



380 volt direct current  
Innovation for the 21<sup>st</sup> century

**BACH  
MANN**

**BSG**



Innovation requires  
competence

There is scarcely any other technology that has influenced people's living standards as much as electrification. Availability and use of electricity are responsible for the prosperity we enjoy today. That is why advanced electrical components have not just always been our core business, but also a central, future-oriented objective. At BACHMANN and BACHMANN Systems, we have analysed trends and are convinced that direct current technology will soon play a significant part in contributing towards a more sustainably oriented economy and society. Indicators from both producers and consumers point towards a renaissance of direct current.

# The future is direct current!

Micro grids for individual buildings and macro grids as a complete network will become the building blocks of a future with direct current. For us, this future has already begun. In many respects, we have set a milestone with our new 380 volt direct current data centre in Stuttgart. From an operational perspective, we have been able to ideally combine business necessity with sustainable action. For our customers and partners this means that: BACHMANN is ready for this leap in innovation with their competence, expertise and products.



# Why alternating current still dominates

## A brief look back

The decision against direct current and in favour of alternating current was taken at the end of the 19<sup>th</sup> century in the so-called power war. The direct current that can be stored in accumulators had always been the appropriate voltage for the final consumer, but it can only be transmitted over short distances without losses. This means that direct current power plants would have had to be built close to or in the middle of cities. In addition, the distribution of high voltages could only be ensured with alternating current. So the decision was made in favour of alternating current. Here, transformers regulate the voltage to be high for transmission and then down again for use in households.

However, using alternating current also has some disadvantages, such as its constantly changing voltage that ultimately results in power fluctuations. This led to the situation where in the middle of the last century, so-called high-voltage, direct-current transmission became increasingly important.



## Direct current

Direct current is a flow of electricity where strength and direction do not change over time. Nowadays, direct current can be found in almost every device because the functionality of the entire electronics industry is built on this. At the device's input point however, alternating current needs to be converted into direct current.

There is no need for this conversion with direct current supply.



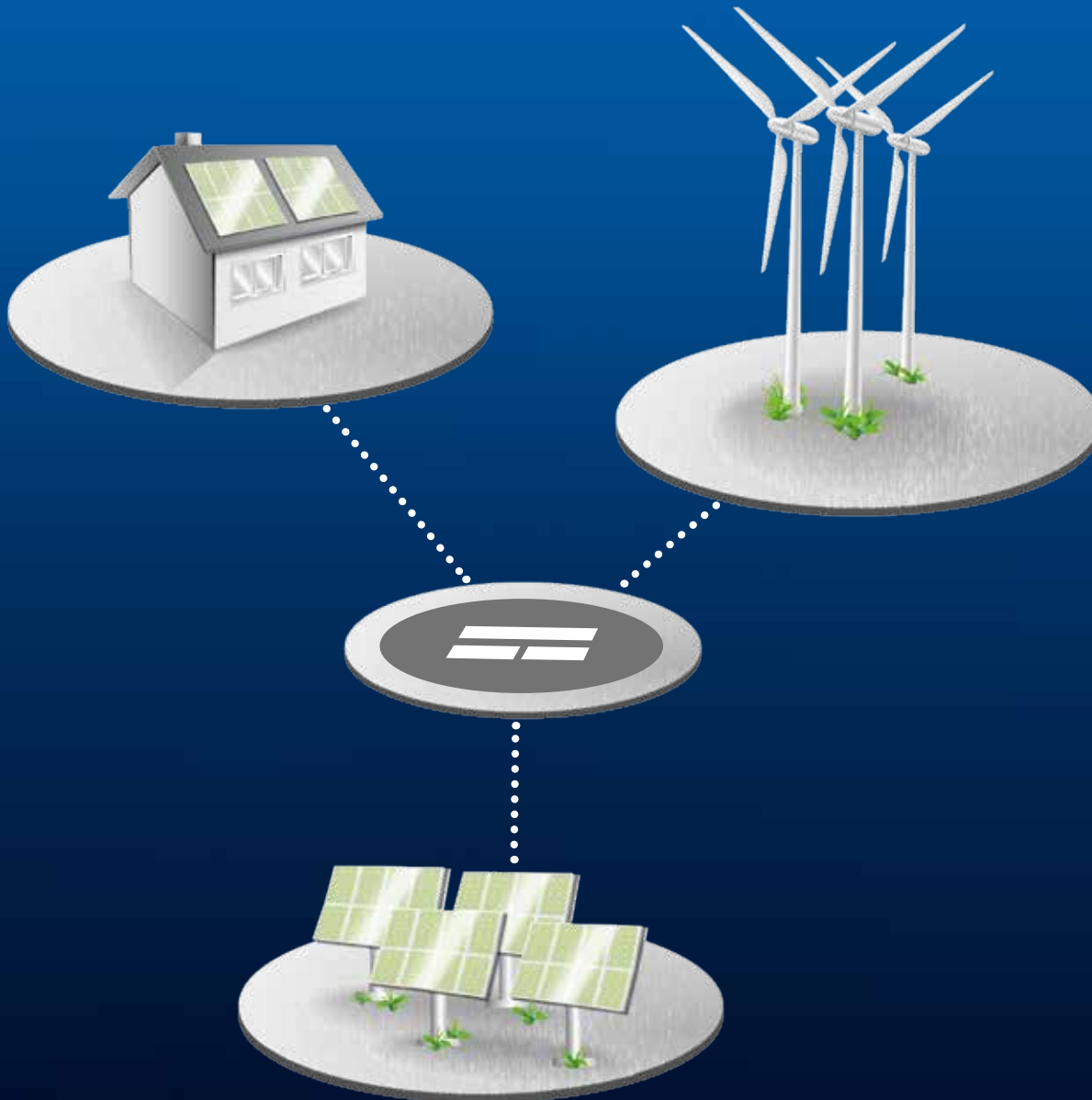
## Alternating current

Alternating current is a flow of electricity that reverses its direction at regular intervals and in which the positive and negative momentary values complement each other providing an equilibrium position on average over time. One of the reasons that alternating current has been able to dominate is because it is relatively easy to produce with generators. Transformers in transformer stations or substations can convert the alternating current up or down to any required voltage level.

# One remains the same and the other changes

## Important knowledge about electricity

Due to the changing views on energy and the increased focus on renewable energies, such as wind, water and photovoltaics, more and more producers are supplying direct current. As the public networks are designed to work with alternating current, the alternatively generated direct current has to be converted into alternating current in a complex and high-loss process. A direct current grid would eliminate the disadvantage and enable parallel switching from several sources.



## A desirable trend

Alternative energy production and energy savings are not a random trend, but a political desire. So by 2022, the European Union wants to reduce energy consumption in its member countries by around 20%.

One way to achieve this is by producing and effectively storing renewable energies. Offshore wind plants and photovoltaic systems produce direct current from the outset. If this electricity flows through direct current networks, it has the advantage over alternating current networks that the electricity can be transmitted over great distances with significantly fewer losses.

High-voltage, direct-current (HVDC) transmission forms the basis of the European super-grid that is planned to be built in the foreseeable future. This will allow cost-efficient transmission of direct current over large distances from offshore wind plants in the north, or huge photovoltaic farms in the south to reach consumers. Although there are still some obstacles to be overcome, a public direct current grid is on the cards. Direct current will not replace alternating current, but will flow in a parallel grid.

# The energy revolution is promoting direct current

## Energy in buildings

There is increasing interest amongst consumers in zero-energy homes. The zero-energy home will be supplied by a range of renewable energy sources and storage systems. And direct current forms the basis for the ideal connection. Most household devices, and already more than 80% of electricity consumers in commercial buildings, work with direct current. In order for them to work, the electricity from the alternating current grid has to be converted into direct current. This is done by devices called rectifiers. In the case of small devices, these are in the power supply units. With a direct current grid, these would no longer be required. Conversion losses in the form of waste heat would also be greatly reduced.

Micro grids for direct current are already both economically and ecologically viable today. We take the view at BACHMANN that more and more people are pursuing the idea of energy saving and resource sustainability, so they are converting their homes and businesses accordingly.

## Energy in data centres

Data centres in Asia demonstrate how the two core topics of efficiency and availability can be implemented with direct current systems and components. In addition to approaching zero probability of failure, economically significant energy savings can also be made from a direct current grid.

The reduction in transformation processes leads to a significantly improved energy balance sheet. Experts are convinced that a direct current network within buildings can result in cost savings of between 10 and 15%.



# Combining strengths Bundling synergies



**Peter Bachmann,**  
CEO BACHMANN Group

“This strategic investment in direct current technology shows that we are implementing the core virtues of medium-sized German companies: strength in innovation and real implementation expertise in fields of technology. We are convinced that direct current technology can offer significant future opportunities for our customers and provide answers to urgent questions of energy efficiency and conservation of resources within the context of society. We are therefore continuously developing our product and service portfolio.”



**Prof. Dr. Martin März,**  
acting Head of the Fraunhofer Institute IISB, Erlangen

“The dynamic and pragmatic approach that medium-sized companies are taking and implementing to address the subject of direct current is very impressive. It has been a valuable experience for us to provide advice to the project over the past 2 years. We are of course particularly pleased that we were able to contribute in a small way to the success of this fantastic project with components such as our direct current switch for lighting installations, or our innovative distribution system for subdivided office workplaces.”



## Joint research

Leading research organisations and providers of power plant technology have grappled with the subject of direct current for quite some time. Although there are no standards or guidelines for direct current as there are for alternating current, the micro grids which are already being used are delivering initial reference values. Direct current networks are increasingly being established within buildings as part of this start-up phase. Many telecommunications companies and other institutions around the world have already converted their exchanges and computer centres

to direct current. BACHMANN Systems is part of a worldwide network of partners that is dedicated to the development of practical direct current solutions. We are also a member of the Association of Electrical Engineering, Electronics and Information Technology e.V. (VDE), which is currently producing a standardisation roadmap for direct current.

With its own innovative 380-volt direct current data centre, BACHMANN is a pioneer and trendsetter in Germany.



**Ulrich Boeke,**  
**Senior Scientist Philips Research Laboratories**

"BACHMANN chose the Philips SmartBalance LED lamp for this installation. This elegant LED recessed or pendant lamp combines innovative design with a very pleasant feeling of space by providing direct and indirect lighting. The LED driver in this lamp for 380 V DC networks has 25% lower losses than the version for 230 V AC mains voltage. Philips is pleased to use this combination of energy efficient LED lighting and particularly efficient 380 V DC networks to support customers' requirements to operate their buildings with particularly high energy efficiency."



**Tilo Püschel,**  
**Business Development & Consulting BACHMANN Systems**

"We have successfully completed our first 380-volt direct current installation. This makes us proud and also shows how highly motivated our employees are in relation to new technologies. I should like to thank Mr Bachmann for this investment and express my thanks to all project partners for their excellent cooperation."



# BACHMANN

## Your direct current expert

### 380 volt direct current micro grid

Our new data centre in Stuttgart has been consistently and uniformly designed for the use of 380 volt direct current. BACHMANN Systems employees planned and managed this innovation project.

On one hand, this allows us to provide evidence for the benefits of using direct current in our data centre, and on the other hand to demonstrate our professional competence in electrification with direct current.

The air conditioning, lighting and all servers and devices in the data centre are supplied with 380 volt direct current. Photovoltaic units on the roof act as an eco-friendly power source.

The company's own electric vehicle is also charged at the new 380 volt charging station.

### Direct current components installed

- 380 V DC\* PDU by BACHMANN
- 380 V DC\* Uninterruptible power supply (UPS) from Emerson Network Power
- 380 V DC\* Air conditioning unit (CRAC unit) from WEISS Klimatechnik
- 380 V DC\* Lighting system from Philips
- 380 V DC\* IT equipment from Hewlett Packard
- 380 V DC\* Circuit breakers from ABB
- 380 V DC\* Voltage converter from Schaefer

\*380 volt direct current

### Innovative solution BACHMANN 380 V DC PDU

With our innovative and modular DC PDU, we at BACHMANN have already developed an intelligent solution for data centres, based on 380 volt direct current. We are working hard on further ideas and products to connect our customers with the efficiency of direct current.

# Customer focus



## BACHMANN Group

Since being founded in 1947, BACHMANN has become a company with a global reach in the electronics technology sector. BACHMANN operates production sites and development and quality management centres in Germany, Rumania and China, as well as numerous international sales companies and partnerships.

BACHMANN also employs more than 500 staff worldwide. The company's success as a manufacturer of electronic components and systems has always been down to the ability to spot trends and use these to develop products with the highest customer benefit. An outstanding example is the BACHMANN BlueNet product range, an innovative and efficient solution for energy management with multi-functional desk connection panels that has already been awarded many international design prizes.



## BACHMANN Systems

An innovation hub, trend scout and service provider – these are the things that BACHMANN Systems stands for and was founded within the BACHMANN Group in 2015. The employees of BACHMANN Systems think far into the future and develop tailor-made technical innovations. The results are practice-oriented products and systems for the lifestyle and processes of tomorrow.

BACHMANN Systems differentiates itself from the competition by its use-oriented and systemic approach. This provides the basis for innovative total solutions for homes, offices, factories and data centres. Direct current technology is one of BACHMANN System's core competencies, which has been expressed professionally in the new 380-volt direct current data centre.

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