GENERAL DESCRIPTION

The DIMENSION UC-Series are DC-UPSs utilizing Electrochemical Double Layer Capacitors (EDLC), commonly known as Ultracapacitors or Supercapacitors, which are installed inside the DC-UPS. They can bridge power failures or voltage fluctuations and supply voltage to the DC 24V bus for a certain period, which allows for a safe shut-down of the system. Expensive downtimes, long restart cycles and loss of data can be avoided.

In times when the power supply provides sufficient voltages, the DC-UPS stores energy in the capacitors. In case of a mains voltage fault, this energy is released to the DC bus in a regulated process.

The DC-UPSs are maintenance-free and have a similar lifetime expectancy as power supplies. No regular replacement of the capacitors is necessary as is required for battery based DC-UPS systems. The wide temperature range from -40°C to +60°C makes the unit suitable for many applications.

The DC-UPSs come in two versions which differ in the size of the installed capacitors.

SHORT-FORM DATA

Nominal voltage DC 24V
Output current 15A continuous
Buffer voltage 22.0 - 22.65V fixed, 15A – 0A during charging, output current not included
Input current typ. 1.1A during charging, output current not included
Capacitor size 6kWs
12kWs
UC10.241
UC10.242
Charging time 16 minutes
32 minutes
UC10.241
UC10.242
Buffer time 16.5s at 10A
33s at 10A
UC10.241
UC10.242
Power losses 4.6W in normal mode at 10A output current
Temperature range -40°C to +60°C operational
Dimensions 126x124x117mm
198x124x117mm
UC10.241
UC10.242
Weight 1150g / 2.54lb
1720g / 3.79lb
UC10.241
UC10.242

ORDER NUMBERS

DC-UPS UC10.241 6kWs energy storage
UC10.242 12kWs energy storage
Accessory ZM2.WALL Panel/ wall-mount bracket

MARKINGS

UL 508
UL 60950-1
EMC, RoHS
IECEx
ATEX
II 3G Ex nA nC II T4 Gc
Class I Div 2

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All parameters are specified at 24V, 10A output current, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.
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TERMINOLOGY AND ABBREVIATIONS

**Normal mode**
Describes a condition where the capacitor is charged, the input voltage is in range and the output is loaded within the allowed limits.

**Buffer mode**
Describes a condition where the input voltage is below the transfer threshold level, the unit is running on capacitor (buffering) and the output is loaded within the allowed limits.

**Charging mode**
Describes a condition where the capacitor is being charged, the input voltage is in range and the output is loaded within the allowed limits.

**Inhibit mode**
Describes a condition where buffering is disabled on purpose (e.g. for service actions)

**T.b.d.**
To be defined, value or description will follow later.

**AC 24V**
A figure displayed with the AC or DC before the value represents a nominal voltage with standard tolerances included.
E.g.: DC 12V describes a 12V battery disregarding whether it is full (13.7V) or flat (10V)

**24Vac**
A figure with the unit (Vac) at the end is a momentary figure without any additional tolerances included.

**may**
A key word indicating flexibility of choice with no implied preference.

**shall**
A key word indicating a mandatory requirement.

**should**
A key word indicating flexibility of choice with a strongly preferred implementation.
1. **INTENDED USE**

This device is designed for installation in an enclosure. Use an appropriate enclosure which protects against mechanical, electrical and fire hazards.

This device is intended for professional use in areas such as in industrial control, office, communication, and instrumentation equipment.

Do not use this device in equipment or systems where malfunction may cause severe personal injury or threaten human life.

2. **INSTALLATION NOTES**

This device may only be installed and put into operation by qualified personnel.

The input must be powered from a SELV or PELV power source.

This device does not contain serviceable parts. The tripping of an internal fuse is caused by an internal defect. If damage or malfunction should occur during installation or operation, immediately turn power off and send unit to the factory for inspection.

Mount the unit on a DIN-rail so that the power terminals are located on the top of the unit.

This device is designed for convection cooling and does not require an external fan. Do not obstruct airflow and do not cover ventilation grid (e.g. cable conduits) by more than 15%!

Keep the following installation clearances: 40mm on top, 20mm on the bottom, 5mm on the left and right sides when the device is loaded permanently with more than 50% of the rated power. Increase this clearance to 15mm in case the adjacent device is a heat source (e.g. a power supply).

![Typical wiring diagram](image)

The EDLC (storage capacitors) contain Acetonitrile and Tetraethylammonium-tetrafluoroborate. These components are declared as non-dangerous goods in regards to shipment. A safety datasheet can be provided when required.

**WARNING** Risk of electrical shock, fire, personal injury or death.

- Turn power off before working on the device. Protect against inadvertent re-powering.
- Make sure that the wiring is correct by following all local and national codes.
- Do not modify or repair the unit.
- Do not open the unit as hazardous energy may be present inside.
  
  Info for service personnel: Before opening the unit, wait at least 45 minutes after disconnecting the unit from input power so that the remaining capacitor charge has completely been discharged.
- Use caution to prevent any foreign objects from entering the housing.
- Do not use in wet locations or in areas where moisture or condensation can be expected.
- Do not touch during power-on, and immediately after power-off. Hot surfaces may cause burns.

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All parameters are specified at 24V, 10A output current, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.

www.pulspower.com  Phone +49 89 9278 0  Germany
Notes for use in hazardous location areas:
The DC-UPS is suitable for use in Class I Division 2 Groups A, B, C, D locations and for use in Group II Category 3 (Zone 2) environments and are evaluated according to EN 60079-0 and EN 60079-15.

WARNING EXPLOSION HAZARDS!
Substitution of components may impair suitability for this environment. Do not disconnect the unit or change unit settings unless power has been switched off or the area is known to be non-hazardous.
A suitable enclosure must be provided for the end product which has a minimum protection of IP54 and fulfils the requirements of the EN 60079-15.

3. Input

<table>
<thead>
<tr>
<th>Input voltage</th>
<th>nom.</th>
<th>DC 24V -20%/+25%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input voltage ranges</td>
<td>typ.</td>
<td>22.5 to 30Vdc</td>
</tr>
<tr>
<td></td>
<td>max.</td>
<td>30 to 35Vdc</td>
</tr>
<tr>
<td></td>
<td></td>
<td>continuous operation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>temporarily allowed, no damage to the unit</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Between 30 and 35Vdc buffering is not possible, the unit indicates “Check Input Voltage” with the red LED on the front</td>
</tr>
</tbody>
</table>

Transfer threshold voltage

<table>
<thead>
<tr>
<th>typ.</th>
<th>max.</th>
<th>min.</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.45V ±1%</td>
<td>22.55V</td>
<td>22.60V</td>
</tr>
<tr>
<td>at no load</td>
<td>at 10A buffer current</td>
<td>at 15A buffer current</td>
</tr>
</tbody>
</table>

The transfer threshold voltage describes the input voltage, where the unit switches into buffer mode and delivers output voltage from the capacitors if the input was above the turn-on level before and all other buffer conditions are fulfilled.

Turn-on voltage

<table>
<thead>
<tr>
<th>typ.</th>
<th>max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>22.8Vdc</td>
<td>23.0V</td>
</tr>
</tbody>
</table>

The output does not switch on if the input voltage is below this level.

Allowed voltage between input and earth (chassis)

<table>
<thead>
<tr>
<th>max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>60Vdc or 42.4Vac</td>
</tr>
</tbody>
</table>

Continuous, IEC 62103

Current consumption

<table>
<thead>
<tr>
<th>typ.</th>
<th>max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>0.09A</td>
<td>1.1A</td>
</tr>
<tr>
<td>capacitors charged, output current not included</td>
<td>during charging, output current not included</td>
</tr>
</tbody>
</table>

Input current

<table>
<thead>
<tr>
<th>max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>17A</td>
</tr>
</tbody>
</table>

during charging an full output current

Return current

<table>
<thead>
<tr>
<th>typ.</th>
<th>max.</th>
</tr>
</thead>
<tbody>
<tr>
<td>-9mA</td>
<td>-11mA</td>
</tr>
</tbody>
</table>

Leakage current to input in buffer mode

Suitable power sources on input

no limitation in the maximum power supply current

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All parameters are specified at 24V, 10A output current, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.
4. **OUTPUT**

The output section of the DC-UPS is fully controlled and is equipped with an electronic current limitation. A current overloading of the DC-UPS cannot happen, independent of which sizes of power supplies are used on the input of the DC-UPS. The current limitation works in a switching mode which reduces the power losses and heat generation to a minimum.

**Output in normal mode:**
In normal mode (and also in charging mode), the output voltage is slightly lower as the input voltage. The output voltage follows the input voltage reduced by the input to output voltage drop.

### Input to output voltage drop
- max. 0.3V at 10A output current
- max. 0.45V at 15A output current

### Ripple & noise voltage
- max. 30mVpp at 20Hz to 20MHz, 50Ohm measurement. This figure indicates the ripple & noise voltage which is produced by the DC-UPS. It can be higher if the supplying source has a higher ripple and noise voltage.

### Output current
- nom. 15A continuously allowed for the entire voltage range

### Overload behavior
- continuous current see Fig. 4-2

### Current limitation
- typ. 16A
- min. 15A

### Short-circuit current
- min. 17.9A load impedance 100mOhm, see Fig. 4-2
- max. 21.0A load impedance 100mOhm, see Fig. 4-2

### Output capacitance
- typ. 1 500μF included inside the DC-UPS

### Capacitive and inductive loads
- No limitation

**Output in buffer mode:**
The output voltage is fully regulated in buffer mode.
The unit switches into buffer mode, when the input voltage falls below the transfer threshold input voltage level. The buffer voltage is slightly lower than this threshold input voltage. The unit switches back to normal mode, as soon as the input voltage exceeds the transfer threshold voltage, which is specified in the input section.

### Output voltage
- typ. 22.45V ±1% at no load
- 22.25V ±1% at 10A buffer current
- 22.12V ±1% at 15A buffer current

### Ripple & noise voltage
- max. 30mVpp at 20Hz to 20MHz, 50Ohm measurement

### Output current
- nom. 15A continuously allowed

### Overload behavior
- continuous current see Fig. 4-2

### Current limitation
- typ. 16A
- min. 15A

### Short-circuit current
- min. 17.9A load impedance 70mOhm, see Fig. 4-2
- max. 21.0A load impedance 50mOhm, see Fig. 4-2

### Capacitive and inductive loads
- No limitation

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All parameters are specified at 24V, 10A output current, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.
Fig. 4-1  Input to output voltage drop in normal mode, typ.

Voltage drop

400mV
300mV
200mV
100mV

Output Current

0 2 4 6 8 10 12 14 16A

Fig. 4-2  Output characteristic and overload behavior in normal and buffer mode, typ.

Output Voltage

28V
24
20
16
12
8
4

Output Current

0 5 10 15 20 25A

Fig. 4-3  Transition from buffer mode to normal mode and vice versa, definitions

Input voltage

24V

Output voltage

24V

Normal mode  Buffer mode  Normal mode

Transfer threshold

Fig. 4-4  Transfer behavior, typ.

24V  Output Voltage  24V

22.25V at 10A

0V  Input Voltage

500ms/DIV
5. Charging

During charging, the DC-UPS consumes additional current from the input. See chapter “Input”. When charging is completed, the “Ready LED” stops flashing and is on solid and the “Ready relay contact” closes.

<table>
<thead>
<tr>
<th>Charging time</th>
<th>UC10.241</th>
<th>UC10.242</th>
</tr>
</thead>
<tbody>
<tr>
<td>initial charging*)</td>
<td>typ. 16 min</td>
<td>32 minutes when capacitor is completely discharged</td>
</tr>
<tr>
<td>recharging**)</td>
<td>typ. 1 min 50s</td>
<td>1 min 50s after discharging with 10A for 10s</td>
</tr>
<tr>
<td></td>
<td>typ. 3 min 50s</td>
<td>7 min 40s after discharging with 10A until buffering stops</td>
</tr>
<tr>
<td></td>
<td>typ. 4 min 40s</td>
<td>9 min 40s after discharging with 5A until buffering stops</td>
</tr>
<tr>
<td></td>
<td>typ. 5 min 40s</td>
<td>11 min 15s after discharging with 1A until buffering stops</td>
</tr>
</tbody>
</table>

Allowed number of charging/discharging cycles: no limitation

*) Initial charging means that no input voltage was applied for several hours or longer and the capacitor is completely discharged by the internal electronics.

**) Recharging means that the electronics inside the DC-UPS has not completely discharged the capacitor. The values in the table apply when the input voltage is applied immediately after buffering has stopped.

Note:
At the end of the charging process the active balancing circuit reduces the charging current periodically, which can be seen as current oscillations on the input current.
6. **Buffer Time**

The following times are typical values for a new product and the aging effect during operation is not included. More information about the reduction of the buffer time over the life of the product can be found in the chapter 11 “Lifetime Expectancy and MTBF”.

<table>
<thead>
<tr>
<th>Buffer Time</th>
<th>UC10.241</th>
<th>UC10.242</th>
</tr>
</thead>
<tbody>
<tr>
<td>typ. 16A</td>
<td>1650s</td>
<td>3300s</td>
</tr>
<tr>
<td>typ. 4A</td>
<td>340s</td>
<td>680s</td>
</tr>
<tr>
<td>typ. 10A</td>
<td>200s</td>
<td>400s</td>
</tr>
<tr>
<td>typ. 12A</td>
<td>68s</td>
<td>136s</td>
</tr>
<tr>
<td>typ. 14A</td>
<td>39s</td>
<td>78s</td>
</tr>
<tr>
<td>typ. 16A</td>
<td>26s</td>
<td>53s</td>
</tr>
<tr>
<td>typ. 18A</td>
<td>16.5s</td>
<td>33s</td>
</tr>
<tr>
<td>typ. 20A</td>
<td>9s</td>
<td>18s</td>
</tr>
</tbody>
</table>

**Fig. 6-1** Buffer time vs. buffer current, typ.
7. READY AND BUFFERING RELAY CONTACT

The DC-UPSs are equipped with two independent relay contacts for remote monitoring and controlling of the unit.

**Ready contact**
Contact is closed when capacitor is completely charged, input voltage is sufficient and inhibit signal is not active.

<table>
<thead>
<tr>
<th>Contact ratings</th>
<th>max.</th>
<th>60Vdc 0.3A, 30Vdc 1A, 30Vac 0.5A</th>
<th>resistive load</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min.</td>
<td>1mA at 5Vdc</td>
<td>min. permissible load</td>
</tr>
</tbody>
</table>

**Isolation voltage**
500Vac, signal port to power port

**Buffering contact**
Contact is closed when unit is buffering.

<table>
<thead>
<tr>
<th>Contact ratings</th>
<th>max.</th>
<th>60Vdc 0.3A, 30Vdc 1A, 30Vac 0.5A</th>
<th>resistive load</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>min.</td>
<td>1mA at 5Vdc</td>
<td>min. permissible load</td>
</tr>
</tbody>
</table>

**Isolation voltage**
500Vac, signal port to power port

8. INHIBIT INPUT

The inhibit input disables buffering. In normal mode, a static signal is required. In buffer mode, a pulse with a minimum length of 250ms is required to stop buffering. The inhibit is stored and can be reset by cycling the input voltage. See also section 23.7 for application notes.

<table>
<thead>
<tr>
<th>Signal voltage</th>
<th>max.</th>
<th>35Vdc</th>
</tr>
</thead>
<tbody>
<tr>
<td>Signal current</td>
<td>max.</td>
<td>6mA, current limited</td>
</tr>
<tr>
<td>Inhibit threshold</td>
<td>min.</td>
<td>6Vdc, buffering is disabled above this threshold level</td>
</tr>
<tr>
<td></td>
<td>max.</td>
<td>10Vdc</td>
</tr>
</tbody>
</table>

**Isolation voltage**
500Vac, signal port to power port
9. PC-MODE

The PC-mode always turns the output off for at least 5s after a buffer event lasting longer than 1s, independent of whether the 24V may have recovered during this time. This function ensures that the PC gets a restart signal. To enable a safe shut-down of the system, the forced turn off of the output is delayed with a constant time of 70s.

To activate the PC-mode, connect the two pins marked with “PC-mode” together on the signal connector together. If the reset is to be controlled by the PC and not the DC-UPS, a wiring option called “external controlled delayed shut-down” is available. See section 23.8 for details.

Example A:
The buffer event is longer than 1s and ends before the buffer capacitors are fully discharged. After 70s of the beginning of the buffer event, the output of the DC-UPS will be switched off for 5s.

Example B:
The buffer event lasts longer than the buffer capacitors can supply the output. The buffer capacitors are fully discharged before the input voltage recovers. The DC-UPS output will turn-on earliest 5s after the power supply output voltage has recovered.
10. Efficiency and Power Losses

<table>
<thead>
<tr>
<th>Efficiency</th>
<th>typ. 97.8%</th>
<th>Normal mode, 10A output current, capacitor fully charged</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>typ. 97.8%</td>
<td>Normal mode, 15A output current, capacitor fully charged</td>
</tr>
<tr>
<td>Power losses</td>
<td>typ. 2.9W</td>
<td>Normal mode, 0A output current, capacitor fully charged</td>
</tr>
<tr>
<td></td>
<td>typ. 4.6W</td>
<td>Normal mode, 10A output current, capacitor fully charged</td>
</tr>
<tr>
<td></td>
<td>typ. 7.7W</td>
<td>Normal mode, 15A output current, capacitor fully charged</td>
</tr>
<tr>
<td></td>
<td>typ. 5.0W</td>
<td>During charging, 0A output current</td>
</tr>
</tbody>
</table>

Fig. 10-1  Efficiency vs. output current in normal mode, typ.

Fig. 10-2  Power losses vs. output current in normal mode, typ.
The lifetime expectancy of the DC-UPS is predominantly affected by the storage capacitors. The biggest influence in lifetime is a combination of operating voltage and operating temperature of these capacitors. To gain longest lifetimes, PULS does not utilize the full allowed working voltage for these capacitors and therefore accepts a slightly shorter buffer time.

The EDLC’s do not experience a true end-of-life, rather the capacitance continually degrades over the life of the DC-UPS. The typical degradation behavior resembles that of an exponential decay in the first couple of 1000 hours followed by a linear degradation. The majority of the capacitance reduction occurs during the initial use of the DC-UPS and this change in performance then levels off over time. When working with the specified lifetime numbers, the remaining capacity must always be taken into account. The buffer time correlates linearly to the capacity. The ultracapacitors have an almost unlimited shelf life (unlike batteries) when stored uncharged at 25°C. The number of charge/discharge cycles does not have an impact on the lifetime as long as the number of cycles does not exceed 100 000. This should not be the case for a typical backup operation.

### Lifetime Expectancy and MTBF

<table>
<thead>
<tr>
<th>Remaining capacity</th>
<th>UC10.241</th>
<th>UC10.242</th>
</tr>
</thead>
<tbody>
<tr>
<td>85%</td>
<td>186 000h</td>
<td>155 000h</td>
</tr>
<tr>
<td>75%</td>
<td>324 000h</td>
<td>270 000h</td>
</tr>
</tbody>
</table>

The Lifetime expectancy shown in the table indicates the minimum operating hours (service life) and is determined by the lifetime expectancy of the built-in electrolytic capacitors and storage capacitors (ultracapacitors). Lifetime expectancy is specified in operational hours and is calculated according to the capacitor’s manufacturer specification.

### MTBF

<table>
<thead>
<tr>
<th>MTBF ***)</th>
<th>UC10.241</th>
<th>UC10.242</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN 29500, IEC 61709</td>
<td>1 519 000h</td>
<td>1 515 000h</td>
</tr>
<tr>
<td>MIL HDBK 217F</td>
<td>525 000h</td>
<td>524 000h</td>
</tr>
</tbody>
</table>

The MTBF figure is a statistical representation of the likelihood of a device to fail. It is the statistical representation of the likelihood of a unit to fail and does not necessarily represent the life of a product. The MTBF figure is a statistical representation of the likelihood of a device to fail. A MTBF figure of e.g. 1 000 000h means that statistically one unit will fail every 100 hours if 10 000 units are installed in the field. However, it can not be determined if the failed unit has been running for 50 000h or only for 100h.

*) The Lifetime expectancy shown in the table indicates the minimum operating hours (service life) and is determined by the lifetime expectancy of the built-in electrolytic capacitors and storage capacitors (ultracapacitors). Lifetime expectancy is specified in operational hours and is calculated according to the capacitor’s manufacturer specification.

***) MTBF stands for Mean Time Between Failure, which is calculated according to statistical device failures, and indicates reliability of a device. It is the statistical representation of the likelihood of a unit to fail and does not necessarily represent the life of a product.
12. FUNCTIONAL DIAGRAM

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All parameters are specified at 24V, 10A output current, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.
13. TERMINALS AND WIRING

The terminals are IP20 finger safe constructed and suitable for field and factory wiring.

<table>
<thead>
<tr>
<th>Type</th>
<th>Input and output</th>
<th>Signals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid wire</td>
<td>max. 6mm²</td>
<td>max. 1.5mm²</td>
</tr>
<tr>
<td>Stranded wire</td>
<td>max. 4mm²</td>
<td>max. 1.5mm²</td>
</tr>
<tr>
<td>American Wire Gauge</td>
<td>AWG 20-10</td>
<td>AWG 24-14</td>
</tr>
<tr>
<td>Max. wire diameter</td>
<td>2.8mm (including ferrules)</td>
<td>1.5mm (including ferrules)</td>
</tr>
<tr>
<td>Wire stripping length</td>
<td>10mm / 0.4inch</td>
<td>8mm / 0.3inch</td>
</tr>
<tr>
<td>Screwdriver</td>
<td></td>
<td>2.5mm slotted</td>
</tr>
</tbody>
</table>

**Instructions:**

a) Use appropriate copper cables that are designed for minimum operating temperatures of:
   - 60°C for ambient up to 45°C and
   - 75°C for ambient up to 60°C and
   - 90°C for ambient up to 70°C minimum.

b) Follow national installation codes and installation regulations!

c) Ensure that all strands of a stranded wire enter the terminal connection!

d) Unused terminal compartments should be securely tightened or closed.

e) Ferrules are allowed.

![Connecting a wire](image)

Fig. 13-1 Connecting a wire

1. Insert the wire
2. Close the lever
   To disconnect wire: reverse the procedure
14. FRONT SIDE AND USER ELEMENTS

**A** Input Terminals (quick-connect spring-clamp terminal)

**B** Output Terminals (quick-connect spring-clamp terminal)
   The minus-pole has the same reference as the minus-pole of the input terminals

**C** Signal Connector (plug connector)
   - **Ready**: contact is closed when status LED indicates ready
   - **Buffering**: contact is closed during buffering
   - **Inhibit**: a voltage applied on this input signal disables buffering (e.g. during service)
   - **PC-Mode**: To activate the PC-mode connect the two pins of the signal connector together; see also section 9.

**D** Status LED (green)
   - **Ready**: capacitors are fully charged, no failures detected
   - **Charging**: capacitors are being charged
   - **Buffering**: capacitors are being discharged

Flashing pattern for the green status LED:

<table>
<thead>
<tr>
<th>Flashing Pattern</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Ready</td>
</tr>
<tr>
<td>1</td>
<td>Charging</td>
</tr>
<tr>
<td>1</td>
<td>Buffering</td>
</tr>
</tbody>
</table>

**E** Diagnosis LED (yellow)
   Helps troubleshooting and indicates the following:
   - **Current Overload**: output voltage below 20Vdc due to a too high output current, ready contact is open
   - **High Temperature**: signal for too high capacitor temperature (>65°C), charging and buffering is still possible, ready contact is open
   - **Buffer Time Expired**: buffering stopped due to discharged capacitors
   - **Inhibit Active**: buffering is blocked by the inhibit signal

Flashing pattern for the yellow diagnosis LED:

<table>
<thead>
<tr>
<th>Flashing Pattern</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Current overload</td>
</tr>
<tr>
<td>0</td>
<td>High temperature</td>
</tr>
<tr>
<td>1</td>
<td>Buffer time expired</td>
</tr>
<tr>
<td>0</td>
<td>Inhibit active</td>
</tr>
</tbody>
</table>

**F** “Warning” LED (red)
   - **Check Input Voltage**: Indicates a too low or too high input voltage. The input voltage must be between 23Vdc and 30Vdc to turn-on the output and to start charging of the capacitors.
   - **PC-Mode Activated**: Indicates, that the PC-Mode (see also section 9) is activated.

Flashing pattern for the red warning LED:

<table>
<thead>
<tr>
<th>Flashing Pattern</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Check input voltage</td>
</tr>
<tr>
<td>0</td>
<td>PC-Mode activated</td>
</tr>
</tbody>
</table>

**G** Chassis Ground (screw)
   Use a M4 ring-type terminal to connect the housing to ground, when required

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All parameters are specified at 24V, 10A output current, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.
15. EMC

The DC-UPS is suitable for applications in industrial environment as well as in residential, commercial and light industry environment without any restrictions.

**EMC Immunity**

<table>
<thead>
<tr>
<th>Phenomenon</th>
<th>Standard</th>
<th>Test Level</th>
<th>Criterion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Electrostatic discharge</td>
<td>EN 61000-4-2</td>
<td>8kV</td>
<td>Criterion A</td>
</tr>
<tr>
<td></td>
<td></td>
<td>15kV</td>
<td>Criterion A</td>
</tr>
<tr>
<td>Electromagnetic RF field</td>
<td>EN 61000-4-3</td>
<td>80MHz-2.7GHz</td>
<td>Criterion A</td>
</tr>
<tr>
<td>Fast transients (Burst)</td>
<td>EN 61000-4-4</td>
<td>input lines</td>
<td>2kV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>output lines</td>
<td>2kV</td>
</tr>
<tr>
<td></td>
<td></td>
<td>signals ***)</td>
<td>2kV</td>
</tr>
<tr>
<td>Surge voltage on input</td>
<td>EN 61000-4-5</td>
<td>+ → -</td>
<td>500V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ / - → chassis ground</td>
<td>1kV</td>
</tr>
<tr>
<td>Surge voltage on output</td>
<td>EN 61000-4-5</td>
<td>+ → -</td>
<td>500V</td>
</tr>
<tr>
<td></td>
<td></td>
<td>+ / - → chassis ground</td>
<td>1kV</td>
</tr>
<tr>
<td>Surge voltage on inhibit input, ready- and buffering contacts and PC-mode selector</td>
<td>EN 61000-4-5</td>
<td>signals → chassis ground</td>
<td>1kV</td>
</tr>
<tr>
<td>Conducted disturbance</td>
<td>EN 61000-4-6</td>
<td>0.15-80MHz</td>
<td>10V</td>
</tr>
</tbody>
</table>

*) Chassis ground connection earthed (grounded)

**) Tested with coupling clamp

**Criterions:**

A: DC-UPS shows normal operation behavior within the defined limits.

**EMC Emission**

<table>
<thead>
<tr>
<th>Phenomenon</th>
<th>Standard</th>
<th>Limits for DC ports acc.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conducted emission</td>
<td>IEC/CISPR 16-1-2, IEC/CISPR 16-2-1</td>
<td>limits for DC power ports acc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>EN 61000-6-3 fulfilled</td>
</tr>
<tr>
<td>Radiated emission</td>
<td>EN 55011, EN 55022</td>
<td>Class B</td>
</tr>
</tbody>
</table>

This device complies with FCC Part 15 rules.

Operation is subjected to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.

**Switching Frequencies**

The unit has two converters with two different switching frequencies and one switch-mode current limiter included.

- **Switching frequency 1**: 100kHz - Boost Converter (active only in buffer mode)
- **Switching frequency 2**: 78kHz - Electronic output current limitation
- **Switching frequency 3**: 19.5kHz - Charger
## 16. ENVIRONMENT

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Specification</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Operational temperature *)</td>
<td>-40°C to +60°C (-40°F to 140°F)</td>
<td>Operational temperature is the same as the ambient or surrounding temperature and is defined as the air temperature 2cm below the unit.</td>
</tr>
<tr>
<td>Storage temperature</td>
<td>-40 to +70°C (-40°F to 158°F)</td>
<td>for storage and transportation</td>
</tr>
<tr>
<td>Humidity **)</td>
<td>5 to 95% r.H.</td>
<td>IEC 60068-2-30</td>
</tr>
<tr>
<td>Vibration sinusoidal</td>
<td>2-17.8Hz: ±1.6mm; 17.8-500Hz: 2g ***)</td>
<td>IEC 60068-2-6</td>
</tr>
<tr>
<td></td>
<td>2 hours / axis</td>
<td></td>
</tr>
<tr>
<td>Shock</td>
<td>30g 6ms, 20g 11ms ***)</td>
<td>IEC 60068-2-27</td>
</tr>
<tr>
<td></td>
<td>3 hours / axis</td>
<td></td>
</tr>
<tr>
<td></td>
<td>3 bumps / direction, 18 bumps in total</td>
<td></td>
</tr>
<tr>
<td>Altitude</td>
<td>0 to 6000m (0 to 20 000ft)</td>
<td>Approvals apply only up to 2000m</td>
</tr>
<tr>
<td>Over-voltage category</td>
<td>II</td>
<td>IEC 62103, EN 50178, EN 60950, UL 840</td>
</tr>
<tr>
<td>Degree of pollution</td>
<td>2</td>
<td>IEC 62103, EN 50178, not conductive</td>
</tr>
<tr>
<td>LABS compatibility</td>
<td>The unit does not release any silicone or other LABS-critical substances and is suitable for use in paint shops.</td>
<td></td>
</tr>
</tbody>
</table>

*) Operational temperature is the same as the ambient or surrounding temperature and is defined as the air temperature 2cm below the unit.

**) Do not energize while condensation is present

***) Higher levels allowed when using the wall mounting bracket ZM2.WALL

![Output current vs. ambient temp.](attachment:fig_16-1.png)

Fig. 16-1  Output current vs. ambient temp.

All parameters are specified at 24V, 10A output current, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.
17. PROTECTION FEATURES

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output protection</td>
<td>Electronically protected against overload, no-load and short-circuits *)</td>
</tr>
<tr>
<td>Output over-voltage protection</td>
<td>typ. 32Vdc max. 35Vdc In case of an internal DC-UPS defect, a redundant circuit limits the maximum output voltage. The output shuts down and automatically attempts to restart.</td>
</tr>
<tr>
<td>Degree of protection</td>
<td>IP 20 For use in a controlled environment according to CSA 22.2 No 107.1-01.</td>
</tr>
<tr>
<td>Penetration protection</td>
<td>&gt; 3.5mm e.g. screws, small parts</td>
</tr>
<tr>
<td>Over-temperature protection</td>
<td>included Output shuts down with automatic restart</td>
</tr>
<tr>
<td>Input over-voltage protection</td>
<td>Max. 35Vdc, no harm or defect of the unit</td>
</tr>
<tr>
<td>Internal input fuse</td>
<td>included Non user replaceable The tripping of this fuse is caused by an internal defect. In such cases, send unit to the factory for inspection.</td>
</tr>
<tr>
<td>Internal capacitor fuse</td>
<td>included Non user replaceable The tripping of this fuse is caused by an internal defect. In such cases, send unit to the factory for inspection.</td>
</tr>
<tr>
<td>Overcharging of capacitors</td>
<td>included The capacitors are permanently monitored. In case of a too high charging voltage, the charger will be switched off with redundant protection measures.</td>
</tr>
<tr>
<td>Balancing of capacitors</td>
<td>included An active balancing circuit ensures uniform capacitor voltages. If necessary, the charging current will be reduced to a safe value.</td>
</tr>
<tr>
<td>Failing of one or more capacitor in the capacitor-string</td>
<td>included Ready contact open, moving light pattern on the three LEDs</td>
</tr>
<tr>
<td>Temperature of capacitors</td>
<td>included Indicated by the diagnosis LED, ready contact open</td>
</tr>
<tr>
<td>Internal errors (broken wires, ...)</td>
<td>included Charging is stopped, ready contact open, moving light pattern on the three LEDs</td>
</tr>
</tbody>
</table>

*) In case of a protection event, audible noise may occur.

18. SAFETY FEATURES

<table>
<thead>
<tr>
<th>Feature</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Output voltage</td>
<td>SELV IEC/EN 60950-1, The input must be powered from a SELV power source.</td>
</tr>
<tr>
<td></td>
<td>PELV IEC/EN 60204-1, EN 50178, IEC 62103, IEC 60364-4-41, The input must be powered from a PELV power source.</td>
</tr>
<tr>
<td>Class of protection</td>
<td>III PE (Protective Earth) connection not required</td>
</tr>
<tr>
<td>Isolation resistance</td>
<td>&gt; 5MOhm Power port to signal port</td>
</tr>
<tr>
<td></td>
<td>&gt; 800kOhm Power port to housing</td>
</tr>
<tr>
<td></td>
<td>&gt; 5MOhm Signal port to housing</td>
</tr>
<tr>
<td>Dielectric strength</td>
<td>500Vac Power port to signal port</td>
</tr>
<tr>
<td></td>
<td>500Vac Power port / signal port to housing</td>
</tr>
<tr>
<td>Touch current (leakage current)</td>
<td>The leakage current which is produced by the DC-UPS itself depends on the input voltage ripple and need to be investigated in the final application. For a smooth DC input voltage, the produced leakage current is less than 100μA.</td>
</tr>
</tbody>
</table>

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All parameters are specified at 24V, 10A output current, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.
19. APPROVALS

EC Declaration of Conformity
The CE mark indicates conformance with the
- EMC directive and the
- RoHS directive.

IEC 60950-1
2nd Edition
IECEE CB SCHEME
CB Scheme, Information Technology Equipment
Applicable for altitudes up to 2000m.

UL 508
UL US LISTED
Listed for use as Industrial Control Equipment;
U.S.A. (UL 508) and Canada (C22.2 No. 107-1-01);
E-File: E198865

UL 60950-1
2nd Edition
Recognized for use as Information Technology Equipment,
Level 5; U.S.A. (UL 60950-1) and Canada (C22.2 No. 60950-1);
E-File: E137006
Applicable for altitudes up to 2000m.

ANSI / ISA 12.12.01-2007
Class I Div 2
Recognized for use in Hazardous Location Class I Div 2 T4
Groups A,B,C,D systems; U.S.A. (ANSI / ISA 12.12.01-2007) and
Canada (C22.2 No. 213-M1987)

EN 60079-0, EN 60079-15
ATEX
 Approval for use in hazardous locations Zone 2 Category 3G.
Number of ATEX certificate: EPS 15 ATEX 1 025 X
The power supply must be built-in in an IP54 enclosure.

IEC 60079-0, IEC 60079-15
IECEX
Suitable for use in Class 1 Zone 2 Groups IIA, IIB and IIC
locations. Number of IECEX certificate: IECEX EPS 15.0049X

EAC TR Registration
(only for CP10.241)
Registration for the Eurasian Customs Union market
(Russia, Kazakhstan, Belarus)

20. ROHS, REACH AND OTHER FULFILLED STANDARDS

RoHS Directive
Directive 2011/65/EU of the European Parliament and the
Council of June 8th, 2011 on the restriction of the use of
certain hazardous substances in electrical and electronic
equipment.

REACH Directive
Directive 1907/2006/EU of the European Parliament and the
Council of June 1st, 2007 regarding the Registration,
Evaluation, Authorisation and Restriction of Chemicals
(REACH)
21. Physical Dimensions and Weight

Weight
- UC10.241: 1150g / 2.54lb
- UC10.242: 1720g / 3.79lb

DIN-Rail
- Use 35mm DIN-rails according to EN 60715 or EN 50022 with a height of 7.5 or 15mm.
- The DIN-rail height must be added to the unit depth (127mm) to calculate the total required installation depth.

Installation Clearances
- See chapter 2

Fig. 21-1  Front view UC10.241
- Width: 126mm 4.96"

Fig. 21-2  Front view UC10.242
- Width: 198mm 7.8"

Fig. 21-3  Side view
- DIN-Rail depth: 117mm 4.61"

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All parameters are specified at 24V, 10A output current, 25°C ambient and after a 5 minutes run-in time unless otherwise noted.
22. Accessories

22.1. ZM2.WALL – Wall-Mounting Bracket

This bracket is used to mount the DC-UPS onto a flat surface without utilizing a DIN-Rail.
23. APPLICATION NOTES

23.1. EXTERNAL INPUT PROTECTION

The DC-UPS is tested and approved for branch circuits up to 50A. An external protection is only required, if the supplying branch has an ampacity greater than this. If an external fuse is necessary or utilized, minimum requirements need to be considered to avoid nuisance tripping of the circuit breaker. A minimum value of 20A B- or C-Characteristic breaker should be used.

Check also local codes and local requirements. In some countries local regulations might apply.

23.2. OUTPUT CIRCUIT BREAKERS

The output of the DC-UPS is equipped with an electronic current limitation. An overload or short-circuit on the output is electronically protected and cannot cause any harms, independent of which sizes of power supplies are used on the input of the DC-UPS.

However, some applications require branch circuit or branch circuit conductor protection. Therefore standard miniature circuit breakers (MCB’s or UL 1077 circuit breakers) are commonly used on 24V branches.

MCB’s are designed to protect wires and circuits. If the ampere value and the characteristics of the MCB are adapted to the wire size that is used, the wiring is considered as thermally safe regardless of whether the MCB opens or not.

To avoid voltage dips and under-voltage situations in adjacent 24V branches which are supplied by the same source, a fast (magnetic) tripping of the MCB is desired. A quick shutdown within 10ms is necessary corresponding roughly to the ride-through time of PLC’s. This requires high peak currents to open the circuit breaker in the required time.

Furthermore, the impedance of the faulty branch must be sufficiently small in order for the current to actually flow. The following table has typical test results showing which C-Characteristic MCBs magnetically trip depending on the wire cross section and wire length.

Maximal wire length*) for a fast (magnetic) tripping:

<table>
<thead>
<tr>
<th>Wire cross section</th>
<th>0.75mm²</th>
<th>1.0mm²</th>
<th>1.5mm²</th>
<th>2.5mm²</th>
</tr>
</thead>
<tbody>
<tr>
<td>C-2A</td>
<td>20m</td>
<td>25m</td>
<td>39m</td>
<td>58m</td>
</tr>
<tr>
<td>C-3A</td>
<td>12m</td>
<td>14m</td>
<td>24m</td>
<td>39m</td>
</tr>
<tr>
<td>C-4A</td>
<td>3m</td>
<td>3m</td>
<td>4m</td>
<td>4m</td>
</tr>
</tbody>
</table>

*) Don’t forget to consider twice the distance to the load (or cable length) when calculating the total wire length (+ and – wire).

23.3. PARALLEL USE TO INCREASE OUTPUT CURRENT

Do not use the DC-UPS in parallel to increase the output power.
23.4. **PARALLEL USE FOR REDUNDANCY**

Two DC-UPSs can be paralleled to build a 1+1 redundant system to gain higher system reliability.

Recommendations for building redundant power systems:

a) Use separate input fuses for each power supply.

b) Set the power supply into “Parallel use” mode if available.

c) Use a redundancy module to decouple the two power sources.

d) Monitor the individual sources. Therefore, use the alarm contacts of the YRM2.DIODE redundancy module. (The YRM2.DIODE is suitable for a 10A redundant system)

e) It is desirable to set the output voltages of all power supplies to the same value (± 100mV) or leave it at the factory setting.

![Wiring example for a fully redundant system, redundant power supplies and redundant DC-UPSs](image)

23.5. **PARALLEL USE FOR LONGER BUFFER TIMES**

DC-UPSs can be paralleled to extend the buffer time.

![Wiring example for parallel use for longer buffer times](image)
23.6. **Series Use for 48V Applications**

A series connection for 48V applications is allowed when utilizing two individual power supplies and two DC-UPSs.

![Wiring example for 48V serial use](image)

23.7. **Using the Inhibit-Input**

The inhibit-input disables buffering. In normal mode, a static signal is required. In buffer mode, a pulse with a minimum length of 250ms is required to stop buffering. The inhibit signal is stored and can be reset by cycling the input voltage.

For service purposes, the inhibit input can also be used to connect a service switch. Therefore, the inhibit signal can be supplied from the output of the DC-UPS.

![Wiring example for inhibit input](image)
23.8. **EXTERNAL CONTROLLED DELAYED SHUT-DOWN**

If the reset is supposed to be controlled by the PC or another external trigger and not the DC-UPS, the following wiring option is possible but requires an external relay:

**Fig. 23-6  Wiring scheme for an external controlled reset after a buffer event**

**Activation of the “external control mode”:**

The PC-Mode pins need to be connected together during a normal mode operation. This connection must be opened within the first second of a buffer event to set the DC-UPS into the “external control mode”. In this mode, a signal on the inhibit input will not immediately execute a shut-down of the DC-UPS’s output but will be delayed by 70s. The output of the DC-UPS will always be switched off for at least 5s.
23.9. **WHAT DO KJ AND KWS MEAN?**

The units kJ (kilo Joule) or kWs (kilo Watt seconds) is used for specifying the installed storage capacitor size.

1 kJ = 1 kWs = 1000Ws

The stored energy of a capacitor can be calculated with the following formula:

\[
\text{Energy(Ws)} = \frac{C \times U^2}{2}
\]

For example: A 350F (Farad) capacitor which is charged to 2.5V has the following energy

\[
E = \frac{350F \times 2.5^2}{2} = 1093\text{Ws} = 1.09\text{kWs}
\]

During discharging of the capacitor, the voltage decreases with the amount of discharge. A boost converter is needed to generate a stable output voltage. The boost converter needs a minimum input voltage (cut-off voltage), which reduces the amount of energy. The cut-off voltage usually depends on the load current, the lower the load current, the lower the cut-off voltage.

Considering this voltage range, the energy can be calculated with the following formula (full charge voltage= U1= 2.5V, cut-off voltage= U2= 1V):

\[
E = \frac{C \times (U1^2 - U2^2)}{2} = \frac{350 \times (2.5^2 - 1^2)}{2} = 919\text{Ws} = 0.92\text{kWs}
\]

The energy which can be used for the 24V loads is further reduced by the efficiency of the boost converter.

The UC10.241 has a rated capacitor size of 6kWs and the UC10.242 12kWs. This is the energy which can be used for 24V load at low load currents.

**Calculation of the needed energy:**

Example: A power of 45W is needed for 2 minutes:

\[
E = P \times t = 45W \times 120s = 5400\text{Ws} = 5.4\text{kWs}
\]

Always check with the buffer time curve (see Fig. 6-1) if the load can be powered for the required period of time!
## 23.10. Troubleshooting

The following guidelines provide instructions for fixing the most common failures and problems. Always start with the most likely and easiest to check condition. Some of the suggestions may require special safety precautions. See notes in section 2 first.

<table>
<thead>
<tr>
<th>Symptom:</th>
<th>Action:</th>
</tr>
</thead>
<tbody>
<tr>
<td>“Check input voltage” LED is on</td>
<td>- Check input voltage (must be between 22.8V and 30V)</td>
</tr>
<tr>
<td>DC-UPS did not buffer</td>
<td>- Inhibit input was set.</td>
</tr>
<tr>
<td></td>
<td>- Capacitor did not have enough time to be charged.</td>
</tr>
<tr>
<td>DC-UPS stopped buffering</td>
<td>- Capacitor was discharged.</td>
</tr>
<tr>
<td></td>
<td>- Capacitor did not have enough time to be charged.</td>
</tr>
<tr>
<td></td>
<td>- Inhibit was activated</td>
</tr>
<tr>
<td></td>
<td>- PC-mode was activated</td>
</tr>
<tr>
<td>Output has shut down in normal mode</td>
<td>- Over-temperature protection might have triggered. Let the DC-UPS cool down.</td>
</tr>
<tr>
<td></td>
<td>- PC-mode was activated (if not longer than 5s)</td>
</tr>
<tr>
<td>DC-UPS constantly switches between normal mode and buffer mode</td>
<td>The supplying source on the input is too small and can not deliver sufficient current. Use a larger power supply or reduce the output load</td>
</tr>
</tbody>
</table>