BENNING

World Class Power Solutions

Industry

INVERTRONIC compact
Modular, Single Phase Inverters

INVERTRONIC compact
Cost Saving Power Protection Availability

Mains failure and mains disturbances may cause serious problems

More and more mission critical loads for industrial and commercial applications require a smooth and uninterrupted supply of electricity.

On the public network, major loads as well as lightning strikes, generate dynamic over voltages, under voltages, sags/brownouts and transients.

Voltage Phenomenon	Time	e.g.
1. Outage - blackouts	> 10 ms	
2. Sags/brownouts	< 16 ms	
3. Dynamic overvoltage	4...16 ms	
4. Undervoltage	continuous	
5. Overvoltage	continuous	
6. Transients (Surge)	< 4 ms	
7. Lightning	sporadic	
8. Voltage distortion HF (Burst)	periodically	
9. Voltage harmonics	continuous	
10. Frequency variations	sporadic	

published by ZVei: UPS Guide

Table of main disturbances

Malfunctions in the public network (see table of mains disturbances above) may cause hardware failure, disruption of critical loads, unplanned production downtime or loss of communication.

Inverter systems are often the perfect choice to supply reliable and conditioned AC power to mission critical applications.

Invertronic *compact* inverter systems ensure continuous power protection availability

Benning`s new advanced INVERTRONIC *compact* single phase inverter systems provide continuous and high quality AC power for mission critical loads in the industrial and commercial market place.

The INVERTRONIC *compact* inverter modules offer a very flexible platform to design compact AC/AC power solutions in combination with the modular rectifier range 3000I and 12000I.
(see pages 5 & 6 for examples)

Fig. 1: 19" Sub-rack with 3 INVERTRONIC compact inverters, static and manual bypass

Fig. 2: 19" Sub-rack with 5 INVERTRONIC compact inverters

The INVERTRONIC *compact* range consists of the following system components:

1. 19"sub-rack

The 19" sub-rack is designed to accommodate the INVERTRONIC modules and can be integrated into 19" floor standing or wall mounted cabinets.

The following sub-rack versions are available:

1. Sub-rack with back plane connections for up to 3 inverter modules, one static bypass module and a manual bypass. (fig. 1)

2. Sub-rack with back plane connections for up to 5 inverter modules. (fig. 2)

INVERTRONIC compact
Modular Design, Multiple System Integration

2. Parallel operating Inverter modules

INVERTRONIC inverter modules are available for use with DC input voltages of 110V or 220V. The standard AC output voltage is 230V, but 220V and 240V are selectable. Each inverter module can supply 1.5kVA rated output power.

The hot-plug design of the inverter modules together with the dimensions of 1/5 19 inch width and 3U height allows the accommodation into 19 inch 3U sub-racks.

3. Static bypass switch

The static bypass switch increases the availability of the inverter system and provides security during overload or short circuit.

The bypass switch transfers the load to the mains if the inverter output deviates outside the acceptable tolerances for both, voltage and frequency, caused by short circuit, overload, or inverter failure.

Automatic transfer of the load back to the inverter is made after the inverter output has returned to within tolerance. The transfer time is less than 2ms.
The static bypass has the same dimensions as the inverter modules and can be integrated into the 19 inch sub-rack. (Fig.5).

4. Manual bypass switch

The additional integrated manual bypass switch is located beside the static bypass switch and allows the manual transfer of the load to the mains or to the inverter output. This switch allows the inverter modules and the static bypass module to be bypassed for service reasons.

INVERTRONIC *compact*
Key Features:

- **Advanced inverter technology with DSP (digital signal processing) and IGBT/MOSFET semiconductors**
- **Scaleable and flexible single phase inverter system with hot -plug inverter modules for parallel operation**
- **Short MTTR (Mean Time To Repair) Replacement of modules without any load break**
- **The combination with Benning's modular rectifier range, allows the realisation of very compact AC-AC systems**
- **High efficiency even at partial loads, means low operating costs**
- **N+1 redundant configuration ensures continuous availability**
- **Excellent dynamic response**
- **High power density with low volume and weight**

Block diagram of the modular construction of INVERTRONIC compact inverter systems

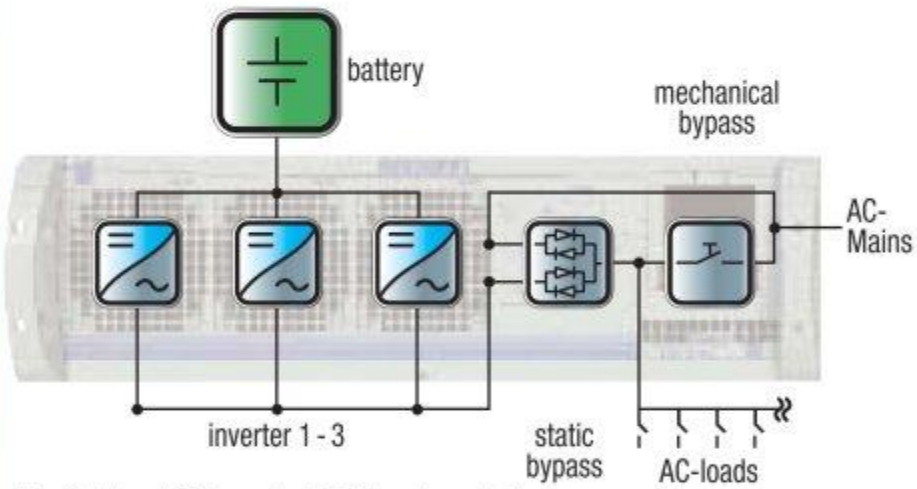

Fig. 3 (above): Sub-rack with 3 inverters, static bypass switch and manual bypass switch

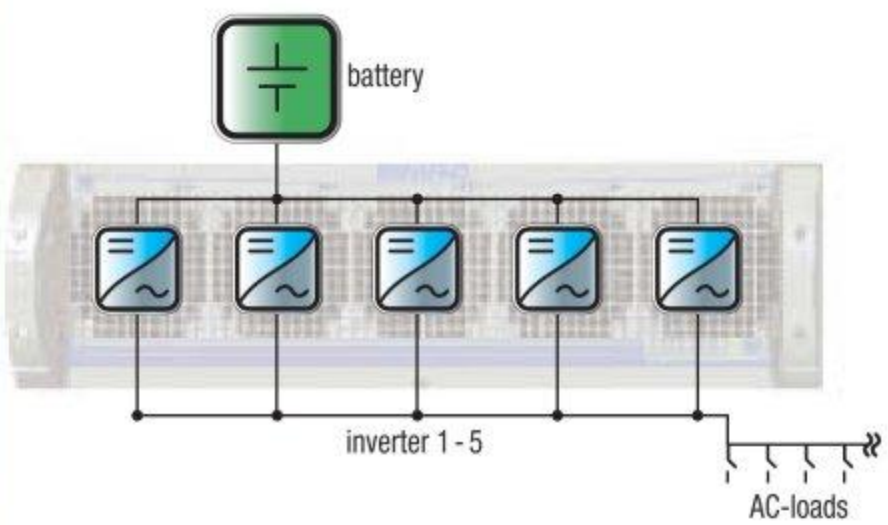

Fig. 4: Sub-rack with 5 inverters, without bypass switch

INVERTRONIC compact

Plug and Play Means Lower Operating Costs

Fig. 5: 19" Sub-rack with 3 inverters, static bypass and manual bypass, output voltage 230 V AC, output power 4.5 kVA

Fig. 6: 19" Sub-rack with 5 inverters, output voltage 230 V AC, output power 7.5 kVA

INVERTRONIC compact

Redundancy Ensures Higher Availability

Multiple system integration

The modular design of the INVERTRONIC *compact* inverters allows flexible configurations of custom designed DC/AC or AC/AC (UPS) power supply solutions.

Fig. 7: Inverter cabinet with
8 inverter modules, static and manual bypass.
Total AC output power 12 kVA

INVERTRONIC compact

Monitoring & Remote Management with MCU 2500

Figs 7 & 8, show different sizes of cabinets with sub-racks for inverters only and a combination of inverters and rectifiers.

The integration of battery and load fuses/breakers is also possible.

Monitoring system MCU 2500

The Monitoring system MCU 2500 allows local or remote operation of the INVERTRONIC *compact* systems.

The display and operation unit mounted on the front door of the system cabinet consists of liquid crystal display, 17 LED`s and 4 push buttons and allows local operation of the power system.

Remote control and monitoring is possible using modem, Ethernet, Web, SNMP, MODbus or Profibus. (Fig10)

Fig. 9: Monitoring and control unit

Fig. 8: Inverter- rectifier cabinet with:
3 inverter modules, static and manual bypass
Total AC output power 4.5 kVA
5 rectifier modules output voltage 220V DC, output current 50A DC

Fig. 10: Monitoring concept of the MCU 2500

Technical Specification
INVERTRONIC compact

Technical Specification

Inverter

Rated output power at (cos φ= 0,8) DC-Input 110 V/220 V	[kVA]	**1.5**	**3.0**	**4.5**	**6.0**	**7.5**
No. of modules		**1**	**2**	**3**	**4**	**5**
Inverter input						
Input voltage range	[%]	-15 to +20				
Permitted ripple Voltage	[%]	< 5 eff.				
Current input at 110 V DC	[A]	12	24	36	48	60
Current input at 220 V DC	[A]	6	12	18	24	30
Inverter output						
Output voltage	[V]	220/230/240 1-ph., N, PE (selectable)				
Voltage tolerance						
- static	[%]	± 1				
- dynamic	[%]	=<10 @100% load step				
Regulation time	[msec]	≤ 25				
Output current at 230 V AC	[A]	6.5	13.0	19.5	26.0	32.5
Motorload		100 % (beware of starting current)				
Overload behaviour:	[%]	2.0 x I - nom for 4 sec., 1.2 x I - nom for 60 sec., then switch off				
Short-circuit current	[A]	2.1 x I - nom for 4 sec.				
Output frequency	[Hz]	50 (60) ± 0.1 % oscillator or mains synchronised				
Synchronisation range	[Hz]	50 (60) ± 5 % (selectable)				
Wave form		sinusoidal				
Distortion factor	[%]	≤ 2 with linear load, ≤ 5 with non linear load according to EN 50091-1-1				
Efficiency at nominal output power and input voltage DC 110/220 V	[%]	≥ 91.5				

Static bypass

Rated output power	[kVA]	23 (at 230 V AC)
Input		
DC voltage	[V]	93 to 270 DC
*Mains voltage	[V]	220/230/240
Tolerance	[%]	±15
*Mains frequency	[Hz]	50/60
	[%]	max. ±5; Inverter synchronisation range
*Inverter output voltage	[V]	220/230/240 AC
Output		
Max. output current	[A]	100
*Nominal output voltage	[V]	220/230/240 AC
Voltage tolerance	[%]	max. ±15 mains operation, max. ±1 inverter operation
*Nominal output frequency	[Hz]	50/60
Max. frequency tolerance	[%]	±5 (±0.1 oscillator controlled)
Power factor	[cos φ]	0.7 ind. to 0.8 cap.
Overload	[%]	120 for 10 min.
Transfer time	[msec]	typ. 2 in accordance with DIN VDE 0558 Part 5, IEC 146-4
*Supply priority		Inverter/mains priority

(*: These adjustments can be made directly on the unit.)

Others

EMC		in according with (EN 55022)
Noise level (at 75 – 100 % load)	[dB(A)]	approx 65
Cooling		forced cooling with speed controlled fans at air inlet
Permitted ambient temperature	[°C]	0- 40°C (up to 55°C with derating 2,5 % PN/°C)
Permitted storage temperature	[°C]	-25 to +70
Relative humidity	[%]	5 – 95 without condensation
Installation altitude at nom. load	[m]	1.000 m without power reduction
Protection		IP 20 in accordance with DIN 40050
Painting		RAL 7035, structured paint finish (frontplate)
Dimensions, Sub-rack		3 U x 19“ x 300 mm (H x W x D)
Weight:		
- Sub-rack with 3 inverters, bypass and manual bypass	[kg]	21.5
- Sub-rack with 5 inverters	[kg]	23.2

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Rectifiers

For Stationary Battery Systems in Nuclear Power Plants

General

2

1.1 Application

Electronically controlled rectifier assemblies are used in conjunction with suitable lead-acid or nickel-cadmium batteries, to provide a protected DC power supply system. These systems are then used to supply power to critical loads in nuclear power plants, both when the mains supply is present, and during power failures.
Typical loads are:

- **Power station equipment**
- **Signalling, control and protective electronics**
- **Telemetering and telecontrol engineering**
- **Telecommunications equipment**
- **Static inverters**
- **AC and DC motors**
- **Solenoid valves**

The rectifier assemblies used normally give output voltages of 110 V or 220 V. When the mains supply is on, they are responsible for providing power to the load and also for supplying the charging and float charging current for the battery. This ensures that, if a mains failure should occur, the battery is ready to supply the full power. The engineering supply is provided by 26 V rectifiers or DC-DC-Converters.

The rectifiers are planned and produced in line with the appropriate KTA guidelines, and can be used in any type of power station.

Optional test equipment can be supplied with the rectifiers, to undertake the repeat measurements necessary in power station applications.

Fig. 1: Test item

1.2 Output characteristics

The units operate with an IU charging characteristic to DIN 41 773 and the variations which can be corrected for are as follows:

- Mains voltage variations of ± 10 %
- Frequency variations of ± 5 %
- Load variations from 0 to 100 %

Float charge voltage 2,23 V per cell
The float charge voltage is the voltage at which the on line loads are supplied and the battery`s nominal charge level is maintained.

Boost charging voltage 2,4 V per cell
With this higher level of constant voltage it is possible to re charge the battery more quickly after mains failure.
Access can be gained to the selector switch required to change from 2.23 V per cell and to the setting potentiometers by opening the front doors.

Commissioning
In order to charge the battery for the first time and for any equalising charges, which may be necessary, the power supply unit is also equipped to operate to a supplementary W characteristic.
With a smooth variable charging current, the battery voltage goes up to 2,7 V per cell.
The change-over of the charging characteristic from charging to commissioning is locked with an auxiliary contact of the distribution feed-in switch.
For NiCd batteries the same characteristic is produced with constant voltage values of 1,4 V per cell or 1,55 V per cell.
The max. commissioning voltage is 1,8 V per cell.

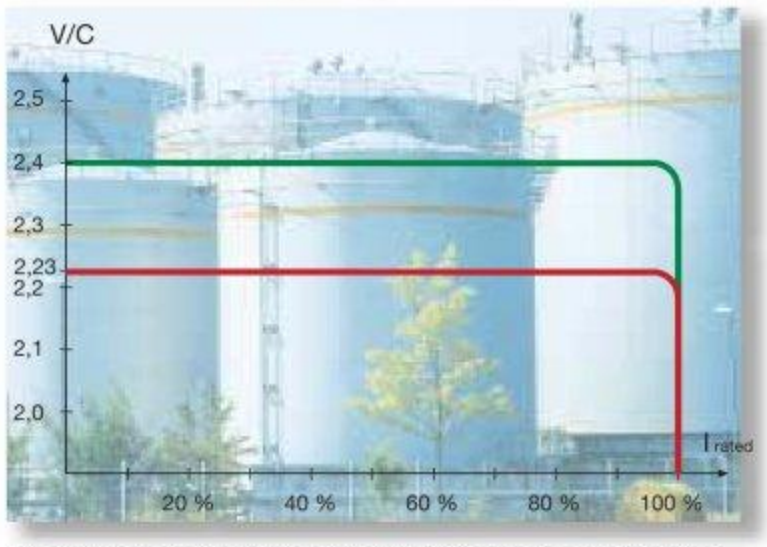


Fig. 2: IU characteristic to DIN 41773 for lead-acid batteries

1.3 Regulation

The units are regulated by a controller with thyristors acting as control devices in the rectifier assembly. The rectifier assembly is in the form of a fully controlled (6-pulse) three-phase bridge circuit.
The semi-conductors are sized to ensure that they are able to operate continuously at full load with natural ventilation. The silicon semi-conductors are protected against short circuits by ultra high-speed fuses which are designed to act as cell fuses at rated currents of more than 100 A.

1.4 Smoothing

As ripple sensitive loads could be connected a reinforced smoothing device is fitted in the units, which limits the ripple of the output voltage when operated without batteries to a value of 5 % peak-to-peak.

2. Signalling and Monitoring Devices

The power supply units are fitted as standard with electronic monitoring modules. These are integrated into a subrack (Fig.3).

2.1 DÜW III Three-Phase Current Monitoring

The DÜW III three-phase current monitoring device has three monitoring functions:

- Mains undervoltage (V_N - 15 %)
- Mains overvoltage (V_N + 15 %)
- Mains balancing

Any disturbance which arises is signalled on the front panel on a yellow LED display.
The signal output terminals are fitted with an operate delay (0.1 - 15 sec.). When the delay period expires, the signal is given on the SME I centralized fault indication module (see section 2.6), which switches off the unit. When the fault is cleared, the unit auomatically switches itself on again. The signal memory is reset using a reset button on the SME I.
If there is an overvoltage in the mains supply, a pot.-free contact is also operated which inhibits the controller for the duration of the overvoltage or for a period of no less than 200 msec, whichever is the longer.

2.2 GKÜ I Unit and Short Circuit Monitoring Device

The GKÜ I has two monitoring functions:

- current dependent undervoltage (characteristic monitoring)
- system short circuit

The unit monitoring device consists of a voltage and a current relay. If the unit output voltage falls to a value less than 2.1 V per cell and the current is less than 80 % of the nominal current, a fault signal is sent, which is indicated on a yellow LED. The short circuit monitoring device also consists of a voltage and a current relay.

If the voltage falls below 1.6 V per cell and the current is 100% of the nominal current, a fault signal is given. The signal is processed on the SME I and in the unit as described in 2.1. However the unit only switches itself back on once acknowledgement has been given on the SME I.

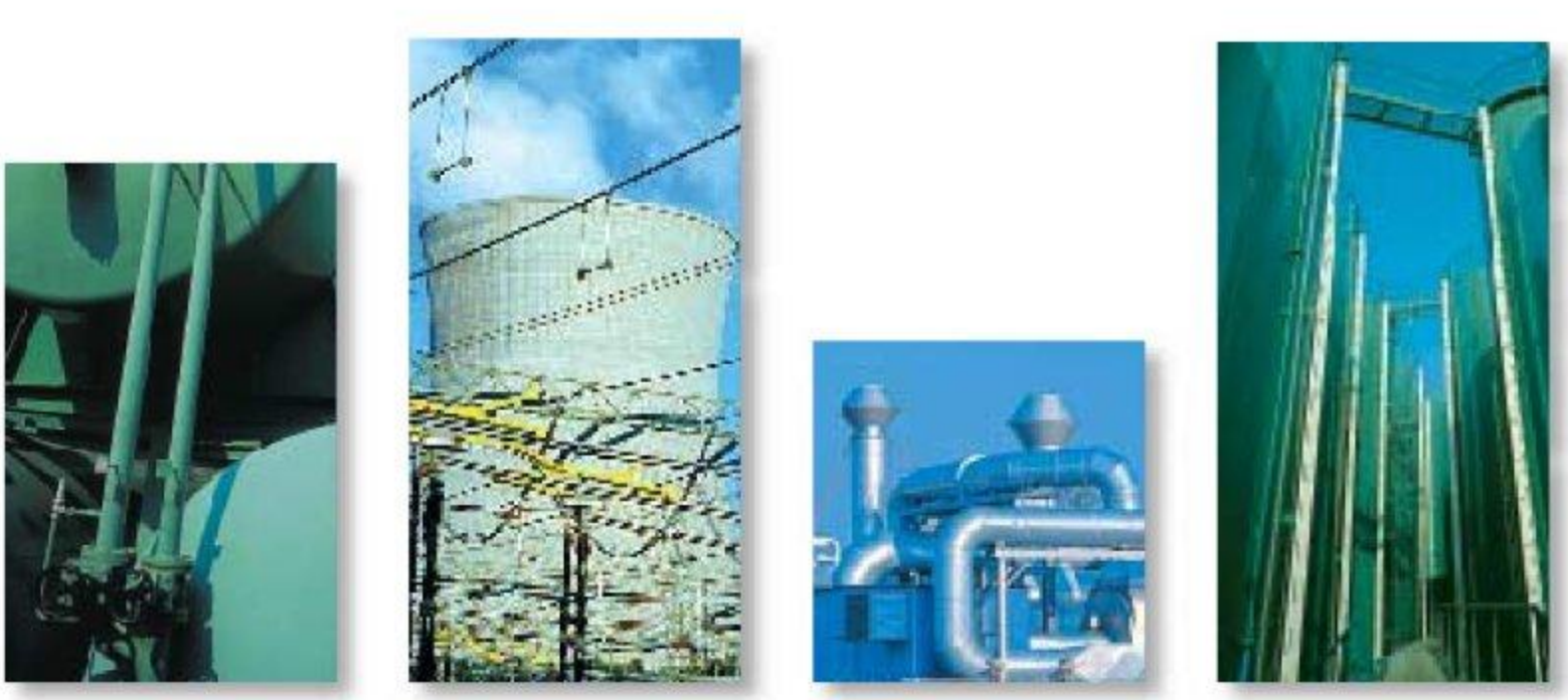
Fig. 3: Signal and Monitoring Device Sub-Rack.

2.3 GSR VII Direct Voltage Relay

The GSR VII is an overvoltage monitoring relay with two functions:

- Dynamic overvoltage monitoring
- Static overvoltage monitoring

The dynamic overvoltage monitoring device is an instantaneous DC voltage monitor with a controller inhibit. If a voltage peak occurs, the controller is instantaneously ($t < 10$ msec.) inhibited for a period of about 200 msec. (Yellow LED lights up).
If such a voltage peak occurs four times in succession within 30 seconds, the unit trips out via a signal to the SME I.
The static overvoltage monitoring device measures the effective value of the DC voltage.
If the specified value is exceeded, a fault signal is sent and is shown on a yellow LED. The signal is processed as already described under 2.2.



Signalling and Monitoring Devices

4

2.4 GUG III Ripple Monitor

The GUG III ripple monitor measures the alternating component of the rectifier units superimposed on the DC voltage.
If the residual ripple content exceeds a set value, a signal is given via a yellow LED.
The signal is processed by the SME I as already described in 2.2.
In rectifier units without reinforcing smoothing, the GUG III can also be used as a battery circuit monitor. In this case the unit tripping and locking function does not apply.

2.5 Fuse Monitoring

The fuses connected ahead of the power semiconductors and the auxiliary circuit and control circuit fuses are monitored for failure. If a fault occurs, a signal is given via the SME I. At the same time the unit is disconnected on the supply side. The disconnection remains locked in and acknowledgement is required.

2.6 SME I Centralized Fault Indicator with First Up Value Recording

In the SME I "Centralized Fault Indicator with First Up Value Recording", all signals are shown as a centralized fault signal.

The SME I has two separate output signals:

- Fault
- Fault Stored

The signal "Fault" is automatically reset when the fault is removed. The signal "Fault Stored" continues to be applied and has to be acknowledged.

The SME I has three functions:

- recording of the first up value, which stores the first fault arising and is signalled by a red LED.
- a "Card Withdrawn" signal, which responds when a monitoring card is taken out from the magazine. The units simultaneously trip out when the signal is given. The tripping out can be blocked for testing purposes.
- a "Function Test" key.
  This key can be used to test all the monitoring cards. All monitoring functions together with the maintenance signal are activated and tested.
  This test lasts about 20 seconds. After this a resetting signal is automatically sent to the monitoring cards.

The monitoring and signalling devices described in 2.2 to 2.6 (with the exception of 2.5) are in the form of plug-in cards (European standard format 3 units high - 7 units deep).
The power is supplied from the alternating current mains at 220 V 50 Hz and diode decoupled from the DC system at 24 V (for 220 V system via a DC - DC converter).

Accessories for 26 V,110 V and 220 V Units
(not provided as standard)

In addition to the standard monitoring relays, the following modules can also be fitted if required.

Fig. 4: SME I

2.7 Battery monitoring

With continuous battery power supply, there is the danger that a failure of the battery or that an interruption in the battery circuit will go unnoticed. This can result in serious disruption to the system, if there is a mains power supply failure. Therefore battery monitoring is strongly recommend.

Two different systems are available:

- Battery circuit monitoring (current control)
- Battery symmetrie monitoring
  (battery center point required)

2.8 Measuring and alarm unit MCU 2000

With the MCU 2000 unit, all measurements and alarms are available on an interface like RS 232.
An event memory for max. 500 events and a graphic display with several LED's for all measurements, alarms and events is integrated.

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3.1 External Construction

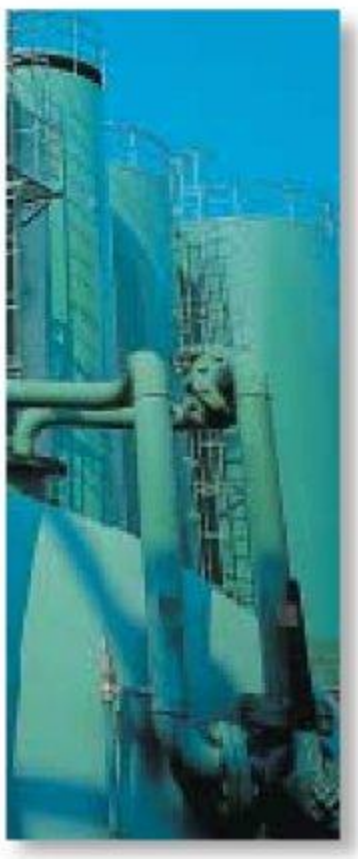
The units are built into a welded steel section framed housing to IP 20 protection standards and are designed with vents at the joints. The side and rear panels can be prepared.
For transportation (loading and unloading) the housing is fitted with crane lifting eyes. If desired, casement-type or espagnolette fasteners can be used.
At seismic requirements, additional mechanical reinforcements are implemented (see figure 6).

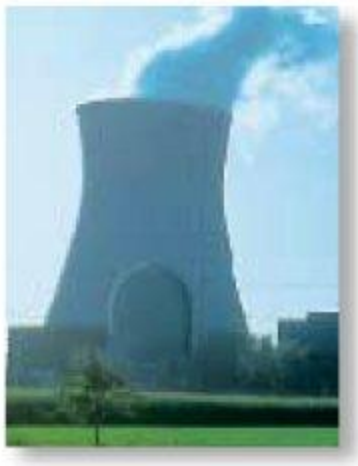
The following display and control elements are positioned on the front door of the housing (see Fig. 5).

- Unit ON/OFF switch
- Moving coil ammeter, class 1,5, format 96 x 96
- Moving coil voltmeter, class 1,5, format 96 x 96
- "Fault" warning light
- "Fault Stored" warning light
- Lamp Testing key
- Manual charging potentiometer

Fig. 5: External view

Fig. 6: Internal view





3.2 Internal Construction

The mains transformer and the smoothing reactor are positioned at the base of the housing on the base frame and bolted on. The thyristor assembly is placed in the upper part of the housing so that the heat given off can be easily dissipated and does not build up.

The thyristors are fitted with special semiconductor fuses with fuse monitors. Auxiliary and control circuits are protected by automatic circuit breakers or motor protection switches.

Controller and monitoring modules are designed in the form of standard European format plug-in cards and built into a sub-rack.

Where the nominal current of the units is greater than approx 400 A, the wiring in the power circuit uses copper bus bar.
At the rectifier output terminal there are fuse switch disconnectors to disconnect the unit from the supply. The connection terminals for the direct and alternating voltage are placed at the base of the unit and are easily accessible when the doors are open.

Specification

Type:	see Type table
Charging characteristic:	IU to DIN 41 773, can be switched to manually controlled W characteristic
Operating modes:	The mode required can be selected with a selector switch. Float charging: Parallel standby operation with IU characteristic, 2.23 V per cell Boost charging: Parallel standby operation with IU characteristic, 2.4 V per cell Commissioning charging: W characteristic at up to 2.7 V per cell. The charging current is smoothly adjustable.
Stability of output values:	Voltage ± 1 %, Current ± 2 %
Permitted variations under DIN 41 773:	Mains voltage ± 10 % at 2.4 V/Z, + 10 - 15 % at 2.23 V/c Mains frequency variations ± 5 %, Load variations 0 - 100 %
Rectifier circuitry:	Fully controlled three-phase bridge circuit
Control and regulation:	Transistorised controller with thyristors as regulating devices
Derating-factor:	≥ 2,5 acc. to VDE 0160
Protection:	The semiconductors are protected by ultra high-speed fuses. Depending upon the power rating of the unit it is protected either by cell fuses or by a fuse in the output.
Dynamic characteristics: (battery disconnected)	If the load increases from 50 % to 100 %, the output voltage does not drop below 20 V / 90 V / 180 V*¹ (t=200ms). If the mains voltage drops by 30 %, the output voltage does not drop below 20 V / 90 V / 180 V (t=200ms). If the load drops from 100 % to 50 % the output voltage does not rise above 33 V / 135 V / 270 V. If the mains voltage rises again from 70 % to 100 %, the output voltage does not exceed 33 V / 135 V / 270 V *¹.
Ripple:	Smoothing facility, which reduces the ripple of the stated DC-voltage to approx. 5 % peak to peak over the entire load range from 0 to 100 % (battery disconnected).
Start-Up Module:	Pulse enable after 300 ms. Avoidance of missing pulses when connecting the rectifier (e.g. bouncing the earthing contacts).
Ramp-Up Module:	Delayed voltage increase when connecting the rectifier unit. The voltage increases following an exponential function.
Meters:	Moving coil ammeter, class 1,5, size 96 x 96 mm Moving coil voltmeter, class 1,5, size 96 x 96 mm
Monitoring facilities:	Undervoltage monitoring facility for mains supply, monitoring facility for semi-conductor fuses, facility for monitoring auxiliary and control circuit fuses, overvoltage monitoring facility on DC side, monitoring facility for current-related undervoltage, short-circuit monitoring facility.
Indications: visual inside the unit	"Mains asymmetry" "High mains voltage" "Low mains voltage" "Unit fault" "Short-circuit" "High battery voltage (stat.)" "High battery voltage (dyn.)" "Fuse fault" „Card withdrawn"
visual on unit and pot.-free on terminals:	General "fault" signal "Fault stored"
Construction:	Free-standing sheet-steel cabinet with doors at front. The side and rear panels can be removed. For dimensions see type table. Standard of enclosure provided by cabinet: IP 20 Painting: RAL 7035
Ambient temperature:	-5 °C to + 40 °C
EMV:	EN 50081-2 and EN 50082-2
Humidity classification:	humidity classification F under DIN 40040
Type of cooling:	Natural air cooling, air enters from below.
Mains supply:	3 x 400 V, 50 Hz, with neutral, other mains voltages if desired.

For other technical data see type table

*¹ Values for 24 V, 110 V and 220 V units

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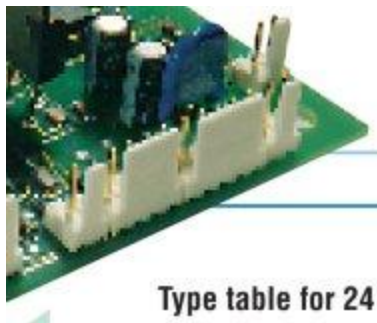


Type table for 24 V units

Type	Mains current at 3 x 400 V	Power factor at 29 V and rated current	Efficiency at 29 V and rated current	Dissipated power in kW	Dimensions H x W x D (mm)	Weights in kp
D 400 G 26/ 400 BWLrug-Dt	29	0,7	83 %	2,4	2200 x 800 x 800	680
D 400 G 26/ 600 BWLrug-Dt	43	0,7	84 %	3,3	2200 x 800 x 800	800
D 400 G 26/ 800 BWLrug-Dt	57	0,7	84 %	4,4	2200 x 1200 x 800	950
D 400 G 26/1000 BWLrug-Dt	71	0,7	85 %	5,2	2200 x 1200 x 800	1100
D 400 G 26/1200 BWLrug-Dt	85	0,7	85 %	6,2	2200 x 1200 x 800	1200
D 400 G 26/1600 BWLrug-Dt	112	0,7	86 %	7,6	2200 x 1600 x 800	1500
D 400 G 26/2000 BWLrug-Dt	138	0,7	87 %	8,7	2200 x 1600 x 800	1900
D 400 G 26/2500 BWLrug-Dt	173	0,7	87 %	10,8	2200 x 2000 x 800	2300
D 400 G 26/3000 BWLrug-Dt	207	0,7	88 %	12,9	2200 x 2000 x 800	2650

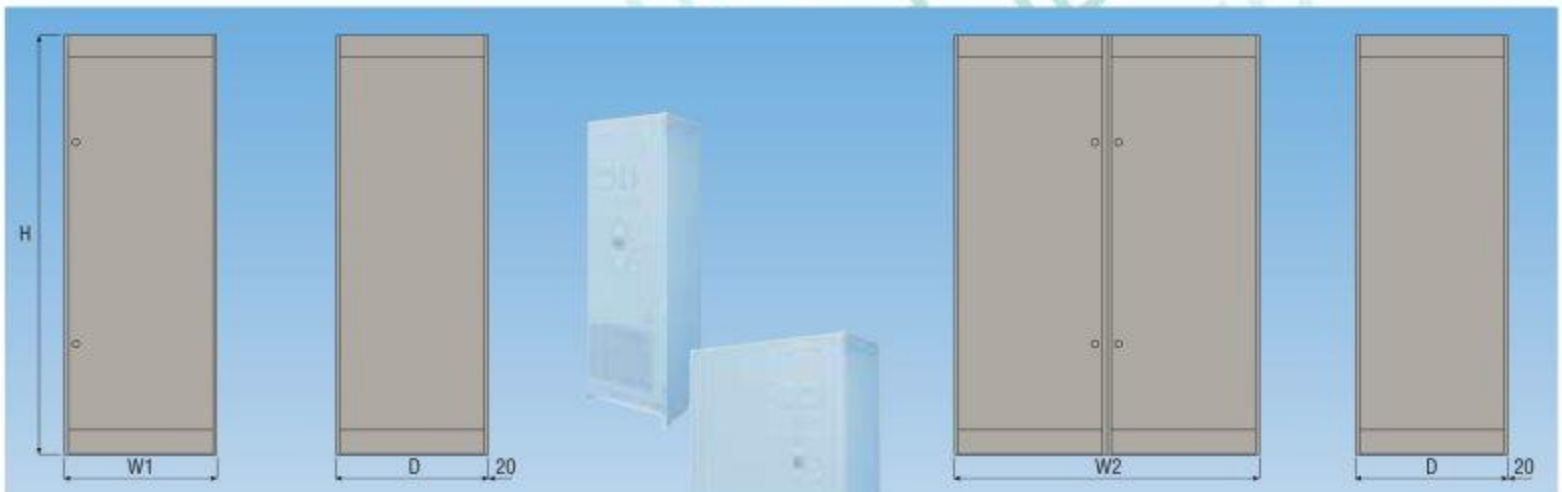
Type table for 110 V units

Type	Mains current at 3 x 400 V	Power factor at 121 V and rated current	Efficiency at 121 V and rated current	Dissipated power in kW	Dimensions H x W x D (mm)	Weights in kp
D 400 G 108/ 200 BWLrug-Dt	54	0,7	90 %	2,5	2200 x 1000 x 800	620
D 400 G 108/ 300 BWLrug-Dt	80	0,7	90 %	3,6	2200 x 1200 x 800	850
D 400 G 108/ 400 BWLrug-Dt	105	0,7	91 %	4,4	2200 x 1200 x 800	1120
D 400 G 108/ 600 BWLrug-Dt	160	0,7	92 %	5,8	2200 x 1600 x 800	1500
D 400 G 108/ 800 BWLrug-Dt	210	0,7	92 %	7,7	2200 x 1600 x 800	1750
D 400 G 108/1000 BWLrug-Dt	265	0,7	93 %	8,4	2200 x 2000 x 800	1900
D 400 G 108/1200 BWLrug-Dt	315	0,7	93 %	10,1	2200 x 2400 x 800	2080
D 400 G 108/1600 BWLrug-Dt	420	0,7	94 %	11,6	2200 x 3200 x 800	2400

Type table for 220 V units

Type	Mains current at 3 x 400 V	Power factor at 245 V and rated current	Efficiency at 245 V and rated current	Dissipated power in kW	Dimensions H x W x D (mm)	Weights in kp
D 400 G 212/ 100 BWLrug-Dt	54	0,7	93 %	1,9	2200 x 800 x 800	530
D 400 G 212/ 200 BWLrug-Dt	107	0,7	95 %	2,7	2200 x 1200 x 800	1030
D 400 G 212/ 300 BWLrug-Dt	160	0,7	95 %	3,9	2200 x 1600 x 800	1480
D 400 G 212/ 400 BWLrug-Dt	210	0,7	96 %	4,2	2200 x 1600 x 800	1700
D 400 G 212/ 600 BWLrug-Dt	316	0,7	96 %	5,8	2200 x 1600 x 800	1900
D 400 G 212/ 800 BWLrug-Dt	418	0,7	97 %	6,1	2200 x 2400 x 800	2300
D 400 G 212/1000 BWLrug-Dt	521	0,7	97 %	7,6	2200 x 3200 x 800	2800
D 400 G 212/1200 BWLrug-Dt	625	0,7	97 %	9,1	2200 x 3200 x 800	3200

Dimensions Diagrams



Type of cabinet	H	W1	D
PS 220808	2200	800	800
PS 221008	2200	1000	800

Type of cabinet	H	W2	D
PS 221208	2200	1200	800
PS 221608	2200	1600	800
PS 222008	2200	2000	800

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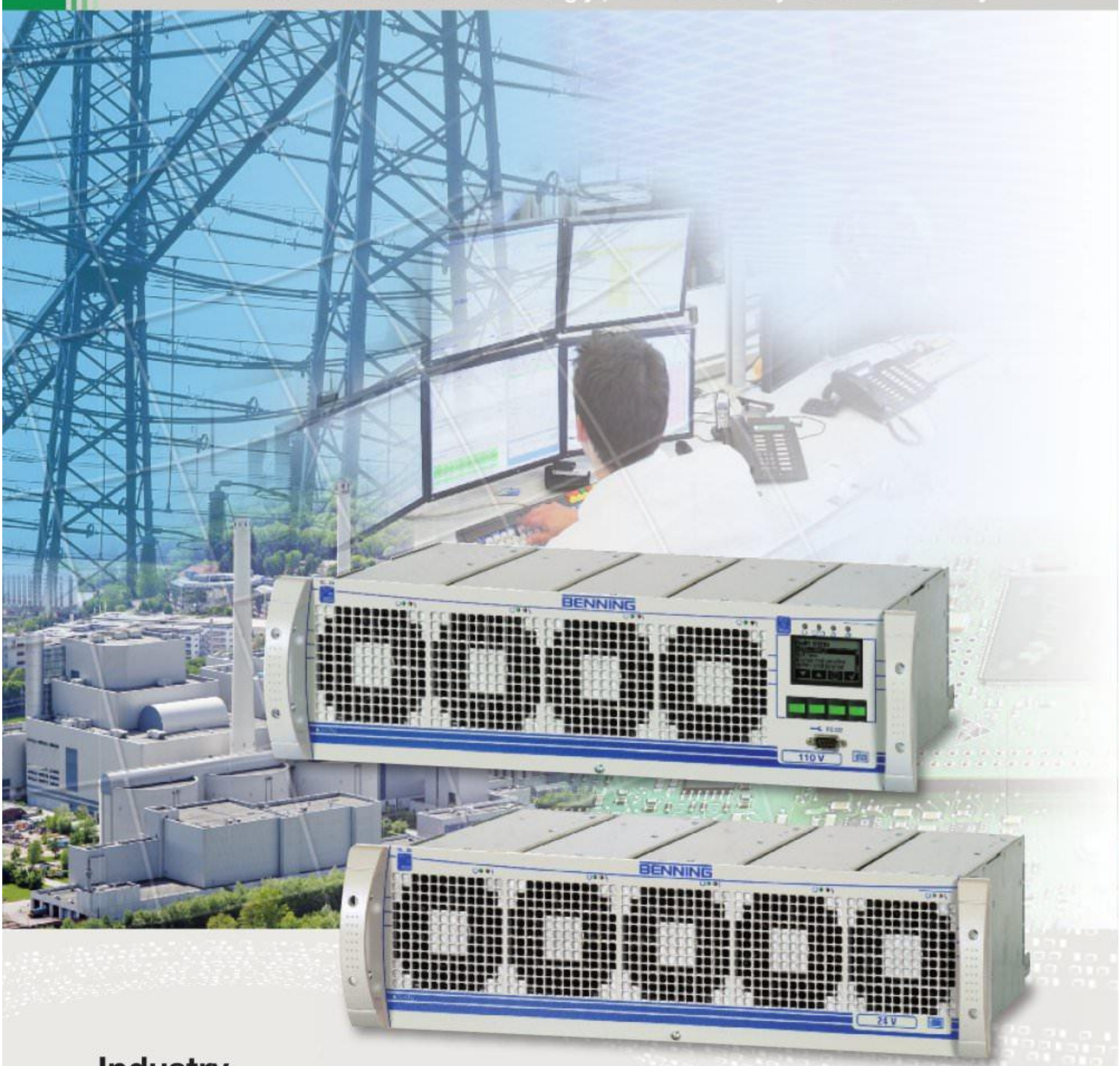


Industry

DC/DC converters
in modular rack-mounted design
Series 3000 IDC

Modular DC/DC converters

high system availability thanks to modular power supplies

Modular DC/DC converters

For many years, BENNING has been supplying modular rectifier and inverter systems for providing power to electronic systems in industry, telecommunications and information technology. These modular systems have proved their worth extremely effectively thanks to their high availability and excellent service friendliness.

The DC/DC converters described below ideally complement these modular systems, as they have the same mechanical platform and the front plate design matches other modules in the range.

Combinations of all three series of units can therefore easily be accommodated in common system cabinets.

The block circuit diagram (Fig. 1) shows the principle of the modular architecture of all three series of units in a power supply system with modular rectifiers, modular inverters and modular DC/DC converters.

Fig. 2 shows an example of a modular power supply system built into a system cabinet with two battery-backed direct voltages and one battery-backed alternating voltage. Monitoring is by means of the MCU 2500 with the indication and control unit fitted in the front door.

Fig. 1: Block circuit diagram of the modular architecture of a power supply system with rectifiers, inverters and DC/DC converters

Fig. 2: Combined power supply system (similar to block circuit diagram Fig. 1)

Modular DC/DC converters

Wide-range voltage input ensures flexibility of use

DC/DC converters in modular rack-mounted design offer flexible power adaptation (scalability), high availability, good energy efficiency and flexibility of use

The large 85 – 240 V DC input voltage range of the modular DC/DC converters allows the units to be used both for 110 V and for 220 V DC networks. Depending on the type, units can be supplied for DC output voltages of 24 V, 48 V, 60 V, 110 V or 220 V.

The DC/DC converters consist of power modules with operationally safe hot-plug rack-mounted design. The appropriate number are fitted in 19" module racks depending on the power required (see Fig. 3 and 4).

DC/DC converter modules are available for the following input and output voltages

DC input voltage 220 V
DC output values: 24 V – 50 A, 48 V – 40 A, 60 V – 40 A, 110 V – 20 A, 220 V – 10 A

DC input voltage 110 V
DC output values: 24 V – 27 A, 48 V – 22 A, 60 V – 22 A, 110 V – 11 A, 220 V – 5.5 A

The power modules are connected in parallel within the module rack enabling the output power to be flexibly scaled and redundant systems to be built up (e.g. n+1 redundancy).

The power modules are distinguished by excellent efficiency and high power density, and require just 3 U of vertical rack space in 19" equipment cabinets.
All DC/DC converters are galvanically isolated and can be used with or without a parallel-connected battery.

The user-friendly hot-plug design enables DC/DC converter modules to be quickly and easily replaced or installed during operation.

A complete 19" DC/DC converter plug-in unit consists of a maximum of five DC/DC converter modules and, for example, has an output current of 250 A at an input voltage of 220 V and an output voltage of 24 V.

When four modules are fitted, the MCU 2500 display and remote monitoring system can also be installed (see Fig. 3).

Main features of the modular DC/DC converters

- **Low volume and weight**
- **Low output ripple**
- **System power scalability**
- **Hot-Plug rack-mounted design for reliable operation**
- **Easy design of redundant system solutions**
- **High energy capability due to good efficiency**
- **Wide-range voltage input from 85 to 265 V DC**
- **Galvanic isolation between input and output**
- **Control, monitoring and indication with MCU 2500**

Fig. 3: 19" DC/DC converter plug-in unit with 4 TEBECHOP 3000 IDC modules and MCU 2500 remote monitoring, output voltage 110 V, output current 80 A

Fig. 4: 19" DC/DC converter plug-in unit with 5 TEBECHOP 3000 IDC modules, output voltage 24 V, output current 250 A

Fig. 5: System cabinet with 2 modular DC/DC converter plug-in units, output voltage 220 V, output current 100 A

Modular DC/DC converters
comprehensive display and monitoring concept

System cabinets

The BENNING range of system cabinets provides a number of options for building up modular DC/DC converter systems.
In the standard version, the DC/DC converter system cabinet comprises the incoming supply panel, one or more DC/DC converter panels with module racks, and the output panel.

Included in the incoming supply panel are two-pole circuit breakers for protecting the DC/DC converter modules on the input side.
Depending on the required DC power, the DC/DC converter panel is fitted with one or more 19" module racks for mounting the DC/DC converter modules.
Single-pole or two-pole circuit breakers are fitted in the output panel. These circuit breakers can be provided with auxiliary or signal contacts (option).

Capacitor banks, which guarantee safe tripping of the load fuses in the event of a possible short-circuit, can be fitted in the output panel as an option.

Fig. 6: Internal view of a system cabinet with MCU 2500 and with DC/DC converters fitted

MCU 2500 remote monitoring system

The microprocessor controlled MCU 2500 remote monitoring system can be supplied as a sub-module (1/5 - 19") for fitting in the 19" system module rack (see Fig. 3), or as a panel-mounted version with the display and control unit mounted in the front door of a system cabinet (see Fig. 5).

The MCU 2500 controls and monitors the DC/DC converter system, wherein the system data can be set up and recorded both locally and by means of the remote monitoring function.

With remote monitoring, data can be transmitted by modem, Ethernet, WEB, SNMP, MODBus or Profibus (see Fig. 8).

The MCU 2500 is extremely versatile due to the large number of additional modules available for monitoring and recording measurements, and can be adapted to suit many customer specifications.

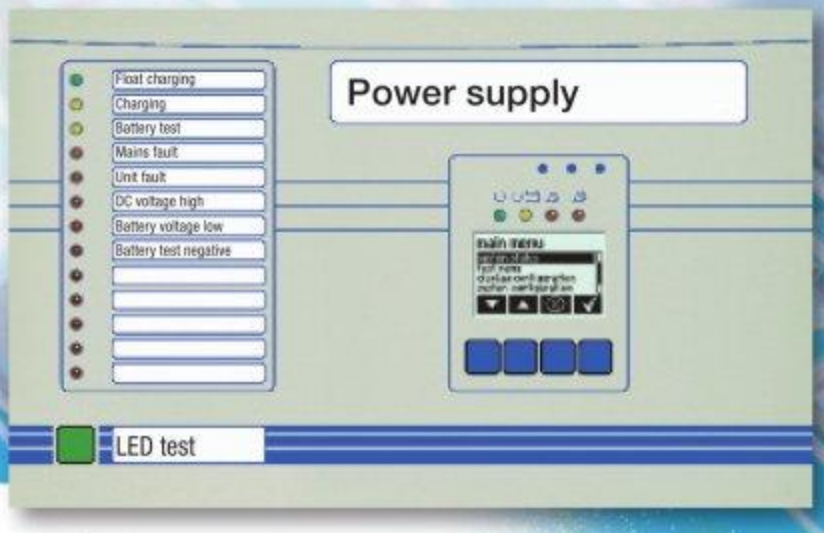
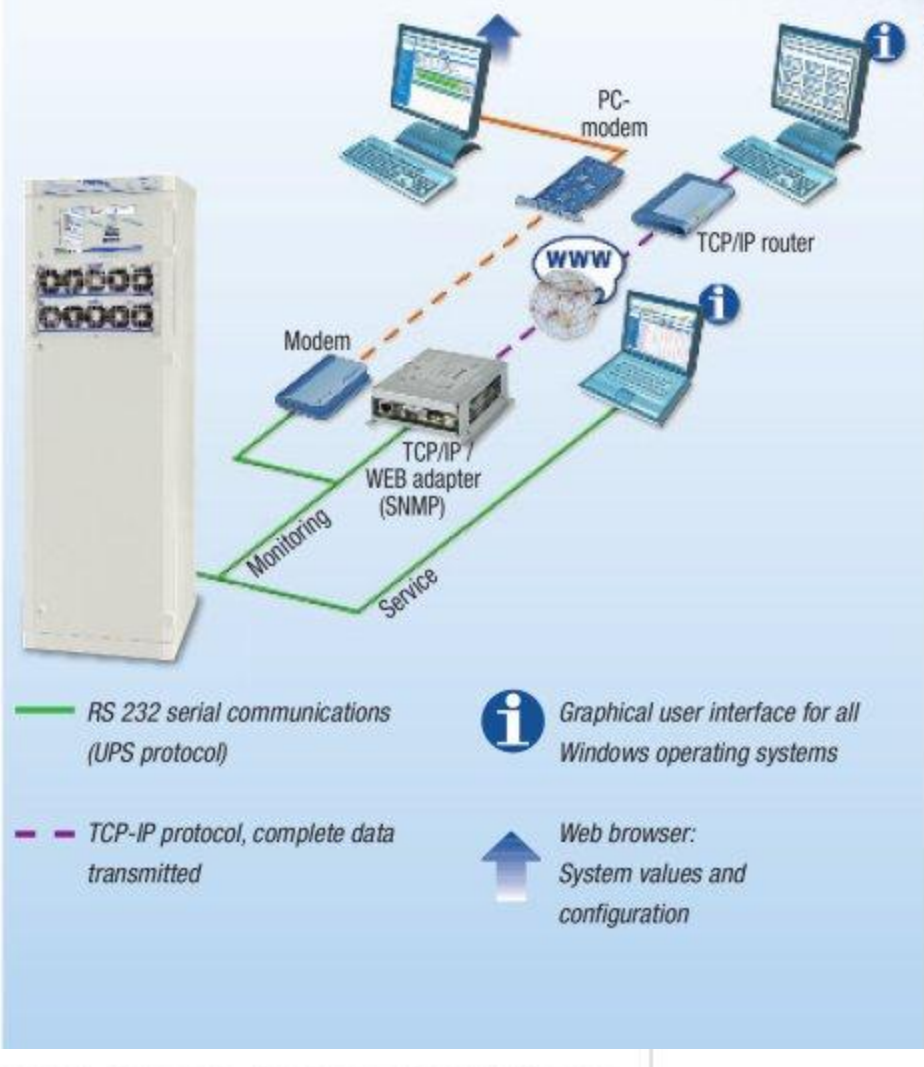


Fig. 7: Display and control unit

Fig. 8: MCU 2500 monitoring concept



Technical data

Number of DC/DC converter modules		1	2	3	4	5
Input						
DC input voltage	[V]	110				
Permissible voltage range	[V]	85 – 265				
Output						
Output current at						
24 V	[A]	27	54	81	108	135
48 V	[A]	22	44	66	88	110
60 V	[A]	22	44	66	88	110
110 V	[A]	11	22	33	44	55
220 V	[A]	5.5	11	165	22	27.5
Input						
DC input voltage	[V]	220				
Permissible voltage range	[V]	85 – 265				
Output						
Output current at						
24 V	[A]	50	100	150	200	250
48 V	[A]	40	80	120	160	200
60 V	[A]	40	80	120	160	200
110 V	[A]	20	40	60	80	100
220 V	[A]	10	20	30	40	50
Characteristic		IU				
Output voltage	[V]	24	48	60	110	220
adjustable	[%]	± 25				
Short-circuit behaviour	[%]	> 2.0 x I_N for max. 2 s, then shut down				
Voltage stability						
steady-state	[%]	± 1 (typically ± 0.5 %)				
dynamic	[%]	± 4 (load Δ 10 % - 90 % - 10 %)				
Settling time	[ms]	< 2 (load Δ 10 % - 90 % - 10 %)				
Efficiency	[%]	85 – 93				
Residual ripple	[%]	< 1				
Radio interference factor		Class B to EN 55022				
Protection class		1 to IEC 60950, EN 60950, UL 1950				
Protection category		IP 20				
Ambient temperature	[°C]	-5 to +40				
Installation altitude	[m]	up to 1000 m ASL, at > 1000 m -10 % per 1000 m				
Humidity class		F to DIN 40040				
Cooling		Fan, monitored				
Visual displays (LED)						
Mains		red/green flashing				
Overvoltage		red flashing				
Running		green				
Fault		red				
Fuse		red flashing				
Dimensions 19" full module						
Height (front plate)	[mm]	133				
Width (front plate)	[mm]			483		
Depth	[mm]	400				
Weight	[kg]	14	17	20	23	26

Subject to technical changes