiple battery modules are used, a control line is affixed to one battery module only.

3.2 Dimensions

The dimensions of the charge and control unit can be seen in Illustration 3.

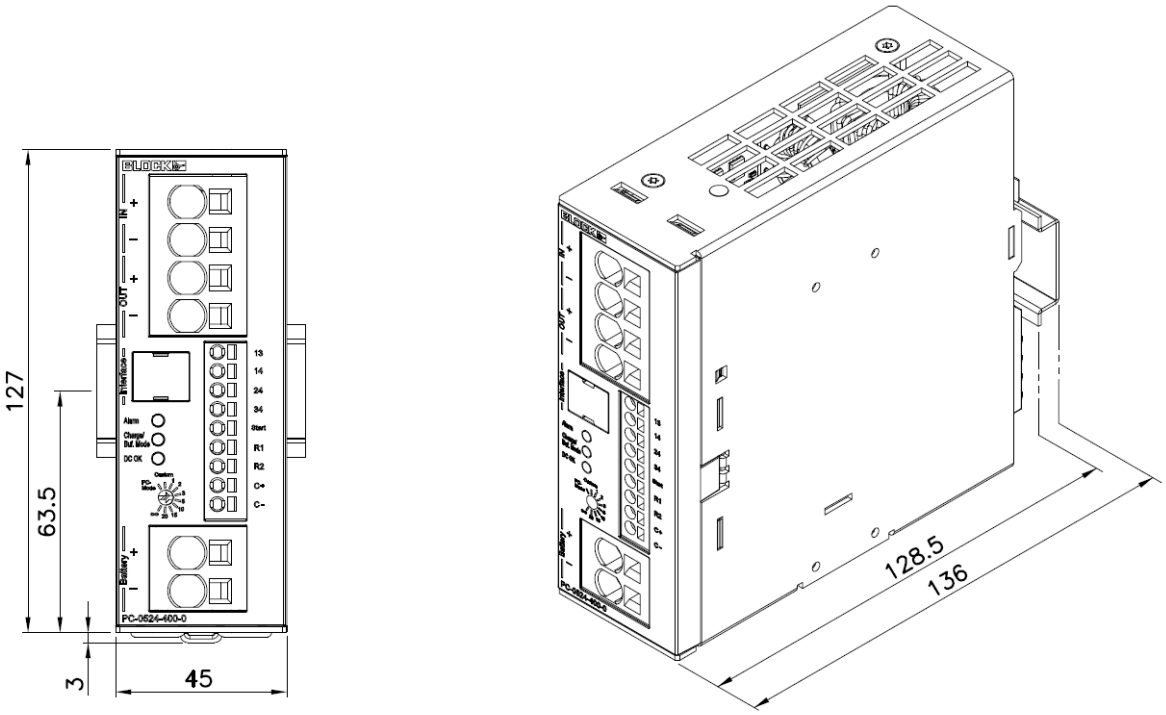


Illustration 3: Dimensions of the charge and control unit

The dimensioning for the associated battery modules can be found in the operating instructions for the battery modules.

3.3 Assembly

The charge and control unit can be mounted on the mounting rail without the use of tools. First, rotate the front of the device is turned upward slightly and placed on the profile rail. Ensure that the device is pushed down until the stop limit. When the device is on the profile rail, press the underside against the mounting rail until it engages with the catch on the profile rail (you will hear a 'click' sound). To check, gently shake the device to ensure that it is properly locked into place.
A standard tool, like a flat-head screwdriver, is needed for disassembly. Press down on the fastening to release the device by lifting the bottom side of the device from the profile rail.

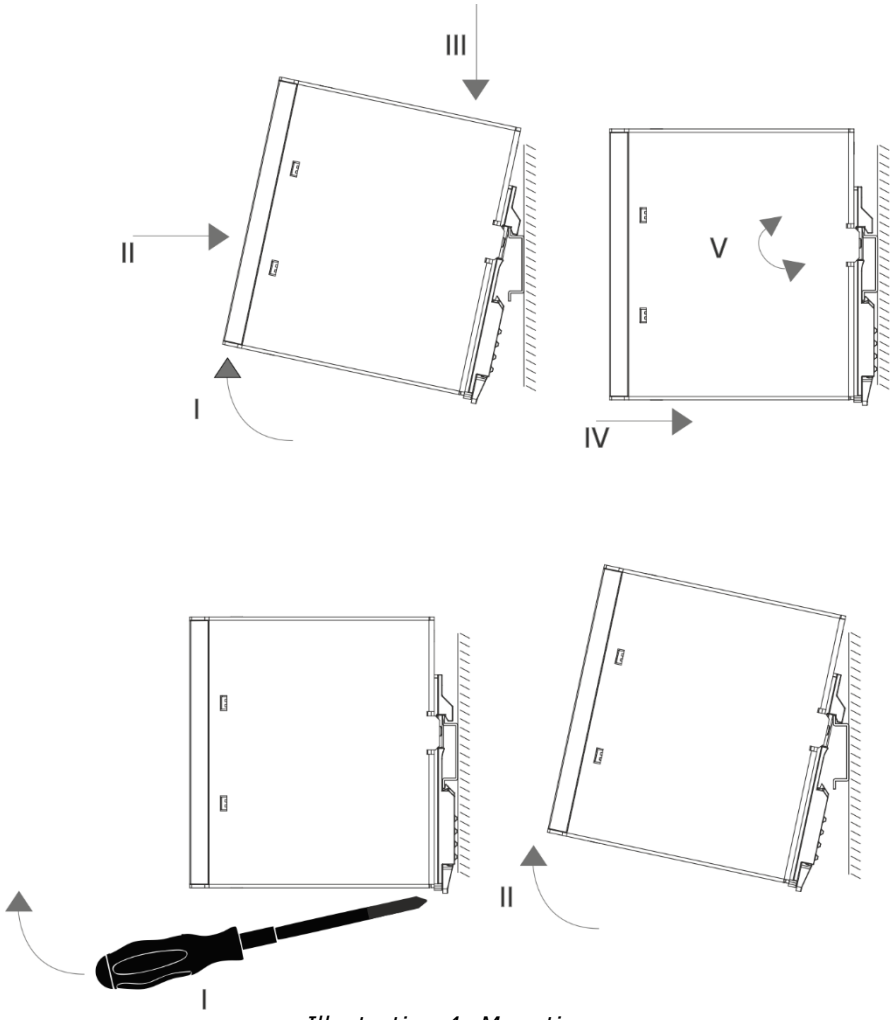


Illustration 4: Mounting

Attention:
Overhead mounting of the battery modules is not permitted.

To ensure cooling through natural convection, a distance of at least 40 mm from neighboring devices must be maintained. Direct side mounting of other devices is not permitted.

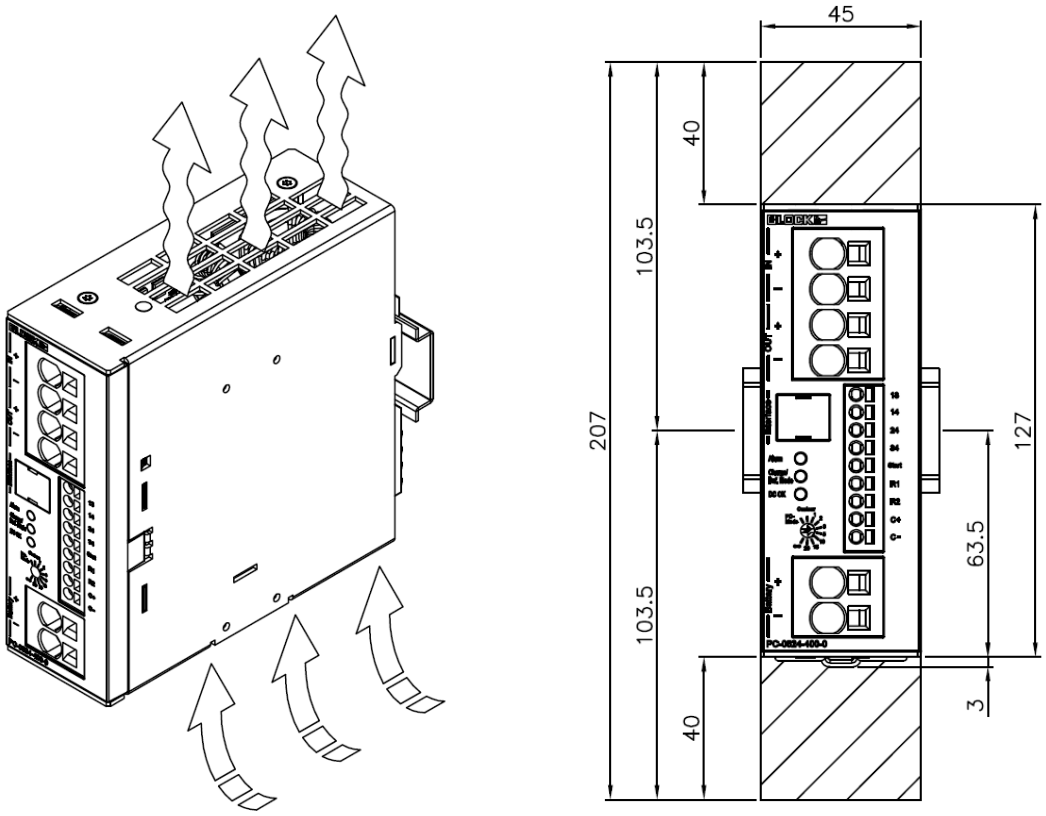
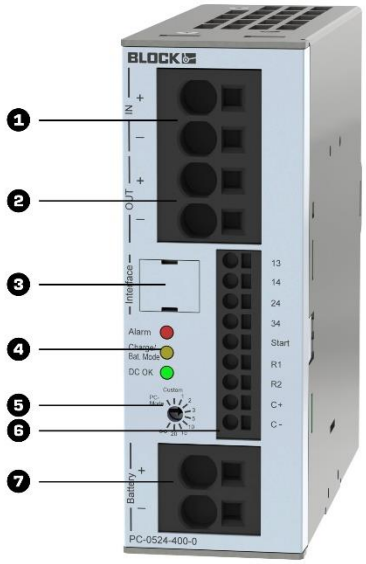


Illustration 5: Convection cooling

Attention:
Install the device horizontally only. A different manner of mounting is **not** permitted.

3.4 Connections and Signaling



No.	Function	Note
1	Power supply input terminals	0.75 – 16 mm² (20…4 AWG)
2	Power supply output terminals	0.75 – 16 mm² (20…4 AWG)
3	PC interface	USB interface connection (USB Type B)
4	Signal lights	LED red: Alarm LED yellow: Bat. Charge /Bat. Mode LED green: DC OK
5	Rotary switch for setting the buffer period	Buffer period in minutes (1-20) IPC Mode (PC Mode) Maximum time (∞) Custom time
6	Signal and indicating contacts	13: Potential-free common input for signal outputs 14/24/34 14: Alarm (default = active low) 24: Battery Mode (default = active high) 34: Battery Charge (default = active high) Start: Start-up in battery mode R1/R2: Remote shutdown in Buffer mode C+/C-: Control line for "Battery Control" 0.2-2.5 mm² (24…12 AWG)
7	Battery connection terminals	0.75-16 mm² (20…4 AWG)

4. Initialization

After connection the battery modules with "Battery Control" will be automatically recognized as long as the "C+/C-" control line for communication between the modules is connected with the correct polarity.

12 V operation

The charge and control unit is suitable for rated voltages of 12 V as well as 24 V (factory default setting). In order to activate 12 V operation, connection to the UPS-Control Software is required. 12 V operation for the connected device must first be activated via UPS-Control. The setting options for activation can be found in the "Parameters" tab under "Advanced Settings".

A separate 12 V battery module is required for 12 V operation. The 24 V battery modules cannot be used in this mode.

Note:
In order for the battery modules to be optimally supplied, operation with connected control lines and battery modules with "Battery Control" is recommended. Attention should be paid to the polarity.
Before the module is supplied with power, the battery modules should be completely connected in order to prevent false signaling.

4.1 Operating Statuses /Signaling

The charge and control unit can signal current operating statuses, warnings and malfunctions. There are three control lights (LEDs) available for function monitoring as well as three potential-free contacts.

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

Chart 2: Configured signal outputs

Status	Signal output	Function
No battery operation possible or battery replacement recommended or output switched off	13/14	high-impedance
UPS is in battery operation	13/24	low-impedance
Battery module is being charged	13/34	low-impedance

The charge and control unit is capable of detecting multiple events that can be linked individually with the three signal outputs via the configuration and management software. The logic (inverted / not inverted and/or low-impedance / high-impedance) can also be changed if necessary.

Chart 3: Detectable statuses

No.	Description
1	Buffer mode
2	Buffer mode not possible: Presence test is negative or the connection for remote switch off (remote input) is not available
3	Battery voltage very low < 20.4 V
4	Battery charge < 85 %
5	Battery replacement recommended
6	Output is switched off
7	Fuse Mode
8	Hiccup Mode
9	Output current too high
10	Temperature monitoring
11	System error
12	Safety shutdown

The charge and control unit has three overload behaviors that can be selected.

Hiccup Mode

The output cannot be powered up within 5 seconds due to a short circuit or continuous overload.
3 startup attempts occur with a wait time of 20 seconds each. If no restart has occurred, there will be a 5 minute break before the next start attempt.

Fuse Mode

The output cannot be powered up within 5 seconds due to a short circuit or continuous overload. The output remains switched off.
To end Fuse Mode, the "Reset Fuse Mode" button must be actuated. This button appears in the UPS-Control Software in the "Overload Behavior" area as soon as Fuse Mode is enabled.
If the restart is unsuccessful, the next attempt can only take place after a wait time of 20 seconds.

Power Boost/Top Boost
(Only in combination with high-performance battery modules. Not compatible with BLOCK battery modules)

If a case of overload is detected, the charge and control unit enables increased loads to be supplied temporarily using the Power Boost.

- Power Boost : max. 65A for max. 10 sec.
- Top Boost : >65 A for max. 55 ms

The Power Boost in grid operation must be supported by the upstream power supply unit.

Note:
Hiccup Mode is enabled in the factory settings. The UPS-Control Software is required in order to activate Fuse Mode or Power Boost.
Fuse Mode or Power Boost can be selected in the UPS-Control Software under the "Parameters" and "Overload Behavior" tabs.

The operating status of the charge and control unit can also be viewed via the LED status display. The light signals have the following meanings.

Chart 4: Signaling via LED status display

Operating status	**Green LED** **DC OK**	**Yellow LED** **Charge/Bat. Mode**	**Red LED** **Alarm**
UPS is in normal operation Output voltage > 20.4 V Battery is charged and OK	on	off	off (flashing (1 HZ) battery replacement recom-mended)
UPS is in normal operation Battery is being charged (Charging < 85 % of rated capacity)	on	on	off (flashing (1 HZ) battery replacement recom-mended)
UPS is in normal operation, no battery operation possible (Presence test negative or remote shut-down R1/R2 active)	on	off	on
UPS is in normal operation Battery replacement recommended	on	off	flashing (1 Hz)
UPS is in Buffer mode/IPC Mode Battery voltage > 20.4 V	on	flashing (1Hz)	off (flashing (1 HZ) battery replacement recom-mended)
UPS is in Buffer mode/IPC Mode Battery voltage > 20.4 V Device is about to switch off	on	flashing (4 Hz)	off (flashing (1 HZ) battery replacement recom-mended)
Deep discharge protection of the UPS Buffer mode is ended (Factory setting battery voltage > 18 V)	off	flashing (4 Hz)	flashing (1 Hz)
Safety shutdown (No buffer mode possible or remote shutdown R1/R2 active or no battery connected)	flashing (1 Hz)	off	on
Safety shutdown (Input voltage too low or too high, out-put switched off)	flashing (1 Hz)	off	off
UPS is in Hiccup Mode	off	off	flashing (1 Hz)
UPS is in Fuse Mode	off	off	flashing (4 Hz)
Shutdown Mode IPC powered down/wait time	off	off	on

Safety shutdown

The output has been switched off to protect the charge and control unit and consumption. If, during the switch-on procedure, it is detected that the voltage is too low < 18 V / 9 V at 24 V / 12 V operation, or that the voltage is too high > 30 V / 15 V at 24 V / 12 V operation, there will be a 60 second wait time for the rated voltage to return. If there is no change to the voltage after the wait time is over, the system switches to Shutdown Mode.

Shutdown Mode

Shutdown Mode has been activated due to safety shutdown.
If the line voltage does not fall below 3 V within 5 seconds, the unit switches to safety shutdown again. If the mains voltage does not reach the rated voltage after three passes, the wait time in Shutdown Mode is extended to 120 seconds.

Buffer mode is stopped (buffer time has expired or buffer mode is stopped due to deep discharge protection) and the mains voltage is not in the rated range. The red LED signals this status for another 5 seconds, after which the system is switched off.

Startup from the battery

If the unit must be started up externally without connecting to the voltage supply, the charge and control unit enables startup from the connected battery. By applying 0 V to the "Start" terminal, the charge and control unit is started in buffer mode and the connected load is completely supplied by the connected batteries.

If mains voltage is present after the unit is powered up, the charge and control unit automatically switches to Normal Mode.

Note:
In the factory settings, the statuses of the LED displays are simultaneously signaled via the signal outputs. If there is a custom assignment of the signal outputs, deviating signal statuses of the LED displays are possible. When creating custom assignments, ensure that only logical combinations are signaled.

4.2 Battery tests

The charge and control unit performs various tests of the battery modules, depending on the operating status. If irregularities are detected the corresponding warnings or malfunctions are generated.

Charging status

In Normal Mode, the battery module is charged. During charging, the charging level is checked every 60 seconds.

If the battery modules are charged < 85 %, the "Battery is being charged" status is signaled. The yellow LED lights up and the "Bat. Charge" signal output is activated (only in factory settings).

Presence test

The presence test detects whether the battery module is correctly connected and functional. It is performed in Normal Mode. During the presence test, a small load is temporarily applied to the battery modules in order to ensure correct connection of the battery module, functionality of the accumulators and an intact fuse.

The presence test is performed in Normal Mode with a charging current of < 1 A every 30 seconds, and with a charging current of > 1 A every 180 seconds. In the event of a negative result the test is performed cyclically every 15 seconds.

If the result of the presence test is negative, the "Buffer mode is not possible" malfunction is signaled. The red LED lights up and the "Alarm" signal output is activated (only in factory settings).

Quality test

Accumulators have a limited operating life that can range from < 1-15 years depending on the model and ambient temperature.

The remaining operating life of the accumulators is dynamically calculated in relation to the ambient temperature in the battery model, where both "Bat. Control" control lines are connected correctly. This test is performed every 10 minutes in Normal Mode. If the quality test has a negative result, the "Battery replacement recommended" warning is generated. The red LED flashes and the "Alarm" signal output is activated.

Note:
It is recommended that the battery module be replaced as quickly as possible after the warning appears in order to maintain stable, ongoing buffer mode.

4.3 Battery charging

The smart battery management enables dynamic adjustments, such as setting the optimum charging current or ensuring temperature-dependent charging voltage for all detected battery modules with "Battery Control".

Temperature-dependent charging voltage

By using "Battery Control" to measure the actual temperature directly inside the battery module, charging can take place in a temperature-compensated manner. The operating life of the installed accumulators is thereby sustainably extended. Setting additional charging parameters is not necessary due to automatic detection.

An IU charging characteristic is the basis for charge regulation. This is a 2-level charging process as depicted below.

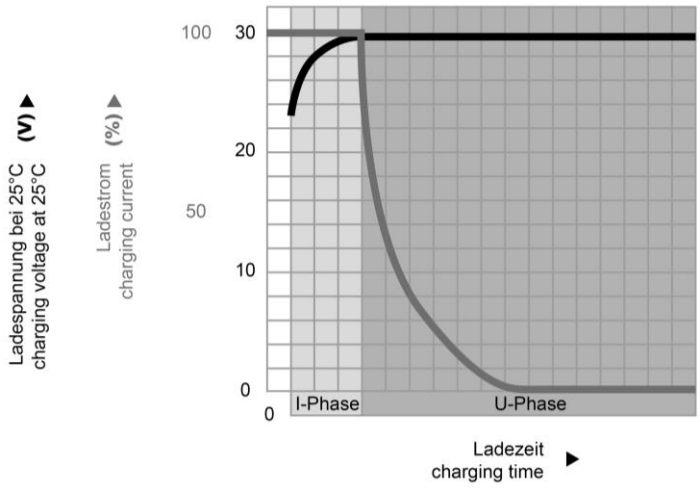


Illustration 6: Charging characteristic

Level	Name	Description
1	Main charge	Constant current charging phase of initial charging current
2	Equalization charge / maintenance charge	Constant voltage charging phase Equalization charging end voltage Maintenance charging end voltage

Alternatively, in the event of communication cable interruptions between the charge and control unit and the battery module, the temperature recorded in the charge and control unit can also be used to guarantee temperature compensation.

Note:
Temperature compensation for battery modules without "Battery Control" is treated like a communication interruption.

If battery modules without communication are used, the adjustment of general charging parameters must be tested and ensured for the specific battery module used.

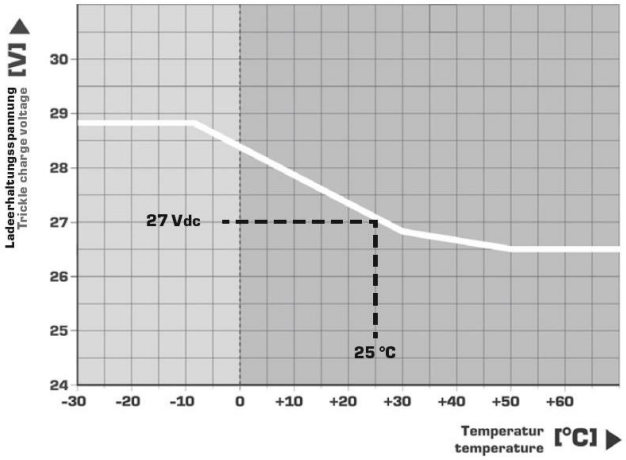


Illustration 7: Compensation charging characteristic

Automatic temperature compensation can be disabled at any time via the configuration software. A customized defined value can be saved for the maintenance charging end voltage.

Factory default charging setting

After the battery modules are detected with "Battery Control", the following factory default charging settings are assumed. Battery modules without "Battery Control" are charged in factory default settings with a voltage of 27.4 V / 13.7 V in 24 V / 12 V operation and a charging current of 0.8 A.

Chart 5: Factory default charging setting

Version	Charging voltage	Charging current
PVAF 24/0.8Ah	28.8 V	0.2 A
PVAF 24/1.2 Ah	28.8 V	0.3 A
PVAF 24/7 Ah	28.8 V	1.8 A
PVAF 24/12 Ah	28.8 V	3.0 A
PVA 24/3.2 Ah	28.8 V	0.8 A
PVA 24/7 Ah	28.8 V	1.8 A
PVA 24/12 Ah	28.8 V	3.0 A
PBAT-1224-025-0	28.8 V	5.0 A
PBAT-1224-130-0	28.8 V	5.0 A

Note:
A customized charging current can always be specified as a fixed target value via the configuration software, regardless of the battery module used.

4.4 Battery operation

When the line voltage fails, the unit switches to buffer mode without interruption. The energy required to maintain the DC 24 V / 12 supply voltage is taken from the battery module. The level of the output voltage is directly dependent on the charging level and the capacity of the accumulators.

Buffer mode is signaled by the slow flashing of the yellow LED (approx. 2 Hz). In the factory default settings this occurrence is linked with the "Bat. Mode" signal output.

The charge and control unit supports not only the maintenance of supply voltage for a configurable period of time, but also the controlled shutdown and restart of an industrial PC (IPC) - see chapter "Buffer mode in IPC Mode".

For software-based shutdown of an IPC, the rotary switch must be set to "PC Mode" or the settings can be adjusted in the Windows software "UPS Control". If the charge and control unit is connected with the IPC, the cyclically sent data from the UPS activates shutdown after a configurable period of time.

Switch-on threshold for buffer mode

If the input voltage drops below the switch-on threshold, energy is provided from the battery modules without interruption. The charge and control unit will then be in buffer mode.
The switch-on threshold is pre-configured to 22 V in the factory default settings. The switch-on threshold can be changed via the UPS-Control configuration software.

- 21 V - 26 V adjustable (24 V operation)
- 10.5 V - 13 V adjustable (12 V operation)

Buffer mode with adjustable buffer time

In the default factory settings the module is pre-configured for the maximum (unlimited) buffer time. With this configuration the entire energy of the battery module is used to maintain the DC 24 V supply voltage. The buffer time can be set via the selection switch.

- 1 ... 20 minutes
- Unlimited until buffer mode is ended through deep discharge protection.
- Custom time via configuration software
- PC mode, see chapter "Buffer mode in IPC mode"

Buffer mode in IPC mode

In IPC mode, the UPS module works in a chronological sequence that ensures the controlled shutdown and reliable restart of an IPC. Changeable times can only be adjusted via the configuration software. The signal for powering down the IPC is transmitted by the potential-free signal contact selected in UPS-Control.

The chronological sequence of "Delay time", "Shutdown time" and "Idle time" is clearly defined in each case. With the option of switching off the output even if mains power returns during buffer mode, an IPC can be reliably restarted after being powered down.

Note:
In order to enable IPC Mode, the rotary switch on the charge and control unit must be set to PC Mode. Only then does the IPC-configuration appear in the UPS-Control Software.

Delay time

If the line voltage returns during the configured delay time while in buffer mode, the output of the charge and control unit is not switched off.
The "Bat. Mode" signal output (which can be configured via the configuration software) remains inactive so that no signal is generated to power down the IPC.

If the input mains supply returns after the configured delay time, the output voltage and signal output are switched in accordance with the sequence diagram.

- 5 - 65,535 seconds adjustable

Shutdown time

After the delay time has lapsed, the "Bat. Mode" signal output is enabled. This signal output remains activated during the entire configured time period. In this way, the IPC receives the prompt to power down. During the entire configured time the IPC continues to be supplied with energy by the charge and control unit.

- 0 - 65,535 seconds adjustable

Idle time

After the end of the switch-off time the output voltage is switched off as long as the input voltage is re-established between the end of the delay time and the start of the wait time. The IPC thereby receives the 0 - 24 V flank necessary to restart after expiry of the PC idle time.

If the input voltage is still not present after expiry of the Shutdown time, the charge and control unit including the output is permanently switched off. After the module is switched off, an automatic restart with connection of the DC 24 V at the output only occurs with the return of the input voltage.

- 0 - 65,535 seconds adjustable

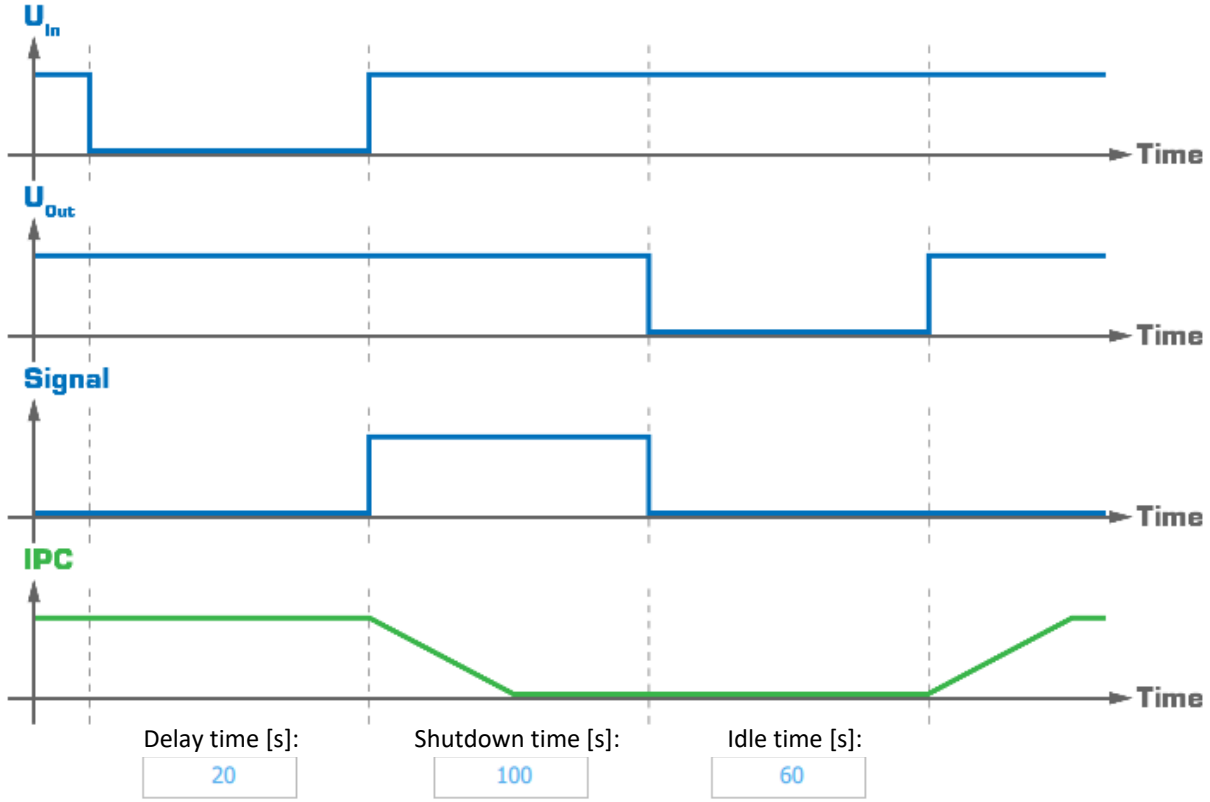


Illustration 8: IPC setting

Remote shutdown in buffer mode

If the connected load at the output of the charge and control unit is not supplied by the battery module, e.g. in EMERGENCY OFF operation, the buffer mode can be shut off. To do so, the connection between both contacts R1/R2 of the "Remote" input must be interrupted.
If this connection is not present in normal operation, the module signals the "No buffer mode possible" malfunction. The red LED glows steadily. In the factory default settings this malfunction is linked with the "Alarm" signal output so that the contact opens.

Deep discharge protection in buffer mode

In order to protect the installed battery module against deep discharge, the buffer mode is forcibly ended at a battery voltage Ubat < 18 V-19.2 V / 9 V-9.6 V (configurable deep discharge threshold) in 24 V / 12 V operation. The module switches the output off.
The signaling with flashing LEDs is maintained in the voltage range Ubat < 19.2 V / 9.6 V in 24 V / 12 V after the output is switched off, before the module switches off completely after the voltage falls below Ubat < 18 V / 9 V in 24 V / 12 V. After the output is switched off, the output is only switched back on when the input voltage returns.
At a battery voltage Ubat < 20.4 V / 10.2 V in 24 V / 12 V operation, the module signals the "Battery almost empty" warning by flashing the yellow LED at 4 Hz.

4.5 Battery module buffer times

The following image shows the maximum possible buffer times for the battery modules. The buffer times symbolize typical average values that result after complete charging of battery modules in new condition.

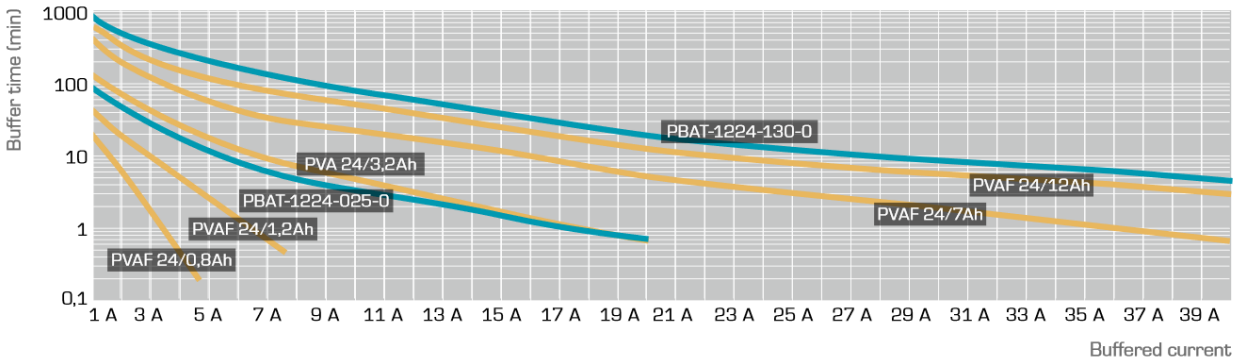


Illustration 9: Battery module buffer times

The buffer time can be extended by adding up to three parallel-connected battery modules. In this case, note that only the same battery modules with the same charge level can be connected.

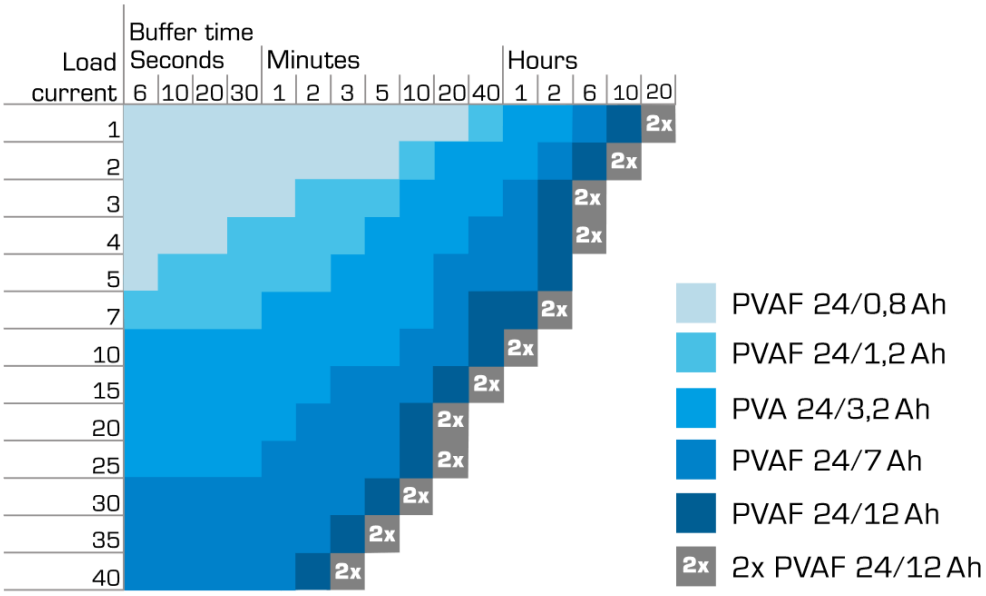


Illustration 10: Buffer time depending on the load current

Attention!
Connecting a 12 V battery module is not permitted in 24 V operation. This can lead to destruction of the battery module.

4.6 Derating

The functionality of the charge and control unit is designed for a wide temperature range. In order to protect the charge and control unit, it should be powered down at temperatures higher than 60 °C in order to prevent overheating of the device.

The maximum output current is provided up to a temperature of 60 °C. In addition, the output rated current must be lowered by 2.5% per Kelvin.

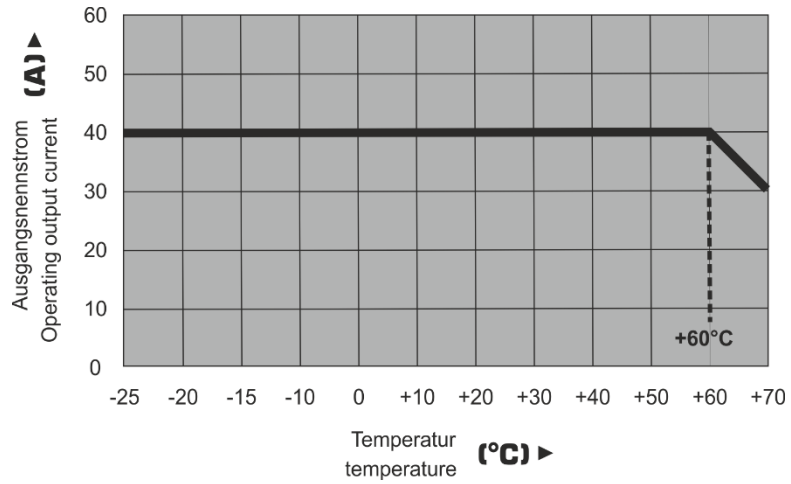


Illustration 11: Temperature behavior of the output rated current

The maximum charging current is provided up to a temperature of 50 °C. In addition, the rated output current is lowered by 3% per Kelvin.

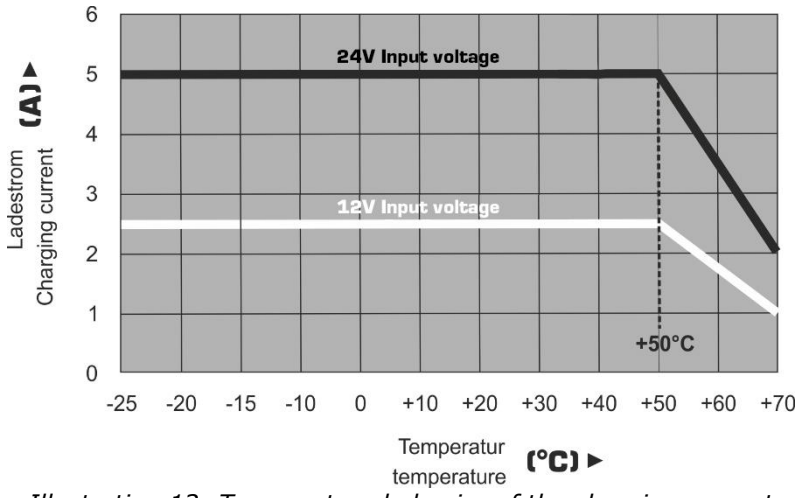


Illustration 12: Temperature behavior of the charging current

5. Maintenance

5.1 Operating life of the battery modules

Closed, maintenance-free, lead fleece accumulators are installed in the PVA and PVAF series battery modules, which are intended for use from -10 °C to +40 °C. Depending on the ambient temperature, the operating life of this battery module ranges from 5 years at 20 °C to one year at 40 °C.

Alternatively, the battery modules from the PBAT series are available, which have maintenance-free pure lead accumulators installed. These are intended for a temperature range of -10 °C to +60 °C. Depending on the ambient temperature, the operating life of this battery module ranges from 15 years at 20 °C to 4 years at 40 °C.

The remaining operating life is dynamically calculated depending on the ambient temperature of the battery module, as long as both control lines are connected between the charge and control unit and the battery module. In addition, the battery modules are cyclically loaded in order to detect exceedance of a permitted voltage drop. In this way, conclusions can be drawn about pre-damaged accumulators even before the end of their operating life.

5.2 Battery module storage

The battery modules are delivered in a pre-charged state in order to ensure immediate availability. The date when they were last charged is listed on the packaging. Commissioning should take place at the latest within 9 months at 20 °C - 30 °C, and/or within 6 months at 30 °C - 40 °C after the most recent charging operation.

Attention:
Do not store battery modules overhead while they are in a switched off state.

When shipping or storing the UPS system, remove the associated device safeguard to protect the battery modules from discharge.