Reference Manual

Original Instructions

Allen-Bradley

DC-UPS with Integrated Battery - 24V, 10 A

Catalog Number 1606-XLS240-UPSC

Allen-Bradley • Rockwell Software

Rockwell Automation

Important User Information

Read this document and the documents listed in the additional resources section about installation, configuration, and operation of this equipment before you install, configure, operate, or maintain this product. Users are required to familiarize themselves with installation and wiring instructions in addition to requirements of all applicable codes, laws, and standards.

Activities including installation, adjustments, putting into service, use, assembly, disassembly, and maintenance are required to be carried out by suitably trained personnel in accordance with applicable code of practice.

If this equipment is used in a manner not specified by the manufacturer, the protection provided by the equipment may be impaired.

In no event will Rockwell Automation, Inc. be responsible or liable for indirect or consequential damages resulting from the use or application of this equipment.

The examples and diagrams in this manual are included solely for illustrative purposes. Because of the many variables and requirements associated with any particular installation, Rockwell Automation, Inc. cannot assume responsibility or liability for actual use based on the examples and diagrams.

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Throughout this manual, when necessary, we use notes to make you aware of safety considerations.

	**WARNING:** Identifies information about practices or circumstances that can cause an explosion in a hazardous environment, which may lead to personal injury or death, property damage, or economic loss.
	**ATTENTION:** Identifies information about practices or circumstances that can lead to personal injury or death, property damage, or economic loss. Attentions help you identify a hazard, avoid a hazard, and recognize the consequence.
IMPORTANT	Identifies information that is critical for successful application and understanding of the product.

Labels may also be on or inside the equipment to provide specific precautions.

	**SHOCK HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that dangerous voltage may be present.
	**BURN HAZARD:** Labels may be on or inside the equipment, for example, a drive or motor, to alert people that surfaces may reach dangerous temperatures.
	**ARC FLASH HAZARD:** Labels may be on or inside the equipment, for example, a motor control center, to alert people to potential Arc Flash. Arc Flash will cause severe injury or death. Wear proper Personal Protective Equipment (PPE). Follow ALL Regulatory requirements for safe work practices and for Personal Protective Equipment (PPE).

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Additional Resources

These documents contain additional information concerning related products from Rockwell Automation.

Resource	Description
Industrial Automation Wiring and Grounding Guidelines, publication 1770-4.1	Provides general guidelines for installing a Rockwell Automation® industrial system.
Product Certifications website, http://www.rockwellautomation.com/global/certification/overview.page	Provides declarations of conformity, certificates, and other certification details.

You can view or download publications at http://www.rockwellautomation.com/global/literature-library/overview.page. To order paper copies of technical documentation, contact your local Allen-Bradley distributor or Rockwell Automation sales representative.

Terminology and Abbreviations

Term	Definition
DC-UPS	Uninterpretable power supply with DC input.
Normal mode	Describes a condition where the battery 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 battery (buffering) and the output is loaded within the allowed limits.
Charging mode	Describes a condition where the battery 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 by using the inhibit input of the DC-UPS. (For example, for service actions, or to save battery capacity)
Buffer time	Same as the term hold-up time.

Product Overview

This uninterrupted power supply (UPS) controller with integrated battery is a compact addition to standard 24V power supplies to bridge power failures or voltage fluctuations. Expensive downturns, long restart cycles, and loss of data can be avoided.

The DC-UPS includes a professional battery management system, which charges and, monitors the battery to achieve the longest battery service life and many diagnostic functions that ensure a reliable operation of the entire system.

A unique feature of the 1606-XLS240-UPSC is that only one 12V battery is required to buffer the 24V output. This makes matching batteries unnecessary and allows a precise battery charging and testing.

The power supply has one easy-to-change integrated 12V, 5 A high-current VRLA battery.

In addition to the power supply, a separate UPS controller which requires an external 12V battery is available when a longer buffer time is required.

The power supply includes these features:

- Compact size and easy installation
- Longest buffer time in class
- Easy battery access
- Stable output voltage in buffer mode

- Superior battery management for long battery life
- Temperature compensated battery charging
- Comprehensive diagnostics and monitoring functions
- Replace battery signal included
- Electronically overload and short circuit protection
- 50% power reserves
- Selectable buffer time limiter

The power supply is also environmentally friendly:

- The unit does not release any silicone and is suitable for the use in paint shops.
- The unit conforms to the RoHS directive 2002/96/EC.
- Electrolytic capacitors included in this unit do not use electrolytes such as Quaternary Ammonium Salt Systems.
- Plastic housings and other molded plastic materials are free of halogens.
- The materials that are used in our production process do not include Polychlorinated Biphenyl (PCB), Pentachlorophenol (PCP), Polychlorinated naphthalene (PCN), Polybrominated Biphenyl (PBB), Polybrominated Biphenyl Oxide (PBO), Polybrominated Diphenyl Ether (PBDE), Polychlorinated Diphenyl Ether (PCDE), Polybrominated Diphenyl Oxide (PBDO), Cadmium, Asbestos, Mercury, or Silica.

Attribute	Description	
Input voltage Range	24V DC, nom 22.5…30V DC	–
Output current	15 A, min 10 A, min	Normal mode Buffer mode
Output voltage	Typ 0.23V lower as input voltage 22.25V	Normal mode Buffer mode, 10 A
Integrated battery	12V, 5 Ah	VRLA lead acid
Temperature range	0…40 °C(32…104 °F)	Operational
Size (W x H x D)	123 x 124 x 11 mm (4.84 x 4.88 x 0.43 in.)	–
Buffer time	16 minutes, 15 s, typ 16 minutes, 15 s, typ	5 A load 10 A load

Figure 1 - Typical Setup of a DC-UPS System with the 1606-XLS240-UPSC

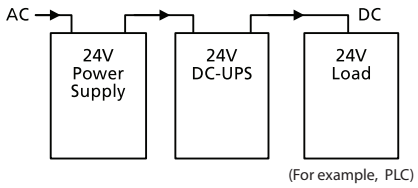


Figure 2 - Markings

Input

Attribute	Description		
Input voltage	Nom	24V DC	
Input voltage ranges	Nom	22.5…30V DC	Continuous operation, see Figure 3.
		30…35V DC	Temporarily allowed, no damage to the DC-UPS.(2)
		35V DC	Absolute maximum input voltage with no damage to the DC-UPS.
		0…22.5V DC	The DC-UPS changes to Buffer mode and delivers output voltage from the battery if the input is above the turn-on level before and all other buffer conditions are fulfilled.
Allowed input voltage ripple	Max	1.5V pp 1V pp	Bandwidth < 400 Hz Bandwidth 400 Hz to 1 kHz
Allowed voltage between input and earth (ground)	Max	60V DC or 42.4V AC	
Turn-on voltage	Typ	22.8V DC	The output does not switch On if the input voltage does not exceed this level.
	Max	23V DC	
Input current(1)	Typ Typ	120 mA 1.1 A	Internal current consumption Current consumption for battery charging in constant current mode at 24V input. See Figure 13.(3)
External capacitors on the input		No limitation	

(1) The unit shows 'Check Wiring' with the red LED and buffering is not possible.

(2) The total input current is the sum of the output current, the current that is required to charge the battery during the charging process and the current that is needed to supply the DC-UPS itself. See Figure 4. This calculation does not apply in overload situations where the DC-UPS limits the output current. See Figure 5.

(3) This is the input current and not the current that flows into the battery during charging. See for the battery current.

Figure 3 - Input Voltage Range

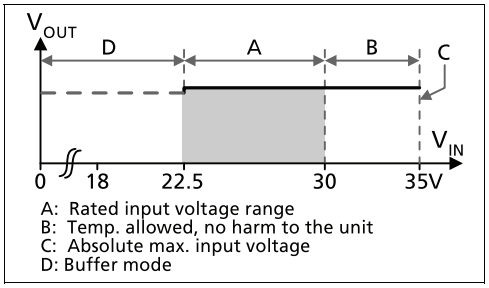
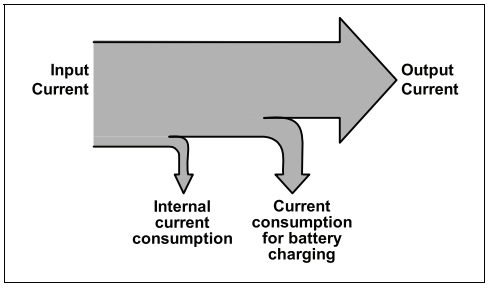


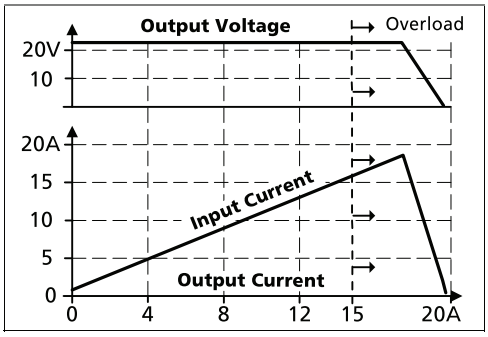
Figure 4 - Input Current, Definitions



Electronic Output Current Limitation

The unit is equipped with an electronic output current limitation. This current limitation works in a switching mode that reduces the power losses and heat generation to a minimum. As a result, the output voltage drops since there is not enough current to support the load. A positive effect of the current limitation in switching mode is that the input current goes down despite an increase in the output current resulting in less stress for the supplying source.

Figure 5 - Input Current and Output Voltage versus Output Current, Typ. (battery fully charged)



Output in Normal Mode

Attribute	Description		
Output voltage	Nom	DC 24V	The output voltage follows the input voltage that is reduced by the input to the output voltage drop.
Voltage drop between input and output	Max Max	0…3V 0.45V	At 10 A output current, see Figure 6 for typical values. At 15 A output current, see Figure 6 for typical values.
Ripple and noise voltage	Max	20 mVpp	20 Hz to 20 MHz, 50 Ohms(1)
Output current	Nom	15 A	Continuously allowed
Output power	Nom	360 W	Continuously allowed
Short circuit current	Min Max	17.9 A 21 A	Load impedance 100 mOhm, see Figure 7 for typical values. Load impedance 100 mOhm, see Figure 7 for typical values.
Capacitive and inductive loads	No limitation		

(1) Shows the ripple and noise voltage that is generated by the DC-UPS. The ripple and noise voltage might be higher if the supplying source has a higher ripple and noise voltage.

Figure 6 - Input to Output Voltage Drop, Typ.

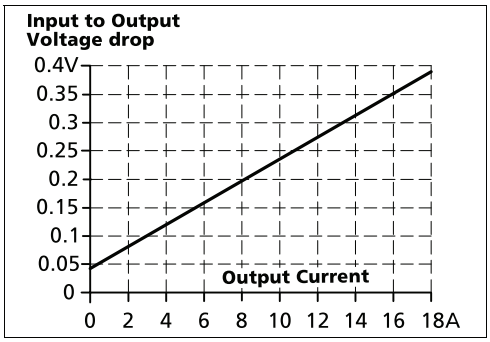
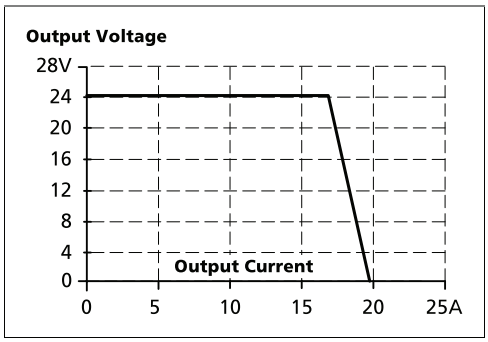


Figure 7 - Output Voltage versus Output Current in Normal Mode at 24V Input, Typ.



Output in Buffer Mode

If the input voltage falls below a certain value (transfer threshold level), the DC-UPS starts buffering without any interruption or voltage dips. Buffering is possible even if the battery is not fully charged.

Attribute	Description		
Output voltage	Nom	24V DC 22.45V 22.25V	The output voltage is stabilized and independent from the battery voltage. at no load at 10 A output current
Transfer threshold for buffering	Typ	80 mV greater than the output voltage in buffer mode.	
Ripple and noise voltage	Max	20 mVpp	20 Hz to 20 MHz, 50 Ohms
Output current	Nom	10 A 15 A	Continuously allowed <5 s with full output voltage(1)
Short Circuit current	Min Max	17.9 A 21 A	Load impedance 100 mOhm(2) Load impedance 100 mOhm(2)

(1) If the output current is in the range 10 A…15 A for longer than 5 s, a hardware-controlled reduction of the maximal output current to 10 A occurs. If the 10 A are not sufficient to maintain the 24V, buffering stops after another 5 s. The buffering is possible again as soon as the input voltage recovers.

(2) If the nominal output voltage cannot be maintained in buffer mode, the DC-UPS switches off after 5 s to save battery capacity.

Figure 8 - Buffering Transition, Definitions

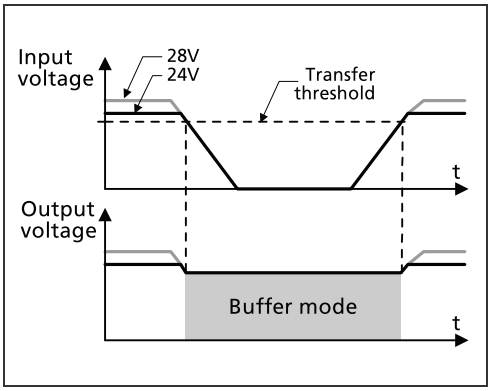


Figure 9 - Transfer Behavior, Typ.

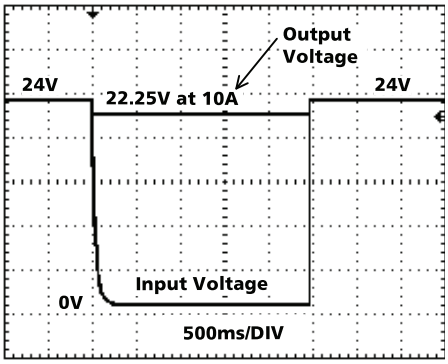


Figure 10 - Available Output Current in Buffer Mode

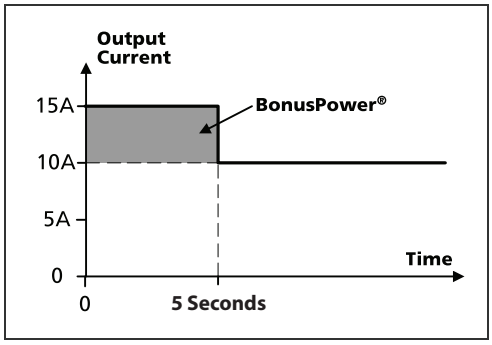
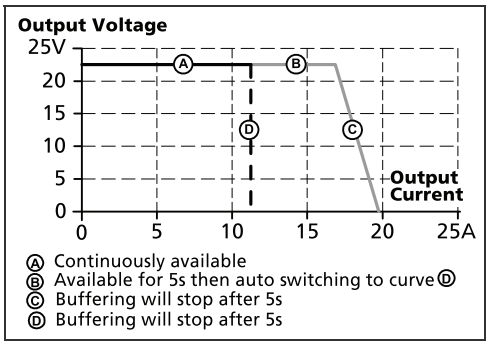


Figure 11 - Output Voltage versus Output Current in Buffer Mode, Typ.



Battery

The required 12V VRLA battery is included with this unit.

Attribute	Description		
Battery voltage	Nom	12V DC	Maintenance-free 12V VRLA lead acid battery
Battery voltage range	 Max Typ	9.0…15V 35V DC 7.4V	Continuously allowed, except deep discharge protection. Absolute maximum voltage with no damage to the unit. Battery charging is possible above this level.
Allowed battery capacity	Nom	5 Ah	High-current version
Battery charging method		CC-CV	Constant current, constant voltage mode
Battery charging current	Nom Max	1.5 A 1.7 A	CC-mode, independent from battery size Corresponding 24V input current. See Figure 13.
End-of-charge voltage (CV-mode)	Typ	13.1…14V	Automatic setting according to ambient temperature
Battery charging time	Typ	3 h(3)	–
Battery discharging current(1)	Typ Typ Max Typ	21 A 0.3 A 50 270 mA	Buffer mode, 10 A output current, 11.5V on the battery terminal of the unit. Buffer mode, 0 A output current At no input, buffering had turned off, all LEDs are off. At no input, buffering had turned off, yellow LED shows that buffer time has expired, (max. 15 minutes).
Deep discharge protection(2)	Typ Typ	10.5V 9V	At 0 A output current At 10 A output current

(1) The current between the battery and the DC-UPS is more than twice the output current. This is caused by boosting the 12V battery voltage to a 24V level.

(2) To ensure longest battery lifetime, the DC-UPS has a battery deep discharge protection feature included. The DC-UPS stops buffering when the voltage on the battery terminals of the DC-UPS falls below a certain value.

(3) The charging time depends on the duration and load current of the last buffer event. The numbers in the table represent a fully discharged battery. A typical figure for a buffer current of 10 A is 2 hours, 20 minutes for a 5 Ah high-current battery. Above 40 °C(104 °F) charging time can be longer.

Figure 12 - Battery Discharging Current versus Output Current, Typ.

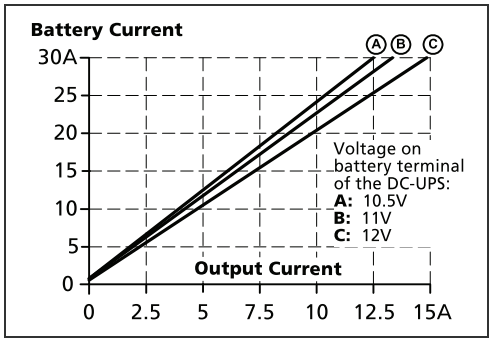
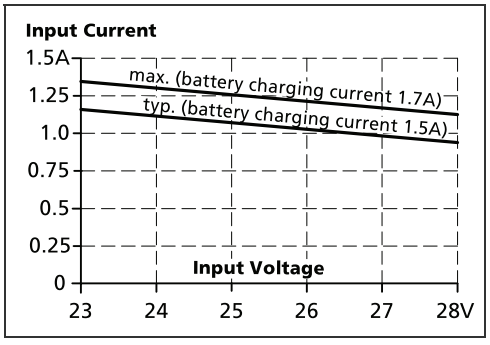


Figure 13 - Required Input Current versus Input Voltage for Battery Charging



Buffer Time

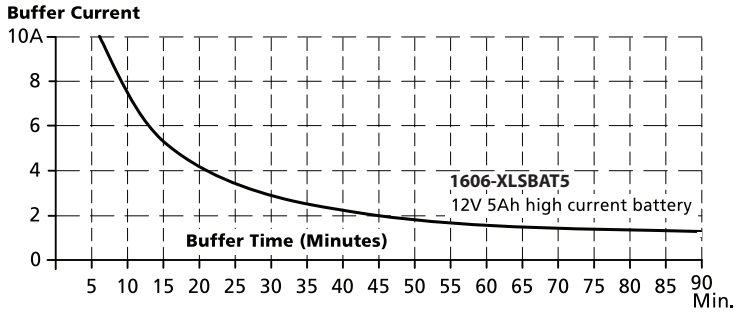
The buffer time depends on the capacity and performance of the battery and the load current. See Figure 14 for the typical buffer times of the standard battery.

Attribute		1606-XLS240-UPSC	Notes
Buffer time with 5 A high-current battery	Min	13’24”	At 5 A output current(1)
	Min	4’54”	At 10 A output current(1)
	Typ	16’15”	At 5 A output current, see Figure 14.(2)
	Typ	6’15”	At 10 A output current, see Figure 14.(2)

(1) Minimum value includes 20% aging and requires a fully charged (min. 24 h) battery.

(2) Typical value includes 10% aging and requires a fully charged (min. 24 h) battery.

Figure 14 - Buffer Time versus Output Current with a 5 Ah High-current Battery



Efficiency and Power Loss

Attribute	Description		
Efficiency	Typ	97.8%	Normal mode, 10 A output current, battery fully charged
Power losses	Typ	2.9 W	Normal mode, 0 A output current, battery fully charged
	Typ	5.5 W	Normal mode, 10 A output current, battery fully charged
	Typ	5.0 W	0 A output current during battery charging

Figure 15 - Efficiency at 24V, typ.

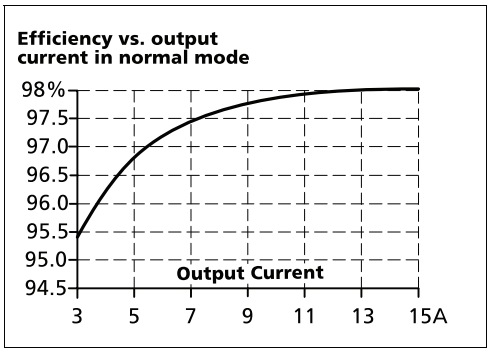
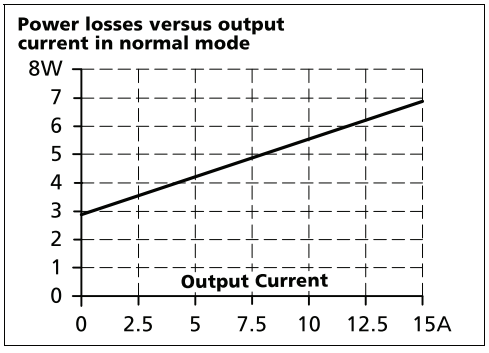
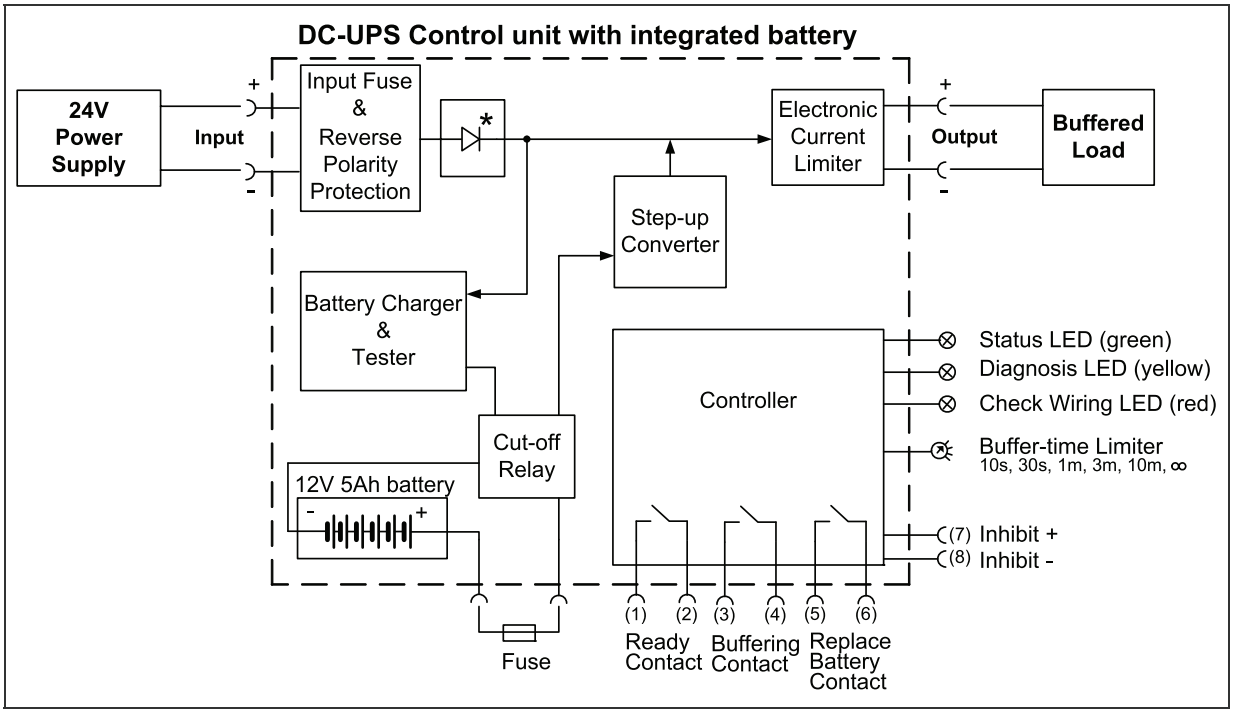


Figure 16 - Losses at 24V, typ.



Functional Diagram

Figure 17 - Functional Diagram



*) Return current protection; This feature utilizes a Mosfet instead of a diode in order to minimize the voltage drop and power losses.

Check Wiring and Battery Quality Tests

The DC-UPS is equipped with an automatic Check Wiring and Battery Quality test.

Check Wiring Test

Under normal circumstances, an incorrect or bad connection from the battery to the DC-UPS or a missing (or blown) battery fuse is not recognized by the UPS when operating in normal mode. Only when backup is required would the unit not be able to buffer. Therefore, a Check Wiring test is included in the DC-UPS. This connection is tested every 10 seconds by loading the battery and analyzing the response from the battery. If the resistance is too high, or the battery voltage is not in range, the unit displays Check Wiring with the red LED. At the same time, the green Ready LED turns off.

State of Health (SOH) Test

The battery has a limited service life and needs to be replaced in a fixed interval that is defined by the specified service life (according to the Eurobat guideline), based on the surrounding temperature and the number of charging and discharging cycles. If the battery is used longer than the specified service life, the battery capacity degrades. The SOH test cannot determine a gradual loss in capacity. However, it can detect a battery failure within the specified service life of the battery. Therefore an SOH test is included in the DC-UPS.

The SOH test consists of different types of tests.

During Charging

If the battery does not reach the ready status within 30 hours, it is considered to be defective. The reason could be a broken cell inside the battery.

During Operation

Once the battery is fully charged, a voltage drop test and a load test are performed alternately every 8 hours. Three of the tests must consecutively produce negative results to indicate a battery problem.

A battery problem is indicated with the yellow LED (replace battery pattern) and the relay contact Replace Battery. It can take up to 50 hours until a battery problem is reported. This should avoid nuisance error messages as any urgent battery problems are reported by the Check Wiring test and create a warning signal.

The battery tests require up to 50 hours uninterrupted operation. Any interruptions in the normal operation of the DC- UPS may result in the Replace Battery test cycle to start over.

When replace battery is indicated, replace the battery as soon as possible.

Relay Contacts and Inhibit Input

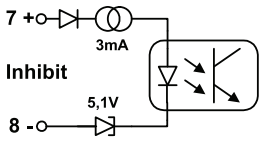
The DC-UPS is equipped with relay contacts and signal inputs for remote monitoring and controlling of the unit.

Relay Contacts

Contact	State
Ready	Contact is closed when battery is charged more than 85%, no wiring failure are recognized, input voltage is sufficient, and inhibit signal is not active.
Buffering	Contact is closed when unit is buffering.
Replace battery	Contact is closed when the unit is powered from the input and the battery quality test (SOH test) reports a negative result.

Attribute	Description	
Relay Contact ratings	Max Min	60V DC, 0.3 A, 30V DC, 1 A, 30V AC, 0.5 A resistive load 1 mA at 5V DC min.
Isolation voltage	Max	500V AC, signal port to power port

Signal Input

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

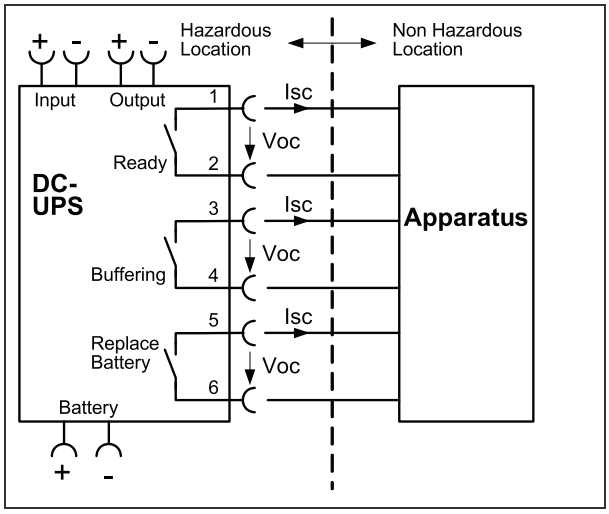
Attribute	Description	
Signal voltage	Max	35V DC
Signal current	Max	6 mA, current limited
Inhibit threshold	Min Max	6V DC, buffering is disabled above this threshold level 10V DC
Isolation	Nom	500V AC, signal port to power port

IMPORTANT The Buffering, Ready, and Replace Battery contact is intended to be used for a separately investigated nonincendive field wiring and/or field wiring apparatus. The DC-UPS may be located in a Class I, Division 2 (Group A, B, C, or D) hazardous (classified) location. Associated apparatus must be installed in accordance with its manufacturer's control drawing and Article 504 of the National Electrical Code (ANSI/NFPA 70) for installation in the United States, or Section 18 of the Canadian Electrical Code for Installations in Canada.

Selected associated apparatus must be third part that is listed as providing nonincendive field circuits for the application, and have Voc not exceeding Vmax, Isc not exceeding Imax.

Non-Associated nonincendive field wiring apparatuses shall not be connected in parallel unless this is permitted by the associated nonincendive field wiring apparatuses approval.

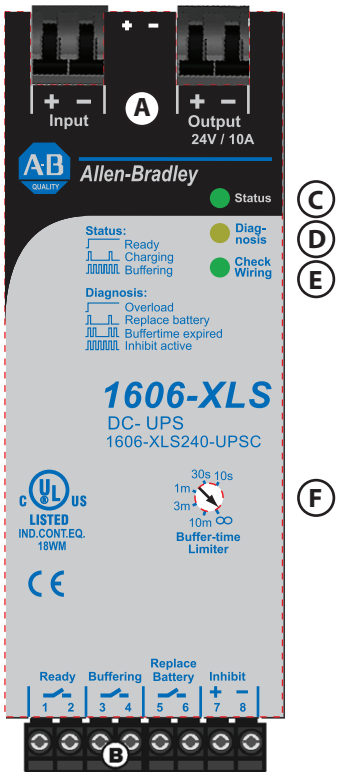
Figure 18 - Contact Control of Drawing for Use in Hazardous Location Environments

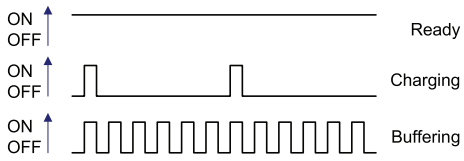
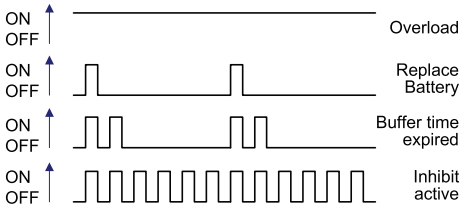


Selected barriers must have entity parameters such that Voc ≤ V max, Isc ≤ I max,
Ca ≥ Ci + Ccable, La ≥ Li + Lcable.
For Ccable and Lcable, if the capacitance per foot or the inductance per foot is not known, then the following values shall be used: Ccable = 60pF/foot and Lcable = 0.2µH/foot.

Contact current: I max = 50mA
Contact voltage: V max. = 35V (DC or AC)
Max. associated circuit capacitance Ci = 0
Max. associated circuit inductance Li = 0
No polarity requirement

Front Side and User Elements

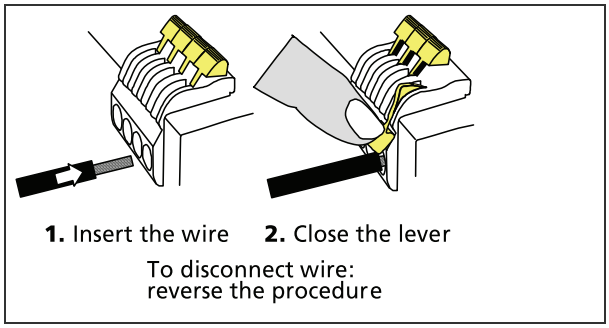


Letter	Definition
A	**Power port** - Quick-connect spring-clamp terminals, connection for input voltage and output voltage.
B	**Signal port** - Plug connector with screw terminals, which are inserted from the bottom. Connections for the Ready, Buffering, Replace Battery relay contacts and for the Inhibit input.
C	**Green Status LED** - **Ready:** Battery is charged > 85%, no wiring failures are recognized, input voltage is sufficient and inhibit signal is not active. **Charging:** Battery is charging and the battery capacity is below 85%. **Buffering:** Unit is in buffer mode. **Figure 19 - Green LED Flashing Pattern** 
D	**Yellow Diagnosis LED** - **Overload:** Output has switched off due to long overload in buffer mode or due to high temperatures. **Replace battery:** Indicates a battery that failed the battery quality test (SoH test). The battery should be replaced as soon as possible. **Buffer-time expired:** Output has switched off due to settings of Buffer- timer Limiter. This signal is displayed for 15 minutes. **Inhibit active:** Indicates that buffering is disabled due to an active inhibit signal. **Figure 20 - Yellow Diagnostic LED** 
E	**Red Check Wiring LED** - This LED indicates a failure in the installation (for example too low input voltage), wiring, battery, or battery fuse.
F	**Buffer-time Limiter** - The dial limits the maximum buffer time in a buffer event to save battery energy. When the battery begins to recharge after a discharging event, the process is completed much faster since only the energy, which was taken out of the battery, needs to be replenished. Buffering durations include 10 s, 30 s, 1 minute, 3 minutes, 10 minutes, and infinity (until the battery is discharged) which allows buffering until the deep discharge helps protect stops buffering.

Terminals and Wiring

Attribute	Power Terminals	Signal Terminals
Type	Bi-stable, quick-connect spring- clamp terminals. IP20 Finger-touch-proof. Suitable for field and factory installation. Shipped in open position.	Plug connector with screw terminal. Finger-touch-proof construction with captive screws for 3.5 mm slotted screwdriver. Suitable for field and factory installation. Shipped in open position. To meet GL requirements, unused terminal compartments should be closed.
Solid wire	0.5…6 mm^2	0.2…1.5 mm^2
Stranded wire	0.5…4 mm^2	0.2…1.5 mm^2
American Wire Gauge	AWG 20…10	AWG 22…14
Ferrules	Allowed but not required	Allowed but not required
Pull-out force	10 AWG:80 N, 12 AWG:60 N 14 AWG:50 N, 16 AWG:40 N according to UL486E	Not applicable
Tightening torque	Not applicable	1 Nm, 9 lb-in
Wiring stripping length	10 mm (0.4 in.)	6 mm (0.24 in.)

Figure 21 - Connecting a Wire with Spring-clamp Terminals



- Use appropriate copper cables that are designed for an operating temperature of 60 °C (140 °F)
- Follow national installation codes and regulations.
- Ensure that all strands of a stranded wire enter the terminal connection.
- You can use up to two stranded wires with the same cross section in one connection point.

Lifetime Expectancy and Mean Time between Failure

Attribute		Description	
Lifetime expectancy(1)	–	min. 137,400 h	at 10 A output current and 40 °C (104 °F)
		min. > 15 years	at 5 A output current and 40 °C (104 °F)
		min. > 15 years	at 10 A output current and 25 °C (77 °F)
MTBF(2)	SN 29500, IEC 61709	886,000 h	at 10 A output current and 40 °C (104 °F)
		1,482,000 h	at 10 A output current and 25 °C (77 °F)
	MIL HDBK 217 F	397,900 h	at 10 A output current and 40 °C (104 °F), Ground Benign GB40
		545,000 h	at 10 A output current and 25 °C (77 °F), Ground Benign GB25

(1) The Lifetime expectancy that is shown in the table indicates the minimum operating hours (service life) and is determined by the lifetime expectancy of the built-in electrolytic capacitors. Lifetime expectancy is specified in operational hours and is calculated according to the capacitors manufacturer specification. The prediction model allows a calculation of up to 15 years (131,400 h) from date of shipment.

(2) MTBF represents 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.

All values except a battery.

EMC

The unit is suitable for applications in industrial environment and in residential, commercial, and light industry environment without any restrictions. CE mark is in conformance with EMC guideline 89/336/EC and 93/68/EC and the low-voltage Low Voltage Directive (LVD) 73/23/EC, 93/68/EC.

EMC Immunity	According to Generic Standards EN 61000-6-1 and EN 61000-6-2			Criterion
Electrostatic discharge	EN 61000-4-2	Contact discharge Air discharge	8 kV 15 kV	Criterion A(2) Criterion A(2)
Electromagnetic RF field	EN 61000-4-3	80 MHz-1 GHz	10V/m	Criterion A
Fast transients (Burst)	EN 61000-4-4	Input lines Output lines Signal lines(1)	2 kV 2 kV 2 kV	Criterion A Criterion A Criterion A
Surge voltage	EN 61000-4-5	Output + ->- Input + ->- + -> housing	500V 500V 500V	Criterion A Criterion A Criterion A
Conducted disturbance	EN 61000-4-6	0.15…80 MHz	10V	Criterion A

(1) Tested with coupling clamp.

(2) DIN rail earthed.

EMC Emission	According to Generic Standards: EN 61000-6-3, EN 610000-6-4	
Conducted emission	EN 55022 input lines EN 55022 output lines	Class B(1) Class B(1)
Radiated emission	EN 55011, EN 55022	Class B
This device complies with FCC Part 15 rules. Operation is subjected to following two conditions: (1) this device cannot cause harmful interference, and (2) this device must accept any interference received, including interference that can cause undesired operation.		

(1) Informative measurement with voltage probe.

Switching Frequency(1)	Description	
Switching frequency of boost converter	100 kHz	Constant frequency
Switching frequency of electronic output current limitation	78 kHz	Constant frequency
Switching frequency of battery charger	19.5 kHz	Constant frequency

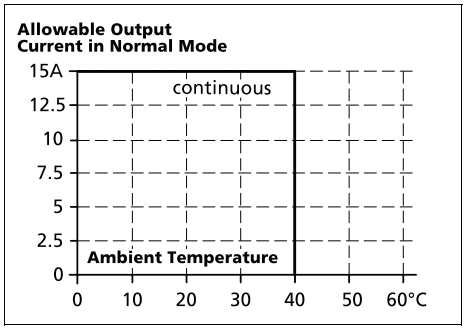
(1) The unit has three converters with three different switching frequencies included.

Environment

Attribute	Description	
Operational temperature	0…40 °C (32…104 °F)	Full output power
Storage temperature	-20…+50 °C (-4…+122 °F)	Storage and transportation
Relative humidity	5…95%	IEC 60068-2-30 Do not energize while condensation is present.
Vibration sinusoidal(1)	2…17.8 Hz: ±1.6 mm (0.62 in.); 17.8…500 Hz: 1 g (0.03 oz)	IEC 60068-2-6
Shock	15 g (0.52 oz) 6 ms, 10 g (0.35 oz) 11 ms	IEC 60068-2-27
Altitude	0…6000 m (0…20,000 ft.)	Approvals apply up to 2000 m (6560 ft).
Overvoltage category	III	EN 50178
	II	EN 50178, altitudes above 2000 (6560 ft)
Degree of pollution	2	EN 50178, non-conductive

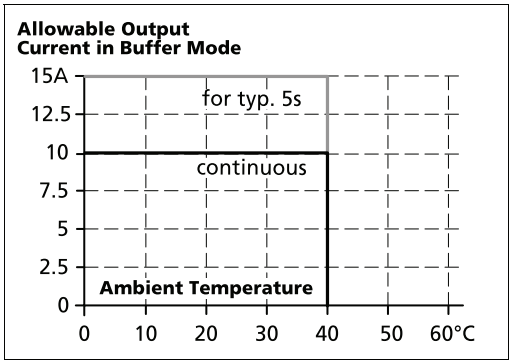
(1) Use wall mounting accessory for greater values.

Figure 22 - Nominal Mode - Output Current versus Ambient Temperature



The ambient temperature is defined 2cm below the unit.

Figure 23 - Buffer Mode - Output Current versus Ambient Temperature



Protection Features

Attribute	Description	
Output protection	Electronically protected against an overload, no-load, and short circuits.	
Output overvoltage protection in buffer mode	Typ 30.5V DC Max 35V DC	In case of an internal power supply anomaly, a redundant circuit limits the maximum output voltage. In such a case, the output shuts down and automatically attempts to restart.
Degree of protection Penetration protection	IP 20 > 3.5 mm (0.13 in.)	EN/IEC 60529 (for example, small parts)
Reverse battery polarity protection Wrong battery voltage protection Battery deep discharge protection	Yes Yes Yes	Max. -35V DC Max. +35V DC (for example, a 24V battery instead of a 12V battery). The limit is battery current dependent.
Over temperature protection	Yes	Output shutdown with automatic restart
Input over voltage protection	Yes	Max. 35V DC, no harm or unit anomaly
Internal input fuse	Included	Not user replaceable

Safety Features

Attribute	Description	
Output voltage	SELV PELV Max. allowed voltage between any input, output, or signal pin and ground	IEC/EN 60950-1 EN 60204-1, EN 50178, IEC 60364-4-41 60V DC or 42.4V AC
Class of protection	III	PE (Protective Earth) connection is not required.
Isolation resistance	> 50 M Ohm	Power port to housing, 500V DC
Dielectric strength	500V AC 500V AC	Power port to signal port Power port/signal port to housing
Touch current (leakage current)	The leakage current that 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 100 µA.	

Standards Compliance and Approvals

UL 508	18WM US LISTED IND. CONT. EQ.	LISTED E56639 Listed for use in the U.S.A. (UL 508) and Canada (C22.2 No. 14-95); Industrial Control Equipment
UL 60950-1		Recognized for use as Information Technology Equipment, Level 5; U.S.A. (UL 60950-1) and Canada (C22.2 No. 60950-1); File: E 168663
ISA 12.12.01 and CSA C22.2, No. 213		RECOGNIZED E244404recognized for use in U.S.A. ISA 12.12.01 and Canada (C22.2 No. 213) Hazardous Location Class I Div 2 T4 Groups A,B,C,D and Class I Zone 2 Groups IIA, IIB and IIC The unit is suitable for use in Class I Division 2 Groups A, B, C, D locations as well as for Class I Zone 2 Groups IIA, IIB and IIC locations. Substitution of components may impair suitability for Class I Division 2 environment. Do not disconnect equipment unless power has been switched off. Wiring must be in accordance with Class I, Division 2 wiring methods of the National Electrical Code, NFPA 70, and in accordance with other local or national codes.
Marine		GL (Germanischer Lloyd) classified for marine and offshore applications.

Approximate Dimensions and Weight

Attribute	Description
Width	123 mm (4.84 in.)
Height	124 mm (4.88 in.)
Depth[1]	119 mm (4.69 in.)
Weight	2850 g (6.28 lb)
DIN Rail	Use 35 mm heavy duty DIN rails according to EN 60715 or EN 50022.

(1) The DIN rail height must be added to the unit depth of 119 mm (4.68 in.) to calculate the total required installation depth.

Dimensions are inches and millimeters.

Figure 24 - Front View

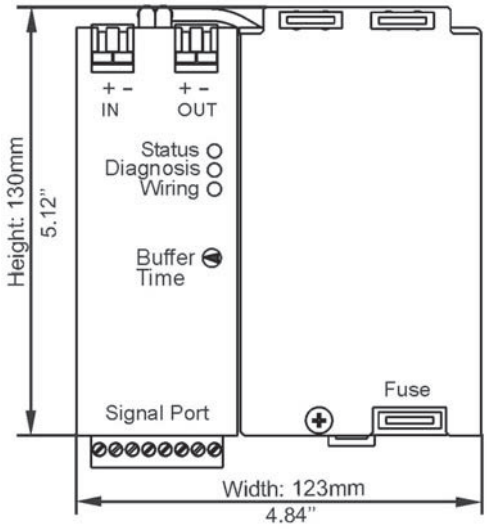
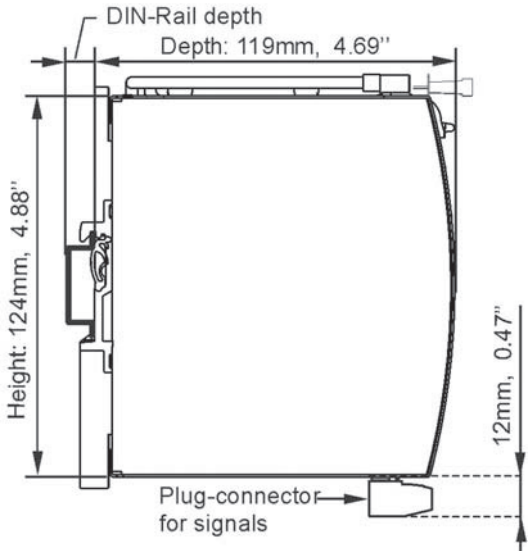


Figure 25 - Side View



Installation Notes

The unit shall only be installed and put into operation by qualified personnel.

ATTENTION: This unit is designed for installation in an enclosure and is intended for general use, such as in industrial control, office, communication, and instrumentation equipment. Do not use this device in aircraft, trains and nuclear equipment, where malfunctioning of the power supply may cause severe personal injury or threaten human life.

ATTENTION: Risk of electrical shock, fire, personal injury, or death.

- Turn power off before working on the device. Protect against inadvertent re powering.
- Do not modify or repair the unit.
- Do not open the unit as high voltages are present inside.
- Use caution to prevent any foreign objects from entering into the housing.
- Do not use in wet locations or in areas where moisture or condensation can be expected.

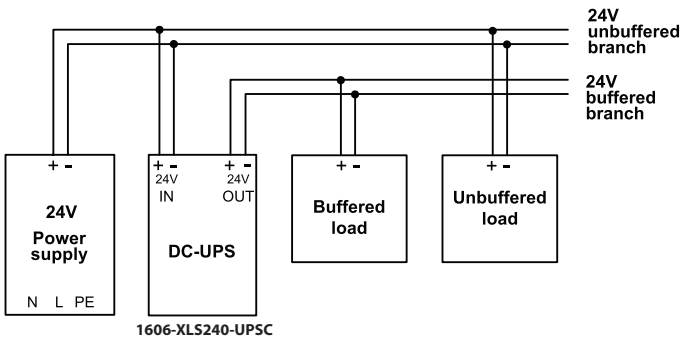
- The power terminals shall be on top of the unit. An appropriate electrical and fire end-product enclosure should be considered in the end use application.
- Do not install unit in airtight housings or cabinets. The site in which the unit is located must have sufficient ventilation according to EN50272-2.
- Convection cooled, no forced air cooling required. Do not obstruct airflow.
- Recommended clearance is 40 mm (1.57 in.) on top, 20 mm (0.78 in.) on the bottom, 5 mm (0.19 in.) left and right side. In case the adjacent device is a heat source, 15 mm (0.59 in.) clearance is recommended.
- The DC-UPS contains an integrated battery that must be changed on a periodic basis.
- The tripping of an internal fuse is caused by an internal fault. If damage or malfunctioning should occur during operation, immediately turn power off and send unit to the factory for inspection.
- It is recommended to install the DC-UPS in a place where the integrated battery is not heated up by adjacent equipment. The unit is equipped with a fuse holder and an ATO® 257 030 battery fuse (30 A) (Littelfuse). The battery fuse helps protects the wires between the battery and the unit. It also allows the disconnection of the battery from the unit that is recommended when working on the battery or unit.

Installing the Power Supply

1. Disconnect the battery fuse before connecting the battery.
2. Connect the power supply to the input terminals of the unit.
3. Connect the buffered load to the output terminals of the unit.

   The output is decoupled from the input allowing load circuits to be easily split into buffered and non-buffered sections. Noncritical loads can be connected directly to the power supply and are not buffered. The energy of the battery can then be used in the circuits that require buffering.
4. Plug in the fuse.

Figure 26 - Typical Wiring Diagram



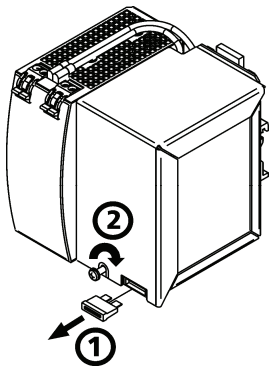
Battery Replacement

The integrated battery should be replaced by qualified personnel on a periodic basis.

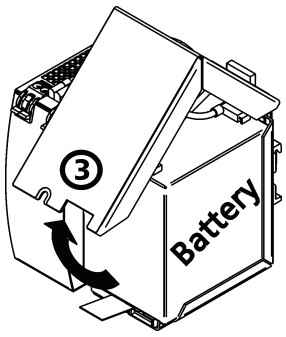
ATTENTION: The battery terminals are always energized. Do not place anything on the battery.

Replacing the battery

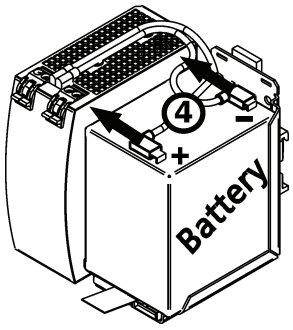
1. Remove the fuse from the battery and then loosen the captive cover screw.



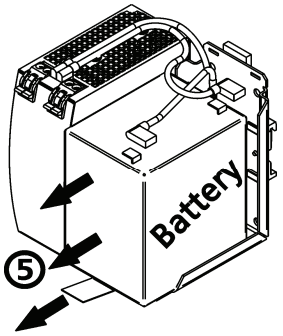
2. Remove the battery cover.



3. Disconnect the cables from the battery terminals.



4. Remove the battery by pulling on the strap.



5. Install the new battery.
6. Connect the red cable (+) to the red positive (+) terminal on the battery.
7. Connect the black cable (-) to the black negative (-) terminal on the battery.
8. Close the cover.
9. Tighten the captive cover screw.
10. Plug in the fuse.

Disposing of the Battery

At the end of its life, the battery that is contained in this product should be collected separately from any unsorted municipal waste.

The collection and recycling of batteries helps protect the environment and contributes to the conservation of natural resources as valuable materials are recovered.

Batteries that are marked with the recycling symbol should be recycled through a competent agency.

Replacement Battery Specifications

The replacement battery needs to meet the requirements in the following table.

Attribute	Description		
Battery type	Nom	12V, 4…6 Ah	VRLA lead acid maintenance-free battery
Design life	Min	3…5 years	Per EUROBAT guidelines
Dimensions	Nom	70 x 106 x 90 mm (2.75 x 4.17 x 3.54 in.)	W x H x D(1)
Pole connection	–	6.35 mm (0.25 in.)	Blade type; fast-on
Approvals	–	UL, Vds	For applications that require UL or V ds
Allowed discharge current	Min	29 A	Continuous

(1) Maximum case height of 102 mm (4.01 in.).

Replacement Intervals

Batteries have a limited life time. They degrade slowly beginning from the production and need to be replaced periodically. The design life figures can be found in the individual data sheets of the batteries and usually is specified according to the Eurobat guideline or according to the manufacturers specifications.

The design life is the estimated life based on laboratory condition, and is quoted at 20 °C (68 °F) using the manufacturers recommended float voltage condition. According to the Eurobat guideline, design lives have been structured into the following different groups.

Replacement Interval	Description
3…5 years	This group of batteries is popular in standby applications and in small emergency equipment. This represents a 4-year design life with a production tolerance of ±1 year.
6…9 years	This group of batteries is used when an improved life is required. This represents a 7.5 year design life with a production tolerance of ±1.5 years.
10…12 years	This group of batteries is used when in applications where longest life and highest safety level are required. This represents an 11 year design life with a production tolerance of ±1 year.

A battery failure within the specified design life of the battery usually results in a complete loss of the battery function (for example, a broken cell or anomaly connection) and is detected and reported by the periodical battery tests that are included in the 1606-XLS240-UPSC control unit.

If the operational parameters differ from those that are specified for the design life, an earlier change of the battery might be necessary. The real life is called service life and is defined as the point at which the cells actual capacity has reached 80% of its nominal capacity. At the end of the service life the capacity degrades much faster, so that a further use of the battery is not recommended.

Effect of Temperature

The temperature has the most impact in the service life. The hotter the temperature, the earlier the wear-out phase of the battery begins. The wear-out results in a degradation of battery capacity.

Effect of Discharging Cycles

The number as well as the depth of discharging cycles is limited. A replacement of the battery might be necessary earlier than the calculated service life if the battery exceeds the numbers and values of Figure 28.

Other Effects on Service Life

- Overcharging and deep discharging shortens the service life and should be avoided. Due to the single battery concept of the 1606-XLS240-UPSC, the end-of-charge voltage is precisely set automatically avoiding unnecessary aging effects.
- Charge retention is important to get the longest battery life. Stored batteries that are not fully charged age faster than charged batteries. Batteries that are not in use should be recharged at least once a year.
- Excessive float charge ripple across the battery has an effect of reducing life and performance. The 1606-XLS240-UPSC does not produce such a ripple voltage. This effect can be ignored when the battery is charged with the 1606-XLS240-UPSC.

Prolonging Service Life

- Place the DC-UPS in a cool location. For example, near the bottom of the control cabinet.
- Do not place the DC-UPS near heat generating devices.
- Do not store discharged batteries.
- Do not discharge the battery more than necessary. Set the buffer time limiter to the required buffer time. The depth of the discharge reduces the service life of the battery and limits the number of cycles. See Figure 28.

Calculating the Service Life

Following is an example demonstrating calculating the service life and required replacement cycle. Uses these parameters for the example:

- A 5 Ah battery with a design life of 3…5 years is used (for example, a Yuasa battery that is used for type 1606-XLSBAT5).
- The average ambient temperature is 30 °C (86 °F).
- One buffer event consumes approx. 25% of the achievable buffer time.
- One buffer event per day.

As shown in Figure 27, curve A can expect to have a service life of 2-years at an ambient temperature of 30 °C (86 °F). The number of discharging cycles is 2 years x 365 cycles that equals 730 cycles. As shown in Figure 28, curve C has to be used (only 25% of the battery capacity is required). 730 cycles have only a minor influence in a battery degradation and can be ignored.

As a result, the battery should be replaced after 2 years. The battery degradation begins from the production date, which is shown on the battery, may shorten the replacement interval.

Figure 27 - Service Life versus Ambient Temperature, typ.

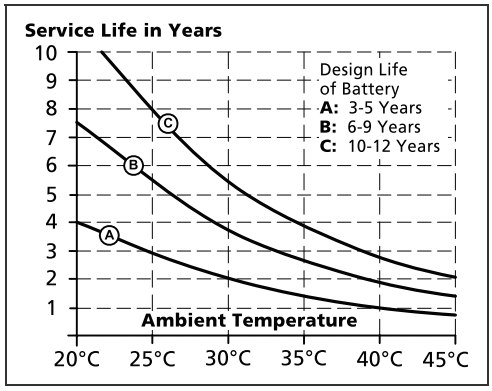
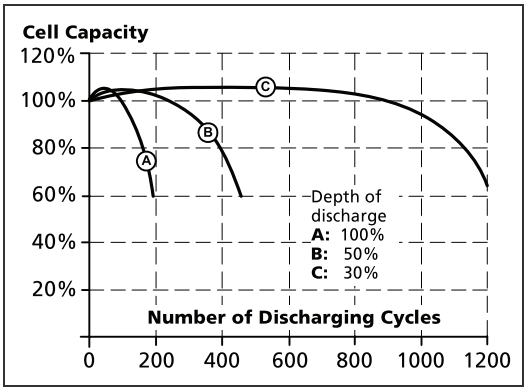


Figure 28 - Cell Capacity Degradation versus Discharging Cycles



Accessories

Battery

The battery should be replaced on a periodic basis. See Replacement Intervals for more information.

Attribute	Description		
Battery type	Nom	12V, 4…6 Ah	VRLA lead acid maintenance-free battery
Design life	Min	3…5 years	Per EUROBAT guidelines
Dimensions	Nom	70 x 106 x 90 mm (2.75 x 4.17 x 3.54 in.)	W x H x D(1)
Pole connection	–	6.35 mm (0.25 in.)	Blade type; fast-on
Approvals	–	UL, Vds	For applications that require UL or V ds
Allowed discharge current	Min	29 A	Continuous

(1) Maximum case height of 102 mm (4.01 in.).

Figure 29 - Battery

Wall Mount Bracket

The order number contains two brackets that are needed for one device.

Application Notes

Parallel and Serial Use

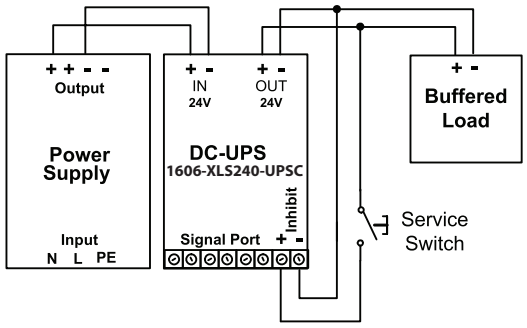
- Do not use the DC-UPS in parallel to increase the output power. However, two units of the DC-UPS can be paralleled for 1+1 redundancy to gain a higher system reliability.
- Do not use batteries in parallel, since the battery quality test might create an error message.
- Do not connect two or more units in a series for higher output voltages.
- Do not connect two or more units in a row to get longer hold-up times.

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 250 ms is required to stop buffering. The inhibit 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.

Figure 30 - Wiring Example for Inhibit Input



Troubleshooting

The LEDs on the front of the unit and relay contacts indicate the status of the DC-UPS.

The following guidelines provide instructions for correcting issues.

Cause	Recommended Action
Checking Wiring LED is illuminated	• Check the wiring between the battery and the DC-UPS. • Check the battery fuse to ensure that it is inserted properly or not blown. • Check the battery voltage (must be typically between 7.4V…15.1V). • Check the input voltage (must be typically between 22.8V…30V). • Check the battery polarity.
DC-UPS did not buffer	• Inhibit input was set. • Battery did not have enough time to be charged and is still below the deep discharge protection limit.
DC-UPS stopped buffering	• Buffer time limiter stopped buffering -> set buffer time limiter to a higher value. • Deep discharge protection stopped buffering -> allow sufficient time for charging the battery. • Output was overloaded or short circuit -> reduce load.
Output has shut down	• Cycle the input power to reset the DC-UPS. • Let the DC-UPS cool down, over temperature protection might have triggered.
DC-UPS constantly switches between Normal mode and Buffer mode	• The supplying source on the input is too small and cannot deliver sufficient current -> Use a more powerful power supply or reduce the output load. • The input voltage is the same as the transfer threshold. -> increase input voltage.

Notes:

Rockwell Automation Support

Use the following resources to access support information.

Technical Support Center	Knowledgebase Articles, How-to Videos, FAQs, Chat, User Forums, and Product Notification Updates.	https://rockwellautomation.custhelp.com/
Local Technical Support Phone Numbers	Locate the phone number for your country.	http://www.rockwellautomation.com/global/support/get-support-now.page
Direct Dial Codes	Find the Direct Dial Code for your product. Use the code to route your call directly to a technical support engineer.	http://www.rockwellautomation.com/global/support/direct-dial.page
Literature Library	Installation Instructions, Manuals, Brochures, and Technical Data.	http://www.rockwellautomation.com/global/literature-library/overview.page
Product Compatibility and Download Center (PCDC)	Get help determining how products interact, check features and capabilities, and find associated firmware.	http://www.rockwellautomation.com/global/support/pcdc.page

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