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Need to Convert AC Power to DC

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Abstract

As the electricity generation systems are in a transition phase, it is important that the conversion of AC to DC systems is carrie out smoothly. This is essential to ensure that the energy consumption pattern that people have gotten used to all over the world is sustained. Electrical energy experts have raised some concerns about the inability of the contemporary power grids to come to terms with the pattern of energy production. This paper deals with the solutions that are essential to fix such problems in electrical system engineering.

Keywords: *Electricity Generation, Powergrids, AC to DC, AC Batteries.*

INTRODUCTION

Electrical energy experts say the electricity grid needs an upgrade. They point out that the electricity grid was built between the 1930s and 1970s and much of the equipment and infrastructure that was lyon is still from that era. For many years, the U.S. didn't invest in the grid. And now the electricity supply is changing. Many coal plants are being decommissioned, while there's an increase in power from natural gas and other sources. Most of the new plants aren't being located close to where we use electricity, like the traditional system that was developed. So we have to move the electricity much further than today than we have in the past, and we don't have a grid infrastructure in place to be able to do that.

WHEN CONSUMERS CREATE ENERGY, IT CHANGES THE EQUATION

As people become more self-reliant, with
Solar panels and micro-grids, they are

sending energy back to grid, which is really a paradigm we never had in the utility industry. So a lot has changed even in the last five years, experts say. He says more extreme natural disasters are also exposing the vulnerabilities of the overhead electric system. Every time there's a big storm or a hurricane, what comes with that is a loss of power, and that makes it very difficult to recover.

While only a small percentage of our energy currently comes from alternative sources, such as solar, wind and biomass power, but electrical experts say it's growing rapidly. As it grows, it will impact electric reliability. The grid was designed to deliver electricity one-way, from large, centralized plants to us as consumers. Now with us as consumers moving it back the other way, we don't have the technology and the infrastructure to deal with that very efficiently right now. Experts say the more energy produced by smaller, distributed sources, the more it will encourage upgrades to the grid.

AC/DC: IF WE DO IT RIGHT, IT CAN ACTUALLY ADD TO RELIABILITY

Experts say if distributed energy sources are balanced with large, stable providers; it can make the power supply more secure. The need of the hour is to convert homes and businesses from AC power to DC. Experts say an increasing number of our devices, laptops, TV screens, appliances, data center operate just on a few volts of DC power, yet we continue to plug all this in, and supplyit from a legacy AC network. We are used to plugging things into a 120 volts - 60 hertz system, that has to then convert that AC to DC, where it's used in the end devices. Experts say they're looking to install more DC power, and to make the conversion from AC more efficient.

NEED OF THE HOUR – ANELECTRIC POWER SYSTEMS LAB

A Power Systems lab and related programs of have been developed by some electrical energy experts in the US over the past several years in collaboration with industry, government, and other constituents to provide innovative education and collaborative research programs in the areas of electric power and energy engineering. Working together with industry partners, along with strong government sponsorship and other constituency support, the experts are contributing to the advancement of modern electric power technology and infrastructure at all levels, from the development of novel power electronics converters, to micro and macro grid modeling and control. They are also committed to the development of solutions to address the aging workforce issue in the electric power and energy sector through modernized educational programs. Through advancements in both technology and education, the initiative establishes a model program for the resurgence and sustainability of university based electric power engineering programs in the U.S.

HOW POWER SUPPLIES TURN AC INTO DC IN ELECTRONIC CIRCUITS

The task of turning alternating current into direct current is called rectification, and the electronic circuit that does the job is called a rectifier. The most common way to convert alternating current into direct current is to use one or more diodes, those handy electronic components that allow current to pass in one direction but not the other.

Although a rectifier converts alternating current to direct current, the resulting direct current isn't a steady voltage. It would be more accurate to refer to it as "pulsating DC." Although the pulsating DC current always moves in the same direction, the voltage level has adistinct ripple to it, rising and falling a bit in sync with the waveform of the AC voltage that's fed into the rectifier.

For many DC circuits, a significant amount of ripple in the power supply can cause the circuit to malfunction. Therefore, additional filtering is required to "flatten" the pulsating DC that comes from a rectifier to eliminate the ripple.

There are three distinct types of rectifier circuits you can build: half-wave, full-wave, and bridge. The following describes each of these three rectifier types.

HALF-WAVERECTIFIER

The simplest type of rectifier is made from a single diode. This type of rectifier is called a half-wave rectifier because it passes just half of the AC input voltage to the output.

When the Ac voltage is positive on the cathode side of the diode, the diode allows the current to pass through to the output.

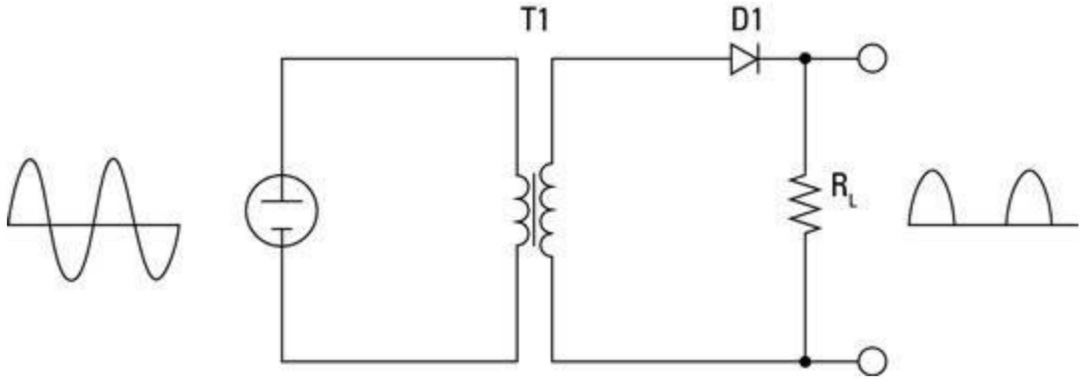

Figure 1: Half Wave Rectifier

But when the AC current reverses direction and becomes negative on the cathode side of the diode, the diode blocks the current so that no voltage appears at the output. See Figure 1.
Half-wave rectifiers are simple enough to build but aren't very efficient. That's because the entire negative cycle of the AC input is blocked by a half-wave rectifier. As a result, output voltage is zero half of the time. This causes the average voltage at the output to be half of the input voltage.

Note the resistor marked RL. This resistor isn't actually a part of the rectifier circuit. Instead, it represents the resistance imposed bythe load that will ultimately be placed on the circuit when the power supply is put to use.

FULL-WAVERECTIFIER

A full-wave rectifier uses two diodes, which enables it to pass both the positive and the negative side of the alternating current input. The diodes are connected to the transformer. See figure 2.

Notice that the full-wave rectifier requires that you use a center-tapped transformer. The diodes are connected to the two outer taps, and the center tap is used as a common ground for the rectified DC voltage. The full-wave rectifier converts both halves of the AC sine wave to positive-voltage direct current.
The result is DC voltage that pulses at twice the frequency of the input AC voltage. In other words, assuming the input is 60 Hz household current, the output will be DC pulsing at 120 Hz.

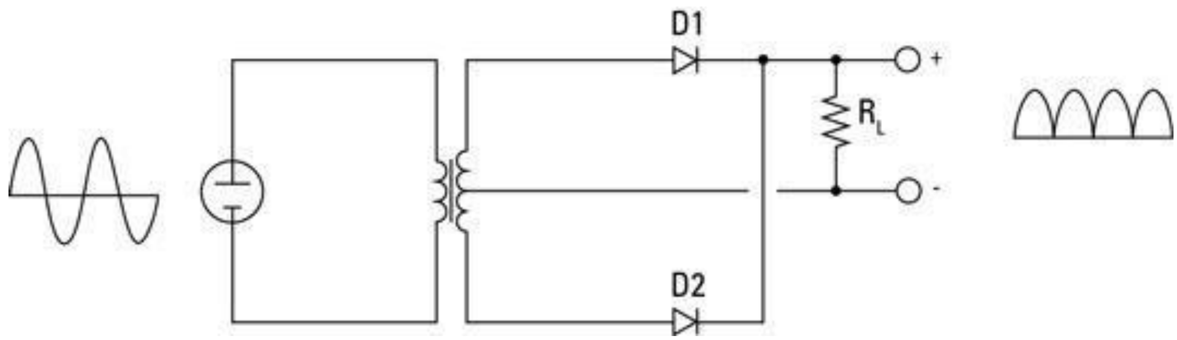

Figure2: Full Wave Rectifier

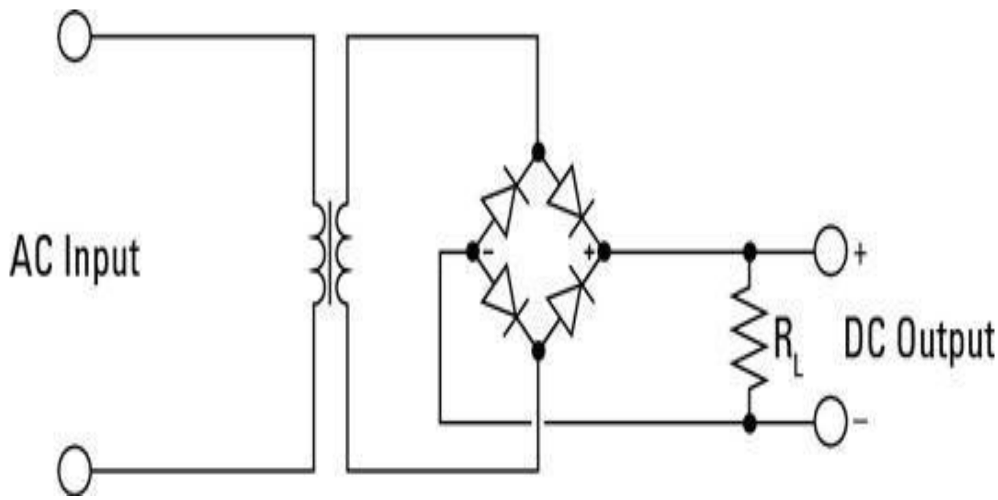

Figure 3: Bridge Rectifier

BRIDGERECTIFIER

The problem with a full-wave rectifier is that it requires a center-tapped transformer, so it produces DC that's just half of the total output voltage of the transformer.

A bridge rectifier overcomes this limitation by using four diodes instead of two. The diodes are arranged in a diamond pattern so that, on each half phase of the AC sine wave, two of the diodes pass the current to the positive and negative sides of the output, and the other two diodes block current. A bridge rectifier doesn't require a center- tapped transformer.

The output from a bridge rectifier is pulsed DC, just like the output from a full-wave rectifier. However, the full voltage of the transformer's secondary coil is used.

You can construct a bridge rectifier using four diodes, or you can use a bridge rectifier IC that contains the four diodes in the correct arrangement. A bridge rectifier IC has four pins: two for the AC input and two for the DC output.

HOW AC BATTERIES WORK IN ELECTRONIC CIRCUITS

The easiest way to provide a voltage source for an electronic circuit is to include a battery. There are plenty of other ways to provide voltage, including AC adapters (which you can plug into the wall) and solar cells (which convert sunlight to voltage). However, batteries remain the most practical source of juice for most electronic circuits.

A battery is a device that converts chemical energy into electrical energy in the form of voltage, which in turn can cause current to flow. A battery works by immersing two plates made of different metals into a Special chemical solution called an electrolyte.

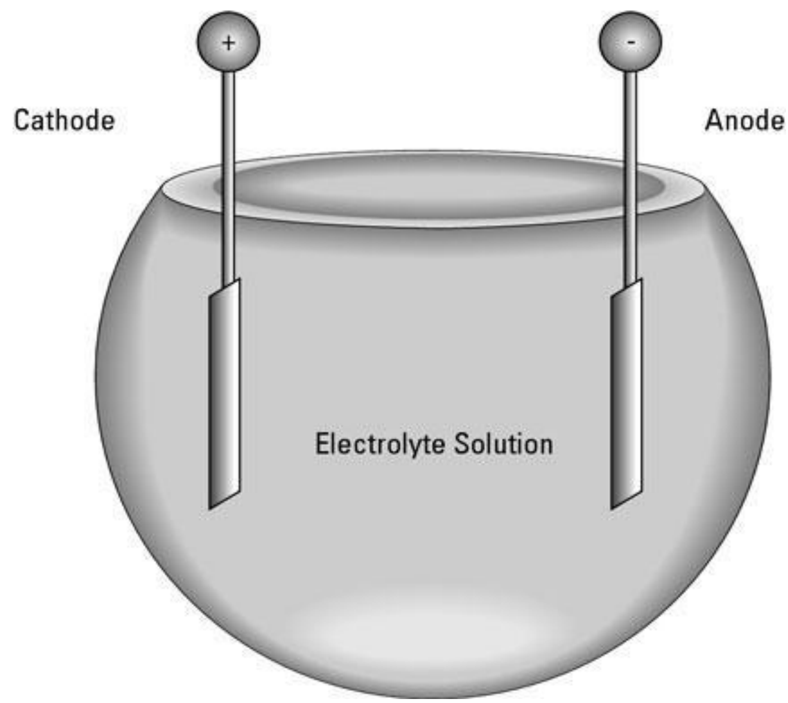

Figure 4

The metals react with the electrolyte to produce a flow of charges that accumulate on the negative plate, called the anode. The positive plate, called the cathode, is sucked dry of charges. As a result, a voltage is formed between the two plates. These plates are connected to external terminals to which you can connect a circuit to cause current to flow.

Batteries come in many different shapes and sizes, but for electronics projects, you need concern yourself only with a few standard types of batteries, all of which are available at any grocery, drug, or department store.

The multimeter will tell you the voltage difference between the negative and positive terminals. For cylindrical batteries (AAA, AA, C, or D) it should be about 1.5 V. For 9 V batteries, it should be about 9 V.

- Rechargeable batteries cost more than non-rechargeable batteries but last longer because you can recharge them when they go dead.
- The easiest way to use batteries in an electronic circuit is to use a battery holder, which is a little plastic gadget designed to hold one or more batteries.
- Wonder why they sell AAA, AA, C, and D cells but not A or B? Actually, A cell and B cell batteries exist. However, those sizes never really caught on.

Figure 5

Cylindrical batteries come in four standard sizes: AAA, AA, C, and D. Regardless of the size, these batteries provide 1.5 V each; the only difference between the smaller and larger sizes is that the larger batteries can provide more current. The cathode, or positive terminal, in a cylindrical battery is the end with the metal bump. The flat metal end is the anode, or negative terminal.

The rectangular battery is a 9 V battery. That little rectangular box actually contains six small cells, each about half the size of an AAA cell. The 1.5 volts produced by each of these small cells combine to create a total of 9 volts. Here are a few other things you should know about batteries:

- Besides AAA, AA, C, D, and 9 V batteries, many other battery sizes are available.

Most of those batteries are designed for special applications, such as digital cameras, hearing aids, laptop computers, and so on.

- All batteries contain chemicals that are toxic to you and to the environment. Treat them with care, and dispose of them properly according to your local aws. Don't just throw them in the trash.
- You can (and should) use your multimeter to measure the voltage produced by your batteries. Set the multimeter to an appropriate DC voltage range (such as 20 V).
- Then, touch there d test lead to the positive terminal of the battery and the black test lead to the negative terminal.

CONCLUSION

It is important to ensure that the new age power grids are compatible with the way energy has been consumed till date. Conversion of AC current to DC and vice-versa is just one aspect of this problem facing the electrical power system developers. This paper deals with all the aspects that need to be considered to ensure that the transition from the traditional power generation systems to the current ones is a smooth one. The need of the hour is to have a system ready that can easily facilitate the transition and allows the consumers of energy as much convenience as they enjoyed with the traditional systems, while not posing any threat to the environment. It is important that the electrical power system engineering addresses this issue as otherwise; it would become difficult to maintain the pattern of power consumption that users have become used to all over the world.

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