

SEI's DC-Uninterruptible Power System Primer

System Engineering International (SEI) presents this Primer to better understand the features and benefits of Direct Current UPSs. For information and pricing on SEI's products, call us at 301-694-9601, email us at info@seipower.com, or visit us on the web at www.seipower.com.

First, what is a DC-UPS?

A DC UPS is an uninterruptible power system that converts incoming alternating current (AC) to direct current (DC) for use in equipment and devices that are powered by DC current and for charging the associated batteries. In the event incoming AC power is lost, the system seamlessly transitions to the batteries as the source of DC power to support the load. A DC UPS is essentially a “DC Plant in a Box” requiring little to no onsite engineering and installation, and typically outputs at 24 Volts DC or 48 Volts DC.

Some typical applications that use DC power include:

Switchgear – The control systems that support and monitor circuit breakers require DC power to ensure the breakers operate properly, regardless of the presence of AC power

Telecommunications – Phones typically operate on 48Vdc, a perfect application for a DC UPS where reliable phones are required

Security Access Devices – Without power, access control devices, biometric readers and video surveillance systems will not provide any security

Process Controls – When plant power goes out, PLC's and other control technology may take minutes or hours to reset if not backed up, significantly delaying production

Wireless Networking – Access Points and Backhaul radios will fail, the mesh will crash when ac power is lost if the radios are not backed up

Urgent Communications – Radio transmissions interrupted by a power outage can become a life or death situation to first responders



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Why do I need a DC UPS instead of an AC UPS?

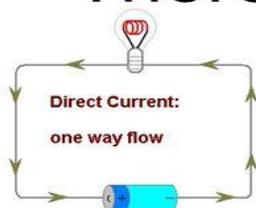
Virtually all equipment and devices operate on DC power. If it accepts AC power, then there is an AC to DC converter within the device to create the internal direct current. Devices that require DC power to operate have no internal AC to DC converter and therefore must receive DC power from an outside source, such as a DC-UPS.

Electricity is converted three times when using an AC UPS; once when AC is converted to DC to charge the batteries, once when DC is converted back to AC to be delivered to the device, and a third conversion from AC *back again* to DC within the device. Using an outside DC power source reduces inefficiencies due to multiple current conversions and isolates and reduces heat generation.

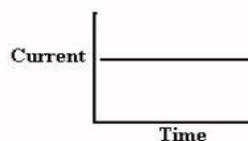
Because a DC system uses fewer components to convert power and requires fewer batteries, the benefits are:

- 40-60% reduced electricity consumption to charge and operate on batteries
- 10-30% reduced HVAC expenses
- Reduced battery size requirements up to 40%
- Reduced real estate requirements (fewer batteries and components require less space)
- Improved overall system reliability

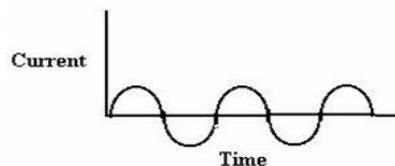
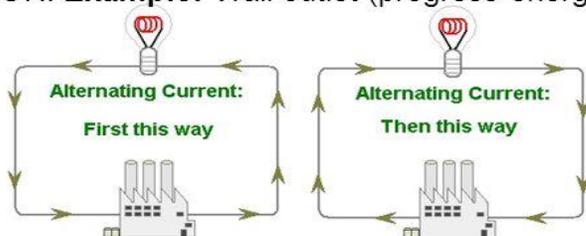
There are 2 types of Current



DC = Direct Current - current flows in one direction
Example: Battery



AC = Alternating Current- current reverses direction many times per second. This suggests that AC devices turn OFF and ON. **Example:** Wall outlet (progress energy)



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What makes up a DC UPS?

A DC UPS system consists of these components:

Rectifiers(s) – Convert the alternating current (AC) from the utility or generator to direct current (DC) for use by the UPS to power the load and charge batteries

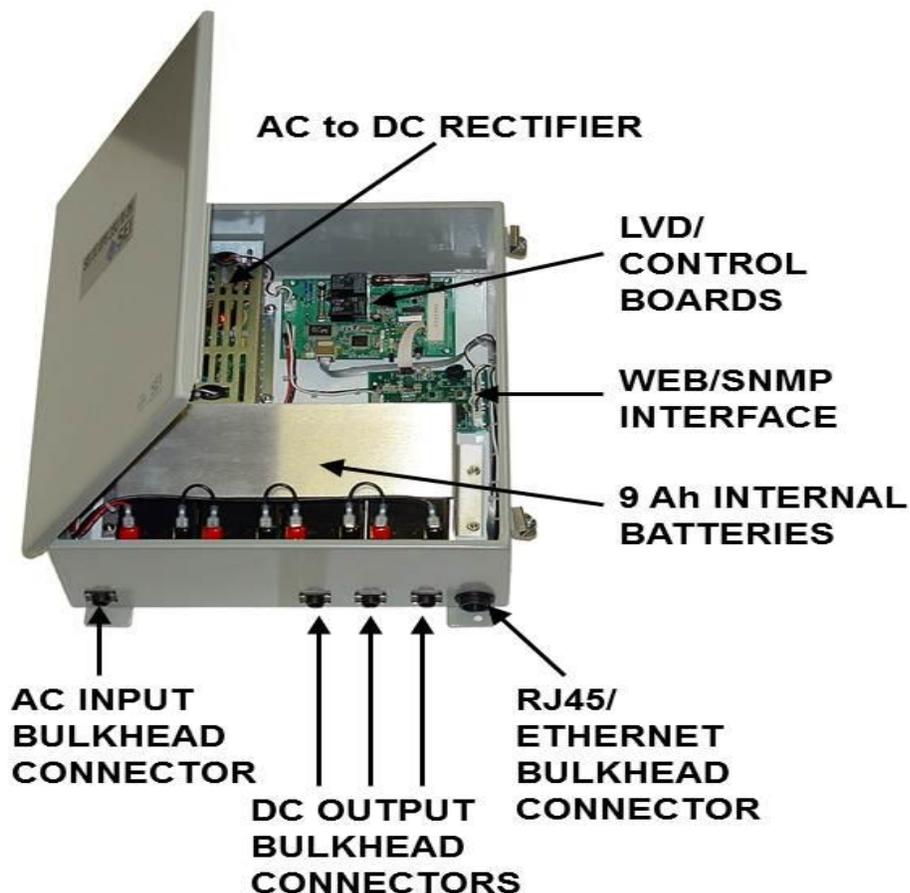
Batteries – Used to store DC power from the rectifier and supply current to the load when input power is lost

Low Voltage Disconnect (LVD) – Automatically shuts off the batteries when they fall below a predetermined voltage to prevent damage to the batteries due to excessive discharge and to the powered devices due to brown-out conditions (low voltage/high current)

Power Distribution Unit (PDU) – Multiple output connections from the UPS to multiple loads

Communications – Analog (contact alarms) or digital (Ethernet/SNMP) communications to provide remote monitoring and management of system parameters

Typical NEMA Enclosed SEI DC UPS



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What is a 'load' and why do I need to know?

The word 'load' designates the device's power requirements in order to operate. Load is the "volume" of electricity or amount of electricity needed for the device to operate. The load is usually expressed in amps or watts as in a 15 amp load or 200 watt load. There can be multiple loads (devices) powered by a single UPS, either through a single connection or through multiple output ports (see PDU).

How do I describe a DC UPS?

There is a vocabulary used to express the capability or design of an DC UPS. These requirements and/or capabilities are listed in the specification sheet of the equipment that is to be powered. (AC UPS terminology uses some different terms, such as KVA, VoltAmps, etc., and are not necessarily relevant to a DC UPS)

Amps – Tells us how much **electrical current** the UPS can deliver or how much current the load requires. An electric current is measured in Amps, i.e., how many amps are needed? Think of a flow or volume of water moving down a river.

Volts – Measures the 'pressure' of the current. The two main voltages we deal with are **24 or 48 volts**. There are two types of current; **alternating current (AC)** or **direct current (DC)**.

Watts – A term that describes the power that the voltage delivers to the load or that the load requires. The watt is a measure of how much power is released each second.

Amp hours – The most common way to rate a battery is AMP-HOUR RATING. This is a unit of measurement for battery capacity, obtained by multiplying a current flow in amps by the time in hours of discharge. (Example: A battery which delivers 5 amps for 20 hours delivers "5 amps" times "20 hours", or "100 amp hours".)

Alternating Current – Alternating current is typically used to transport electricity from a generating source to the location where it will be used. Few devices actually use AC power (electric motors or incandescent light bulbs). Alternating current is ideal for transport because it more efficient to transmit over long distances. It must be converted to DC power to actually be used by the device(s).

Direct Current – Direct current is used in virtually all technology applications. Computers, radios, sensors, batteries, and even LED lightbulbs are powered by DC electricity. It is the only way presently to store electricity in batteries.

So electricity is the flow (like water) of electrons through a conductor like a wire. The rate at which electricity flows is measured as an electric current and is measured in amps. The pressure of the current is the voltage, and watts (amps times voltage) is the power the water creates.

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How do I configure or design a DC UPS?

To design or specify a DC UPS, you need to know three main parameters:

What is the DC voltage that the load requires; 12Vdc, 24Vdc, 48Vdc, etc.? Does the voltage need to be the same at all times (regulated), or can it vary at the load? Most loads allow for a certain amount of input variance.

What is the power, in watts or amps, the load or device(s) require(s) to operate?

How long, in minutes or hours, must the DC UPS support the load, (holdover or backup time), once AC current is lost? **View Battery holdover chart to specify backup time.**

OK, let's configure a DC UPS!

What's the voltage needed? _____

What's the load in amps or watts? _____

What is the holdover or backup time needed? _____

Need Help? Call us at 301-694 -9601 x214 to talk to an engineer or email us at info@seipower.com

The Power Distribution Unit (PDU)

To connect the power to the load, SEI DC-UPSs can have up to **ten output connections** to provide interfaces for multiple loads. Each port is individually fused for safety, and can output system voltage or an alternative regulated output voltage. This gives the use the ability to power both 24Vdc and 48Vdc devices from one unit.

Combined with our Power Management Package, each port can be individually controlled, turned on/off, set battery priority and monitor each port's load. SNMP traps can be sent to a network management system to alert on changes in status of a variety of parameters, including loss of AC, battery test failure, or port shut-down.



Typical power distribution setup of an SEI 1200/48-2M/3P-PMP with external battery connector (yellow), 4 molex connections, 3 binding post connections, ethernet and AC input.

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How can a DC UPS be packaged or installed?

A DC UPS can be packaged in a variety of ways:

Rackmount – The unit is mounted in a standard equipment rack. An SEI unit can require as little as two 'U' of space, *including batteries*

Wall or floor mount

NEMA cabinet or enclosure – Outdoor or harsh environment

Custom Enclosure – Ppackaged to fit into user designed housing



Wall or Rack Mount configuration



2U Rack Mount configuration



Custom Mobile enclosure



NEMA Enclosure (outdoor or harsh environments)

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How does the user communicate with the DC UPS?

There are three ways to communicate with the DC UPS:

Visually – The control board utilizes LEDs to indicate the unit's power and battery statuses.

Alarm Contacts – 'Form C' contacts connect the unit to a monitoring center to alert on loss of input power or on battery test failure. (SEI's ACC option)

Remote Management – A network interface via ethernet or SNMP, such as SEI's Power Management Package (PMP), provides an easy to use interface to monitor and manage system, battery and port parameters.



What options can the SEI UPS have?

Increased backup time – If your load/holdover time parameters exceed our standard products, external battery packs and cabinets can be incorporated into your configuration.

Multi-voltage outputs – Using multiple connections from our PDU, 12Vdc, 24Vdc, 48Vdc, and other voltages can be supported by a single DC UPS.

Regulated voltage outputs – Devices that require tightly controlled (+/- 1%) voltage output can be supported with the addition of dc/dc regulators.

Power Management Package (web/SNMP) – Our PMP option monitors and manages DC powered devices and maximizes the efficiency and reliability of the UPS and battery backup.

Extended temperature ranges – Batteries are severely impacted by temperatures over 30C. Upgraded enclosures to include air conditioning or temperature-resistant batteries will prolong the life and maximize reliability of a DC UPS system



External battery cabinet on wheels



Environmentally controlled
NEMA Enclosure



Custom micro configuration



External rack mount battery

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Battery Holdover Chart

48Vdc

HOLDOVER Time Required (hours)

Amount of Load to be supported

WATTS	AMPS	0.25	0.5	0.75	1	1.25	1.5	1.75	2	4	6	8	12	24	
50	1	0.3	0.7	1.0	1.4	1.7	2.1	2.4	2.8	5.6	8.3	11.1	16.7	33.3	
100	2	0.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6	11.1	16.7	22.2	33.3	66.7	
150	3	1.0	2.1	3.1	4.2	5.2	6.3	7.3	8.3	16.7	25.0	33.3	50.0	100.0	
200	4	1.4	2.8	4.2	5.6	6.9	8.3	9.7	11.1	22.2	33.3	44.4	66.7	133.3	
250	5	1.7	3.5	5.2	6.9	8.7	10.4	12.2	13.9	27.8	41.7	55.6	83.3	166.7	
300	6	2.1	4.2	6.3	8.3	10.4	12.5	14.6	16.7	33.3	50.0	66.7	100.0	200.0	
400	8	2.8	5.6	8.3	11.1	13.9	16.7	19.4	22.2	44.4	66.7	88.9	133.3	266.7	
500	10	3.5	6.9	10.4	13.9	17.4	20.8	24.3	27.8	55.6	83.3	111.1	166.7	333.3	
600	12	4.2	8.3	12.5	16.7	20.8	25.0	29.2	33.3	66.7	100.0	133.3	200.0	400.0	
700	14	4.9	9.7	14.6	19.4	24.3	29.2	34.0	38.9	77.8	116.7	155.6	233.3	466.7	
800	16	5.6	11.1	16.7	22.2	27.8	33.3	38.9	44.4	88.9	133.3	177.8	266.7	533.3	
900	18	6.3	12.5	18.8	25.0	31.3	37.5	43.8	50.0	100.0	150.0	200.0	300.0	600.0	
1000	21	6.9	13.9	20.8	27.8	34.7	41.7	48.6	55.6	111.1	166.7	222.2	333.3	666.7	
1200	25	8.3	16.7	25.0	33.3	41.7	50.0	58.3	66.7	133.3	200.0	266.7	400.0	800.0	
		2.5 Ah Internal Battery				2.5Ah									
		9 Ah Internal Battery				9Ah									
		Add one BP-9U				18Ah									
		Add two BP-9U				27Ah									
		Add 35 Ah Battery Tray/Cabinet				44Ah									
		Add 55 Ah Battery Tray/Cabinet				64Ah									
		Add 90 Ah Battery Tray/Cabinet				99Ah									

24Vdc

HOLDOVER Time Required (hours)

Amount of Load to be supported

WATTS	AMPS	0.25	0.5	0.75	1	1.25	1.5	1.75	2	4	6	8	12	24	
50	2	0.7	1.4	2.1	2.8	3.5	4.2	4.9	5.6	11.1	16.7	22.2	33.3	66.7	
100	4	1.4	2.8	4.2	5.6	6.9	8.3	9.7	11.1	22.2	33.3	44.4	66.7	133.3	
150	6	2.1	4.2	6.3	8.3	10.4	12.5	14.6	16.7	33.3	50.0	66.7	100.0	200.0	
200	8	2.8	5.6	8.3	11.1	13.9	16.7	19.4	22.2	44.4	66.7	88.9	133.3	266.7	
250	10	3.5	6.9	10.4	13.9	17.4	20.8	24.3	27.8	55.6	83.3	111.1	166.7	333.3	
300	12	4.2	8.3	12.5	16.7	20.8	25.0	29.2	33.3	66.7	100.0	133.3	200.0	400.0	
400	16	5.6	11.1	16.7	22.2	27.8	33.3	38.9	44.4	88.9	133.3	177.8	266.7	533.3	
500	20	6.9	13.9	20.8	27.8	34.7	41.7	48.6	55.6	111.1	166.7	222.2	333.3	666.7	
600	25	8.3	16.7	25.0	33.3	41.7	50.0	58.3	66.7	133.3	200.0	266.7	400.0	800.0	
700	29	9.7	19.4	29.2	38.9	48.6	58.3	68.1	77.8	155.6	233.3	311.1	466.7	933.3	
800	33	11.1	22.2	33.3	44.4	55.6	66.7	77.8	88.9	177.8	266.7	355.6	533.3	1066.7	
900	37	12.5	25.0	37.5	50.0	62.5	75.0	87.5	100.0	200.0	300.0	400.0	600.0	1200.0	
1000	41	13.9	27.8	41.7	55.6	69.4	83.3	97.2	111.1	222.2	333.3	444.4	666.7	1333.3	
1200	50	16.7	33.3	50.0	66.7	83.3	100.0	116.7	133.3	266.7	400.0	533.3	800.0	1600.0	
		5 Ah Internal Battery				5Ah									
		18 Ah Internal Battery				18Ah									
		Add one BP-18U				36Ah									
		Add two BP-18U				54Ah									
		Add 70 Ah Battery Tray/Cabinet				88Ah									
		Add 110 Ah Battery Tray/Cabinet				128Ah									
		Add 180 Ah Battery Tray/Cabinet				198Ah									

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Why buy from SEI?

Founded in 1977, SEI manufactures DC (direct current) critical power systems for industrial users, wireless, telephone service providers, and the military. SEI is located in a 24,000 sq. ft. modern manufacturing facility in Frederick, Maryland. SEI has **shipped over 30,000 DC power systems** to customers around the world. SEI products are proudly **made in the USA**.

We build DC uninterruptible power systems (UPS) that provide 48 Vdc and 24 Vdc battery backed-up power. These 'power plant in a box' systems have output power distribution modules and options that facilitate use in a wide variety of applications. Batteries provide holdover time from 20 minutes to 8 hours. [Find out more about SEI's DC-UPSs.](#)

SEI also builds DC powering systems and Network Termination Units (NT1s). These provide power and computer interfaces for Digital Centrex telephones, which employ ISDN as its protocol. SEI is the largest supplier of these products in North America. [Find out more about SEI's line of ISDN products.](#)

Our Power over Ethernet (PoE) midspan injectors provide power for voice and data over Ethernet for IP telephones and devices that require power to be delivered over a LAN. SEI participated in the IEEE task force that formulated the 802.3af standard for Power over Ethernet, and has engineered power and battery backup solutions for this technology. [Find out more about SEI's Ethernet power solutions.](#)



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