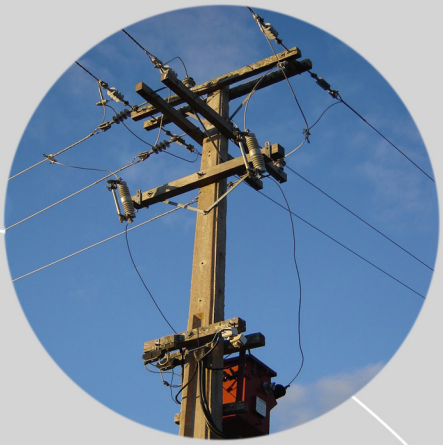
microGrid



ALPHATRON

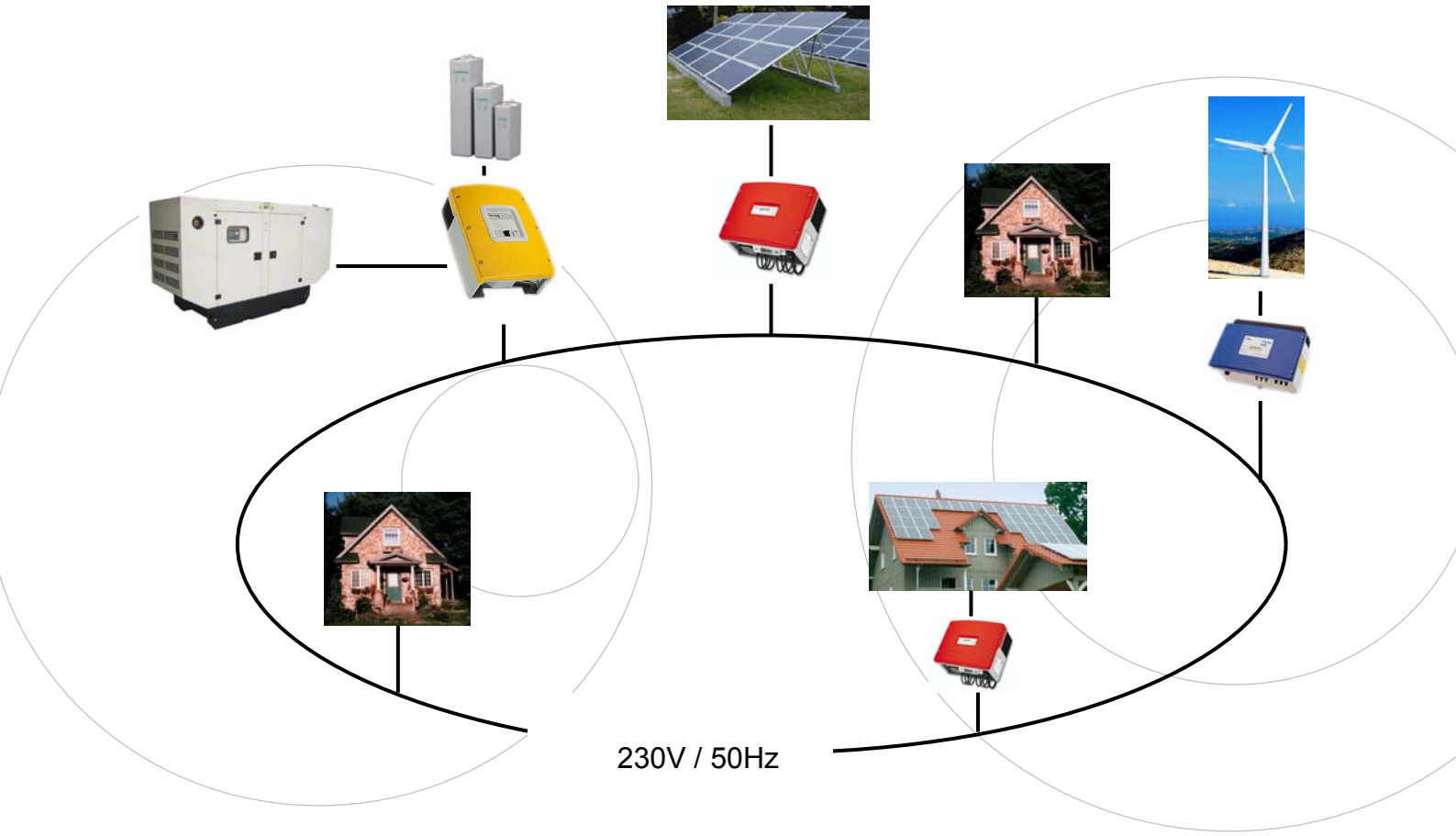
Systems for stand-alone power grids

- AC-coupled solar systems
- Island grid systems

Unlike solar home systems that are designed to power a single home or batch, Alphatron microGrids are designed to easily expand by including multiple homes and/or multiple generation sources.

The difference between solar home systems (such as the Alphatron solarPak) and a microGrid, is in the way the system components are connected together. In a solar home system, the different generation sources and inverters are connected together on the DC (battery) side. This limits the distance that components can be placed apart and it also limits the way in which the system can be expanded.

Drawing on technology developed by SMA Technologie for grid-connected PV systems, in a microGrid, the generation sources, battery and loads (consumers) are all connected together on the ac-side. This is called ac-coupling. In contradiction to DC-power, AC-power is uniform and heavily standardized. Normal ac-reticulation can be used and different sources such as PV, wind, hydro, multiple battery banks etc. can all be integrated into one microGrid.



Alphatron microGrid systems are the best choice of power source for the following applications:

- Power systems for communities or sites with multiple dwellings
- Power systems with more than one source of generation (Solar, wind, hydro etc.)
- Power systems with large distance between source and consumer (e.g. wind turbine on hill)
- Off grid PV solar systems with more than 1kWp solar

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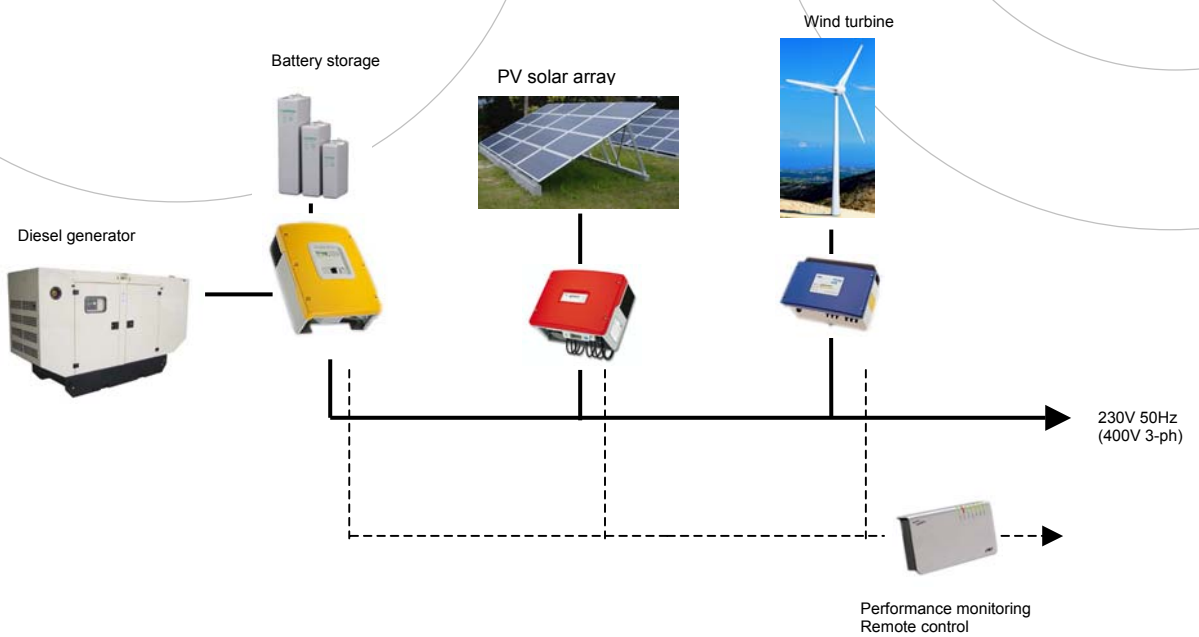
Advantages of ac-coupling

The main advantages of ac-coupling are:

- ***Natural sharing of resources***. Much like the public grid, within a microGrid, there will be diversification between the connected consumers. The more users are connected to the microGrid, the bigger the advantage of diversification. Less equipment will be required for the same power requirement when the consumers are connected to a microGrid as compared to powering each consumer with a solar home system.
- ***Easy expansion***. Additional consumers, additional generation sources and additional battery capacity can be easily added to a microGrid at any time. The microGrid can grow as e.g. the village grows.
- ***Power transmission over long distance***. Because system components are connected together on the ac-side, they can be further apart from each other without the need for heavy DC cables. Standard reticulation techniques such as step-up transformers can be used to transmit power over even greater distances.
- ***Easy incorporation of multiple generation sources***. Because the microGrid uses grid-tie technology, different sources such as PV solar, wind, hydro and diesel can all be connected to the system using standard grid-tie inverters.
- ***High efficiency.*** In a microGrid, PV solar (wind / hydro) power is directly converted into ac-power at very high efficiency (up to 98%). So power can flow directly from source to consumer. This in contrast to solar home systems where PV solar (wind) power is first converted to dc-battery charge voltages and than back again to ac-power for the consumer.
- ***High yield.*** Using state of the art technology such as string inverters with high voltage string arrays (minimizing cable losses) and Maximum Power Point tracking, ensure that the maximum possible is taken out of the connected PV / wind / hydro generator.
- ***Longer battery life.*** In a microGrid, there is always one and one only controller that is “in charge” of the battery charging process. This in contrast to solar home systems where multiple controllers follow their own charging regime (e.g. PV controller, wind controller, ac-charger etc.)
- ***Easy expansion of battery capacity.*** Old and new batteries should not be mixed. If battery capacity needs to be increased in a solar home system, this means the complete battery bank must be replaced. In a microGrid, additional battery capacity can be connected to the system via its own battery inverter, thus increasing the total storage capacity in the microGrid system without making the old battery bank obsolete.



microGrid system components

A microGrid system is built with the following system components:

Sunny Island Battery Inverter. The SMA SunnyIsland Battery Inverter is the heart of the system. It creates the grid to which the grid-connect inverters are connected. It also controls the charging of the battery and the start and stop of the diesel generator. Three models are available for different power requirements. Multiple SI 5048 can be used in parallel (1- or 3-phase) and in multi cluster configurations

	SI 3324	SI 4248	SI 5048
DC Voltage	24V	48V	48V
Continuous ac-power [W]	3300	4200	5000
P 30 min / 1 min	4200 / 5000	5400 / 7000	6500 / 8400
I nominal [A]	14.5	18	21.7
I max (100ms) [A]	100	100	100
Max generator current [A]	56	56	56
Auto generator start	Yes	Yes	Yes
Load shedding	Yes	Yes	Yes
Cont. charge current [A]	104	80	100
Max charge current [A]	140	100	120
Standby consumption	< 4W	< 4W	< 4W
Max efficiency	94.5%	95%	95%
Connect in parallel	No	No	Yes
Programmable relays	2	2	2
Interfaces	RS232, RS485	RS232, RS485	RS232, RS485, CAN
Protection	IP30	IP30	IP40
Dimensions w x h x d [mm]	390 x 590 x 245	390 x 590 x 245	467 x 612 x 235
Weight [kg]	39	39	63

microGrid models. Each microGrid initially starts as one of the below microGrid base models. These base models are upwards compatible, so a system 1 can grow into a system 2 and so forth. Each microGrid base models comes with all circuit protection devices, cabling and cable ducts required to build the core of the system. ***gridPak*** PV generators are then added to build the microGrid system.

	microGrid-1	microGrid-2	microGrid-3	microGrid-MC
Type	1-phase	1-phase	1-ph / 3-ph	Multi cluster
Battery banks	1	1	1	multiple
P continuous	5 kW	10 kW	15kW	> 10kW
P 1 min	8.4 kW	16.8 kW	25.2 kW	> 16.8 kW
P surge	100A	200A	300A	> 200A
Max ac generator	56A	112A	168A	> 112A

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Battery Bank. The battery bank connects to the Sunny Island and provides energy storage. Our microGrids use either deep cycle gel or deep cycle flooded batteries. Alphatron can assist in sizing optimum energy storage for your application.

24V Battery Banks Flooded					
Model	**Cells**	**Lxbxh (cell)**	**Weight [kg/cell]**	**C_{10} [Ah]**	**Storage [kWh]**
OpzS-600-12	12	147 x 208 x 710	57.7	686	8.2
OPzS-800-12	12	215 x 193 x 710	78.2	915	10.9
OPzS-1200-12	12	215 x 277 x 710	113.5	1372	16.4

48V Battery Banks Flooded					
Model	**Cells**	**Lxbxh (cell)**	**Weight [kg/cell]**	**C_{10} [Ah]**	**Storage [kWh]**
OpzS-600-24	24	147 x 208 x 710	57.7	686	16.4
OPzS-800-24	24	215 x 193 x 710	78.2	915	22.0
OPzS-1200-24	24	215 x 277 x 710	113.5	1372	32.4

24V Battery Banks GEL					
Model	**Cells**	**Lxbxh (cell)**	**Weight [kg/cell]**	**C_{10} [Ah]**	**Storage [kWh]**
OpzV-600-12	12	147 x 208 x 710	50	644	7.7
OPzV-800-12	12	215 x 193 x 710	68	859	10.3
OPzV-1200-12	12	215 x 277 x 710	97	1288	15.4

48V Battery Banks GEL					
Model	**Cells**	**Lxbxh (cell)**	**Weight [kg/cell]**	**C_{10} [Ah]**	**Storage [kWh]**
OpzV-600-24	24	147 x 208 x 710	50	644	15.4
OPzV-800-24	24	215 x 193 x 710	68	859	20.6
OPzV-1200-24	24	215 x 277 x 710	97	1288	30.8

*) Storage based on 50% depth of discharge

PV String Inverter. Alphatron microGrids use SMA SunnyBoy string inverters to connect PV solar arrays to the microGrid.
PV modules are connected in series to build high voltage strings, which are connected to the string inverter. Using high voltage reduces cable losses and reduces cable cost.
Each string inverter is equipped with a Maximum Power Point Tracker to ensure that the PV array always operates in its maximum power point.

gridPak. A convenient way to add PV to your microGrid is to use an Alphatron ***gridPak***. A gridPak contains all equipment and materials (PV modules, module support structure, inverter, special cabling etc.) to build a complete PV solar generator that connects to the microGrid.

Wind / Hydro inverter. SMA WindyBoy iverters are used to connect wind turbines or hydro turbines to the microGrid.

Generator. A generator is optional in the microGrid system. When a generator is included, the Sunny Island inverter controls the start- and stop of the generator depending on remaining energy reserves and on ac-power demand in the microGrid. The operation, including generator warm up- and cool down time and connection of the generator to the microGrid is fully automatic.

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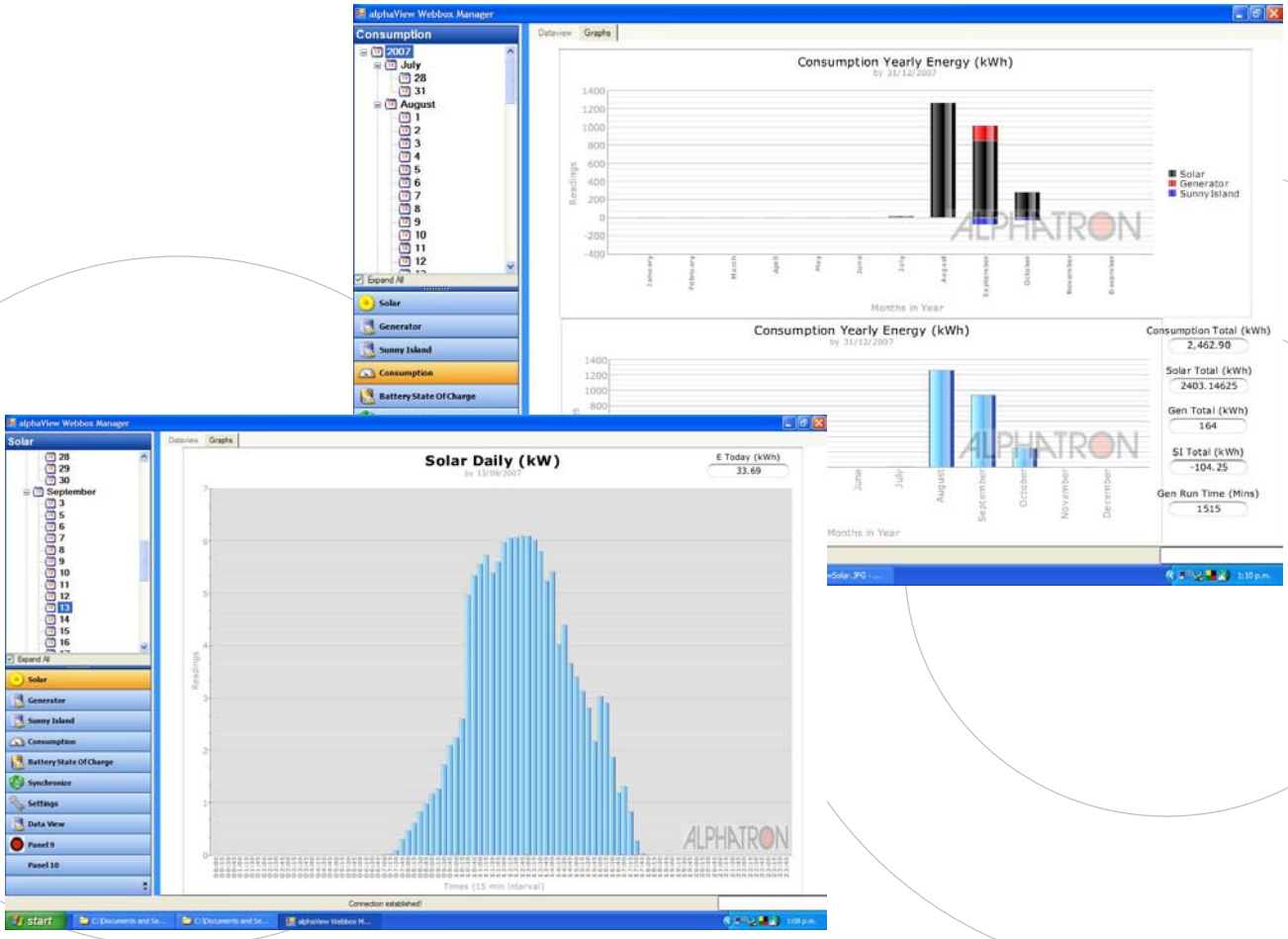
Sunny WebBox monitoring

The Sunny WebBox provides easy interfacing of the microGrid to the internet. The system can be monitored and controlled from any PC with internet access and a web browser. With the optional SensorBox, a complete weather data and system performance monitoring and data logger can be built. The data collected can be used for applications such as updating internet websites in real time or to drive large public displays.

Use the ***alphaView*** software package to organize your generation and consumption data by day, month or year and to log system parameters, including state of charge of batteries and diagnostic codes.



Use ***SunnyPortal*** to access your plant via the internet from anywhere in the world.

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microGrid Dimensioning Questionnaire

Customer information

Project _____ ☐ New plant
Customer Name _____ ☐ Upgrade / refurbish
Address _____ ☐ Commissioning by Alphatron required
_____
E-mail _____ Delivery date

Site data

Site Location _____
_____
Solar irradiation _____ kWh/m2/a
Average wind speed _____ m/s
Ambient temperature _____ °C min _____ °C max
Altitude _____
Roof cladding _____
Roof orientation _____
Roof pitch _____

Loads / Consumption

	Daily		Summer		Winter		Yearly	
Energy	_____	kWh/d	_____	kWh/d	_____	kWh/d	_____	kWh/a
Nominal load	_____	kW	_____	kW	_____	kW	_____	kW
Max load	_____	kW	_____	kW	_____	kW	_____	kW
Min load	_____	kW	_____	kW	_____	kW	_____	kW

Specific loads. Are there any loads with special requirements? (e.g. high start currents) _____
_____
_____

Electric data

Grid Voltage _____ V ☐ Island Grid ☐ Utility backup
Frequency _____ Hz ☐ 1-phase ☐ 3-phase

Battery Voltage ☐ 24V ☐ 48V
Capacity (C10) _____ Ah or Autonomy _____ h

Generation Sources ☐ Diesel ☐ PV ☐ Wind ☐ Hydro ☐ Other

Communication ☐ ADSL ☐ Modem ☐ GSM ☐ Off-line ☐ Not required

Please include system block diagrams / daily load curves etc. if available

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Generation Sources

Diesel generator ☐ Existing ☐ New
Manufacturer _____ Model _____
Type ☐ Synchronous ☐ Asynchronous
Power _____ kVA
Voltage _____ V
Current _____ A

PV Solar ☐ Existing ☐ New
Manufacturer _____ Model _____
Power _____ kWp
Voltage _____ V
Current _____ A
Mounting ☐ Free standing ☐ Roof top ☐ Façade ☐ Building integrated
Orientation Azimuth _____ Pitch _____

Wind turbine ☐ Existing ☐ New
Manufacturer _____ Model _____
Type ☐ Synchronous ☐ Asynchronous
Power _____ kVA
Voltage _____ V
Current _____ A
F Control ☐ Electronic ☐ Mechanical
V Control ☐ Electronic ☐ None
Grid forming ☐ Yes ☐ No

Hydro turbine ☐ Existing ☐ New
Manufacturer _____ Model _____
Type ☐ Synchronous ☐ Asynchronous
Power _____ kVA
Voltage _____ V
Current _____ A
F Control ☐ Electronic ☐ Mechanical
V Control ☐ Electronic ☐ None
Grid forming ☐ Yes ☐ No

Other ☐ Existing ☐ New
Manufacturer _____ Model _____
Type ☐ Synchronous ☐ Asynchronous
Power _____ kVA
Voltage _____ V
Current _____ A
F Control ☐ Electronic ☐ Mechanical
V Control ☐ Electronic ☐ None
Grid forming ☐ Yes ☐ No

Comments

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