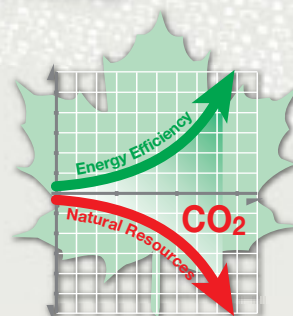


Excellent Technology, Efficiency and Quality



**ENERTRONIC modular**  
Three Phase UPS System  
with Modular, Hot-Plug Design





# ENERTRONIC modular Three Phase UPS System with Modular, Hot-Plug Design

## Introduction

BENNING has been supplying modular DC power solutions for IT, telecom and industrial applications for more than 20 years. These DC systems are very reliable as they consist of parallel operating hot-plug DC power modules with n+1 redundant configuration. This design allows easy and rapid replacement as well as upgrade or downgrade of the power capacity following any change in the load requirements.

## ENERTRONIC modular the modular UPS System with premium Availability and high Flexibility

Each module within the ENERTRONIC modular is an independent double conversion UPS with three phase input, rectifier, inverter, static-bypass, DSP regulator and three phase output.

The power modules, with true hot-plug design, allow the addition or replacement of modules without any power interruption. The advanced decentralised parallel architecture of the ENERTRONIC modular UPS system offers maximum power protection availability. (Fig. 1)

## Features of the ENERTRONIC modular UPS Systems:

- Scalable UPS systems with hot-plug power modules
- N+1 redundancy ensures maximum availability
- Advanced UPS design with IGBT and MOSFET semiconductors and DSP processors
- UPS classification VFI-SS-111 in accordance with EN/IEC 62040-3
- High efficiency, also at partial load, reduces energy losses
- Sinewave input current (powerfactor 0.99)
- Input current with low harmonic distortion (THDi < 5%)
- Short MTTR (Mean Time To Repair)  
Replacement of modules without load interruption
- Online diagnosis and monitoring

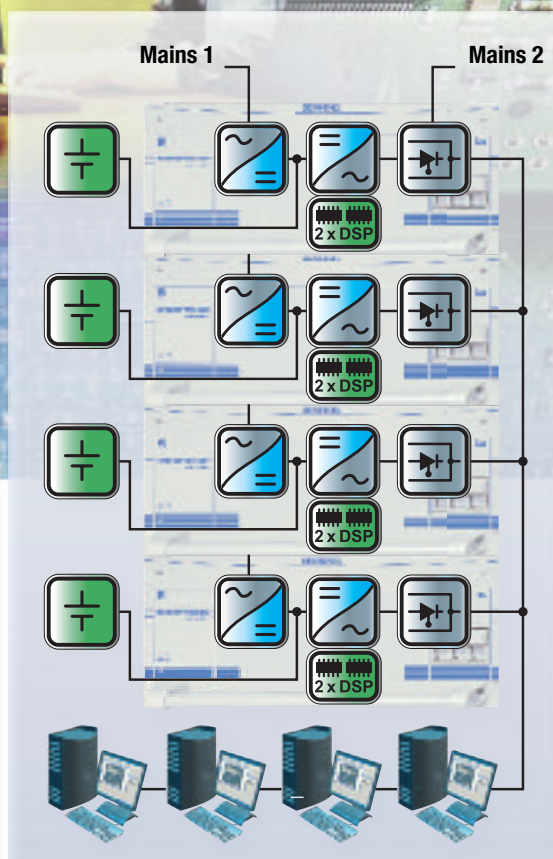


Fig. 1: Decentralised parallel architecture

The modules can be replaced without the loss of output power.

Following this trend in the standby DC market, more and more customers are now demanding a similar modular, n+1 redundant, solution for their UPS requirements.

BENNING followed these customers requests and has developed the ENERTRONIC modular UPS range with parallel operating, three phase hot-plug, UPS modules.

ENERTRONIC modular UPS systems are available with 20 kVA or 40 kVA modules. These modules provide scalable solutions with steps between 40 kVA and 480 kVA (n+1 redundant).

The modular design simplifies system upgrade or downgrade and avoids high investment costs for power which is not required at initial installation.

# ENERTRONIC modular

## Reliable, Cost Saving, Scalable

### DSP Technology

In each ENERTRONIC module two Digital Signal Processors (DSP) are responsible for regulation and monitoring. Thanks to this advanced design the quantity of electronic components has been reduced compared to conventional UPS systems which results in better MTBF figures.

The power section of the ENERTRONIC modules is based on MOSFET and IGBT technology which results in less module weight and size (30% to 50% lower), compared to conventional UPS systems.

### High Efficiency, even at partial loads, means less TCO (Total Cost of Ownership)

High efficiency of UPS systems is essential to reduce operating costs.

The ENERTRONIC modular UPS has been designed to provide high efficiency at full rated loads and also at partial loads. (Fig. 2)

This excellent efficiency lowers the UPS energy consumption as well as the investment and operating costs for the air-conditioning equipment.

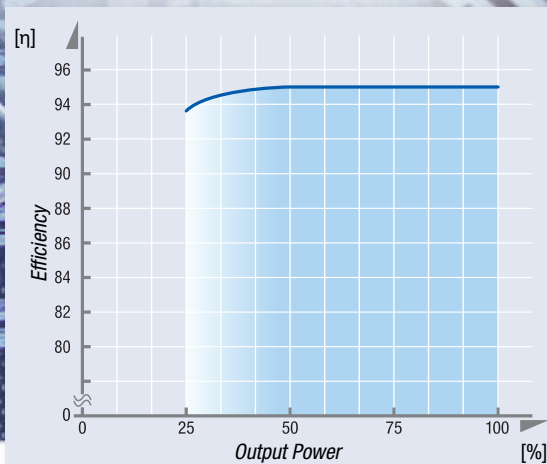


Fig. 2: Efficiency versus output power (40 kVA module)

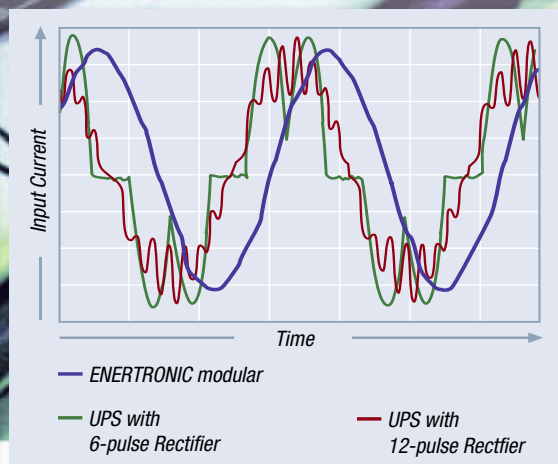


Fig. 3: The near unity power factor of the ENERTRONIC modular, results in very low harmonic distortion on the mains.

### Sinewave Input Current and less than 5% THDI results in Investment and Energy Savings (Fig. 3)

The level of harmonic pollution on the input current of conventional UPS systems is about 33%.

Input cables and fuses as well as generator sets have to be oversized to operate these UPS systems as they take additional reactive power from the mains.

In some cases, especially for bigger UPS systems, 12-pulse rectifiers or filter systems are necessary to compensate this reactive power value, resulting in increased investment and operating costs.

The THDI value of ENERTRONIC modular UPS systems is less than 5%. Thanks to the inbuilt active power factor correction, the  $\cos \phi$  of the sinewave input current is 0.99. As a result of these advantages, ENERTRONIC modular UPS systems do not need any filter systems or oversized gensets.

### Classification of the ENERTRONIC modular UPS in accordance with EN/IEC 62040-3 (Fig. 5)

The ENERTRONIC modular UPS is classified as level VFI-SS-111 in accordance with EN/IEC 62040-3.

| Part 1  | Part 2  | Part 3   |
|---|---|--|
| (VFI, VI, VFD)  | (SS, XX, YY)  | (111, 222, 333)  |
| defines the dependency of the UPS output with regard to the mains input | defines the output waveform, sinusoidal or non-sinusoidal | Defines the output voltage limits under dynamic deviations |

**Part 1 (VFI):** The output voltage is independent of all mains voltage and frequency variations.

**Part 2 (SS):** The output waveform is sinusoidal with all linear and non-linear loads.

**Part 3 (111):** The dynamic deviation of the output voltage will not exceed the three tolerance curves of the standard EN/IEC 62040-3 if

- the operation mode changes
- during linear load steps
- during non-linear loadsteps



# ENERTRONIC modular Availability without Compromise



Fig. 4: Comparison of parallel redundant UPS configurations. ENERTRONIC modular compared to traditional standalone UPS systems.



Fig. 5 (above): ENERTRONIC modular with combination cabinet and batteries, output power 20 kVA (n+1)

## Hot-plug modular redundant Design means highest Availability and short MTTR (Mean Time To Repair)

The modular n+1 redundant concept of the ENERTRONIC modular UPS, together with real hot-plug design, provides the highest availability of power protection.

The redundant design still provides 100% power to the load even if one module fails.

The replacement of the faulty module can be achieved in less than 10 minutes if a spare is available on site. After replacement, the UPS is back to redundant operation. Redundancy with conventional UPS systems requires a second complete system for parallel operation (Fig. 4).

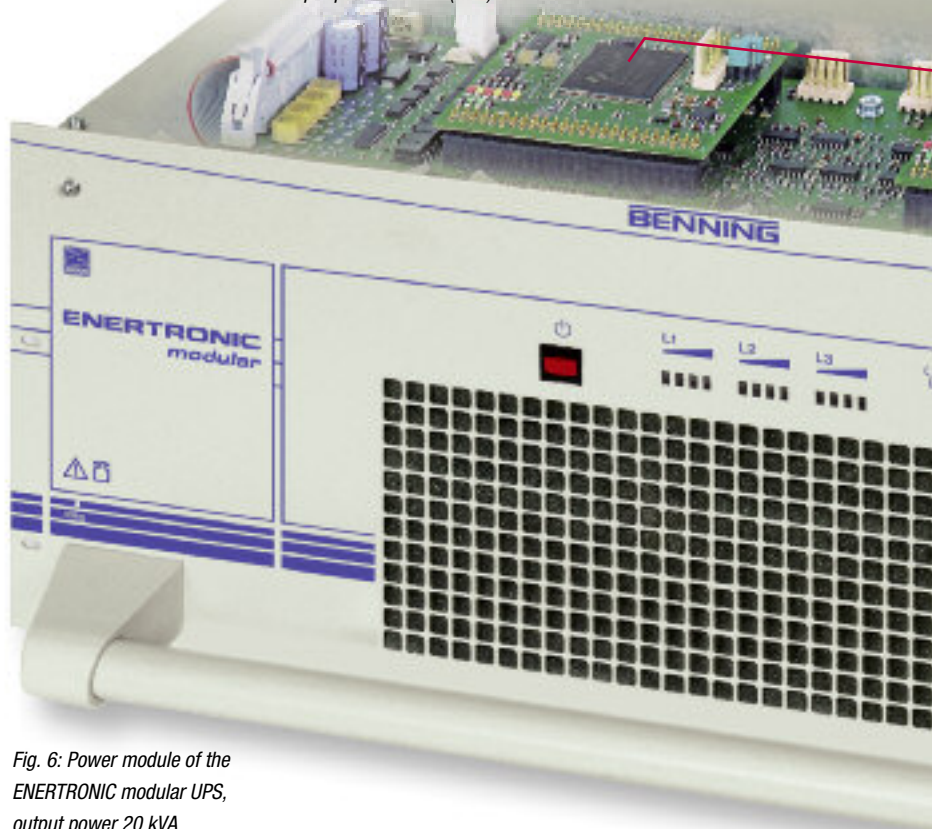


Fig. 6: Power module of the ENERTRONIC modular UPS, output power 20 kVA

# ENERTRONIC modular *Simple Operation, rapid Diagnosis*

## **Compact UPS Cabinets with high Power Density need less Floor Space**

The dimensions of standard cabinets for 20 kVA modules are 1800/2000 x 600 x 800 mm (H x W x D).

The cabinets are designed to accommodate up to 5 or 6 power modules (depending on height) with 20 kVA modules providing 80 kVA or 100 kVA system power in n+1 configuration.

No additional cabling is required for future power upgrade.

For the integration of batteries and 20 kVA power modules combination cabinets are available. (Fig 5)

## **Improved Output Power and higher Power Density with 40 kVA Power Modules**

The dimensions of system cabinets designed for 40 kVA power modules are 1800/2000 x 800 x 800 mm (H x W x D).

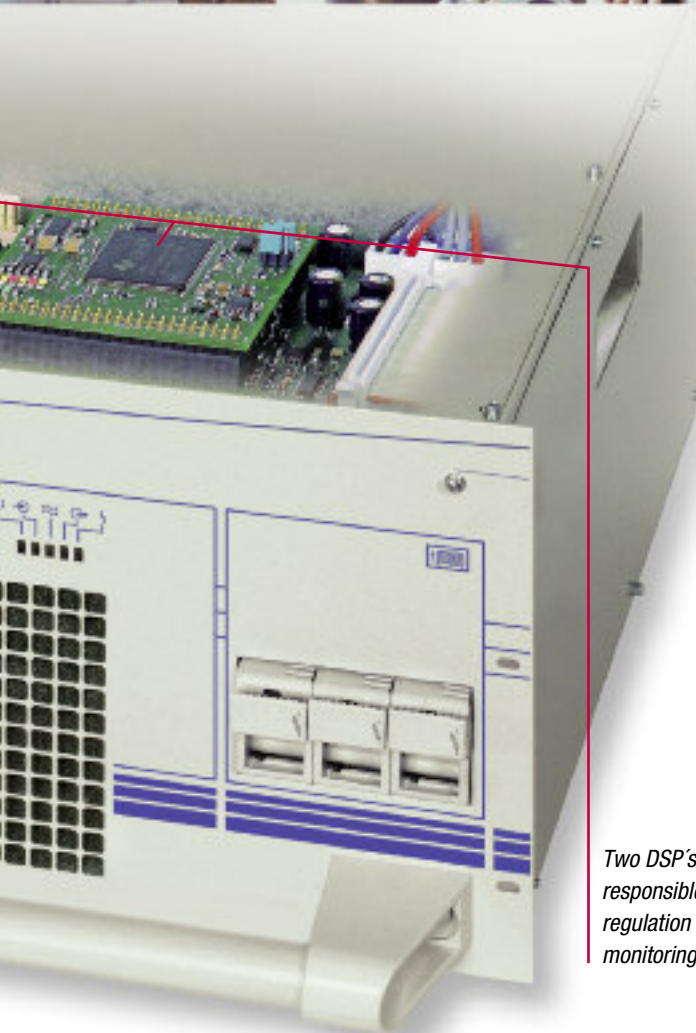
These cabinets can accommodate up to four or five 40 kVA power modules (depending on height) providing 120 kVA or 160 kVA system power in n+1 configuration.

## **More Output Power with Distribution Cabinets**

The 2000 mm high standard cabinets can accommodate up to six 40 kVA power modules if the system distribution cabinet with built-in manual by-pass and input and output terminals is used.



Fig. 7:  
ENERTRONIC modular with distribution cabinet,  
output power 200 kVA (n+1)



Two DSP's are responsible for all regulation and monitoring functions.

## **UPS Remote Monitoring and Management System MCU with Front Panel Display**

The MCU provides local and remote monitoring and control of the UPS ENERTRONIC modular.

The front panel with graphic display and keypad enables easy local operation and monitoring of the system as well as the selection of different options and parameters.

The built-in event recorder stores up to 250 events which are date and time stamped.

Remote control and monitoring of the MCU is possible via a modem or over the Internet.

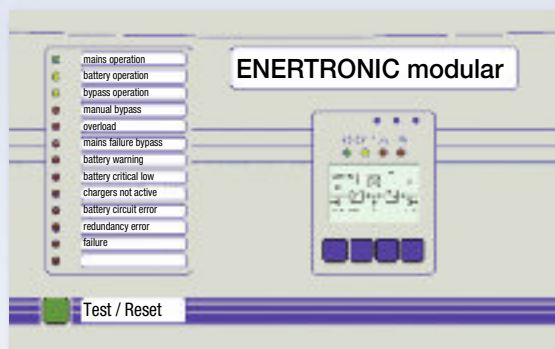


Fig. 8: Display and control unit

# ENERTRONIC modular Local and Remote Monitoring System

## ENERTRONIC modular with maximum Output Power Capacity

With two UPS cabinets each housing six power modules and one distribution cabinet, the output power capacity increases to 440 kVA (n+1 configuration).

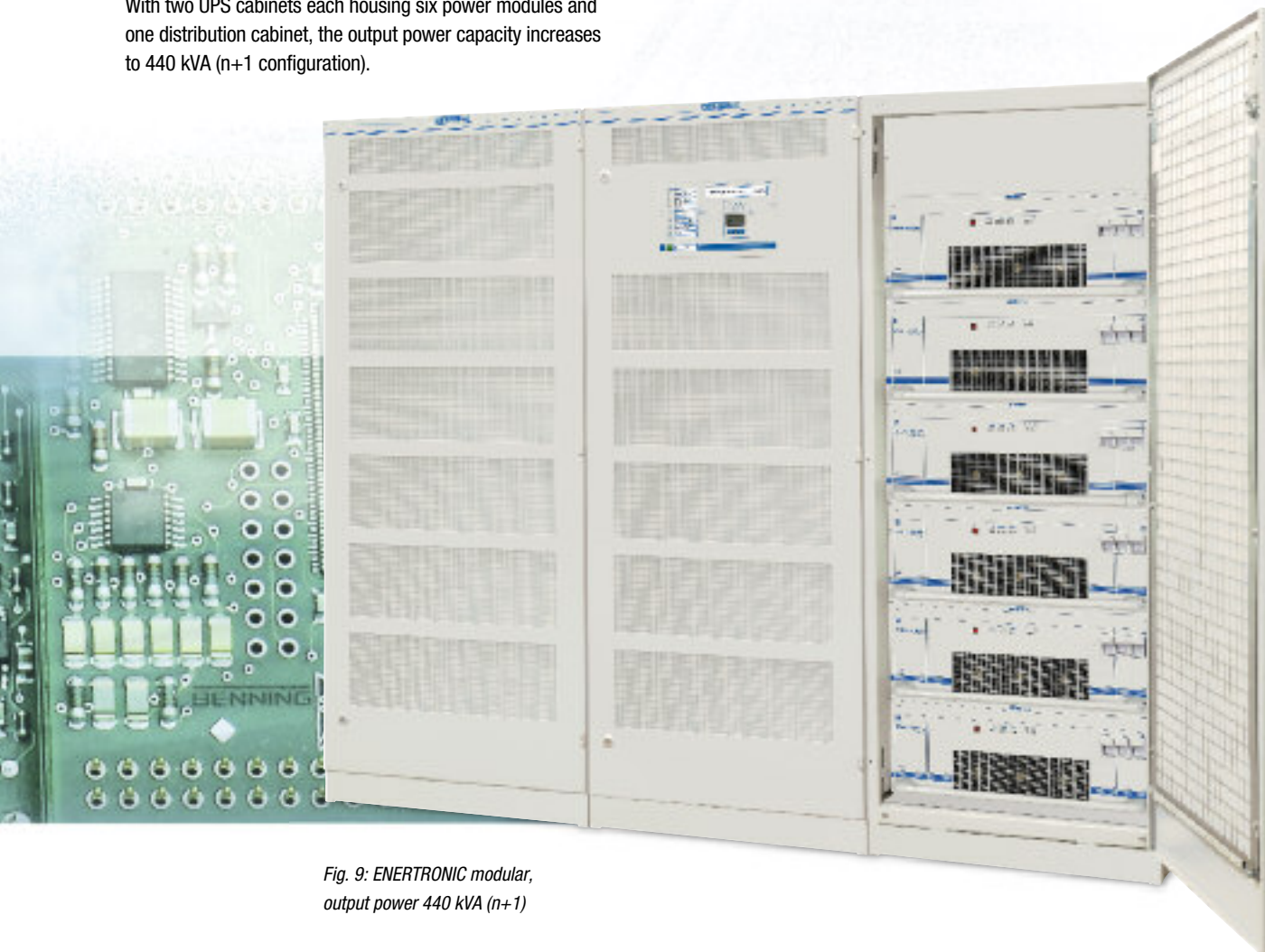


Fig. 9: ENERTRONIC modular, output power 440 kVA (n+1)

### SNMP – Network Management Integration

The internationally recognised simple network management protocol (SNMP) is provided as standard and allows simple monitoring of the UPS.

The ENERTRONIC modular UPS can also be integrated into Network systems like HP-Openview, IBM-Netview, Novell NMS and other compatible systems.

### RCCMD automatic Power-Shutdown and Monitoring Software

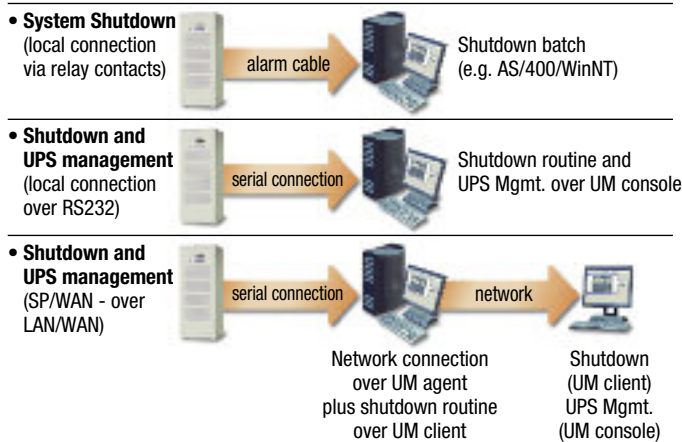
RCCMD allows the automation of different actions based on certain events. E. g. arranged shut down of individual PC's over the network or broadcasting messages or e-mails e.g. battery undervoltage.

### BENNING MCU Service-Software

This software package allows the complete monitoring and control of the ENERTRONIC modular UPS on site or via serial interface, network or modem.

It is also able to monitor realtime processing information and past events.

### UPS Communication – 3 Possibilities:



### Remote Control

The following remote control functions are provided as standard

- Emergency power off (EPO)
- Generator operation (blocks the bypass)
- External battery disconnecting switch open

# Technical Specification

## ENERTRONIC modular 40 – 480 kVA

### UPS ENERTRONIC modular with 20 kVA modules

|                    |       |    |    |    |     |     |  |
|--------------------|-------|----|----|----|-----|-----|--|
| Rated output power | [kVA] | 40 | 60 | 80 | 100 | 120 |  |
|                    | [kW]  | 32 | 48 | 64 | 80  | 96  |  |
| No. of modules     |       | 2  | 3  | 4  | 5   | 6   |  |

#### Input

|                 |     |                                  |    |     |     |     |  |
|-----------------|-----|----------------------------------|----|-----|-----|-----|--|
| Input current   | [A] | 62                               | 93 | 124 | 155 | 186 |  |
| Nominal voltage | [V] | 3 x 400 / 230 ± 15 %, +N (± 5 %) |    |     |     |     |  |

### UPS ENERTRONIC modular with 40 kVA modules

|                |       |    |     |     |     |       |  |
|----------------|-------|----|-----|-----|-----|-------|--|
| Output power   | [kVA] | 80 | 120 | 160 | 200 | 240*1 |  |
| No. of modules |       | 2  | 3   | 4   | 5   | 6     |  |

#### Input

|               |      |     |     |     |     |     |  |
|---------------|------|-----|-----|-----|-----|-----|--|
| Input current | [A]  | 124 | 186 | 248 | 310 | 372 |  |
| Input power   | [kW] | 86  | 129 | 172 | 215 | 256 |  |

### UPS ENERTRONIC modular with 40 kVA modules

|                |       |       |       |       |       |       |       |
|----------------|-------|-------|-------|-------|-------|-------|-------|
| Output power   | [kVA] | 280*1 | 320*1 | 360*1 | 400*1 | 440*1 | 480*1 |
| No. of modules |       | 7     | 8     | 9     | 10    | 11    | 12    |

#### Input

|               |      |     |     |     |     |     |     |
|---------------|------|-----|-----|-----|-----|-----|-----|
| Input current | [A]  | 434 | 496 | 558 | 620 | 682 | 744 |
| Input power   | [kW] | 301 | 344 | 387 | 430 | 473 | 516 |

|                          |     |                         |  |  |  |  |  |
|--------------------------|-----|-------------------------|--|--|--|--|--|
| Distortion factor (THDi) | [%] | 20 kVA ≤ 4 / 40 kVA ≤ 5 |  |  |  |  |  |
| Power factor (cos φ)     |     | ≥ 0.99                  |  |  |  |  |  |

#### Output

|                    |      |   |  |  |  |  |  |
|--------------------|------|---|--|--|--|--|--|
| Output voltage     | [V]  | 3 x 400 / 230 +N (± 5 % programmable)                         |  |  |  |  |  |
| Voltage tolerance  |      |   |  |  |  |  |  |
| static             |      | ≤ 1   |  |  |  |  |  |
| asymmetric load    | [%]  | ≤ 2 with 100 %  |  |  |  |  |  |
| dynamic            |      | ≤ 5 with 100 % load step                                      |  |  |  |  |  |
| Regulation time    | [ms] | ≤ 20  |  |  |  |  |  |
| Nominal frequency  | [Hz] | 50 ± 0.1 %  |  |  |  |  |  |
| Distortion factor  | [%]  | ≤ 2 with linear load<br>≤ 5 with non linear load EN 50091-1-1 |  |  |  |  |  |
| Crest factor       | [%]  | ≥ 3 : 1   |  |  |  |  |  |
| Overload           |      |   |  |  |  |  |  |
| Inverter           |      | 150 % for 60 sec, 125 % for 10 min with three phase load      |  |  |  |  |  |
| Electronic by-pass |      | 150 % for 10 min, 500 % for 100 ms                            |  |  |  |  |  |
| Short circuit      |      | 200 % for 3 sec   |  |  |  |  |  |
| Service by-pass    |      | installed   |  |  |  |  |  |

### Other specifications

|                         |      |  |
|-------------------------|------|--|
| Efficiency              | [%]  | 94.5   |
| EMC                     |      | IEC 62040 - C3                                   |
| Permitted ambient temp. | [°C] | 0 to +40   |
| Storage temp.           | [°C] | -25 to +70                                       |
| Relative humidity       | [%]  | 5 to 95 non condensing                           |
| Installation height     | [m]  | < 2000 m over absolute altitude without derating |
| Cabinet protection      |      | IP 20  |
| Painting                |      | RAL 7035 textured                                |
| Weight / 20 kVA modules | [kg] | 40   |
| 40 kVA modules          |      | 65   |

### Pb-Battery

|                               |  |               |
|-------------------------------|--|---------------|
| No. of cells / 20 kVA modules |  | 2 x 108 – 144 |
| 40 kVA modules                |  | 2 x 120 – 144 |

**Standards** EN 60801, EN 60950, EN 61000, EN 62040-1, EN 62040-2, EN 62040-3, EN 62040-1-1, VGB 4

(\*1: Systems above 240 kVA output power need the additional distribution cabinet.)

### Cabinets for systems with 20 kVA modules

| Type                 | Height  | Width  | Depth  | Weight*2 |
|----------------------|---------|--------|--------|----------|
| PSJ 1868 (5 modules) | 1800 mm | 600 mm | 800 mm | 190 kg   |
| PSJ 2068 (6 modules) | 2000 mm | 600 mm | 800 mm | 210 kg   |

(\*2: without modules)

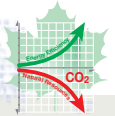
Specifications are subject to change without notice.

### Cabinets for systems with 40 kVA modules

| Type                         | Height  | Width  | Depth  | Weight*2 |
|------------------------------|---------|--------|--------|----------|
| <b>Standard cabinets</b>     |         |        |        |          |
| PSJ 1888 (4 modules)         | 1800 mm | 800 mm | 800 mm | 210 kg   |
| PSJ 2088 (5 modules)*3       | 2000 mm | 800 mm | 800 mm | 240 kg   |
| <b>Distribution cabinets</b> |         |        |        |          |
| PSJ 2088                     | 2000 mm | 800 mm | 800 mm | 250 kg   |

(\*3: Standard cabinets with six 40 kVA modules need the additional distribution cabinet.)

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