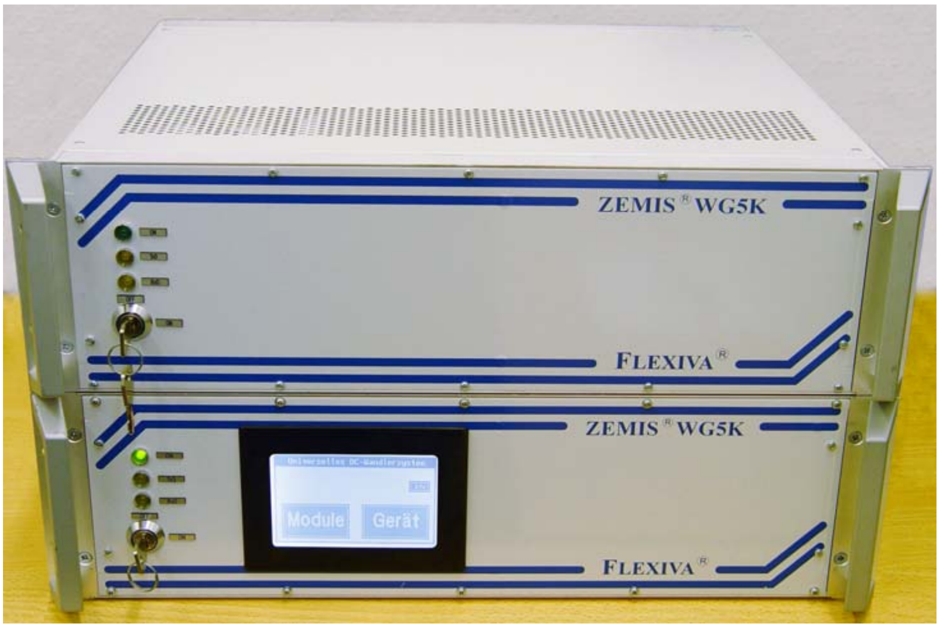
Short Description



WG5Kxxx

Modular DC Converter System

FLEXIVA®
automation & Robotik

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General Characteristics

The modular DC converter system is useful for the DC coupling of various electrical components (sources, sinks, buffer stores) of different ranges of operating voltages (0...350V DC, 230V AC). The coupling is carried out by voltage conversion and "normalization" to a joint voltage of 380V DC. A bidirectional exchange of electrical energy can then be realized between the connected components by means of the DC link arising that way.

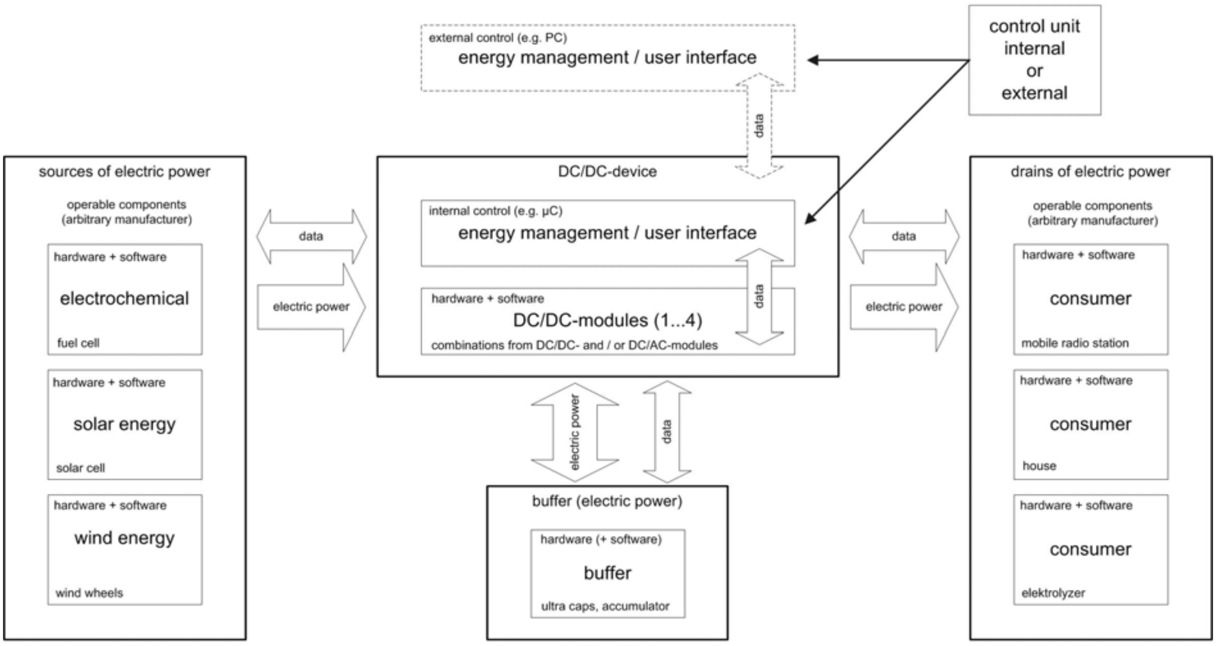

Fig. 1 Basic structure of the converter system

Hardware Components

The DC converter system is based on the converter modules (DC/DC, DC/AC) and module carriers (types 1, 2, 3) developed and produced by the Flexiva company. Every module carrier can be equipped with a maximum number of 4 DC/DC modules and/or with 3 DC/DC and one DC/AC modules (230V AC). There are any combinations of the DC module variants (30V, 45V, 60V, 120V, 350V) possible you like (compare Fig. 2).

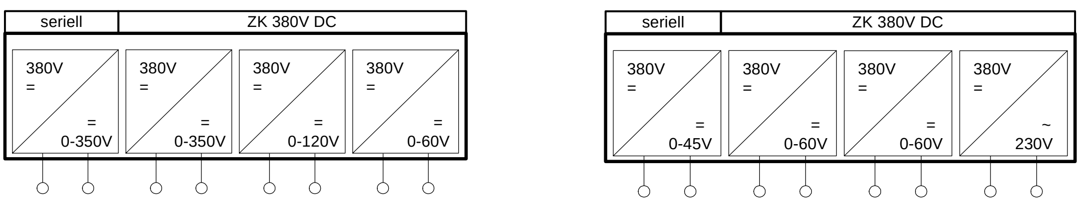

Fig. 2 Examples for variable equipment with DC/DC and DC/AC modules

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D – 09439 Amtsberg

The following variants of modules and module carriers are available:

Type	Order No.	Power	Variable voltage	Current	Characteristics			
					bidirectional	galvanically isolated	connection in parallel	others
DC/DC	ZEMIS® PM3K030	2.5kW	0 … 30V DC	-100 ... 0 … 100A	yes	yes	yes	
DC/DC	ZEMIS® PM3K045	2.5kW	0 …45V DC	-75 ... 0 … 75A	yes	yes	yes	
DC/DC	ZEMIS® PM3K060	2.5kW	0 … 60V DC	-50 ... 0 … 50A	yes	yes	yes	
DC/DC	ZEMIS® PM3K120	2.5kW	0 … 120V DC	-25 ... 0 … 25A	yes	yes	yes	
DC/DC	ZEMIS® PM3K350	3.0kW	0 … 350V DC	-10 … 0 … 10A	yes	no	yes	
DC/AC	ZEMIS® PM3AC10	2.3kW	230V AC	10A / 16 A for 30s	yes	no	no	mains/isolated operation possible

Tab. 1 Types of modules

Type	Order No.	Characteristics
MT V1	ZEMIS® WG5K010	max. 4 modules, 1 serial interface per module
MT V2	ZEMIS® WG5K020	max. 4 modules, 1 serial interface per module
MT V3	ZEMIS® WG5K030	max. 4 modules, µ-controller, 1 LAN-interface

Tab. 2 Types of module carriers

Usage and Possibilities of Application

Fundamentally, the converter system represents a very flexible modular system platform that is not reserved for any special field of application. It permits the regulated bidirectional energy flow as well as the voltage adaptation in very wide fields.

Applications in the Power Electronics

It is possible to use the DC/DC modules both as a single module and as coupled modules. Because of the galvanic isolation, both the connection in series and in parallel of the modules is possible to increase the power and/or the voltage at the side of the DC link. Excellent possibilities for the combination with AC applications result from the inverter module also available in the converter system and/or the easy coupling with conventional converter components.

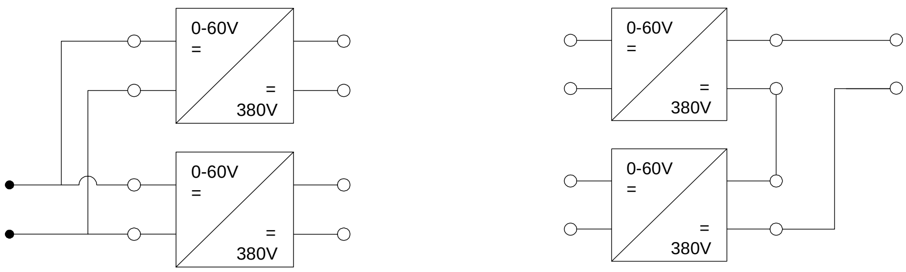

Fig. 3 Connection variants, connection in parallel and in series

The fields of application for individual modules and/or various system configurations are, for example:

- Electrical engineering, power engineering, power electronics, electrical automotive equipment, drive engineering in industry, trade, and education
- Research and development institutions as well as testing laboratories and/or corresponding sectors of industry and trade

Application in the Field of Alternative Power Systems

The big advantages of the system show particularly in the field of power engineering. Apart from the direct feeding of individual regenerative energy sources into the power supply system, local hybrid energy systems gain more and more in importance. The combination of various regenerative components increases the availability and utilization characteristics of such hybrid systems considerably.
The power range of the converter from 2.5 … 5kW, the simple integration of energy storage mechanisms, and the also available AC-voltage interface to the consumer/network are an outstanding basis for a wide application in the private and commercial sectors. The system represents a flexible platform for the coupling of the components becoming established in this performance range on the sector of regenerative energies such as for example:

- Photovoltaic units
- Small-sized wind generators
- Stirling machinery
- Other conventional electric generators
- Fuel-cell heaters
- Other components of the combined heat and power generation
- Fuel cells
- Electrolyzers

System Variants

With regard to its basic equipment concerning control / operation management of the connected components, the converter system is basically offered in the two variants:

1. Converter systems **without** µ-controller (modules + modul carriers of types 1 and 2)
2. Converter systems **with** µ-controller (modules + module carriers of type 3)

Characteristics of **both** variants:

- Mechanical fixing of all modules existing in the system,
- Linkage of the DC link voltages of all modules to the DC link,
- Distribution of the necessary external auxiliary voltage (12..30V DC) to all modules,
- Flexible integration of the modules / module groupings into existing systems (19-inch plug-in units; leading-out of DC link and auxiliary voltage),
- Control / operation management for simple applications realizable by the modules themselves (precondition: appropriate parameterization of the modules),
- Data exchange by means of simple ASCII instructions (protocol disclosed),
- Comfortable PC software for the parameterization included in the scope of delivery.

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Characteristics of the converter systems **without** µ-controller (Appendix 1)

- Control / operation management for complex applications by means of an **external** control unit required,
- Data connection:
    - module carrier type 1: 1 serial interface per module
    - module carrier type 2: 1 serial interface for the complete system (internal RS232, multiplexer for RX and TX) or 1 external LAN interface (TCP/IP).

Characteristics of the converter system **with** µ-controller (Appendix 2)

- Control / operation management for complex applications by means of **internal** or **external** control unit possible,
- Data connection:
    - internal LAN interface (TCP/IP)

Both variants of the converter system (19-inch plug-in units) can also be coupled to form larger-sized units, for example for the performance increase. In case of a great number and diversity of the connected components, the usage of a high-performance (>µC) external control unit for the control / system management is recommended (e.g. Powermanagement Control Unit from Flexiva).

Independent of the chosen variant, many different possibilities and configurations of application offer themselves some variants of which are mentioned in the following and are described in a more detailed way in separate overview sheets.

Control of the Energy Flow → Energy Management

In the converter system, all connected components are electrically joined in the DC link. The actual energy management now consists in the task to take care that there is always enough electrical energy available in the DC link. This leads to the consequence that any inflows of electrical energy **into** the DC link and/or outflows of electrical energy **from** the DC link have to be regulated in a variable way in order to keep the available electrical energy always at a certain level. For this purpose, the voltage of the DC link serves as an indicator for the available energy.
The task of controlling the inflows and outflows of electrical energy **from** and **to** the DC link is assumed by the DC/DC and/or DC/AC modules of the system that are installed between the connected component and the DC link. Every module gets a specific desired voltage specification for the DC link. Furthermore, it is instructed to take care that the intermediate DC link voltage reaches this certain value and keeps it. Independent of the other modules, every module now tries to fulfill its task by influencing the quantity and direction of the current flowing through itself.
It depends on the parameterization of every module in what way it fulfills its task and contributes to the regulation of the energy flow in the DC link. In addition to detailed specifications for the internally proceeding control algorithms, this parameterization includes mainly specifications for currents and voltages of the DC link and the component side as well as the mode of operation in which the module is to work. The modules can be configured so that either only inflow or only outflow of electrical energy are realized through them or that they change over automatically between inflow and outflow (bidirectional) by themself.

The correct parameterization of the modules is decisive for the reliable functioning of the energy management. Therefore, every module is preparameterized by the manufacturer according to the component to be connected to it and taking into account the energy management task to be accomplished in the system. These factory settings are applied after

every restart of the system and are the respective start values, in particular also for the internal or external control.
This way, a part of the energy management can be carried through during the parameterization by means of well thought-out default values alone. But to take into account all premises, in particular with regard to more complex systems, it is required to modify the parameterization of some modules or of all modules during the operation or to switch-in or switch-off modules (e.g. for MPP tracking of the solar cells, charging of the accus, feed-in control into the electrical network). They assume control functions and control algorithms in the higher-level control for the modules (internally or externally in case of module carriers of type 3, externally in case of module carriers of type 1 and 2). In addition to that, the higher-level control can also assume functions such as error monitoring, measurement data acquisition, data preparation, visualization, and data storage.

Depending on the system variant and its modules installed (with energy sources, sinks, and buffer stores), the control of the energy flow is possible both **with** and **without** higher-level control. The prerequiste is in both cases the well-aimed parameterization of the mode of operation, current and voltage values of all modules used according to the components connected to them and the energy flow strategies to be realized. As far as this is concerned, the variant with higher-level control offers the decisive advantage that the parameterization of every module can be changed or reparameterized as you like while the system is running. This results in the possibility of a flexible management of modules connected in parallel in case of the connection of components with a higher performance and their distribution to several modules *) as well as the realization of any buffer store, source, and sink management you like *). Because of the considerably higher flexibility in the operation, the variant with the higher-level control is to be preferred by all means. The following comparison is to underpin this:

Without Higher-Level Control

1. Minimum configuration: 1 source , 1 sink at one module each
2. Maximum configuration: 1 source, 1 sink, 1 buffer store at one module each
3. Components with bigger powers can be distributed to several modules with regard to their power but only with a **static** (firmly specified) power distribution.
4. Components of the same kind (e.g. 2 sources) can be connected to 2 modules but only with a **static** (firmly specified) power distribution.
5. The energy flow is controlled by (self-)monitoring of the DC link voltages of the source module and the buffer store module (if available).
6. The DC link voltage is mainly maintained by the source. The buffer store is only connected when the source is no longer able alone to keep up the DC link voltage.
7. The sink is also supplied by the source in a prioritized way.
8. Flexible source, sink, and buffer store management *) (flexible prioritization) is **not possible**.

With Higher-Level Control

1. Minimum configuration: 1 source, 1 sink, 1 buffer store at one module each
2. Maximum configuration: theoretically any number of sources, sinks, buffer stores you like distributed to any number of modules you like (→ interconnection of several module carriers by coupling of the led-out DC link)
3. Components with bigger powers can be distributed to several modules with regard to their power and this with a **dynamic** (changeable) power distribution.
4. Components of the same kind (e.g. 2 sources) can be connected to 2 modules and this with a **dynamic** (changeable) power distribution.

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5. The energy flow is, for example, controlled by (external) monitoring of the charging condition of the buffer store by the higher-level control.
6. The DC link voltage is mainly maintained by the buffer store. The source is only connected by the higher-level control when the value falls under a fixed charging condition of the buffer store.
7. Consequently, the sink is mainly supplied by the buffer store in this case.
8. Flexible source, sink, and buffer store management *) (flexible prioritization) is **possible**.

***) Explanation**

Management of modules connected in parallel
- power depending connection of modules respectively balancing of the load distribution

Source management
- e.g. staggering of various sources according to priorities

Buffer store management / sink management
- various strategies according to the configured components

Appendixes:

Appendix 1: Connectors
Appendix 2: Basic circuit diagram
Appendix 3: Overview of the structure of the converter system without µ-controller
Appendix 4: Overview of the structure of the converter system with µ-controller

Additional Documents:

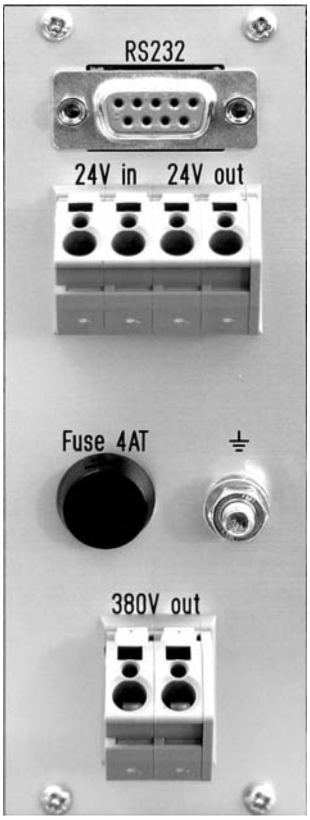
Data sheets
Price list / optional equipment
Variant representations of alternative energy systems (overview sheets)

Terminals:

To operate the module carrier, an auxiliary power supply must be connected to the terminal **"24V in"**. It powers the internal interface switcher as well as the built-in DC/DC modules (30, 45, 60 and 120V DC) (depending on the configuration of the whole system).

For the operation of built-in DC/AC (230V AC) and DC/DC modules (350V DC) there must be an additional voltage of 100V DC, connected to the terminal **"380V out"**.

Further details referred to the operation of the modules are described in the manuals.



RS 232:
Data communication with PC

Bits per Second	115200
Data bits	8
Parity	None
Stop bits	1
Flow control	None

24V in
Auxiliary input voltage, 10 to 30V DC, max. 2A

24V out
Auxiliary output voltage, switched via key switch

Fuse 4AT
Fuse for auxiliary voltage, 4A slow

PE icon
PE terminal

380V out
Output of the DC link voltage

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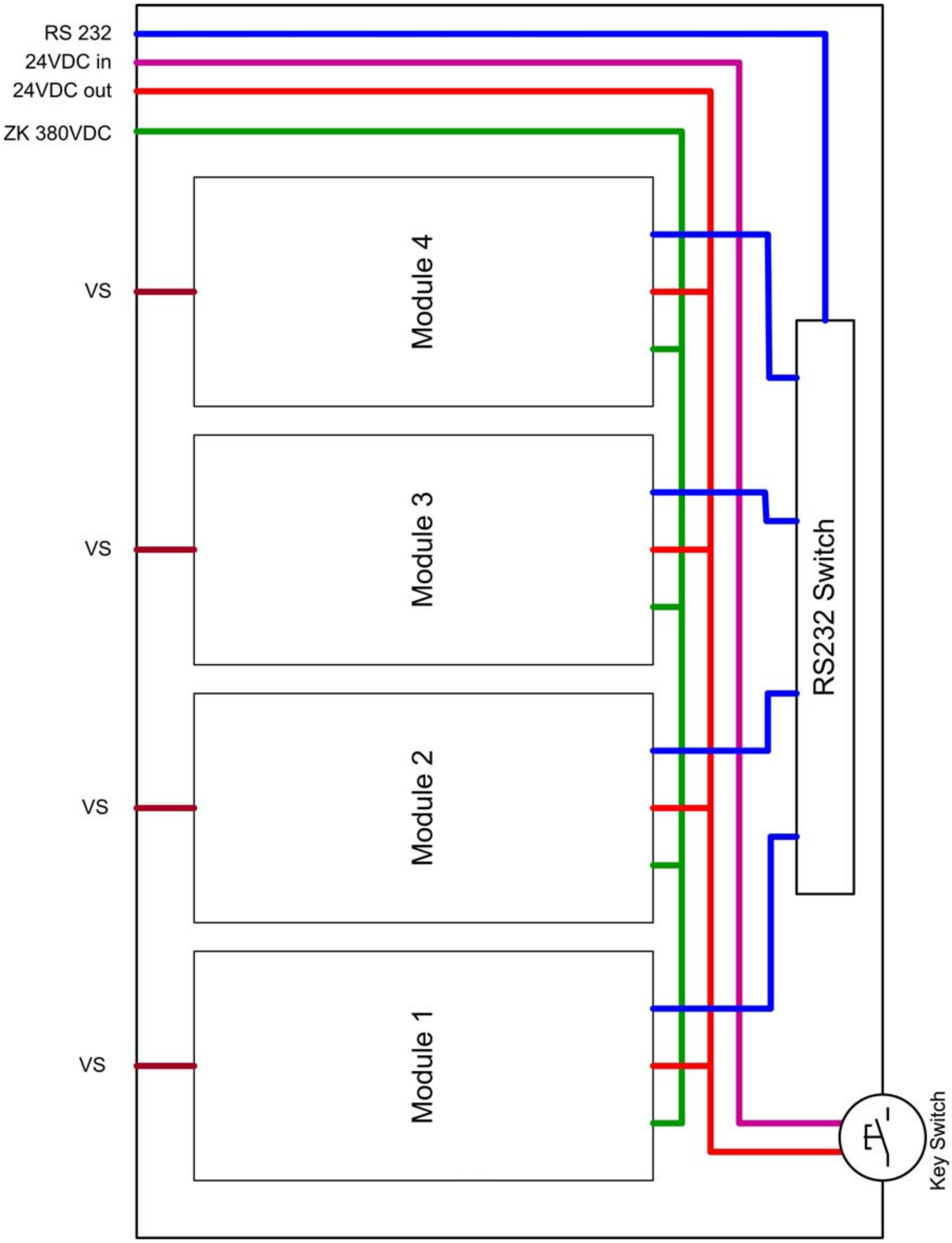
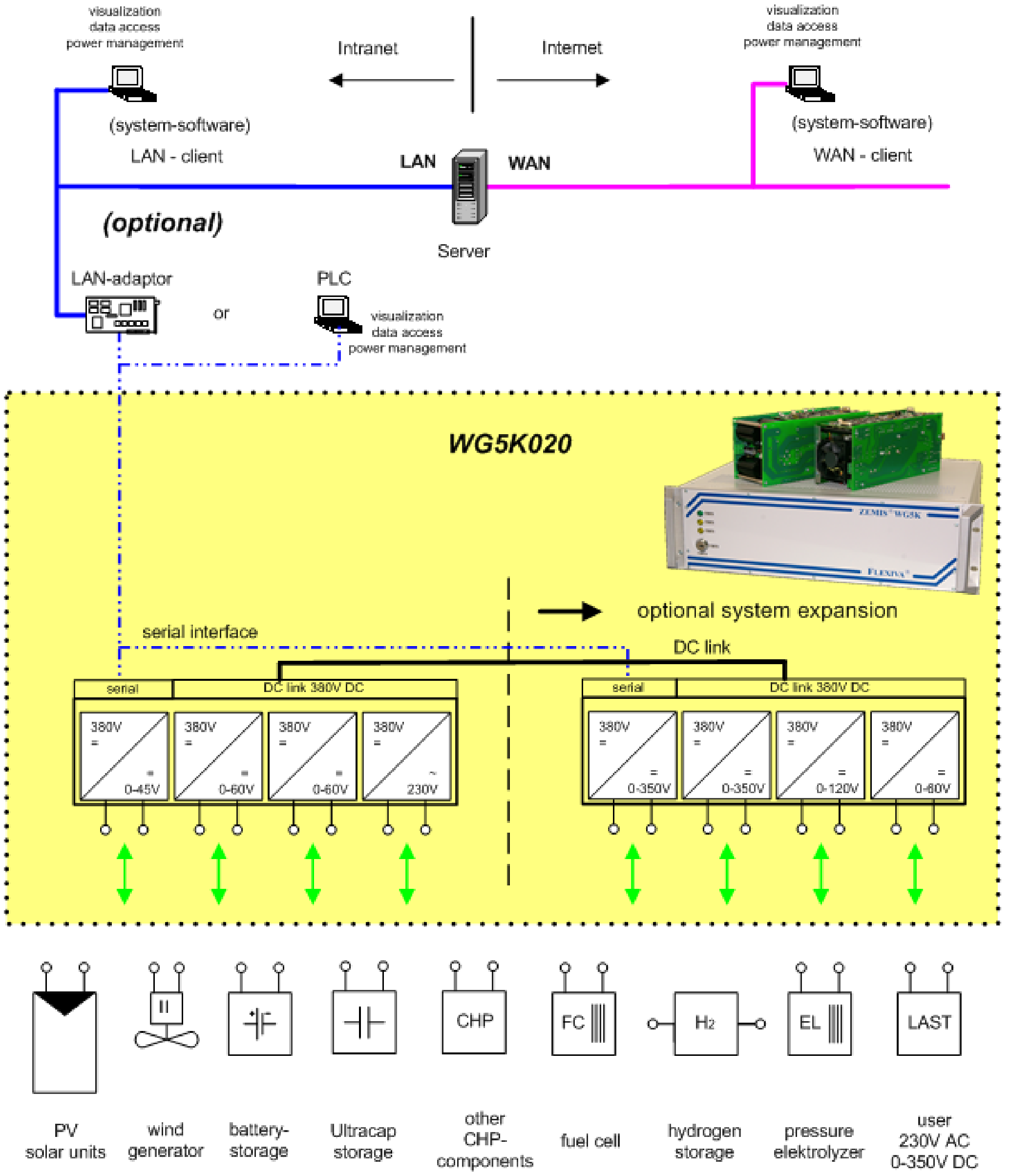


Appendix 2 - Block diagram

service, monitoring, external power management



Components of a regenerative energy-system (examples):

Features:

- modular configurable converter system, typical power per module 2,5 kW
- dynamic and bidirectional control of the energy flow
- different ranges of operating voltages to couple different components (0…350V DC)
- parallel connection of the modules is possible for power adjustment (2,5kW → 5kW)
- comfortable Software to configure the device or the modules

WG5K020:

- power management by means of an external control (PC, PLC...) is possible
- integration into existing systems by means of an open serial interface is possible
- an external LAN interface is optional

Appendix 3

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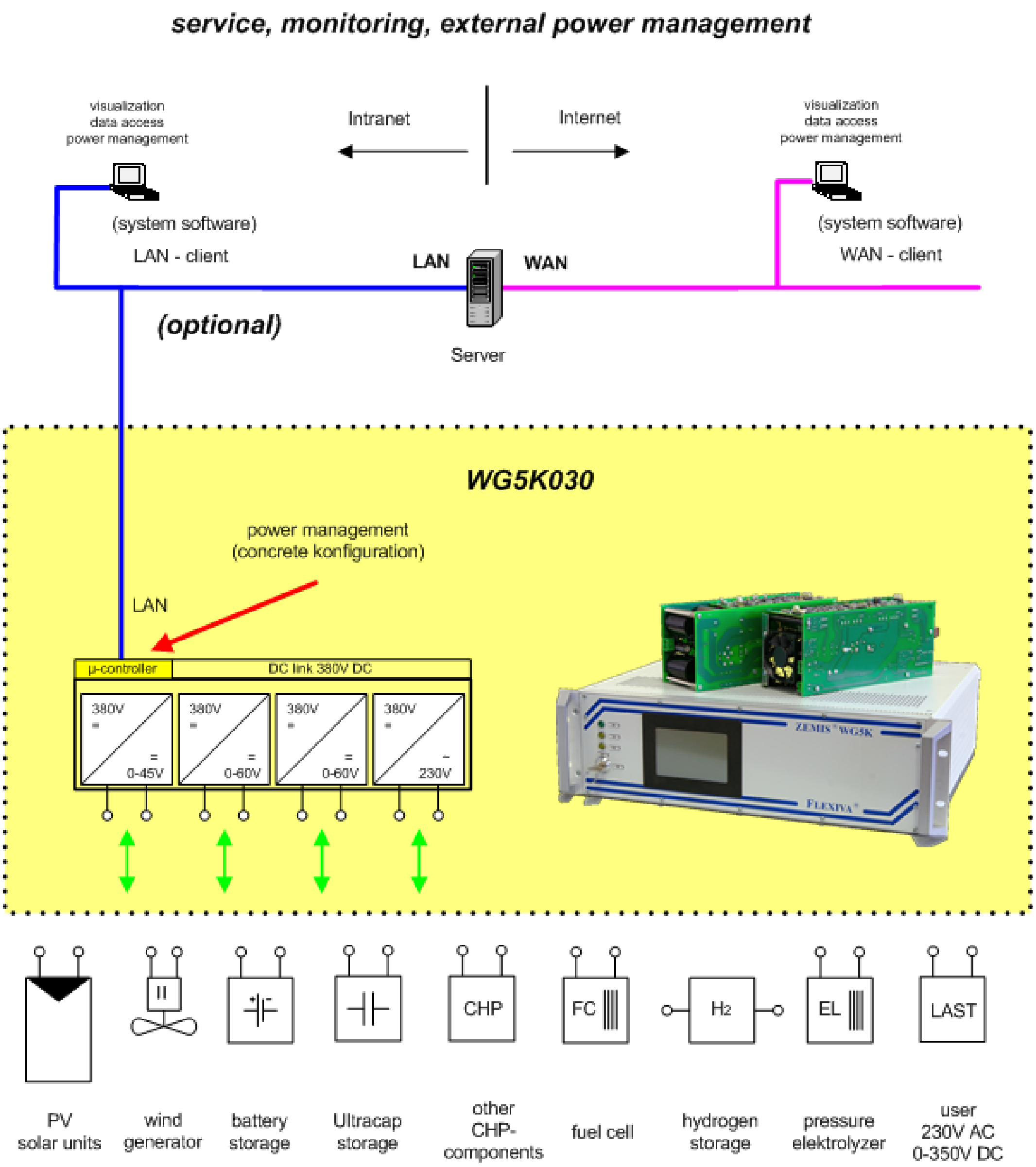

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<u>Features:</u>

- modular configurable converter system, typical power per module 2,5kW
- dynamic and bidirectional control of the energy flow
- different ranges of operating voltages to couple different components (0…350V DC)
- parallel connecction of the modules is possible for power adjustment (2,5kW → 5kW)
- comfortable Software to configure the device or the modules

<u>WG5K030:</u>

- power management is possible by means of an internal controller or an external control (PC, PLC…)
- LAN interface is integrated

Appendix 4