Technical Article

Neousys Technology

Why We Need SuperCAP UPS for Industrial Computers

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Impact of electric loss

Electricity powers most means of our daily lives and is vital in modern industrial digitalization. For critical tasks, the sudden loss of power meant the loss of data, stoppage of work, and possibly hardware damage resulting in extended business operation downtime.

The uninterruptable power supply

The uninterruptable power supply (UPS) was invented back in 1934. It is an electrical apparatus consisting of batteries or electrical power storage cells that provide emergency power to a load when the input power source or mains power fails. The UPS differs from an auxiliary or emergency power system or standby generator in that it will provide near-instantaneous protection from input power interruptions.

Aside from operation downtime, data, and hardware protection, a UPS is also used in instances where an unexpected power disruption to the equipment could cause injuries or fatalities. When a UPS takes over, the battery-supplied run-time is relatively short (only a few minutes). The UPS aims to supply sufficient power long enough to start up a standby power source or allow the equipment to properly shut down, and save valuable data in the process. In essence, the UPS is a type of continual power system.

▲Home/ office UPS

UPS in Commercial/ Factory Applications

As previously mentioned, some UPS are powerful enough to supply electricity to a whole factory, building, or even a small town. The question is how long can the UPS sustain the electricity supply for? The answer is, usually not very long. Or it should be said that the commercial UPS usually can't supply electricity long enough to sustain an operation of production value. This is the reason why you tend to see commercial UPS for servers, sustain the server operation for a short time to protect the data, and hand the operation over to a redundant server at a remote site. Or, it will sustain it long enough to kick-start a generator.

▲Commercial/ factory UPS

However, having a UPS that sustains a whole factory is rarely seen, unless the sudden cease of operation may cause fatality or immediate danger to workers. Such instances may apply to chemical plants or heavy machinery factories. But with high automation integration in today's factories, part of the ongoing efforts to bring safer than safe working conditions, such dangerous situations may not be that common. Nevertheless, the loss of electricity will cause the computer to suddenly shut down, damaging the computer and lose valuable data that may set back the production schedule. So the key is to install a UPS for the industrial/ factory computer where all the important data is stored, and the data can be protected in the event of an electrical blackout.

The Downside of Battery and Why Supercapacitor

A UPS for the industrial/ factory computer can sustain the computer long enough for an operator to shutdown the computer to save valuable data stored on the hard drives. But will a standard UPS with batteries storing electrical energy do the trick? Or more specifically, will the battery stand up to the test of high ambient operating temperatures over time? For decades, the battery has been the preferred form of energy storage as it offered a high energy density (10~100 Wh/kg). However, limited by operating temperature (typically 0°C to 40°C) and cycle life (2 years or 500 charge-discharge cycles), the battery is neither rugged nor durable enough for industrial applications. Most importantly, the battery life is affected dramatically by ambient temperatures. Studies have shown, in general, at -5.5°C, a battery's energy storage capacity may be reduced by approximately 50%. And for battery lifecycle degradation, the first 200 charge/ recharge cycles operating in a 25°C environment, the battery is degraded by 3.3% while operating in a 45°C environment, the same 200 charge/ recharge cycle saw a 6.7% degradation. The degradation rate doubled at the higher operating temperature, and the rate continues to multiply with the rising temperature.

To create a UPS suited for industrial environments, we need to look at supercapacitors, also called the electric double-layer capacitor (EDLC). It is an emerging category of capacitors offering 10~100 times more energy density than electrolytic capacitors (1 to 10 Wh/kg). In addition to their impressive energy density, supercapacitors also have a wide operating temperature range (-40°C to 65°C) where the storage capacity or lifecycle are not affected by temperature fluctuations and have long operating life (10 years or 500,000 charge-discharge cycles). These two traits help make it a reliable industrial power backup solution.

Neousys SuperCAP UPS

Unlike battery cells, the Neousys SuperCAP UPS are composed of ultracapacitors and can operate in wide temperature environments from -25 to 65°C. They offer industrial-grade reliability and are highly durable lasting over 10 years while operating in demanding industrial conditions.

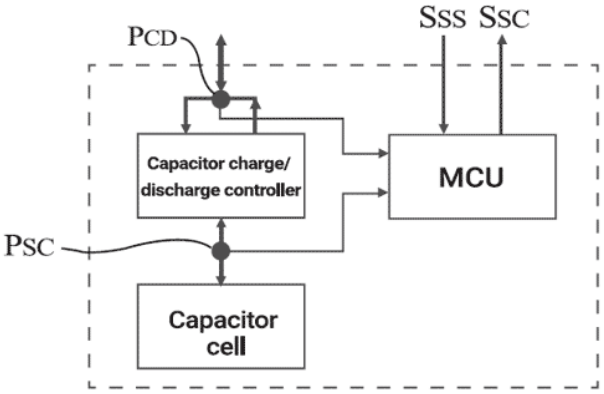
The Neousys SuperCAP UPS is coupled with the patented CAP energy management technology. It monitors the back-end system to reliably supply the needed power for auto boot and shutdown management without installing additional drivers/ software. In addition, the SuperCAP UPS not only supplies power to sustain operation to a proper shutdown, but it also acts as a protective barrier against unstable fluctuating voltage by offering a constant flow of electricity despite changes in the power supplied. This is extremely beneficial, especially in factories or industrial environmental settings where the flow of electricity is often unstable.

The Neousys SuperCap UPS applications extend beyond industrial factories. In addition to a UPS-like power backup mode, the standalone Neousys SuperCAP UPS also offers two advanced ignition control modes for in-vehicle applications. The Neousys standalone SuperCAP can either connect to an in-vehicle computer and operate as a standard SuperCAP UPS, or act as a stable power supply and execute user-configurable power-on/ power-off delay according to IGN signal input.

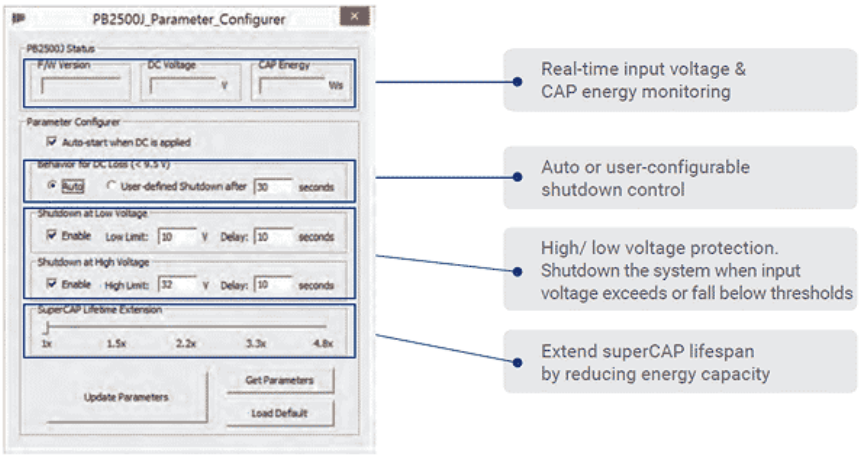
Neousys' Patented CAP Energy Management Technology

Incorporated into the SuperCAP UPS is Neousys' patented SuperCAP energy management. Designed to create a reliable supercapacitor-base d power backup system with fundamental techniques such as charge/ discharge control, active load balance, and DC/ DC regulation, it can get the most out of the capacitor energy while ensuring the system shuts down safely during the blackout.

The patented SuperCAP energy management architecture (R.O.C. Patent No. I598820) integrates a microprocessor along with the super-capacitor and charge/ discharge controller. The proprietary firmware embedded in the MCU not only monitors back-end system energy consumption level continuously, but it can also automatically initiates a soft-shutdown process to prevent data loss/ corruption during unforeseen electrical blackouts.



The patented architecture provides sophisticated features such as real-time energy monitoring, high/low voltage protection, and auto/ manual shutdown control. Users can also extend the lifespan of ultracapacitors up to 4.8x by reducing the utilization of energy capacity via the parameter configuration utility.



Unlike traditional UPS which use batteries to store electrical energy which restricts their deployment in offices and homes, the Neousys UPS module can be flexibly deployed into volatile industrial environments. With an operating range of -40°C to 65°C, the Neousys SuperCAP module can thrive in industrial applications, or in-vehicle applications without the energy storage cells degrading significantly over time. By offering constant electricity flow to the connected back-end system, Neousys SuperCap module can help avoid data loss during unforeseen power outages in harsh industrial environments!

Rolling Stock Deployment

Overcoming environmental factors (shock, vibration, high temperature), the Neousys SuperCAP UPS module has been deployed onto trains by our customers in recent years to sustain computers operating in unstable electricity rolling stock conditions.

In railway systems, the common methods for supplying power can be divided into three types. One, the use of a generator to provide the electricity to system load; two, the use of overhead pantograph to collect electricity and transfers to the system via a static converter; and three, deployment of battery management system to provide energy to the train's electric system. During the electricity transition stage, due to the sudden voltage drop or a short-term power failure, electric power on the train will be unstable for a short time, maybe a fraction of a second to maybe a few seconds, depending on the type of power backup system deployed.

There are two instances where a large voltage fluctuation on the system may occur. Specifically, when the system's power equipment is turned on/ off, the converter may be damaged by the large voltage fluctuation; and the other is, due to a short circuit on a DC supply distribution line and subsequent operation of fuse/circuit breakers, input voltage may suddenly be reduced to 0V for a fraction of a second, which is defined in the EN 50155 standard. EN 50155 is the European standard for railway electrical equipment and it is the standard most countries will refer to.

One of the definitions of EN 50155 standard is that the normal input voltage must comply to 0.7 to 1.25 times the steady-state (continuous) voltage; and comply to 0.6 to 1.4 times the fluctuation voltage range for a fraction of a second. Please refer to the table below:

Normal Input voltage (V)	Steady-state (continuous) voltage range (0.7*V – 1.25*V)	Fluctuation voltage range 0.6*V (0.1s) – 1.4*V (0.1s)
24	16.8 - 30	14.4 – 33.6

Another railway application the Neousys SuperCAP is particularly useful is for trains operating on “Third Rail System” or the “Conductor Rail System”. One of the disadvantages of the Third Rail system is the gaps in the conductor rail at level crossings and junctions where the train is in a position with no electrical power. Hence the minimum length of trains required to be able to push the “gapped train” contact shoes back onto the live rail.

The use of Neousys SuperCAP UPS not only acts an energy storage backup module for temporary lost of electricity, but also as the perfect medium to counteract the flunctuating voltage often occurring on trains. Accepting a wide range 12 to 35VDC input and supports up to 180W power output to sustain operations of the connected backend computer system, it can ensure proper shutdown of the system to protect the computer hardware and data. Unlike most UPS, the shutdown process is auto-initiated and not manually operated. Coupled with Neousys’ SuperCAP management utility, it will monitor and adapt to the power usage of the connected backend system to regulate power output and elongate SuperCAP module’s lifespan in the process.

For more information, please visit Neousys Technology SuperCAP UPS, or contact Neousys for any inquiries you may have in regards to Neousys products.